SIEMENS

TCA 440
AM Receiver Circuit

AM receiver circuit for LW, MW, and SW in battery and line operated radio receivers. It includes an RF prestage with AGC, a balanced mixer, separate oscillator, and an IF amplifier with AGC. Because of its internal stabilization, all characteristics are largely independent of the supply voltage. For use in high quality radio sets the TDA 4001 should be preferred to the TCA 440.

Features

- Separately controlled prestage
- Multiplicative push-pull mixer with separate oscillator
- High large signal capability from 4.5 V supply voltage on
- 100 dB feedback control range in 5 stages
- Direct connection for tuning meter
- Few external components

Maximum ratings

Supply voltage	V_S	15	V
Storage temperature range	T_{stg}	–40 to 125	°C
Junction temperature	T_j	150	°C
Thermal resistance (system-air)	R_{thSA}	120	K/W

Operating range

Supply voltage	V_S	4.5 to 15	V
Ambient temperature	T_A	–15 to 80	°C

Characteristics

$V_S = 9$ V; $T_A = 25$ °C; $f_{iRF} = 600$ kHz; $f_{mod} = 1$ kHz

Total current consumption		I_S	10.5	mA
RF level deviation for	$\Delta V_{AF} = 6$ dB	ΔG_{RF}	65	dB
$m = 80\%$	$\Delta V_{AF} = 10$ dB	ΔG_{RF}	80	dB
AF output voltage for V_{iRF} (symm. measured at 1–2)				
for $m = 80\%$	$V_{iRF} = 20$ µV	$V_{AF\,rms}$	140	mV
	$V_{iRF} = 1$ mV	$V_{AF\,rms}$	260	mV
	$V_{iRF} = 500$ mV	$V_{AF\,rms}$	350	mV
for $m = 30\%$	$V_{iRF} = 20$ µV	$V_{AF\,rms}$	50	mV
	$V_{iRF} = 1$ mV	$V_{AF\,rms}$	100	mV
	$V_{iRF} = 500$ mV	$V_{AF\,rms}$	130	mV
Input sensitivity (measured at 60 Ω, $f_{iRF} = 1$ MHz, $m = 30\%/0\%$, $R_G = 540$ Ω)				
at signal-to-noise ratio (in acc. with DIN 45405)	$\frac{S+N}{N} = 6$ dB	V_{iRF}	1	µV
	$\frac{S+N}{N} = 26$ dB	V_{iRF}	7	µV
	$\frac{S+N}{N} = 58$ dB	V_{iRF}	1	mV

RF stage

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 ($THD_{AF} = 10\%$), symmetrically measured at pins 1 and 2	$V_{iRF\,pp}$	2.6	V
(mean carrier value)	$V_{iRF\,rms}$	0.5	V
IF suppression between 1–2 and 15	a_{IF}	20	dB
RF input impedance			
a) unsymmetrical coupling			
at $G_{RF\,max}$	Z_i	2/5	kΩ/pF
at $G_{RF\,min}$	Z_i	2.2/1.5	kΩ/pF
b) symmetrical coupling			
at $G_{RF\,max}$	Z_i	4.5	kΩ/pF
at $G_{RF\,min}$	Z_i	4.5/1.5	kΩ/pF
Mixer output impedance (pins 15 or 16)	Z_q	250/4.5	kΩ/pF

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IF stage

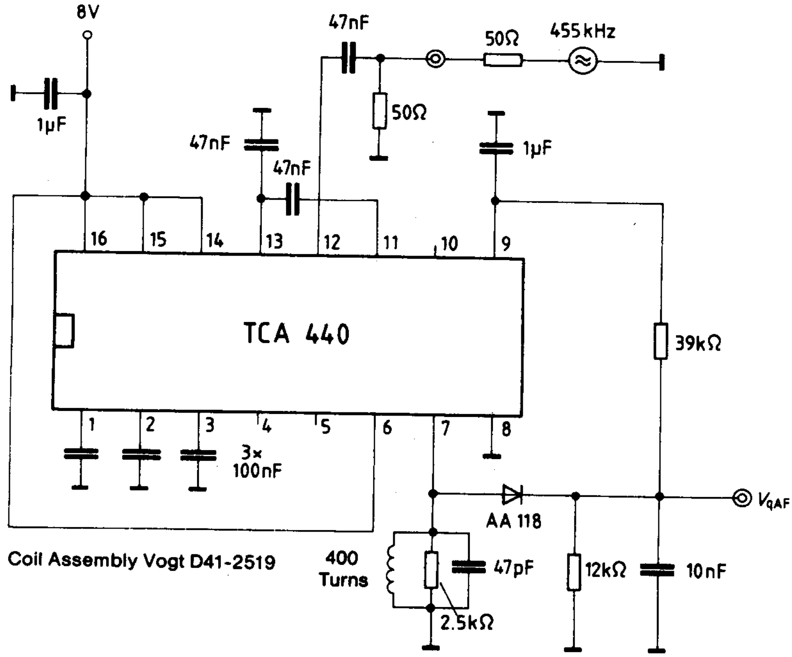
Input frequency range	$f_{i\,IF}$	0 to 2	MHz
Control range at 460 kHz	ΔG_V	62	dB
Input voltage (mean carrier value) at G_{min} for overdrive (THD_{AF} = 10%), measured at pin 12 (60 Ω to ground, $f_{i\,IF}$ = 460 kHz, m = 80%; f_{mod} = 1 kHz)	$V_{IF\,rms}$	200	mV
AF output voltage for $V_{i\,IF}$ at 60 Ω (pin 12)			
$V_{i\,IF}$ = 30 µV, m = 80%; f_{mod} = 1 kHz	$V_{7\,AF\,rms}$	50	mV
$V_{i\,IF}$ = 3 mV, m = 80%; f_{mod} = 1 kHz	$V_{7\,AF\,rms}$	200	mV
$V_{i\,IF}$ = 3 mV, m = 30%; f_{mod} = 1 kHz	$V_{7\,AF\,rms}$	70	mV
$V_{i\,IF}$ = 200 µV; m = 30%, f_{IF} = 455 kHz; $f_{q\,AF}$ = 1 kHz	$V_{7\,AF\,rms}$	35 to 60	mV
IF input impedance (unsymm. coupling)	Z_i	3/3	kΩ/pF
IF output impedance	$Z_{q\,7}$	200/8	kΩ/pF

Tuning meter

Recommended instruments: 500 µA (R_i = 800 kΩ)
or 300 µA (R_i = 1.5 kΩ)

The IC offers a tuning meter voltage of 600 mV_{EMF} max. with a source impedance of approx. 400 Ω.

Measurement circuit for output voltage



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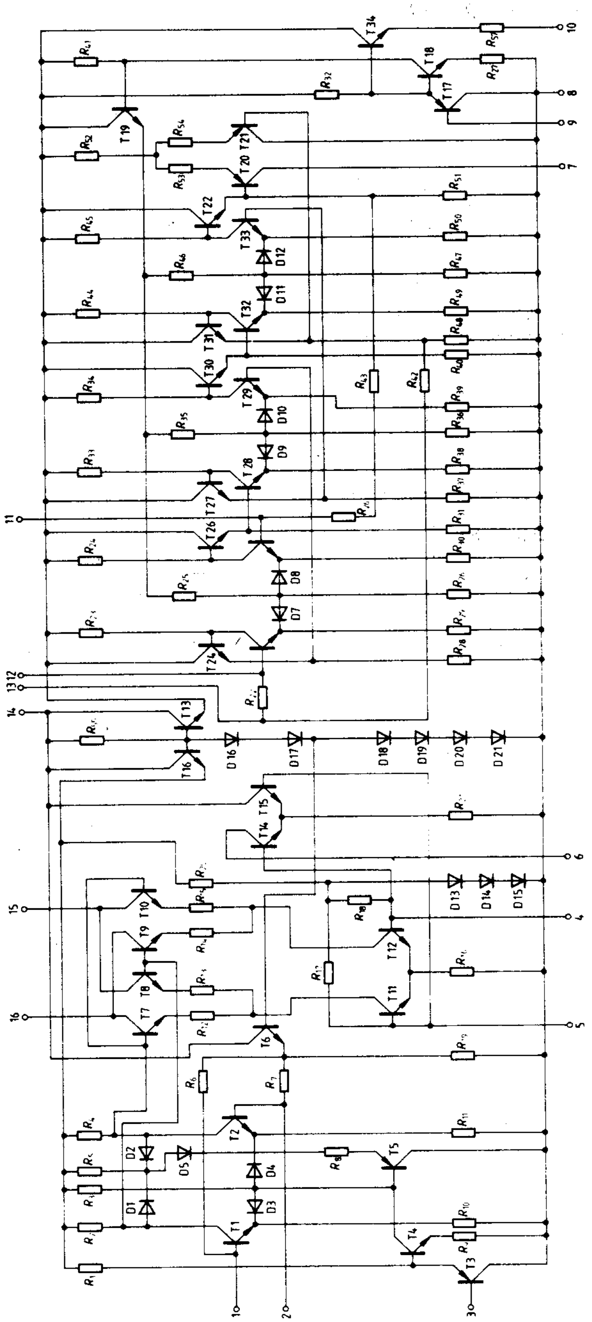
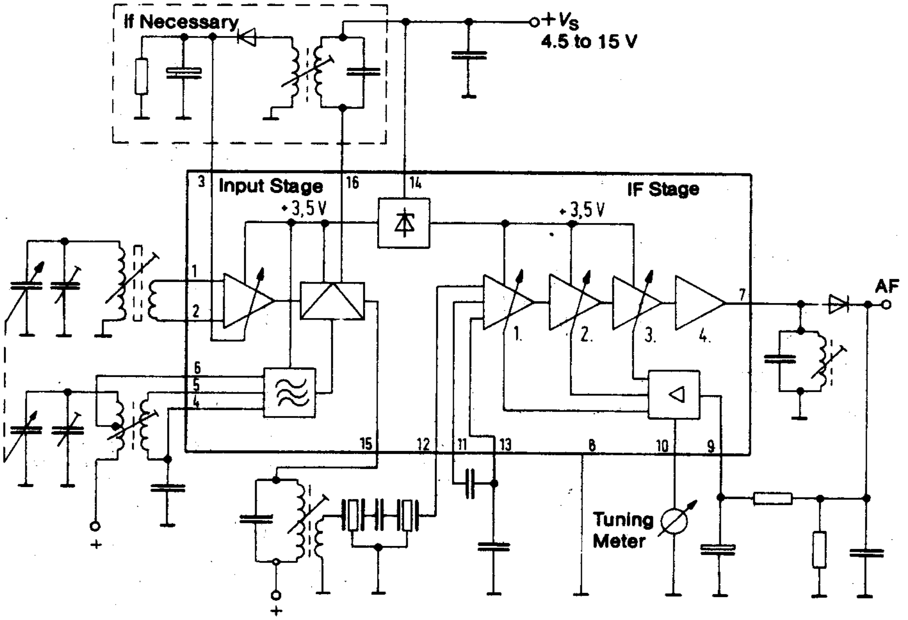
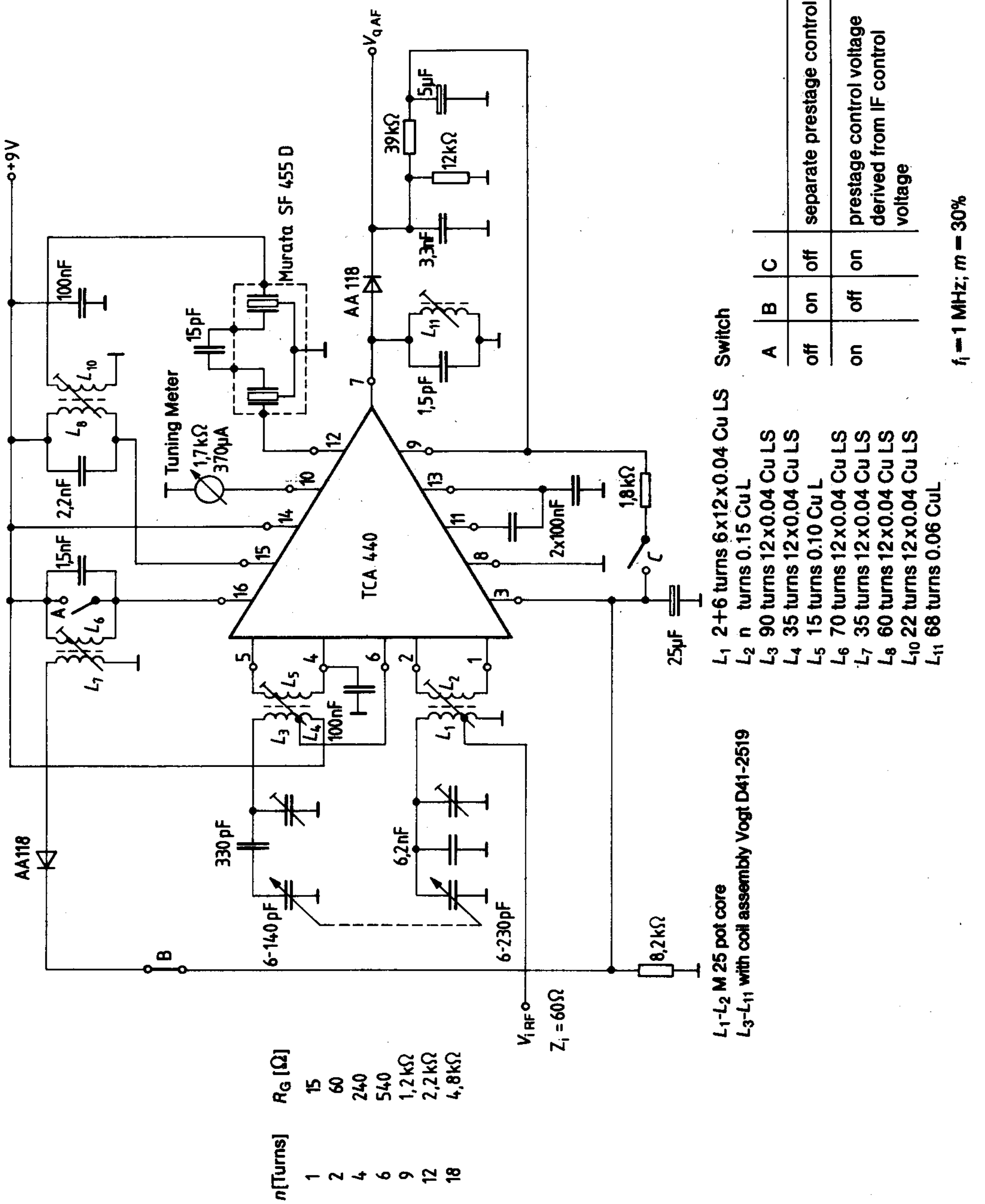
Circuit diagram



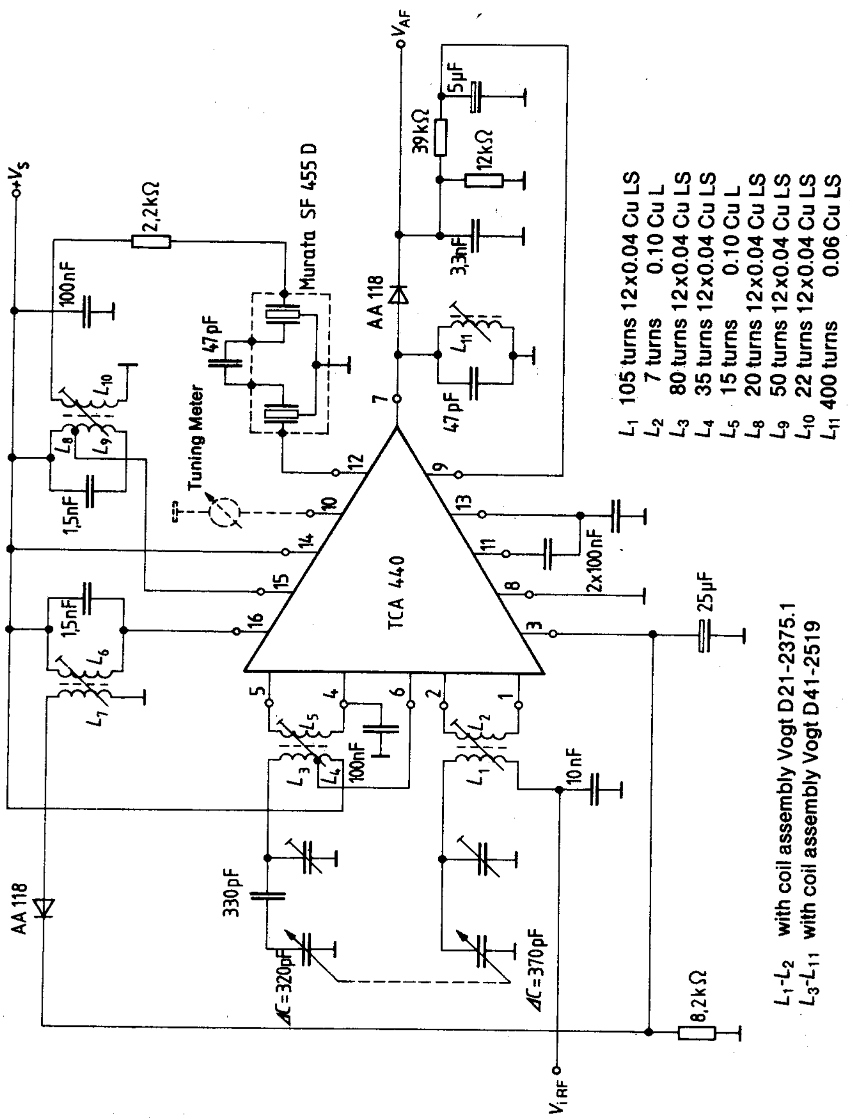
Block diagram



Measurement circuit for signal-to-noise ratio



Application example for MW with TCA 440



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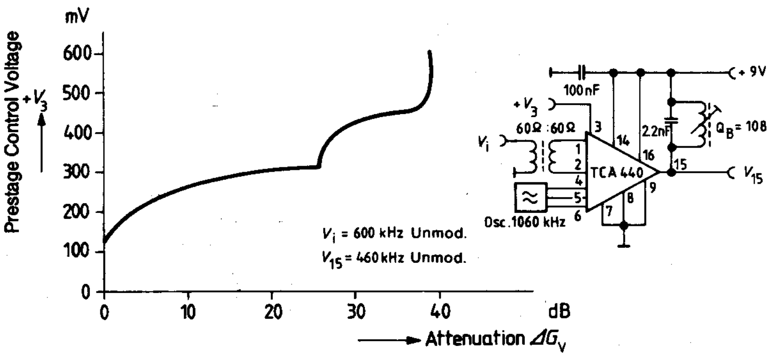
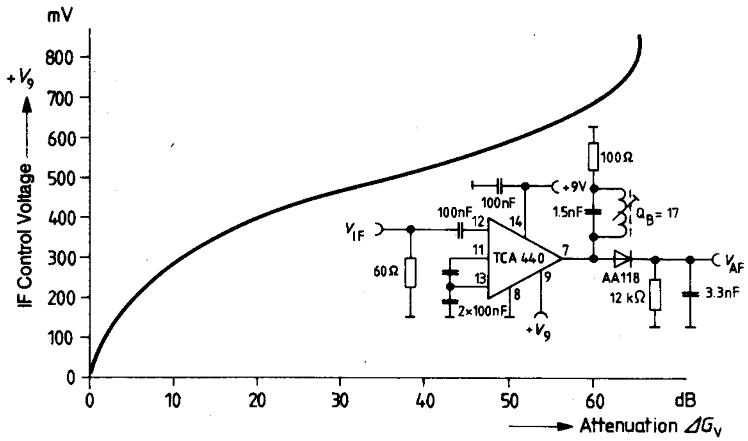
Prestage control TCA 440



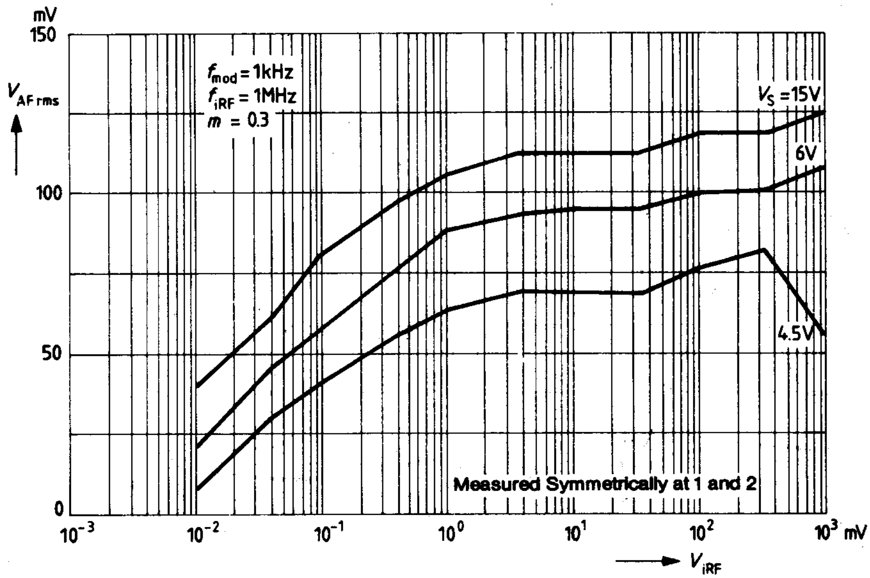
The input ist not power matched and can be driven with a higher resistance. The selected V_i ensures a constant V_{15} (50 mV peak-to-peak).

