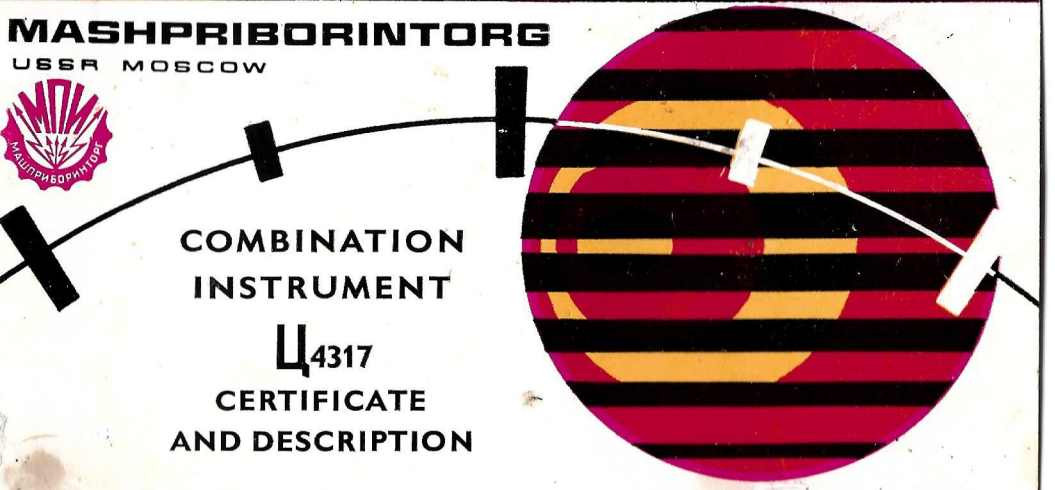
MASHPRIBORINTORG

USSR MOSCOW



COMBINATION INSTRUMENT Ц4317 CERTIFICATE AND DESCRIPTION

CERTIFICATE

1. PURPOSE

The instrument is designed for measuring current and voltage in D.C. and A.C. circuits, D.C. resistance, and relative A.C. voltage level.

2. SPECIFICATION

Class of Accuracy:

in D.C. measurements 1.5
in A.C. measurements ..... 2.5 (4.0 on 0.5 V range)

Measuring Ranges:

Direct current, mA 0.05–0.5–1–5–10–50–250–1,000–5,000
Alternating current, mA 0.25–0.5–1–5–10–50–250–1,000–5,000
D.C. voltage, V 0.1–0.5–2.5–10–25–50–100–250–500–1,000
A.C. voltage, V 0.5–2.5–10–25–50–100–250–500–1,000
D.C. resistance, kOhm 0.2–3–30–300–3,000
A.C. voltage transmission level, dB ..... from –5 to +10
Frequency range (for the majority of measuring ranges), Hz 45–1,000–5,000

Fundamental Measuring Error:

D.C. and D.C. voltage, % of full scale value ..... $\leqslant \pm 1.5$
A.C. and A.C. voltage, % of full scale value ..... $\leqslant \pm 2.5$
On 0.5 V A.C. range, % of full scale value ..... $\leqslant \pm 4.0$
D.C. resistance, % of effective range ..... $\leqslant \pm 1.5$
A.C. voltage transmission level, % of effective range ..... $\leqslant \pm 2.5$
Instrument mass, kg ..... $\leqslant 2.0$
Overall dimensions, mm ..... $\leqslant 225 \times 120 \times 95$

3. STANDARD EQUIPMENT

Combination instrument Ц4317 109	1
Cell 332 (built-in)	3
Connecting wire with lugs	1
Connecting wire with lug and probe	2
Detachable flat lug	2
Detachable alligator clip	2
Case for instrument and accessories	1
Spare parts:	
germanium diode	2
brace ПлСр–20М0.25	1
Description and Operating Instructions	1
Certificate	1

4. ACCEPTANCE CERTIFICATE

The instrument has been tested for compliance with the Specifications and found fit for service.

Date of manufacture 1 **197**5

Inspector _____
(signature)

DESCRIPTION

1. PURPOSE

1.1. The Ц4317 portable combination instrument is designed for measuring current and voltage in D.C. and A.C. circuits, D.C. resistance, and relative A.C. voltage level.

