US008862063B2

(12) **United States Patent**
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(10) **Patent No.: US 8,862,063 B2**
(45) **Date of Patent: *Oct. 14, 2014**

(54) **DEVICES AND METHODS FOR PHASE SHIFTING A RADIO FREQUENCY (RF) SIGNAL FOR A BASE STATION ANTENNA**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/710,346**

(22) Filed: **Dec. 10, 2012**

(65) **Prior Publication Data**

US 2013/0099877 A1 Apr. 25, 2013

Related U.S. Application Data

(63) Continuation of application No. 12/723,161, filed on Mar. 12, 2010, now abandoned.

(30) **Foreign Application Priority Data**

Jan. 28, 2010 (IN) 222/CHE/2010

(51) **Int. Cl.**
H04B 1/00 (2006.01)

(Continued)

(52) **U.S. Cl.**
CPC ***H01P 1/184*** (2013.01); ***H01Q 1/246*** (2013.01); ***H01Q 3/32*** (2013.01)
USPC **455/63.4**; 455/562.1; 455/42; 455/304; 455/276.1; 455/523; 333/204; 333/219; 333/246; 333/238

(58) **Field of Classification Search**
CPC H01P 1/184
USPC 455/63.4, 562.1, 42
See application file for complete search history.

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(57) **ABSTRACT**

Methods and devices for phase shifting an RF signal for a base station antenna are provided. The device includes a transmission line that has a stationary ground plane coupled to the top of a substrate and a signal line on the bottom of the substrate. The signal line has an input port and an output port. The input port receives the RF signal with a certain phase and travels across the bottom of the substrate to the output port. The RF signal has a different phase at the output port because defected ground structures etched on the stationary ground plane shift the phase of the RF signal. In addition, the device includes a movable ground plane that may cover a portion of the defected ground structures, the substrate, and the stationary ground plane such that the moveable ground plane further adjusts the phase of the RF signal.

17 Claims, 9 Drawing Sheets