

TU-5 RISETIME SPECIFICATION ERROR

2-11-65

Long-form Catalog 23, pages 138 and 270, infer that the risetime of the TU-5 is 3 nsec and 0.3 nsec -- neither is correct.

Two versions of the TU-5 exist in the field:

- (1) Early version had a risetime specified to be 1.5 ns or less;
- (2) Present production TU-5 is specified to have a risetime of 1.0 ns maximum -- typically 0.5 ns.

Change in specified risetime is due to use of a new tunnel diode -- mod date was June 10, 1964.

No markings were placed on the TU-5 by which you can identify the version you have in your hand. Here's how you can tell:

- (1) Remove the cover and inspect for presence of a particular type of tunnel diode encapsulation:
 - (A) Early version contains a miniature top-hat tunnel diode, P/N 152-0102-00;
 - (B) Present production TU-5 uses an epoxy-encapsulated tunnel diode, P/N 152-0154-00.
- (2) Set up a sampling scope and actually measure the risetime produced. --Charles V. Sanford

TU-5 PULSER

Tektronix Part No. 015-038

General Information

The TU-5 is a tunnel-diode which provides a fast-rise pulse for adjusting the transient response of high-frequency plug-in units such as the Tektronix Types 82 and 86.

The TU-5 must be driven by a +100-volt square pulse such as the 1-kc amplitude calibrator signal available from most Tektronix oscilloscopes. (The amplitude calibrator in the Type 560-Series, Type 647, and Type RM647 Oscilloscopes will not switch the TU-5.) A Tektronix Type 105 Square-Wave Generator may be used to drive the TU-5 if an adapter (see Fig. 1) is used. The adapter converts the negative pulse output from the Type 105 to the positive pulse required to drive the TU-5. The Type 105 should be used only at repetition rates of 1 kc and higher. Higher repetition rates will provide a brighter crt display when fast sweep rates are used.

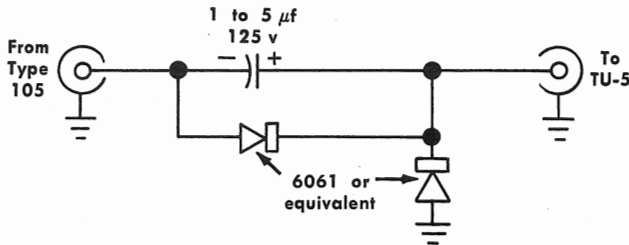


Fig. 1. Adapter for using a Type 105 to drive a TU-5.

Characteristics

Output Signal Risetime: 1.5 nanoseconds or less into 50 ohms.

Output Voltage: At least 200 millivolts into 50 ohms.

Input Voltage Required: +100-volt square wave capable of supplying 10 milliamps.

Connecting the TU-5 to the Plug-In Unit

Whenever possible, use the connection method shown in Fig. 2. Connect the termination as close as possible to the input of the plug-in to reduce undesirable reactances and provide a clean step-function at the input to the plug-in unit.

Turn off the oscilloscope Amplitude Calibrator while connecting the TU-5 to or disconnecting the TU-5 from the BNC cable. The 100 volts from the calibrator could cause a slight shock.

Setting the TU-5 Bias

The knob on the TU-5 sets the bias on the tunnel diode. The bias should be set each time the TU-5 is used. Set the bias as follows:

1. With the TU-5 and termination connected as shown in Fig. 2, set the bias control fully counterclockwise and the oscilloscope Amplitude Calibrator for a 100-volt output.

2. Set the oscilloscope vertical sensitivity at 0.1 volts/div. and the sweep rate at 0.2 millisecond/div.

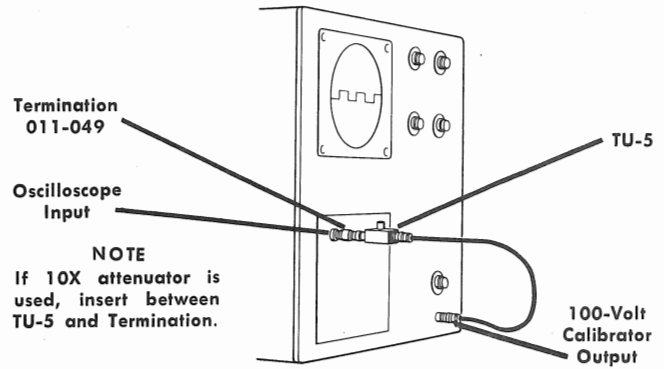


Fig. 2. Proper connection of the TU-5 and Termination to the oscilloscope input and Calibrator.