IF control



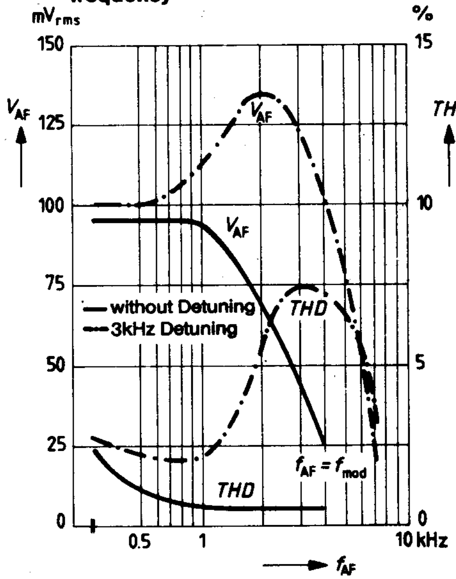
The selected V_{IF} (469 kHz; m = 80%; f_{mod} = 1 kHz) ensures a constant V_{AF} (200 mV, rms).

AF output voltage versus RF input voltage

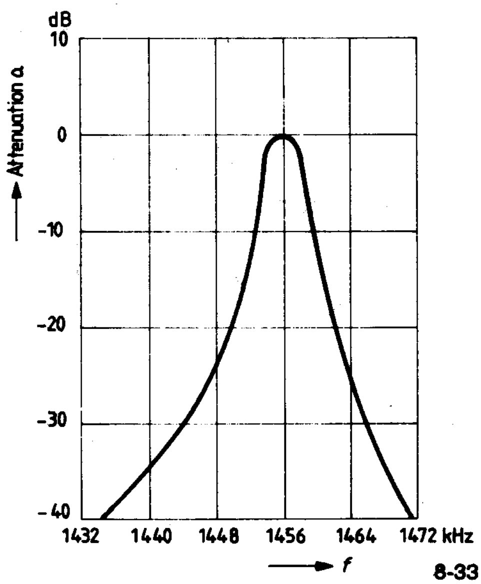


Example for medium wave applications

AF output voltage versus output frequency
Total harmonic distortion versus modulation frequency



Passband characteristic versus input frequency, measured from input to output of the circuit



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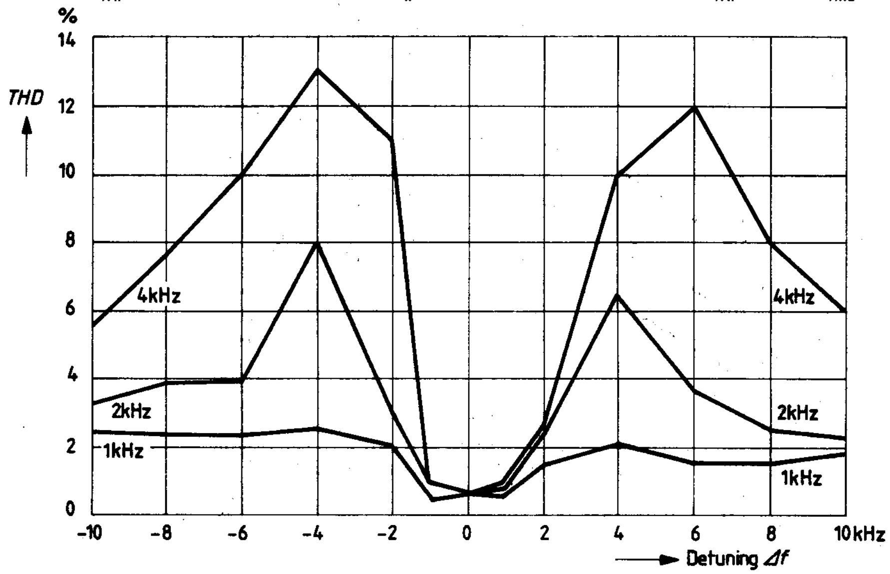
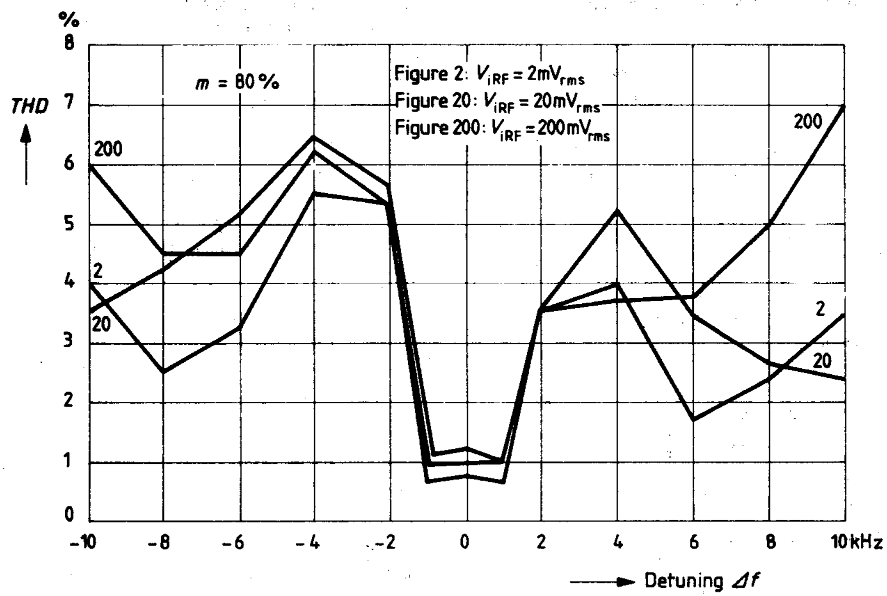
Total harmonic distortion versus detuning (parameter: modulation frequency)

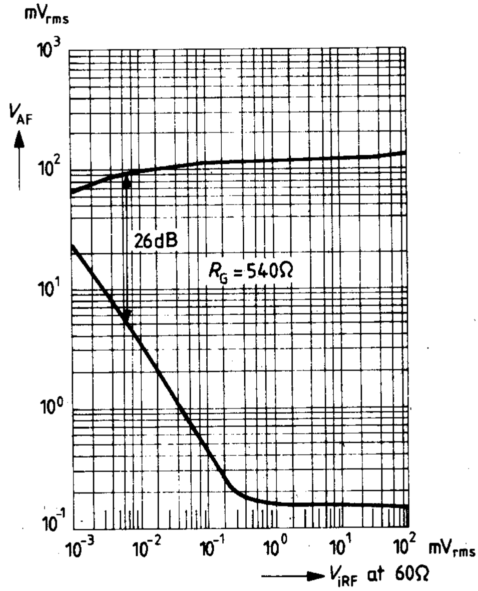
$V_S = 9$ V $f_{OSC} = 1.455$ MHz $\pm\ \Delta f$ $m = 30\%$
$f_{iRF} = 1$ MHz $f_{IF} = 455$ kHz $V_{iRF} = 20$ mV$_{rms}$



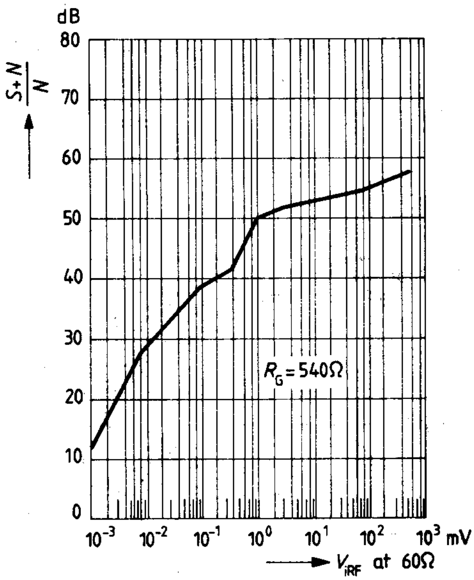
Total harmonic distortion versus detuning (parameter: RF input voltage)



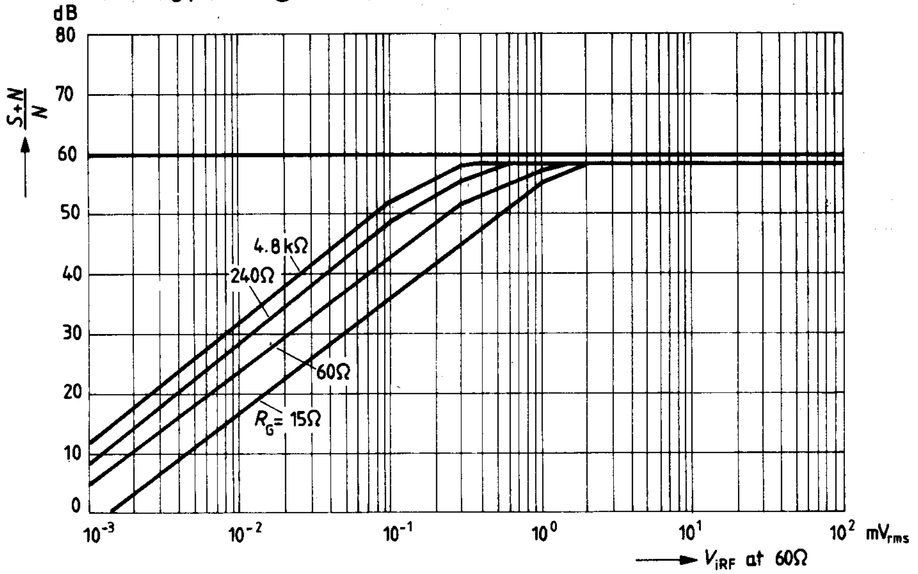
AF output voltage and noise figure versus RF input voltage
switching position ①



Signal-to-noise ratio versus RF input voltage
switching position ②



Signal-to-noise ratio versus RF input voltage
(parameter is generator impedance)
switching position ①



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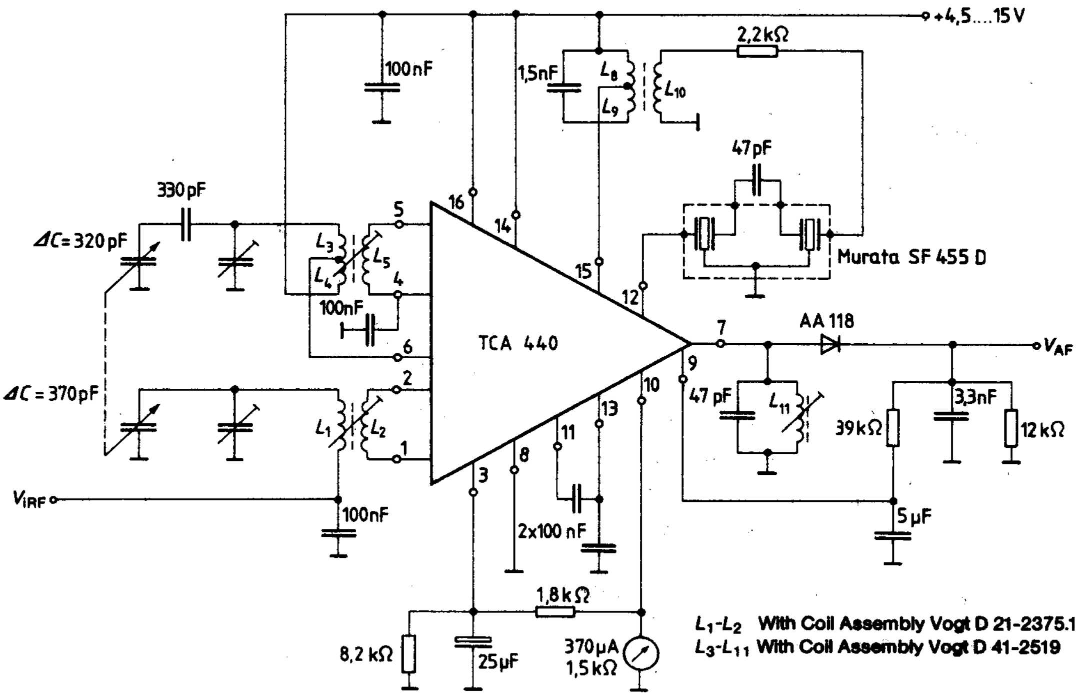
Application example for MW

Prestage control is derived from IF control



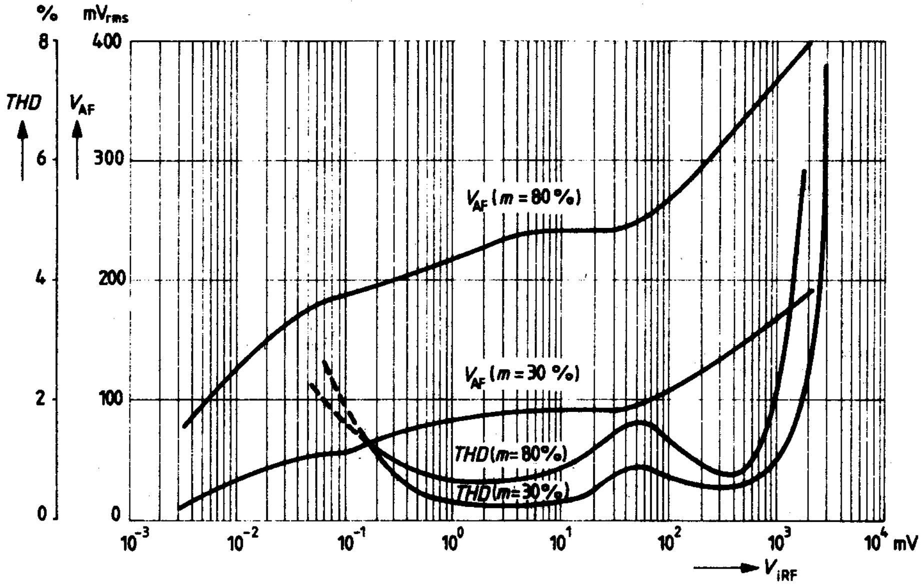
L_1-L_2 With Coil Assembly Vogt D 21-2375.1
L_3-L_{11} With Coil Assembly Vogt D 41-2519

L_1	105 turns	12x0.04 Cu LS
L_2	7 turns	0.10 Cu L
L_3	80 turns	12x0.04 Cu LS
L_4	35 turns	12x0.04 Cu LS
L_5	15 turns	0.10 Cu L
L_8	20 turns	12x0.04 Cu LS
L_9	50 turns	12x0.04 Cu LS
L_{10}	22 turns	12x0.04 Cu LS
L_{11}	400 turns	0.04 Cu L

Test figures for application example for MW

Total harmonic distortion and AF output voltage versus RF input voltage measured symmetrically at pins 1 and 2

$f_i = 1$ MHz, $f_{mod} = 1$ kHz, $f_{IF} = 455$ kHz, $V_S = 9$ V



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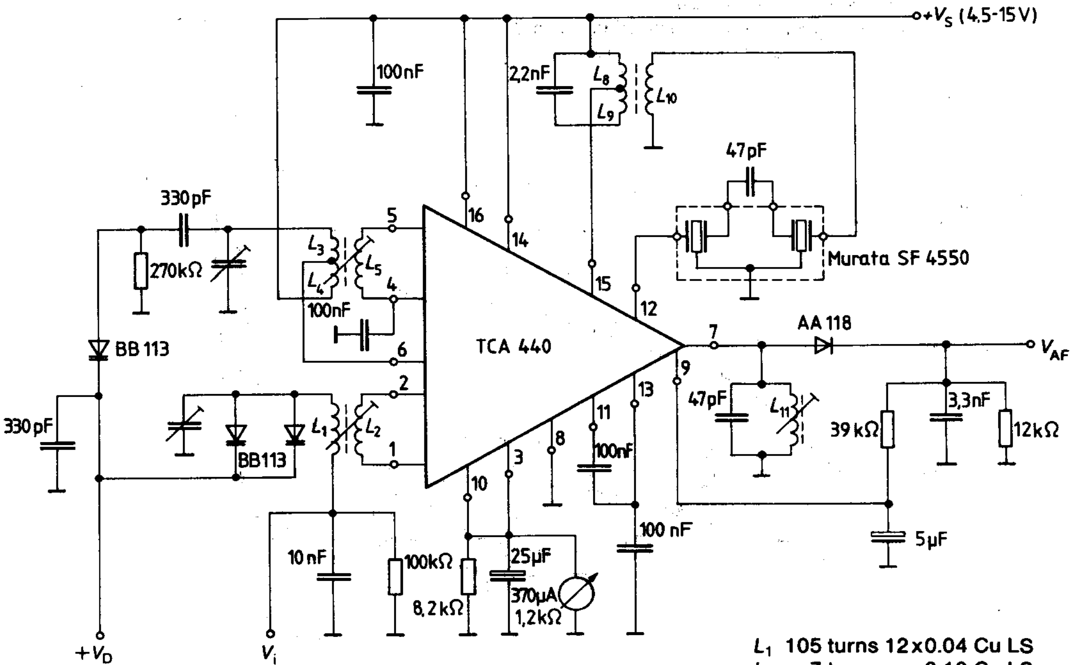
Application example for MW using BB 113 varicap diodes

