BESCHREIBUNG

SELEKTIVES MIKROVOLTMETER

Type USVH BN 1521

ENGLISH INSTRUCTION BOOK
see page 83

Anmerkung: Wir bitten, bei technischen Anfragen, insbesondere bei der Anforderung von Ersatzteilen, außer der Type und Bestellnummer (BN) immer auch die Fabrikationsnummer (FNr.) des Gerätes anzugeben.

Ausgabe 1521 A/367 d/e
Printed in Western Germany

1. Specifications

Frequency range . . . . 10 kHz to 30 MHz

in 6 ranges . . . .

10 to 100 kHz	1 to 3 MHz
100 to 300 kHz	3 to 10 MHz
300 to 1000 kHz	10 to 30 MHz

(100 kHz to 30 MHz at 5-kHz IF bandwidth)

Frequency accuracy

10 kHz to 1 MHz . . . . ±2% ±3 kHz
1 MHz to 30 MHz . . . . ±2% ±50 kHz

Incremental frequency control in narrow-band operation at 500-Hz IF bandwidth . . . . –2.5 to 0 to +2.5 kHz

Voltage and level ranges . . . . 0.2 µV to 1 V or –134 to +2 dB

in 13 ranges, the frequency range being restricted

Voltage		Level	Frequency range
300 to 1000 mV	or	–20 to +2 dB	10 kHz ... 30 MHz / 20 kHz ... 30 MHz / 30 kHz ... 30 MHz
100 to 300 mV		–30 to –8 dB	10 kHz ... 30 MHz / 20 kHz ... 30 MHz / 30 kHz ... 30 MHz
30 to 100 mV		–40 to –18 dB	10 kHz ... 30 MHz / 20 kHz ... 30 MHz / 30 kHz ... 30 MHz
10 to 30 mV		–50 to –28 dB	10 kHz ... 30 MHz / 20 kHz ... 30 MHz / 30 kHz ... 30 MHz
3 to 10 mV		–60 to –38 dB	10 kHz ... 30 MHz / 20 kHz ... 30 MHz / 30 kHz ... 30 MHz
1 to 3 mV		–70 to –48 dB	10 kHz ... 30 MHz / 20 kHz ... 30 MHz / 30 kHz ... 30 MHz
0.3 to 1 mV		–80 to –58 dB	10 kHz ... 30 MHz / 20 kHz ... 30 MHz / 30 kHz ... 30 MHz
100 to 300 µV		–90 to –68 dB	10 kHz ... 30 MHz / 20 kHz ... 30 MHz / 30 kHz ... 30 MHz
30 to 100 µV		–100 to –78 dB	10 kHz ... 30 MHz / 20 kHz ... 30 MHz / 30 kHz ... 30 MHz
10 to 30 µV		–110 to –88 dB	20 kHz ... 30 MHz / 30 kHz ... 30 MHz
3 to 10 µV		–120 to –98 dB	20 kHz ... 30 MHz / 30 kHz ... 30 MHz
1 to 3 µV		–130 to –108 dB	30 kHz ... 30 MHz
0.2 to 1 µV		–134 to –118 dB	30 kHz ... 30 MHz

Scale expansion . . . . relative calibration 7 to 10

Voltage accuracy at 1 MHz and 1 V . . ±3%, after calibration

Frequency response referred to 1 MHz

20 kHz to 10 MHz . . . . ±5%
10 kHz to 30 MHz . . . . ±10%

Attenuation accuracy . . . . ±2%

IF bandwidth, selectable . . . . 500 Hz or 5 kHz
(5 kHz between 100 kHz and 30 MHz only)

Image frequency rejection . . . . . . > 60 dB

Selectivity at twice the bandwidth from centre frequency

at 500-Hz IF bandwidth	down 35 dB, approx.
at 5-kHz IF bandwidth	down 50 dB, approx.

Noise voltage at 500-Hz IF bandwidth and tuning

to $f > 50$ kHz	0.15 µV, approx.	at a generator output impedance of less than 1 kΩ
to $f < 50$ kHz	0.25 µV, approx.	
at 5 kHz IF bandwidth	0.45 µV, approx.	

Input	13-mm coaxial socket
Input impedance	50 Ω, 60 Ω, 75 Ω, 150 Ω, 600 Ω and 500 kΩ shunted by 20 pF, switch-selected
AF output	2 telephone jacks
Output impedance	6 kΩ, approx.
Output voltage at full-scale deflection	1 V, approx. at 30% modulation
Power supply	115/125/220/235 V ±10% 47 to 63 Hz (85 VA)
Valves, etc.	1 valve E 180 F 1 valve CC 903 4 valves ECC 801 S 4 valves EF 800 1 valve EF 805 S 1 valve EF 806 S 2 valves PL 81 1 reference tube 85 A 2 1 fuse 0.4 A; M 0,4 C DIN 41571 (for 220/235 V) 1 miniature glow lamp RL 210
Dimensions	540 x 268 x 378 mm (R&S Standard Cabinet 57)
Weight	30 kg

2. Uses

Exceptionally high sensitivity and selectivity make the Selective Microvoltmeter Type USVH useful for a great number of measurements for which up to now an instrument of similar type was either unsuitable or could be employed only in conjunction with auxiliary units. A few examples of possible applications are:

(a) Selective attenuation and frequency-response measurements of 4-terminal networks up to about 130 dB. Type USVH is particularly useful when only small voltages can be applied to the item under test.

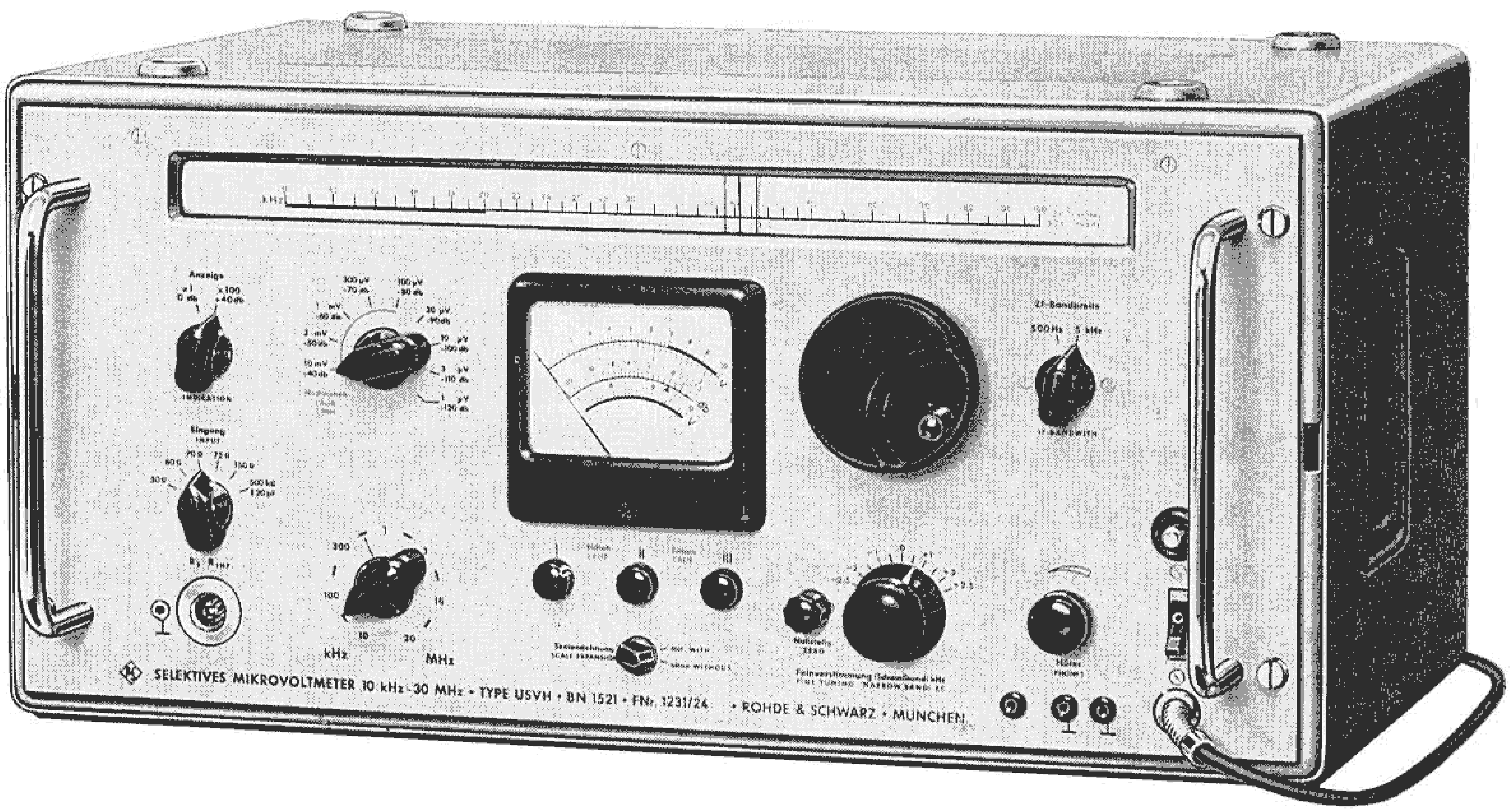


Fig. 1 Front view of the Selective Microvoltmeter Type USVH

(b) Selective frequency-response measurements of amplifiers and filters in the pass band. An expanded scale calibrated 7 to 10 offers easy reading of very small output-voltage variations of the network under measurement.