3. Set the time-base triggering controls for a stable display. With the bias control set fully counterclockwise, the tunnel diode will not switch due to insufficient current. However, there will be about a 50-mv waveform on the crt. This is the calibrator signal feeding through the TU-5 and not the fast-rise output signal that occurs when the tunnel diode is switching.

4. Slowly turn the bias control clockwise until the waveform amplitude suddenly increases to about 2 divisions (see Fig. 3). This point is the proper bias setting.

Output Waveforms

Figs. 3 and 4 show typical output signals from the TU-5 at various sweep rates. The small intensified portion at the base of each pulse shown in Fig. 3 is the relatively slow rising portion of the calibrator signal just before the tunnel diode switches.

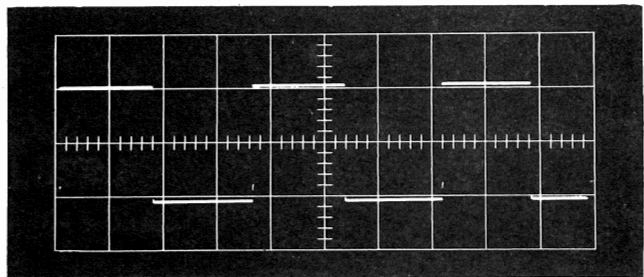


Fig. 3. Sweep rate 0.2 millisecond/div.

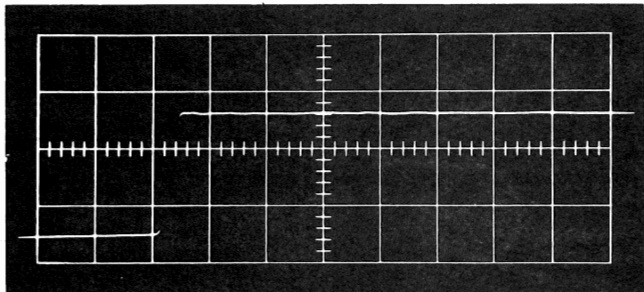
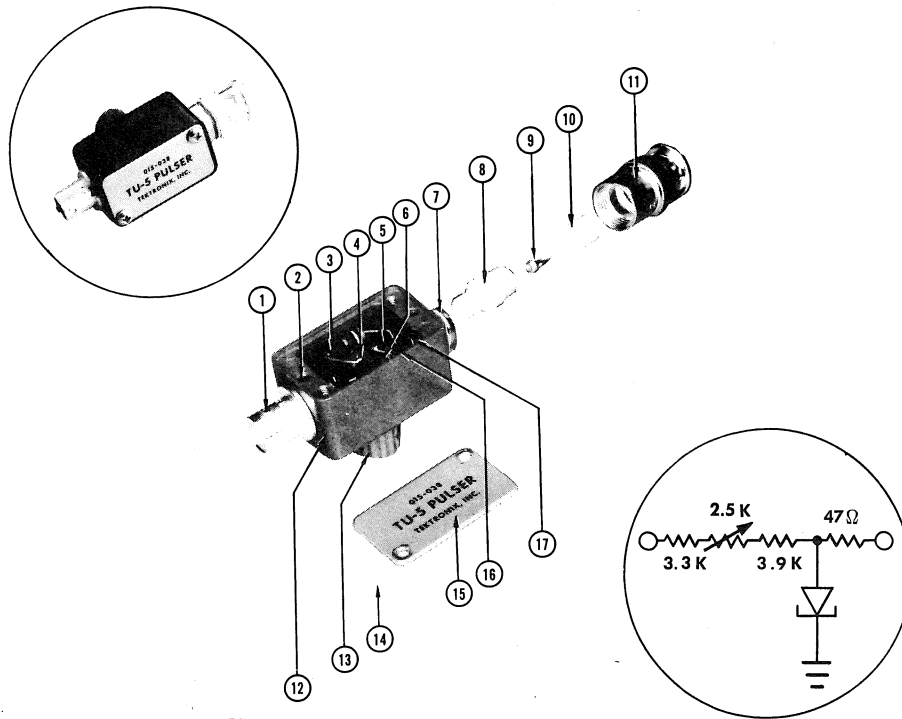


Fig. 4. Sweep rate 20 nanoseconds/div.

