Since the frequency response of the URV 3 measuring heads is exclusively determined by the built-in measuring diodes and the mechanical design of the measuring head, the frequency response need only be checked after the measuring head has been repaired.

The frequency response is best measured with the test setup shown in Fig. 7; the thermal power meter, however, should be connected directly to the URV 3 measuring head without inserting an attenuator set.

Adjustment of the set

a) Make the adjustments at a temperature between 20 and 25°C.

b) Select the 1-V range with rotary switch 1.

c) Connect the probe to socket 6 and insert it into the BNC adapter.

d) Calibrate the power meter with DC voltage.

e) Apply an AC voltage to the BNC adapter with frequency variable from 100 kHz to 1000 MHz and distortion factor < 0.3% (use lowpass filter, if necessary).

Performance check

Adjust the amplitude of the AC voltage so that it gives the same deflection on the power meter as a DC voltage of 1.000 V and keep it constant.
Set the frequencies in the order given in Table 5 and read the value indicated on meter 7. The deviation from 1.000 V must not exceed the limits specified in Table 5.

Table 5

Frequency/MHz	Max. permissible deviation from 1.000 V
0.1	±4%
1	±3%
100	±3%
200	±5%
500	±9%
1000	±20%

3.2.3 Measurement of Frequency Response of Insertion Units

The frequency response of the insertion units is best measured with the test setup according to Fig. 7, the thermal power meter being connected to the URV 3 measuring head without inserting an attenuator box.

Adjustment of the set

a) Make the adjustments at a temperature between 20 and 25°C.

b) Select the 1-V or 100-mV range with switch 1 (Fig. 2).

c) Connect the cable of the insertion unit to be checked to socket 6 and terminate the insertion unit at one end with the 50-Ω probe of a power meter (Fig. 7).

d) Calibrate the power meter with DC voltage.

e) Feed an AC voltage to the insertion unit with a frequency being variable from 10 kHz to 2000 MHz and a distortion factor < 0.3% (use lowpass filter, if necessary).

Performance check

Adjust the amplitude of the AC voltage so that it causes the same deflection on the power meter as a DC voltage of 1.000 V and keep it constant. Set the frequencies according to Table 6 and read the value indicated on meter 7. The deviation must not exceed the limits specified in the following table.

Table 6

Frequency	Max. permissible deviation from the indication	
	1 V 10-V insertion unit	100 mV 100-V insertion unit
10 kHz	±3%	---
1 MHz	±3%	±3%
10 MHz	±3%	±3%
100 MHz	±3%	±3%
200 MHz	±4%	±4%
500 MHz	±7%	±7%
1000 MHz	±9%	±9%
1600 MHz	±14%	±14%
2000 MHz	±22% +)	±22%

+) Only with 50-Ω version

3.2.4 DC Output

Adjustment of the set

a) Make the adjustments at a temperature between 20 and 25°C.

b) Select the 1-V range with rotary switch 1 (Fig. 2).

c) Connect a measuring head to socket 6.

d) Apply an AC voltage to the measuring head with an amplitude causing an indication of 1.000 V on meter 7.

e) Connect a digital voltmeter to output sockets 2 and 3.

Performance check

If the readout on meter 7 is 1.000 V, the output voltage must be 1.000 V ±10 mV.

3.3 Electrical Maintenance

Under normal operating conditions, the URV 3 does not require regular electrical maintenance. The batteries or the charging condition of the accumulator should be checked occasionally according to section 2.3.1.

3.3.1 Replacing the Diodes in the Probe

See Fig. 9

If any of the diodes in the probe have been destroyed by an excessive input voltage, all four diodes must be replaced. A selected quad can be obtained from Rohde & Schwarz under the order number 243.9001. To replace the diodes proceed as follows:

a) Push back the cable bushing.

b) Loosen the fixing screw of the probe sleeve.

c) Withdraw the probe sleeve towards the cable.

d) Replace the quad GL1I - GL1IV shown in Fig. 9 with the aid of a pair of tweezers.

!! No soldering, diodes are plugged in !!

If any soldering must be done in the measuring head, first remove the four diodes from their sockets to protect them from inadmissibly high temperature.

3.3.2 Replacing the Diodes in the 10-V and 100-V Insertion Units

See Fig. 10

If any of the diodes have been destroyed by an excessive input voltage, all four diodes must be replaced. A selected quad can be obtained from Rohde & Schwarz under the order number 288.8304. To replace the diodes, proceed as follows:

a) Unscrew the cover with the engravings. All four diodes are now accessible.

b) Pull out the diodes GL1III and GL1IV towards the top. The diode leads are plugged into miniature sockets; they are not soldered in place.

c) Likewise, the diodes GL1I and GL1II are plugged into miniature sockets. First pull the lead facing the coaxial section out of the miniature socket towards the top. Then pull the diode towards the front, which at the same time pulls the other lead out of the socket located in the chamber partition wall.

d) For insertion of the new diodes see Fig. 10.