(c) Measurement of RF distortion in LF, MF and HF signal generators. Although in comparison with attenuation measurements the range is narrowed down by the inherent distortion of the instrument, harmonic distortion is measurable down to 0.1% or 60 dB.

(d) Modulation depth measurement at carrier frequencies of 10 kHz to 30 MHz and modulation frequencies above 1 kHz. Measurement of the amplitude of the carrier and of the amplitudes of the sidebands enables the modulation depth in % to be calculated in a simple manner. See section 3.9.4. Here, a particular advantage is the incremental tuning facility, a separate scale permitting the tuning to be varied by ± 2.5 kHz for any carrier frequency. A modulation depth down to 10% can be measured at a modulation frequency of 1 kHz. At higher modulation frequencies smaller modulation depths are measurable.

(e) The modulation distortion can be determined by measuring the amplitudes of a sideband; see section 3.9.3. Modulation distortion is measurable down to 0.5%.

(f) Measurement of inter-channel cross-talk attenuation in carrier-frequency systems.

(g) Testing of attenuators in signal generators down to 10 μV with an accuracy of ± 2%. Particularly in the short-wave range, these measurements have up to now been possible only by comparison with calibrated attenuators.

(h) Measurement of conversion transconductance directly at the anode of a mixer valve. The high selectivity of Type USVH permits such measurements to be made even at a relatively high oscillator voltage and low signal voltage. Type USVH gives correct reading of the amplitudes of the difference frequencies without requiring an input filter.

(i) RF leakage measurements of shieldings or RF chokes. Voltages down to fractions of one microvolt are easily detectable.

3. Preparation for Use and Operating Instructions

3.1 Adjusting to the Local AC Supply Voltage

Type USVH leaves our factory adjusted for operation from 220 V AC. For use on supply voltages of 115 V, 125 V, or 235 V, remove the chassis from its cabinet after loosening the cheese-head screws on the left and right-hand edges of the front panel. Insert a suitable fuse into the pair of clips provided on the fuse panel above the power transformer and marked with the given AC supply voltage. The 400-mA fuse used for 220 V is also suitable for 235 V. For 115 V and 125 V use a 800-mA fuse, M 0,8 C DIN 41571. Place the instrument back into its cabinet, plug in the power cord, and throw the toggle switch at the lower right of the front panel on. The miniature glow lamp above the on-off switch serves as a voltage indicator.

Note: The values given under "1. Specifications" for frequency accuracy, frequency response, etc. are obtained after a warming-up period of about one hour. Especially for measurements in the frequency ranges from 1 to 30 MHz at an IF bandwidth of 500 Hz it is necessary to wait for good stability of the local oscillator Rö10; at 30 MHz, for example, the frequency stability must be about ±0.00007% to avoid tuning drift.

3.2 Setting the Mechanical Zero on the Meter

With the instrument switched off, the pointer of the meter should be at its mechanical zero, i. e. the "0" mark of the voltage scales. The slotted shaft recessed in the meter housing enables corrections to be made.

Zero can also be checked while the instrument is switched on. In this case, care must be taken to ensure that no signal or noise voltage is applied to the diode voltmeter. To set the mechanical zero while the instrument is switched on, put the range switch to "10 mV/–40 dB", IF BANDWIDTH switch to "500 Hz", and SCALE EXPANSION switch to WITHOUT.

3.3 Calibration (see also front panel)

Three calibrations must be made to ensure that calibration is correct in the four operating ranges:

(A) Frequency ranges 100 to 1000 kHz with an IF bandwidth of 5 kHz
(B) Frequency ranges 10 to 1000 kHz with an IF bandwidth of 500 Hz
(C) Frequency ranges 1 to 30 MHz with an IF bandwidth of 5 kHz
(D) Frequency ranges 1 to 30 MHz with an IF bandwidth of 500 Hz.

During calibration set the range switch to CALIBRATION (1 MHz) and the SCALE EXPANSION switch to WITHOUT.

Calibration I

(a) Put frequency range switch to "1 TO 3 MHz";

(b) Put IF BANDWIDTH switch to "5 kHz";

(c) Set cursor of frequency dial to the range marked red at 1 MHz and tune for maximum meter deflection;

(d) With CALIBRATION I knob set the pointer of the meter to "0 dB".

Calibration II

(a) Put frequency range switch to "300 kHz TO 1 MHz";

(b) Put IF BANDWIDTH switch to "5 kHz";

(c) Set cursor of frequency dial to the range marked red at 1000 kHz and tune for maximum meter deflection;

(d) With CALIBRATION II knob set the pointer of the meter to "0 dB".

Calibration III

(a) Frequency range switch remains at "300 kHz TO 1 MHz;

(b) IF BANDWIDTH switch remains at "5 kHz";

(c) Tune for maximum meter deflection ("0 dB" as in calibration II);

(d) Put IF BANDWIDTH switch to "500 Hz";

(e) Put FINE TUNING (NARROW BAND) knob to "0 kHz";

(f) Adjust ZERO knob so that meter indicates again maximum deflection;

(g) With CALIBRATION III knob set meter pointer to "0 dB".

When the corresponding knob has to be turned through a very wide range, calibration II may somewhat influence the gain corrected by calibration I. It is therefore recommended that calibration I be checked after calibration II has been made. If necessary, the two calibrations must be repeated until the influence has become neglibible. From time to time all three calibrations should be checked since they may change a little due to AC supply fluctuations.

Not always are all three calibrations necessary. When only operating range A or C is used, calibration I is sufficient.

Note: When the instrument is calibrated shortly after switching on, the pointer of the meter will not remain at the calibration mark "0 dB", but go back slowly. This is not due to any fault in the instrument but **only** to the unavoidable warming-up period of the local oscillator Rö10. To obtain stable calibration reflection in the range 1 to 3 MHz, this oscillator must have a frequency of ±0.0025% for the 5-kHz bandwidth and of ±0.0001% for the 500-Hz bandwidth. This short-term stability can only be expected after a warming-up period of about one hour. The calibration is not affected by this frequency drift occuring during warming up, since no variation of calibration voltage is involved. It is sufficient to tune for the calibration frequency, 1 MHz, and then to adjust the CALIBRATION control for a deflection of "0 dB". When soon afterwards the deflection changes or goes back all they way, this has no influence on the calibration accuracy. It is just necessary to correct the tuning at the frequency dial to obtain the original calibration deflection.

3.4 Input Impedance

The input impedance of the instrument can be matched to the usual values of output impedances of items to be measured and of characteristic impedances of cables. The switch over the input socket provides for selection of the values 50 Ω, 60 Ω, 75 Ω, 150 Ω, and 600 Ω. In the last switch position no resistor is switched in circuit. The impedance in this position is the input impedance of the first amplifier stage. In the position "x 1/+0 dB" of the INDICATION switch, this input impedance is 500 kΩ in shunt with 20 pF. In the position "x 100/+40 dB", it is much higher, the input capacitance being about 10 pF.

3.5 IF Bandwidth of 500 Hz when f ≧ 10 kHz or of 5 kHz when f ≧ 100 kHz

The choice of the IF bandwidth depends on the required resolution. When only one frequency is present at the input of the instrument it is preferable to choose the IF bandwidth 5 kHz which enables easy tuning even at the highest frequency, 30 MHz. However, only the 500-Hz bandwidth will give sufficient resolution if there is a spectrum of closely adjacent frequencies or an amplitude-modulated voltage where the amplitudes of the carrier and the individual sidebands are to be measured. When measuring a frequency-modulated voltage (e. g. a carrier with hum modulation) it must be taken into account that the indication is dependent on the magnitude and the frequency of the deviation. The difference from the indication with unmodulated carrier is especially noticeable at an IF bandwidth of 500 Hz, since in particular at a great deviation the signal lies only for a short time in the pass band of the narrow-band filter so that only narrow pulses are indicated.

In order to obtain a stable indication after tuning for resonance in the frequency range from 1 to 30 MHz with an IF bandwidth of 500 Hz, the built-in local oscillator must have an extremely high frequency stability, from ±0.0001% to ±0.00007%. It is easily understood that in spite of carefully stabilized operating voltages and the use of precision components an oscillator variable from 41 to 70 MHz can maintain such a high frequency stability only for a short time. Even with a relatively stable supply voltage it is to be expected that for a short period of time the frequency will increase or decrease by approximately 0.0001%. With a 70-MHz oscillator frequency, for a 30-MHz input frequency, this results in a frequency drift of approximately 70 Hz, which may cause the indication to drift by several per cent:

The frequency stability of the voltage under test should be approximately 0.0001%, when measurements are to be made with a 500-Hz bandwidth and tuning drift to be avoided. Even precision signal generators do not always fulfil this requirement. However, this condition plays but a subordinate role since it does not reduce the application possibilities of Type USVH. It is just necessary to rotate the tuning control slowly through its range and to read the maximum obtainable deflection.