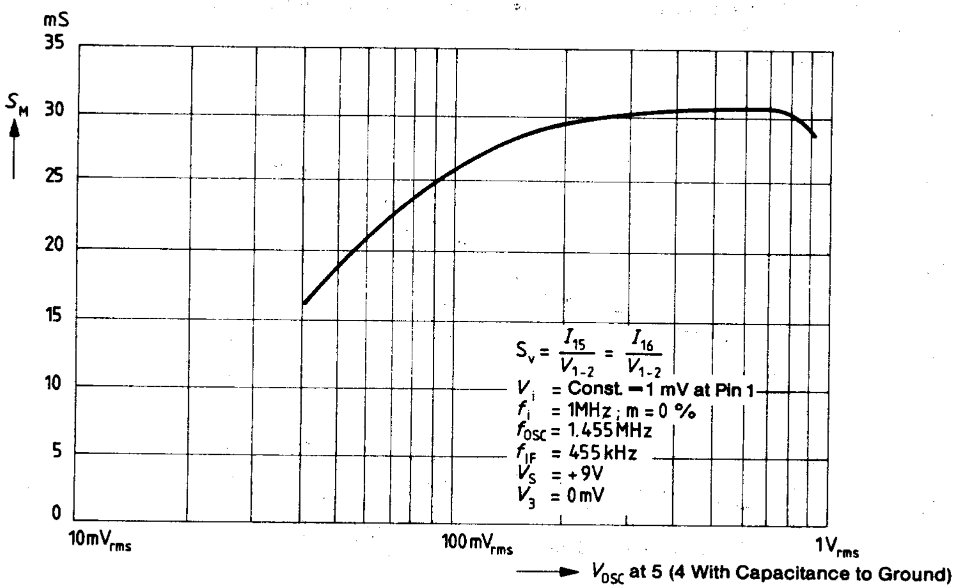


L_1-L_2 With Coil Assembly Vogt D21-2375.1
L_3-L_{11} With Coil Assembly Vogt D41-2519

V_{tun} = 8.5 V ⟶ f_i = 800 kHz
V_{tun} = 30 V ⟶ f_i = 1620 kHz

L_1	105 turns	12x0.04 Cu LS
L_2	7 turns	0.10 Cu LS
L_3	80 turns	12x0.04 Cu LS
L_4	35 turns	12x0.04 Cu LS
L_5	15 turns	0.10 Cu LS
L_8	20 turns	12x0.04 Cu LS
L_9	50 turns	12x0.04 Cu LS
L_{10}	22 turns	12x0.04 Cu LS
L_{11}	400 turns	0.06 Cu L

Conversion transconductance versus oscillator voltage



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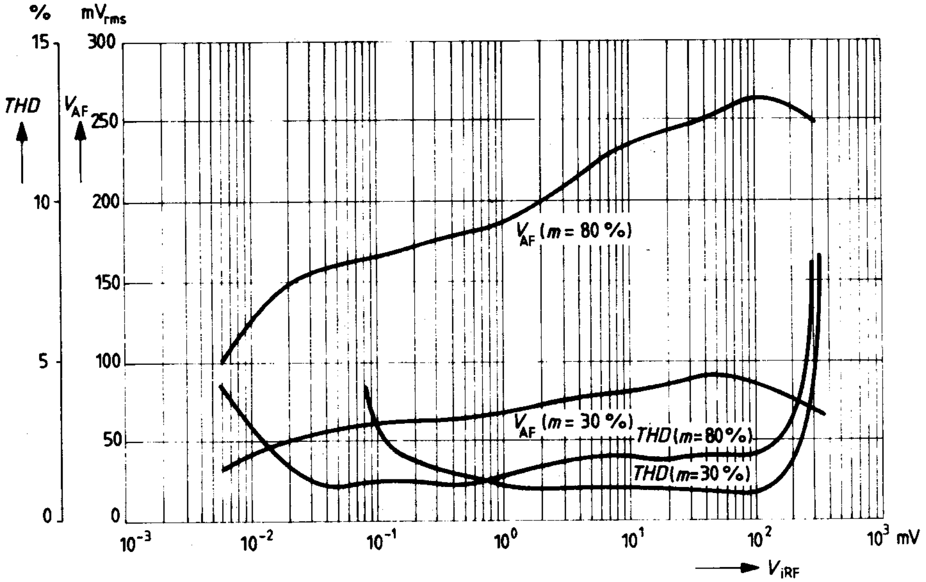
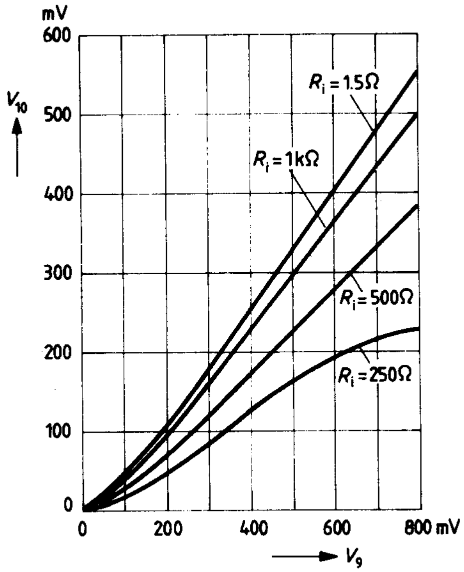
Measured values for application example for MW using diode BB 113

AF output voltage and total harmonic distortion versus RF input voltage
f_i = 1 MHz; f_{mod} = 1 kHz; f_{IF} = 455 kHz
V_S = 9 V; V_{iRF} symmetrically measured at pins 1 and 2



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



Example for moving coil instruments

R_i	Full-service deflection
1.5 kΩ	100 µA
1.5 kΩ	170 µA
2 kΩ	200 µA
350 Ω	500 µA

SiMI
Silicium Microelectronic Integration GmbH

Technical Data

TCA 440 / T

Edition 12/95

AM - Receiver Circuit

Description

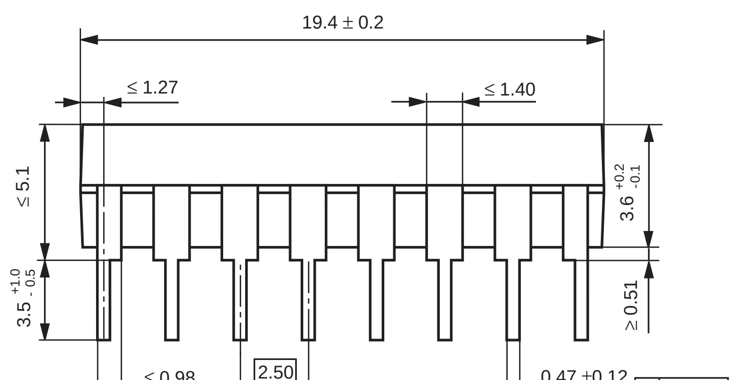
This is an efficient bipolar monolithic circuit to apply in battery - powered or mains - operated radio receivers up to 30 MHz. It contains controlled RF stage, mixer, separated oscillator and regulated multistage IF amplifier.

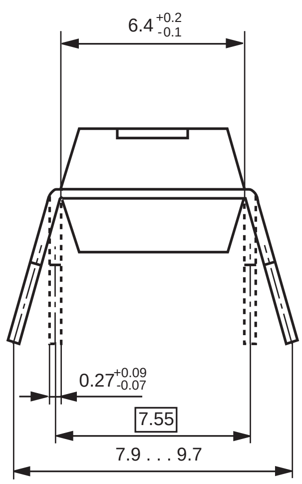
Features

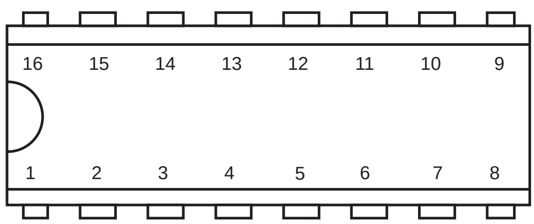
- symmetrical structured circuitry
- controlled RF prestage
- multiplicative balanced mixer, separated oscillator
- very well implemented large - signal characteristic begins already from 4.5 V supply voltage
- terminals for indicating instrument
- controlled IF amplifier implementing 60 dB control range
- external demodulator (diode)
- wide range of supply voltage between 4.5 and 15 V

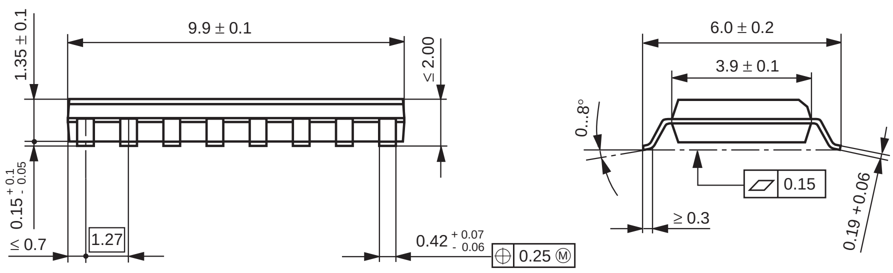
Package

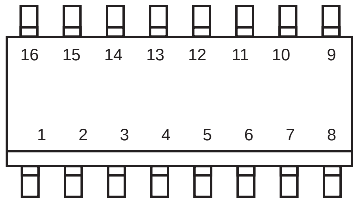
TCA 440 • DIP 16







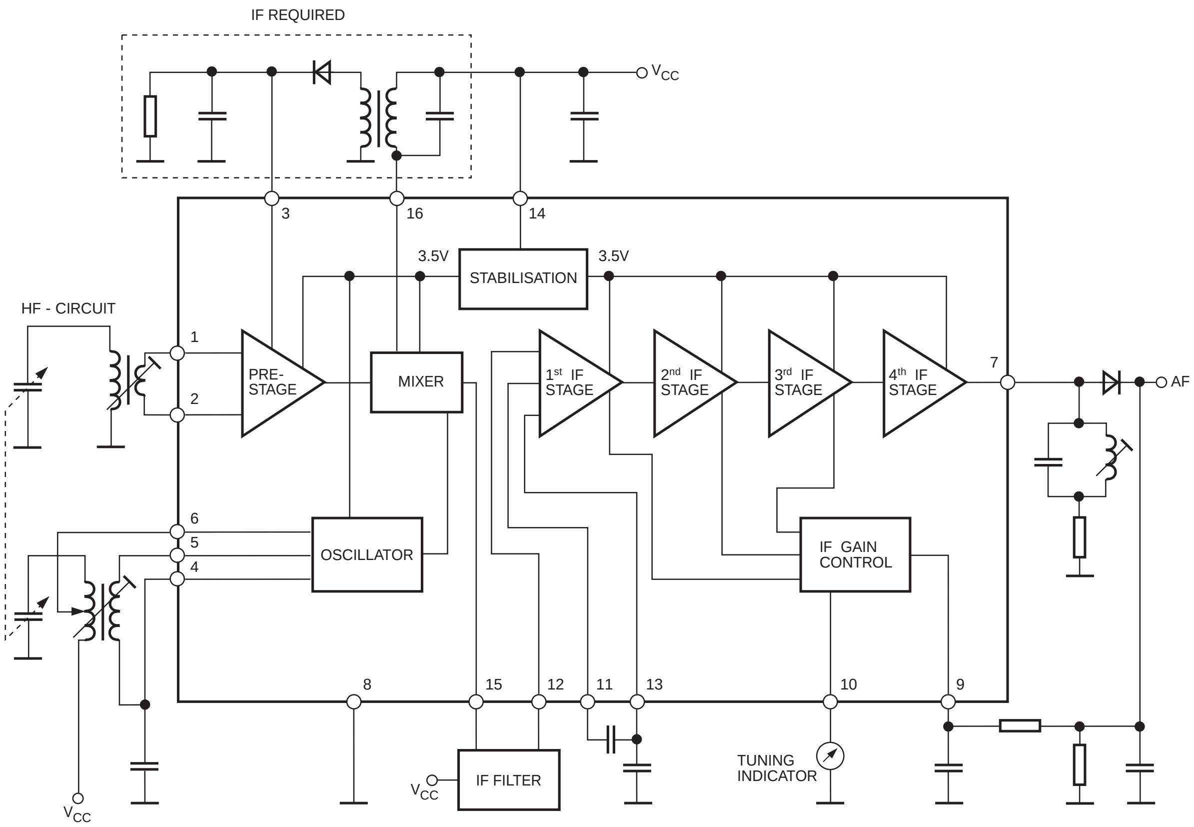




Pin configuration

1	RF prestage, input 1	9	input IF control amplifier
2	RF prestage, input 2	10	indicator output IF control amplifier
3	RF control amplifier input	11	IF blocking
4	oscillator circuit pin 1	12	input IF amplifier
5	oscillator circuit pin 2	13	IF blocking
6	oscillator circuit pin 3	14	supply voltage
7	IF output	15	mixer output 1
8	ground	16	mixer output 2

Block diagram



Functional description

It contains several function units, which enable designing and assembling of efficient AM tuners. Caused by internal voltage stabilization characteristics are rather independent from supply voltage.

The RF input signal reaches via a controllable and overdriving proof preselector stage a balanced mixer. By means of a RF - signal generated by a separated oscillator the input signal is transported into IF. Multiplicative mixing causes only few harmonic content. Gain control is carried out by means of two separated feedback control loops for preselector stage and IF amplifier. By these a loop bandwidth of approximately 100 dB is obtained. The control voltage of the IF - amplifier can be used to drive a moving - coil instrument (field strength indicator). The IF amplifier consists of 4 amplifier stages, the first, second and third can be controlled. The bandwidth of the IF amplifier is approximately 2 MHz and on that account sufficient for usual IF frequencies in the AM range of approximately 460 kHz.
The symmetrical arrangement of the entire circuitry guarantees well oscillating. The bridge of the mixer avoids direct breakdown.

Absolute maximum ratings

		min	max	unit
Supply voltage	V_{CC}	4.5	15.0	V
Junction temperature	T_j		150	°C
Ambient operating temperature	T_a	-15	80	°C
Storage temperature	T_s	-40	125	°C
Total thermal resistance	R_{thja}		120	K/W

Recommended operational conditions

		min	max	unit
Supply voltage	V_{CC}	4.5	15	V
Ambient operating temperature	T_a	-10	70	°C

Characteristics

refer to application examples, f_i = 1 MHz, f_{osc} = 1.455 kHz, f_{IF} = 455 kHz, V_{CC} = 9 V, f_m = 1 kHz, m = 0.8, voltages refer to ground, T_a = 20 to 25 °C, unless specified otherwise

		min	typ	max	unit
Current and voltage supply (no RF signal)					
Supply voltage	V_{14-8}	4.5	9	15	V
Current consumption					
V_{14-8} = 4.5 V	I_{14}		7		mA
V_{14-8} = 9 V	I_{14}		10.5	16	mA
V_{14-8}= 15 V	I_{14}		12		mA
Entire receiver					
RF level variation					
with ΔV_{NF} = 6 dB	ΔV_{RF}		65		dB
with ΔV_{NF} = 10 dB	ΔV_{RF}		80		dB
NF output voltages (symmetrically measured at 1-2)					
V_{iHF} = 20 µV, m = 0.8	$V_{NF(rms)}$	60	140		mV
V_{iHF} = 1 mV, m = 0.8	$V_{NF(rms)}$		260		mV
V_{iHF} = 500 mV, m = 0.8	$V_{NF(rms)}$	100	350	560	mV
V_{iHF} = 20 µV, m = 0.3	$V_{NF(rms)}$		50		mV
V_{iHF} = 1 mV, m = 0.3	$V_{NF(rms)}$		100		mV
V_{iHF} = 500 mV, m = 0.3	$V_{NF(rms)}$		130		mV
RF input sensitivity measured at 60 Ω, m = 0.3, R_G = 540 Ω signal-to-noise ratio					
S + N/N = 6 dB	V_{iRF}		1		µV
S + N/N = 26 dB	V_{iRF}		7		µV
S + N/N = 58 dB	V_{iRF}		1		mV
Maximum RF input voltage (THD = 10 %)	V_{iHF}			1.5	V
Total harmonic distortion					
V_{HF} = 500 mV	THD		4.5	10	%
V_{HF} = 30 mV	THD		2.8	8	%
RF part					
Input frequency range	f_{iHF}	0		50	MHz
Output frequency					
$f_{IF} = f_{osc} - f_{iHF}$	f_{IF}		455		kHz
Control range	ΔG_V		38		dB

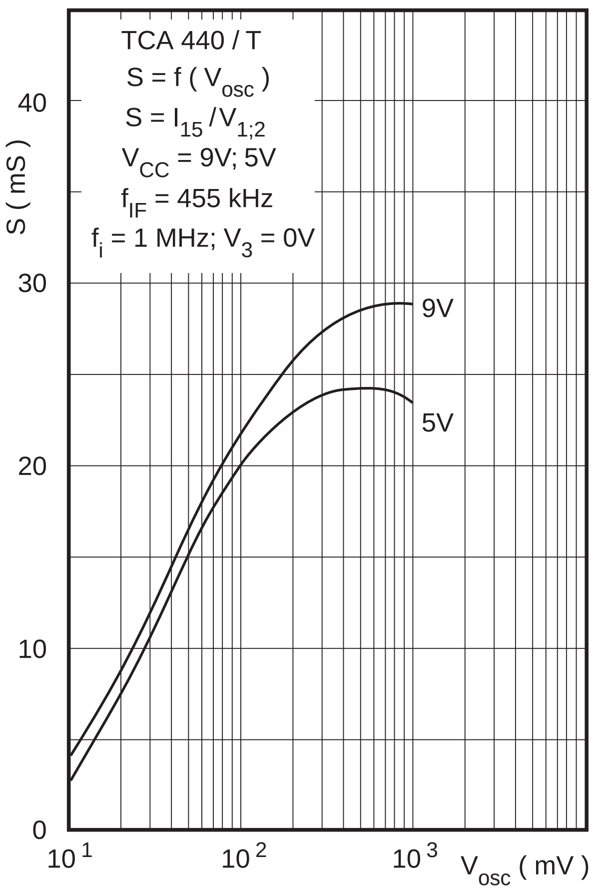
		min	typ	max	unit
IF suppression between 1 - 2 and 15	a_{IF}		20		dB
RF input impedance unbalanced coupling V_{iHFmax} V_{iHFmin} balanced coupling V_{iHFmax} V_{iHFmin}	 Z_i Z_i Z_i Z_i		 2 II 5 2.2 II 1.5 4.5 4.5 II 1.5		 kΩIIpF kΩIIpF kΩ kΩIIpF
Mixer output impedance (pin 15 or 16)	 Z_o		 250 II 4.5		 kΩIIpF
Steepness	S_{HF}		28		mS
<u>IF part</u>					
Input frequency range	f_{iIF}	0		2	MHz
Control range f_{iIF} = 455 kHz, ΔV_{NF} = 10 dB	ΔG_V		62		dB
Start of control (ΔV_{iIF} / ΔV_{NF} = 10 dB / 3 dB)	V_{ctrlF}		140		µV
maximum IF input voltage (THD_{NF} = 10 %)	V_{iIFmax}		200		mV
NF output voltage applied to 60 Ω V_{ZF} = 30 µV V_{ZF} = 3 mV V_{ZF} = 3 mV; m = 0.3	 $V_{NF(rms)}$ $V_{NF(rms)}$ $V_{NF(rms)}$		 50 200 70		 mV mV mV
IF input impedance (unbanlanced coupling)	 Z_{iIF}		 3 II 3		 kΩllpF
IF output impedance (pin 7)	Z_O		200 II 8		kΩIIpF

