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Data Book 1976/77

Analog integrated circuits

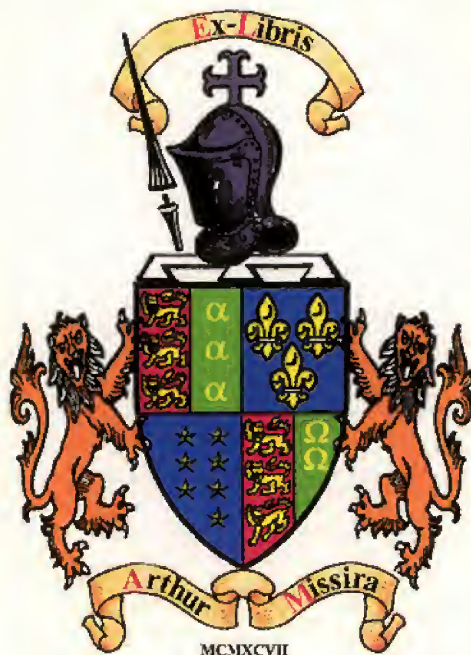
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Summary of types

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▼ New type

Summary of Digital Integrated Circuits

contained in Data Book 1976/77, German edition
(Order No. B1572)

1. TTL Series FL 100-7400

With exception of the following types FLJ 331, FLJ 471, 74278, 74279, 74284, 74285, 74298, FLJ 101, FLQ 141, FLR 111, FLR 121, FLR 151, series FL 100 can also be supplied in temperature range 5.

FLH 101	7400	Quadruple 2-input NAND-gate
FLH 111	7410	Triple 3-input NAND-gate
FLH 121	7420	Dual 4-input NAND-gate
FLH 131	7430	8-input NAND-gate
FLH 141	7440	Dual 4-input NAND-powergate
FLH 151	7450	Dual 2+2-input AND/OR-gate, inverting with expander node
FLH 161	7451	Dual 2+2-input AND/OR-gate, inverting
FLH 171	7453	2+2+2+2-input AND/OR-gate, inverting with expander
FLH 181	7454	2+2+2+2-input AND/OR-gate, inverting
FLH 191	7402	Quadruple 2-input NOR-gate
FLH 191 S	7402 S 1	as FLH 191/195, however output 6.5 V/500 μ A
FLH 201	7401	Quadruple 2-input NAND-gate with open collector output
FLH 201 S	7401 S 1	as FLH 201/205, however output 15 V/250 μ A
FLH 201 T	7401 S 3	as FLH 201/205, however output 5.5 V/50 μ A
FLH 211	7404	Hexinverter
FLH 221	7480	1 bit fulladder
FLH 231	7482	2 bit fulladder
FLH 241	7483	4 bit fulladder
FLH 251	4929	Dual 2-input NAND-gate and quadruple inverter
FLH 271	7405	Hexinverter with open collector output
FLH 271 S	7405 S 1	as FLH 271/275, however output 15 V/250 μ A
FLH 271 T	7405 S 3	as FLH 271/275, however output 5.5 V/50 μ A
FLH 281	7442	BCD-decimal decoder
FLH 291	7403	Quadruple 2-input NAND-gate with open collector output
FLH 291 S	7403 S 1	as FLH 291/295, however output 15 V/250 μ A
FLH 291 T	7403 S 3	as FLH 291/295, however output 5.5 V/50 μ A
FLH 291 U	7426	as FLH 291/295, however output 15 V/50 μ A
FLH 321	4930	Quadruple 2-input NAND-powergate
FLH 331	4931	Dual 5-input NAND-gate
FLH 341	7486	Quadruple 2-input exclusive OR-gate
FLH 351	7413	Dual 4-input NAND-Schmitt Trigger
	7414	Hex NAND-Schmitt Trigger
FLH 361	7443	Excess 3-decimal decoder
FLH 371	7444	Excess 3-Gray-decimal decoder
FLH 381	7408	Quadruple 2-input AND-gate

FLH 391	7409	Quadruple 2-input AND-gate with open collector output
FLH 391 T	7409 S 1	as FLH 391/395, however output 15 V/250 μ A
FLH 401	74181	4 bit arithmetic logic unit (ALU)
FLH 411	74182	Lookahead carry generator for ALU
FLH 421	74180	8 bit parity generator
FLH 431	7485	4 bit comparator
FLH 441	74 H 87	4 bit complement unit
FLH 451	74 H 183	Dual 1 bit fulladder
FLH 461	4934	Hexinverter with expander node and open collector
FLH 471	4935	Hexinverter with expander node
FLH 481	7406	Hexinverter with open collector output with 30 V/40 mA
FLH 481 T	7416	Hexinverter with open collector output with 15 V/40 mA
FLH 491	7407	Hexinverter with open collector output with 30 V/40 mA
FLH 491 T	7417	Hexbuffer with open collector output with 15 V/40 mA
FLH 501	7412	Triple 3-input NAND-gate with open collector output
FLH 511	7423	Dual 4-input NOR-gate with strobe and expander node
FLH 521	7425	Dual 4-input NOR-gate with strobe
FLH 531	7437	Quadruple 2-input NAND-powergate
FLH 541	7438	Quadruple 2-input NAND-powergate with open collector output
FLH 551	7448	BCD-7-segment decoder
FLH 561	74184	6 bit binary BCD converter
FLH 571	74185 A	6 bit binary BCD converter
FLH 601	74132	Quadruple 2-input NAND-Schmitt Trigger
FLH 611	7422	Dual 4-input NAND-gate with open collector output
FLH 621	7427	Triple 3-input NOR-gate
FLH 631	7432	Quadruple 2-input OR-gate
FLH 641	49703	Hex delay element
FLH 731	49713	Dual 3-input NAND-Schmitt Trigger with high input impedance
FLH 731	49713 S 1	Dual 3-input NAND-Schmitt Trigger with high input impedance
FLH 661	7428	Quadruple 2-input NOR-gate
	7433	Quadruple 2-input NOR-gate with open collector
	74128	Quadruple 2-input NOR-buffer for 50- Ω -lines
	7483 A	4 bit fulladder
	74283	4 bit fulladder
	74125	Quadruple 1-input AND-gate with control input and tri-state output
	74126	Quadruple 1-input AND-gate with control input and tri-state output
	74136	Quadruple 2-input exclusive OR-gate with open collector output
	74147	4 bit decimal BCD converter
	74148	3 bit decimal BCD converter
FLJ 101	7470	3+3-input JK flipflop
FLJ 111	7472	JK-Master-Slave flipflop
FLJ 121	7473	Dual JK-Master-Slave flipflop with reset
FLJ 131	7476	Dual JK-Master-Slave flipflop with set and reset
FLJ 141	7474	Dual D-flipflop
FLJ 151	7475	Quadruple D-flipflop

FLJ 161	7490 A	Decimal counter
FLJ 171	7492 A	Divide-by-twelve counter
FLJ 181	7493 A	4 bit binary counter
FLJ 191	7495 A	4 bit shiftregister, reversible
FLJ 201	74190	Reversible decimal counter
FLJ 211	74191	Reversible 4 bit binary counter
FLJ 221	7491 A	8 bit shiftregister, serial in/out
FLJ 231	7494	4 bit shiftregister, parallel in, serial out
FLJ 241	74192	Decimal counter with one clock input each for up and down count
FLJ 251	74193	4 bit binary counter with one clock input each for up and down count
FLJ 261	7496	5 bit shiftregister
FLJ 271	74107	Dual JK-Master-Slave flipflop
FLJ 281	74104	JK-Master-Slave flipflop with JK input
FLJ 291	74105	JK-Master-Slave flipflop with $\bar{J}$, $\bar{K}$ and JK inputs
FLJ 301	74100	Eight D flipflop
FLJ 311	74198	Universal 8 bit shiftregister, reversible
FLJ 321	74199	Universal 8 bit shiftregister
FLJ 331	7497	Programmable 6 bit rate multiplier
FLJ 341	74110	JK-Master-Slave flipflop with data lockout
FLJ 351	74111	Dual JK-Master-Slave flipflop with data lockout
FLJ 361	74118	Hex RS-flipflop with common reset
FLJ 371	74119	Hex RS-flipflop with separate reset
FLJ 381	74196	Decimal counter for 50 MHz
FLJ 391	74197	4 bit binary counter for 50 MHz
FLJ 401	74160	Synchronous decimal counter with set and reset
FLJ 411	74161	Synchronous 4 bit binary counter with set and reset
FLJ 421	74162	Fully synchronous decimal counter with set and reset
FLJ 431	74163	Fully synchronous 4 bit binary counter with set and reset
FLJ 441	74164	8 bit shiftregister, parallel out
FLJ 451	74165	8 bit shiftregister, parallel in
FLJ 461	74166	Universal 8 bit shiftregister
FLJ 471	74167	Programmable decimal rate multiplier
FLJ 481	4932	Dual 8 bit shiftregister
FLJ 491	49702	Quadruple D-flipflop with common reset
FLJ 501	49704	Dual 4 bit binary counter for 50 MHz
FLJ 511	49705	Dual decimal counter for 50 MHz
FLJ 521	74115	Dual JK-Master-Slave flipflop with data lockout
FLJ 531	74174	Hex D-flipflop with common reset
FLJ 541	74175	Quadruple D-flipflop with common reset
FLJ 551	74194	Synchronous 4 bit parallel shiftregister, reversible
FLJ 561	74195	Synchronous 4 bit parallel shiftregister with JK inputs
	74109	Dual JK flipflop with set and reset
	74173	Quadruple D-flipflop with tri-state output
	74176	Decimal counter for 35 MHz
	74177	4 bit binary counter for 35 MHz

	74178	4 bit parallel shiftregister
	74179	4 bit parallel shiftregister
	74278	4 bit priority register
	74279	Quadruple RS-flipflop with separate reset inputs
	74298	Quadruple 2 bit dataselctor with memory
FLK 101	74121	Monostable multivibrator
FLK 111	74122	Monostable multivibrator with reset
FLK 121	74123	Dual monostable multivibrator with reset
FLL 101	74141	BCD-decimal decoder-driver for indicator tubes
FLL 111	7445	BCD-decimal decoder-driver with open collector outputs
FLL 111 T	74145	as FLL 111, however outputs 15 V/80 mA
FLL 121 U	7446 A	BCD-7-segment decoder-driver with open collector outputs with 30 V/40 mA
FLL 121 V	7447 A	as FLL 121 U, however outputs 15 V/40 mA
FLL 131	49700	Dual AND-powerdriver for 30 V/160 mA and dual 2-input NAND-gate
FLL 131 T	49700 S1	as FLL 131, however outputs 60 V/160 mA
FLL 141	49701	Quadruple powerdriver for 30 V/80 mA
FLL 141 T	49701 S1	as FLL 141, however outputs 60 V/80 mA
FLL 151	74142	Decimal counter, latch, decoder and driver for indicator tubes
FLL 171	74143	4 bit binary counter, latch 7-segment decoder and driver
FLL 171 T	74144	4 bit binary counter, latch 7-segment decoder and driver
FLQ 101	7489	64 bit random access memory
FLQ 111	7481 A	16 bit random access memory
FLQ 121	7484 A	16 bit random access memory
FLQ 131	74170	16 bit random access memory, 4 words of 4 bits
FLQ 141		256 bit random access memory with tristate outputs
	74172	16 bit random access memory
FLY 101	7460	Expander for FLH 151, FLH 171 and FLH 511
FLY 111	74150	16 bit data selector/multiplexer
FLY 121	74151	8 bit data selector/multiplexer
FLY 131	74153	Dual 4 bit data selector/multiplexer
FLY 141	74154	4 bit binary decoder/demultiplexer
FLY 151	74155	Dual 2 bit binary decoder/demultiplexer
FLY 161	74156	Dual 2 bit binary decoder/demultiplexer with open collector outputs
FLY 171	74157	Quadruple 2 bit data selector/multiplexer
FLY 181	74120	Dual pulse synchroniser
	74284	Dual 4 bit parallel multiplier
	74285	Dual 4 bit parallel multiplier

2. LSL-Series FZ 100

FZH 101 A, FZH 105 A	Quadruple 2-input NAND-gate
FZH 111 A, FZH 115 A	Quadruple 2-input NAND-gate with N-input
FZH 121, FZH 125	Dual 5-input NAND-gate
FZH 131, FZH 135	Dual 5-input NAND-gate with N-input

FZH 141, FZH 145	Dual 5-input NAND-powergate with N-input
FZH 151, FZH 155	Dual AND/OR-gate with N-input
FZH 161, FZH 165	Quadruple LSL-TTL-level-converter
FZH 171, FZH 175	Dual 4-input NAND-gate with expander nodes N_1 and N-input
FZH 181, FZH 185	Quadruple TTL-LSL-level-converter
FZH 191, FZH 195	Triple 3-input NAND-gate with N-input
FZH 201, FZH 205	Hexinverter with strobe inputs
FZH 211, FZH 215	Quadruple 2-input NAND-gate with open collector output and N-input
FZH 231, FZH 235	Dual 5-input NAND-gate with open collector output and N-input
FZH 241, FZH 245	Dual 4-input NAND-Schmitt-Trigger with expander node N_1 and N-input
FZH 251, FZH 255	Quadruple 2-input AND-gate with N-input
FZH 261, FZH 265	Dual 2-input NAND-gate and quadruple Inverter
FZH 271, FZH 275	Quadruple 2-input exclusive-OR-gate with N-input
FZH 281, FZH 285	Quadruple 2-input NOR-gate with N-input
FZH 291, FZH 295	Quadruple 2-input OR-gate with N-input
FZJ 101, FZJ 105	JK-master-slave-flipflop with two J and K-inputs
FZJ 111, FZJ 115	JK-master-slave-flipflop with N-inputs
FZJ 121, FZJ 125	Dual JK-master-slave-flipflop with set and reset
FZJ 131, FZJ 135	Quadruple D-flipflop
FZJ 141, FZJ 145	Synchronous decimal counter
FZJ 141 A, FZJ 145 A	Synchronous decimal counter with N-input
FZJ 151, FZJ 155	Synchronous 4-bit-binary counter
FZJ 151 A, FZJ 155 A	Synchronous 4-bit-binary counter with N-input
FZJ 161, FZJ 165	4-bit shiftregister with N-inputs
FZK 101, FZK 105	Timing circuit with N-input
FZL 101	BCD-decimal decoder-driver for indicator tubes
FZL 111	BCD-7-segment decoder-driver
FZL 121, FZL 125	Short-circuit-proof power stage with open collector output
FZL 131, FZL 135	Short-circuit-proof power stage with open emitter output
FZL 141, FZL 145	Short-circuit-proof driver stage

3. MOS-Circuits

SAJ 131, SAJ 135	
SAJ 131-I, SAJ 135-I	Frequency divider 1000 : 1
SAJ 131 A, SAJ 135 A	
SAJ 131 A-I,	
SAJ 135 A-I	Frequency divider 1000 : 1 with external reset
SAJ 141	Frequency divider 1000 : 1, 100 : 1, 10 : 1
SAJ 205	Staircase generator for electronic organs
SAJ 341	4-decade counter (also for clock applications)
SAJ 410	7-stage frequency divider for electronic organs
S 120	
S 121	Push button dialler
S 163	Automatic bass system for electronic organs

S 175	Triple programmable analog memory
S 178	Video impulse generator
S 181	Movie camera controller
S 187	Frequency synthesizer
S 190	Digital multimeter IC
S 551	
S 552	Decoder for FM road-traffic information service, used in car radios
S 554 Receiver	
S 556 Transmitter	Infrared remote control system for TV sets
S 607	10 k Bit ROM for character generators
TDA 1195	Electronic selector switches for AF signals (four channels)

New Type Nomenclature for Integrated Circuits¹⁾

The code consists of: **Three letters** followed by a **serial number**

First two letters

A. Solitary circuits

The **first letter** identifies the circuit as:

S: Solitary digital circuit

T: Analogue circuit

U: Mixed analogue/digital circuit

The **second letter** has no special significance, except the letter H which stands for hybrid circuits.

B. Family circuits

These are digital circuits related in their specifications and primarily designed to be mutually connected.

The **first two letters** identify the family.

The **third letter**: indicates the operational temperature range or exceptionally, another significant characteristic.

A – No temperature range specified

B – 0 to + 70 °C

C – -55 to + 125 °C

D – -25 to + 70 °C

E – -25 to + 85 °C

F – -40 to + 85 °C

If a circuit is designed for a wider temperature range, but does not qualify for a higher classification, the code letter for the narrower temperature range is used.

The **serial number**: may be either a 4-figure number (assigned by PRO ELECTRON) or the serial number of minimum 4 digits (combining figures and numbers) of an existing "house number". "House numbers" consisting of less than 4 digits are extended to a 4-digit number by adding zeros (0) before them.

A **version letter**: can be added to indicate a variant of a basic type.

– For package variants the following letters are recommended:

C: Cylindrical package

F: Flat pack

D: Dual in-line

Q: Quadruple in-line

– For other variants the version letter has no fixed meaning, except the letter Z which stands for types with customised wiring.

Examples: GXB10000: Digital circuit, GX-family; temperature range: 0 to 70 °C; circuit derived from the MC10000.

TDA1000: Analogue circuit; temperature range: not specified; serial number: 1000.

Former code

First two letters: same as new code.

The third letter: indicates the function

H – Combinatorial circuit

J – Bistable or multistable sequential circuit (static)

K – Monostable sequential circuit

L – Level converter (dynamic)

N – Bi-metastable or multi-metastable sequential circuit

Q – Read-write memory circuit

R – Read-only memory circuit

S – Sense amplifier with digital output

Y – Miscellaneous

The third figure (of the serial number of three figures) indicates the operating temperature range.

0 – No temperature range specified

1 – 0 to + 70 °C

2 – -55 to + 125 °C

3 – -10 to + 85 °C

4 – +15 to + 55 °C

5 – -25 to + 70 °C

6 – -40 to + 85 °C

¹⁾ Applied since 1973.

General Mounting Instructions

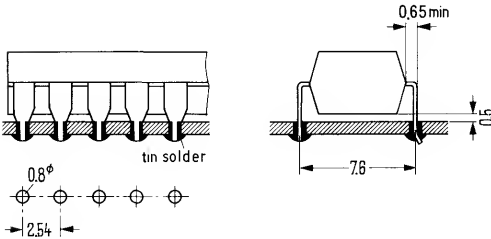
1. Plastic plug-in package

Plastic packages are soldered on the side of the printed circuit board opposite to the case, the pins are vertically bent and fit into holes at an equal distance of 7.6×2.54 mm and a diameter of .7 to .9 mm.

The distance between the package and the printed circuit board is determined by shoulders (see picture).

After inserting the package into the printed circuit board two or more pins should be bent at an angle of app. 30° . Thus the package need not be held down while soldering.

The maximum allowable solder temperature for iron soldering amounts to 265°C (max. 10 s) and for dip soldering 240°C (max. 4 s).



2. Flat-pack

a) Soldering on the side of the printed board opposite to the case. After bending the leads vertically the case is inserted into holes of .6 to .8 mm diameter in the printed circuit board. The distance of the bend from the case may not be below .8 mm (see picture 1).

After inserting the case into the printed circuit board two or more leads should be bent at an angle of app. 30° (see picture 1).

Thus the case need not be held down while soldering.

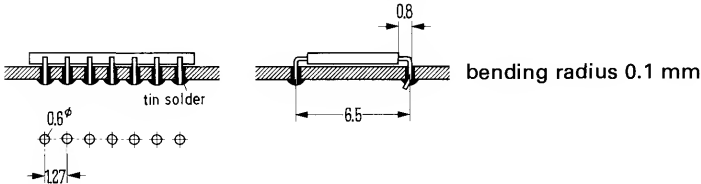
The leads should be clipped before soldering.

Iron or dip soldering may be applied.

The maximum solder times are:

$t_{\max} = 2$ s for 300°C solder temperature

$t_{\max} = 5$ s for 250°C solder temperature



picture 1

b) In case of soldering on printed circuit board (picture 2), holes are not necessary. The leads are connected to the printed circuit by iron soldering or spot welding.

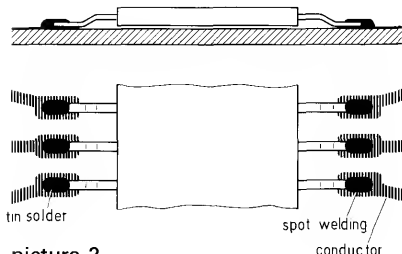
The maximum solder times are:

$t_{\max} = 15 \text{ s}$ for 250°C solder temperature

$t_{\max} = 12 \text{ s}$ for 300°C solder temperature

$t_{\max} = 7 \text{ s}$ for 350°C solder temperature

Thereby the minimal soldering distance from the case must be at least 1.5 mm.



picture 2

c) Miniature plastic package

I. Bending of the leads

When bending, the leads must not be stressed between leads and case.

The distance of the bend from the case may not be below .4 mm; bending radius more than .5 mm.

II. Soldering

Iron soldering: Solder temperature 245°C max. 10 s. The minimum soldering distance from case must be at least 1.5 mm. Maximum case temperature 150°C , no stress between leads and case.

Spot welding } Solder temperature 245°C max. 4 s. The minimum soldering distance from case must be at least 1.5 mm; maximum case temperature 150°C , no stress between leads and case.

3. Package 5 H 8 DIN 41873 and similar cases with 8, 10 and 12 pins

The position of the case is arbitrary. The pins may be bent up to a minimum distance of 1.5 mm from the case.

The pins should be clipped before soldering.

Iron or dip soldering may be applied.

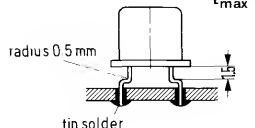
The maximum solder times are

a) for dip soldering $t_{\max} = 5 \text{ s}$ for 250°C solder temperature

$t_{\max} = 4 \text{ s}$ for 300°C solder temperature

b) for iron soldering $t_{\max} = 15 \text{ s}$ for 250°C solder temperature

$t_{\max} = 12 \text{ s}$ for 300°C solder temperature



picture 3

Glossary of Terms

1. Main terms

<i>a</i>	suppression
<i>a</i>	intermodulation
AC	alternating-current voltage
AF	audio frequency
AM	amplitude modulated
<i>B</i>	Bandwidth
<i>C</i>	capacity
CMRR	common mode rejection ratio
DC	direct voltage
<i>f</i>	frequency
Δf	frequency deviation
FM	frequency modulation
G	giga (10 ⁹)
<i>G</i>	gain
Hz	cycles per second (Hertz)
<i>I</i>	current
<i>I_{cc}</i>	supply current
IF	intermediate frequency
<i>k</i>	harmonic distortion
K	Kelvin
k	kilo (10 ³)
<i>L</i>	inductance
m	milli (10 ⁻³)
M	mega (10 ⁶)
<i>m</i>	linearity
<i>m</i>	modulation factor
MW	medium wave
<i>P</i>	power dissipation
<i>Q, Q_B</i>	Q-factor
<i>R</i>	resistance
RF	radio frequency
S/N	signal to noise
<i>T</i>	temperature
<i>t</i>	time
<i>V, V</i>	voltage
<i>V_{cc}</i>	supply voltage
<i>V_n</i>	noise voltage
W	watt
Z	impedance
Z	Zener

2. Index terms

AF	audio frequency
AM	amplitude modulation
amb	ambient
B	base
C	collector
C	capacity
D	differential
E	emitter
eff	effective
fb	feedback
FM	frequency modulated
G	generator
<i>i</i>	input
IF	intermediate frequency
<i>j</i>	junction
lim	limiting
lk	leakage
mod	modulated
<i>o</i>	offset
OD	overdrive
osc	oscillator
pp	peak to peak
<i>q</i>	output
RF	radio frequency
<i>s</i>	storage
sy	system
S/N	signal to noise
th _{samb}	thermal (system-air)
th _{s-case}	thermal (system-case)
tot	total
<i>v</i>	open loop
V	voltage

Quality Data for Analog Integrated Circuits

1. Warranty

If incoming testing shows that the AQL (Acceptable Quality Level) figures stated are exceeded, the customer is entitled to refuse acceptance and demand replacement of the shipment received.

2. AQL-figures

The AQL-figures define the maximum number of defective components up to which a shipment received must be accepted.

Electrical defects

Single AQL, gradual electrical defects (1)	.65
Single AQL, critical electrical defects (2)	.40
Σ AQL, electrical defects	.65

Mechanical defects

Single AQL, gradual mechanical defects (3)	1.00
Single AQL, critical mechanical defects (4)	.65
Σ AQL, mechanical defects	1.00

Breakdown of defects

- ad 1: Defects affecting the function in a minor way (electrical data too low or too high, noise etc.).
- ad 2: Catastrophic failures (no function, short circuits between the pins, no output) and defects seriously limiting the function (oscillation, high noise level, falling below maximum data by more than 50%).
- ad 3: Slight mechanical defects (missing type-marking, marking difficult to identify, wrong dimensions, heavy stamping burs at the pins, bent pins).
- ad 4: Catastrophic failures (broken or cracked packages, wrong type-marking, wrong position of the package-nose or marking of pin 1, pins not solderable).

3. Receiving quality

The figures shown in the table are warranty-figures. However, the Average Outgoing Quality (AOQ) of shipments is considerably higher, i.e. the proportion of defective components is much smaller than indicated by the AQL-figures.

4. Random sample testing

The AQL-figures are warranted for tests in accordance with random sampling test plan MIL Std. 105 D inspection level II.

5. Rejections

Returned IC's can be accepted only if the faulty samples are added to the rejected delivery.

Quality Figures for Analog Integrated Circuits

Random-sampling test-plan for normal inspection (MIL-Std. 105 D, inspection level II)

Lot-size	sample size	0.065	0.10	0.15	0.25	0.40	0.65	1.0	1.5	2.5	4.0	6.5
		Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re
2 to 8	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
9 to 15	3	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	0 1
16 to 25	5	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↑
26 to 50	8	↓	↓	↓	↓	↓	↓	0 1	0 1	↑	↓	1 2
51 to 90	13	↓	↓	↓	↓	↓	0 1	↑	↑	↑	1 2	2 3
91 to 150	20	↓	↓	↓	↓	↓	0 1	↑	↑	1 2	2 3	3 4
151 to 280	32	↓	↓	↓	↓	0 1	↑	↓	1 2	2 3	3 4	5 6
281 to 500	50	↓	↓	↓	↓	↑	↑	1 2	2 3	3 4	5 6	7 8
501 to 1200	80	↓	↓	0 1	↑	↑	1 2	2 3	3 4	5 6	7 8	10 11
1201 to 3200	125	↓	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15
3201 to 10000	200	↑	↑	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑
10001 to 35000	315	↑	↑	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑
35001 – 150000	500	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑
150001 – 500000	800	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑	↑
500001 and more	1250	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑	↑	↑

Ac = permissible number of defective sample elements: lot accepted

Re = exceeding number of defective sample elements: lot rejected

Additional requirement

As the combination "Acceptance 0 and Rejection 1" has a low degree of significance the next larger sample-size is to be used.

Our deliveries are subject to the "Allgemeine Verkaufsbedingungen für Erzeugnisse und Leistungen der Elektroindustrie" (General Sales Conditions for Products and Performances of the Electrotechnical Industry) and the "Allgemeine Lieferbedingungen für Erzeugnisse und Leistungen der Elektroindustrie" (General Delivery Conditions for Products and Performances of the Electrotechnical Industry).

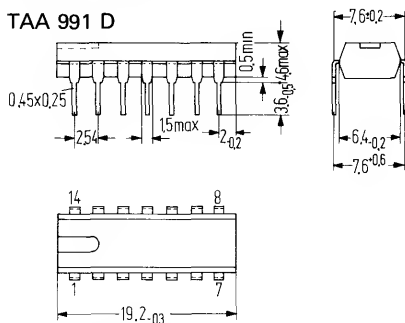
Combined AM/FM IF amplifier for radio receivers. The circuit is suited for AC- and batteryoperated sets. An additionally available control voltage (pin 12) permits control of a RF-pre-amplifier stage.

- Good control for AM operation
- Good limiting qualities for FM operation
- Low current requirement
- Low supply voltage dependence

Type	Ordering codes
TAA 991 D	Q67000-A289
TAA 991 Q	Q67000-A726

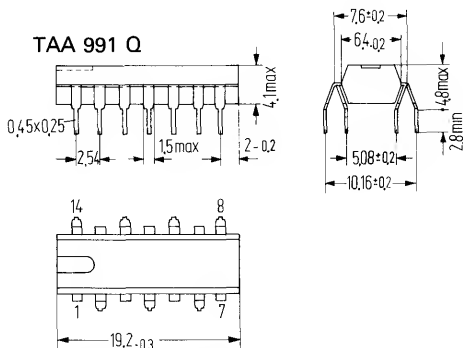
Package outlines

TAA 991 D



Plastic plug-in package
14 pins, dual-in-line
20 A 14 DIN 41 866
Weight approx. 1.1 g

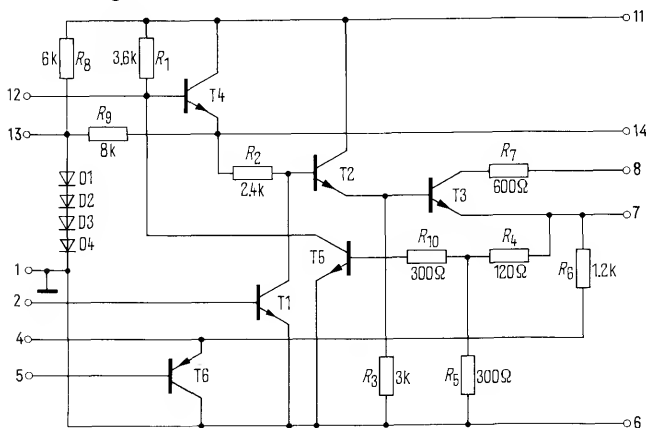
TAA 991 Q



Plastic plug-in package
14 pins, quad-in-line
similar 20 A 14 DIN 41 866
Weight approx. 1.1 g

Dimensions in mm

Circuit diagramm



Absolute maximum ratings

Supply voltage

Storage temperature

Junction temperature

Thermal resistance (system-air)

V_{cc}	11
T_s	-30 to +125
T_j	150
R_{thsa}	120

V
°C
°C
K/W

Range of operating

Supply voltage	V_{CC}	4.5 to 11	V
Ambient temperature in operation	T_{amb}	-15 to +18	°C

Electrical characteristics ($T_{amb} = 25^{\circ}\text{C}$)

AM operation ($f_{IF} = 460 \text{ kHz}$, $V_{CC} = 5 \text{ V}$)

Total current consumption (without signal)	I_{CC}	3.6	mA
Collector current of Tr 3 (without signal)	I_8	2	mA
Stabilized voltage	V_{13}	2.8 (2.6–3.2)	V
Voltage gain	G_v	80	dB
Control range	ΔG_v	50	dB
Voltage starting control ¹⁾	V_{ieff}	50	μV
Feedback voltage ($V_{ieff} = 50 \mu\text{V}$; $f_{mod} = 1 \text{ kHz}$; $m = 80\%$)	$-V_{fb}$	200 (> 100)	mV
AF output voltage	V_{qAF}	120	mV
($V_{ieff} = 50 \mu\text{V}$; $f_{mod} = 1 \text{ kHz}$; $m = 80\%$)			
Input voltage causing overdrive	V_{ieff}	15	mV

AM operation ($f_{IF} = 460 \text{ kHz}$, $V_{CC} = 9 \text{ V}$)

Total current consumption (without signal)	I_{CC}	6	mA
Collector current Tr 3 (without signal)	I_8	2	mA
Stabilized voltage	V_{13}	2.9 (2.6–3.2)	V
Voltage gain	G_v	90	dB
Control range	ΔG_v	60	dB
Voltage starting control ¹⁾	V_{ieff}	15	μV
Feedback voltage ($V_{ieff} = 15 \mu\text{V}$, $f_{mod} = 1 \text{ kHz}$, $m = 80\%$)	$-V_{fb}$	200 (> 100)	mV
AF output voltage ($V_{ieff} = 15 \mu\text{V}$, $f_{mod} = 1 \text{ kHz}$, $m = 80\%$)	V_{qAF}	120	mV
Input voltage causing overdrive	V_{ieff}	25	mV
Harmonic distortion ($V_{ieff} = 15 \text{ mV}$, $f_{mod} = 1 \text{ kHz}$, $m = 80\%$) k		< 10	%
AF output voltage ($V_{ieff} = 15 \text{ mV}$, $f_{mod} = 1 \text{ kHz}$, $m = 80\%$)	V_{qAF}	300	mV
Base current of Tr 6 ($V_{ieff} = 15 \text{ mV}$, $f_{mod} = 1 \text{ kHz}$, $m = 80\%$)	I_5	< 30	μA
Input voltage starting prestage control	V_{ieff}	1	mV
Prestage control voltage	V_{12}	> 2.8	V
	V_{12}	< .5	V
Input impedance ($V_{ieff} = 50 \mu\text{V}$)	Z_i	1250/100	Ω/pF

FM operation ($f_{IF} = 10.7 \text{ MHz}$; $V_{CC} = 5 \text{ V}$; $\Delta f = 75 \text{ kHz}$; $f_{mod} = 1 \text{ kHz}$)

Voltage gain	G_v	76	dB
Input voltage for limiting ²⁾	V_{ieff}	300	μV
AF output voltage	V_{qAF}	200	mV

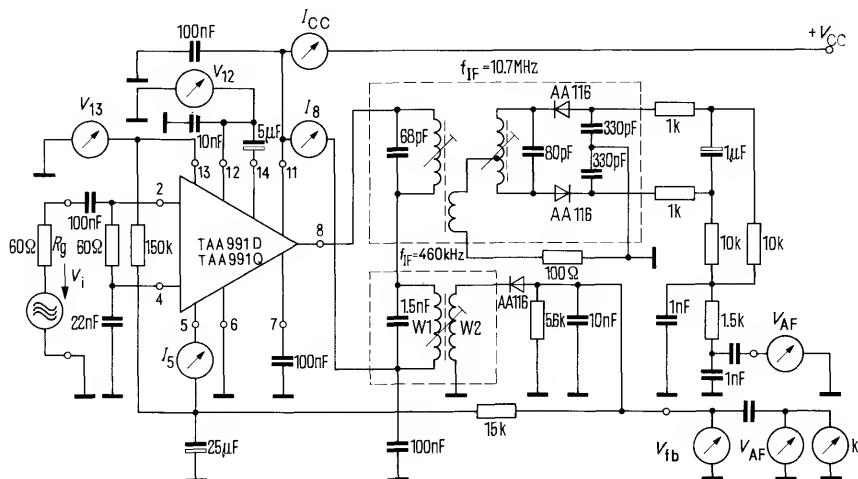
FM operation ($f_{IF} = 10.7 \text{ MHz}$; $V_{CC} = 9 \text{ V}$; $\Delta f = \pm 75 \text{ kHz}$; $f_{mod} = 1 \text{ kHz}$)

Voltage gain	G_v	86	dB
Input voltage for limiting ²⁾	V_{ieff}	225	μV
AF output voltage ($V_{ieff} = 100 \text{ mV}$)	V_{qAF}	300	mV
AM suppression ($m = 30\%$)	V_{FM}/V_{AM}	50	dB
Input impedance ($V_{ieff} = 2 \text{ mV}$)	Z_i	150/70	Ω/pF

¹⁾ Start of regulation is defined as the input voltage for which $\frac{V_{ieff}}{V_{AF}} = \frac{10}{3}$ dB.

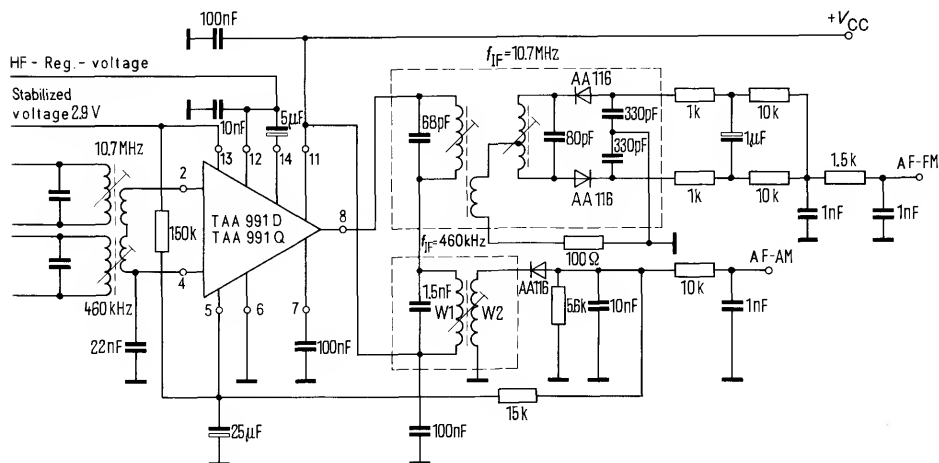
²⁾ Start of limiting is defined as the input voltage at which the AF output voltage has dropped by 3 dB; reference potential is $V_{ieff} = 100 \text{ mV}$.

Test circuit



$W_1 = 77$ HF-litz 12×0.04 Cul
 $W_2 = 55$ HF-litz 12×0.04 Cul

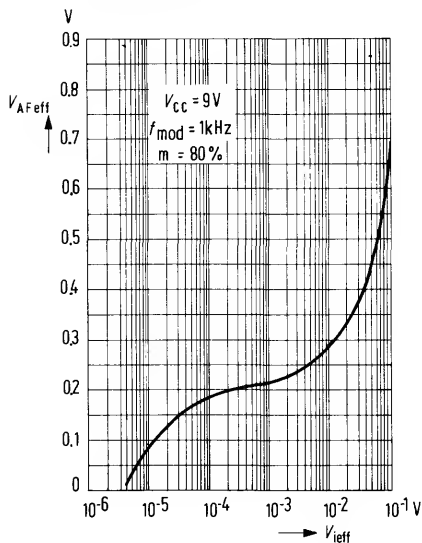
Application circuit



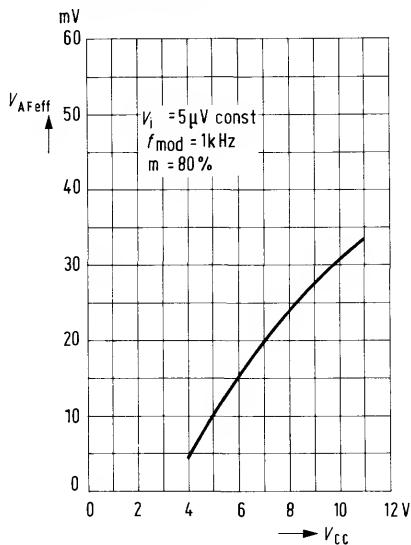
$W_1 = 77$ HF-litz 12×0.04 Cul
 $W_2 = 55$ HF-litz 12×0.04 Cul

AM operation ($f_F = 460$ kHz)

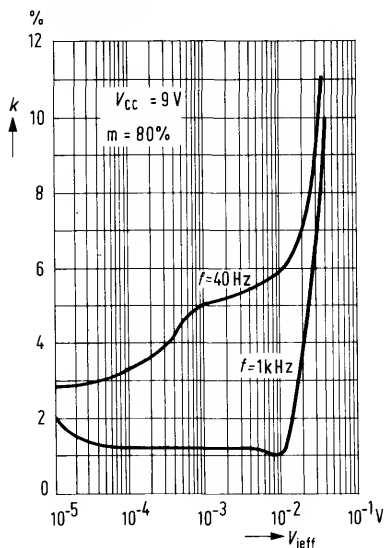
AF output voltage versus input voltage



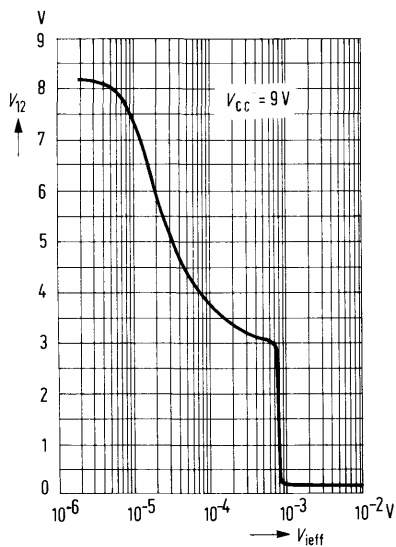
AF output voltage versus supply voltage



Harmonic distortion versus input voltage

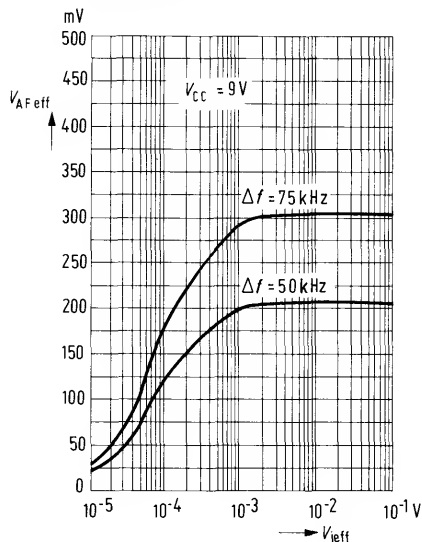


Prestage control voltage v. input voltage

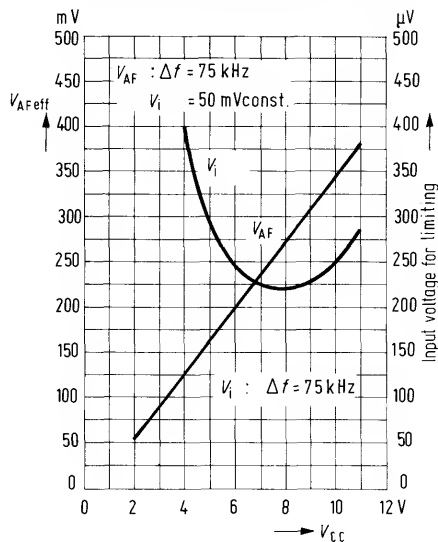


FM operation ($f_{IF} = 10.7 \text{ MHz}$)

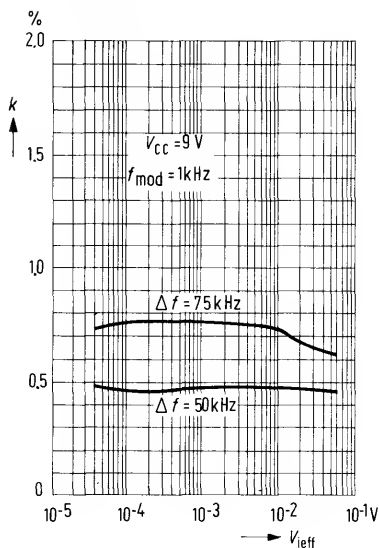
AF output voltage versus input voltage



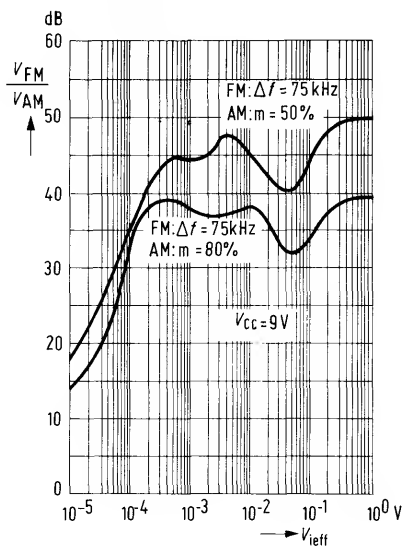
AF output voltage and input voltage starting limiting versus supply voltage



Harmonic distortion versus input voltage



AM suppression versus input voltage



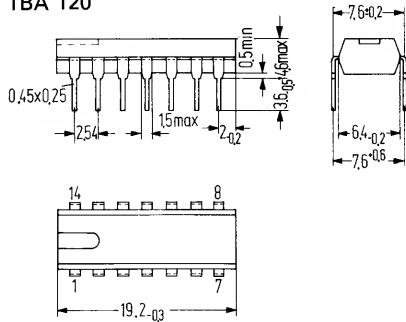
Symmetrical six-stage amplifier with symmetrical coincidence demodulator for the amplification, limiting and demodulation of frequency-modulated signals. Especially suited for radio receivers and the sound-IF units in TV sets. These circuits are applicable as limiter amplifiers, as controlled demodulators or modulators or as mixers with excellent suppression of the input frequency.

- Outstanding limiting
- Very good frequency stability of the converter characteristic
- Wide range of operation (5 to 15V)
- Very few external components (i.e. for hum suppression)

Type	Ordering codes
TBA 120	Q67000-A151
TBA 120A	Q67000-A175

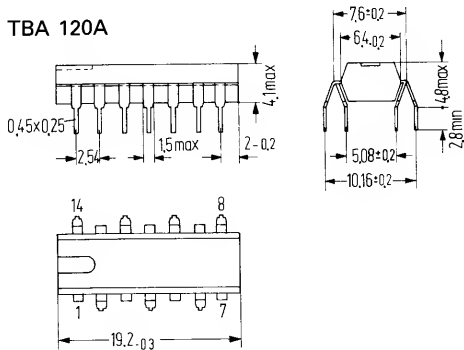
Package outlines

TBA 120



Plastic plug-in package
20 A 14 DIN 41866
14 pins, dual-in-line
Weight approx. 1.1 g

TBA 120A



Plastic plug-in package
20 A 14 DIN 41866
14 pins, quad-in-line
Weight approx. 1.1 g

Dimensions in mm

Absolute maximum ratings

Supply voltage
Storage temperature
Junction temperature
Thermal resistance (system-air)

V_{cc}	15	V
T_s	-40 to +125	$^{\circ}C$
T_j	150	$^{\circ}C$
R_{thsa}	120	K/W

Range of operation

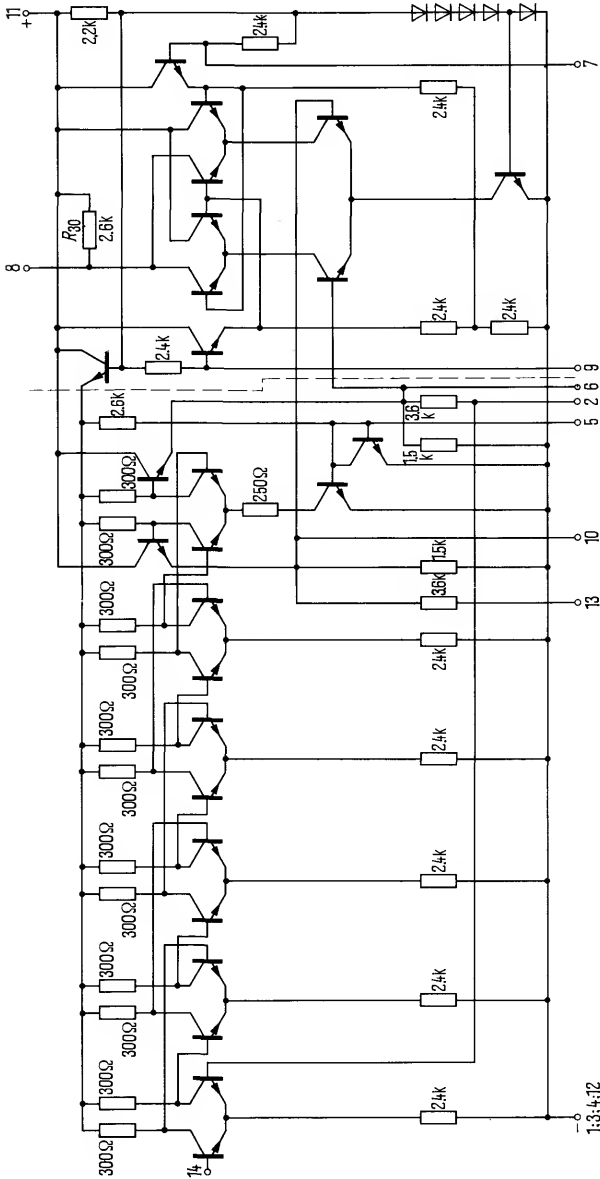
Supply voltage
Ambient temperature in operating
Frequency range

V_{cc}	5 to 15	V
T_{amb}	-15 to +70	$^{\circ}C$
f	0 to 35	MHz

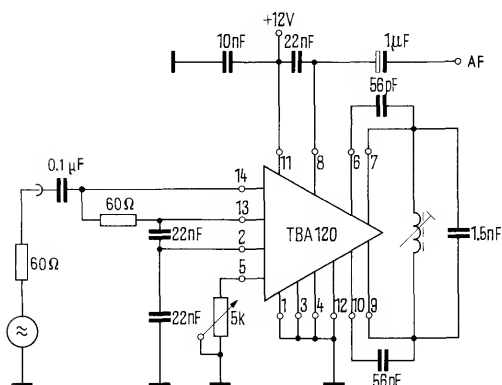
Electrical characteristics ($T_{amb} = 25^{\circ}\text{C}$, $V_{cc} = 12\text{ V}$)

	min	typ	max	
Total current consumption	I_{cc}	12.5	16.5	20.5 mA
IF voltage gain ($f = 5.5\text{ MHz}$)	G_v	60	60	dB
IF output voltage at limiting each output	V_{opp}	240		mV
AF output voltage	V_{AFeff}	.6	.85	V
($f_{iF} = 5.5\text{ MHz}$, $\Delta f = \pm 25\text{ kHz}$, $V_i = 10\text{ mV}$, $f_{mod} = 1\text{ kHz}$, $Q_B \approx 45$)				
AF output voltage	V_{AFeff}	1.2	1.7	V
($f_{iF} = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$, $V_i = 10\text{ mV}$, $f_{mod} = 1\text{ kHz}$, $Q_B \approx 45$)				
Harmonic distortion ($f_{iF} = 5.5\text{ MHz}$, $\Delta f = \pm 25\text{ kHz}$, $V_i = 10\text{ mV}$, $f_{mod} = 1\text{ kHz}$, $Q_B \approx 45$)	k	1.8	3	%
Input voltage for limiting	$V_{i\text{ lim}}$	50	100	μV
($f_{iF} = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$, $f_{mod} = 1\text{ kHz}$, $Q_B \approx 45$)				
Input impedance	Z_i	15/7.8		k Ω /pF
($f_{iF} = 5.5\text{ MHz}$, $f_{iF} = 10.7\text{ MHz}$)	Z_i	7.2/6.2		k Ω /pF
Output impedance (pin 8)	R_q	2.6	3.3	k Ω
Range of volume control	V_{AFmax}	60		dB
DC level of output signal ($V_i = 0$)	V_{AFmin}			
AM suppression	V_8	6.1	7.3	8.6 V
($f_{iF} = 5.5\text{ MHz}$, $V_i = 10\text{ mV}$, $m = 30\%$, $f_{mod} = 1\text{ kHz}$, $\Delta f = \pm 50\text{ kHz}$)	a_{AM}	55		dB

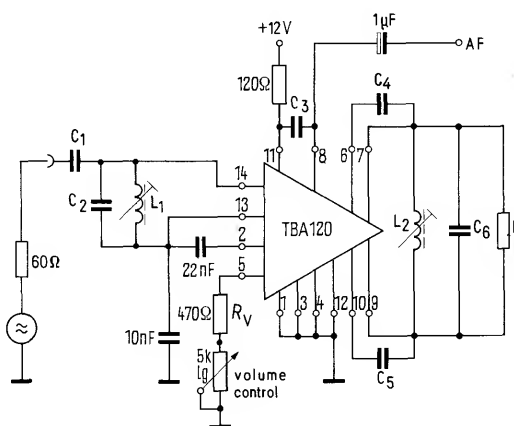
Circuit diagram for TBA 120 and TBA 120A



Test circuit



Recommended application circuit



Component data for various applications

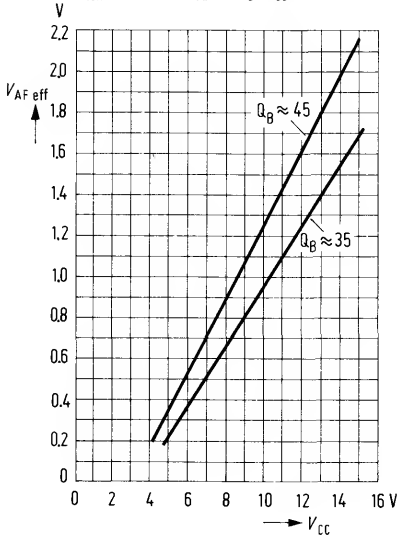
	Sound IF in TV sets	FM-IF in radio sets	
	5.5 MHz	10.7 MHz Mono	10.7 MHz Stereo
C_1	47 pF	27 pF	47 pF
C_2	220 pF	120 pF	150 pF
C_3	22 nF	22 nF	470 pF
C_4	56 pF	27 pF	30 pF
C_5	56 pF	27 pF	30 pF
C_6	1.5 nF	470 pF	330 pF
L_1	20 turns	20 turns	15 turns
L_2	8 turns	8 turns	12 turns
R_1	∞	∞	1 k

A capacitive decoupling of supply voltage input 11 is not necessary. The 22 nF capacitor between pins 8 and 11, together with the integrated resistor R 30, constitutes the de-emphasis and may be reduced if required.

The distance of the peaks on the S-curve can be adjusted with the Q_B of the phase-shifting circuit. Zero crossing corresponds to resonance frequency. The two coupling capacitors of equal size connected between pins 6/7 and 9/10 should be dimensioned to produce approx. 250 mV_{pp} at the tank circuit at resonance.

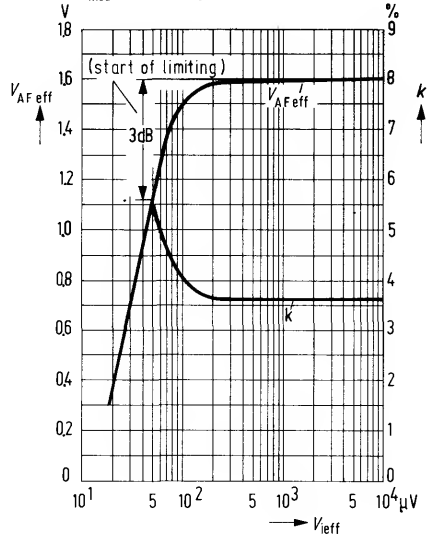
AF output voltage versus supply voltage

$f_{IF} = 5.5 \text{ MHz}$, $\Delta f = \pm 50 \text{ kHz}$, $f_{mod} = 1 \text{ kHz}$,
 $V_{cc} = 12 \text{ V}$, $V_{Aeff} \sim Q_B (V_{cc} - 4 \text{ V})$



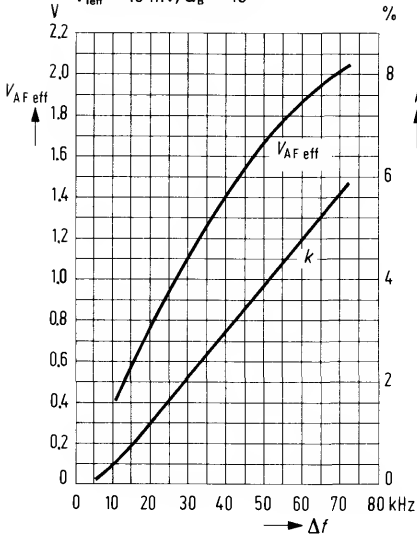
AF output voltage and harmonic distortion v. input voltage

$V_{cc} = 12 \text{ V}$, $f_{IF} = 5.5 \text{ MHz}$, $\Delta f = \pm 50 \text{ kHz}$,
 $f_{mod} = 1 \text{ kHz}$, $Q_B \approx 45$



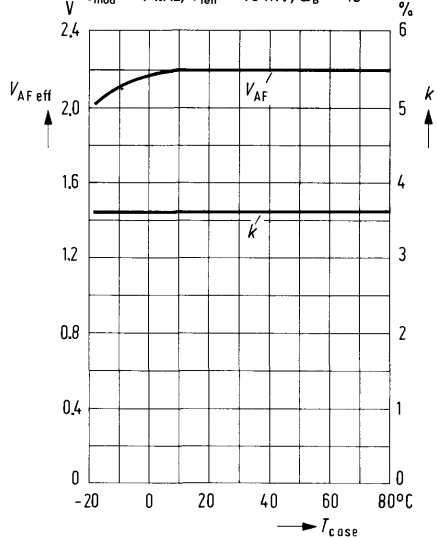
AF output voltage and harmonic distortion versus frequency deviation

$V_{cc} = 12 \text{ V}$, $f_{IF} = 5.5 \text{ MHz}$, $f_{mod} = 1 \text{ kHz}$,
 $V_{ieff} = 10 \text{ mV}$, $Q_B \approx 45$



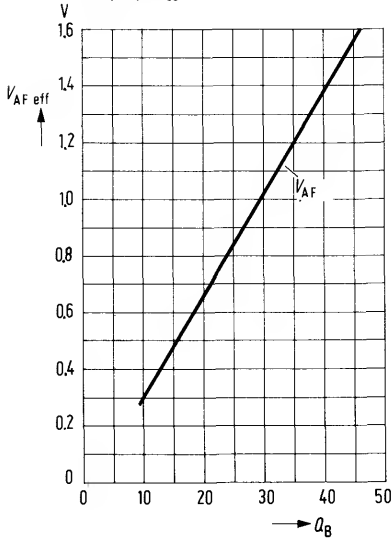
AF output voltage and harmonic distortion versus temperature of case

$V_{cc} = 15 \text{ V}$, $f_{IF} = 5.5 \text{ MHz}$, $\Delta f = \pm 50 \text{ kHz}$,
 $f_{mod} = 1 \text{ kHz}$, $V_{ieff} = 10 \text{ mV}$, $Q_B \approx 45$

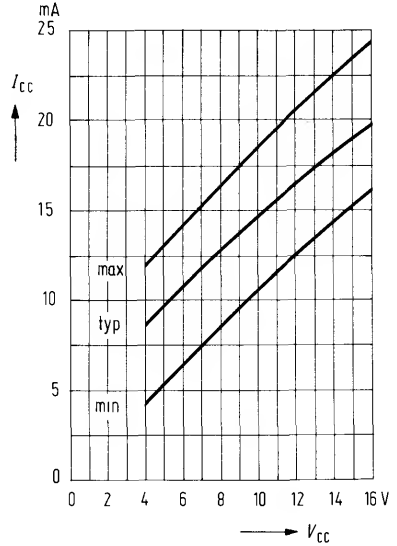


AF output voltage v. Q_B -factor

$V_{cc} = 12\text{ V}$, $f_F = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$,
 $f_{mod} = 1\text{ kHz}$, $V_{AF eff} = 10\text{ mV}$
 $V_{AF prop} (V_{cc} - 4\text{ V})$

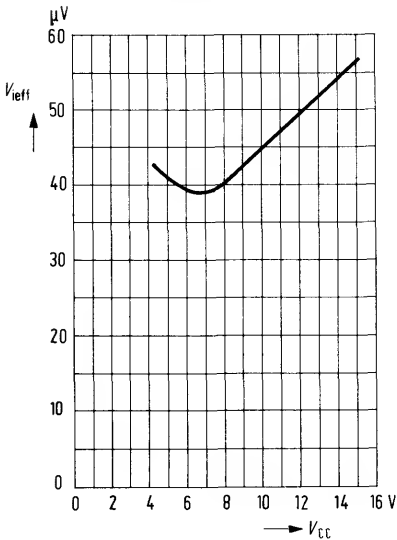


Current consumption versus supply voltage



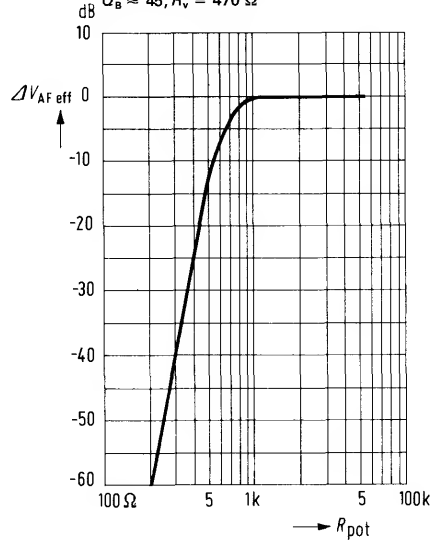
Input voltage for -3dB limiting versus supply voltage

$f_F = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$,
 $f_{mod} = 1\text{ kHz}$, $Q_B \approx 45$

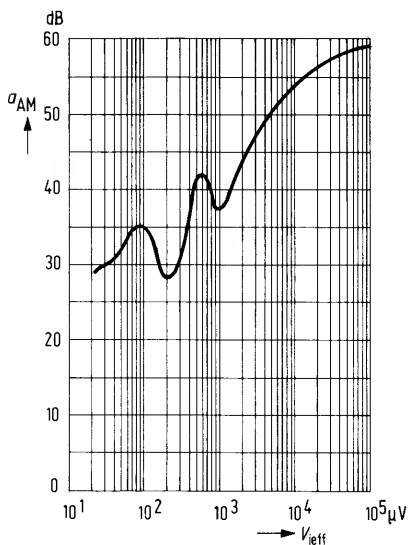


Volume control versus potentiometer resistance

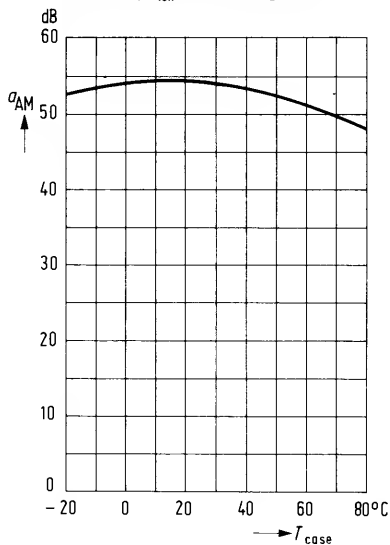
$V_{cc} = 12\text{ V}$, $f_F = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$,
 $f_{mod} = 1\text{ kHz}$, $V_{eff} = 10\text{ mV}$,
 $Q_B \approx 45$, $R_v = 470\ \Omega$



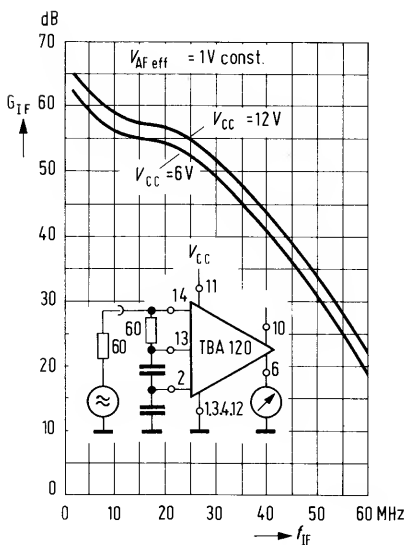
AM suppression versus input voltage
 $V_{cc} = 12\text{ V}$, $f_{IF} = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$,
 $f_{mod} = 1\text{ kHz}$, $m = 30\%$, $Q_B \approx 45$



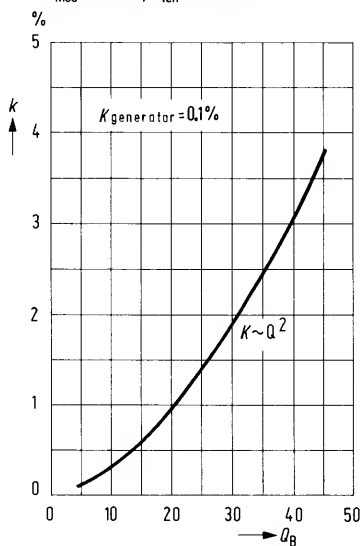
AM suppression versus temperature of case
 $V_{cc} = 12\text{ V}$, $f_{IF} = 5.5\text{ MHz}$, $f_{mod} = 1\text{ kHz}$,
 $m = 30\%$, $V_{ieff} = 10\text{ mV}$, $Q_B \approx 45$



IF amplification versus IF frequency



Harmonic distortion v. Q_B -factor
 $V_{cc} = 12\text{ V}$, $f_{IF} = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$,
 $f_{mod} = 1\text{ kHz}$, $V_{ieff} = 10\text{ mV}$



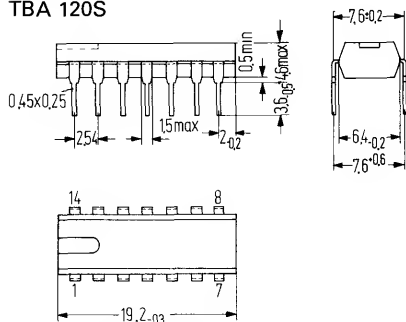
Symmetrical 8-stage amplifier with symmetrical coincidence demodulator for amplification, limiting and demodulation of frequency-modulated signals, especially suited for the sound IF units in TV sets and FM IF amplifiers in radio sets. The circuit is directly interchangeable with TBA 120/A (pin-compatible).

- Outstanding limiting qualities
- Very good frequency stability of converter characteristic
- Wide range of operation (6 to 18 V)
- Very low external component requirement
- Voltage for AFT

Type	Ordering codes
TBA 120S	Q67000-A490
TBA 120AS	Q67000-A525

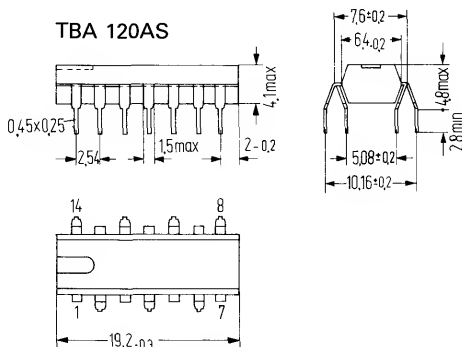
Package outlines

TBA 120S



Plastic plug-in package
20 A 14 DIN 41866 14 pins, dual-in-line,
Weight approx. 1.1 g

TBA 120AS



Plastic plug-in package
20 A 14 DIN 4186 (similar) 14 pins,
quad-in-line
Weight approx. 1.1 g

Dimensions in mm

Absolute maximum ratings

Supply voltage¹⁾

Storage temperature

Z current

(for max. 1 min)

Voltage

Current

Current

Junction temperature

Thermal resistance (system-air)

V_{cc}	18	V
T_s	-40 to +125	°C
I_{12}	15	mA
I_{12}	20	mA
V_5	4	V
I_3	5	mA
I_4	2	mA
T_j	150	°C
R_{thsa}	≤120	K/W

Range of operation

Supply voltage

Ambient temperature in operation

Frequency range

V_{cc}	6 to 18	V
T_{amb}	-15 to +70	°C
f	0 to 12	MHz

¹⁾ The circuit must not plugged in or out when supply voltage is switched on.

Electrical characteristics ($V_{cc} = 12\text{ V}$, $T_{amb} = 25^\circ\text{ C}$, $f = 5.5\text{ MHz}$ and 10.7 MHz)

			min	typ	max	
Total current consumption	$R_5 = \infty$	I_{cc}	10	14	18	mA
	$R_5 = 0$	I_{cc}	11	15.2	20	mA
IF voltage gain		G_v		68		dB
IF output voltage at limiting (each output)		V_{qpp}	170	250		mV
Output resistance (pin 8)		R_q	1.9	2.6	3.3	k Ω
Shunt resistance		R_{13-14}			1	k Ω
Range of volume control		$\frac{V_{AF\ max}}{V_{AF\ min}}$	70	75		dB
DC level of output signal		V_8	6.2	7.4	8.5	V
Potentiometer resistance						
	- 1 dB down	R_5		3.7	4.7	k Ω
	-70 dB down	R_5	1.0	1.4		k Ω
Voltage						
	- 1 dB down	V_5		2.4		V
	-70 dB down	V_5		1.3		V
Signal-to-noise distance		$a_{S/N}$	75	85		dB
($V_i = 10\text{ mV}$, $\Delta f = \pm 50\text{ kHz}$)						
Harmonic distortion		k		1.3	2.5	%
($V_i = 10\text{ mV}$, $\Delta f = \pm 25\text{ kHz}$)						
Noise voltage (according to DIN 45405)		V_n		80	140	μVs

Operation at 5.5 MHz ($\Delta f = \pm 50\text{ kHz}$, $f_{mod} = 1\text{ kHz}$)

AF output voltage ($V_i = 10\text{ mV}$)	$V_{AF\ eff}$	.7	1.0		V
Input voltage for -3 dB limiting	$V_{i\ lim}$		30	60	μV
AM suppression ($m = 30\%$)					
	$V_i = 500\ \mu\text{V}$	a_{AM}	45	55	dB
	$V_i = 10\text{ mV}$	a_{AM}	60	68	dB
Input impedance	Z_i		40/4.5		k Ω /pF

Operation at 10.7 MHz ($\Delta f = \pm 75\text{ kHz}$, $f_{mod} = 1\text{ kHz}$, $m = 30\%$, $Q_B \approx 45$)

AF output voltage ($V_i = 10\text{ mV}$)	$V_{AF\ eff}$	.4	.7		V
Input voltage for -3 dB limiting	$V_{i\ lim}$		50	100	μV
AM suppression					
	$V_i = 500\ \mu\text{V}$	a_{AM}	40	50	dB
	$V_i = 10\text{ mV}$	a_{AM}	60	68	dB
Input impedance	Z_i		20/4		k Ω /pF

Characteristics of the additive circuit

	min	typ	max		
Z-voltage ($I_{12} = 5 \text{ mA}$)	V_{12}	11.2	12	13.2	V
Z-resistance	R_z	30	55		Ω
Breakdown voltage	V_{CBO}	26	40		V
Breakdown voltage ($I_3 = 500 \text{ }\mu\text{A}$)	V_{CEO}	13			V
Current gain ($V_{CE} = 5 \text{ V}$, $I_C = 1 \text{ mA}$)	G_C	25	80		

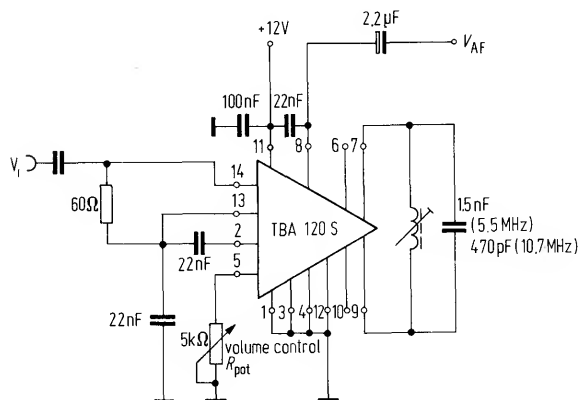
Pins 3 and 4 are connected to collector and base of a transistor, respectively, which may be used as an AF preamplifier ($I_C \leq 5 \text{ mA}$) or as a bass/treble switch (dc on- or off-switching of a RC-circuit).

At pin 12 a Z diode (12 V) is accessible which can be used to stabilize the supply voltage of this integrated circuit or the voltage of other circuit elements in the set ($I_Z \leq 15 \text{ mA}$).

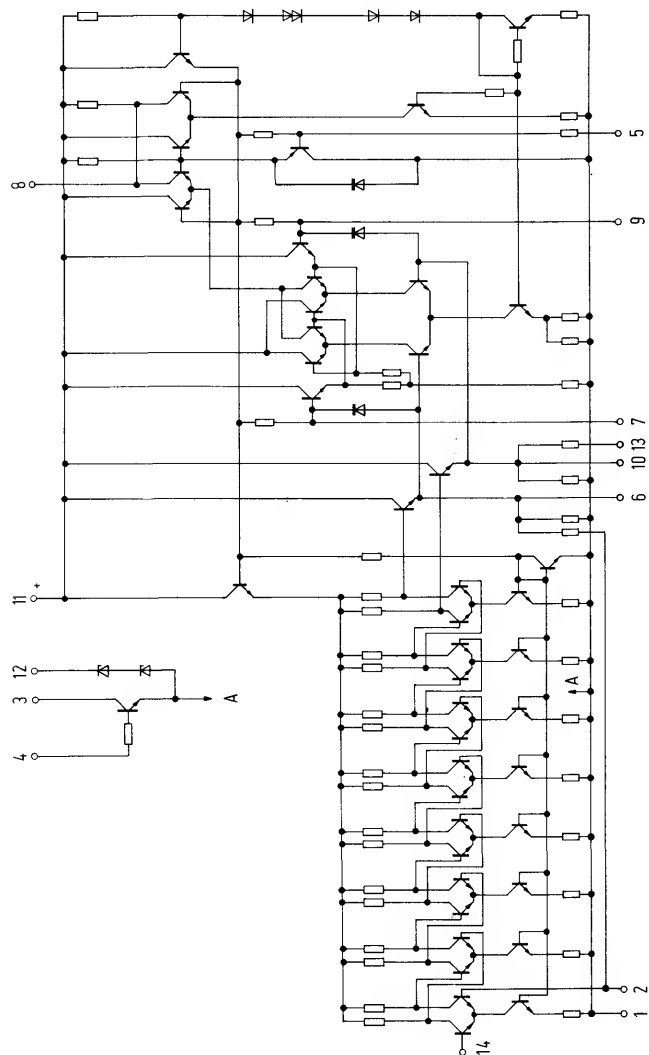
The integrated circuit TBA 120S is supplied in different groups. Parameter is the volume. A decrease of 30 dB requires a resistor between pin 5 and ground with a resistance value depending on the group number as shown below. The group number is imprinted on the plastic package.

Group	II	III	IV	V	
R 5	1.9 to 2.2	2.1 to 2.5	2.4 to 2.9	2.8 to 3.3	k Ω

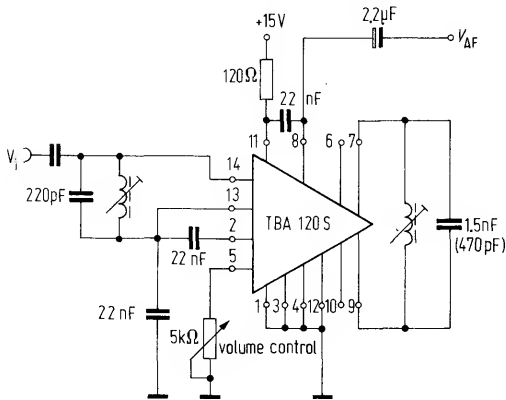
Test circuit



Circuit diagram

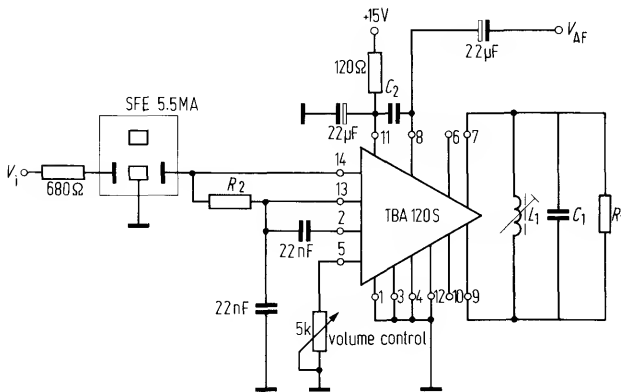


Recommended application circuit 5.5 MHz (10.7 MHz)



TBA 120S with ceramic filter (Murata)

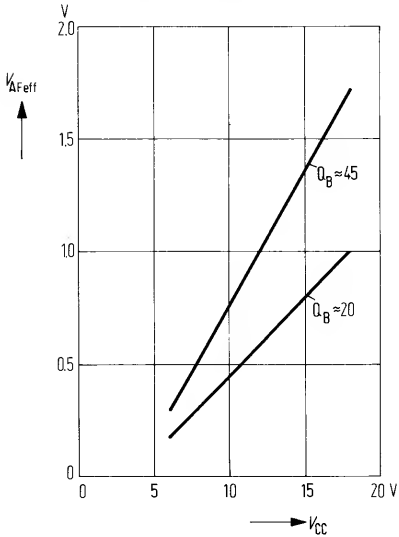
For a good far-away-selectivity the ceramic filter should be combined with a LC circuit



	Sound IF in TV sets	Sound IF in TV sets of American Std.	FM-IF in radio mono sets	FM-IF in radio stereo sets
C_1	1.5 nF	2.2 nF	470 pF	330 pF
C_2	22 nF	22 nF	22 nF	470 pF
L_1	8 turns	8 turns	8 turns	12 turns
R_1	∞	∞	∞	1 kΩ
R_2	680 Ω	1 kΩ	330 Ω	330 Ω
Filter (Murata)	SFE 5.5 MA	SFE 4.5 MA	SFE 10.7 MA	SFE 10.7 MA

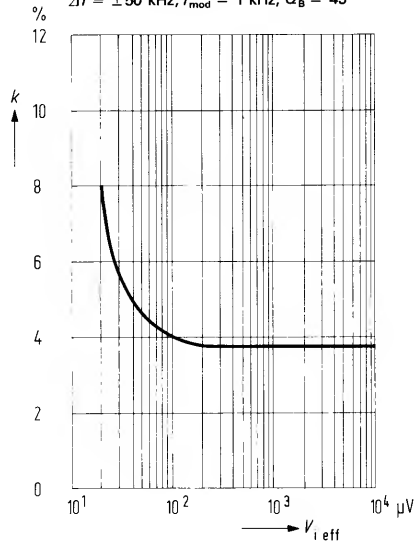
AF output voltage versus supply voltage

$f_F = 5.5 \text{ MHz}$, $\Delta f = \pm 50 \text{ kHz}$,
 $f_{\text{mod}} = 1 \text{ kHz}$, $V_i = 10 \text{ mV}$



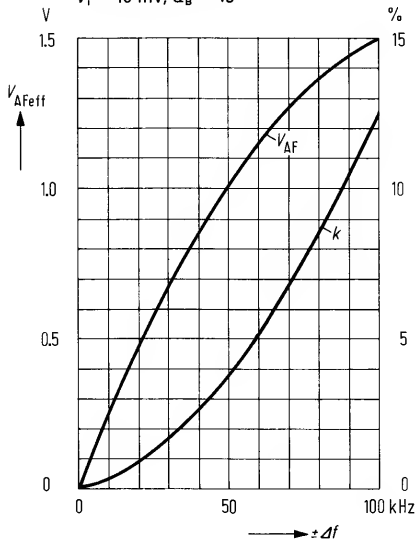
Total harmonic distortion v. input voltage

$V_{\text{cc}} = 12 \text{ V}$, $f_F = 5.5 \text{ MHz}$,
 $\Delta f = \pm 50 \text{ kHz}$, $f_{\text{mod}} = 1 \text{ kHz}$, $Q_B = 45$



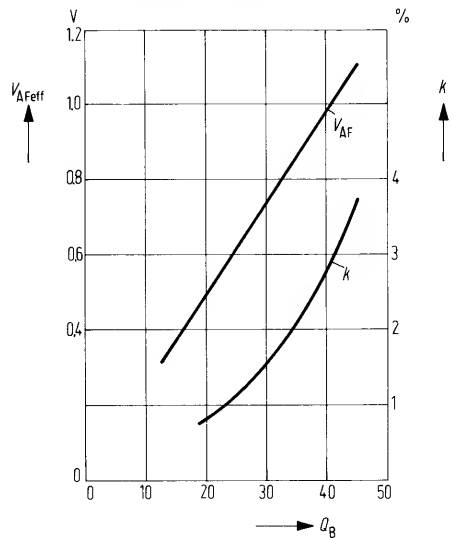
AF output voltage and harmonic distortion v. frequency deviation

$V_{\text{cc}} = 12 \text{ V}$, $f_F = 5.5 \text{ MHz}$, $f_{\text{mod}} = 1 \text{ kHz}$,
 $V_i = 10 \text{ mV}$, $Q_B = 45$

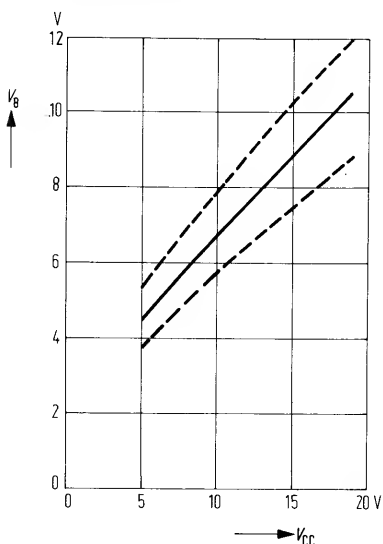


AF output voltage and harmonic distortion v. Q_B -factor

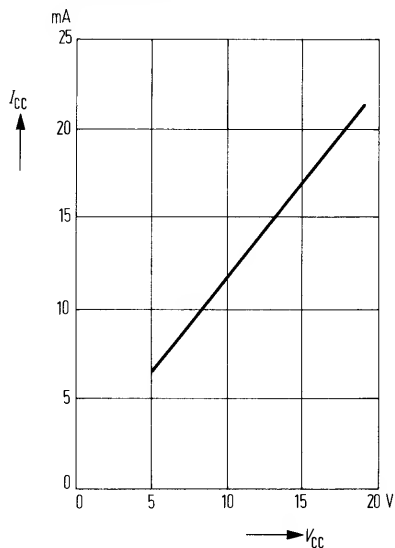
$V_{\text{cc}} = 12 \text{ V}$, $\Delta f = \pm 50 \text{ kHz}$,
 $f_{\text{mod}} = 1 \text{ kHz}$, $V_i = 10 \text{ mV}$



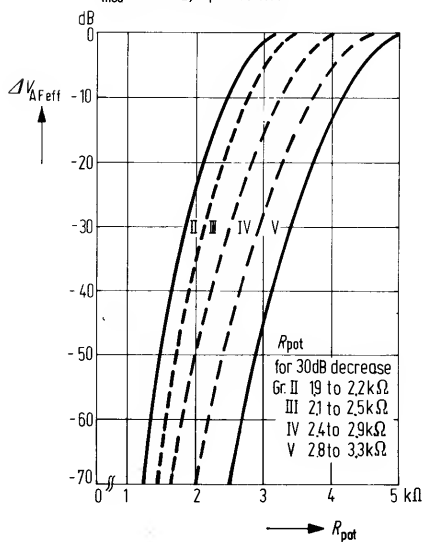
DC output voltage versus supply voltage



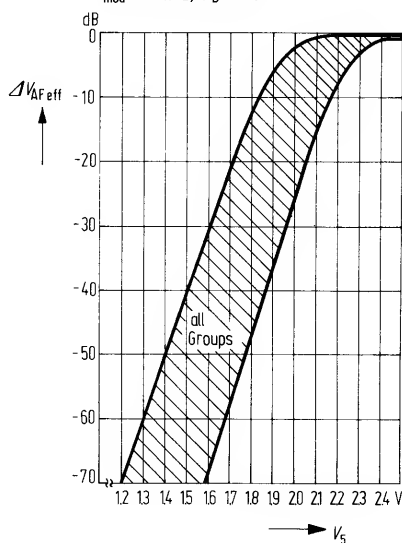
Current consumption versus supply voltage



Volume control v. potentiometer resistance
 $V_{CC} = 12\text{ V}$, $f_F = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$,
 $f_{mod} = 1\text{ kHz}$, $V_I = 10\text{ mV}$

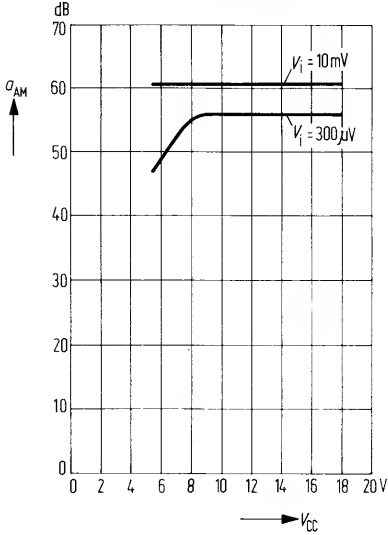


Volume control versus voltage to pin 5
 $V_{CC} = 12\text{ V}$, $f_F = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$,
 $f_{mod} = 1\text{ kHz}$, $Q_B \approx 45$



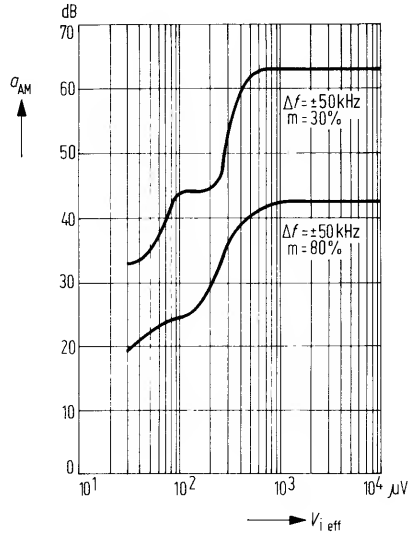
AM suppression versus supply voltage

$f_{IF} = 5.5 \text{ MHz}$, $\Delta f = \pm 50 \text{ kHz}$,
 $f_{mod} = 1 \text{ kHz}$, $m = 30\%$, $Q_B \approx 45$



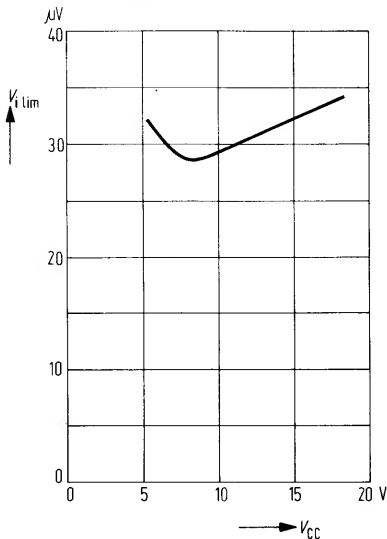
AM suppression versus input voltage

$V_{CC} = 12 \text{ V}$, $f_{IF} = 5.5 \text{ MHz}$, $\Delta f = \pm 50 \text{ kHz}$,
 $f_{mod} = 1 \text{ kHz}$, $Q_B \approx 45$



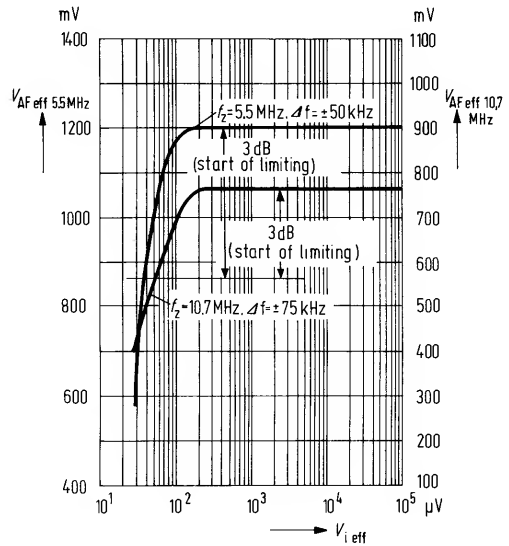
Input voltage for -3 dB limiting versus supply voltage

$f_{IF} = 5.5 \text{ MHz}$, $\Delta f = \pm 50 \text{ kHz}$,
 $f_{mod} = 1 \text{ kHz}$, $Q_B \approx 45$



AF output voltage versus input voltage

$V_{CC} = 12 \text{ V}$, $f_{mod} = 1 \text{ kHz}$, $Q_B \approx 45$



TBA 120T

- Input and demodulator are designed for use with ceramic resonators.
- Additional output before volume control (constant audio signal) for the connection of headphones and video recorders.
- Additional audio input for connection of video recorders (playback).
- Constant audio output voltage between 10 and 18 V supply voltage of the same level as TBA 120S operating at 15 V supply voltage.
- Insensitive against hum from the supply voltage therefore very little need for smoothing capacitors.
- As there is very little residual IF voltage on the audio output, there is no interference of the video-IF due to harmonics of the sound-IF.
- No selection for volume control characteristic is necessary.

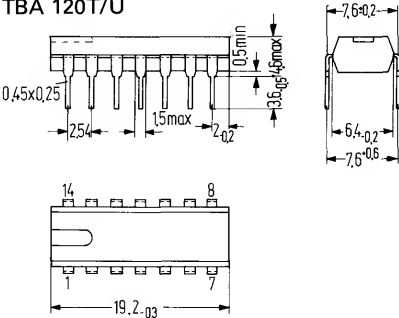
TBA 120U

- This circuit incorporates all the advantages of TBA 120T but input and demodulator are designed for use in connection with standard LC-circuits.

Type	Ordering codes
TBA 120T	Q67000-A919
TBA 120U	Q67000-A920

Package outlines

TBA 120T/U



Plastic plug-in package
20 A 14 DIN 41866
14 pins, dual-in-line
Weight approx. 1.1 g
Dimensions in mm

Absolute maximum ratings

Supply voltage	V_{cc}	18	V
Junction temperature	T_j	150	°C
Storage temperature	T_s	-40 to +125	°C
Voltage	V_s	6	V
Current	I_4	5	mA
Thermal resistance (system-air)	R_{thsa}	≤ 120	K/W

Range of operation

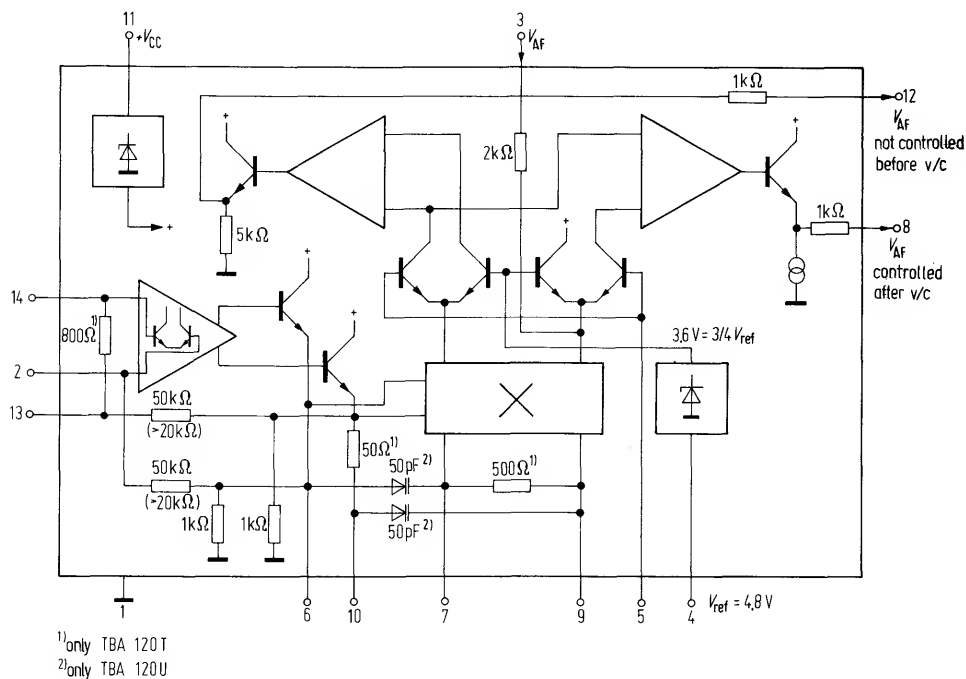
Supply voltage	V_{cc}	10 to 18	V
Ambient temperature in operation	T_{amb}	-15 to +70	°C
Frequency range	f	0 to 12	MHz

Electrical characteristics ($V_{cc} = 12\text{ V}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$)

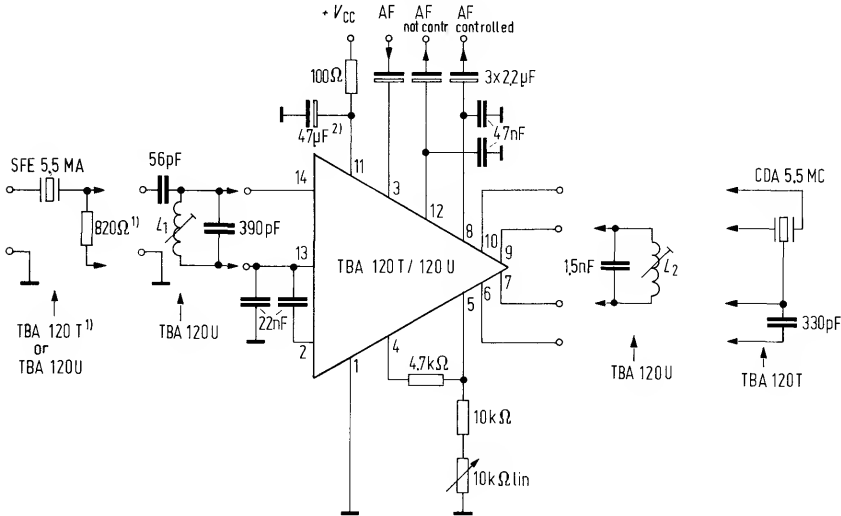
		min	typ	max	
Total current consumption	I_{cc}	9.5	13.5	17.5	mA
IF voltage gain V_6/V_{14} ($f_{IF} = 5.5\text{ MHz}$)	G_V		68		dB
Output voltage with limiting at each output	V_{qpp}		250		mV
Output impedance Pin 8	R_{q8}		1.1		k Ω
Pin 12	R_{q12}		1.1		k Ω
Shunt resistance	R_{13-14}			1	k Ω
Input impedance	R_{13}		2		k Ω
Internal impedance	R_{14}		12		Ω
DC level of output signal ($V_i = 0$)	V_8		4		V
	V_{12}		4.9		V
Stabilized voltage	V_4	4.2	4.8	5.3	V
Residual IF voltage without deemphasis	V_8		20		mV
	V_{12}		30		mV
AF gain (AF not controlled)	V_8/V_3		7.5		
Down control	$V_{AF/8}$	24	30	34	dB
($R_{4-5} = 5\text{ k}\Omega$, $R_{5-1} = 13\text{ k}\Omega$)					
Range of volume control	V_{AFmax}	70	85		dB
(referred to pin 8)	V_{AFmin}				
Resistance	$R_{4-5}^{1)}$	1		10	k Ω
Input voltage for limiting	V_{lim}		30	60	μV
($f_{IF} = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$, $f_{mod} = 1\text{ kHz}$)					
Hum suppression	V_8/V_{11}		35		dB
	V_{12}/V_{11}		30		dB
Signal-to-noise distance	$a_{S/N}$	80	85		dB
Noise voltage (according to DIN 45405)	V_n		50	150	μV
TBA 120 T only:					
Input impedance ($f_{IF} = 5.5\text{ MHz}$)	Z_i		800/5		Ω/pF
AM suppression	a_{AM}	50	60		dB
($f_{IF} = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$, $V_i = 500\text{ }\mu\text{V}$, $f_{mod} = 1\text{ kHz}$, $m = 30\%$)					
AF output voltage	$V_{8\text{ eff}}$	650	900		mV
($f_{IF} = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$, $f_{mod} = 1\text{ kHz}$)	$V_{12\text{ eff}}$	400	650		mV
TBA 120 U only:					
Input impedance ($f_{IF} = 5.5\text{ MHz}$)	Z_i	15/6	40/4.5		k Ω/pF
AM suppression	a_{AM}	50	60		dB
($f_{IF} = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$, $V_i = 500\text{ }\mu\text{V}$, $f_{mod} = 1\text{ kHz}$, $m = 30\%$)					
AF output voltage	$V_{8\text{ eff}}$	850	1200		mV
($f_{IF} = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$, $V_i = 10\text{ mV}$, $f_{mod} = 1\text{ kHz}$, $Q_B \approx 45$, $k = 4\%$)	$V_{12\text{ eff}}$	600	1000		mV
Harmonic distortion	k		1		%
($f_{IF} = 5.5\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$, $V_i = 10\text{ mV}$, $f_{mod} = 1\text{ kHz}$, $Q_B \approx 20$)					

¹⁾ If DC volume control is not used, pin 4 has to be connected directly to pin 5.

