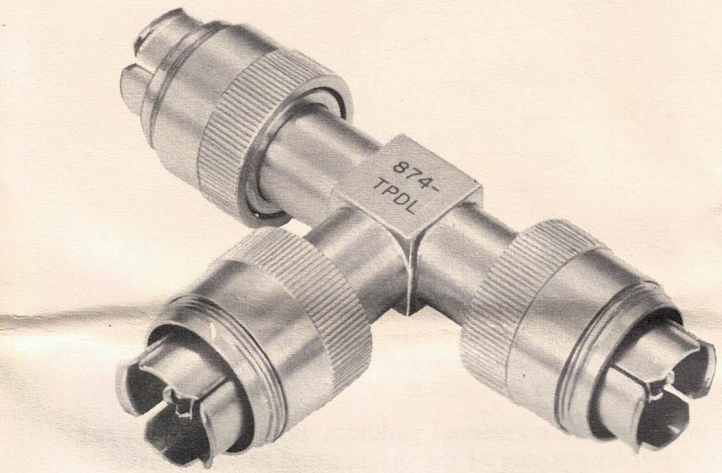

Figure 1. Type 874-TPDL Power Divider.

TYPES 874-TPD,-TPDL COAXIAL POWER DIVIDERS

DESCRIPTION.

The Types 874-TPD and -TPDL Power Dividers each comprise a three-port coaxial tee that is nominally matched at any port (throughout the frequency range), when the remaining two ports are terminated in 50.0-ohm loads. The extremely broad-band match is obtained by the use of three 16.67-ohm series resistors, one in each leg of the tee; the surroundings of the resistors are carefully compensated. The insertion loss between any two ports, when the third port is connected to a matched termination, is nominally 6 dB.

These dividers utilize deposited-carbon-film resistors that combine high stability with high peak-power capacity. The VSWR specifications (see Figure 2) provide a linear rise in VSWR with frequency for all ports.

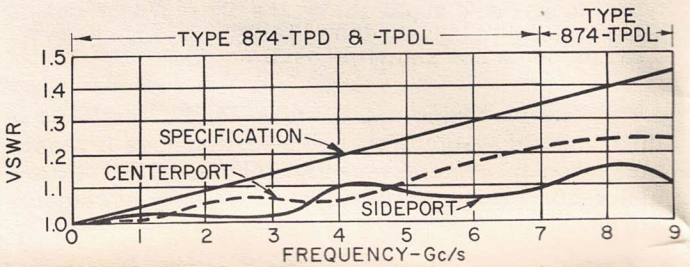

Figure 2. VSWR performance characteristics for Types 874-TPD/-TPDL Power Dividers.

The Type 874-TPDL Power Divider (Figure 1) is equipped with Type 874-BBL locking connectors, which ensure stable and repeatable junction performance to 9 Gc/s. Leakage at the connector, when it is mated with any GR874 locking connector, is typically better than 120 dB down, through 7 Gc/s.

The Type 874-TPD Power Divider is equipped with Type 874-B nonlocking connectors, which are optimum quick-disconnect connectors.

Both connector types are hermaphrodite, so that any connector will mate with any other GR874 connector. This eliminates the need to consider male and female junctions, yet furnishes direct and positive connections. Low-VSWR plug and jack adaptors from GR874 to most other leading coaxial connectors are available.

All of these features make the dividers particularly well suited for pulse applications. They are also useful whenever power splitting, with minimum reflection, is required. The package is small and works down to dc.

PRINCIPLES OF OPERATION.

The Type 874-TPD(L) Power Divider is shown schematically in Figure 3. To consider the dc case first, if 50.0-ohm resistors are connected at any two ports, the resistance at the third port is 50 ohms. In fact, so long as the 16.67-ohm series resistors appear lumped, the third-port impedance remains at 50 ohms. At frequencies at which the series resistors must be treated as distributed, the surroundings of the resistor become increasingly important. Thus, the extent to which the resistors and their surroundings can be made to simulate lumped series resistances determines the nearness to 50.0 ohms of the impedance observed at the third port.

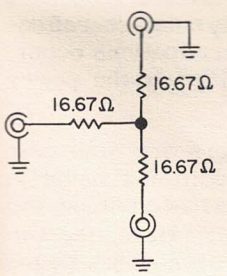

Figure 3. Simplified schematic of Power Divider.

