amplitude. The VOLTS control is the 0 to 1 multiplier for the two ranges.

When the RANGE switch is set to the VARIABLE position, the step amplitude may be preset by the VARIABLE control to any uncalibrated amplitude from 0 to approximately 50 volts when driving a 125-ohm load. To determine the amplitude of the step for any setting of the VARIABLE control, apply the step waveform from the OUTPUT 125 Ω connector through a 125-ohm cable (and attenuator, if needed) to the SIGNAL 125 Ω connector. Measure the amplitude of the vertical deflection in centimeters and multiply the distance measured by the sensitivity of the oscilloscope (and attenuation if used).

Adjusting the Drive and Frequency

Two front-panel controls, DRIVE and FREQUENCY, control the movement of the dry-reed switch. These controls are adjusted to cause the reed to make-and-break contact with a minimum of contact bounce.

To adjust the two controls, they must first be preset fully counterclockwise. Then advance the DRIVE control until the reed vibrates (makes a buzzing sound). Advance the FREQUENCY control until the reed fails to operate and then rotate the control slightly counterclockwise to start the reed operating again. Slowly rotate the DRIVE control counterclockwise while rotating the FREQUENCY control back and forth to find the resonant frequency of the reed. The resonant frequency is found when the drive is decreased to a point where the reed will vibrate in only one small rotational area of the FREQUENCY control range. For optimum operation the DRIVE and FREQUENCY controls are then adjusted to obtain the most stable waveform near the resonant frequency of the reed. When adjusting the DRIVE control, use enough drive to get solid closures of the reed contacts. The resonant frequency of most reeds is usually within the range of 700 to 800 cps.

NOTE

The reed switches used in the Type 519 are chosen to produce the best possible waveform. The high requirements of these switches frequently result in a short lifetime. To extend the life of the reed switch set the RANGE switch to STANDBY when the Calibration-Step Generator is not being used.

ACCESSORIES

The following information pertains to the accessories which are included with the Type 519 Oscilloscope. Other optional accessories which are available are accompanied by specific application notes. See also Section 7, Accessories.

(1) 125 Ω Termination

The 125 Ω Termination (Fig. 2-9) is supplied as a spare for the T519P-A CRT termination or to terminate any 125-ohm cable.

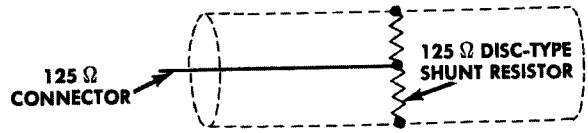

Fig. 2-9. Construction of the 125Ω Termination.

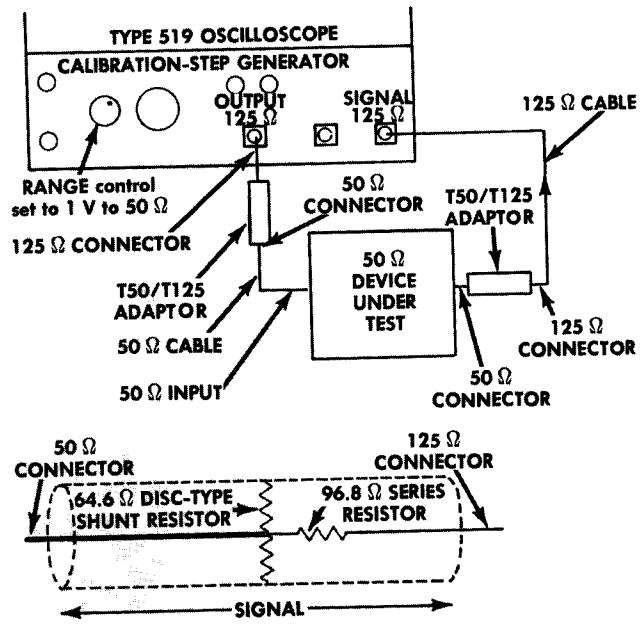

Fig. 2-10. Construction of the T50/T125 Adaptor. Also shown are two typical applications for this adaptor.