Block circuit diagram



Recommended application circuit (5.5 MHz)



L_1 : 20 turns 15×0.05 CuLS; $Q_o \approx 73$

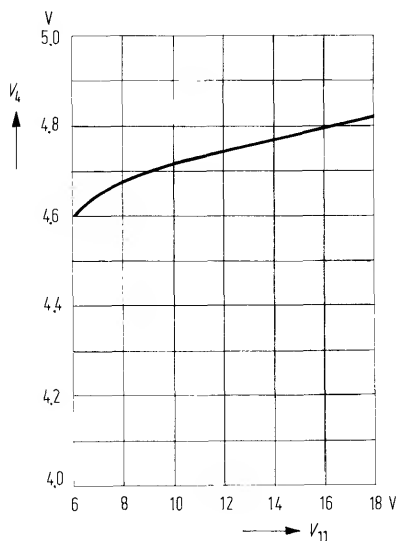
L_2 : 9 turns 0.25 CuLS; $Q_o \approx 40$

Coil Assembly Vogt D41 – 2165 (2438) without gaussian core

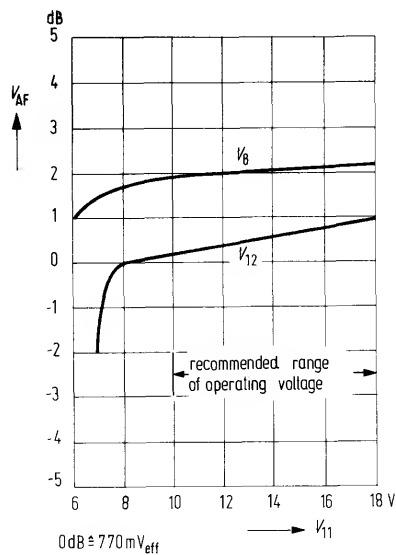
¹⁾ 820 Ohm is no longer necessary for TBA 120T, as resistance is integrated.

²⁾ Omitting the electrolytic capacitor 47 μ F on pin changes volume-control range.

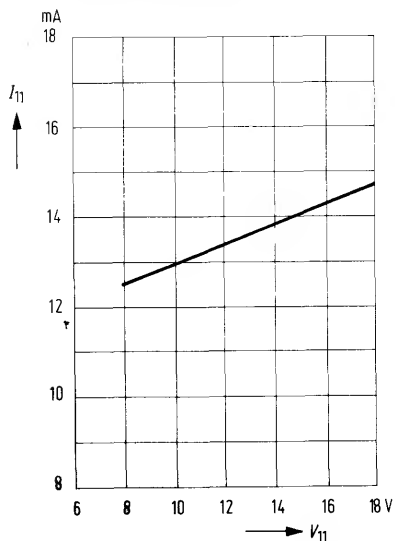
Z voltage versus supply voltage



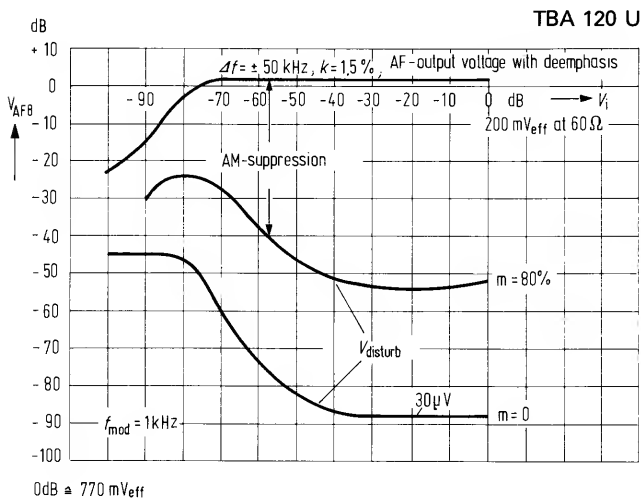
AF output voltage v. supply voltage



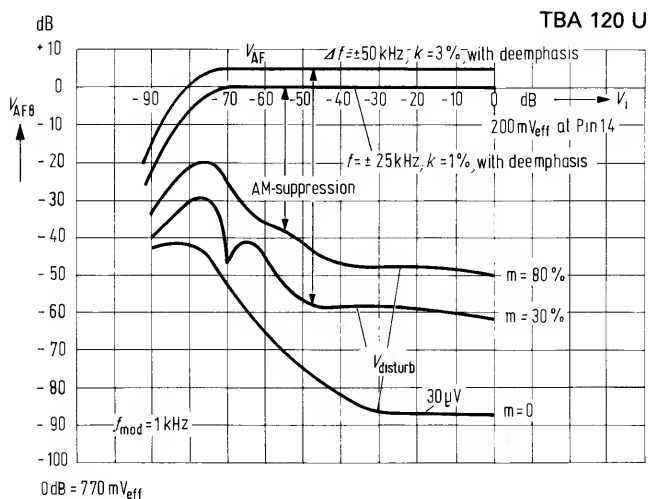
Total current consumption versus supply voltage



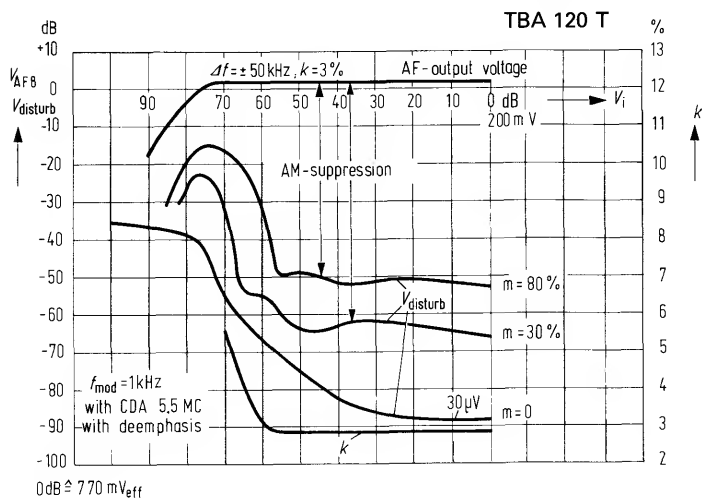
AF output voltage and disturbance voltage versus input voltage
(Input wired with SFE 5.5 MA/Murata)



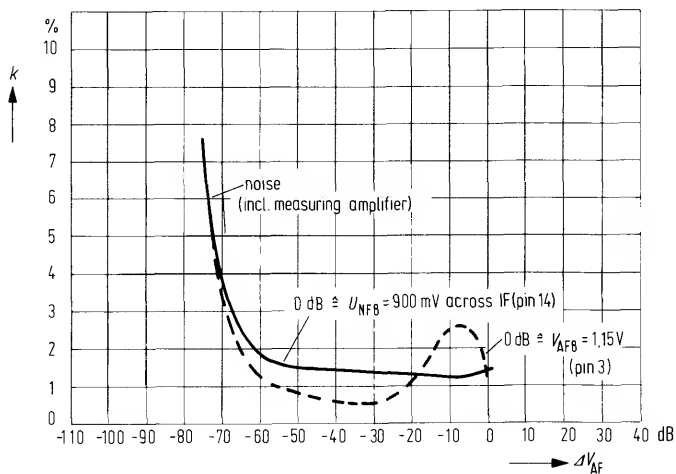
AF output voltage and disturbance voltage versus input voltage
(Input 60 Ω impedance, broadband)



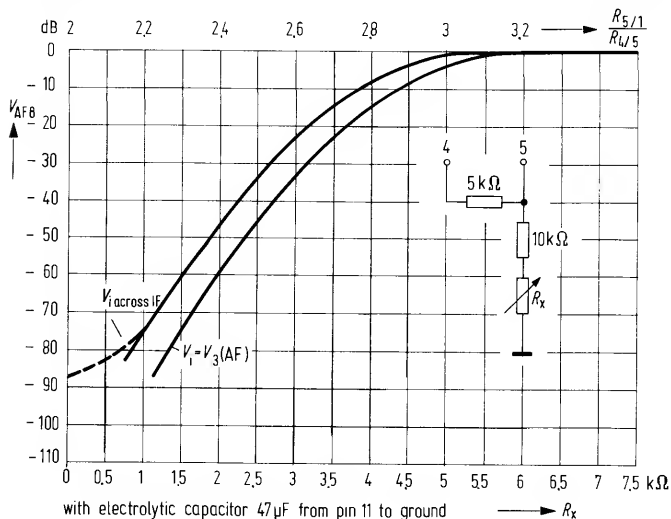
AF output voltage (pin 8), disturbance voltage and harmonic distortion versus input voltage



Harmonic distortion versus volume control

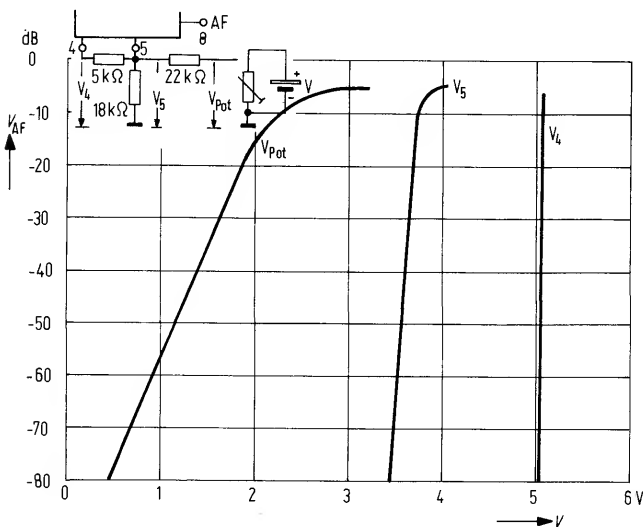


AF output voltage (pin 8) versus potentiometer resistance and versus ratio of resistance

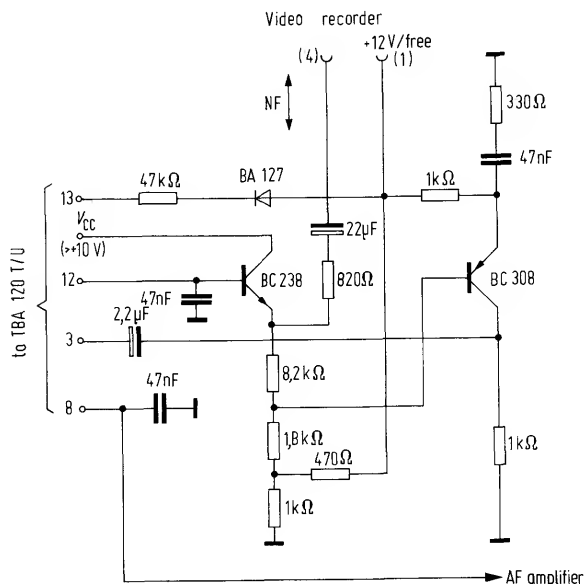


AF output voltage (pin 8) versus voltage feeding into pin 5

$V_{IRF} = 60 \text{ mV}_{eff}$, $f_{IRF} = 5.5 \text{ MHz}$, $\Delta f = \pm 50 \text{ kHz}$, $f_{mod} = 1 \text{ kHz}$, $V_{cc} = 18 \text{ V}$



Circuit for direct connection to video recorders



- Socket (1): Switching voltage: at playback: +12V
at recording: free
- Socket (4): Simultaneous in and output for AF

Function:

When switching voltage applied the emitter follower, BC 238, on the output is blocked and the buffer stage, BC 308, is switched on. It includes a pre-emphasis to balance the de-emphasis at the AF-output. The IF-amplifier is put out of operation by the diode, BA 127, and the 47 k Ohm resistor. The remote controllable volume regulator in the TBA 120 T/U is used for recording and playback.

Not for new development

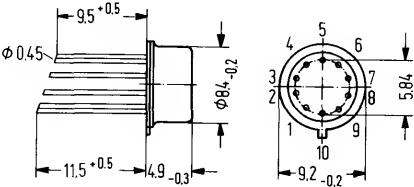
Gain-controlled 3-stage monolithic integrated broadband amplifier with symmetrical input and output, especially suited for application as video IF amplifier in TV sets.

- 75 dB gain, 60 dB control range
- Very good linearity of gain over the entire control range
- Distortion-free processing of input signals up to 240 mV_{eff}
- Noise figure at 30 dB down-control typically 8 dB

Type	Ordering codes
TBA 400	Q67000-A228
TBA 400D	Q67000-A623

Package outlines

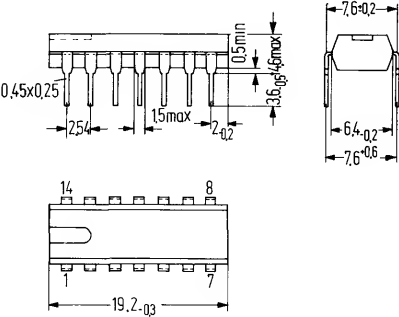
TBA 400



Package 5 J 10 DIN 41873
(similar to TO 100)
Weight approx. 1.1 g

Dimensions in mm

TBA 400D



Plastic plug-in package
20 A 14 DIN 41866
14 pins, dual-in-line
Weight approx. 1.1 g

Absolute maximum ratings

- Supply voltage
- Control current
- Junction temperature
- Storage temperature
- Thermal resistance (system-air)

V_{cc}	14	V
I_s	1	mA
T_j	150	°C
T_s	-40 to +125	°C
R_{thsa}	100	K/W

Range of operation

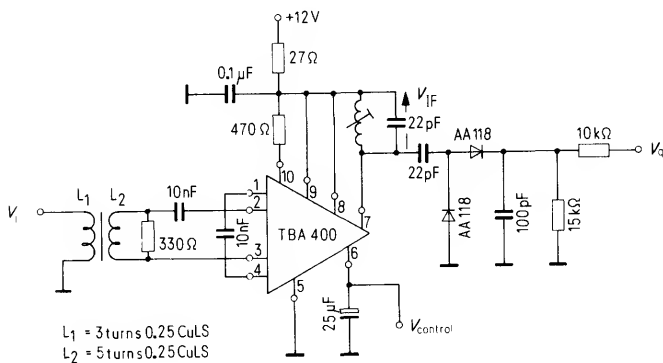
- Supply voltage
- Ambient temperature in operation
- Frequency

V_{cc}	7 to 14	V
T_{amb}	-15 to +80	°C
f	0 to 200	MHz

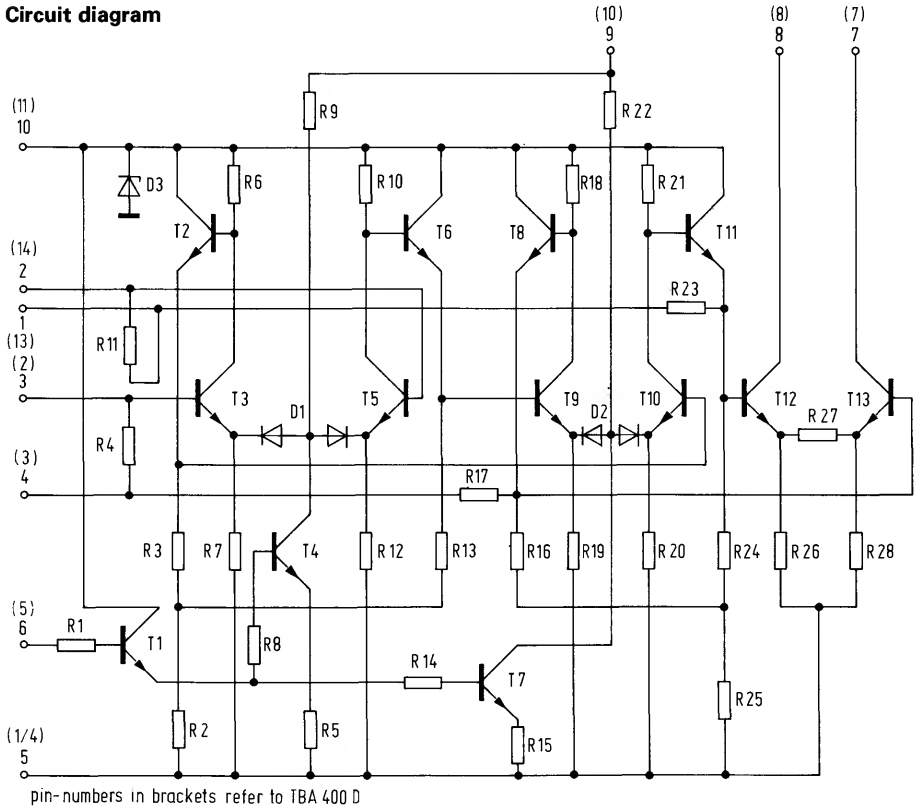
Electrical characteristics ($V_{cc} = 12\text{ V}$, $T_{amb} = 25^\circ\text{C}$)

		min	typ	max	
Total current consumption	I_{cc}		25	32	mA
Output current	I_7, I_8	2.7	4.5	6.3	mA
Difference in output currents	$V_6 = 0$ $V_6 = 4\text{ V}$		.4 .5	.9 1.6	mA
Control voltage	G_{Vmax} G_{Vmin}			1	V
	V_6	4.0			V
Control current (G_{Vmin} , $V_6 = 4\text{ V}$)	I_6			33	μA
Input impedance ($f = 36\text{ MHz}$)	G_{Vmax} G_{Vmin}		.33/17 1.5/0		k Ω /pF k Ω /pF
Output voltage	$V_6 < 1\text{ V}$ $V_6 = 4\text{ V}$		V_{qeff} V_{qeff}		V V
($f = 36\text{ MHz}$, $V_i = 120\text{ mV}$, $f_{mod} = 1\text{ kHz}$, $m = 80\%$, $k = 5\%$)		1.1	2.0 2.9		
Input voltage	$V_{imax\ eff}$		240		mV
($f = 36\text{ MHz}$, $V_6 \geq 4\text{ V}$, $f_{mod} = 1\text{ kHz}$, $m = 80\%$, $k = 5\%$)					
Voltage gain	V_{qeff}		75		dB
($f = 36\text{ MHz}$, $O_B = 9$)	V_{ieff} $V_{video\ pp}$		73		dB
Voltage gain	V_{ieff}				dB
Control range	G_{Vmax} G_{Vmin}	55	60		dB
($f = 33\text{ to }40\text{ MHz}$)					

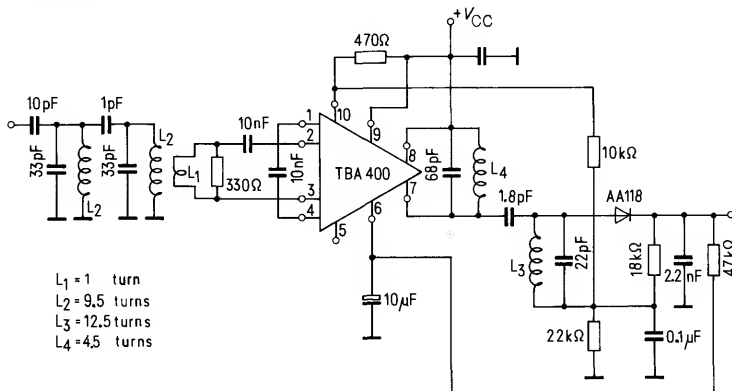
Test circuit



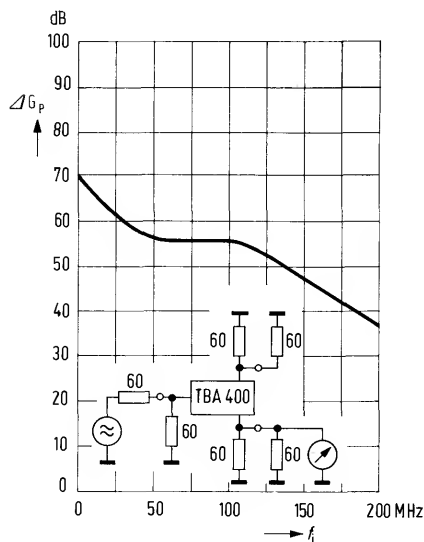
Circuit diagram



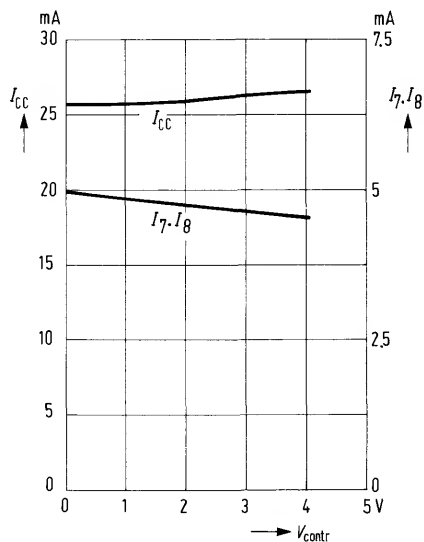
Application circuit for 39.2 MHz



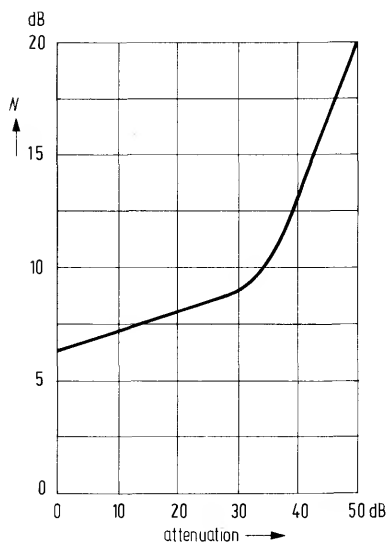
Power gain versus input frequency
 $V_{cc} = 12\text{ V}$, $V_a = 16\text{ mV}$ const



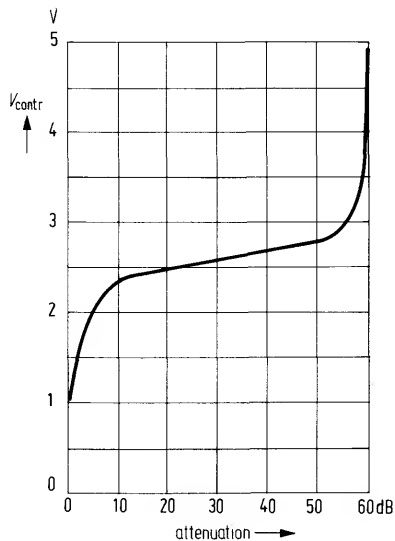
Total current consumption and output currents v. control voltage
 $V_{cc} = 12\text{ V}$



Noise figure versus attenuation
 $V_{cc} = 12\text{ V}$, $f = 36\text{ MHz}$



Voltage control versus attenuation
 $V_{cc} = 12\text{ V}$, $f = 36\text{ MHz}$



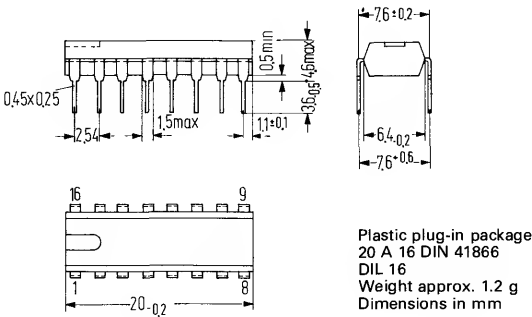
Not for new development

This circuit comprises a high-gain controlled video IF amplifier, a controlled demodulator and two low-resistance video outputs with positive and negative going signal as well as the complete key control and delayed tuner control.
P and N are differentiated only in the polarity of the control voltage for the tuner prestage: TBA 440 P is suitable for tuner prestages with PNP transistors and TBA 440 N for NPN prestages. P and N types are able to control the PIN diode attenuators common today without additional transistors.

- Complete video IF in **one** integrated circuit
- Wide range of control with low noise and high levels of control
- High sensitivity
- Controlled demodulator – therefore minimum 1.07 MHz interference
- Low-resistance video outputs of positive and negative video signals
- Internal temperature stabilization
- White levels of video signals at outputs 11 and 12 are independent of battery voltage
- White **and** black levels are adjustable separately

Type	Ordering codes
TBA 440 P	Q67000-A911
TBA 440 N	Q67000-A910

Package outlines TBA 440 P/N



Absolute maximum ratings

Supply voltage	V_{13}	15 ¹⁾	V
Voltage at pin 5	V_5	20	V
Voltage at pin 4	V_4	5	V
Voltage at pin 14	V_{14}	5	V
Junction temperature	T_j	150	°C
Thermal resistance (system-air)	R_{thsa}	100	K/W
Ohmic resistance between pins 8 and 9	R_{8-9}	20	ohms
Storage temperature	T_s	-40 to +125	°C

Operation range

Supply voltage	V_{13}	10.5 to 15	V
Ambient temperature in operation	T_{amb}	-25 to +60	°C

¹⁾ briefly 16,5 V

Electrical characteristics

($T_{amb} = 25^{\circ}\text{C}$; $V_{13} = 13\text{ V}$; all data with reference to ground unless otherwise stated)

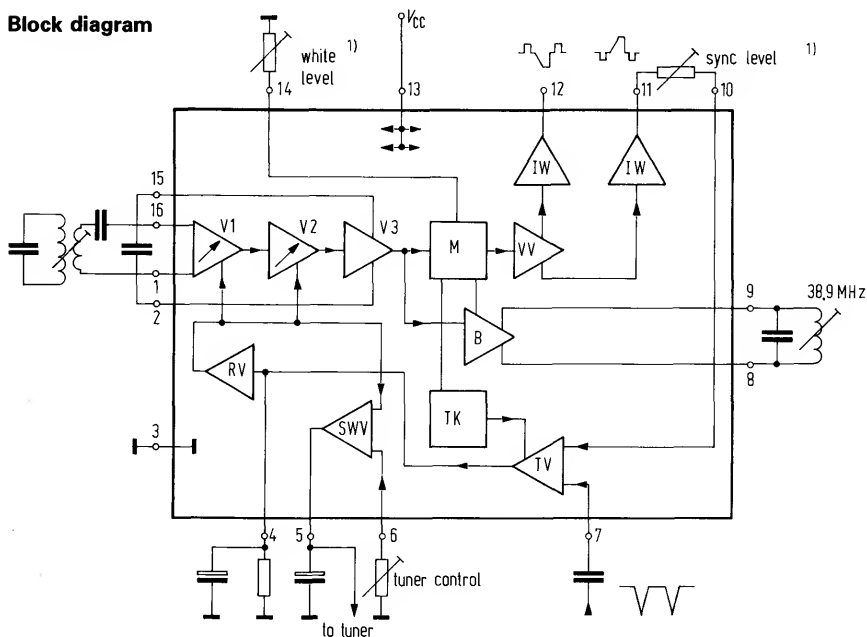
		min	typ	max	
Current consumption ($V_{13} = 15\text{ V}$)	I_{13}	28	40	52	mA
Dc output voltage	$R_{14} = \infty$ V_{11}	4.1	5.1	6.1	V
($V_i = 0$)	$R_{14} = 0$ V_{11}	6.6	8.4	10.2	V
DC output voltage	$R_{14} = \infty$ V_{12}	.5	1.1	1.8	V
($V_i = 0$)	$R_{14} = 0$ V_{12}	1.2	2.4	3.5	V
White level deviation	$\Delta V_{11}/\Delta V_{13}$		.15		
	$\Delta V_{12}/\Delta V_{13}$		.05		
Resistance for $\Delta V_{11} = 1\text{ V}$	R_{14-3}		1		k Ω
AGC threshold $V_{10} = \text{sync pulse level}$	$V_{10} = V_{11}$		1.2		V
for $R_{10-11} = 0$	R_{10-11}/V_{11}		4.5		k Ω/V
Control slope					
Sync pulse level with async or					
without gating pulses	V_{sync}		.2		V
Control current for tuner prestage	I_5	11	18	27	mA
($V_5 > 2\text{ V}$)					
(TBA 440 P: 10 dB following AGC					
TBA 440 N: 10 dB previous to AGC)					
IF control voltage for	max gain V_4	0		.5	V
	min gain V_4	2.5		5	V
Gating pulse voltage	$-V_7$	2		3	V
Residual IF voltage (basic frequency)	$V_{11}; V_{12}$		50		mV
Output current to ground	$I_{11}; I_{12}$			5	mA
Output current to V_{13}	$I_{11}; I_{12}$			-1	mA
Input impedance at	max gain Z_{1-16}		1.8/2		k Ω/pF
	min gain Z_{1-16}		1.9/0		k Ω/pF
Input voltage ¹⁾ for $V_{11} = 3 V_{pp}$	V_i	70	100	200	μV
Video bandwidth	B_{video}		7		MHz
AGC range	ΔG_V	52	58		dB
Intermodulation with reference					
color carrier (1.07 MHz)	a^2)		55		dB

¹⁾ V_{in} effective sync pulse level at 60 Ohms via transformer 3:5.

²⁾ measured with demodulator capacitance 22 pF at any position of the control.

$V_{11} = 0.3$ to $1.5 V_{pp}$ (yellow). IF carrier level $d_{cc} = -2\text{ dB}$; sound carrier level -24 dB with reference to the video carrier.

Block diagram

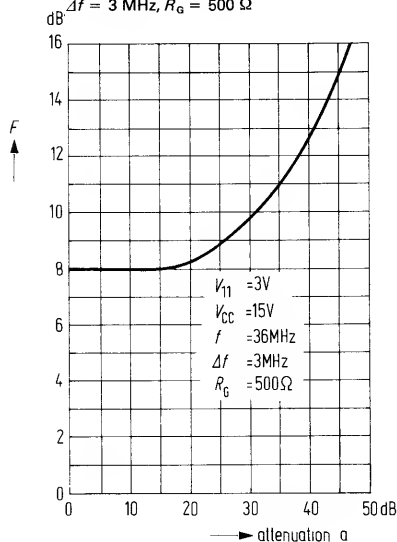


¹⁾ potentiometer only if necessary, otherwise normal resistor

- V1, V2 IF AGC stages
- V3 IF amplifier stage
- M Mixer
- VV Video amplifier
- IW Impedance buffer
- B Limiter amplifier
- RV Control voltage amplifier
- SWV Threshold amplifier
- TK Temperature compensation
- TV Key amplifier

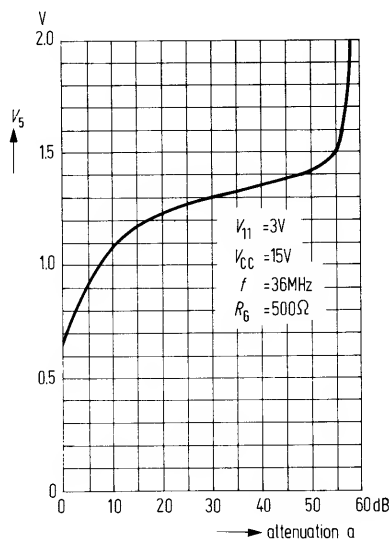
Noise figure v. attenuation
(measured at video frequency)

$-V_{fb} = 3\text{ V}$, $V_{cc} = 15\text{ V}$, $f = 36\text{ MHz}$,
 $\Delta f = 3\text{ MHz}$, $R_G = 500\ \Omega$



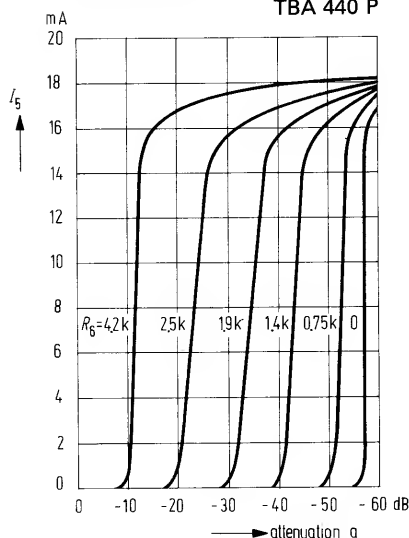
Control voltage v. attenuation

$-V_{fb} = 3\text{ V}$, $V_{cc} = 15\text{ V}$, $f = 36\text{ MHz}$,
 $R_G = 500\ \Omega$



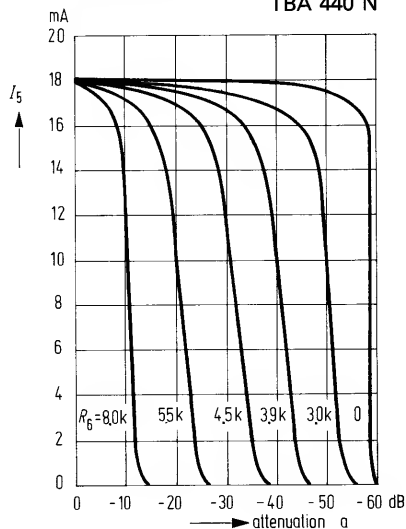
Tuner control current versus attenuation
 $R_G = \text{Parameter}$

TBA 440 P

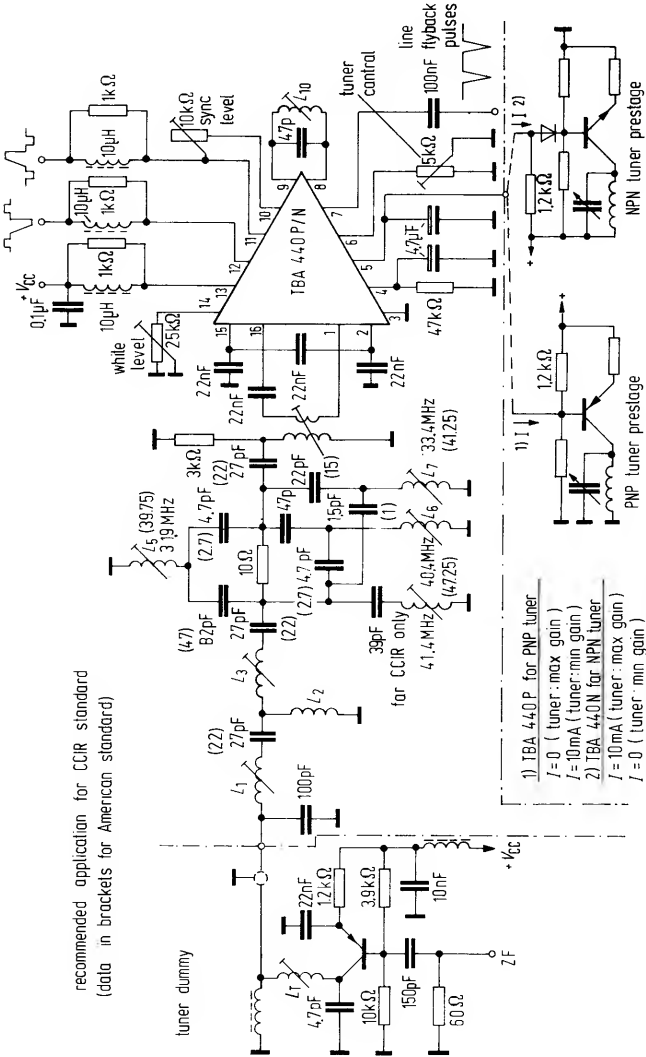


Tuner control current versus attenuation
 $R_G = \text{Parameter}$

TBA 440 N



IF application with TBA 440 P or TBA 440 N

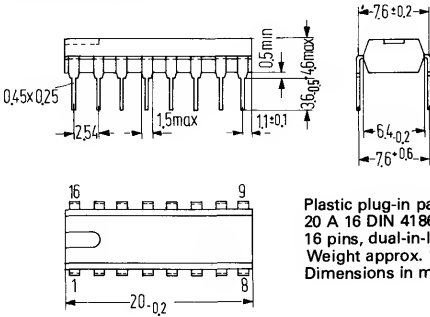


Not for new development

Integrated stereo decoder according to matrix procedure. Automatic mono-stereo switching and manual stereo-mono switching (forced mono). Driver for indicating lamp up to 100 mA.

Type	Ordering code
TBA 450N	Q67000-A621

Package outlines



Absolute maximum ratings

Supply voltage	V_{cc}	18	V
Auxiliary voltage	V_{aux}	3	V
Lamp voltage	V_{ip}	18	V
Current for stereo indication	I_1	100	mA
Storage temperature	T_s	-40 to +125	°C
Junction temperature	T_j	150	°C
Thermal resistance (system-air)	R_{thsa}	120	K/W

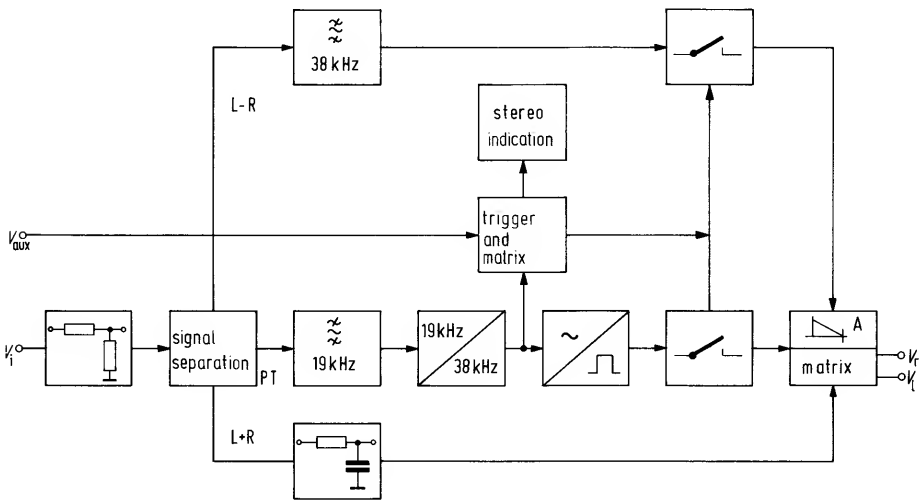
Range of operation

Supply voltage	V_{cc}	4.5 to 18	V
Ambient temperature in operation	T_{amb}	0 to +70	°C

Electrical characteristics ($T_{amb} = 25^{\circ}\text{C}$, $V_{cc} = 15\text{ V}$)

Total current consumption ($I_1 = 80\text{ mA}$)	I_{cc}	20	mA
Input resistance	R_i	>25	k Ω
Output resistance per channel	R_o	4.5	k Ω
MPX input voltage	V_{ipp}	<2	V
Output voltage per channel	V_{opp}	2	V
Saturation voltage of lamp driver ($I_1 = 80\text{ mA}$)	V_{CEsat}	<1.5	V
Harmonic distortion ($f_{AF} = 1\text{ kHz}$; $V_{opp} = 350\text{ mV}$)	k	<0.5	%
Auxiliary voltage for switching from mono to stereo from stereo to mono	V_5	>0.71	V
	V_5	<0.47	V
Attenuation at 19 kHz at 38 kHz at 67 kHz (SCA signal)	a_{PT}	>40	dB
	a_{PT}	>40	dB
	a_{SCA}	>35	dB
(without additional circuit) Cross-talk attenuation	a_{ct}	>36	dB
	a_{ct}	>30	dB
	a_{bal}	<0.2	dB
Balance			

Block diagram



Not for new development

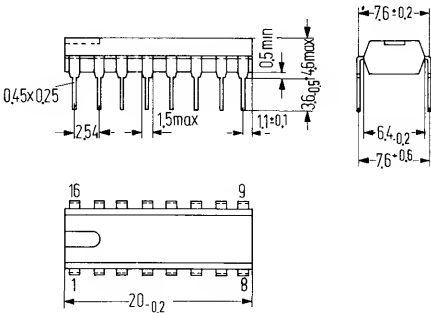
Combined AM/FM IF amplifier with AF pre-amplifier. A high level of integration as well as excellent characteristics of both amplifiers permit a universal application in battery and AC-operated receivers.

- IF unit**
- good control characteristics for AM operation
 - good limiting characteristics for FM operation
- AF unit**
- good frequency characteristics 30 Hz . . . 70 kHz
 - high driver current 130 mA, P_{max} (with AD 161; AD 162) = 10 W
 - small harmonic distortion: up to 8W, $k < 1\%$

Type	Ordering codes
TBA 460	Q67000-A284
TBA 460Q	Q67000-A579

Package outlines

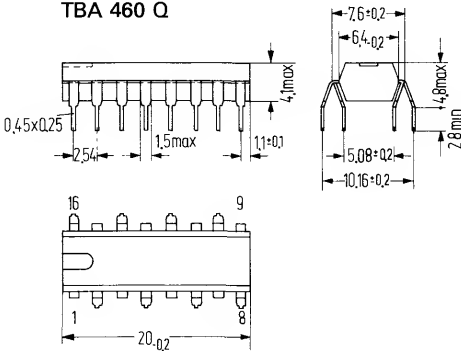
TBA 460



Plastic plug-in package
20 A 16 DIN 41866
16 pins, dual-in-line
Weight approx. 1.2 g

Dimensions in mm

TBA 460 Q



Plastic plug-in package
20 A 16 DIN 41866 (similar)
16 pins, quad-in-line
Weight approx. 1.2 g

Absolute maximum ratings

- Supply voltage IF unit
AF unit
Storage temperature
Junction temperature
Thermal resistance (system-air)

V_{ccIF}	12	V
V_{ccAF}	18	V
T_s	-40 to +125	°C
T_j	150	°C
R_{thsa}	120	K/W

Range of operation

- Supply voltage IF unit
AF unit
Ambient temperature in operation

V_{ccIF}	5 to 12	V
V_{ccAF}	5 to 18	V
T_{amb}	0 to +70	°C

Electrical characteristics ($V_{cc} = 9\text{ V}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$)

		min	typ	max	
Total current (without signal)	I_{cc}		29		mA
Partial current (without signal)	I_{11}	8	11	14	mA

IF unit, AM operation ($f_{iF} = 460\text{ kHz}$, $f_{AF} = 1\text{ kHz}$, $m = 80\%$)

Stabilized voltage	V_{16}	2.8		2.95	V
Voltage gain	ΔG_v		90		dB
Range of control ($\Delta V_{AF} \leq 10\text{ dB}$)	ΔG_v		60		dB
Voltage for starting control ¹⁾	V_i		15		μV
Feedback voltage ($V_i = 15\text{ }\mu\text{V}$)	$-V_{fb}$		200		mV
AF output voltage ($V_i = 15\text{ }\mu\text{V}$)	V_{AF}		120		mV
Input voltage starting overdrive ($k = 10\%$)	V_{OD}		25		mV
Input voltage starting pre-stage control	V_i		.9		V
Voltage for prestage control $V_i \leq 200\text{ }\mu\text{V}$	V_{15}	2.8		.5	V
$V_i \geq 3\text{ mV}$	V_{15}				V

IF unit, FM operation ($f_{iF} = 10.7\text{ MHz}$; $f_{AF} = 1\text{ kHz}$; $\Delta f = \pm 75\text{ kHz}$)

Voltage gain	ΔG_v		86		dB
Input voltage for limiting ²⁾	V_i		500		μV
AF output voltage at limiting	$V_{AF\text{ eff}}$		350		mV
AM suppression	V_{FM}/V_{AM}		50		dB

(FM: $\Delta f = \pm 75\text{ kHz}$; AM: $m = 50\%$) at limiting

AF unit

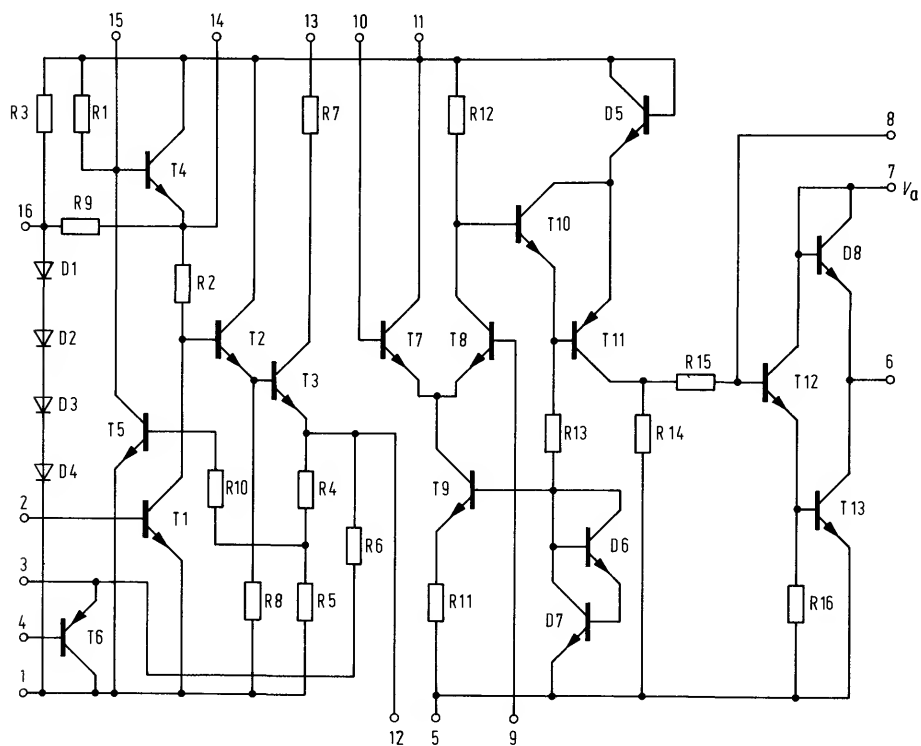
Current consumption	$I_{7/6}$		22.5		mA
Diode voltage	$V_{7/6}$		.7		V
Quiescent voltage gain	G_{Vo}		72		dB
Output voltage ($G_v = 45\text{ dB}$; $k = 10\%$)	$V_{q\text{ eff}}$		3.2		V
Harmonic distortion	k		.3		%
($V_{q\text{ eff}} = 2\text{ V}$; $G_v = 45\text{ dB}$; $R_G = 1\text{ k}\Omega$)					
Signal-to-noise ratio ($V_q = 1\text{ V}$)	$a_{S/N}$	60			dB
	V_q				
Voltage/frequency characteristic ($\pm 3\text{ dB}$)	V_{q1000}		30 Hz to 70 kHz		
Maximum permissible collector current T13	I_{max}		130		mA
Noise voltage	V_n		2.5		μV

(referred to the input, $R_G = 1\text{ k}\Omega$)

¹⁾ Start of control is defined as that input voltage for which $\frac{\Delta V_i}{\Delta V_{AF}} = \frac{10}{3}\text{ dB}$.

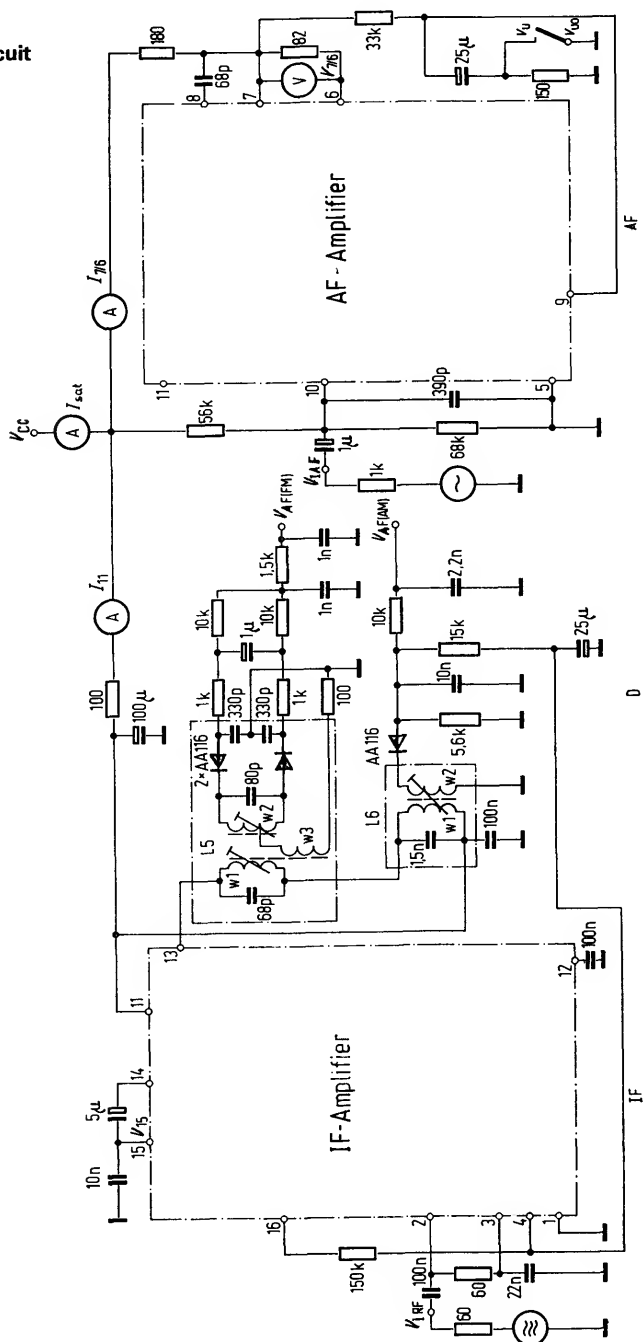
²⁾ Start of limiting is defined as that input voltage for which the AF output voltage is down 3 dB. Reference potential is $V_i = 100\text{ mV}$.

Circuit diagram



If the AF unit is operated separately, pin 5 should be connected to pin 1.

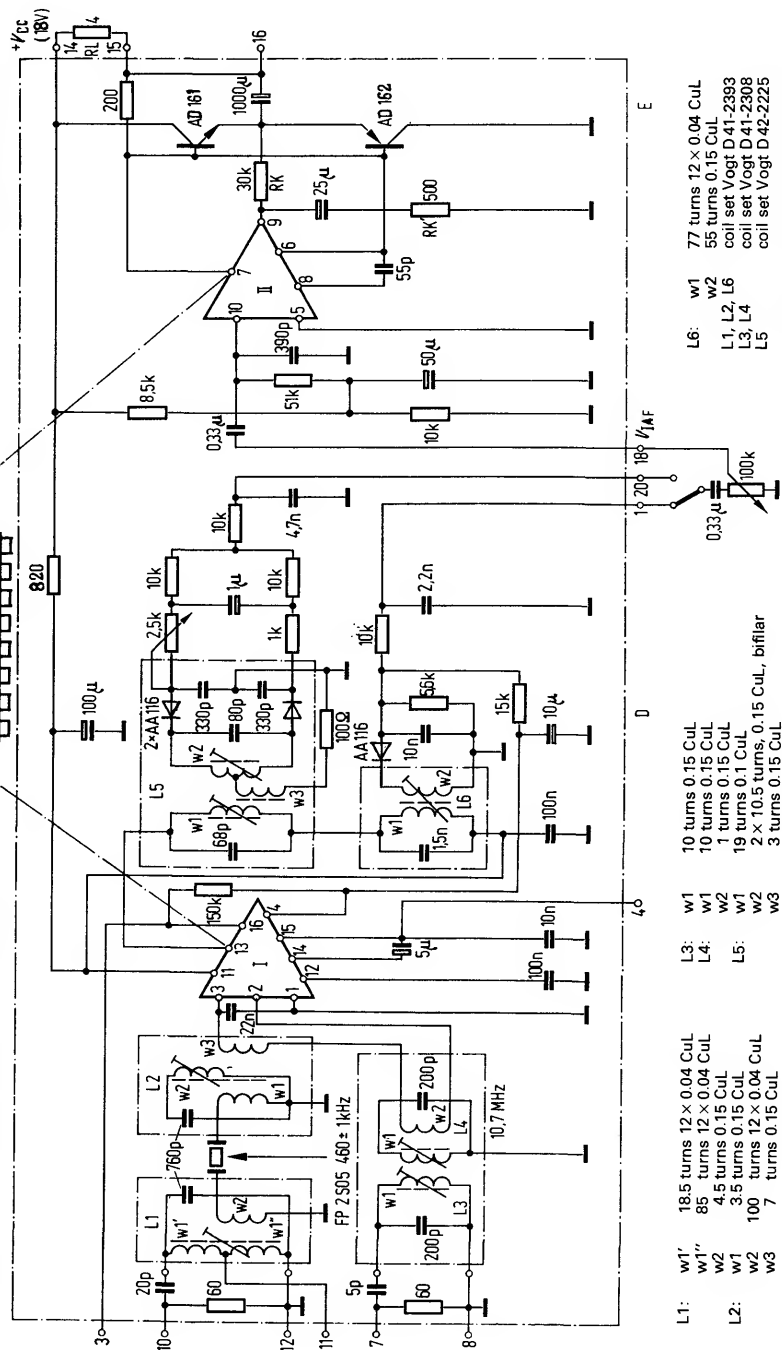
Test circuit



TBA 460

II AF preamplifier

II AF preamplifier



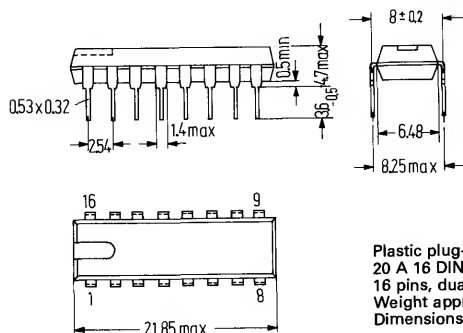
TBA 460
TBA 460 Q

The TBA 530 is an integrated circuit for colour TV receivers incorporating a matrix preamplifier for RGB cathode or grid drive of the picture tube without clamping circuits. The chip lay-out has been designed to ensure tight thermal coupling between all the transistors in each channel to minimize and equalize thermal drifts between channels. Also, each channel follows an identical lay-out to ensure equal frequency behaviour of the three channels.

This integrated circuit has been designed to be driven from the TBA 520 synchronous demodulator integrated circuit.

Type	Ordering code
TBA 530	Q67000-A360F1

Package outlines



Plastic plug-in package
20 A 16 DIN 41866
16 pins, dual-in-line
Weight approx. 1.2 g
Dimensions in mm

Absolute maximum ratings

Supply voltage
Currents

Total power dissipation
Ambient temperature in operation
Storage temperature

V_8	13.2	V
$I_1 = I_{11} = I_{14}$	10	mA
$I_{10} = I_{13} = I_{16}$	50	mA ¹⁾
P_{tot}	400	mW ¹⁾
T_{amb}	-20 to + 60	°C
T_s	-20 to +125	°C

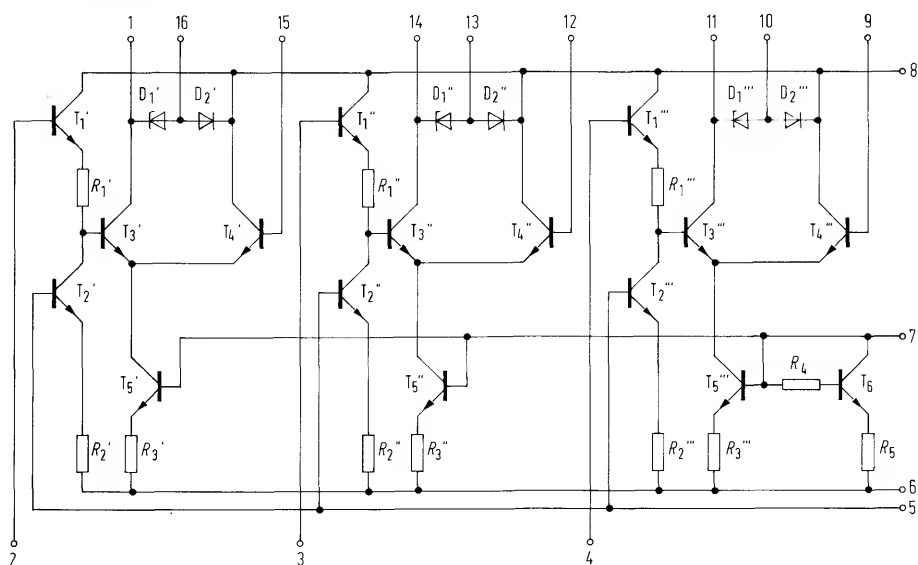
¹⁾ At increased voltages due to external failures (e.g. collector-base breakdown in the output transistors) a maximum current of 50 mA is permitted between pins 16 and 8, 13 and 8, 10 and 8. The maximum allowable dissipation in this case is 500 mW.

Electrical characteristics ($V_a = 12\text{ V}$, $T_{\text{amb}} = 25^\circ\text{C}$,
black level: $V_{R-Y} = V_{G-Y} = V_{B-Y} = 7.5\text{ V}$, $V_Y = 1.5\text{ V}$)

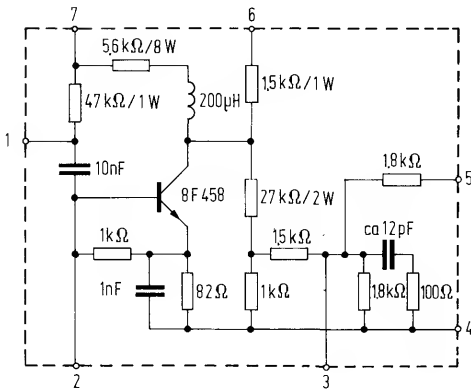
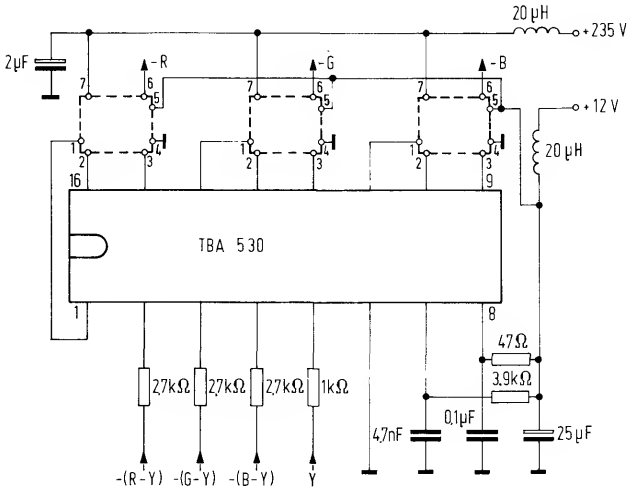
Input DC voltage	$V_{R-Y} = V_2$	7.5	V
	$V_{G-Y} = V_3$	7.5	V
	$V_{B-Y} = V_4$	7.5	V
	$V_Y = V_5$	1.5	V
Input signal voltage	$V_{R-Y} = V_2$	1.4	V_{pp}
	$V_{G-Y} = V_3$	.82	V_{pp}
	$V_{B-Y} = V_4$	1.78	V_{pp}
	$V_Y = V_5$	1	V_{pp}
Gain of color channels ¹⁾ ($f = .5\text{ MHz}$)	G_2	100	
	G_3	100	
	G_4	100	
Ratio of gain of luminance amplifier to colour amplifier	V_{RGB-Y}/V_Y	1	
DC output voltage	V_R	165	V
	V_G	165	V
	V_B	165	V
Input impedance of colour difference amplifiers at $f = 1\text{ MHz}$	Z_{IRGB-Y}	60/3	k Ω /pF
Input impedance of luminance amplifier at $f = 1\text{ MHz}$	Z_{IY}	20/10	k Ω /pF
Bandwidth of all channels (3 dB)	B	6	MHz
Total current consumption	I_{cc}	30	mA

¹⁾ G is defined as the voltage ratio between the input signals at the pins 2, 3, 4 and the output signals at the collectors of the output transistors.

Circuit diagram



Application circuit



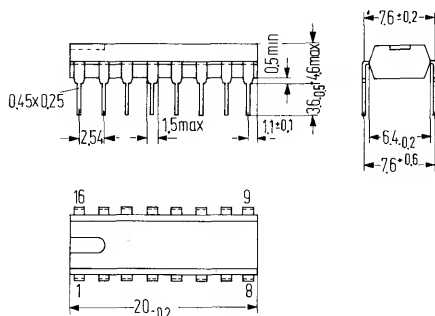
The types TBA 1440 G (for pnp tuner prestages) and TBA 1441 (for npn tuner prestages) have been developed from TBA 440 P/N. Their decisive improvements are

- Reduced residual IF at outputs 11 and 12
- Reduced residual IF at pin 13
- Considerably improved intermodulation distance
- Excellent tuning attitude even with low-ohmic tank circuit at demodulator

The IC's contain a high – amplifying controllable video IF amplifier, a controlled demodulator and two low-resistance video outputs with positive- and negative-going signals as well as the complete keyed control and delayed tuner control.

- Large control range with low noise and wide dynamic range
- High sensitivity
- Controlled demodulator, so minimum 1.07 MHz disturbances
- Internal temperature stabilization
- The white levels of the video signals at the positive and negative video output are independent of the operating voltage.
- The whites and black levels can be adjusted separately

Package outlines TBA 1440 G, TBA 1441



Type	Ordering codes
TBA 1440 G	Q67000-A1022
TBA 1441	Q67000-A1224

Plastic plug-in package
20 A 16 DIN 41866
16 pins, dual-in-line
Weight approx. 1.2 g
Dimensions in mm

Absolute maximum ratings

Supply voltage
Voltages

Ohmic resistance between pins 8 and 9
Thermal resistance (system-air)
Junction temperature
Storage temperature

V_{13}	15 ¹⁾	V
V_4	5	V
V_5	20	V
V_{14}	5	V
R_{3-9}	≤ 20	Ω
R_{thsa}	100	K/W
T_j	150	°C
T_s	-40 to +125	°C

Range of operation

Supply voltage
Ambient temperature in operation

V_{13}	10.5 to 15	V
T_{amb}	-25 to +60	°C

¹⁾ briefly 16.5 V

Electrical characteristic ($V_{13} = 13 \text{ V}$; $f_{\text{IF}} = 38.9 \text{ MHz}$; $T_{\text{amb}} = 25^\circ\text{C}$; all data with reference to ground, unless otherwise stated)

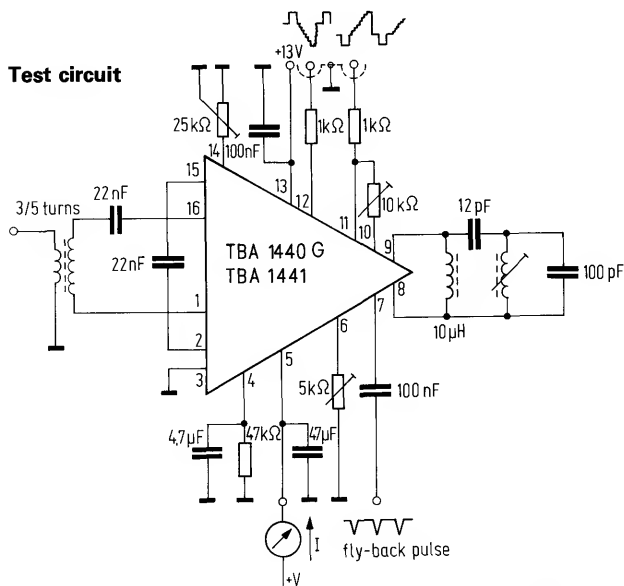
		min	typ	max	
Current consumption ($V_{13} = 15 \text{ V}$)	I_{13}	34	47	60	mA
DC voltage at output 11 ($V_{13} = 15 \text{ V}$; $V_i = 0$) $R_{14-3} = \infty$	V_{11}		5.5		V
$R_{14-3} = 0$	V_{11}		9.6		V
DC voltage at output 12 ($V_{13} = 15 \text{ V}$; $V_i = 0$) $R_{14-3} = \infty$	V_{12}		1.9		V
$R_{14-3} = 0$	V_{12}		3.5		V
White level deviation	$\Delta V_{11}/\Delta V_{13}$		100		mV/V
	$\Delta V_{12}/\Delta V_{13}$		20		mV/V
	R_{14-3}		8.5		k Ω
Resistance for $\Delta V_{11} = 1 \text{ V}$	$V_{10} = V_{11}$		1.9		V
AGC threshold $V_{10} = \text{sync pulse level}$ for $R_{10-11} = 0$	R_{10-11}		2.4		k Ω
Resistance for sync pulse level deviation of 1 V	$V_{11 \text{ sync}}$		.5		V
Sync pulse level with async or without gating pulses (peak level control)	I_5	10	15		mA
Control current for tuner prestage ($V_5 > 2 \text{ V}$)	V_4	0		.5	V
(TBA 1440 G: 10 dB after AGC TBA 1441 : 10 dB previous to AGC)	V_4	2.5		5	V
IF control voltage for max gain for min gain	$-V_7$	2		5	V
Gating pulse voltage	$V_{11}; V_{12}$		10		mV
Residual IF (basic frequency)	$I_{11}; I_{12}$			5	mA
Output current to ground to $+V_{13}$	$I_{11}; I_{12}$			-1	mA
Input impedance at max gain	Z_{1-16}		1.8/2		k Ω /pF
at min gain	Z_{1-16}		1.9/0		k Ω /pF
Input voltage ¹⁾ for $V_{11} = 3 \text{ V}_{\text{pp}}$	V_i	70	100	300	μV
Video band width (-3 dB)	B_{video}	6	7		MHz
AGC range	ΔG_V		55		dB
Intermodulation with reference colour carrier ²⁾	a		45		dB
Output impedance	$Z_{q \text{ 8-9}}$		2/2.5		k Ω /pF

¹⁾ According to test circuit: $V_i = \text{effective sync pulse level at } 60 \Omega$

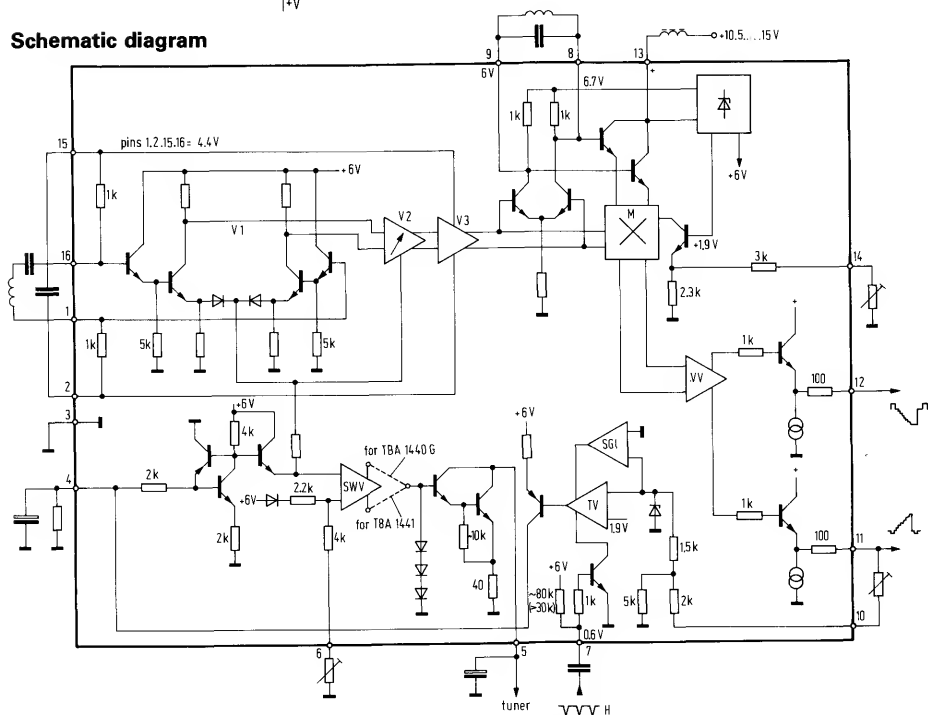
²⁾ Test level $a_{cc} = -3 \text{ dB}$

$a_{sc} = -20 \text{ dB}$ referring to picture carrier

Test circuit



Schematic diagram

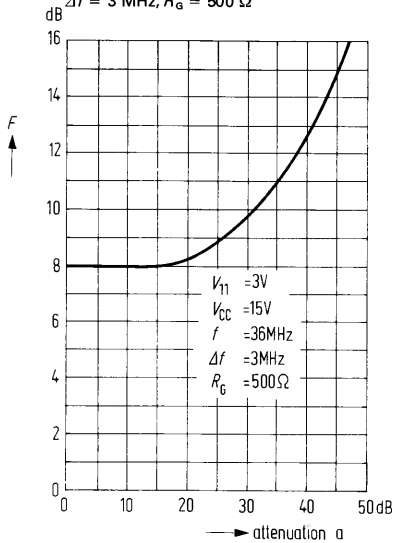


V1, V2, V3 amplifiers
M mixer
TV key amplifier

SGI peak rectifier
VV video amplifier

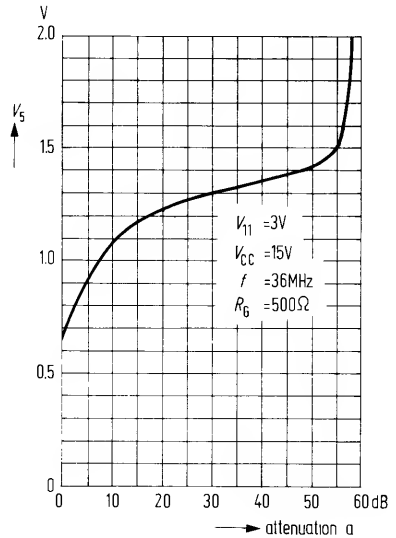
Noise figure v. attenuation
(measured at video frequency)

$-V_{fb} = 3 \text{ V}$, $V_{cc} = 15 \text{ V}$, $f = 36 \text{ MHz}$,
 $\Delta f = 3 \text{ MHz}$, $R_G = 500 \Omega$



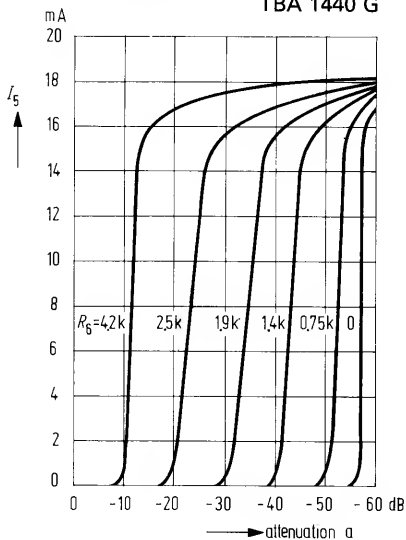
Control voltage v. attenuation

$-V_{fb} = 3 \text{ V}$, $V_{cc} = 15 \text{ V}$, $f = 36 \text{ MHz}$,
 $R_G = 500 \Omega$



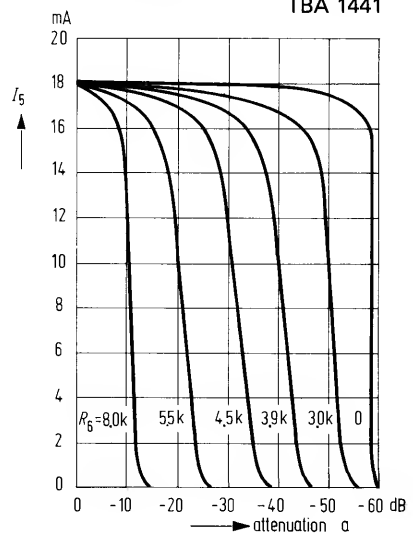
Tuner control current versus attenuation
 $R_G = \text{Parameter}$

TBA 1440 G

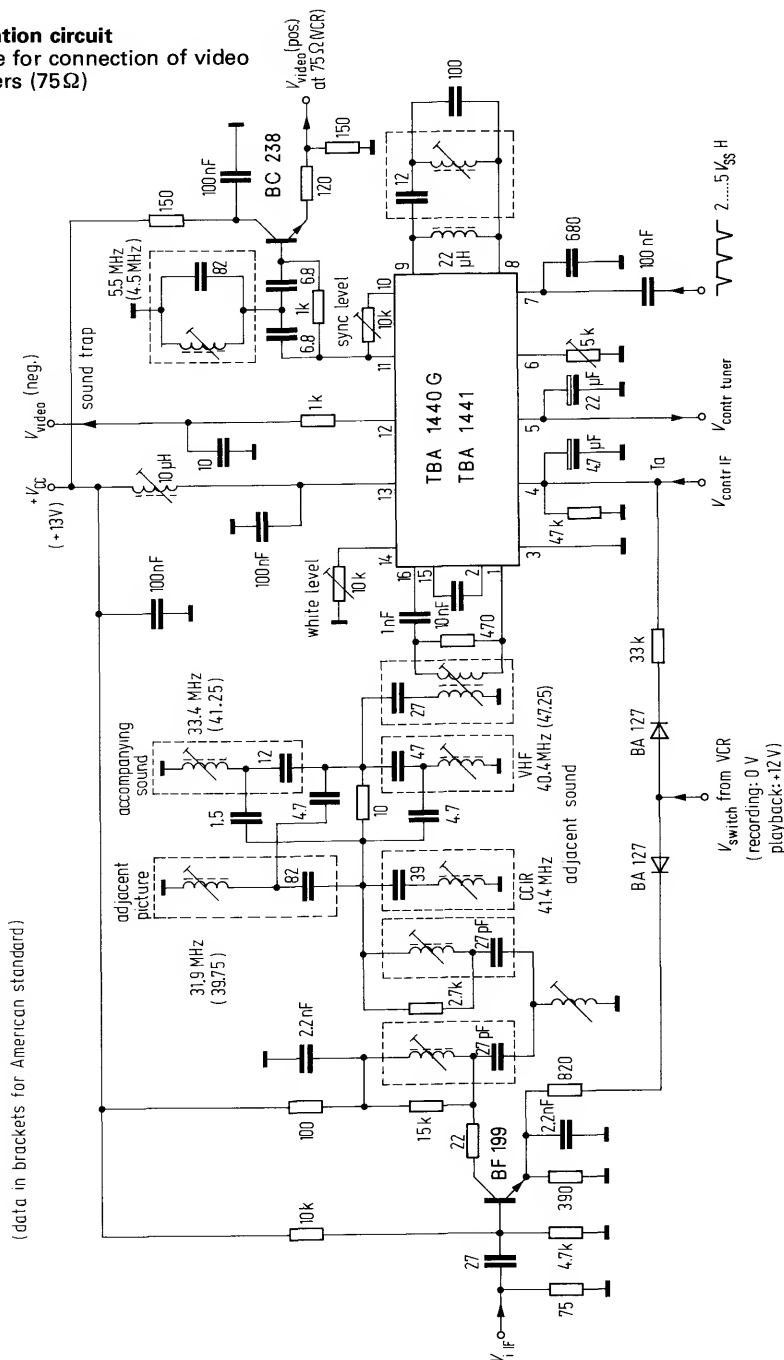


Tuner control current versus attenuation
 $R_G = \text{Parameter}$

TBA 1441



Application circuit
suitable for connection of video
recorders (75 Ω)

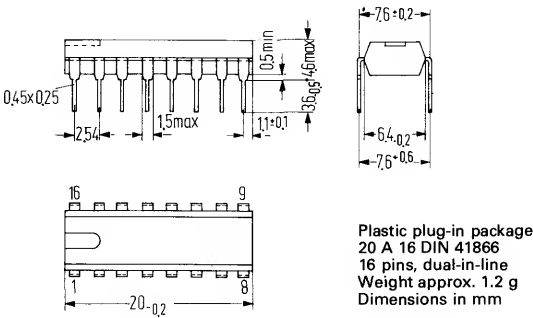


TCA 440 is a monolithic IC, especially developed for AM receivers up to 50 MHz. It includes a RF prestage with AGC, a balanced mixer, separate oscillator and an IF amplifier with AGC. Because of its low current consumption and of its internal stabilization the TCA 440 is perfectly suited for battery operated portables, car and home radios either.

- Balanced circuit
- Separately controllable prestage
- Multiplicative push-pull mixer with separate oscillator
- High large capability even with 4.5 V supply voltage
- 100 dB feedback control range in 5 stages
- Direct connection for tuning meter
- Minimum external components

Type	Ordering codes
TCA 440	Q67000-A669
TCA 440 I	Q67000-A669 S2
TCA 440 II	Q67000-A669 S3

Package outlines



Absolute maximum ratings

Supply voltage	V_{cc}	15	V
Storage temperature	T_s	-30 to +125	°C
Junction temperature	T_j	150	°C
Thermal resistance	R_{thsa}	120	K/W

Range of operation

Supply voltage	V_{cc}	4.5 to 15	V
Ambient temperature in operation	T_{amb}	-15 to +80	°C

Electrical characteristics ($V_{cc} = 9\text{ V}$, $T_{amb} = 25^\circ\text{C}$, $f_{IRF} = 600\text{ kHz}$, $f_{mod} = 1\text{ kHz}$)

Total current consumption at $V_{cc} = 4.5\text{ V}$		I_{cc}	7	mA
$V_{cc} = 9\text{ V}$		I_{cc}	10.5	mA
$V_{cc} = 15\text{ V}$		I_{cc}	12	mA
RF level deviation for ($m = 80\%$)	$\Delta V_{AF} = 6\text{ dB}$	ΔG_{RF}	65	dB
	$\Delta V_{AF} = 10\text{ dB}$	ΔG_{RF}	80	dB
AF output voltage for V_{IRF} (symm. measured at 1–2)				
$m = 80\%$:	$V_{IRF} = 20\text{ }\mu\text{V}$	V_{AFeff}	140	mV
	$V_{IRF} = 1\text{ mV}$	V_{AFeff}	260	mV
	$V_{IRF} = 500\text{ mV}$	V_{AFeff}	350	mV
$m = 30\%$:	$V_{IRF} = 20\text{ }\mu\text{V}$	V_{AFeff}	50	mV
	$V_{IRF} = 1\text{ mV}$	V_{AFeff}	100	mV
	$V_{IRF} = 500\text{ mV}$	V_{AFeff}	130	mV
Input sensitivity (measured at $60\text{ }\Omega$, $f_{IRF} = 1\text{ MHz}$, $m = 30\%/0\%$, $R_G = 540\text{ }\Omega$)				
at signal-to-noise distance	$\frac{S+N}{N} = 6\text{ dB}$	V_{IRF}	1	μV
	$\frac{S+N}{N} = 26\text{ dB}$	V_{IRF}	7	μV
	$\frac{S+N}{N} = 58\text{ dB}$	V_{IRF}	1	mV

RF unit

Input frequency range		f_{IRF}	0 to 50	MHz
Output frequency $f_{IF} = f_{osc} - f_{IRF}$		f_{IF}	460	kHz
Control range		ΔG_V	38	dB
Input voltage (for 600 kHz , $m = 80\%$) for overdrive ($k_{AF} = 10\%$), symmetrically measured at pins 1 and 2 (mean carrier value)				
		V_{IRFpp}	2.6	V_{pp}
		V_{IRFeff}	.5	V
IF suppression between 1–2 to 15		a_{IF}	20	dB
RF input impedance				
a) unsymmetrical coupling at	G_{RFmax}	Z_i	2/5	k Ω /pF
	G_{RFmin}	Z_i	2.2/1.5	k Ω /pF
b) symmetrical coupling at	G_{RFmax}	Z_i	4/5	k Ω /pF
	G_{RFmin}	Z_i	4.5/1.5	k Ω /pF
Mixer output impedance (pins 15 or 16)		Z_{qosc}	250/4.5	k Ω /pF

IF unit

Input frequency range

Control range at 460 kHz

Input voltage (mean carrier value) at $G_{\min}$
for overdrive ($k_{AF} = 10\%$), measured at pin 12
(60 Ω to ground, $f_{IF} = 460$ kHz, $m = 80\%$, $f_{mod} = 1$ kHz)AF output voltage for V_{iIF} at 60 Ω (pin 12)($f_{mod} = 1$ kHz) $V_{IF} = 30$ μ V, $m = 80\%$ $V_{IF} = 3$ mV, $m = 80\%$ $V_{IF} = 3$ mV, $m = 30\%$

IF input impedance (unsymm. coupling)

IF output impedance (pin 7)

f_{iIF}	0 to 2	MHz
ΔG_V	62	dB
$V_{iF\ eff}$	200	mV
V_{AFeff}	50	mV
V_{AFeff}	200	mV
V_{AFeff}	70	mV
Z_i	3/3	k Ω /pF
Z_g	200/8	k Ω /pF

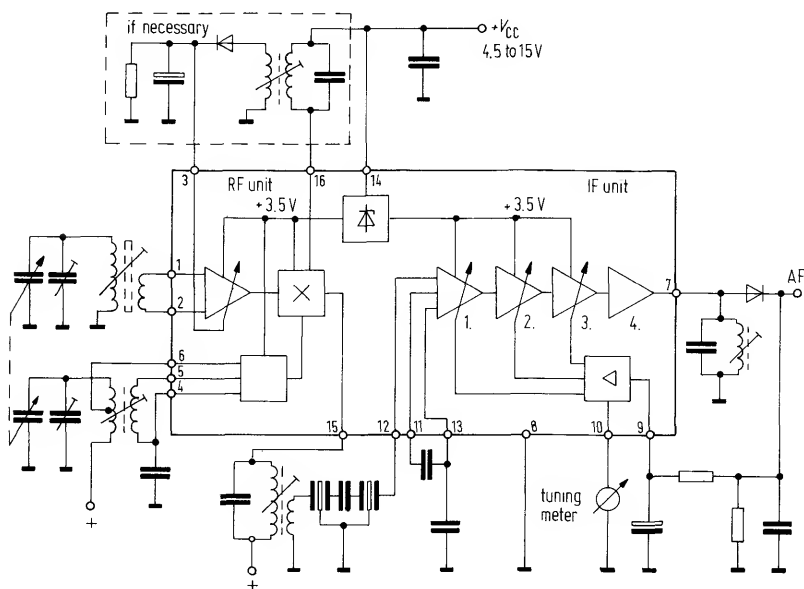
Tuning meterRecommended instruments: 500 μ A ($R_i = 800$ k Ω)or 300 μ A ($R_i = 1.5$ k Ω)The IC offers at pin 10 a tuning meter voltage of 600 mV_{EMP} max. with a source impedance of approx. 400 Ω .**Selection**TCA 440 is selected in 2 groups as concerns the output voltage V_7 :Parameter: $V_{cc} = 8$ V, $V_{iIF} \approx 4.5$ mV_{eff}, $m = 30\%$, $f_{IF} = 455$ kHz, $f_{AF} = 1$ kHz.TCA 440 I: $V_7 = 40$ to 80 mV_{eff}TCA 440 II: $V_7 = 55$ to 100 mV_{eff}

The number of the group is stamped on the IC.

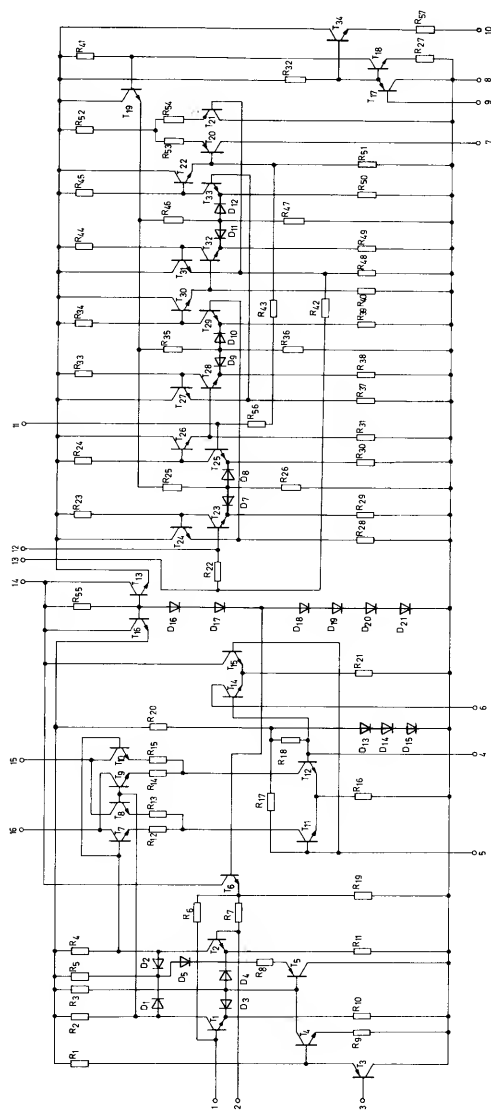
Function

As you see in the circuit diagram the TCA 440 comprises two control loops independent of each other which are working on the prestage and the IF stages. By the AGC of prestage an excellent large signal handling is obtained. A voltage of 2.6 V_{pp} on the IC input is handled nearly distortionless. The push-pull mixer is operating multiplicatively. Thereby are resulting particularly few harmonic mixing products and whistling points. The oscillator which is separated from the mixer is also apted excellently for short waves. From AGC of the RF amplifier a voltage is derived for a tuning meter which is connectable directly. The symmetric composition of the circuit allows a high stability against oscillating and, at the same time, an AGC range of more than 100 dB. The bridge circuit of the mixer suppresses very well the RF frequencies. Thereby the otherwise feared tendency of oscillating at low frequencies of the range of medium waves is disappearing.

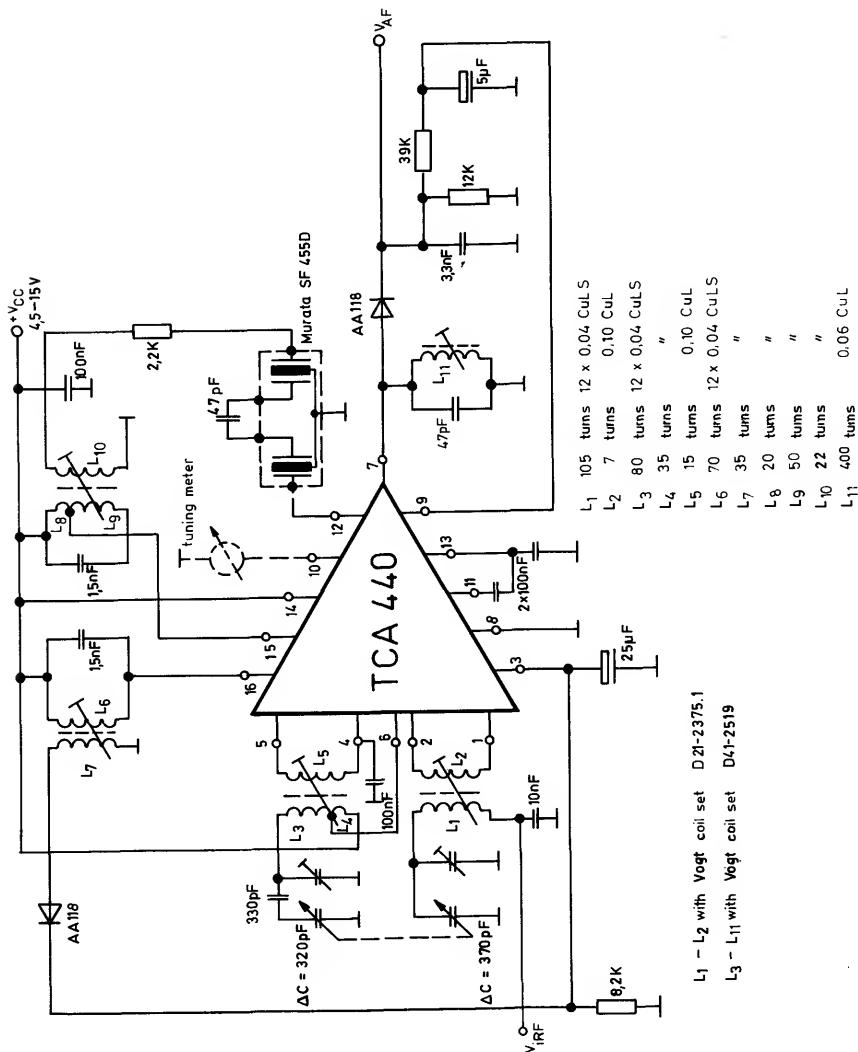
Block diagram



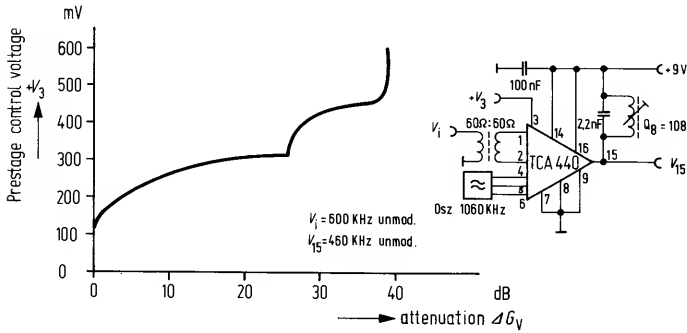
Circuit diagram



Application example for MW

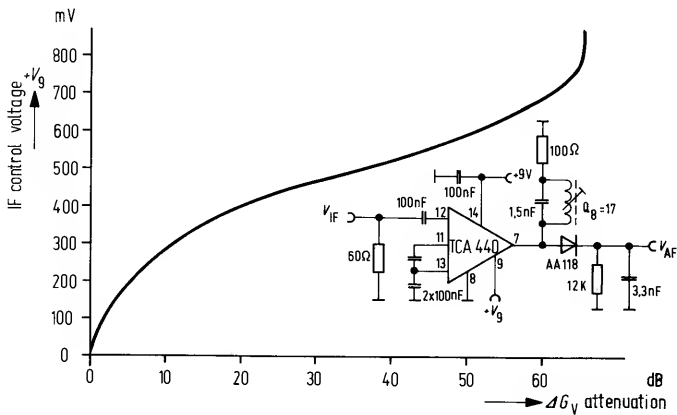


Prestage control



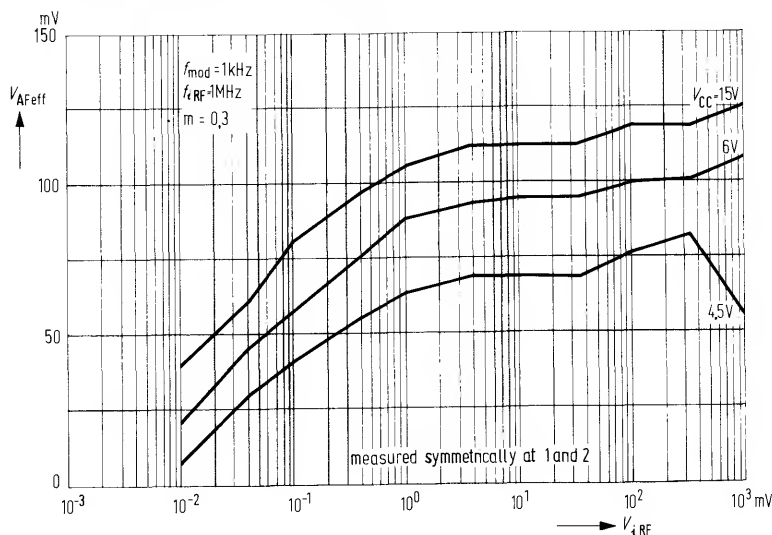
The input is not power matched and can be driven with a higher resistance. V_i is chosen so that a constant V_{i5} is obtained (50 mV_{pp}).

