

INSTRUCTION MANUAL

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TYPE P6023 PROBE

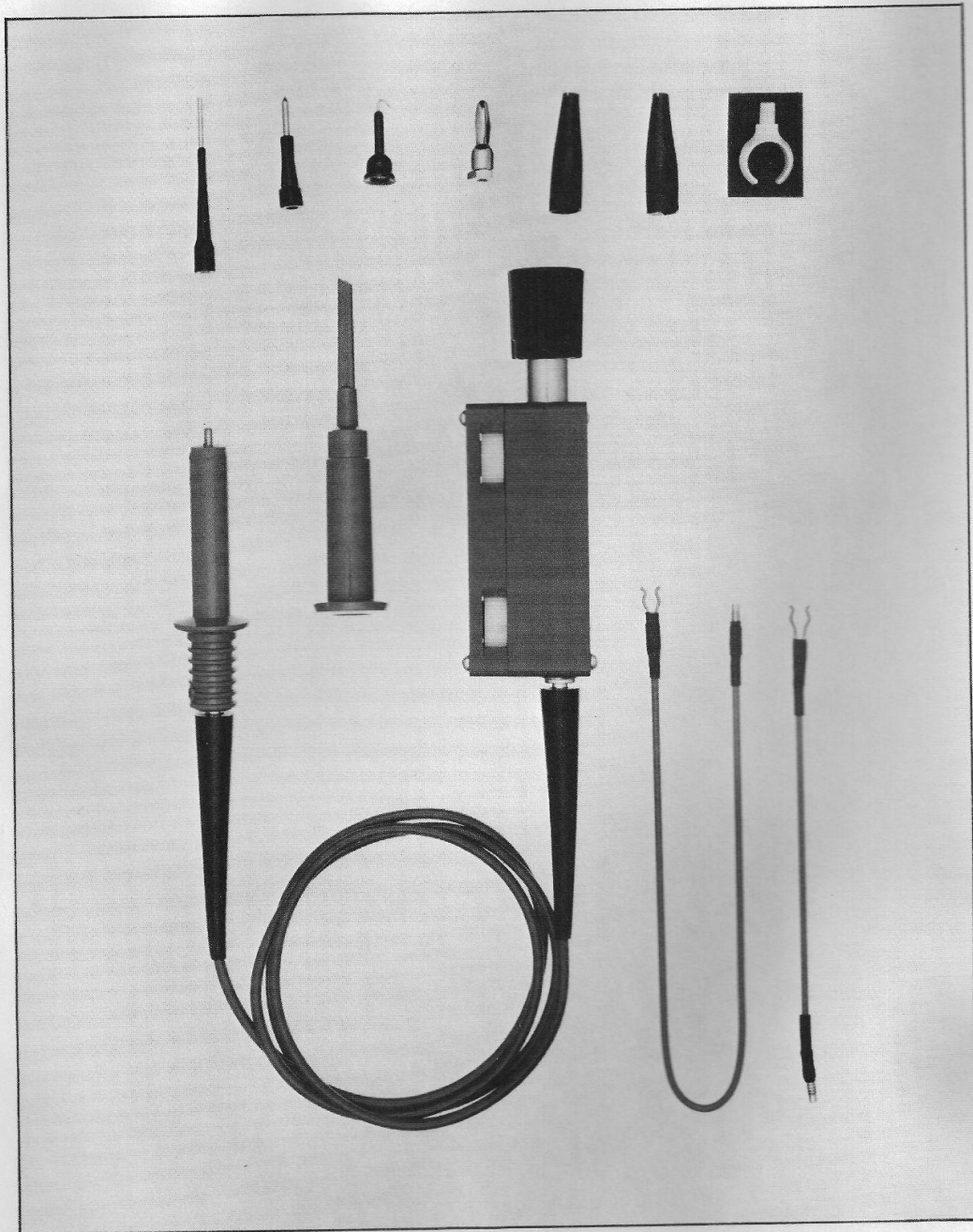


Fig. 1. P6023 Probe and accessories.

P6023 Probe

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TYPE P6023 LOW-CAPACITANCE PROBE

General Information

The Type P6023 Probe is a low-capacitance, adjustable attenuation-ratio probe. Attenuation ratio is nominally $\times 10$ and is adjustable over a $\pm 2.5\%$ range ($\times 9.75$ to $\times 10.25$). Designed for use with Tektronix differential amplifiers, the probe offsets the one-percent tolerance resistors used in amplifier attenuators. With the use of two such probes, the attenuator-factor differences of the attenuators can be eliminated and thus increase the common-mode rejection ratio of the system.

The Type P6023 Probe is especially useful with the Type W, 10A1, and 1A7 Differential Comparator Plug-In Units. When used during differential comparator operation, the probe can be accurately adjusted so that voltages can be read directly from the Comparison Voltage helical and multiplied by the nominal attenuation factor without having to take into account the attenuation factor tolerances generally encountered with other probes. During differential preamplifier operation when using two of these probes, the differential capabilities of the plug-in unit are increased and accurate rejection ratio computations can be made.