(2) Adaptor T50/T125*

This adaptor (Fig. 2-10) is commonly known as a minimum loss matching pad. Designed to match between a 50-ohm line and 125-ohm line, the attenuator presents minimum loss and reflections. It contains a network composed of a shunt and a series resistor. Though the attenuator presents a correct impedance match "in either direction", the signal voltage transmission factor of 0.225 in going from 125 ohms to 50 ohms is less than the N50/N125 adaptor described later. In going from 50 ohms to 125 ohms, the signal voltage transmission factor is approximately 0.564. The primary advantage of the T50/T125 adaptor is that it receives signals into either end without producing reflections.

(3) Adaptor T50/N125

This adaptor is usually called a 50-ohm termination adaptor and the internal circuitry is shown in Fig. 2-11. In actual use the 83.3-ohm resistor is shunted by the 125-ohm input impedance of the load. The combined resistances present a total input impedance of 50-ohms to the signal source.

* The letter "T" in an adaptor type means "Terminated"; "N" means "Not Terminated".

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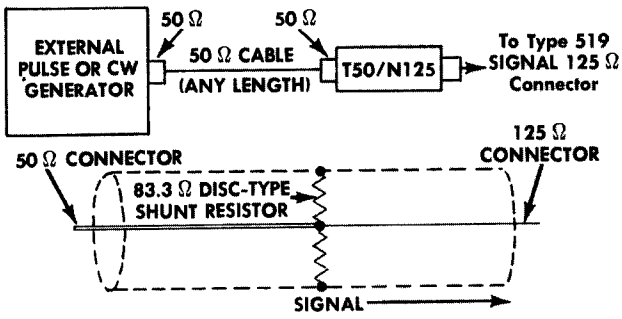

Fig. 2-11. Construction of the T50/N125 Adaptor. A typical application for this adaptor is also shown.

The adaptor is designed to handle pulse or continuous-wave signals originating from a 50-ohm source. It is not generally used to handle a signal traveling in the 125-ohm to 50-ohm direction, since it does not provide a termination for the 125-ohm connector. When a T50/N125 is used to connect a 50-ohm signal to the 519 signal input connector, the signal voltage is unchanged and the signal cable is fully terminated. The vertical deflection system has 50 nsec of delay before it is terminated in 125 ohms. Any reflections from the CRT, its connections, or termination, would return through the delay line and reflect from the nonterminating end of the T50/N125 to reappear at the CRT 90 to 100 nanoseconds after the original signal.

(4) Adaptor N50/N125

Also called an unterminated adaptor, this accessory (Fig. 2-12) is a straight-thru connector which connects a 50-ohm line directly to a 125-ohm line. This unit is used primarily for pulse applications. If a pulse from 50 ohms is applied to the 50-ohm end of the adaptor, the pulse amplitude increases 1.43 times at the 125-ohm end due to the reflection at the end of the 50-ohm system. In going from 125 to 50 ohms, approximately a 0.572 transmission factor results. This is more than for any of the other adaptors. Since it is a nonterminating unit, it will produce a high VSWR when used with high-frequency sine waves.

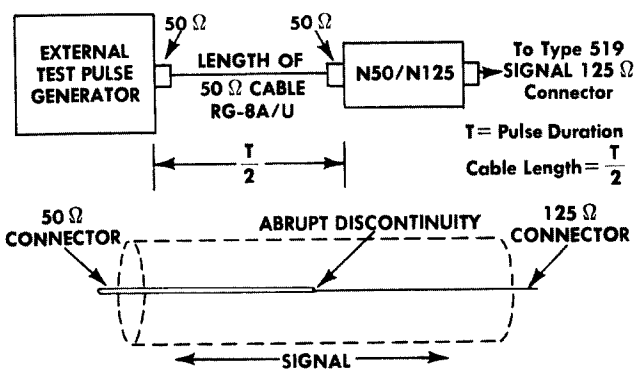

Fig. 2-12. Construction of the N50/N125 Adaptor. Also shown is a typical application for the adaptor.

When the adaptor is used for pulses, the abrupt discontinuity inherent in the unit causes a reflection to occur which may interfere with the displayed waveform unless certain precautionary measures are taken. To prevent a reflection from occurring on the displayed waveform, make the electrical length of the cable supplying the adaptor equal to or more than T/2, where T is the length of the pulse to be observed. The reflection will then appear after the displayed waveform.