IF control



V_{IF} (469 kHz; $m = 80\%$; $f_{mod} = 1$ kHz) is chosen so that always a constant V_{AF} is obtained (200 mV_{eff}).

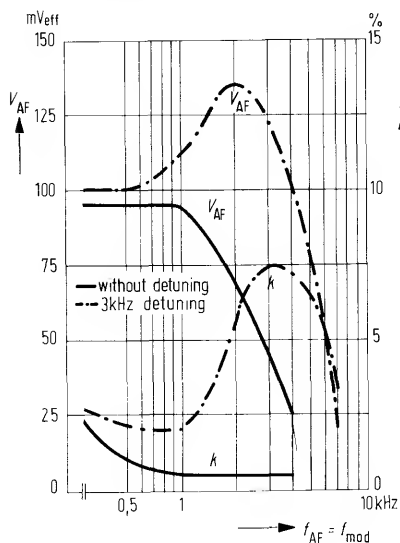
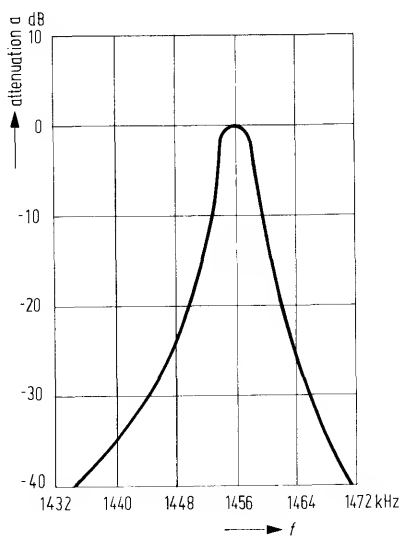
AF output voltage versus RF input voltage



Application for MW

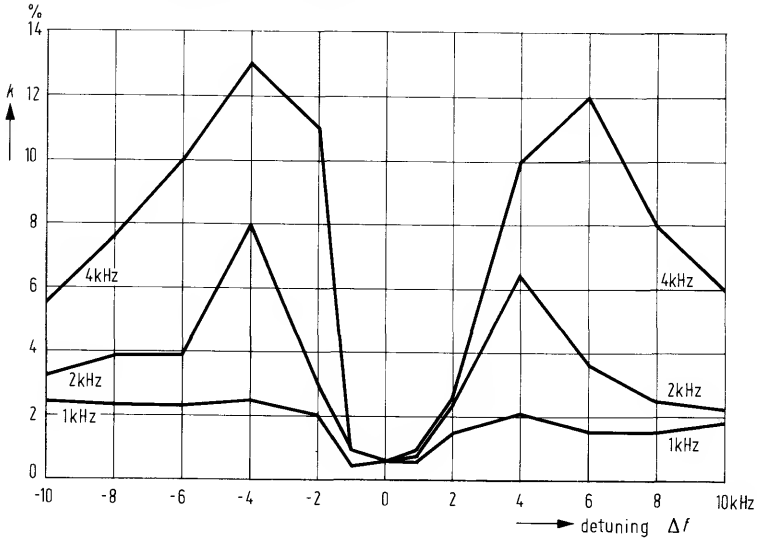
AF output voltage versus output frequency
Harmonic distortion versus modulation frequency

$f_{\text{RF}} = 1\text{ MHz}$, $f_{i\text{F}} = 456\text{ kHz}$, $V_{CC} = 9\text{ V}$,
 $m = 30\%$, $V_{\text{RF}} = 50\text{ mV}_{\text{eff}}$

Pass band figure versus
input frequency,
measured from input to output
of the circuit

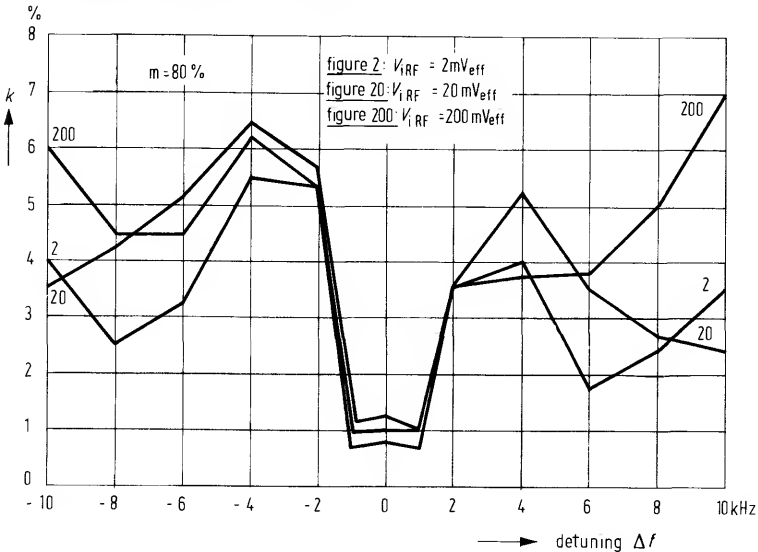
**Harmonic distortion versus detuning
(parameter is modulation frequency)**

$V_{cc} = 9\text{ V}$, $f_{osc} = 1.455\text{ MHz} \pm \Delta f$, $m = 30\%$,
 $f_i = 1\text{ MHz}$, $f_{IF} = 455\text{ kHz}$, $V_{iRF} = 20\text{ mV}_{eff}$

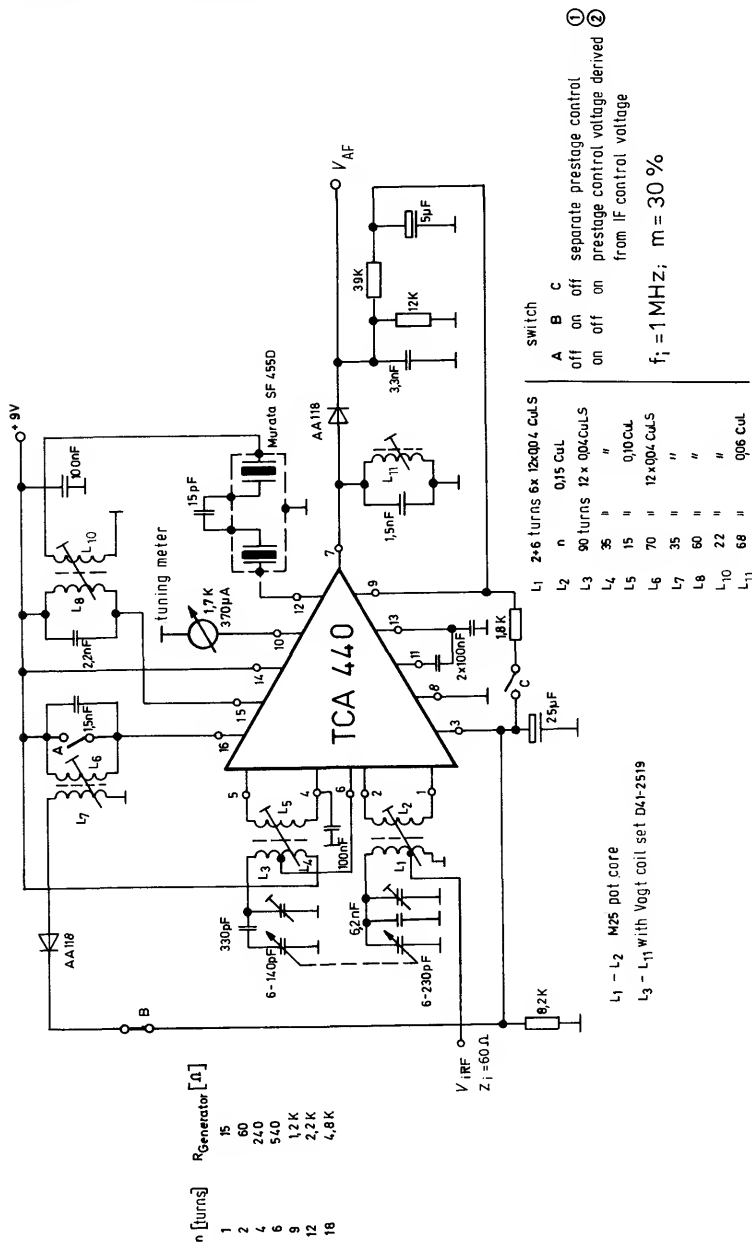


**Harmonic distortion versus detuning
(parameter is RF input voltage)**

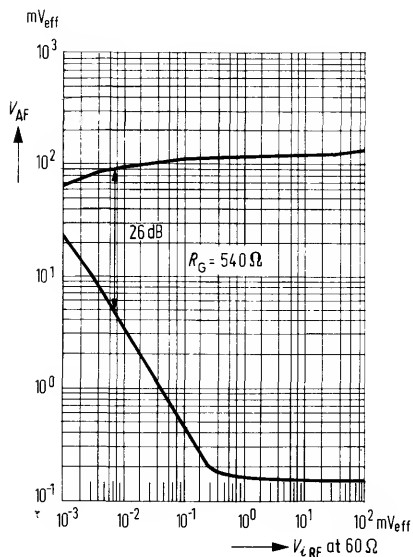
$V_{cc} = 9\text{ V}$, $f_{osc} = 1.455\text{ MHz} \pm \Delta f$, $m = 30\%$,
 $f_i = 1\text{ MHz}$, $f_{IF} = 455\text{ kHz}$, $V_{iRF} = 20\text{ mV}_{eff}$



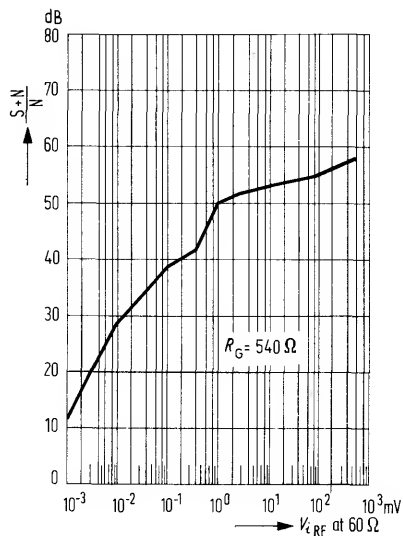
Test circuit for noise figure



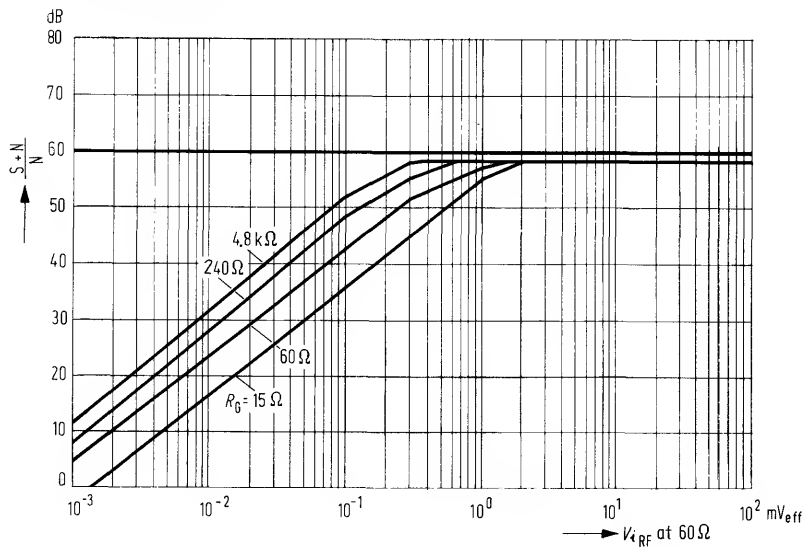
**AF output voltage and noise
figure v. RF input voltage
(switching position 1)**



**Signal to noise distance v.
RF input voltage
(switching position 2)**

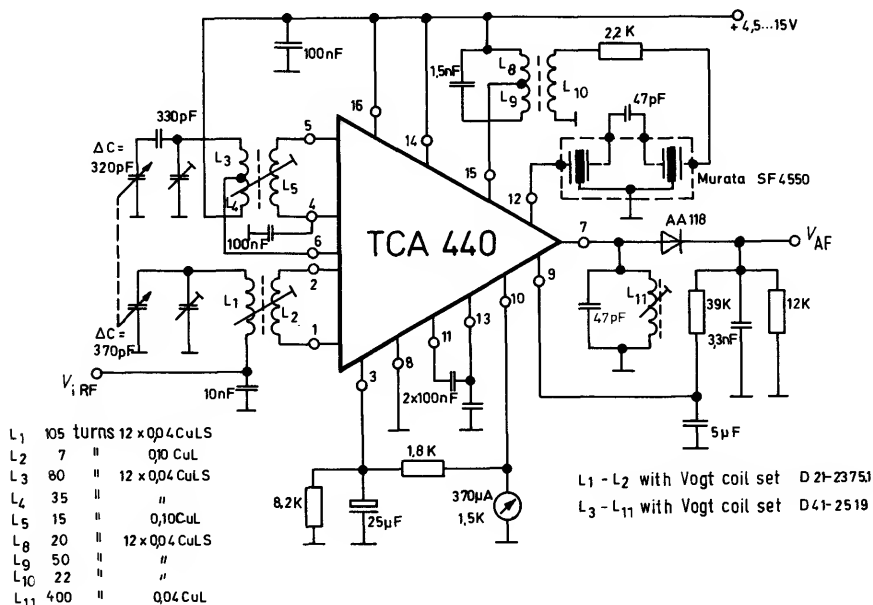


**Signal to noise distance v.
RF input voltage
(parameter is generator impedance)
(switching position 1)**

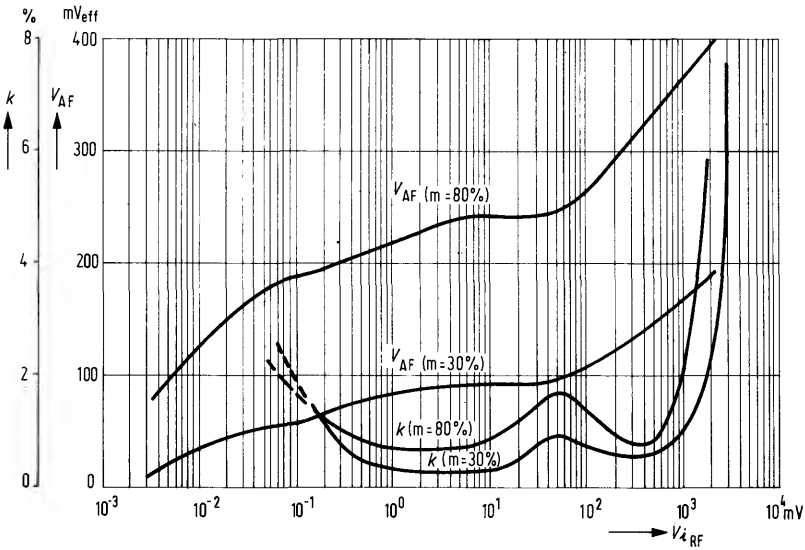


Application example for MW

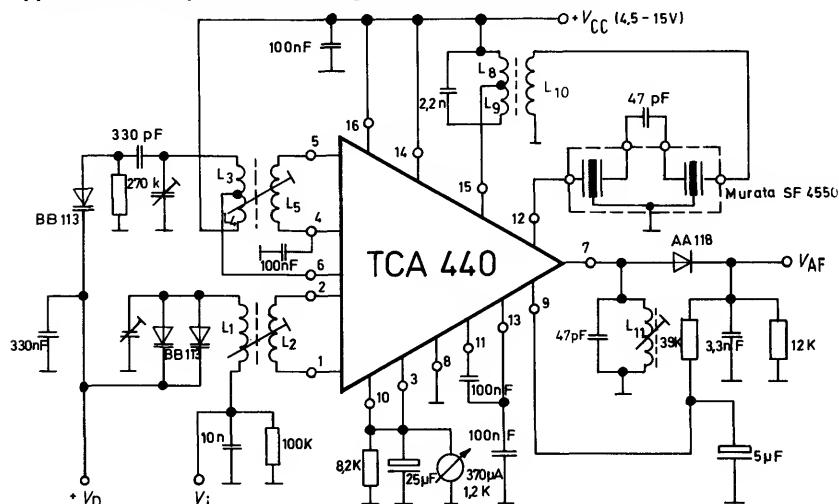
Prestage control is derived from IF control



Test figures for application example for MW
 Harmonic distortion and AF output voltage
 versus RF input voltage
 measured symmetrically at pins 1 and 2
 $f_i = 1 \text{ MHz}$, $f_{\text{mod}} = 1 \text{ kHz}$, $f_F = 455 \text{ kHz}$, $V_{cc} = 9 \text{ V}$



Application example for MW using varicap diodes BB 113



L ₁	105	turns	12 x 0,04 CuLs
L ₂	7	"	0,10 CuL
L ₃	80	"	12 x 0,04 CuLs
L ₄	35	"	"
L ₅	15	"	0,10 CuL
L ₈	20	"	12 x 0,04 CuLs
L ₉	50	"	"
L ₁₀	22	"	"
L ₁₁	400	"	0,06 CuL

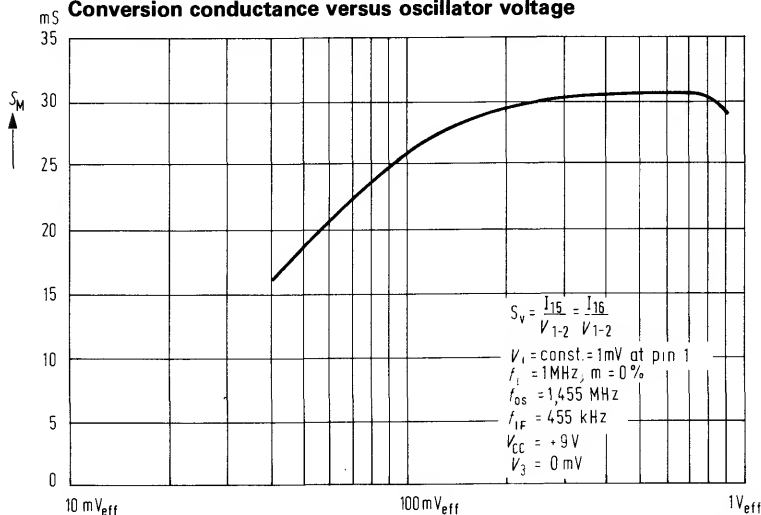
L₁ - L₂ with Vogt. coil set D 21- 2375 1

L₃ - L₁₁ with Vogt. coil set D 41- 25 19

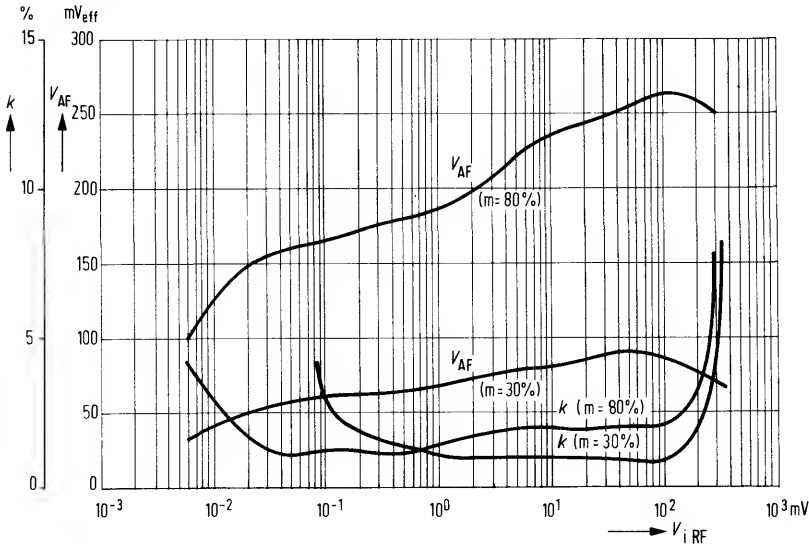
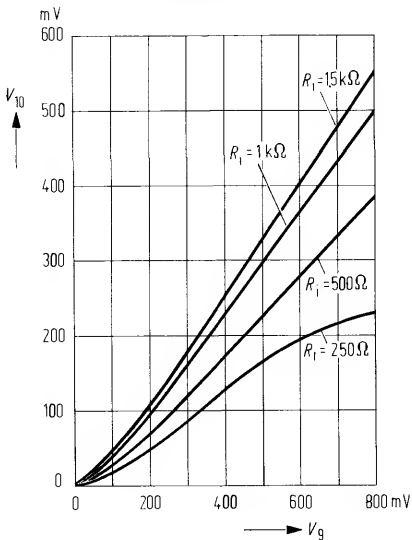
$V_D = 8,5V \rightarrow f_i = 800 \text{ kHz}$

$V_D = 30V \rightarrow f_i = 1620 \text{ kHz}$

Conversion conductance versus oscillator voltage



Test figures for application example for MW using BB 113
 $f_i = 1 \text{ MHz}$, $f_{\text{mod}} = 1 \text{ kHz}$, $f_{\text{IF}} = 455 \text{ kHz}$, $V_{cc} = 9 \text{ V}$,

 V_{IRF} measured symmetrically at pins 1 and 2

Tuning meter voltage versus IF control voltage
 (parameter is impedance of tuning meter)


Example for moving coil instruments

 R_1 for full-scale deflection

1.5 k Ω	100 μA
1.5 k Ω	170 μA
2 k Ω	200 μA
350 Ω	500 μA

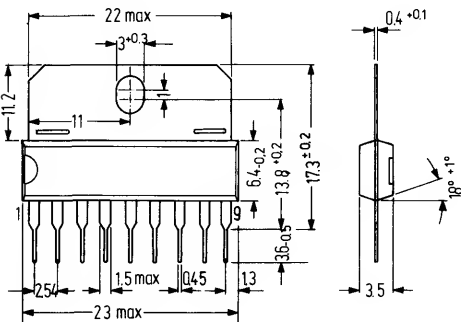
Preliminary data

AF amplifier for use in radio and TV sets. Its wide supply voltage range allows manifold use. The amplifier has class-B push-pull output and is furnished in single-in-line package. The integrated shutdown protects the IC from overheating.

- Large supply voltage range: 4 V to 28 V
- High output power up to 8 W
- Large output current up to 2.5 A
- Simple Mounting

Type	Ordering code
TDA 1037	Q67000-A1229

Package outlines



Plastic package
Single-In-Line, 9 pins
Cooling fin
Weight approx. 1.9 g
Dimensions in mm

Absolute maximum ratings

Supply voltage	V_{cc}	28	V
Output peak current (not periodical)	I_q	3.5	A
Output current (periodical)	I_a	2.5	A
Junction temperature	T_j	150	°C
Thermal resistance (system-case)	R_{thsc}	12	K/W
Storage temperature	T_s	-40 to +125	°C

Range of operation

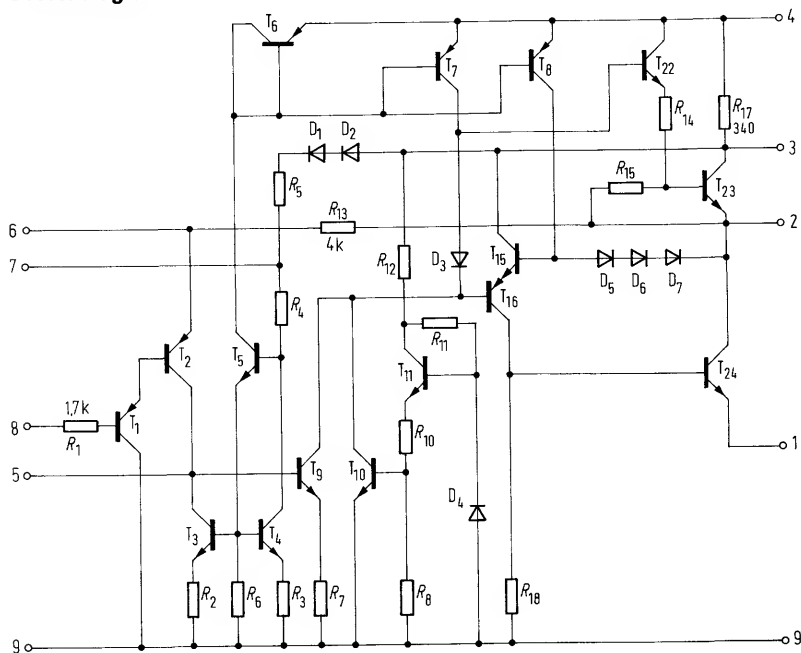
Supply voltage	V_{cc}	4 to 28	V
Ambient temperature in operation	T_{amb}	-25 to +85	°C

Preliminary data

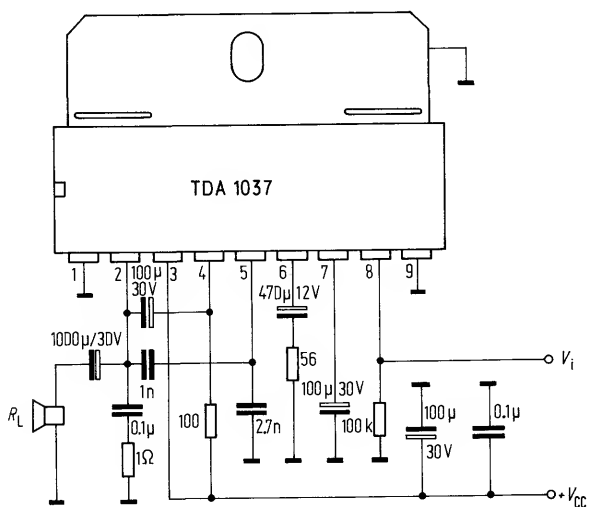
Electrical characteristics (with reference to test circuit; $T_{amb} = 25^{\circ}\text{C}$; $f_i = 1\text{ kHz}$)

		min	typ	max	
Output DC voltage					
$V_{cc} = 24\text{ V}$	V_2	11	12	13	V
$V_{cc} = 18\text{ V}$	V_2	8	9	10	V
$V_{cc} = 14\text{ V}$	V_2	6.4	7.2	8	V
Quiescent current consumption					
$V_{cc} = 24\text{ V}$	$I_3 + I_4$		15	25	mA
$V_{cc} = 18\text{ V}$	$I_3 + I_4$		13	22	mA
$V_{cc} = 14\text{ V}$	$I_3 + I_4$		12	20	mA
Input DC current					
$V_{cc} = 24\text{ V}$	I_8		1		μA
$V_{cc} = 18\text{ V}$	I_8		.6		μA
$V_{cc} = 14\text{ V}$	I_8		.4		μA
Output power ($k = 10\%$)					
$V_{cc} = 24\text{ V}, R_L = 16\Omega$	P_q		5.5		W
$V_{cc} = 18\text{ V}, R_L = 8\Omega$	P_q		5.0		W
$V_{cc} = 14\text{ V}, R_L = 4\Omega$	P_q		5.0		W
Input sensitivity ($P_q = 5\text{ W}$)					
$V_{cc} = 24\text{ V}, R_L = 16\Omega$	V_i		150		mV
$V_{cc} = 18\text{ V}, R_L = 8\Omega$	V_i		110		mV
$V_{cc} = 14\text{ V}, R_L = 4\Omega$	V_i		80		mV
Input impedance	R_i	1	5		$\text{M}\Omega$
Frequency range (-3 dB)	f	35		20000	Hz
Total harmonic distortion ($P_q = .05 \dots 3\text{ W}$; $V_{cc} = 14\text{ V}$; $R_L = 4\Omega$)	THD		.3		%
Voltage gain					
with negative feedback	G_v	33	36	39	dB
without negative feedback	G_v		70		dB
Mains hum suppression ($V_{cc} = 14\text{ V}$; $R_L = 4\Omega$; $f_{hum} = 100\text{ Hz}$)	a_{hum}		38		dB
Noise voltage acc. DIN 45405 (with reference to input; $R_g = 100\text{ k}\Omega$)				10	μV

Circuit diagram



Test and application circuit



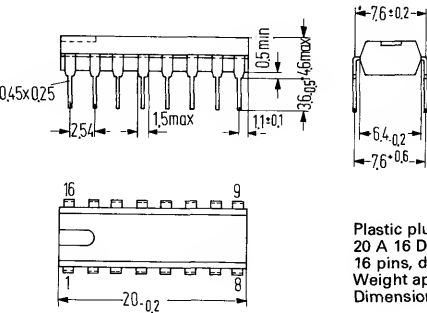
Preliminary data

TDA 1046 is a monolithic IC suitable for AM receivers up to 30 MHz in car radios as well as mains-operated radio sets. For the use in high-quality radio sets the TDA 1046 is preferred to the TCA 440. TDA 1046 contains a controlled RF pre and intermediate stage, a multiplicative push-pull mixer with separate oscillator, controlled IF amplifier, full-wave demodulator, active low pass, as well as an amplifier to directly feed a field-strength indicator instrument. By means of its amplitude-controlled oscillator, the TDA 1046 is particularly suited for applications with varicap diodes. The circuit is balanced.

- Provision of internal AGC-voltage
- High capability for large signals
- Internal demodulator
- Internal AF filtering
- Direct feed of a logarithmical field strength indicator (range 90 dB)
- High AF output voltage with low distortion factor
- Minimisation of external components
- Provisions for additional RF-circuit

Type	Ordering code
TDA 1046	Q67000-A1092

Package dimensions



Plastic plug-in package
20 A 16 DIN 41866
16 pins, dual-in-line
Weight approx. 1.2 g
Dimensions in mm

Absolute maximum ratings

Operating voltage	V_7	18	V
Thermal resistance	R_{thsa}	120	K/W
Junction temperature	T_j	150	°C
Storage temperature	T_s	-40 to +125	°C

Range of operation

Operating voltage	V_7	8 to 18	V
Oscillator frequency	f_{osc}	.5 to 31	MHz
Input frequency RF part	f_{iRF}	0 to 30	MHz
IF part	f_{iIF}	.2 to 1	MHz
Ambient temperature in operation	T_{amb}	-15 to +85	°C

Preliminary data

Electrical characteristics ($V_7 = 10 \text{ V}$, $T_{\text{amb}} = 25^\circ\text{C}$, $f_{\text{mod}} = 1 \text{ kHz}$, $f_{\text{IRF}} = 1000 \text{ kHz}$)
according to application circuit

Current consumption	I_{cc}	18	mA
AF output voltage and distortion factor			
$m = 80\%$; $V_{\text{IRF}} = 2.5 \text{ mV}_{\text{eff}}$	V_{AF}	800	mV_{eff}
	THD_{typ}	.8	%
$m = 80\%$; $V_{\text{IRF}} = 25 \text{ mV}_{\text{eff}}$	V_{AF}	800	mV_{eff}
	THD_{max}	1.5	%
$m = 30\%$; $V_{\text{IRF}} = 2.5 \text{ mV}_{\text{eff}}$	V_{AF}	280	mV_{eff}
	THD_{typ}	.6	%
$m = 30\%$; $V_{\text{IRF}} = 45 \text{ mV}_{\text{eff}}$	V_{AF}	300	mV_{eff}
	THD_{max}	.9	%
Total range of AGC (variation of AF voltage $\Delta V_6 < 6 \text{ dB}$)	ΔG_{Vtyp}	85	dB
Input voltage for AGC triggering			
with tuned LC circuit	$V_{i \text{ 9-10}}$	19	μV
with wide-band circuit	$V_{i \text{ 9-10}}$	28	μV
Input sensitivity (measured at 60Ω ; $m = 30\%/0\%$)			
at signal-to-noise ratio $\frac{S+N}{N} = 6 \text{ dB}$	V_{IRF}	2.5	μV
$\frac{S+N}{N} = 26 \text{ dB}$	V_{IRF}	14	μV
$\frac{S+N}{N} = 53 \text{ dB}$	V_{IRF}	1	mV
Instrument current ($V_{\text{cc}} = 15 \text{ V}$; at G_{min} ; $V_{11} \leq V_7 - 3 \text{ V}$)	I_{11}	1.5	mA
AF output impedance	R_6	3	k Ω

Preliminary data**Electrical characteristics RF stage**

($V_7 = 10\text{ V}$, $T_{\text{amb}} = 25^\circ\text{C}$, $f_{\text{IRF}} = 1000\text{ kHz}$, $f_{\text{mod}} = 1\text{ kHz}$, $m = 95\%$, $f_{\text{IF}} = 450\text{ kHz}$)

according to test circuit 1

Oscillator voltage ($f_{\text{osc}} = 1.45\text{ MHz}$)	V_{15}	600	mV_{ss}
AGC range of RF prestage	ΔG_V	40	dB
Voltage gain	G_V	40	dB
Voltage gain of RF stage	$G_V 13-9/10$	20	dB
Input impedance	$Z_{i\ 9-1} = Z_{i\ 10-1}$	2/5	$\text{k}\Omega/\text{pF}$
	$Z_{i\ 9-10}$	4/5	$\text{k}\Omega/\text{pF}$
Input voltage for prestage AGC-triggering	$V_{i\ 9-10}$	1	mV_{eff}
Input voltage for overload ($\text{THD}_{\text{mod}} = 10\%$)	$V_{i\ 9-10}$	2	V_{ss}
Reference voltage ($I_{16} \leq 1\text{ mA}$)	V_{16}	3.3	V

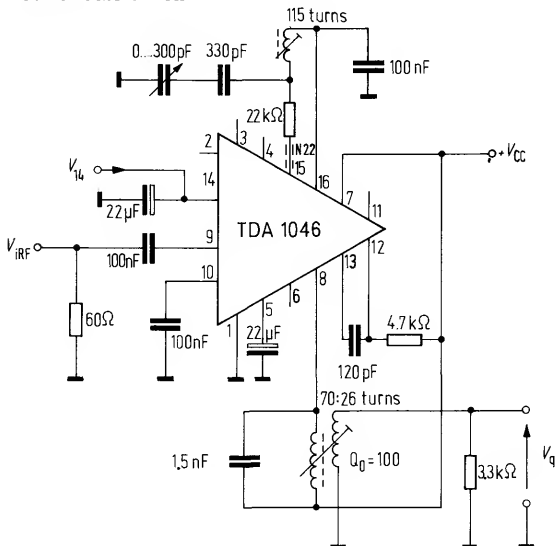
Electrical characteristics IF stage

($V_7 = 10\text{ V}$, $T_{\text{amb}} = 25^\circ\text{C}$, $f_{\text{IF}} = 450\text{ kHz}$, $f_{\text{mod}} = 1\text{ kHz}$, $m = 95\%$)

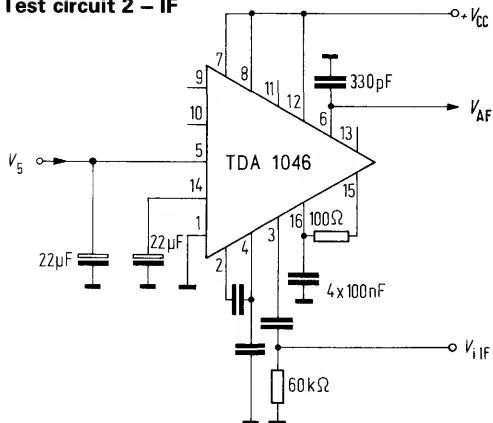
according to test circuit 2

AGC range at 450 kHz	ΔG	45	dB
Input voltage for overload ($\text{THD} = 10\%$)	V_3	120	mV_{eff}
AGC-triggering-level at 450 kHz	V_3	.6	mV_{eff}
Input impedance	Z_3	3.3/3	$\text{k}\Omega/\text{pF}$
AF output voltage ($V_3 = 10\text{ mV}_{\text{eff}}$, $m = 50\%$)	V_{AF}	360	mV_{eff}

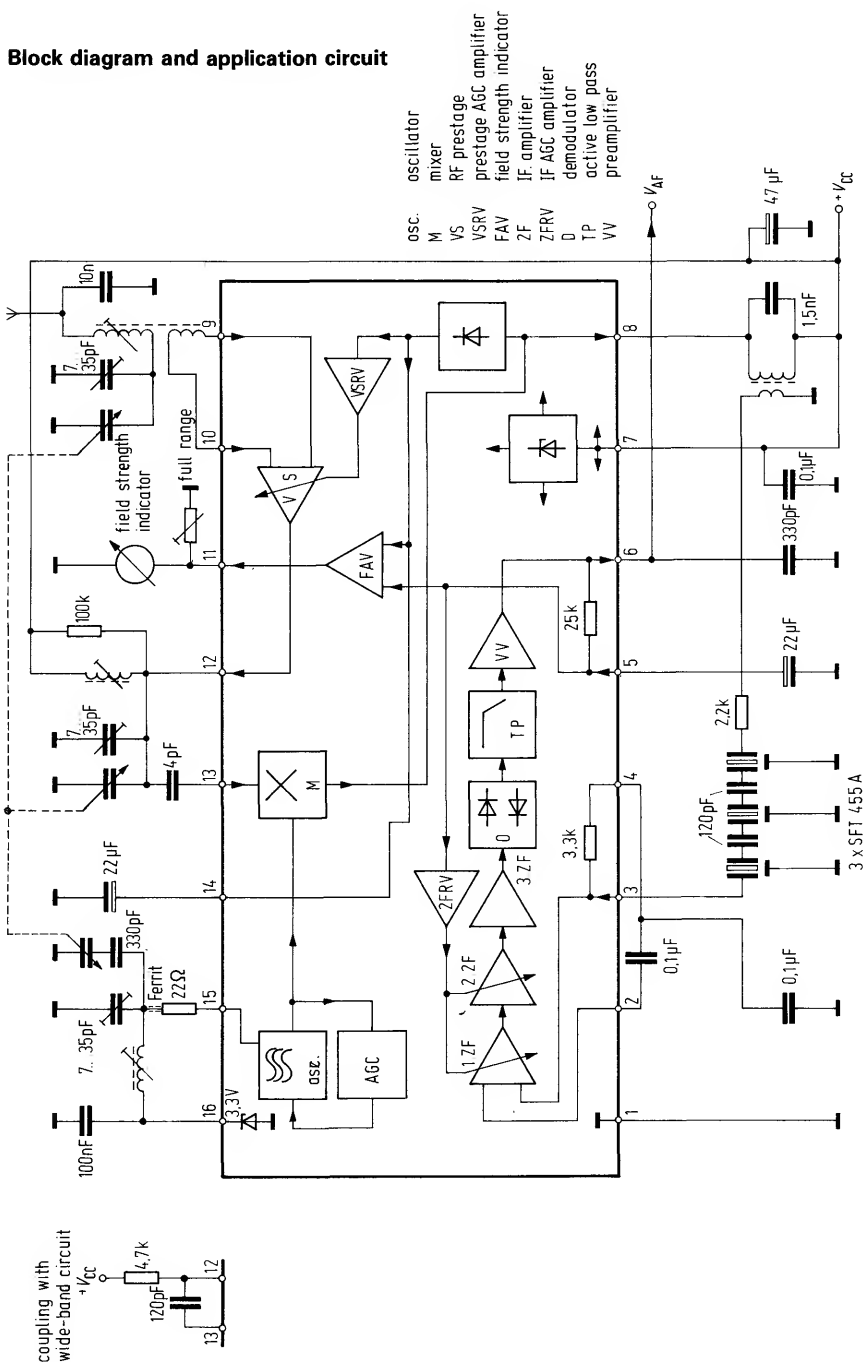
Test circuit 1 – RF



Test circuit 2 – IF

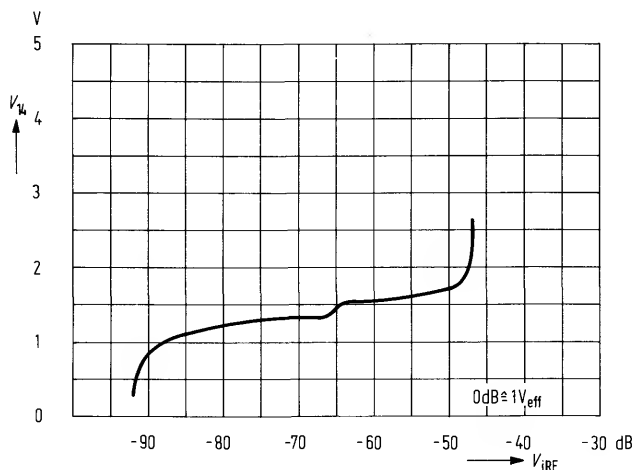


Block diagram and application circuit



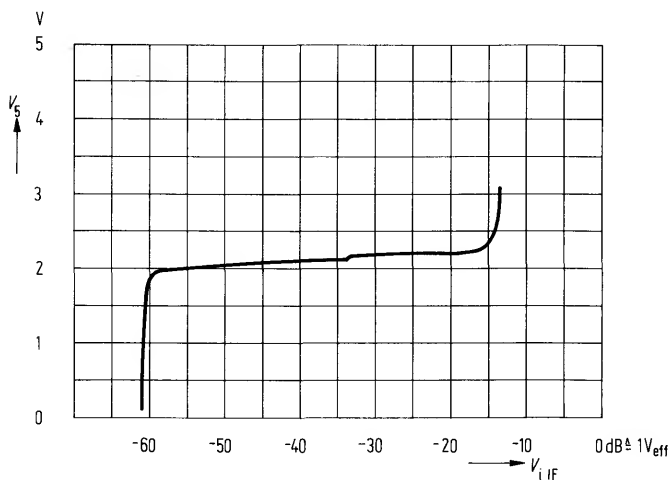
Prestage control
according to test circuit 1

$V_{cc} = 10 \text{ V}$; $T_{amb} = 25^\circ\text{C}$; $f_{iRF} = 1000 \text{ kHz}$; $f_{mod} = 1 \text{ kHz}$;
 $m = 80\%$; $V_{iF} = V_q = \text{const.}$

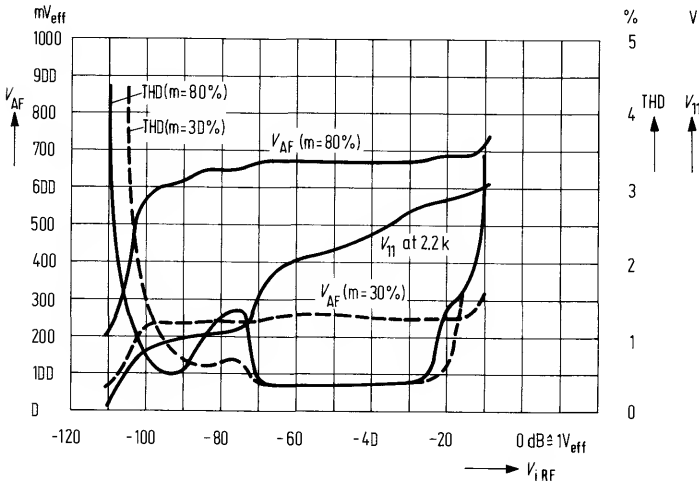


IF-stage control
according to test circuit 2

$V_{cc} = 10 \text{ V}$; $T_{amb} = 25^\circ\text{C}$; $f_{iIF} = 450 \text{ kHz}$; $f_{mod} = 1 \text{ kHz}$;
 $V_{AF} = V_6 = \text{const.}$



AF output voltage, total harmonic distortion, instrument voltage versus RF input voltage
 $V_{cc} = 15\text{ V}$, Coupling with wide-band circuit



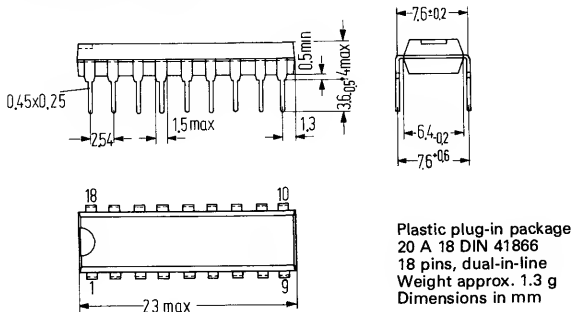
Preliminary data

TDA 1047 is a monolithic, symmetrical, 8-stage amplifier with symmetrical coincidence demodulator designed for amplification, limiting and demodulation of frequency-modulated signals, especially suited for the FM-IF part of radio sets. The TDA 1047 offers provisions for the feeding of an amplitude indicator, either positive or negative going mono-stereo voltage, AFT output (push-pull-current output) with automatic switch-off, squelch adjustable for more than 40 dB range of input signal and depending on detuning.

- Excellent limiting qualities
- Excellent frequency stability of demodulator characteristic
- Large range of operating voltage between 4 and 18 V
- Low current consumption
- Externally adjustable squelch
- Few peripheral components

Type	Ordering code
TDA 1047	Q67000-A1091

Package dimensions



Absolute maximum ratings

Operating voltage	V_{12}	18	V
Thermal resistance	R_{thsa}	120	K/W
Junction temperature	T_j	150	°C
Storage temperature	T_s	-40 to +125	°C

Range of operation

Operating voltage	V_{12}	4 to 18	V
Frequency	f	0 to 15	MHz
Ambient temperature in operation	T_{amb}	-25 to +85	°C

Preliminary data

Electrical characteristics ($V_{cc} = 12\text{ V}$; $T_{amb} = 25^\circ\text{C}$; $f_i = 10.7\text{ MHz}$; $f_{mod} = 1\text{ kHz}$; $\Delta f = \pm 75\text{ kHz}$)

according to application circuit

Current consumption ($I_{14} = 0$)	I_{12}	12	mA
Voltage for field strength indicator ($R_{14} = 3.3\text{ k}\Omega$)	V_{14}	2.5	V
$V_i = 160\text{ mV}_{eff}$	V_{14}	10	mV
$V_i = 16\text{ }\mu\text{V}_{eff}$	I_{14}	3.6	mA
Maximum current	I_{14}	3.6	mA
Voltage for squelch adjustment (approx. log.)	V_{15}	0	V
$V_i = 8\text{ mV}_{eff}$	V_{15}	2.5	V
$V_i = 16\text{ }\mu\text{V}_{eff}$	I_{15}	3.6	mA
Maximum current	V_7	2.1	V
AF output DC voltage	V_7	300	mV _{eff}
AF output voltage ($V_i = 10\text{ mV}$)	V_7	300	mV _{eff}
Internal DC voltage of output emitter follower	I_7	200	μA
Total harmonic distortion ($V_i = 10\text{ mV}$)	I_7	200	μA
Input voltage for limiting	THD	.4	%
Input resistance	V_i	30	μV
AF output resistance ¹⁾ (emitter follower output)	R_{i18}	≥ 10	k Ω
Threshold of detuning-depending squelch	R_{q7}	≤ 1	k Ω
(referring to $f = 10.7\text{ MHz}$)	Δf	± 100	kHz
Switch off voltage for AFT	ΔU_2	≥ 20	mV _{op}
Input resistance	R_{i2}	100 (>40)	k Ω
Voltage for AFT off	V_3	$\geq .8$	V
IF output voltage for limiting	V_{8-11}	500	mV _{pp}
Input resistance for demodulator circuit	R_{9-10}	5.4	k Ω
Recommended volt. for demod. circuit ²⁾	V_{9-10}	500	mV
Threshold for AF off	V_{13}	.85	V
AF on	V_{13}	.6	V
Internal resistance for AF switch off time constant	R_{q6}	500	Ω

¹⁾ The output resistance R_{q7} can be reduced by connecting of a resistor of at least 2.7 k Ω between pin 7 and ground.

²⁾ The recommended voltage at the demodulator circuit V_{9-10} can be adjusted by the capacitors C_{8-9} and C_{10-11} , which are also influencing the voltages V_{14} and V_{15} .

If the slider of potentiometer P is grounded, the field-strength-dependent squelch is switched off.

If pin 13 is grounded, both the field-strength- and the detuning-dependent squelch are switched off.

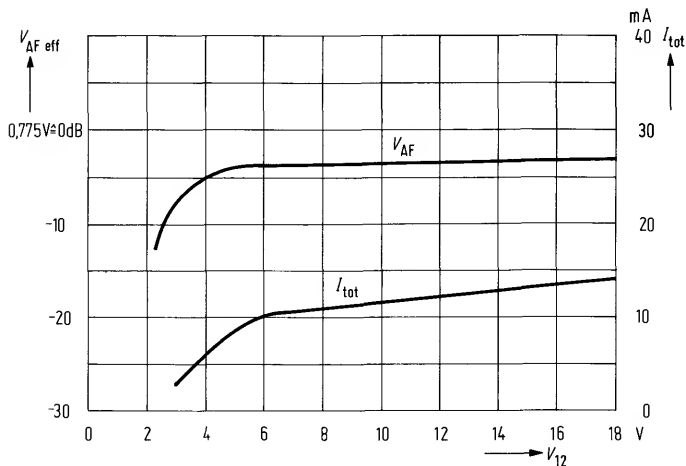
The noise level between the transmitters becomes more or less audible, when pin 6 is loaded with a resistance to +12 V in case of "squelch on". Noise attenuation increases with the size of the resistance ($R \geq 10 \text{ k}\Omega$).

Pin connections

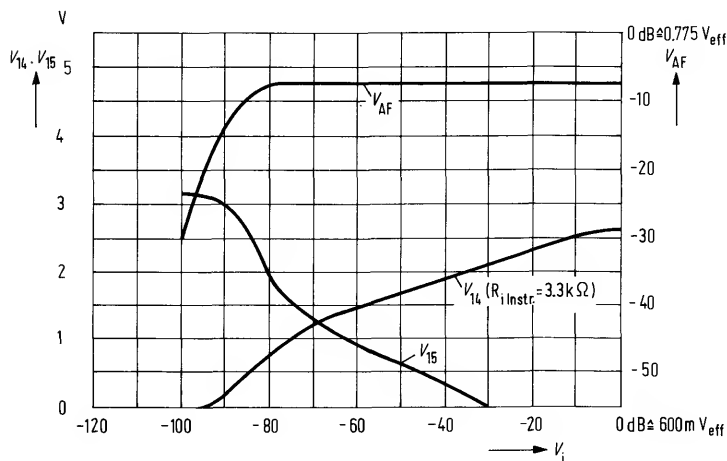
Pin	1	Ground
	2	Sensor input for AFT switch off
	3	AFT switch off time constant
	4	Low-pass capacitor for detuning-dependent AF switch off
	5	AFT output (push-pull output)
	6	Low-pass capacitor for suppression of switch off clicks in case of detuning and insufficient field strength
	7	AF output (emitter follower with constant-current source)
	8	Output of limiter amplifier
	9 }	Phase shifting circuit
	10 }	
	11	Output of limiter amplifier
	12	Positive operating voltage
	13	Input for amplitude-dependent switch off
	14	Instrument connection and stereo switching voltage (positive going)
	15	Squelch and stereo switching voltage (negative going)
	16 }	Feedbacks for IF amplifier
	17 }	
	18	IF input

AF output voltage, total current consumption vs operating voltage

$V_{\text{IFF}} = 60 \text{ mV}_{\text{eff}}$ wide band, pin 13 to ground, $V_{9-10} = 500 \text{ mV}_{\text{pp}}$

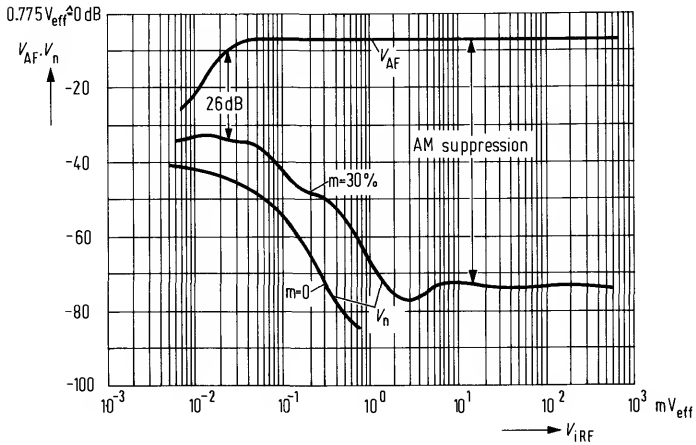
**AF output, indicator, squelch-voltage vs input voltage**

$V_{12} = 15 \text{ V}$, $f = 10.7 \text{ MHz}$, $\Delta f = \pm 75 \text{ kHz}$, $f_{\text{mod}} = 1 \text{ kHz}$,
 $V_{9-10} = 500 \text{ mV}_{\text{pp}}$, wide band measured by 100 nF , $\text{THD} = .4\%$



AF output voltage, noise voltage versus input voltage

$f = 10.7 \text{ MHz}$, $\Delta f = \pm 75 \text{ kHz}$, $V_{12} = 15 \text{ V}$



Preliminary data

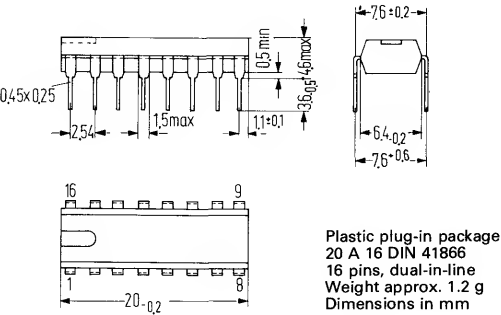
The monolithic integrated circuit TDA 1048 contains a gain-controlled push-pull amplifier, a demodulator, and a DC volume control. The AF outputs are referred to ground and stabilized against hum of the supply voltage.

The IC TDA 1048 is particularly suited for the use in the sound section of TV sets of French Standard (amplitude modulation).

- High input sensitivity
- Distortion-low control
- Distortion-low demodulation
- Volume control by D.C. voltage
- Internally stabilized supply voltage

Type	Ordering code
TDA 1048	Q67000-A1090

Package outlines



Absolute maximum ratings

Supply voltage	V_{cc}	16.5	V
Output current	I_{11}	5	mA
Thermal resistance (system-air)	R_{thsa}	120	K/W
Junction temperature	T_j	150	°C
Storage temperature	T_s	-40 to +125	°C

Range of operation

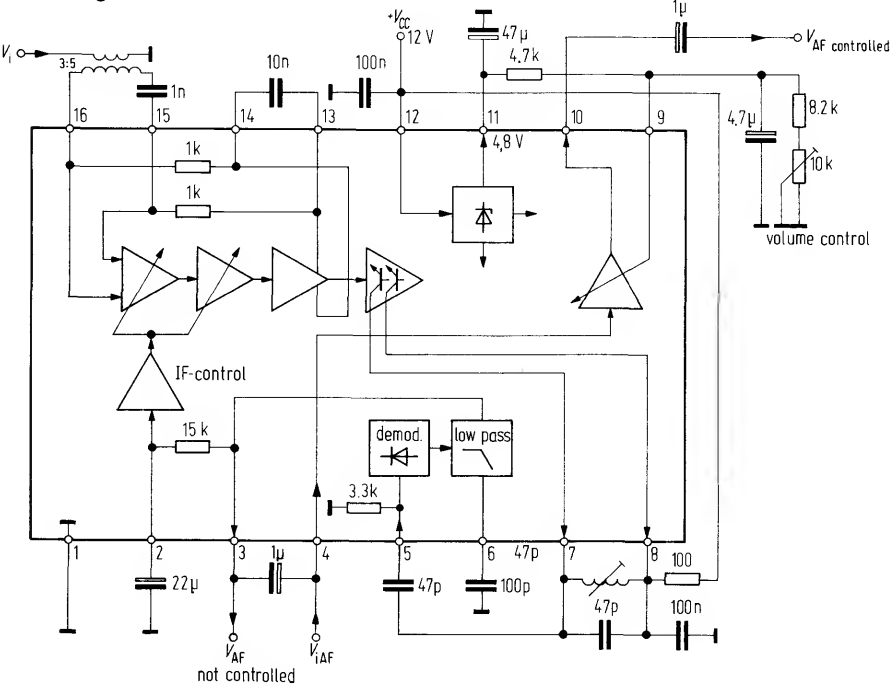
Supply voltage	V_{cc}	10 to 15	V
Ambient temperature in operation	T_{amb}	0 to +60	°C

Preliminary data

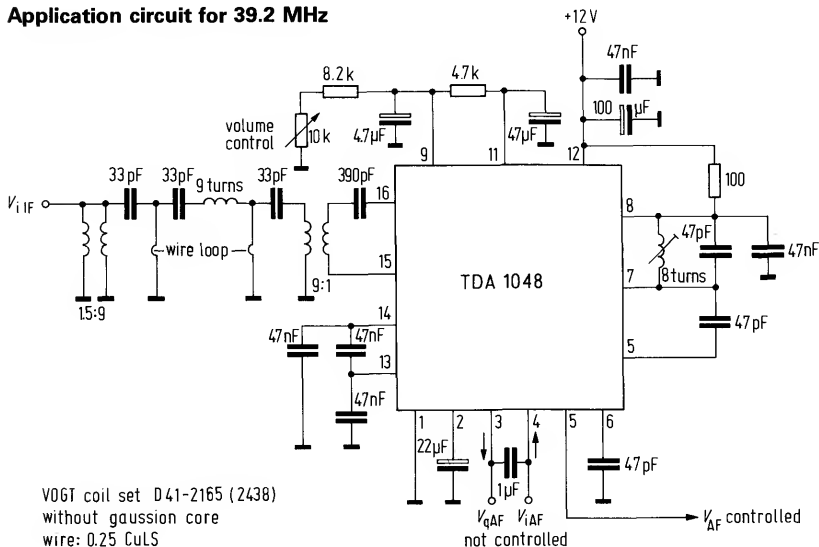
Electrical characteristics ($V_{cc} = 12\text{ V}$; $f_i = 40\text{ MHz}$, $T_{amb} = 25^\circ\text{C}$)

Total current consumption	$I_{12} = I_7 + I_8 + I_{11}$	37	mA
Output DC currents of amplifier	$I_7 = I_8$	4	mA
Input voltage for starting of control (measured via input transmitter 3:5)	V_i	200	μV
AF output voltage ($m = 80\%$)	V_{AF}	≤ 1	V_{eff}
Range of volume control	V_{AFmax}/V_{AFmin}	≥ 70	dB
Output resistance	R_{q3}	150	Ω
	R_{q10}	100	Ω
Load resistance	R_{L3}	≥ 5	k Ω
	R_{L10}	≥ 5	k Ω
Stabilized voltage	V_{11}	4.8	V

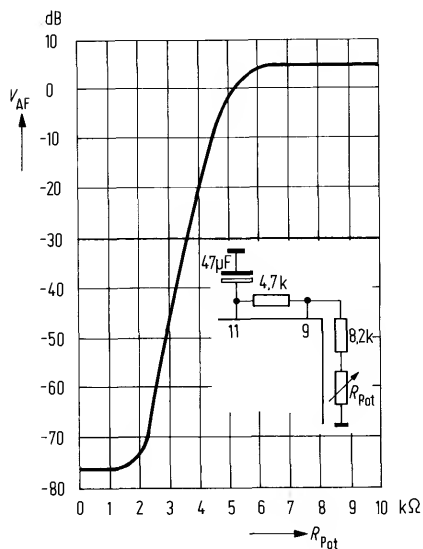
Block diagram and Test circuit



Application circuit for 39.2 MHz



AF output voltage versus potentiometer resistance



Preliminary data

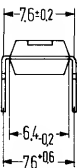
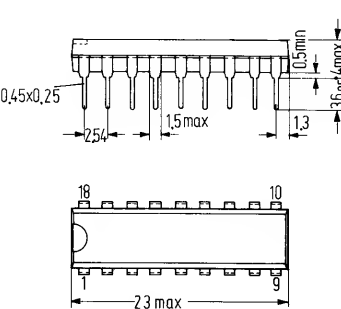
The TDA 1055 is a PLL stereo decoder. It is used in time multiplex (switch) operation or frequency multiplex (matrix) operation. The IC has an automatic pilot-dependent mono/stereo switch and a connection for the stereo-indicating lamp. The lamp current is internally limited to max. 40 mA. The adjustment of the stereo base width from stereo to mono is continuously carried out by means of the auxiliary voltage V_{aux} . V_{aux} can be derived from voltage V_{14} of TDA 1047. By means of the variable base width, this stereo decoder is best suited for car radios. The switch Mo/St serves for switching on forced mono. With the switch St-Such stereo transmitters can be selected. Mono transmitters remain mute, when the switches Mo/St and St-Such are opened. By means of the input OP, slight frequency corrections can be done according to the following formula so that height reductions are balanced. Thus, cross-talking can be improved.

$$\frac{V_q}{V_i} \approx 1 + C_i R_{i2}$$

- Deemphasis either before (matrix) or after (switch) demodulation of (L-R) signal
- Large supply voltage range
- Continuously adjustable stereo base width
- Automatic pilot-dependent stereo switch
- Mute switch of mono transmitters (Stereo-Such)
- Frequency correction of MPX signal

Type	Ordering code
TDA 1055	Q67000-A1145

Package outlines



Plastic plug-in package
20 A 18 DIN 41866
18 pins, dual-in-line
Weight approx. 1.3 g
Dimensions in mm

Absolute maximum ratings

- Supply voltage
- Auxiliary voltage
- Stereo- Such voltage
- Lamp voltage
- Current for stereo indication
- Thermal resistance (system-air)
- Junction temperature
- Storage temperature

V_{cc}	18	V
V_{aux}	4	V
V_{st-s}	4	V
V_{ip}	18	V
I_{ip}	40	mA
R_{thsa}	120	K/W
T_j	150	°C
T_s	-40 to +125	°C

Preliminary data

Range of operation

Supply voltage
Ambient temperature in operation

V_{cc}	8.5 to 18	V
T_{amb}	-25 to +70	°C

Electrical characteristics ($V_{cc} = 15V$, $T_{amb} = 25^{\circ}C$)

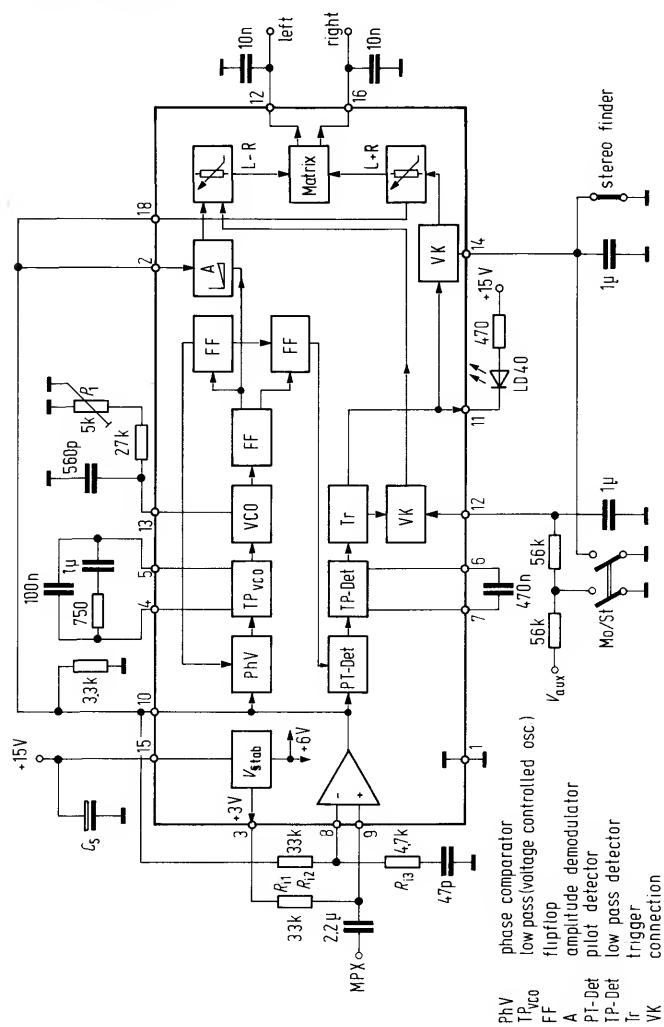
Total current consumption without lamp
MPX input voltage¹⁾
Output voltage per channel with stereo
Input resistance
Output resistance
Total harmonic distortion ($V_{qeff} = 1V$, $f = 1kHz$)
Cross-talk attenuation at 1 kHz
Attenuation at 19 kHz²⁾
 38 kHz²⁾
 76 kHz²⁾
 67 kHz (SCA signal)²⁾
Saturation voltage lamp driver ($I_{ip} = 30mA$)
Switch threshold for stereo
Switch hysteresis
Channel separation control range
 (L-R) = -40 dB mono
 (L-R) = 0 dB stereo
Control range
 (L+R) = 0 dB normal
 (L+R) = 40 dB stereo-such.

I_{cc}	30	mA
V_i	≤ 3	V_{pp}
V_q	3	V_{pp}
R_i	acc. external circuitry	
R_q	5	k Ω
THD	$\leq .3$	%
a_{CT}	≥ 40 (≥ 40)	dB
a_{PT19}	≥ 30 (≥ 30)	dB
a_{PT38}	≥ 40 (≥ 30)	dB
a_{PT76}	≥ 50 (≥ 50)	dB
a_{SCA}	≥ 35 (≥ 40)	dB
V_{sat}	≤ 2.0	V
V_{PT}	≥ 10	mV _{eff}
$H_{st/m}$	5	dB
V_{aux}	<.6	V
V_{aux}	>2.7	V
V_{st-s}	<.7	V
V_{st-s}	>2.2	V

¹⁾ In case of OP amplification $V_{op} = 1$ for all MPX frequencies. When height increasing the MPX signal, the OP output voltage must not exceed $V_{qMPX} = 3V_{pp}$.

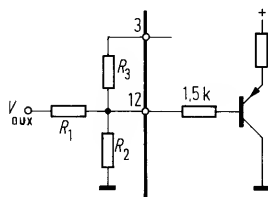
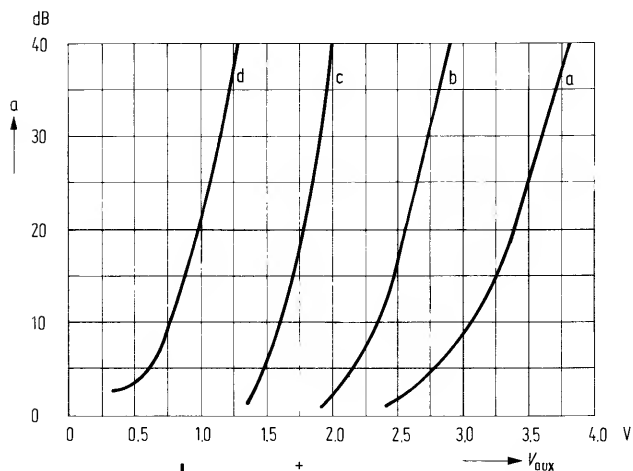
²⁾ The figures without brackets are for switch operation, those with brackets are for matrix operation.

Switch operation



Channel separation depending on auxiliary voltage V_{aux}

(V_{aux} can be taken from the TDA 1047 [pin 14] as field-strength-dependent voltage)



	R_1	R_2	R_3
a	56k	56k	∞
b	56k	100k	∞
c	0	∞	∞
d	110k	∞	330

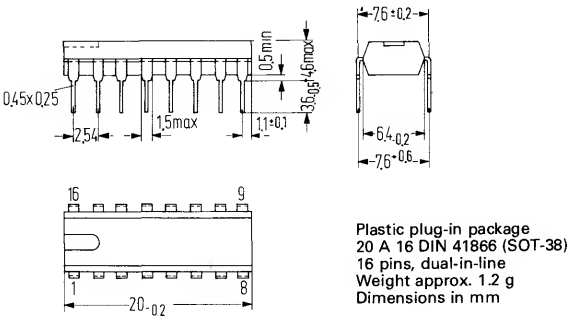
Preliminary data

The monolithic integrated circuit TDA 2522 entails a 8.8-MHz colour subcarrier oscillator with divider stage for the production of both 4.4-MHz reference signals.

- Circuit for the production of the chrominance signal control voltage and a reference voltage
- Circuit for the production of the colour-killer and identification signal
- Colour-killer delay
- Two synchronous demodulators for (B-Y) and (R-Y) signals
- Matrix for (G-Y)-signals
- PAL flipflop and PAL switch
- Blanking in the synchronous demodulators

Type	Ordering code
TDA 2522	Q67000-A1230

Package outlines



Absolute maximum ratings

Supply voltage
Storage temperature
Ambient temperature in operation
Total power dissipation

$V_{11/4max}$	14	V
T_s	-20 to +125	$^{\circ}C$
T_{amb}	-20 to +60	$^{\circ}C$
P_{tot}	600	mW

Preliminary data

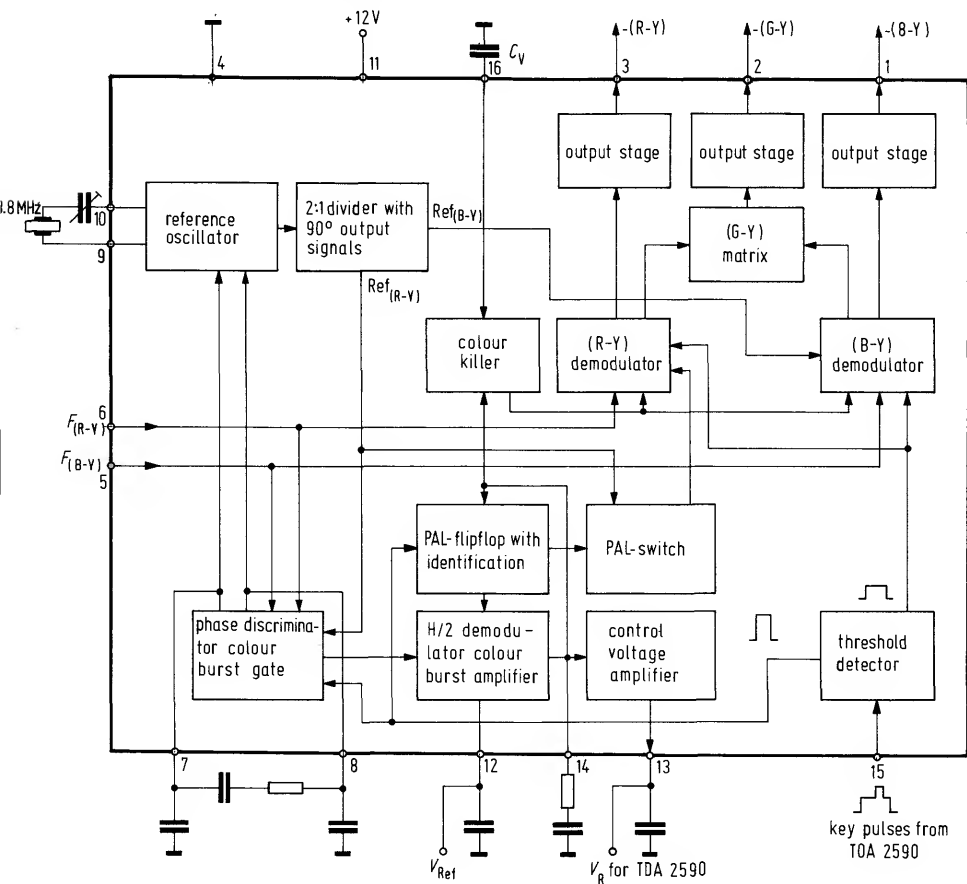
Electrical characteristics ($V_{P(11/4)} = 12\text{ V}$, $T_{\text{amb}} = 25\text{ }^{\circ}\text{C}$)

Typical current consumption	$I_{P(11)}$	40	mA
Ratio of demodulated signals at $V_{F(B-Y)} = V_{F(R-Y)}$	$V_{(B-Y)}$	$1.78 V_{(R-Y)}$	
Matrix for (G-Y)-signal	$(G-Y)$	$-0.51 (R-Y) - 0.19 (B-Y)$	
Input resistance of the chrominance signal inputs	$R_{ch(R-Y)}$	≥ 800	Ω
	$R_{ch(B-Y)}$	≥ 800	Ω
Input capacitance of the chrominance signal inputs	$C_{ch(R-Y)}$	≤ 10	pF
	$C_{ch(B-Y)}$	≤ 10	pF
Output voltages of colour difference signal	$V_{(R-Y)}$	≥ 2.4	V_{pp}
	$V_{(G-Y)}$	≥ 1.35	V_{pp}
	$V_{(B-Y)}$	≥ 3.0	V_{pp}
DC voltage at the colour difference signal outputs	$V_{3/4}$	5.6	V
	$V_{2/4}$	5.6	V
	$V_{1/4}$	5.6	V
Impedance of the colour difference signal outputs	$Z_{(R-Y)}$	250	Ω
	$Z_{(G-Y)}$	250	Ω
	$Z_{(B-Y)}$	250	Ω
H/2 ripple voltage at (R-Y)-output	$V_{H/2}$	≤ 10	mV _{pp}
Input resistance of the 8.8 MHz oscillator	$R_{9/4}$	270	Ω
Output resistance of the 8.8 MHz oscillator	$R_{10/4}$	200	Ω
Total holding range	Δf	± 500	Hz
Key pulses (at pin 15) coming from horizontal combination TDA 2590			
Colour sync. signal keying	ON	$V_{15/4}$	≥ 7.5 V
	OFF	$V_{15/4}$	≥ 6.5 V
Blanking	ON	$V_{15/4}$	≥ 2.0 V
	OFF	$V_{15/4}$	≥ 1.0 V

Preliminary data**Electrical characteristics** (contin.)

Voltage at pin 14			
without colour sync signal	$V_{14/4}$	7.0	V
with colour sync signal			
(peak-to-peak value) of 0.25V at pins 5 and 6	$V_{14/4}$	5.5	V
Reference output voltage	$V_{12/4}$	7.0	V
Chrominance signal control voltage			
(depending on $V_{14/4}$) at $\pm I_{13} \leq 200 \mu\text{A}$	$V_{13/4}$	.5 . . . 5.0	V
at $V_{14/4} \leq 5.5\text{V}$	$V_{13/4}$	≤ 1.0	V
Phase difference between reference signal and	φ	$\pm 5^\circ$	
colour syncsignal at $\pm 400\text{ Hz}$ frequency deviation			
Colour killing at	$V_{14/4}$	≥ 6	V
or at	$V_{16/4}$	12	V
Colour setting at	$V_{14/4}$	≤ 5.6	V
or at	$V_{16/4}$	0	V
Colour setting delay (by C_Y at pin 16)	t_Y	24	ms/ μF

Block diagram with application hint



Preliminary data

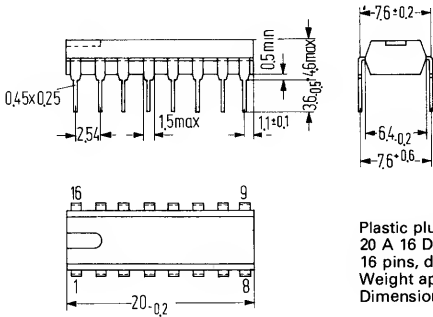
The monolithic integrated circuit TDA 2560 contains

- luminance amplifier
- with adaptation circuit for Y-delay line
- contrast and brightness adjustment
- blanking and keying
- additional video output with positively directed synchronous level

- chrominance amplifier
- with controlled chrominance signal amplifier
- saturation and contrast adjustment
- direct driving of the PAL delay line
- common output for chrominance and colour sync signal (without influencing the colour sync signal amplitude by contrast and saturation adjustment)

Type	Ordering code
TDA 2560	Q67000-A1231

Package outlines



Plastic plug-in package
20 A 16 DIN 41866 (SOT-38)
16 pins, dual-in-line
Weight approx. 1.2 g
Dimensions in mm

Absolute maximum ratings

Supply voltage
Storage temperature
Ambient temperature in operation
Total power dissipation

$V_{8/5 \max}$	14	V
T_s	-25 to +125	°C
T_{amb}	-25 to +65	°C
P_{tot}	930	mW

Preliminary data

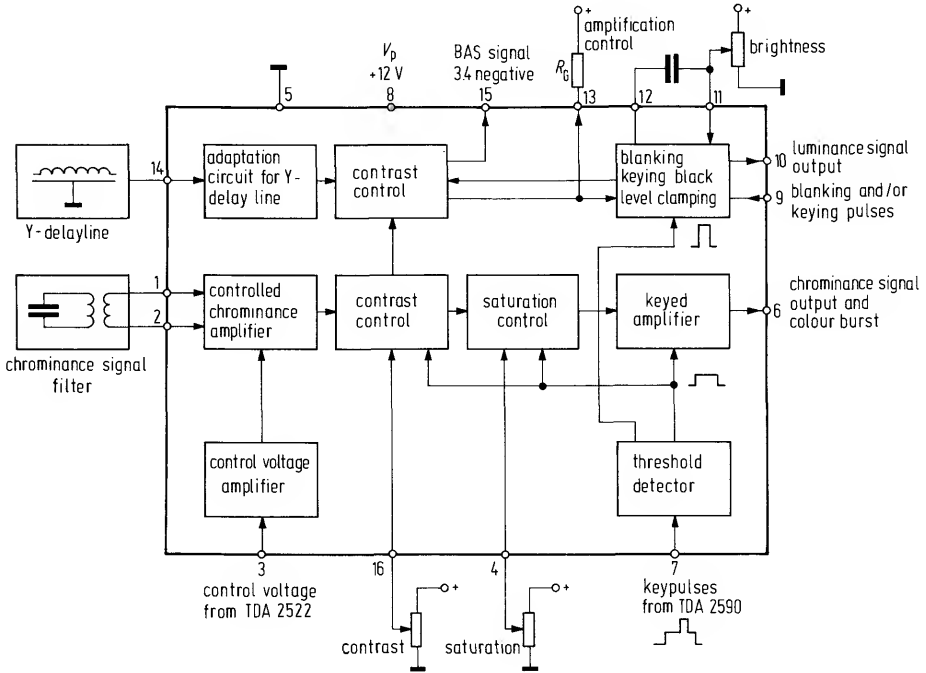
Electrical characteristics ($V_{P(8/5)} = 12 \text{ V}$; $T_{\text{amb}} = 25^\circ \text{C}$)
according to application circuit

Current consumption	$I_{P(8)}$	46	mA
Luminance amplifier²⁾			
Input current	I_{14}	.2	mA _{pp}
Input impedance	$Z_{14/5}$	150	Ω
Contrast adjusting range	E_c	> 20	dB
Brightness adjusting range (black level)	$V_{10/5}$	1 .. 3	V
Brightness adjusting voltage	$V_{11/5}$	1 .. 3	V
Black level shifting by contrast adjustment, picture contents and temperature	ΔV	< ± 20	mV
3 dB band width	B	5	MHz
BAS output voltage with positively directed sync level	$V_{15/5}$	3.4	V _{pp}
Black level clamping pulse ³⁾	$V_{7/5}$	8	V
Blanking pulses ⁴⁾			
for 0 V at output (pin 10)	$V_{9/5}$	3	V
for 1.55 V at output (pin 10)	$V_{9/5}$	6	V
Chrominance amplifier			
Input voltage	$V_{2/1}$	4 .. 80	mV _{pp}
Reachable output signal ⁵⁾	$V_{6/5}$	2	V _{pp}
Control range of the chrominance signal amplifier		> 30	dB
Starting of the chrominance signal control ⁶⁾	$V_{3/5}$	1.1	V
Contrast synchronism (at 10-dB contrast variation)		± 1	dB
Saturation adjustment range ⁷⁾	E_s	+6 ... -50	dB
Colour sync signal gating ³⁾	$V_{7/5}$	2	V
Signal-noise ratio at nominal input voltage	S/N	> 50	dB
Phase shifting of the colour sync signal to the chrominance signal	φ	< $\pm 5^\circ$	

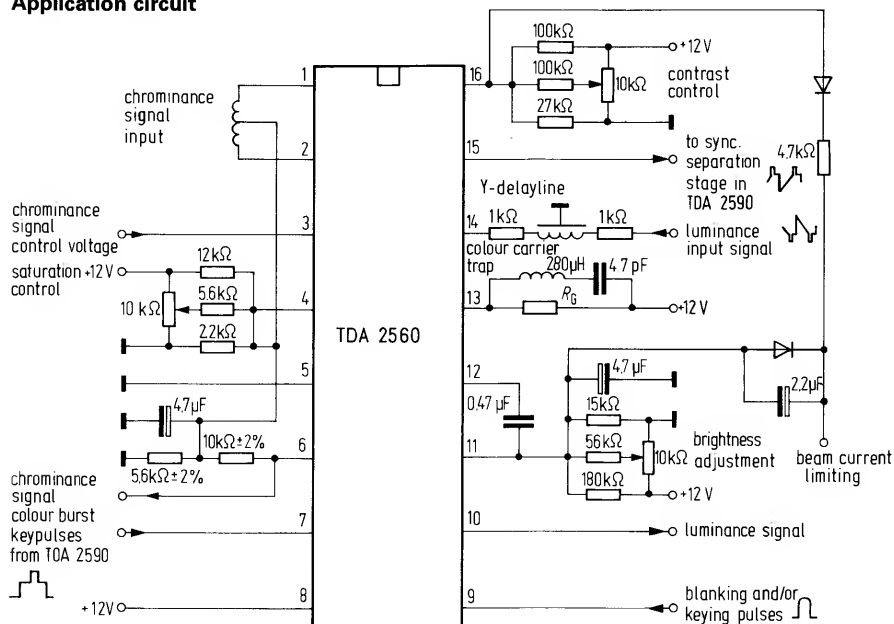
Remarks to the previous page

- 1) Supply voltage range $V_P = 9 \dots 14 \text{ V}$,
admissible hum voltage $V_P = 100 \text{ mV}_{pp}$
- 2) The gain of the luminance amplifier can be influenced by the load resistance R_g at pin 13. The scattering of the gain is reduced to a minimum, since it depends only from the scattering of the relationship between Y delay line end resistor and the resistor R_g .
- 3) Key pulses (from TDA 2590) for colour sync signal keying and for black level clamping are sent to pin 7.
The black level clamping becomes effective at +8 V, key pulses must be in that time that clamping only becomes effective at the back slope of the black shoulder.
The colour sync signal gate circuit, which switches the gain of the chrominance signal amplifier during its return to maximum, becomes effective at +2 V.
- 4) The luminance signal is keyed via pin 9:
when the key pulse reaches +3 V, the luminance signal output (10) is blanked;
at +6 V, a standard level of approx. 1.55 V is keyed which can be used for clamping.
- 5) Chrominance signal and colour sync signal are both available at pin 6. The colour sync signal is not influenced by contrast and saturation adjustment; it remains stable by means of the control voltage of TDA 2522.
The ratio of the chrominance signal to the colour sync signal is at nominal contrast (3 dB below maximum) and at nominal saturation (6 dB below maximum) the same at the output and at the input.
- 6) When the voltage becomes more negative, the gain is reduced.
- 7) Linear range up to -40 dB

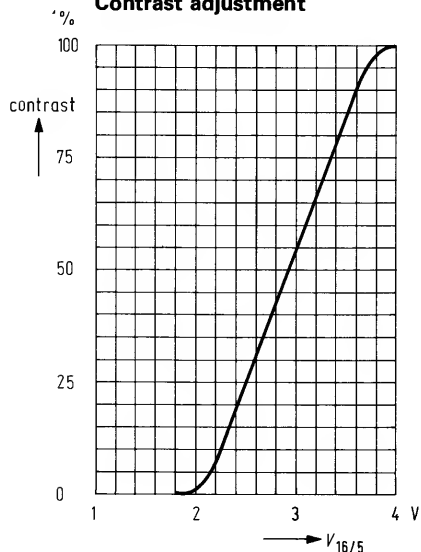
Block diagram



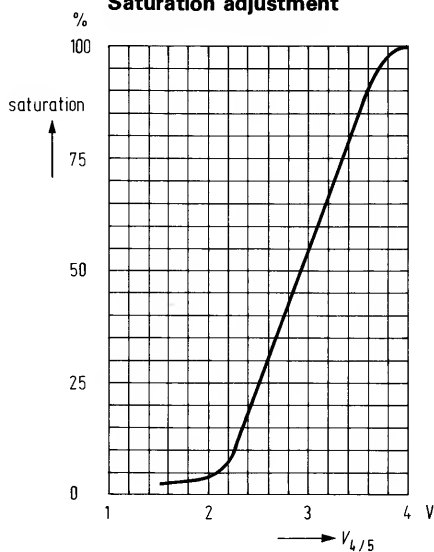
Application circuit



Contrast adjustment



Saturation adjustment



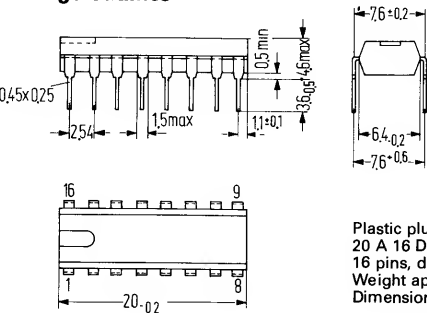
Preliminary data

The monolithic integrated circuit TDA 2590 is adapted to the integrated colour circuits TDA 2522 and TDA 2560

- with line oscillator according to the threshold switch principle
- phase comparison between sync pulse and oscillator (φ_1)
- phase discriminator φ_2 for phase position between line flyback pulse and oscillator
- capture range extension by coincidence detector φ_3
- time constant and gate switching (VCR operation)
- sync pulse separation stage
- blanking circuit for interference signal
- vertical sync pulse separation stage
- production of key pulses for colour sync signal and for line flyback blanking pulses
- phase shifter for control pulse
- switching of control pulse width and switch-off
- output stage with separate supply voltage for direct triggering of thyristor deflection circuits

Type	Ordering code
TDA 2590	Q67000-A1232

Package outlines



Plastic plug-in package
20 A 16 DIN 41866 (SOT-38)
16 pins, dual-in-line
Weight approx. 1.2 g
Dimensions in mm

Absolute maximum ratings

- Ambient temperature in operation
- Storage temperature
- Voltages

Currents

T_{amb}	-20 to +60	°C
T_s	-25 to +125	°C
$V_{P(1/16)}$	13.2	V ¹⁾
$V_{P(2/16)}$	18.0	V
$V_{4/16}$	13.2	V
$\pm V_{9/16}$	6.0	V
$\pm V_{10/16}$	6.0	V
$V_{11/16}$	13.2	V
I_{2M}	400	mA
$-I_{3M}$	400	mA
I_4	1	mA
$\pm I_6$	10	mA
$-I_7$	10	mA
I_{11}	2	mA

¹⁾ with power supply

Preliminary data**Electrical characteristics** ($V_{P(1/16)} = 12 \text{ V}$; $T_{\text{amb}} = 25^\circ\text{C}$)**Inputs**

Sync pulse separating stage (pin 9)

Input switching voltage	V_{9s}	.8	V
Input switching current	I_{9s}	5 to 100	μA
Input leakage current (at $V_9 = -5 \text{ V}$)	I_{9lk}	≤ 1	μA

Interference signal blanking circuit (pin 10)

Input modulation voltage	V_{10mod}	1.0	V
Input switching voltage	V_{10s}	1.4	V
Input modulation current	I_{10mod}	5 to 100	μA
Input switching current	I_{10s}	150	μA
Input leakage current (at $V_{10} = -5 \text{ V}$)	I_{10lk}	≤ 1	μA

Line flyback pulse input (pin 6)

Input current	I_6	≥ 10	μA
Input switching voltage	V_{6s}	1.4	V
Input voltage limitation	V_{6l}	$-0.7/+1.4$	V
Input resistance	R_{16}	400	Ω

Switching to VCR operation (pin 11)

Input voltage	V_{11}	0 to 1.5	V
Input current	$-I_{11}$	≥ 200	μA
or			
Input voltage	V_{11}	9.0 to 13.2	V
Input current	I_{11}	1 to 2	mA

Switching of control pulse widths (pin 4)

for $t = 6\mu\text{s}$ input voltage	V_4	9.4 to 13.2	V
input current	I_4	≥ 200	μA
for $t = 14\mu\text{s} + t_d$ input voltage	V_4	0 to 4	V
input current	$-I_4$	≥ 200	μA
for $t = 0$ ($V_3 = 0$) input voltage ¹⁾	I_4	0	V

¹⁾ or input 4 open

Preliminary data**Electrical characteristics (contd.)****Outputs****Vertical sync pulses, positive (pin 8)**

Output voltage	V_8	11 (≥ 10)	V_{pp}
Output resistance	R_{q8}	2	k Ω

Colour sync key pulses, positive (pin 7)

Output voltage	V_7	11 (≥ 10)	V_{pp}
Output resistance	R_{q7}	400	k Ω

Line flyback blanking pulses, positive (pin 7)

Output voltage	V_7	2.5 to 3.5	V_{pp}
Output resistance	R_{q7}	400	Ω

Control pulses, positive (pin 3)

Output voltage	V_3	10.5	V_{pp}
Output current, average value	$-I_{3AV}$	2.5	mA
Output resistance for front slope	R_{qf3}	2.5	Ω
Output resistance for back slope	R_{pr3}	20	Ω

Oscillator (pins 14 and 15)

lower threshold voltage	V_{14thl}	4.4	V
upper threshold voltage	V_{14thu}	7.6	V
Reverse current	I_{15}	$\pm .47$	mA

Phase comparison φ_1 sync pulse/oscillator (pin 13)

Control voltage range	V_{13}	3.8 to 8.2	V
Control current	$\pm I_{13M}$	1.9 to 2.3	mA _{pp}
Output leakage current at $V_{13} = 4 \dots 8$ V	I_{13q}	≤ 1	μA
Output resistance, $V_{13} = 4 \dots 8$ V	R_{q13}	high ohmic	¹⁾
Output resistance, $V_{13} < 3.8$ V / > 8.2 V	R_{q13}	low ohmic	²⁾

Output of the time constant switch (pin 12)

Output voltage	V_{12}	6.0	V
Output current	$\pm I_{12}$	≤ 1	mA
Output resistance, $V_{11} = 2.5 \dots 7.0$ V	R_{q12}	100	Ω
Output resistance, $V_{11} \leq 1.5$ V / ≥ 9 V	R_{q12}	30	k Ω

Coincidence detector φ_3 (pin 11)

Output voltage	V_{11}	.5 to 6.0	V
Output current, no coincidence	I_{11M}	.1	mA
Output current, with coincidence	$-I_{11M}$	.5	mA

¹⁾ Current source output²⁾ Emitter follower

Preliminary data**Electrical characteristics (contd.)****Phase comparison φ_2 line flyback pulse/ oscillator (pin 6)**

Control voltage range	V_6	5.4 to 7.6	V
Control current	$\pm I_{SM}$	1	mA _{pp}
Output and/or input resistance			
at $V_6 = 5.4 \dots 7.6$ V	$R_{q/16}$	high ohmic	¹⁾
at $V_6 < 5.4$ V / > 7.6 V	$R_{q/16}$	8	k Ω
Input current with blocked phase detector and $V_6 = 6.5$ V	I_6	≤ 5	μ A

Operating data at $V_{P(1/16)} = 12$ V
and the indicated external circuitry

Sync pulse separation stage (pin 9)

Input signal (BAS)	V_9	3 to 4	V_{pp} ²⁾
Input key current	I_{9k}	≤ 100	μ A

Interference signal blanking circuit (pin 10)

Input signal (BAS)	U_{10}	3 to 4	V_{pp} ²⁾
Input key current	I_{10k}	≤ 100	μ A
Admissible superposed interference signal	V_{10}	≤ 7	V_{pp}

Vertical sync pulse separation

Delay between front slopes of input signal and output signal	$t_{S\ on}$	12	μ s
Delay between back slopes of input signal and output signal	$t_{V\ off}$	$\geq t_{V\ on}$	
Output voltage	V_8	11	V_{pp}
Output resistance	R_{q8}	2	k Ω

Oscillator

Oscillator frequency (unsynchronized)	f_o	15.625	kHz
with $C_{osc} = 4.7$ nF, $R_{osc} = 12$ k Ω	Δf_o	$\leq +5$	% ³⁾
Scattering of oscillator frequency	$\Delta f_o / \Delta I$	31	Hz/ μ A
Frequency-adjusting level			
Adjusting range for the indicated external circuitry	Δf_o	± 10	%
Dependence of the oscillator frequency from the supply voltage	$\frac{\Delta f_o / f_o}{\Delta V_{cc} / V_{cc}}$	$\leq \pm 0.05$	²⁾
Frequency modification with supply voltage lowered to 4 V	Δf_o	$\leq \pm 10$	% ³⁾
Temperature coefficient of oscillator frequency	TC_f	$\leq \pm 10^{-4} / K$	³⁾

¹⁾ Current source switching

²⁾ Admissible range 1 to 7 V

³⁾ Scattering of external components is not considered.