Because of the symmetry inherent in these dividers when they are driven at the center leg of the tee, the output signals at the remaining two ports are very nearly equal in amplitude and phase. Figure 4 shows a plot of the typical equality of output signals in decibels.

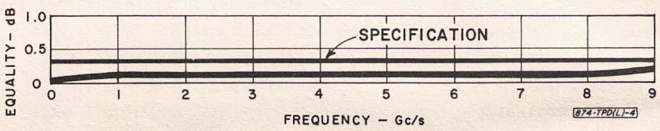

Figure 4. Output equality of Type 874-TPD/-TPDL Power Divider.

Owing to the distributed effects of the resistors at higher frequency, the insertion loss between the center port and a side port deviates somewhat from 6 dB with increasing frequency. A plot of side-port output, relative to the input (in decibels), is given in Figure 5.

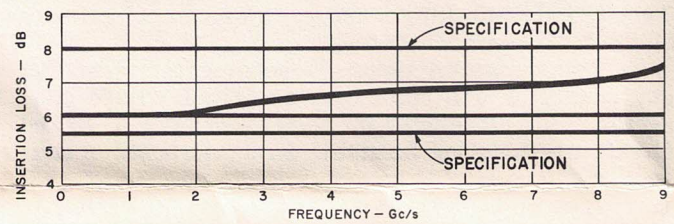

Figure 5. Relative output level at Type 874-TPD/TPDL side ports with center port driven.

CW APPLICATIONS.

The Type 874-TPD(L) dividers are used to split a signal into two nearly equal components, with a minimum of reflections introduced in the process.

As shown in Figure 6, the power divider can be used to split the output of a common rf source between two loads. If the loads are ≈50 ohms, each will be driven at a level 6 dB below the source output.

Very little signal from the source is reflected at the power divider, owing to the low input VSWR. Any signals reflected from the loads are isolated, by the 6-dB insertion loss of the power divider, from each other and from the source. Also, only small re-reflection of reflected signals from the terminations occur, owing to the low VSWR's seen looking into the power divider from the output ports.

The Type 874-TPD(L) dividers are also used (usually in conjunction with some additional isolation devices, such as GR874 Attenuators) to combine two signals, as illustrated in Figure 7. Here, the two source signals are isolated from each other by the

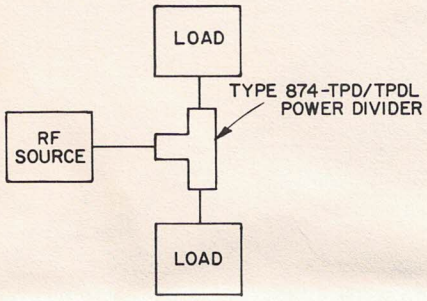

Figure 6. Power Divider used to split source output between two loads.

divider and the additional padding. Both signals appear at the common port of the divider and are delivered to the load.

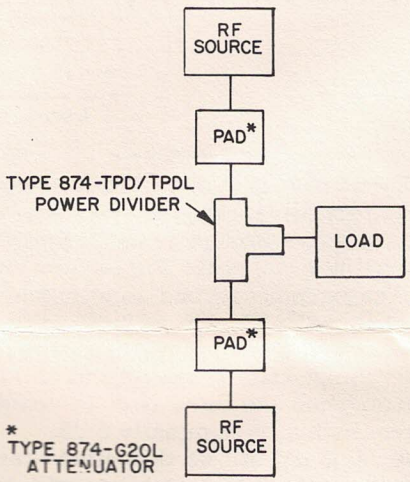

Figure 7. Power Divider used to combine two rf source outputs to drive a common load.

In all these applications, the Type 874-W50BL is recommended as a low-VSWR 50-ohm standard termination (i.e., $1.005 + 0.013\ f_{Gc}$) to 9 Gc/s.

The foregoing applications can be combined in dual-channel systems, such as insertion-loss or phase-measurement systems (see Figures 8 and 9). They are also useful in antenna-feed systems to split or combine signals.

PULSE APPLICATIONS.

The Type 874-TPD/-TPDL Coaxial Power Dividers can be used to considerable advantage in a number of applications with pulse-type instrumentation, such as sampling oscilloscopes and fractional-nanosecond-rise-time pulse generators. Since most commercially available instruments of this type are equipped with the GR874 connector, these power dividers make ideal accessories.