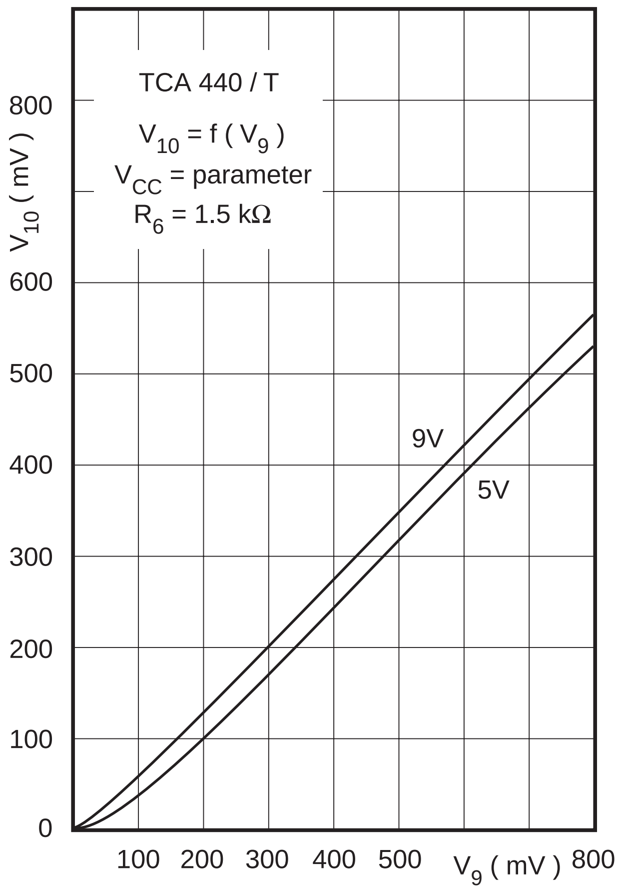
Indication instrument

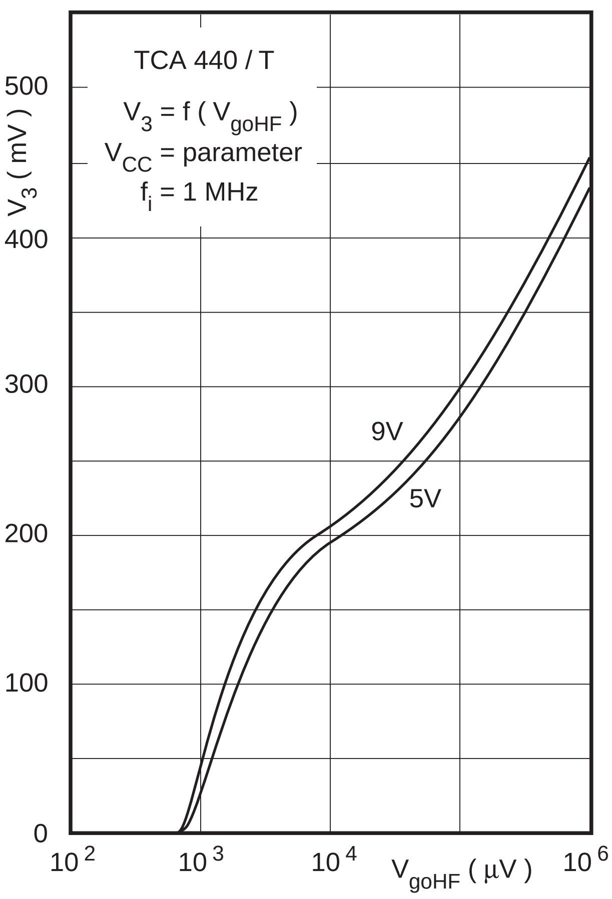
Recommended indication instruments: 500 µA (R_i = 800 Ω)
300 µA (R_i = 1.5 kΩ)

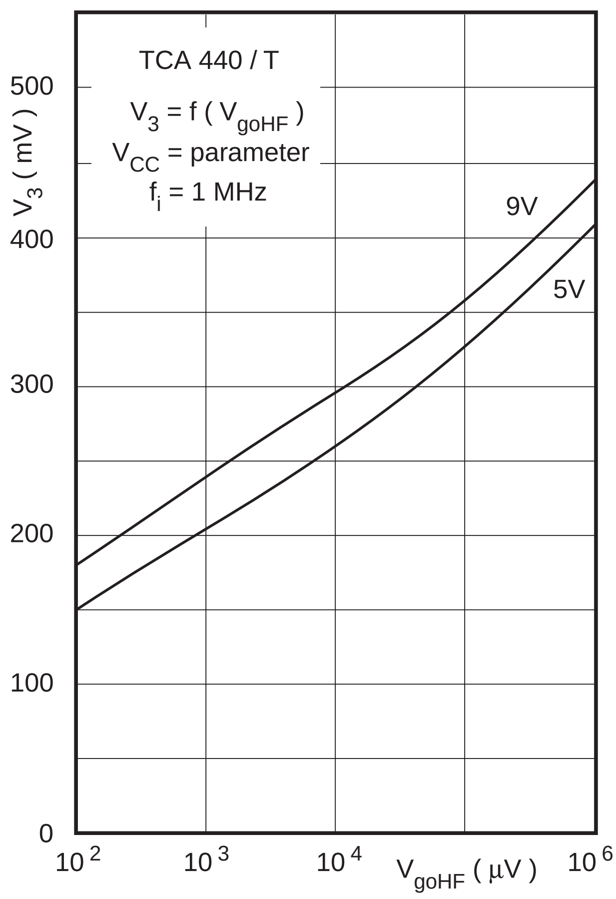
For indication a voltage source of 600 m $V_{(EMF)}$ and an internal source impedance of 400 Ω is available.

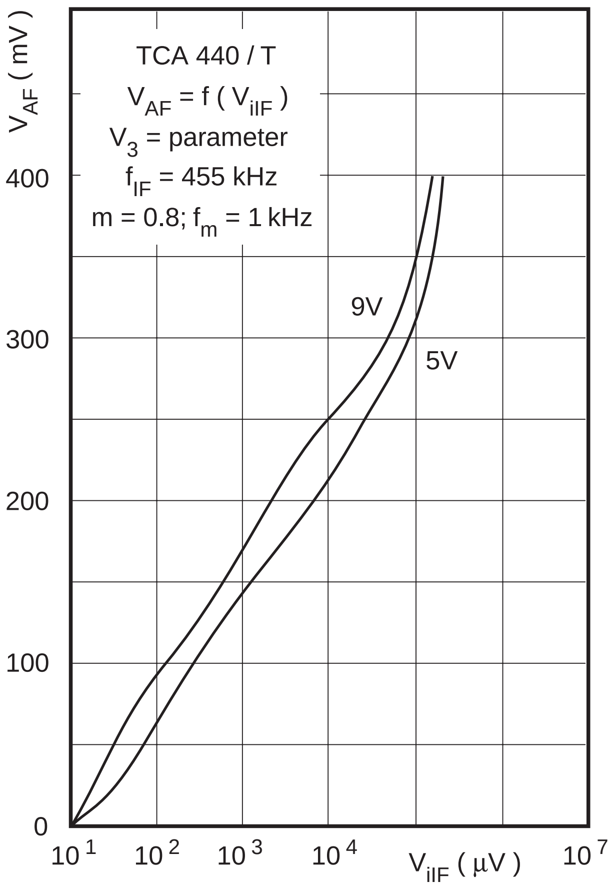
Dependences

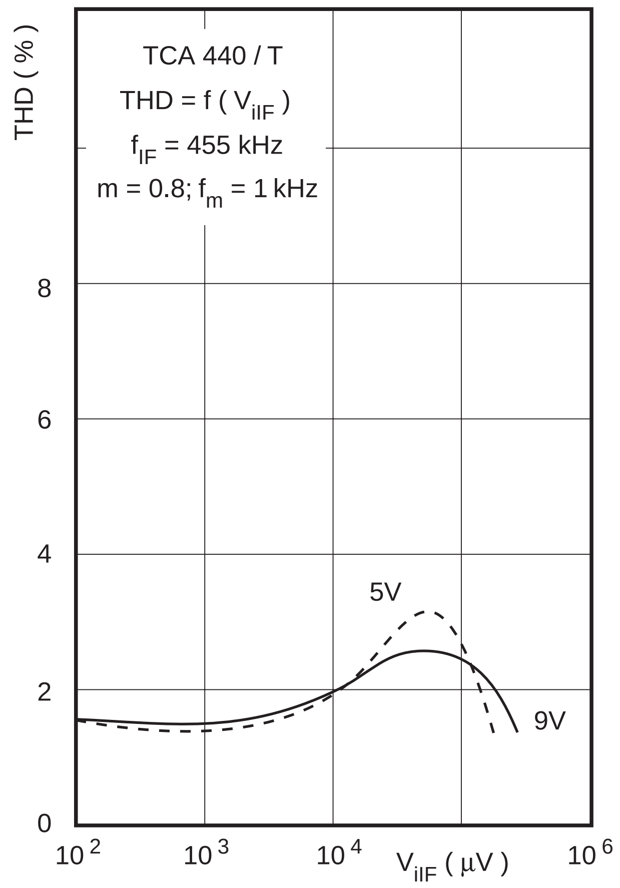


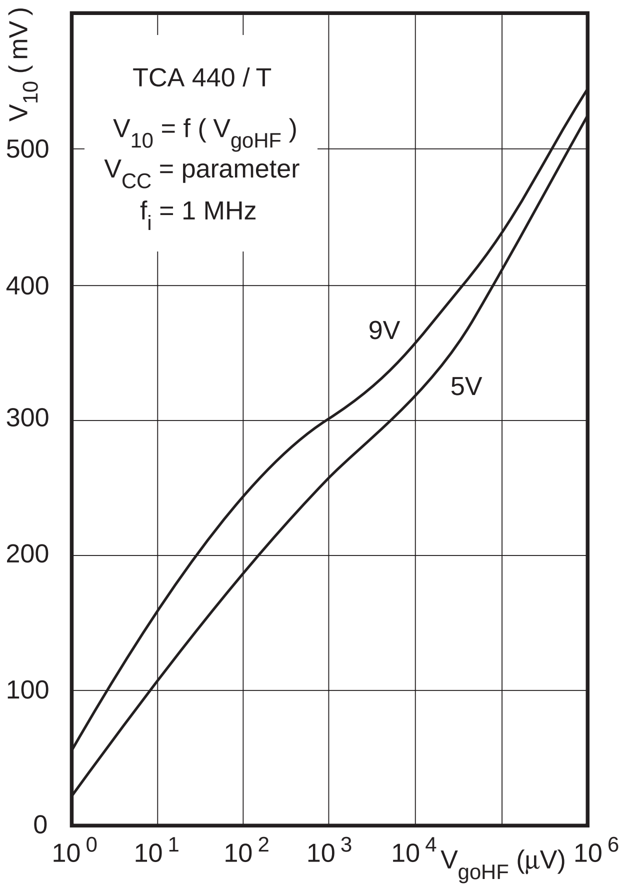


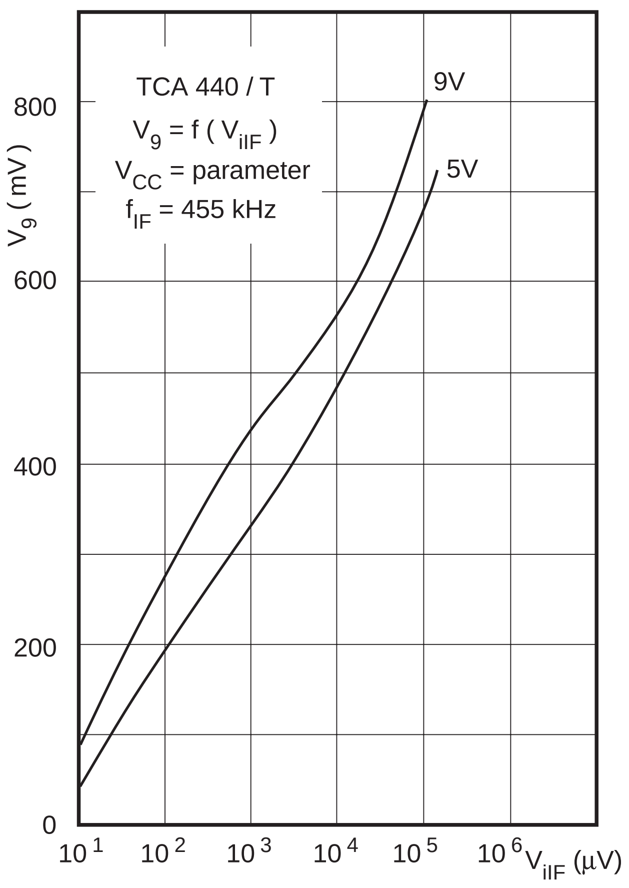


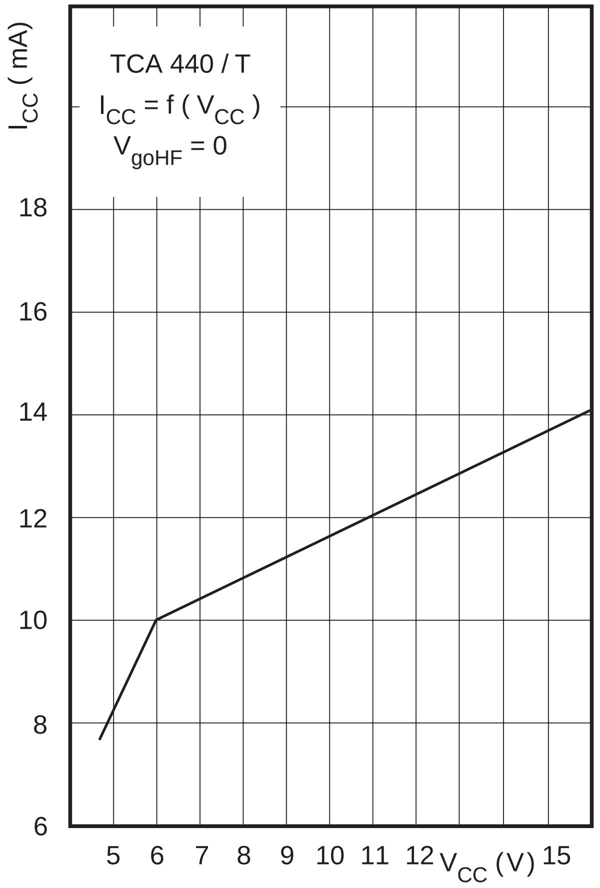


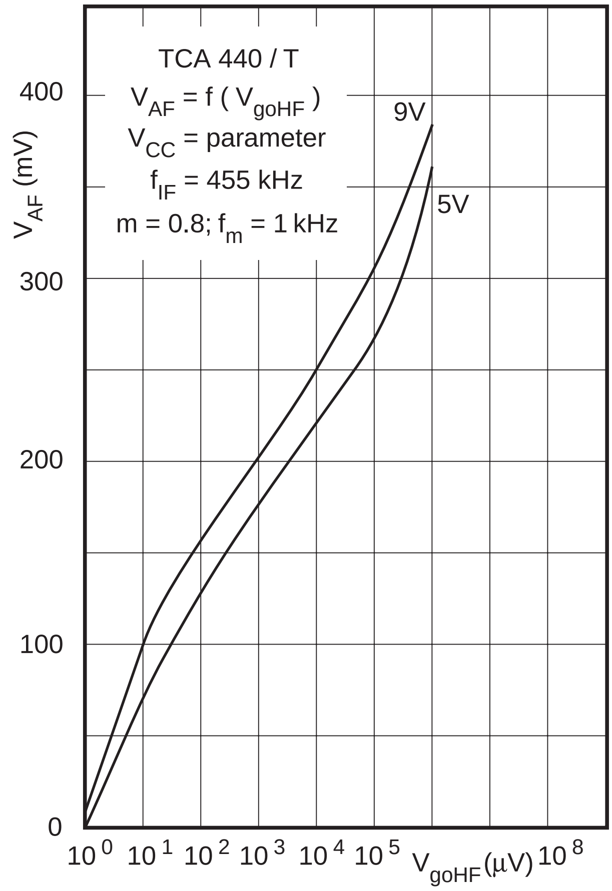

TCA 440 / T
VAF = f (ViIF)
V3 = parameter
fIF = 455 kHz
m = 0.8; fm = 1 kHz
9V
5V
VAF (mV)
400
300
200
100
0
10 1
10 2
10 3
10 4
ViIF (µV)
10 7

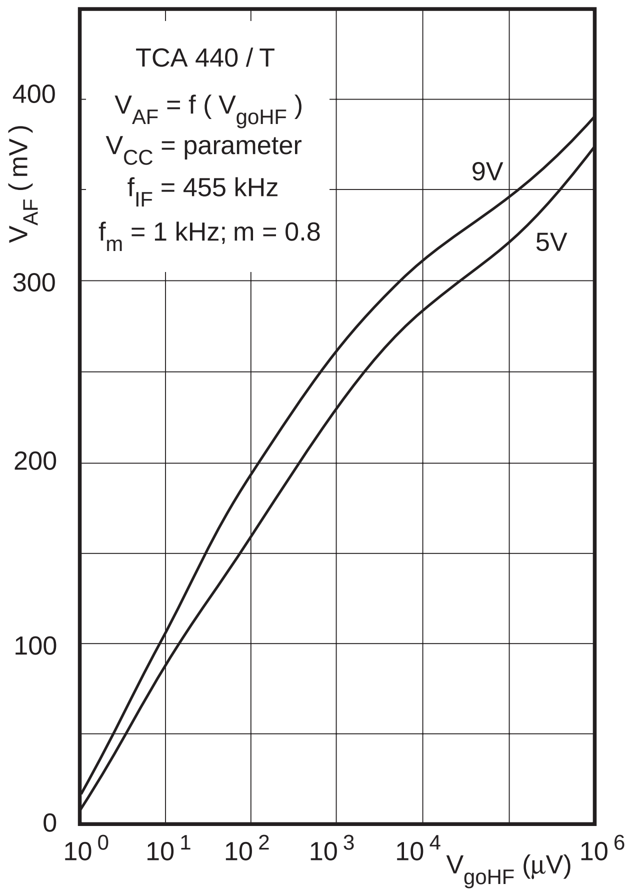

TCA 440 / T
THD = f (ViIF)
fIF = 455 kHz
m = 0.8; fm = 1 kHz
5V
9V
THD (%)
8
6
4
2
0
10 2
10 3
10 4
ViIF (µV)
10 6