Preliminary data**Operating data (contd.)****Phase comparison φ_1 sync pulse/oscillator**

Control sensitivity	$S\varphi$	2	kHz/ μ s
Scattering of control sensitivity	$\Delta S\varphi$	± 10	% ¹⁾
Catching and holding range	Δf	± 780	Hz
Scattering of catching and holding range	$\Delta(\Delta f)$	± 10	% ¹⁾

Time constant switch

compare electrical characteristics

Coincidence detector φ_3

compare electrical characteristics

Phase comparison φ_2 line flyback pulses/oscillator

Admissible delay between front slope and line flyback pulse ($t_{H1} = 12 \mu$ s)	t_{dmax}	15	μ s
Static control error	$\Delta t/\Delta t_d$	$\leq .2$	%

Total phase position

Phase position between mid sync pulse and mid line flyback pulse	Δt	2.6	μ s
Phase position tolerance	$\Delta(\Delta t)$	$\leq .7$	μ s

Total phase position and phase position of front slope of control pulse is set automatically by phase comparison φ_2 .

For any additional setting:

Voltage supply	$\Delta V/\Delta t$	.1	V/ μ s
Current supply	$\Delta I/\Delta t$	30	μ A/ μ s
Scattering of supply current	$\Delta(\Delta I)$	≤ 10	% ¹⁾

Colour sync signal key pulse

Phase position between mid sync pulse at input and back slope of colour sync signal key pulse at $V = 7$ V	Δt	6.75 (5.8 to 7.7)	μ s
Width of colour sync signal key pulse	t	5.0 (4.3 to 5.6)	μ s

¹⁾ Scattering of external components is not considered.

Preliminary data

Operating data (contd.)

Control pulse switch

compare electrical characteristics

Control pulse output

Duration of control pulse

at $V_4 \geq 9.4 \text{ V}$

at $V_4 \leq 4 \text{ V}$

Control pulse switch off with supply voltage

t	6.0 (4.5 to 7.5)	μs
t	$14 \mu\text{s} + t_d$	
V_{cc}	≤ 4	V

Key pulse

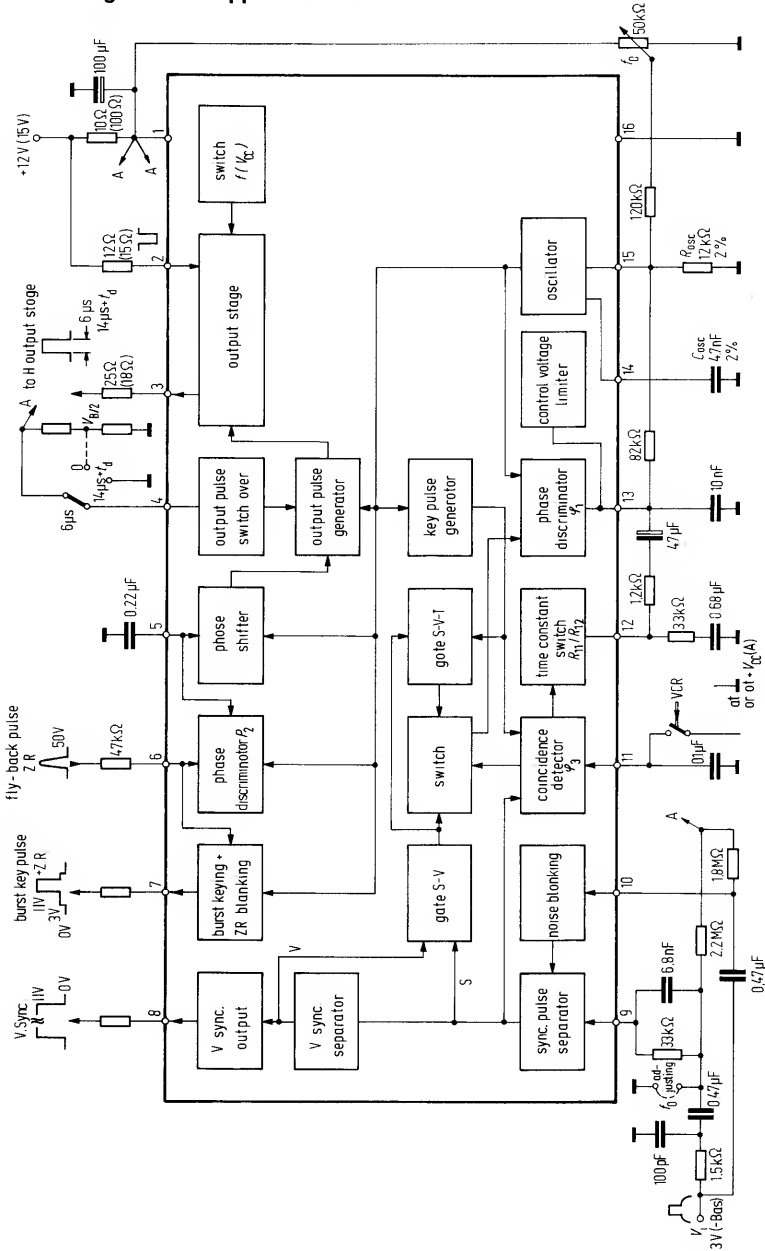
Duration of key pulse

Time between front slope of key pulse
and mid of sync pulse

Time between back slope of key pulse
and mid of sync pulse

t	8	μs
Δt	$4 (\geq 2.75)$	μs
Δt	$4 (\geq 2.75)$	μs

Block diagram with application note

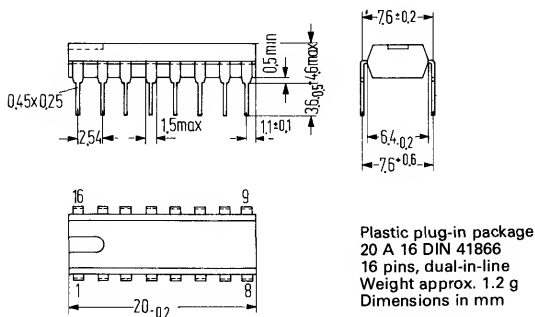


The monolithic integrated circuits SAS 560 S and SAS 570 S are particularly suited for radio and TV sets, elevators etc. Each stage can be selected with very low current. Two outputs are available for each stage: one for tuning voltage and the other for channel indication and/or bandswitch. The high input sensitivity allows its use in equipments without mains isolation.

- High input sensitivity
- Low saturation voltage of switching transistors
- Low temperature drift of the output switching transistor for the tuning voltage
- Schmitt-Trigger-Circuit ensures for the SAS 560 S switching of stage 1 in case of setting of supply voltage

Type	Ordering code
SAS 560 S	Q67000-S30
SAS 570 S	Q67000-S31

Package outlines



Absolute maximum ratings

Supply voltage 1	V_7	36	V
Supply voltage 2	V_8	26.5	V
Voltage	V_2	6	V
Driver current	$I_9, I_{11}, I_{13}, I_{15}$	55	mA
Max. driver current, $t_{\max} \leq 2s$	$I_9, I_{11}, I_{13}, I_{15\max}$	100	mA
Tuning current	I_3, I_4, I_5, I_6	1.5	mA
Max. tuning current, $t_{\max} \leq 2s$	$I_3, I_4, I_5, I_{6\max}$	10	mA
Junction temperature	T_j	150	°C
Thermal resistance (system-air)	R_{thsa}	120	°K/W
Storage temperature	T_s	-40 to +125	°C

Range of operation

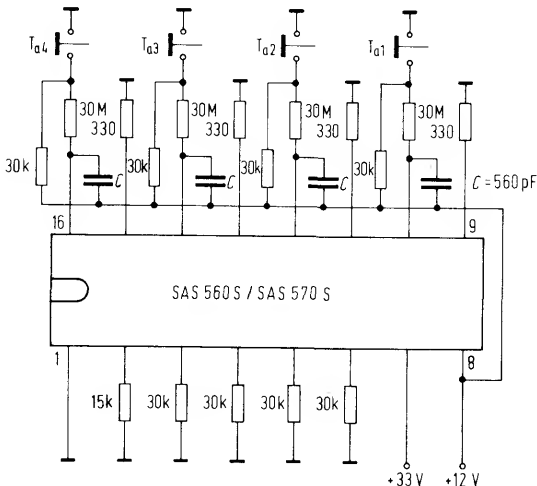
Supply voltage 1	V_7	11 to 35	V
Supply voltage 2	V_8	5 to 25	V
Ambient temperature in operation	T_{amb}	0 to +70	°C

Electrical characteristics ($V_7 = 33\text{ V}$, $V_8 = 12\text{ V}$, $T_{\text{amb}} = 25^\circ\text{C}$, according to test circuit)

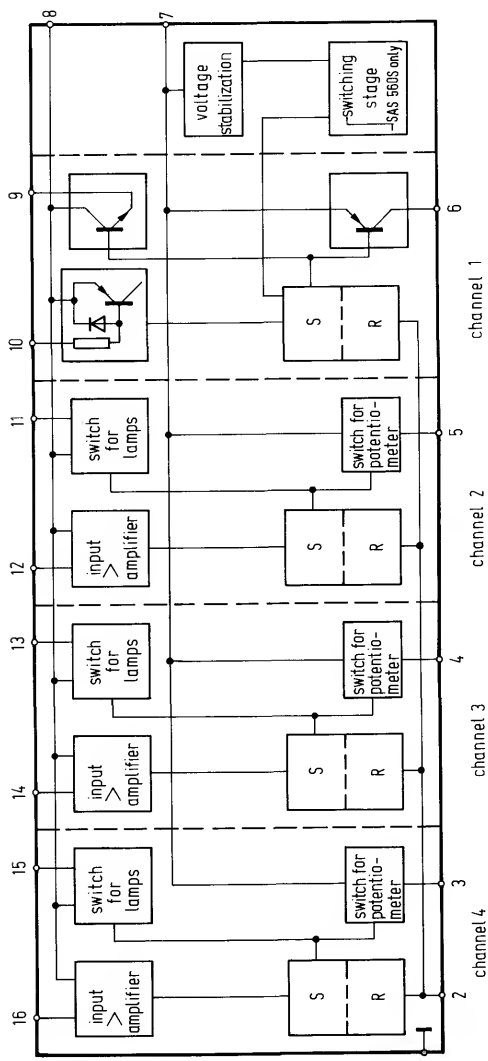
		min	typ	max	
Voltage at pin 2 ($R_k = 15\text{ k}\Omega$)					
during touching	V_{2-1}	4.3	4.7	5.1	V
after touching	V_{2-1}	2.6	3.2	3.7	V
Saturation voltage of driver outputs	V_{15-8} , V_{13-8}		.9	1.5	V
	V_{11-8} , V_{9-8}		.9	1.5	V
Saturation voltage of tuning voltage outputs	V_{3-7} , V_{4-7}		.15	.5	V
Temperature drift of saturation voltage of tuning outputs	V_{5-7} , V_{6-7}		.15	.5	V
($T_{\text{amb}} = 25 \dots 55^\circ\text{C}$)	V_{3-7} , V_{4-7}		.3	1	mV/deg
	V_{5-7} , V_{6-7}		.3	1	mV/deg
Current consumption					
during touching	I_7	3.3	4.3	5.3	mA
after touching	I_7		4.7	5.7	mA
Current consumption (without load)	I_7	.7	1.4	2.1	mA
Input current	I_{10} , I_{12} , I_{14} , I_{16}		100	300	nA
Reverse current of driver outputs	I_9 , I_{11} , I_{13} , I_{15}			10	μA
Reverse current of tuning voltage outputs	I_3 , I_4 , I_5 , I_6			1	μA

After simultaneous selection of more than one channel, only **one** channel will be selected. After switching off V_8 , the last selected channel is stored so long as V_7 supply is maintained.
SAS 560 S only: On application of supply voltage V_7 , channel 1 (outputs 6 and 9) is automatically selected.

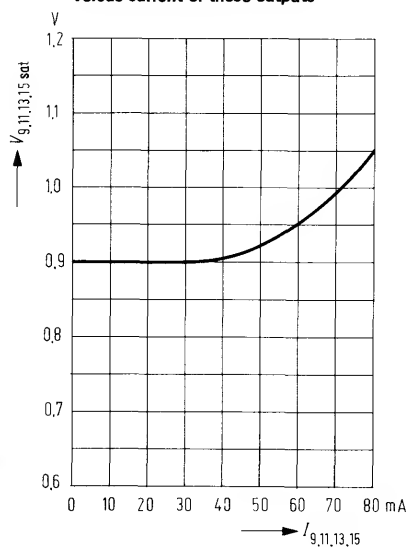
Test circuit



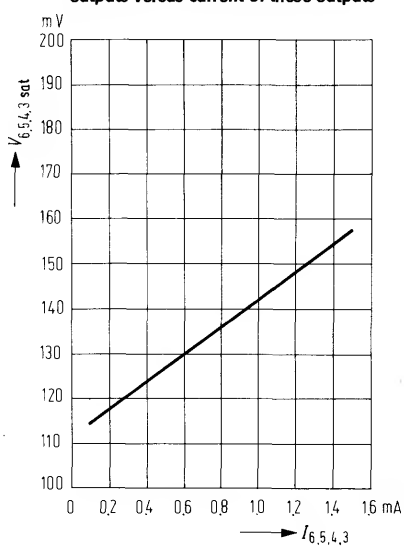
Block circuit diagram



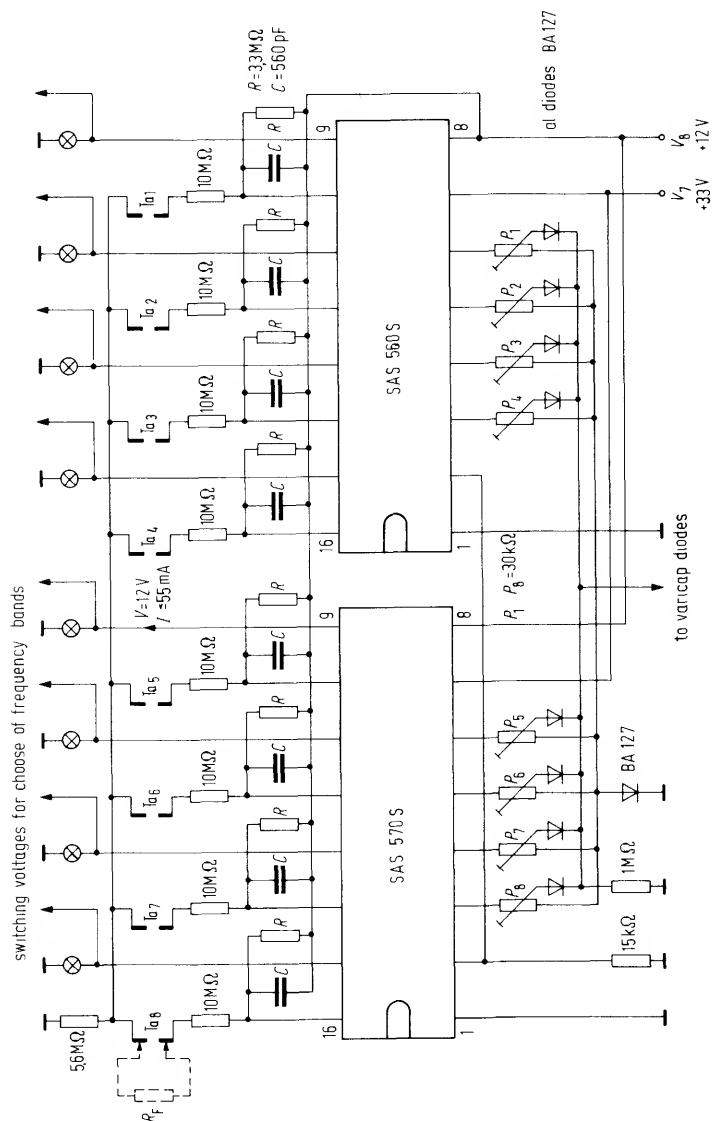
**Saturation voltage of driver outputs
 versus current of these outputs**



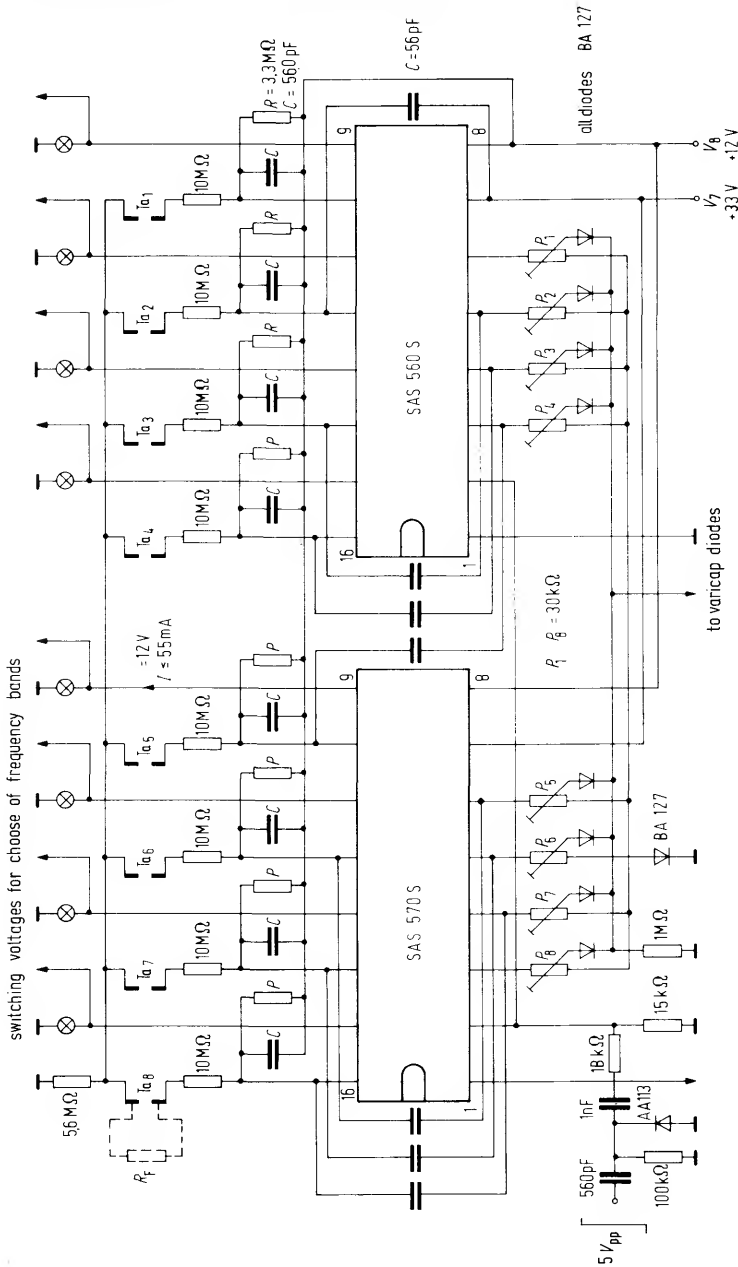
**Saturation voltage of tuning voltage
 outputs versus current of these outputs**



Application circuit I



Application circuit II as ring counter circuit



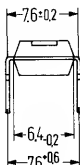
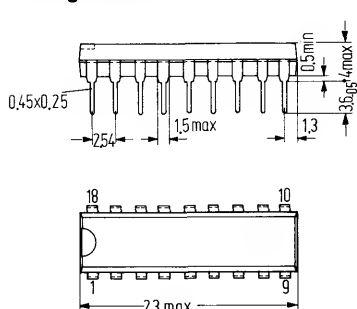
The monolithic integrated circuits SAS 580 and SAS 590 have been developed from SAS 560 S/570 S which are being further produced. SAS 580 is the basic component for the first 4 channels. By adding any number of SAS 590, the number of channels can be extended by 4 channels each one.

The new ICs offer with even less external circuitry higher operating comfort:

- Integrated ring counter for remote control saves external components and permits higher frequency
- Potentiometers are switched by sliders. External diodes are unnecessary
- The outputs are able of directly driving filamental lamps, LED's, neon lamps or nixie tubes
- Complete function for supply voltage between 10 and 36 V, i.e. the supply voltage can be strongly reduced during stand-by operation, a selected channel remains switched without any additional circuitry

Type	Ordering codes
SAS 580	Q67000-S28
SAS 590	Q67000-S29

Package outlines



Plastic plug-in package
20 A 18 DIN 41866
18 pins, dual-in-line
Weight approx. 1.3 g
Dimensions in mm

Absolute maximum ratings

Supply voltage
Current consumption
(for operation with higher voltage than 36 V,
a series resistor is required)
Driver current
for $t_{\max} \leq 2s$
Junction temperature
Thermal resistance (system-air)
Storage temperature

V_{16}	36	V
I_{16}	15	mA
I_3, I_5, I_7, I_9	55	mA
$I_3, I_5, I_7, I_{9\max}$	100	mA
T_j	150	°C
R_{thsa}	120	°K/W
T_s	-40 to +125	°C

Range of operation

Supply voltage
Ambient temperature in operation

V_{16}	10 to 36	V
T_{amb}	0 to +70	°C

Electrical characteristics (see test circuit, $V_{16} = 30 \text{ V}$, $T_{\text{amb}} = 25^\circ\text{C}$)

		min	typ	max	
Internal current consumption					
channel switched	I_1	4.5	7.0	9.5	mA
channel not switched	I_{16}	3.0	5.0	8.5	mA
Voltage at pin 18 ($R_C = 3 \text{ k}\Omega$)					
during touching	V_{18s}	3.4	3.8	4.2	V
after touching	V_{18h}	2.6	3.0	3.4	V
Saturation voltage of driver outputs					
$R_L = 1 \text{ k}\Omega$	V_3, V_5, V_7, V_9		.8	1.5	V
$R_L = 30 \text{ k}\Omega$	V_3, V_5, V_7, V_9		30	60	mV
Reverse voltage of driver outputs					
$I_{\text{rev}} = 100 \mu\text{A}$	V_3, V_5, V_7, V_9	60			V
$I_{\text{rev}} = 5 \mu\text{A}$	V_3, V_5, V_7, V_9	50			V
Tuning voltage	$V_{12}, V_{13}, V_{14}, V_{15}$	.5		$V_{16}-2$	V
Input current of tuning voltage inputs	$I_{12}, I_{13}, I_{14}, I_{15}$		150	300	nA
Offset voltage of tuning switches ¹⁾	V_{12-11}, V_{13-11}			± 100	mV
	V_{14-11}, V_{15-11}			± 100	mV
Temperature drift of tuning voltage switches ($T_{\text{amb}} 20 \dots 50^\circ\text{C}$) ¹⁾	V_T			5	mV
Impedance of tuning output ($I_{11} < \pm 30 \mu\text{A}$)	R_{q11}		3		k Ω
Trigger current for channel switching	I_2, I_4, I_6, I_8	20	80	200	nA
Input threshold voltage of switch amplifiers ($I_2, I_4, I_6, I_8 = 80 \text{ nA}$)	V_2, V_4, V_6, V_8		5.5		V
Switch frequency of ring counter	f_{rc}		10		kHz

¹⁾ measured between switched input and pin 11.

Summary

The integrated circuits SAS 580/590 have been developed for electronic channel selection in radio and TV sets with varicap diodes. The selection can be carried out by merely touching the sensor plates. By selecting a stage, a pre-set tuning voltage is switched and a driver stage operated which are controlling the band selection and the channel indication. For the indication, it can be chosen between neon lamps, nixie tubes, LED's or filamental lamps. Each integrated circuit contains 4 channel memories. An internal ring counter allows continued switching from channel to channel. The IC's can be lined up in any number.

Concept

The concept is that already the first IC SAS 580 is a fully functioning unit which can be extended by adding further IC's. The number of channel memories per package resulted from the necessary functional extent and the number of pins at disposal. The DIL 18 package houses 4 channel memories. Picture 1 shows the block diagram of the SAS 580.

Each stage consists of a RS flipflop which is set either from input by input amplifier A_1 or in the ring counter function by amplifier A_2 . At the same time, a previously selected stage is reset via the coupling resistance R_c which is common to all stages.

The RS flipflop controls two switches. Switch S_1 switches the tuning voltage preselected with the potentiometer to the tuning output pin 11, switch S_2 sends a signal to the output for channel indication and band selection.

Instead of the ring counter amplifier A_2 , the SAS 580 contains in the first stage a switching stage which sets the IC automatically at the first stage after application of the supply voltage. The SAS 580 also contains an auxiliary circuit SB by means of which all inputs can be blocked (stand-by operation), and a current generator CG as common operating resistance for the separator amplifier OP's of all stages.

Realisation of switching functions

Picture 2 shows the circuit of one stage. The amplifiers A_1 and A_2 have two stages each (T_3, T_4 and T_1, T_2). The gain of A_1 is designed so that the memories can also be selected by bridging the key T_a with the finger. The RS flipflop is set by T_6 . This is maintained by T_7 . Since the voltage at the coupling resistance R_c is during the switching procedure higher than the holding voltage at T_7 , each switching procedure annuls an existing holding state.

The tuning switch S_1 and the indication switch S_2 are controlled by the holding circuit (T_8, T_9, R_7, R_8). The switch S_2 can supply a maximum current of 55 mA. By short-circuit between base and emitter (T_{11}), S_2 obtains a reverse voltage $V_{CES} \approx 60$ V.

Switching through of the tuning voltage

The switching through of the tuning voltage was subject to particular care during development.

For adjusting the tuners, voltages between .5 V and 28.5 V with low temperature drift are necessary. As shown in block diagram, picture 1, switching through is carried out by means of operational amplifiers as impedance transformer circuit. A small input current and a low output impedance are the advantages of this circuit. The current source CG serves as operating resistance for the amplifiers of all stages, even for those of further components.

By selecting a memory, the respective operational amplifier is connected to the operating resistance. Operational amplifier and current source are adapted to each other so that the operational amplifier works with almost symmetrical currents. Differing V_{BE} -voltages and a resulting temperature drift are thus avoided.

Figure 3 shows the dimensions of the operational amplifier and the current source as well as the test circuit used for the drift tests carried out.

The resistance R_p corresponds to the potentiometer resistance. Tests were carried out with $R_p = 25$ k Ω , which corresponds to a 100 k Ω potentiometer in its most unfavourable position.

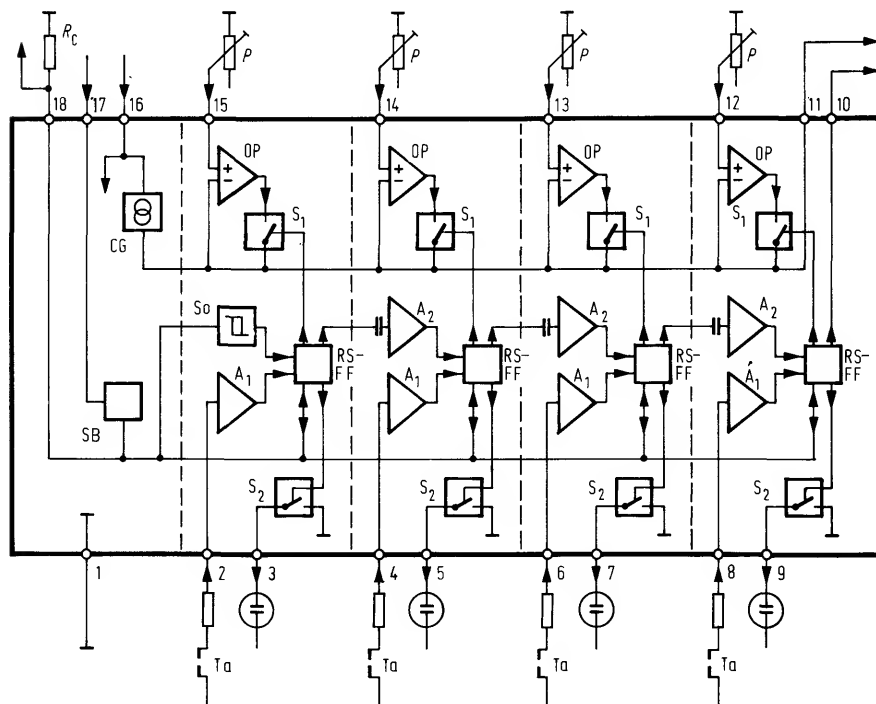
Figure 4 shows the test results in the interesting temperature range, represented as voltage difference between input and output. The test was carried out for different tuning voltages. As can be seen, the temperature drift is inferior.

The application

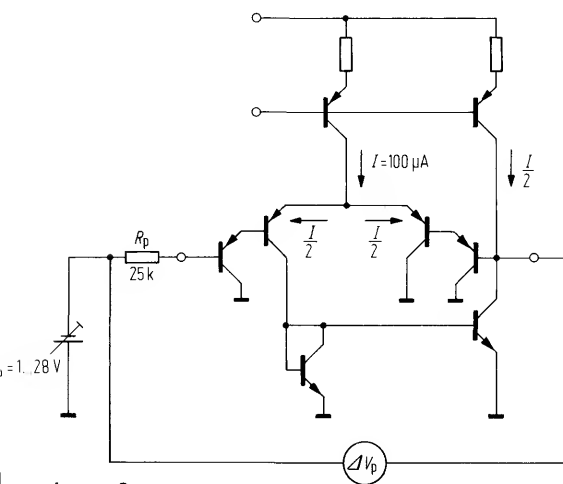
The described Integrated Circuits can be used in all cases where a channel selection 1-out of -n shall be carried out. They have been developed in consideration of the particular requirements of radio and TV sets. Figure 5, therefore, shows, as example of a typical application, a circuit for the selection of 8 channels in a TV sets. Each channel may, with the pre-selection switches, be assigned to all transmitting bands. The selected channel is indicated by a nixie tube. Continued switching from channel to channel is obtained by positive pulses to pin 18.

Figure 6 shows an application circuit for filamental lamps or LED's as indicating elements. The displays are in series to the band switches so that the diodes from application, figure 5, are not needed.

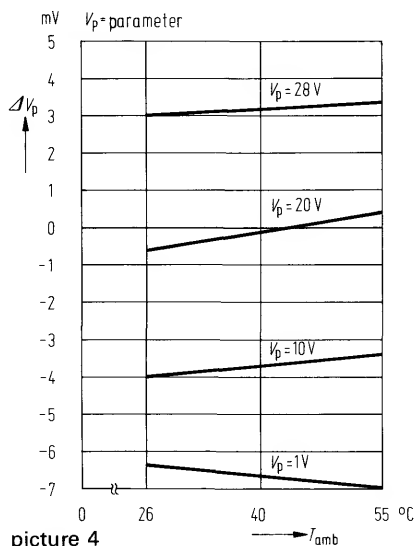
Block circuit diagram



picture 1

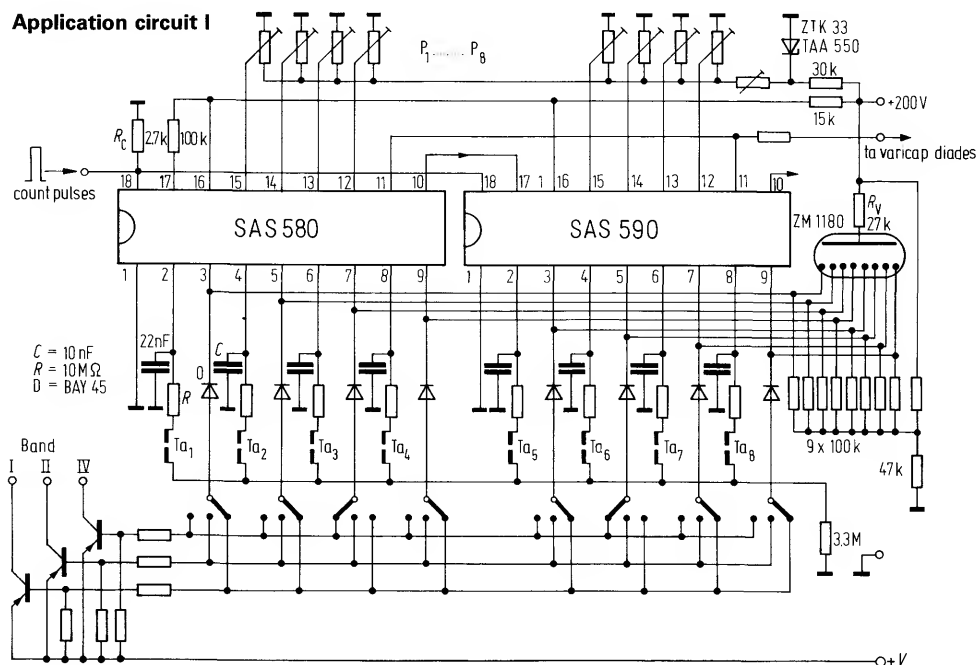


picture 3



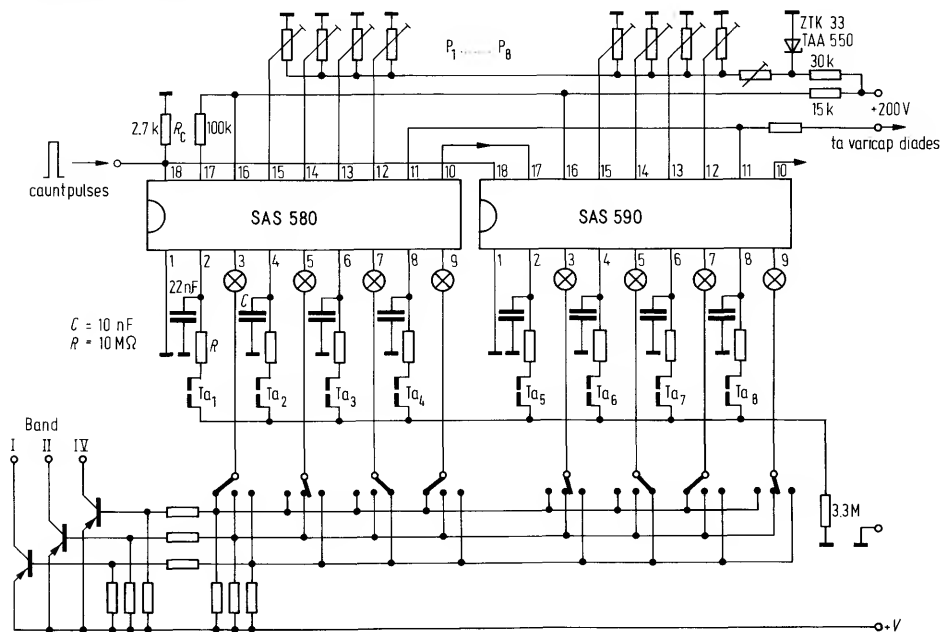
picture 4

Application circuit I



picture 5

Application circuit II



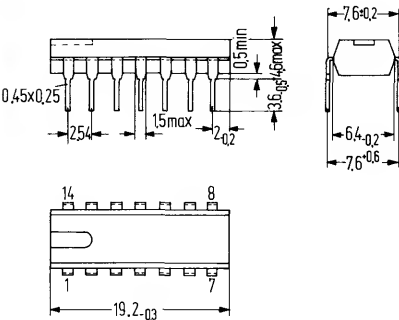
picture 6

S 041 is a symmetrical, six-stage amplifier with symmetrical coincidence demodulator for the amplification, limiting and demodulation of frequency-modulated signals. S 041 is particularly suited for sets where a low current consumption is of importance, or where major supply voltage fluctuations occur.
Pin connexions correspond to the well known TBA 120. However, pin 5 of S 041 P is not connected internally. The S 041 is especially suited for applications in narrow-band FM systems (455 kHz) and in usual FM IF systems (10.7 MHz).

Type	Ordering codes
S 041 P	Q67000-A529
S 041 E	Q67000-A694

Package outlines

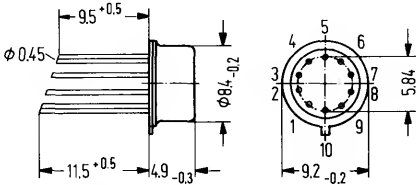
S 041 P



Plastic plug-in package
20 A 14 DIN 41866
14 pins, dual-in-line
Weight approx. 1.1 g

Dimensions in mm

S 041 E



Package 5 J 10 DIN 41873
(similar to TO 100)
10 pins
Weight approx. 1.1 g

Absolute maximum ratings

	S 041 P S 041 E	
Supply voltage	15	V
Storage temperature	-40 to +125	°C
Junction temperature	150	°C
Thermal resistance (system-air)		
S 041 P	120	°K/W
S 041 E	190	°K/W

Range of operation

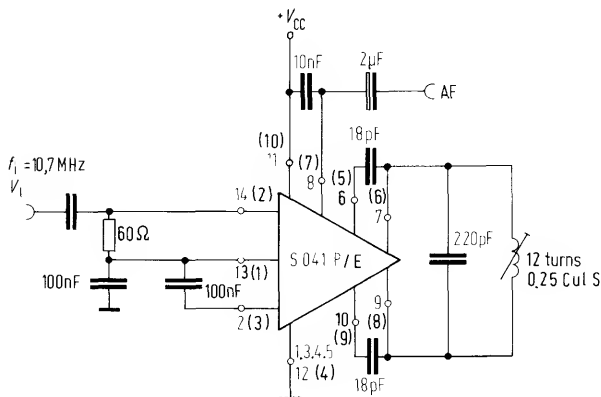
Supply voltage	4 to 15	V
Frequency range	0 to 35	V
Ambient temperature in operation	-25 to +85	°C

Electrical characteristics ($V_{cc} = 12\text{ V}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$)

	min	typ	max	
Total current consumption	I_{cc}	4.0	5.4	mA
IF voltage gain ($f_{IF} = 10.7\text{ MHz}$)	G_v	68	68	dB
IF output voltage at limiting (each output)	V_{θ} , V_{10pp}	130	130	mV
AF output voltage	V_{AFeff}	100	170	mV
($f_{IF} = 10.7\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$, $V_i = 10\text{ mV}$, $f_{mod} = 1\text{ kHz}$, $Q \approx 35$)				
Harmonic distortion	k	.55	1.0	%
($f_{IF} = 10.7\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$, $V_i = 10\text{ mV}$, $f_{mod} = 1\text{ kHz}$, $Q \approx 35$)				
Deviation of AF output voltage	ΔV_{AF}	1.5		dB
($V_{cc} = 15\text{ V} \rightarrow 4\text{ V}$, $f_{IF} = 10.7\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$, $f_{mod} = 1\text{ kHz}$)				
Input voltage for limiting	$V_{i\text{ lim}}$	30	60	μV
($f_{IF} = 10.7\text{ MHz}$, $\Delta f = \pm 50\text{ kHz}$, $V_i = 10\text{ mV}$, $f_{mod} = 1\text{ kHz}$, $Q \approx 35$)				
Input impedance for 10.7 MHz	Z_i	20/2		k Ω /pF
for 455 kHz	Z_i	50/4		k Ω /pF
Output resistance (pin 9)	R_q	5	8.5	k Ω
Voltage drop at AF ballast resistance	V_{11-8}	1.5		V
AM suppression	a_{AM}	60		dB
($V_i = 10\text{ mV}$, $\Delta f = \pm 50\text{ kHz}$, $m = 30\%$, $f_{mod} = 1\text{ kHz}$)				

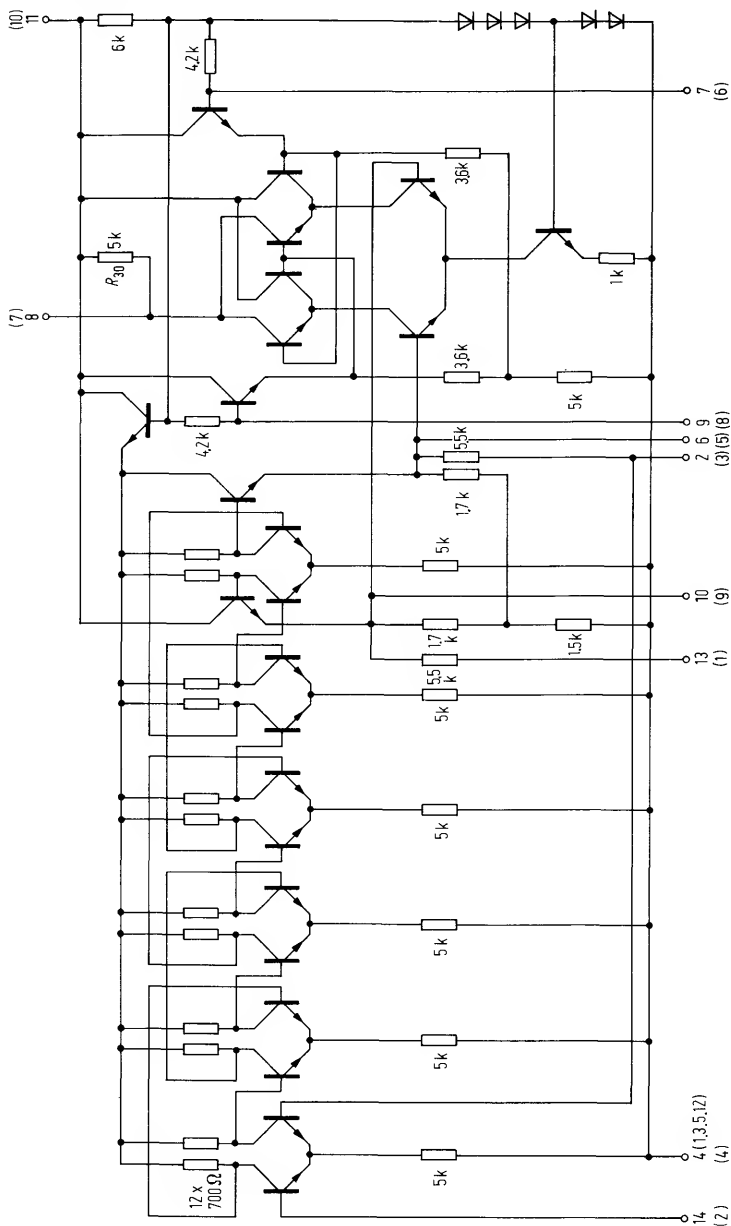
All connections mentioned in the index are referring to S 041 P (e.g. V_{11}).

Test circuit



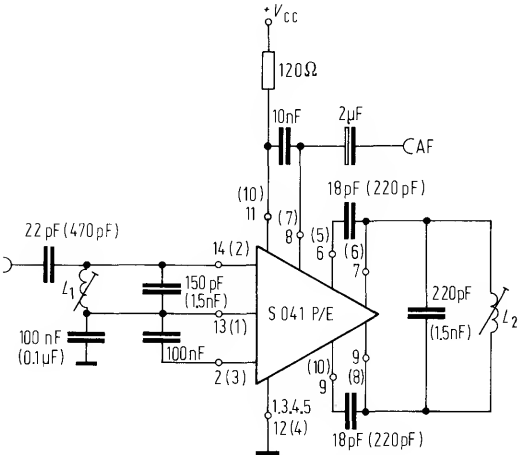
pin connections in brackets are for S 041 E

Circuit diagram



pin connections in brackets refer to S 041 E

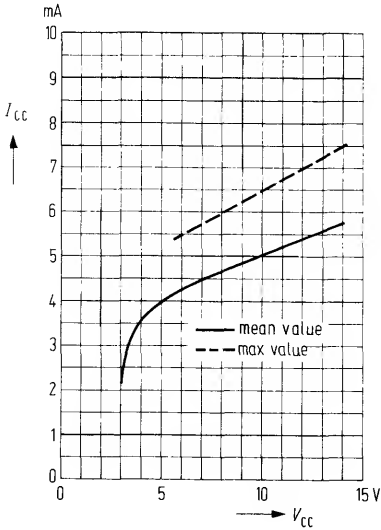
**Application circuit for 10.7 MHz (VHF-FM-IF)
and 455 kHz (narrow band FM)**



data in brackets for 455 kHz (narrow-band FM)
pin connections in brackets refer to S 041 E

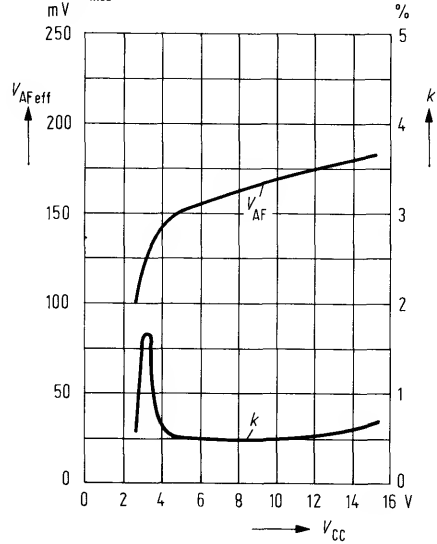
Coils	10.7 MHz	455 kHz
L ₁	15 turns/.15 CuLS	71.5 turns/12 × .04 CuLS
L ₂	12 turns/.25 CuLS	71.5 turns/12 × .04 CuLS
Coil set	D 41-2165	D 41-2393 of Messrs. Vogt

Current consumption versus supply voltage

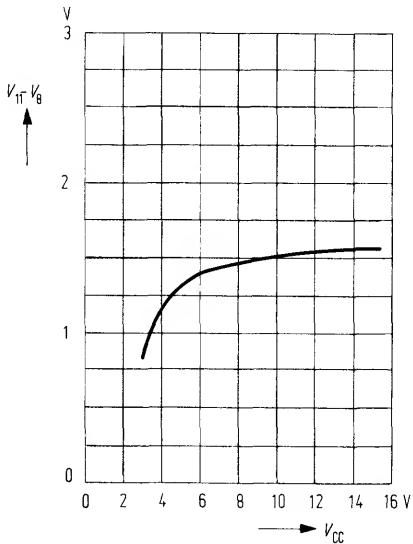


AF output voltage and harmonic distortion versus supply voltage

$f_{IF} = 10.7 \text{ MHz}$, $\Delta f = \pm 50 \text{ kHz}$,
 $f_{mod} = 1 \text{ kHz}$, $Q \approx 35$

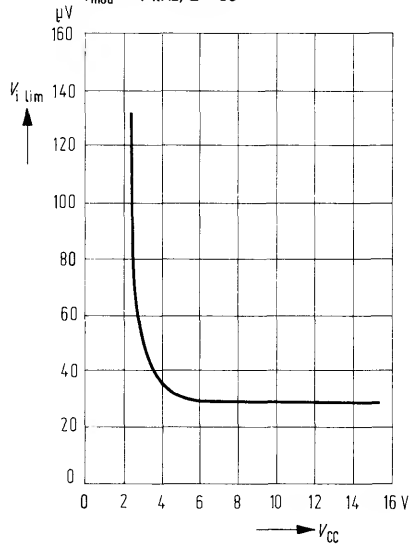


DC output voltage difference versus supply voltage (without signal)



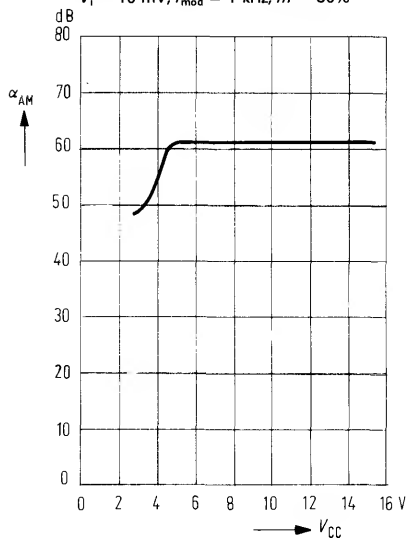
Input voltage for limiting versus supply voltage

$f_{IF} = 10.7 \text{ MHz}$, $\Delta f = \pm 50 \text{ kHz}$,
 $f_{mod} = 1 \text{ kHz}$, $Q \approx 35$



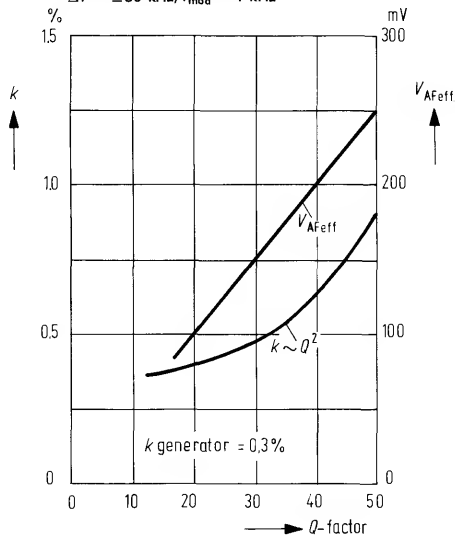
AM suppression versus supply voltage

$f_F = 10.7 \text{ MHz}$, $\Delta f = \pm 50 \text{ kHz}$,
 $V_i = 10 \text{ mV}$, $f_{\text{mod}} = 1 \text{ kHz}$, $m = 30\%$



AF output voltage and harmonic distortion versus Q-factor

$V_{CC} = 12 \text{ V}$, $f_F = 10.7 \text{ MHz}$,
 $\Delta f = \pm 50 \text{ kHz}$, $f_{\text{mod}} = 1 \text{ kHz}$



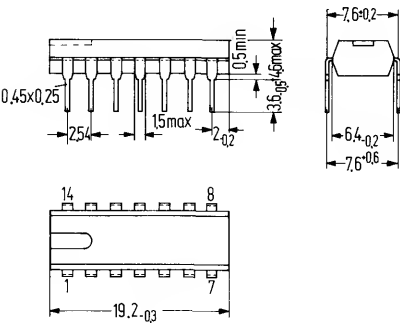
The S 042 is an universally applicable symmetrical mixer for frequencies up to 200 MHz. It can be driven from an external source or from the built-in oscillator. The input signals are suppressed at the outputs. In addition to the usual mixer applications in receivers, converters and demodulators for AM and FM, the S 042 can be used as an electrical polarity switch, multiplier etc.

- Wide range of supply voltage
- Numerous application possibilities
- Few external components
- High conversion transconductance
- Low noise figure

Type	Ordering codes
S 042 P	Q67000-A335
S 042 E	Q67000-A627

Package outlines

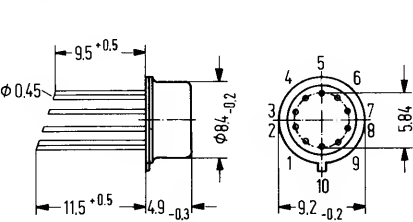
S 042 P



Plastic plug-in package
20 A 14 DIN 41866
14 pins, dual-in-line
Weight approx. 1.1 g

Dimensions in mm

S 042 E



Package 5 J 10 DIN 41873
(similar to TO 100)
10 pins
Weight approx. 1.1 g

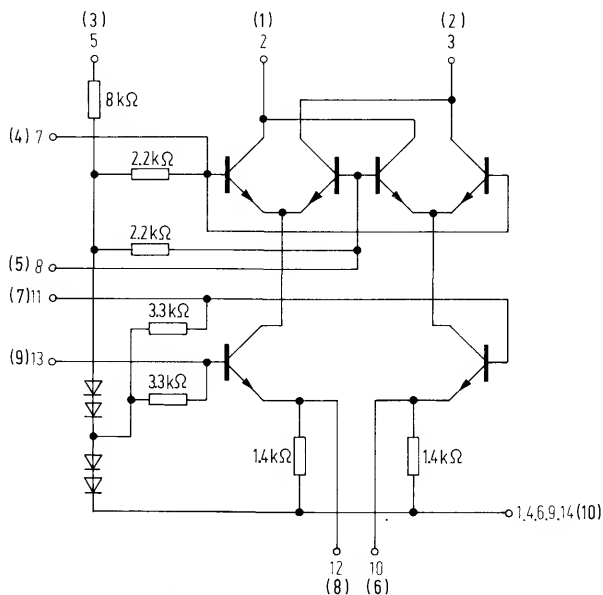
Absolute maximum ratings

	S 042 P S 042 E	
Supply voltage	15	V
Storage temperature	-40 to +125	°C
Junction temperature	150	°C
Thermal resistance S 042 P:	110	K/W
S 042 E:	190	K/W

Range of operation

Supply voltage	V _{cc}	4 to 15	V
Ambient temperature in operation	T _{amb}	-15 to +70	°C

Circuit diagram

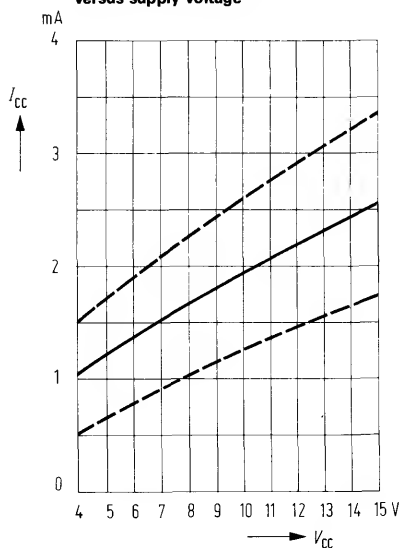


connections in brackets refer to S 042 E

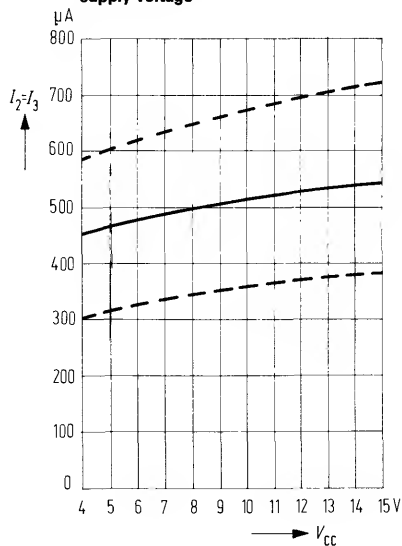
A galvanic connection between pins 7 and 8 and pins 11 and 13 through coupling windings is recommended.

Between pins 10 and 14 (ground) and between pins 12 and 14, a resistance of at least 200 Ω may be connected to increase the currents and therefore the conversion transconductance. Pins 10 and 12 may be connected through any impedance. In case of a direct connection between pins 10 and 12, the resistance from this pins to 14 must be at least 100 Ω . Depending on the layout, a capacitor (10 to 50 pF) may be required between pins 7 and 8 to prevent oscillations in the VHF band.

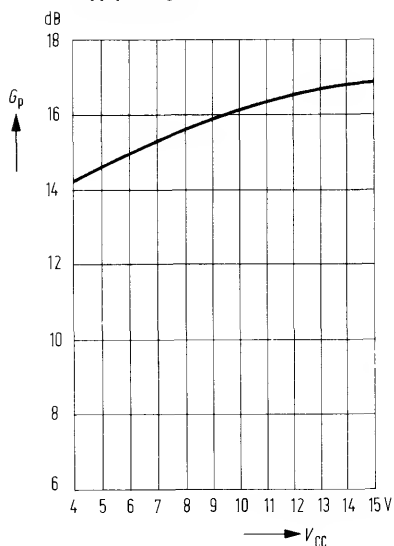
**Total current consumption
versus supply voltage**



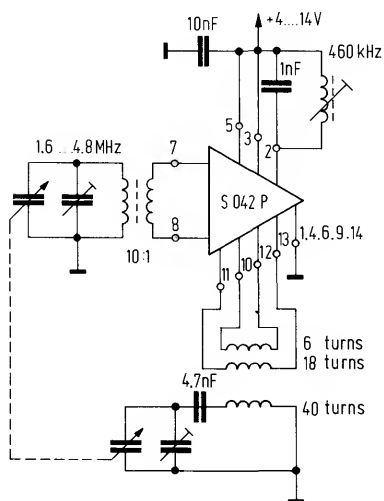
**Output voltages versus
supply voltage**



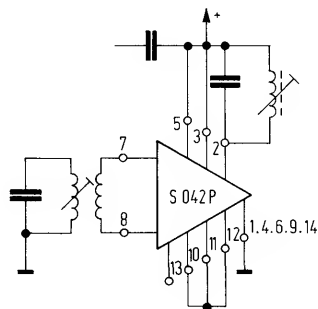
**Power gain versus
supply voltage**



**Mixer for short wave application
in self-oscillating operation**



**Differential amplifier with internal
neutralisation, also suited for limiting,
for frequencies up to 50 MHz, at
higher currents up to 100 MHz**



all pin connections refer to S 042 P

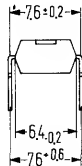
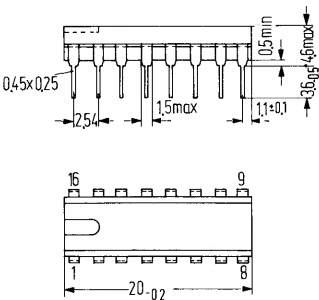
Integrated Circuit for Driving LED Lines (light spot display)

UAA 170

Integrated circuit for driving 16 light emitting diodes. By connecting two UAA 170 's in parallel 30 LED's can be driven. In analogy to the input voltage, the discrete LED's are forming at the output a light spot. With external circuitry (modification of R_4), the light transition can be arranged between "smooth" and "abrupt". The basic brightness of the LED's can be modified by ($R_7 + R_8$) or by a phototransistor.

Type	Ordering code
UAA 170	Q67000-A940

Package outlines



Plastic plug-in package
20 A 16 DIN 41866
16 pins, dual-in-line
Weight approx. 1.2 g
Dimensions in mm

Absolute maximum ratings

- Supply voltage
- Input voltages
- Load current
- Storage temperature
- Junction temperature
- Thermal resistance (system-air)

V_{10}	18	V
V_{11}, V_{12}, V_{13}	6	V
I_{14}	3	mA
T_s	-40 to +125	°C
T_j	150	°C
R_{thsa}	120	K/W

Range of operation

- Supply voltage
- Ambient temperature in operation

V_{10}	10.5 to 18 ¹⁾	V
T_{amb}	-25 to +85	°C

¹⁾ The lower limit is only valid for a forward voltage of the LED's of approx. 1.5 V; the lower limit increases according to higher forward voltage.

Electrical characteristics ($V_{10} = 12\text{ V}$; $T_{\text{amb}} 25\text{ }^{\circ}\text{C}$)

	min	typ	max	
Current consumption ($I_{14} = 0$; $I_{16} = 0$)		4	10	mA
Control input current			2	μA
Reference input current			3	μA
Voltage difference for smooth light transition		1.4		V
Voltage difference for abrupt light transition		4		V
Stabilized voltage $I_{14} = 300\text{ }\mu\text{A}$		5.0	6.0	V
$I_{14} = 5\text{ mA}$				V
Reference input voltage			6.0	V
			4.9	V
Voltage difference			6.0	V
Tolerance of forward voltages of LED's mutually			.5	V
Internal limited diode current for LED's			50	mA

The values of the resistances R_1 to R_5 can be varied in wide ranges provided that the relationships mentioned below are observed.

$$R_1 = R_5$$

$$R_3 \triangleq V_{\text{contr min}}$$

$$R_2 = R_3 + R_4$$

$$V_{\text{ref}} = V_{\text{contr max}}$$

Block circuit diagram

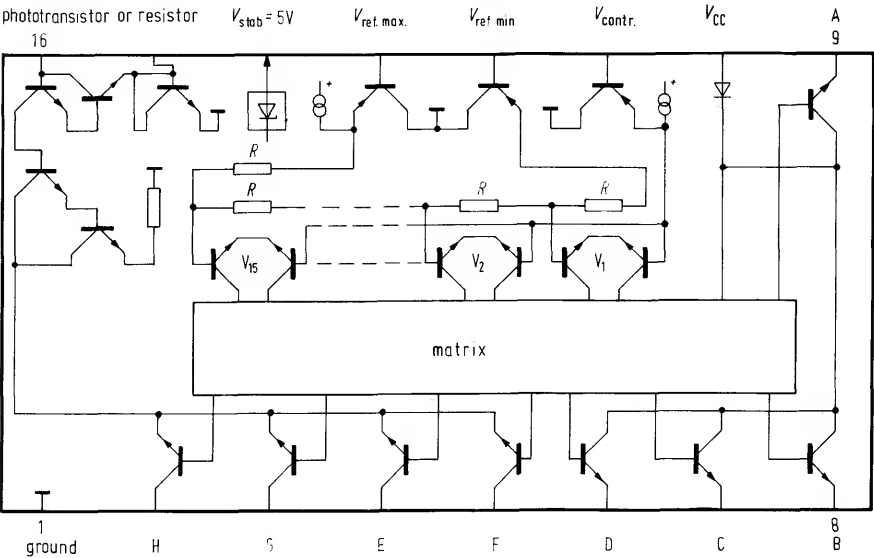


Figure 1

Application circuit

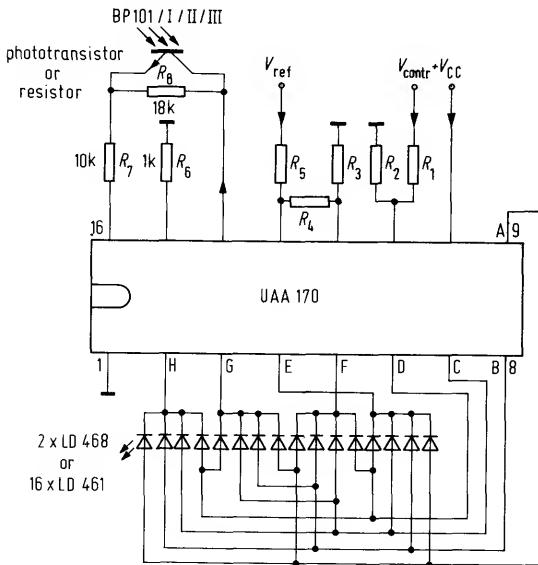


Figure 2

1. V_{contr} : e.g. tuning voltage for varicap diodes.
2. The voltage difference between pins 12 and 13 adjusted by R_1 to R_5 and V_{ref} corresponds to the range of the control voltage V_{contr} which is indicated by the diodes. The highest voltage indicated linear is determined by the voltage of pin 13, the lowest by the voltage of pin 12. If the control voltage rises above or falls below this range, either the first or the last diode lights up.
3. A stabilized voltage (approx. 5 V) is coming from pin 14 to pin 16 via a resistor. The size of the resistor is decisive for the diode current. If a phototransistor is used, the diode current is additionally controlled by ambient light.
4. If instead of 16 LED's only 4, 8, or 12 shall be used, this may be realized by switching a single LED with the cathode from plus voltage (pin 10) to H instead of a group of 4 LED's (e.g. to pin H). If two or three groups of four are replaced, pins G and/or E are connected in parallel to pin H.

Scale displays by means of a wandering light point are particularly suitable for indicating approximate values. Applications of this kind can be used for level sensors, VU-meters, tachometers, radio scales etc. When using the displays in measuring equipment, multicoloured luminescence diodes are offering as range limitation. Ring scales are obtained by a circular arrangement of the diodes. The IC UAA 170 has especially been developed for driving a scale of 16 luminescence diodes. The circuitry of the component is shown in figure 2. The input voltages at pins 11, 12 and 13 are freely selectable in the range between 0 and 6 V. Any kind of adjustment, as for instance to 18 V, is enabled by suitable voltage dividers. The D. C. value V_{contr} is always assigned to a certain spot of the diode chain. The voltage difference ΔV_{contr} for switching from one to the next LED is adjustable by means of the reference voltage V_{ref} and the respective voltage divider R_3, R_4, R_5 . The voltage difference between pins 12 and 13 corresponds thereby to the possible indication range. $\Delta V_{12/13}$ defines at the same time the light transition between two diodes. With $\Delta V_{12/13} \sim 1.4$ V, the light point glides smooth along the scale. With increasing voltage difference, the passage becomes more abrupt. With $\Delta V_{12/13} \sim 4$ V, the light point jumps from diode to diode.

Input voltages beyond the selected indication range cause the diodes D_1 and/or D_{16} to light up so that only an exceeding of the range is recognized. The actual value can only be measured at transition from D_1 to D_2 . The value recognition disappears with the transition from D_{15} to D_{16} . The relationship between the control voltage and the reference voltage can be determined simply by choosing identical voltage dividers at pins 11, 12 and 13.

Provided that $R_2 = R_3 + R_4$, the following is valid:

1.
$$\frac{V_{\text{ref}}}{\Delta V_{12/13}} = \frac{R_3 + R_4 + R_5}{R_4}$$
2.
$$\frac{V_{\text{ref}}}{V_{\text{contr min}}} = \frac{R_3 + R_4}{R_3} = 1 + \frac{R_4}{R_3}$$
3. $V_{\text{contr max}} = V_{\text{ref}}$
4. $V_{\text{cc}} = 18$ V

From 3. results that maximum control voltage and reference voltage must be equal, i.e. $V_{\text{contr max}} = 18$ V = V_{ref} . The desired voltage difference ΔV_{contr} for transition to the next diode determines the minimum control voltage as follows $V_{\text{contr min}} = V_{\text{contr max}} - 15 \Delta V_{\text{contr}}$. If ΔV_{contr} is e.g. 1 V, then $V_{\text{contr min}} = 3$ V. Thus the relationships are:

with gliding point ($\Delta V_{12/13} = 1.2$ V):

$$\frac{R_3 + R_4 + R_5}{R_4} = \frac{18}{1.2} = 15$$

$$\frac{R_4}{R_3} = \frac{18}{3} - 1 = 5$$

with jumping point ($\Delta V_{12/13} = 4$ V):

$$\frac{R_3 + R_4 + R_5}{R_4} = \frac{18}{4} = 4.5$$

$$\frac{R_4}{R_3} = \frac{18}{3} - 1 = 5$$

The divider current I shall be measured so that the influence of the input current of the UAA 170 of some μA can be neglected. A good approximate value is $I \approx 100 \mu\text{A}$ or $R_3 + R_4 + R_5 \approx 150$ k Ω .

In consideration of the nearest standard values, the following is valid:

for gliding point (figure 2):

$$\begin{aligned} R_4 &= 10 \text{ k}\Omega \\ R_3 &= 2 \text{ k}\Omega \\ R_2 &= 12 \text{ k}\Omega \\ R_1 &= 140 \text{ k}\Omega = R_5 \end{aligned}$$

for jumping point:

$$\begin{aligned} R_4 &= 33 \text{ k}\Omega \\ R_3 &= 5.6 \text{ k}\Omega \\ R_2 &= 39 \text{ k}\Omega \\ R_1 &= 110 \text{ k}\Omega = R_5 \end{aligned}$$

The indication is as follows:

Diode =	D ₁	D ₂	D ₃	D ₁₄	D ₁₅	D ₁₆
Value V_{contr} =	< 4	4	5	16	17	> 17 V

Pins 14, 15, and 16 serve to determine the diode current. Corresponding to the desired light intensity, the forward current of the diodes is variable linear in the range $I_f \approx 0$ to 50 mA. The resistance $R_6 = 1 \text{ k}\Omega$ at pin 15 defines the adjusting range. A resistance ($R_7 + R_8$) between pin 14 and pin 16 determines the current. Figure 2 shows the possibility of rendering this resistance adjustable by means of a phototransistor BP 101 in order to adapt the light intensity to changing ambient brightness. The adjusting range of the diode current lies between $I_f \approx 5 \text{ mA}$ (BP 101 not lighted) and $I_f \approx 50 \text{ mA}$ (BP 101 fully lighted). Without phototransistor suffices a fixed resistance which must have approx. $10 \text{ k}\Omega$ with a diode current $I_f \approx 50 \text{ mA}$ and approx. $40 \text{ k}\Omega$ with $I_f \approx 0$.

Application circuit for the control of 30 LED's with 2 × UAA 170

Range of control voltage $V_{\text{contr}} = 0$ to 5 V

Voltage difference $V_{12-13} = 2 \times 1.2 \text{ V} = 2.4$

Since the diodes D_{16} and D_{17} are permanently lighting up, when the maximum or minimum voltages adjusted by R_3, R_4, R_5 are exceeded or lower values are reached, the diodes should be covered.

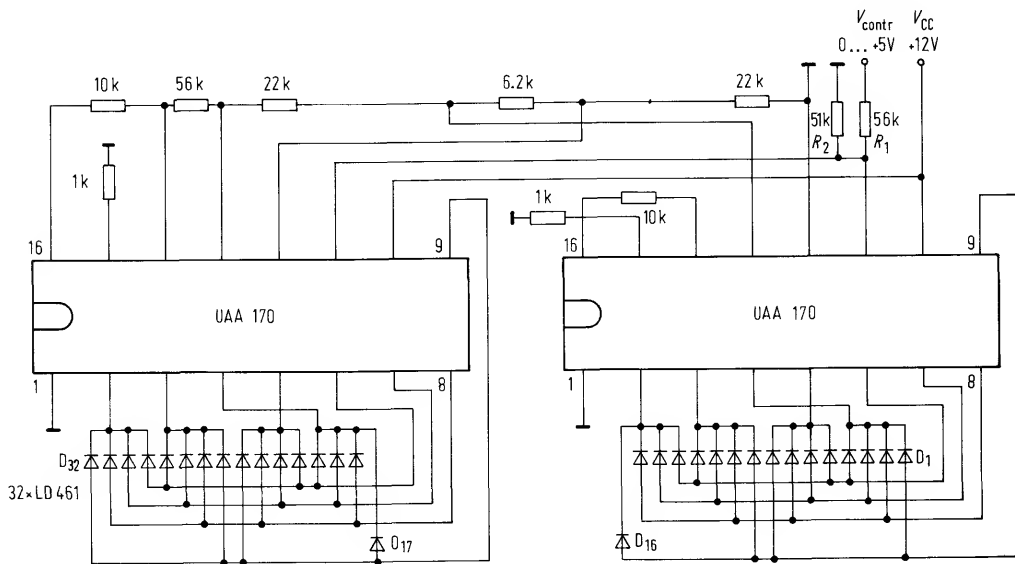


Figure 3

Figure 3 shows an extension of the circuit to 30 diodes with 2 UAA 170. The diodes D_{16} or D_{17} light permanently, when the reciprocal absolute ratings are exceeded. They should be covered. The reference voltage $\Delta V_{12/13} = 2 \times 1.2 = 2.4 \text{ V}$ is derived from a stabilized D. C. voltage of typ. 5 V available at pin 14. A resistance of $6.2 \text{ k}\Omega$ provides an overlapping of the ranges in order to ensure a smooth transition from D_{15} to D_{18} . The control voltage V_{contr} is fed to pins 11 parallel via a divider R_1, R_2 . The voltage divider is to be dimensioned according to the desired input voltage. With a divider current of $I = 100 \mu\text{A}$ and a control voltage of $V_{\text{contr}} = 10 \text{ V}$, the following is valid:

$$R_2 = \frac{\Delta U_{12/13}}{I} = \frac{2.4}{.1} = 24 \text{ k}\Omega \text{ and}$$

$$R_1 = \frac{U_{\text{contr}} - \Delta U_{12/13}}{I} = \frac{7.6}{.1} = 76 \text{ k}\Omega$$

The nearest standard value is $R_1 = 75 \text{ k}\Omega$. The voltage difference for switching one step is then $\Delta V_{\text{contr}} = \frac{10 \text{ V}}{30} = 0.16 \text{ V}$.

Integrated circuit for driving 12 light emitting diodes forming a light band, the length of which is directly proportional to a D.C. value V_{contr} switched to input 17, similar to a thermometer scale.

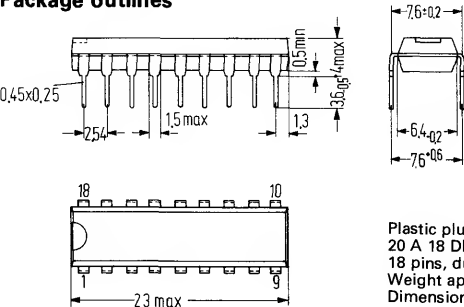
By external circuitry, the light passage between two adjacent LED's can be arranged between "smooth" and "jumping". The display range is determined by the resistors R_3 , R_4 , and R_5 .

The basic brightness is determined by the resistor R_7 (approx. 1 M Ω). In order to render the lighting of the diodes dependent on the ambient brightness, it is also possible to connect a phototransistor parallel to the resistor R_7 . Maximum brightness of the LED's is obtained by pin 2 open. Maximum brightness can be reduced in the voltage divider R_7/R_6 by means of R_6 .

With adequate external circuitry several IC's can be connected in series. With 2 IC's 24 LED's can be driven.

Type	Ordering code
UAA 180	Q67000-A1104

Package outlines



Plastic plug-in package
20 A 18 DIN 41866
18 pins, dual-in-line
Weight approx. 1.3 g
Dimensions in mm

Absolute maximum ratings

Supply voltage
Input voltages

Storage temperature
Junction temperature
Thermal resistance (system-air)

V_{18}	18	V
V_3	6	V
V_{16}	6	V
V_{17}	6	V
T_s	-40 to +125	°C
T_j	150	°C
R_{thsa}	120	K/W

Range of operation

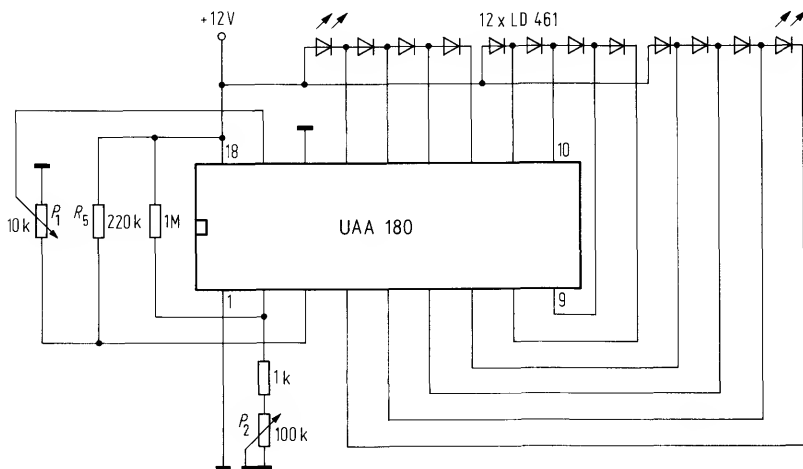
Supply voltage
Ambient temperature in operation

V_{18}	10 to 18	V
T_{amb}	-25 to +85	°C

Electrical characteristics ($V_{cc} = 12\text{ V}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$)

	min	typ	max	
Current consumption ($I_2 = 0$) (without LED current)		5.5	8.2	mA
Input currents		.3	1	μA
($V_3 - V_{16} < 2\text{ V}$)		.3	1	μA
		.3	1	μA
Voltage difference for smooth light transition		.9		V
Diode current per diode		10		mA
Tolerance of LED forward voltages			1.0	V

Test circuit



- P_1 light band test
 P_2 brightness test

Scale displays by means of a growing light band are particularly suitable for the measuring of approximate values. Applications of this kind can be used for level sensors, VU-meters, tachometers, field strength indicators etc. When using the displays in measuring equipment, multicoloured luminescence diodes are offering as range limitation. Ring scales are obtained by a circular arrangement of the diodes. The input voltages at pins 3, 16, and 17 are freely selectable in the range of 0 and 6 V. Suitable voltage dividers allow any possible adaptation, as e. g. to 18 V. The DC value V_{contr} is always assigned to a certain spot of the diode chain. The voltage difference for switching from one to the next LED is adjustable by means of the reference voltage V_{ref} and the respective voltage divider R_3, R_4, R_5 . The voltage difference between pins 16 and 3 corresponds thereby to the possible indication range. $\Delta V_{16/3}$ defines at the same time the light passage between two diodes. With $\Delta V_{16/3} \approx .9 \text{ V}$, the light band glides smoothly along the scale. With increasing voltage difference, the passage becomes more abrupt, until with $\Delta V_{16/3} \approx 4 \text{ V}$, the light band jumps from diode to diode. Input voltages beyond the selected display range cannot be determined. The actual value can only be measured during the passage from D1 to D2. The relationship between the control voltage and the reference voltage can be determined simply by choosing identical voltage dividers at pins 7, 6, and 3.

Provided that $R_2 = R_3 + R_4$, the following is valid:

1.
$$\frac{V_{\text{ref}}}{\Delta V_{16/3}} = \frac{R_3 + R_4 + R_5}{R_4}$$
2.
$$\frac{V_{\text{ref}}}{V_{\text{contr min}}} = \frac{R_3 + R_4}{R_3} = 1 + \frac{R_4}{R_3}$$
3.
$$V_{\text{contr max}} = U_{\text{ref}}$$
4.
$$V_{\text{cc}} = 18 \text{ V}$$

From 3. results that the maximum control voltage and reference voltage must be equal, i. e. for instance $V_{\text{contr max}} = 18 \text{ V} = V_{\text{ref}}$. The desired voltage difference V_{contr} for switching to the next diode determines the minimum control voltage as follows $V_{\text{contr min}} = V_{\text{contr max}} - 15 V_{\text{contr}}$. If ΔV_{contr} is e. g. 1 V, then follows $V_{\text{contr min}} = 3 \text{ V}$. Thus the resistance relationship are:

for gliding point:

$$\frac{R_3 + R_4 + R_5}{R_4} = \frac{18}{.9} = 20$$

$$\frac{R_4}{R_3} = \frac{18}{3} - 1 = 5$$

for jumping point ($V_{16/3} = 4 \text{ V}$)

$$\frac{R_3 + R_4 + R_5}{R_4} = \frac{18}{4} = 4.5$$

$$\frac{R_4}{R_3} = \frac{18}{3} - 1 = 5$$

The divider current shall be measured so that the influence of the input current of the UAA 180 of few μA remains neglectable. A good approximate value is $I \approx 100 \mu\text{A}$ and/or $R_3 + R_4 + R_5 \approx 150 \text{ k}$.

So, in consideration of the nearest standard values, the following is valid:

for **gliding** point:

$$\begin{aligned} R_4 &= 10 \text{ k}\Omega \\ R_3 &= 2 \text{ k}\Omega \\ R_2 &= 12 \text{ k}\Omega \\ R_1 &= 140 \text{ k}\Omega = R_5 \end{aligned}$$

for **jumping** point:

$$\begin{aligned} R_4 &= 33 \text{ k}\Omega \\ R_3 &= 5.6 \text{ k}\Omega \\ R_2 &= 39 \text{ k}\Omega \\ R_1 &= 110 \text{ k}\Omega = R_5 \end{aligned}$$

The display is as follows:

Diode	=	D1	D2	D3	D10	D11	D12
Value V_{contr}	=	< 4	4	5	16	17	> 17 V

Each quartet must consist of homogeneous diodes in order to ensure the function. Therefore, it is possible to provide the first and third quartet lighting red and the second quartet green in order to mark a working range.

Pin 2 serves to determine the diode current. Corresponding to the desired light intensity, the forward current of the diodes is variable linear in the range $I_f \approx 0$ to 10 mA. A resistance ($R_6 + R_7$) at pin 2 determines the current. Figure 3 shows the possibility of rendering this resistance adjustable by means of a phototransistor BP 101 in order to adapt the light intensity to changing ambient brightness. The adjusting range of the diode current lies between $I_f \approx 5$ mA (BP 101 not lighted) and $I_f \approx 10$ mA (BP 101 fully lighted). If pin 2 is open the diode current is 10 mA.

Figure 4 shows an extension of the circuit to 24 diodes with 2 UAA 180. The reference voltage is then

$$\Delta V_{16/3} = 2 \times .9 \text{ V} = 1.8 \text{ V}$$

The control voltage V_{contr} is supplied to pins 17 parallel via a divider $R_1 : R_2$. The voltage divider must be dimensioned according to the desired input voltage. If the divider current is $I = 100 \mu\text{A}$ and a control voltage of $V_{\text{contr}} = 10 \text{ V}$ is assumed, then follows:

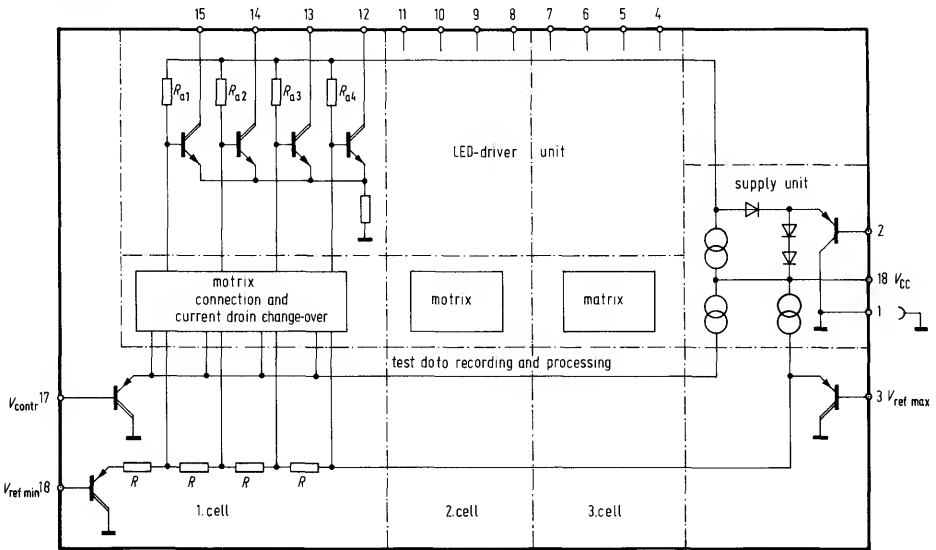
$$R_2 = \frac{\Delta V_{16/3}}{I} = \frac{1.8}{.1} = 18 \text{ k}\Omega \quad \text{and}$$

$$R_1 = \frac{V_{\text{contr}} - \Delta V_{16/3}}{I} = \frac{8.2}{.1} = 82 \text{ k}\Omega$$

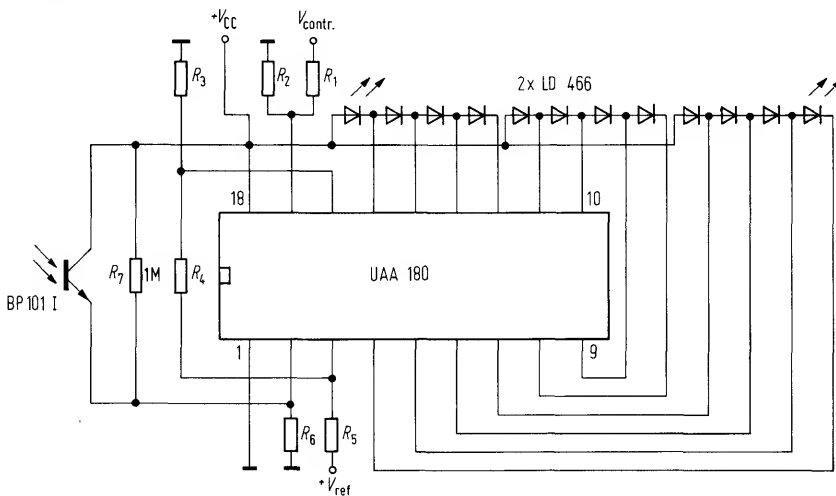
The voltage difference for switching on is then

$$\Delta V_{\text{contr}} = \frac{10 \text{ V}}{24} = .42 \text{ V}.$$

Block diagram



Application circuit



Proposal for a smooth light transition:

- $R_3 = 2.2\ k\Omega$
- $R_4 = 10\ k\Omega$
- $R_5 = 150\ k\Omega$
- $R_6 = 2.2\ k\Omega \dots 100\ k\Omega$

Application circuit for cascading several UAA 180 (up to 7)

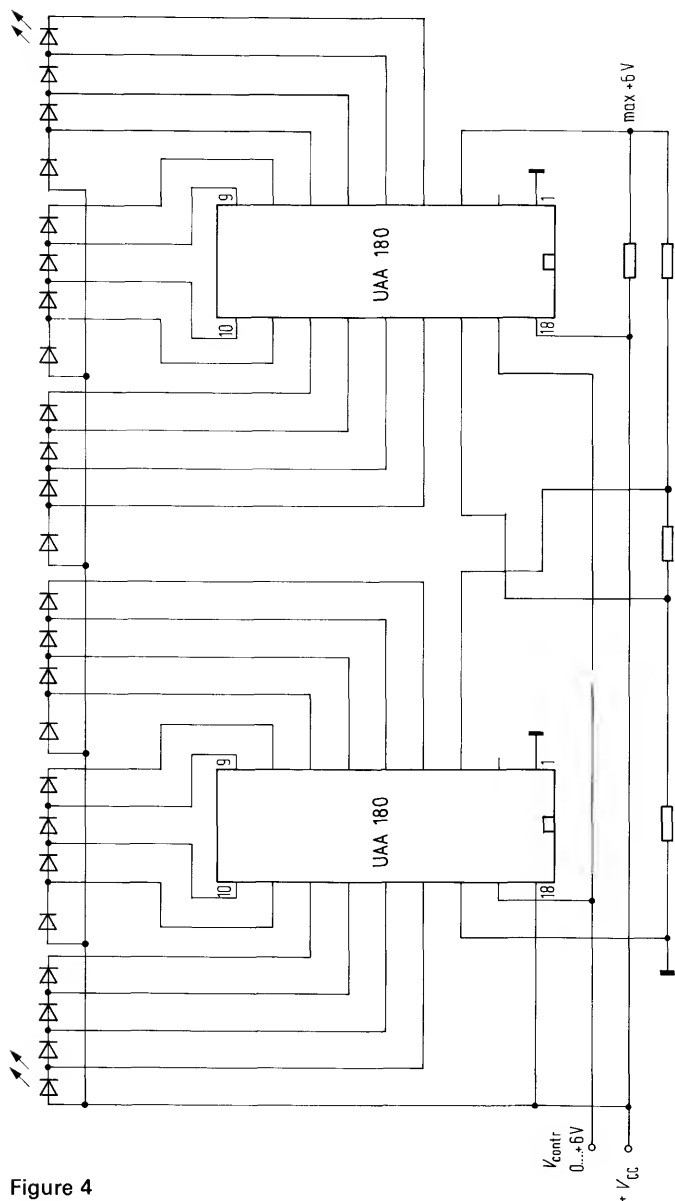
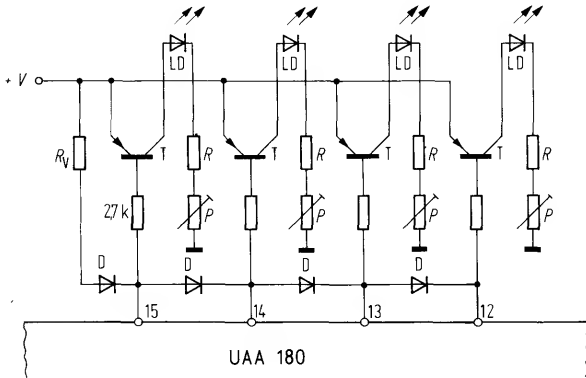


Figure 4

Application circuit
for driving filamental lamps
or LED's with higher current consumption

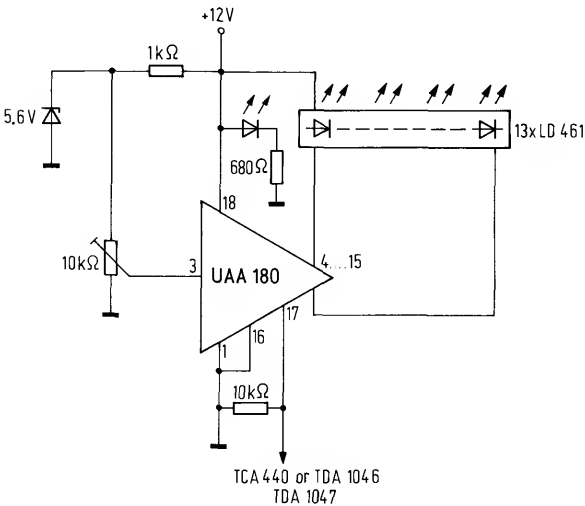


an example:

+V = 12 V
LD = LD 50 (max 100 mA)
 $R = 1 \text{ k}\Omega$
 $P = 5 \text{ k}\Omega$
 $R_v = 22 \Omega$

D: BA 127
T: according to required current e.g.
BC 308
BC 328
 $R+P$: current setting

Application circuit for field strength indication



TCA 440 or TDA 1046
TDA 1047

Analog Integrated Circuits for Industrial Applications

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▼ New type

Preface on Operational Amplifiers

Integrated operational amplifiers are dc-amplifiers with a very broad range of applications in automatic control systems, industrial electronics and the audio frequency area.

1. Symbols and terms used

The logic symbol "operational amplifier" shows only signal inputs and outputs. Figure 1 shows the symbol used, with an inverting input 1, a non-inverting input 2 and output 3. A positive signal at "1" results in a negative signal at output 3.

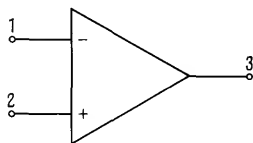


Fig. 1

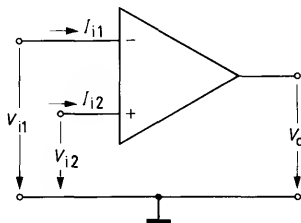


Fig. 2

Definitions of the most important terms generally used to characterize an operational amplifier are listed below. All definitions refer to symmetrical supply voltages.

- a) Input offset voltage V_{io} is the dc voltage which must be applied between the input terminals to force the quiescent dc output voltage to 0V (Fig. 2).

$$V_{io} = V_{i1} - V_{i2} \text{ at } V_q = 0 \text{ and generator resistance } R_g = 50 \Omega.$$

- b) Input current I_i is the current required for the operation of the OP (Fig. 2).

$$I_i = \frac{I_{i1} + I_{i2}}{2}$$

- c) Input offset current I_{io} is the difference between the currents into the two input terminals with the output at zero volts. At high values of generator resistance I_{io} can cause difficulties (Fig. 2).

$$I_{io} = I_{i1} - I_{i2} \text{ at } V_q = 0.$$

- d) Open-loop voltage gain G_v is the voltage gain without negative feedback from the output to the input (Fig. 3).

$$G_v = \frac{V_q}{V_i}$$

- e) Common-mode voltage gain G_{vcm} is the voltage gain resulting when an identical signal is simultaneously applied to both inputs (Fig. 4).

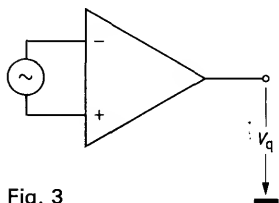


Fig. 3

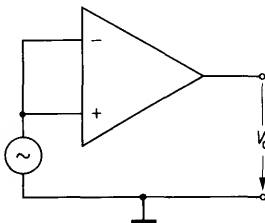
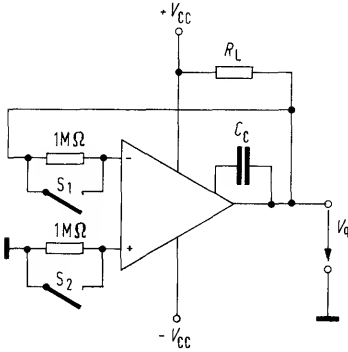


Fig. 4

2. Test Circuits for operational amplifiers

Input current, Input offset current.



S1 open – S2 closed.

$$I_{I-} = \frac{V_q}{1 \text{ M}\Omega}$$

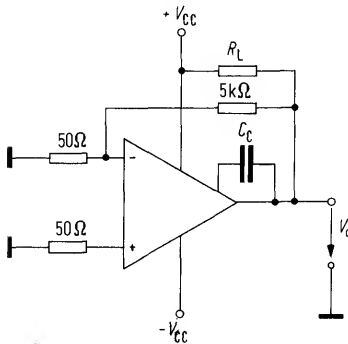
S2 open – S1 closed

$$I_{I+} = \frac{V_q}{1 \text{ M}\Omega}$$

S1 + S2 open

$$I_{I0} \approx \frac{V_q}{1 \text{ M}\Omega}$$

Input offset voltage

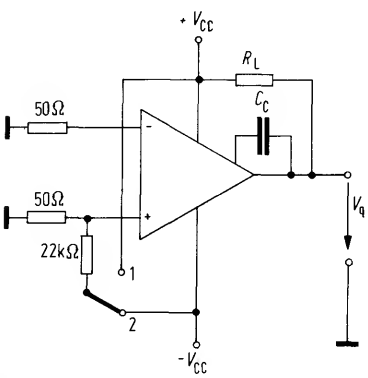


$$V_{io} = V_{qo}/G_v$$

$$G_v \approx 100$$

$$V_{io} = \frac{V_{qo}}{100}$$

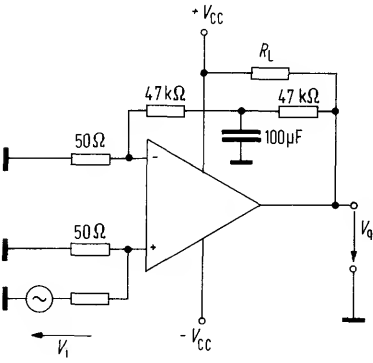
Output voltage



S in position 1. $V_q = V_{qL}$

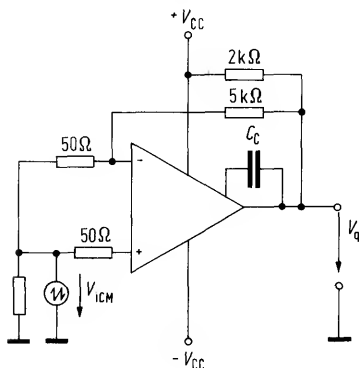
S in position 2. $V_q = V_{qH}$

Open loop voltage gain ($f = 1\text{ kHz}$)



$$G_v = 20 \log \left(\frac{V_q}{V_i} \right) \text{ [dB]}$$

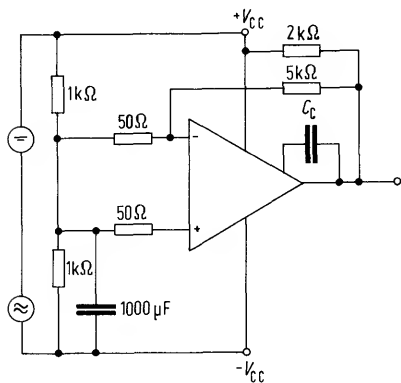
Common mode rejection ratio



$$G_{VCM} = \frac{\Delta V_o}{\Delta V_{ICM}}$$

$$CMRR = 20 \log \frac{V_o}{V_{ICM}} \text{ [dB]}$$

Sensitivity to supply voltage variations

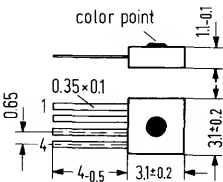


$$\frac{\Delta V_{io}}{\Delta V_{cc}} = \frac{\Delta V_{qo}}{100 \times \Delta V_{cc}}$$

The integrated circuit TAA 131 is especially well suited for small battery-operated sets.

