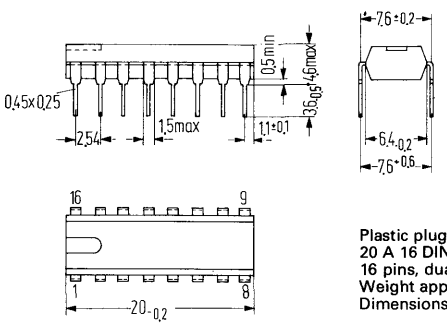
TCA 440 is a monolithic IC, especially developed for AM receivers up to 50 MHz. It includes a RF prestage with AGC, a balanced mixer, separate oscillator and an IF amplifier with AGC. Because of its low current consumption and of its internal stabilization the TCA 440 is perfectly suited for battery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




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 | $V_{cc}$ | 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 V, $T_{amb}$ = 25 °C, $f_{iRF}$ = 600 kHz, $f_{mod}$ = 1 kHz)

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

| | | | |
|---|---|---|---|
| Input frequency range | $f_{iRF}$ | 0 to 50 | MHz |
| Output frequency $f_{IF} = f_{osc} - f_{iRF}$ | $f_{IF}$ | 460 | kHz |
| Control range | $\Delta G_V$ | 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 | kΩ/pF |
| $G_{RFmin}$ | $Z_i$ | 2.2/1.5 | kΩ/pF |
| b) symmetrical coupling at $G_{RFmax}$ | $Z_i$ | 4/5 | kΩ/pF |
| $G_{RFmin}$ | $Z_i$ | 4.5/1.5 | kΩ/pF |
| Mixer output impedance (pins 15 or 16) | $Z_{qosc}$ | 250/4.5 | kΩ/pF |

### IF unit

| | | | |
|---|---|---|---|
| Input frequency range | $f_{IIF}$ | 0 to 2 | MHz |
| Control range at 460 kHz | $\Delta G_V$ | 62 | dB |
| 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) | $V_{IF\ eff}$ | 200 | mV |
| AF output voltage for $V_{IIF}$ at 60 Ω (pin 12) | | | |
| ($f_{mod}$ = 1 kHz) $V_{IF}$ = 30 µV, m = 80% | $V_{AFeff}$ | 50 | mV |
| $V_{IF}$ = 3 mV, m = 80% | $V_{AFeff}$ | 200 | mV |
| $V_{IF}$ = 3 mV, m = 30% | $V_{AFeff}$ | 70 | mV |
| IF input impedance (unsymm. coupling) | $Z_i$ | 3/3 | kΩ/pF |
| IF output impedance (pin 7) | $Z_g$ | 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 at pin 10 a tuning meter voltage of 600 $mV_{EMP}$ max. with a source impedance of approx. 400 Ω.

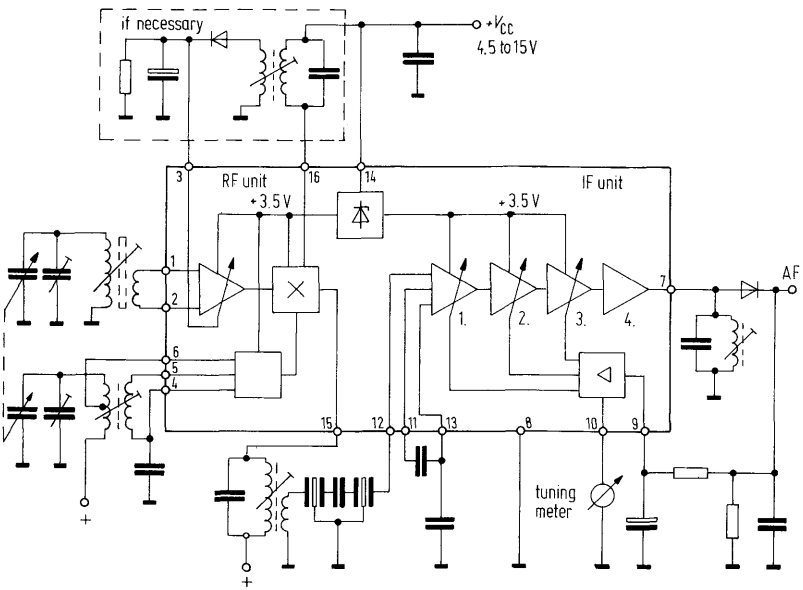
### Selection

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.

