

## 16 Channel Head / Neck Matrix Coils for 3 Tesla

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### Introduction:

A novel approach for a 3 Tesla 16 Channel Head/Neck coil design for neuro-vascular applications, implementing the Tim Technology™ is presented. The Head and Neck Matrix Coils consist of 16 independent elements combined to clusters via Mode Matrices. The matrix coils are designed for optimal PAT performance, allowing the application of high acceleration factors in anterior-posterior, left-right and head-feet direction. Furthermore, the Head and Neck Matrix coils can be seamlessly combined with other Matrix coils for extended coverage up to whole body applications [1-3].

### Methods:

The Head and Neck Matrix coil set consists of 16 independent array elements.

The head coil is formed by 12 elements arranged in a ring (Fig. 1a). Each of the 12 elements is equipped with its own preamplifier followed by several RF traps for common mode rejection during the transmit phase. The amplified output signals from the elements are grouped in clusters of three which are connected to a Mode Matrix combiner network which is forming a new set of three mode signals. Using proper recombination for such a network, the total information and therefore SNR and spatial information is preserved [4,5].

The Neck Matrix comprises 4 array elements grouped in 2 clusters (Fig. 1b). The two amplified signals from each cluster are connected to a Mode Matrix creating a forward and a reverse CP mode signal. Active as well as passive detuning circuits within each element of the array are utilized for the adequate suppression of currents on the coil structures during the transmit phase.

All 16 mode signals of the Head and Neck Matrix coils are made available to the system for parallel reception. In addition, the Head and Neck Matrix coils can be seamlessly combined with the Body and Spine Matrix coils for extending the coverage into the thorax and abdomen.

Neighboring Matrix coils are inductively decoupled through an adequate overlap of adjacent coil elements.

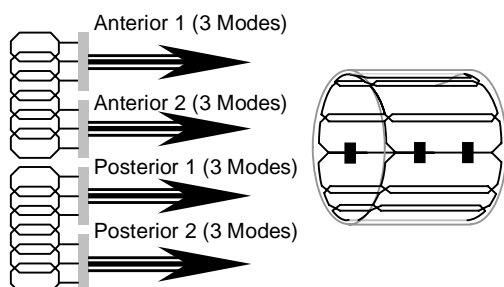


Fig. 1a Schematic Layout of the 3T Head Matrix coil

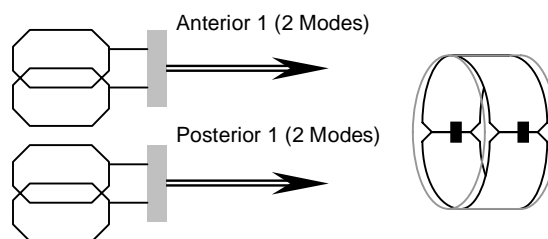


Fig. 1b Schematic Layout of the 3T Neck Matrix coil

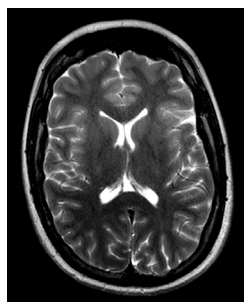


Fig. 2a: T2 TSE (PAT=2)

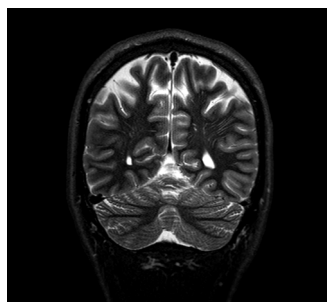


Fig. 2b: TIRM (PAT=2)

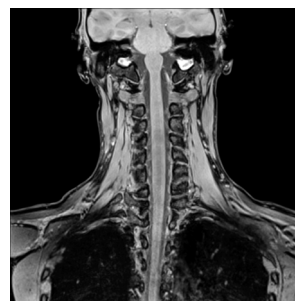


Fig. 2c: T1 3D Vibe (PAT=3)

### Results and Conclusions:

Figs. 2a-c show early results obtained with the Head and Neck Matrix coils on a 3.0 T Siemens Trio scanner with Total imaging matrix technology.

Fig. 2a is a T2 TSE used as part of a complete head protocol with acceleration PAT=2 (TA=0:45, FoV=240) using only the Head Matrix portion of the Head and Neck coil set.

Fig. 2b shows a TIRM with PAT=2 (TA=2:00min, FoV=219) also using only the Head Matrix portion of the Head and Neck coil set.

Fig. 2c shows a combination of Head, Neck and Spine Matrix coils obtained with a T1 3D VIBE and PAT=3 (TA=3:06, FoV=280) with a sub millimeter isotropic resolution of 0.9mm<sup>3</sup>. Fig. 2c also shows the advantage of being able to combine neighboring Matrix coils to increase total coverage as needed (in this case Spine Matrix in addition to Head and Neck Matrix).

In summary, the high SNR in conjunction with the high number of array elements of the Matrix Coils allows for increased acceleration factors as well as increased coverage. In addition, the number of receiver channels can be scaled due to the implemented Mode Matrix combiner according to the need of the application or the number of installed receivers on the system.

### References:

- [1] Matschl V. et al., "48 Channel Body / Spine Matrix Coils for 3 Tesla", submitted to ISMRM Annual Meeting, Miami, 2005.
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- [5] King, S.B., et al., Proc. ISMRM 11th Ann. Meeting, Toronto, 2003 p. 712.