PARTS LIST



REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	131-126			1	Connector, coax, chassis mt.
	210-962			1	Washer, bevel, grey
2	213-075			2	Screw, set 4-40 x 3/32 inch
3	301-392			1	Resistor, 3.9 K, 1/2 W, 5%
4	311-443			1	Resistor, 2500 Ω var. 20%
5	152-102			1	Diode, tunnel, STD 615 10 ma
6	301-332			1	Resistor, 3.3 K 1/2 W, 5%
7	132-081			1	Nut
8	166-217			1	Tube, spacer, insulator
9	214-109			1	Pin, probe contact, male
10	358-072			1	Bushing, insulator
11	134-044			1	Plug, probe
12	202-095			1	Box, standardizer
13	366-203			1	Knob, gray
					Includes:
	213-004			1	Screw, set, 6-32 x 3/16 inch HHS
	210-046			1	Lockwasher, internal tooth
	210-583			1	Nut, hex, 5/16 inch brass 1/4-32
14	213-035			2	Screw, 4-40 x 1/4 inch PHS
15	200-427			1	Cover, pulser box
16	316-470			1	Resistor, 47 Ω, 1/4 W, 10%
17	210-223			1	Lug, solder (not shown)

PROBE PULSER

Tektronix Part No. 015-0088-00

General Information

The Probe Pulser incorporates a tunnel diode which provides a fast-rise pulse for checking transient response and risetime of Tektronix high-frequency miniature-tip probes, such as the P6045 FET Probe.

The Pulser must be driven by a +100-volt square-wave pulse, such as the 1-kHz amplitude calibrator signal available from most Tektronix oscilloscopes. (The amplitude calibrators in the 560-Series and 640-Series Oscilloscopes and in the Tektronix 067-0502-00 Standard Amplitude Calibrator will not switch the Pulser.)

Characteristics

Output Impedance: $\approx 25 \Omega$.

Output Signal Risetime: 0.5 ns or less.

Output Signal Amplitude: At least 260 mV.

Input Signal Required: +100-volt square wave capable of supplying 10 mA.

Adjusting Bias

The bias on the tunnel diode is adjusted with the knob on the Probe Pulser. The bias should be set each time the Probe Pulser is used.

To set the bias, use the following procedure.

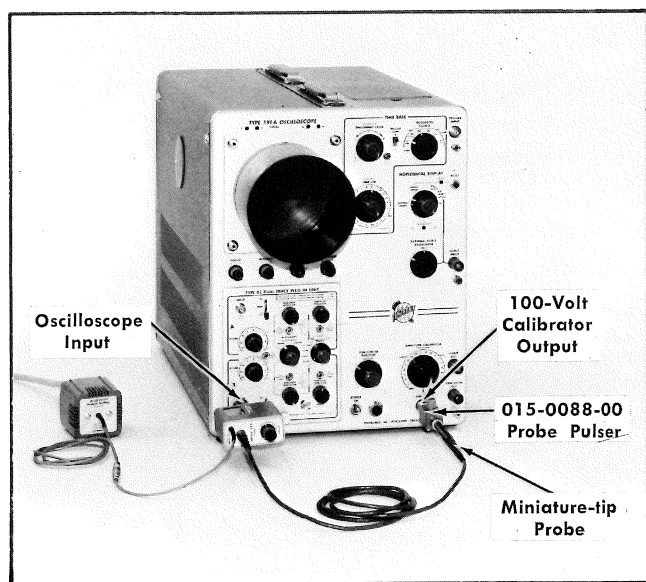


Fig. 1. Correct connection of Probe Pulser and probe to oscilloscope calibrator output and vertical channel input. (Shown with a P6045 FET Probe.)

1. Connect the Probe Pulser to the oscilloscope Calibrator Output and insert the probe tip into the Probe Pulser as shown in Fig. 1.

2. Set the oscilloscope vertical sensitivity to 0.1 V/cm and the sweep rate to 0.2 mSec/cm.

3. Set the bias control fully counterclockwise and the oscilloscope Amplitude Calibrator for a 100-volt square-wave output.

4. Set the time-base triggering controls for a stable display. With the bias control set fully counterclockwise, the tunnel diode will not switch due to insufficient current. However, there will be a waveform of ≈ 40 mV on the CRT screen. This is the calibrator signal feeding through the Probe Pulser and not the fast-rise output signal that occurs when the tunnel diode is switching.

5. Slowly turn the bias control clockwise until the waveform amplitude suddenly increases to about 3 divisions (see Fig. 2A). This indicates the tunnel-diode is now switching and this is the proper bias setting.