3.6 Fine Tuning (Narrow Band)

The knob marked FINE TUNING (NARROW BAND) is effective only at the 500-Hz IF bandwidth. It permits the tuning on the frequency dial to be varied by ±2.5 kHz. First, however, the zero of this knob must be corrected:

(a) Put frequency range switch to "300 kHz TO 1 MHz";

(b) Put voltage range switch to CALIBRATION (1 MHz);

(c) Put IF BANDWIDTH switch to "5 kHz";

(d) Put SCALE EXPANSION switch to WITHOUT;

(e) Adjust FINE TUNING (NARROW BAND) knob to "0 kHz";

(f) Tune frequency dial for maximum meter deflection at 1000 kHz;

(g) Put IF BANDWIDTH switch to "500 Hz";

(h) Adjust knob ZERO FOR FINE TUNING for maximum meter deflection.

Because of the selectivity characteristic of the 5-kHz IF filter, which is connected ahead of the 500-Hz filter, an additional error in indication occurs when fine tuning is made. This error amounts to approximately –0.6 dB at 1 kHz off-tune and to approximately –2 dB at 2 kHz off-tune.

3.7 PHONES Output

The PHONES sockets provide for connection of a high-impedance head-set to monitor the modulation of the voltage to be measured. Of course, only audio frequencies which are within the selected IF bandwidth are transmitted. The knob provided above the sockets and marked VOLUME permits continuous control of the AF output voltage. Modulation monitoring facilitates a great number of measurements. For example, it makes it easier to pick the desired frequency out of a spectrum; or, when the instrument is used as the null detector of an RF bridge, it is more convenient to adjust for minimum volume than to observe the pointer deflection.

3.8 Cable Connection between Type USVH and Item under Test

A well-shielded coaxial patch cord fitted with 13-mm connectors should be used for connection between Type USVH and the item under test, especially at higher frequencies, and the cable impedance should correspond to the input impedance of Type USVH; greater difference in impedance will cause a voltage transformation, so that the voltage at the input of Type USVH is higher or lower than that at the output of the item to be measured. Suitable coaxial patch cords with connectors (standard lengths 50 cm and 100 cm) can be supplied by ROHDE & SCHWARZ.

In measurements of very small voltages it must be ensured that all the parts of the test assembly — e. g. generator → connecting cable → item under test — are well shielded. Otherwise an interference voltage, for example, the field of a broadcast transmitter, may enter at some point of the test assembly, and may be mistaken for the voltage to be measured. When in doubt, disconnect the voltage source(s) of the test assembly and find out if it is still possible to tune for a meter deflection within the frequency range considered.

3.9 Measurements

3.9.1 Absolute Voltage and Level Measurements

To measure the absolute value of a voltage or level always put the SCALE EXPANSION switch to WITHOUT. The nine-step range switch and the two-step INDICATION switch permit obtaining the voltage and level ranges specified in Table 1. In the voltage ranges 1 μV, 10 μV, 100 μV, etc. take the reading from the scale calibrated 0 to 10 V, in the ranges 3 μV, 30 μV, 300 μV, etc. from the scale 0 to 3 V.

It would be possible to obtain, for example, the range 30 to 100 µV with the nine-step range switch set at "1 µV" and the INDICATION switch at "x 100". This is not recommended however. Because of the unavoidable inherent noise voltage of the instrument, the nine-step range switch should always be set to the maximum possible range and the INDICATION switch should be changed from "x 1" to "x 100" only if the input voltage is higher than 10 mV.

The scale calibrated from –20 to +2 dB applies to all thirteen dB ranges. The measured decibel value is the sum of the dB values indicated by the switch positions and the dB value read from the scale. For example, a pointer deflection of –5 dB with the

Table 1, holds for IF bandwidth of 500 Hz

Frequency range	Voltage and level ranges	INDICATION switch to	Range switch to
10 kHz to 30 MHz	0 to –20 dB 1000 to 300 mV	+40 dB x 100	–40 dB 10 mV
	–10 to –30 dB 300 to 100 mV		–50 dB 3 mV
	–20 to –40 dB 100 to 30 mV		–60 dB 1 mV
	–30 to –50 dB 30 to 10 mV		–70 dB 300 µV
	–40 to –60 dB 10 to 3 mV	+0 dB x 1	–40 dB 10 mV
	–50 to –70 dB 3 to 1 mV		–50 dB 3 mV
	–60 to –80 dB 1 to 0.3 mV		–60 dB 1 mV
	–70 to –90 dB 300 to 100 µV		–70 dB 300 µV
	–80 to –100 dB 100 to 30 µV		–80 dB 100 µV
20 kHz to 30 MHz	–90 to –110 dB 30 to 10 µV		–90 dB 30 µV
	–100 to –120 dB 10 to 3 µV		–100 dB 10 µV
30 kHz to 30 MHz	–110 to –130 dB 3 to 1 µV		–110 dB 3 µV
	–120 to –134 dB 1 to 0.2 µV		–120 dB 1 µV

In the frequency ranges of 100 kHz to 30 MHz and with an IF bandwidth of 5 kHz measurements can be made in all 13 ranges.

nine-step range switch at "–70 dB" and the INDICATION switch at "+40 dB" gives a measured value = (–5) + (–70) + (+40) = –35 dB.

What has been said about the range to be selected in voltage measurements holds also for dB measurements. Because of the inherent noise voltage which is particularly noticeable in the most sensitive range, the level range –100 to –80 dB, for example, should not be obtained by setting the range switch to "–120 dB" and the INDICATION switch to "+40 dB"; the ranges should rather be selected in correspondence with Table 1.

3.9.2 Relative Measurements with Expanded Range 7 to 10

In frequency-response measurement, for example, the absolute voltage or level value is of minor importance, the main purpose being to measure the relative value by which the output voltage of the item under measurement varies due to frequency variation. In the pass band of filters these variations may be so small that they are not easily readable on a normal scale with the usual range of 1 to 10. For this reason, an expanded scale of 7 to 10 has been provided on the meter in addition to the three normal scales.

This scale is calibrated in relative values and is to be used when the SCALE EXPANSION switch is at WITH. The value "10" of this scale corresponds to a deflection of "10" or "3.16" of the unexpanded volt scale. What deflection to choose as reference point for the measurement will depend on the shape of the frequency response curve. If this curve falls off, the deflection "10" should be chosen as reference point. The deflection is brought to the desired reference point by choosing the range corresponding with the voltage to be measured and by slightly varying the signal generator output to the item under test.

For example, when an output voltage of about 5 mV is desired from the item measurement, put the range switch of Type USVH to "3 mV" and the INDICATION switch to "x 1". Next, reduce the output voltage of the signal generator until the meter of Type USVH reads "10". Variations of the reference point setting smaller than ±3 dB are also adjustable with the CALIBRATION I knob of Type USVH. In this case, do not forget to calibrate the instrument again in accordance with section 3.3 before making an absolute measurement.

3.9.3 Measurement of Harmonic Distortion

Harmonics of an oscillator may be desirable or undesirable, depending on the purpose. In the first case, the harmonics are intentionally generated by suitable circuits, such as harmonic generators, in the second case, it often costs much time and money to avoid generation of harmonics or to eliminate them by suitable networks, such as low-pass filters. In both cases it is necessary to measure the ratio between fundamental and harmonics. Equally important is the distortion measurement in manufacture and servicing of broad-band amplifiers such as used in carrier-frequency systems where often a large frequency spectrum must be analysed.

High sensitivity and selectivity make Type USVH excellently suited for these measurements as well as for distortion measurements on items to which only a relatively low voltage can be applied since otherwise the inherent distortion would be greatly increased. According to the CCIF definition of distortion, the amplitudes A_0 of the fundamental and A_1, A_2, A_3, etc. of the harmonics are measured by the single-frequency method. Then

$$\% \text{ distortion} = \frac{\sqrt{A_1^2 + A_2^2 + A_3^2 \ldots}}{\sqrt{A_0^2 + A_1^2 + A_2^2 + A_3^2 \ldots}} \cdot 100$$

Type USVH also permits distortion measurements to be made according to the intermodulation method. As shown in Fig. 2, two equal voltages of closely adjacent frequencies f_1 and f_2 are applied to the input of the item under measurement where they produce the harmonics $2f_1, 3f_1 \ldots$ and $2f_2, 3f_2 \ldots$ in addition to a number of combination frequencies such as f_1+f_2, f_1-f_2, $2f_1-f_2$, etc., the amplitudes of which can be measured individually with Type USVH. If the amplitudes of the fundamentals E_{f2} and E_{f1} are kept equal, the following definition holds for distortion measurements: the quadratic intermodulation distortion is