1.2. Two instrument modifications are available:

Ц4317 – for use at ambient temperatures between 0 and +35 °C and relative humidity up to 80%;

Ц4317Т – for indoor operation under conditions of dry and humid tropical climates at ambient temperatures between 0 and +45 °C and relative humidity up to 95%.

2. SPECIFICATION

2.1. The fundamental error of the instrument at normal affecting factors (see Table 4) does not exceed ±1.5% when measuring D.C., D.C. voltage and D.C. resistance, ±2.5%, when measuring A.C., A. C. voltage and relative transmission level of A.C. voltage, and ±4% when taking measurements on the "0.5 V" A.C. range.

2.2. The instrument measuring ranges, current consumption, and normal values of the parameters affecting the instrument operation, are given in Tables 1–4.

Table 1

D.C. measuring ranges (—)

Voltage, V	F.S.D. current, μA	Current, mA	Voltage drop, V (max.)
1	2	3	4
1,000 500	50	5,000 1,000	0.65 0.35

1	2	3	4
250		250	0.30
100		50	0.30
50		10	0.30
25	50	5	0.30
10		1	0.30
2.5		0.5	0.20
0.5		0.05	0.10
0.1		–	–

Table 2

A. C. measuring ranges (~)

Voltage		F.S.D. current, µA	Current, mA	Voltage drop, V (max.)
V	dB			
1,000	+52		5,000	1.50
500	+46		1,000	1.20
250	+40		250	1.00
100	+32	0.25	50	1.00
50	+26		10	1.00
25	+20		5	1.00
10	+12	1	1	1.00
2.5	dB scale	5	0.5	0.80
0.5	–14	0.25	0.25	0.50

Table 3

Resistance measurements

Measuring range	Limit value	Maximum current consumption, mA
Ω	200 Ohm	15
kΩ×1	3 kOhm	7
kΩ×10	30 kOhm	0.7
kΩ×100	300 kOhm	0.07
MΩ	3 MOhm	0.07

Table 4

Normal Values of Parameters Affecting Instrument Operation

Parameters	Normal value
Working position	Horizontal to ±2%
Temperature	Between +15 and +25 °C (between +22 and +32 °C for Ц4317T), hereafter referred to as t_n
Voltage when measuring D.C. resistance:	
a) on ranges "Ω", "kΩ×1" "kΩ×10", "kΩ×100"	between 1.25 and 1.65 V
b) on "MΩ" range	between 12 and 15 V (from additional D.C. source)
Frequency when measuring current and voltage	Within the rated frequency range
Current or voltage waveform	Sinusoidal with distortion not over 2%

2.3. Normal and extended frequency ranges are given in Table 5.

Table 5

Measuring range	Rated frequency range, Hz	Extended frequency range, Hz
1,000 V	45–55	55–65
500, 250 V	45–60	60–100
100, 50, 25 V	45–100	100–400
The other (current and voltage) ranges	45–1,000	1,000–5,000

2.4. Instrument Complementary Errors.

2.4.1. Instrument reading variations due to tilts up to 10° in any direction from the horizontal position does not exceed ±1.5%.

2.4.2. Instrument reading variations due to a change in the ambient temperature from the normal to any point between 0 and +35 °C for the Ц4317 instruments and between 0 and +45 °C for the Ц4317T instruments, do not exceed the values given in Table 6 per each 10 °C change.

Table 6

Type of instrument	Reading variations, %		
	D. C.	for Ohmmeter	A.C.
Ц4317	±1.5	±0.7	±2.5 (4.0 for 0.5 V)
Ц4317Т	±1.2	±0.7	±2 (4.0 for 0.5 V)

2.4.3. Instrument reading variations due to a change in frequency from the limit rated frequency to any point within the adjacent extended range do not exceed ±2.5% when measuring A.C., A.C. voltage, and relative level of A.C. voltage.

2.4.4. A change in the instrument readings caused by a deviation of the current or voltage waveform from sinusoidal under the influence of the 2nd, 3rd, or 5th harmonic comprising 5% of the effective value of measured current or voltage, does not exceed ±2.5%.

2.4.5. Instrument reading variations caused by the effect of a constant uniform magnetic field of 400 A/m intensity of the most unfavourable direction, does not exceed ±2.5%. When measurements are carried out on A.C., the instrument error, due to the influence of a uniform magnetic field sinusoidally changing in time with frequency equal to that of the current passing through the instrument under test, does not exceed ±5%.

