# Tunable Antenna Matching Architecture for LTE Application

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***Abstract* – A broadband tunable matching architecture for LTE application is proposed. The proposed matching architecture is independent of PIFA antenna pattern by connecting an inductor at antenna ground terminal. The matching circuit architecture of this paper use the less number of expensive tunable elements to achieve broadband antenna matching, so as to lower overall implement cost.**

***Index Terms* — LTE Antenna, Tunable Matching Circuit, Broadband Antenna.**

## I. INTRODUCTION

Modern wireless standard requires wireless signaling to be carried out at multiple bands distributed over a wide frequency range. For example, to support LTE (Long term Evolution) telecommunication standard, wireless signaling not only needs to be implement at conventional bands of 2G (GSM) and 3G (WCDMA/TD-SCDMA) standards, but also at additional bands such as 700 MHz to 824 MHz and 2300 MHz to 2690MHz. However, supporting bands over such broad frequency range is difficult to fulfill by traditional antenna design methodology.

To address issues difficult to be solved by antenna design, this paper discloses a low-cost antenna matching circuit to overcome unsatisfactory characteristics of antenna, e.g., antenna impedance which is difficult to be matched at multiple bands distributed over broad frequency range. The matching circuit according to the invention may be implemented by inexpensive tunable elements like diode(s) and/or switch(es), so as to reduce implement cost by avoiding use of expensive tunable capacitors and tuning module. Conventionally, architecture of a matching circuit is tailored for, and applicable to, only a particular kind of antenna as [1], and [2] proposed, thus different kinds of antennas need respective matching circuits of different architectures. However, according to the proposed, matching circuit is independent of PIFA antenna pattern.

## II. DESIGN CONSIDERATION

Fig. 1 shows a broadband tunable matching architecture for an antenna of whatever PIFA antenna pattern, includes a ground circuit and a feed circuit. The ground circuit connects an inductor to the ground (LG), and provides an inductive impedance at the ground terminal (G). The feed circuit connects a feed signal to a feed terminal (F) of the antenna. The feed circuit is capable of switching between a first mode and a second mode for respectively providing the first

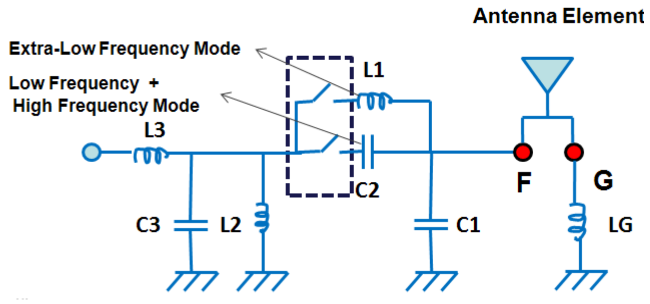


Fig. 1. The broadband tunable antenna matching circuit

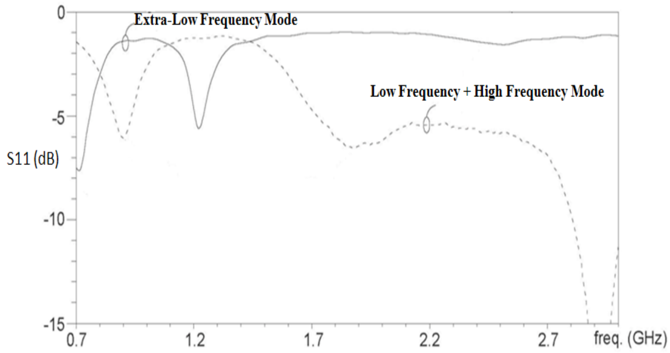


Fig. 2. S11 of the difference switching mode

equivalent impedance and the second equivalent impedance between the feed signal and the feed terminal. In a first switching mode for enabling extra-low frequency antenna resonance mode, the switch connects to the feed terminal via inductive impedance; in a second switching mode for enabling low frequency + high frequency antenna resonance mode, the switch connects to the feed terminal via capacitance impedance. The return loss of above two switching mode is showed in Fig. 2. In this example, extra-low frequency mode could cover 704MHz~787MHz and low frequency + high frequency mode could cover 824MHz ~ 960MHz and 1710MHz ~ 2690MHz.

## III. RESULT AND DISCUSSION

Architecture of the proposed matching circuit is independent of PIFA antenna pattern; for example, matching circuits of the same architecture can be respectively applied to a dual branch planar inverted-F antenna as show in Fig. 3

(a), and a single branch planar inverted-F antenna as show in Fig. 4(a).

*A. Dual Branch Inverted-F Antenna*

The dual branch inverted-F type antenna is very popular for cell phone antenna design because the antenna tuning method of this type antenna is quit straightforward, longer arm is the resonator of low band and shorter arm is the resonator for high band. Fig. 4(a) is dual branch inverted-F antenna design for full band LTE cell phone, Fig. 4(b) and Fig. 4(c) shows the measured return loss and total efficiency of this antenna.