Variable shunt resistance and capacitances in the compensating box permit the probe to be compensated for correct attenuation ratio at DC and to provide uniform frequency-response characteristics. The cable used with the probe is a Tektronix coaxial cable which has a resistive center conductor*. The resistance value of the conductor

is chosen for optimum transient response. Resilient bend-relief boots protect the cable where it joins the probe body and the compensator box.

The maximum voltage that can be applied to the probe is 1000 volts DC or DC plus peak AC. However, when applying voltage in the range of 900 to 1000 volts to the probe, it should be applied intermittently. Continuous application causes R1 ($7.2\text{-M}\Omega$ resistor located in the probe body) to heat up which, in turn, will produce some voltage-measurement error. Exceeding this rating either in peak-to-peak AC voltage or DC voltage, can cause a short circuit through the probe body to ground. The short circuit could result in damage to other components in the probe body as well as the device under test.

CHARACTERISTICS

Attenuation Ratio—9.75:1 to 10.25:1.

Input Capacitance, Input Resistance, Risetime and Frequency Response—Refer to Table 1.

Voltage Rating—1000 volts DC or DC plus peak AC. (See Fig. 5 for derating curves.)

Cable Length—42 inches.

Cable Connector—Locking BNC or UHF.

Net Weight—Complete probe (including ground lead) weight 15 ounces.

*Patent No. 2,883,619.

TABLE 1

Instrument Type	Input Capacitance	Input Resistance	Risetime	Frequency Response (3 dB down)
P6023 Probe Only	Approx. 12 pF	10.5 M Ω to 12 M Ω	7 ns	DC to 50 MHz
P6023 Probe and Type D Plug-In Unit and 540-Series Oscilloscope or equivalent.	Approx. 12 pF (Input capacitance remains the same when used with Tektronix Plug-In Units or Oscilloscopes having 20 pF to 47 pF input capacitance.)	7.8 M Ω to 8.2 M Ω	1.2 μ s	DC to 300 kHz
P6023 Probe with Type G Plug-In Unit and 540-Series Oscilloscope or equivalent.			19.5 ns	DC to 18 MHz
P6023 Probe with Type W Plug-In Unit and 540-Series Oscilloscope or equivalent.			17 ns	DC to 20 MHz
P6023 Probe with Type 1A7 Plug-In Unit and 540-Series Oscilloscope or equivalent.			0.7 μ s	DC to 500 kHz
P6023 Probe with Type 2A63 Plug-In Unit and 560-Series Oscilloscope.			1.2 μ s	DC to 300 kHz
P6023 Probe with Type 10A1 Plug-In Unit and 567 Oscilloscope.			10.5 ns	DC to 33 MHz

ADJUSTMENT PROCEDURES

General Information

Two adjustment procedures are provided in this instruction manual. The first procedure describes how the P6023 Probe is adjusted when used with a differential amplifier, in this case a Type W Plug-In Unit. The second procedure tells how two probes are adjusted for optimum common-mode rejection ratio using the Type W. Similar procedures can be used with other differential amplifiers such as those listed in Table 1.

Probe Adjustment Procedure with a W Unit

The COMPARISON VOLTAGE helidial on the front panel of the Type W is used to measure the amplitude of the Calibrator signal. This setting is then used, with the DISPLAY switch set to A-Vc, to set the DC resistance of the probe to exactly ten times attenuation. To set the probe

attenuation adjustment accurately, the resolution accuracy of the Type W depends on these main factors: differential balance, vertical resolution, and COMPARISON VOLTAGE helidial setting.

Differential balance can be quickly checked by following the instructions given in the Type W instruction manual.

Vertical Resolution is the accuracy with which the trace can be returned to the null or zero reference point.

1. Preset the Type W controls as follows:

COMPARISON	
VOLTAGE	5.00
Vc RANGE	+11
CH A	GND
CH B	GND
INPUT ATTEN	10
DISPLAY	A-B
POSITION	trace centered

2. Free-run the sweep and obtain a display.

3. Adjust the DC BAL for no shift when the MILLIVOLTS/CM control is turned throughout its range. After finding the null point turn the MILLIVOLTS/CM control to 5. Place the trace on the center graticule line with the POSITION control.

4. Connect a coaxial cable from the calibrator, set for 50 volts, to the channel A input. The calibrator squarewave through the ten-times attenuator is 5 volts.

5. Turn the Display switch to A-Vc and the channel A input to DC.

6. Adjust the Vc helidial until the top of the calibrator waveform is on the center graticule line.

7. Remove the coaxial cable and connect a 1.2 megohm resistor from the calibrator output to ground. Connect the probe tip to the calibrator output connector.

8. Change the INPUT ATTEN switch to 1 and connect the probe to the channel A input.

9. Adjust the P6023 DC ATTN CALIBRATION until the top of the waveform is on the center graticule line.

10. Adjust the AC COARSE COMP and AC COMP FINE for a display similar to Fig. 2c.

NOTE

The remaining steps describe how to differentially adjust a second probe connected to the channel B input connector and how to adjust for common-mode operation.

