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Built-In Coil Current Sensing for 7-Tesla $^{1}H/^{23}Na$ and $^{1}H/^{31}P$ Magnetic Resonance Imaging

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Abstract

This article introduces two designs for dual-tuned built-in radio-frequency coil current sensing in 7-Tesla magnetic resonance imaging based on the current forcing property of the quarter-wave transmission line. The first design offers dual-tuned built-in coil current sensing at $^{1}H/^{23}Na$ resonant frequencies to probe the coil current consecutively at 298 MHz and 78.8 MHz, without the need for any integrated sensor on the coil. The second design enables dual-tuned built-in coil current sensing at $^{1}H/^{31}P$ resonant frequencies to probe the coil current at 298 MHz and 120 MHz consecutively. The first design achieved good matching (<-40 dB) and low insertion loss (<0.5 dB) for ^{1}H and ^{23}Na magnetic resonance signals. The $^{1}H/^{31}P$ design also exhibited good matching (<-30 dB) and low insertion loss (<0.67 dB). Therefore, both designs show promising potential for monitoring current flows in dual-tuned coils at the Larmor frequencies of different atomic nuclei.

Key words: Current Sensing, Dual-Tuned, Magnetic Resonance Imaging, Power Amplifier, Radio Frequency