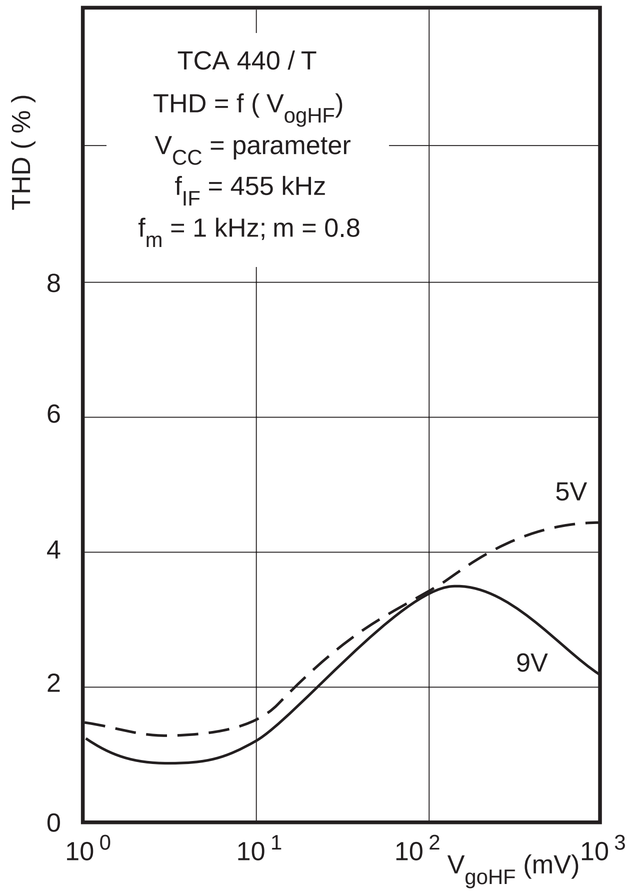

TCA 440 / T
V10 = f (VgoHF)
VCC = parameter
fi = 1 MHz
9V
5V
V10 (mV)
500
400
300
200
100
0
10 0
10 1
10 2
10 3
10 4
VgoHF (µV)
10 6

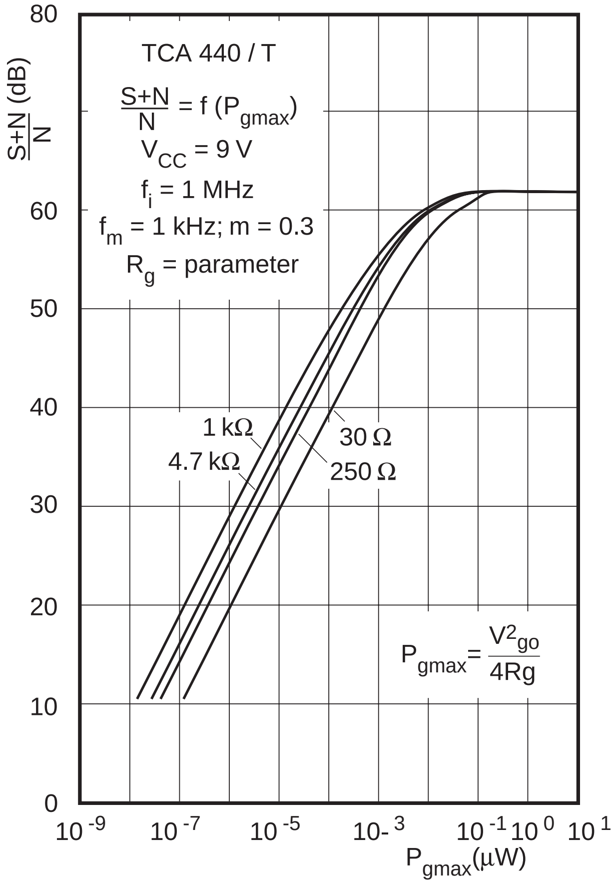

TCA 440 / T
V9 = f (ViIF)
VCC = parameter
fIF = 455 kHz
9V
5V
V9 (mV)
800
600
400
200
0
10 1
10 2
10 3
10 4
10 5
10 6
ViIF (µV)

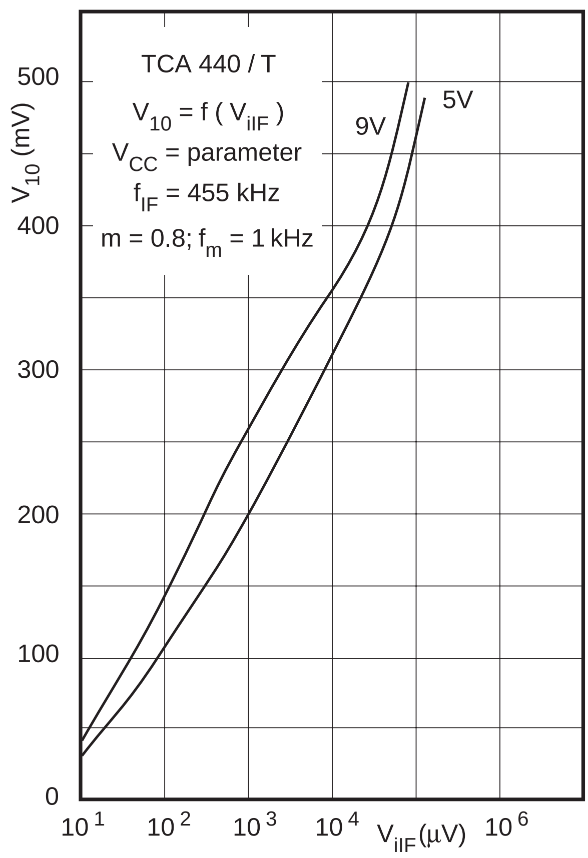

TCA 440 / T
$I_{CC} = f (V_{CC})$
$V_{goHF} = 0$
I_{CC} (mA)
18
16
14
12
10
8
6
5 6 7 8 9 10 11 12 V_{CC} (V) 15

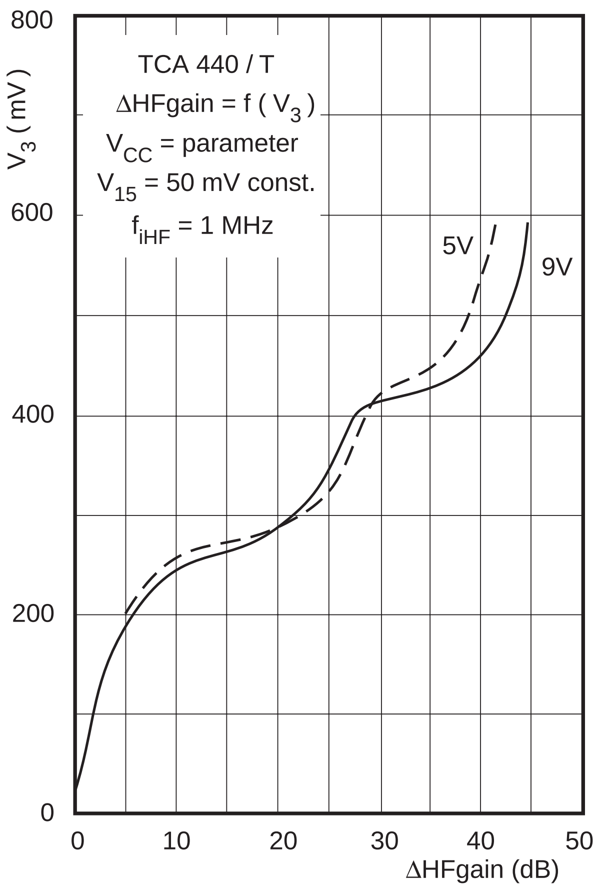

TCA 440 / T
$V_{AF} = f (V_{goHF})$
V_{CC} = parameter
f_{IF} = 455 kHz
m = 0.8; f_m = 1 kHz
9V
5V
V_{AF} (mV)
400
300
200
100
0
10^0 10^1 10^2 10^3 10^4 10^5 V_{goHF}(µV) 10^8

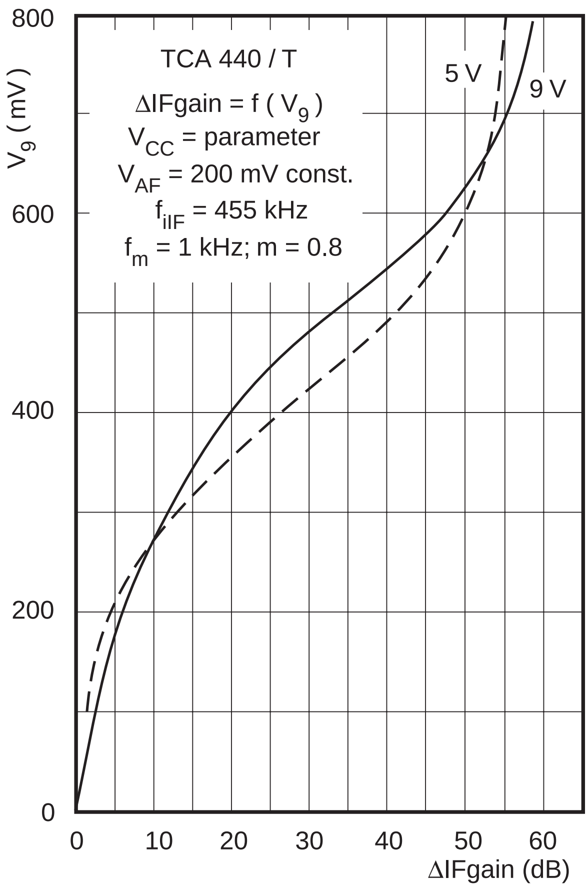

TCA 440 / T
$V_{AF} = f (V_{goHF})$
V_{CC} = parameter
f_{IF} = 455 kHz
f_m = 1 kHz; m = 0.8
9V
5V
V_{AF} (mV)
400
300
200
100
0
10^0 10^1 10^2 10^3 10^4 V_{goHF} (µV) 10^6

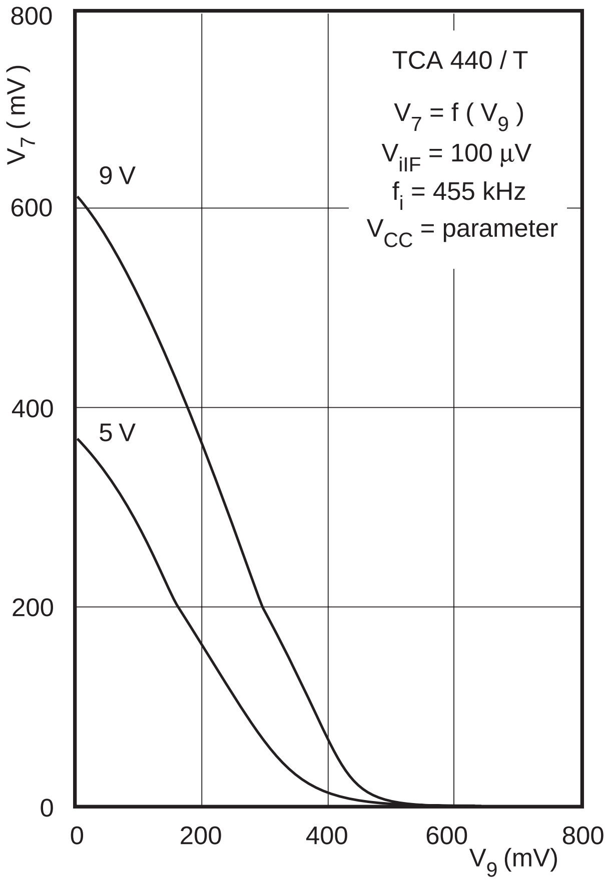

TCA 440 / T
THD = f (V_{ogHF})
V_{CC} = parameter
f_{IF} = 455 kHz
f_m = 1 kHz; m = 0.8
5V
9V
THD (%)
8
6
4
2
0
10^0 10^1 10^2 V_{goHF} (mV) 10^3

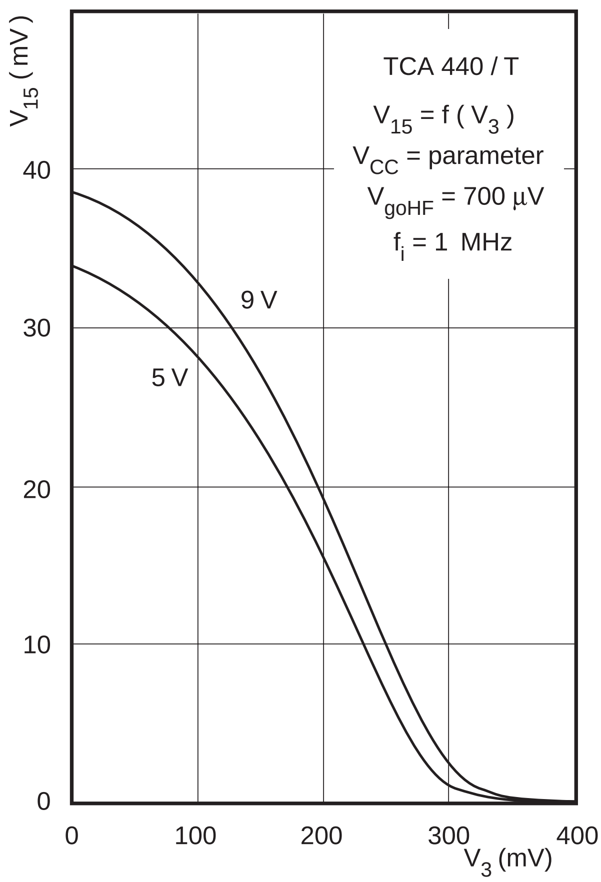

TCA 440 / T
$\frac{S+N}{N} = f(P_{gmax})$
V_{CC} = 9 V
f_i = 1 MHz
f_m = 1 kHz; m = 0.3
R_g = parameter
1 kΩ
4.7 kΩ
30 Ω
250 Ω
$P_{gmax} = \frac{V^2_{go}}{4Rg}$
$\frac{S+N}{N}$ (dB)
P_{gmax}(µW)


TCA 440 / T
$V_{10} = f(V_{iIF})$
V_{CC} = parameter
f_{IF} = 455 kHz
m = 0.8; f_m = 1 kHz
9V
5V
V_{10} (mV)
V_{iIF}(µV)


TCA 440 / T
ΔHFgain = f (V_3)
V_{CC} = parameter
V_{15} = 50 mV const.
f_{iHF} = 1 MHz
5V
9V
V_3 (mV)
ΔHFgain (dB)

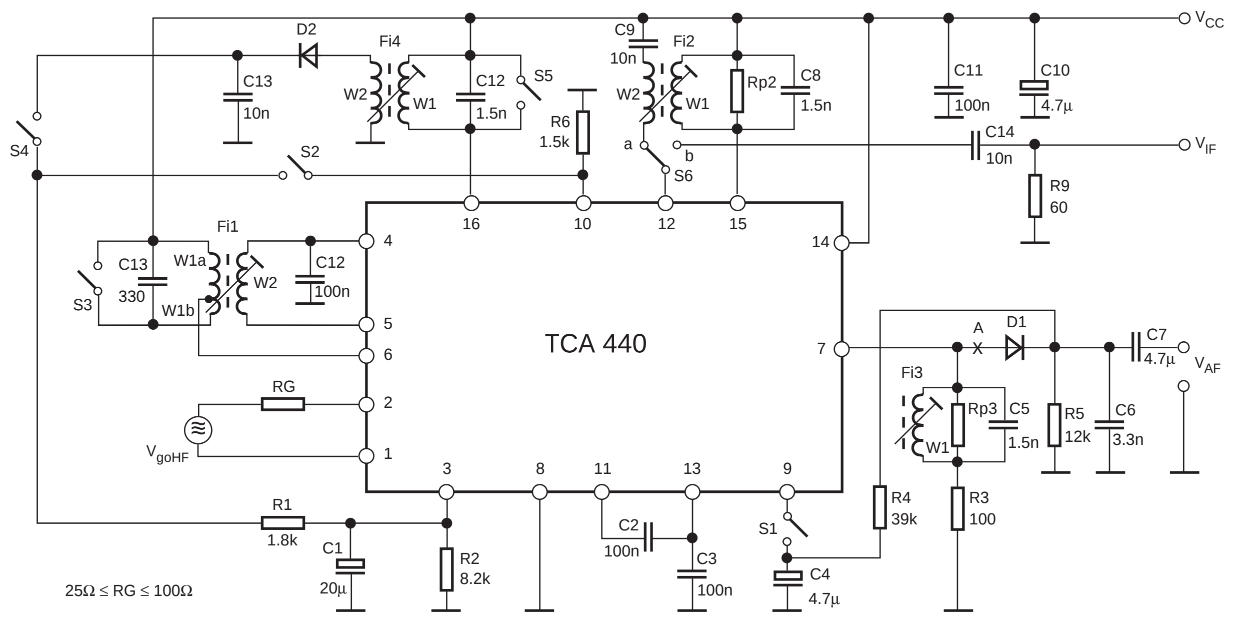

TCA 440 / T
ΔIFgain = f (V_9)
V_{CC} = parameter
V_{AF} = 200 mV const.
f_{iIF} = 455 kHz
f_m = 1 kHz; m = 0.8
5 V
9 V
V_9 (mV)
ΔIFgain (dB)



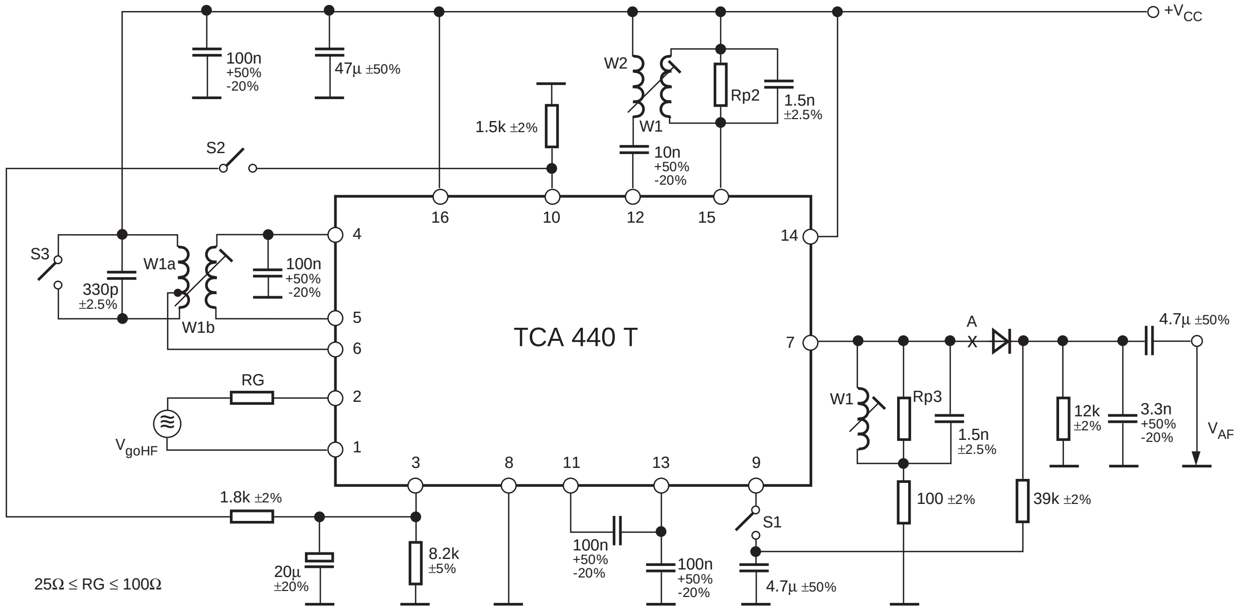


Application examples

- TCA 440



• TCA 440 T



Application hints

The PCB is to arrange such that there are maximum ground lines (ground area) voltage supply has to be blocked to ground by a capacitor of 10...100 nF in order to avoid distortions. Blocking should be as close as possible to the circuit.

