Stubline Tuner

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1 Introduction

This report documents the design of a stubline tuner. The tuner is part of an antenna system, currently in development, described (in concept) in [1]. This antenna system is being developed as part of our project “Antenna Systems for Multiband Mobile & Portable Radio” [2].

2 Design

The constructed stubline is shown in Figure 1. The stubline consists of a 50Ω microstrip line with 10 switchable stubs, spaced 1.0 cm apart. The total length of the stubline (between the footprint centers of the SMA input and output jacks) is 11.4 cm. The distance from the left connector (J1) to the first stub junction is 0.9 cm. The length of the stub (measured from junction point on the primary transmission line to the footprint center of the stub’s SMA connector) is 1.3 cm, and can be extended by attaching SMA connectorized coaxial cable.

The printed circuit board is 2-layer FR4 (relative permittivity ≈ 4.5) 0.062 in (1.575 mm) thick. The primary transmission line is 0.11 in (2.8 mm) wide. The velocity factor prior to installation of the relays is estimated to be 60%.

The schematic and board layout are shown in Figures 2 and 3, respectively. Switching is done using NAiS Model AGN2104H single-coil latching relays. Since the relays are of the latching variety, no power is required except to change state. A voltage of about 2.5 V across the coil is sufficient to activate the latch; applying a signal of the opposite polarity changes the state.

3 Performance

Figure 4 shows $s_{21}$ through the stubline with all relays open (i.e., no stubs connected). The worst case insertion loss is about 0.9 dB. To isolate the effect of the (open) relays from the primary transmission line, the latter was also measured prior to installing the relays; the result is shown in Figure 5. In this case the worst case insertion loss is about 0.4 dB.

Figure 6 shows $s_{11}$ measured at the left (J1) jack, again with all relays open. The worst case return loss is about 8 dB, corresponding to a VSWR of 2.3. $s_{22}$ is essentially the same.
Figure 1: Stubline.

Figure 2: Stubline PCB layout.
Figure 3: Stubline schematic.

Figure 4: Stubline $s_{21}$, all relays open.
Figure 5: Stubline $s_{21}$, prior to installation of relays.
Figure 6: Stubline $s_{11}$, all relays open.
References