11. Disconnect the first probe from the calibrator output. Connect a second P6023 Probe to the channel B input and connect to the calibrator.

12. Set the Type W controls as follows:

COMPARISON	as in step 6
VOLTAGE	
Vc RANGE	+11

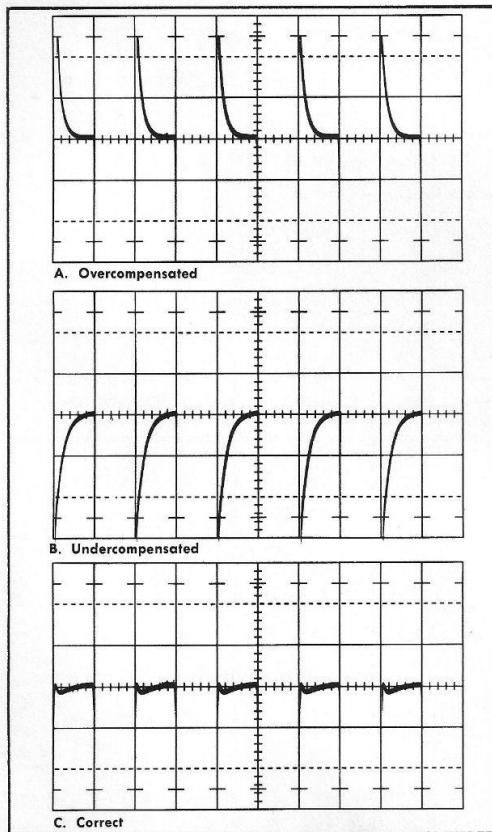


Fig. 2. P6023 Probe compensation using channel A of Type W (A-Vc).

CH A	GND
CH B	DC
INPUT ATTEN	1
DISPLAY	Vc-B
POSITION	as in step 3

13. Adjust the channel B input probe DC ATTEN CALIBRATION until the bottom of the waveform is on the center graticule line.

14. Adjust the AC COARSE COMP and AC COMP FINE for a display similar to Fig. 3c.

15. Reconnect the channel A input probe to the signal and set the Type W controls as follows:

DISPLAY	A-B
INPUT ATTEN	10
CH A	DC

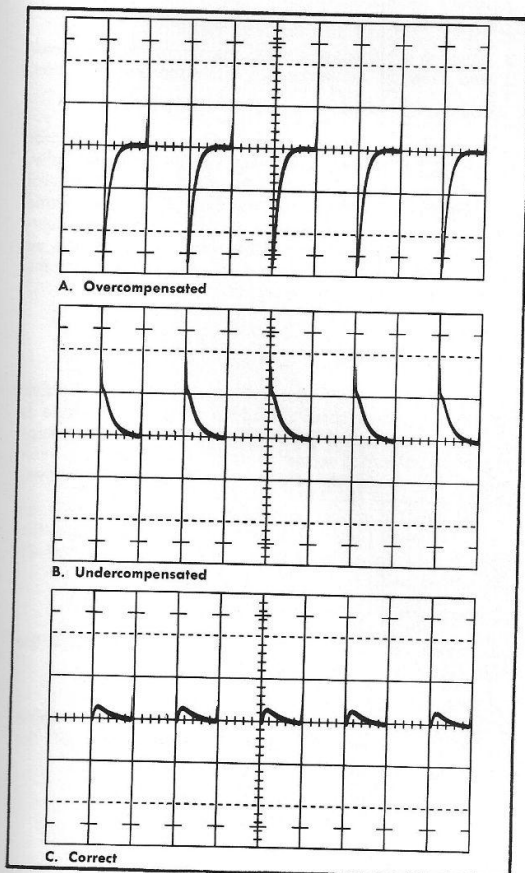


Fig. 3. P6023 Probe compensation using channel B of Type W (Vc-B).

16. To obtain maximum common-mode rejection ratio, a slight readjustment may be necessary. See Fig. 4.

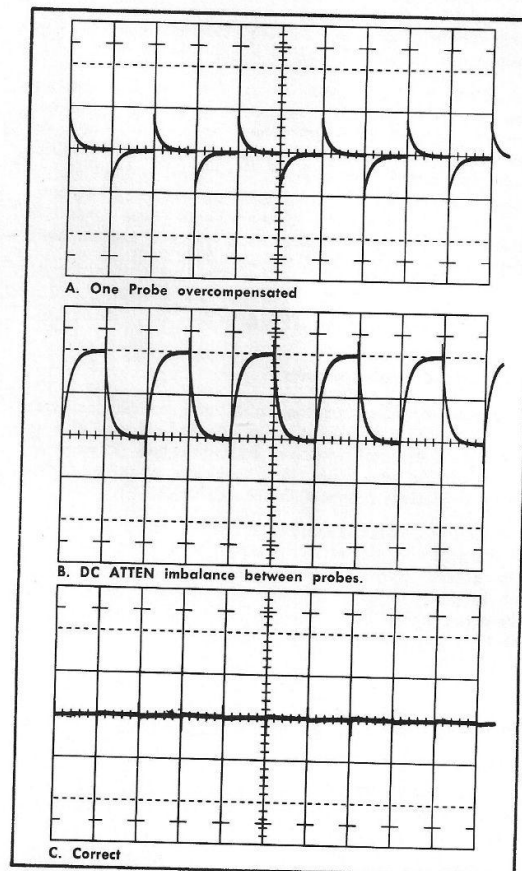


Fig. 4. Two P6023 Probes in common-mode using Type W (A-B).