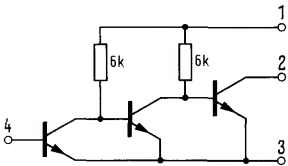
Type	Ordering code
TAA 131	Q61901-A131

Package outlines



Plastic coating (U 38)
Weight approx. .2 g
Dimensions in mm

Circuit diagram



Absolute maximum ratings

Supply voltage
Output collector current
Junction temperature
Storage temperature
Thermal resistance (air-system)

V_{cc}	5	V
I_2	12	mA
T_j	150	°C
T_s	-40 to +125	°C
R_{thSamb}	≤ 600	K/W

Range of operation

Supply voltage
Ambient temperature in operation

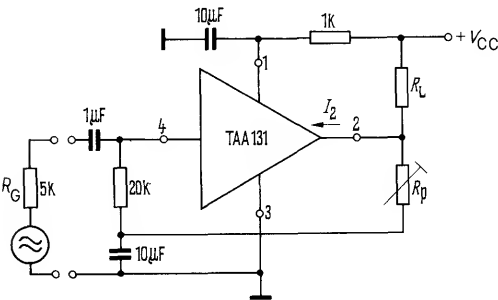
V_{CC}	1.3 to 5	V
T_{amb}	-20 to +70	°C

Electrical characteristics $T_{amb} = 25^{\circ}\text{C}$
(Referring to the test circuit)

Pot.-resistance
Supply current ($V_{cc} = 1.3\text{ V}$)
Voltage gain ($f = 1\text{ kHz}$)
Harmonic distortion
($V_{q\text{ eff}} = .1\text{ V}$, $f = 1\text{ kHz}$)
Lower cutoff frequency (-3 db)
Upper cutoff frequency (-3 db)
Noise voltage
(referred to the input,
DIN 45405, $R_G = 5\text{ k}\Omega$)

	min	typ	max	
R_p	40	400	1000	$\text{k}\Omega$
I_{cc}			1.2	mA
G_v	50	57		dB
k			10	%
f_l			40	Hz
f_u	20			kHz
V_n			5	μV

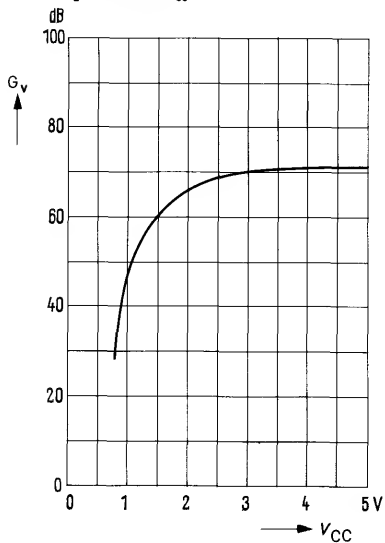
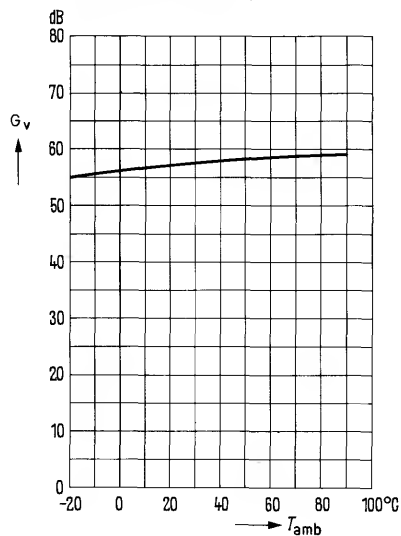
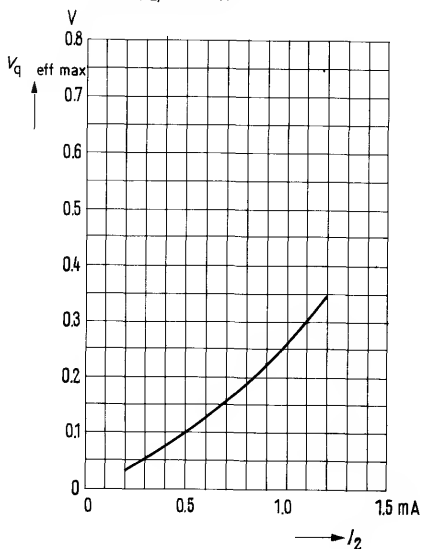
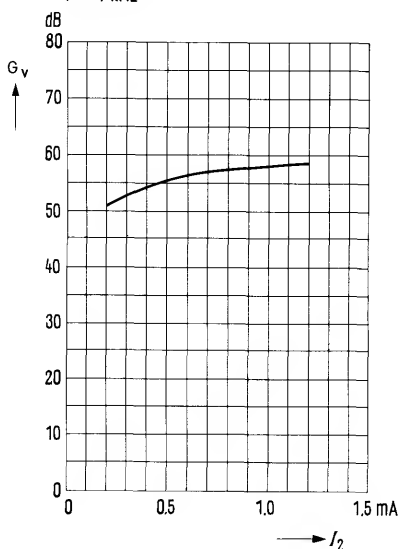
Test circuit



$V_{cc} = 1.3\text{ V}$
 $R_L = 500\ \Omega$
Using R_p adjuste I_2 to .75 mA

Voltage gain v. supply voltage $f = 1 \text{ kHz}$, $R_L = 500 \Omega$

Quiescent point set to

 $I_2 = .75 \text{ mA}/V_{CC} = 1.3 \text{ V}$ **Voltage gain v. amb. temperature** $V_{CC} = 1.3 \text{ V}$, $R_L = 500 \Omega$, $f = 1 \text{ kHz}$ Quiescent point set to $I_2 = .75 \text{ mA}$ at $T_{amb} = 25^\circ \text{C}$, using R_p **Output voltage v. current I_2** $V_{CC} = 1.3 \text{ V}$, $R_L = 500 \Omega$, $f = 1 \text{ kHz}$, $k = 10\%$ **Voltage gain v. current I_2** $V_{CC} = 1.3 \text{ V}$, $R_L = 500 \Omega$, $f = 1 \text{ kHz}$ 

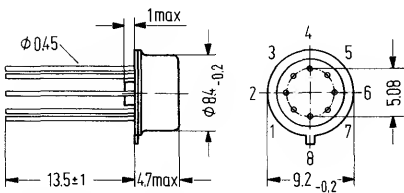
The integrated circuits TAA 521, TAA 521 A and TAA 522 are integrated operational amplifiers for demanding applications. These are exceptionally well suited for industrial applications such as servo-systems, analog computers, measuring equipment etc. The frequency response can be adjusted by external circuits.

- High-resistance symmetrical input
- Low-resistance single-ended output
- Excellent temperature stability
- High common mode rejection

Type	Ordering codes
TAA 521	Q67000-A3
TAA 521 A	Q67000-A164
TAA 522	Q67000-A84

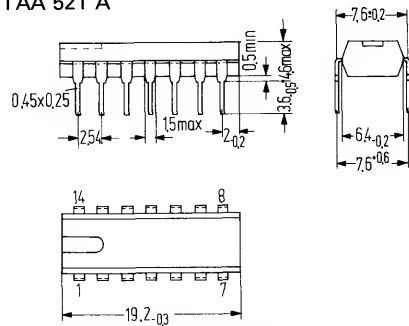
Package outlines

TAA 521, TAA 522



Package similar to 5 G 8 DIN 41873
(similar T0-99)
Weight approx. 1.1 g
Pin 4 is electrically connected to case

TAA 521 A



Plastic plug-in package (14 pins)
20 A 14 DIN 41866 (T0-116)
Weight approx. 1.1 g

Dimensions in mm

Maximum ratings

Supply voltages
Differential input voltage
Input voltage
Output short circuit duration
Storage temperature
Junction temperature
Thermal resistance:
 System-ambient air
 System-Case

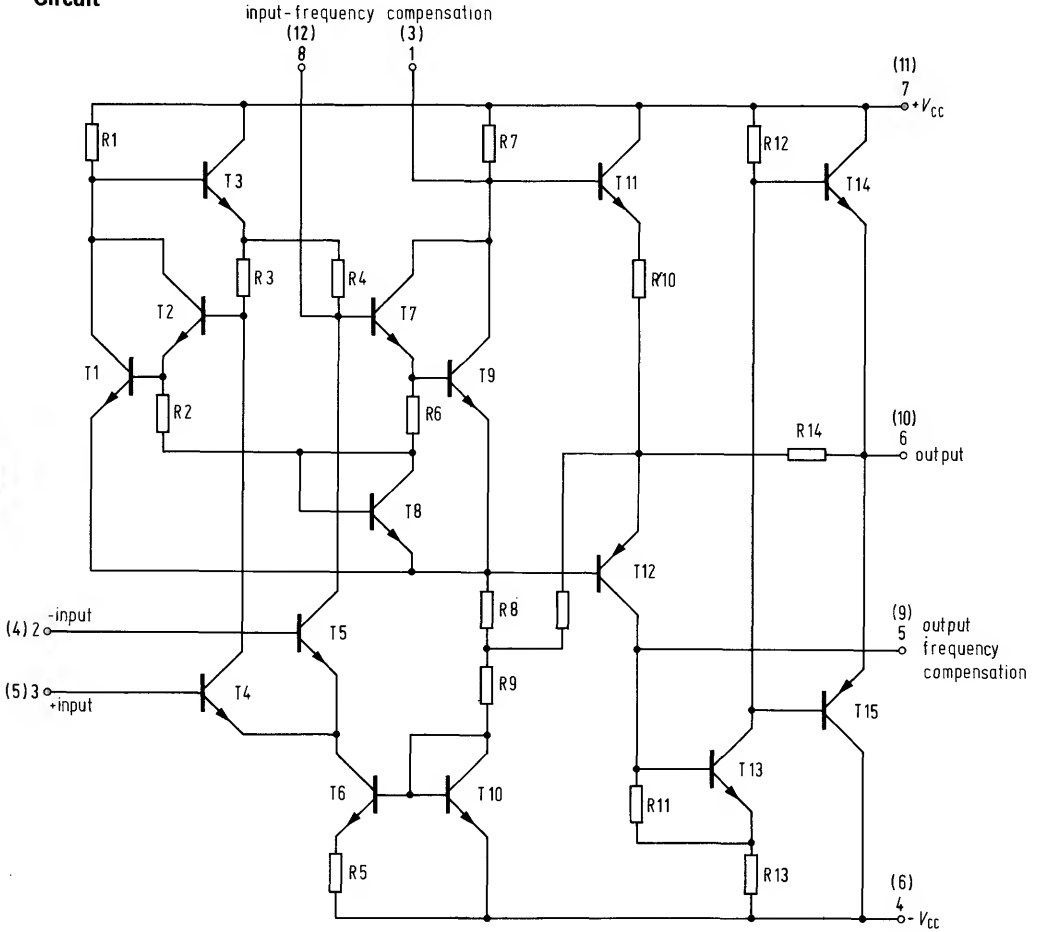
	TAA 521 TAA 521 A	TAA 522	
V_{CC}	± 18	± 18	V
V_{ID}	± 5	± 5	V
V_I	± 10	± 10	V
	5	5	s
T_S	-55 to +150	-65 to +150	°C
T_j	150	150	°C
R_{thSamb}	190/120	190	K/W
$R_{thScase}$	80/-	80	K/W

Range of operation

Supply voltage
Ambient temperature in operation

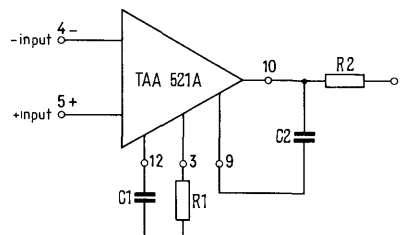
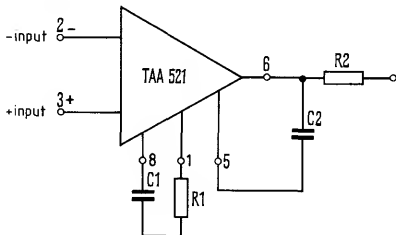
V_{CC}	10 to 18	10 to 18	V
T_{amb}	0 to +70	-55 to +125	°C

Circuit



Numbers in brackets refer to TAA 521A

Frequency compensating circuit: $R2 = 50 \Omega$ for capacitive loads



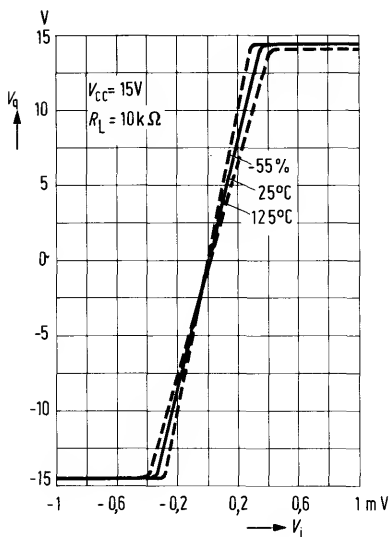
Operating characteristics

$V_{CC} = \pm 15 \text{ V}$, $T_{amb} = 25^\circ\text{C}$

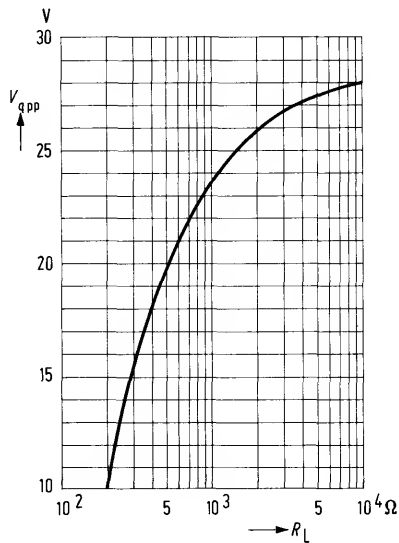
unless stated otherwise

		TAA 521 TAA 521 A			TAA 522		
		min	typ	max	min	typ	max
Power consumption (no load, no signal)	P_{tot}		80	200		80	165
Input offset voltage ($R_G < 10 \text{ k}\Omega$)	V_{io}	-7.5	± 2	7.5	-5	± 1	5
($T_{amb} = 0 \text{ to } 70^\circ\text{C}$)	V_{io}	-10		10	-6		6
Input offset current ($T_{amb} = 0 \text{ to } 70^\circ\text{C}$)	I_{io}	-500	± 100	500	-200	± 50	200
($T_{amb} = -55 \text{ to } +125^\circ\text{C}$)	I_{io}	-750		750			
Input current ($T_{amb} = 0 \text{ to } 70^\circ\text{C}$)	I_i		.3	1.5		± 20	200
($T_{amb} = -55 \text{ to } +125^\circ\text{C}$)	I_i			2.0		.2	.5
Input impedance ($T_{amb} = -55 \text{ to } +125^\circ\text{C}$)	Z_i	50	250		150	500	1500
Output voltage ($R_L > 10 \text{ k}\Omega$)	V_{opp}	12	± 14	-12			
($R_L > 10 \text{ k}\Omega$, $T_{amb} = -55 \text{ to } +125^\circ\text{C}$)	V_{opp}				12	± 14	-12
($R_L > 2 \text{ k}\Omega$, $T_{amb} = -55 \text{ to } +125^\circ\text{C}$)	V_{opp}	10	± 13	-10			
Output impedance	Z_q		150		10	± 13	-10
Voltage gain ($V_{qpp} = \pm 10 \text{ V}$, $R_L = 2 \text{ k}\Omega$)	G_v	83.6	93				
($V_{qpp} = \pm 10 \text{ V}$, $R_L = 2 \text{ k}\Omega$, $T_{amb} = 0 \text{ to } 70^\circ\text{C}$)	G_v	81.5					
($V_{qpp} = \pm 10 \text{ V}$, $R_L > 2 \text{ k}\Omega$, $T_{amb} = -55 \text{ to } +125^\circ\text{C}$)	G_v				88	93	
Common mode rejection ratio ($R_G < 10 \text{ k}\Omega$)	$CMRR$	65	90		70	90	
Average temperature coefficient of input offset voltage ($R_G < 10 \text{ k}\Omega$, $T_{amb} = 0 \text{ to } 70^\circ\text{C}$)	α_{Vio}		10				
($R_G = 50 \Omega$, $T_{amb} = -55 \text{ to } +125^\circ\text{C}$)	α_{Vio}					3	
($R_G < 10 \text{ k}\Omega$, $T_{amb} = -55 \text{ to } +125^\circ\text{C}$)	α_{Vio}					6	
Input common mode range	V_{iCM}	± 8	± 10		± 8	± 10	
Sensitivity to supply voltage variations	$\frac{\Delta V_{io}}{\Delta V_{CC}}$		25	200		25	200
Rise time of V_q	$\frac{dV_q}{dt_r}$		.3			.3	

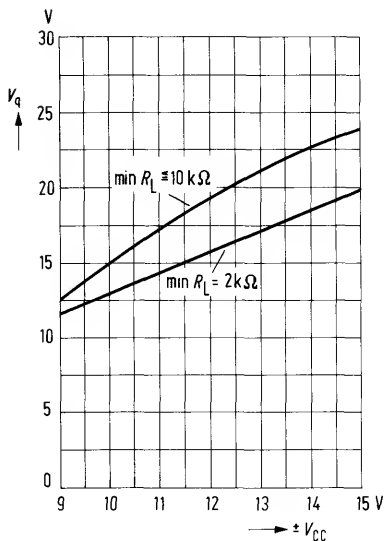
Transfer characteristic $V_q = f(V_i)$



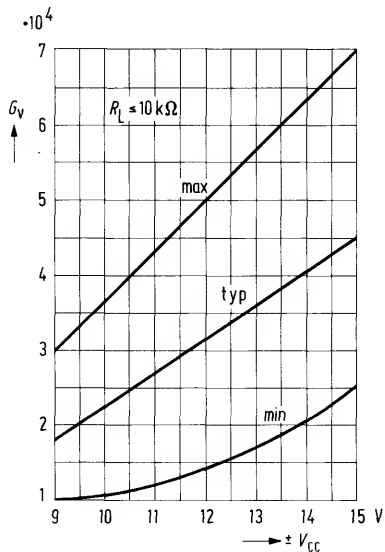
Output voltage $V_{app} = f(R_L)$



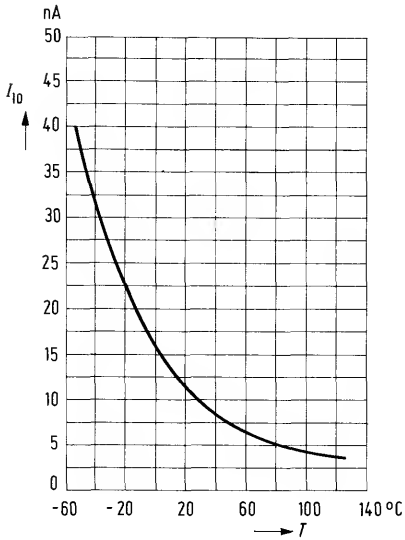
PP-output voltage $V_q = f(V_{CC})$



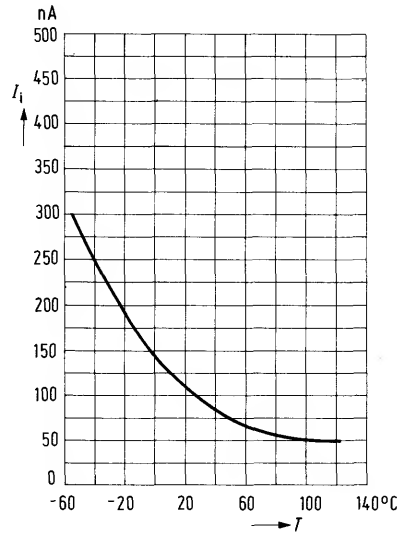
Open loop voltage gain $G_v = f(V_{CC})$



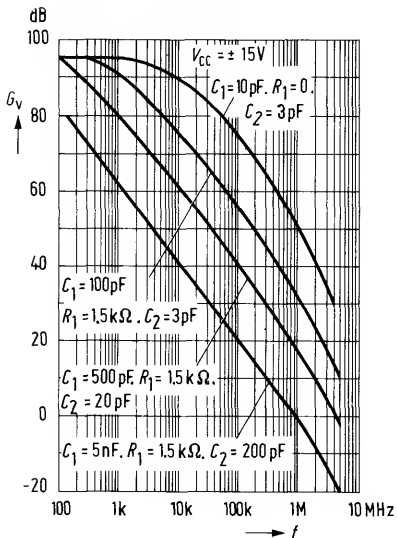
Input offset current $I_{io} = f(T)$



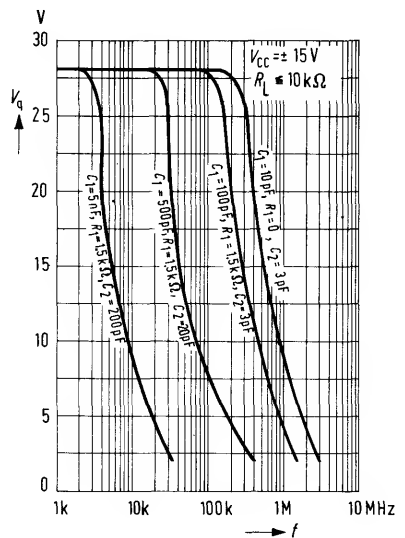
Input current $I_i = f(T)$



Open loop gain for various degrees of compensation $G_v = f(f)$



PP-output voltage $V_o = f(f)$

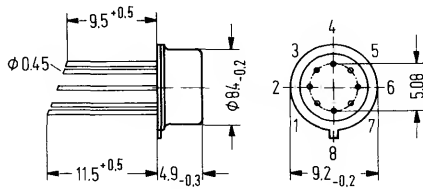


The integrated circuits TAA 721 and TAA 722 are differential amplifiers with wide bandwidth.

- Differential inputs and outputs
- Wide bandwidth of 0 to 40 MHz
- High common-mode rejection of 85 dB
- Excellent stability
- Intensive to asymmetrical supply voltages

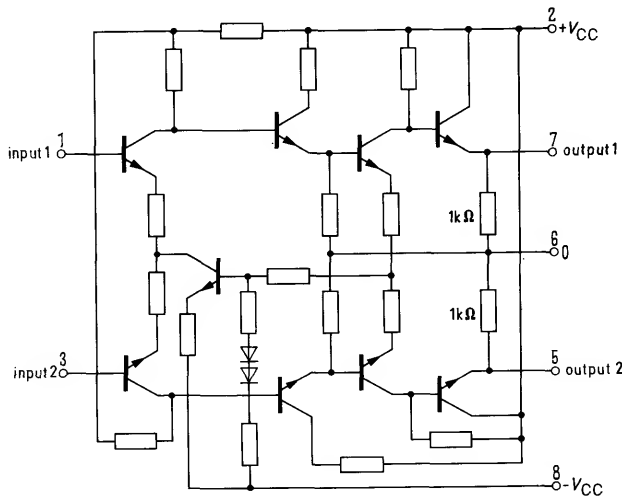
Type	Ordering codes
TAA 721	Q67000-A82
TAA 722	Q67000-A83

Package outlines



Package 5 G 8 DIN 41873
(similar T078)
Weight approx. 1.1 g
Dimensions in mm

Circuit diagram



(pin 4 connected to case)

Maximum ratings

		TAA 721	TAA 722	
Suppl voltage	V_{CC}	± 8	± 8	V
Differential input voltage	V_{ID}	5	5	V
Output current (between Pins 6/5, Pins 6/7)	I_q	10	10	mA
Ambient operating temperature	T_{amb}	0 to 70	-55 to +125	°C
Storage temperature	T_S	-55 to +150	-65 to +150	°C
Junction temperature	T_j	150	150	°C
Thermal resistance:				
System-ambient air	R_{thSamb}	190	190	K/W

Operating characteristics

$V_{CC} = \pm 6$ V, $T_{amb} = 25$ °C

		TAA 721			TAA 722			
		min	typ	max	min	typ	max	
Current consumption	$+I_{CC}$		14.5			14.5	25	mA
	$-I_{CC}$		9			9	16	mA
Input current	I_i		50	100		40	80	µA
Input offset current	I_{io}		3	30		3	30	µA
Input impedance	Z_i		6			6		kΩ
Output voltage ($R_L = 5$ kΩ, $f = 100$ kHz)	V_{qpp}		3.7			3.7		V
Output offset voltage ¹⁾	V_{qo}		.5	2.0		.5	1.2	V
Output impedance	Z_q		35			35		Ω
Voltage gain ²⁾ ($V_i = 1$ mV, $R_L = 5$ kΩ, $f = 100$ kHz)	G_V	38.5	40.4	41.8	38.5	40.4	41.8	dB
Common mode rejection ratio ($f = 100$ kHz, $R_L = 5$ kΩ)	$CMRR$		85			85		dB
Common mode voltage gain ($V_{iCM} = 0.3$ V, $R_L = 5$ kΩ, $f = 100$ kHz)	G_{VCM}		-45	-30		-45	-30	dB
Bandwidth (-3 dB)	B		40			40		MHz
Distortion factor ($V_i = 1$ V, $R_L = 5$ kΩ, $f = 10$ kHz)	k		1.5			1.5		%
Impulse measurements made with following measuring circuit ($V_{CC} = \pm 5$ V, $T_{amb} = 25$ °C, with $V_i = 10$ mV)								
Rise time of the output pulse	t_r		10	15		9	12	ns
Fall time of the output pulse ($V_i = 5$ mV)	t_f		10	15		9	12	ns
Amplification between the channels with $V_i = 250$ mV	G_V				60	68		dB
Storage time	t_s					25	40	ns
Modulation voltage	V_{qpp}				1.2	1.4		V

¹⁾ measured between both outputs.

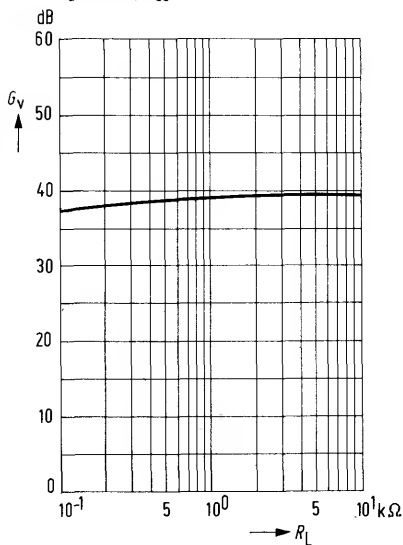
²⁾ output voltage to ground. Between both outputs, the gain measured is twice as high, the outputs being of opposite phase.

[illegible]

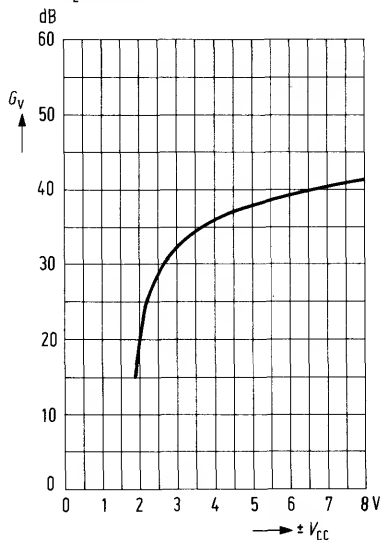
The diagram illustrates the timing characteristics of a device. The top trace, labeled "input pulse", is a rectangular pulse with a duration of 100 ns and a peak voltage V_i . The bottom trace, labeled "output pulse", shows the device's response. It features a smooth rise from 10% to 100% of the input level, a flat top (storage time), and a smooth fall back to 10%. The time intervals for these transitions are labeled as t_r (rise time), t_s (storage time), and t_f (fall time). The horizontal axis for both traces is time t .

Not for new development

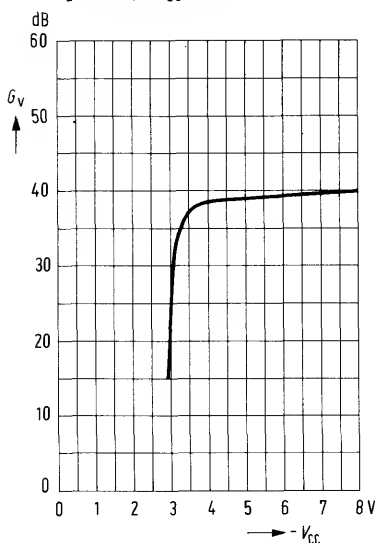
Voltage gain $G_V = f(R_L)$
 $f = 100 \text{ kHz}$, $T_{\text{amb}} = 25^\circ\text{C}$, $R_G = 50 \Omega$
 $R_L = 5 \text{ k}\Omega$, $V_{CC} = \pm 6 \text{ V}$



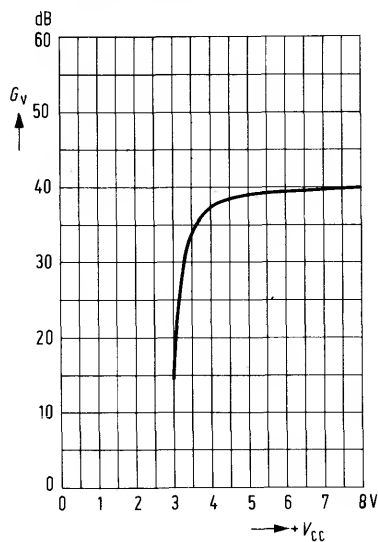
Voltage gain $G_V = f(\pm V_{CC})$
 $f = 100 \text{ kHz}$, $T_{\text{amb}} = 25^\circ\text{C}$, $R_G = 50 \Omega$
 $R_L = 5 \text{ k}\Omega$



Voltage gain $G_V = f(-V_{CC})$
 $f = 100 \text{ kHz}$, $T_{\text{amb}} = 25^\circ\text{C}$, $R_G = 50 \Omega$
 $R_L = 5 \text{ k}\Omega$, $+V_{CC} = 6 \text{ V}$

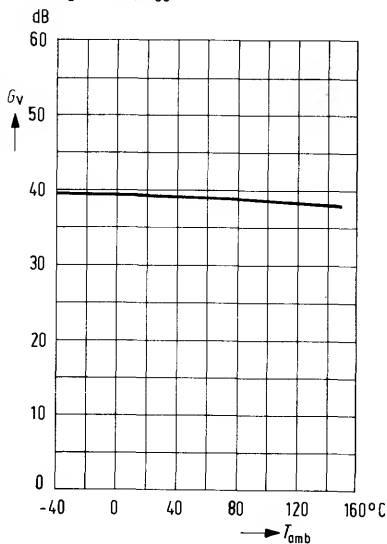


Voltage gain $G_V = f(+V_{CC})$
 $f = 100 \text{ kHz}$, $T_{\text{amb}} = 25^\circ\text{C}$, $R_G = 50 \Omega$
 $R_L = 5 \text{ k}\Omega$, $-V_{CC} = 6 \text{ V}$

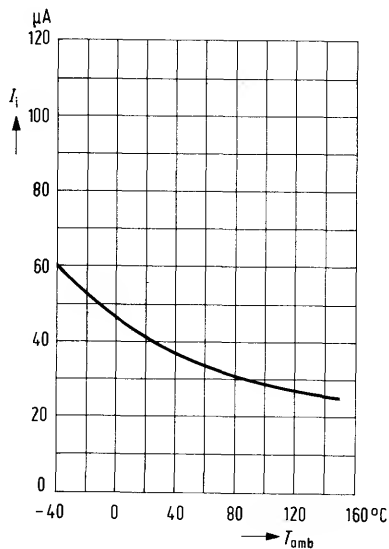


Not for new development

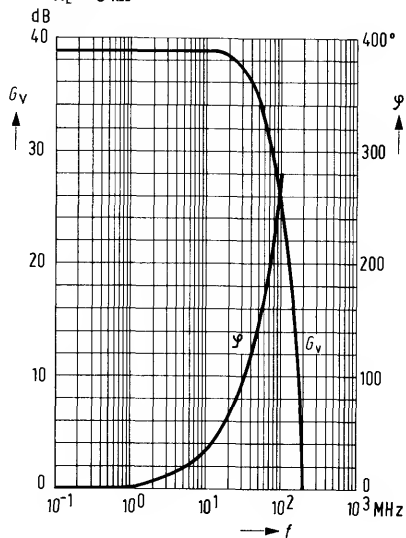
Voltage gain $G_V = f(T_{amb})$
 $f = 100 \text{ kHz}$, $T_{amb} = 25^\circ\text{C}$, $R_G = 50 \Omega$
 $R_L = 5 \text{ k}\Omega$, $V_{CC} = \pm 6 \text{ V}$



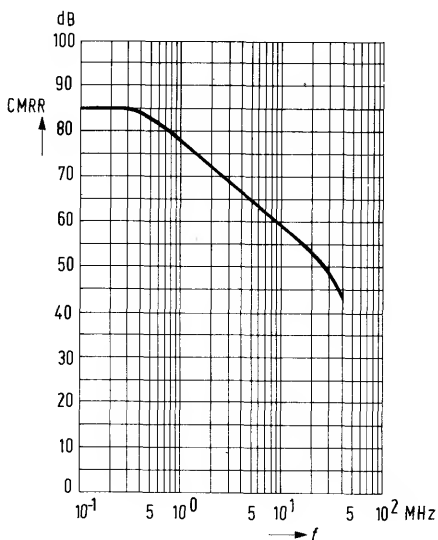
Input current $I_i = f(T_{amb})$
 $V_{CC} = \pm 6 \text{ V}$



Voltage gain $G_V = f(f)$
Phase deviation $\varphi = f(f)$
 $V_{CC} = \pm 6 \text{ V}$, $T_{amb} = 25^\circ\text{C}$, $R_G = 50 \Omega$
 $R_L = 5 \text{ k}\Omega$



Common mode rejection $CMRR = f(f)$
 $V_{CC} = \pm 6 \text{ V}$, $T_{amb} = 25^\circ\text{C}$, $R_G = 50 \Omega$
 $R_L = 5 \text{ k}\Omega$



Operational Amplifier

TAA 761; A; W
TAA 762
TAA 765; A; W

A particularly economical and universal operational amplifier which by its excellent performance qualities is well suited for a wide range of applications, such as automatic controls, automobile electronics, AF-circuits, analog computers etc.

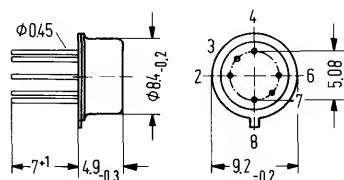
In addition to a high gain, high input resistance, low offset voltage, low temperature- and supply voltage-dependence, the amplifier features

- Wide common-mode range,
- Large supply voltage range,
- Large control range,
- Wide temperature range (TAA 762),
- High output current,
- Simple frequency compensation

Type	Ordering codes
TAA 761	Q67000-A224
TAA 761 A	Q67000-A522
TAA 761 W	Q67000-A598
TAA 762	Q67000-A523
TAA 765	Q67000-A226
TAA 765 A	Q67000-A524
TAA 765 W	Q67000-A599

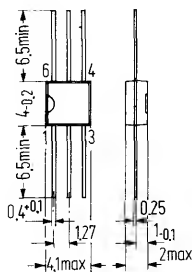
Package outlines

TAA 761, TAA 762, TAA 765



Case 5 H 6
DIN 41873
(similar T0-18)
Weight approx. 1 g

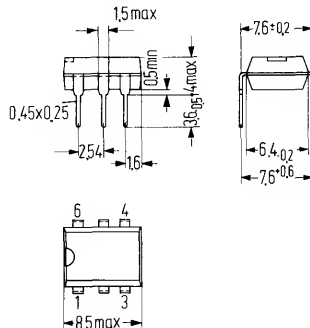
TAA 761 W, TAA 765 W



Miniature plastic case
6 Pins
Weight approx. .1 g
Colour code
TAA 761 W white/white
TAA 765 W yellow/yellow

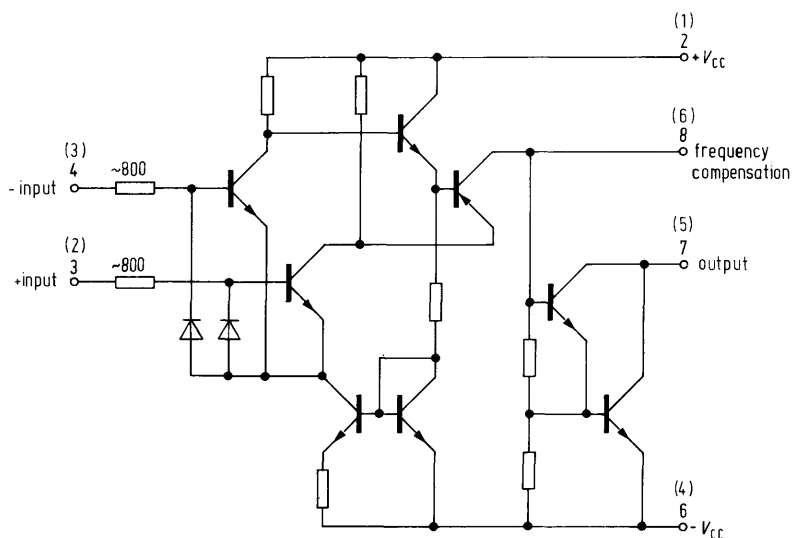
Dimensions in mm

TAA 761 A, TAA 765 A



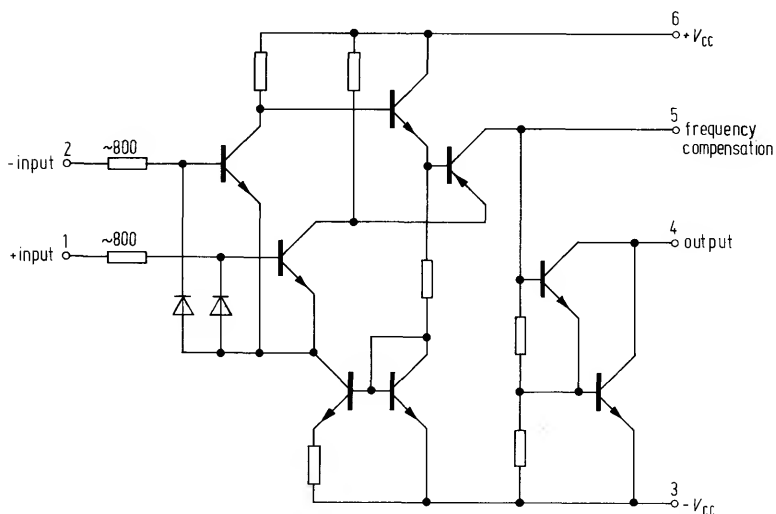
Plastic plug-in case
6 Pins
20 A 6 DIN 41866
Weight approx. .7 g

Circuit for TAA 761, 762, 765



Pin-numbers in brackets refer to TAA 761A and TAA 765A

Circuit for TAA 761 W and TAA 765 W



Maximum ratings

		TAA 761/TAA 761 A TAA 761 W/TAA 762 TAA 765/TAA 765 A TAA 765 W	
Supply voltage	V_{CC}	± 18	V
Output current	I_g	70	mA
Differential input voltage	V_{ID}	$\pm V_{CC}$	
Junction temperature	T_j	150	°C
Storage temperature	T_s	-55 to +125	°C
Thermal resistances:			
System-case (TAA 761, TAA 762, TAA 765)	$R_{thScase}$	80	K/W
System-ambient air (TAA 761/762/765)	R_{thSamb}	190	K/W
System-ambient air (TAA 761 A, TAA 765 A)	R_{thSamb}	140	K/W
System-ambient air (TAA 761 W, TAA 765 W)	R_{thSamb}	200	K/W

Range of operation

Supply voltage	V_{CC}	± 1.5 to ± 18	V
Ambient temperature in operation			
TAA 761/A/W	T_{amb}	0 to +70	°C
TAA 765/A/W	T_{amb}	-25 to +85	°C
TAA 762	T_{amb}	-55 to +125	°C

Operating characteristics

$V_{CC} = \pm 15$ V

		TAA 761/A/W TAA 765/A/W			TAA 762					
		$T_{amb} = 25^\circ\text{C}$			$T_{amb} = 25^\circ\text{C}$			$T_{amb} = -55$ to 125 °C		
		min	typ	max	min	typ	max	min	max	
Supply current	I_{CC}		1.5	2.5		1.5	2.5			mA
Input offset voltage ($R_G = 50\ \Omega$)	V_{io}	-6		6	-4		4	-6	6	mV
Input offset current	I_{io}	-300	± 80	300	-100	± 50	100	-300	300	nA
Input current	I_i		.5	1.0		.3	.7		1.0	μA
Output voltage ($R_L = 2\ \text{k}\Omega$)	V_{qpp}	14.9		-14	14.9		-14	14.8	-14	V
($R_L = 620\ \Omega$)	V_{qpp}	14.9		-12.5	14.9		-12.5	14.8	-12	V
($R_L = 2\ \text{k}\Omega$, $f = 100\ \text{kHz}$)	V_{qpp}		± 10			± 10				V
Input impedance ($f = 1\ \text{kHz}$)	Z_i		200			200				k Ω
Open-loop voltage gain ($R_L = 2\ \text{k}\Omega$, $f = 1\ \text{kHz}$)	G_v	81.5	85		85	87		80		dB
($R_L = 10\ \text{k}\Omega$, $f = 1\ \text{kHz}$)	G_v		90			92				dB
($R_L = 2\ \text{k}\Omega$, $f = 1\ \text{MHz}$)	G_v		43			43				dB
Output leakage current I_{qlik}			1	10		1	10			μA

Operating characteristics

$V_{CC} = \pm 15 \text{ V}$

TAA 761/A/W
TAA 765/A/W

$T_{amb} = 25^\circ\text{C}$

TAA 762

$T_{amb} = 25^\circ\text{C}$

$T_{amb} = -55 \text{ to } +125^\circ\text{C}$

		$T_{amb} = 25^\circ\text{C}$			$T_{amb} = 25^\circ\text{C}$			$T_{amb} = -55 \text{ to } +125^\circ\text{C}$	
		min	typ	max	min	typ	max	min	max
Input common-mode range ($R_L = 2 \text{ k}\Omega$)	V_{ICM}	12	± 13.5	-12	12	± 13.5	-12		V
Common-mode rejection ratio ($R_L = 2 \text{ k}\Omega$)	$CMRR$	65	79		70	81			dB
Sensitivity to supply voltage variations ($G_V = 100$)	$\frac{\Delta V_{io}}{\Delta V_{CC}}$		25	200		25	200		$\mu\text{V/V}$
Temp. coefficient of V_{io} α_{Vio} ($R_G = 50 \Omega$)			6			6	25		$\mu\text{V/K}$
Temp. coefficient of I_{io} α_{Iio} ($R_G = 50 \Omega$)			.3			.3	1.5		nA/K
Rise time of V_q for non-inverting operation (test circuit 1)	$\frac{dV_q}{dt_r}$		9			9			V/ μs
Rise time for V_q for inverting operation (test circuit 2)	$\frac{dV_q}{dt_r}$		18			18			V/ μs
Noise voltage (to spec. DIN 45405; measured at input $R_S = 2.5 \text{ k}\Omega$)	V_N		3			3			μV
Supply current ($V_{CC} = \pm 5 \text{ V}$)	I_{CC}		0.7			0.7			mA
Input offset voltage	V_{io}	-6		6	-4		4		mV
Input offset current	I_{io}	-300		300	-70		70		nA
Input current	I_i			1.0			0.6		μA
Output voltage ($R_L = 2 \text{ k}\Omega$)	V_{opp}	4.9		-4	4.9		-4	4.8	-4 V
Open loop voltage gain G_V ($R_L = 2 \text{ k}\Omega$, $f = 1 \text{ kHz}$)		70			70				dB

Especially economical and universal operational amplifiers which by their excellent performance qualities are well suited for a wide range of applications, such as automatic controls, automobile electronics, AF-circuits, analog computers etc.

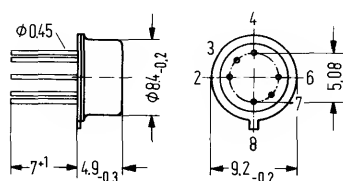
In addition to a high gain, high input resistance, low offset voltage, low temperature- and supply voltage-dependence, the amplifiers feature

- Wide common-mode range,
- Large supply voltage range,
- Large control range,
- High output current,
- Simple frequency compensation,
- Wide temperature range (TAA 862)

Type	Ordering codes	Type	Ordering codes
TAA 861	Q67000-A89	TAA 865	Q67000-A109
TAA 861 A	Q67000-A278	TAA 865 A	Q67000-A279
TAA 861 W	Q67000-A89-S3	TAA 865 W	Q67000-A109-S3
TAA 862	Q67000-A236		

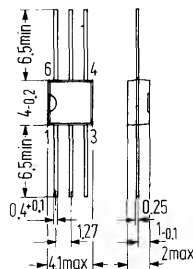
Package outlines

TAA 861, TAA 862, TAA 865

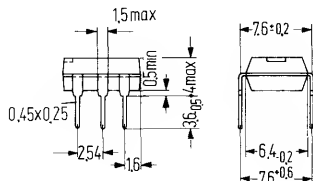


Package 5 H 6 DIN 41873
(similar TO-78)
Weight approx. 1 g

TAA 861 W, TAA 865 W TAA 861 A, TAA 865 A



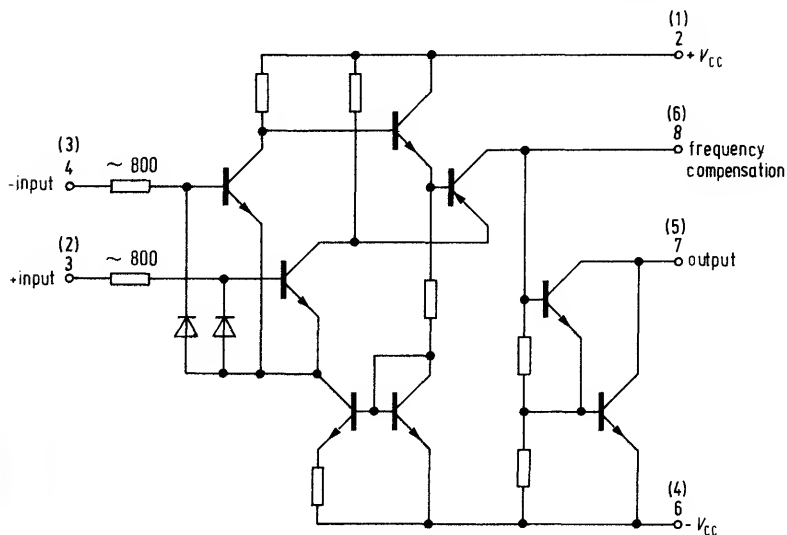
Miniature plastic
package
6 pins
Weight approx. .1 g
Colour code
TAA 861 W green/green
TAA 865 W blue/blue



Plastic plug-in package
6 pins
20 A 6 Din 41866
Weight approx. .7 g

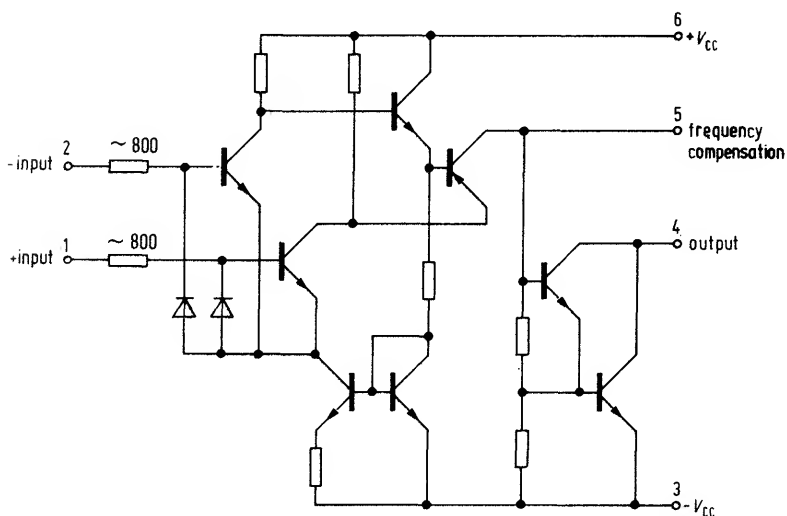
Dimensions in mm

Circuit for TAA 861, TAA 865, TAA 862 and TAA 861 A, TAA 865 A



Numbers in brackets refer to TAA 861A and TAA 865A

Circuit for TAA 861 W, TAA 865 W



Maximum ratings

	TAA 861/TAA 865 TAA 861 A/TAA 865 A TAA 861 W/TAA 865 W TAA 862	
Supply voltage	V_{CC}	± 10 V
Output current	I_q	70 mA
Differential input voltage	V_{ID}	$\pm V_{CC}$
Junction temperature	T_J	150 °C
Storage temperature	T_S	-55 to +125 °C
Thermal resistance:		
System-case (TAA 861, TAA 862, TAA 865)	$R_{thScase}$	80 K/W
System-ambient air (TAA 861/862/865)	R_{thSamb}	190 K/W
System-ambient air (TAA 861 A, TAA 865 A)	R_{thSamb}	140 K/W
System-ambient air (TAA 861 W, TAA 865 W)	R_{thSamb}	200 K/W

Range of operation

Supply voltage	V_{CC}	± 1.5 to ± 10 V
Ambient temperature in operation		
TAA 861/A/W	T_{amb}	0 to +70 °C
TAA 865/A/W	T_{amb}	-25 to +85 °C
TAA 862	T_{amb}	-55 to +125 °C

TAA 861; A; W

TAA 862

TAA 865; A; W

Operating characteristics $V_{CC} = \pm 10\text{ V}$		TAA 861/A/W TAA 865/A/W $T_{amb} = 25^\circ\text{C}$			TAA 862					
					$T_{amb} = 25^\circ\text{C}$			$T_{amb} = -55\text{ to }+125^\circ\text{C}$		
		min	typ	max	min	typ	max	min	max	
Supply current	I_{CC}		1.0	1.5		1.0	1.5			mA
Input offset voltage ($R_G = 50\ \Omega$)	V_{io}	-10		10	-4		4	-6	6	mV
Input offset current	I_{io}	-300	± 80	300	-100	± 50	100	-300	300	nA
Input current	I_i		.5	1.0		.3	.7		1.0	μA
Output voltage ($R_L = 2\text{ k}\Omega$)	V_{qpp}	9.8		-9	9.9		-9	9.8	-9	V
($R_L = 400\ \Omega$)	V_{qpp}	9.8		-8	9.8		-8	9.8	-7.5	V
($R_L = 2\text{ k}\Omega$, $f = 100\text{ kHz}$)	V_{qpp}		± 7			± 7				V
Input impedance ($f = 1\text{ kHz}$)	Z_i		200			200				$\text{k}\Omega$
Output impedance ($f = 1\text{ kHz}$)	Z_o		800							Ω
Open-loop voltage gain ($R_L = 2\text{ k}\Omega$, $f = 1\text{ kHz}$)	G_V	75	80		85	87		80		dB
($R_L = 10\text{ k}\Omega$, $f = 1\text{ kHz}$)	G_V		90			90				dB
($R_L = 2\text{ k}\Omega$, $f = 1\text{ MHz}$)	G_V		43			43				dB
Input common-mode range ($R_L = 2\text{ k}\Omega$)	V_{ICM}	8	± 9	-8	8	± 9	-8			V
Common mode rejection ratio ($R_L = 2\text{ k}\Omega$)	$CMRR$	60	74		70	81				dB
Sensitivity to supply voltage variations ($G_V = 100$)	$\frac{\Delta V_{io}}{\Delta V_{CC}}$	25	200		25	200				$\mu\text{V/V}$
Temperature-coefficient of V_{io} ($R_G = 50\ \Omega$, $T_{amb} = 0\text{ to }70^\circ\text{C}$)	α_{vio}		6			6	25			$\mu\text{V/K}$
Temperature-coefficient of I_{io} ($R_G = 50\ \Omega$, $T_{amb} = 0\text{ to }70^\circ\text{C}$)	$\alpha_{I_{io}}$		.3			.3	1.5			nA/K
Rise time of V_q for non-inverting operation (test circuit 1, TAA 861)	$\frac{dV_q}{d_{tr}}$		9			9				V/ μs
Rise time of V_q for inverting operation (test circuit 2, TAA 861)	$\frac{dV_q}{d_{tr}}$		18			18				V/ μs

Operating characteristics

$V_{CC} = \pm 10\text{ V}$

Output leakage current

Noise voltage

(to spec. DIN 45405 measured at input $R_S = 2.5\text{ k}\Omega$)

$V_{CC} = \pm 5\text{ V}$

Supply current

Input offset voltage

Input offset current

Input current

Output voltage

($R_L = 2\text{ k}\Omega$)

($T_{amb} = -55\text{ to }+125\text{ }^\circ\text{C}$)

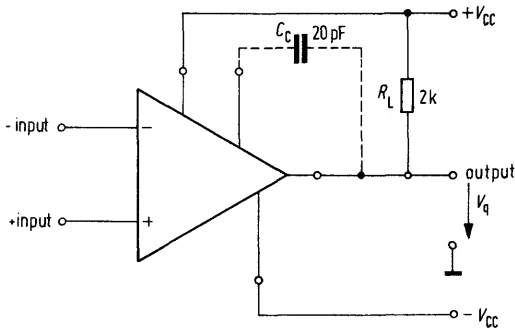
Open-loop voltage gain

($R_L = 2\text{ k}\Omega$, $f = 1\text{ kHz}$)

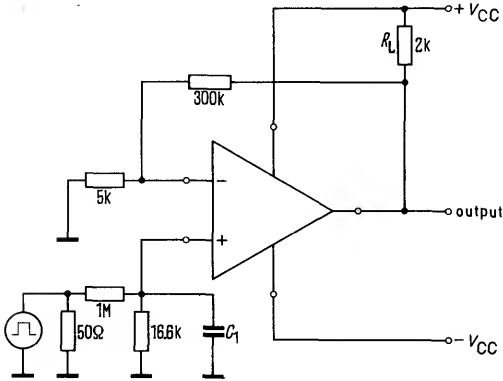
	TAA 861/A/W TAA 865/A/W			TAA 862			
	$T_{amb} = 25^{\circ}\text{C}$			$T_{amb} = 25^{\circ}\text{C}$			
	min	typ	max	min	typ	max	
I_{glk}		10	100		1	10	μA
V_N		3			3		μV
I_{CC}		.7			.7		mA
V_{io}	-10		10	-4		4	mV
I_{io}	-300		300	-70		70	nA
I_i			1.0			.6	μA
V_{qpp}	4.8		-4	4.9		-4	V
V_{qpp}				4.8		-4	V
G_v	70			70			dB

Connection diagram

C_C = output frequency compensation; R_L = load resistor

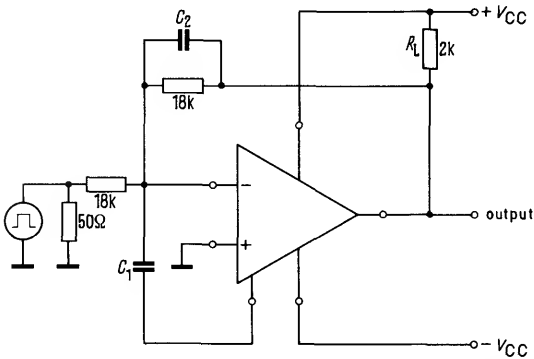


1. Test circuit for rise time of V_q (non-inverting operation)



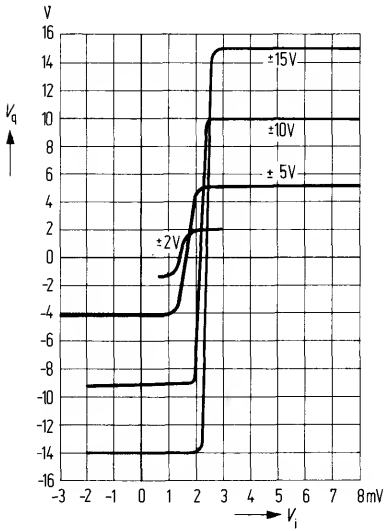
$C_1 \approx 22 \text{ pF}$ for min overshoot

2. Test circuit for rise time of V_q (inverting operation)

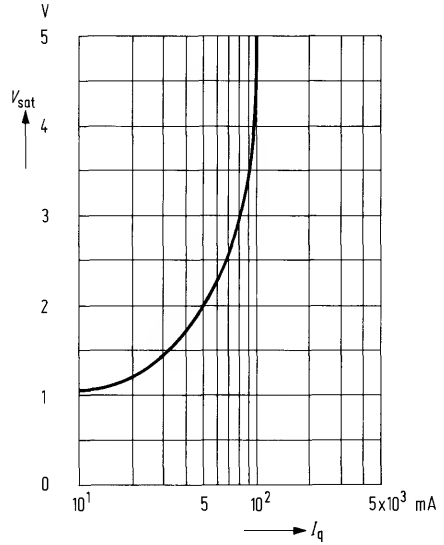


C_2 is for a frequency dependent compensation of the reduction of rise times
 C_1 3.9 pF for min overshoot

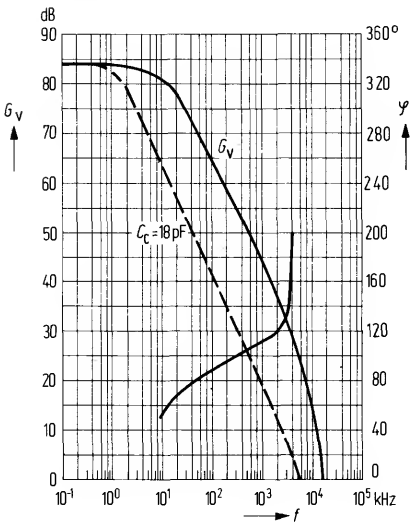
Transfer characteristic $V_o = f(V_i)$
 V_{CC} = parameter, $R_L = 2 \text{ k}\Omega$



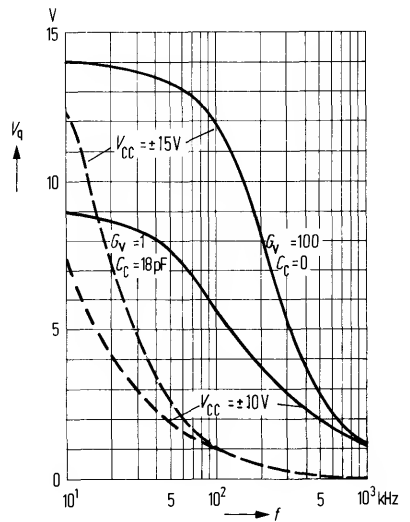
Saturation voltage $V_R = f(I_q)$
 $T_{amb} = 25^\circ \text{C}$



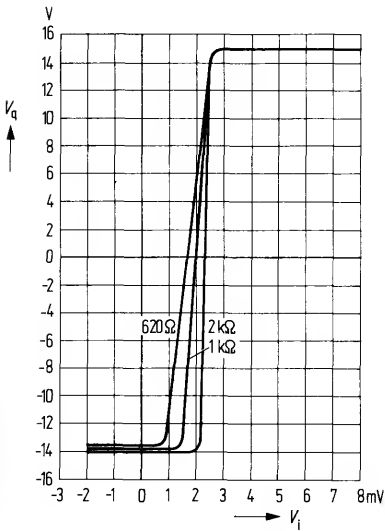
Open-loop voltage gain and phase
 $G_V = f(f)$; $\varphi = f(f)$; $V_{CC} = \pm 10 \text{ V} / \pm 15 \text{ V}$



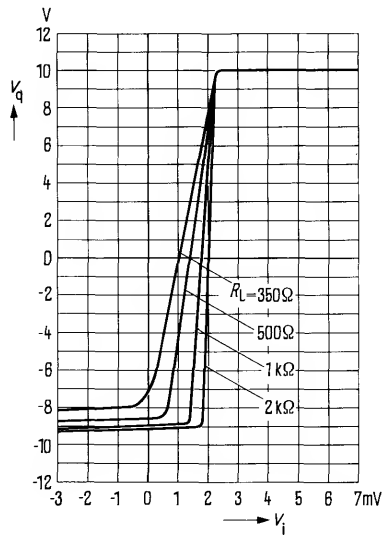
Frequency dependence of large signal modulation $V_o = f(f)$



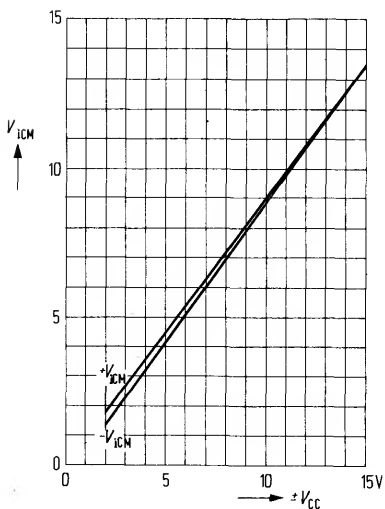
Transfer characteristic $V_o = f(V_i)$
 $V_{RR} = \pm 15 \text{ V}$, $R_o = \text{parameter}$



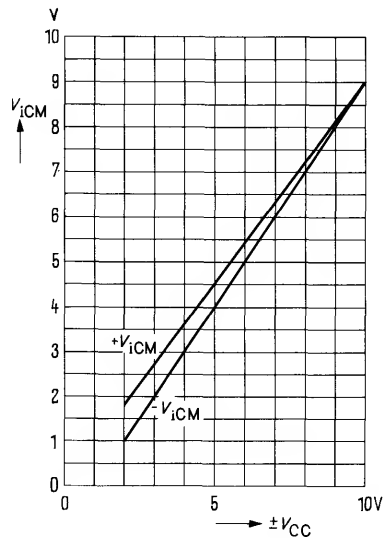
Transfer characteristic $V_o = f(V_i)$
 $V_{CC} = \pm 15 \text{ V}$, $R_o = \text{parameter}$



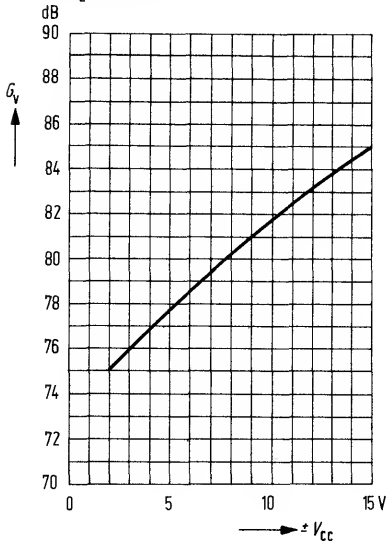
Common mode range $V_{ICM} = f(V_{CC})$



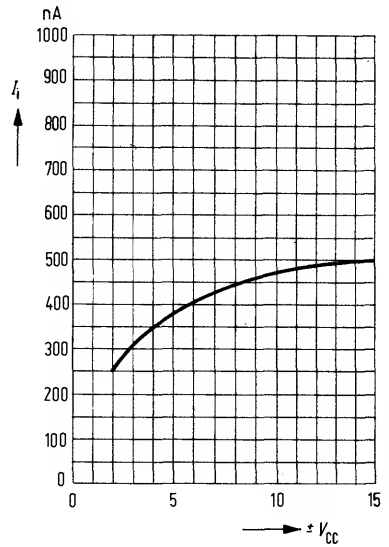
Common mode range $V_{ICM} = f(V_{CC})$



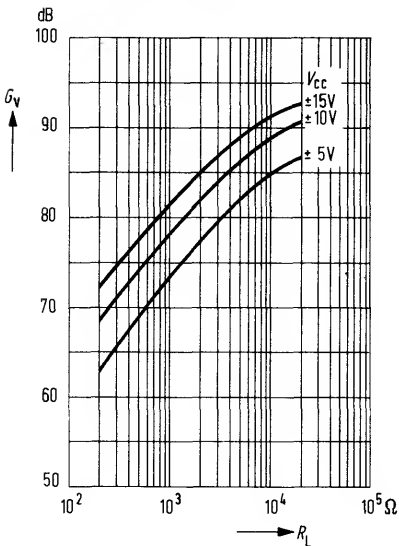
Open-loop voltage gain
 $G_v = f(V_{CC}); T_{amb} = 25^\circ\text{C}$
 $R_L = 2\text{ k}\Omega$



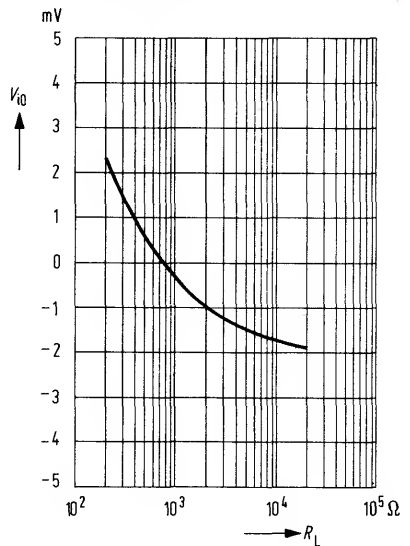
Input current
 $I_i = f(V_{CC})$



Open-loop voltage gain
 $G_v = f(R_L); T_{amb} = 25^\circ\text{C}$

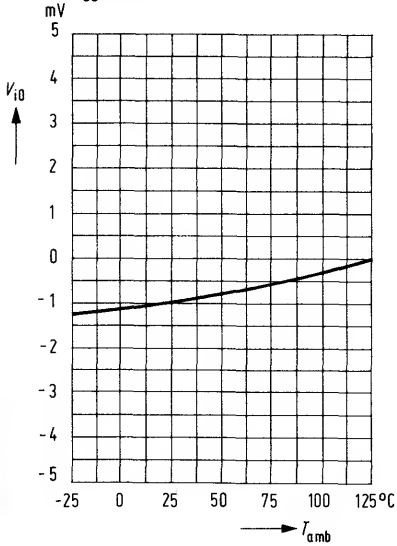


Input offset voltage
 $V_{io} = f(R_L); V_{CC} = \pm 15\text{ V}$



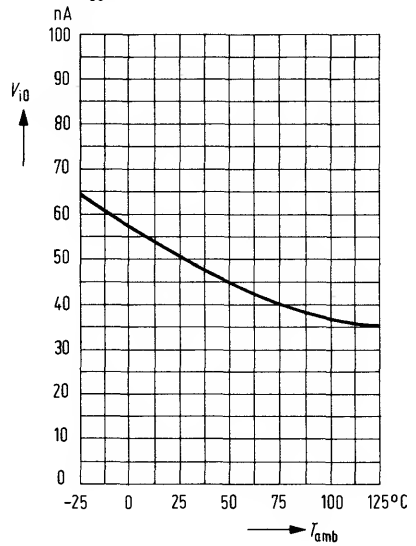
Input offset voltage

$V_{io} = f(T_{amb}); R_L = 2 \text{ k}\Omega$
 $V_{CC} = \pm 10 \text{ V}$



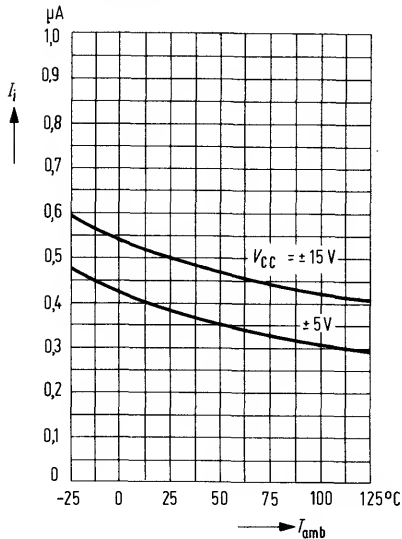
Input offset current

$V_{io} = f(T_{amb}); R_L = 2 \text{ k}\Omega$
 $V_{CC} = \pm 10 \text{ V}$



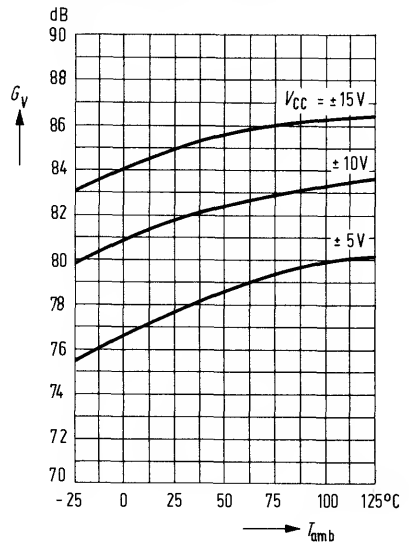
Input current

$I_i = f(T_{amb}); R_L = 2 \text{ k}\Omega$



Open-loop voltage gain

$G_v = f(T_{amb}); R_L = 2 \text{ k}\Omega; f = 1 \text{ kHz}$



Especially economical and universal operational amplifiers in package 5 G 8 DIN 41873 (TO 99) which by their excellent performance qualities are well suited for a wide range of applications. No external components for frequency compensation are required. TAA 2761 A (8 pins) in plastic plug-in package.

For single amplifier performance, see TAA 761 data sheet.

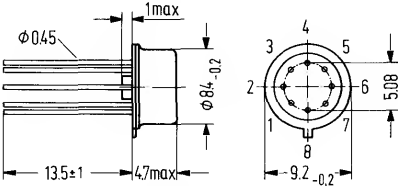
Additional features:

- Wide common-mode range
- Large supply voltage range
- Wide temperature range (TAA 2762)
- Protection against destruction
- High output current
- Large control range
- No frequency compensation

Type	Ordering codes
TAA 2761	Q67000-A1027
TAA 2761 A	Q67000-A1028
TAA 2762	Q67000-A1029
TAA 2765	Q67000-A1030
TAA 2765 A	Q67000-A1031

Package outlines

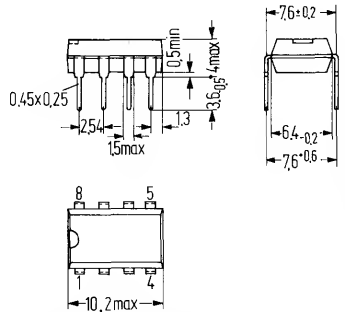
TAA 2761, TAA 2762, TAA 2765



Package similar to 5 G 8 DIN 41873 (similar TO-99)
 weight approx. 1.1 g

Dimensions in mm

TAA 2761 A, TAA 2765 A



Plastic plug-in package, 8 pins;
 20 A 8 DIN 41866, weight approx. .7 g

Maximum ratings

Supply voltage	
Output current	
Differential input voltage	
Junction temperature	
Storage temperature	
Thermal resistance:	
System-case (TAA 2761/2/5)	
System-ambient air (TAA 2761/2/5)	
System-ambient air (TAA 2761 A/2765 A)	

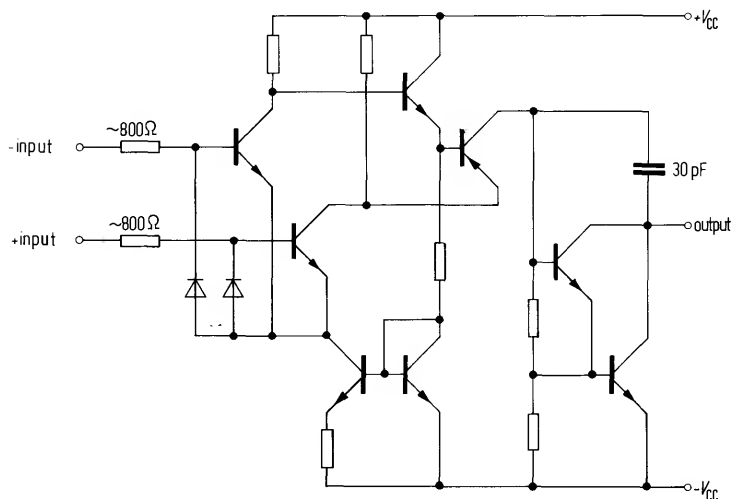
	TAA 2761/A TAA 2762 TAA 2765/A	
V_{CC}	± 15	V
I_Q	70	mA
V_{ID}	$\pm V_{CC}$	
T_j	150	°C
T_s	-55 to +125	°C
$R_{thSCase}$	80	K/W
R_{thSamb}	190	K/W
R_{thSamb}	140	K/W

Range of operation

Supply voltage	
Ambient temperature in operation	
TAA 2761/A	
TAA 2762	
TAA 2765/A	

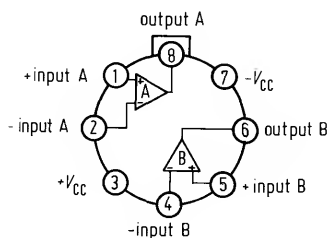
V_{CC}	± 2 to ± 15	V
T_{amb}	0 to +70	°C
T_{amb}	-55 to +125	°C
T_{amb}	-25 to +85	°C

Circuit of one operational amplifier

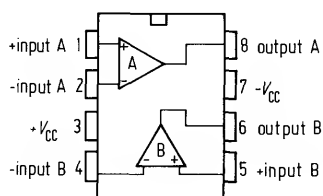


Pin configuration

TAA 2761
TAA 2762
TAA 2765



TAA 2761 A
TAA 2765 A



Operating characteristics

($V_{cc} = \pm 15\text{ V}$)

Operating characteristics ($V_{cc} = \pm 15\text{ V}$)		TAA 2761/A TAA 2765/A $T_{amb} = 25\text{ }^{\circ}\text{C}$			TAA 2762 $T_{amb} = 25\text{ }^{\circ}\text{C}$			$T_{amb} = -55$ to $+125\text{ }^{\circ}\text{C}$		
		min	typ	max	min	typ	max	min	max	
Supply current	I_{cc}		.5	1.5		.5	1.5			mA
Input offset voltage ($R_G = 50\text{ }\Omega$)	V_{io}	-6		6	-4		4	-6	6	mV
Input offset current	I_{io}	-300	± 80	300	-100	± 50	100	-300	300	nA
Input current	I_i		.5	1.0		.3	.7		1.0	μA
Output voltage:										
$R_L = 2\text{ k}\Omega$	V_{qpp}	14.9		-14	14.9		-14	14.8	-14	V
$R_L = 620\text{ }\Omega$	V_{qpp}	14.9		-12.5	14.9		-12.5	14.8		V
Input impedance ($f = 1\text{ kHz}$)	Z_i		200			200				k Ω
Open loop voltage gain										
$R_L = 2\text{ k}\Omega$, $f = 100\text{ Hz}$	G_v	80	85		85	87		80		dB
$R_L = 10\text{ k}\Omega$, $f = 100\text{ Hz}$	G_v		90			92				dB
Output leakage current	I_{qlik}		1	10		1	10			μA
Input common mode range ($R_L = 2\text{ k}\Omega$)	V_{iCM}	12	± 13.5	-12	12	± 13.5	-12			V
Common mode rejection mode ($R_L = 2\text{ k}\Omega$)	$CMRR$	65	79		70	81				dB
Sensitivity to supply voltage variations ($G_v = 100$)	$\frac{\Delta V_{io}}{\Delta V_{cc}}$		25	100		25	100			$\mu\text{V/V}$
Temp. coefficient of V_{io} ($R_G = 50\text{ }\Omega$)	α_{Vio}		6			6	25			$\mu\text{V/K}$
Temp. coefficient of I_{io} ($R_G = 50\text{ }\Omega$)	α_{Iio}		.3			.3	1.5			nA/K
Noise voltage (to spec. DIN 45405; measured at input $R_s = 2.5\text{ k}\Omega$)	V_N		3			3				μV
Output saturation voltage ($I_q = 10\text{ mA}$) ($V_{cc} = \pm 5\text{ V}$)	V_{qsat}			1			1			V
Supply current	I_{cc}		.5			.5				mA
Input offset voltage	V_{io}	-6		6	-4		4			mV
Input offset current	I_{io}	-300		300	-100		100			nA
Input current	I_i			1.0			.6			μA
Output voltage ($R_e = 2\text{ k}\Omega$)	V_{qpp}	4.9		-4	4.9		-4	4.8	-4	V
Open loop voltage gain ($R_e = 2\text{ k}\Omega$, $f = 1\text{ Hz}$)	G_v	70			70					dB

Especially economical and universal operational amplifiers in plastic plug-in packages (14 pins) 20 A 14 DIN 41866, which by their excellent performance qualities are well suited for a wide range of applications. No external components for frequency compensation are required.

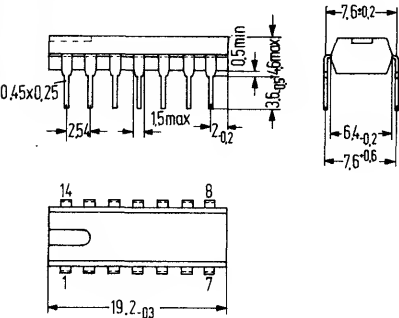
For single amplifier performance, see TAA 761 data sheet.

Additional features:

- Wide common-mode range
 - Large supply voltage range
 - Protection against destruction
- High output current
 - Large control range
 - No frequency compensation

Type	Ordering codes
TAA 4761 A	Q67000-A1032
TAA 4765 A	Q67000-A1033

Package outlines



Weight approx. 1.1 g
Plastic plug-in package 20 A 14 DIN 41866 (14 pins)
Dimensions in mm

Maximum ratings

- Supply voltage
- Output current
- Differential input voltage
- Junction temperature
- Storage temperature
- Thermal resistance system – ambient air

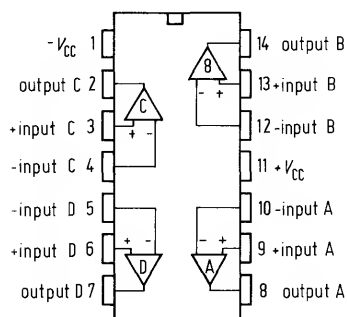
	TAA 4761 A TAA 4765 A	
V_{CC}	± 15	V
I_q	70	mA
V_{ID}	$\pm V_{CC}$	
T_J	150	°C
T_s	-55 to +125	°C
R_{thSamb}	140	K/W

Range of operation

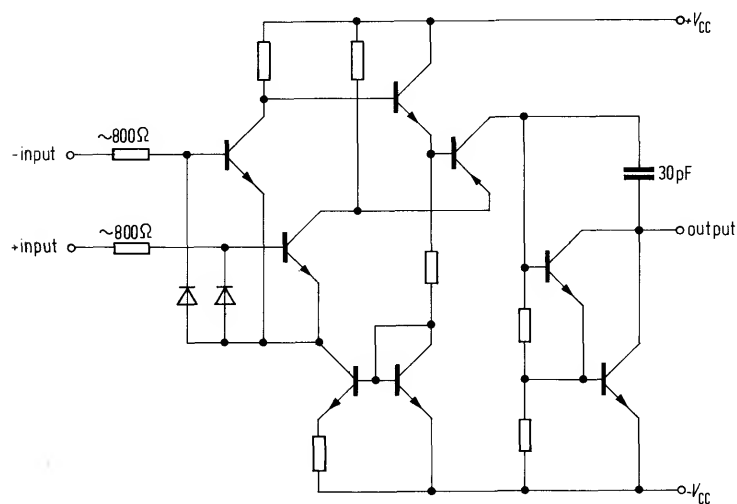
- Supply voltage
- Ambient temperature in operation (TAA 4761 A)
(TAA 4765 A)

V_{CC}	± 2 to ± 15	V
T_{amb}	0 to +70	°C
T_{amb}	-25 to +85	°C

Pin configuration



Circuit of one operational amplifier



Operating characteristics

($V_{cc} = \pm 15 \text{ V}$; $T_{amb} = 25^\circ \text{C}$)

		TAA 4761 A TAA 4765 A			
		min	typ	max	
Supply current	I_{cc}		1	3	mA
Input offset voltage ($R_G = 50 \Omega$)	V_{io}	-6		6	mV
Input offset current	I_{io}	-300	± 80	300	nA
Input current	I_i		.5	1.0	μA
Output voltage: $R_L = 2 \text{ k}\Omega$	V_{qpp}	14.9		-14	V
$R_L = 620 \Omega$	V_{qpp}	14.9		-12.5	V
Input impedance ($f = \text{kHz}$)	Z_i		200		$\text{k}\Omega$
Open-loop voltage gain: $R_L = 2 \text{ k}\Omega$, $f = 100 \text{ Hz}$	G_v	80	85		dB
$R_L = 10 \text{ k}\Omega$, $f = 100 \text{ Hz}$	G_v		90		dB
Output leakage current	I_{glk}			10	μA
Input common-mode range ($R_L = 2 \text{ k}\Omega$)	V_{iCM}	12	± 13.5	-12	V
Common-mode rejection ratio ($R_L = 2 \text{ k}\Omega$)	$CMRR$	65	79		dB
Sensitivity to supply voltage variations ($G_v = 100$)	$\frac{\Delta V_{io}}{\Delta V_{cc}}$		25	100	$\mu\text{V/V}$
Temp. coefficient of V_{io} ($R_G = 50 \Omega$)	α_{vio}		6		$\mu\text{V/K}$
Temp. coefficient of I_{io} ($R_G = 50 \Omega$)	α_{lio}		.3		nA/K
Noise voltage (to spec. DIN 45405, measured at input $R_s = 2.5 \text{ k}\Omega$)	V_N		3		μV
Output saturation voltage ($I_q = 10 \text{ mA}$)	V_{qsat}			1	V
($V_{cc} = \pm 5 \text{ V}$)					
Supply current	I_{cc}		1		mA
Input offset voltage	V_{io}	-6		6	mV
Input offset current	I_{io}	-300		300	nA
Input current	I_i			1	μA
Output voltage ($R_L = 2 \text{ k}\Omega$)	V_{qpp}	4.9		-4	V
Open-loop voltage gain ($R_L = 2 \text{ k}\Omega$, $f = 100 \text{ Hz}$)	G_v	70			dB

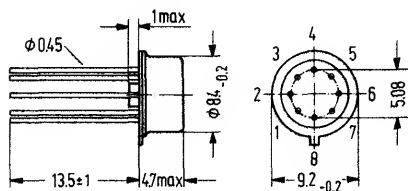
These operational amplifier are short circuit protected against $+V_{CC}$, $-V_{CC}$ and ground. No external components for frequency compensation are required. An internal gain reduction of 6 dB/octave yields maximum stability in feedback circuit applications.

- Simple handling
- Large input differential voltage
- Short circuit protected
- High open loop voltage gain
- Large supply voltage range

Type	Ordering codes
TBA 221	Q67000-A134
TBA 221 A	Q67000-A225
TBA 221 B	Q67000-A281
TBA 221 W	Q67000-A923
TBA 221 G	Q67000-A923 G
TBA 222	Q67000-A97
TBA 222 Q1	Q67000-A97-Q1
TBA 222 Q2	Q67000-A97-Q2
TBA 222 S1	Q67000-A97-S1

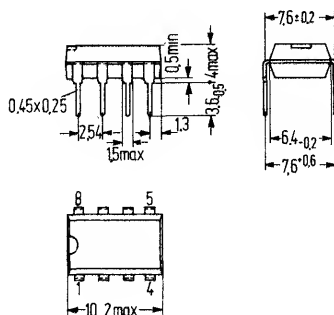
Package outlines

TBA 221, TBA 222



Case similar to 5 G 8 DIN 41873 (TO-99)
Weight approx. 1.2 g
Pin 4 and case connected

TBA 221 B

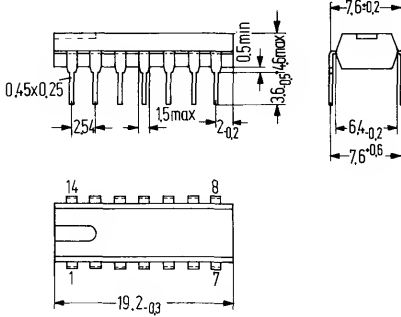


Plastic plug-in package, 8 pins
20 A 8 DIN 41866
Weight approx. .7 g

Dimensions in mm

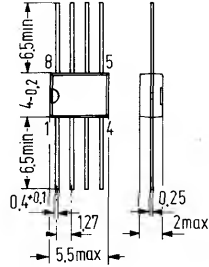
Package outlines

TBA 221 A



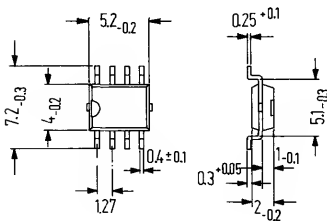
Plastic plug-in package, 14 pins
 20 A 14 DiN 41866 (TO-116)
 Weight approx. 1.1 g

TBA 221 W



Miniature plastic package, 8 pins
 Weight approx. .15 g
 Colour code brown/brown

TBA 221 G

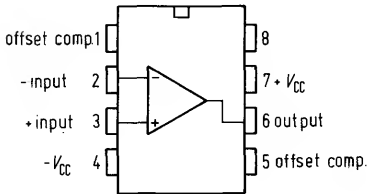


Miniature plastic package, 8 pins
 Weight approx. .15 g

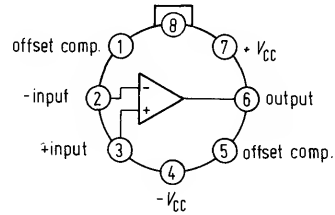
Dimensions in mm

Pin connection

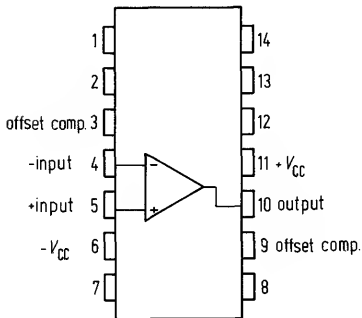
TBA 221 B



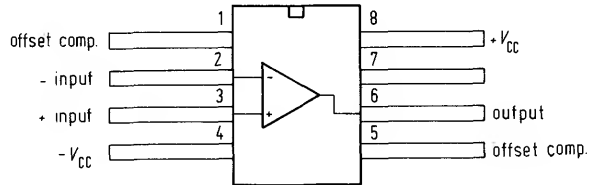
**TBA 221, TBA 222, TBA 222 Q1, TBA 222 Q2
TBA 222 S1**



TBA 221 A



TBA 221 W, TBA 221 G



TBA 221; A; B; W; G-741
TBA 222; S1; Q1; Q2-741

Maximum ratings

		TBA 221 TBA 221 A TBA 221 B TBA 221 G TBA 221 W	TBA 222 TBA 222 Q 1 TBA 222 Q 2 TBA 222 S 1	
Supply voltage	V_{CC}	± 18	± 22	V
Input voltage ($V_{CC} = \pm 4$ to ± 15 V)	V_i	$\pm V_{CC}$	$\pm V_{CC}$	V
Input voltage ($V_{CC} = \pm 15$ to ± 18)	V_i	± 15	± 15	V
Differential input voltage	V_{iD}	± 30	± 30	V
Short circuit duration ¹⁾	t_{SC}	∞	∞	
Storage temperature	T_s	-65 to +150	-65 to +150	°C
Junction temperature	T_j	150	150	°C

Thermal resistance:

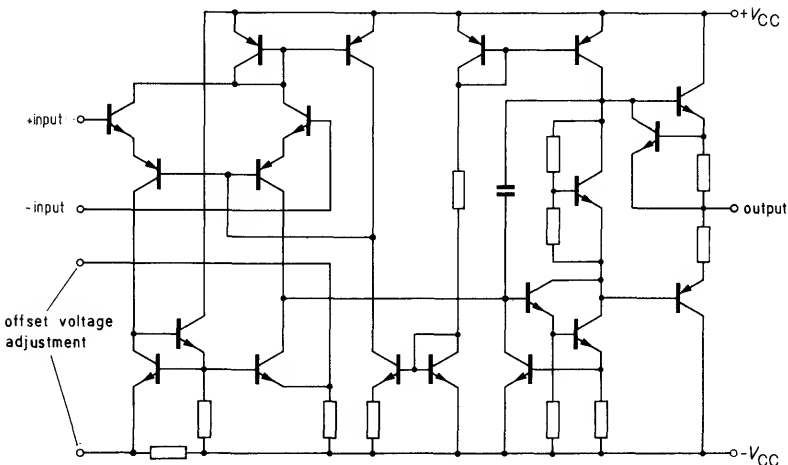
System-case (TBA 221/222)	$R_{thScase}$	80	80	K/W
System-ambient air (TBA 221/222)	R_{thSamb}	190	190	K/W
System-ambient air (TBA 221 A)	R_{thSamb}	120		K/W
System-ambient air (TBA 221 B)	R_{thSamb}	140		K/W
System-ambient air (TBA 221 W/G)	R_{thSamb}	200		K/W

Range of operation

Supply voltage	V_{CC}	± 4 to ± 18	± 4 to ± 22	V
Ambient temperature in operation	T_{amb}	0 to +70	-55 to +125	°C

¹⁾ Short circuit may be ground or $\pm V_{CC}$, thereby the maximum ratings like T_j must not be exceeded.

Circuit diagram



Operating characteristics

($V_{CC} = \pm 15$ V, $T_{amb} = 25^\circ\text{C}$
when not otherwise stated)

		TBA 221			TBA 222			
		TBA 221 A	TBA 221 B	TBA 221 G	TBA 222 Q 1	TBA 222 Q 2	TBA 222 S 1	
		min	typ	max	min	typ	max	
Input offset voltage	V_{io}	-6		6	-4		4	mV
($R_G \leq 10$ k Ω , $T_{amb} = 0$ to 70°C)	V_{io}	-7.5		7.5				mV
($R_G \leq 10$ k Ω , $T_{amb} = -55$ to $+125^\circ\text{C}$)	V_{io}				-5.5		5.5	mV
Adjustable range of input offset voltage	ΔV_{io}	6	± 15	-6	6	± 15	-6	mV
Input offset current	I_{io}	-200	± 20	200	-100	± 20	100	nA
($T_{amb} = 0$ to 70°C)	I_{io}	-300		300				nA
($T_{amb} = -55$ to $+125^\circ\text{C}$)	I_{io}				-400		400	nA
Input current	I_i		80	500		80	350	nA
($T_{amb} = 0$ to 70°C)	I_i			800				nA
($T_{amb} = -55$ to $+125^\circ\text{C}$)	I_i					.3	1.2	μA
Current supply	I_{CC}		1.7	2.8		1.7	2.8	mA
Positive output short circuit current	I_{qsc+}	15	20	25	15	20	25	mA
Negative output short circuit current	I_{qsc-}	-25	-20	-15	-25	-20	-15	mA
Input resistance	R_i	300	2000		300	2000		k Ω
Input capacitance	C_i		1.4			1.4		pF
Output resistance	R_o		75			75		Ω
Output voltage ($R_L \geq 10$ k Ω)	V_{qpp}	12	± 14	-12	13	± 14	-12.5	V
($R_L \geq 2$ k Ω)	V_{qpp}	10	± 13	-10	11	± 13	-11	V
Common mode input voltage range	V_{ICM}	12	± 13	-12	12	± 13	-12	V
Voltage gain								
($V_{qpp} = \pm 10$ V, $R_L \geq 2$ k Ω)	G_v	86	100		94	106		dB
($V_{qpp} = \pm 10$ V, $R_L \geq 2$ k Ω , $T_{amb} = 0$ to 70°C)	G_v	83.5						dB
($V_{qpp} = \pm 10$ V, $R_L \geq 2$ k Ω , $T_{amb} = -55$ to $+125^\circ\text{C}$)	G_v				88			dB
Common-mode rejection ratio	$CMRR$	70	90		80	90		dB
Sensitivity to supply voltage variations	$\frac{\Delta V_{io}}{\Delta V_{cc}}$		30	150		30	150	$\mu\text{V/V}$
Transient behaviour of the output voltage at $G_v = 1$:								
Rise time ($V_i = 20$ mV, $R_L = 2$ k Ω , $C_L < 100$ pF)	t_r		.3			.3		μs
Overshoot			5			5		%
Leading edge slope	$\frac{dV_{qpp}}{dt}$		.5			.5		V/ μs
($R_L \geq 2$ k Ω)								
Temperature coefficient of V_{io}	α_{Vio}					3		$\mu\text{V/K}$
Temperature coefficient of I_{io}	α_{Iio}					.4		nA/K

TBA 222 Q 1: similar to TBA 222, however with special quality features

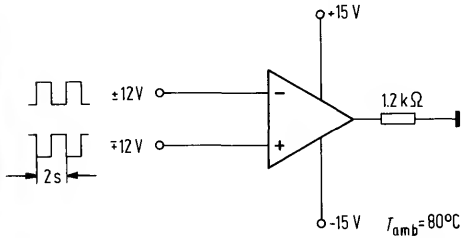
1. Burn-in at $T_{amb} = 80^{\circ}\text{C}$, 168 hours; $V_{CC} = \pm 15\text{ V}$ according to the test-circuit
2. Noise voltage $< 5\text{ }\mu\text{V}_p$, according to the test-circuit and DIN 45405
3. AQL, critical electrical defects: 0.25

TBA 222 Q 2: similar to TBA 222, however with guaranteed noise voltage $< 5\text{ }\mu\text{V}_p$ according to the test circuit AQL, critical electrical defects: 0.25

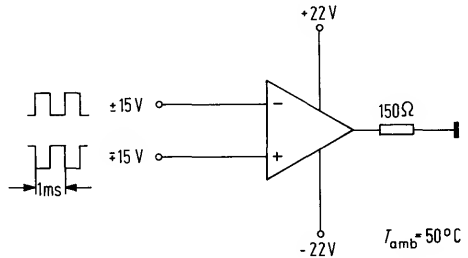
TBA 222 S 1: similar to TBA 222 Q 1, however with another burn-in.