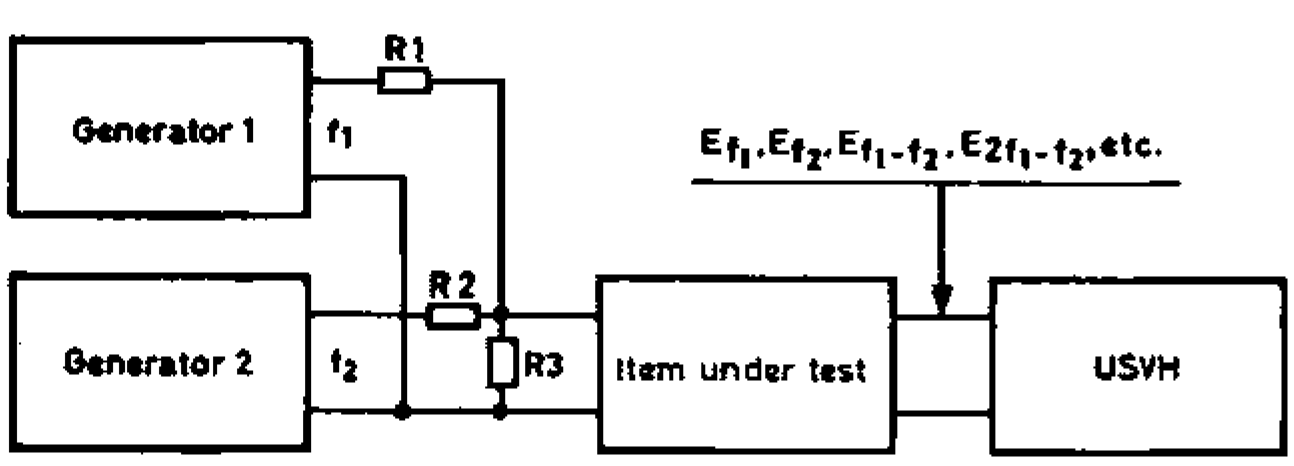


Fig. 2. Test setup for intermodulation method

$$d_2 = \frac{E_{f_1 - f_2}}{E_{f_1} + E_{f_2}},$$

the cubic intermodulation factor is

$$d_3 = \frac{E_{2f_1 - f_2}}{E_{f_1} + E_{f_2}} \quad \text{or} \quad \frac{E_{2f_2 - f_1}}{E_{f_1} + E_{f_2}}$$

The intermodulation method has three essential advantages over the single-frequency method: The frequencies to be measured may lie in the transmission range, the method is independent of the inherent distortion of the two generators, and it comes closer to the conditions in service. The frequencies f_1 and f_2 should be such that the difference frequencies of various magnitudes do not happen to coincide.

The following fixed relation between intermodulation factor and distortion may be given, if the terms of higher order are neglected.

$$d_2 = k_2$$
$$d_3 = 1.5 \times k_3$$

where

$$k_2 = \frac{A_1}{\sqrt{A_0^2 + A_1^2 + A_2^2 \ldots}} \quad \text{and } k_3 = \frac{A_2}{\sqrt{A_0^2 + A_1^2 + A_2^2 \ldots}}$$

To measure i distortion lower than 0.1%, which cannot be measured directly with Type USVH because of its inherent distortion, a frequency-sensitive RC network may be connected ahead of the input of the instrument to attenuate the fundamental with respect to the harmonics. This attenuation is measured and entered in the calculation. In the same way, the measurement range can be extended for the intermodulation method by attenuating the amplitudes E_{f1} and E_{f2} with respect to the amplitudes of the difference frequencies.

Type USVH also provides for relatively simple measurement of modulation distortion. One measures, for example, the amplitudes A_o, A_1, A_2 ... at the lower side of the carrier f_o (see Fig. 3) and obtains

$$\%\ \text{modulation distortion} = \frac{\sqrt{A_1^2 + A_2^2 \ldots}}{\sqrt{A_0^2 + A_1^2 + A_2^2 \ldots}}\ 100$$

In this type of measurement the fine-tuning facility of Type USVH is of great advantage since it permits easy tuning to the individual sideband frequencies at frequencies as high as 30 MHz.

Note: Since the instrument has a broadband input and its measurement ranges are partly chosen with the voltage divider INDICATION/x 1/x 100 connected to the input, care must be taken in distortion measurements to prevent overloading of the instrument; otherwise the distortion would appear higher than it really is. The following simple rule should be observed: When the fundamental amplitude has been measured in the switch position INDICATION x 100, then the INDICATION switch should not be set to "x 1" for the measurement of the harmonic amplitudes, but the **sensitivity should be increased with the nine-step range switch**; otherwise the instrument would be overloaded by the fundamental amplitude. When measuring a distortion factor lower than 1% it should be ensured that the voltage at the grid of the first valve, Rö1, is not higher than 1 mV; otherwise the inherent distortion of the instrument would not be low enough. This means that, according to Table 1, no measurement should be made in the ranges 1 to 3 mV, 3 to 10 mV, 100 to 300 mV, and 300 to 1000 mV. When the amplitude of the fundamental is higher than 1 mV and distortion is to be measured down to 0.1%, it is recommended that a frequency-independent attenuator be connected ahead of the input of Type USVH to reduce the voltage to 1 mV. This attenuator may, at the same time, serve to achieve any desired impedance transformation. A frequency sensitive voltage divider, e. g., an RC network, connected ahead of the input extends the distortion range down to 0.05%, 66 dB, as may be required sometimes for carrier-frequency systems.

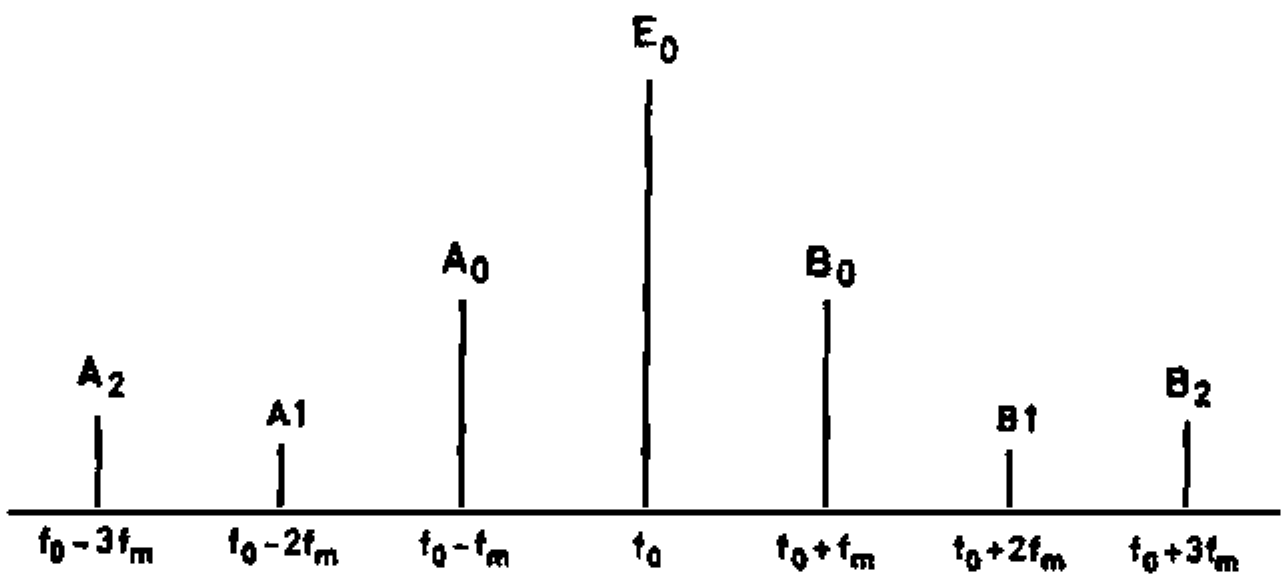


Fig. 3. Measurement of modulation depth and modulation distortion

3.9.4 Measurement of Modulation Depth

The high selectivity of Type USVH provides a simple method of measuring the depth of modulation of an amplitude-modulated RF voltage, provided the carrier is modulated with one single frequency of constant amplitude. Measurements of the carrier amplitude E_o and of the two side-band amplitudes A_o and B_o (see Fig. 3) give the depth of modulation in per cent:

$$m = \frac{A_o + B_o}{E_o} \times 100$$

The FINE TUNING (NARROW BAND) knob permits accurate tuning to the carrier and the sideband frequencies. This facility offers the advantage that small frequency variations of the generator under test can easily be traced. As listed under "1. Specifications" the carrier amplitude it attenuated 35 dB, when detuned by 2 x 500 Hz; therefore, the modulation frequency should not be lower than 1 kHz when the amplitudes of the sideband frequencies are to be measured.