PRACTICAL OPERATING HINTS

Here are a few hints that will help you obtain proper performance from your probe(s).

1. Check the compensation of the probe before using it, especially when the probe is transferred from one channel to the other or from one amplifier to another. For precise measurements frequent calibration checks are recommended.
2. To obtain accurate measurements when using the probe with the W unit, recalibrate the probe each time a different MILLIVOLTS/CM switch setting is used.
3. During differential amplifier operation when the attenuation factor of the amplifier is changed, readjust the probe for optimum common-mode rejection ratio.
4. When optimum accuracy is desired, allow the probe body to reach ambient temperature before recalibrating it.

P6023 Probe

5. During differential operation, when fast-rise pulses containing very-high frequency components are applied, lead length is important. Using a pincher tip on one probe and a short tip on the other, for example, will cause a time delay difference between channels. This will cause fast-rise positive and negative spikes to appear on the display.

6. When a P6023 Probe and a conventional probe are used together during AC-coupled preamplifier operation, the differences in input-circuit time constants will introduce low-frequency response measurement errors. With the P6023 Probe connected to the amplifier, the time constant of the input circuit is 0.357 second and low-frequency response is 0.447 Hz at -3 dB; with a conventional probe connected to the amplifier, the time constant is 1 second and the low-frequency response is 0.159 Hz at -3 dB.

MAINTENANCE

Preventive Maintenance

Regular inspection of the cable and coaxial-connector setscrews will prevent possible mechanical damage due to twisting. These setscrews are 0.050-inch hex. screws and if they should work loose, they should be tightened so the probe connectors are held firmly in place.

In addition, check the 0.035-inch hex. setscrew in the nose of the probe. If this screw becomes loose, intermittent contact troubles may result. Retighten the screw but do not use too much force or the lead from R1 may be sheared. The screw should be tightened just enough to make a good electrical contact between the lead of R1 and the threaded probe nose.

Repairing the Probe Body

To disassemble the probe body, proceed as follows:

1. Loosen the 0.035-inch hex. setscrew located in the nose of the probe and the 0.050-inch hex. setscrew in the probe base.
2. Slide the probe body forward and off R1-C1.
3. Note the physical location of the components. R1 and C1 are a special assembly. The outer sleeve of C1 is adjusted at the factory in such a way that it compensates for the environmental characteristics of R1. This results in a linear-frequency characteristic of the assembly and once the adjustment is made, no further adjustment is necessary. To maintain the adjustment setting, the lead from the outer sleeve of C1 is soldered to the lead of R1. The assembly is then soldered to the center conductor of the probe cable. The center conductor is a fine, resistive wire which is brought through a hole in the center of a ceramic insulator. In the hole area the ceramic is silvered and tinned for instant soldering.

4. If you need to replace the R1-C1 assembly, apply the tip of the soldering iron to the tinned area of the ceramic insulator. When the solder melts, slide the lead of R1 out until it is free of the insulator.

5. When installing the replacement nose assembly, note that the rear lead has a crimp $\frac{1}{8}$ inch from the end. Push the rear lead into the cup until the crimp hits the cup and stops further progress. The assembly is now positioned properly, and may be soldered in this position.

6. Install the probe body.

7. Cut off the excess lead length from R1 that protrudes beyond the probe nose.

Repairing the Compensator Box

A. Replacing the Coaxial Connector

1. Remove the cover plate.
2. Loosen the 0.050-inch hex. setscrew holding the coaxial connector.
3. Apply the soldering iron to the tip of the connector and slide the connector out of the compensator box.

B. Replacing Components in the Compensator Box

By removing the cover plate(s) from the compensator box, any of the internal components can be replaced easily. 0.035-inch hex. setscrews hold the knobs on the control shafts. Always mount the replacement part in the same location as the part which was removed. When remounting the AC COMP. FINE ADJUST knob, set the knob so that the index mark indicates the midrange position of the control. Tighten the knob setscrew.

Replacing the Probe Cable

As mentioned earlier, the cable contains fine, resistive wire which requires careful handling. The 42-inch cable is available as an assembly. The length of the cable is kept to a close tolerance to maintain a close match between probes. To remove the probe cable proceed as follows:

1. Remove the probe body and the R1-C1 assembly as outlined in steps 1 through 4 under the title "Repairing the Probe Body". Take care not to change the position of R1 with respect to C1.
2. Remove the compensator box cover plate.
3. Loosen the 0.050-inch hex. setscrew which holds the cable in the compensator box.
4. Unsolder the selected resistor where it connects to C2 and remove the cable. Install the replacement cable assembly. Use the information given in step 5 of the "Repairing the Probe Body" instructions.

