TCA 440-N

## DESCRIPTION

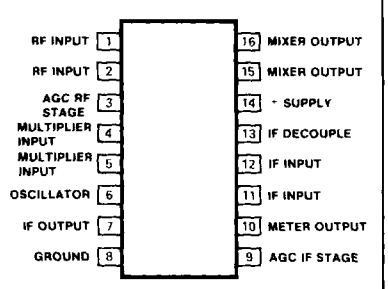
TCA440 is a monolithic IC, especially developed for AM receivers up to 50MHz. It includes a RF stage with AGC, a balanced mixer, separate oscillator and an IF amplifier with AGC. Because of its low current consumption and of its internal stabilization the TCA440 is perfectly suited for battery operated portables, car and home radios.

## FEATURES

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

## PIN CONFIGURATION

N PACKAGE

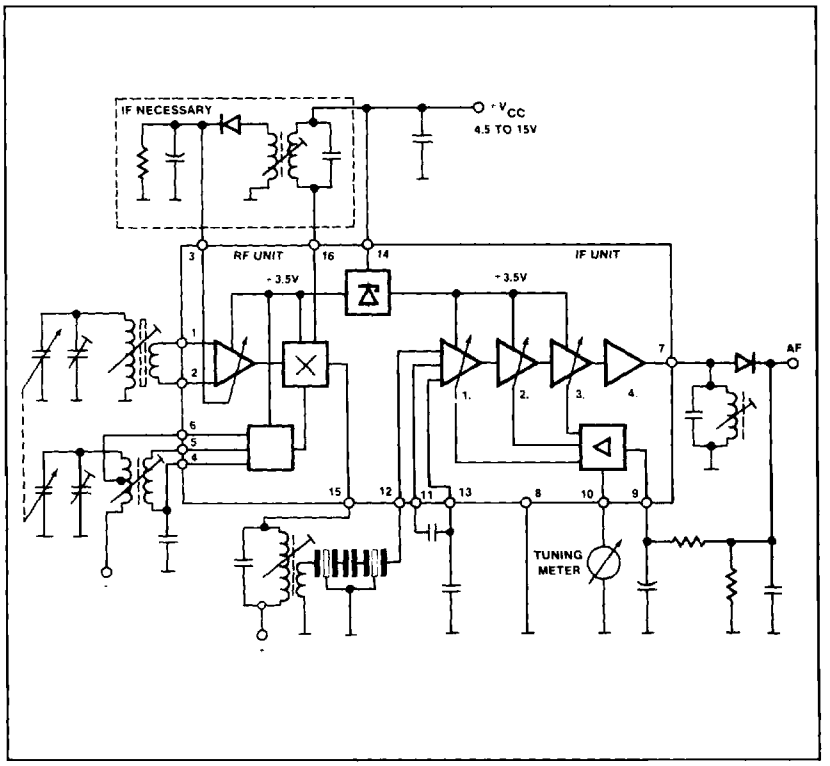



ORDER PART NO.
TCA440N

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER | | RATING | UNIT |
|---|---|---|---|
| $V_{CC}$ | Supply voltage | 15 | V |
| $T_{amb}$ | Ambient temperature in operation | -15 to +80 | °C |
| $T_s$ | Storage temperature | -30 to +125 | °C |
| $V_{CC}$ | Range of operation | 4.5 to 15 | V |

## BLOCK DIAGRAM




## TUNING METER

Recommended instruments:

or $500\mu A$ ($R_I = 800k\Omega$)
$300\mu A$ ($R_I = 1.5k\Omega$)

The IC offers at pin 10 a tuning meter voltage of 600 $mV_{EMF}$ max. with a source impedance of approx. 400Ω.

## FUNCTION

As pictured in the circuit diagram the TCA440 comprises two control loops independent of each other which control the RF stage and the IF stages. By AGCing the RF stage, excellent signal handling is obtained. A voltage of $2.6V_{pp}$ on the IC input can be handled with very low distortion. The push-pull mixer operates multiplicatively, thereby resulting in few harmonic mixing products and whistling points. The oscillator which is separated from the mixer is also apted excellently for short waves. From the AGC of the RF amplifier a voltage is derived for a tuning meter which can be connected directly to the meter. The symmetric composition of the circuit provides high stability against oscillation and, at the same time, an AGC range of more than 100dB. The bridge circuit of the mixer provides good isolation of the oscillator.