3.9.5 Measurement of Interference from Oscillators and Receivers

The Microvoltmeter Type USVH enables measurement of interference voltage wherever continuous-signal generators are involved. The interferences may be fundamental or harmonic waves, leaking, for example, from a signal generator via the power or modulation line or through the openings provided for the meters in the metal cabinet. Reradiation of receivers is, in most countries, subject to regulations imposing certain limitations on the voltage which the local oscillator reradiates to the receiver input. When measuring an interference voltage in an active line such as a power or modulation line of a signal generator, care must be taken to ensure that Type USVH is not overloaded by the signal voltage present in addition to the interference voltage. It is, for example, impossible to measure directly an interference signal leaking out via the power cord of a signal generator. In these cases, it is absolutely necessary to connect a suitable high-pass filter, say, an LC or RC section, ahead of the input of Type USVH in order to reduce the signal voltage, e. g. 220 V, 50 Hz, so that it is not appreciably higher than the interference voltage to be measured. Simultaneous attenuation of the interference voltage can easily be determined and taken into account.

4. Description

The Selective Microvoltmeter Type USVH is a highly sensitive superheterodyne receiver whose output voltage is indicated on a diode voltmeter. Single frequency changing is used in the three frequency ranges from 10 to 1000 kHz, double frequency changing is employed in the other three ranges from 1 to 30 MHz. Further frequency changing takes place when the IF amplifier operates with a bandwidth of 500 Hz.

The principle of operation can be seen from the **block diagram.** In the frequency ranges 10 to 100 kHz, 100 to 300 kHz, and 300 to 1000 kHz, the voltage to be measured is amplified by the valve Rö1 followed by the low-pass filter L1 to L8, and again amplified by Rö2 followed by the low-pass filter L14 to L18 and the mixer Rö3I. Here the input frequency, 10 to 1000 kHz, is heterodyned with the frequency, 1660 to 2650 kHz, of the local oscillator Rö10 and thus converted to the intermediate frequency of 1650 kHz. After this stage, operation is the same in all six frequency ranges.

In the frequency ranges 1 to 3 MHz, 3 to 10 MHz, and 10 to 30 MHz, the voltage to be measured follows the same path up to Rö2; here the input frequency, 1 to 30 MHz, is mixed with the frequency, 41 to 70 MHz, of the local oscillator Rö10 and changed to 40 MHz; in these ranges, the 40-MHz band-pass filter L10 to L13 operates in the anode circuit of Rö2 instead of the low-pass filter L14 to L18. In the mixer Rö3I, the 40-MHz frequency is combined with a frequency of 38.35 MHz, which is generated by the crystal oscillator Rö3II, and is also changed to the intermediate frequency of 1650 kHz. After this, there is no difference in operation between the three frequency ranges from 10 to 1000 kHz and the three ranges from 1 to 30 MHz.

The mixer is followed by the 1650-kHz band-pass filter L21–L22 and the valve Rö4. The subsequent inductance L23 transforms the impedance down to 60 Ω so that the 8 x 10-dB attenuator providing for range selection can consist of relatively low-valued resistors. The impedance is then stepped up again by L24. Subsequently, the signal is amplified by Rö5 and, after passing through the 1650-kHz band-pass filter L25 to L28, is applied to Rö6. After this point, the IF bandwidth can be reduced to 5 kHz or 500 Hz. At a bandwidth of 5 kHz, Rö6 operates as an amplifier and the IF valve Rö7 is preceded and followed, respectively, by the two 1650-kHz band-pass filters L31–L32 and L37–L38. At the 500-Hz bandwidth, Rö6 operates as a mixer. The 1650-kHz frequency from Rö5 is combined with the 1600-kHz arriving from oscillator Rö11I and is thus converted to 50 kHz. Then the signal is applied to the two IF band-pass filters

L33 to L36 and L39–L40. Rö8I is arranged as a cathode follower; it serves as an impedance transformer between the last pair of IF filters and the low-impedance diode voltmeter which consists of rectifier Gl2 and moving-coil meter J1.

The 13 voltage and level ranges covering a total of 1 µV to 1 V and –120 to 0 dB are obtained with the capacitive divider C2–C3 provided at the input and with the 8 x 10-dB attenuator connected to the IF amplifier. When the input voltage is not divided, the ranges 1 µV to 10 mV and –120 to –40 dB can be set with the 8 x 10-dB attenuator. These ranges may be extended to a hundred times higher value, or by 40 dB, by switching the input attenuator into circuit.

The switchable resistors at the input permit adapting the input impedance of Type USVH to the output impedance of the voltage source under measurement. Input impedances of 50 Ω, 60 Ω, 75 Ω, 150 Ω, and 600 Ω can be selected. In the last step of the switch, no resistor is cut in, only the input impedance of the first amplifier stage is effective. The input capacitance is about 20 pF; it is present in all switch positions but has an appreciable influence only for an input impedance of 600 Ω or 500 kΩ.

For aural monitoring of the modulation of the voltage to be measured, the IF voltage is demodulated by the detector Gl1, and the AF signal is applied via the buffer Rö8II to the PHONES output. Potentiometer R100 permits continuous control of the AF output voltage.

Further details of circuitry can be seen from the **circuit diagram.** Switch S4VIII, which cuts in the anode-supply voltage of the crystal oscillator Rö3II for the frequency ranges 1 to 30 MHz, and switches S4V, S4VI, and S4VII, which change the local oscillator Rö10 over from the grid of Rö2 to the grid of Rö3I, are all ganged with the frequency range switch S4I to S4IV and are operated when changeover is made from the frequency range 300 to 1000 kHz to the range 1 to 3 MHz.

The changing over of the IF bandwidth from 5 kHz to 500 Hz is made by the ganged switch S5IB–S5IA. S5IB cuts in the anode-supply voltage of the 1600-kHz oscillator Rö11I. S5IA, which is shown at the lower right of the circuit diagram, operates the relay RsA in the IF section so that the output of the band-pass filter L33 to L36 is applied to the grid of Rö7 via the contact al. The band-pass filters L37–L38 and L39–L40 between Rö7 and Rö8I are not changed over.

The 1600-kHz oscillator Rö11I, which operates only at 500-Hz bandwidth, is provided with two variable capacitors. C175 is for fine tuning by ±2.5 kHz, e. g., for percentage modulation measurements, C174 serves to correct the zero of C175. Both capacitors are adjustable from the front panel; the corresponding controls are marked FINE TUNING (NARROW BAND) and ZERO.

Meter J1 has four scales: two for voltage measurements, calibrated 0 to 3 V and 0 to 10 V; one for level measurements, calibrated –20 to +2 dB; and the expanded scale calibrated 7 to 10 and used for measurement of small relative voltage ratios from 0 to 3 dB. For the first, second, and third scales, switch S6 must be on WITHOUT SCALE EXPANSION, for the fourth scale on WITH SCALE EXPANSION. In the expanded range, rectifier Gl2 is biased with a DC voltage derived from the reference tube Rö12 and controlled by R121. Thus a meter deflection is obtained only when the IF voltage at the rectifier exceeds the magnitude of the bias voltage. After this, the meter deflection is proportional to the IF voltage. The meter operates with suppressed zero. The bias voltage is set with R120–R121–R122, shown near Rö12 in the circuit diagram, so that the deflection "10" is obtained in the expanded range when in the unexpanded voltage ranges the deflection is "10" or "3.16".

The calibration oscillator Rö9I + Rö9II and the three calibrating potentiometers R98 for calibration I, R23 for calibration II and R79 for calibration III elimniate the need for an external reference voltage when it is necessary to correct the gain (calibration) after valve aging or other influences. Switch S3III is closed and the calibration oscillator in operation when the range switch S3IIR + S3IR of the 8 x 10-dB attenuator is set to CALIBRATION (1 MHz). This oscillator delivers a well-stabilized 1-MHz voltage of 7.75 mV to the input of the first amplifier stage, resulting in a deflection of 0 dB when the total gain corresponds to its nominal value. When in one of the four operating ranges the gain deviates from the nominal value, it can be corrected with the corresponding calibrating potentiometer. The following operating ranges must be considered:

(A) Frequency ranges 100 to 1000 kHz with an IF bandwidth of 5 kHz

(B) Frequency ranges 10 to 1000 kHz with an IF bandwidth of 500 Hz

(C) Frequency ranges 1 to 30 MHz with an IF bandwidth of 5 kHz

(D) Frequency ranges 1 to 30 MHz with an IF bandwidth of 500 Hz

Knob CALIBRATION I (R98) influences the gain of Rö5, i. e., it has the same effect in all four types of operation. Knob CALIBRATION II (R23) varies the gain of Rö2 if this valve operates as an amplifier in the frequency ranges 10 to 1000 kHz; lying ahead of the third mixer Rö6, is has the same effect at both bandwidths. In the ranges 1 to 30 MHz, where Rö2 operates as a mixer, R23 has very little influence on the mixer gain of Rö2. Knob CALIBRATION III (R79) varies the gain of Rö7 in the entire frequency range of 10 kHz to 30 MHz, but is effective only at 500 Hz bandwidth; in the 5-kHz bandwidth it is short-circuited by contact all since the relay RsA has dropped. By means of these three front-panel knobs, the instrument may be so adjusted that the calibration is correct in all four operating modes. The procedure to be followed is explained in section 3.3.