The RF circuit has to layout such that 150 $mV_{(rms)}$ oscillator voltage are applied to pin 5. Symmetrically applying an external oscillator is possible to pin 4 or pin 5. The unused input must be connected to ground via capacitor and in the same time be connected to supply voltage at pin 6.

It is recommendable to profide off earth connections 1 and 3, because in this way common - mode interferences more effectively can be suppessed. Single - sided capacitive control of pin 1 and 2 is possible, the unused input must be connected to ground via capacitor.
Mixer outputs 15 and 16 can be used equivalently.

Load resistances of the mixer (IF selection) at pin 15 respectively pin 16 should run to approximately 7 kΩ.

To avoid saturation of the multiplier the maximum peak voltage occuring during operation should not exceed the level (V_{CC} - 3 V) IF response to voltage from pin 15 respectively pin 16 to pin 12 should be approximately - 18 dB that the control characteristics of IF - and RF - part optimally be matched.

Peak voltage at pin 7 occuring during operation should not exceed 2 V that the IF output does not go into saturation.

All the RF bypass capacitors should amount to 100 nF. Sufficient decoupling of wavemagnet and oscillator coil is to be taken into consideration.

All components and parts must be carefully proportioned in order to obtain optimum wise characteristics.

Wavemagnets applied should so much mass as possible. The transformation ratio of the input circuitry should run to 10...12.

In order to improve RF response characteristic a RF preselector can be additionally preceded or the wavemagnet can be tighty coupled by means of an emitter follower impedance transformer.

Improvement of signal - to - noise ratio at average input voltages can be obtained by delayed control of the RF part. Control should be start at approximately 1...2 mV.

GSG 勁力 半導体

Gunter Semiconductor GmbH

TCA440

EDITION 09/00

Integrated AM Circuit for frequencies up to 30 MHz

For inquiry please contact :

China	Tel: 0086-755-3200442	Fax: 0086-755-3355520
Hong Kong	Tel : 00852-26190748	Fax: 00852-24948080
e-mail	sales@gsg-asia.com	

AM - Receiver Circuit

Description

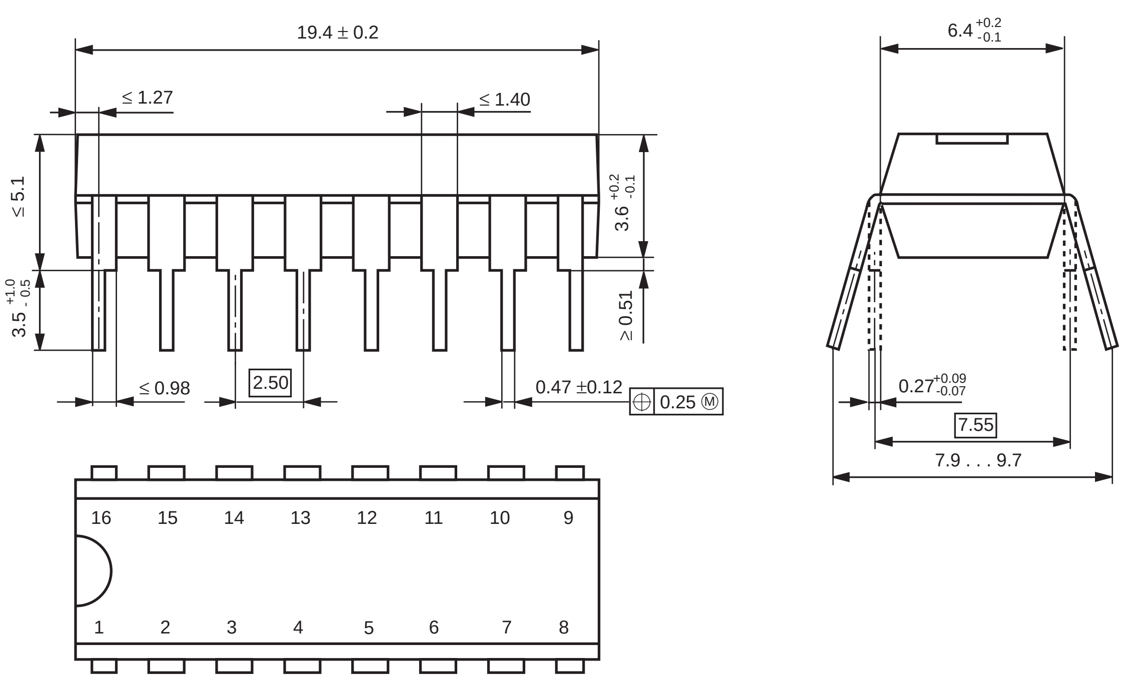
The TCA440/T is an efficient bipolar monolithic circuit to apply in battery - powered or mains - operated radio receivers up to 30 MHz. It contains controlled RF stage, mixer, separated oscillator and regulated multistage IF amplifier.

Features

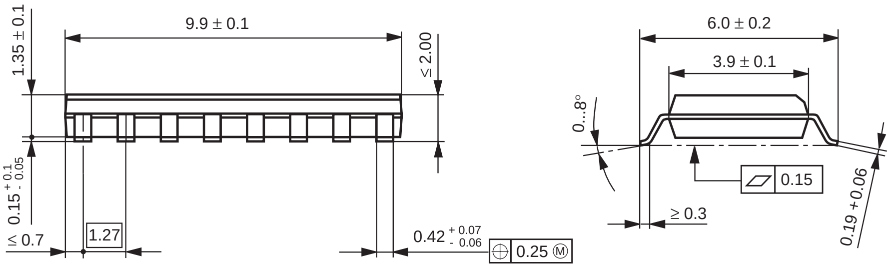
- symmetrical structured circuitry
- controlled RF prestage
- multiplicative balanced mixer, separated oscillator
- very well implemented large - signal characteristic begins already from 4.5 V supply voltage
- terminals for indicating instrument
- controlled IF amplifier implementing 60 dB control range
- external demodulator (diode)
- wide range of supply voltage between 4.5 and 15 V

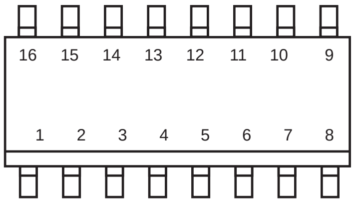
Package

TCA440 • DIP 16



TCA440 T • SOP 16

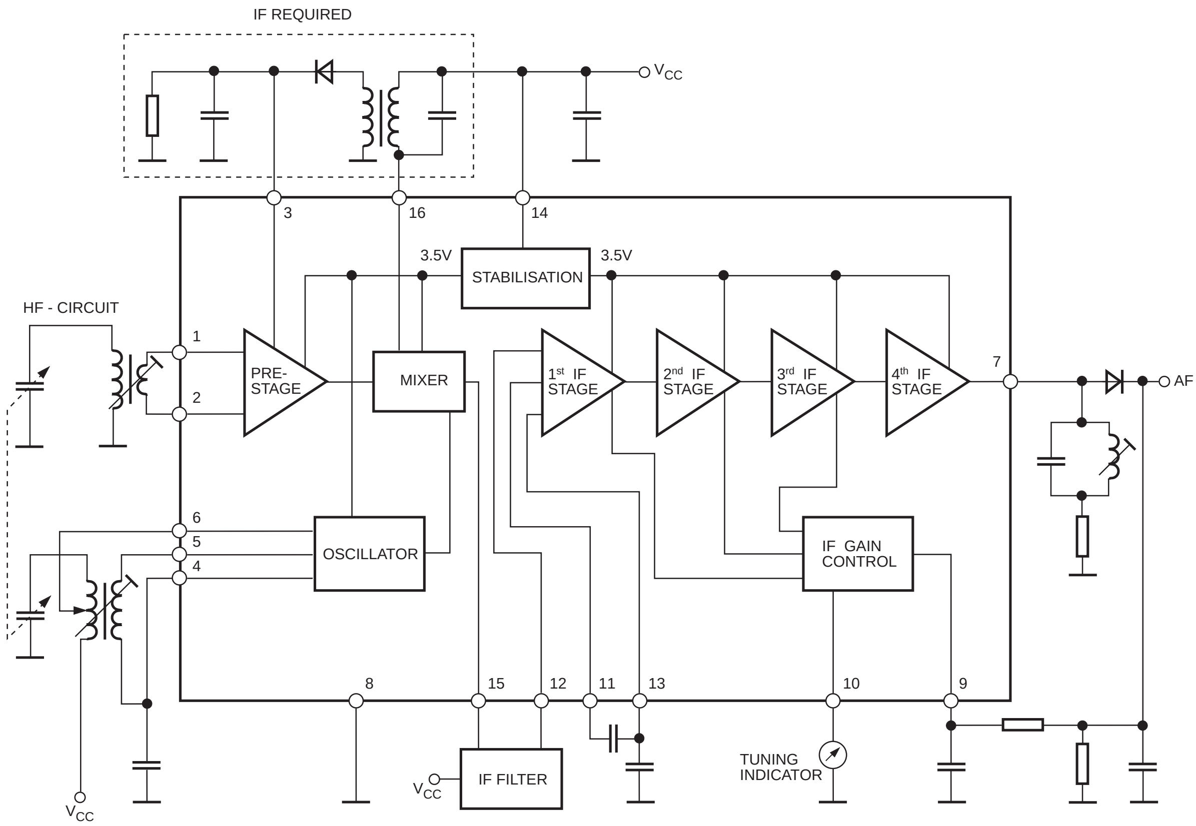




Pin Configuration

1	RF prestage, input 1	9	input IF control amplifier
2	RF prestage, input 2	10	indicator output IF control amplifier
3	RF control amplifier input	11	IF blocking
4	oscillator circuit pin 1	12	input IF amplifier
5	oscillator circuit pin 2	13	IF blocking
6	oscillator circuit pin 3	14	supply voltage
7	IF output	15	mixer output 1
8	ground	16	mixer output 2

Block Diagram



Functional Description

It contains several function units, which enable designing and assembling of efficient AM tuners. Caused by internal voltage stabilization characteristics are rather independent from supply voltage.

The RF input signal reaches via a controllable and overdriving proof preselector stage a balanced mixer. By means of a RF - signal generated by a separated oscillator the input signal is transported into IF. Multiplicative mixing causes only few harmonic content. Gain control is carried out by means of two separated feedback control loops for preselector stage and IF amplifier. By these a loop bandwidth of approximately 100 dB is obtained. The control voltage of the IF - amplifier can be used to drive a moving - coil instrument (field strength indicator). The IF amplifier consists of 4 amplifier stages, the first, second and third can be controlled. The bandwidth of the IF amplifier is approximately 2 MHz and on that account sufficient for usual IF frequencies in the AM range of approximately 460 kHz.
The symmetrical arrangement of the entire circuitry guarantees well oscillating. The bridge of the mixer avoids direct breakdown.

Absolute Maximum Ratings

		min	max	unit
Supply voltage	V_{CC}	4.5	15.0	V
Junction temperature	T_j		150	°C
Ambient operating temperature	T_a	-15	80	°C
Storage temperature	T_s	-40	125	°C
Total thermal resistance	R_{thja}		120	K/W

Recommended Operational Conditions

		min	max	unit
Supply voltage	V_{CC}	4.5	15	V
Ambient operating temperature	T_a	-10	70	°C

Characteristics

refer to application examples, f_i = 1 MHz, f_{osc} = 1.455 kHz, f_{IF} = 455 kHz, V_{CC} = 9 V, f_m = 1 kHz, m = 0.8, voltages refer to ground, T_a = 20 to 25 °C, unless specified otherwise

		min	typ	max	unit
Current and voltage supply (no RF signal)					
Supply voltage	V_{14-8}	4.5	9	15	V
Current consumption					
V_{14-8} = 4.5 V	I_{14}		7		mA
V_{14-8} = 9 V	I_{14}		10.5	16	mA
V_{14-8}= 15 V	I_{14}		12		mA
Entire receiver					
RF level variation					
with ΔV_{NF} = 6 dB	ΔV_{RF}		65		dB
with ΔV_{NF} = 10 dB	ΔV_{RF}		80		dB
NF output voltages (symmetrically measured at 1-2)					
V_{iHF} = 20 µV, m = 0.8	$V_{NF(rms)}$	60	140		mV
V_{iHF} = 1 mV, m = 0.8	$V_{NF(rms)}$		260		mV
V_{iHF} = 500 mV, m = 0.8	$V_{NF(rms)}$	100	350	560	mV
V_{iHF} = 20 µV, m = 0.3	$V_{NF(rms)}$		50		mV
V_{iHF} = 1 mV, m = 0.3	$V_{NF(rms)}$		100		mV
V_{iHF} = 500 mV, m = 0.3	$V_{NF(rms)}$		130		mV
RF input sensitivity measured at 60 Ω, m = 0.3, R_G = 540 Ω signal-to-noise ratio					
S + N/N = 6 dB	V_{iRF}		1		µV
S + N/N = 26 dB	V_{iRF}		7		µV
S + N/N = 58 dB	V_{iRF}		1		mV
Maximum RF input voltage (THD = 10 %)	V_{iHF}			1.5	V
Total harmonic distortion					
V_{HF} = 500 mV	THD		4.5	10	%
V_{HF} = 30 mV	THD		2.8	8	%
RF part					
Input frequency range	f_{iHF}	0		50	MHz
Output frequency $f_{IF} = f_{osc} - f_{iHF}$	f_{IF}		455		kHz
Control range	ΔG_V		38		dB

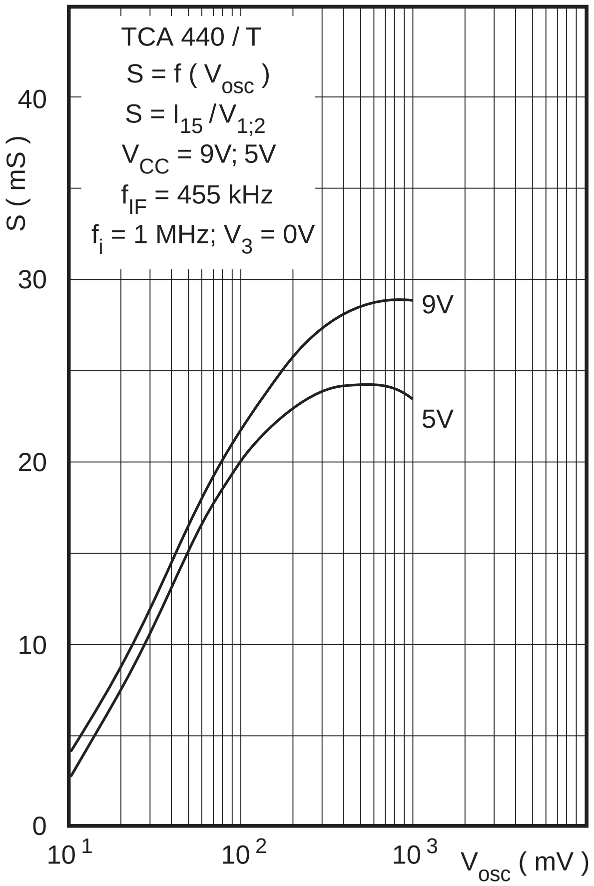
		min	typ	max	unit
IF suppression between 1 - 2 and 15	a_{IF}		20		dB
RF input impedance unbalanced coupling					
V_{iHFmax}	Z_i		2 II 5		kΩIIpF
V_{iHFmin}	Z_i		2.2 II 1.5		kΩIIpF
balanced coupling					
V_{iHFmax}	Z_i		4.5		kΩ
V_{iHFmin}	Z_i		4.5 II 1.5		kΩIIpF
Mixer output impedance (pin 15 or 16)	Z_o		250 II 4.5		kΩIIpF
Steepness	S_{HF}		28		mS
<u>IF part</u>					
Input frequency range	f_{iIF}	0		2	MHz
Control range f_{iIF} = 455 kHz, ΔV_{NF} = 10 dB	ΔG_V		62		dB
Start of control (ΔV_{iIF} / ΔV_{NF} = 10 dB / 3 dB)	V_{ctrlF}		140		µV
maximum IF input voltage (THD_{NF} = 10 %)	V_{iIFmax}		200		mV
NF output voltage applied to 60 Ω					
V_{ZF} = 30 µV	$V_{NF(rms)}$		50		mV
V_{ZF} = 3 mV	$V_{NF(rms)}$		200		mV
V_{ZF} = 3 mV; m = 0.3	$V_{NF(rms)}$		70		mV
IF input impedance (unbanlanced coupling)	Z_{iIF}		3 II 3		kΩllpF
IF output impedance (pin 7)	Z_O		200 II 8		kΩIIpF