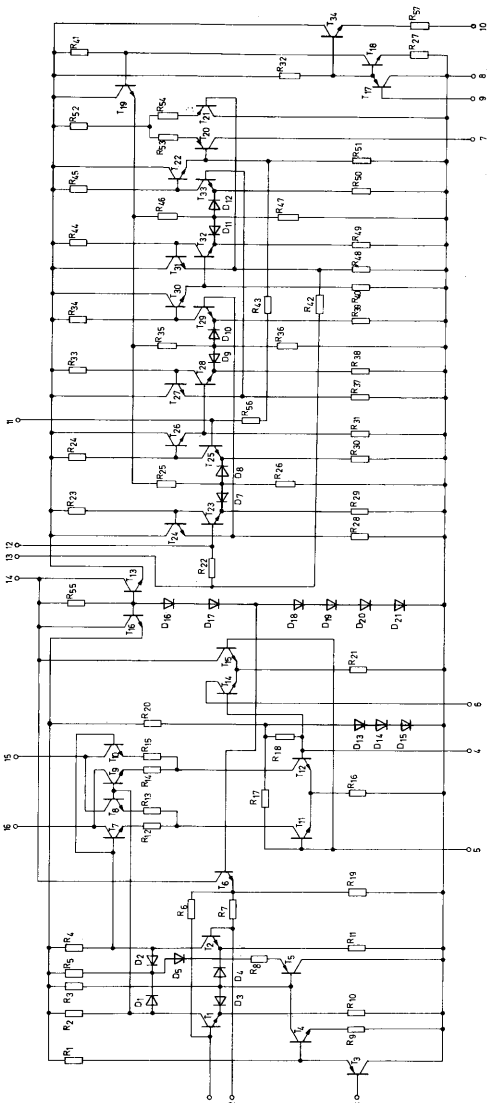
### Function

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 multiplicatavely. 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.