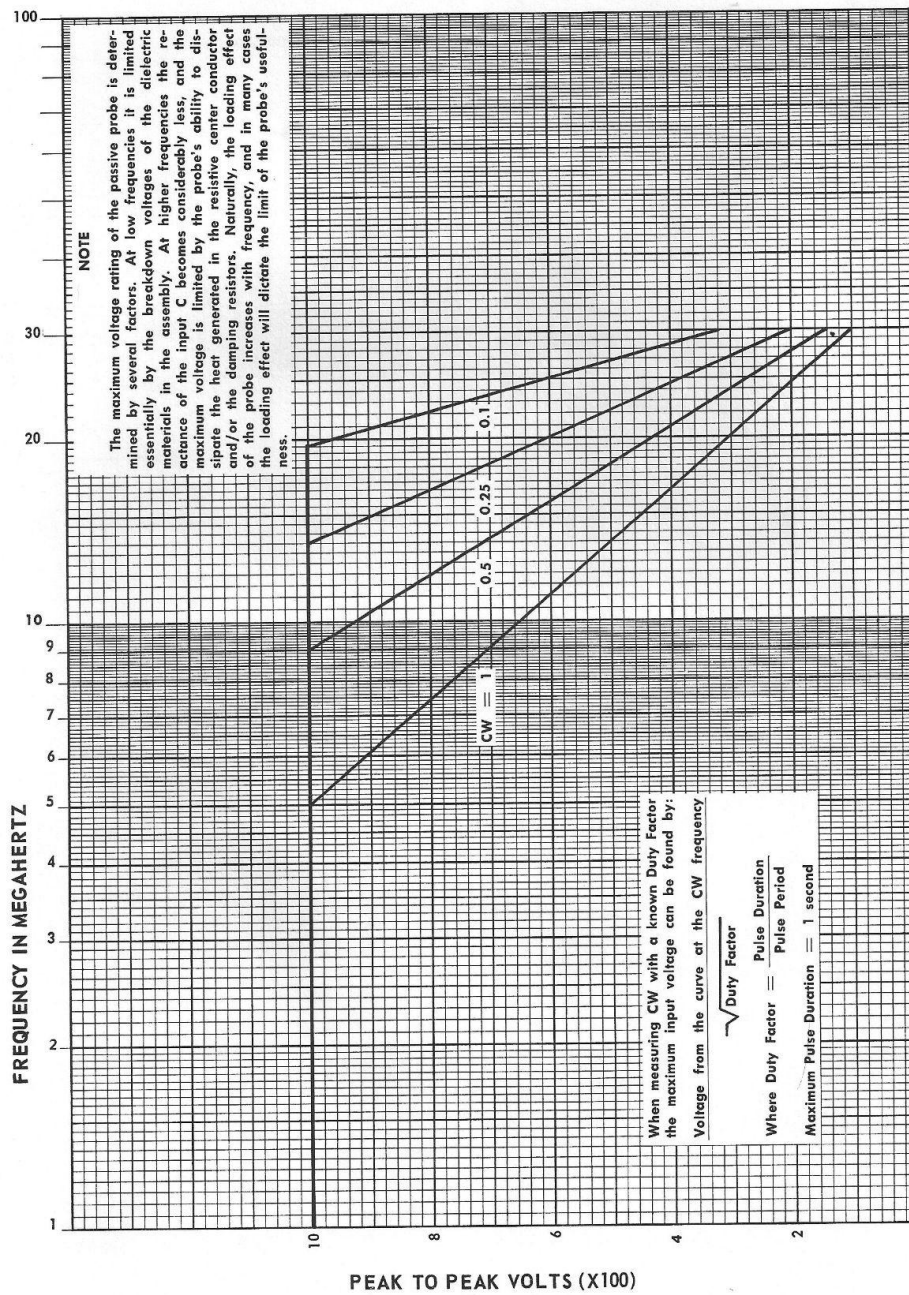


Fig. 5. Maximum applied voltage at specific duty factors.

