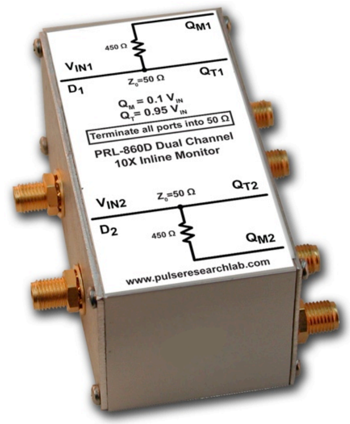
PRL-860D: Dual Channel 10X In-Line Signal Monitor/Low-Loss Pickoff Tee

APPLICATIONS

- In-Line GHz ECL and RF Signal Monitoring
- Differential Signal Monitoring
- Permanent In-line Installations for System Monitoring
- Trigger Pick-Off Signal Generation

FEATURES

- Dual Channel for CLK/DATA Monitoring
- SMA I/O, 50 Ω Impedance
- Through Port Bandwidth > 7 GHz
- Monitor Port Bandwidth > 6 GHz
- Through Port Retains 95% of Input Signal (0.42 dB insertion loss)
- Monitor Port Retains 10% of Through Signal (20 dB attenuation ratio)
- Applicable to Single-Ended or Differential Inputs



PRL-860D-SMA

DESCRIPTION

The PRL-860D is a dual channel wideband signal splitter, intended for inline signal monitoring applications. As shown above, the input signal travels from Input Port D to the Through Port Q_T via a 50 Ω transmission line. A small fraction of the input signal is extracted by the 450 Ω resistor and diverted to the Monitor Port Q_M. A typical connection set up is shown in Fig. 1. The signal generator with a source resistance R_S is connected to Port D, and Q_T is connected to the intended load R_L. Q_M, which monitors the input signal going through Q_T, is connected to a 50 Ω input scope.

When operating in a 50 Ω environment, typically 95% of the input signal applied to port D is transmitted to port Q_T and 10% to port Q_M. For optimum inline monitoring performance, Q_M must always be connected a 50 Ω-input instrument. Q_T, however, can be left open or connected to an arbitrary load, because it is the function of the Q_M port to capture the input signal when it is going through the Q_T port. For example, if Q_T is left open, Q_M will display the input signal at the end of a transmission line terminated into 500 Ω. More detailed discussion on this subject will be made available on our website.

From Fig. 1, before Q_M is connected to the scope, the Thevenin output impedance Z_{TH} looking into the 50 Ω Z_0 bus is simply $R_S//R_L$, and the Thevenin output voltage measured at the same point is V_{TH}. After Q_M is connected to the scope, the equivalent circuit is shown in Fig. 2, where Z_{TH} and V_{TH} are given in Fig.1. Fig. 2 is intended for DC calculations only, as it does not include the interconnecting cable between Q_T and the load R_L. For a given input V_S, the Through port voltage V_{QT} and the Monitor-Port voltage V_{QM} can be calculated as follows:

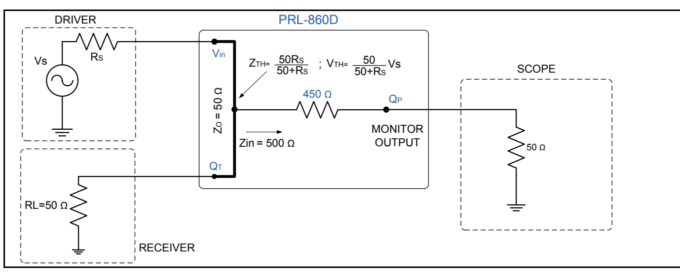


Fig. 1. Typical Set Up

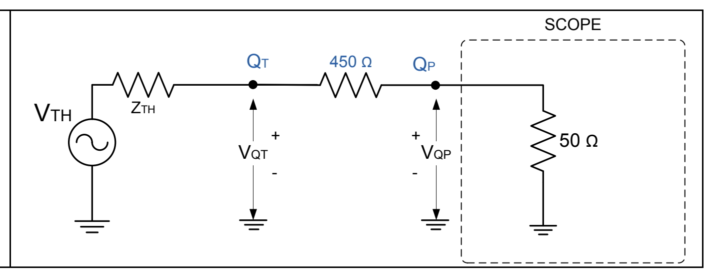


Fig. 2. Simplified Equivalent Circuit of Fig. 1

From Fig. 2, $V_{QT} = V_{TH} \times 500/(Z_{TH} + 500)$ (1)
If $R_S = R_L = 50$ Ω, then,
$Z_{TH} = 25$ Ω, and $V_{TH} = V_S/2$, or $0.5\ V_S$.
Using these values of Z_{TH} and V_{TH} in (1),
$V_{QT} = 0.476\ V_S$ (2)

Equation (2) states that, after loading the Q_M port, the Through Port output is reduced to 0.476/0.5 = 95.2% of V_{TH}, the unloaded value. From Fig. 2, V_{QM} is simply 0.1 V_{QT}, due to the 450 Ω/50 Ω, 10 to 1 divider.