At frequencies between 45 and 60 Hz the field intensity should be 400 A/m, and at higher frequencies (f) the magnetic field intensity (H) should be determined from the formula:

$$H = \frac{24{,}000}{f} \quad A/m$$

2.5. The insulation between all insulated electric circuits and the instrument chassis at normal temperatures and humidity withstands a practically sinusoidal test voltage of 3 kV applied at 50 Hz for 1 min.

3. DESIGN AND PRINCIPLE OF OPERATION

3.1. This is a taut-suspension moving-coil internal-magnet instrument.

3.2. An automatic breaker protects the instrument circuitry against overloads.

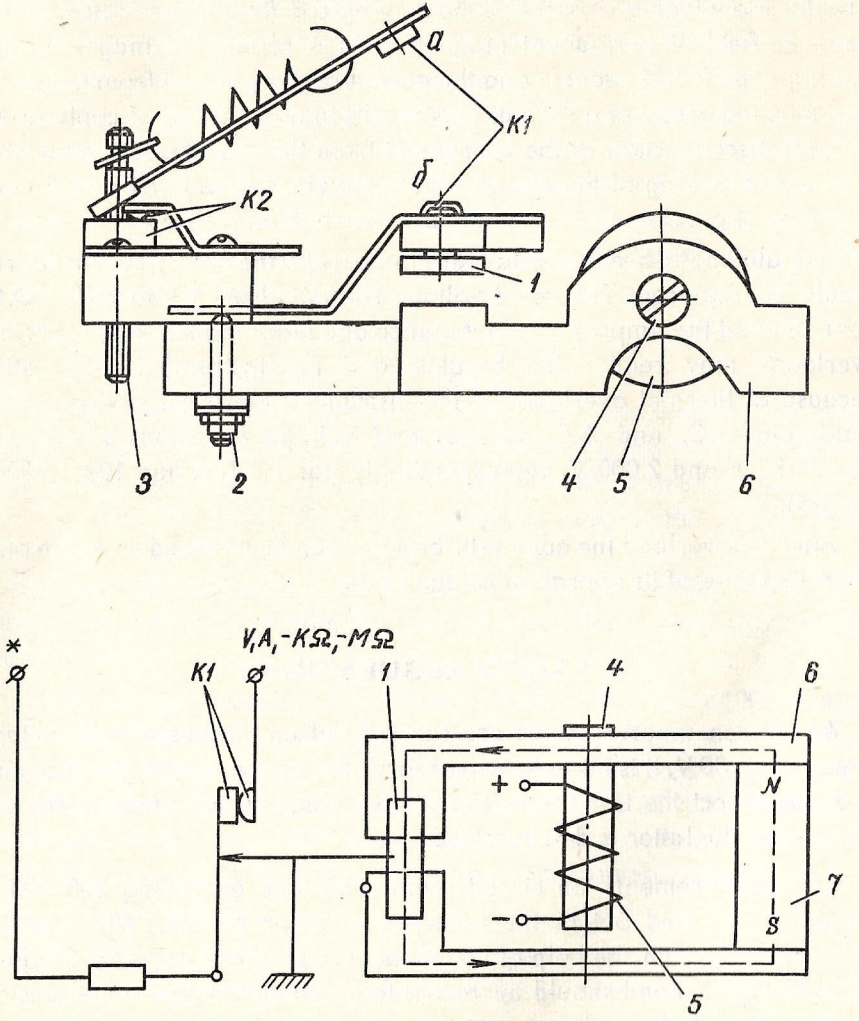


Fig. 1. Protection of the Instrument Against Electrical Overloads

When the input voltage is higher than 6 times the rated, the overload signal is rectified (in case of A.C.) and amplified. Current flowing through the winding of coil *5* of the moving-coil (Fig. 1) interacts with the magnetic field of permanent magnet 7. As a result, the magnetic flux holding armature *1* reduces and the armature is separated from magnetic core *6* by the action of a spring. This results in the opening of contacts *K1* and *K2*, disconnection of the instrument from the circuit under examination, and breaking of the power supply circuit. Contacts *K1* and *K2* are closed by depressing the automatic breaker button.

If the automatic breaker relay fails to operate, the power supply source should be replaced. The rated voltage range is from 2.6 to 3.8 V D.C. Bear in mind that improper maintenance and more than 25-fold electrical overloads may render the breaker and the instrument inoperative because of thermal overloads of the instrument electrical elements. The maximum D.C. and A.C. current and voltage overloads should not exceed 25 A and 2,000 V, correspondingly (for 1–5.0 A and 100–1,000 V ranges).