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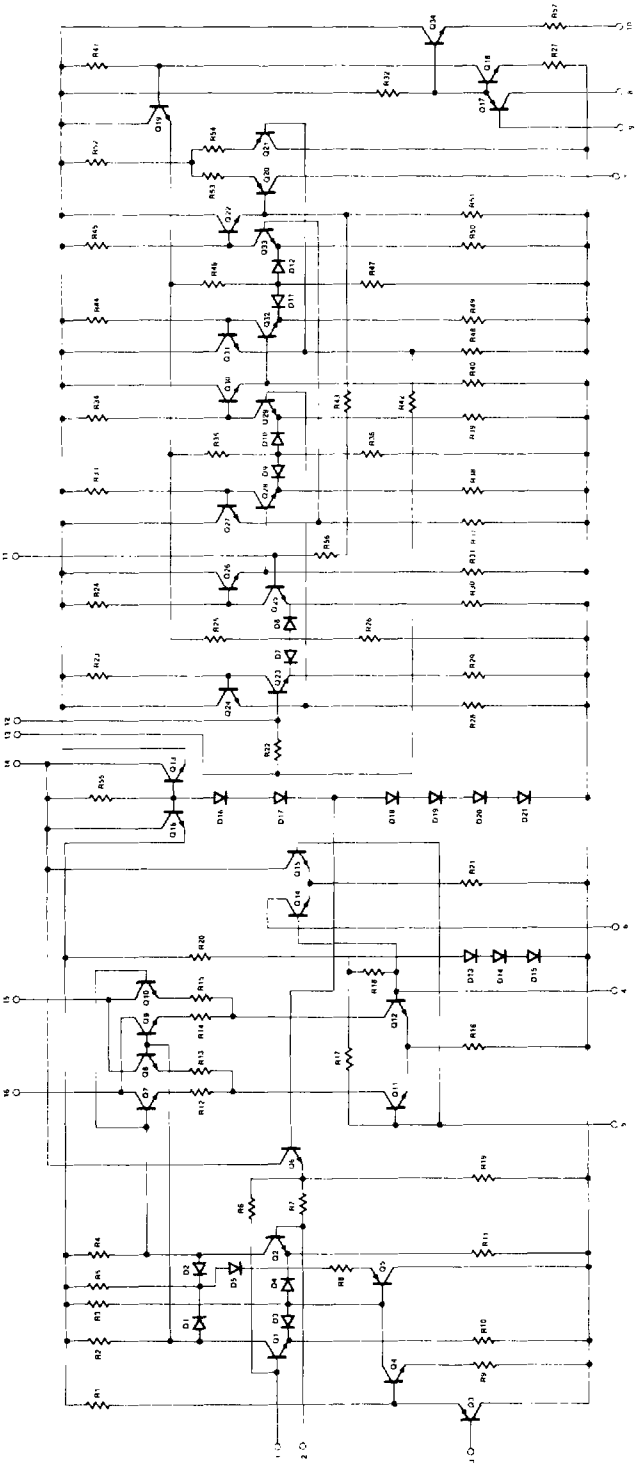
## EQUIVALENT SCHEMATIC



TCA 440-N

## DC ELECTRICAL CHARACTERISTICS $V_{CC}$ = 9V, $T_A$ = 25°C unless otherwise specified.

| PARAMETER | | TEST CONDITIONS | TCA 440 | | | UNIT |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| $I_{CC}$ | Total current consumption at: | $V_{CC}$ = 4.5V | | 7 | | mA |
| | | $V_{CC}$ = 9V | | 10.5 | | mA |
| | | $V_{CC}$ = 15V | | 12 | | mA |

## AC ELECTRICAL CHARACTERISTICS $V_{CC}$ = 9V, $T_A$ = 25°C, $f_{IRF}$ = 600kHz, fmod = 1kHx unless otherwise specified.