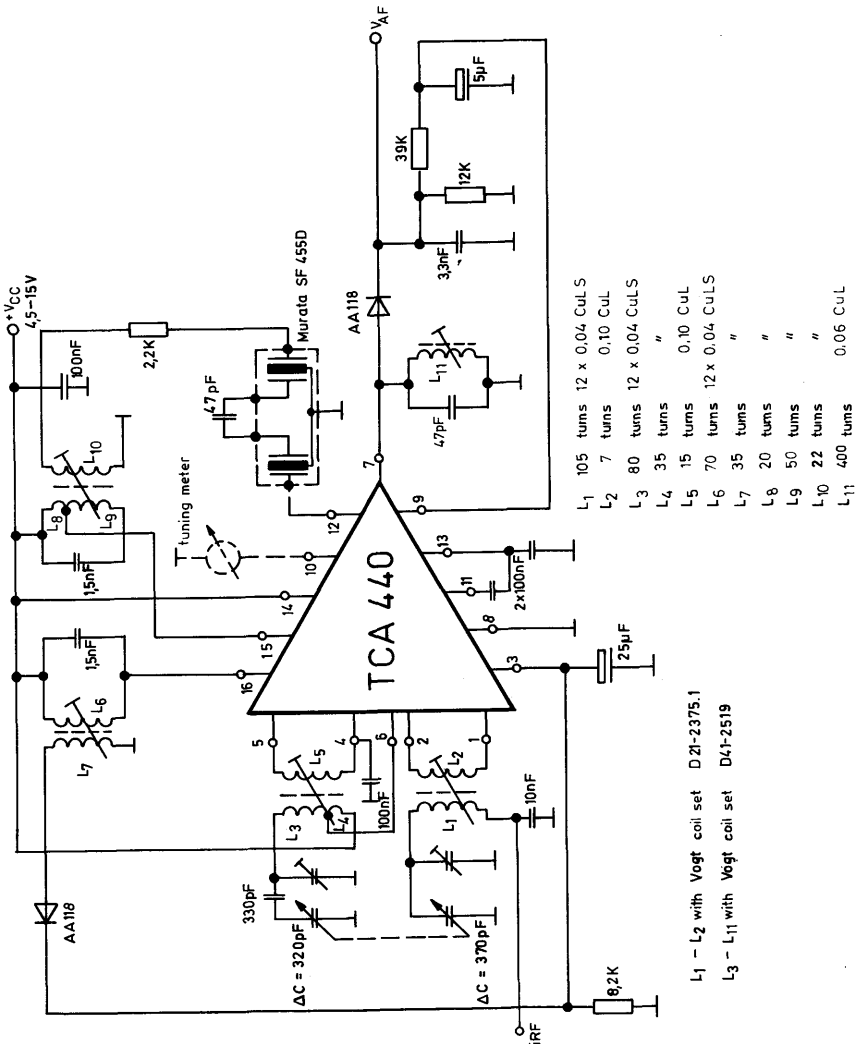
## Block diagram



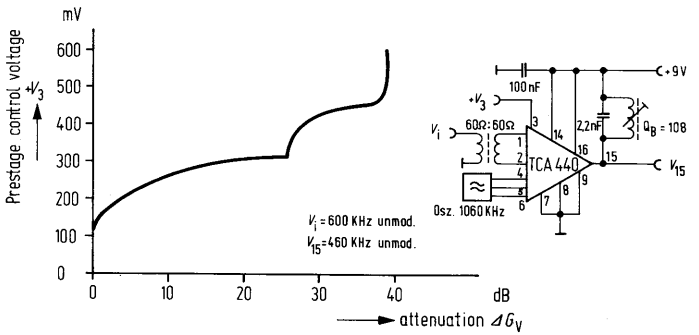
## Circuit diagram



## Application example for MW

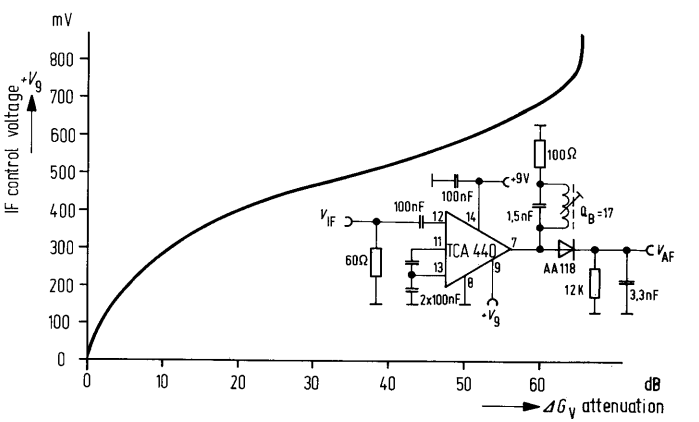


## Prestage control



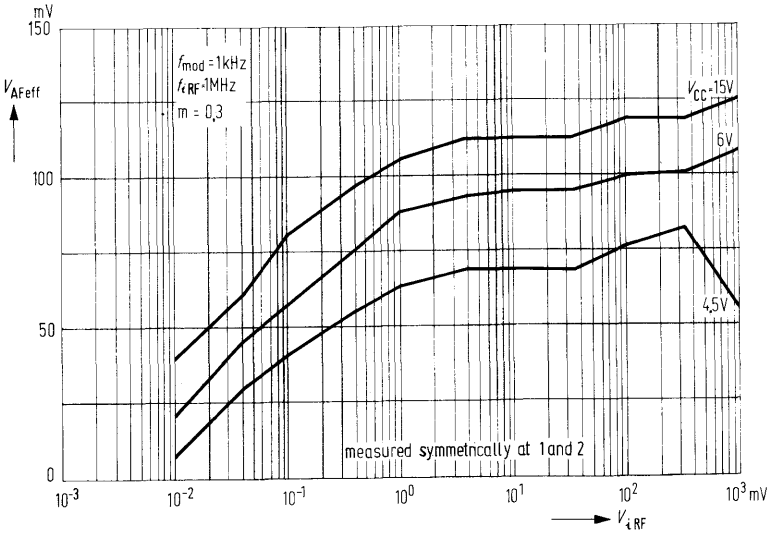

The input is not power matched and can be driven with a higher resistance. $V_i$ is chosen so that a constant $V_{15}$ is obtained (50 $mV_{pp}$).

