INSTRUCTION BOOK

SELECTIVE MICROVOLTMETER

Type USVH BN 1521

Note: Always quote the Type and Order Number (BN) in addition to the Serial Number (FNr.) of the set when asking for technical information and, in particular, when ordering repair parts.

Edition 1521 A/463 d/e

B E I B L A T T

zur Beschreibung Ausgabe 1521 A/463 d/e

SELEKTIVES MIKROVOLTMETER Type USVH BN 1521

Änderungen in der Schaltteilliste und im Stromlauf:

Kenn-zei-chen	Benennung	Wert	R&S-Sach-Nr.
C26	Keramik-Kondensator Ker. Rohrtrimmer	12 pF 1...6 pF	CCH 31/12 CV 7205 par.
C27	Keramik-Kondensator	0,5 pF	CCG 11/0,5
C28	Keramik-Kondensator Ker. Rohrtrimmer	12 pF 1...6 pF	CCH 31/12 CV 7205 par.
C29	Keramik-Kondensator Ker. Rohrtrimmer	0,5 pF 0,5...2 pF	CCG 11/0,5 CV 7202
C31	Keramik-Kondensator	0,5 pF	CCG 11/0,5
C155	Lufttrimmer	4...10 pF	CV 8006
C156	Lufttreimmer	4...10 pF	CV 8006
C176	Keramik-Kondensator	Trimmwert	CCG 68/...

Im Stromlauf entfallen die Trimmer von C27 und C31. Diese Trimmer sind zwar eingebaut, aber nicht angeschlossen.

TAZ: Einkleben in 1521 A/463 d/e zwischen den Seiten 34 und 35

S U P P L E M E N T

to Instruction Book Edition 1521 A/463 d/e

SELECTIVE MICROVOLTMETER Type USVH BN 1521

Modifications in the table of replaceable parts and in the circuit diagram:

Ref. No.	Designation	Ratings	R&S Stock No.
C26	Capacitor, ceramic Trimmer, tubular, ceramic	12 pf 1 to 6 pf	CCH 31/12 CV 7205 par.
C27	Capacitor, ceramic	0.5 pf	CCG 11/0,5
C28	Capacitor, ceramic Trimmer, tubular, ceramic	12 pf 1 to 6 pf	CCH 31/12 CV 7205 par.
C29	Capacitor, ceramic Trimmer, tubular, ceramic	0.5 pf 0.5 to 2 pf	CCG 11/0,5 CV 7202
C31	Capacitor, ceramic	0.5 pf	CCG 11/0,5
C155	Trimmer, air	4 to 10 pf	CV 8006
C156	Trimmer, air	4 to 10 pf	CV 8006
C176	Capacitor, ceramic	factory-adjusted	CCG 68/...

The trimmers of C27 and C31 are to be deleted in the circuit diagram. They are incorporated in the set but not connected in circuit.

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Table of Contents

1. Specifications 37

2. Uses 39

3. Preparation for Use and Operating Instructions 40

3.1 Adjusting to the Local AC Supply Voltage 40

3.2 Setting the Mechanical Zero on the Meter 41

3.3 Calibration 41

3.4 Input Impedance 43

3.5 IF Bandwidth 43

3.6 Fine Tuning (Narrow Band) 44

3.7 PHONES Output 44

3.8 Cable Connection between the Type USVH and Item under Test 44

3.9 Measurements 45

3.9.1 Absolute Voltage and Level Measurements 45

3.9.2 Relative Measurements with Expanded Range 7 to 10 46

3.9.3 Measurement of Harmonic Distortion 47

3.9.4 Measurement of Modulation Depth 50

3.9.5 Measurement of Interference from Oscillators and Receivers 50

4. Description 51

5. Table of Replaceable Parts 57

Front panel and condensed operating instructions 69

Block diagram 71

Circuit diagram 73

1. Specifications

Frequency range . . . . . 10 kc to 30 Mc

in 6 ranges . . . . . 10 to 100 kc | 1 to 3 Mc
100 to 300 kc | 3 to 10 Mc
300 to 1000 kc | 10 to 30 Mc
(100 kc to 30 Mc at 5-kc IF bandwidth)

Frequency accuracy
10 kc to 1 Mc . . . . . ±2% ±3 kc
1 Mc to 30 Mc . . . . . ±2% ±50 kc

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

Voltage and level ranges . . . . . 0.2 μv to 1 v or – 134 to +2 db

in 13 ranges, the frequency range being restricted

10 kc to 30 Mc	300 to 1000 mv	or – 20 to	+2 db
	100 to 300 mv	– 30 to	– 8 db
	30 to 100 mv	– 40 to	– 18 db
	10 to 30 mv	– 50 to	– 28 db
	3 to 10 mv	– 60 to	– 38 db
	1 to 3 mv	– 70 to	– 48 db
	0,3 to 1 mv	– 80 to	– 58 db
20 kc to 30 Mc	100 to 300 μv	– 90 to	– 68 db
	30 to 100 μv	– 100 to	– 78 db
	10 to 30 μv	– 110 to	– 88 db
	3 to 10 μv	– 120 to	– 98 db
30 kc to 30 Mc	1 to 3 μv	– 130 to	– 108 db
	0.2 to 1 μv	– 134 to	– 118 db

Scale expansion . . . . . relative calibration 7 to 10

Voltage accuracy at 1 Mc and 1 v . . . . . ±3%, after calibration

Frequency response referred to 1 Mc . . . .
20 kc to 10 Mc . . . . . ±5%
10 kc to 30 Mc . . . . . ±10%

Attenuation accuracy . . . . . ±2%
IF bandwidth, selectable . . . . . 500 cps or 5 kc
(5 kc between 100 kc and 30 Mc only)

Image frequency rejection	better than 60 db
Selectivity at twice the bandwidth from centre frequency	
at 500-cps IF bandwidth	down 35 db, approx.
at 5-kc IF bandwidth	down 50 db, approx.
Noise voltage	
at 500-cps IF bandwidth	0.15 μv, approx. } with a generator output impedance of less than 1 kΩ
at 5-kc IF bandwidth	0.4 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; selected by switch
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 cps (85 va)
Valves, etc.	1 valve E 180 F 1 valve EC 93 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 amp; 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. The Type USVH is particularly useful when only small voltages can be applied to the item under test.