After an overload the automatic breaker can be switched on again only after the cause of its operation is found out.

4. SAFETY REGULATIONS

4.1. When measurements are carried out on circuits with a voltage higher than 30 V, it is necessary to observe the safety regulations. Connect and disconnect the instrument to a high-voltage circuit under measurement when the latter is de-energized.

4.2. Measurements on circuits with a voltage exceeding 200–300 V should be carried out in the presence of other people. When taking measurements with the help of the probe, use only one hand for the purpose, the other hand should be vacant to preclude the passing of electric current through the body.

4.3. If measurements are taken with the use of a current transformer, it is recommended to hold the automatic breaker button in the closed position to preclude overtension in the secondary circuit in case of its accidental break.

4.4. When mounting a rear nameplate, it is necessary to place an insulating gasket between the nameplate and the power supply source.

5. OPERATION

Prior to taking measurements position the instrument horizontally and using the corrector set its pointer to the initial scale division.

5.1. Current and Voltage Measurement.

Set the mode-of-operation switch to the "–" position in case of D.C. measurements and to "~" position in case of A.C. measurements.

Set the range switch to a position corresponding to the current or voltage to be measured.

Connect the instrument to the circuit being measured and read the measured quantity on the scale.

5.2. Measurement of D.C. Resistance.

5.2.1. Measurements on the "Ω" Range.

Set the mode-of-operation switch to the "r_x" position and the range switch to the "Ω" position; using a wire shunt the instrument terminals, and turning the "YCT.0" (ZERO ADJ.) knob set the instrument pointer to "∞" on the "Ω" scale. (If this is impossible, replace the power supply source).

Connect the resistance to be measured to the"*" terminal and "+Ω" socket either directly or with the help of connecting wires, and take the scale reading.

5.2.2. Measurements on the "kΩ×1", "kΩ×10", "kΩ×100" Ranges.

Set the mode-of-operation switch to the "r_x" position and the range switch to a position corresponding to the measured value, shunt the instrument terminals with a wire, and turning the ZERO ADJ. knob zero the instrument on the "kΩ, MΩ" scale. Remove the connecting wire from the terminals, connect to them the resistance under measurement and read the result on the scale.

5.2.3. Measurements on the "MΩ" Range.

An external power supply source of 12–15 V is used. If there is no internal power supply source, the external power supply source voltage should be 12.5–16.5 V. In this case the contacts for the connection of an internal source should be shorted out. Set the switches to the positions indicated in Para 5.2.2.

Connect the negative pole of the supply source to the "*" terminal and the positive pole to the "V, A, – kΩ, – MΩ" terminal, and turning the ZERO ADJ. knob set the instrument pointer to the zero mark on the "kΩ, MΩ" scale. Disconnect the positive pole of the source from the

terminal and cut in the resistance under measurement between the pole and the terminal. Read the measurement result on the scale.

5.3. Measuring the Relative Level of A.C. Voltage.

The accepted absolute level of A.C. voltage is 0.775 V, which corresponds to a 1 mw power dissipated across a 600-Ohm resistance. The relative A.C. voltage level expressed in decibels, is determined from the formula:

$$N = 20 \lg \frac{U_x}{0.775 \text{ V}},$$

where U_x is the measured voltage in volts.

When measurements are taken on the 2.5 V range, the relative level of alternating voltage is read direct on the "dB" scale. When changing over to other measuring ranges, instrument readings should be increased accordingly in compliance with the data given in Table 7.

Table 7

Measuring range, V	0.5	2.5	10	25	50	100	250	500	1,000
Increase in "dB" scale reading	−14	0	+12	+20	+26	+32	+40	+46	+52

6. MAINTENANCE

6.1. The instrument is intended for indoor operation and storage in heated premises in atmospheres free from corrosive admixtures, at ambient temperatures between +10 and +35 °C and relative humidity up to 80% at +25 °C ambient.

Instruments in transportation packing withstand transit shaking with an acceleration of up to 30 m/s² at a frequency of 80 to 120 impacts per minute, for 2 hours without damage.

6.2. At least once a year it is necessary to check the instrument for accuracy of readings.

This checking should be carried out on all current and voltage measuring ranges by comparing the instrument readings with those of reference instruments. The latter should have the class of accuracy minimum 0.2 for D.C. measurements and 0.5 for A.C. measurements.