## IF control



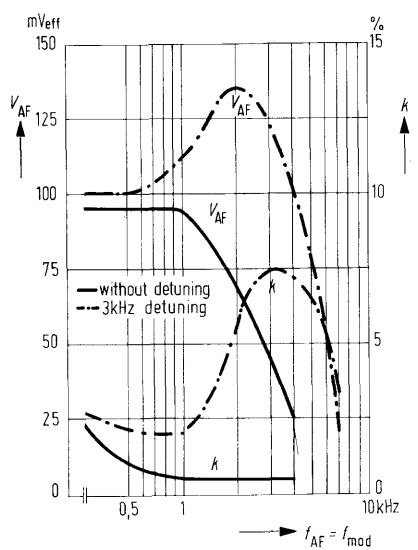

$V_{IF}$ (469 kHz; $m = 80\%$; $f_{mod} = 1$ kHz) is chosen so that always a constant $V_{AF}$ is obtained (200 $mV_{eff}$).

**AF output voltage versus RF input voltage**

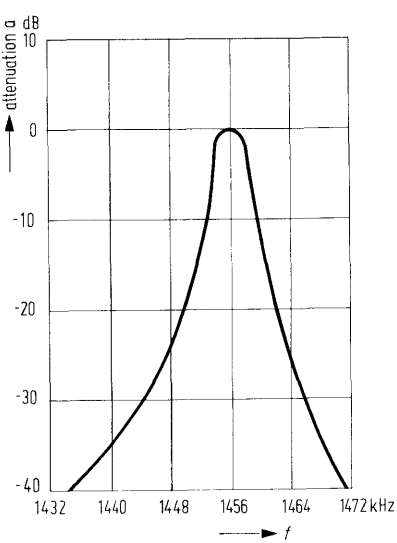



**Application for MW**

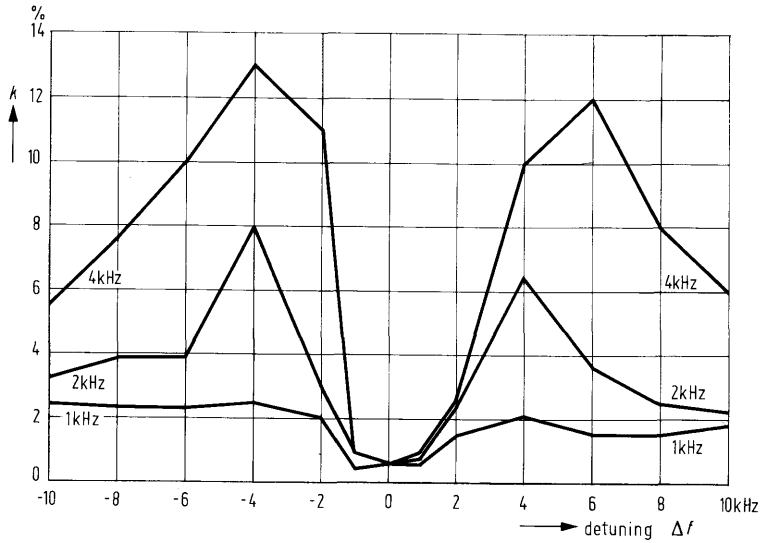
**AF output voltage versus output frequency**
**Harmonic distortion versus modulation frequency**
$f_{RF}$ = 1 MHz, $f_{IF}$ = 456 kHz, $V_{cc}$ = 9 V,
$m$ = 30%, $V_{RF}$ = 50 $mV_{eff}$