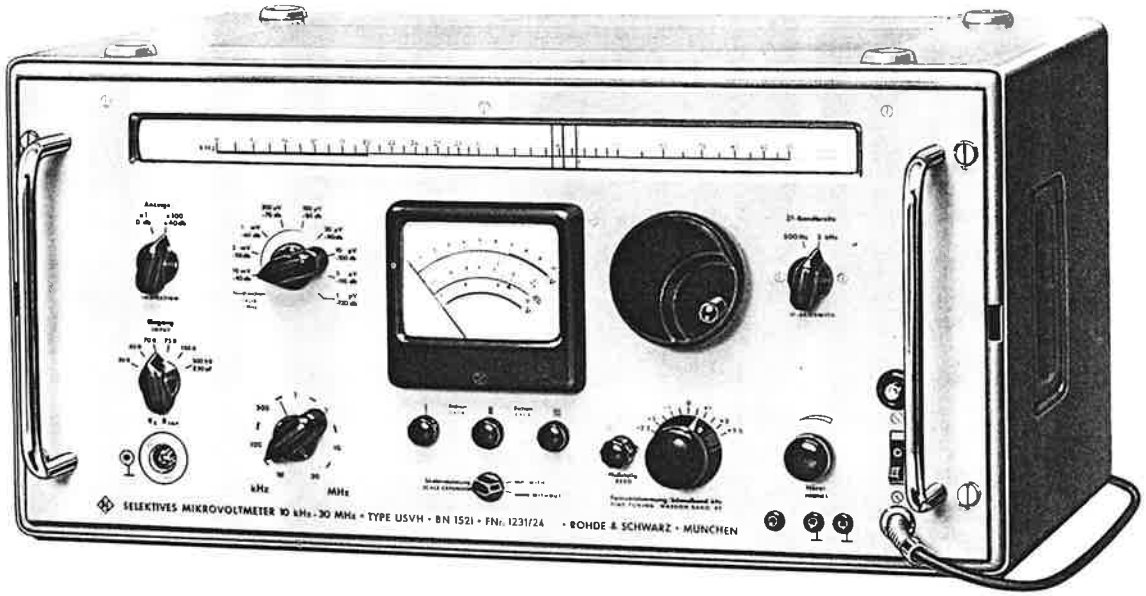


Fig. 1. Front view of the Selective Microvoltmeter Type USVH

(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 kc to 30 Mc and modulation frequencies above 1 kc. 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 kc for any carrier frequency. A modulation depth down to 10% can be measured at a modulation frequency of 1 kc. 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 the Type USVH permits such measurements to be made even at a relatively high oscillator voltage and low signal voltage. The Type USVH gives correct reading of the amplitudes of the difference frequencies without requiring an input filter.

(i) RF leakage measurements on 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

The 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, 0,8 C DIN 41571. Place the instrument back into its cabinet, plug in the power cord, and put the toggle switch in the lower right of the front panel up for 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 Mc at an IF bandwidth of 500 cps it is necessary to wait for good stability of the local oscillator Rö10; at 30 Mc, 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 correction to be made.

The 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 CPS", and SCALE EXPANSION switch to WITHOUT.

3.3 Calibration (see also front panel and condensed operating instructions)

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

(A) Frequency ranges 100 to 1000 kc with an IF bandwidth of 5 kc
(B) Frequency ranges 10 to 1000 kc with an IF bandwidth of 500 cps
(C) Frequency ranges 1 to 30 Mc with an IF bandwidth of 5 kc
(D) Frequency ranges 1 to 30 Mc with an IF bandwidth of 500 cps.

During calibration put the range switch to CALIBRATION (1 Mc) and the SCALE EXPANSION switch to WITHOUT.

Calibration I

(a) Put frequency range switch to "1 TO 3 MC";
(b) Put IF BANDWIDTH switch to "5 KC";
(c) Set cursor of frequency dial to the range marked red at 1 Mc and tune for maximum meter deflection;
(d) Vary CALIBRATION I knob until the pointer of the meter is at "0 db".

Calibration II

(a) Put frequency range switch to "300 KC TO 1 MC";
(b) Put IF BANDWIDTH switch to "5 KC";

(c) Set cursor of frequency dial to the range marked red at 1000 kc and tune for maximum meter deflection;
(d) Vary CALIRBATION II knob until the pointer of the meter is at "0 db".

Calibration III

(a) Frequency range switch remains at "300 KC TO 1 MC";
(b) IF BANDWIDTH switch remains at "5 KC";
(c) Tune for maximum meter deflection ("0 db" as in calibration II);
(d) Put IF BANDWIDTH switch to "500 CPS";
(e) Put FINE TUNING (NARROW BAND) knob to "0 KC";
(f) Adjust ZERO knob so that meter indicates again maximum deflection;
(g) Vary CALIBRATION III knob until meter pointer is at "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 negligible. 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 condition 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 deflection in the range 1 to 3 Mc, this oscillator would have to have a frequency stability of $\pm 0.0025\%$ for the 5-kc bandwidth and of $\pm 0.0001\%$ for the 500-cps 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 Mc, and then to adjust the CALIBRATION control for a deflection of "0 db". When soon afterwards the deflection changes or goes back all the 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 cps when f is greater than 10 kc or of 5 kc when f is greater than 100 kc

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 KC" which enables easy tuning even at the highest frequency, 30 Mc. However, only the 500-cps 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 noticable at an IF bandwidth of 500 cps, 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 Mc with an IF bandwidth of 500 cps, 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 Mc 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-Mc oscillator frequency, for a 30-Mc input frequency, this results in a frequency drift of approximately 70 cps, 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-cps 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 the 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-cps IF bandwidth. It permits the tuning on the frequency dial to be varied by ±2.5 kc. First, however, the zero of this knob must be corrected:

(a) Put frequency range switch to "300 KC TO 1 MC";
(b) Put voltage range switch to CALIBRATION (1 MC);
(c) Put IF BANDWIDTH switch to "5 KC";
(d) Put SCALE EXPANSION switch to WITHOUT;
(e) Adjust FINE TUNING (NARROW BAND) knob to "0 KC";
(f) Tune frequency dial for maximum meter deflection at 1000 kc;
(g) Put IF BANDWIDTH switch to "500 CPS";
(h) Adjust knob ZERO FOR FINE TUNING for maximum meter deflection.

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

3.7 PHONES Output

The PHONES sockets provide for connection of a high-impedance headset 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 the Type USVH and Item under Test

A well-shielded patch cord should be used for connection between the Type USVH and the item under test, especially at higher frequencies, and the cable impedance should correspond with the input impedance of the Type USVH; greater difference in

impedance will cause a voltage transformation, so that the voltage at the input of the Type USVH is higher or lower than that at the output of the item to be measured. Suitable coaxial patch cords with plugs (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 nine-step range switch at "–70 db" and the INDICATION switch at "+40 db" gives a

$$\text{measured value} = (-5) + (-70) + (+40) = -35 \text{ db}.$$

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,

Table 1, holds for IF bandwidth of 500 cps

Frequency range	Voltage and level ranges	INDICATION switch to	Range switch to
10 kc to 30 Mc	0 to —20 db 1000 to 300 mv	+ 40 db × 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 × 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 kc to 30 Mc	—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 kc to 30 Mc	—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 kc to 30 Mc and with an IF bandwidth of 5 kc measurements can be made in all 13 ranges.

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 the 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 the Type USVH reads "10". Variations of the reference point setting smaller than ±3 db are also adjustable with the CALIBRATION I knob of the 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 the 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

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

The 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 $2f_1$, $3f_1$ ... and $2f_2$, $3f_2$ ... 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 the Type USVH. If the amplitudes of the fundamentals E_{f_2} and E_{f_1} are kept equal, the following definition holds for distortion measurements: the quadratic intermodulation distortion is

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

the cubic intermodulation factor is

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

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 different order 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.

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

where

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

To measure a distortion lower than 0.1%, which cannot be measured directly with the 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_{f_1} and E_{f_2} with respect to the amplitudes of the difference frequencies.

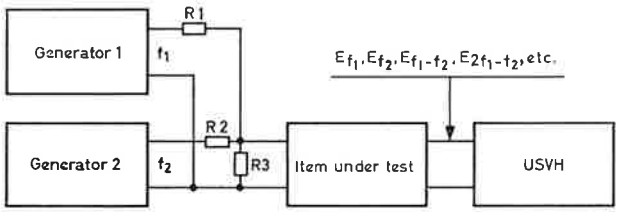


Fig. 2. Test setup for intermodulation method

The Type USVH also provides for relatively simple measurement of modulation distortion. One measures, for example, the amplitudes A_0, A_1, A_2 . . . at the lower side of the carrier f_o (see Fig. 3) and obtains

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

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

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;

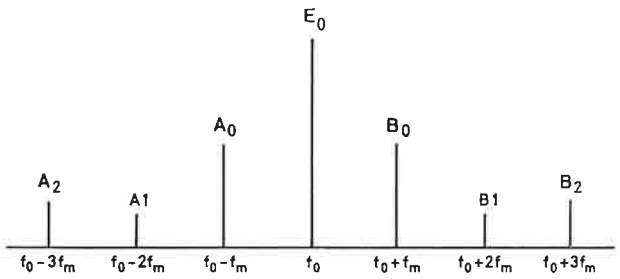


Fig. 3. Measurement of modulation depth and modulation distortion

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 put over 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 the 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.