| PARAMETER | | TEST CONDITIONS | TCA 440 | | | UNIT |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| $\Delta G_{RF}$ | RF level deviation for (m = 80%) | $\Delta V_{AF}$ = 6dB | | 65 | | dB |
| | | $\Delta V_{AF}$ = 10dB | | 80 | | dB |
| $V_{AFeff}$ | AF output voltage for $V_{IRF}$ (symm. measured at 1-2) | m = 80% $V_{IRF}$ = 20µV | | 140 | | mV |
| | | $V_{IRF}$ = 1mV | | 260 | | |
| | | $V_{IRF}$ = 500mV | | 350 | | |
| | | m = 30% $V_{IRF}$ = 20µV | | 50 | | mV |
| | | $V_{IRF}$ = 1mV | | 100 | | |
| | | $V_{IRF}$ = 500mV | | 130 | | |
| $V_{IRF}$ | Input sensitivity (measured at 60Ω, $f_{IRF}$ = 1MHz, m = 30%/0%, $R_G$ = 540Ω) | At signal-to-noise distance | | | | |
| | | $\frac{S+N}{N}$ = 6dB | | 1 | | µV |
| | | $\frac{S+N}{N}$ = 26dB | | 7 | | µV |
| | | $\frac{S+N}{N}$ = 58dB | | 1 | | mV |
| RF unit | | | | | | |
| $f_{IRF}$ | Input frequency range | | | 0 to 50 | | MHz |
| $f_{IF}$ | Output frequency | $f_{IF} = f_{OSC} - f_{IRF}$ | | 460 | | kHz |
| $\Delta G_V$ | Control range | | | 38 | | dB |
| $V_{IRFpp}$ | Input voltage | for 600kHz, m = 80%, for Overdrive, $k_{AF}$ = 10%, Symmetrically measured at pins 1 & 2 (mean carrier value) | | 2.6 | | Vpp |
| $V_{IRFeff}$ | | | | .5 | | V |
| $s_{IF}$ | IF suppression between 1-2 to 15 | | | 20 | | dB |
| $Z_I$ | RF input impedance | Asymmetrical coupling at: | | | | |
| | | $G_{RFmax}$ | | 2/5 | | kΩ/pF |
| | | $G_{RFmin}$ | | 2.2/1.5 | | kΩ/pF |
| | | Symmetrical coupling at: | | | | |
| | | $G_{RFmax}$ | | 4/5 | | kΩ/pF |
| | | $G_{RFmin}$ | | 4.5/1.5 | | kΩ/pF |
| $Z_{gosc}$ | Mixer output impedance | Pins 15 or 16 | | 250/4.5 | | kΩ/pF |
| IF unit | | | | | | |
| $f_{IIF}$ | Input frequency range | | | 0 to 2 | | MHz |
| $\Delta G_V$ | Control range at 460kHz | | | 62 | | dB |
| $V_{IFeff}$ | Input voltage | Mean carrier value at $G_{min}$ for Overdrive ($k_{AF}$ = 10%), measured at Pin 12 (60Ω to ground, $f_{IF}$ = 460kHz, m = 80%, $f_{mod}$ = 1kHz) | | 200 | | mV |
| $V_{AFeff}$ | AF output voltage | $V_{IIF}$ at 60Ω (Pin 12) $f_{mod}$ = 1kHz | | | | |
| | | $V_{IF}$ = 30µV, m = 80% | | 50 | | mV |
| | | $V_{IF}$ = 3mV, m = 80% | | 200 | | mV |
| | | $V_{IF}$ = 3mV, m = 30% | | 70 | | mV |
| $Z_I$ | IF input impedance | Asymmetrical coupling | | 3/3 | | kΩ/pF |
| $Z_g$ | IF output impedance | Pin 7 | | 200/8 | | kΩ/pF |