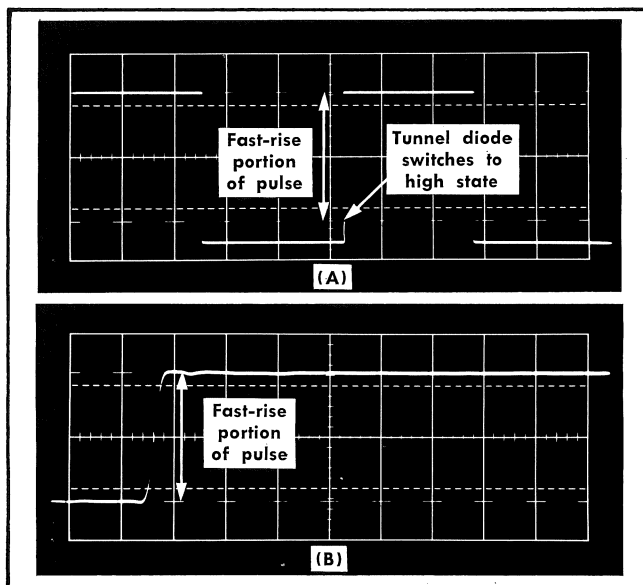
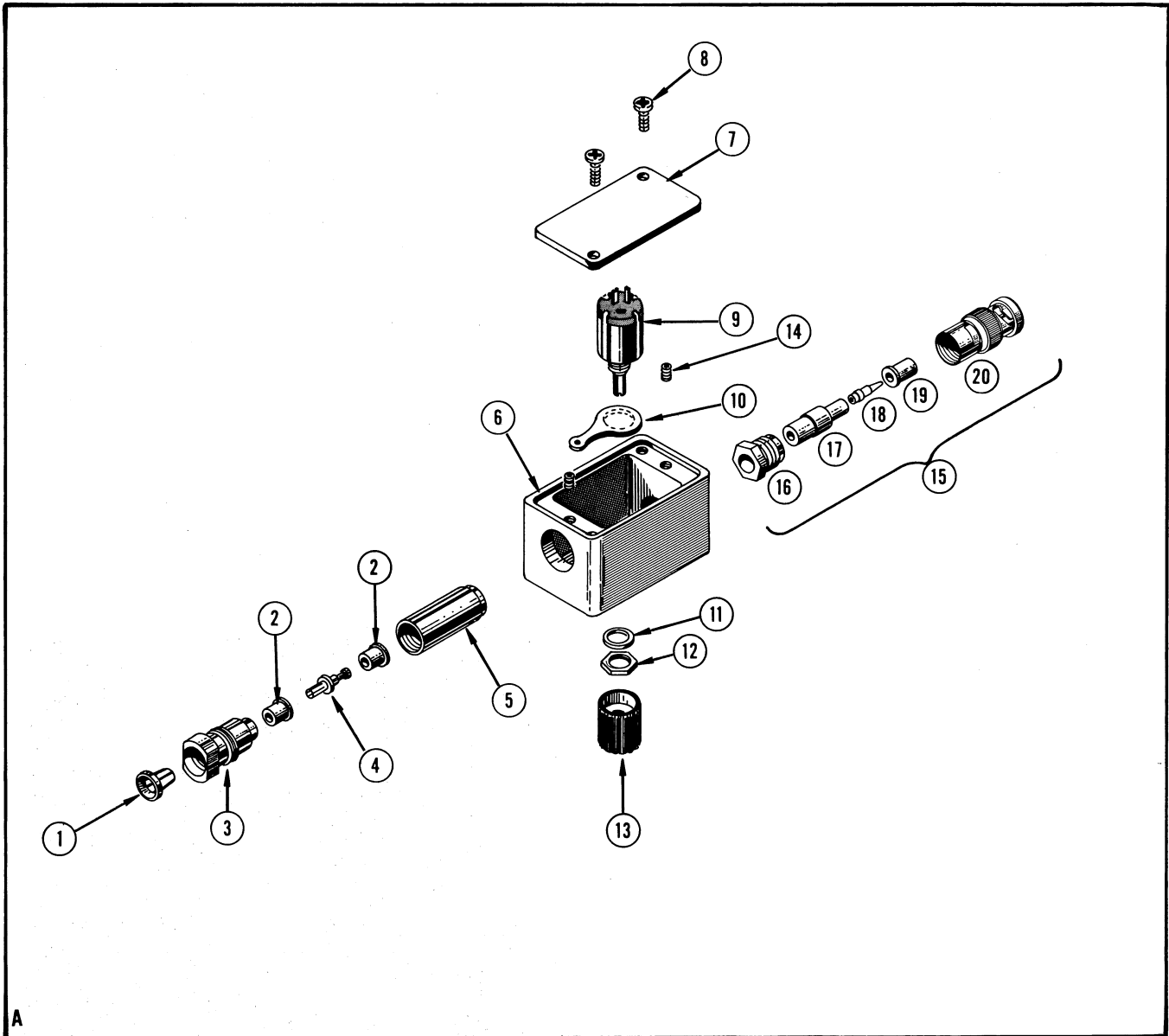