3.9.4 Measurement of Modulation Depth

The high selectivity of the 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_0 and of the two sideband amplitudes A_0 and B_0 (see Fig. 3) give the depth of modulation in per cent:

$$m = \frac{A_0 + B_0}{E_0} \cdot 100$$

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 is attenuated 35 db, when detuned by 2 x 500 cps; therefore, the modulation frequency should not be lower than 1 kc 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. Re-radiation 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 the 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 the Type USVH in order to reduce the signal voltage, e.g. 220 v, 50 cps, 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 kc, double frequency changing is employed in the other three ranges from 1 to 30 Mc. Further frequency changing takes place when the IF amplifier operates with a bandwidth of 500 cps.

The principle of operation can be seen from the **block diagram.** In the frequency ranges 10 to 100 kc, 100 to 300 kc, and 300 to 1000 kc, 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 kc, is heterodyned with the frequency, 1660 to 2650 kc, of the local oscillator Rö10 and thus converted to the intermediate frequency of 1650 kc. After this stage, operation is the same in all six frequency ranges.

In the frequency ranges 1 to 3 Mc, 3 to 10 Mc, and 10 to 30 Mc, the voltage to be measured follows the same path up to Rö2; here the input frequency, 1 to 30 Mc, is mixed with the frequency, 41 to 70 Mc, of the local oscillator Rö10 and changed to 40 Mc; in these ranges, the 40-Mc 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-Mc frequency is combined with a frequency of 38.35 Mc, which is generated by the crystal oscillator Rö3II, and is also changed to the intermediate frequency of 1650 kc. After this, there is no difference in operation between the three frequency ranges from 10 to 1000 kc and the three ranges from 1 to 30 Mc.

The mixer is followed by the 1650-kc 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-kc band-pass filter L25 to L28, is applied to Rö6. After this point, the IF bandwidth can be reduced to 5 kc or 500 cps. At a bandwidth of 5 kc, Rö6 operates as an amplifier and the IF valve Rö7 is preceded and followed, respectively, by the two 1650-kc band-pass filters L31-L32 and L37-L38. At the 500-cps bandwidth, Rö6 operates as a mixer. The 1650-kc frequency from Rö5 is combined with the 1600-kc frequency arriving from oscillator Rö11I and is thus converted to 50 kc. 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 GI2 and moving-coil meter I1.

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 the 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 GI1, 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 Mc, 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 kc to the range 1 to 3 Mc.

The changing over of the IF bandwidth from 5 kc to 500 cps is made by the ganged switch S5IB-S5IA. S5IB cuts in the anode-supply voltage of the 1600-kc 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 a1. The band-pass filters L37-L38 and L39-L40 between Rö7 and Rö8I are not changed over.

The 1600-kc oscillator Rö11I, which operates only at 500-cps bandwidth, is provided with two variable capacitors. C175 is for fine tuning by ±2.5 kc, 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 I1 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 calibration controls R98 for calibration I, R23 for calibration II und R79 for calibration III eliminate 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 Mc). This oscillator delivers a well-stabilized 1-Mc 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 conditions the gain deviates from the nominal value, it can be corrected with the corresponding calibration control. The following operating conditions must be considered:

(A) Frequency ranges 100 to 1000 kc with an IF bandwidth of 5 kc
(B) Frequency ranges 10 to 1000 kc with an IF bandwidth of 500 cps
(C) Frequency ranges 1 to 30 Mc with an IF bandwidth of 5 kc
(D) Frequency ranges 1 to 30 Mc with an IF bandwidth of 500 cps

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

Replacement of Valves: The valves **Rö1, Rö6, Rö7, Rö8, Rö9, Rö10, Rö11, Rö13, Rö14,** and **Rö15** may be replaced by the same type without any trimming being required.

After replacement of the amplifier and mixer valve **Rö2,** the four-section 40-Mc bandpass filter must be retuned with the trimmer C26. This trimmer is incorporated in the

filter and is accessible from below, near Rö2. Retuning can be made without an external voltage. Select the frequency range "1 TO 3 MC", put the IF BANDWIDTH switch to "5 KC", tune to the frequency of 1 Mc of the calibration oscillator and adjust the trimmer C26 for maximum meter deflection.

After replacement of the double triode **Rö3** the same adjustments must be made as after replacement of Rö2, with the exception that the 40-Mc band-pass filter must be tuned with the trimmer C32. The slotted shaft of this trimmer is accessible from the rear, beside Rö3. In addition, the tuning of the tank circuit L19-C51 of the crystal oscillator must be checked and corrected, if necessary. It can be considered correct if at the cathode resistor R26 an RF voltage (38.35 Mc) of about 1.2 v is measured, the input capacitance of the voltmeter being not higher than about 5 pf.

After replacement of **Rö4** it may be necessary to tune the anode circuit with C67. This trimmer is accessible from below, beside Rö4. Tuning to the calibration frequency is possible in the range "300 TO 1000 KC" or "1 TO 3 MC".

Replacement of **Rö5** may necessitate tuning of the grid circuit L24-C74. The trimmer C74 is tunable from below, beside Rö5. Tuning is possible in the range "300 TO 1000 KC" or "1 TO 3 MC".

After replacement of the reference tube **Rö12** the calibration voltage, 7.75 mv, produced by the calibration oscillator Rö9, may change if the operating voltage of the new valve differs from that of the original one. It is therefore advisable to check the calibration against an external reference level. Select the level range –20 to 0 db, apply a 1-Mc reference level of 0 db to the input of the Type USVH, tune accurately, and adjust the CALIBRATION I control, R98, so that the meter reads 0 db. If the range of variation of R98 is not sufficient, the overall gain may be adjusted with the control R64 in the cathode circuit of Rö5.

Disconnect the standard level source from the input, put the range switch to CALIBRATION, tune accurately and adjust the trimmer C141, located near Rö9, so that the meter again reads 0 db. The trimmer C141 is accessible from above, beside Rö9. It is recommended that the frequency range "300 TO 1000 KC" and the IF bandwidth of 5 kc be selected while these two adjustments are made.

After replacement of the reference tube Rö12 it will generally be necessary to adjust the bias voltage of the rectifier Gl2 which is tapped from the voltage divider R120-

R121-R122 for the expanded range of indication, 7 to 10. Bring the meter to the deflection "10" – for example, by means of the calibration voltage of Rö9 – in the switch position WITHOUT SCALE EXPANSION; then switch over to WITH SCALE EXPANSION and adjust R121 so that the meter reads "10".

