

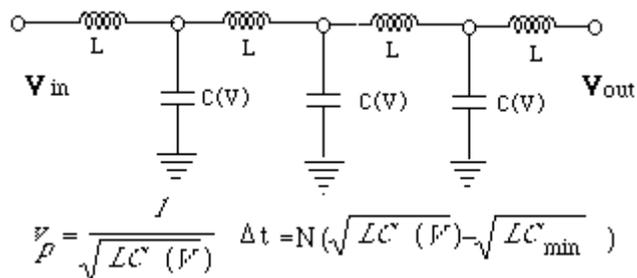
## 5 and 10MHz 90°Phase shifter

For calibration and testing of oscillators and relative devices by frequency standard laboratories, there is a need to use a Phase Noise Test-set. To test amplifier Frequency multiplier one of the necessary accessory is a Phase shifter to have the mixer's quadrature.

This paper presents two simple 90° Phase shifter designed for the two most commonly used frequency in a Frequency Standard Laboratory. The main characteristic over the 90° Phase shift presented are:

Low signal attenuation  
Small physical dimensions

Any coaxial cable can be represented as LC delay series as represented in the following figure.



The coaxial cable used is the Pastenack Enterprises RG188A/U, it is a 50 Ohms impedance, outer diameter .110", silver covered copper clad steel, nominal capacitance 29.4 pF/ft and a nominal 10 MHz attenuation 3.80 dB per 100 Feet.



Fig 1 The 10 MHz version

To test the correct length of the cable for 90° shift a simple method is to use a mixer and few more component as described in fig 2.

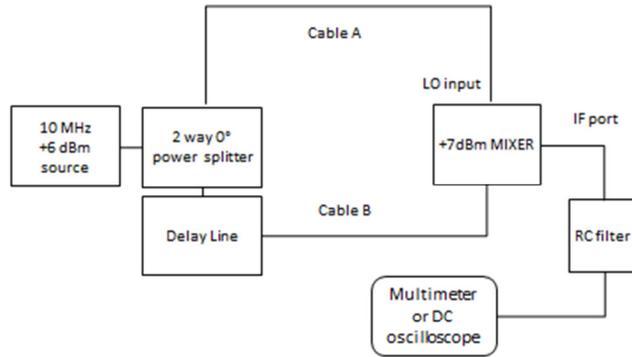


Fig 2 Test set

To test the exact delay you can use the mixer method itself. The Cable A and B are same length and cable type and for the RC low pass filter can be used a 5k Ohm serie and 1uF un-polarized to ground . When the shift is exactly 90° at the working frequency the DC output have to be zero.

Physical length of the cables:

90° Delay Line for 5MHz. Cable's length 10.44 meters RG188A/U attenuation 0.7 dB  
 90° Delay Line for 10MHz. Cable's length 5.22 meters RG188A/U attenuation 0.4 dB



Fig 3 The two Delay Line with SMA connectors

To measure very low Phase noise a fine null of phase will be necessary in the picoseconds area, and an analog variable Delay Line have to be added in series in one of the two bridges of the Phase Noise test-set.

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Reference 1) Coaxial cable delay. Jacques Audet VE2AZX <http://www.ve2azx.net/technical/CoaxialCableDelay.pdf>

Reference 2) Calculating the propagation delay of coaxial cable GPS Source <http://www.gpssource.com/files/Cable-Delay-FAQ.pdf>

Reference 3) Pasternack Enterprises INC [www.pasernack.com](http://www.pasernack.com)