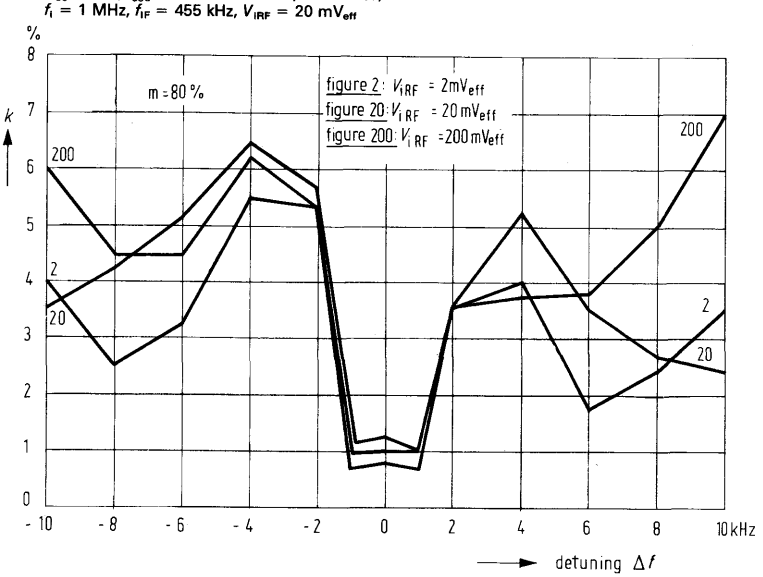

**Pass band figure versus input frequency, measured from input to output of the circuit**



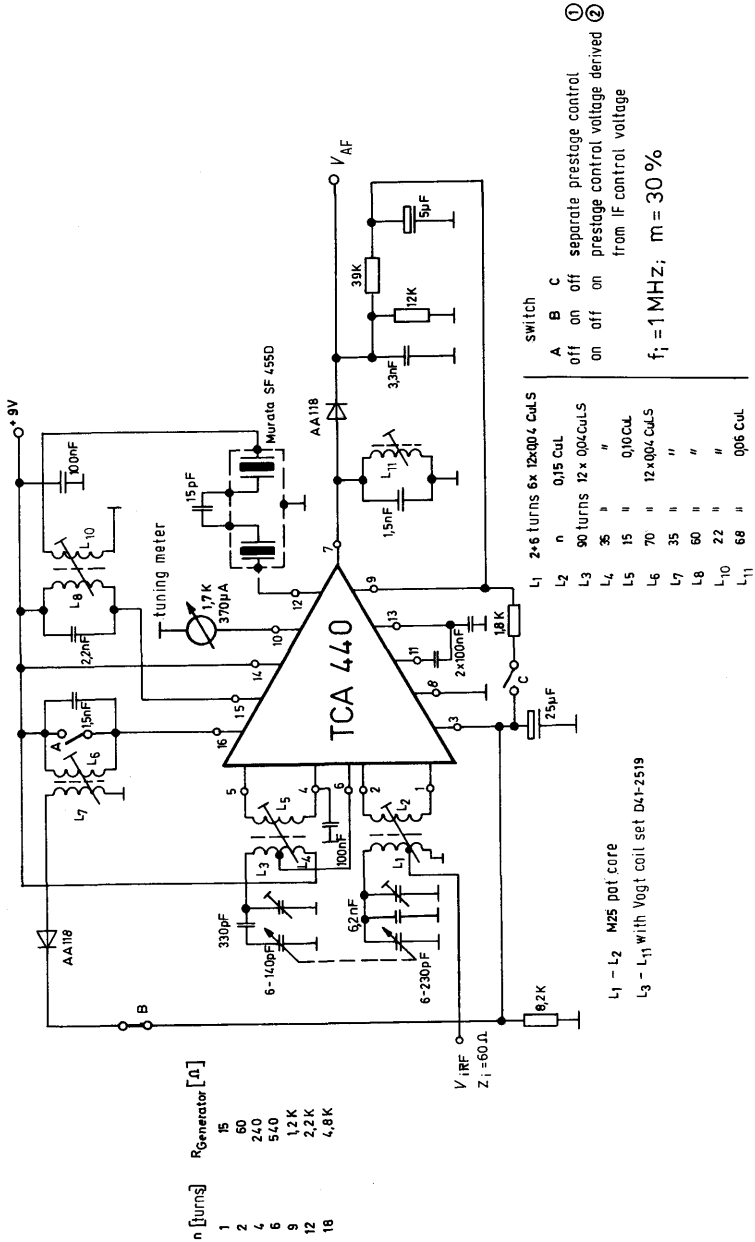
**Harmonic distortion versus detuning**
**(parameter is modulation frequency)**
$V_{cc}$ = 9 V, $f_{osc}$ = 1.455 MHz ± $\Delta f$, $m$ = 30%,
$f_I$ = 1 MHz, $f_{IF}$ = 455 kHz, $V_{IRF}$ = 20 $mV_{eff}$



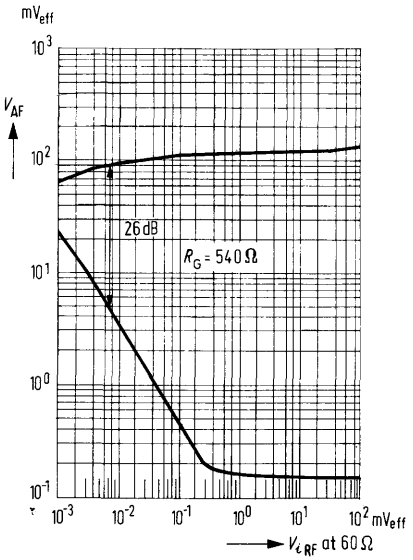

**Harmonic distortion versus detuning**
**(parameter is RF input voltage)**
$V_{cc}$ = 9 V, $f_{osc}$ = 1.455 MHz ± $\Delta f$, $m$ = 30%,
$f_I$ = 1 MHz, $f_{IF}$ = 455 kHz, $V_{IRF}$ = 20 $mV_{eff}$