Correction of the Frequency Calibration: Should the frequency calibration of the local oscillator Rö10 vary after a long period in service, it can be corrected if a standard signal generator or frequency standard is available:

1st range:	calibrate at	100 kc with C160	4th range:	calibrate at	3 Mc with C156
	calibrate at	10 kc with C166		calibrate at	1 Mc with C164
2nd range:	calibrate at	300 kc with C159	5th range:	calibrate at	10 Mc with C155
	calibrate at	100 kc with C165		calibrate at	3 Mc with C163
3rd range:	calibrate at	1000 kc with C158	6th range:	at	30 Mc change C157
	calibrate at	300 kc with L49		calibrate at	10 Mc with C162

5. Table of Replaceable Parts

Ref. No. according to circuit diagram

Ref. No.	Designation	Ratings	R & S Stock No.
C 1	Capacitor, synth. foil	1000 pf/500 v	CKS 1000/500
C 2	Trimmer, tubular, ceramic	3 pf	CV 7203/1
C 3	Capacitor, ceramic	180 pf	CCH 68/180
C 4	Capacitor, ceramic	1 pf	CCG 21/1
C 5	Capacitor, paper	50,000 pf/250 v	CPK 50 000/250
C 6	Capacitor, electrolytic Capacitor, paper	10 µf/15 v 10,000 pf/250 v	CED 21/10/15 CPK 10 000/250 parallel
C 7	Capacitor, paper	10,000 pf/250 v	CPK 10 000/250
C 8	Capacitor, paper Capacitor, synth. foil	25,000 pf/630 v 2500 pf/500 v	CPK 25 000/630 CKS 2500/500 parallel
C 9	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 10	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 11	Capacitor, paper	25,000 pf/250 v	CPK 25 000/250
C 13	Trimmer, tubular, ceramic	1 to 6 pf	CV 7205
C 14	Trimmer, tubular, ceramic	1 to 6 pf	CV 7205
C 15	Trimmer, tubular, ceramic Capacitor, ceramic	1 to 6 pf 10 pf	CV 7205 CCG 68/10 parallel
C 16	Trimmer, tubular, ceramic	1 to 6 pf	CV 7205
C 20	Trimmer, tubular, ceramic	3 pf	CV 7203/1
C 21	Capacitor, electrolytic Capacitor, paper	10 µf/15 v 10,000 pf/250 v	CED 21/10/15 CPK 10 000/250 parallel
C 22	Capacitor, paper	10,000 pf/250 v	CPK 10 000/250
C 23	Capacitor, feed-through, ceramic	50,000 pf/630 v	CPK 50 000/630
C 24	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 25	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 26	Capacitor, ceramic Capacitor, ceramic Trimmer, tubular, ceramic	12 pf 2 pf 1 to 6 pf	CCH 31/12 CCG 41/2 CV 7205 parallel
C 27	Capacitor, ceramic Trimmer, tubular, ceramic	1 pf 2 pf	CCG 11/1 CV 7202 in series
C 28	Capacitor, ceramic Trimmer, tubular, ceramic	15 pf 1 to 6 pf	CCH 31/15 CV 7205 parallel
C 29	Capacitor, ceramic Trimmer, tubular, ceramic	0.5 pf 2 pf	CCG 11/0,5 CV 7202 in series
C 30	Capacitor, ceramic Capacitor, ceramic Trimmer, tubular, ceramic	18 pf 2 pf 1 to 6 pf	CCH 31/18 CCG 41/2 CV 7205 parallel

Ref. No.	Designation	Ratings	R&S Stock No.
C 31	Capacitor, ceramic Trimmer, tubular, ceramic	1 pf 2 pf	CCG 11/1 CV 7202 in series
C 32	Capacitor, ceramic Capacitor, ceramic Trimmer, tubular, ceramic	18 pf 2 pf 1 to 6 pf	CCH 31/18 CCG 41/2 CV 7205 parallel
C 35	Capacitor, ceramic	39 pf	CCH 31/39
C 36	Capacitor, paper	100,000 pf/400 v	CPK 100 000/400
C 37	Capacitor, ceramic Trimmer, disc	33 pf 10 to 60 pf	CCH 31/33 CV 944 parallel
C 38	Capacitor, ceramic Trimmer, disc	56 pf 10 to 60 pf	CCH 31/56 CV 944 parallel
C 39	Capacitor, ceramic Trimmer, disc	100 pf 10 to 60 pf	CCH 31/100 CV 944 parallel
C 40	Capacitor, ceramic Trimmer, disc	100 pf 10 to 60 pf	CCH 31/100 CV 944 parallel
C 41	Trimmer, disc	10 to 60 pf	CV 944
C 42	Capacitor, ceramic Trimmer, disc	39 pf 10 to 60 pf	CCH 31/39 CV 944 parallel
C 43	Capacitor, ceramic Trimmer, disc	56 pf 10 to 60 pf	CCH 31/56 CV 944 parallel
C 44	Trimmer, disc	10 to 60 pf	CV 944
C 45	Capacitor, ceramic	100 pf	CCH 31/100
C 47	Capacitor, ceramic	270 pf	CCH 68/270
C 48	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 51	Trimmer, air	4 to 29 pf	CV 8025
C 52	Capacitor, synth. foil	2500 pf/250 v	CKS 2500/250
C 53	Capacitor, ceramic	18 pf	CCG 68/18
C 54	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 55	Capacitor, synth. foil	10,000 pf/250 v	CKS 10 000/250
C 56	Capacitor, ceramic	3 pf	CCG 41/3
C 57	Capacitor, ceramic	22 pf	CCH 31/22
C 58	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 59	Capacitor, paper	50,000 pf/250 v	CPM 50 000/250
C 61	Trimmer, air Capacitor, ceramic Capacitor, ceramic	4 to 29 pf 100 pf 120 pf	CV 8025 CCH 32/100 CCH 32/120 parallel
C 62	Trimmer, tubular, ceramic	2 pf	CV 7202
C 63	Trimmer, air Capacitor, ceramic Capacitor, ceramic	4 to 29 pf 100 pf 120 pf	CV 8025 CCH 32/100 CCH 32/120 parallel
C 64	Capacitor, ceramic	10 to 20 pf	CCG 68/10
C 65	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500

Ref. No.	Designation	Ratings	R&S Stock No.
C 66	Capacitor, paper	10,000 pf/250 v	CPK 10 000/250
C 67	Capacitor, ceramic Trimmer, air	15 pf 4 to 29 pf	CCG 68/15 CV 8025 parallel
C 68	Capacitor, paper	10,000 pf/250 v	CPK 10 000/250
C 69	Capacitor, paper	10,000 pf/250 v	CPK 10 000/250
C 73	Capacitor, ceramic	approx. 15 pf	CCH 11/15
C 74	Capacitor, ceramic Trimmer, air	15 pf 4 to 29 pf	CCH 31/15 CV 8025 parallel
C 75	Capacitor, paper	10,000 pf/250 v	CPK 10 000/250
C 76	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 77	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 78	Capacitor, paper	100,000 pf/250 v	CPK 100 000/250
C 79	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 80	Capacitor, feed-through, paper	50,000 pf/300 v	CPD 50 000/300
C 81	Capacitor, paper	10,000 pf/250 v	CPM 10 000/250
C 82	Capacitor, paper	50,000 pf/250 v	CPM 50 000/250
C 83	Trimmer, air Capacitor, ceramic Capacitor, ceramic	4 to 29 pf 100 pf 120 pf	CV 8025 CCH 32/100 CCH 32/120 parallel
C 84	Trimmer, tubular, ceramic	2 pf	CV 7202
C 85	Trimmer, air Capacitor, ceramic Capacitor, ceramic	4 to 29 pf 100 pf 120 pf	CV 8025 CCH 32/100 CCH 32/120 parallel
C 86	Trimmer, tubular, ceramic	2 pf	CV 7202
C 87	Trimmer, air Capacitor, ceramic Capacitor, ceramic	4 to 29 pf 100 pf 120 pf	CV 8025 CCH 32/100 CCH 32/120 parallel
C 88	Trimmer, tubular, ceramic	2 pf	CV 7202
C 89	Trimmer, air Capacitor, ceramic Capacitor, ceramic	4 to 29 pf 100 pf 120 pf	CV 8025 CCH 32/100 CCH 32/120 parallel
C 90	Capacitor, ceramic	6 pf	CCG 41/6
C 91	Trimmer, tubular, ceramic	2 pf	CV 7202
C 92	Capacitor, paper	50,000 pf/250 v	CPM 50 000/250
C 93	Capacitor, feed-through, paper	50,000 pf/300 v	CPD 50 000/300
C 94	Capacitor, feed-through, paper	50,000 pf/300 v	CPD 50 000/300
C 95	Capacitor, paper	10,000 pf/250 v	CKM 10 000/250
C 96	Capacitor, paper	2500 pf/1000 v	CPK 2500/1000
C 98	Trimmer, air Capacitor, ceramic Capacitor, ceramic	4 to 29 pf 100 pf 120 pf	CV 8025 CCH 32/100 CCH 32/120 parallel