The power section is designed for operation from AC supply voltages of 115 V, 125 V, 220 V, and 235 V. The miniature glow lamp Rl1 located above the on-off switch is the voltage indicator. The anode-supply voltage is developed by the rectifier Gl5, filtered by the L-C section L54–C186, and stabilized by the four valves Rö13–Rö14–Rö15–Rö12.

Rö13 and Rö14, which are connected in parallel, are the series regulator valves which pass the total anode current, Rö15 is the control amplifier of Rö13–Rö14, and the reference tube Rö12 serves to maintain the grid bias voltage of Rö15.

When, for example, the AC supply voltage decreases, the anode-supply voltage, 220 V across C183, and thus the grid voltage of Rö15 derived between R127 and R126, also decrease, i. e., the negative grid bias of this valve increases. Thus its anode resistance increases, the voltage drop across its anode load resistor R133 decreases and the negative grid voltages of the series regulator valves Rö13–Rö14 decrease. As a result, their anode resistances decrease so that the anode-supply voltage increases to its original value. Potentiometer R129 is factory-adjusted for an anode voltage of 220 V. R125 serves to adjust for minimum influence of the AC supply voltage.

5. Maintenance

The Selective Microvoltmeter Type USVH requires very little maintenance. It mainly suffices to carry out occasional performance checks and replace valves that are defective or have aged after a long period of service. For more details, see section 7.2.1. The intervals at which performance checks are made largely depend on how often the set is used. A check will, however, always be advisable if the correctness of a test result appears doubtful. The performance check itself needs a number of instruments, but in most laboratories using Type USVH these will be available. If not, we recommend that you contact the nearest R&S branch.

5.1 Performance Check

The performance of the set is satisfactory when none of the error limits specified in the section "Specifications" are exceeded. The performance check must therefore be made on the basis of these specifications.

5.1.1 Checking the Frequency Calibration

The frequency calibration is usually uncritical since it is possible to tune to the input frequency even if the frequency calibration is incorrect. If it is considered desirable to keep to the specified frequency accuracy, the frequency calibration check is very simple. A voltage of sufficiently accurate frequency (calibration frequency) is applied, the set is tuned to it and the value read from the frequency scale is compared with the calibration frequency.

Depending on the available instruments, the calibration frequency may be supplied by a signal generator controlled by a frequency meter of adequate accuracy, or directly from a frequency meter that delivers voltages of sufficiently accurate frequency. The quickest way of carrying out the test is by using a harmonic generator, since Type USVH needs only be tuned to each harmonic successively. The set should warm up for approximately two hours before commencement of the test.

5.1.2 Checking the Bandwidths, Far-off Selectivity and IF Rejection

The bandwidth and far-off selectivity need only be checked at one frequency. It is best to use the range 100 kHz to 300 kHz. The IF rejection, however, should be checked at at least one frequency in each frequency range.

Required Equipment:

(a) A signal generator which permits accurate incremental tuning by ±10 kHz (for determining the far-off selectivity at a bandwidth of 5 kHz) and a setting accuracy of ±10 Hz (for determining the bandwidth at 500 Hz). For measuring the IF rejection, the signal generator must be able to deliver frequencies between 3.3 MHz and 110 MHz.

(b) A valve voltmeter with an insertion unit for checking the input voltage when the signal generator has no reliable device for measuring the output voltage.

Procedure for Checking Bandwidth and Far-off Selectivity

(a) Adjustments on Type USVH: At a signal output voltage of approximately 1 V set input attenuator **1** to "x 100/ +40 dB" and main attenuator **3** to "10 mV/–40 dB"; at a signal output voltage of approximately 10 mV set input attenuator **1** to "x 1/+0 dB" and main attenuator **3** to "10 mV/ –40 dB". Set bandwidth switch **8** to "5 kHz". Using range switch **17**, select the range covering the frequency intended as centre frequency for the test. When testing the 5-kHz bandwidth ensure that the centre frequencies do not lie below 100 kHz. With switch **19**, match the input impedance of Type USVH to the output impedance of the signal generator.

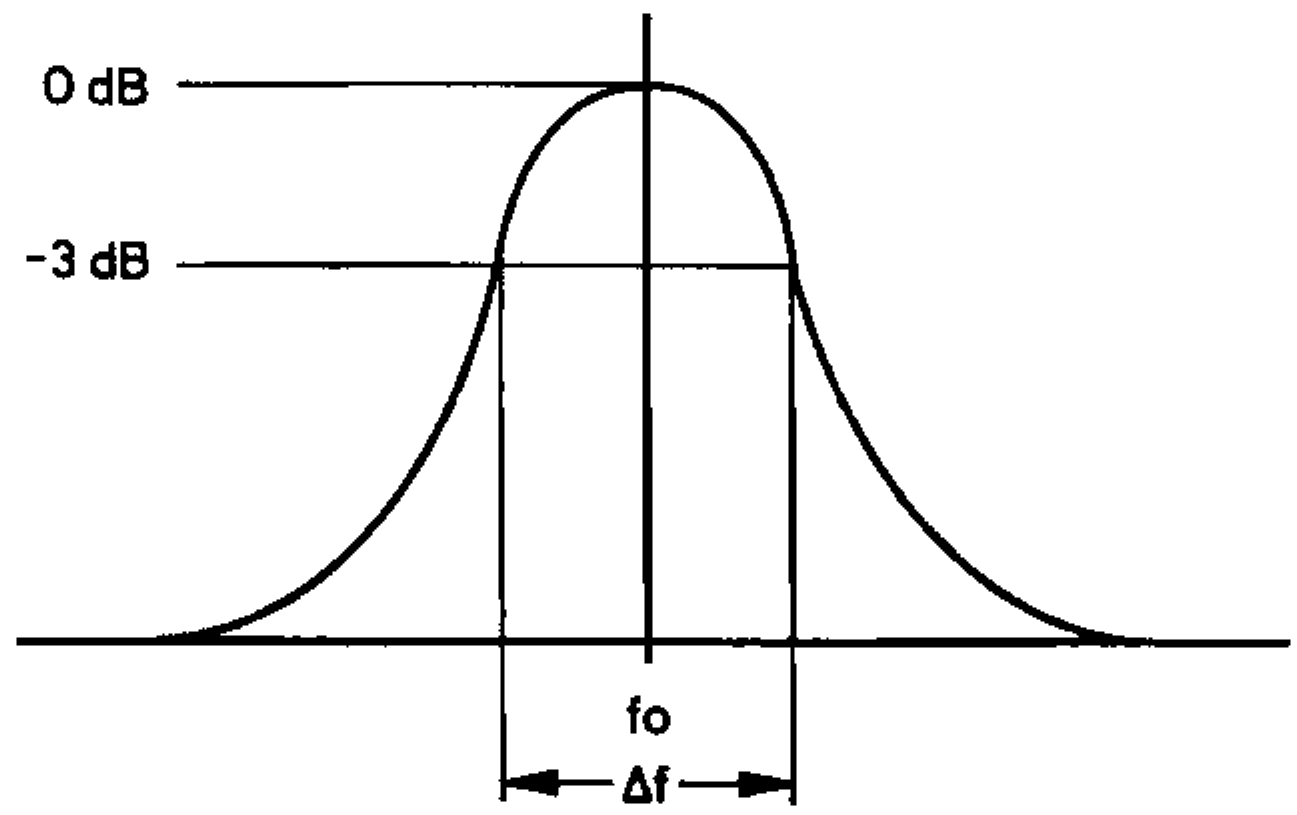


Fig. 4. Definition of bandwidth

(b) Apply the signal voltage to input **18** and tune Type USVH to its frequency.

(c) Adjust the signal voltage such that the meter on Type USVH reads 0 dB.

(d) Adjust the signal generator frequency first to high and then to low frequencies until the panel meter on Type USVH reads –3 dB in each case. Take the two frequency readings. Their difference is the bandwidth. Nominal value: $\Delta f = 5\ \text{kHz} \pm 100\ \text{Hz}$.

(e) Starting from the same centre frequency, vary the frequency by ±10 kHz but leave the input voltage unchanged (check by means of valve voltmeter). Set the main attenuator for higher sensitivity until the pointer on the panel meter of Type USVH deflects. The far-off selectivity is obtained by adding the difference of the indicated dB values (on panel meter) to the difference of the main attenuator dB values. Nominal value: > 56 dB. Maximum permissible unbalance: 2 dB.

(f) Set bandwidth switch **8** to "500 Hz" and proceed as specified under (b) to (d). Nominal value: $\Delta f = 500\ \text{Hz} \pm 10\ \text{Hz}$.

(g) Starting from the same centre frequency, vary the frequency by ±1 kHz but leave the input voltage unchanged. Proceed as under (e). Nominal value: > 36 dB. Maximum permissible unbalance: 2 dB.

Procedure for Checking IF Rejection

(a) Set main attenuator to "10 mV/–40 dB".

(b) Set the signal generator to a frequency approximately in the middle of the frequency range selected on Type USVH.

(c) Set the voltage on the signal generator such that the meter on Type USVH indicates 0 dB.

