

Within the last decade, several investigators have measured SAR distributions in models of the human head using isotropic electric probes [Cleveland and Athey, 1989; Balzano et al., 1978, 1995; Kuster and Balzano, 1992; Schmid et al., 1996]. **Fig. 1** gives a map of SAR measured from a fiberglass skull filled with brain-equivalent, liquid dielectric phantom material. A maximum SAR of 1.1 W/kg appears in the ear lobe next to a "flip" cellular telephone with its antenna extended. It can be seen that most of the power deposition is on the side of the head nearest to the radiating structure of the cellular telephone. The SAR is considerably lower elsewhere in the head. **Table 3** summarizes measured SAR in homogeneous models of head phantoms exposed to several wireless communication devices. In each case, the transceiver is tilted and placed to the side of the head with the antenna about 1-3 cm from the surface of the head model. The maximum values of SAR quoted are in brain tissue unless otherwise indicated. Location of the highest SAR typically occurred near the feed point of the antenna. It is seen that the maximum SAR in head tissue is close to 1.6 W/kg which is the lower limit of ANSI/IEEE C95.1-1992 protection guide. In addition, for some cases, SAR values can exceed the limit.

The variation in measured SARs given in **Table 3** may have stemmed, in part, from difficulties associated with performing accurate and reliable SAR measurements when the source is in close proximity to the head. The measured values of SAR also depend on the transceiver and the position of its antenna with respect to the head. It is noteworthy that the maximum SARs are lower for longer antennas compared to shorter (1/4 wave) antennas such as when the antenna of a flip cellular telephone is collapsed. The reason is that the high current region for the longer antenna is higher up along the antenna and is further away from the surface of the head.

Table 3. Measured SAR in head phantoms exposed to wireless communication devices (600 mW output power).

Frequency (MHz)	Max. SAR (Brain) (W/kg)	Distance (cm)	Antenna Type	Author Date
835	0.44	1.0	1/2-Wave	Anderson & Joyner [1995]
	0.63	1.0	1/4-Wave	
	0.83	1.0	1/2-Wave	
835	1.1 (Ear)	2.5	Flip	Balzano et al. [1995]
	1.8 (Ear)	2.5	1/4-Wave	
900	3.6	2.5	1/2-Wave	Kuster & Balzano [1992]
815	1.0	1-2	1/4-Wave	Cleveland & Athey [1989]
855	2.1	1-2	1/2-Wave	

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