*B. Single Branch Antenna*

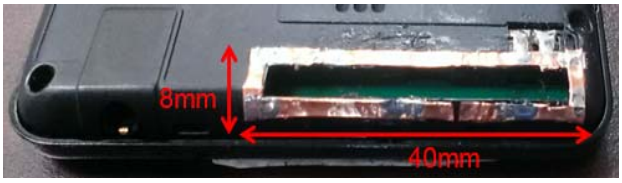

Fig. 3(a) Dual branch inverted-F antenna

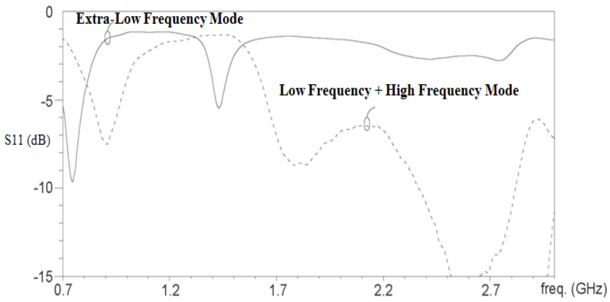

Fig. 3(b) S11 of dual branch inverted-F antenna

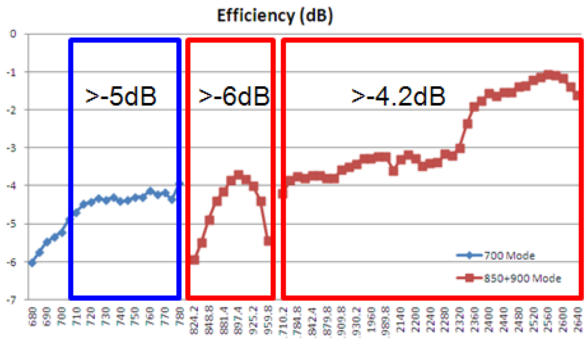

Fig. 3(c) Total Efficiency of dual branch inverted-F antenna

Though a single branch antenna may provide multiple bands, typically only one of the bands can be well manipulated and matched; the remaining bands are difficult to be matched, and then can hardly be utilized for telecommunication. However, with the matching circuit of the invention, even the single branch antenna can provide multiple useful bands for telecommunication, because architecture of the matching circuit can ease matching of single branch antenna over broad frequency range. Fig. 5(a) shows a single branch antenna design for cell phone which could support full LTE bands. The measured return loss and total efficiency are shown as Fig. 5(b) and Fig. 5(c).

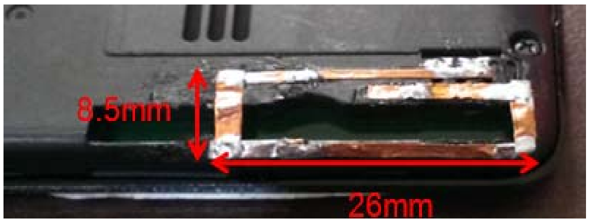

Fig. 4(a) Single branch inverted-F antenna

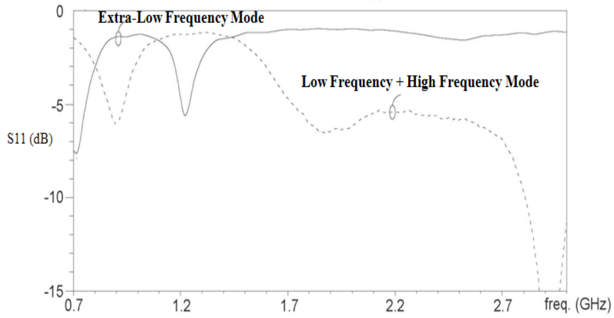

Fig. 4(b) S11 of single branch inverted-F antenna

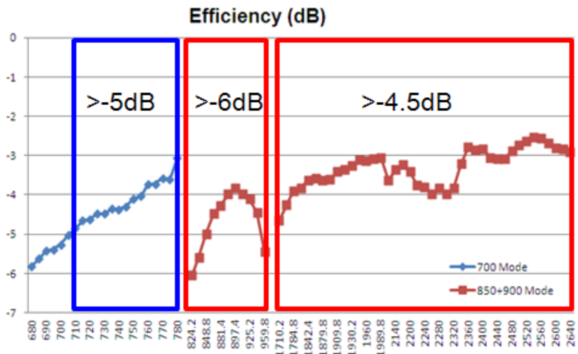

Fig. 4(c) Total Efficiency of single branch inverted-F antenna

## IV. Conclusion

A new broadband tunable antenna matching architecture is proposed. The proposed can ease matching different type of antenna by using the less number of inexpensive tunable elements like diode(s) and/or switch(es). This proposal is suitable for any wireless device which has broad bandwidth and low cost requirement.

## References

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