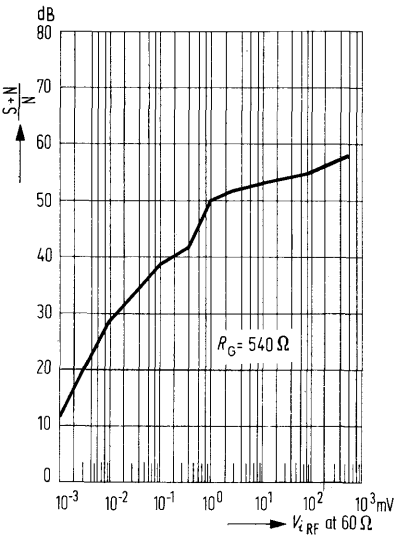
## Test circuit for noise figure



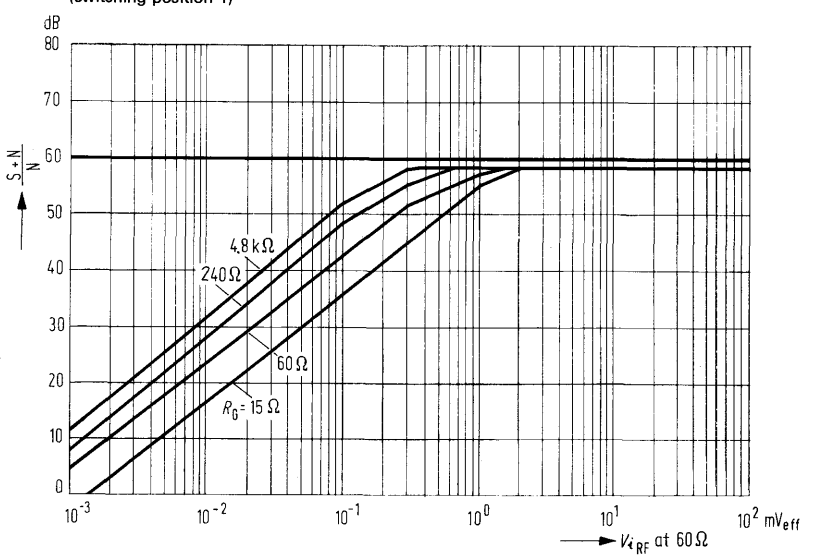
**AF output voltage and noise figure v. RF input voltage**
(switching position 1)