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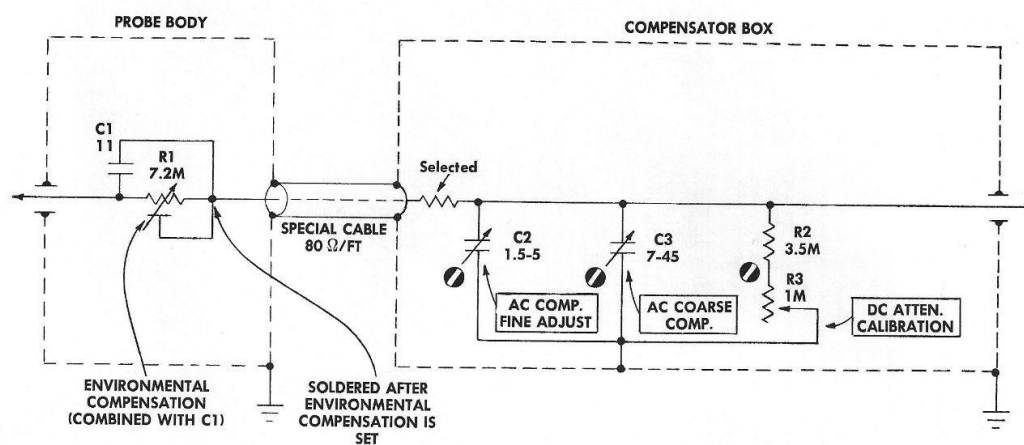
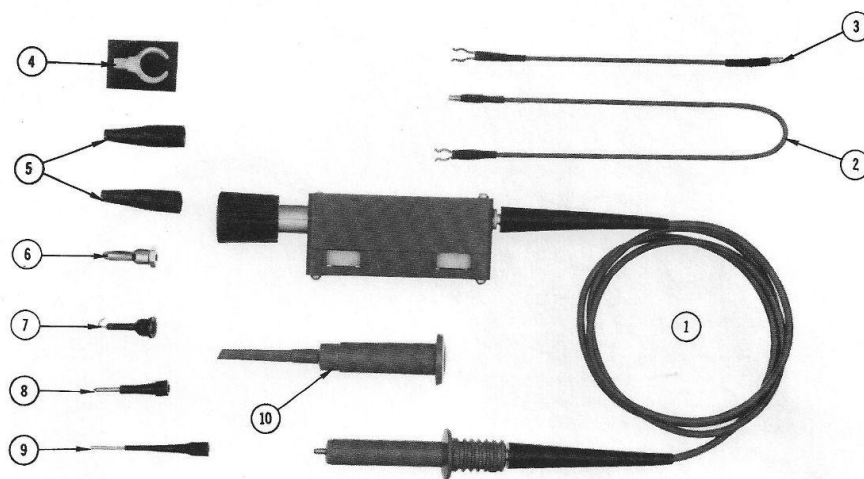


Fig. 6. Schematic diagram of the Type P6023 Probe.