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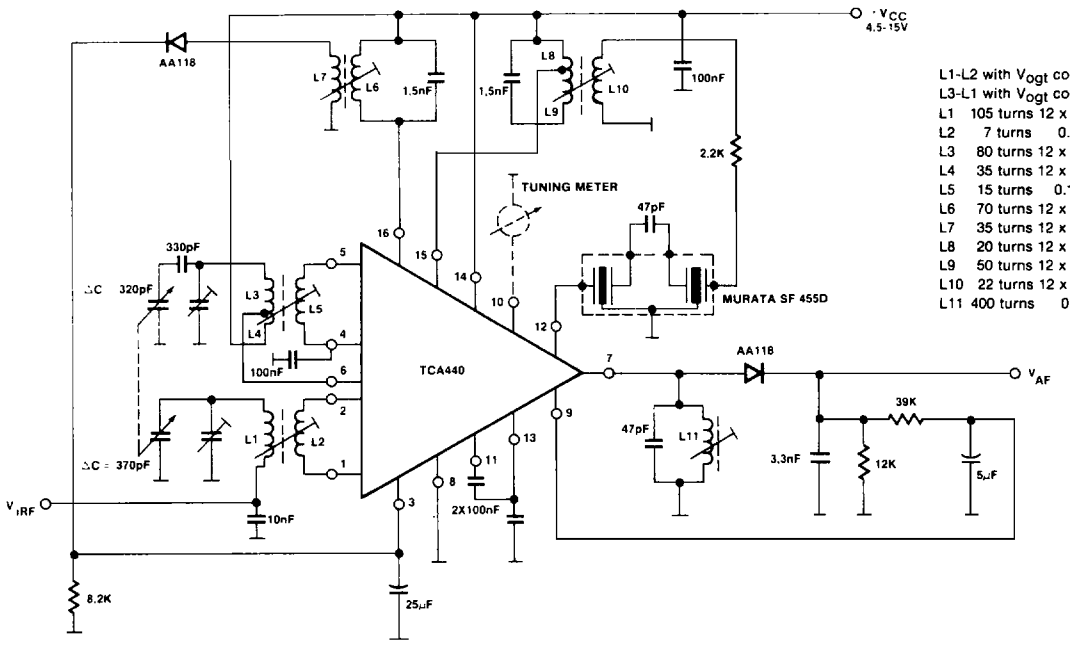
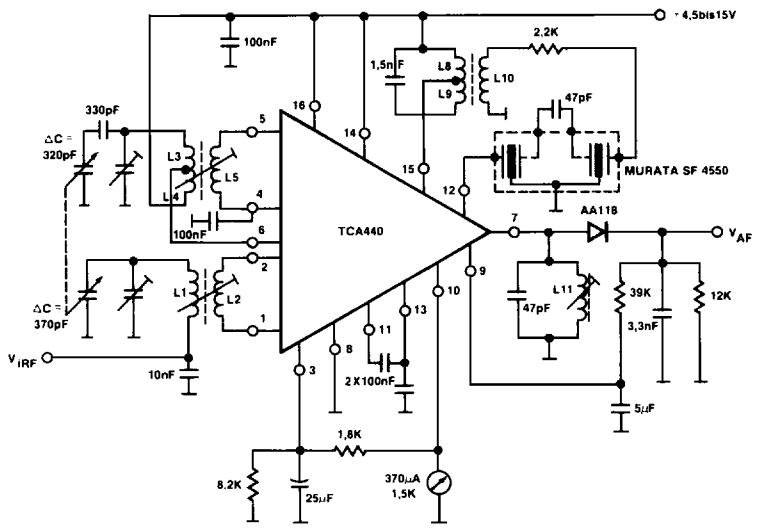
## TYPICAL APPLICATIONS

### APPLICATION EXAMPLE FOR MW




L1-L2 with $V_{ogt}$ coil set D21-2375.1
L3-L1 with $V_{ogt}$ coil set D41-2519
L1 105 turns 12 x 0.04 CuLS
L2 7 turns 0.10 CuL
L3 80 turns 12 x 0.04 CuLS
L4 35 turns 12 x 0.04 CuLS
L5 15 turns 0.10 CuL
L6 70 turns 12 x 0.04 CuLS
L7 35 turns 12 x 0.04 CuLS
L8 20 turns 12 x 0.04 CuLS
L9 50 turns 12 x 0.04 CuLS
L10 22 turns 12 x 0.04 CuLS
L11 400 turns 0.06 CuL