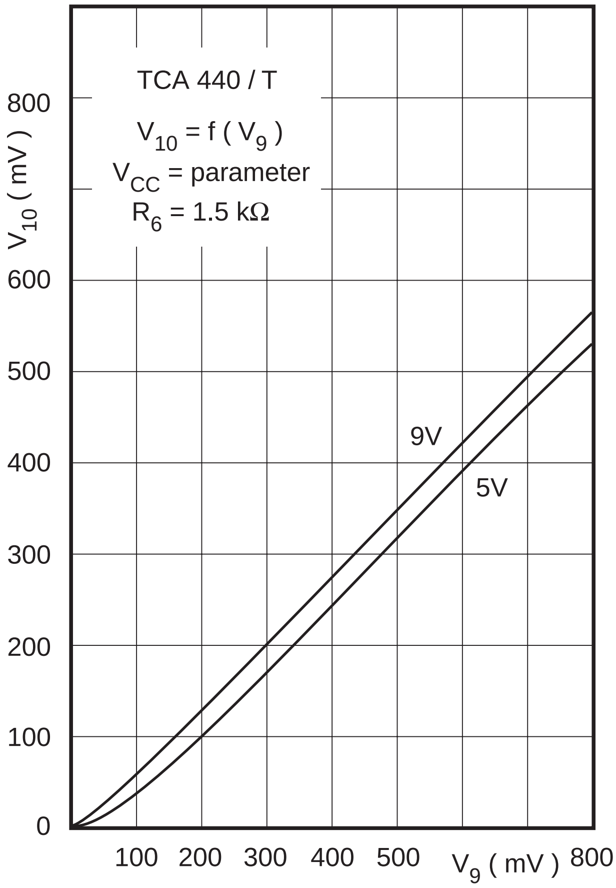
Indication instrument

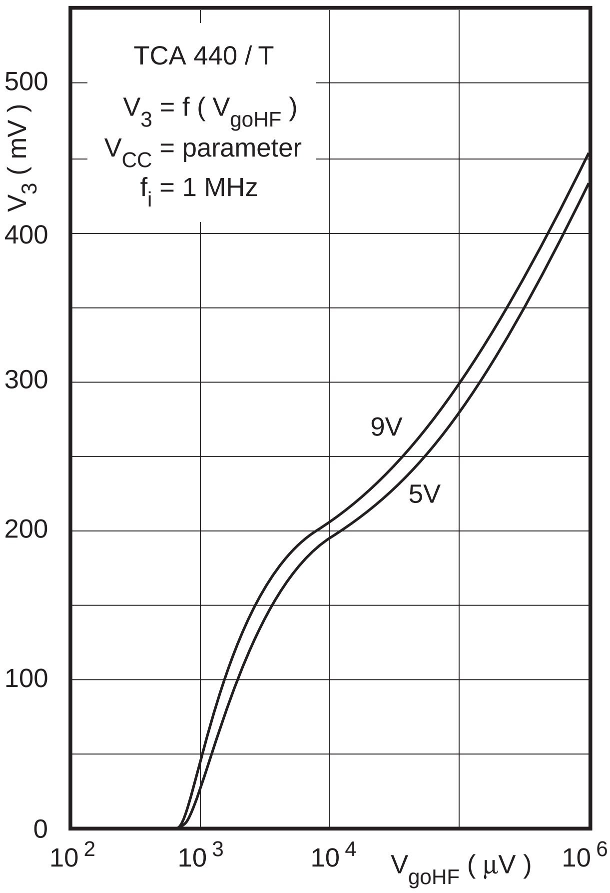
Recommended indication instruments: 500 µA (R_i = 800 Ω)
300 µA (R_i = 1.5 kΩ)

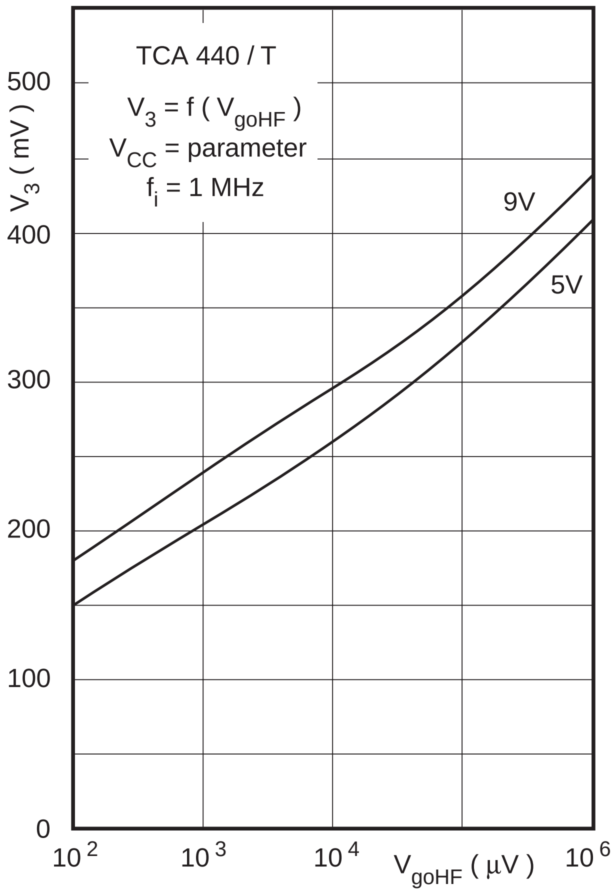
For indication a voltage source of 600 m $V_{(EMF)}$ and an internal source impedance of 400 Ω is available.

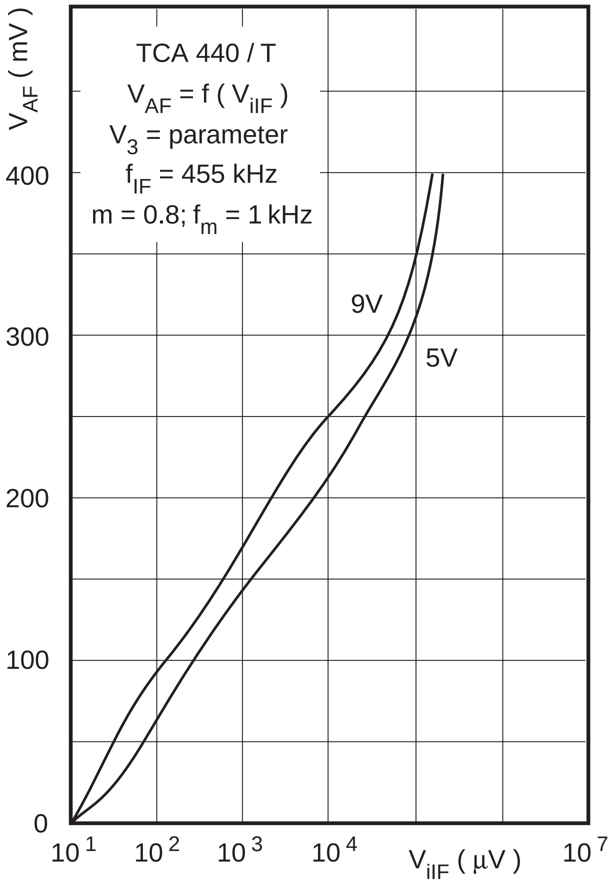
Dependences

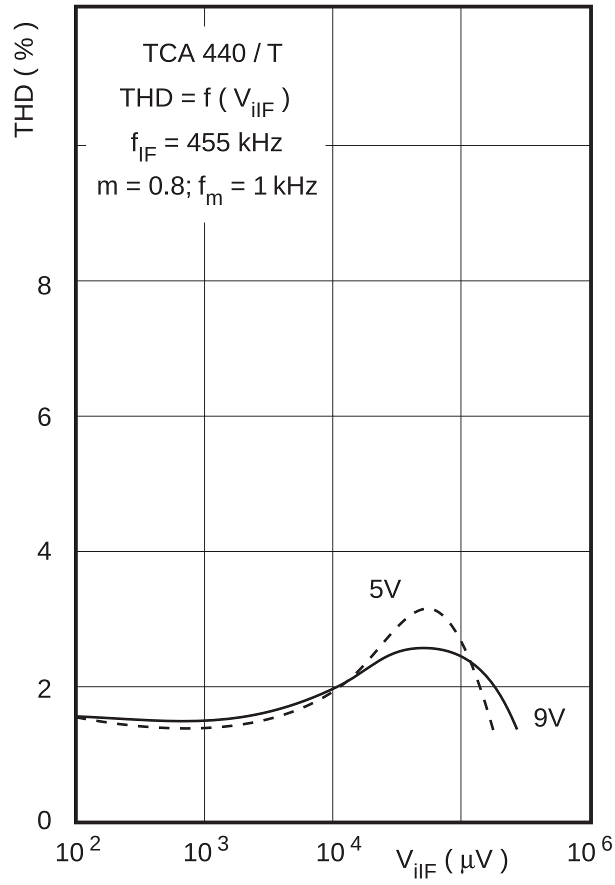


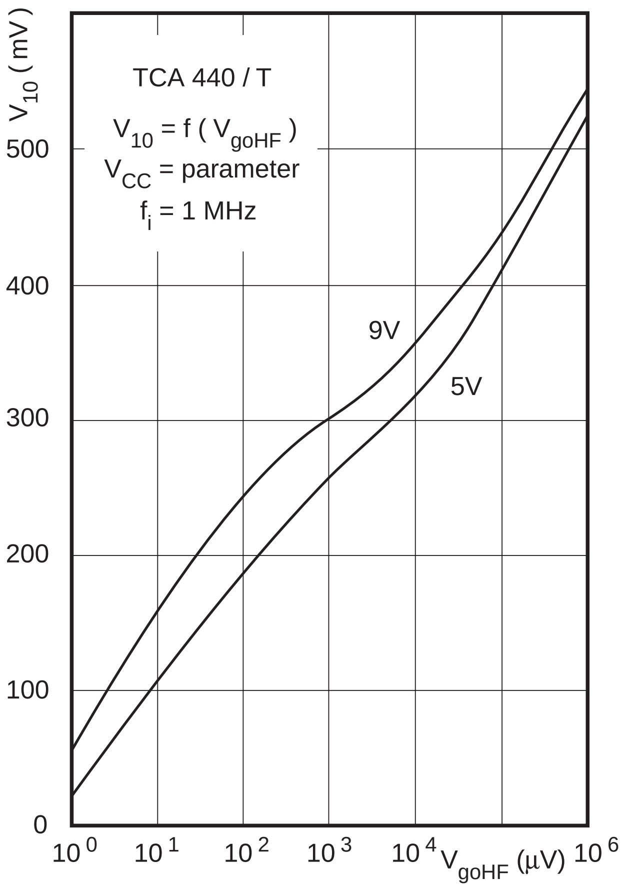


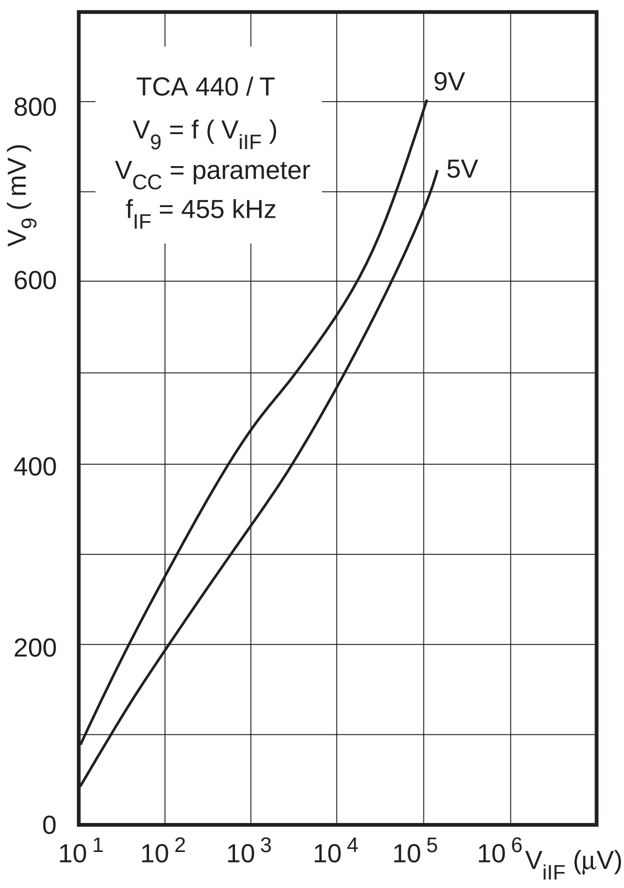


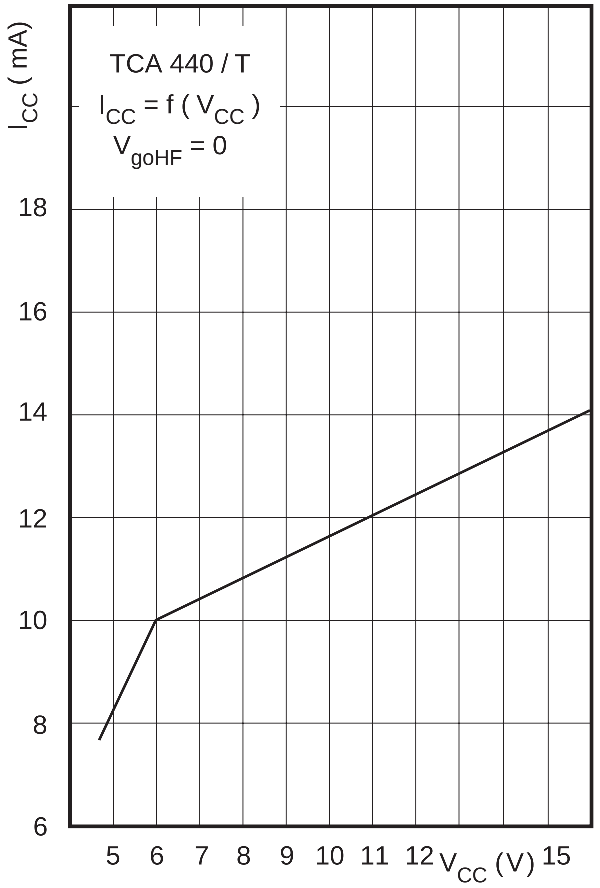


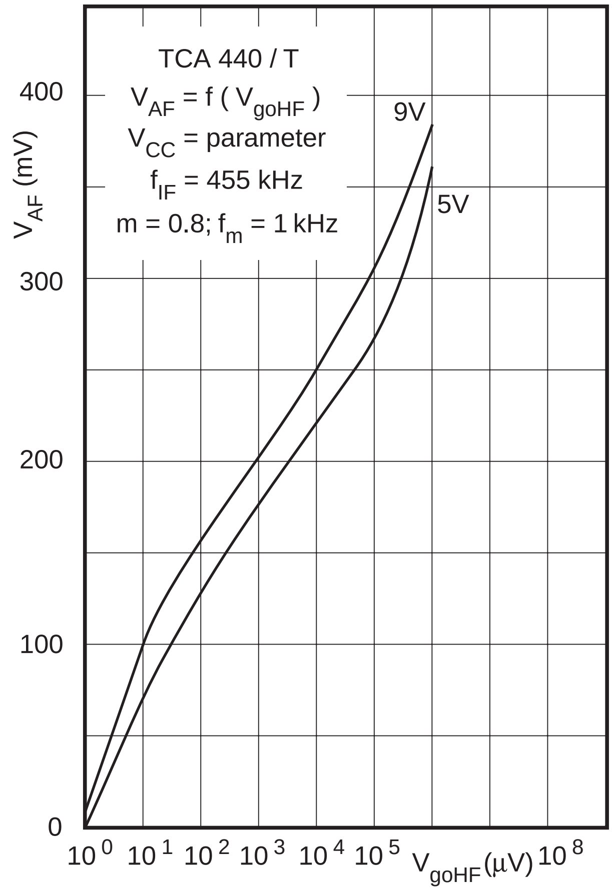

TCA 440 / T
V_AF = f (V_iIF)
V_3 = parameter
f_IF = 455 kHz
m = 0.8; f_m = 1 kHz
9V
5V
V_AF (mV)
400
300
200
100
0
10 1
10 2
10 3
10 4
V_iIF (µV)
10 7

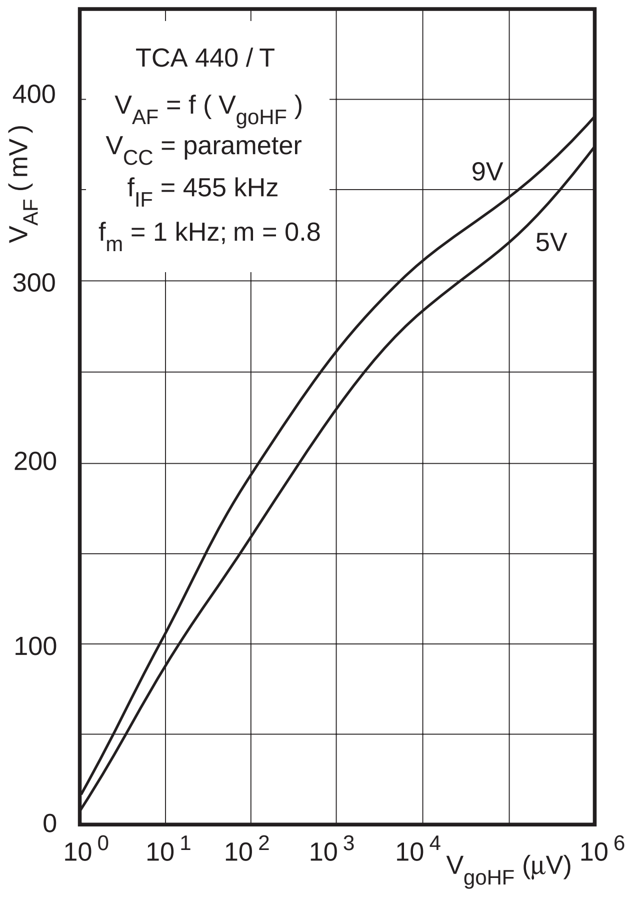

TCA 440 / T
THD = f (V_iIF)
f_IF = 455 kHz
m = 0.8; f_m = 1 kHz
5V
9V
THD (%)
8
6
4
2
0
10 2
10 3
10 4
V_iIF (µV)
10 6

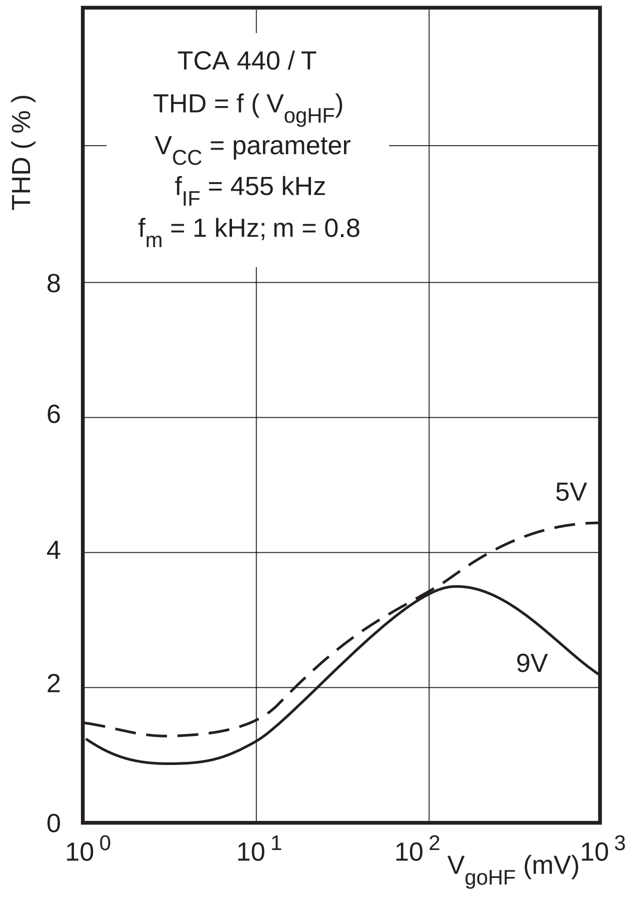

TCA 440 / T
V_10 = f (V_goHF)
V_CC = parameter
f_i = 1 MHz
9V
5V
V_10 (mV)
500
400
300
200
100
0
10 0
10 1
10 2
10 3
10 4
V_goHF (µV)
10 6