Ref. No.	Designation	Ratings	R&S Stock No.
C 99	Trimmer, tubular, ceramic	2 pf	CV 7202
C 100	Trimmer, air Capacitor, ceramic Capacitor, ceramic	4 to 29 pf 100 pF 120 pF	CV 8025 CCH 32/100 CCH 32/120 parallel
C 101	Capacitor, ceramic	220 pf	CCH 68/220
C 102	Capacitor, ceramic Trimmer, tubular, ceramic	12 pf 1 to 11 pf	CCH 31/12 CV 7210 parallel
C 103	Capacitor, synth. foil	1000 pf/500 v	CKS 1000/500
C 104	Trimmer, air	4 to 29 pf	CV 8025
C 105	Capacitor, synth. foil	1000 pf/500 v	CKS 1000/500
C 106	Trimmer, disc	10 to 60 pf	CV 944
C 107	Capacitor, synth. foil	1000 pf/500 v	CKS 1000/500
C 108	Trimmer, air	4 to 29 pf	CV 8025
C 109	Capacitor, synth. foil	1000 pf/500 v	CKS 1000/500
C 110	Capacitor, paper	100,000 pf/250 v	CPK 100 000/250
C 111	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 112	Capacitor, feed-through, paper	50,000 pf/300 v	CPD 50 000/300
C 113	Capacitor, feed-through, paper	50,000 pf/300 v	CPD 50 000/300
C 114	Capacitor, paper	2500 pf/1000 v	CPK 2500/1000
C 115	Capacitor, paper	10,000 pf/250 v	CPM 10 000/250
C 116	Trimmer, air Capacitor, ceramic Capacitor, ceramic	4 to 29 pf 100 pf 120 pf	CV 8025 CCH 32/100 CCH 32/120 parallel
C 117	Trimmer, tubular, ceramic	2 pf	CV 7202
C 118	Trimmer, air Capacitor, ceramic Capacitor, ceramic	4 to 29 pf 100 pf 120 pf	CV 8025 CCH 32/100 CCH 32/120 parallel
C 119	Capacitor, ceramic	220 pf	CCH 68/220
C 120	Capacitor, feed-through, paper	50,000 pf/300 v	CPD 50 000/300
C 121	Capacitor, synth. foil	1000 pf/500 v	CKS 1000/500
C 122	Trimmer, air	4 to 29 pf	CV 8025
C 123	Capacitor, synth. foil	1000 pf/500 v	CKS 1000/500
C 125	Capacitor, feed-through, paper	50,000 pf/300 v	CPD 50 000/300
C 126	Capacitor, feed-through, paper	50,000 pf/300 v	CPD 50 000/300
C 127	Capacitor, feed-through, paper	50,000 pf/250 v	CPM 50 000/250
C 128	Capacitor, paper	10,000 pf/250 v	CPK 10 000/250
C 129	Capacitor, synth. foil	1000 pf/500 v	CKS 1000/500
C 130	Capacitor, paper	100,000 pf/250 v	CPK 100 000/250

Ref. No.	Designation	Ratings	R&S Stock No.
C 131	Capacitor, paper	100,000 pf/250 v	CPK 100 000/250
C 132	Capacitor, feed-through, ceramic	10,000 pf/300 v	CPD 10 000/300
C 133	Capacitor, feed-through, ceramic	500 pf/500 v	CFR 1/500/500
C 134	Capacitor, paper	10,000 pf/500 v	CPM 10 000/500
C 135	Capacitor, paper	10,000 pf/250 v	CPK 10 000/250
C 136	Capacitor, paper	10,000 pf/250 v	CPK 10 000/250
C 140	Capacitor, ceramic	56 pf	CCH 31/56
C 141	Trimmer, air	4 to 29 pf	CV 8025
C 142	Capacitor, ceramic	3 pf	CCG 41/3
C 143	Capacitor, paper	2500 pf/1000 v	CPK 2500/1000
C 144	Capacitor, ceramic Trimmer, air	27 pf 4 to 29 pf	CCH 31/27 CV 8025 parallel
C 145	Capacitor, ceramic	100 pf 180 pf	CCH 31/100 CCH 31/180 parallel
C 146	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 147	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 148	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 149	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 150	Capacitor, ceramic	1000 pf	CCG 94/1000
C 151	Capacitor, ceramic	5 pf	CCG 41/5
C 152	Capacitor, ceramic	3 pf	CCG 41/3
C 153	Capacitor, ceramic	1000 pf	CCG 94/1000
C 154	Capacitor, paper	10,000 pf/630 v	CPK 10 000/630
C 155	Capacitor, ceramic Trimmer, air	8 pf 4 to 10 pf	CCG 68/8 CV 8006 parallel
C 156	Capacitor, ceramic Trimmer, air	33 pf 4 to 10 pf	CCH 31/33 CV 8006 parallel
C 157	Capacitor, ceramic	approx. 5 pf	CCG 68/5
C 158	Trimmer, air	4 to 29 pf	CV 8025
C 159	Capacitor, ceramic Trimmer, air	39 pf 4 to 29 pf	CCH 31/39 CV 8025 parallel
C 160	Capacitor, ceramic Trimmer, air	56 pf 4 to 29 pf	CCH 31/56 CV 8025 parallel
C 161	Capacitor, variable		1521 – 9.6
C 162	Capacitor, ceramic Trimmer, air	47 pf 4 to 29 pf	CCH 31/47 CV 8025 parallel
C 163	Trimmer, air Capacitor, ceramic	4 to 10 pf 12 pf	CV 8006 CCG 68/12 parallel
C 164	Capacitor, ceramic Trimmer, air	10 pf 8 pf 4 to 10 pf	CCG 68/10 CCG 41/8 CV 8006 parallel