### APPLICATION EXAMPLE FOR MW

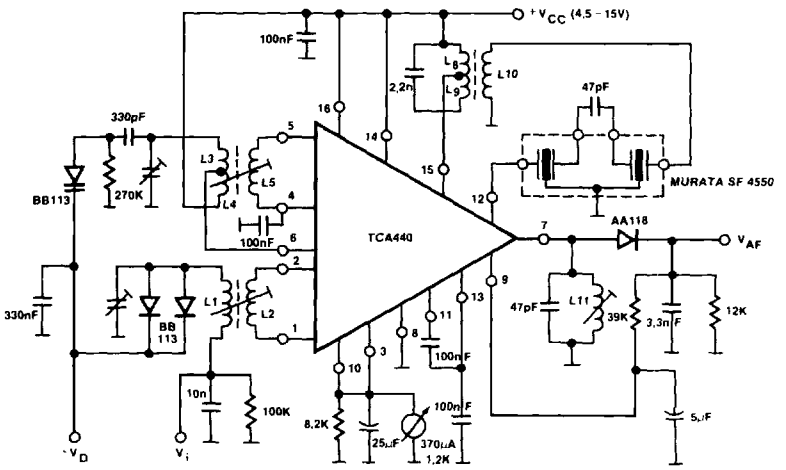



**Prestage control is derived from IF control**

L1 105 turns 12 x 0.04 CuLS
L2 7 turns 0.10 CuL
L3 80 turns 12 x 0.04 CuLS
L4 35 turns 12 x 0.04 CuLS
L5 15 turns 0.10 CuL
L8 20 turns 12 x 0.04 CuLS
L9 50 turns 12 x 0.04 CuLS
L10 22 turns 12 x 0.04 CuLS
L11 400 turns 0.04 CuL
L1-L2 with $V_{ogt}$ coil set D21-23751
L3-L11 with $V_{ogt}$ coil set D41-2519

## TYPICAL APPLICATIONS (Cont'd)

### APPLICATION EXAMPLE FOR AM USING VARICAP DIODES BB 113

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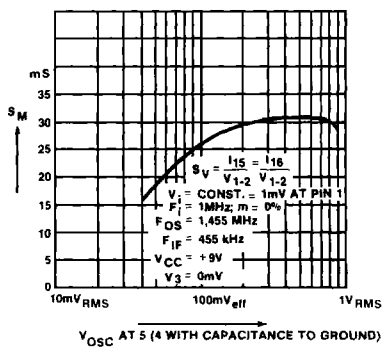
L5 15 turns 0.10 CuL
L8 20 turns 12 x 0.04 CuLS
L9 50 turns 12 x 0.04 CuLS
L10 22 turns 12 x 0.04 CuLS
L11 400 turns 0.06 CuL

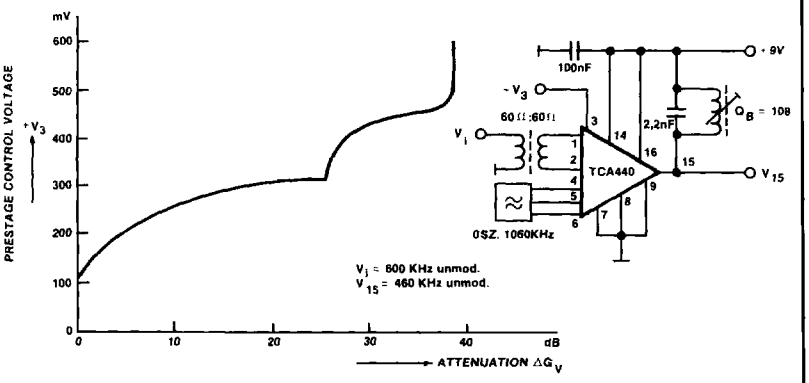
L1-L2 with Vogt coil set D21-23751
L3-L11 with Vogt coil set D41-2519