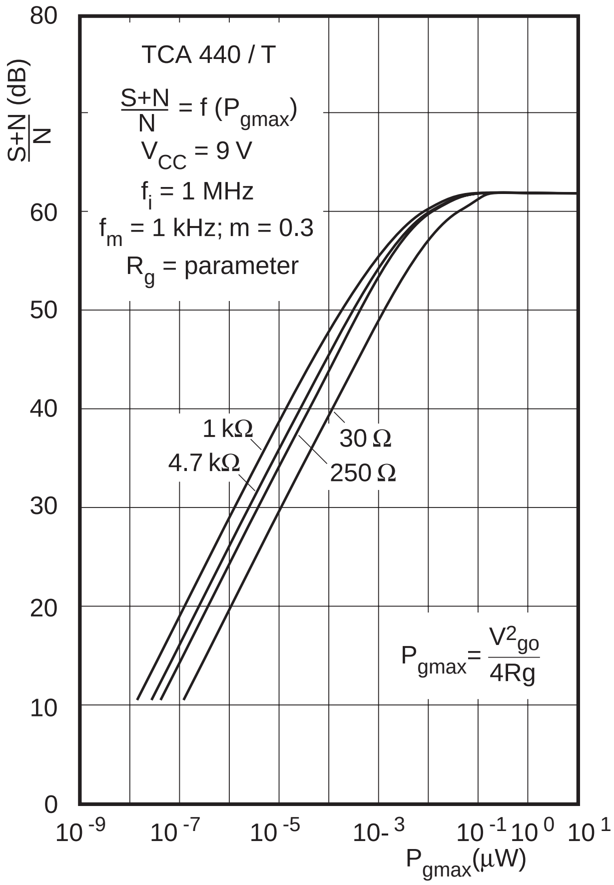

TCA 440 / T
V_9 = f (V_iIF)
V_CC = parameter
f_IF = 455 kHz
9V
5V
V_9 (mV)
800
600
400
200
0
10 1
10 2
10 3
10 4
10 5
10 6
V_iIF (µV)

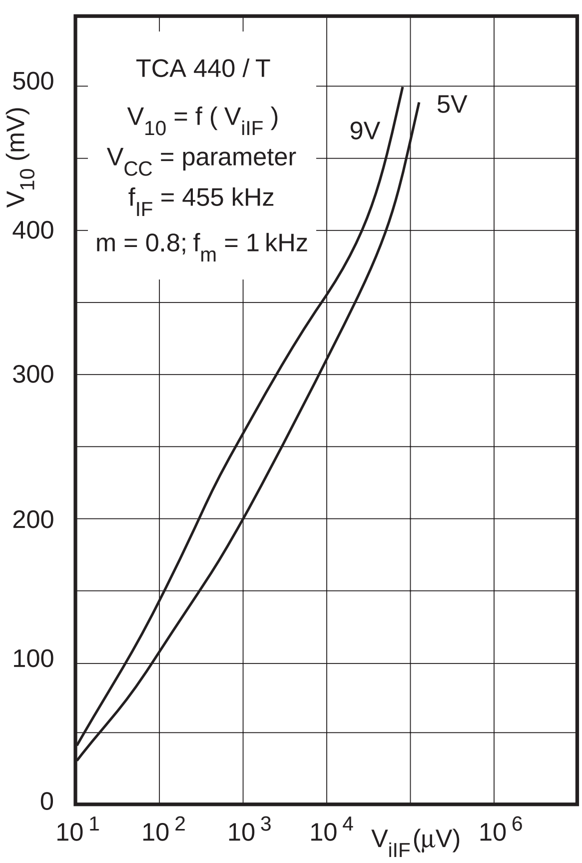

TCA 440 / T
$I_{CC} = f(V_{CC})$
$V_{goHF} = 0$
I_{CC} (mA)
18
16
14
12
10
8
6
5 6 7 8 9 10 11 12 V_{CC} (V) 15

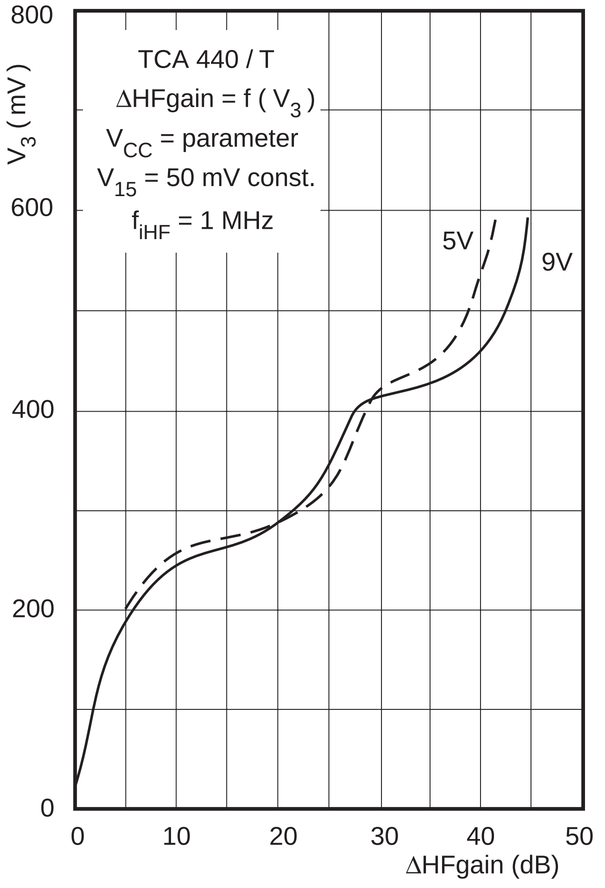

TCA 440 / T
$V_{AF} = f(V_{goHF})$
V_{CC} = parameter
f_{IF} = 455 kHz
m = 0.8; f_m = 1 kHz
9V
5V
V_{AF} (mV)
400
300
200
100
0
10^0 10^1 10^2 10^3 10^4 10^5 V_{goHF}(µV) 10^8

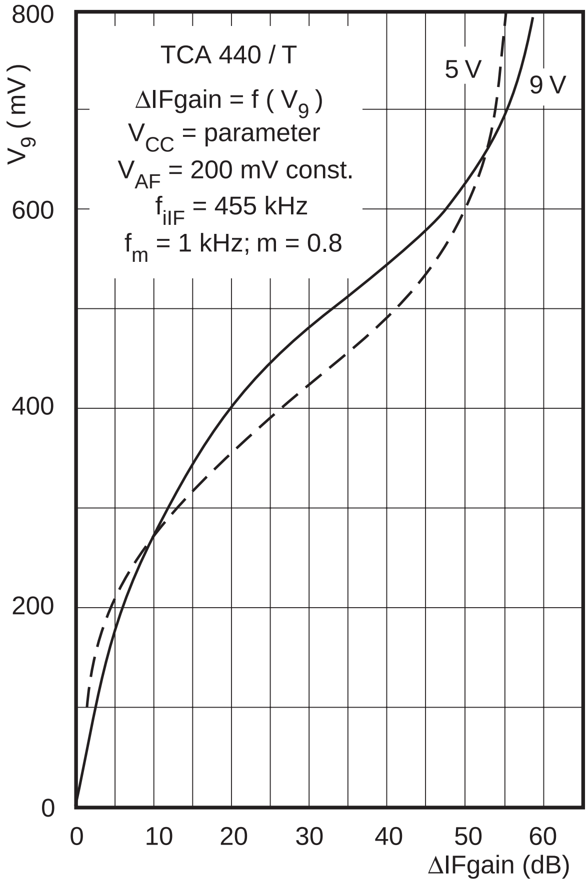

TCA 440 / T
$V_{AF} = f(V_{goHF})$
V_{CC} = parameter
f_{IF} = 455 kHz
f_m = 1 kHz; m = 0.8
9V
5V
V_{AF} (mV)
400
300
200
100
0
10^0 10^1 10^2 10^3 10^4 V_{goHF} (µV) 10^6

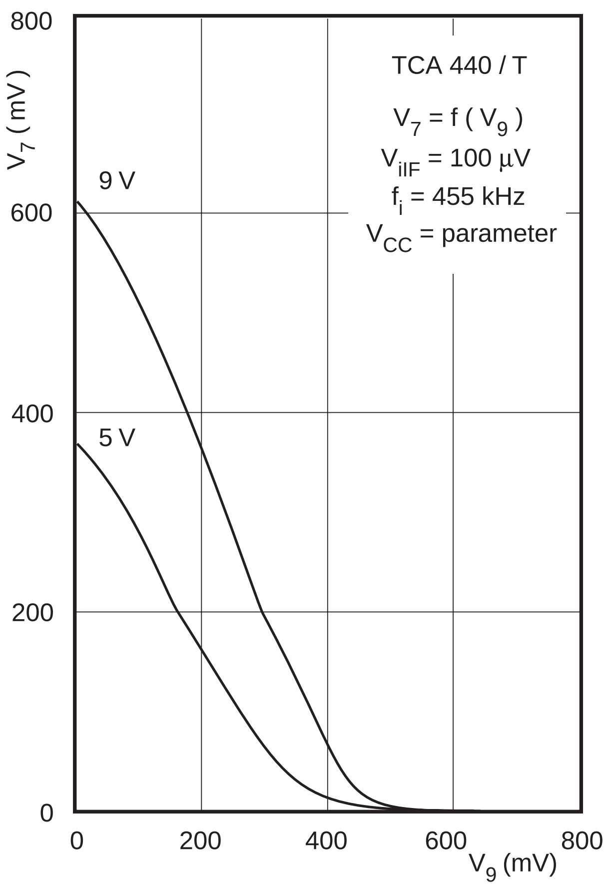

TCA 440 / T
THD = f (V_{ogHF})
V_{CC} = parameter
f_{IF} = 455 kHz
f_m = 1 kHz; m = 0.8
5V
9V
THD (%)
8
6
4
2
0
10^0 10^1 10^2 V_{goHF} (mV) 10^3

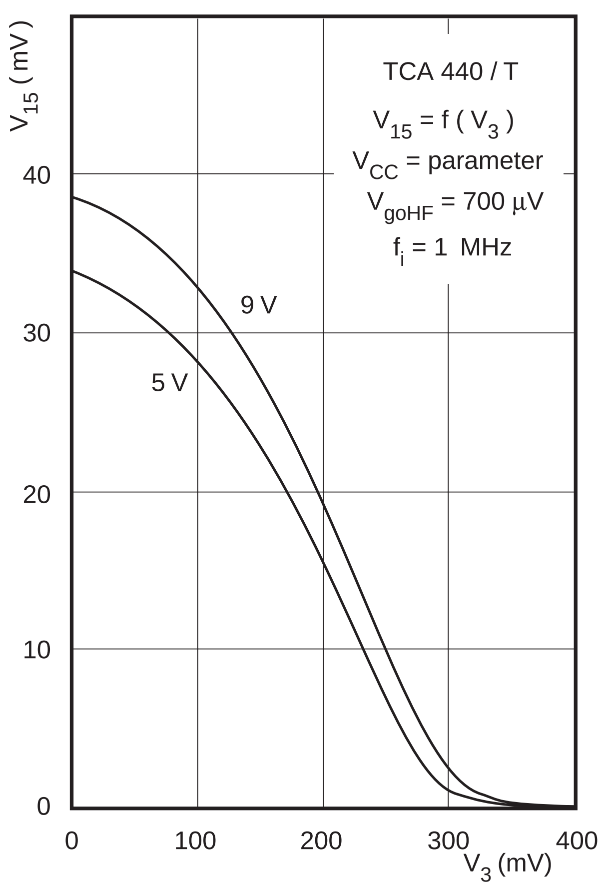

TCA 440 / T
S+N/N = f (Pgmax)
VCC = 9 V
fi = 1 MHz
fm = 1 kHz; m = 0.3
Rg = parameter
1 kΩ
4.7 kΩ
30 Ω
250 Ω
Pgmax= V2go/4Rg
S+N/N (dB)
Pgmax(µW)
80
60
50
40
30
20
10
0
10 -9
10 -7
10 -5
10- 3
10 -1
10 0
10 1


TCA 440 / T
V10 = f (ViIF)
VCC = parameter
fIF = 455 kHz
m = 0.8; fm = 1 kHz
9V
5V
V10 (mV)
ViIF(µV)
500
400
300
200
100
0
10 1
10 2
10 3
10 4
10 6


TCA 440 / T
ΔHFgain = f (V3)
VCC = parameter
V15 = 50 mV const.
fiHF = 1 MHz
5V
9V
V3 (mV)
ΔHFgain (dB)
800
600
400
200
0
0
10
20
30
40
50

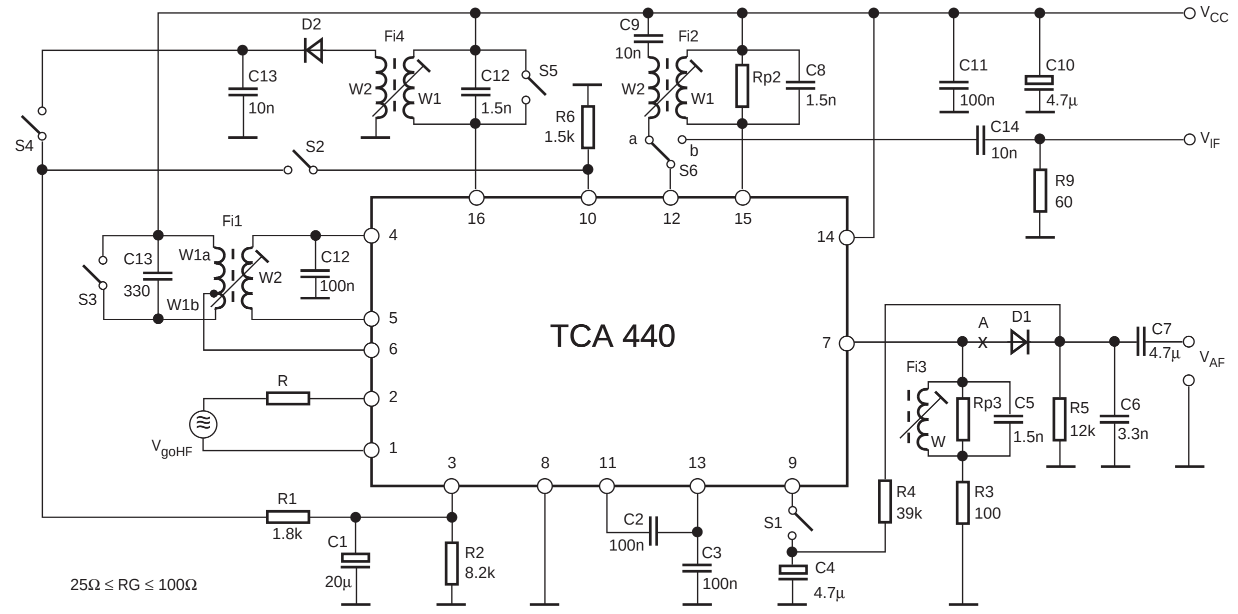

TCA 440 / T
ΔIFgain = f (V9)
VCC = parameter
VAF = 200 mV const.
fiIF = 455 kHz
fm = 1 kHz; m = 0.8
5 V
9 V
V9 (mV)
ΔIFgain (dB)
800
600
400
200
0
0
10
20
30
40
50
60



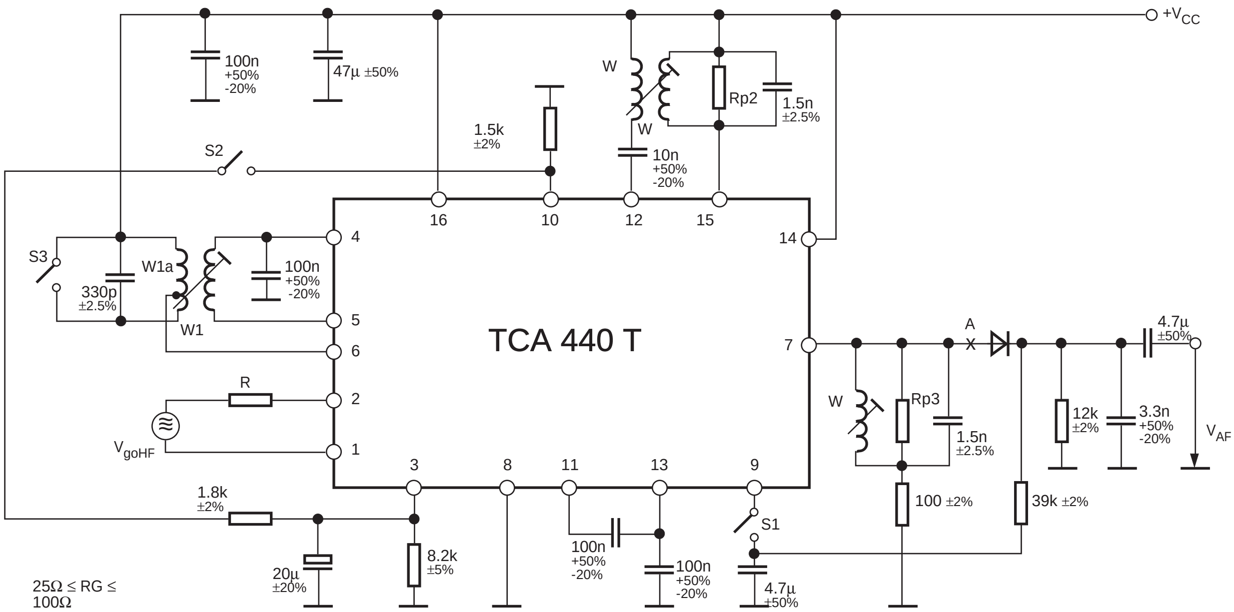


Application Examples

- TCA 440



• TCA440 T



Application Hints

The PCB is to arrange such that there are maximum ground lines (ground area) voltage supply has to be blocked to ground by a capacitor of 10...100 nF in order to avoid distortions. Blocking should be as close as possible to the circuit.

The RF circuit has to layout such that 150 $mV_{(rms)}$ oscillator voltage are applied to pin 5. Symmetrically applying an external oscillator is possible to pin 4 or pin 5. The unused input must be connected to ground via capacitor and in the same time be connected to supply voltage at pin 6.

It is recommendable to profide off earth connections 1 and 3, because in this way common - mode interferences more effectively can be suppesed. Single - sided capacitive control of pin 1 and 2 is possible, the unused input must be connected to ground via capacitor.
Mixer outputs 15 and 16 can be used equivalently.

Load resistances of the mixer (IF selection) at pin 15 respectively pin 16 should run to approximately 7 kΩ.

To avoid saturation of the multiplier the maximum peak voltage occuring during operation should not exceed the level (V_{CC} - 3 V) IF response to voltage from pin 15 respectively pin 16 to pin 12 should be approximately - 18 dB that the control characteristics of IF - and RF - part optimally be matched.

Peak voltage at pin 7 occuring during operation should not exceed 2 V that the IF output does not go into saturation.

All the RF bypass capacitors should amount to 100 nF. Sufficient decoupling of wavemagnet and oscillator coil is to be taken into consideration.

All components and parts must be carefully proportioned in order to obtain optimum wise characteristics.

Wavemagnets applied should so much mass as possible. The transformation ratio of the input circuitry should run to 10...12.

In order to improve RF response characteristic a RF preselector can be additionally preceded or the wavemagnet can be tighty coupled by means of an emitter follower impedance transformer.

Improvement of signal - to - noise ratio at average input voltages can be obtained by delayed control of the RF part. Control should be start at approximately 1...2 mV.