# A 8 channel TX/RX decoupled loop array for cardiac/body imaging at 7T

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**Introduction**
First results for body and cardiac imaging at 7T have been published recently (/1/, /2/, /3/). These results indicate that the traditional concept of a fix-mounted body coil seems not to be appropriate at 7T. For this reason it is conceptually appealing to pursue the concept of local TX/RX coil arrays for 7T body imaging to enable B1 shimming and Tx SENSE, which are essential at 7T/300MHz. For this purpose an 8 channel TX/RX cardiac/body coil design is being proposed and its feasibility for cardiac imaging is demonstrated.

**Method**
One of the main issues for coil arrays is the decoupling of the individual elements. Whereas for receive arrays preamp decoupling addresses this problem, it is essential for TX arrays to have good decoupling values. Depending on the type of coil various decoupling schemes have been proposed. In the case of loop coils either inductive or capacitive decoupling can be used. For inductive decoupling a partial overlap of neighboring coils cancels the mutual flux of one coil to its neighboring element.
Capacitive decoupling can be accomplished by using a common conductor for nearest neighbor coil elements together with suitable capacitors in series with this common conductor /3/. There are several advantages of this approach over the inductive decoupling method. The decoupling is adjustable, which is not easily feasible for inductive decoupling. The coil layout is very simple, a single sided PCB is sufficient. The current in the common conductor is just the difference between the two loop currents, which means reduced losses compared to the inductive decoupling with two separate conductors.
The coil setup (Figure 1) comprises five angled loops for the anterior and three flat loops for the posterior part (Figure 2). Dimensions are 10 cm × 16 cm and 12 cm × 16 cm for an anterior and posterior loop, respectively. Capacitive shortening was applied extensively. Coaxial cable traps were used at each feed cable.
For the decoupling between the upper and lower parts of the coil setup no special precautions were taken, sufficient decoupling results from the damping by the patients body itself. In order to reduce radiation losses, an RF screen made of thin slotted double sided copper foil on an insulating dielectric was mounted at the rear side of the loop elements at a distance of 20 mm. A minimum conductor distance of 10 mm to the patient's body was ensured by a foam layer on the patient side of the coil.

**Results**
The RF characteristics measured on the bench were: decoupling under patient load condition between neighboring loops ~18dB, between next neighboring loops >20dB, between opposite loops >20db, unloaded Q = 70, loaded Q = 15.
Figure 3 demonstrates first cardiac imaging results (2D FLASH, TE=3.15ms, TR=50ms, voxel size=1.6mm x 1.6mm x 4 mm), obtained with a non CP phase distribution (optimized for B1 homogeneity) but equal amplitude excitation of the individual loops. All measurements were performed on a 7 Tesla whole body scanner (Siemens, Erlangen, Germany).

**Conclusion**
While a quantitative characterization of the coil's performance is not yet available, the results obtained so far clearly demonstrate the general feasibility of the approach. Even when driving the coil in a simple non-CP-phase mode, cardiac and abdominal images of acceptable quality are obtained. So far, $B_1$ inhomogeneities, which are clearly visible in the images, have not yet been properly addressed. Just by careful positioning of the coil array and a rough optimization of the excitation phases it was possible, however, to remove the worst artifacts from the region of interest.
We expect considerable improvements once the potential of our multichannel transmit array ($B_1$ shimming, Tx SENSE) is fully exploited.

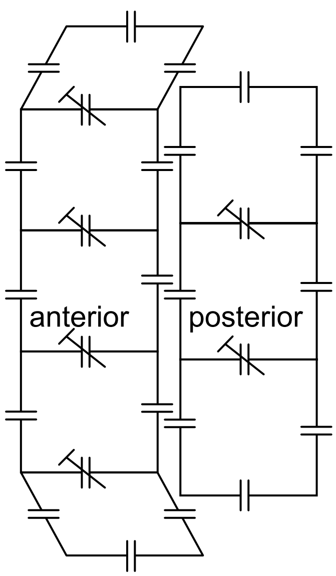


**Figure 1:** The principal circuit diagram of the coil. The variable capacitors are used to adjust the decoupling of the coil elements.

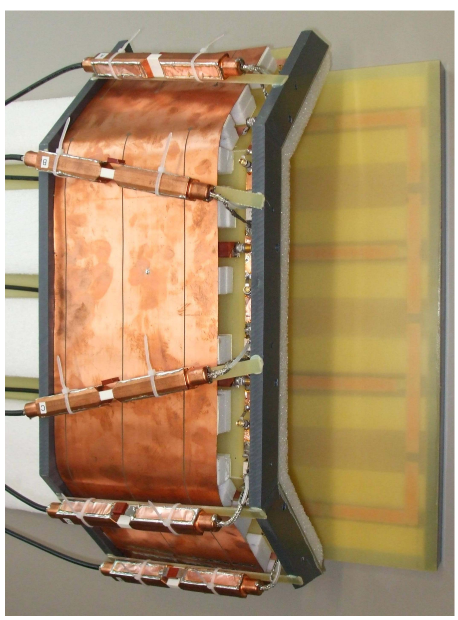

**Figure 2:** 8 channel TX/RX cardiac coil, consisting of an anterior and a posterior section. The coil is shown with the slotted backside RF screen, but without casing.

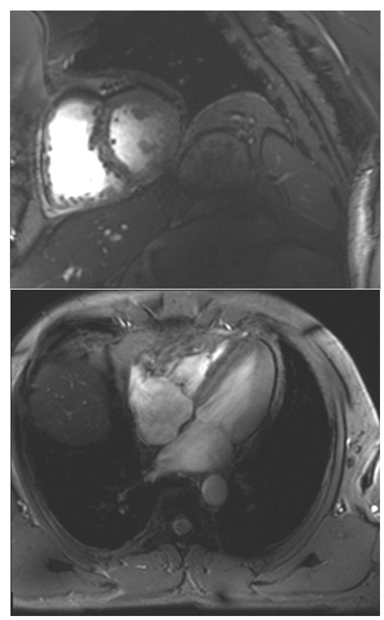

**Figure 3:** First 2D FLASH cardiac imaging results obtained with a non CP phase distribution for the single elements.

**References**
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