Ref. No.	Designation	Ratings	R&S Stock No.
C 165	Capacitor, ceramic Trimmer, air	33 pf 4 to 29 pf	CCH 31/33 CV 8025 parallel
C 166	Trimmer, air	4 to 29 pf	CV 8025
C 169	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 170	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 171	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 172	Capacitor, synth. foil	200 pf/500 v 30 pf/500 v	CKD 2/200/500 CKD 2/30/500 parallel
C 173	Capacitor, ceramic	2 pf	CCG 41/2
C 174	Capacitor, variable	3 to 13 pf	CV 52110
C 175	Capacitor, variable	2 to 4.5 pf	CV 52103
C 176	Capacitor, ceramic	10 pf	CCG 68/10
C 177	Capacitor, paper	10,000 pf/250 v	CPM 10 000/250
C 178	Capacitor, ceramic	18 pf	CCG 68/18
C 179	Capacitor, feed-through, ceramic	5000 pf/500 v	CFR 1/5000/500
C 183	Capacitor, MP	4 µf/350 v	CMR 4/350
C 184	Capacitor, ceramic	100 pf	CCH 68/100
C 185	Capacitor, ceramic	100 pf	CCH 68/100
C 186 C 187	Capacitor, MP	8 µf/350 v 8 µf/350 v	CMR 8+8/350
C 188	Capacitor, paper	2500 pf/1000 v	CPK 2500/1000
C 189	Capacitor, paper	2500 pf/1000 v	CPK 2500/1000
D 1	Filter, lead-through		DFP 13502
Gl 1	Diode, germanium		GK 2591
Gl 2	Diode, germanium		GK 6111
Gl 5	Rectifier	2 x 360 v/100 ma	GN 19/720/100 M
Gl 6	Rectifier	30 v/250 ma	GNB 11/30/250 B
I 1	Ammeter, moving-coil	100 µa/2500 Ω	INS 30106 mit Skala nach 1521—15
K 1	Cable, RF		LKK 91600
K 2	Cable		1521—8.1
K 3	Cable		1521—8.2
K 4	Cable		1521—13
K 5	Cable, RF		LKK 92220
K 6	Power cord		LKA 08031
K 7	Cable, RF		LKK 92220

Ref. No.	Designation	Ratings	R&S Stock No.
L 1	Coil, low-pass filter		1521 – 5.2/2
L 2	Coil, low-pass filter		1521 – 5.3/2
L 3	Coil, low-pass filter		1521 – 5.4/2
L 4	Coil, low-pass filter		1521 – 5.4/2
L 5	Coil, low-pass filter		1521 – 5.5/2
L 6	Coil, low-pass filter		1521 – 5.6/2
L 7	Coil, low-pass filter		1521 – 5.7/2
L 8	Coil, low-pass filter		1521 – 5.9
L 9	Coil		1521 – 3.35
L 10	Coil		1521 – 6.2
L 11	Coil		1521 – 6.2
L 12	Coil		1521 – 6.2
L 13	Coil		1521 – 6.6
L 14	Coil, low-pass filter		1521 – 7.2
L 15	Coil, low-pass filter		1521 – 7.3
L 16	Coil, low-pass filter		1521 – 7.3
L 17	Coil, low-pass filter		1521 – 7.2
L 18	Coil, low-pass filter		1521 – 7.2
L 19	Coil, ceramic body		MCC 0203/0,5
L 21	Coil, IF		1521 – 3.3.6
L 22	Coil, IF		1521 – 3.3.10
L 23	Coil, transformer, IF		1521 – 3.4.3
L 24	Coil, transformer, IF		1521 – 3.4.3
L 25	Coil, IF		1521 – 3.3.10
L 26	Coil, IF		1521 – 10.6.2
L 27	Coil, IF		1521 – 10.7.1
L 28	Coil, IF		1521 – 10.6.2
L 29	Choke		DUF 311/20
L 31	Coil, IF		1521 – 3.3.10
L 32	Coil, IF		1521 – 10.6.2
L 33	Coil, IF		1521 – 10.8.1
L 34	Coil, IF		1521 – 10.8.2
L 35	Coil, IF		1521 – 10.8.1
L 36	Coil, IF		1521 – 10.8.2
L 37	Coil, IF		1521 – 3.3.10
L 38	Coil, IF		1521 – 10.6.2
L 39	Coil, IF		1521 – 10.8.1
L 40	Coil, IF		1521 – 10.8.2
L 41	Choke		DUF 311/20

Ref. No.	Designation	Ratings	R&S Stock No.
L 42	Choke		DUF 311/20
L 43	Choke		DUF 311/20
L 44	Choke		DUF 311/20
L 46	Coil		1521 – 3.5
L 47	Coil		1521 – 9.4
L 48	Coil		1521 – 9.5
L 49	Coil		1521 – 9.2.3
L 50	Coil		1521 – 9.2.4
L 51	Coil		1521 – 9.2.4
L 52	Coil		1521 – 3.6
L 54	Choke		DB 125/2
L 55	Choke		DUF 411/200
L 56	Choke		DUF 411/200
L 57	Choke		enth. in 1521 – 4.7
Q 1	Crystal		QA 21025/38350
R 1	Resistor, depos. carbon	50 Ω ± 1%/0.5 w	WF 50/1/0,5
R 2	Resistor, depos. carbon	60 Ω ± 1%/0.5 w	WF 60/1/0,5
R 3	Resistor, depos. carbon	75 Ω ± 1%/0.5 w	WF 75/1/0,5
R 4	Resistor, depos. carbon	150 Ω ± 1%/0.5 w	WF 150/1/0,5
R 5	Resistor, depos. carbon	600 Ω ± 1%/0.5 w	WF 600/1/0,5
R 6	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R 7	Resistor, depos. carbon	630 Ω ± 1%/0.5 w	WF 630/1/0,5
R 8	Resistor, depos. carbon	50 Ω/0.25 w	WF 50/0,25
R 9	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R 10	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5
R 11	Resistor, depos. carbon	600 Ω/0.5 w	WF 600/0,5
R 12	Resistor, depos. carbon	50 Ω/0.25 w	WF 50/0,25
R 13	Resistor, depos. carbon	600 Ω/0.25 w	WF 600/0,25
R 14	Resistor, depos. carbon	300 Ω/0.5 w	WF 300/0,5
R 15	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R 16	Resistor, depos. carbon	1.25 kΩ/0.5 w	WF 1,25 k/0,5
R 17	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R 18	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R 19	Resistor, depos. carbon	1.25 kΩ/0.25 w	WF 1,25 k/0,25
R 20	Resistor, depos. carbon	3 kΩ/0.5 w	WF 3 k/0,5
R 21	Resistor, depos. carbon	100 Ω/0.25 w	WF 100/0,25
R 22	Resistor, depos. carbon	16 Ω/0.25 w	WF 16/0,25