PROBE PACKAGE



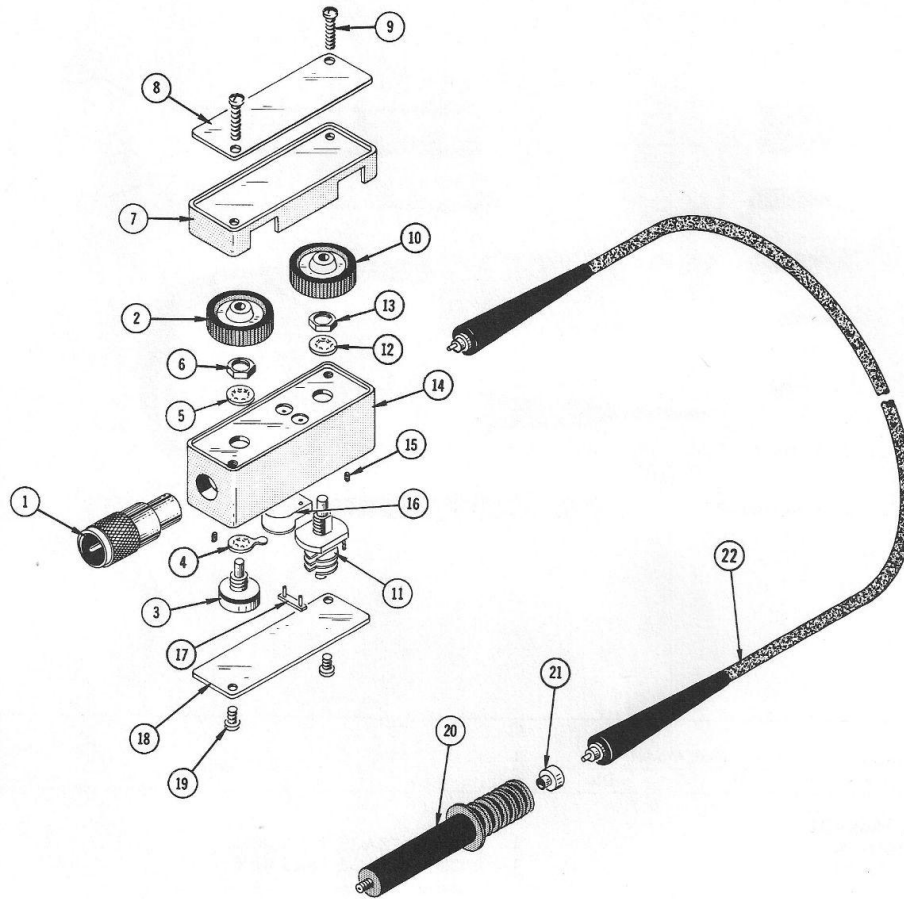
B

Ref. No.	Tektronix Part No.	Serial/Model No.		Q	t	y	1	2	3	4	5	Description
		Eff	Disc									
PROBE PACKAGE												
1—10	010-0167-00				1							PROBE PACKAGE, P6023 (BNC)
	010-0065-00				1							PROBE PACKAGE, P6023 (UHF)
	- - - - -				-							probe includes:
PROBE ONLY												
1	010-0168-00				1							PROBE (BNC)
	010-0097-00				1							PROBE (UHF)
STANDARD ACCESSORIES												
2	175-0125-00				1							CABLE, ground lead, 12 inches
3	175-0124-00				1							CABLE, ground lead, 5 inches
4	352-0068-00				1							HOLDER, probe
5	344-0046-00				2							CLIP, probe
6	134-0013-00				1							PLUG, banana, female
7	206-0105-00				1							TIP, hook
8	206-0060-00				1							TIP, spring
9	206-0100-00				1							TIP, calibration
10	013-0071-00				1							TIP, pincher
	070-0294-01				1							MANUAL, instruction (not shown)

B

P6023 Probe

REPLACEMENT PARTS



A

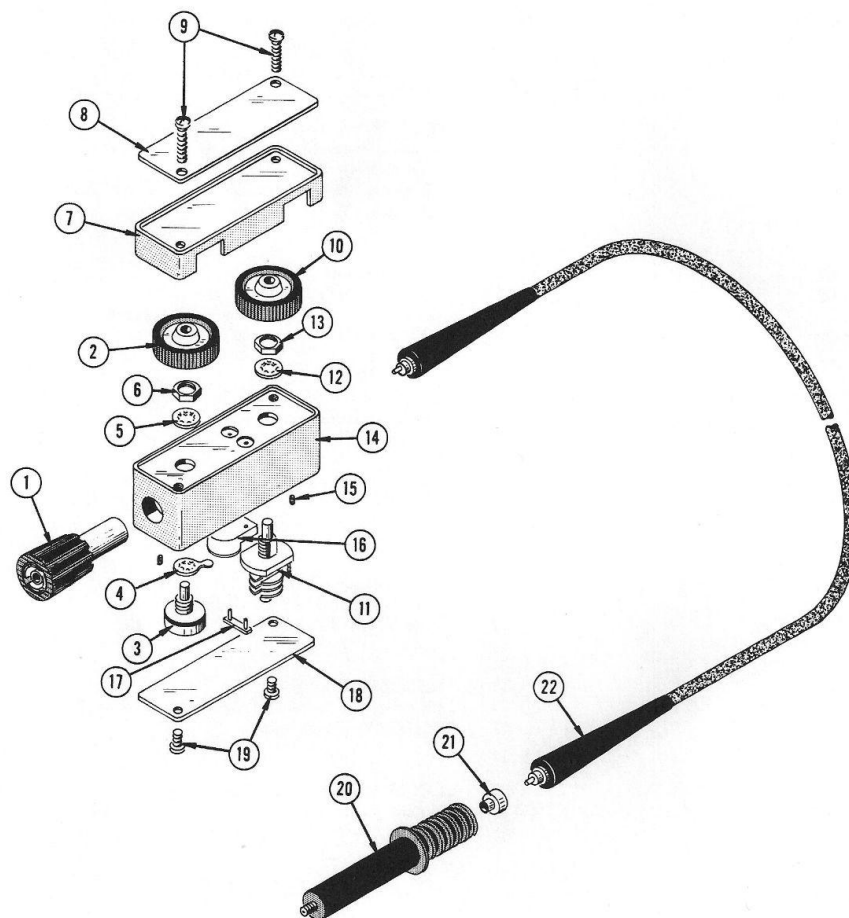
Ref. No.	Tektronix Part No.	Serial/Model No.		Q	t	y	1	2	3	4	5	Description
		Eff	Disc									
1-22	010-0097-00											1 PROBE, P6023 (UHF)
1	131-0058-00											- probe includes:
	131-0196-00											1 CONNECTOR, coaxial, 1 contact (UHF)
	200-0026-00											- connector includes:
	366-0128-00											1 CONNECTOR, coaxial, 1 contact
2	213-0076-00											1 COVER, coaxial connector
												1 KNOB, white—DC ATTEN CALIBRATION
												- knob includes:
												2 SCREW, set, 2-56 x 1/8 inch, HSS

REPLACEMENT PARTS (Cont)