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

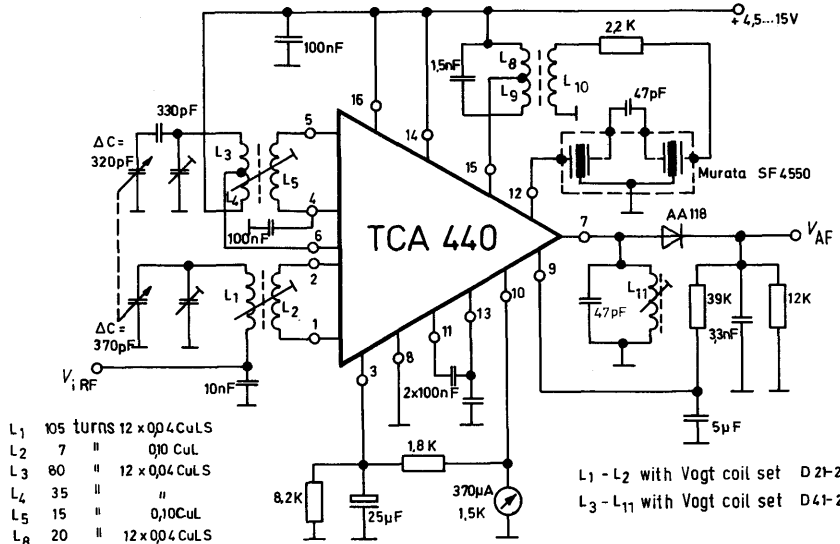



**Signal to noise distance v. RF input voltage**
(parameter is generator impedance)
(switching position 1)



### Application example for MW

Prestage control is derived from IF control

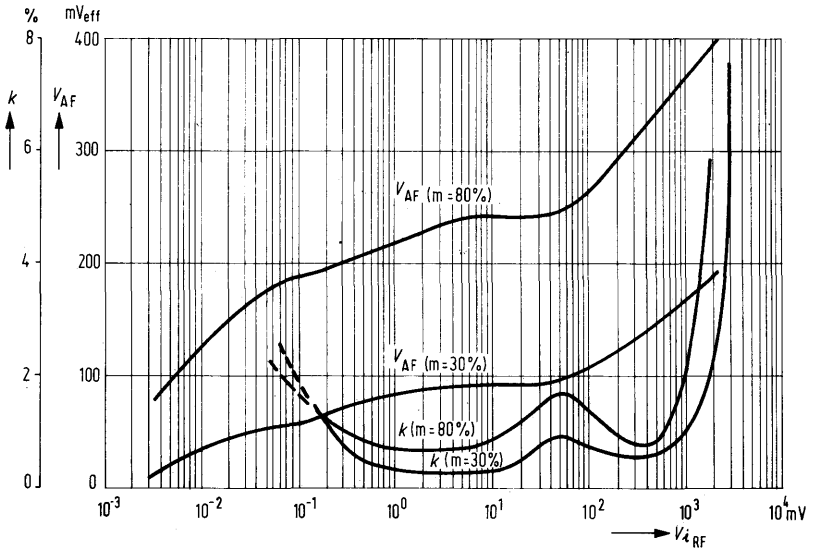



| | | | |
|---|---|---|---|
| $L_1$ | 105 | turns | 12 x 0,04 CuLS |
| $L_2$ | 7 | " | 0,10 CuL |
| $L_3$ | 80 | " | 12 x 0,04 CuLS |
| $L_4$ | 35 | " | " |
| $L_5$ | 15 | " | 0,10CuL |
| $L_8$ | 20 | " | 12 x 0,04 CuLS |
| $L_9$ | 50 | " | " |
| $L_{10}$ | 22 | " | " |
| $L_{11}$ | 400 | " | 0,04 CuL |

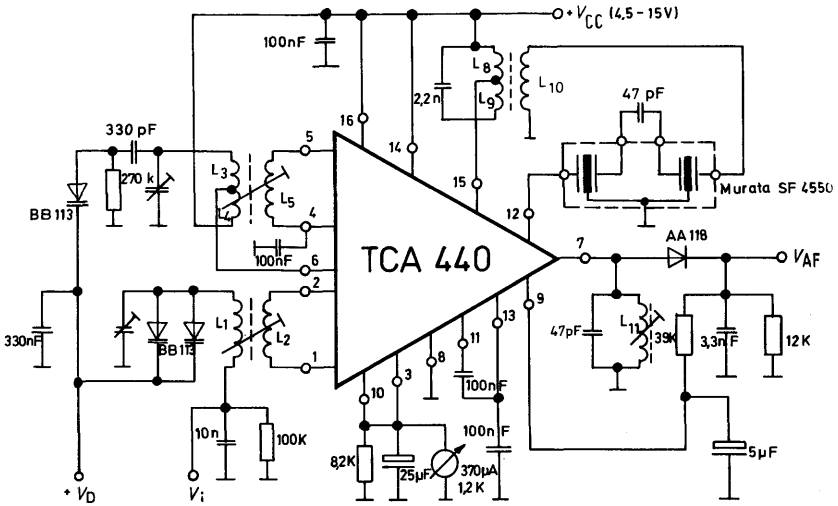
$L_1$ - $L_2$ with Vogt coil set D 21-2375.1