The limit value of the reference instrument scale should not differ from that of the instrument under test by more than 25%.

Check the instrument on the resistance measurement ranges with the help of a resistance box whose class of accuracy should not be worse than 0.2. Read the instrument error directly off its scale.

Check the "dB" scale on the "2.5" V A.C. measurement range by voltages applied to the instrument terminals according to Table 8.

Read the instrument error directly off its scale.

Table 8

Scale mark tested	–5	0	+5	+10
Voltage across instrument terminals, V	0.436	0.775	1.38	2.45

7. POSSIBLE TROUBLES AND REMEDY

7.1. The instrument may have the following troubles:
break of a resistor or failure of diodes and transistors.

7.2. To eliminate the trouble it is necessary to open the instrument proceeding as follows: turn off the attachment screw and remove the rear nameplate, turn off the four nuts fastening the instrument cover to the base and remove the base.

Any instrument element mounted on the panel can be easily found with the help of the instrument circuit diagram and specification list. Faults are detected during examinations and tentative measurements. Damaged parts should be repaired or replaced by new ones.

When repairing the automatic breaker, do not fail to adjust the moving-coil relay and electronic circuit of the instrument.

To adjust the relay (Fig. 1) proceed as follows:

a) Set a springy effort of armature plate *1* along the *K16* contact vertical axis equal to 80±5 gf, by adjustment of screw *2*.

b) With contacts *K1a* and *K16* closed adjust the contact pressure to 40±5 gf by means of screw *3* (armature *1* is attracted to the magnetic core).

c) Adjust the relay operate current which should not exceed 20 mA, by means of magnetic shunt *4*.

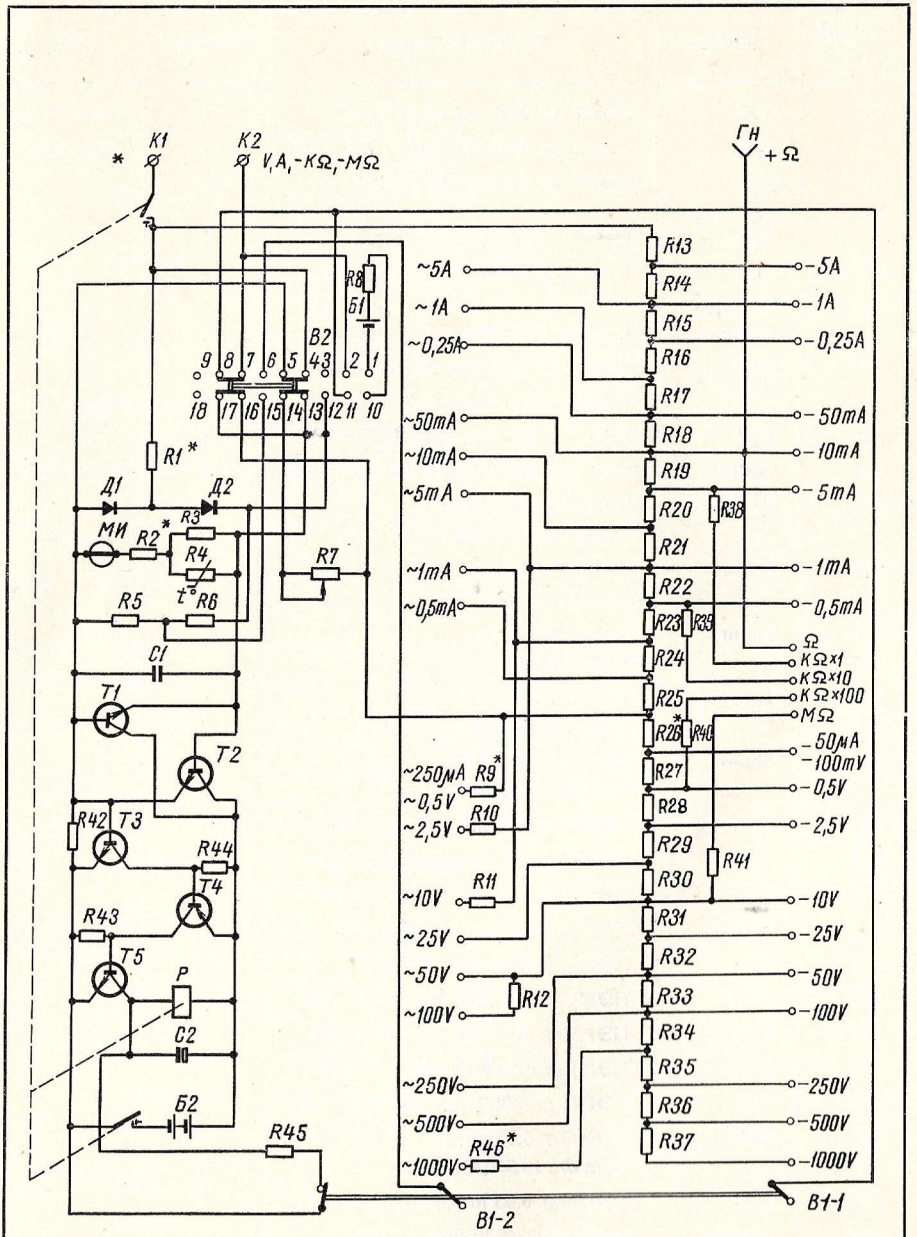
When replacing two input transistors, the "base-emitter" junction current at 0.2 V D.C. (positive potential is applied to the base, negative to the emitter) should not exceed 0.015 μA±3% at normal temperature. All other elements should be installed in compliance with the specifications to the electric circuit diagram.