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Bandwidth and Rise Time Considerations for Ideal Passive Loading Conditions

From Fig. 1, it is seen that the path from the input connector D to the Through Port connector Q_T is simply a very short 50 Ω transmission line shunted by a 500 Ω load. The bandwidth is limited by the PCB material and the microstrip line Z_0 on the PCB surface. When driven by the Tektronix 80E04 TDR generator (t_R = 25 ps) the Through Port Q_{T1}, Fig. 3 C3, shows a rise time of 52 ps. With the source rise time of 25 ps taken into account, the rise time of Q_{T1} is actually less than 46 ps, or an equivalent BW greater than 7.6 GHz. The Monitor Port, Q_{M1}, Fig. 3 C4, shows a slower rise time of 59 ps, or an equivalent BW greater than 6 GHz.

The slight overshoot and the perturbations on the pulse top shown in Fig 3, C4, are due to the capacitive coupling effect across the 450 Ω resistor. When a slower rise time input signal of 150 ps is used, both the over shoot and pulse top perturbations are greatly reduced, as shown in Fig.4. C4. It should be noted that the set up used in both Fig. 3 and Fig. 4 is based on that shown in Fig. 1, and both Q_T and Q_M outputs are connected to sampling scope inputs, which are essentially ideal 50 Ω terminations. When real life receivers are involved, as will be shown in a separate Application Note, signal kickback will occur when the receivers are switched on and off. These kickback signals, visible only through the Q_M port, are seldom of concern until things are not working correctly.

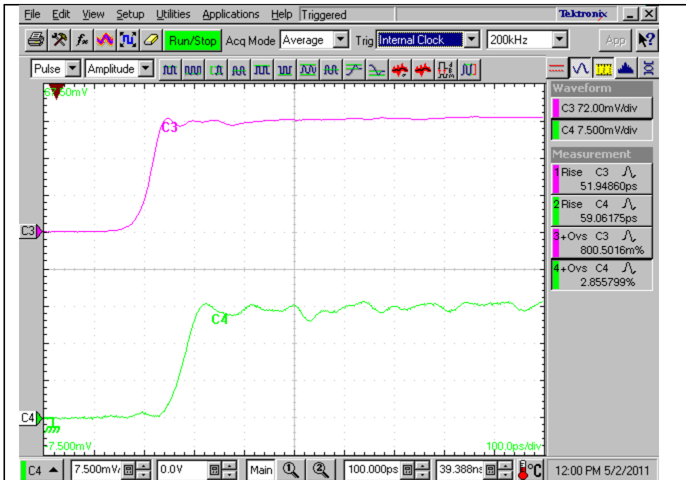

Fig. 3. C3/Q_{T1} and C4/Q_{M1} driven by 80E04 TDR (t_R = 25 ps)

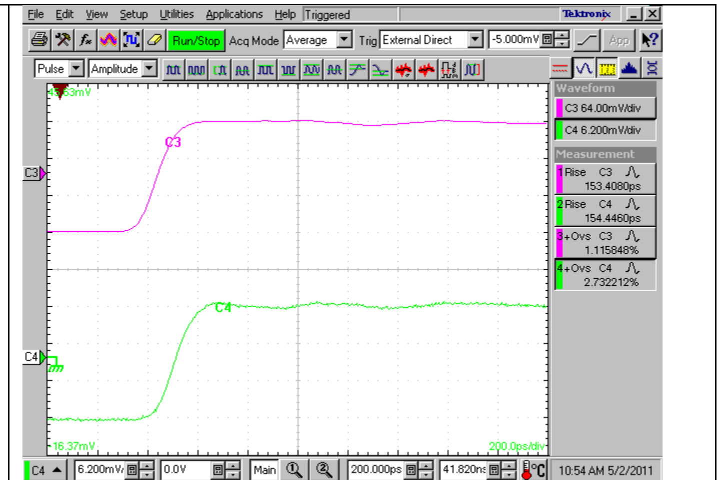

Fig. 4. C3/Q_{T2} and C4/Q_{M2} driven by PRL-430LP (t_R = 150 ps)

*SPECIFICATIONS (0⁰ C ≤ T_A ≤ 35 °C)

Unless otherwise specified, the set up shown in Fig. 1 with R_S = R_L= 50 Ω, including the 50 Ω scope termination, will be used for all measurements

SYMBOL	PARAMETER	Min	Typ	Max	UNIT
R_{IN}	Input Resistance (V_{IN} port D)	45.00	45.45	45.90	Ω
$R_{OUT\ I}$	Output Resistance (Q_T port)	45.00	45.45	45.90	Ω
$R_{OUT\ II}$	Output Resistance (Q_M port)	470	475	480	Ω
t_{R1}(1)	Q_T Rise Time (10%-90%)		50	60	ps
BW1	Equivalent 3 dB Bandwidth	5.8	7.0		GHz
t_{R2}(1)	Q_M Rise Time (10%-90%)		55	65	ps
BW2	Equivalent 3 dB Bandwidth	5.3	6.0		GHz
t_{PLHI}	Propagation Delay to Q_T Port		300		ns
t_{PLHII}	Propagation Delay to Q_M Port		350		ns
IL_{PCT}	Insertion Loss, Q_T Port, %		5		%
IL_{dB}	Insertion Loss, Q_T Port, dB		0.42		dB
t_{SKEW}	Skew between Q_T and Q_M		75	150	ps
	Size	2.9W x 1.3H x 1.5L			in
	Weight		5		Oz

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