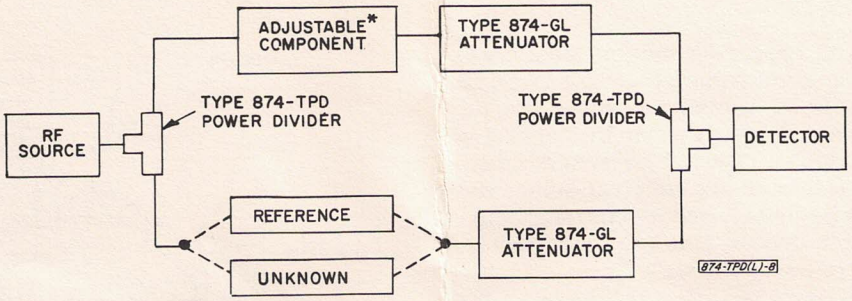

Figure 8. Coaxial test setup using Type 874-TPD, -TPDL Power Dividers for substitution measurements.

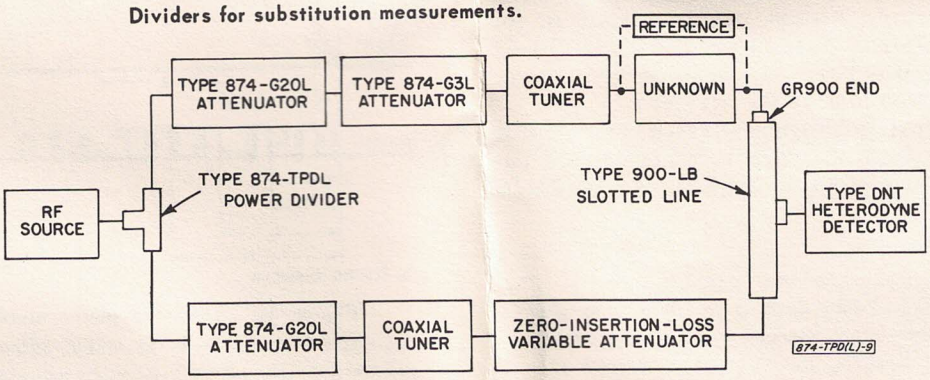

Figure 9. Precision coaxial phase measurement system using a Type 874-TPDL Power Divider.

Time-Domain Reflectometry - The low VSWR introduced by the power dividers, in conjunction with nominal insertion loss and good isolation, increases the accuracy and resolution of time-domain-reflectometry instrumentation, particularly in measurements of unknowns with which multiple reflections are encountered. Inserted as shown in Figure 10, the power divider transforms the pulse generator into a nearly matched source, thereby significantly reducing troublesome re-reflections, even in the presence of large discontinuities in the unknown.

The coaxial reference air line, called for in the diagram, is a convenient method of precise impedance calibration of the measurement system. The Type 874-L Air Lines plug directly into the power divider and possess a characteristic impedance of 50 ohms ±0.4%. The Types 874-L10, -L20, and -L30 all work equally well in this application; those with locking GR874 connectors are usable up to 9.0 Gc/s.

Sampling Oscilloscope Accessory - The sensitivity of sampling oscilloscopes that operate in the gigacycle region can be increased by a factor of five by use of the power divider in the signal-input line. The performance improvement is brought about by external division of the signal to increase the trigger input. Thus, a representative sampling oscilloscope that requires a 50-mV signal to provide 5 mV of trigger internally can trigger equally reliably on input signals of only 10 mV, by use of the power divider. Figure 11 shows the principle.

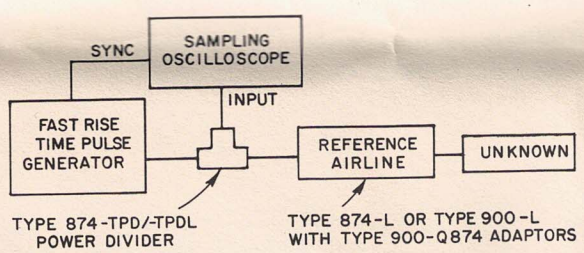

Figure 10. Use of the Type 874-TPD/-TPDL Power Divider in time-domain reflectometry instrumentation built around a sampling oscilloscope.

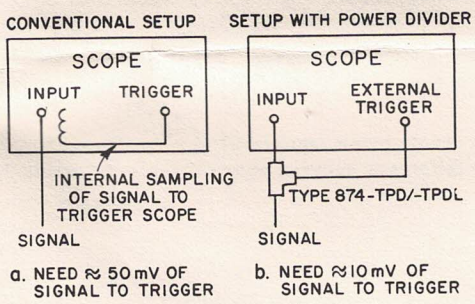

Figure 11. Use of the Type 874-TPD/-TPDL Power Divider to increase the sensitivity of sampling oscilloscopes.