SPECIFICATIONS TO CIRCUIT DIAGRAM

Fig. 2. Electric Circuit Diagram
Resistances marked with an asterisk (*) are selected during adjustment.

Closing of Mode-of-operation Switch Contacts

Position	Contact No.
—	4–5; 7–8; 13–14; 16–17
~	3–4; 6–7; 12–13; 15–16
rx	1–2; 4–5; 10–11; 13–14


К1
К2
V,A,-КΩ,-МΩ
ГН
+Ω
R8
Б1
В2
9 8 7 6 5 4 3 2 1
18 17 16 15 14 13 12 11 10
R1*
Д1
Д2
R3
МИ
R2*
R4
t°
R6
R5
R7
C1
T1
T2
R42
T3
R44
T4
R43
T5
P
C2
Б2
R45
R46*
~5A
~1A
~0,25A
~50mA
~10mA
~5mA
~1mA
~0,5mA
~250мA
~0,5V
~2,5V
~10V
~25V
~50V
~100V
~250V
~500V
~1000V
R9*
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26*
R27
R28
R29
R30
R31
R32
R33
R34
R35
R36
R37
R38
R39
R40
R41
-5A
-1A
-0,25A
-50mA
-10mA
-5mA
-1mA
-0,5mA
Ω
КΩ×1
КΩ×10
КΩ×100
МΩ
-50мA
-100mV
-0,5V
-2,5V
-10V
-25V
-50V
-100V
-250V
-500V
-1000V
В1-1
В1-2