(d) Adjust for the image frequency at the same signal voltage. The image frequency is obtained from the following equation: image frequency = input frequency + 2IF. In the lower three frequency ranges (10 kHz to 1000 kHz) the intermediate frequency (IF) is 1.65 MHz and in the upper three frequency ranges (1 to 30 MHz) 40 MHz.

(e) Increase the sensitivity of the main attenuator 3 until a readable deflection occurs on the meter. The IF rejection is obtained by adding the difference of the indicated dB values to the difference of the main attenuator dB values. Nominal value: > 60 dB.

(f) Carry out the measurement from (a) to (e) in each of the six frequency ranges.

5.1.3 Checking the Voltage Indication

5.1.3.1 Checking the Scale Calibration of the Meter

Required Equipment:

(a) A signal generator that can deliver 1 V or 10 mV at a frequency of 1 MHz. The voltage must be adjustable. There are no special requirements as regards frequency accuracy but good voltage and frequency stability is essential.

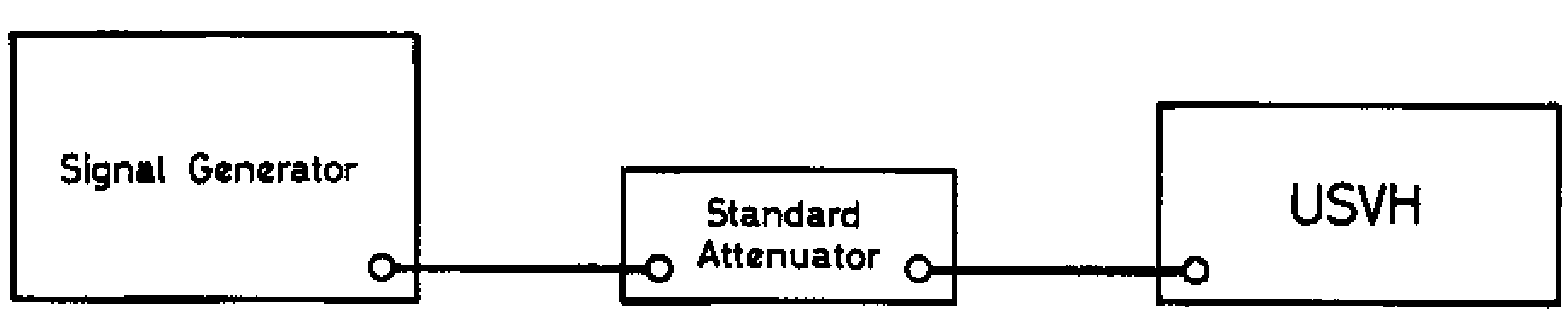


Fig. 5. Setup for checking the scale calibration of the meter

(b) A standard attenuator with an attenuation variable in 1-dB steps and an attenuation error no greater than ±0.2 dB.

Test Procedure:

(a) Adjustments on Type USVH: Using switch **19** match the input impedance of Type USVH to the characteristic impedance of the standard attenuator. Set input attenuator **1** to "x 100/+40 dB" at 1 V input voltage and to "x 1/+0 dB" at 10 mV input voltage. Set bandwidth switch **8** to "5 kHz". Set range switch **17** to "300–1000 kHz" or "1–30 MHz".

(b) Adjust the standard attenuator for a basic, or minimum, attenuation of 10 dB.

(c) Adjust the signal generator for a frequency of 1 MHz and a voltage of approximately 1 V or 10 mV, depending on what voltage the signal generator can deliver. Feed this voltage into input **18** of Type USVH. Tune Type USVH to the frequency of the input voltage; the panel meter will now show a deflection.

(d) Adjust the signal generator voltage such that the meter on Type USVH indicates "0 dB".

(e) Raise the attenuation of the standard attenuator in steps of 1 dB. The deflection on the meter than correspondingly falls in steps of 1 dB. Read off the deflection after each step. No great importance need be attached to the absolute value of the input voltage, since in this case merely the scale calibration is being checked.

5.1.3.2 Checking the Switchover WITH/WITHOUT SCALE EXPANSION

A signal generator is all that is required for this test.

Test Procedure:

(a) Set switch **14** to WITHOUT. Adjust the attenuation of the input attenuator and main attenuator to correspond to the magnitude of the input voltage.

(b) Feed into the input of Type USVH a signal voltage of any frequency, preferably from the lower range (10 to 100 kHz), and adjust it such that after tuning, the panel meter shows full-scale deflection at "10" on the upper scale.

(c) Set switch **14** to WITH. The deflection on the meter must not change. The value "10" on the upper scale is reached with the same deflection as that on the lower scale.

(d) Set switch **14** back to WITHOUT and reduce the signal voltage until the meter on Type USVH indicates "7"on the upper scale.

(e) Set switch **14** to WITH. The meter should now indicate the value "7" at the beginning of the lower scale. Permissible error: ±3% of full-scale deflection.

(f) Should inadmissible errors occur, correction is possible according to section 7.2.2.10.

5.1.3.3 Checking the Standardizing Oscillator

Required Equipment:

(a) A signal generator that can deliver an output voltage of 1 V at f = 1 MHz.

(b) A valve voltmeter with insertion unit.

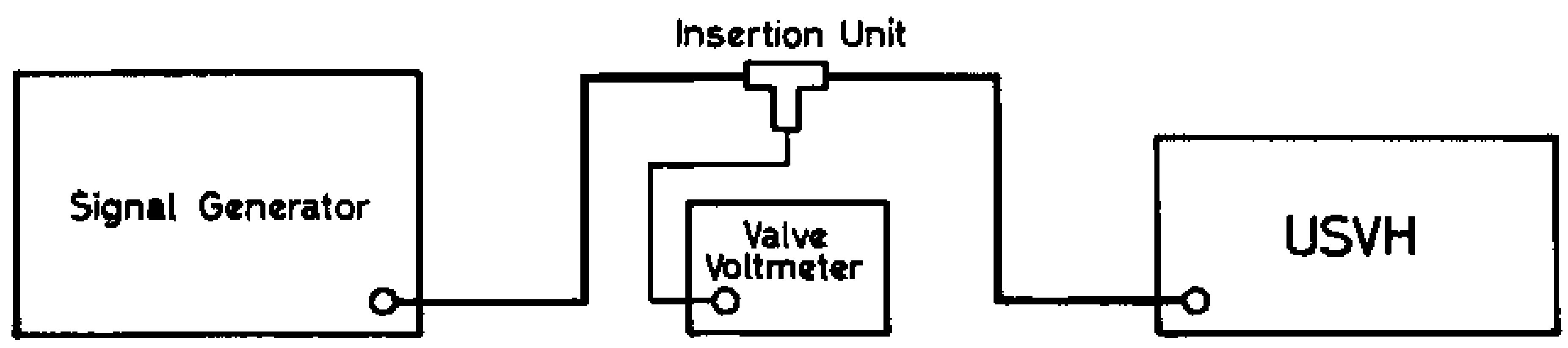


Fig. 6 Setup for checking the standardizing oscillator

Test Procedure:

(a) Adjustments on Type USVH: Set input attenuator **1** to "x 100/+40 dB". Set main attenuator **3** to "10 mV/–40 dB". Set bandwidth switch **5** to "5 kHz". Set switch **14** to WITHOUT. Set range switch **17** to "300 kHz to 1 MHz" or "1 to 3 MHz". Match the input impedance to the characteristic impedance of the insertion unit by means of switch **19.**

(b) Feed signal voltage to the input **18** and tune Type USVH to its frequency.

(c) Adjust the signal voltage such that the valve voltmeter (check instrument) reads 0 dB (0.775 V), and using knob **16** set the meter deflection on Type USVH also to 0 dB.

(d) Disconnect the voltage from input **18.** Set the main attenuator **3** to CALIB. The panel meter must now also indicate 0 dB (calibration mark). For inadmissible deviations see section 7.2.2.7.

5.1.3.4 Checking the Main Attenuator

Required Equipment:

(a) A signal generator that delivers a voltage of 30 mV or more at a frequency between 100 kHz and 30 MHz. Good stability of the voltage and frequency is important.

(b) A standard attenutor whose attenuation can be varied by 80 dB in 10-dB steps.

(c) A valve voltmeter with insertion unit.