1. Burn-in at $T_{amb} = 50^{\circ}\text{C}$, 168 hours, $V_{CC} = \pm 22\text{ V}$ according to the test-circuit
2. Noise voltage $< 5\text{ }\mu\text{V}_{pp}$
3. AQL, critical electrical defects: 0.25

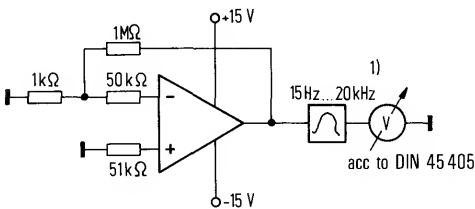
Burn-in circuit for TBA 222 Q 1



Burn-in circuit for TBA 222 S 1

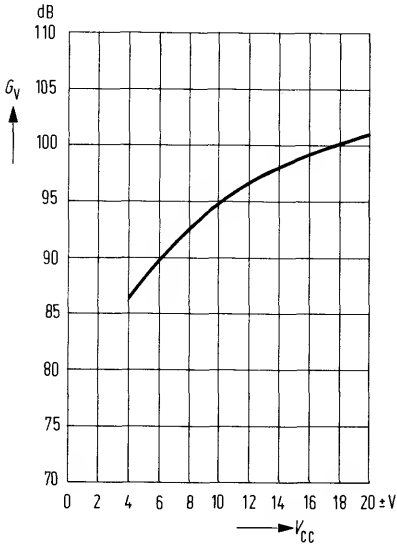


Test circuit for noise voltage: TBA 222 Q 1
TBA 222 Q 2
TBA 222 S 1

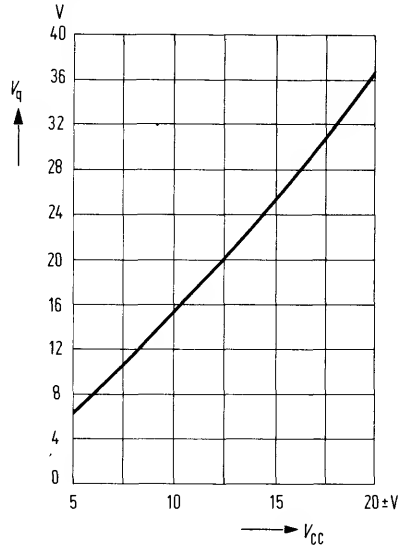


¹⁾ for TBA 222 S 1: 0.1 Hz to 20 kHz

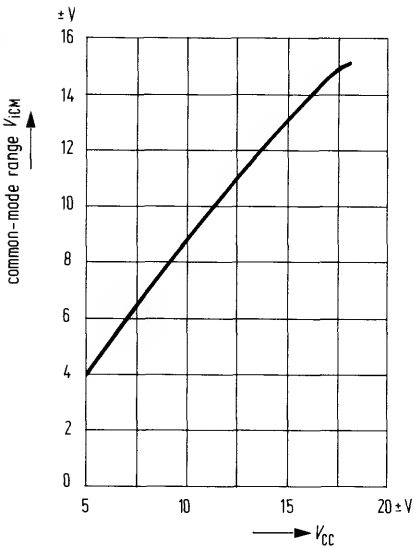
Open-loop voltage gain
 $G_V = f(V_{CC})$



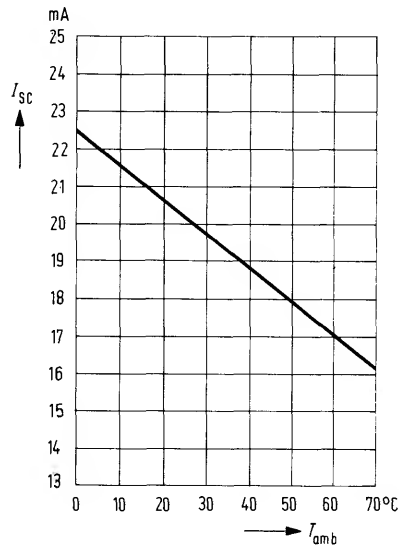
Output voltage $V_q = f(V_{CC})$
 $R_L \geq 2 \text{ k}\Omega$



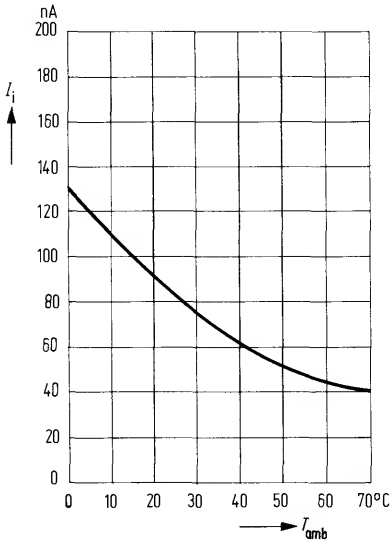
Common mode voltage range $V_{ICM} = f(V_{CC})$
 $R_L = 2 \text{ k}\Omega$



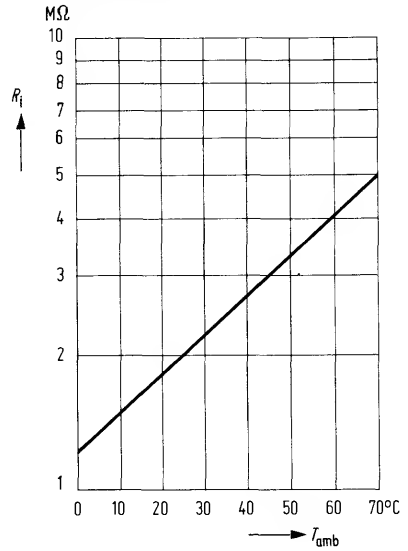
Short circuit current $I_{SC} = f(T_{amb})$



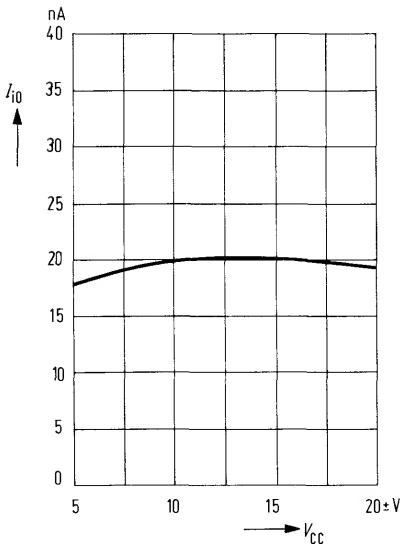
Input current $I_i = f(T_{amb})$
 $V_{CC} = \pm 15 \text{ V}$



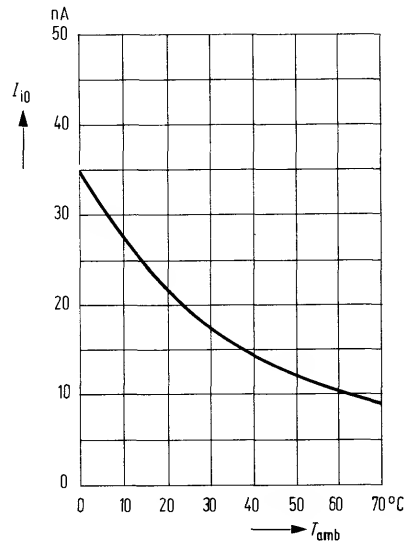
Input resistance $R_i = f(T_{amb})$
 $V_{CC} = \pm 15 \text{ V}$



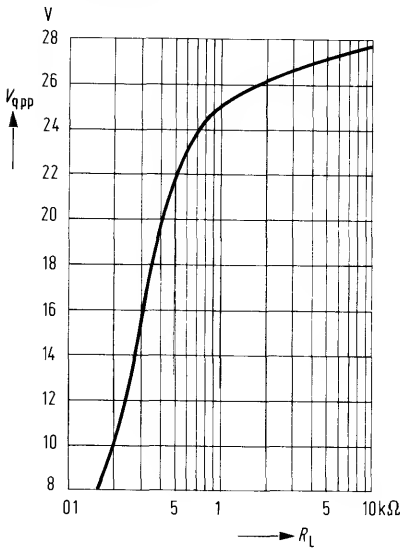
Input offset current $I_{IO} = f(V_{CC})$



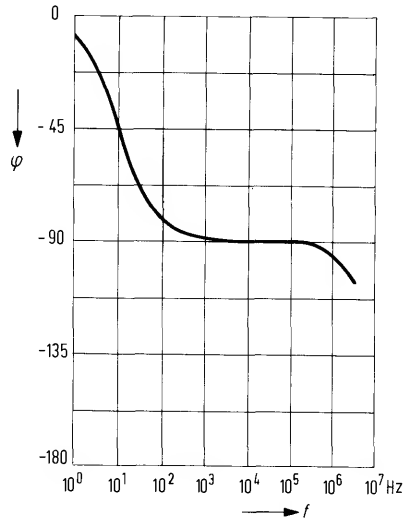
Input offset current $I_{IO} = f(T_{amb})$
 $V_{CC} = \pm 15 \text{ V}$



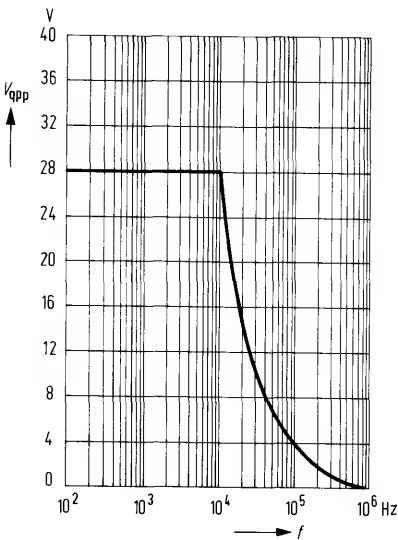
Output voltage $V_{app} = f(R_L)$
 $V_{CC} = \pm 15 \text{ V}$



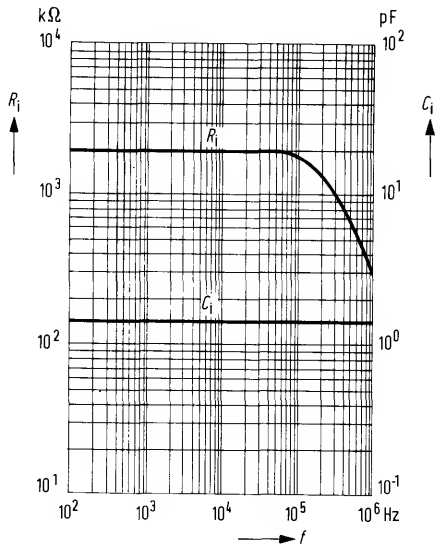
Phase of open-loop voltage gain
 $\varphi = f(f); V_{CC} = \pm 15 \text{ V}$



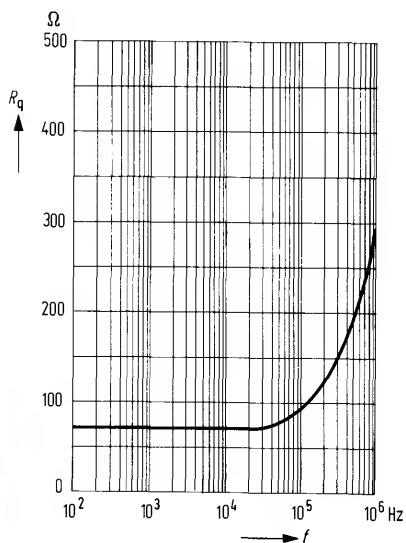
Output voltage $V_{app} = f(f)$
 $V_{CC} = \pm 15 \text{ V}; R_L = 10 k\Omega$



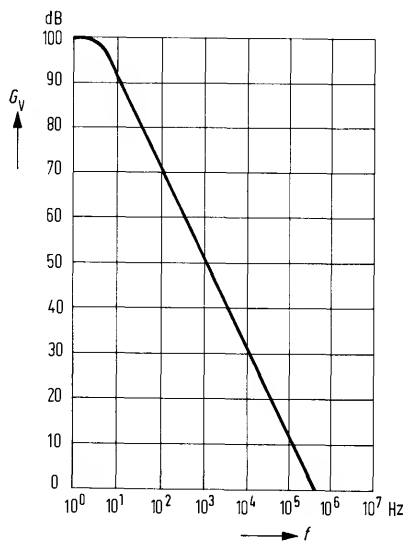
Input resistance $R_i = f(f)$
Input capacitance $C_i = f(f)$



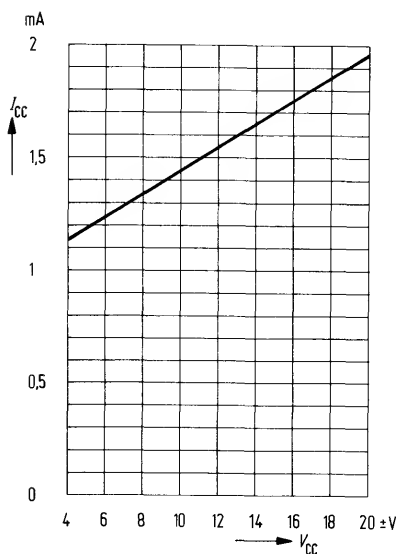
Output resistance $R_q = f(f)$



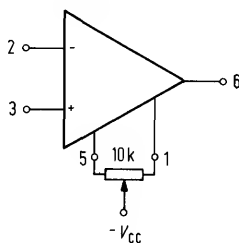
Open-loop voltage gain
 $G_v = f(f)$



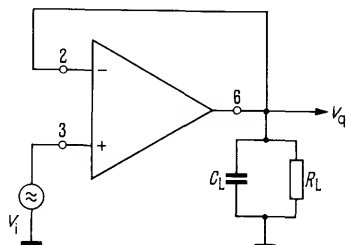
Supply current $I_{CC} = f(V_{CC})$



Offset voltage adjustment circuit



Test circuit for the transient behavior of V_{app}

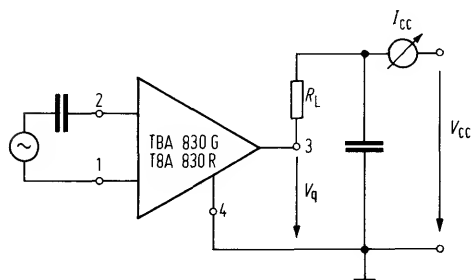


Two-stage microphone amplifiers; the ac output voltage is superimposed on the supply voltage. These amplifiers are especially well suited for piezoelectric microphones in telephone sets.

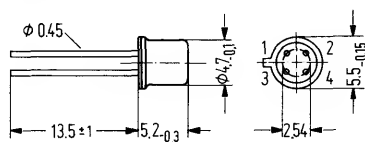
- Gain 40 dB
- Small change in gain with supply current variations
- Good frequency characteristic
- No destruction by reversal of polarity

Type	Ordering codes
TBA 830 G	Q67000-A546
TBA 830 R	Q67000-A547

Test circuit



Case outlines



Case 18 A 4 DIN 41876 (similar TO-72), weight approx. .4 g
Dimensions in mm

Maximum ratings

Supply voltage
Frequency range
Storage temperature
Junction temperature
Power dissipation
Thermal resistance:
System-case

	TBA 830 G TBA 830 R	
$V_{3,4}$	16	V
f	0 to 20	kHz
T_S	-55 to 125	°C
T_J	150	°C
P_{tot}	500	mW
$R_{thScase}$	120	K/W

Range of operation

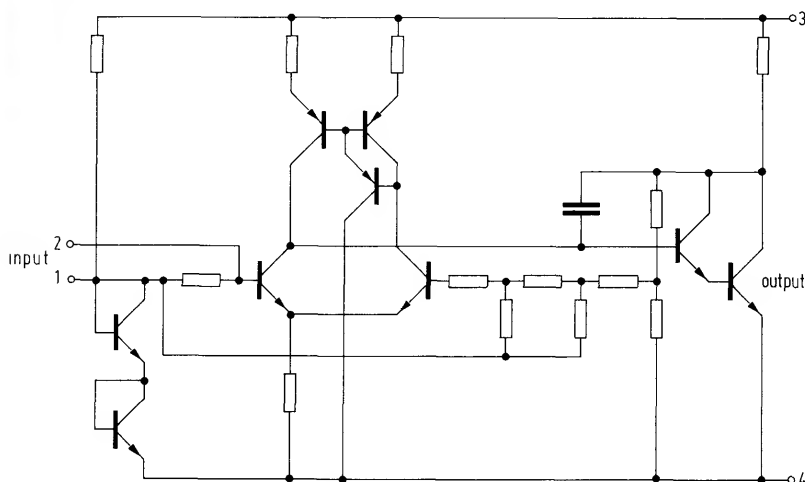
Operating current range
Ambient temperature in operation

I_{CC}	7.5 to 50	mA
T_{amb}	-20 to +55	°C

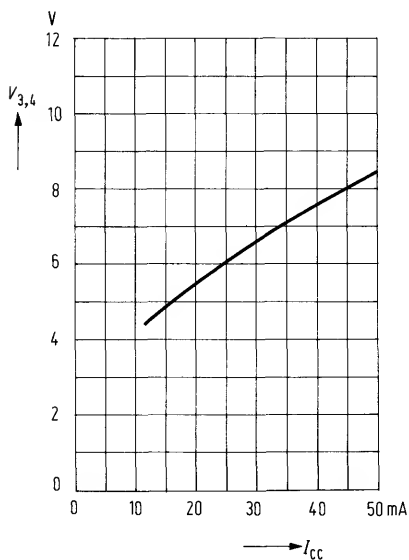
Operating characteristics ($f = 1 \text{ kHz}$, $R_L = 400 \Omega$, $I_{CC} = 15 \text{ mA}$, $V_{q\text{rms}} = 400 \text{ mV}$, $T_{\text{amb}} = 25^\circ\text{C}$)

		Test Conditions	min	typ	max	
Voltage gain	G_V	Red	40	41	43	dB
	G_V	Green	38		40	dB
Change of gain	ΔG_V	15/7.5 mA		0	.5	dB
	ΔG_V	15/50 mA	-.5	0		dB
Distortion factor	k			1	2	%
Output dc resistance	R_q			330	400	Ω
Output ac resistance	Z_q		100	110	150	Ω
Input ac resistance	Z_i		12	15		k Ω
Output ac voltage	$V_{q\text{rms}}$			1.5		V
$k = 10\%$						
Noise voltage measured from $f = 300 \text{ Hz}$ to $\sim 3 \text{ kHz}$	$V_{N\text{rms}}$		.2		.4	mV

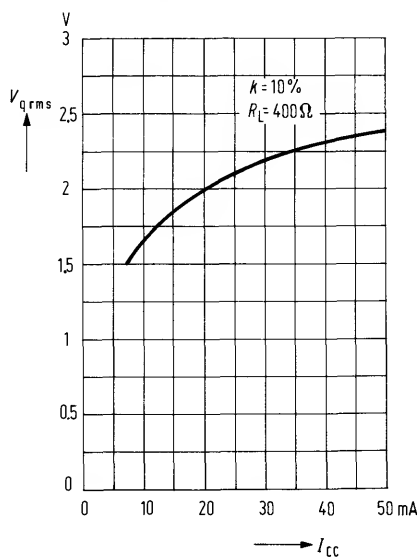
Circuit diagram



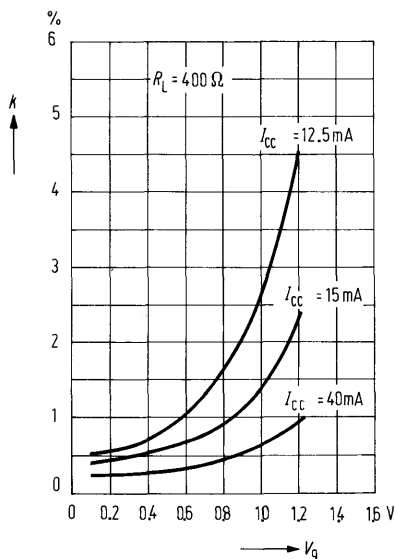
Supply voltage V_3 : $V_4 = f(I_{CC})$



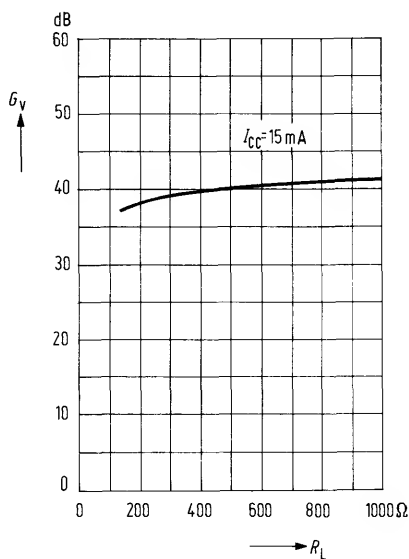
Max ac output voltage $V_{qms} = f(I_{CC})$



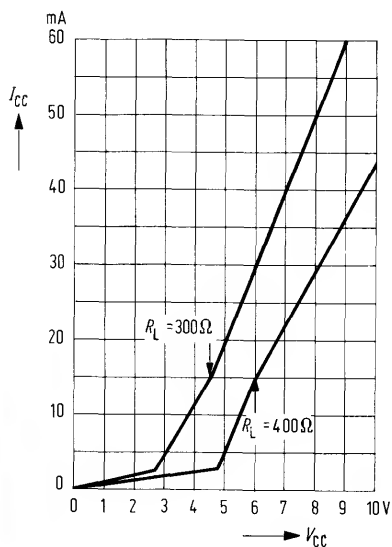
Distortion $k = f(V_q)$



Voltage gain $G_v = f(R_L)$



Current-Voltage characteristic



TBB 0747 and TBC 0747 are monolithic integrated dual operational amplifiers in packages similar to 5 J 10 DIN 41873 (TO 100). They are outstanding by reason their large common-mode voltage range and short circuit protection. In addition, they feature an adjustable input offset-voltage. No external components for frequency compensation are required. An internal gain reduction of 6 dB/octave yields maximum stability in feedback circuit applications. TBB 0747 A (14 pins) in plastic plug-in package.

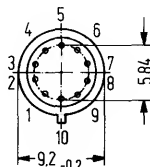
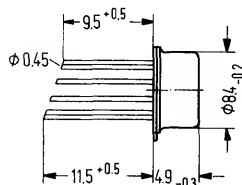
For single performance, see TBA 221 data sheet.

Type	Ordering codes
TBB 0747:	Q67000-A1038
TBB 0747 A:	Q67000-A1039
TBC 0747:	Q67000-A1040

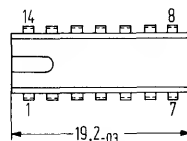
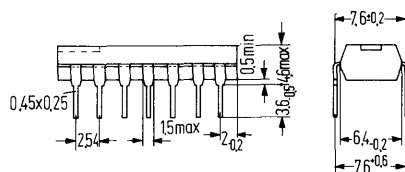
TBB 0747 A

Package outlines

TBB 0747, TBC 0747



Case 5 J 10 DIN 41873
(similar TO-100)
Weight approx. 1.1 g



Plastic plug-in package (14 pins)
20 A 14 DIN 41866 (TO-116)
Weight approx. 1.1 g

Dimensions in mm

Maximum ratings

Supply voltage
Input voltage¹⁾
Differential input voltage
Short circuit duration²⁾
Storage temperature
Junction temperature
Thermal resistance:
System-case (TBB/TBC 0747)
System-ambient air (TBB/TBC 0747)
System-ambient air (TBB 0747 A)

	TBB 0747 TBB 0747 A	TBC 0747	
V_{CC}	± 18	± 22	V
V_i	± 15	± 15	V
V_{ID}	± 30	± 30	V
t_{SC}	∞	∞	
T_S	-65 to +150	-65 to +150	°C
T_J	150	150	°C
$R_{thScase}$	80	80	K/W
R_{thSamb}	190	190	K/W
R_{thSamb}	110		K/W

Range of operation

Supply voltage
Ambient temperature in operation

V_{CC}	± 4 to ± 18	± 4 to ± 22	V
T_{amb}	0 to +70	-55 to +125	°C

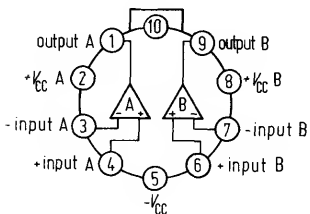
¹⁾ For supply voltage less than ± 15 V the maximum input voltage is equal to the supply voltage

²⁾ Short circuit may be ground or $\pm V_{CC}$.

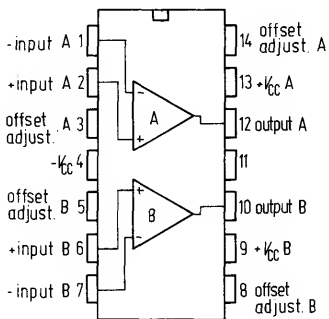
TBB 0747 -747
TBB 0747 A-747
TBC 0747 -747

Pin connection

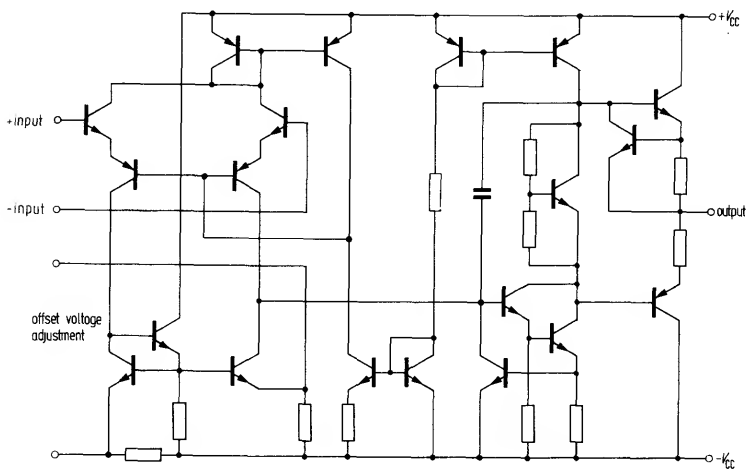
TBB 0747
TBC 0747



TBB 0747 A



Circuit diagram of a single op amp



Operating characteristics

($V_{CC} = \pm 15$ V, $T_{amb} = 25$ °C
when not otherwise stated)
(for a single opamp)

Input offset voltage

($R_G \leq 10$ k Ω , $T_{amb} = 0$ to 70 °C)

($R_G \leq 10$ k Ω , $T_{amb} = -55$ to $+125$ °C)

Adjustable range of input offset
voltage

Input offset current

($T_{amb} = 0$ to 70 °C)

($T_{amb} = -55$ to $+125$ °C)

Input current

($T_{amb} = 0$ to 70 °C)

($T_{amb} = -55$ to $+125$ °C)

Current supply

Output short circuit current

Input resistance

Input capacitance

Output resistance

Output voltage ($R_L \geq 10$ k Ω)

($R_L \geq 2$ k Ω)

Common mode input voltage
range

Voltage gain

($V_{app} = \pm 10$ V, $R_L \geq 2$ k Ω)

$T_{amb} = 0$ to 70 °C

$T_{amb} = -55$ to $+125$ °C

Common-mode rejection ratio
($R_G \leq 10$ k Ω)

Sensitivity to supply voltage
variations

Transient behaviour of the output
voltage ($G_V = 1$, $V_i = 20$ mV,
 $R_L = 2$ k Ω , $C_L < 100$ pF)

Rise time

Overshoot

Leading edge slope

($R_L \geq 2$ k Ω)

Temperature coefficient of V_{io}

Temperature coefficient of I_{io}

TBB 0747
TBB 0747 A

TBC 0747

	min	typ	max	min	typ	max	
V_{io}	-6		6	-4		4	mV
V_{io}	-7.5		7.5				mV
V_{io}				-6		6	mV
ΔV_{io}	6	± 15	-6	6	± 15	-6	mV
I_{io}	-200	± 20	200	-100	± 20	100	nA
I_{io}	-300		300				nA
I_{io}				-500		500	nA
I_i		80	500		80	350	nA
I_i			800				nA
I_i					.3	1.5	μ A
I_{CC}		1.7	2.8		1.7	2.8	mA
I_{qsc}		± 18			± 18		mA
R_i	300	2000		300	2000		k Ω
C_i		1.4			1.4		pF
R_q		75			75		Ω
V_{qpp}	12	± 14	-12	13	± 14	-12.5	V
V_{qpp}	10	± 13	-10	11	± 13	-11	V
V_{ICM}	12	± 13	-12	12	± 13	-12	V
G_V	86	100		94	106		dB
G_V	83.5						dB
G_V				88			dB
$CMRR$	70	90		80	90		dB
$\frac{\Delta V_{io}}{\Delta V_{CC}}$		30	150		30	150	μ V/V
t_r		.3			.3		μ s
		5			5		%
$\frac{dV_{qpp}}{dt}$		.5			.5		V/ μ s
α_{Vio}					3		μ V/K
α_{Iio}					.4		nA/K

Test circuits and typical performance curve see TBA 221

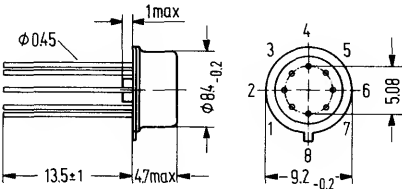
TBB 0748 and TBC 0748 are monolithic integrated operational amplifiers in packages similar to 5 G 8 DIN 41873 (TO-99). They are outstanding by their large common-mode voltage range, high differential input voltage range and permanently short-circuit proof. In addition, they feature an adjustable input offset-voltage and have the same pin configuration as the popular TBA 221 operational amplifier. Unity gain frequency compensation is achieved by means of a single 30 pF capacitor. TBB 0748 B (8 pins) in plastic plug-in package.

Type	Ordering codes
TBB 0748:	Q67000-A1041
TBB 0748 B:	Q67000-A1042
TBC 0748:	Q67000-A1073

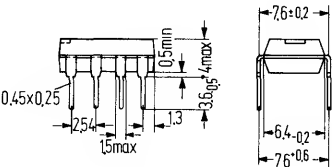
TBB 0748 B

Package outlines

TBB 0748, TBC 0748



Case similar 5 G 8 DIN 41873 (TO-99)
Weight approx. 1.2 g



Plastic plug-in package, 8 pins
20 A 8 DIN 41866
Weight approx. .7 g

Dimensions in mm

Maximum ratings

Supply voltage	V_{CC}
Input voltage ¹⁾	V_i
Differential input voltage	V_{iD}
Short circuit duration ²⁾	t_{SC}
Storage temperature	T_s
Junction temperature	T_j
Thermal resistance:	
System-case (TBB 0748/TBC 0748)	$R_{thScase}$
System-ambient air (TBB 0748, TBC 0748)	R_{thSamb}
System-ambient air (TBB 0748 B)	R_{thSamb}

	TBB 0748 TBB 0748 B	TBC 0748	
	± 18	± 22	V
	± 15	± 15	V
	± 30	± 30	V
	∞	∞	
	-65 to +150	-65 to +150	°C
	150	150	°C
	80	80	K/W
	190	190	K/W
	110		K/W

Range of operation

Supply voltage	V_{CC}
Ambient temperature in operation	T_{amb}

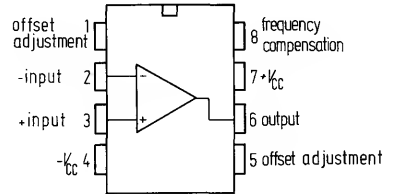
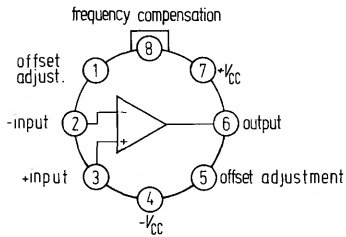
± 4 to ± 18	± 4 to ± 22	V
0 to +70	-55 to +125	°C

¹⁾ For supply voltage less than ± 15 V the maximum input voltage is equal to the supply voltage
²⁾ Short circuit may be ground or $\pm V_{CC}$.

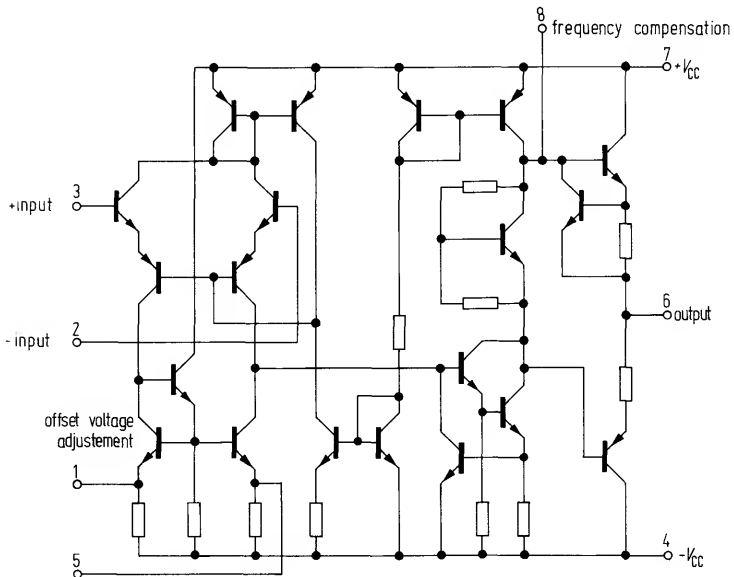
Pin connection

TBB 0748
TBC 0748

TBB 0748 B



Circuit diagram



With TBB and TBC 0748 pin 4 is electrically connected to case.

Operating characteristics

($V_{CC} = \pm 15V$, $T_{amb} = 25^\circ C$, $C = 30$ pF
when not otherwise stated)

Input offset voltage ($R_G \leq 10$ k Ω)
($T_{amb} = 0$ to $70^\circ C$)
($T_{amb} = -55$ to $+125^\circ C$)

Adjustable range of input offset
voltage

Input offset current

($T_{amb} = 0$ to $70^\circ C$)

($T_{amb} = -55$ to $+125^\circ C$)

Input current

($T_{amb} = 0$ to $70^\circ C$)

($T_{amb} = -55$ to $+125^\circ C$)

Current supply

Output short circuit current

Input resistance

Input capacitance

Output resistance

Output voltage ($R_L \geq 10$ k Ω)
($R_L \geq 2$ k Ω)

Common mode input voltage
range

Voltage gain

($V_{qpp} = \pm 10$ V, $R_L \geq 2$ k Ω)

($T_{amb} = 0$ to $70^\circ C$)

($T_{amb} = -55$ to $+125^\circ C$)

Common-mode rejection ratio
($R_G = 10$ k Ω)

Sensitivity to supply voltage
variations ($R_G = 10$ k Ω)

Transient behaviour of the output
voltage at $G_V = 1$ ($V_i = 20$ mV,
 $R_L = 2$ k Ω , $C_L < 100$ pF)

Rise time

Overshoot

Leading edge slope

($R_L \geq 2$ k Ω)

Temperature coefficient of V_{io}

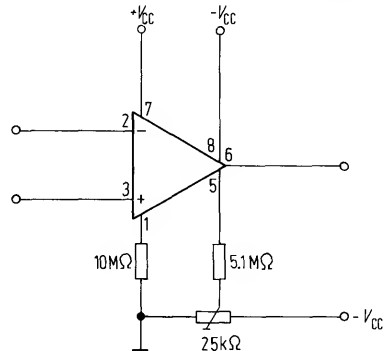
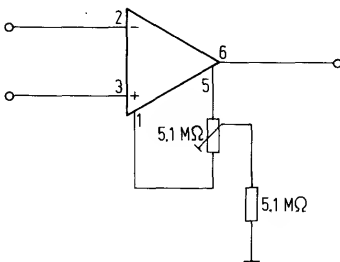
Temperature coefficient of I_{io}

TBB 0748/B

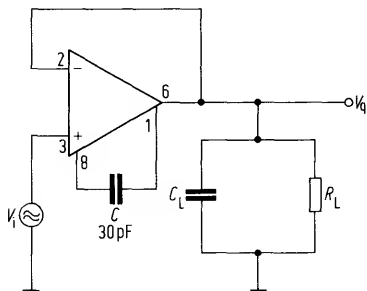
TBC 0748

	min	typ	max	min	typ	max	
V_{io}	-6		6	-4		4	mV
V_{io}	-7.5		7.5				mV
V_{io}				-6		6	mV
ΔV_{io}	6	± 15	-6	6	± 15	-6	mV
I_{io}	-200	± 20	200	-100	± 20	100	nA
I_{io}	-300		300				nA
I_{io}				-500		500	nA
I_i		80	500		80	350	nA
I_i			800				nA
I_i					.3	1.5	μA
I_{CC}		1.7	2.8		1.7	2.8	mA
I_{qsc}		± 18			± 18		mA
R_i	300	2000		300	2000		k Ω
C_i		2			2		pF
R_o		75			75		Ω
V_{qpp}	12	± 14	-12	13	± 14	-12.5	V
V_{qpp}	10	± 13	-10	11	± 13	-11	V
V_{ICM}	12	± 13	-12	12	± 13	-12	V
G_V	86	100		94	103		dB
G_V	83						dB
G_V				88			dB
$CMRR$	70	90		80	90		dB
$\frac{\Delta V_{io}}{\Delta V_{CC}}$		30	150		30	100	$\mu V/V$
$\frac{\Delta V_{CC}}{\Delta V_{CC}}$							
t_r		.3			.3		μs
		5			5		%
$\frac{dV_{qpp}}{dt}$		5.5			5.5		V/ μs
$\frac{dV_{qpp}}{dt}$							
α_{Vio}					3		$\mu V/K$
α_{Iio}					.4		nA/K

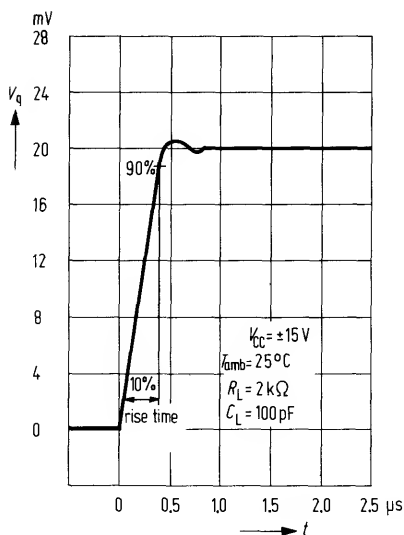
Adjustement of offset voltage.



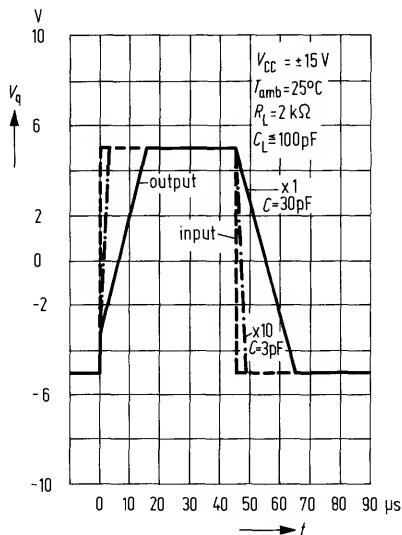
Test circuit: Transient response



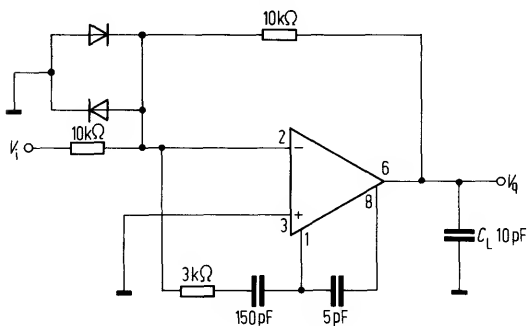
Transient response of the output voltage
 $V_o = f(t); G_v = 1$



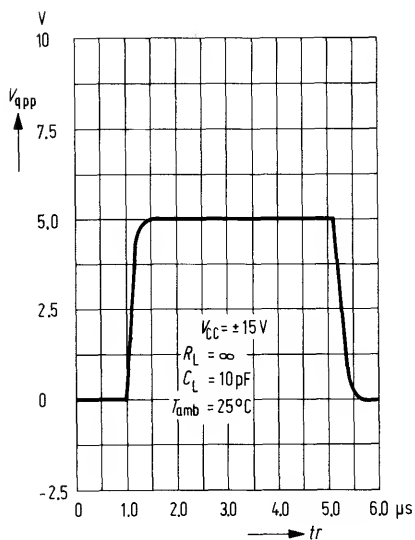
Large signal pulse response
 $V_o = f(t)$



Feed-forward compensation

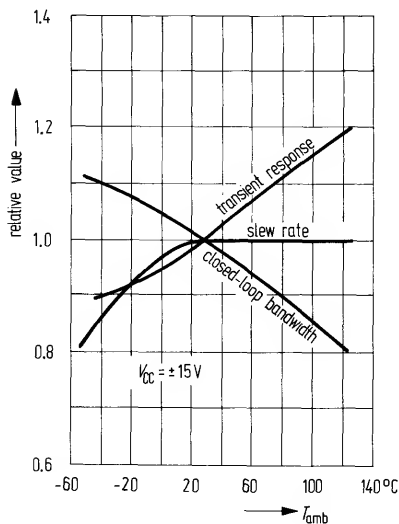


Large signal feed-forward transient response

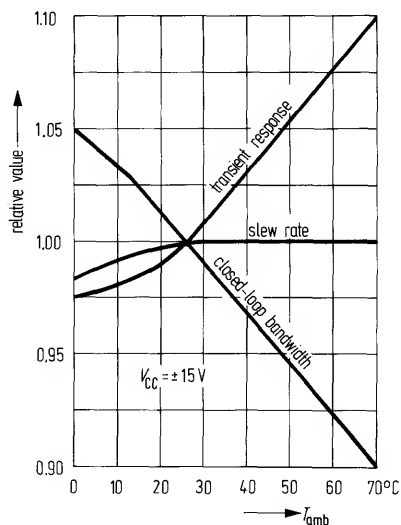


Performance curves for TBB 0748/B and TBC 0748

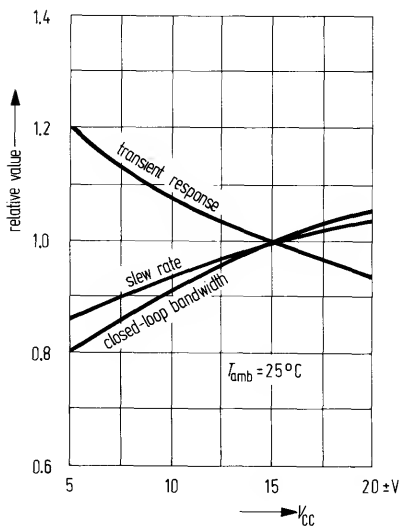
**TBC 0748 Frequency characteristics
as a function of ambient temperature**



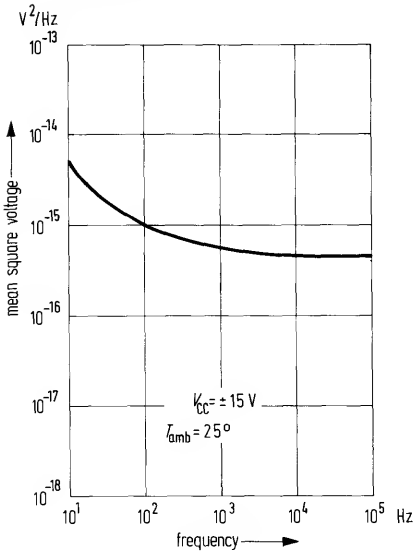
**TBB 0748 B Frequency characteristics
as a function of ambient temperature**



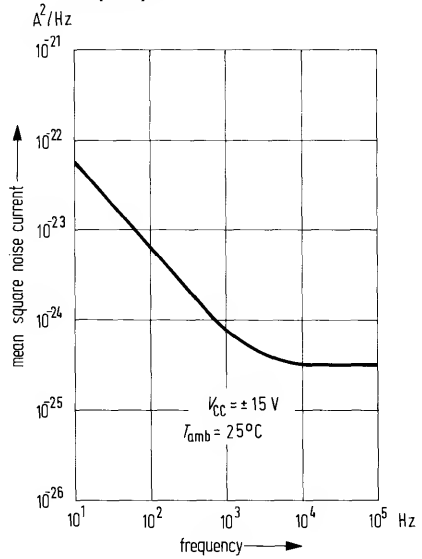
**Frequency characteristics as a
function of supply voltage**



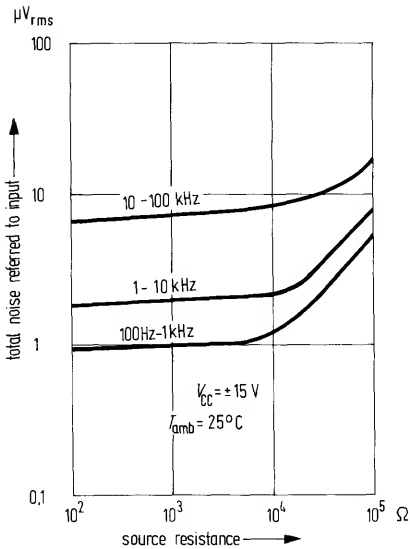
Input noise voltage as a function of frequency



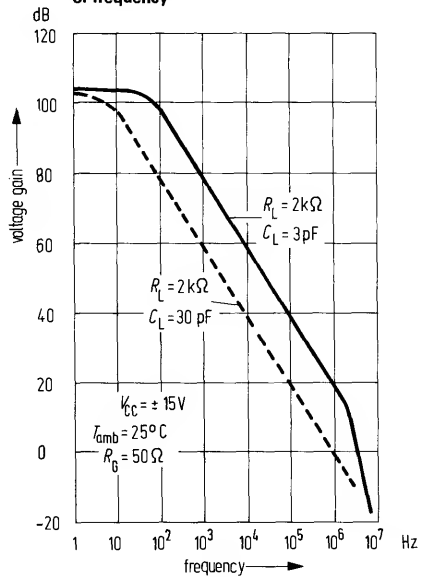
Input noise current as a function of frequency



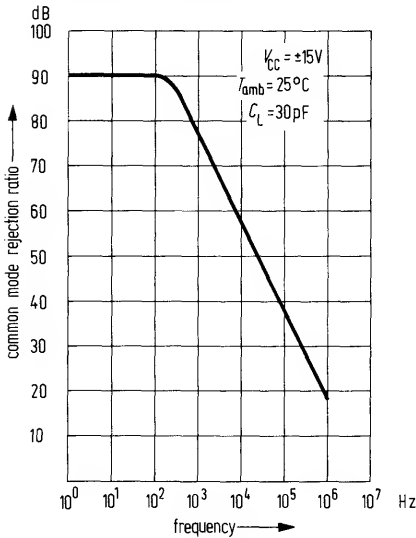
Broadband noise for various bandwidths



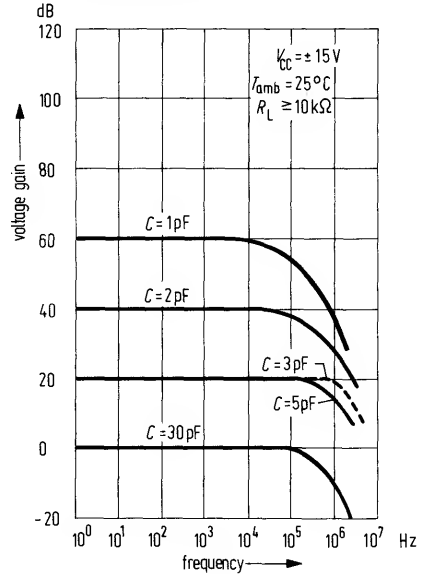
Open loop voltage gain as a function of frequency



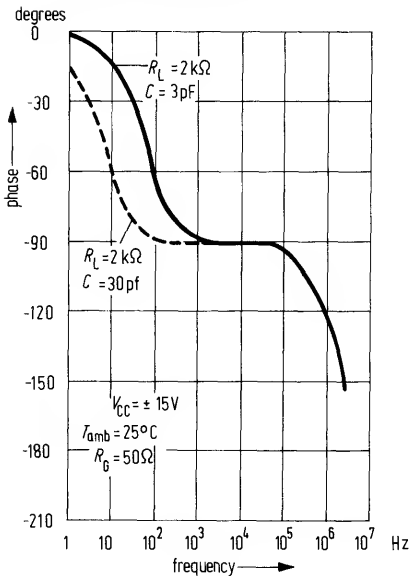
Common mode rejection ratio as a function of frequency



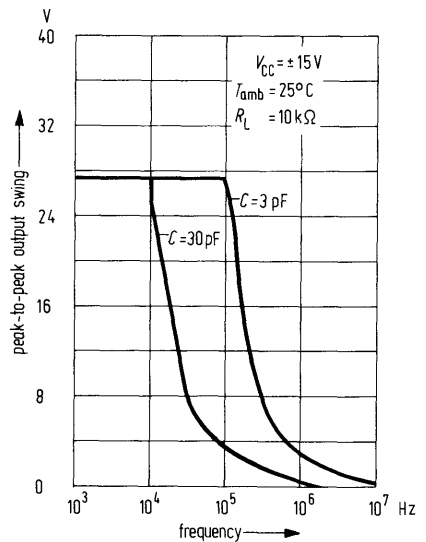
Frequency response for various closed loop gains



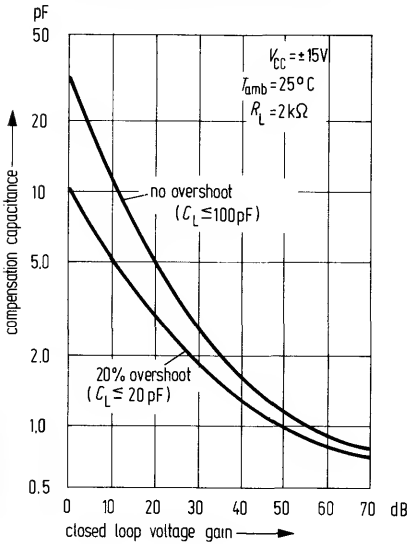
Open loop phase response as a function of frequency



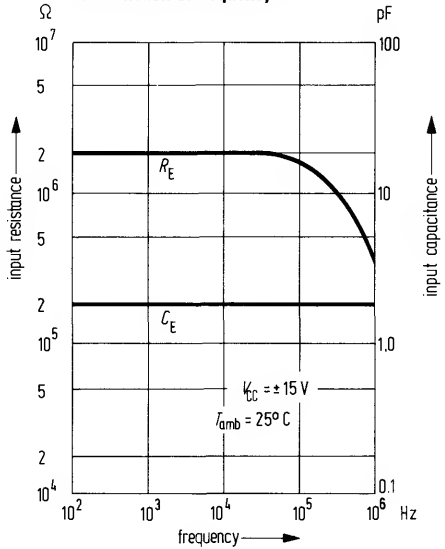
Output voltage swing as a function of frequency



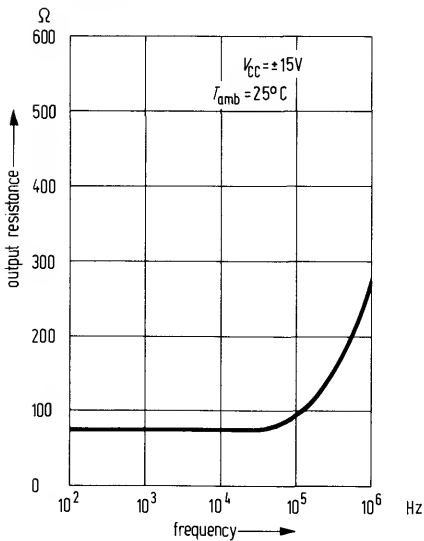
Compensation capacitance as a function of closed loop voltage gain



Input resistance and input capacitance as a function of frequency



Output resistance as a function of frequency



Further performance curves see data sheet TBA 221

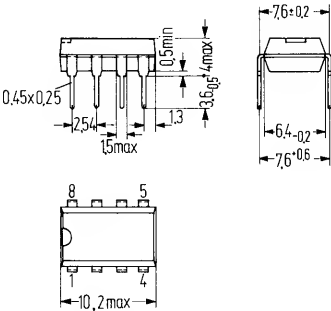
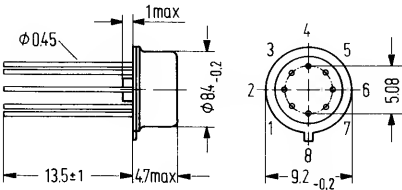
TBB 1458 and TBC 1458 are monolithic integrated dual operational amplifiers in packages similar to 5 G 8 DIN 41873. They are outstanding by reason of their large common-mode and differential voltage range and short-circuit protection. No external components for frequency compensation are required. TBB 1458 B (8 pins) in plastic plug-in package. For single amplifier performance, see the TBA 221 data sheet.

Type	Ordering codes
TBB 1458	Q67000-A1035
TBB 1458 B	Q67000-A1036
TBC 1458	Q67000-A1037

TBB 1458 B

Package outlines

TBB 1458, TBC 1458



Case similar to 5 G 8 DIN 41873 (TO-99)
Weight approx. 1.2 g

Dimensions in mm

Plastic plug-in package, 8 pins
20 A 8 DIN 41866
Weight approx. 0.7 g

Maximum ratings

Supply voltage
Input voltage¹⁾
Differential input voltage²⁾
Short circuit duration³⁾
Storage temperature
Junction temperature
Thermal resistance:
System-case (TBB 1458/TBC 1458)
System-ambient air
(TBB 1458, TBC 1458)
System-ambient air (TBB 1458 B)

	TBB 1458 TBB 1458 B	TBC 1458	
V_{CC}	± 18	± 22	V
V_i	± 15	± 15	V
V_{ID}	± 30	± 30	V
t_{SC}	∞	∞	
T_s	-65 to +150	-65 to +150	°C
T_j	150	150	°C
$R_{thScase}$	80	80	K/W
R_{thSamb}	190	190	K/W
R_{thSamb}	140		K/W

Range of operation

Supply voltage
Ambient temperature in operation

V_{CC}	± 4 to ± 18	± 4 to ± 22	V
T_{amb}	0 to +70	-55 to +125	°C

¹⁾ For supply voltage less than ± 15 V the maximum input voltage is equal to the supply voltage

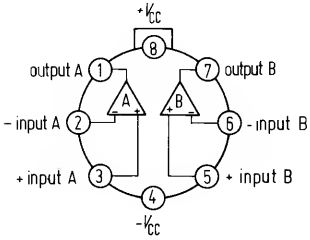
²⁾ For supply less than ± 15 V the maximum differential input voltage is equal to $\pm (V_{CC} + |V_{CC-}|)$

³⁾ Short circuit may be ground or $\pm V_{CC}$.

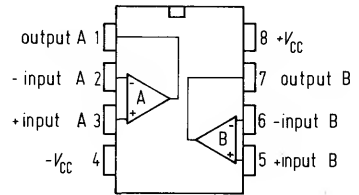
TBB 1458 -1458
TBB 1458 B-1458
TBC 1458 -1558

Pin connection

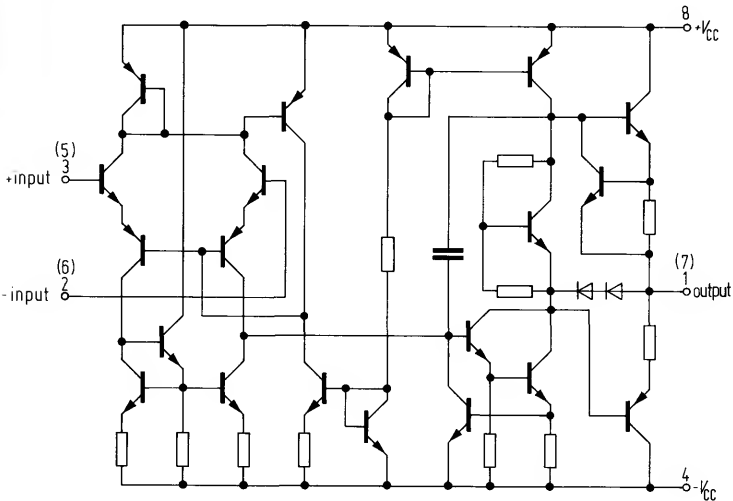
TBB 1458
TBC 1458



TBB 1458 B



Equivalent circuit (each side)



Operating characteristics

($V_{CC} = \pm 15\text{ V}$, $T_{amb} = 25^\circ\text{C}$
when not otherwise stated)

Input offset voltage ($R_G \leq 10\text{ k}\Omega$)

($T_{amb} = 0\text{ to }70^\circ\text{C}$)

($T_{amb} = -55\text{ to }+125^\circ\text{C}$)

Input offset current

($T_{amb} = 0\text{ to }70^\circ\text{C}$)

($T_{amb} = -55\text{ to }+125^\circ\text{C}$)

Input current

($T_{amb} = 0\text{ to }70^\circ\text{C}$)

($T_{amb} = -55\text{ to }+125^\circ\text{C}$)

Current supply

Output short circuit current

Input resistance

Input capacitance

Output resistance

Output voltage ($R_L \geq 10\text{ k}\Omega$)

($R_L \geq 2\text{ k}\Omega$)

Input voltage range

Voltage gain

($V_{qpp} = \pm 10\text{ V}$, $R_L \geq 2\text{ k}\Omega$)

($T_{amb} = 0\text{ to }70^\circ\text{C}$)

($T_{amb} = -55\text{ to }+125^\circ\text{C}$)

Common-mode rejection ratio

($R_G \leq 10\text{ k}\Omega$)

Sensitivity to supply voltage
variations

Leading edge slope

($R_L \geq 2\text{ k}\Omega$)

Temperature coefficient of V_{io}

Temperature coefficient of I_{io}

TBB 1458

Tbb 1458 B

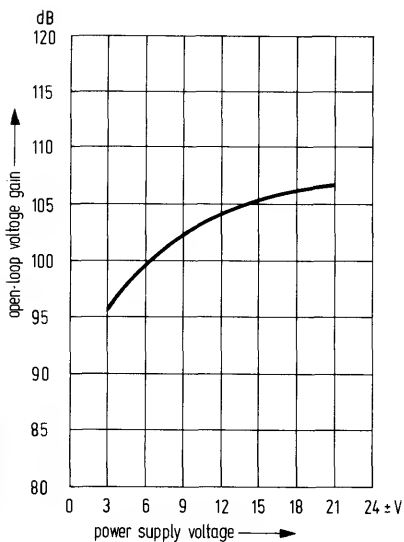
min typ max

TBC 1458

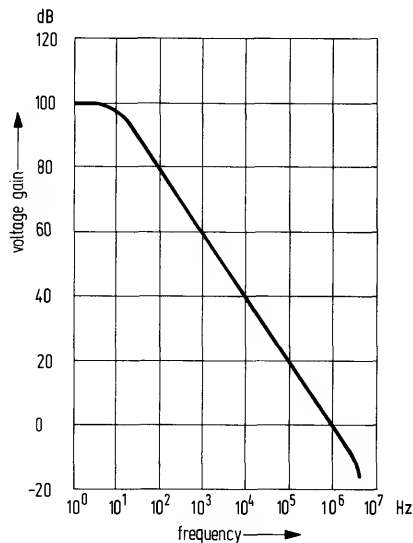
min typ max

V_{io}	-6		6	-4		4	mV
V_{io}	-7.5		7.5				mV
V_{io}				-6		6	mV
I_{io}	-200	± 20	200	-100	± 20	100	nA
I_{io}	-300		300				nA
I_{io}				-500		500	nA
I_i		80	500		80	350	nA
I_i			800				nA
I_i					.3	1.5	μA
I_{CC}		3.4	5.6		3.4	5.6	mA
I_{qsc}		± 18			± 18		mA
R_i	300	1000		300	1000		k Ω
C_i		6			6		pf
R_q		75			75		Ω
V_{qpp}	12	± 14	-12	13	± 14	-12.5	V
V_{qpp}	10	± 13	-10	11	± 13	-11	V
V_i	12	± 13	-12	12	± 13	-12	V
G_v	86	100		94	106		dB
G_v	84						dB
G_v				88			dB
$CMRR$	70	90		80	90		dB
$\frac{\Delta V_{io}}{dt}$		30	150		30	150	$\mu\text{V/V}$
$\frac{dV_{qpp}}{dt}$		.5			.5		V/ μs
α_{Vio}					3		$\mu\text{V/K}$
α_{Iio}					.4		nA/K

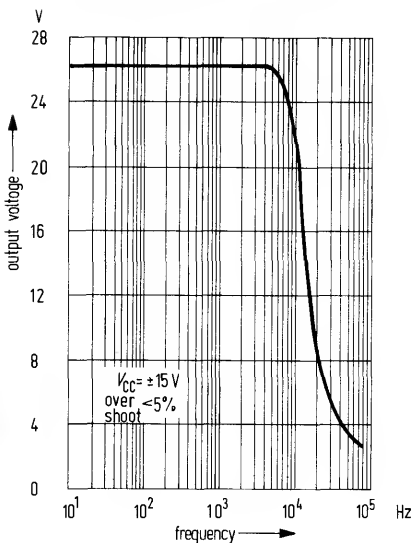
Open-loop voltage gain versus power supply voltage



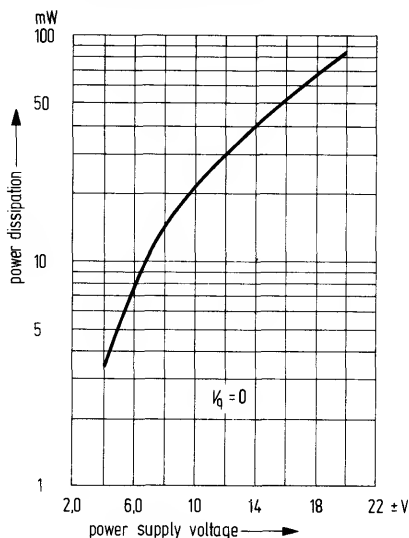
Open-loop frequency response



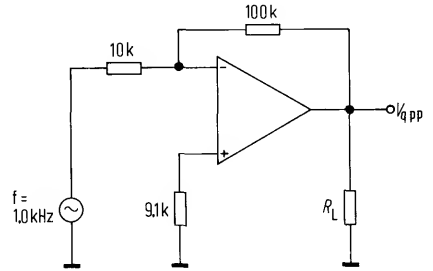
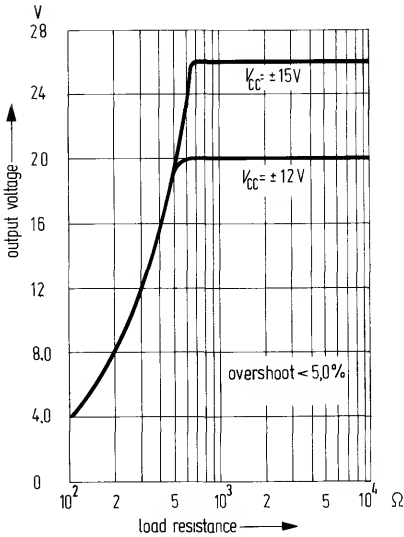
**Power bandwidth
(large signal swing versus frequency)**



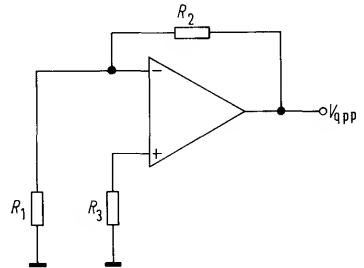
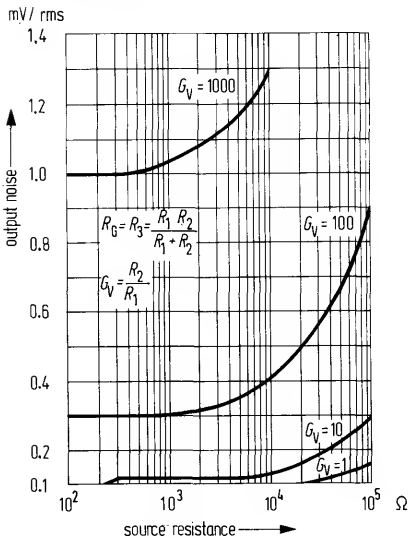
**Power dissipation
versus power supply voltage**



Output voltage swing versus load resistance



Output noise versus source resistance



For further performance curves, see TBA 221 data sheet

Dual Operational Amplifier with Darlington Input

TBB 2331/B
TBC 2332
TBE 2335/B

An economical and universal operational amplifier which by its excellent performance qualities is well suited for a wide range of applications such as measurement- and servo-systems, automobile electronics, AF-circuits, analog computers etc. The low input current of this amplifier is particularly advantageous in measurement- and servo system applications. In addition to a high gain, low offset voltage, small temperature- and supply voltage-dependence, the amplifier features

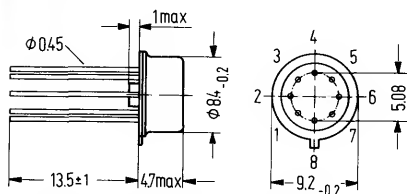
- High input resistance
- Wide common-mode range
- Large supply voltage range
- Large control range
- High output current

Type	Ordering codes
TBB 2331	Q67000-A1161
TBB 2331 B	Q67000-A1162
TBC 2332	Q67000-A1163
TBE 2335	Q67000-A1164
TBE 2335 B	Q67000-A1165

For single amplifier performance, see TCA 331 data sheet. TBB 2331 B and TBE 2335 B (8 pins) in plastic plug-in package

Package outlines

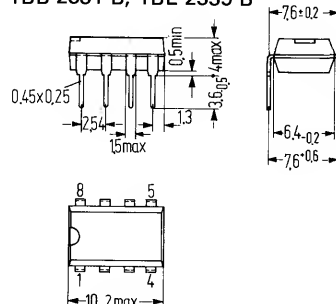
TBB 2331, TBC 2332
TBE 2335



Case similar to 5 G 8 DIN 41873 (TO-99)
Weight approx. 1.2 g

Dimensions in mm

TBB 2331 B, TBE 2335 B



Plastic plug-in package, 8 pins
20 A 8 DIN 41866
Weight approx. .7 g

Maximum ratings

Supply voltage
Output current
Differential input voltage $V_{CC} = \pm 13$ to ± 15 V
Differential input voltage $V_{CC} = \pm 2$ to ± 13 V
Junction temperature
Storage temperature
Thermal resistance:
System-case (TBB 2331, TBC 2332, TBB 2335)
System-ambient air (TBB 2331, TBC 2332, TBB 2335)
System-ambient air (TBB 2331 B, TBE 2335 B)

	TBB 2331/B	TBC 2332	TBE 2335/B
V_{CC}	± 15		V
I_g	70		mA
V_{ID}	± 13		V
V_{ID}	$\pm V_{CC}$		
T_j	150		°C
T_s	-55 to +125		°C
$R_{thScase}$	80		K/W
R_{thSamb}	190		K/W
R_{thSamb}	140		K/W

Range of operation

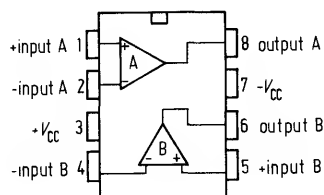
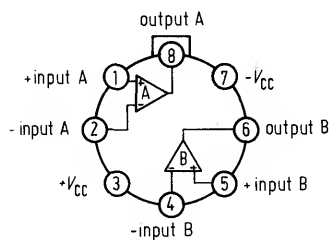
Supply voltage
Ambient temperature in operation
TBB 2331/B
TBE 2335/B
TBC 2332

V_{CC}	± 2 to ± 15	V
T_{amb}	0 to +70	°C
T_{amb}	-25 to +85	°C
T_{amb}	-55 to +125	°C

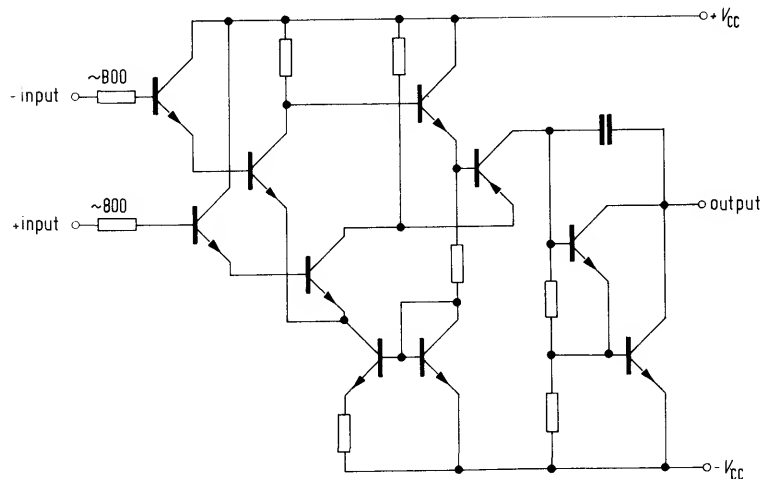
Pin connection

TBB 2331
TBC 2332
TBE 2335

TBB 2331 B
TBE 2335 B



Equivalent circuit



Operating characteristics ($V_{CC} = \pm 15\text{ V}$)		TBB 2331/B TBE 2335/B $T_{amb} = 25^\circ\text{C}$			TBC 2332 $T_{amb} = 25^\circ\text{C}$					
		min	typ	max	min	typ	max	$T_{amb} = -55\text{ to }125^\circ\text{C}$		
								min	max	
Supply current	I_{CC}		.5	1.5		.5	1.5			mA
Input offset voltage ($R_G = 50\ \Omega$)	V_{io}	-15		15	-10		10	-15	15	mV
Input offset current	I_{io}	-25	± 10	25	-15		15	-40	40	nA
Input current	I_i		30	50			30		80	nA
Output voltage ($R_L = 2\text{ k}\Omega$)	V_{opp}	14.9		-14	14.9		-14	14.8	-14	V
($R_L = 620\ \Omega$)	V_{qp}	14.9		-12.5	14.9		-12.5	14.8	-12	V
Input impedance ($f = 1\text{ kHz}$)	Z_i		3			3				M Ω
Open-loop voltage gain ($R_L = 2\text{ k}\Omega$, $f = 100\text{ Hz}$)	G_V	75	80		80	83		75		dB
($R_L = 10\text{ k}\Omega$, $f = 100\text{ Hz}$)	G_V		85			88				dB
Output leakage current I_{qlik}			1	10		1	10			μA
Input common-mode range ($R_L = 2\text{ k}\Omega$)	V_{ICM}	12	± 13.5	-12	12	± 13.5	-12			V
Common mode rejection ratio ($R_L = 2\text{ k}\Omega$)	$CMRR$	65	79		70	81				dB
Temperature-coefficient of V_{io} ($R_G = 50\ \Omega$)	α_{Vio}		12			12	50			$\mu\text{V/K}$
Temperature-coefficient of I_{io} ($R_G = 50\ \Omega$)	α_{iio}		50			50				pA/K
Sensitivity to supply voltage variations ($G_V = 100$)	$\frac{\Delta V_{io}}{\Delta V_{CC}}$		25	100		25	100			$\mu\text{V/V}$
Rise time of V_q for inverting operation (test circuit 2, TAA 861)	$\frac{dV_q}{dt_r}$		18			18				V/ μs
Output saturation voltage ($I_q = 10\text{ mA}$) $V_{CC} = \pm 5\text{ V}$	V_{qsat}			1			1			V
Supply current	I_{CC}		.5			.5				mA
Input offset voltage	V_{io}	-15		15	-10		10			mV
Input offset current	I_{io}	-25	± 10	25	-15		15			nA
Input current	I_i		30	50			30			μA
Output voltage ($R_L = 2\text{ k}\Omega$)	V_{opp}	4.9		-4	4.9		-4	4.8	-4	V
Open-loop voltage gain ($R_L = 2\text{ k}\Omega$, $f = 1\text{ kHz}$)	G_V	70			70					dB

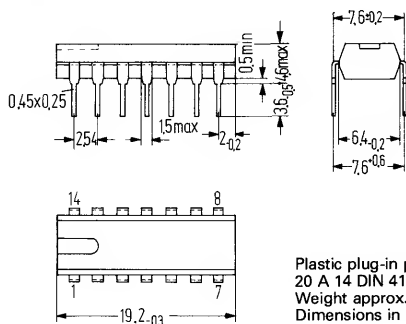
An economical and universal operational amplifier which by its excellent performance qualities is well suited for a wide range of applications such as measurement- and servo-systems, automobile electronics, AF-circuits, analog computers etc. The low input current of this amplifier is particularly advantageous in measurement- and servo system applications. In addition to a high gain, low offset voltage, small temperature- and supply voltage-dependence, the amplifier features

- High input resistance
- Wide common-mode range
- Large supply voltage range
- Large control range
- High output current

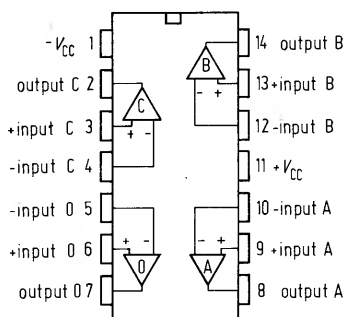
Type	Ordering codes
TBB 4331 A	Q67000-A1166
TBE 4335 A	Q67000-A1167

For single amplifier performance, see TCA 311 data sheet.

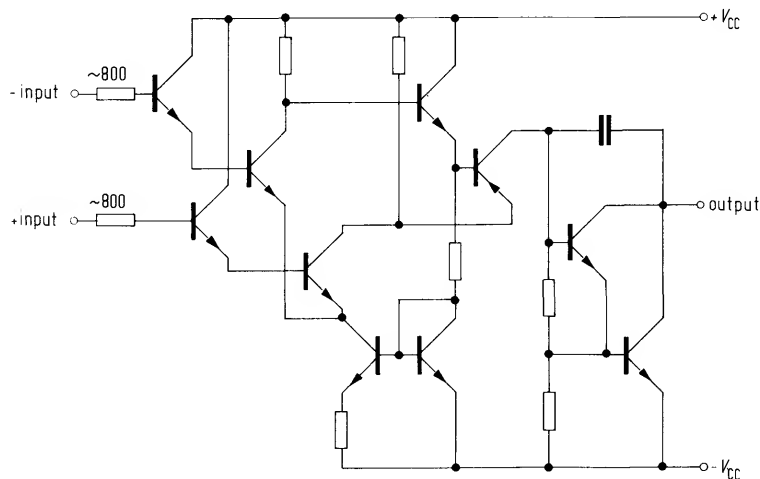
Package outlines



Pin connection



Equivalent circuit



Maximum ratings

Supply voltage
 Output current
 Differential input voltage $V_{CC} = \pm 13$ to ± 15 V
 Differential input voltage $V_{CC} = \pm 2$ to ± 13 V
 Junction temperature
 Storage temperature
 Thermal resistance:
 System-ambient air

	TBB 4331 A TBE 4335 A	
V_{CC}	± 15	V
I_q	70	mA
V_{ID}	± 13	V
V_{ID}	$\pm V_{CC}$	
T_J	150	°C
T_S	-55 to +125	°C
R_{thSamb}	140	k/W

Range of operation

Supply voltage
 Ambient temperature in operation
 TBB 4331 A
 TBE 4335 A

V_{CC}	± 2 to ± 15	V
T_{amb}	0 to +70	°C
T_{amb}	-25 to +85	°C

Operating characteristics

($V_{CC} = \pm 15$ V, $T_{amb} = 25^\circ\text{C}$)

Supply current
 Input offset voltage
 ($R_G = 50 \Omega$)
 Input offset current
 Input current
 Output voltage
 ($R_L = 2 \text{ k}\Omega$)
 ($R_L = 620 \Omega$)
 Input impedance
 ($f = 1 \text{ kHz}$)
 Open-loop voltage gain
 ($R_L = 2 \text{ k}\Omega$, $f = 100 \text{ Hz}$)
 ($R_L = 10 \text{ k}\Omega$, $f = 100 \text{ Hz}$)
 Output saturation voltage
 ($I_q = 10 \text{ mA}$)
 Output leakage current
 Input common-mode range
 ($R_L = 2 \text{ k}\Omega$)
 Common-mode rejection ration
 ($R_L = 2 \text{ k}\Omega$)
 Sensitivity to supply voltage variation
 ($G_V = 100$)
 Temp.-coefficient of V_{io}
 ($R_G = 50 \Omega$)
 Temp.-coefficient of I_{io}
 ($R_G = 50 \Omega$)
 $V_{CC} = \pm 5$ V
 Supply current
 Input offset voltage
 Input offset current
 Input current
 Open-loop voltage gain
 ($R_L = 2 \text{ k}\Omega$, $f = 1 \text{ kHz}$)
 Output voltage ($R_L = 2 \text{ k}\Omega$)

	TBB 4331 A TBE 4335 A			
	min	typ	max	
I_{CC}		1	3	mA
V_{io}	-15		15	mV
I_{io}	-25		25	nA
I_i		30	50	nA
V_{qpp}	14.9		-14	V
V_{qpp}	14.9		-12.5	V
Z_i		3		M Ω
G_V	75	80		dB
G_V		85		dB
V_{qsat}			1	V
I_{qlik}		1	10	μA
V_{iCM}	12	± 13.5	-12	V
$CMRR$	65	79		dB
$\frac{\Delta V_{io}}{\Delta V_{CC}}$		25	100	$\mu\text{V/V}$
α_{Vio}		12		$\mu\text{V/K}$
α_{Iio}		50		pA/K
I_{CC}		1		mA
V_{io}	-15		15	mV
I_{io}	-25	± 10	25	nA
I_i		30	50	nA
G_V	70			dB
V_{qpp}	4.9		-4	V

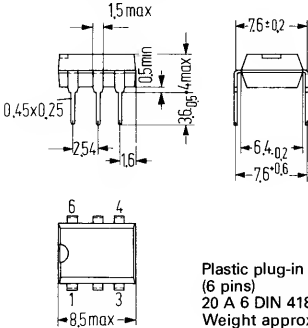
TCA 105, TCA 105 B, TCA 105 BW and TCA 105 W comprise an oscillator stage, a threshold switch and two anti-valent output stages. In addition, these circuits contain a voltage stabilization and are especially well suited for an application in proximity switches, light beam- and other contactless switching applications.

- Wide range of battery voltage 4.5 to 30 V
- High output current 50 mA
- TTL compatible
- Triggerable with dc-signals

Type	Ordering codes
TCA 105	Q67000-A527
TCA 105 W	Q67000-A600
TCA 105 B	Q67000-A587
TCA 105 BW	Q67000-A601

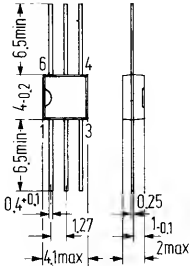
Package outlines

TCA 105, TCA 105 B



Plastic plug-in package
 (6 pins)
 20 A 6 DIN 41866
 Weight approx. .7 g

TCA 105 W, TCA 105 W



Plastic miniature package
 Weight approx. .1 g

Dimensions in mm

Colour code

TCA 105 W orange/white
 TCA 105 BW orange/red

Maximum ratings

Supply voltage
 Output voltage (pin 4.5)
 Output current
 Switching frequency
 Junction temperature
 Storage temperature
 Thermal resistance:
 System-ambient air
 TCA 105, TCA 105 B
 TCA 105 W, TCA 105 BW

	TCA 105 TCA 105 W	TCA 105 B TCA 105 BW	
V_{CC}	30	20	V
V_q	30	20	V
I_q	50	50	mA
f	40	40	kHz
T_j	150	150	°C
T_s	-55 to +125	-55 to +125	°C
R_{thSamb}	140	140	K/W
R_{thSamb}	200	200	K/W

Range of operation

Supply voltage
 Oscillating frequency range
 Ambient temperature in operation

V_{CC}	4.5 to 30	4.5 to 20	V
I_{osc}	1 to 4.5	1 to 4.5	MHz
T_{amb}	-25 to +85	-25 to +85	°C

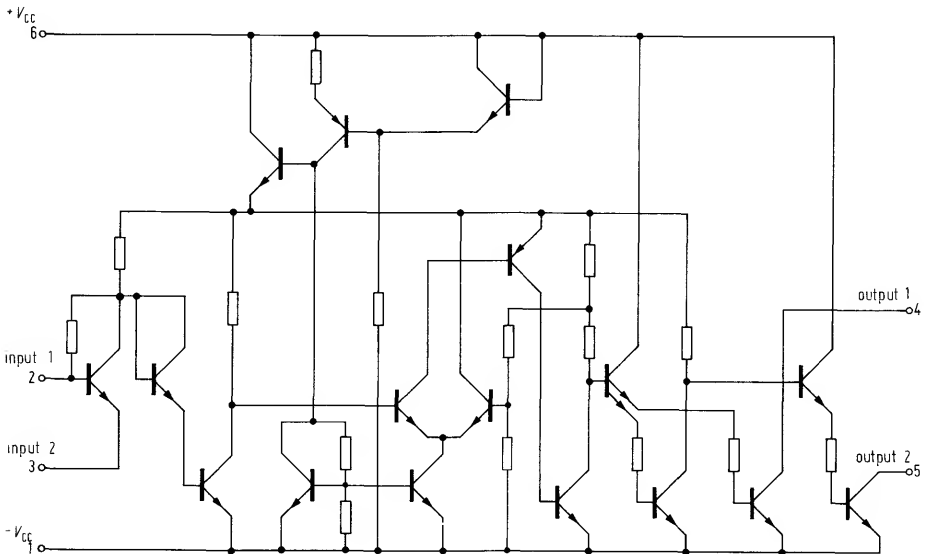
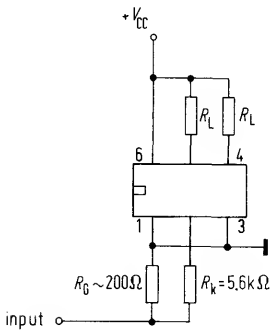
Operating characteristics

Static measurement, pins 3 and 1 connected
($V_{CC} = 12\text{ V}$, $T_{amb} = 25^\circ\text{C}$)

Supply current
Input threshold voltage with
compensation resistor R_C
Input threshold current
Hysteresis
Saturation voltage
($I_q = 16\text{ mA}$)
Saturation voltage
($I_q = 50\text{ mA}$)
Output voltage
Leakage current
 $V_{CC} = 30\text{ V}$ and/or 20 V
Switching time in TTL-operation
($I_q = 16\text{ mA}$)

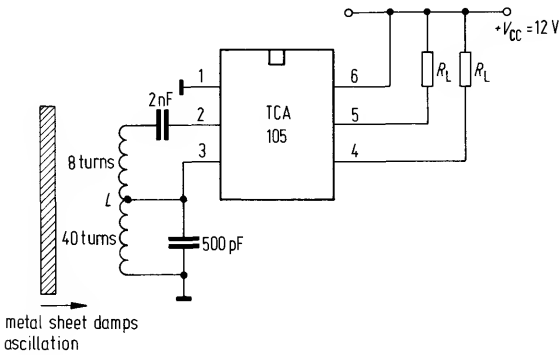
	min	typ	max	
I_{CC}		3.4	5	mA
V_i	300	400	480	mV
I_i		-60		μA
ΔK_i	25	35	50	mV
V_{qsat}		.25	.35	V
V_{qsat}		.7	1.15	V
V_q	dependant on V_{CC}			
I_{qlik}			60	μA
t		3		μS

Test circuit



Applications

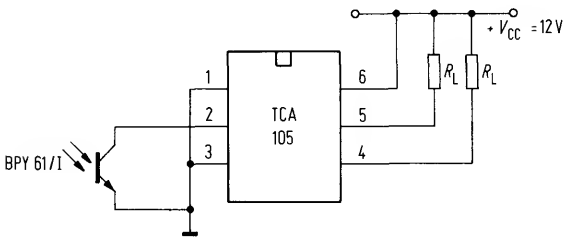
Inductive slot switch



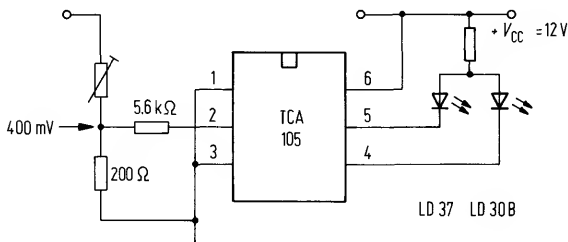
SIFERRIT pot core 9 mm $\varnothing$
B65935-A0000-X025

Number of turns: $n = 25$
(litz wire $12 \times .04$ mm)
Distance between pot core halves:
2.5 to 3.5 mm

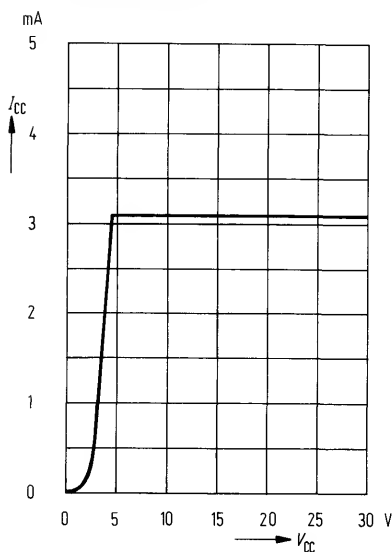
Light beam switch



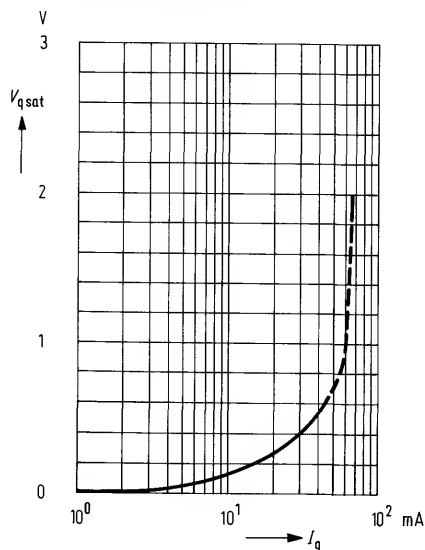
Battery voltage indicator



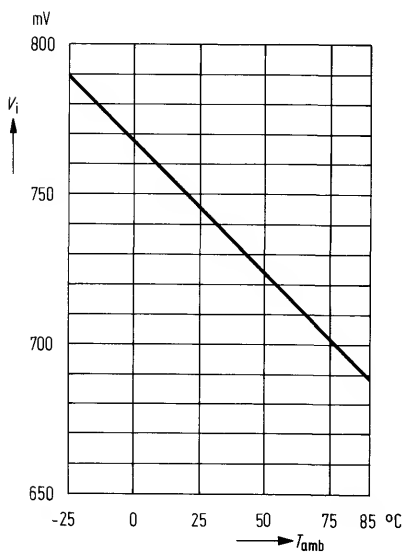
Supply current $I_{CC} = f(V_{CC})$
 $T_{amb} = 25\text{ }^{\circ}\text{C}; R_L = \infty$



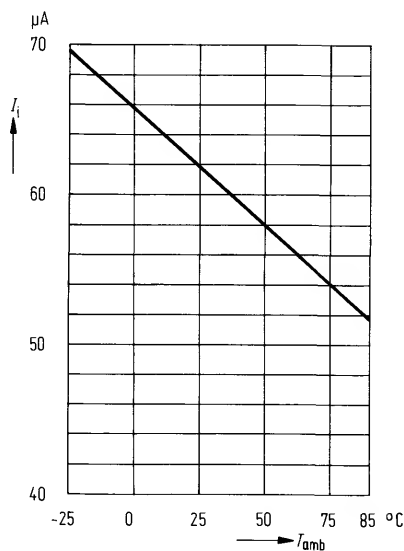
Saturation voltage $V_{q\text{sat}} = f(I_q)$
 $T_{amb} = 25\text{ }^{\circ}\text{C}; V_{CC} = 12\text{ V}$



Input threshold voltage $V_i = f(T_{amb})$
 $V_{CC} = 12\text{ V}; R_K = 0$

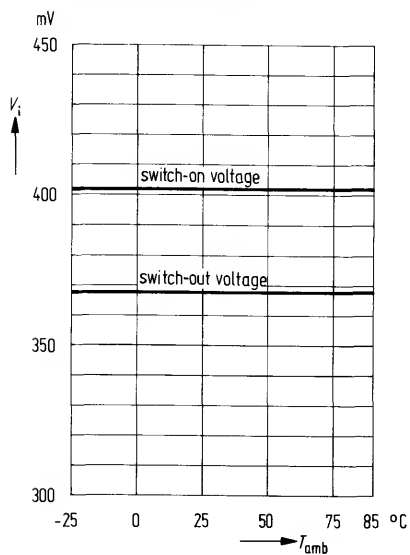


Input current $I_i = f(T_{amb})$
 $V_{CC} = 12\text{ V}; R_K = 5.6\text{ K}$

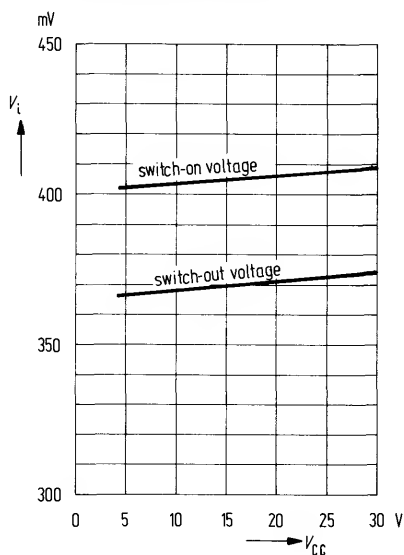


TCA 105
TCA 105 W
TCA 105 B
TCA 105 BW

Input threshold voltage $V_i = f(T_{amb})$
 $V_{CC} = 12 \text{ V}; R_K = 5.6 \text{ k}\Omega$



Input threshold voltage $V_i = f(V_{CC})$
 $T_{amb} = 25 \text{ °C}; R_K = 5.6 \text{ k}\Omega$



This circuit is well suited for applications in proximity switches. Outputs 1 and 2 switch, when the oscillation is damped (i. e. by approaching of a metal piece).

The switching-point is adjustable by resistor.

TCA 205 A and TCA 205 WII can be used for applications in proximity and slit switches. TCA 205 WI is particularly suitable for proximity switches.