$L_3$ - $L_{11}$ with Vogt coil set D 41-2519

**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 MHz, $f_{mod}$ = 1 kHz, $f_{IF}$ = 455 kHz, $V_{cc}$ = 9 V



## Application example for MW using varicap diodes BB 113

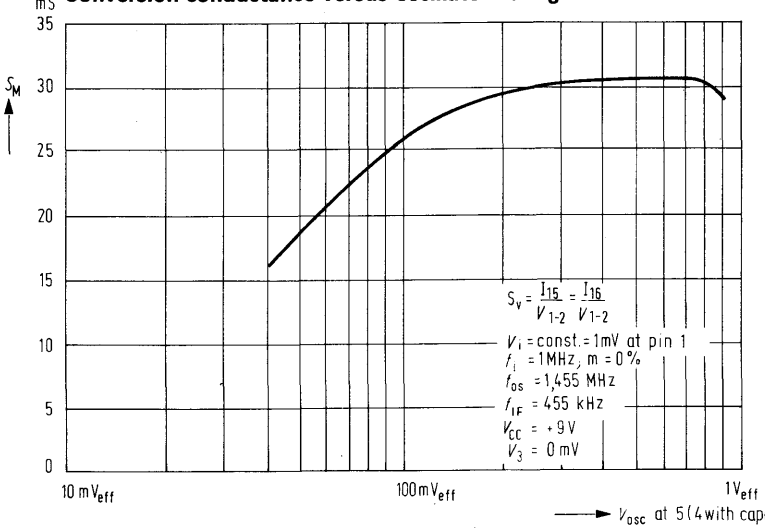



| | | | |
|---|---|---|---|
| $L_1$ | 105 | turns | 12 x0,04 CuLS |
| $L_2$ | 7 | " | 0,10 CuL |
| $L_3$ | 80 | " | 12x0,04 CuLS |
| $L_4$ | 35 | " | " |
| $L_5$ | 15 | " | 0,10CuL |
| $L_8$ | 20 | " | 12 x 0,04 CuLS |
| $L_9$ | 50 | " | " |
| $L_{10}$ | 22 | " | " |
| $L_{11}$ | 400 | " | 0,06 CuL |

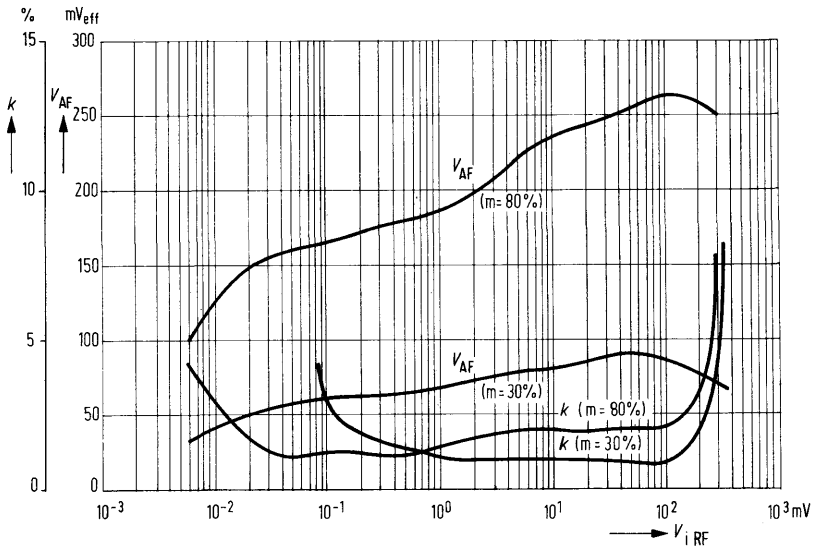
$L_1$ – $L_2$ with Vogt. coil set D 21-2375 1
$L_3$ – $L_{11}$ with Vogt coil set D 41-2519

$V_D$ =8,5V ⟶ $f_i$ = 800 kHz
$V_D$ = 30V ⟶ $f_i$ = 1620 kHz

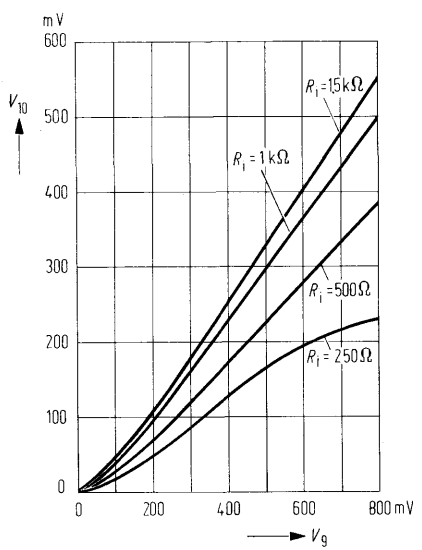
### Conversion conductance versus oscillator voltage



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

| $R_i$ for full-scale deflection | |
|---|---|
| 1.5 kΩ | 100 µA |
| 1.5 kΩ | 170 µA |
| 2 kΩ | 200 µA |
| 350 Ω | 500 µA |