The input frequency should not be lower than 100 kHz but may be selected at will above this value. Since the main attenuator is located in the 1.65-MHz IF amplifier, it suffices to make one single measurement at one frequency. The signal voltage of at least 30 mV

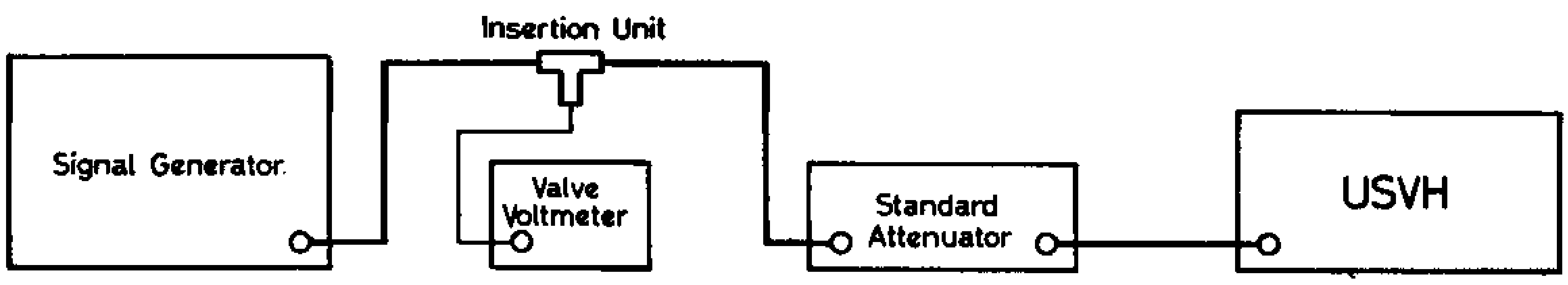


Fig. 7 Setup for checking the main attenuator

is applied to the input of Type USVH via a standard attenuator which is switchable in 10-dB steps with an accuracy of ±0.2 dB. The voltage at the input of the standard attenuator is checked by means of a valve voltmeter to ensure its stability for the duration of the measurement. It is advisable to adjust the standard attenuator for a basic attenuation of 10 dB. If the voltage at the input of the standard attenuator exceeds 30 mV, the residual attenuation must be correspondingly raised so that approximately 10 mV are available at the input of Type USVH. It must, however, still be possible to raise the attenuation of the standard attenuator by 80 dB.

Test Procedure

(a) Set input attenuator **1** to "x 1/+0 dB.

(b) Set main attenuator **3** to "10 mV/–40 dB".

(c) Set bandwidth switch **8** to "5 kHz".

(d) Set range switch **17** to the input frequency range.

(e) With the input impedance switch **19**, match the input impedance to the characteristic impedance of the standard attenuator.

(f) Set switch **14** to WITHOUT.

(g) Set the standard attenutor such that 10 mV are available across the input of Type USVH.

(h) Tune Type USVH to the input frequency.

(i) Adjust the signal voltage or, using knob **16**, the gain of Type USVH, such that the panel meter indicates 0 dB. Voltage calibration of Type USVH is not necessary since this is a relative measurement.

(j) Adjust bandwidth switch **8** to "500 Hz". Tune to maximum using the FINE TUNING knob **11**. Then, using knob **13**, reset the pointer of the meter to 0 dB.

(k) Raise the attenuation of the standard attenuator in 10-dB steps and after each step switch back the main attenuator by 10 dB. The attenuation of the main attenuator is altogether reduced by 80 dB and the attenuation of the standard attenuator correspondingly raised by 80 dB as against the basic attenuation. With the steps –40 dB to 110 dB of the main attenuator the meter indication may deviate from the nominal value (0 dB) by $\leqq \pm 0.2$ dB. With the –120-dB step the error may be ± 0.3 dB, since the inherent noise of Type USVH becomes noticeable at this high sensitivity. The stability of the voltage at the input of the standard attenuator and the tuning of Type USVH should be repeatedly checked during these measurements. If the indication of the meter noticeable changes when the main attenuator is switched to and from neighbouring positions, there is every reason to believe that the contacts of the main attenuator switch are dirty. The error can be eliminated by cleaning the switch contacts. If the attenuation ratio is incorrect in a certain position of the main attenuator switch, this means that an attenuator resistor has changed its value. This error should, however, occur only rarely.

To remove the main attenuator see section 7.1.2.

5.1.3.5 Checking the Input Attenuator

Required Equipment:

If the main attenuator has been checked according to section 5.1.3.4 and proves to be in good working order, the only requirement is a signal generator that delivers a voltage of approximately 10 mV at 1 MHz, 25 MHz and 30 MHz.

Test Setup: As specified under section 5.1.3.4 but without standard attenuator and valve voltmeter.

Test Procedure

(a) Set input attenuator to "x 1/+40 dB".

(b) Set main attenuator to "10 mV/– 40 dB".

(c) Set bandwidth switch **8** to "5 kHz".

(d) Adjust range switch **17** to the range of the test frequency.

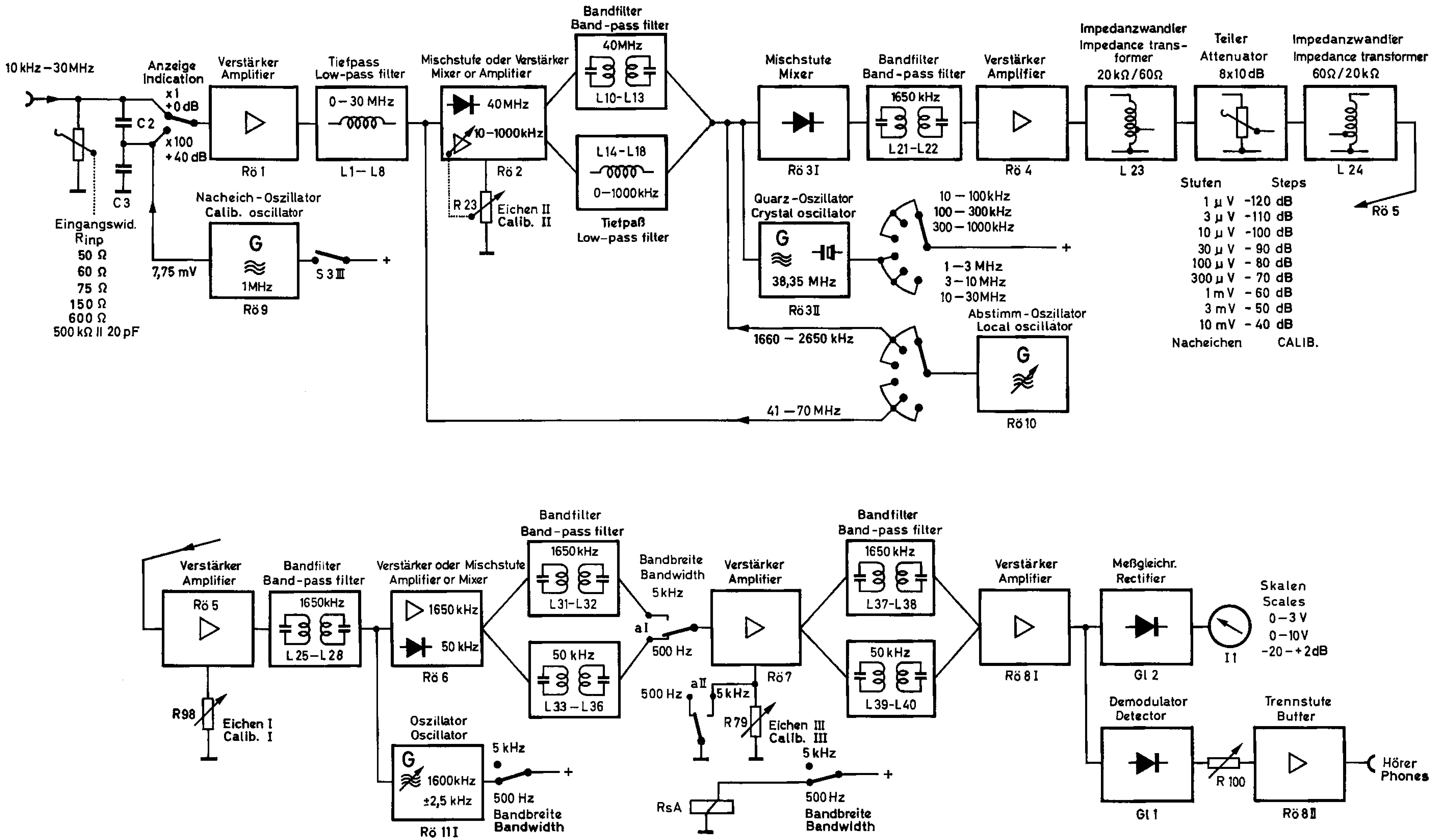
(e) Using switch **19** match the input impedance of Type USVH to the output impedance of the signal generator.

(f) Tune Type USVH to the test frequency. The input attenuator should be tested at three frequencies in the order 1 MHz, 25 MHz and 30 MHz.

(g) Adjust the signal voltage such that the meter on Type USVH indicates 0 dB.

(h) Switch the input attenuator to "x 100/+40 dB" and increase the sensitivity of the main attenuator by 40 dB. The reading on the meter must not change by more than ±0.2 dB. Section 7.2.2.9 gives details on possible error correction.

This test procedure can be used provided that the main attenuator is working efficiently. If the input attenuator is to be checked without previous testing of the main attenuator, the input voltage must be applied to the input of the Type USVH via a standard attenuator. The main attenuator is then set to "100 μV/– 80 dB" and remains unchanged throughout the measurements. At the beginning of each measurement the attenuation of the standard attenuator is at least 40 dB. A higher attenuation is better, since on subsequent reduction of the attenuation by 40 dB a residual attenuation still remains. All other adjustments mentioned apply here also, except that the standard attenuator instead of the main attenuator is switched by 40 dB to a more sensitive setting.



Blockschaltbild
Block Diagram