Fig. 2. Typical oscilloscope displays of pulse waveform: (A) With sweep rate of $0.2 \mu\text{s}/\text{cm}$; (B) With sweep rate of $20 \text{ ns}/\text{cm}$.

Output Waveforms

Figs. 2A and B show typical output signals from the Probe Pulser at slow and fast sweep rates. The small intensified portion at the base of each pulse shown in Fig. 2A is the relatively slow-rising portion of the calibrator signal just before the tunnel diode switches. When measuring risetime, only the fast-rise portion of the output signal is used (see Fig. 2B).

REPLACEABLE PARTS



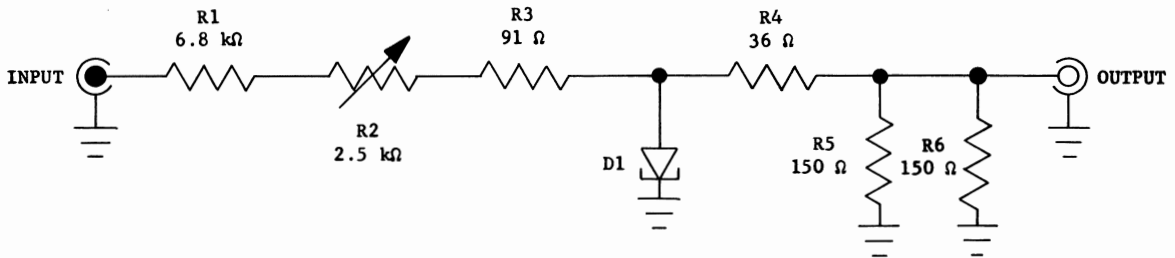
A

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Disc	Q	t					Description
				1	2	3	4	5	
1	166-0356-00		1						SLEEVE, adapter
2	358-0234-00		2						BUSHING, insulator, 3/8 inch diameter
3	103-0040-00		1						ADAPTER, 1/2 inch diameter
4	214-0809-01		1						CONTACT, electric
5	205-0069-00		1						SHELL, probe, connector
6	202-0095-00		1						BOX
7	334-1077-00		1						PLATE, identification
8	213-0141-00		-						mounting hardware: (not included w/plate)
9			1						RESISTOR, variable
			-						mounting hardware: (not included w/resistor)

REPLACEABLE PARTS

Fig. & Index No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Q					Description	
				t	y	1	2	3		4
10	210-0223-00			1						LUG, solder, 1/4 ID x 7/16 inch OD, SE
11	210-0940-00			1						WASHER, flat, 1/4 ID x 3/8 inch OD
12	210-0583-00			1						NUT, hex., 1/4-32 x 5/16 inch
13	366-0203-00			1						KNOB, gray
	- - - - -			-						knob includes:
	213-0004-00			1						SCREW, set, 6-32 x 3/16 inch, HSS
14	213-0075-00			2						SCREW, set, 4-40 x 3/32 inch, HSS
15	131-0428-00			1						CONNECTOR, assembly, BNC
	- - - - -			-						connector includes:
16	132-0081-00			1						NUT, BNC
17	166-0217-00			1						TUBE, spacer, insulator, plastic
18	214-0109-00			1						PIN, probe contact, male
19	358-0072-00			1						BUSHING, insulator, 0.273 inch diameter
20	134-0044-00			1						PLUG, probe, BNC

ELECTRICAL PARTS



Ckt. No.	Tektronix Part No.	Description			
Diode					
D1	152-0154-00	Tunnel	TD253		10 mA
Resistors					
Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.					
R1	301-0682-00	6.8 kΩ	$\frac{1}{2}$ W		5%
R2	311-0443-00	2.5 kΩ		Var	
R3	315-0910-00	91 Ω	$\frac{1}{4}$ W		5%
R4	317-0360-00	36 Ω	$\frac{1}{8}$ W		5%
R5	317-0151-00	150 Ω	$\frac{1}{8}$ W		5%
R6	317-0151-00	150 Ω	$\frac{1}{8}$ W		5%