Symbol in Fig. 2	Name	Type and Ratings	Quantity	Note
R1	Coil	ПЭМС ⌀ 0.08 mm up to 800 Ohm	1	Adjustable
R2	Coil	ПЭМС ⌀ 0.05 mm up to 1,700 Ohm	1	Adjustable
R3	Coil	ПЭМС ⌀ 0.1 mm, 250+2.5 Ohm	1	
R4	Thermo-resistor	ММТ-8-430±20 %, 430 Ohm	1	
R5, R6	Coil	ПЭМС ⌀ 0.05 mm, 1040+5 Ohm	2	
R7	Variable resistor	СП3-9а-20±20 %, 3.3 kOhm	1	
R8	Coil	ПЭМС ⌀ 0.15 mm, 98±0.5 Ohm	1	
R9	Coil	ПЭВ ⌀ 0.03 mm up to 700 Ohm	1	Adjustable
R10	Coil	ПЭМС⌀ 0.1 mm, 323±1 Ohm	1	
R11	Resistor	МЛТ-0.5-4.7 ±5 %, 9,230+30 Ohm	2	In series
R12	Resistor	МЛТ-0.5-100 kOhm ±5 %, 200±1 kOhm	2	In series
R13	Shunt	МнМц-3-12 tape, 0.036+0.00005 Ohm	1	
R14	Shunt	МнМц-3-12 tape, 0.144+0.0002 Ohm	1	
R15	Shunt	МнМц-3-12 ⌀ 0.5 mm, 0.54±0.0008 Ohm	1	
R16	Shunt	МнМц-3-12 ⌀ 0.8 mm, 0.18±0.00025 Ohm	1	
R17	Coil	ПЭМС ⌀ 0.3 mm, 2.7±0.004 Ohm	1	
R18	Coil	ПЭМС ⌀ 0.2 mm, 14.4±0.02 Ohm	1	
R19	Coil	ПЭМС ⌀ 0.2 mm, 18±0.025 Ohm	1	
R20	Coil	ПЭМС ⌀ 0.15 mm, 54±0.08 Ohm	1	
R21	Coil	ПЭМС ⌀ 0.15 mm, 90±0.14 Ohm	1	
R22	Coil	ПЭМС ⌀ 0.1 mm, 180±0.25 Ohm	1	
R23	Coil	ПЭМС ⌀ 0.1 mm, 540±0.8 Ohm	1	
R24	Coil	ПЭМС⌀ 0.08 mm, 900±1.4 Ohm	1	
R25	Coil	ПЭМС ⌀ 0.05 mm, 1,800±2.7 Ohm	1	
R26	Coil	ПЭМС⌀ 0.1 mm, from 470 to 570 Ohm	1	Adjustable
R27	Coil	ПЭММ⌀ 0.03 mm, 8,000±12 Ohm	1	
R28	Resistor	МрГч-0.25-40 kOhm, ±0.1Б	1	
R29	Resistor	МЛТ-0.5-20 kOhm±10 %	1	In series
		МЛТ-0.5-30 kOhm±5 %, 50±0.15 kOhm	1	

Symbol in Fig. 2	Name	Type and Ratings	Quantity	Note
R30	Resistor	МрГч-0.25-100 kOhm, ±0.1Б 100 kOhm	1	
R31	Resistor	МрГч-0.25-300 kOhm ±0.1Б 300 kOhm	1	
R32	Resistor	МЛТ-0.5-200 kOhm ±10%	1	In series
		МЛТ-0.5-300 kOhm ±5% 500 ±1.5 kOhm	1	
R33	Resistor	МрГч-0.25-1 MOhm ±0.1Б 1 MOhm	1	
R34	Resistor	МЛТ-1-1 MOhm ±5%, 2±0.006 MOhm	2	In series
R35	Resistor	МВСГ-0.25-1 MOhm±0.1Б, 1 MOhm	1	
R36	Resistor	МВСГ-0.25-5 MOhm±0.1Б, 5 MOhm	1	
R37	Resistor	МЛТ-1-5.1 MOhm ±5%, 10±0.03 MOhm	2	In series
R38	Coil	ПЭМС ⌀ 0.15 mm, 101±0.5 Ohm	1	
R39	Coil	ПЭМС ⌀ 0.05 mm, 1,956±10 Ohm	1	
R40	Resistor	МЛТ-0.5-6.2 kOhm±10%	1	
		МЛТ-0.5-6.8 kOhm±5%, 13.54±0.065 kOhm	1	In series
R41	Resistor	МЛТ-0.5-20 kOhm±10% 39.54±0.2 kOhm	2	In series
R42	Resistor	МЛТ-0.5-120 kOhm ±10% 120 kOhm	1	
R43, *R44*	Resistor	МЛТ-0.5-5.1 kOhm±10%, 5.1 kOhm	2	
R46	Resistor	МЛТ-0.5 up to 120 kOhm	1	Adjustable
R45	Resistor	МЛТ-0.5-56 Ohm±5%, 56 Ohm		
C1	Capacitor	К40У-9-200-0.22±10%, 0.20 μF	1	
C2	Capacitor	К-50-6-10-20±20%, 20 μF	1	
МИ	Measuring unit	I_o = 29 μA, 600 turns ПЭВ-1 ⌀ 0.03 mm	1	
Д1,*Д2*	Diode	Д 10А	2	
Б1	Galvanic cell	332	1	
Б2	Galvanic cell	332	2	

Symbol in Fig. 2	Name	Type and Ratings	Quantity	Note
T1, *T2*, *T3*, *T5*	Transistor	МП 113	4	
T4	Transisor	МП 41	1	

Notes. 1. The instrument Ц4317Т is built up of units and parts designed for use in tropical climates and is powered from a 332Т galvanic cell.

2. Circuit elements of other types with analogous parameters can be used in the instrument.

Внешторгиздат. Изд. № 274М