4. Circuit Description

See circuit diagram 302.9014 S.

The values stated in this section are not guaranteed; only the specifications given in the data sheet are binding.

The operating principle of the URV 3 is based on the comparison of the output voltages of two detector circuits.

Besides a detector for measuring the RF voltage, a reference detector of similar design is provided in the probe or insertion unit, to which a reference AC voltage produced in the URV 3 is taken. The difference between the two detected voltages is amplified in the set. Since the detected voltages of the detectors may be less than 1 µV, the input amplifier of the URV 3 is designed as a chopper-stabilized DC voltage amplifier consisting of the chopper transistors T1 and T2, the amplifier T3 and B12, the synchronous detector B11, the transistor T4 and the amplifier B13. Generator B10 supplies the switching voltage for the chopper amplifier and the synchronous detector. The boosted voltage passes via T5 and T8 to the attenuator R75 to R81. Transistors T5 and T8 act as a rectifier passing positive voltages and inhibiting negative voltages, thus keeping the control loop stable.

After attenuation according to the selected subrange, the output voltage is applied to the feedback circuit by means of FET switch B17. B2 transforms the attenuated DC output voltage into an amplitude-proportional 5-kHz squarewave AC voltage. The trigger voltage for B2 is derived from generator B3. The transformer TR2, capacitor C7 and the resistors R9 - R11 form a damped resonant circuit whose resonant frequency is 5 kHz and which transform the 5-kHz squarewave voltage into a sinewave voltage. After amplification in the driver amplifier B1, the sinewave voltage is applied via transformer TR1 to the reference detector in the measuring head (probe or insertion unit). The gain of the driver amplifier can be varied with R8, to obtain full-scale reading on the meter.

On account of the high loop gain of the control circuit, the amplitude of the reference voltage is adjusted such that the difference between the detected voltages is zero except for a small offset. Since the diodes in the measuring and reference detectors are selected for matched characteristics, the rms values of measured and reference voltages having the same (sinusoidal) waveform are identical.

Through the feedback circuit a proportional function between the DC output voltage and the rms value of a sinusoidal test voltage is established. As a result, the meter reading is proportional to the rms value of a sinusoidal test voltage. The measurement accuracy is mainly determined by the matching of the characteristics of the four diodes used in the measuring head.

The measurement ranges are adjusted by means of the switch 1 (Fig. 2) and FET switch B17. The wide dynamic range of the control circuit permits switching over in 20-dB steps. The 10-dB intermediate steps are achieved by switching the detector/amplifier.

The amplified DC voltage is taken via the attenuator R104 - R106 to the detector/amplifier B18 which acts as a buffer for meter J1. Due to the resistors R104 - R108 - R111 and the capacitor C33, the amplifier B18 has a differentiating behaviour, compensating for the inertia of meter J1. This compensation and the resulting transient response of the indication can be adjusted with R108.

Power supply

In the switching stage T17 and T18, the operating voltage (from batteries, AC supply, accumulator or external power source) is transformed to a square-wave voltage having a frequency of 10 kHz. Generator B19 supplies the switching voltage for T17 and T18 via the driver transistors T15 and T16. The AC voltage is stepped up in TR3 and rectified with GL15 - GL18. The stabilized DC voltage of +15 V and -15 V is derived from the control circuit T9 - T14.

The blinker circuit T19 - T21 feeds the LED GL3 with a pulse-shaped current having a frequency of approximately 1 Hz and a duty cycle of 0.01. GL3 blinks when the set is on.

5. Repair Instructions

The values stated in this section are not guaranteed; only the specifications given in the data sheet are binding.

The component parts used in the URV 3 are carefully selected and the set itself is subjected to a rigid examination prior to delivery. Failures are, therefore, not very likely to occur. In the case of a failure, however, refer to the following to locate the trouble source:

a) Circuit description - section 4.
b) Circuit diagrams with voltage and resistance values.
c) Section 5.2 in which the checking of the various functional groups is described.

All components are readily accessible. Loosen the Phillips screws on either side of the set to remove the upper and lower covers. All essential components are arranged on a single PC board which is accessible from both sides after removing the covers and thus need not be withdrawn from the set in case of repair. All connecting elements are plugged so that the PC board can easily be dismounted, if necessary. All integrated circuits are plugged into sockets to facilitate repairs. The PC board is equipped with a 16-contact test socket, to which all important test points are connected. This permits easy location of electrical faults. The test socket is designated Bu1 and the corresponding connections may be seen from the circuit diagram.