Ref. No.	Tektronix Part No.	Serial/Model No.		Q † y 1 2 3 4 5	Description
		Eff	Disc		
3	- - - - -			1	RESISTOR, variable
	- - - - -			-	mounting hardware: (not included w/resistor)
4	210-0212-00			1	LUG, rectifier
5	210-0011-00			1	LOCKWASHER, internal, 1/4 ID x 1 5/32 inch OD
6	210-0465-00			1	NUT, hex., 1/4-32 x 3/8 inch
7	202-0076-00			1	BOX, compensating dial
8	200-0586-00			1	COVER, compensating dial box
	- - - - -			-	mounting hardware: (not included w/cover)
9	211-0016-00			2	SCREW, 4-40 x 5/8 inch, RHS
10	366-0127-00			1	KNOB, white—AC COMP FINE ADJUST
	- - - - -			-	knob includes:
	213-0076-00			2	SCREW, set, 2-56 x 1/8 inch, HSS
11	- - - - -			1	RESISTOR, variable
	- - - - -			-	mounting hardware: (not included w/resistor)
12	210-0011-00			1	LOCKWASHER, internal, 1/4 ID x 1 5/32 inch OD
13	210-0465-00			1	NUT, hex., 1/4-32 x 3/8 inch
14	202-0075-00			1	BOX, compensating
	- - - - -			-	mounting hardware: (not included w/box)
15	213-0075-00			2	SCREW, set, 4-40 x 3/8 inch
16	- - - - -			1	RESISTOR, variable
	- - - - -			-	mounting hardware: (not included w/resistor)
17	214-0153-00			1	FASTENER, plastic snap
18	200-0287-00			1	COVER, compensating box
	- - - - -			-	mounting hardware: (not included w/cover)
19	210-0010-00			2	SCREW, 4-40 x 1/4 inch, RHS
20	204-0054-00			1	BODY, probe
	- - - - -			-	body includes:
	213-0075-00			1	SCREW, set, 4-40 x 3/32 inch, HSS
	213-0076-00			1	SCREW, set, 2-56 x 1/8 inch, HSS
21	162-0026-00			FT.	TUBE, plastic, 3/8 inch
22	175-0190-00			1	CABLE ASSEMBLY
	175-0190-01	6618	6617	1	CABLE ASSEMBLY

P6023 Probe

REPLACEMENT PARTS



A

Ref. No.	Tektronix Part No.	Serial/Model No.		Q	Description
		Eff	Disc		
1—22	010-0168-00			1	PROBE, P6023 (BNC)
				-	probe includes:
1	131-0319-00			1	CONNECTOR, coaxial, 1 contact (BNC)
2	366-0128-00			1	KNOB, white—DC ATTN CALIBRATION
				-	knob includes:
	213-0076-00			2	SCREW, set, 2-56 x 1/8 inch, HSS
3				1	RESISTOR, variable
				-	mounting hardware: (not included w/resistor)
4	210-0212-00			1	LUG, rectifier
5	210-0011-00			1	LOCKWASHER, internal, 1/4 ID x 15/32 inch OD
6	210-0465-00			1	NUT, hex., 1/4-32 x 3/8 inch

REPLACEMENT PARTS (Cont)

Ref. No.	Tektronix Part No.	Serial/Model No.		Q						Description	
		Eff	Disc	t	y	1	2	3	4		5
7	202-0076-00				1						BOX, compensating dial
8	200-0586-00				1						COVER, compensating dial box
	- - - - -				-						mounting hardware: (not included w/cover)
9	211-0016-00				2						SCREW, 4-40 x 5/8 inch, RHS
10	366-0127-00				1						KNOB, white—AC COMP FINE ADJUST
	- - - - -				-						knob includes:
	213-0076-00				2						SCREW, set, 2-56 x 1/8 inch, HSS
11	- - - - -				1						RESISTOR, variable
	- - - - -				-						mounting hardware: (not included w/resistor)
12	210-0011-00				1						LOCKWASHER, internal, 1/4 ID x 15/32 inch OD
13	210-0465-00				1						NUT, hex., 1/4-32 x 3/8 inch
14	202-0075-00				1						BOX, compensating
	- - - - -				-						mounting hardware: (not included w/box)
15	213-0075-00				2						SCREW, set, 4-40 x 3/8 inch
16	- - - - -				1						RESISTOR, variable
	- - - - -				-						mounting hardware: (not included w/resistor)
17	214-0153-00				1						FASTENER, plastic snap
18	200-0287-00				1						COVER, compensating box
	- - - - -				-						mounting hardware: (not included w/cover)
19	210-0010-00				2						SCREW, 4-40 x 1/4 inch, RHS
20	204-0054-00				1						BODY, probe
	- - - - -				-						body includes:
	213-0075-00				1						SCREW, set, 4-40 x 3/32 inch, HSS
	213-0076-00				1						SCREW, set, 2-56 x 1/8 inch, HSS
21	162-0026-00			FT.							TUBE, plastic, 3/8 inch
22	175-0190-00				1						CABLE ASSEMBLY
	175-0190-01	6618	6617		1						CABLE ASSEMBLY

P6023 Probe**ELECTRICAL PARTS LIST**

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description	S/N Range
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Capacitors

Tolerance $\pm 20\%$ unless otherwise indicated.

C1 ¹				
C2	281-0056-00	1.5-5 pF	Air	Var
C3	281-0012-00	7-45 pF	Cer	Var

Resistors

Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R1 ¹						
R2	309-0086-00	3.5 M Ω	1/2 W		Prec	1%
R3	311-0252-00	1 M Ω		Var		

¹Furnished as a unit with Probe Nose Assembly (*206-0076-00).

P6023

TEXT CORRECTION

Page 1

Table 1

CHANGE: last item in Instrument Type column to read:

P6023 Probe with Type 10A1 Plug-In Unit and
647A Oscilloscope.

C1/1170