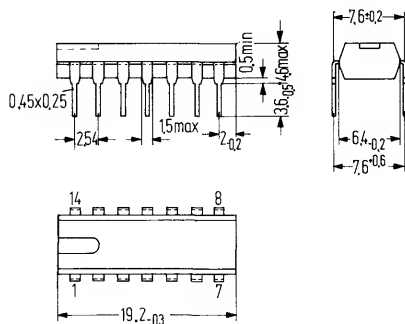
Particular characteristics:

- Large supply voltage range by internal voltage stabilisation
- High output current
- Antivalent outputs
- Adjustable distance
- Adjustable hysteresis
- Turn-on delay

Type	Ordering codes
TCA 205 A	Q67000-A1034
TCA 205 WI	Q67000-A1034-W1
TCA 205 WII	Q67000-A1034-W2

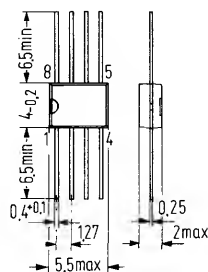
Package outlines

TCA 205 A



Plastic plug-in package 20 A DIN 41866
(TO-116)
(14 pins, DIL) weight approx. 1.1 g

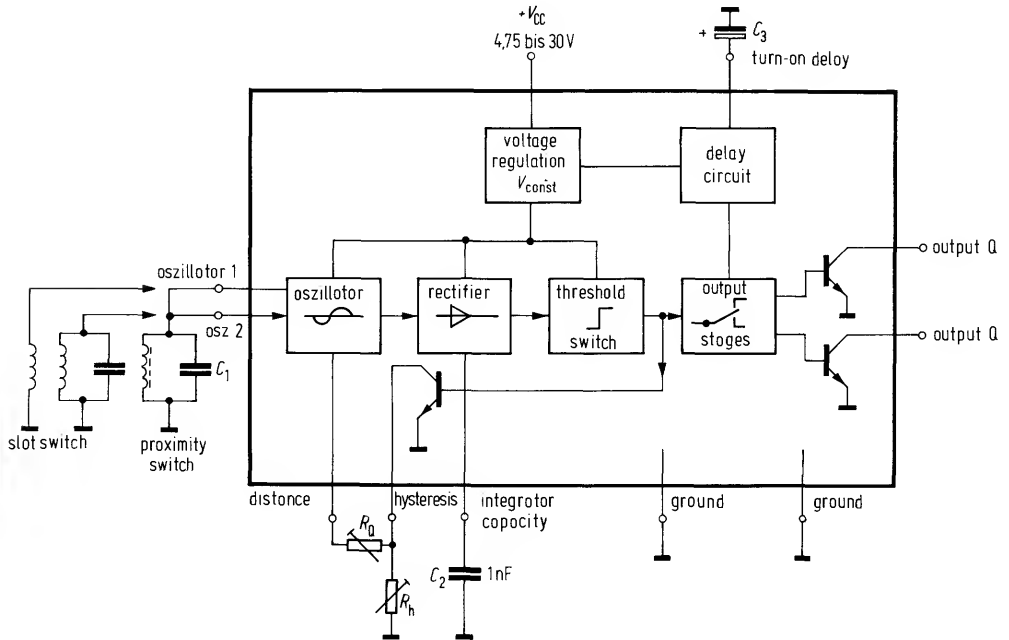
TCA 205 WI, TCA 205 WII



Miniature plastic package, 8 pins
Weight approx. .15 g

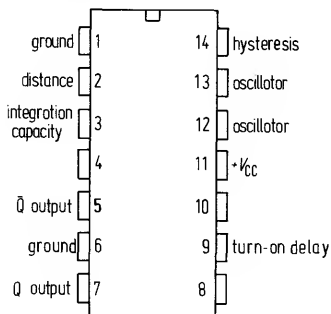
Dimensions in mm

Block diagram

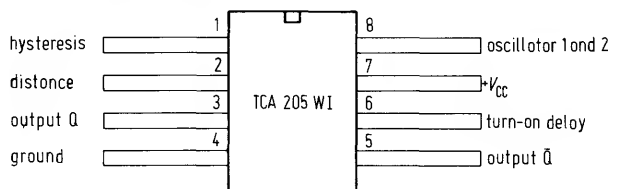


Pin configuration

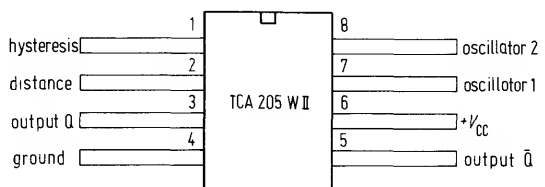
TCA 205 A



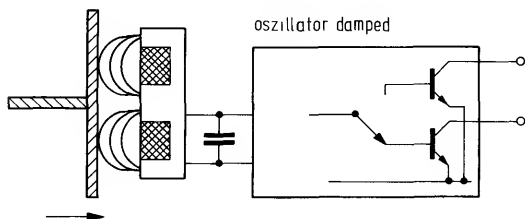
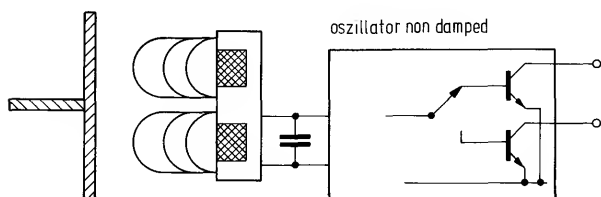
TCA 205 WI



TCA 205 WII



Application principle



Maximum ratings

Supply voltage	V_{CC}	30	V
Output voltage	V_q	V_{CC}	
Output current	I_q	50	mA
Junction temperature	T_j	150	°C
Storage temperature	T_s	−40 to +125	°C
Thermal resistance: system-ambient air	R_{thSU}	120	K/W

Range of operation

Supply voltage	V_{CC}	4.75 to 30	V
Ambient temperature in operation	T_{amb}	−25 to +85	°C

Operating characteristics

($V_{CC} = 12$ V; $T_{amb} = 25$ °C)

	min	typ	max	
Supply current TCA 205 WI, TCA 205 WII		1	2	mA
TCA 205 A		3	5	mA
Output saturation voltage: $I_q = I_q = 5$ mA		.8	1.0	V
$I_q = I_q = 50$ mA		1.25	1.5	V
Output leakage current ($V_{CC} = 30$ V)			100	μA
Range of adjustable distance	R_d	3		kΩ
Range of adjustable hysteresis	R_h	0		kΩ
Oscillation frequency	f_{osc}	.015	1.5	MHz
Switching frequency without external capacity	f		5	kHz
Turn-on delay (not for TCA 205 WII)	t	200		ms/μF
Integration capacity (at pin 3, only TCA 205 A)	C_2	0		pF

Max. switching distance without coil screening .6 × diameter of the pot core

Min. hysteresis 3% of switching distance

Operational Amplifier with Darlington Input

TCA 311; A; W
TCA 312
TCA 315; A; W

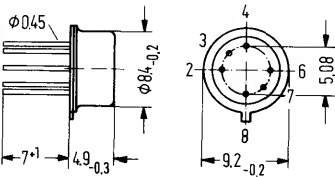
An economical operational amplifier which is well suited to be used as a Schmitt-trigger or comparator for control applications and automobile electronics. The output has been designed to control TTL-circuits directly. In addition to a high gain, low offset-voltage, small temperature- and supply voltage dependence, the amplifier features

- Very high input resistance
 - Wide common-mode range
 - Large supply voltage range
 - Large control range
- High output current
 - Low output saturation voltage
 - TTL compatible

Type	Ordering codes
TCA 311	Q67000-A1001
TCA 311 A	Q67000-A1002
TCA 311 W	Q67000-A1003
TCA 312	Q67000-A1004
TCA 315	Q67000-A1011
TCA 315 A	Q67000-A561
TCA 315 W	Q67000-A1005

Package outlines

TCA 311, TCA 312, TCA 315

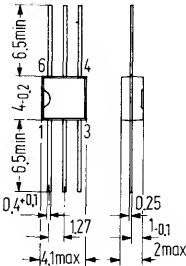


Package 5 H 6 DIN 41873
(similar TO-78)
Weight approx. 1 g

TCA 311 W

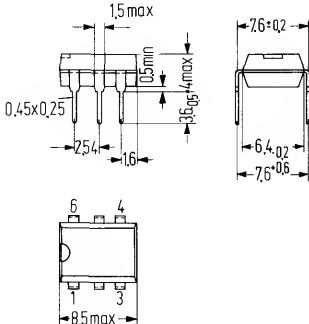
TCA 315 W

TCA 311 A, TCA 315 A



Miniature plastic package
6 pins
Weight approx. .1 g
Colour code
TCA 311 W red/white
TCA 315 W red/yellow

Dimensions in mm



Plastic plug-in package
6 pins
20 A 6 DIN 41866
Weight approx. .7 g

Maximum ratings

- Supply voltage
- Output current
- Current at pin R
- Differential input voltage $V_{CC} = \pm 13$ to ± 15 V
- Differential input voltage $V_{CC} = \pm 2$ to ± 13 V
- Junction temperature
- Storage temperature
- Thermal resistances:
 - System-case (TCA 311, 312, 315)
 - System-ambient air (TCA 311, 312, 315)
 - System-ambient air (TCA 311 A, 315 A)
 - System-ambient air (TCA 311 W, 315 W)

	TCA 311/A/W TCA 312 TCA 315/A/W	
V_{CC}	± 15	V
I_q	70	mA
I_R	10	mA
V_{ID}	± 13	V
V_{ID}	$\pm V_{CC}$	
T_j	150	°C
T_s	-55 to +125	°C
$R_{thScase}$	80	K/W
R_{thSamb}	190	K/W
R_{thSamb}	140	K/W
R_{thSamb}	200	K/W

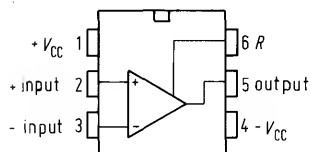
Range of operation

- Supply voltage
- Ambient temperature in operation TCA 311/A/W
- TCA 315/A/W
- TCA 312

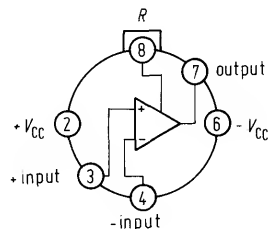
V_{CC}	± 2 to ± 15	V
T_{amb}	0 to +70	°C
T_{amb}	-25 to +85	°C
T_{amb}	-55 to +125	°C

Pin connection

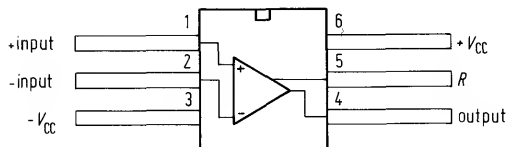
TCA 311 A
TCA 315 A



TCA 311
TCA 312
TCA 315

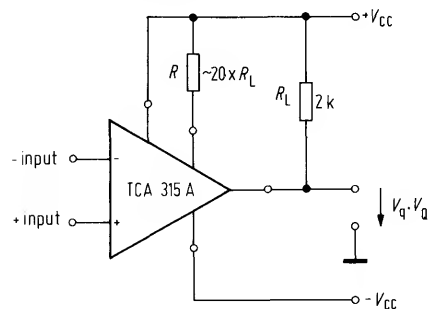


TCA 311 W
TCA 315 W

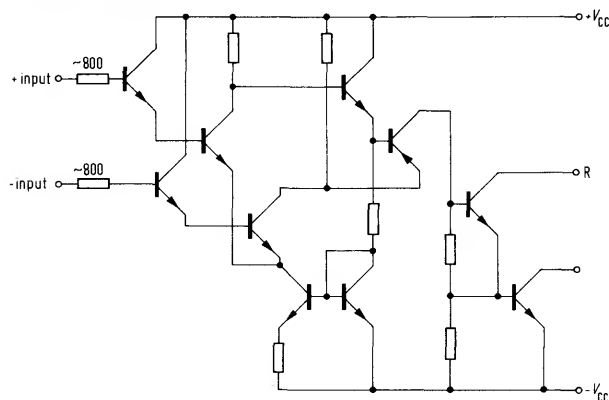


Connection diagram

R_L = load resistance



Circuit diagram



Operating characteristics

($V_{CC} = \pm 15$ V,
 $R = 6.8$ k Ω)

TCA 311/A/W
TCA 315/A/W
 $T_{amb} = 25^{\circ}\text{C}$

TCA 312

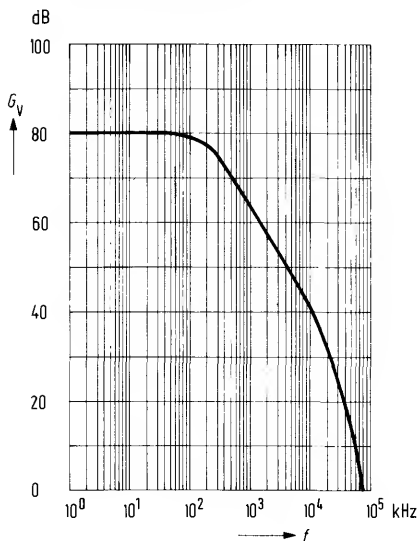
$T_{amb} = 25^{\circ}\text{C}$

$T_{amb} = -55$
to 125°C

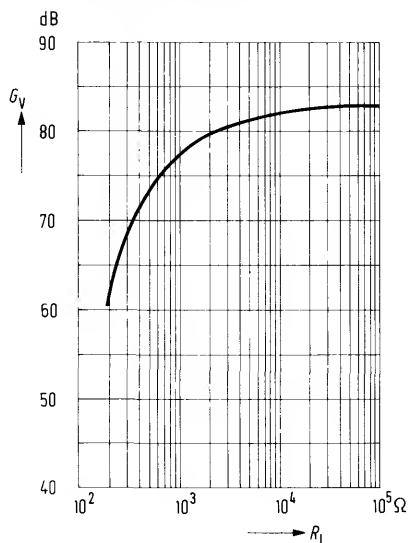
		min	typ	max	min	typ	max	min	max	
Supply current	I_{CC}		1.5	2.5		1.5	2.5			mA
Input offset voltage ($R_G = 50$ Ω)	V_{io}	-20		20	-14		14	-20	20	mV
Input offset current	I_{io}	-25	± 10	25	-15		15	-40	40	nA
Input current ($V_{ID} = 0$)	I_i		30	50			30		80	nA
Input current ($V_{ID} = \pm 13$ V)	I_i			200			200			nA
Output voltage ($R_L = 2$ k Ω)	V_{opp}	14.9		-14.8	14.9		-14.8	14.8	-14.6	V
($R_L = 620$ Ω)	V_{opp}	14.9		-14.0	14.9		-14.8	14.8	-13.5	V
($R_L = 2$ k Ω , $f = 100$ kHz)	V_{opp}		± 10			± 10				V
Input impedance ($f = 1$ kHz)	Z_i		3			3				M Ω
Open-loop voltage gain										
($R_L = 2$ k Ω , $f = 1$ kHz)	G_v	75	80		80	83		75		dB
($R_L = 10$ k Ω , $f = 1$ kHz)	G_v		85			88				dB
($R_L = 2$ k Ω , $f = 1$ MHz)	G_v		60			60				dB
Input common-mode range	V_{ICM}	13		-13	13		-13			V
($R_L = 2$ k Ω)										
Common mode rejection ratio ($R_L = 2$ k Ω)	$CMRR$	60	74		65	77				dB
Sensitivity to supply voltage variation ($G_v = 100$)	$\frac{\Delta V_{io}}{\Delta V_{CC}}$		25	200		25	200			$\mu\text{V/V}$
Temp. coefficient of V_{io} ($R_G = 50$ Ω)	ΔV_{io}		12			12	50			$\mu\text{V/K}$
Temp. coefficient of I_{io}	ΔI_{io}		50			50				pA/K

Operating characteristics (continued) $V_{CC} = \pm 15\text{ V};$ $R = 6.8\text{ k}\Omega$		TCA 311/A/W TCA 315/A/W $T_{\text{amb}} = 25\text{ }^{\circ}\text{C}$			TCA 312 $T_{\text{amb}} = 25\text{ }^{\circ}\text{C}$ $T_{\text{amb}} = -55$ to $+125\text{ }^{\circ}\text{C}$					
		min	typ	max	min	typ	max	min	max	
Rise time of V_q for non-inverting operation (see TAA 761 test circuit 1)	$\frac{dV_q}{dt_r}$		30			30				V/ μs
Output saturation voltage ($I_q = 10\text{ mA}$)	V_{qsat}			200			200		400	mV
Output leakage current I_{qlik}			1	10		1	10			μA
$V_{CC} = \pm 5\text{ V}, R = 6.8\text{ k}\Omega$										
Input offset voltage	V_{io}	-20		20	-14		14			mV
$R_G = 50\text{ }\Omega$										
Input offset current	I_{io}	-25	± 10	25	-15		15			nA
Input current	I_i		30	50			30			nA
Open loop voltage gain G_v ($R_L = 2\text{ k}\Omega, f = 1\text{ kHz}$)		65			70					dB

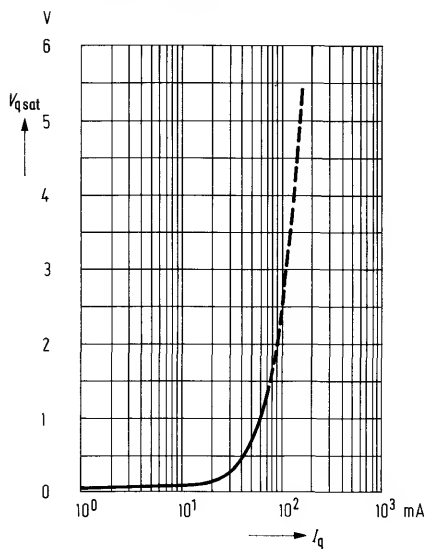
Open-loop voltage gain $G_V = f(f)$
 $R_L = 2 \text{ k}\Omega$; $R = 6.8 \text{ k}\Omega$



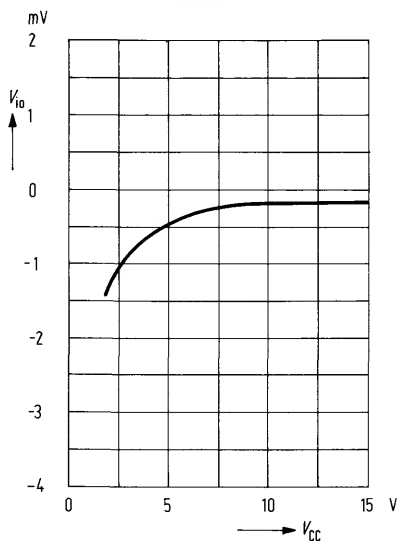
Open-loop voltage gain $G_V = f(R_L)$
 $T_{\text{amb}} = 25^\circ\text{C}$; $R = 6.8 \text{ k}\Omega$



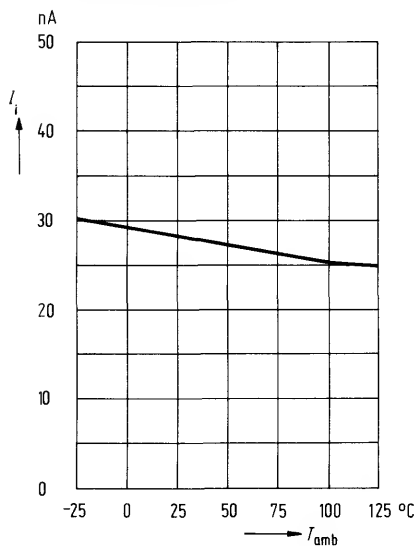
Output saturation voltage $V_{\text{qsat}} = f(I_q)$
 $T_U = 25^\circ\text{C}$; $R = 6.8 \text{ k}\Omega$



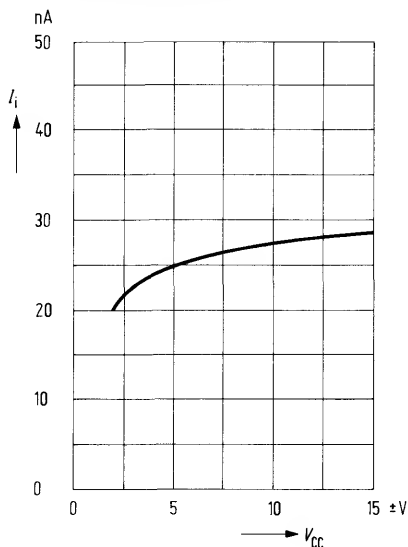
Input offset voltage $V_{io} = f(V_{CC})$
 $T_{\text{amb}} = 25^\circ\text{C}$; $R = 6.8 \text{ k}\Omega$



Input current $I_i = f(T_{amb})$
 $R_L = 2\text{ k}\Omega$; $V_{CC} = \pm 15\text{ V}$



Input current $I_i = f(V_{CC})$
 $T_{amb} = 25\text{ °C}$; $R_L = 2\text{ k}\Omega$



For further performance curves see TAA 761

Operational Amplifier TTL Compatible

TCA 321; A; W
TCA 322
TCA 325; A; W

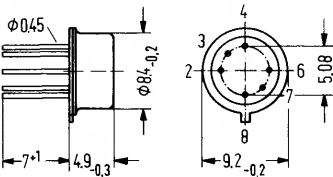
An economical operational amplifier which is well suited to be used as a Schmitt-trigger or comparator for control applications and automobile electronics. The output has been designed to control TTL-circuits directly. In addition to a high gain, low offset voltage, small temperature- and supply voltage dependence, the amplifier features:

- Wide common-mode range
- Large supply voltage range
- Wide control range
- High output current
- Low output saturation voltage
- TTL compatible

Type	Ordering codes
TCA 321	Q67000-A1006
TCA 321 A	Q67000-A1007
TCA 321 W	Q67000-A1008
TCA 322	Q67000-A1009
TCA 325	Q67000-A1010
TCA 325 A	Q67000-A562
TCA 325 W	Q67000-A1012

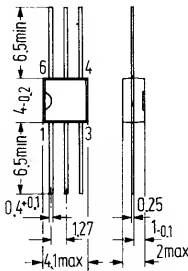
Package outlines

TCA 321, TCA 322, TCA 325



Case 5 H 6
DIN 41873
(similar T0-78)
Weight approx. 1 g

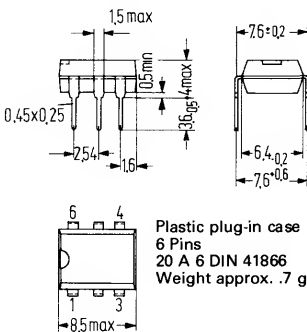
TCA 321 W, TCA 325 W



Miniature plastic case
6 Pins
Weight approx. .1 g
Colour code
TCA 321 W green/white
TCA 325 W green/yellow

Dimensions in mm

TCA 321 A, TCA 325 A



Plastic plug-in case
6 Pins
20 A 6 DIN 41866
Weight approx. .7 g

Maximum ratings

- Supply voltage
- Output current
- Current (pin R)
- Differential input voltage
- Junction temperature
- Storage temperature
- Thermal resistance:
 - System-case (TCA 321, TCA 322, TCA 325)
 - System-ambient air (TCA 321, 322, 325)
 - System-ambient air (TCA 321 A, TCA 325 A)
 - System-ambient air (TCA 321 W, TCA 325 W)

	TCA 321/A/W TCA 322 TCA 325/A/W	
V_{CC}	± 15	V
I_q	70	mA
I_R	10	mA
V_{ID}	$\pm V_{CC}$	
T_J	150	°C
T_S	-55 to +150	°C
$R_{thScase}$	80	K/W
R_{thSamb}	190	K/W
R_{thSamb}	140	K/W
R_{thSamb}	200	K/W

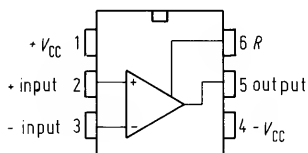
Supply voltage	V_{CC}	± 2 to ± 15	V
Ambient temperature in operation TCA 321/A/W	T_{amb}	0 to +70	°C
TCA 325/A/W	T_{amb}	-25 to +85	°C
TCA 322	T_{amb}	-55 to +125	°C

Range of operation

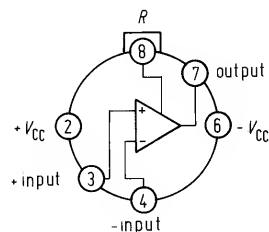
- Supply voltage
- Ambient temperature in operation TCA 321/A/W
- TCA 325/A/W
- TCA 322

Pin connection

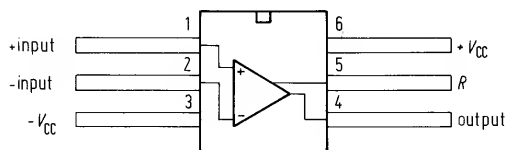
TCA 321 A
TCA 325 A



TCA 321
TCA 322
TCA 325

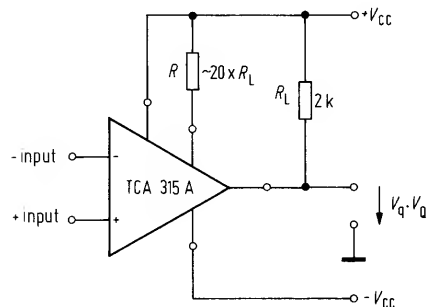


TCA 321 W
TCA 325 W

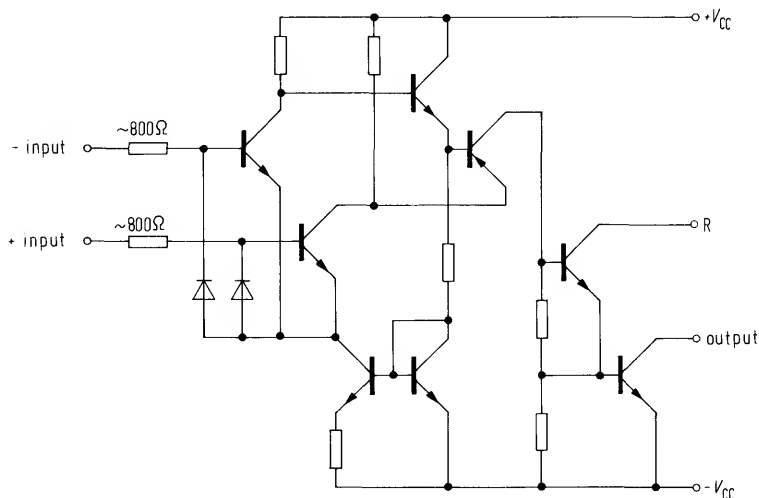


Connection diagram

R_L = load resistance



Circuit diagram



Operating characteristics

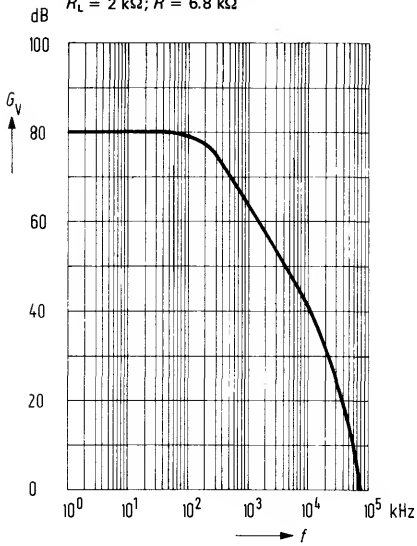
($V_{CC} = \pm 15\text{ V}$,
 $R = 6.8\text{ k}\Omega$)

		TCA 321/A/W TCA 325/A/W $T_{amb} = 25\text{ }^{\circ}\text{C}$			TCA 322					
		min	typ	max	$T_{amb} = 25\text{ }^{\circ}\text{C}$			$T_{amb} = -55\text{ to }125\text{ }^{\circ}\text{C}$		
					min	typ	max	min	max	
Supply current	I_{CC}		1.5	2.5		1.5	2.5			mA
Input offset voltage ($R_G = 50\text{ }\Omega$)	V_{io}	-7.5		7.5	-5		5	-7.5	7.5	mV
Input offset current	I_{io}	-300	± 80	300	-100	± 50	100	-300	300	nA
Input current	I_i		.5	1.0		.3	.7		1.0	μA
Output voltage	V_{opp}	14.9		-14.8	14.9		-14.8	14.8	-14.6	V
($R_L = 2\text{ k}\Omega$)	V_{opp}	14.9		-14.0	14.9		-14.0	14.8	-13.5	V
($R_L = 2\text{ k}\Omega$, $f = 100\text{ kHz}$)	V_{opp}		± 10			± 10				V

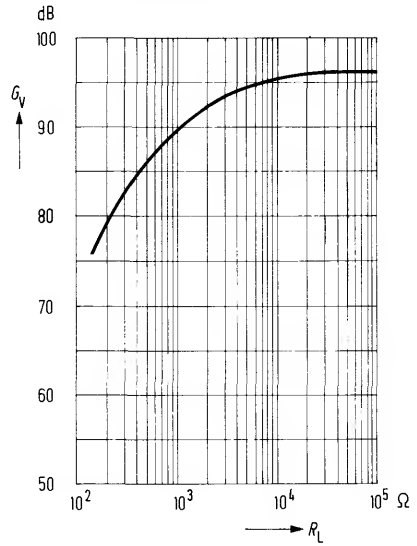
Operating characteristics $V_{CC} = \pm 15\text{ V}$, $R = 6.8\text{ k}\Omega$		TCA 321/A/W TCA 325/A/W $T_{amb} = 25\text{ }^{\circ}\text{C}$			TCA 322				
					$T_{amb} = 25\text{ }^{\circ}\text{C}$			$T_{amb} = -55\text{ to }+125\text{ }^{\circ}\text{C}$	
		min	typ	max	min	typ	max	min	max
Input impedance ($f = 1\text{ kHz}$)	Z_i		200			200			$\text{k}\Omega$
Open-loop voltage gain ($R_L = 2\text{ k}\Omega$, $f = 1\text{ kHz}$) G_V		75	80		80	83		75	dB
($R_L = 10\text{ k}\Omega$, $f = 1\text{ kHz}$) G_V			85			88			dB
($R_L = 2\text{ k}\Omega$, $f = 1\text{ MHz}$) G_V			60			60			dB
Input common-mode range ($R_L = 2\text{ k}\Omega$)	V_{ICM}	13		-13	13		-13		V
Common-mode rejection ration ($R_L = 2\text{ k}\Omega$)	$CMRR$	60	74		65	77			dB
Sensitivity to supply voltage variations $\frac{\Delta V_{io}}{\Delta V_{CC}}$			25	200		25	200		$\mu\text{V/V}$
Temperature-coefficient of V_{io} ($R_G = 50\text{ }\Omega$)	α_{Vio}		6			6	25		$\mu\text{V/K}$
Temperature-coefficient of I_{io} ($R_G = 50\text{ }\Omega$)	α_{Iio}		.3			.3	1.5		nA/K
Rise time of V_q for non-inverting operation (test circuit 1, TAA861)	$\frac{dV_q}{d_{tr}}$		50			50			$\text{V}/\mu\text{s}$
Output saturation voltage ($I_q = 10\text{ mA}$)	V_{qsat}			200			200	400	mV
Output leakage current $V_{CC} = \pm 5\text{ V}$; $R = 6.8\text{ k}\Omega$	I_{qik}		1	10		1	10		μA
Input offset voltage ($R_G = 50\text{ }\Omega$)	V_{io}	-7.5		7.5	-5		5		mV
Input offset current	I_{io}	-300	± 50	300	-100		100		nA
Input current	I_i		.5	1.0		.3	.7		μA
Open-loop voltage gain ($R_L = 2\text{ k}\Omega$, $f = 1\text{ kHz}$)	G_V	65			70				dB

TCA 321; A; W
TCA 322
TCA 325; A; W

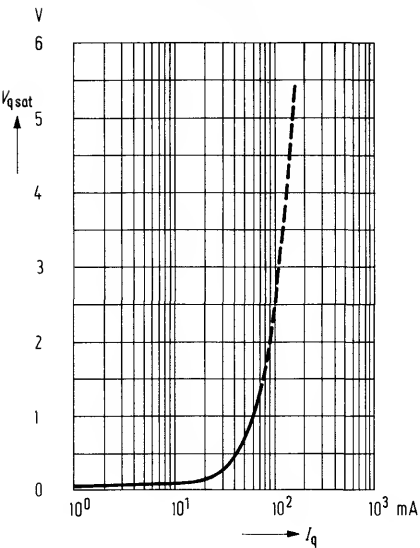
Open-loop voltage gain
 $G_V = f(V_{CC}); T_{amb} = 25^\circ\text{C}$
 $R_L = 2\text{ k}\Omega; R = 6.8\text{ k}\Omega$



Open-loop voltage gain $V_{CC} = \pm 15\text{ V}$
 $G_V = f(V_{CC}); T_{amb} = 25^\circ\text{C}$



Saturation voltage $V_{qsat} = f(I_q)$
 $T_{amb} = 25^\circ\text{C}; R = 6.8\text{ k}\Omega$



For further performance curves
 see TAA 761

Operational Amplifier with Darlington Input

TCA 331; A; W
TCA 332
TCA 335; A; W

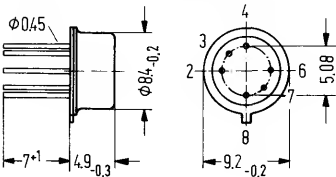
An economical and universal operational amplivier which by its excellent performance qualities is well suited for a wide range of applications such as measurement- and servo-systems, automobile electronics, AF-circuits, analog computers etc. The low input current of this amplifier is particularly advantageous in measurement- and servo system applications. In addition to a high gain, low offset voltage, small temperature- and supply voltage-dependence, the amplifier features

- High input resistance
- Wide common-mode range
- Large supply voltage range
- Large control range
- High output current
- Simple frequency compensation

Type	Ordering code
TCA 331	Q67000-A1013
TCA 331 A	Q67000-A1014
TCA 331 W	Q67000-A1015
TCA 332	Q67000-A1016
TCA 335	Q67000-A1017
TCA 335 A	Q67000-A563
TCA 335 W	Q67000-A1018

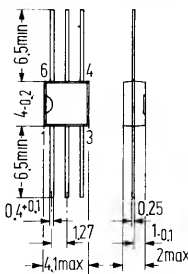
Package outlines

TCA 331, TCA 332, TCA 335



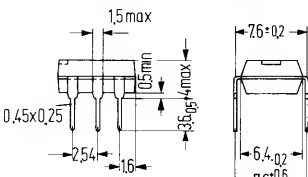
Package 5 H 6 DIN 41873
(similar TO-78)
Weight approx. 1 g

TCA 331 W, TCA 335 W



Miniature plastic
package
6 pins
Weight approx. .1 g
Colour code
TCA 331 W blue/white
TCA 335 W blue/yellow

TCA 331 A, TCA 335 A



Plastic plug-in package
6 pins
20 A 6 DIN 41866
Weight approx. .7 g

Dimensions in mm

Maximum ratings

Supply voltage
Output current
Differential input voltage $V_{CC} = \pm 13$ to ± 15 V
Differential input voltage $V_{CC} = \pm 2$ to ± 13 V
Junction temperature
Storage temperature
Thermal resistance:
System-case (TCA 331, 332, 335)
System-ambient air (TCA 331, 332, 335)
System-ambient air (TCA 331 A, TCA 335 A)
System-ambient air (TCA 331 W, TCA 335 W)

	TCA 331/A/W TCA 332 TCA 335/A/W	
V_{CC}	± 15	V
I_o	70	mA
V_{iD}	± 13	V
V_{iD}	$\pm V_{CC}$	
T_j	150	°C
T_s	-55 to +150	°C
$R_{thScase}$	80	K/W
R_{thSamb}	190	K/W
R_{thSamb}	140	K/W
R_{thSamb}	200	K/W

Range of operation

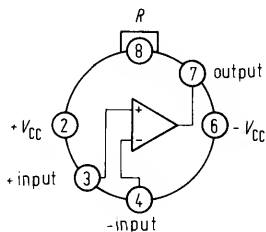
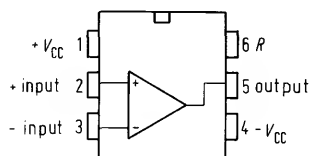
Supply voltage
Ambient temperature in operation
TCA 331/A/W
TCA 335/A/W
TCA 332

V_{CC}	± 2 to ± 15	V
T_{amb}	0 to +70	°C
T_{amb}	-25 to +85	°C
T_{amb}	-55 to +125	°C

Pin connection

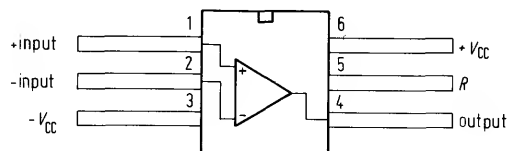
TCA 331 A
TCA 335 A

TCA 331
TCA 332
TCA 335



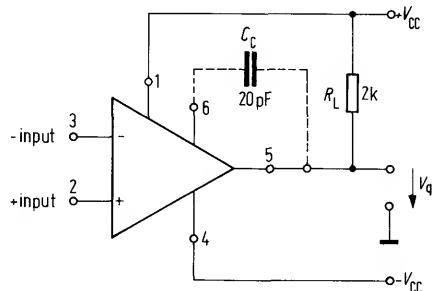
TCA 331 W
TCA 335 W

R = frequency compensation

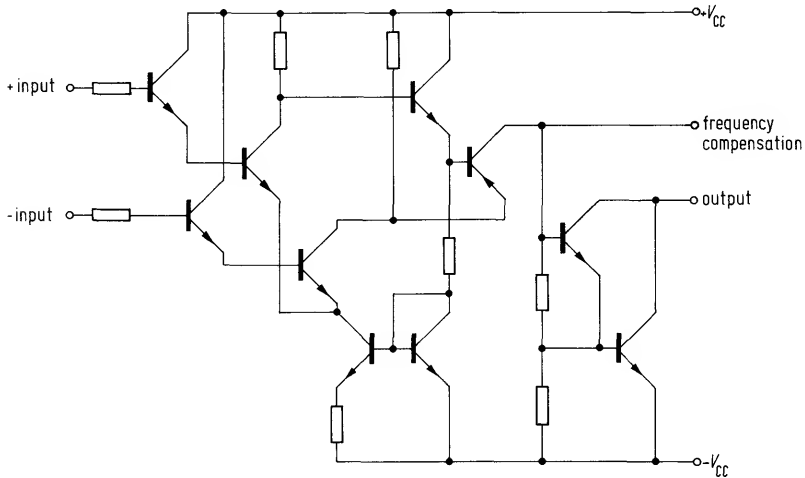


Connection diagram

C_C = Output frequency compensation,
 R_L = load resistance



Circuit diagram



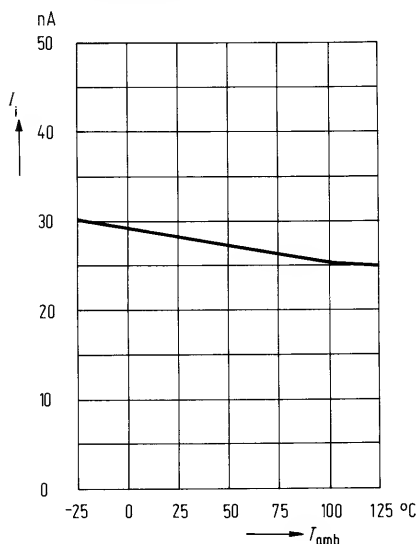
Operating characteristics
 $(V_{CC} = \pm 15 \text{ V})$

		TCA 331/A/W TCA 335/A/W $T_{amb} = 25^\circ\text{C}$			TCA 332					
		$T_{amb} = 25^\circ\text{C}$			$T_{amb} = 25^\circ\text{C}$			$T_{amb} = -55 \text{ to } 125^\circ\text{C}$		
		min	typ	max	min	typ	max	min	max	
Supply current	I_{CC}		1.5	2.5		1.5	2.5			mA
Input offset voltage ($R_G = 50 \Omega$)	V_{io}	-20		20	-14		14	-20	20	mV
Input offset current	I_{io}	-25	± 10	25	-15		15	-40	40	nA
Input current	I_i		30	50			30		80	nA
Input current ($V_{io} = \pm 13 \text{ V}$)	I_i			200			200			nA
Output voltage ($R_L = 2 \text{ k}\Omega$)	V_{qpp}	14.9		-14.0	14.9		-14.0	14.8	-14.0	V
($R_L = 620 \Omega$)	V_{qpp}	14.9		-12.5	14.9		-12.5	14.8	-12.0	V
($R_L = 2 \text{ k}\Omega$, $f = 100 \text{ kHz}$)	V_{qpp}		± 10			± 10				V

Operating characteristics (continued) $V_{CC} = \pm 15\text{ V}$	TCA 331/A/W TCA 335/A/W $T_{amb} = 25^\circ\text{C}$			TCA 332					
				$T_{amb} = 25^\circ\text{C}$			$T_{amb} = -55\text{ to }+125^\circ\text{C}$		
	min	typ	max	min	typ	max	min	max	
Input impedance ($f = 1\text{ kHz}$)	Z_i	3			3				$M\Omega$
Open-loop voltage gain ($R_L = 2\text{ k}\Omega$, $f = 1\text{ kHz}$)	G_V	75	80	80	83		75		dB
($R_L = 10\text{ k}\Omega$, $f = 1\text{ kHz}$)	G_V		85		88				dB
($R_L = 2\text{ k}\Omega$, $f = 1\text{ MHz}$)	G_V		43		43				dB
Input common-mode range ($R_L = 2\text{ k}\Omega$)	V_{ICM}	13	-13	13		-13			V
Common-mode rejection ratio ($R_L = 2\text{ k}\Omega$)	$CMRR$	60	74	65	77				dB
Sensitivity to supply voltage variations ($C_C = 1\text{ pf}$, $G_V = 100$)	$\frac{\Delta V_{io}}{\Delta V_{CC}}$		25		25	200			$\mu\text{V/V}$
Temp. coefficient of V_{io} ($R_G = 50\text{ }\Omega$)	α_{Vio}		12		12	50			$\mu\text{V/K}$
Temp. coefficient of I_{io} ($R_G = 50\text{ }\Omega$)	α_{Iio}		50		50				pA/K
Rise time of V_q for non-inverting operation (test circuit 1)	$\frac{dV_q}{dt_r}$		9		9				$\text{V}/\mu\text{s}$
Rise time of V_q for inverting operation (test circuit 2)	$\frac{dV_q}{dt_r}$		18		18				$\text{V}/\mu\text{s}$
Output saturation voltage ($I_q = 10\text{ mA}$)	V_{qsat}		1			1			V
Output leakage current $V_{CC} = \pm 5\text{ V}$	I_{qlik}		1		1	10			μA
Input offset voltage ($R_G = 50\text{ }\Omega$)	V_{io}	-20	20	-14		14			mV
Input offset current	I_{io}	-25	± 10	-15		15			nA
Input current	I_i		30			30			nA
Open loop voltage gain ($R_L = 2\text{ k}\Omega$, $f = 1\text{ kHz}$)	G_V	65		70					dB

Input current

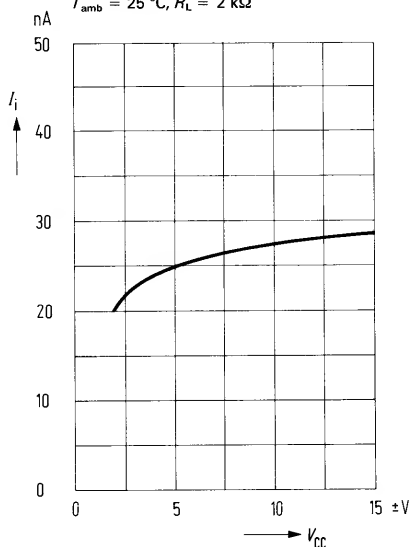
$$I_i = f(T_{amb}); R_L = 2 \text{ k}\Omega$$



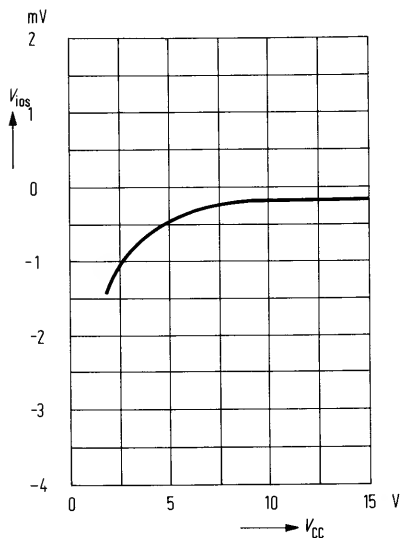
Input current

$$I_i = f(V_{CC})$$

$$T_{amb} = 25^\circ\text{C}, R_L = 2 \text{ k}\Omega$$



Input offset voltage $V_{los} = f(V_{CC})$



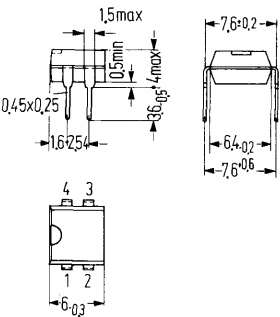
For further performance curves
 see TAA 761

A threshold switch for battery operation with very low current requirement and low input currents. The threshold is fixed with a voltage proportional to the supply voltage.

- TTL compatible
- High output current
- Very high input resistance
- High stability by hysteresis
- Small number of external components

Type	Ordering code
TCA 345 A	Q67000-A564

Package outlines



Plastic plug-in package
20 A 4 DIN 41866
(4 pins)
Weight approx. .5 g
Dimensions in mm

Maximum ratings

Supply voltage	V_{CC}	10	V
Output current	I_q	70	mA
Input voltage	V_i	0 to V_{CC}	V
Inductivity at output	L_q	500	mH
Storage temperature	T_s	-40 to +125	°C
Junction temperature	T_j	150	°C
Thermal resistance	R_{thSamb}	180	K/W
System-ambient air			

Range of operation

Supply voltage	V_{CC}	2 to 10	V
Ambient in operation temperature	T_{amb}	-25 to +85	°C

Operating characteristics ($T_{amb} = 25^{\circ}\text{C}$)

Supply current for output current

$$I_q = 0 \text{ mA}; V_{CC} = 2 \text{ V}$$

$$I_q = 40 \text{ mA}; V_{CC} = 2 \text{ V}$$

Saturation voltage $I_q = 40 \text{ mA}, V_{CC} = 2 \text{ V}$

Output leakage current $V_{CC} = 10 \text{ V}$

Threshold voltage ($V_{CC} = 2 \text{ to } 10 \text{ V}$)¹⁾

Linearity error of threshold voltage ($V_{CC} = 2 \text{ V}$)

Hysteresis (in % of V_{CC}) $V_{CC} = 2 \text{ V}$

$$V_{CC} = 5 \text{ V}$$

$$V_{CC} = 10 \text{ V}$$

Input current

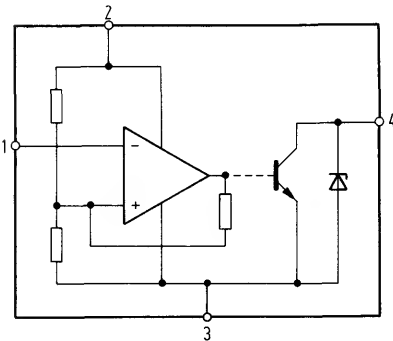
Zener voltage at output

Temp. coefficient of V_i

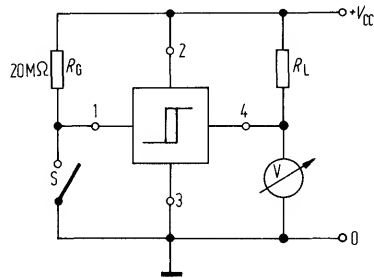
	min	typ	max	
I_{CC}		.55	.8	mA
I_{CC}		1.35	2.0	mA
I_{CC}		1.85	3.0	mA
I_{CC}		7.0	9.0	mA
V_{qsat}		150	300	mV
I_{qik}			30	μA
V_i	$.63 \times V_{CC}$	$.66 \times V_{CC}$	$.69 \times V_{CC}$	V
			3	%
ΔV_i	6.0	10		%
ΔV_i	6.0	20		%
ΔV_i	6.0	20		%
I_i		10	30	nA
V_z	11.0	13.6	15.0	V
α_{vi}		30		ppm/K

¹⁾ measured by rising input voltage

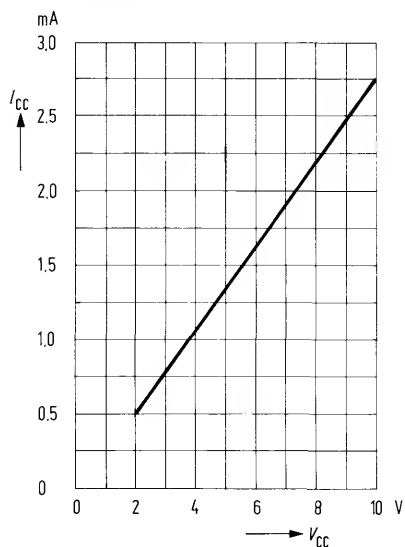
Circuit diagram



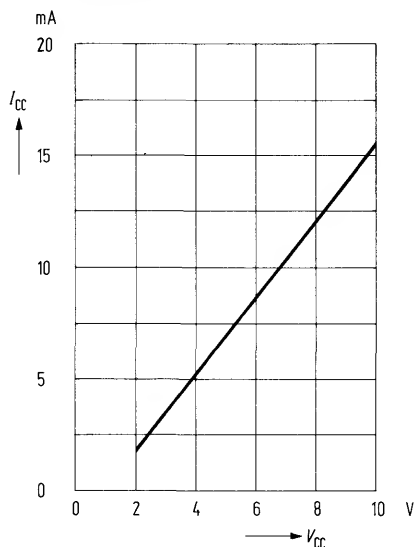
Test circuit



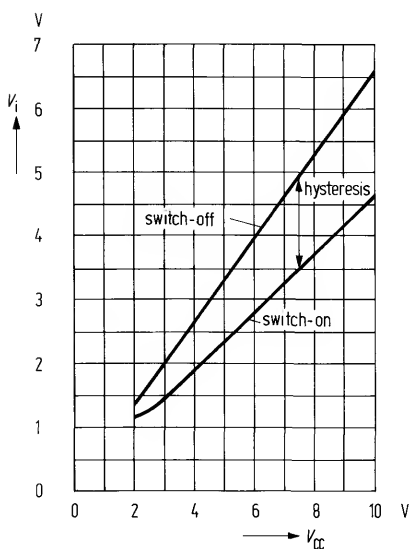
Supply current $I_{CC} = f(V_{CC})$
 $I_q = 0 \text{ mA}$



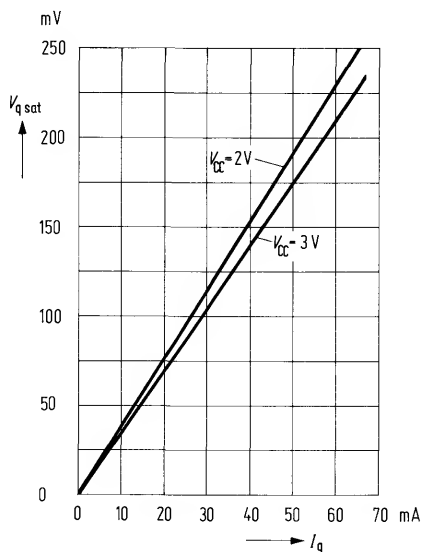
Supply current $I_{CC} = f(V_{CC})$
 $I_q = 40 \text{ mA}$



Threshold voltage $V_i = f(V_{CC})$

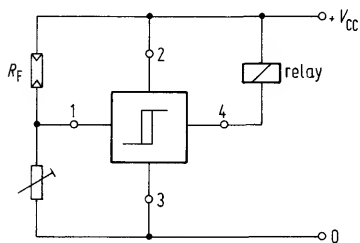
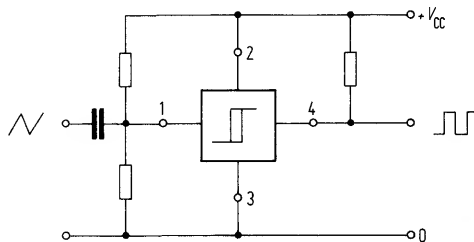
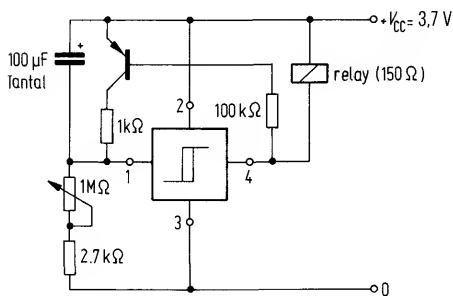


Saturation voltage $V_{q \text{ sat}} = f(I_q)$



Applications circuits:**Dimmer circuit**

(Switch on with darkness)

**Triangle-Rectangular-Converter****Astable Multivibrator**

Transistor Array with 5 NPN Transistors

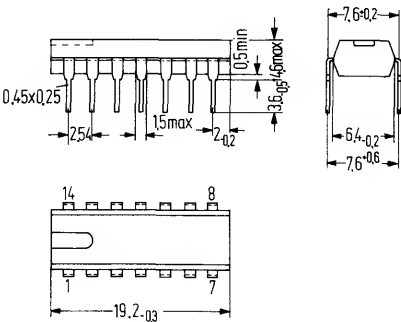
TCA 671
TCA 871
TCA 971
TCA 991

TCA 671, TCA 871, TCA 971, and TCA 991 each consist of five general-purpose silicon npn transistor on a common monolithic substrate. Two of the transistors are internally connected to form a differentially-connected pair. The arrays are well suited to switch and amplify applications till 10 MHz. In addition they provide the very significant inherent integrated circuit advantages of close electrical and thermal matching.

- General use
- Matched V_{BE} and B
- High output current

Type	Ordering code
TCA 671	Q67000-T1
TCA 871	Q67000-T2
TCA 971	Q67000-T11
TCA 991	Q67000-T12

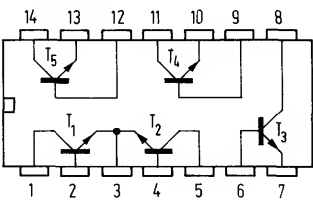
Package outlines



Plastic plug-in package (14 pins)
20 A 14 DIN 41866 (TO-116)
Weight approx. 1.1 g

Dimensions in mm

Main circuit



Maximum ratings

	TCA 671 TCA 971	TCA 871 TCA 991	
Collector-base breakdown voltage	V_{CBO} 50	35	V
Collector-emitter breakdown voltage	V_{CEO} 42	32	V
Emitter-base breakdown voltage	V_{EBO} 6	6	V
Collector-substrate voltage ($I_C = 100 \mu A$)	V_{CS} 80	80	V
Collector current	I_C 200	200	mA
Base current	I_B 10	10	mA
Power dissipation for a single transistor	P_{tot} 300	300	mW
Thermal resistance			
System-ambient air	R_{thSamb} 120	120	K/W
Junction temperature	T_i 150	150	°C
Storage temperature	T_s -40 to +125	-40 to +125	°C

Range of operation

Ambient in operation temperature	T_{amb}	-25 to +85	-25 to +85	°C
----------------------------------	-----------	------------	------------	----

Operating characteristics

($T_{amb} = 25^{\circ}\text{C}$)

		TCA 671 TCA 971			TCA 871 TCA 991			
		min	typ	max	min	typ	max	
Collector-base breakdown voltage at $I_C = 100\text{ }\mu\text{A}$, $I_E = 0$	$V_{(BR)CBO}$				35			V
Collector-emitter breakdown voltage at $I_C = 100\text{ }\mu\text{A}$, $I_B = 0$	$V_{(BR)CEO}$	42			32			V
Collector-substrate breakdown voltage at $I_C = 100\text{ }\mu\text{A}$, $I_{CI} = 0$	V_{CI}	80			80			V
Emitter-base breakdown voltage at $I_E = 100\text{ }\mu\text{A}$, $I_C = 0$	$V_{(BR)EBO}$	6			6			V
Collector-emitter saturation voltage at $I_C = 50\text{ mA}$, $I_B = 5\text{ mA}$	V_{CEsat}		200	350		200	350	mV
Collector-base cut-off current at $V_{CB} = 25\text{ V}$, $I_E = 0$	I_{CBO}		.02	1		.02	10	μA
Collector-emitter cut-off current at $V_{CE} = 25\text{ V}$, $I_B = 0$	I_{CEO}			10		1	100	μA
Static current gain	B							
at $V_{CE} = 1\text{ V}$, $I_C = 100\text{ }\mu\text{A}$		40	80		40	80		
at $V_{CE} = 1\text{ V}$, $I_C = 2\text{ mA}$		100	140		100	140		
at $V_{CE} = 1\text{ V}$, $I_C = 20\text{ mA}$		100	160		100	160		
at $V_{CE} = 1\text{ V}$, $I_C = 100\text{ mA}$		40	100		40	100		

Differential base current for
 $T_1 + T_2$ at $V_{CE} = 3 \text{ V}$; $I_C = 1 \text{ mA}$

Base-emitter voltage of

$V_{CE} = 3 \text{ V}$; $I_C = 1 \text{ mA}$

Differential base-emitter voltage

$T_1 - T_2$ at $V_{CE} = 3 \text{ V}$; $I_C = 1 \text{ mA}$

Differential base-emitter voltage for

T_3 till T_5 at $V_{CE} = 3 \text{ V}$; $I_C = 1 \text{ mA}$

Temp. coeff. of base-emitter

voltage at $V_{CE} = 3 \text{ V}$; $I_C = 1 \text{ mA}$

Limit frequency

	TCA 671 TCA 971			TCA 871 TCA 991			
	min	typ	max	min	typ	max	
V_{BE}		0.5	1		1		μA
		0.65			0.65		V
		2	5		4		mV
		4	10		6		mV
$\frac{\Delta V_{BE}}{\Delta T}$		-2			-2		mV/K
f_T	300	550		300	550		MHz

Switching times

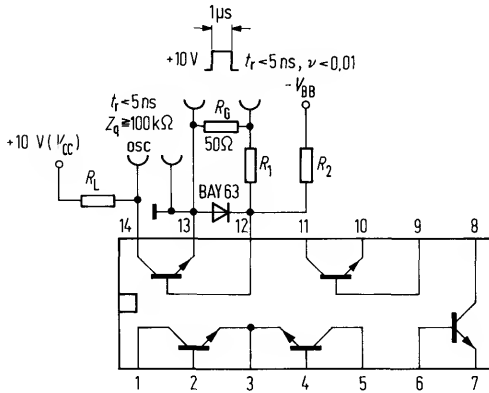
$I_C : I_{B1} : -I_{B2} \approx 10:1:1 \text{ mA}$; $R_1 = 5 \text{ k}\Omega$; $R_2 = 5 \text{ k}\Omega$; $V_{BB} = 3.5 \text{ V}$; $R_L = 990 \Omega$

$t_{on} \mid 85 (<150) \text{ ns}$ $t_{off} \mid 480 (<800) \mid \text{ ns}$

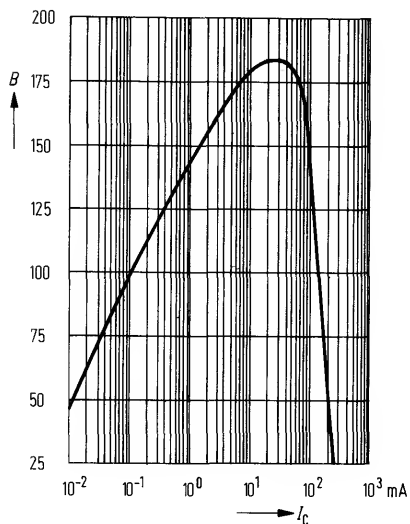
$I_C : I_{B1} : -I_{B2} \approx 100:10:10 \text{ mA}$; $R_1 = 500 \Omega$; $R_2 = 700 \Omega$; $V_{BB} = 5 \text{ V}$; $R_L = 98 \Omega$

$t_{on} \mid 55 (<150) \text{ ns}$ $t_{off} \mid 450 (<800) \mid \text{ ns}$

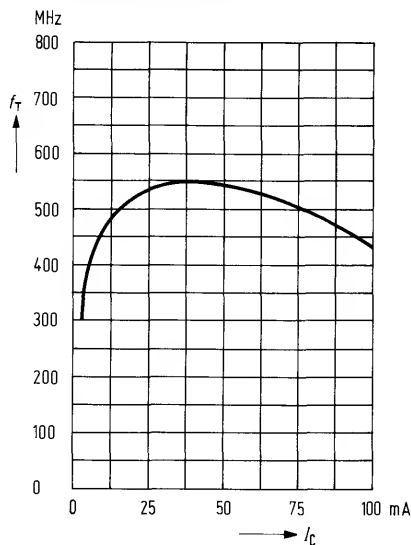
Test circuit for switching times



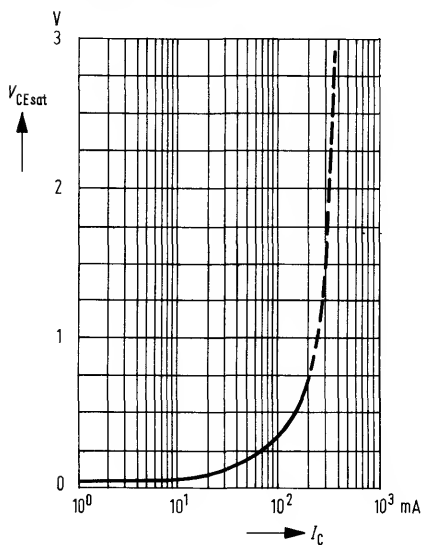
Static current gain $B = f(I_C)$
 $V_{CE} = 3 \text{ V}; T_{amb} = 25^\circ \text{C}$



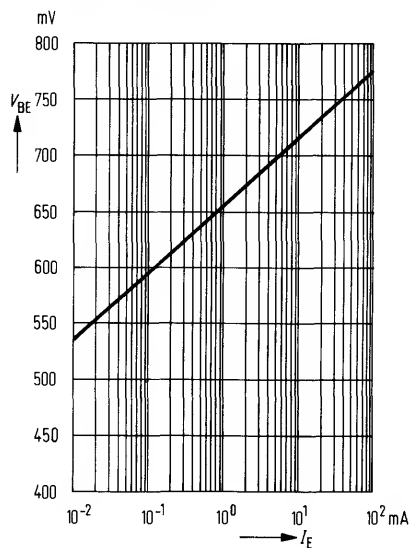
Limit frequency $f_T = f(I_C)$
 $V_{CE} = 3 \text{ V}; T_{amb} = 25^\circ \text{C}$



Collector-emitter saturation voltage
 $V_{CEsat} = f(I_C); B = 20$



Base-emitter-voltage $V_{BE} = f(I_E)$
 $V_{CE} = 3 \text{ V}; T_{amb} = 25^\circ \text{C}$



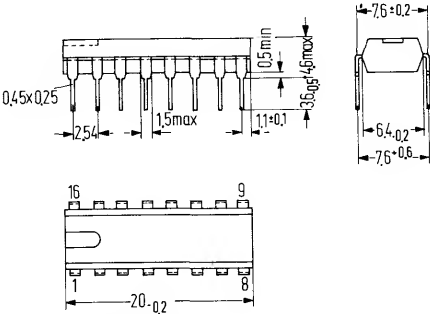
The TCA 955 is suitable for speed regulation of dc motors. It works according to a clocked regulation. To be noted are its high regulation accuracy, its large supply voltage range and the possible current saving. Moreover the IS possesses a battery voltage indicator.

Typical applications:

- Speed regulation in reel to reel tape recorders
 - cassette recorders
 - turntables
 - movie cameras
- in drivings of control systems.

Type	Ordering code
TCA 955	Q67000-A983

Package outlines:



Plastic plug-in package
16 pins, dual-in-line
20 A 16 DIN 41866
Weight approx. 1.1 g
Dimensions in mm

Maximum ratings

- Supply voltage
- Supply voltage (pin 11 and pin 15 connected)
- Output current (pin 16)
- Output current (pin 12, LED output)
- Power consumption LED output
- Junction temperature
- Storage temperature
- Thermal resistance: System-ambient air

V_{CC}	16	V
V_{CC}	6	V
I_q	200	mA
I_{qLED}	15	mA
P_{qLED}	150	mW
T_j	150	°C
T_s	-55 to +125	°C
R_{thSamb}	120	K/W

Operating range

With internal short-circuit stabilization
(pin 11 and pin 15 connected)

V_{CC}	2 to 6	V
----------	--------	---

With internal stabilization (V_{CC} to pin 15)

V_{CC}	4.8 to 16.0	V
----------	-------------	---

Ambient in operation temperature

T_{amb}	-25 to +85	°C
-----------	------------	----

Operating characteristics

($T_{amb} = 25\text{ °C}$, $V_{CC} = 2.2$ to 16.0 V)

Regulation part

Supply current: $V_{CC} = 4.8\text{ V}$
 $V_{CC} = 16\text{ V}$

	min	typ	max	
I_{CC}		8.3	12	mA
I_{CC}		15.5	24	mA
V_{Stab}	2.75	3.0	3.3	V

Stabilized voltage

$V_{CC} = 4.8\text{ V to }16\text{ V}$

Input threshold (pin 3) to ground

V_i	$.46 \times V_{11}$	$.485 \times V_{11}$	$.51 \times V_{11}$	V
-------	---------------------	----------------------	---------------------	---

Hysteresis of input threshold

ΔV_i		$.015 \times V_{11}$	$.03 \times V_{11}$	V
--------------	--	----------------------	---------------------	---

Offset voltage (pin 3 to pin 2)

V_{io}		11	20	mV
----------	--	----	----	----

Input current (pin 3)

I_i			1	μA
-------	--	--	---	----

Output saturation voltage

$I_q = 50\text{ mA}$

V_{qsat}		.84	1.0	V
------------	--	-----	-----	---

$I_q = 100\text{ mA}$

V_{qsat}		.92	1.25	V
------------	--	-----	------	---

Output leakage current

I_{qlik}			30	μA
------------	--	--	----	----

Duty cycle – range of regulation¹⁾

ν	0		1	
-------	---	--	---	--

Nom. rotational speed²⁾

n	$\frac{12.55}{p \cdot R_1 \cdot C_2}$	$\frac{14.85}{p \cdot R_1 \cdot C_2}$	$\frac{17.64}{p \cdot R_1 \cdot C_2}$	rpm
---	---------------------------------------	---------------------------------------	---------------------------------------	-----

Error in rotational speed by
duty cycle³⁾ of 0 to 1

			$\frac{.224}{N \cdot p \cdot C_3}$	%
--	--	--	------------------------------------	---

Switching oscillator

Frequency

f	$\frac{1}{.4 \cdot R_2 \cdot C_4}$			Hz
-----	------------------------------------	--	--	----

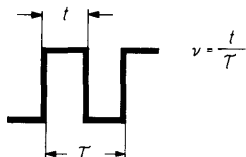
Typ. voltage pin 10

V_{qosz}	$.48 \times V_{11}$			V
------------	---------------------	--	--	---

Voltage pin 11

V_{qoszpp}	$.18 \times V_{11}$			V
--------------	---------------------	--	--	---

¹⁾ Duty cycle



²⁾ p = number of pole pairs

³⁾ in application without switching oscillator

Battery gauge

	min	typ	max	
Threshold voltage	V_{ion}		1.5	V
	V_{loff}			V
Hysteresis	V_H	220		mV
Input current	I_i		.2	μA
Saturation voltage	$V_{\phi LED}$		$.5 \times 500 \times I_{LED}$	V
LED output ¹⁾				

Formula:

Nom. rotational speed $n = \frac{14.85}{p \cdot R_1 \cdot C_2}$ [rpm]

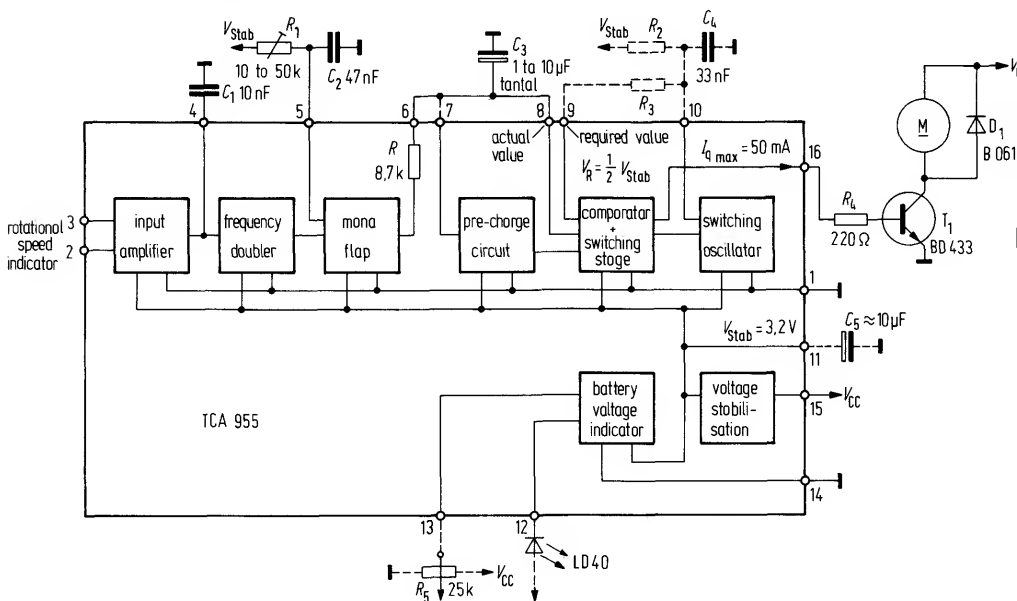
Switching frequency
(in application without
switching oscillator) $f = \frac{n \cdot p}{30}$ [Hz]

Actual value $V_{act.} = .44 \times V_{11}$ [V]

Preloading voltage at C_3 $V = .87 \times V_{act}$ [V]
(pin 6 and pin 7 connected)

¹⁾ Inside the integrated circuit, a protective resistance of $500 \Omega \pm 20\%$ is integrated.

Recommended application circuit

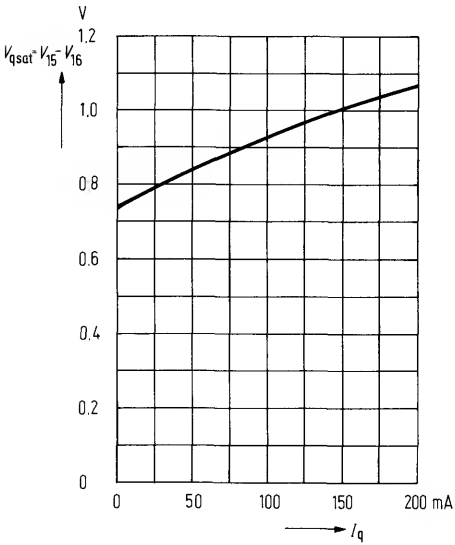


Features for use:

1. The internal voltage stabilization offers the following advantages: operation with highly changing supply voltage, large range of supply voltage.
2. In order to receive pulses with a steady duty cycle at the output, symmetrical pulses must be given to the input.
3. It is recommendable to use high multi-pole speed-generator to improve the regulation precision and perhaps the power consumption.
4. Power consumption is considerably reduced if sequence of the switching frequency is equal to or shorter than the electric motor time constant.
5. Higher accuracy can be obtained by using a filter of second order instead of C_3 .
6. When using rapidly rising motors, the preload circuitry reduces an overrun.

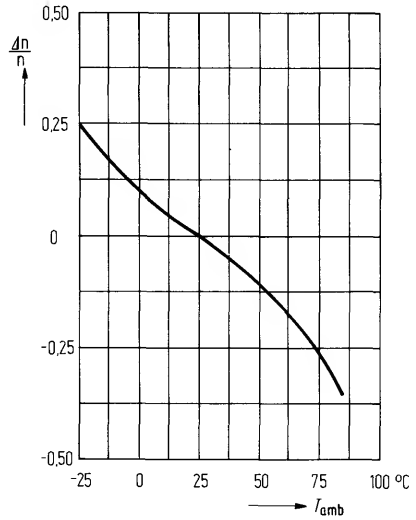
Saturation voltage

$$V_{\text{qsat}} = f(I_{\text{q}})$$

**Rotational speed**

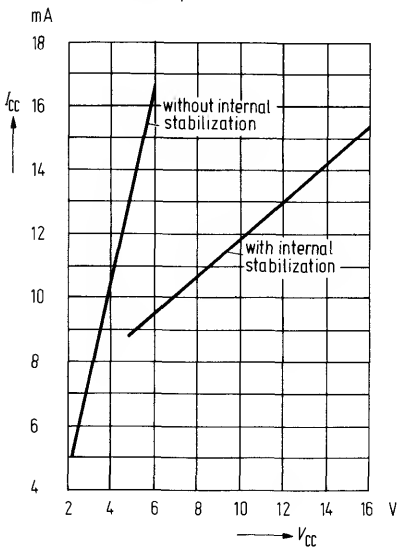
$$\frac{\Delta n}{n} = f(T_{\text{amb}})$$

$$\% \quad V_{\text{CC}} = 12 \text{ V}; R_1 \cdot C_2 = 100 \mu\text{s}$$

**Supply current**

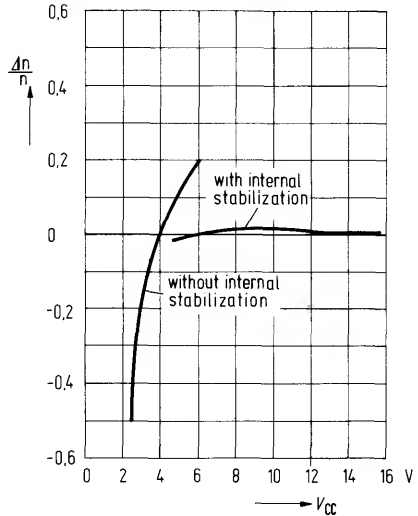
$$I_{\text{CC}} = f(V_{\text{CC}})$$

$$T_{\text{amb}} = 25^\circ\text{C}; I_{\text{q}} = 0 \text{ mA}$$

**Rotational speed**

$$\frac{\Delta n}{n} = f(V_{\text{CC}})$$

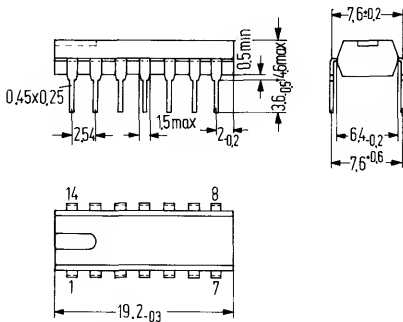
$$\% \quad T_{\text{amb}} = 25^\circ\text{C}; R_1 \cdot C_2 = 100 \mu\text{s}$$



The TCA 965 is a monolithic integrated window discriminator in package similar to 20 A 14 DIN 41886 (TO 116). It is particularly suitable for control systems as follow-up and adjusting control device with dead space. It can also be used in measuring systems of dc should remain within the tolerated deviations from the required values.

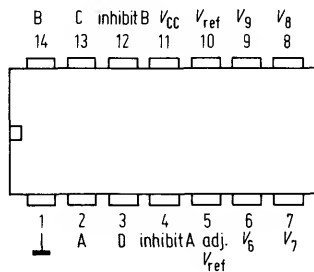
Type	Ordering code
TCA 965	Q67000-A982

Package outlines



Plastic plug-in package
20 A 14 DIN 41886
14 pins, dual-in-line
Weight approx. 1.1 g
Dimensions in mm

Pin configuration



Maximum ratings

Supply voltage
Input voltage between 2 inputs
Output current
Junction temperature
Storage temperature
Thermal resistance system-ambient air

V_{CC}	27	V
V_i	V_{CC}	V
I_g	50	mA
T_j	150	°C
T_s	-55 to +125	°C
R_{thSamb}	120	K/W

Range of operation

Supply voltage	V_{CC}	4.75 to 27	V
Ambient temperature in operation	T_{amb}	-25 to +85	°C

Operating characteristics ($T_{amb} = 25^{\circ}\text{C}$; $V_{CC} = 10\text{ V}$)

	min	typ	max	
Supply current (pin 2 and pin 13 high state)		4	5	mA
Input current (pin 6, 7, 8)		50		nA
Input current (pin 9)		-400		nA
Input offset voltage (pin 6/8, pin 7/8)		± 10		mV
Input voltage range (pin 6, 7, 8)			$V_{CC} - 1.0$	V
Input voltage range (pin 9)			$.5 \times V_{CC}$	V
Reference voltage (without load)		3.0	3.2	V
Stabilized voltage		6.0	6.5	V
(without external resistor, $V_{CC} \geq 7.9\text{ V}$)				
Temperature coefficient of V_5		.5		mV/K
Sensitivity of V_5 to supply voltage variations		3		mV/V
Output saturation voltage ($I_q = 10\text{ mA}$)		100	200	mV
Hysteresis (window level)		7		mV
Inhibit voltage at pin 4, 12 ¹⁾		1.5		V
Inhibit current at pin 4, 12		-100		μA

¹⁾ Inhibition occurs, if pin 4, pin 12 are grounded.

Application:

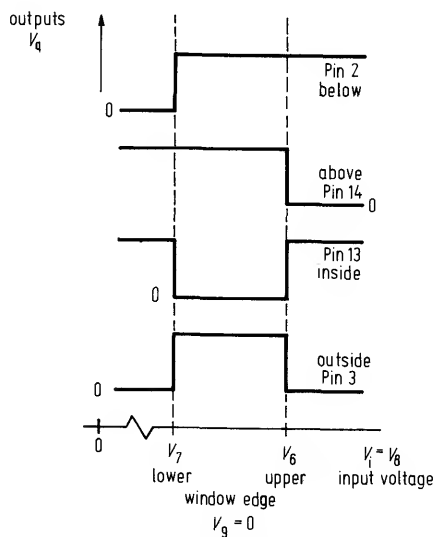
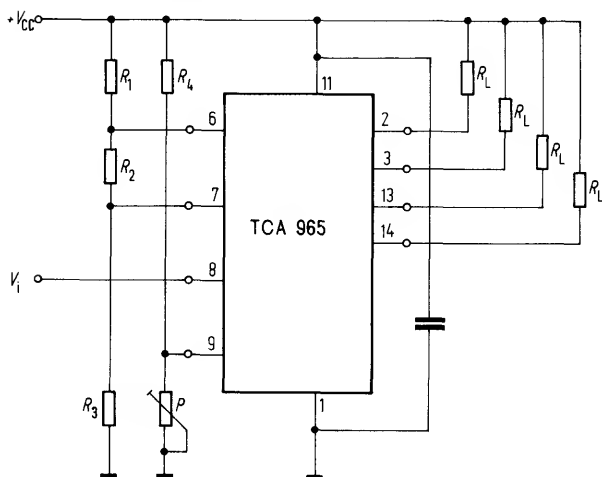
The window discriminator analyses the height of the input voltage between two externally adjustable limits. The window within which the circuit reacts "well" can be entered either by an upper limit (V_6) or a lower limit (V_7) or through the middle of the window (V_8) and, independently thereof, by a voltage V (V_9) which corresponds to half of the window width and is offered to ground. A Schmitt-Trigger characteristic with low hysteresis appears at the switching points. Four output signals are available which have the following meanings: input signal within, outside of the window (well, bad), too high, too low. All outputs have open collectors which are supplying up to 50 mA for the control of small relays, glow lamps, LED's. All usual logic families can directly be operated with only little additional circuitry. Moreover, the IC comprises a reference voltage from which all thresholds can be derived. It is practically independent of temperature and supply voltage.

Truth Table

V_i		Outputs			
application circuit I $V_i = V_8$	application circuit II $V_i = V_{6/7}$	pin 2	pin 14	pin 13	pin 3
$V_8 < (V_7 - V_9)$	$V_{6/7} > (V_8 + V_9)$	L(H)	H(H)	H(L)	L(H) ¹⁾
$V_8 > (V_6 + V_9)$	$V_{6/7} < (V_8 - V_9)$	H(H)	L(H)	H(L)	L(H) ²⁾
$(V_6 + V_9) > V_8 > (V_7 - V_9)$	$(V_8 + V_9) > V_{6/7} > (V_8 - V_9)$	H	H	L	H
$V_6 + V_9$ upper window level $V_7 - V_9$ lower window level $(V_6 + V_9) - (V_7 - V_9)$ window width	V_8 window center V_9 half window width (versus ground)	Values in brackets refer to external inhibition with pin 4 and pin 12 ¹⁾ inhibition pin 4 to ground ²⁾ inhibition pin 12 to ground			

Application circuit I:

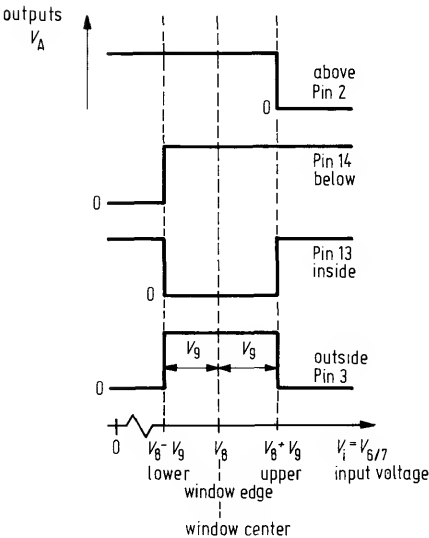
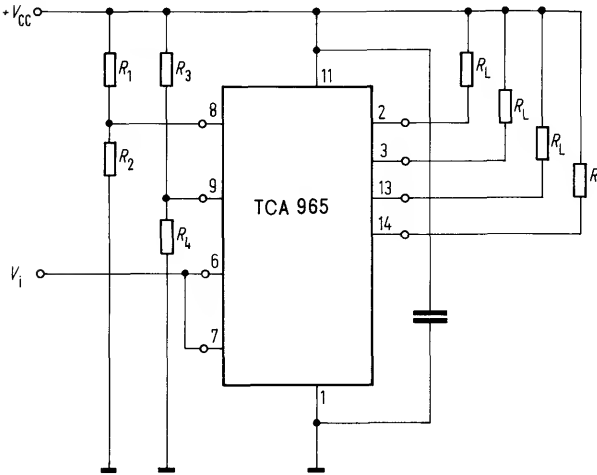
```
Outputs: pin 2 "below"
         pin 3 "outside"
         pin 13 "inside"
         pin 14 "above"
```



Outputs pin 2 and pin 14 can be inhibited externally, then they are H.

Application circuit II:

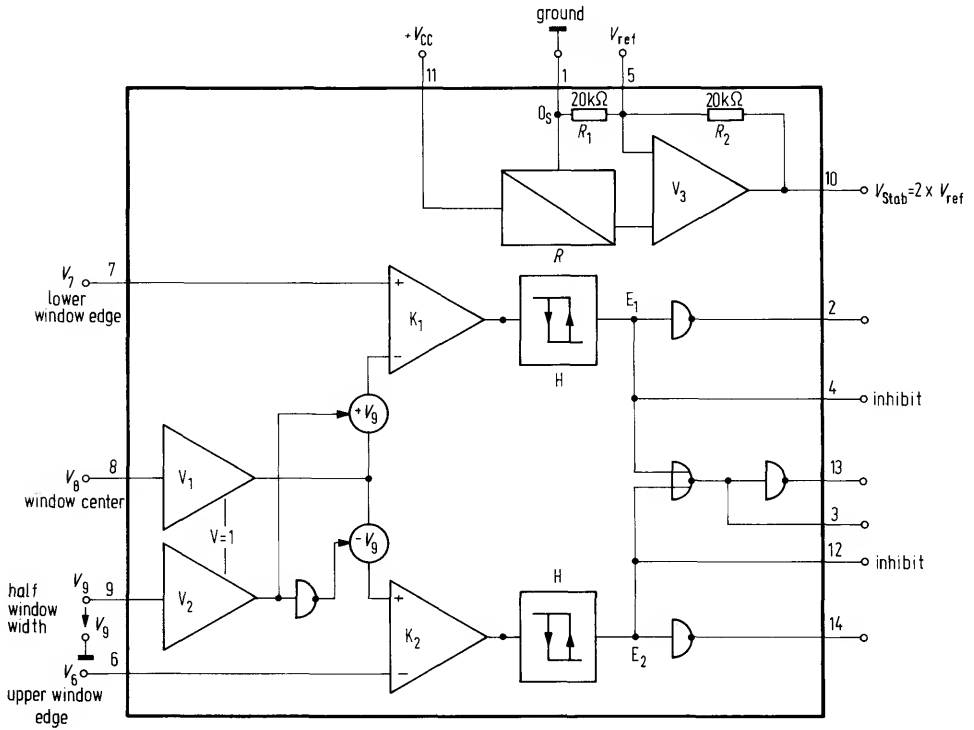
Outputs: pin 2 "above"
 pin 3 "outside"
 pin 13 "inside"
 pin 14 "below"



V_8 : window center
 V_g : $\pm$ half window width
 V_i : pin 6 and pin 7 connected

Outputs pin 2 and pin 14 can be inhibited externally, then they are H.

Block diagram



Timer

TDB 0555 -555
TDB 0555 B-555
TDC 0555 -555

TDB 0555 and TDC 0555 are monolithic integrated timing circuits in packages similar to 5 G 8 DIN 14873 (TO-99), which by their excellent performance qualities are well suited for accurate time delays and oscillation. Additional terminals are provided for triggering or resetting if desired.