$V_D$ = 8.5V→$f_i$ = 800kHz
$V_D$ = 30V→$f_i$ = 1620kHz

### CONVERSION CONDUCTANCE vs OSCILLATOR VOLTAGE



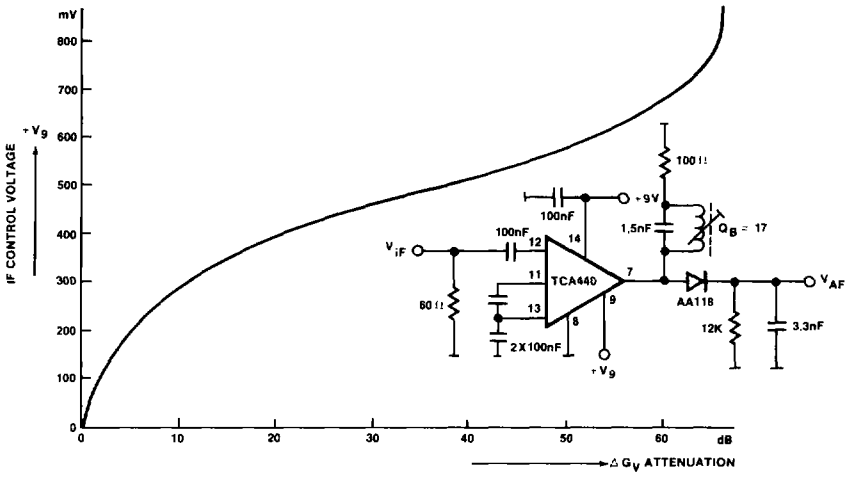

### RF STAGE CONTROL




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 (50mV$_{pp}$).

## TYPICAL APPLICATIONS (Cont'd)

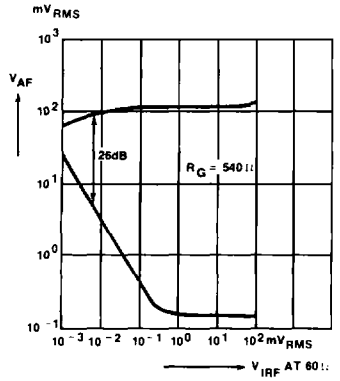
### IF CONTROL



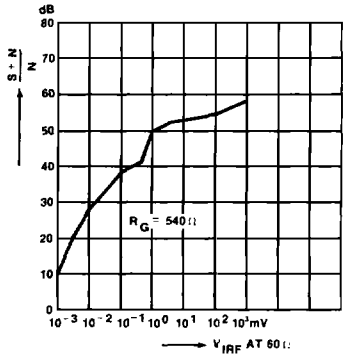

$V_{IF}$ (469kHz; $m$ = 80%; $f_{mod}$ = 1kHz) is chosen so that always a constant $V_{AF}$ is obtained (200mV$_{RMS}$)

## TYPICAL PERFORMANCE CHARACTERISTICS

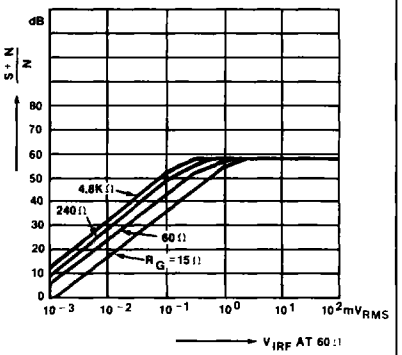
**AF OUTPUT VOLTAGE AND NOISE FIGURE vs RF INPUT VOLTAGE (switching position 1)**




**SIGNAL TO NOISE DISTANCE vs RF INPUT VOLTAGE (switching position 2)**

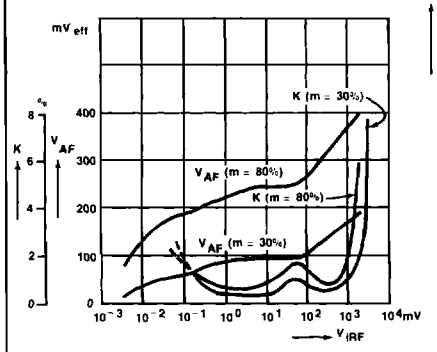



**SIGNAL TO NOISE DISTANCE vs RF INPUT VOLTAGE (parameter is generator impedance) (switching position 1)**

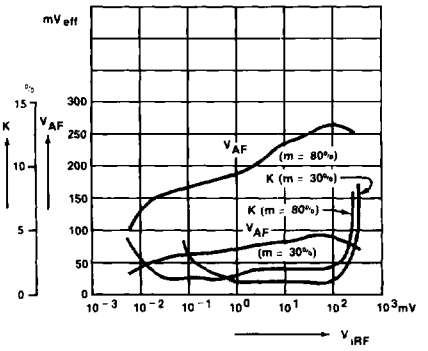


## TYPICAL PERFORMANCE CHARACTERISTICS (Cont'd)

**TEST FIGURES FOR APPLICATION EXAMPLE FOR MW HARMONIC DISTORTION AND AF OUTPUT VOLTAGE vs RF INPUT VOLTAGE MEASURED SYMMETRICALLY AT PINS 1 AND 2 $f_i$ = 1MHz, $f_{mod}$ = 1kHz, $f_{IF}$ = 455kHz, $V_{CC}$ = 9V**