Use only replacement parts of the same type and equal quality. For the necessary ordering information refer to the respective parts lists (appendix).

5.1 Measuring Instruments and Auxiliary Equipment Required

The measuring instruments and auxiliary equipment necessary for repairs are listed in Table 7.

5.2 Trouble Shooting

This section covers all measurements, performance data and settings required for performance checking of the individual subassemblies and ensuing trouble shooting and repair. The location of the adjusting elements can be seen from Fig. 11.

The specifications of the various performance checks are generally based on the assumption that the subassembly concerned and all subassemblies functionally linked with it are properly operating.

Unless stated otherwise, the current and voltage specifications apply to the nominal operating voltage (6 V). All voltages are measured at high impedance versus the reference potential of 0 V.

Following a repair on the URV 3 carry out the performance check according to section 3.2, to make sure that the set is functioning properly.

5.2.1 Power Supply

See circuit diagram 302.9014 S and component location plan 302.9614.

The operating frequency of the voltage converter is approximately 10 kHz. Generator B19 drives the switching stage T17 and T18 via the driver transistors T15 and T16. The amplitude of the squarewave voltage at the primary of transformer TR3 is

$$V_{pp} \approx V_b - 0.3 \quad [V]$$

With an operating voltage of 6 V, the rectified secondary voltage at the charging capacitor C44 is -24 V and that at capacitor C45 +24 V, provided the meter shows no or only a slight deflection. In the case of full-scale reading, the voltage may drop to +18 V and -18 V. The +15-V operating voltage is stabilized in the control circuit T12 - T14; the tolerance range extends from +14.2 to +15.2 V. The -15-V operating voltage is derived from the +15-V voltage. Thus the output voltage of -15 V is only correct if the +15-V output voltage is available.

5.2.2 Switch-on Indication

The transistors T20 and T21 form an astable multivibrator oscillating with a frequency of about 1 Hz. The collector voltage of T20 is differentiated via C48 and R136 and taken to the driver transistor T19. The current flowing through the LED GL3 is pulse-shaped with a pulse width of approximately 10 ms and an amplitude of about 50 mA.

5.2.3 Chopper Generator

Generator B10 delivers a symmetrical squarewave voltage to its output, the frequency being approximately 23 Hz and the amplitude

$$V_{pp} \approx 12 \text{ V}.$$

The negative portion of the generator voltage switches the chopper transistors T1 and T2, while the synchronous detector B11 is directly controlled by the generator voltage.

5.2.4 Reference Generator

Generator B3 supplies a symmetrical squarewave AC voltage with a frequency of 5 kHz and an amplitude of +15 V. The frequency of this generator can be slightly varied with R18. The DC output voltage of the reference generator is transformed to a squarewave AC voltage of equal amplitude in B2 and taken to transformer TR2 via the resistors R9 - R11. TR2 and C7 form a damped resonant circuit with a frequency of 5 kHz, thus converting the squarewave voltage to a sinewave voltage which is amplified in the driver amplifier B1 and delivered via the transformer TR1 to the reference detector in the measuring head. The DC input voltage of the reference generator is available at the test socket Bu1, contact 13, and the AC output voltage of 5 kHz is present at socket 1, contact 5.

At a DC input voltage of 1 V at Bu1.13, the AC output voltage of the reference generator at Bu1.5 must be about 300 mV (NOTE: output impedance at the test socket Bu1.5 = 10 kΩ).

5.2.5 Feedback Attenuator

The feedback attenuator for range switching is provided between the amplifier output and the reference generator whose input is connected to Bu1.13. In the ranges 10 V, 3 V and 1 V, no division takes place. In the ranges 0.3 V and 100 mV, the division factor is 10, in the ranges 30 mV and 10 mV 100 and in the range 3 mV 1000.

5.2.6 Detector/Amplifier

The DC output voltage is taken via the attenuators R104 - R106 to the detector/amplifier B18. The division factor is 10 in the range 10 V, $\sqrt{10}$ in the ranges 3 V, 0.3 V, 30 mV and 3 mV, 1 in the ranges 1 V, 100 mV and 10 mV.

B18 is designed as a differentiating amplifier, the differentiating time constant being adjusted with R108 and matched to the characteristic of meter J1. Due to the differentiation, the needle is accelerated and thus seems to be almost inertialess. The temperature-dependent resistor R100 compensates for the temperature-dependent output impedance of the meter. R101 serves for adjusting full-scale reading of the meter.

5.3 Adjustments

Prior to any adjustment make sure that the URV 3 is in perfect operating condition; check the operating voltage according to section 2.3.1.