Features:

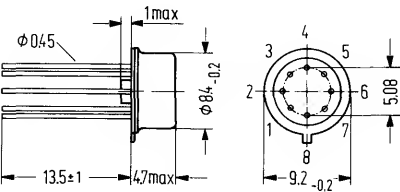
- High output current
- TTL compatible
- Temperature stability of .05% per K
- Adjustable duty cycle
- Timing through nine decades

Type	Ordering codes
TDB 0555	Q67000-A1043
TDB 0555 B	Q67000-A1044
TDC 0555	Q67000-A1045

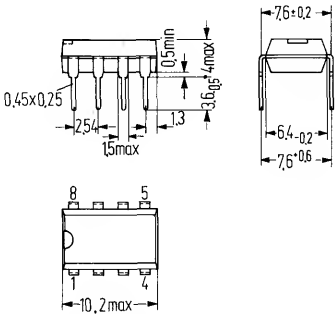
Package outlines

TDB 0555 and TDC 0555

TDB 0555 B



Case similar 5 G 8 DIN 14873 (TO-99)
Weight approx. 1.2 g



Plastic plug-in package, 8 pins
20 A 8 DIN 41866, weight approx. .7 g

Dimensions in mm

Maximum ratings

- Supply voltage
Junction temperature
Storage temperature
Thermal resistance:
System-case (TDB 0555/TDC 0555)
System-ambient air (TDB 0555/TDC 0555)
System-ambient air (TDB 0555 B)

	TDB 0555 TDB 0555 B	TDC 0555	
V_{CC}	16	18	V
i_j	150	150	°C
T_s	-65 to +150	-65 to +150	°C
$R_{thScase}$	80	80	K/W
R_{thSamb}	190	190	K/W
R_{thSamb}	140		K/W

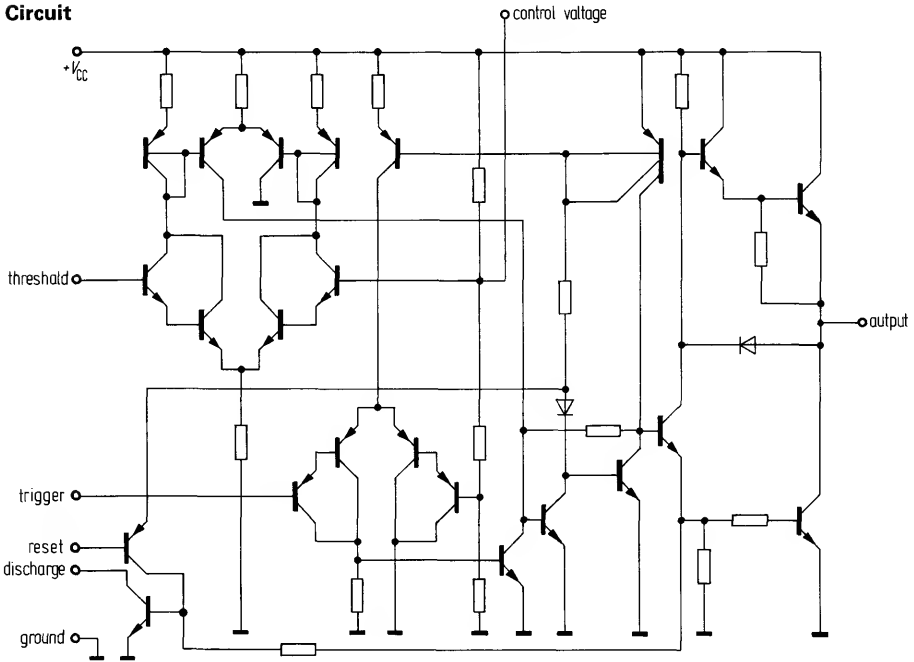
Operating range

- Supply voltage
Ambient temperature in operation

V_{CC}	4.5 to 16	4.5 to 18	V
T_{amb}	0 to +70	-55 to +125	°C

TDB 0555 -555
TDB 0555 B-555
TDC 0555 -555

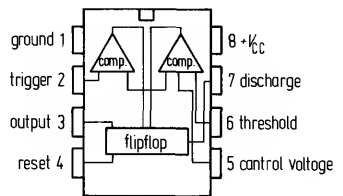
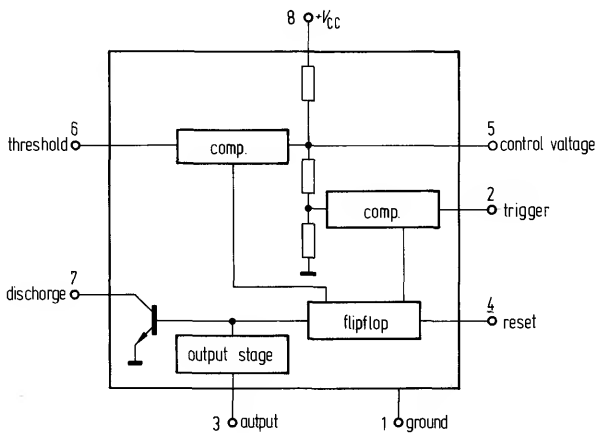
Circuit



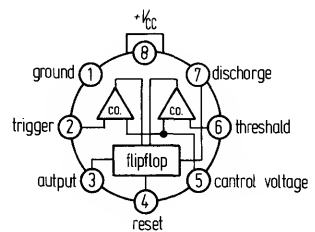
Pin connection

TDB 0555 B

Block diagram



TDB 0555
TDC 0555

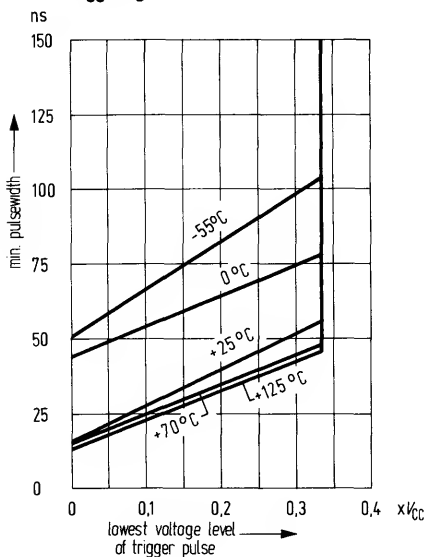


Operating characteristics(V_{CC} = 15 V, T_{amb} = 25°C unless otherwise specified)

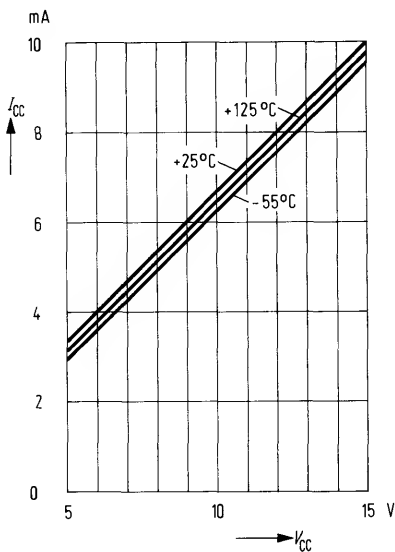
		TDB 0555 TDB 0555 B			TDC 0555		
		min	typ	max	min	typ	max
Supply current ($R_L = \infty$, $I_q < 1$ mA)	I_{CC}		10	15		10	12
Frequency range	f	10 ⁻³		10 ⁶	10 ⁻³		10 ⁶
Timing error ($R_A = 1$ to 100 k Ω , C = .1 μ F) (see appl.)							
Initial accuracy			1			.5	2
Drift with temperature			50			30	100
Drift with supply voltage			.1			.05	.2
Threshold voltage			$\frac{2}{3} \times V_{CC}$			$\frac{2}{3} \times V_{CC}$	
Trigger voltage			5		4.8	5	5.2
Trigger current			.5			.5	
Reset voltage		.4	.7	1.0	.4	.7	1.0
Reset current			.1			.1	
Threshold current ($R_A \leq 20$ M Ω)			.1	.25		.1	.25
Control voltage level		9	10	11	9.6	10	10.4
Output voltage drop (low)	V_{qsat}						
$I_{sink} = 10$ mA			.1	.25		.1	.15
$I_{sink} = 50$ mA			.4	.75		.4	.5
$I_{sink} = 100$ mA			2.0	2.5		2.0	2.2
$I_{sink} = 200$ mA			2.5			2.5	
Output voltage drop (high)	V_q						
$I_{source} = 200$ mA			12.5			12.5	
$I_{source} = 100$ mA		12.75	13.3		13.0	13.3	
Rise time of output			100			100	
Fall time of output			100			100	
(V _{CC} = 5 V, T _{amb} = 25°C unless otherwise specified)							
Supply current ($R_L = \infty$, $I_q < 1$ mA)			3	6		3	5
Trigger voltage			1.67		1.45	1.67	1.9
Control voltage level		2.6	3.33	4	2.9	3.33	3.8
Output voltage drop (low)	V_{qsat}						
$I_{sink} = 5$ mA			.25	.35			
$I_{sink} = 8$ mA						.1	.25
Output voltage drop (high)	V_q						
$I_{source} = 100$ mA		2.75	3.3		3.0	3.3	
Timing error ($R_A = 1$ to 100 k Ω , C = .1 μ F) (see appl.)							
Initial accuracy			1			.5	2
Drift with temperature			50			30	100
Drift with supply voltage			.1			.05	.2

Typical characteristics

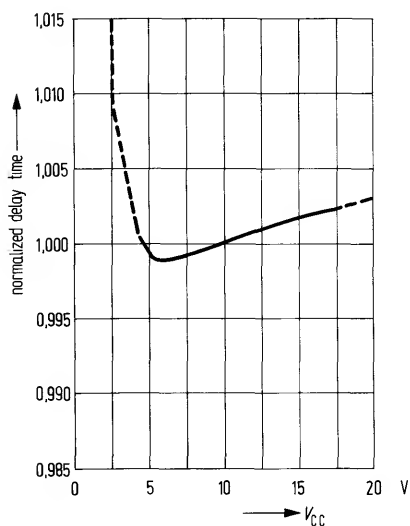
Minimum pulse width required for triggering



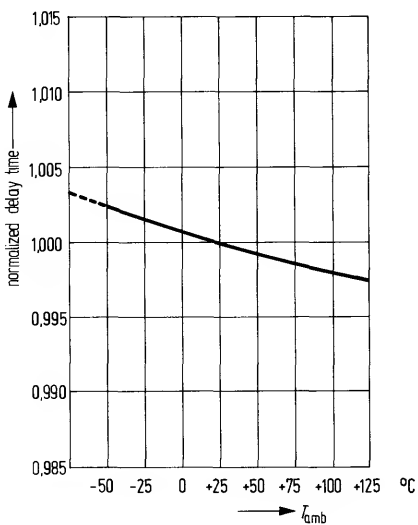
Supply current vs supply voltage



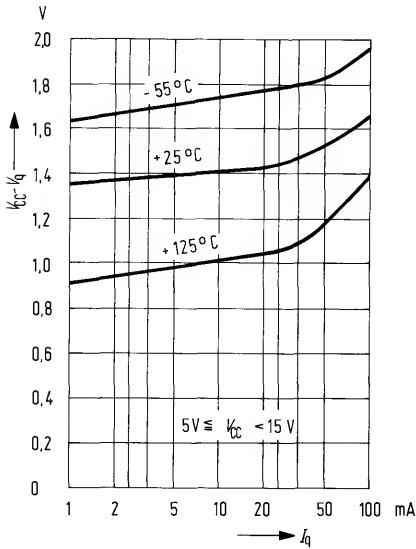
Delay time vs supply voltage



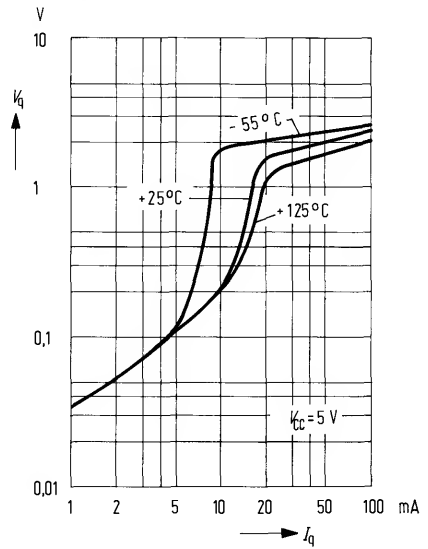
Delay time vs temperature



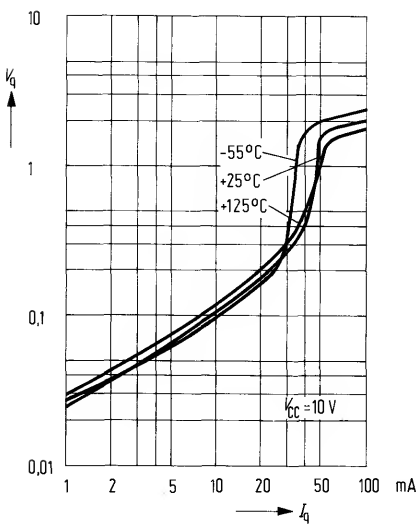
Low output voltage vs output sink current



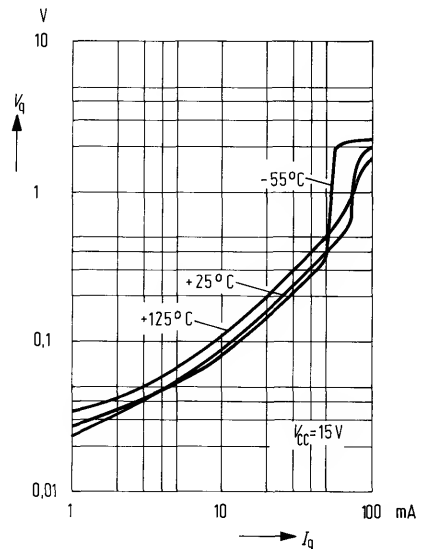
High output voltage vs output source current



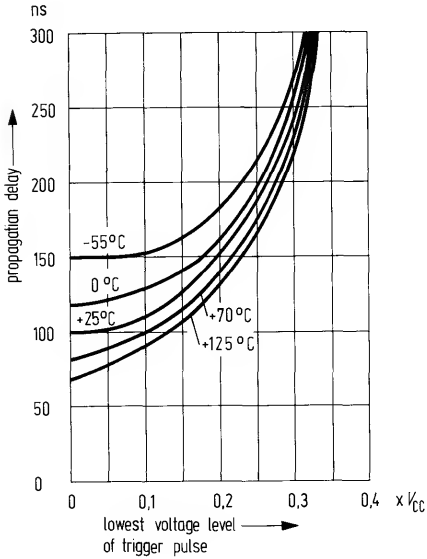
Low output voltage vs output sink current



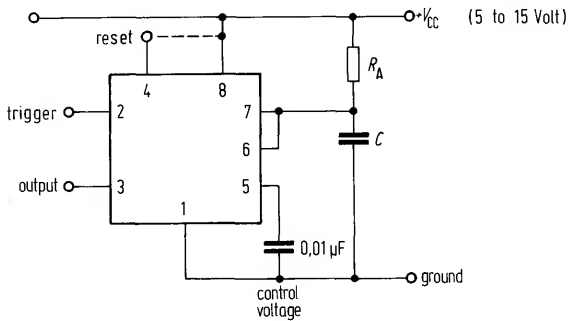
Low output voltage vs output sink current



Propagation delay vs voltage level of trigger pulse



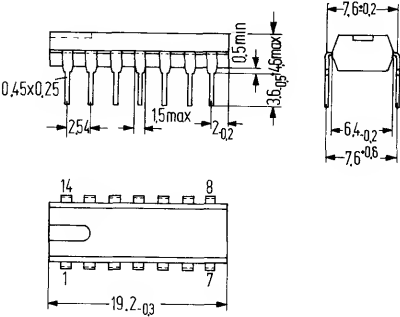
Application: monostable multivibrator



TDB 0556 A replaces two TDB 0555 in plastic plug-in package (14 pins) similar to 20 A 14 DIN 41866 (TO-116).

Type	Ordering code
TDB 0556 A	Q67000-A1046

Package outlines



Plastic plug-in package, 14 pins
20 A 14 DIN 41866 (TO-116)
Weight approx. 1.1 g
Dimensions in mm

Maximum ratings

Supply voltage
Storage temperature
Junction temperature
Thermal resistances: System-case

V_{CC}	16	V
T_S	-65 to +150	°C
T_J	150	°C
$R_{thScase}$	120	K/W

Range of operation

Supply voltage
Ambient temperature in operation

V_{CC}	4.5 to 16	V
T_{amb}	0 to +70	°C

Operating characteristics $V_{CC} = 5$ to 15 V, $T_{amb} = 25^{\circ}\text{C}$

unless otherwise specified

Supply current ($R_L = \infty$, $I_q = 1$ mA) $V_{CC} = 5$ V $V_{CC} = 15$ V

Frequency range

Timing error (monostable; $R_A = 2$ to 100 k Ω , $C = .1$ μF)Initial accuracy ($V_{CC} = 5$ and/or 15 V)Drift with temperature ($V_{CC} = 15$ V)Drift supply voltage ($V_{CC} = 5$ and/or 15 V)Timing error (astable; $R_A, R_B = 2$ to 100 k Ω , $C = .1$ μF)Initial accuracy ($V_{CC} = 5$ and/or 15 V)Drift with temperature ($V_{CC} = 15$ V)Drift with supply voltage ($V_{CC} = 5$ and/or 15 V)

Threshold voltage

Threshold current (determines the max. value of

 $R_A + R_B$ for 15 V, max $R_A + R_B \leq 20$ M Ω)Trigger voltage: $V_{CC} = 15$ V $V_{CC} = 5$ V

Trigger current

Reset voltage

Reset current

Control voltage level: $V_{CC} = 15$ V $V_{CC} = 5$ V

Output voltage drop (low)

 $V_{CC} = 15$ V $I_{\text{sink}} = 10$ mA $I_{\text{sink}} = 50$ mA $I_{\text{sink}} = 100$ mA $I_{\text{sink}} = 200$ mA $V_{CC} = 5$ V $I_{\text{sink}} = 5$ mA

Output voltage drop (high)

 $V_{CC} = 15$ V $I_{\text{source}} = 100$ mA $I_{\text{source}} = 200$ mA $V_{CC} = 5$ V $I_{\text{source}} = 100$ mA

Rise time of output

Fall time of output

Discharge leakage current

Matching characteristics (refer to the difference between performance characteristics of each timer section)

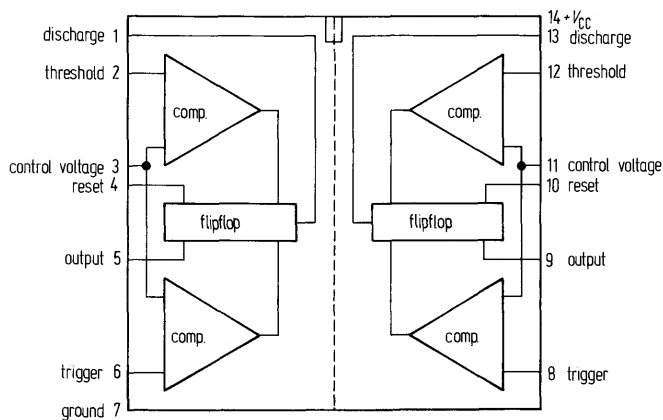
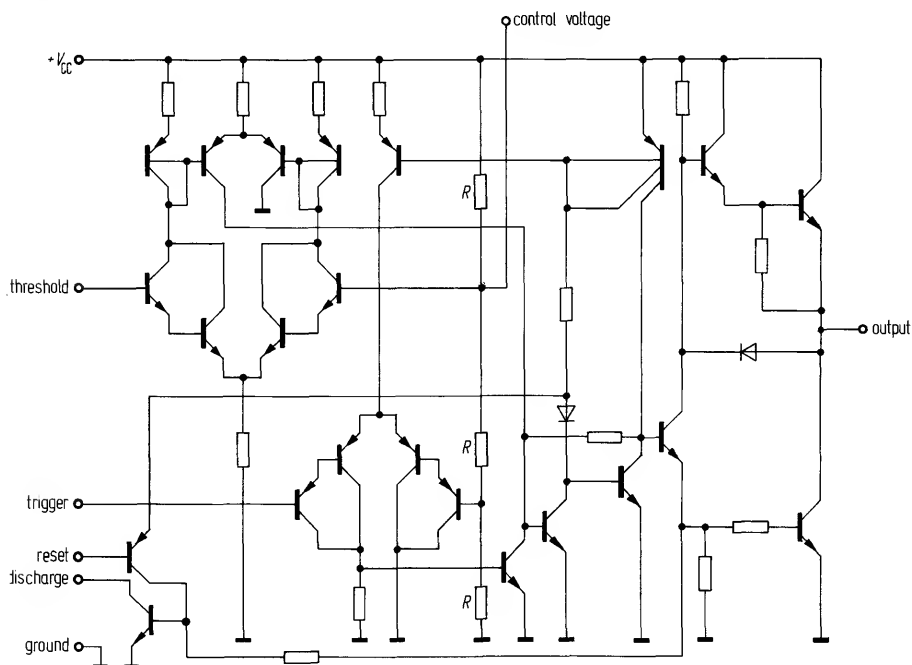
Initial timing accuracy

Timing drift with temperature

Drift with supply voltage

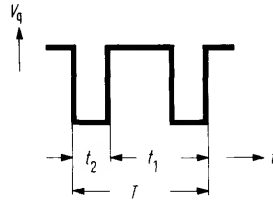
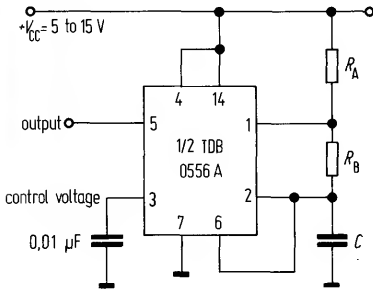
	min	typ	max	
V_{qsat}	10^{-3}	3	6	mA
		10	14	mA
			10^6	Hz
		.75		%
		50		ppm/K
		.1		%/K
		2.25		%
		150		ppm/K
		.3		%/V
		$\frac{2}{3} \times V_{CC}$		
V_q	9.0 2.6	30	100	nA
		5		V
		1.67		V
		.5		μA
		.7	1.0	V
		.1		mA
		10	11	V
		3.33	4	V
		.1	.25	V
		.4	.75	V
V_q		2.0	2.75	V
		2.5		
		.25	.35	V
		13.3		V
		12.5		V
		3.3		V
		100		ns
		100		ns
		20	100	nA
		.1	.2	%
		± 10		ppm/K
		.2	.5	%/V

For typical characteristics see TDB 0555 data sheet.

Block diagram**Equivalent circuit (shown for one side only)**

Application circuits

astable multivibrator

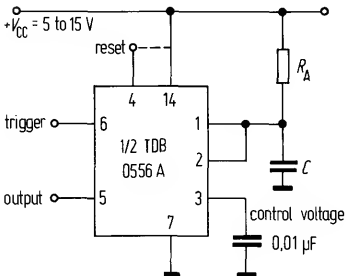


$$t_1 = 0.693 \cdot (R_A + R_B) \cdot C$$

$$t_2 = 0.693 \cdot R_B \cdot C$$

$$T = t_1 + t_2 = 0.693 \cdot (R_A + 2 R_B) \cdot C$$

monostable multivibrator



$$t_{on} = 1.1 \cdot R_A \cdot C$$

Precision Voltage Regulator

TDB 0723 -723
TDB 0723 A-723
TDC 0723 -723

The TDB 0723 is a monolithic voltage regulator and is intended for use with positive or negative supplies as a series, shunt, switching or floating regulator.

In addition to a low temperature drift, low standby current drain and high ripple rejection the voltage regulators feature:

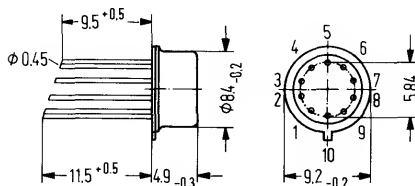
● Line regulation ($V_i = 12$ to 15 V)	.01% V_q
● Load regulation ($I_q = 1$ to 50 mA)	.03% V_q
● Ripple rejection	74 dB
● Average temperature coefficient of V_q	.002%/K
● Output noise voltage ($f = 100$ Hz to 1 kHz, $C_{ref} = 0$)	20 μV_{eff}
● Long time stability	.1%/1000 h
● Output voltage range	2 to 37 V
● Output current range	0 to 150 mA

Type	Ordering codes
TDB 0723	Q67000-A1068
TDB 0723 A	Q67000-A1069
TDC 0723	Q67000-A1070

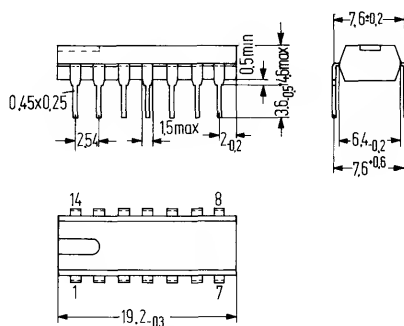
Package outlines

for TDB 0723 and TDC 0723

for TDB 0723 A



Package 5 J 10 DIN 41873
(similar TO-100)
Weight approx. 1.1 g



Plastic plug-in package, 14 pins,
20 A 14 DIN 41866 (TO-116),
Weight approx. 1.1 g

Dimensions in mm

Maximum ratings

- Pulse voltage from +V_{CC} to -V_{CC} (50 ms)
- Continuous voltage from +V_{CC} to -V_{CC}
- Input/output voltage differential
- Differential input voltage
- Voltage between non-inverting input and -V_{CC}
- Current from V_Z
- Current from V_{Ref}
- Junction temperature
- Storage temperature
- Thermal resistances
- System-case (TDB 0723, TDC 0723)
- System-ambient air (TDB 0723, TDC 0723)
- System-ambient air (TDB 0723 A)

	TDB 0723	TDB 0723 A	TDC 0723
V _{pp}	50		V
V _{CC}	40		V
V _i -V _q	40		V
V _{Di}	±5		V
	8		V
	25		mA
	15		mA
T _J	150		°C
T _s	-65 to +150		°C
R _{thScase}	80		K/W
R _{thSamb}	190		K/W
R _{thSamb}	120		K/W

Range of operation

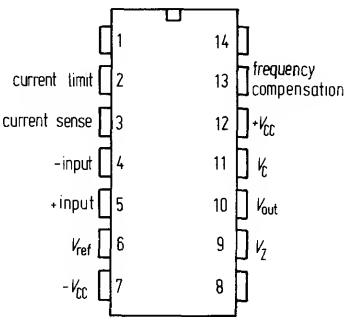
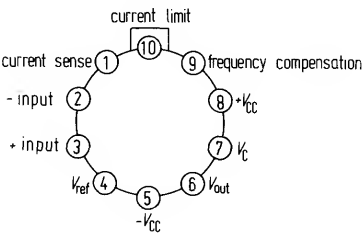
- Ambient temperature in operation TDB 0723 A
- TDC 0723

T _{amb}	0 to +70	°C
T _{amb}	-55 to +125	°C

Pin connection

TDB 0723 and TDC 0723

TDB 0723 A



Operating characteristics

($V_i = V_c = +V_{cc} = 12\text{ V}$;
 $-V_{cc} = 0\text{ V}$; $V_q = 5\text{ mA}$
 $I_q = 1\text{ mA}$) (see fig 1)

Line regulation

$V_i = 12\text{ to }15\text{ V}$

$V_i = 12\text{ to }40\text{ V}$

Load regulation

($I_q = 1\text{ to }50\text{ mA}$)

Ripple rejection

$f = 50\text{ Hz to }10\text{ kHz}$

$f = 50\text{ Hz to }10\text{ kHz}$,

$C_{ref} = 5\text{ }\mu\text{F}$

Temperature
coefficient of V_q

Short circuit
current limit

$R_{sc} = 10\text{ }\Omega$, $V_q = 0$

Reference voltage

Output noise voltage

$f = 100\text{ Hz to }10\text{ kHz}$

$f = 100\text{ Hz to }10\text{ kHz}$,

$C_{ref} = 5\text{ }\mu\text{F}$

Long term stability

Standby current drain

($I_q = 0$, $V_i = 30\text{ V}$)

Input voltage range V_i

Output voltage range V_q

Input/output voltage
differential

TDB 0723

TDB 0723 A

$T_{amb} = 25\text{ }^\circ\text{C}$

TDC 0723

$T_{amb} = 25\text{ }^\circ\text{C}$

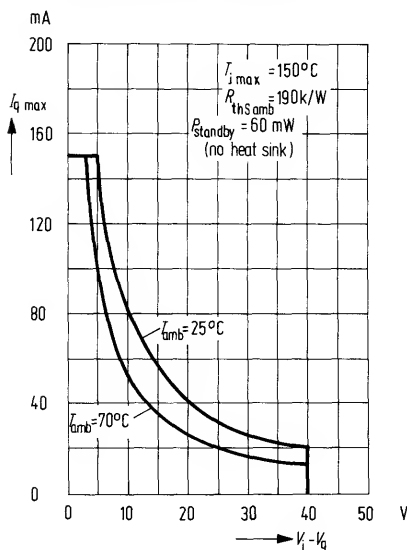
$T_{amb} = -55$

to $+125\text{ }^\circ\text{C}$

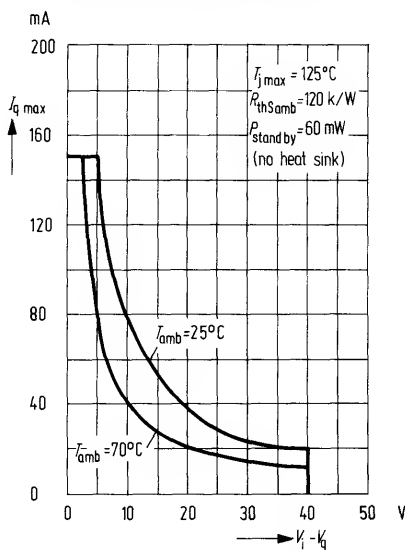
	min	typ	max	min	typ	max	min	max	
		.01	.1		.01	.1		.3	% V_q
		.1	.5		.02	.2			% V_q
		.03	.2		.03	.15		.6	% V_q
		74			74				dB
		86			86				dB
		.003	.015					.015	%/K
		65			65				mA
	6.80	7.15	7.50	6.95	7.15	7.35			V
		20			20				μV_{rms}
		2.5			2.5				μV_{rms}
		.1			.1				%/ 1000 h
		2.3	4.0		2.3	3.5			mA
	V_i 9.5		40	9.5		40			V
	V_q 2.0		37	2.0		37			V
	3.0		38	3.0		38			V

Typical performance curves for TDB 0723/A

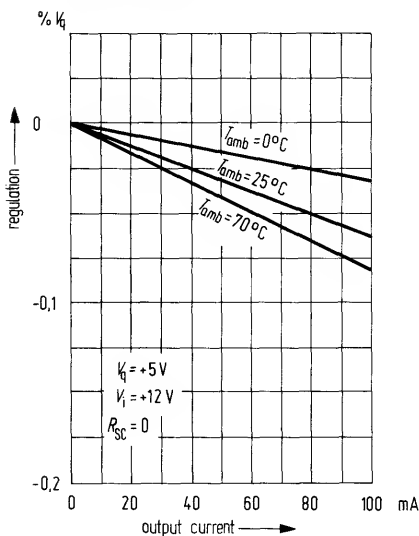
Maximum load current as a function of input/output voltage differential



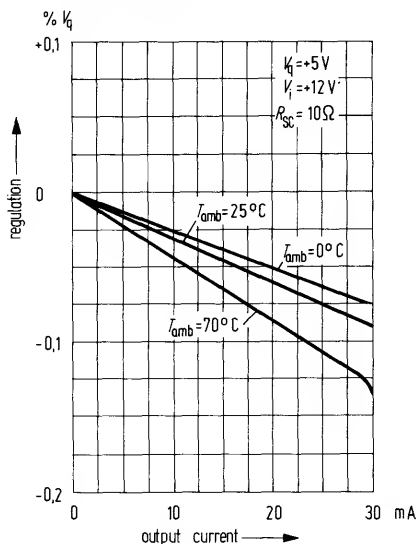
Maximum load current as a function of input/output voltage differential



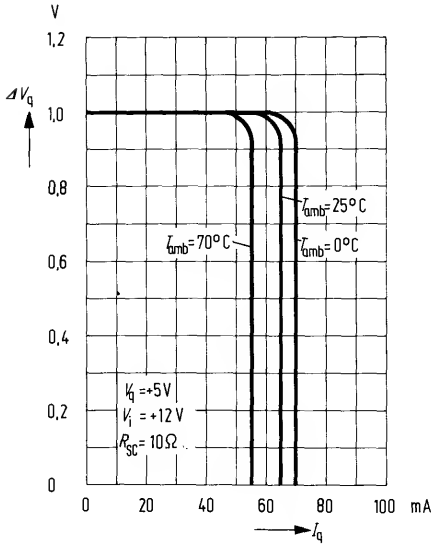
Load regulation characteristics without current limiting



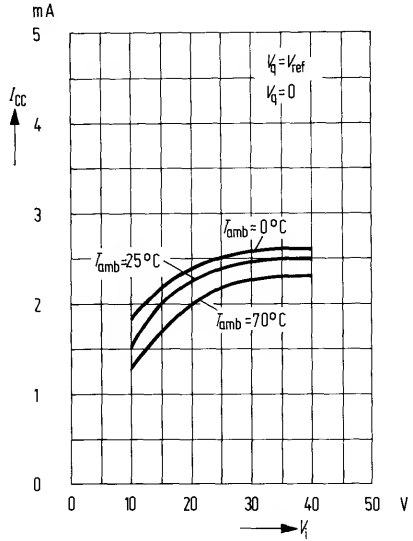
Load regulation characteristics with current limiting



Current limiting characteristics

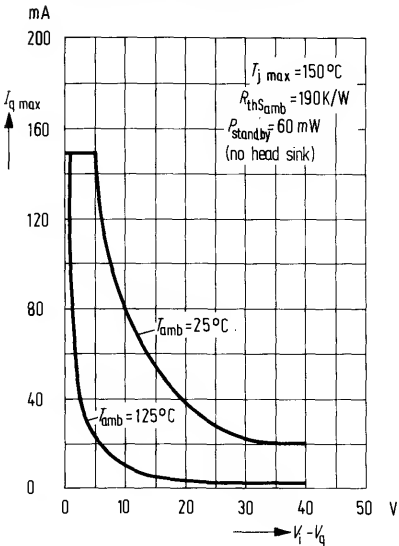


Standby current drain as a function of input voltage

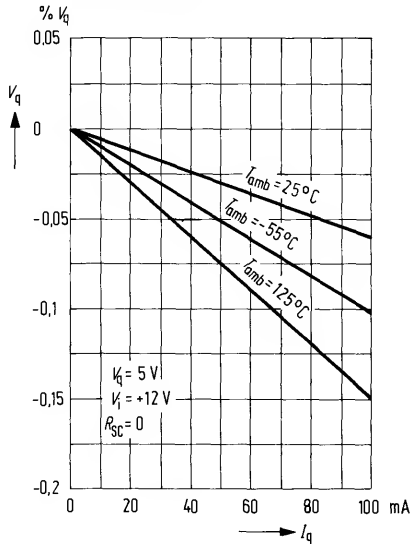


Typical performance curves for TDC 0723

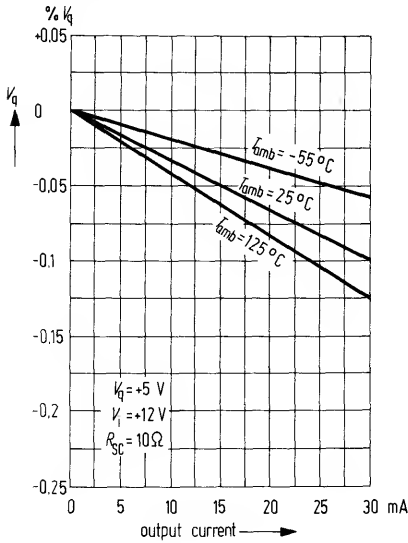
Maximum load current as a function of input/output voltage differential



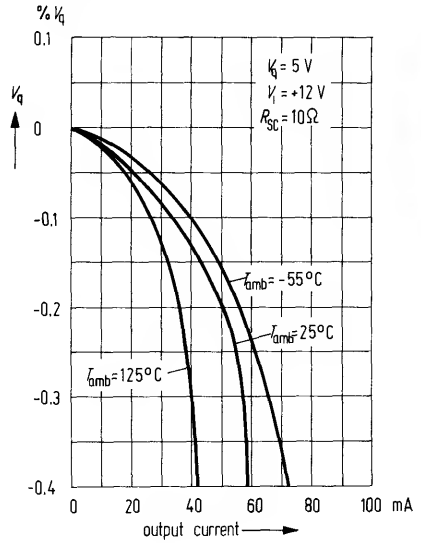
Load regulation characteristics without current limiting



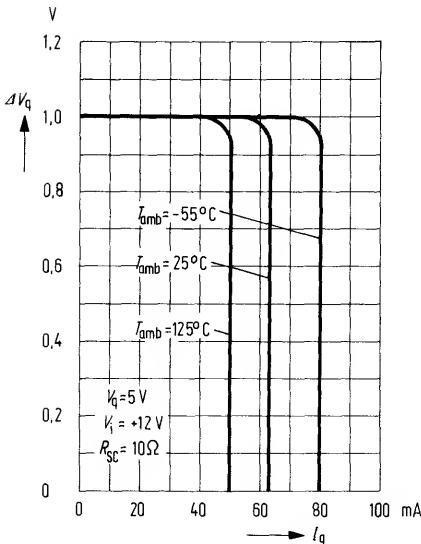
Load regulation characteristics with current limiting



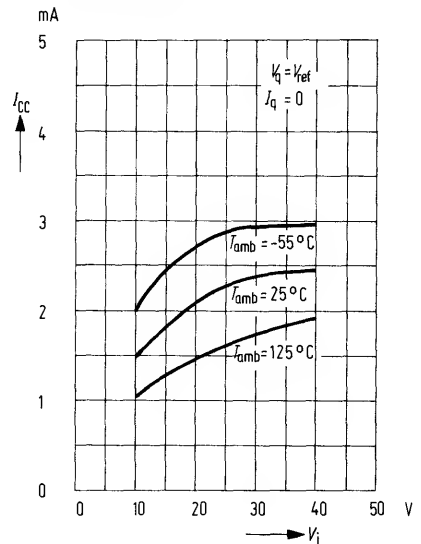
Load regulation characteristics with current limiting



Current limiting characteristics

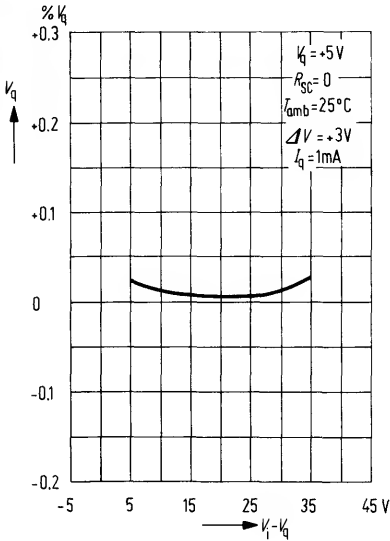


Standby current drain as a function of input voltage

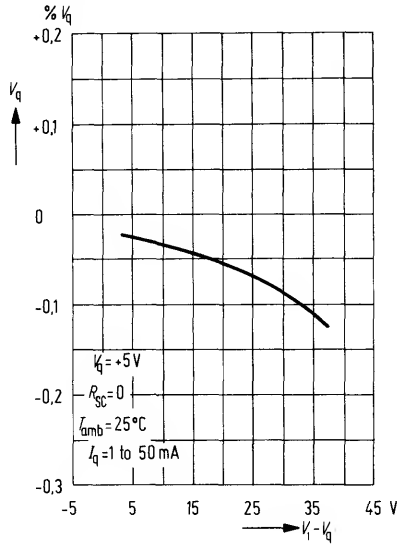


Typical performance curves for TDB 0723/A and TDC 0723

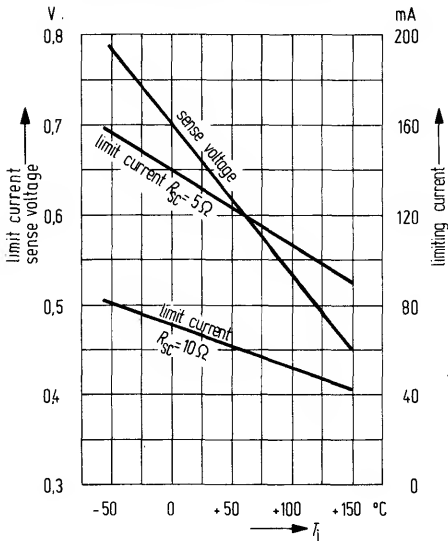
Line regulation as a function of input/output voltage differential



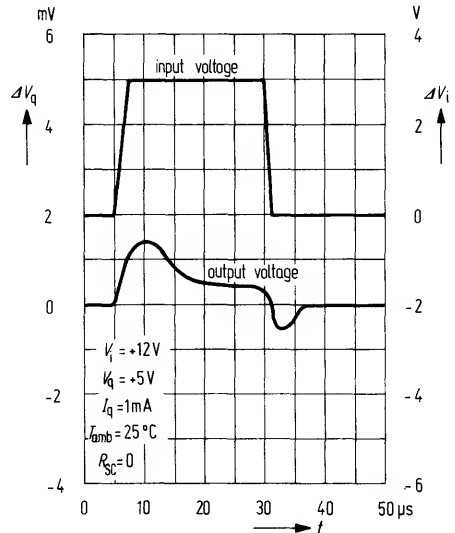
Load regulation as a function of input/output voltage differential



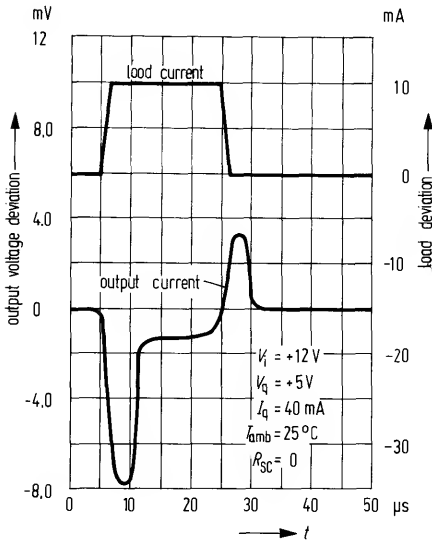
Current limiting characteristics as a function of junction temperature



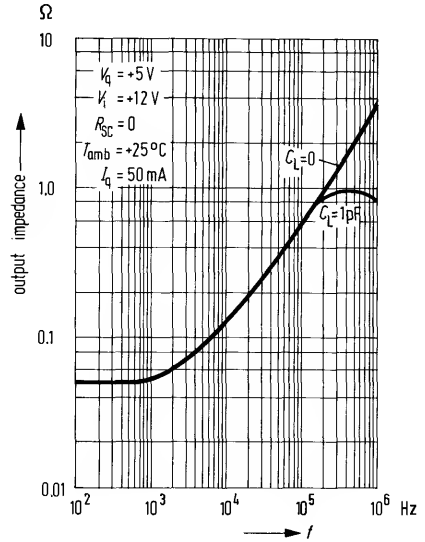
Line transient response



Load transient response



Output impedance as a function of frequency



Block diagram

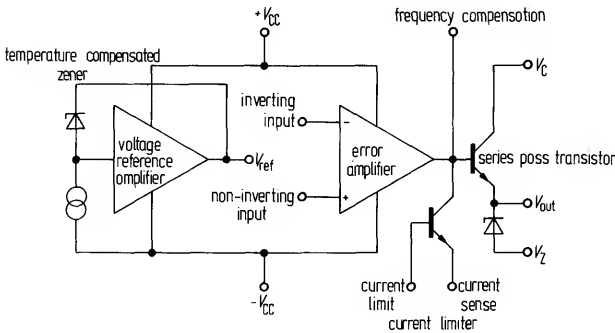


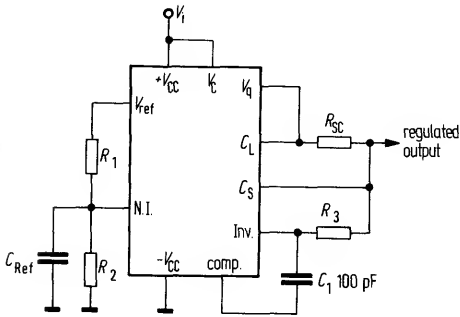
Table I
Resistor values (kΩ) for standard output voltages

Positive output voltage	Applicable figures	Fixed output ±5%		Output adjustable ±10% (fig. 13)		
		R_1	R_2	R_1	P_1	R_2
+ 3.0	1, 5, 6, 9, 12	4.12	3.01	1.8	.5	1.2
+ 3.6	1, 5, 6, 9, 12	3.57	3.65	1.5	.5	1.5
+ 5.0	1, 5, 6, 9, 12	2.15	4.99	0.75	.5	2.2
+ 6.0	1, 5, 6, 9, 12	1.15	6.04	0.5	.5	2.7
+ 9.0	2, 4	1.87	7.15	0.75	1.0	2.7
+ 12	2, 4	4.87	7.15	2.0	1.0	3.0
+ 15	2, 4	7.87	7.15	3.3	1.0	3.0
+ 28	2, 4	21.0	7.15	5.6	1.0	2.0
+ 45	7	3.57	48.7	2.2	10	39
+ 75	7	3.57	78.7	2.2	10	68
+100	7	3.57	102	2.2	10	91
+250	7	3.57	255	2.2	10	240
- 6 (+ $V_{cc} \geq 3$)	3	3.57	2.43	1.2	.5	.75
- 9	3, 10	3.48	5.36	1.2	.5	2.0
- 12	3, 10	3.57	8.45	1.2	.5	3.3
- 15	3, 10	3.65	11.5	1.2	.5	4.3
- 28	3, 10	3.57	24.3	1.2	.5	10
- 45	8	3.57	41.2	2.2	10	33
-100	8	3.57	97.6	2.2	10	91
-250	8	3.57	249	2.2	10	240

Table II
Formulare for intermediate output voltages

Outputs from +2 to +7 volts [Figures 1, 5, 6, 9, 12] $V_q = V_{ref} \cdot \frac{R_2}{R_1 + R_2}$	Outputs from +4 to +250 volts (Figure 7) $V_q = \frac{V_{ref}}{2} \cdot \frac{R_2 - R_1}{R_1};$ $R_3 = R_4$	Current limiting $I_{limit} = \frac{V_{sense}}{R_{sc}}$
Outputs from +7 to +37 volts [Figures 2, 4] $V_q = V_{ref} \cdot \frac{R_1 + R_2}{R_2}$	Outputs from -6 to -250 volts (Figures 3, 8, 10) $V_q = \frac{V_{ref}}{2} \cdot \frac{R_1 + R_2}{R_1};$ $R_3 = R_4$	Foldback current limiting $I_{knee} = \frac{V_q \cdot R_3}{R_{sc} \cdot R_4} + \frac{V_{sense} (R_3 + R_4)}{R_{sc} R_4}$ $I_{short\ ckt} = \frac{V_{sense}}{R_{sc}} \cdot \frac{R_3 + R_4}{R_4}$

Fig. 1 Basic low voltage regulator ($V_q = 2$ to 7 V)

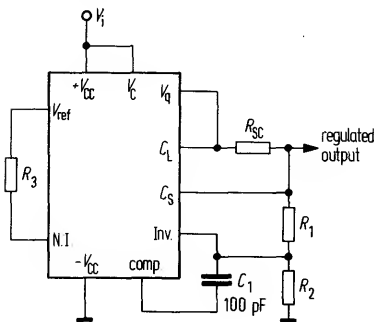


Typical performance

Regulated output voltage	5 V
Line regulation ($\Delta V_i = 3$ V)	.5 mV
Load regulation ($\Delta I_q = 50$ mA)	1.5 mV

Note: $R_3 = \frac{R_1 \cdot R_2}{R_1 + R_2}$ for minimum temperature drift.

Fig. 2 Basic high voltage regulator ($V_q = 7$ to 37 V)



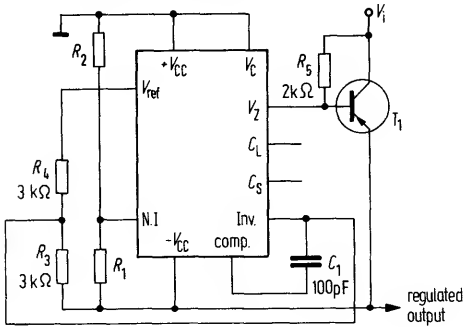
Typical performance

Regulated output voltage	15 V
Line regulation ($\Delta V_i = 3$ V)	1.5 mV
Load regulation ($\Delta I_q = 50$ mA)	4.5 mV

Note: $R_3 = \frac{R_1 \cdot R_2}{R_1 + R_2}$ for minimum temperature drift.

R_3 may be eliminated for minimum component count.

Fig.3 Negative voltage regulator

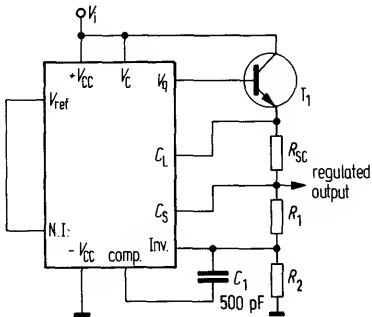


Typical performance

Regulated output voltage	-15 V
Line regulation ($\Delta V_i = 3$ V)	1 mV
Load regulation ($\Delta I_q = 100$ mA)	2 mV

For metal can applications where V_Z is required, an external 6.2 V zener diode should be connected in series with V_q .

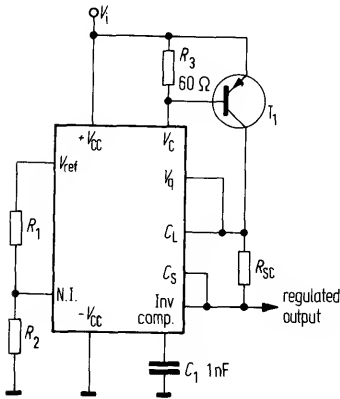
Fig.4 Positive voltage regulator (External NPN Pass Transistor)



Typical performance

Regulated output voltage	+15 V
Line regulation ($\Delta V_i = 3$ V)	1.5 mV
Load regulation ($\Delta I_q = 1$ A)	15 mV

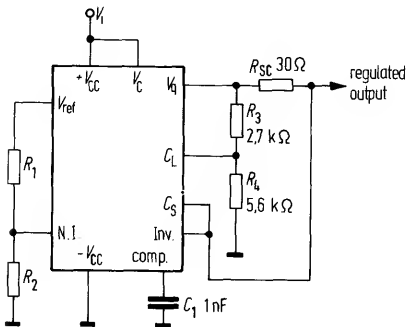
Fig. 5 Positive voltage regulator (External PNP Pass Transistor)



Typical performance

Regulated output voltage	+5 V
Line regulation ($\Delta V_i = 3$ V)	.5 mV
Load regulation ($\Delta I_q = 1$ A)	5 mV

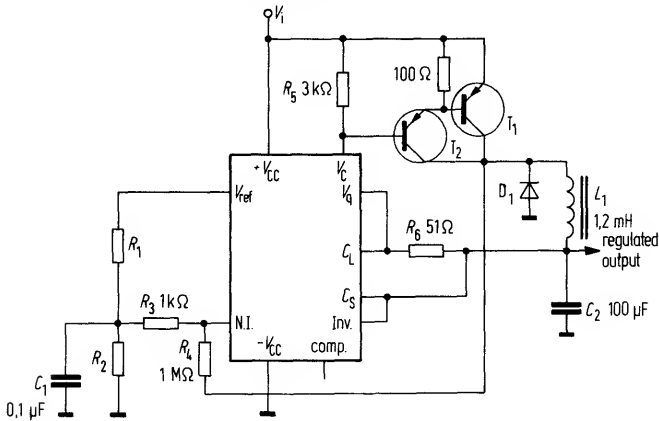
Fig. 6 Foldback current limiting



Typical performance

Regulated output voltage	+5 V
Line regulation ($\Delta V_i = 3$ V)	.5 mV
Load regulation ($\Delta I_q = 10$ mA)	1 mV
Short circuit current	20 mA

Fig.9 Positive switching regulator

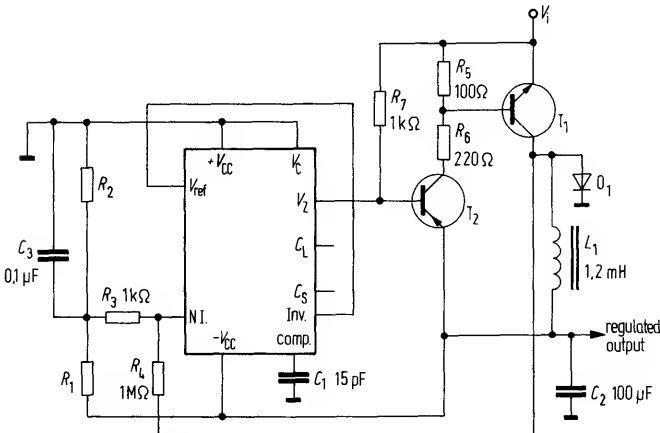


Typical performance

Regulated output voltage	+5 V
Line regulation ($\Delta V_i = 30$ V)	10 mV
Load regulation ($\Delta I_q = 2$ A)	80 mV

L_1 is 40 turns of No 20 enameled copper wire wound on pot core.

Fig.10 Negative switching regulator



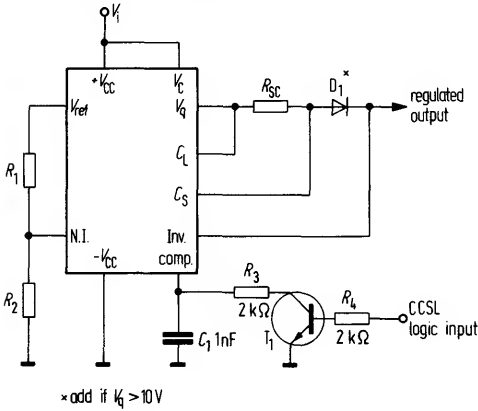
Typical performance

Regulated output voltage	-15 V
Line regulation ($\Delta V_i = 20$ V)	8 mV
Load regulation ($\Delta I_q = 2$ A)	6 mV

L_1 is 40 turns of No 20 enameled copper wire wound on pot core.

For metal can applications, where V_z is required, an external 6.2 V zener diode should be connected in series with V_q .

Fig. 11 Remote shutdown regulator with current limiting



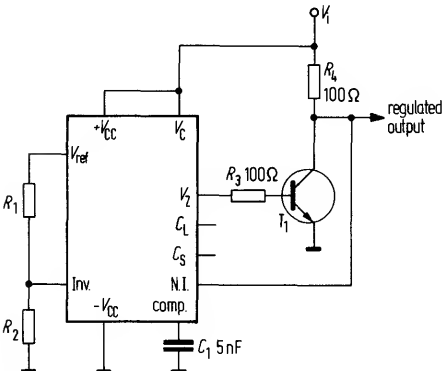
Typical performance

Regulated output voltage	+5 V
Line regulation ($\Delta V_i = 3\text{ V}$)	0.5 mV
Load regulation ($\Delta I_q = 50\text{ mA}$)	1.5 mV

Note 1: Current limit transistor may be used for shutdown if current limiting is not required.

Note 2: Add if $V_q > 10\text{ V}$

Fig. 12 Shunt regulator

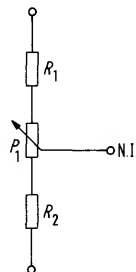


Typical performance

Regulated output voltage	+5 V
Line regulation ($\Delta V_i = 10\text{ V}$)	0.5 mV
Load regulation ($\Delta I_q = 100\text{ mA}$)	1.5 mV

For metal can applications where V_z is required, an external 6.2 V zener diode should be connected in series with V_q .

Fig. 13 Output voltage adjust



Three-Terminal Positive Voltage Regulators

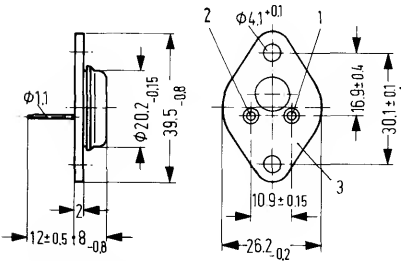
TDB 7800 -7800
TDB 7800 T-7800
TDC 7800 -7800

TDB 7800 and TDC 7800 are monolithic three-terminal positive regulators in packages similar to 3 A 2 DIN 41872 (TO-3). These regulators employ internal current limiting, thermal shutdown and safe-area compensation, without external components. If adequate heat sinking is provided, they can deliver over 1 A output current. These devices can be used with external components to obtain adjustable output voltages and currents and also as the power pass element in precision regulators.

Output voltages: 5V, 6V, 8V, 12V, 15V, 18V and 24V in TO-3 and TO-220 packages.

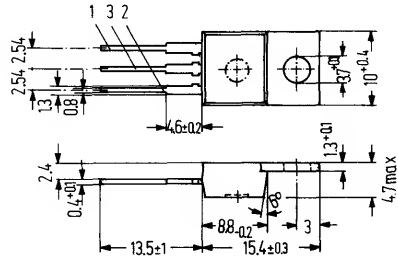
Package outlines

for TDB 7800 and TDC 7800



3 A 2 DIN 41872 (TO-3)
Weight approx 16.5 g

for TDB 7800 T



TO-220 AB
Weight approx 18 g
Pin 3 electrically connected
with heat sinking

Dimensions in mm

Maximum ratings

Input voltage ($V_q = 5$ to 18 V)
($V_q = 24$ V)
Junction temperature
Storage temperature
Thermal resistance:
System-case: TDB 7800, TDC 7800
System-case: TDB 7800 T
System-ambient air: TDB 7800, TDC 7800
System-ambient air: TDB 7800 T

	TDB 7800 TDB 7800 T TDC 7800	
V_i	35	V
V_o	40	V
T_j	150	°C
T_s	-65 to +150	°C
$R_{thScase}$	4	K/W
$R_{thScase}$	4	K/W
R_{thSamb}	35	K/W
R_{thSamb}	50	K/W

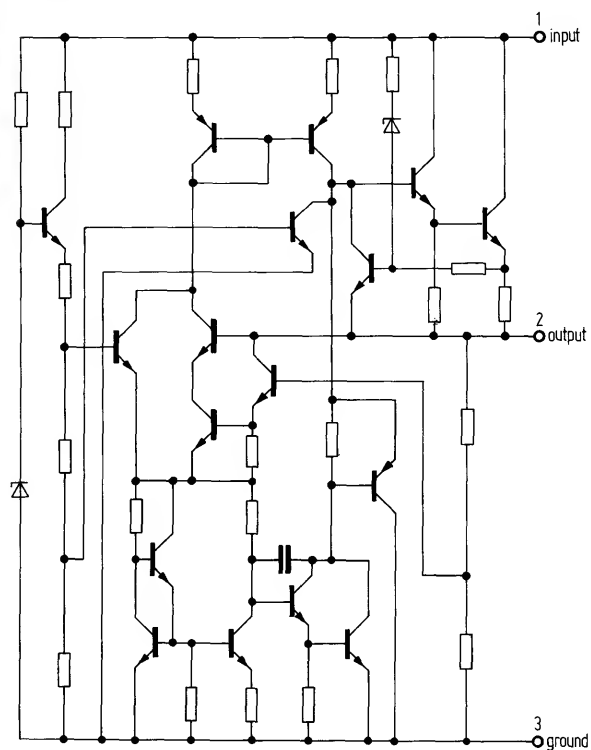
Range of operation

Ambient temperature in operation
TDB 7800; TDB 7800 T
TDC 7800

T_{amb}	0 to +85	°C
T_{amb}	-55 to +125	°C

TDB 7800 -7800
TDB 7800 T-7800
TDC 7800 -7800

Circuit



Type	Ordering codes
TDB 7805	Q67000-A1047
TDB 7805 T	Q67000-A1048
TDC 7805	Q67000-A1049

Operating characteristics

($V_i = 10\text{ V}$; $I_q = 500\text{ mA}$)

$T_{amb} = 25\text{ }^{\circ}\text{C}$)

Output voltage

Line regulation:

$7\text{ V} \leq V_i \leq 25\text{ V}$

$8\text{ V} \leq V_i \leq 12\text{ V}$

Load regulation:

$5\text{ mA} \leq I_q \leq 1.5\text{ A}$

$250\text{ mA} \leq I_q \leq 750\text{ mA}$

Output voltage:

$P \leq 15\text{ W}$ $7.0\text{ V} \leq V_i \leq 20\text{ V}$

$5\text{ mA} \leq I_q \leq 1.0\text{ A}$

$0\text{ }^{\circ}\text{C} \leq T_{amb} \leq 70\text{ }^{\circ}\text{C}$

$P \leq 15\text{ W}$ $8.0\text{ V} \leq V_i \leq 20\text{ V}$

$5\text{ mA} \leq I_q \leq 1.0\text{ A}$

$-55\text{ }^{\circ}\text{C} \leq T_{amb} \leq +125\text{ }^{\circ}\text{C}$

Quiescent current

Quiescent current change

$0\text{ }^{\circ}\text{C} \leq T_{amb} \leq +70\text{ }^{\circ}\text{C}$:

$7\text{ V} \leq V_i \leq 25\text{ V}$

$5\text{ mA} \leq I_q \leq 1.0\text{ A}$

$-55\text{ }^{\circ}\text{C} \leq T_{amb} \leq +125\text{ }^{\circ}\text{C}$:

$8\text{ V} \leq V_i \leq 25\text{ V}$

$5\text{ mA} \leq I_q \leq 1.0\text{ A}$

Output noise voltage:

$10\text{ Hz} \leq f \leq 100\text{ kHz}$

Long term stability:

$0\text{ }^{\circ}\text{C} \leq T_{amb} \leq +70\text{ }^{\circ}\text{C}$

$-55\text{ }^{\circ}\text{C} \leq T_{amb} \leq +125\text{ }^{\circ}\text{C}$

Ripple rejection

($f = 120\text{ Hz}$; $8\text{ V} \leq V_i \leq 18\text{ V}$)

$0\text{ }^{\circ}\text{C} \leq T_{amb} \leq +70\text{ }^{\circ}\text{C}$

$-55\text{ }^{\circ}\text{C} \leq T_{amb} \leq +125\text{ }^{\circ}\text{C}$

Dropout voltage ($I_q = 1.0\text{ A}$)

Short circuit current

Peak output current

Output resistance ($f = 1\text{ kHz}$)

$0\text{ }^{\circ}\text{C} \leq T_{amb} \leq +70\text{ }^{\circ}\text{C}$

$-55\text{ }^{\circ}\text{C} \leq T_{amb} \leq +125\text{ }^{\circ}\text{C}$

Temperature coefficient of V_q ($I_q = 5\text{ mA}$)

$0\text{ }^{\circ}\text{C} \leq T_{amb} \leq +70\text{ }^{\circ}\text{C}$

$0\text{ }^{\circ}\text{C} \leq T_{amb} \leq +125\text{ }^{\circ}\text{C}$

	TDB 7805 TDB 7805 T			TDC 7805			
	min	typ	max	min	typ	max	
V_q	4.8	5.0	5.2	4.8	5.0	5.2	V
		3	100		3	50	mV
		1	50		1	25	mV
		15	100		15	50	mV
		5	50		5	25	mV
V_q	4.75		5.25				V
V_q				4.65		5.35	V
		4.2	8.0		4.2	6.0	mA
			1.3				mA
			.5				mA
						.8	mA
						.5	mA
		40			40		μV
			20				mV/ 1000 h
						20	mV/ 1000 h
	62	78		68	78		dB
		2.0			2.0		dB
I_{qsc}		750			750		V
I_q		2.2			2.2		mA
R_q		17					A
R_q					17		m Ω
α_E	-1.1						m Ω
α_E					-1.1		mV/K
							mV/K

Type	Ordering codes
TDB 7806	Q67000-A1050
TDB 7806 T	Q67000-A1051
TDC 7806	Q67000-A1052

Operating characteristics

($V_i = 11\text{ V}$; $I_q = 500\text{ mA}$; $T_{\text{amb}} = 25^\circ\text{C}$)

		TDB 7806 TDB 7806 T			TDC 7806			
		min	typ	max	min	typ	max	
Output voltage	V_q	5.75	6.0	6.25	5.75	6.0	6.25	V
Line regulation:								
8 V $\leq V_i \leq 25\text{ V}$			5	120		5	60	mV
9 V $\leq V_i \leq 13\text{ V}$			1.5	60		1.5	30	mV
Load regulation:								
5 mA $\leq I_q \leq 1.5\text{ A}$			14	120		14	60	mV
250 mA $\leq I_q \leq 750\text{ mA}$			4	60		4	30	mV
Output voltage:								
$P \leq 15\text{ W}$ 8 V $\leq V_i \leq 25\text{ V}$	V_q	5.7		6.3				V
5 mA $\leq I_q \leq 1.0\text{ A}$								
$0^\circ\text{C} \leq T_{\text{amb}} \leq 70^\circ\text{C}$								
$P \leq 15\text{ W}$ 9 V $\leq V_i \leq 21\text{ V}$	V_q				5.65		6.35	V
5 mA $\leq I_q \leq 1.0\text{ A}$								
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$								
Quiescent current			4.3	8.0		4.3	6.0	mA
Quiescent current change								
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$:								
8 V $\leq V_i \leq 25\text{ V}$				1.3				mA
5 mA $\leq I_q \leq 1.0\text{ A}$				.5				mA
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$:								
9 V $\leq V_i \leq 25\text{ V}$						.8		mA
5 mA $\leq I_q \leq 1.0\text{ A}$						.5		mA
Output noise voltage: 10 Hz $\leq f \leq 100\text{ kHz}$			45			45		μV
Long term stability:								
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$				24				mV/1000 h
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$							24	mV/1000 h
Ripple rejection ($f = 120\text{ Hz}$; 9 V $\leq V_i \leq 19\text{ V}$)								
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$		59	75					dB
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$					65	75		dB
Dropout voltage ($I_q = 1.0\text{ A}$)			2.0			2.0		V
Short circuit current	I_{qsc}		550			550		mA
Peak output current	I_q		2.2			2.2		A
Output resistance ($f = 1\text{ kHz}$)								
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$	R_q		19					m Ω
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$	R_q					19		m Ω
Temperature coefficient of V_q ($I_q = 5\text{ mA}$)								
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$	α_E		-8					mV/K
$0^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$	α_E					-8		mV/K

Type	Ordering codes
TDB 7808	Q67000-A1053
TDB 7808 T	Q67000-A1054
TDC 7808	Q67000-A1055

Operating characteristics

($V_i = 14\text{ V}$; $I_q = 500\text{ mA}$; $T_{\text{amb}} = 25^\circ\text{C}$)

	TDB 7808 TDB 7808 T			TDC 7808			
	min	typ	max	min	typ	max	
Output voltage	V_q	7.7	8.0	8.3	7.7	8.0	8.3 V
Line regulation:							
$10.5\text{ V} \leq V_i \leq 25\text{ V}$		6	160		6	80	mV
$11\text{ V} \leq V_i \leq 17\text{ V}$		2	80		2	40	mV
Load regulation:							
$5\text{ mA} \leq I_q \leq 1.5\text{ A}$		12	160		12	80	mV
$250\text{ mA} \leq I_q \leq 750\text{ mA}$		4	80		4	40	mV
Output voltage:							
$P \leq 15\text{ W}$ $10.5\text{ V} \leq V_i \leq 23\text{ V}$	V_q	7.6	8.4				V
$5\text{ mA} \leq I_q \leq 1.0\text{ A}$							
$0^\circ\text{C} \leq T_{\text{amb}} \leq 70^\circ\text{C}$							
$P \leq 15\text{ W}$ $11.5\text{ V} \leq V_i \leq 23\text{ V}$	V_q			7.6		8.4	V
$5\text{ mA} \leq I_q \leq 1.0\text{ A}$							
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$							
Quiescent current		4.3	8.0		4.3	6.0	mA
Quiescent current change							
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$:			1.0				mA
$10.5\text{ V} \leq V_i \leq 25\text{ V}$			.5				mA
$5\text{ mA} \leq I_q \leq 1.0\text{ A}$							
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$:						.8	mA
$11.5\text{ V} \leq V_i \leq 25\text{ V}$						.5	mA
$5\text{ mA} \leq I_q \leq 1.0\text{ A}$							μV
Output noise voltage: $10\text{ Hz} \leq f \leq 100\text{ kHz}$		52			52		
Long term stability:			32				mV/1000 h
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$							mV/1000 h
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$						32	
Ripple rejection							
($f = 120\text{ Hz}$; $11.5\text{ V} \leq V_i \leq 21.5\text{ V}$)							
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$		56	72		62	72	dB
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$							dB
Dropout voltage ($I_q = 1.0\text{ A}$)			2.0			2.0	V
Short circuit current	I_{qsc}		450			450	mA
Peak output current	I_q		2.2			2.2	A
Output resistance ($f = 1\text{ kHz}$)							
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$	R_q		16				m Ω
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$	R_q				16		m Ω
Temperature coefficient of V_q ($I_q = 5\text{ mA}$)							
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$	α_E		-8				mV/K
$0^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$	α_E					-8	mV/K

Type	Ordering codes
TDB 7812	Q67000-A1056
TDB 7812 T	Q67000-A1057
TDC 7812	Q67000-A1058

Operating characteristics

($V_i = 19\text{ V}$; $I_q = 500\text{ mA}$; $T_{amb} = 25^\circ\text{C}$)

Output voltage	V_q	11.5	12	12.5	11.5	12	12.5	V
Line regulation:								
$14.5\text{ V} \leq V_i \leq 30\text{ V}$			10	240		10	120	mV
$16\text{ V} \leq V_i \leq 22\text{ V}$			3	120		3	60	mV
Load regulation:								
$5\text{ mA} \leq I_q \leq 1.5\text{ A}$			12	240		12	120	mV
$250\text{ mA} \leq I_q \leq 750\text{ mA}$			4	120		4	60	mV
Output voltage:								
$P \leq 15\text{ W}$ $14.5\text{ V} \leq V_i \leq 27\text{ V}$	V_q	11.4		12.6				V
$5\text{ mA} \leq I_q \leq 1.0\text{ A}$								
$0^\circ\text{C} \leq T_{\text{amb}} \leq 70^\circ\text{C}$								
$P \leq 15\text{ W}$ $15.5\text{ V} \leq V_i \leq 27\text{ V}$	V_q				11.4		12.6	V
$5\text{ mA} \leq I_q \leq 1.0\text{ A}$								
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$								
Quiescent current			4.3	8.0		4.3	6.0	mA
Quiescent current change								
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$:								
$14.5\text{ V} \leq V_i \leq 30\text{ V}$				1.0				mA
$5\text{ mA} \leq I_q \leq 1.0\text{ A}$				.5				mA
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$:								
$15\text{ V} \leq V_i \leq 30\text{ V}$							.8	mA
$5\text{ mA} \leq I_q \leq 1.0\text{ A}$							.5	mA
Output noise voltage: $10\text{ Hz} \leq f \leq 100\text{ kHz}$			75			75		μV
Long term stability:								
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$				48				mV/
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$							48	1000 h
								mV/
								1000 h
Ripple rejection								
($f = 120\text{ Hz}$; $15\text{ V} \leq V_i \leq 25\text{ V}$)								
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$		55	71					dB
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$					61			dB
Dropout voltage ($I_q = 1.0\text{ A}$)			2.0			71		V
Short circuit current	I_{qsc}		350			2.0		mA
Peak output current	I_q		2.2			350		A
Output resistance ($f = 1\text{ kHz}$)						2.2		
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$	R_q		18					m Ω
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$	R_q					18		m Ω
Temperature coefficient of V_q ($I_q = 5\text{ mA}$)								
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$	α_E		-1.0					mV/K
$0^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$	α_E					-1.0		mV/K

Type	Ordering codes
TDB 7815	Q67000-A1059
TDB 7815 T	Q67000-A1060
TDC 7815	Q67000-A1061

Operating characteristics

($V_i = 23 \text{ V}$; $I_q = 500 \text{ mA}$; $T_{\text{amb}} = 25^\circ\text{C}$)

	TDB 7815 TDB 7815 T			TDC 7815			
	min	typ	max	min	typ	max	
Output voltage	V_q	14.4	15	15.6	14.4	15	15.6 V
Line regulation:							
$17.5 \text{ V} \leq V_i \leq 30 \text{ V}$		11	300		11	150	mV
$20 \text{ V} \leq V_i \leq 26 \text{ V}$		3	150		3	75	mV
Load regulation:							
$5 \text{ mA} \leq I_q \leq 1.5 \text{ A}$		12	150		12	150	mV
$250 \text{ mA} \leq I_q \leq 750 \text{ mA}$		4	75		4	75	mV
Output voltage:							
$P \leq 15 \text{ W}$ $17.5 \text{ V} \leq V_i \leq 30 \text{ V}$	V_q	14.25	15.75				V
$5 \text{ mA} \leq I_q \leq 1.0 \text{ A}$							
$0^\circ\text{C} \leq T_{\text{amb}} \leq 70^\circ\text{C}$							
$P \leq 15 \text{ W}$ $18.5 \text{ V} \leq V_i \leq 30 \text{ V}$	V_q			14.25		15.75	V
$5 \text{ mA} \leq I_q \leq 1.0 \text{ A}$							
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$							
Quiescent current		4.4	8.0		4.4	6.0	mA
Quiescent current change							
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$:							
$17.5 \text{ V} \leq V_i \leq 30 \text{ V}$			1.0				mA
$5 \text{ mA} \leq I_q \leq 1.0 \text{ A}$			.5				mA
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$:							
$18.5 \text{ V} \leq V_i \leq 30 \text{ V}$						.8	mA
$5 \text{ mA} \leq I_q \leq 1.0 \text{ A}$						.5	mA
Output noise voltage: $10 \text{ Hz} \leq f \leq 100 \text{ kHz}$		90		90			μV
Long term stability:			60				mV/1000 h
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$							mV/1000 h
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$						60	
Ripple rejection		54	70	60	70		dB
($f = 120 \text{ Hz}$; $18.5 \text{ V} \leq V_i \leq 28.5 \text{ V}$)							dB
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$					2.0		V
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$					2.0		
Dropout voltage ($I_q = 1.0 \text{ A}$)			2.0				
Short circuit current	I_{qsc}		230		230		mA
Peak output current	I_q		2.1		2.1		A
Output resistance ($f = 1 \text{ kHz}$)							
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$	R_q		19				$\text{m}\Omega$
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$	R_q				19		$\text{m}\Omega$
Temperature coefficient of V_q ($I_q = 5 \text{ mA}$)							
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$	α_E		-1.0				mV/K
$0^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$	α_E				-1.0		mV/K

Type	Ordering codes
TDB 7818	Q67000-A1062
TDB 7818 T	Q67000-A1063
TDC 7818	Q67000-A1064

Operating characteristics

($V_i = 27\text{ V}$; $I_q = 500\text{ mA}$; $T_{amb} = 25^\circ\text{C}$)

Operating characteristics ($V_i = 27\text{ V}$; $I_q = 500\text{ mA}$; $T_{\text{amb}} = 25^\circ\text{C}$)		TDB 7818 TDB 7818 T			TDC 7818			
		min	typ	max	min	typ	max	
Output voltage	V_q	17.3	18	18.7	17.3	18	18.7	V
Line regulation:								
$21\text{ V} \leq V_i \leq 33\text{ V}$			15	360		15	180	mV
$24\text{ V} \leq V_i \leq 30\text{ V}$			5	180		5	90	mV
Load regulation:								
$5\text{ mA} \leq I_q \leq 1.5\text{ A}$			12	360		12	180	mV
$250\text{ mA} \leq I_q \leq 750\text{ mA}$			4	180		4	90	mV
Output voltage:								
$P \leq 15\text{ W}$ $21\text{ V} \leq V_i \leq 33\text{ V}$	V_q	17.1		18.9				V
$5\text{ mA} \leq I_q \leq 1.0\text{ A}$								
$0^\circ\text{C} \leq T_{\text{amb}} \leq 70^\circ\text{C}$								
$P \leq 15\text{ W}$ $22\text{ V} \leq V_i \leq 33\text{ V}$	V_q				17.1		18.9	V
$5\text{ mA} \leq I_q \leq 1.0\text{ A}$								
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$								
Quiescent current			4.5	8.0		4.5	6.0	mA
Quiescent current change								
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$:								
$21\text{ V} \leq V_i \leq 33\text{ V}$				1.0				mA
$5\text{ mA} \leq I_q \leq 1.0\text{ A}$				.5				mA
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$:								
$22\text{ V} \leq V_i \leq 33\text{ V}$						.8		mA
$5\text{ mA} \leq I_q \leq 1.0\text{ A}$						.5		mA
Output noise voltage: $10\text{ Hz} \leq f \leq 100\text{ kHz}$			110		110			μV
Long term stability:								
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$			72					mV/ 1000 h
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$						72		mV/ 1000 h
Ripple rejection								
($f = 120\text{ Hz}$; $22\text{ V} \leq V_i \leq 32\text{ V}$)								
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$		53	69					dB
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$				59	69			dB
Dropout voltage ($I_q = 1.0\text{ A}$)			2.0		2.0			V
Short circuit current	I_{qsc}		200		200			mA
Peak output current	I_q		2.1		2.1			A
Output resistance ($f = 1\text{ kHz}$)								
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$	R_q		22					$\text{m}\Omega$
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$	R_q				22			$\text{m}\Omega$
Temperature coefficient of V_q ($I_q = 5\text{ mA}$)								
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$	α_E	-1.0						mV/K
$0^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$	α_E				-1.0			mV/K

Type	Ordering codes
TDB 7824	Q67000-A1065
TDB 7824 T	Q67000-A1066
TDC 7824	Q67000-A1067

Operating characteristics

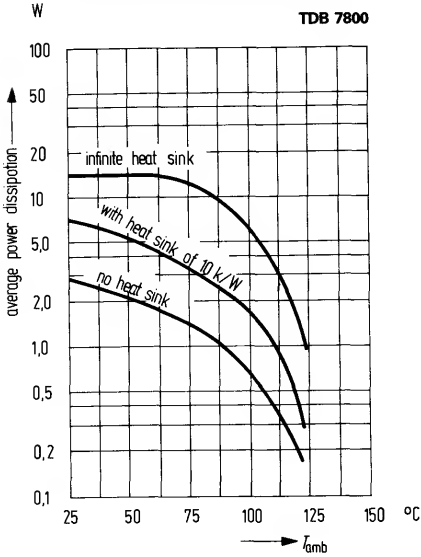
($V_i = 33 \text{ V}$; $I_q = 500 \text{ mA}$; $T_{\text{amb}} = 25^\circ\text{C}$)

Operating characteristics ($V_i = 33\text{ V}$; $I_q = 500\text{ mA}$; $T_{\text{amb}} = 25^\circ\text{C}$)	TDB 7824 TDB 7824 T			TDC 7824					
	min	typ	max	min	typ	max			
Output voltage	V_q	23	24	25	23	24	25	V	
Line regulation:									
27 V $\leq V_i \leq 38\text{ V}$			18			18		mV	
30 V $\leq V_i \leq 36\text{ V}$			6			6		mV	
Load regulation:									
5 mA $\leq I_q \leq 1.5\text{ A}$			12			12		mV	
250 mA $\leq I_q \leq 750\text{ mA}$			4			4		mV	
Output voltage:									
$P \leq 15\text{ W}$ 27 V $\leq V_i \leq 38\text{ V}$	V_q	22.8						V	
5 mA $\leq I_q \leq 1.0\text{ A}$									
$0^\circ\text{C} \leq T_{\text{amb}} \leq 70^\circ\text{C}$									
$P \leq 15\text{ W}$ 28 V $\leq V_i \leq 38\text{ V}$	V_q			22.8			25.2	V	
5 mA $\leq I_q \leq 1.0\text{ A}$									
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$									
Quiescent current			4.6			4.6		8.0	mA
Quiescent current change									
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$:									
27 V $\leq V_i \leq 38\text{ V}$								1.0	mA
5 mA $\leq I_q \leq 1.0\text{ A}$								.5	mA
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$:									
28 V $\leq V_i \leq 38\text{ V}$								.8	mA
5 mA $\leq I_q \leq 1.0\text{ A}$								.5	mA
Output noise voltage: 10 Hz $\leq f \leq 100\text{ kHz}$			170			170			μV
Long term stability:									
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$								96	mV/1000 h
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$								96	mV/1000 h
Ripple rejection									
($f = 120\text{ Hz}$; 28 V $\leq V_i \leq 38\text{ V}$)									
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$		50	66						dB
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$									dB
Dropout voltage ($I_q = 1.0\text{ A}$)					56	66			V
Short circuit current	I_{qsc}		2.0			2.0			mA
Peak output current	I_q		150			150			A
Output resistance ($f = 1\text{ kHz}$)			2.1			2.1			
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$									
$-55^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$									
Temperature coefficient of V_q ($I_q = 5\text{ mA}$)									
$0^\circ\text{C} \leq T_{\text{amb}} \leq +70^\circ\text{C}$	R_q		28						m Ω
$0^\circ\text{C} \leq T_{\text{amb}} \leq +125^\circ\text{C}$	R_q					28			m Ω
	α_E		-1.5						mV/K
	α_E					-1.5			mV/K

TDB 7800 -7800
TDB 7800 T-7800
TDC 7800 -7800

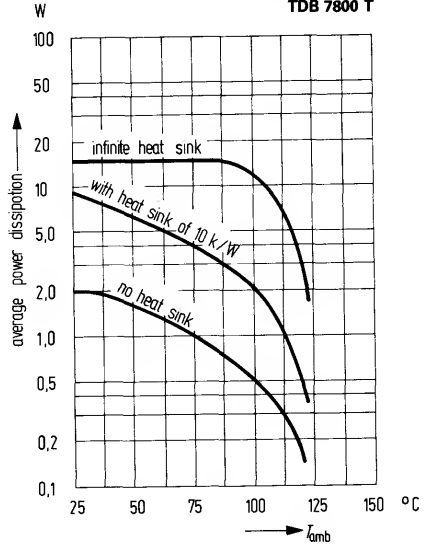
**Maximum average power dissipation
as a function of ambient temperature**

TDB 7800



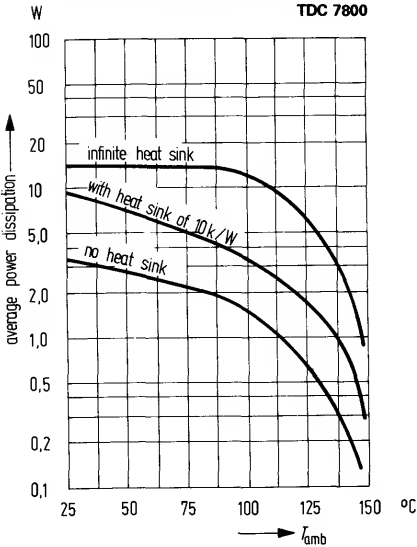
**Maximum average power dissipation
as a function of ambient temperature**

TDB 7800 T

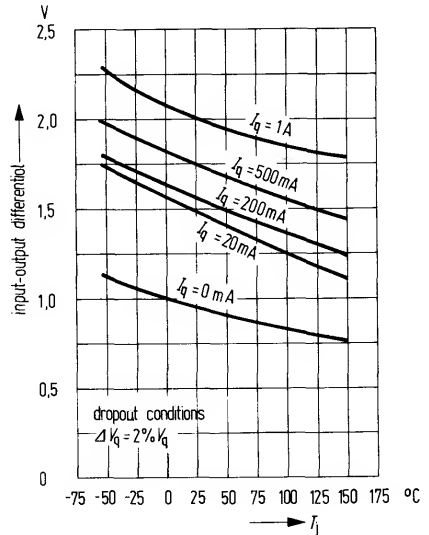


**Maximum average power dissipation
as a function of ambient temperature**

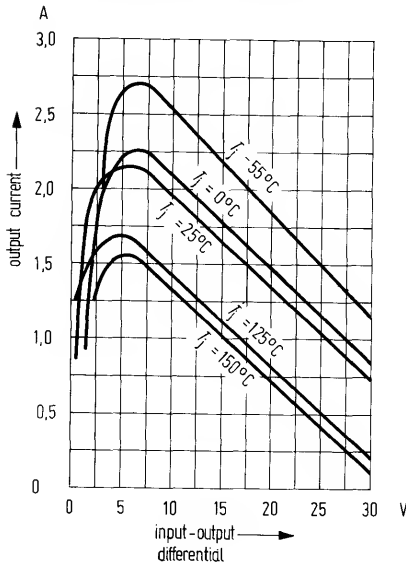
TDC 7800



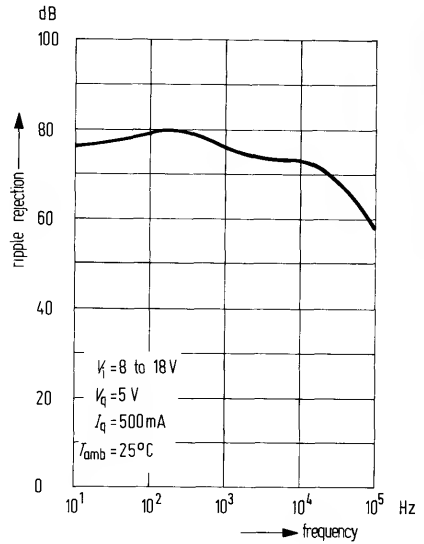
**Dropout voltage as a function of
junction temperature**



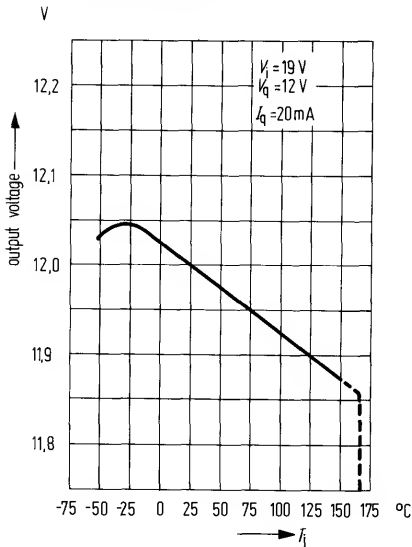
Peak output current as a function of input/output differential voltage



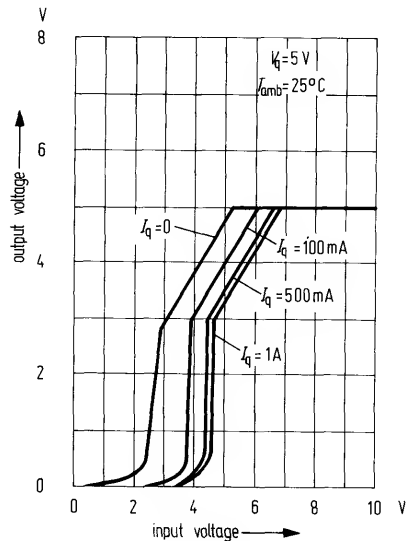
Ripple rejection as a function frequency



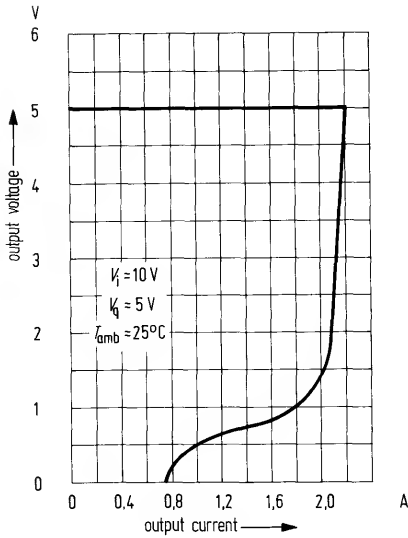
Output voltage as a function of junction temperature



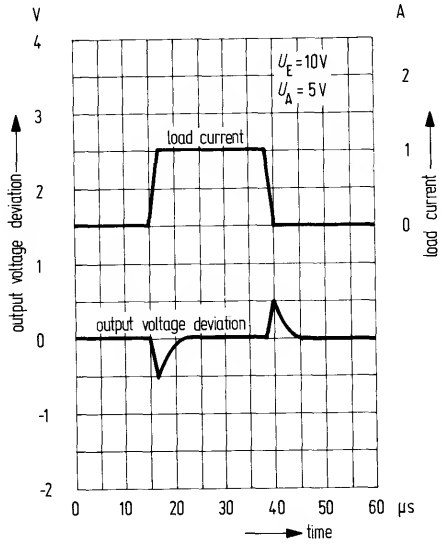
Dropout characteristics



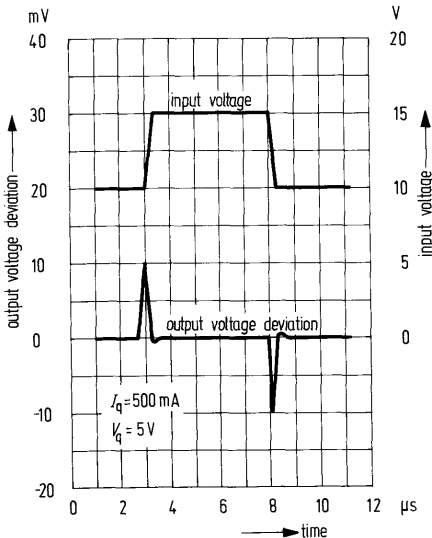
Current limiting characteristics



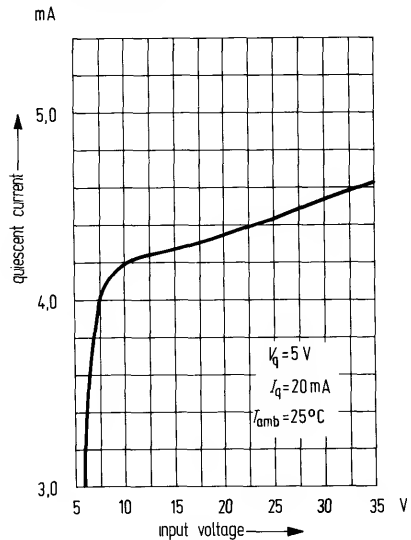
Load transient response



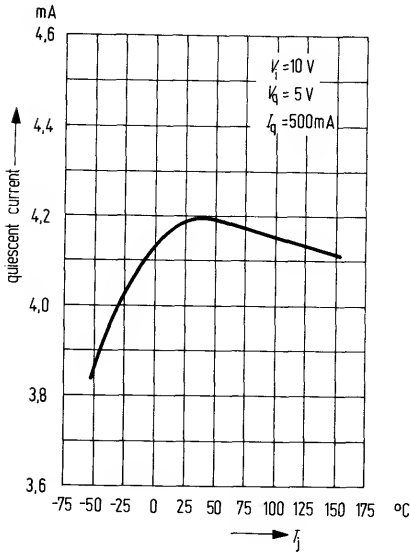
Line transient response



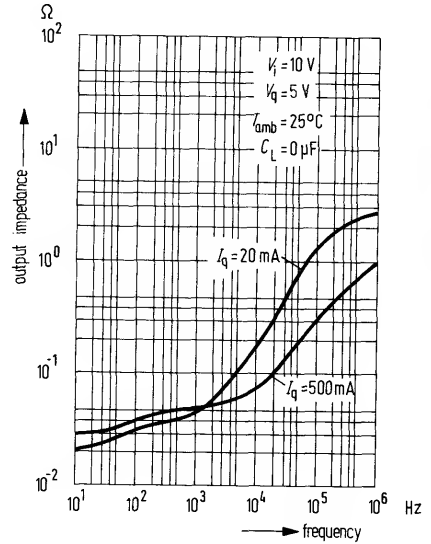
Quiescent current as a function of input voltage



Quiescent current as a function of temperature



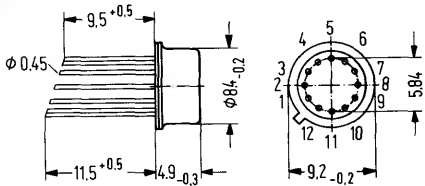
Output impedance as a function of frequency



The active matrix-point P 1 is used for the switching of signals with a large bandwidth. It may be used, for example, in video distribution networks.

Type	Ordering code
P 1	Q67000-A528

Package outlines



Package 5 J 10
DIN 41873 (similar TO-100)
Weight approx. 1.1 g

Dimensions in mm

Maximum ratings ($T_{amb} = 25\text{ }^{\circ}\text{C}$)

Supply voltages

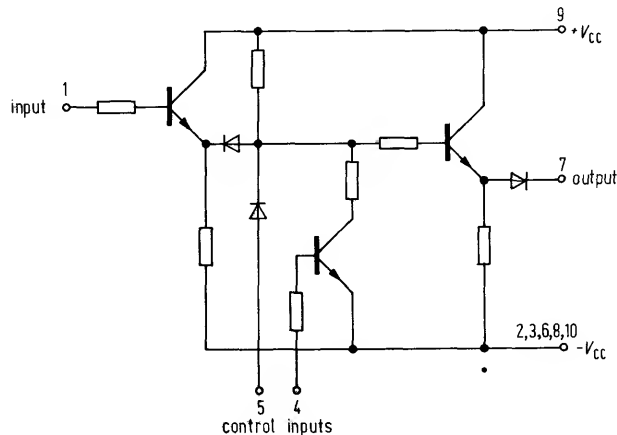
Total power consumption
($T_{case} = 45\text{ }^{\circ}\text{C}$)

Ambient operating temperature

Storage temperature

V_{CC+}	10	V
V_{CC-}	10	V
P_{tot}	350	mW
T_{amb}	-25 to +85	$^{\circ}\text{C}$
T_s	-55 to +150	$^{\circ}\text{C}$

Circuit diagram



Operating characteristics at $V_{CC} = \pm 9$ V, $V_i = 3$ V and $R_L = 2$ k Ω ($T_{amb} = 25^\circ\text{C}$), for the test circuit shown below.

If required, the circuits can be supplied in selected groups of dc-shift.

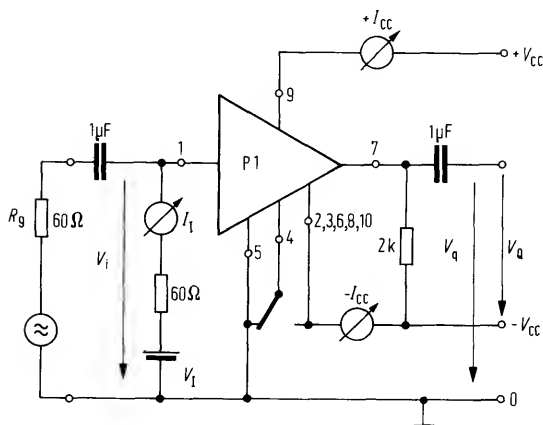
		Test conditions	min	typ	max	
Output dc-voltage	V_q		1.20	1.40	1.60	V
DC-shift ¹⁾²⁾	$V_{1,7}$		1.40	1.60	1.80	V
Max. output voltage	V_{qms}	$f = 1$ MHz	1.6	2.0		V
Differential amplitude	DA	$f = 5$ MHz		.3	.7	% per Volt
Differential phase	DP	$V_i = 0$ to 1 V _{pp}		.07	.2	°/V
Input current	I_i			25	80	μA
Control current	I_A			50		μA
Signal attenuation	A	$f = 1$ MHz		.40	.60	dB
Cross-talk suppression ³⁾	A_{CT}	$f = 1$ MHz	82	87		dB
Cross-talk suppression ³⁾	A_{CT}	$f = 5$ MHz		74		dB
Input resistance	R_i			100		k Ω
Output resistance	R_q	$f = 1$ to 5 MHz		23		Ω
Input capacitance	C_i				3.4	pF
Output inductance	L_q			600		nH
Cutoff frequency (-3 dB)	f_U		20	30		MHz
Current requirement	I_{CC+}	circuit conducting		11	15	mA
	I_{CC-}	circuit conducting		11	15	mA
	I_{CC+}	circuit non-conducting		12	16	mA
	I_{CC-}	circuit non-conducting		16	21	mA

¹⁾ Can be selected in groups of $\Delta V_{1,7}$ in 50 mV intervals.

²⁾ $V_{1,7} = V_i - V_q$.

³⁾ Connection in a matrix yields a cross-talk suppression which is typically higher than 8 dB.

Test circuit



Offices

Federal Republic of Germany and Berlin (West)

Siemens AG
Salzufer 6-8
Postfach 11 05 60
1000 Berlin 11
☎ (030) 39 39-1, ☎ 1 83 766

Siemens AG
Contrescarpe 72
Postfach 10 78 27
2800 Bremen 1
☎ (0421) 3 64-1, ☎ 2 45 451

Siemens AG
Lahnweg 10
Postfach 1115
4000 Düsseldorf 1
☎ (0211) 30 30-1, ☎ 8 581 301

Siemens AG
Gutleutstraße 31
Postfach 41 83
6000 Frankfurt 1
☎ (0611) 2 62-1, ☎ 4 14 131

Siemens AG
Lindenplatz 2
Postfach 10 56 09
2000 Hamburg 1
☎ (040) 2 82-1, ☎ 2 162 721

Siemens AG
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Postfach 53 29
3000 Hannover 1
☎ (0511) 199-1, ☎ 9 22 333

Siemens AG
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Postfach 20 21 09
8000 München 2
☎ (089) 92 21-1, ☎ 5 29 421

Siemens AG
Von-der-Tann-Straße 30
Postfach 48 44
8500 Nürnberg 1
☎ (0911) 6 54-1, ☎ 6 22 251

Siemens AG
Martin-Luther-Straße 25
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☎ (0681) 30 08-1, ☎ 4 421 431

Siemens AG
Geschwister-Scholl-Straße 24
Postfach 120
7000 Stuttgart 1
☎ (0711) 20 76-1, ☎ 7 23 941

Siemens AG
N 7, 18 (Siemenshaus)
Postfach 20 24
6800 Mannheim 1
☎ (0621) 2 96-1, ☎ 4 62 261

Europe

Austria

Siemens Aktiengesellschaft
Österreich
Apostelgasse 12
Postfach 326
A-1031 Wien
☎ (0222) 72 93-0, ☎ 11 866

Belgium

Siemens S.A.
chaussée de Charleroi 116
B-1060 Bruxelles
☎ (02) 5 37 31 00, ☎ 21 347

Bulgaria

RUEN,
Technisches Beratungsbüro
der Siemens Aktiengesellschaft
uliza Nikolai Gogol 5,
agal Boulevard Lenin
BG-1504 Sofia
☎ 45 70 82, ☎ 22 763

Czechoslovakia

EFEKTIM
Technisches Büro Siemens AG
Anglická ulice 22
P.O.B. 1087
CS-12000 Praha 2
☎ 25 84 17, ☎ 122 389

Denmark

Siemens A/S
Borupvang 3
DK-2750 Ballerup
☎ (02) 65 65 65, ☎ 35 313

Finland

Siemens Osakeyhtiö
Mikonkatu 8
Fach 8
SF-00101 Helsinki 10
☎ (90) 16 26-1, ☎ 12 465

France

Siemens Société Anonyme
39-47, boulevard Ornano
B.P. 109
F-93203 Saint-Denis CEDEX 1
☎ (16-1) 8 20 61 20, ☎ 620 853

Great Britain

Siemens Limited
Siemens House
Windmill Road
Sunbury-on-Thames
Middlesex TW 16 7HS
☎ (09327) 85 691, ☎ 89 51 091

Greece

Siemens Hellas E.A.E.
Voulas 7
P.O.B. 601
Athen 125
☎ (021) 32 93-1, ☎ 216 291

Hungary

Intercooperation AG,
Siemens Kooperationsbüro
Böszörményi út 9-11
P.O.B. 15 25
H-1126 Budapest
☎ (01) 15 49 70, ☎ 224 133

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Tokyo 100-91
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Korea (Republic)

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Seoul

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Karachi 3

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Philippines

Engineering Equipment, Inc.
Machinery Division,
Siemens Department
E. Rodriguez Avenue
Murphy, Quezon City
Philippines
P.O.Box 7160
Airmail Exchange Office
Manila International Airport
Philippines 3120
☎ 77 30 11,
☎ RCA 722 2382, EEC 3695
Telegramme: Engcomach Manila

Saudi Arabia

E. A. Juffali & Bros.
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King Abdul-Aziz-Street
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