Ref. No.	Designation	Ratings	R&S Stock No.
R 23	Resistor, wire-wound, variable	500 Ω lin.	WR 4/500
R 25	Resistor, depos. carbon	20 kΩ/0.25 w	WF 20 k/0,25
R 26	Resistor, depos. carbon	200 Ω/0.5 w	WF 200/0,5
R 27	Resistor, depos. carbon	100 Ω/0.25 w	WF 100/0,25
R 28	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R 29	Resistor, depos. carbon	12.5 kΩ/0.5 w	WF 12,5 k/0,5
R 31	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R 32	Resistor, depos. carbon	600 kΩ/0.25 w	WF 600 k/0,25
R 33	Resistor, depos. carbon	300 Ω/0.5 w	WF 300/0,5
R 34	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R 35	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R 41	Resistor, depos. carbon	115.6 Ω ± 1%/0.25 w	WF 115,6/1/0,25
R 42	Resistor, depos. carbon	170.8 Ω ± 1%/0.25 w	WF 170,8/1/0,25
R 43	Resistor, depos. carbon	115.6 Ω ± 1%/0.25 w	WF 115,6/1/0,25
R 44	Resistor, depos. carbon	170.8 Ω ± 1%/0.25 w	WF 170,8/1/0,25
R 45	Resistor, depos. carbon	115.6 Ω ± 1%/0.25 w	WF 115,6/1/0,25
R 46	Resistor, depos. carbon	170.8 Ω ± 1%/0.25 w	WF 170,8/1/0,25
R 47	Resistor, depos. carbon	115.6 Ω ± 1%/0.25 w	WF 115,6/1/0,25
R 48	Resistor, depos. carbon	170.8 Ω ± 1%/0.25 w	WF 170,8/1/0,25
R 49	Resistor, depos. carbon	115.6 Ω ± 1%/0.25 w	WF 115,6/1/0,25
R 50	Resistor, depos. carbon	170.8 Ω ± 1%/0.25 w	WF 170,8/1/0,25
R 51	Resistor, depos. carbon	115.6 Ω ± 1%/0.25 w	WF 115,6/1/0,25
R 52	Resistor, depos. carbon	170.8 Ω ± 1%/0.25 w	WF 170,8/1/0,25
R 53	Resistor, depos. carbon	115.6 Ω ± 1%/0.25 w	WF 115,6/1/0,25
R 54	Resistor, depos. carbon	170.8 Ω ± 1%/0.25 w	WF 170,8/1/0,25
R 55	Resistor, depos. carbon	115.6 Ω ± 1%/0.25 w	WF 115,6/1/0,25
R 56	Resistor, depos. carbon	170.8 Ω ± 1%/0.25 w	WF 170,8/1/0,25
R 57	Resistor, depos. carbon	79.0 Ω ± 1%/0.25 w	WF 79,0/1/0,25
R 61	Resistor, depos. carbon	20 Ω/0.25 w	WF 20/0,25
R 62	Resistor, depos. carbon	600 kΩ/0.25 w	WF 600 k/0,25
R 63	Resistor, depos. carbon	200 Ω/0.5 w	WF 200/0,5
R 64	Resistor, wire-wound, variable	1 kΩ lin.	WR 4 F/1 k
R 65	Resistor, depos. carbon	30 kΩ/0.5 w	WF 30 k/0,5
R 66	Resistor, depos. carbon	10 kΩ/1 w	WF 10 k/1
R 67	Resistor, depos. carbon	80 kΩ/0.5 w	WF 80 k/0,5
R 69	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R 70	Resistor, depos. carbon	200 Ω/0.5 w	WF 200/0,5
R 71	Resistor, depos. carbon	20 kΩ/0.5 w	WF 20 k/0,5

Ref. No.	Designation	Ratings	R&S Stock No.
R 72	Resistor, depos. carbon	10 kΩ/1 w	WF 10 k/1
R 75	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R 76	Resistor, depos. carbon	600 kΩ/0.25 w	WF 600 k/0,25
R 77	Resistor, depos. carbon	300 Ω/0.5 w	WF 300/0,5
R 78	Resistor, depos. carbon	30 kΩ/0.5 w	WF 30 k/0,5
R 79	Resistor, wire-wound, variable	1 kΩ lin.	WR 4/1 k
R 80	Resistor, depos. carbon	10 kΩ/1 w	WF 10 k/1
R 81	Resistor, depos. carbon	1 kΩ/0.25 w	WF 1 k/0,25
R 82	Resistor, depos. carbon	600 kΩ/0.25 w	WF 600 k/0,25
R 83	Resistor, depos. carbon	200 Ω/0.5 w	WF 200/0,5
R 84	Resistor, depos. carbon	6 kΩ/0.5 w	WF 6 k/0,5
R 85	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5
R 86	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R 87	Resistor, depos. carbon	2.5 kΩ/0.25 w	WF 2,5 k/0,25
R 88	Resistor, depos. carbon	6 kΩ/0.5 w	WF 6 k/0,5
R 89	Resistor, depos. carbon	2.5 kΩ/0.5 w	WF 2,5 k/0,5
R 90	Resistor, depos. carbon	100 kΩ/0.5 w	WF 100 k/0,5
R 91	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R 92	Resistor, depos. carbon	6 kΩ/0.5 w	WF 6 k/0,5
R 93	Resistor, depos. carbon	1 kΩ/0.5 w	WF 1 k/0,5
R 95	Resistor, depos. carbon	1 kΩ/1 w	WF 1 k/1
R 98	Resistor, wire-wound, variable	500 Ω lin.	WR 4/500
R 99	Resister, depos. carbon	40 kΩ/0.5 w	WF 40 k/0,5
R 100	Resistor, depos. carbon, variable	500 kΩ log.	WS 7226/500 k
R 101	Resistor, depos. carbon	approx. 50 kΩ/0.5 w	WF 50 k/0,5
R 106	Resistor, depos. carbon	1 MΩ/0.25 w	WF 1 M/0,25
R 107	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R 111	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R 112	Resistor, depos. carbon	approx. 10 kΩ/1 w	WF 10 k/1
R 113	Resistor, depos. carbon	approx. 3 kΩ/1 w	WF 3 k/1
R 114	Resistor, depos. carbon	approx. 6 kΩ/1 w	WF 6 k/1
R 116	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R 117	Resistor, depos. carbon	10 kΩ/0.5 w	WF 10 k/0,5
R 120	Resistor, depos. carbon	40 kΩ/0.5 w	WF 40 k/0,5
R 121	Resistor, depos. carbon, variable	5 kΩ lin.	WS 9122 F/5 k
R 122	Resistor, depos. carbon	40 kΩ/0.5 w	WF 40 k/0,5
R 123	Resistor, depos. carbon	400 kΩ/0.25 w	WF 400 k/0,25

Ref. No.	Designation	Ratings	R&S Stock No.
R 124	Resistor, depos. carbon	50 kΩ/0.5 w	WF 50 k/0,5
R 125	Resistor, depos. carbon, variable	10 kΩ lin.	WS 9122 F/10 k
R 126	Resistor, depos. carbon	30 kΩ/0.5 w	WF 30 k/0,5
R 127	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R 128	Resistor, depos. carbon	25 kΩ/0.5 w	WF 25 k/0,5
R 129	Resistor, depos. carbon, variable	10 kΩ lin.	WS 7122 F/10 k
R 130	Resistor, depos. carbon	5 kΩ/0.5 w	WF 5 k/0,5
R 131	Resistor, depos. carbon	2 kΩ/0.5 w	WF 2 k/0,5
R 132	Resistor, depos. carbon	20 kΩ/2 w	WF 20 k/2
R 133	Resistor, depos. carbon	800 kΩ/0.25 w	WF 800 k/0,25
R 134	Resistor, depos. carbon	200 kΩ/0.25 w	WF 200 k/0,25
R 135	Resistor, depos. carbon	500 kΩ/0.25 w	WF 500 k/0,25
R 136	Resistor, depos. carbon	50 Ω/0.5 w	WF 50/0,5
R 137	Resistor, depos. carbon	100 kΩ/0.25 w	WF 100 k/0,25
R 138	Resistor, depos. carbon	50 Ω/0.5 w	WF 50/0,5
RsA	Relay		RSS 120048
Rl 1	Lamp, glow, miniature	220 v	RL 210
Rö 1	Pentode		E 180 F
Rö 2	Pentode		EF 800
Rö 3	Duo-triode		ECC 801 S
Rö 4	Pentode		EF 800
Rö 5	Pentode		EF 805 S
Rö 6	Pentode		EF 800
Rö 7	Pentode		EF 800
Rö 8	Duo-triode		ECC 801 S
Rö 9	Duo-triode		ECC 801 S
Rö 10	Triode		EC 93
Rö 11	Duo-triode		ECC 801 S
Rö 12	Reference tube		85 A 2
Rö 13	Pentode, output		PL 81
Rö 14	Pentode, output		PL 81
Rö 15	Pentode		EF 806 S