Pulser Accessory - The repetition rate of most fractional-nanosecond-rise-time pulse generators can be extended from hundreds of cycles per second to the region of several hundred megacycles by cascading power dividers. As shown in Figure 12, power dividers can be cascaded to fractionize the original pulse, and additional dividers can be used to recombine the resulting signal, after suitable delays, into a train of pulses, adjustably spaced in times T_1 through T_4.

This application envisions as a pulse generator one that consists of a 50-ohm charge line operated with a mercury-wetted reed switch.

GR874 Air Lines can be used for minute delays (up to 1 ns) and GR874 Attenuators are available to achieve compensatory losses, where required, for pulse bursts of uniform amplitude. The Type 874-G6 (6 dB or 2X) attenuator bears the most convenient relation to the insertion loss in the divider.

A comprehensive assortment of GR874-equipped ells, patch cords, and adaptors to other-series unknowns, needed to complete the system, are available.

See the General Radio Catalog for details on the comprehensive line of rf sources and GR874 coaxial instruments and devices available for use with the power dividers.

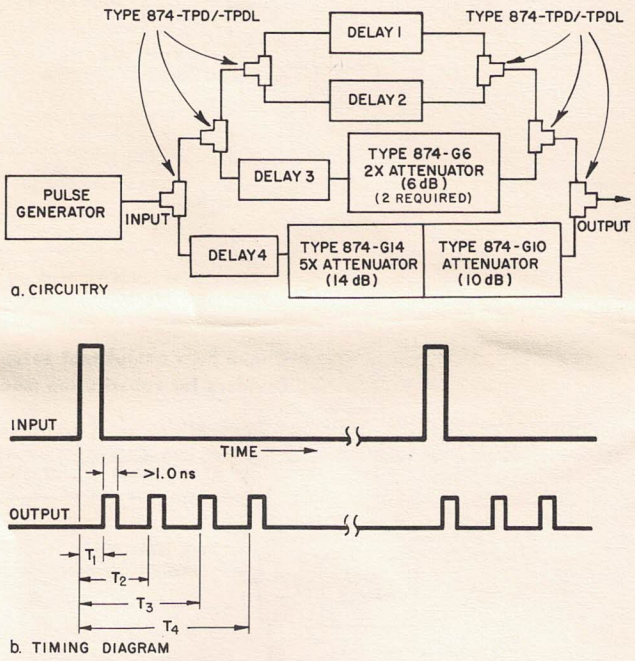

Figure 12. Cascaded power dividers used to construct a pulse burst which effectively raises the repetition rate of a subnanosecond-rise-time pulse generator to several hundred megacycles.

SPECIFICATIONS

TYPE 874-TPDL POWER DIVIDER

Frequency Range: 0 - 9 Gc/s.

VSWR: (At any port, when remaining ports are terminated in matched 50-ohm terminations) 1.0 + 0.05 f_{Gc} to 9 Gc/s.

Characteristic Impedance: 50 ohms, nominal.

Insertion Loss: (Between any two ports, when remaining port is terminated in a matched 50-ohm termination) 6 dB, nominal.

Dc Resistance: (At any port, when remaining ports are terminated in 50.00-ohm resistors) 50.00 ± 0.25 ohms (0.5%).

Input Power: 1 watt CW.

Output Characteristics: (When driven from center port of tee into matched 50-ohm loads)

Equality of output signals: Within 0.3 dB.

Output levels below input level: $6\ ^{+2}_{-0.5}$ dB.

Phase difference between output signals: 0° nominal.

Maximum Input Power: 2W continuous.

Dimensions: Width 4, height 2 5/16, depth 1 1/16 inches (105 by 60 by 25 mm).

Net Weight: 6 ounces (170 grams).

TYPE 874-TPD POWER DIVIDER

Same as Type 874-TPDL, except:

Frequency Range: 0 - 7 Gc/s.

VSWR: (At any port, when remaining ports are terminated in matched 50-ohm terminations) 1.0 + 0.05 f_{Gc} to 7 Gc/s.

Dimensions: Width 4, height 2 5/16, depth 13/16 inches (105 by 60 by 20 mm).

Net Weight: 5 ounces (145 grams).

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