Carry out the adjustments at a temperature between 20 and 25°C and allow for a warm-up period of at least 10 minutes.

Use the test setup shown in Fig. 8 and observe the following:

a) The lowpass filter is not required if the signal generator supplies a low-distortion output voltage (k < 0.3%).

b) As a measuring head for the URV 3, it is advisable to use the probe together with the BNC adapter (insertion adapter). The use of an insertion head is also possible but requires the connection of a T-section ahead of it, in order to make the inner conductor accessible for voltage measurements.

For adjustment proceed as follows:

a) Set the attenuator to 0 dB and the zero potentiometer R200 (9 in Fig. 3) on the rear panel to mid-position.

b) Select the 1-V range.

c) Apply a voltage with a frequency of 1 MHz and an amplitude V_{rms} = 1 V to the measuring head.

d) Adjust the pointer deflection on meter 7 exactly to minimum with R18 (Fig. 11).

e) Remove the test voltage and turn R27 to the right-hand stop.

f) Measure the voltage at Bul.14 with an oscilloscope and adjust the AC component (approx. 22 Hz) to minimum with R42.

g) Check the mechanical zero of meter 7 and, if necessary, adjust. Now set the electrical zero with R109.

h) Switch on the 3-mV range and adjust R27 so that the pointer of meter 7 remains within the field designated "AC-Null". During this procedure, no voltage must be available at the measuring head.

i) Select the 1-V range and calibrate the test setup with a DC voltage.

k) Apply a voltage with a frequency of 1 MHz, an amplitude of V_{rms} = 1 V ±1 mV and a distortion factor of < 0.3% to the measuring head.

l) Connect a digital voltmeter to sockets 2 and 3 and adjust the indicated DC output voltage of the URV 3 to 1.000 V ±1 mV using R8.

m) Adjust the value indicated on meter 7 to the scale value 10 (≙ 1 V).

n) Decrease the AC input voltage stepwise by about 10 dB (attenuator) and then increase it again. In doing so, observe the indication on meter 7 and adjust for optimum transient response (aperiodic critical case).

o) Remove the input voltage and cut in the range 3 mV.

p) Check again the electrical zero according to g).

q) Apply the same AC voltage as above (1 MHz, 1.000 V ±1%) and switch in 60 dB with the attenuator. This results in 1 mV on the measuring head.

r) Adjust for an indication of 1 mV on meter 7 using R16 (0 - 3 scale).

Table 7

Measuring instruments and auxiliary equipment for maintenance (section 3)

Item	o Type of equipment, required specifications • Recommended R&S instrument	Type	Order No.	Use acc. to section
1	o Digital voltmeter 0 to 10 V; with input for external reference voltage; can be used as a ratiometer			3.2.1 3.2.2 3.2.3 3.2.4 5.2.1 5.2.4 5.3
2	o Signal generator(s) 10 kHz to 2 GHz			3.2.1 3.2.2 3.2.3 3.2.4 5.3
	• Power Signal Generator 25 to 1000 MHz	SMLU	200.1009.02	
	• UHF Power Signal Generator 0.275 to 2.75 GHz	SLRD	100.4194.02	
3	o Power meter 10 kHz to 2 GHz with 50-Ω probe			3.2.1 3.2.2 3.2.3 5.3
	• Microwave Power Meter with 50-Ω probe	NRS	100.2433.92 100.2440.50	
4	o Precision attenuator, 50 Ω 0 to 1 GHz			3.2.1 3.2.2 3.2.3
	• Programmable Attenuator 50 Ω, 0 to 139.9 dB; 0 to 1000 MHz	DFVP	214.8017.52	5.3
5	o Termination, 50 Ω 0 to 2 GHz			3.2.1 3.2.2 3.2.3
	• Termination	RMC	100.2940.50	
6	o DC voltage source 0 to 10 V			3.2.1 3.2.2 3.2.3
	• Power Supply	NGR	100.5084...	5.3
7	o Lowpass filter 50 Ω (not required if low-distortion signal generators are used)			3.2.1 3.2.2 3.2.3 5.3
8	o Frequency counter			5.2.1 5.2.3 5.2.4
9	o Oscilloscope			5.2.1 5.2.2 5.2.3 5.2.4 5.3
10	o Attenuator 2 GHz; 20 dB; 2 W; 50 Ω			3.2.1
	• High-power Attenuator 2.4 GHz; 20 dB; 20 W; 50 Ω	RBD	100.2985.50	
11	o Three-port junction 0 to 1 GHz; 50 Ω			3.2.1
	• Three-port Junction Box 0 to 1000 MHz, 50 Ω	DVU 3	100.5303.50	
12	• BNC insertion adapter	URV-Z6		3.2.1 3.2.2 3.2.3 5.3