TABLE 2-3

SIGNAL VOLTAGE TRANSMISSION FACTORS		
SIGNAL DIRECTION 50 Ω to 125 Ω	ADAPTOR TYPE	SIGNAL DIRECTION 125 Ω to 50 Ω
.564	T50/T125	.225
1.000	T50/N125	Not Used
Not Used	N50/T125	.400
1.43	N50/N125	.572
1.58	Theoretical Maximum Power Transfer	.633

(5) 125 Ω Insertion Unit

This unit is a hollow tube with 125-ohm connectors on each end and access holes located on each side to permit small components to be mounted inside. A snap-on sleeve cover permits adequate shielding of components and provides minimum discontinuity in the line. The unit facilitates 125-ohm (or 50-ohm, if desired) connections for pulse testing components such as diodes or transistors. It can also be used for testing or design of networks such as filters, attenuators, impedance-matching circuits, etc., and measurements on amplifiers and many other devices. The device makes it unnecessary to use a chassis with long leads and poor impedance matching. Instead, the components or circuit can be mounted in the small insertion unit and used as part of the 125-ohm system.

For series tests, the effective impedance of the test circuit is $2Z_0$. For shunt tests, the effective test circuit impedance is $Z_0/2$. Thus, for tests using 125-ohm cable, a series measurement is with 250 ohms equivalent series resistance while a test from center conductor to ground is with a 62.5-ohm equivalent source resistance. The above conditions assume proper termination impedances in both directions from the test point.

(6) 125 Ω Coupling Capacitor

The 125 Ω Coupling Capacitor connector contains a silvered-ceramic, wafer-type capacitor connected in series with the inner conductor. A slight amount of compensating inductance is supplied by the conductors butt-soldered to the capacitor. (See Fig. 2-13).

This unit is normally used for ac-coupling high-frequency signals to the Type 519 Oscilloscope with minimum reflections. Low-frequency signals and dc are blocked. Its characteristics are:

Coupling Capacitance: 0.01 μf ±20%, 0.0082 μf GMV.

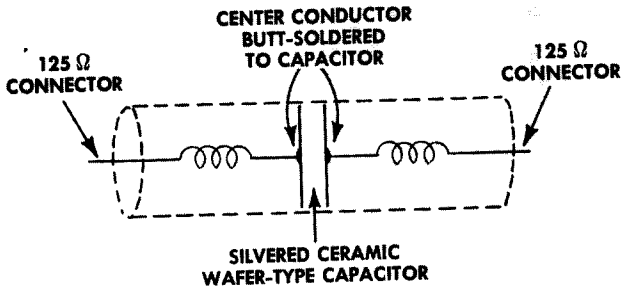

Fig. 2-13. Construction of the 125Ω Coupling Capacitor.

Voltage Rating:	400 volts.
Reflections:	Negligible.
Low-Frequency Cutoff in 125 Ω:	Approximately 65 kc.

(7) 125 Ω 1 KMC Timing Standard

The 125 Ω 1 KMC Timing Standard is a Sweep Calibrator which can be used to make periodic sweep calibration checks of the 2- and 5-nanosecond/cm rates. Refer to the Calibration Procedure section of this manual.

(8) 125 Ω Delay Cables

Different length cables are supplied for use in coupling the signal and/or trigger to the appropriate input connectors on the front panel of the Type 519 Oscilloscope. The loss per foot of RG-63/U cable is 0.06 db at 1 kmc. The delay time marked on each cable is the time required for a signal to travel from one end of the cable to the other.

(9) 125 Ω Cable Connector Parts

(a) Double Button Assembly. Used for replacing a damaged or worn insert in any of the 125-ohm front-panel connectors or cable connectors.

(b) Panel Adaptor Assembly. Replacement for any of the front-panel 125-ohm connectors.

(c) 125 Ω Cable Connector. Replacement for any of the cable connectors.

(10) Reed Switch

Two spare reed switches are included as replacements for the reed switch used in the Calibration-Step Generator. To replace the reed switch refer to the Maintenance section of this manual.