Ref. No.	Designation	Ratings	R&S Stock No.
S 1	Switch, midget step		SRW 14110
S 2	Switch, midget		SR/1 SM 1
S 3 I/II	Switch, wafer		SRN 323/2/32
S 3 III	Switch, toggle, forked		SR 131/2
S 4 I . . . IV	Switch, midget step		1521 – 9.16
S 4 V	Switch, midget		SR/1 SM 1
S 4 VI	Switch, midget		SR/1 SM 1
S 4 VII	Switch, midget		SR/1 SM 1
S 4 VIII	Switch, midget		SR/1 SM 1
S 5	Switch, midget step		SRW 14120
S 6	Switch, rotary		SR 113/3
S 7	Fuse panel		FD 60511
S 8	Switch, toggle		SKK 120
Si 1	Fuse	400 ma	0,4 C DIN 41571
Tr 1	Transformer, power		1521 – 12/2

Condensed Operating Instructions

Calibration (Section 3.3 condensed)

3 to CALIBRATION (1 MC)

14 to WITHOUT

17 to 1 TO 3 MC

8 to 5 KC

Put dial cursor **6** to the red mark **2** using **7** and tune for maximum deflection of **5**.

Vary **16** until the pointer of **5** is exactly at 0 db.

Switch **17** over to 300 KC TO 1 MC.

Put dial cursor **6** to the red mark (at the right end of the dial) using **7** and tune for maximum deflection of **5**.

Vary **15** until the pointer of **5** is exactly at 0 db.

Switch **8** over to 500 CPS.

Set **11** to 0 KC.

Adjust **12** for maximum deflection of **5**.

Vary **13** until **5** reads exactly 0 db.

Measuring with 5-kc IF bandwidth

Possible frequency range 100 cps to 30 Mc.

Voltage measurement range 0.2 μv to 1 v.

Select required input impedance using **19.**

For 0.2 μv to 10 mv, set **1** to "x 1/+0 db" and **3** to one of the nine ranges depending on the voltage.

For 10 mv to 1 v, set **1** to "x100/+40 db" and **3** to one of the nine ranges depending on the voltage.

Multiply the voltage value resulting from **3** and **5** by 100.

Set **14** to WITHOUT.

Set **8** to 5 KC.

Apply voltage to be measured via coaxial cable to **18.**

Adjust **17** to range which covers the frequency of the voltage to be measured.

Select frequency using **7** and tune for maximum deflection of **5**. Read off voltage.

If, for example, **1** is on "x 100/+40 db", **3** on "100 μV/– 80 db" and pointer of **5** on 7 v (upper scale), $E_x = 70\ \mu v \times 100 = 7000\ \mu v = 7$ mv; this equals the level of (+40 db) + (– 80 db) + (–1 db) = – 41 db.

Measuring with 500-cps IF bandwidth

Possible frequence range
10 kc to 30 Mc if $E_x = 30\ \mu v$ to 1 v,
20 kc to 30 Mc if $E_x = 3\ \mu v$ to 1 v,
30 kc to 30 Mc if $E_x = 0.2\ \mu v$ to 1 v.

Set **8** to 500 CPS.

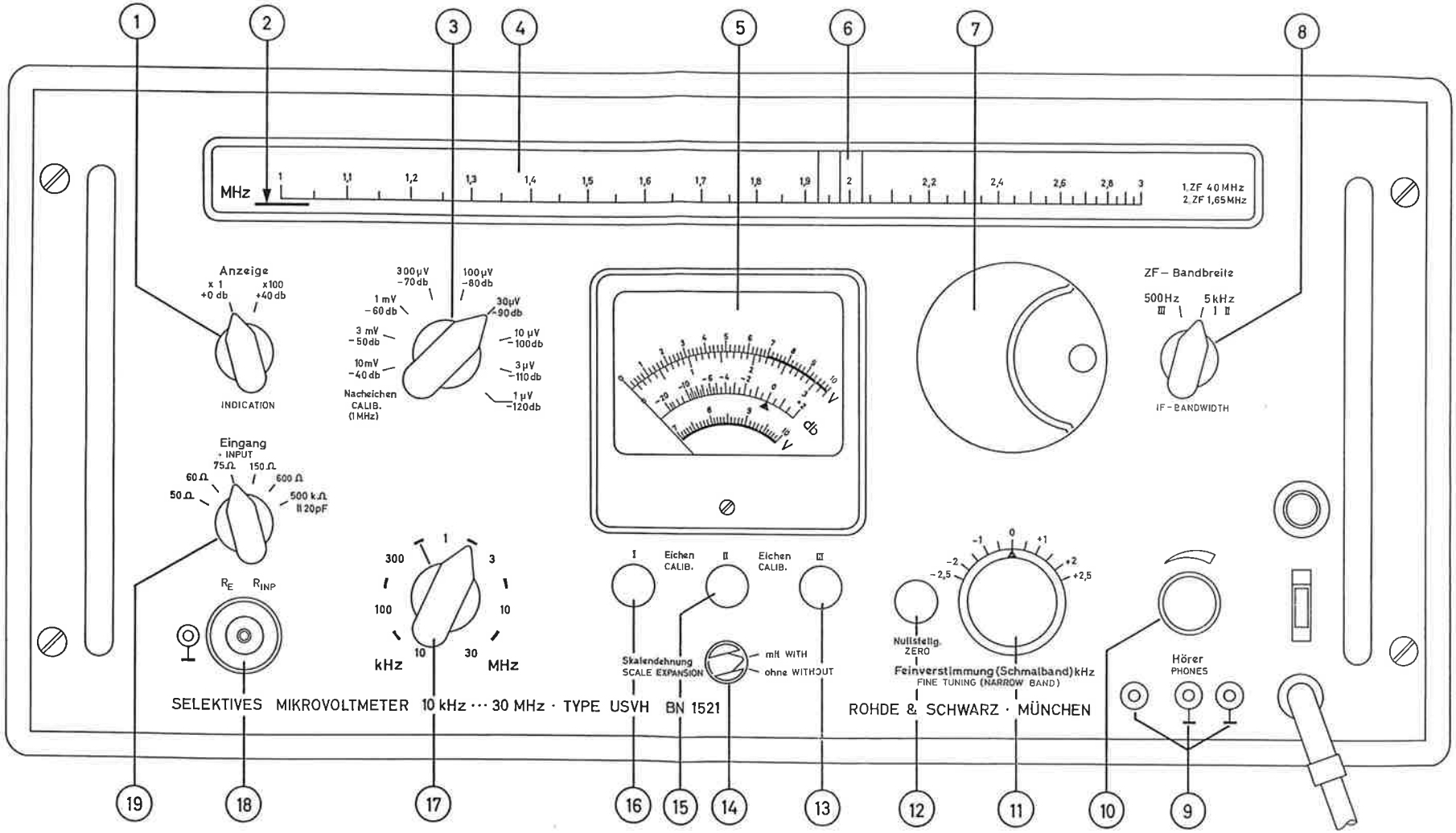
Otherwise, same as for measuring with 5-kc IF bandwidth.

Measuring WITH SCALE EXPANSION
(see Section 3.9.2, page 46)

FINE TUNING (NARROW BAND)
(see Section 3.6, page 44)

Output PHONES (see Section 3.7, page 44)

Frontplatte
Front panel



Kurz

Eicher

3 au

14 au

17 au

8 au

Mit **7** drehe aussc

16 ei ze

17 au

Mit **7** rechte abstir

15 ei ze

8 au

11 au

12 ei

13 ei

Mess

Mögl 30 M

Span

Eingc

Für 0 geste der 9

Für 1 geste