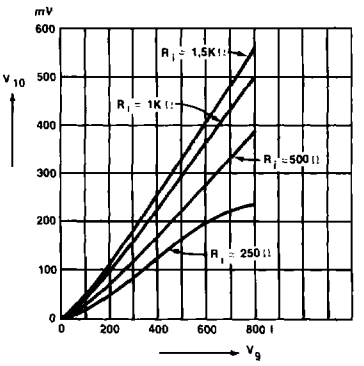

**TEST FIGURES FOR APPLICATION EXAMPLE FOR AM USING BB 113 $f_i$ = 1MHz, $f_{mod}$ = 1kHz, $f_{IF}$ = 455 kHz, $V_{CC}$ = 9V, $V_{IRF}$ measured symmetrically at pins 1 and 2**




Example for moving coil instruments

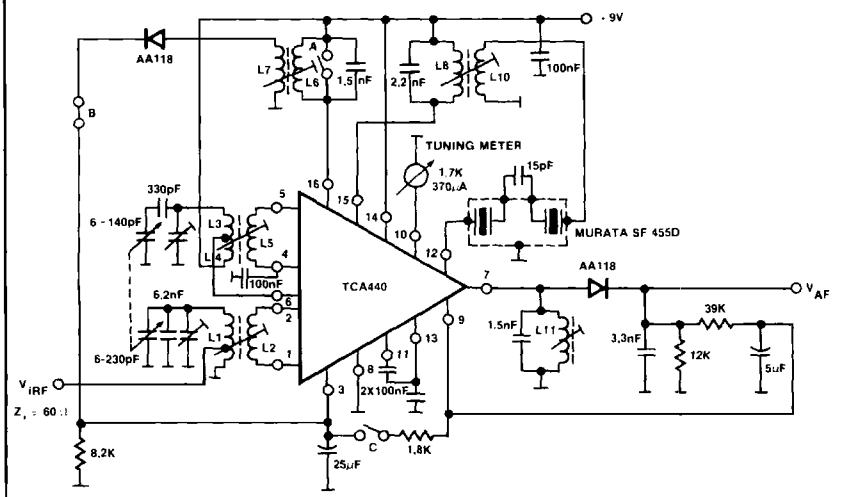
| $R_i$ for full-scale deflection | |
|---|---|
| 1.5kΩ | 100μA |
| 1.5kΩ | 170μA |
| 2kΩ | 200μA |
| 350Ω | 500μA |

**TUNING METER VOLTAGE vs IF CONTROL VOLTAGE (parameter is impedance of tuning meter)**




## TEST CIRCUITS

**TEST CIRCUIT FOR NOISE FIGURE**




L1-L2 M25 *pot core*
L3-L11 with Vogt coil set D41-2519

| | | |
|---|---|---|
| L1 | 2 + 6 | turns 6 x 12 x 0.04 CuLS |
| L2 | n | 0.15 CuL |
| L3 | 90 | turns 12 x 0.04 CuLS |
| L4 | 35 | turns 12 x 0.04 CuLS |
| L5 | 15 | turns 0.10 CuL |
| L6 | 70 | turns 12 x 0.04 CuLS |
| L7 | 35 | turns 12 x 0.04 CuLS |
| L8 | 60 | turns 12 x 0.04 CuLS |
| L10 | 22 | turns 12 x 0.04 CuLS |
| L11 | 68 | turns 0.06 CuL |

| switch A | switch B | switch C | |
|---|---|---|---|
| off | on | off | separate RF stage control |
| on | off | on | RF stage control voltage derived from IF control voltage |

$f_i$ = 1MHz; m = 30%

| n(turns) | $R_{Generator}(\Omega)$ |
|---|---|
| 1 | 15 |
| 2 | 60 |
| 4 | 240 |
| 6 | 540 |
| 9 | 1,2K |
| 12 | 2,2K |
| 18 | 4,8K |