Erich Zimmermann, HB 9 MIN

A Simple dB-Linear S-Meter for Microwave Applications

The runaway development of integrated circuits for the mobile radio sector also means more and more new and useful modules are being showered on radio amateurs. Thus, for instance, integrated intermediate frequency circuits for cellular applications have characteristics which make it possible to display reception levels on a dB-linear scale.

1. SUMMARY

Available for selection are the MC 3356P from Motorola and the NE 604 AN and NE 605 AN from Signetics-Philips. The wiring required by the Motorola module is extremely simple and problem-free.

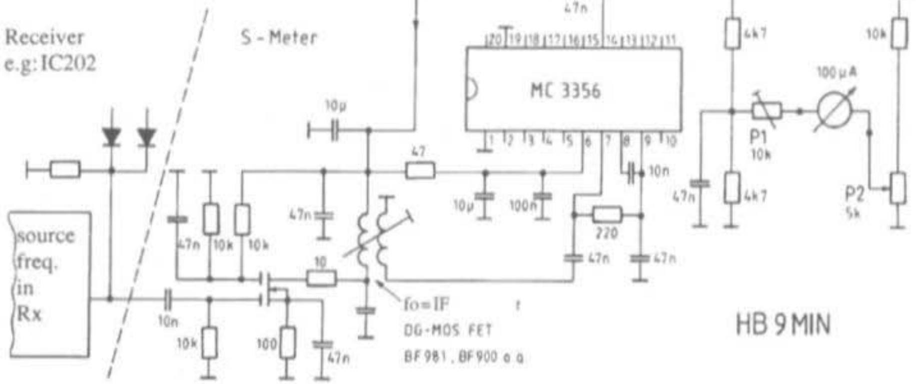

Fig.1

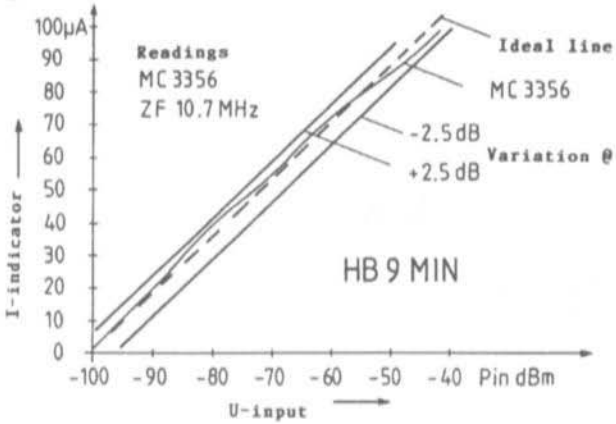

Fig.2:

The wide dynamic range provides for 70dB at 10.7 MHz, and still gives 58dB at 21.4 MHz, with an error of ±1 dB.

The two integrated circuits from Signetics-Philips, NE 604 AN and NE 605 AN, are even designed for 85dB dynamics with an error of ±2 dB. Unfortunately, the wiring required is more expensive, since an additional intermediate-frequency filter is needed.

The signal is passed on to pin-7 of the MC 3356P. For correct operation, the input voltage range lies between 30µV (-77dBm) and 80mV (-1dBm), measured at pin-20. From pin-14, the output signal goes through a voltage divider and a pre-resistance and arrives at the indicator. With the given circuit, a range of 50dB can be displayed linearly on an indicator with a full-scale reading of 100µA. The gradient is thus 2µA/dB (Fig.2).

2. DESCRIPTION OF CIRCUIT

The circuit shown here with the MC 3356P operates in the broad band, from approximately 5 MHz to 22 MHz. Only the input circuit of the pre-amplifier has to be in resonance with the intermediate frequency.

The intermediate-frequency signal is transmitted from the crystal filter of the adjuster to the MOS-FET pre-amplifier (Fig.1). The latter has to amplify the signal and simultaneously minimise the load of the crystal filter. The drain oscillation circuit is tuned to the intermediate frequency in use.

3. PRE-TUNING

1. An intermediate-frequency signal is fed in to pin-7 at -70dBm. The indicator is set precisely to 0µA using potentiometer P2.

2. Raise the signal level to -20dBm and tune the indicator deflection to 100µA (full-scale reading). The linearity is controlled by reducing the signal in 10dB stages.

Should it not be possible to calibrate, P1 can be replaced by an 8.2kΩ resistor.

4. INSTRUCTIONS FOR ASSEMBLY

❶ The completed circuit should be pre-tuned and tested for correct operation before assembly, together with the indicator, using a standard signal generator and a reducer (corresponding to 3).

❷ The signal for the S-meter is drawn off after the SSB crystal filter. To keep the additional capacity load low, a UHF-FET with a small Cg1S should be used.

❸ The MOS-FET amplifier should be mounted in close proximity to the crystal filter. Using the SMD technique for assembly is advantageous. The remaining part of the circuit is placed in a free corner of the equipment and connected by means of thin coaxial cable.

❹ No AGC stages should be present between the RX input and the S-meter. Should there be an AGC, disconnect it and replace it by fixed voltages.

❺ The display range of the S-meter incorporated into the RX is dependent on the amplification of the equipment between the aerial socket and the crystal filter output.

Examples of MOS-FET stages:

AGC prior to G1; now connect G1 at 0 V DC.

AGC prior to G2; now connect G2 (DC), at about 4 V higher than the voltage connected to the source (measured against the earth).

5. FINAL TUNING

❶ The built-in S-meter is now adjusted to the equipment. The output circuit of the S-meter pre-amplifier is tuned to the maximum reading by means of a test signal at the receiver input.

❷ Now increase the input signal in 10 dB stages until the indicator registers 100 micro-A as precisely as possible. Set the pointer to full-scale reading (100 micro-A) using P2. The linearity is checked by reducing the input signal. Finally the equipment is marked with an appropriate scale.

❸ Example: a signal of -80dBm gives, e.g., 96µA. So this is corrected to 100µA using P2. Thus we can obtain: 100µA = -80dBm, 80µA = -90dBm, 60µA = -100dBm.

6. LITERATURE

(1) Specification sheet MC 3356 from Motorola

(2) Specification sheet NE 604 / NE 605 from Signetics / Philips