Technical Correspondence

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HOW DANGEROUS IS RF RADIATION?

☐ Workers at Motorola have recently conducted experiments of great interest to most amateurs. Their results have been published in several IEEE publications.[1-3] I'm grateful to Mr. Ronald Brecher, WA2EUN, who supplied a copy of the March, 1977, document.

The experimenters constructed a simulated human head and torso and exposed it to the radiated fields from 150- and 450-MHz 6-watt, handheld transceivers. Both radios were equipped with helical or "rubber duck" antennas. In addition, tests were performed with a 1/4-wavelength antenna installed on the 450-MHz unit. A thermal probe was used to measure temperature rise due to exposure. These experiments were performed because of concern that the newer, high-power units might pose a health hazard. Previous measurements of the field strength surrounding these radios had indicated that an incident field intensity exceeding 10 mW/cm^2 might exist. This is a safety standard for human exposure to rf energy at higher frequencies.

Because the field would be concentrated by a probe causing nontypical localized heating, the probe was removed while the transmitter was operating. The "dummy" was exposed for from 15 to 60 seconds. After power was removed, the probe was again inserted and the temperature change determined. Steps were taken to prevent thermal transients caused by insertion and removal of the probe. It would have been possible for heating to occur in small areas not being monitored by a probe. To look for "hot spots," an IR (infrared) scanner was used to take thermograms of the dummy.

Assuming the transceiver was positioned as it would be during normal operation, no significant heating effects were noticed on either band. Even at 450 MHz, the temperature rise was slight. At a shallow probe depth (0.2 inch or 5 mm), the greatest temperature rise was less than 1°C. At deeper probe penetrations the temperature rise was less. Attempting to determine possible hazards from a measurement of radiated field intensity may cause misleading results. The low total energy and high field impedance which exist when such radios are brought in close proximity to the body will result in lower energy transfer than field-strength measurements alone would seem to infer. For example, at a point two inches (50 mm) from the helical antenna of the 150-MHz transmitter (Fig. 1), a Narda field probe measured a maximum field intensity of 168 mW/cm^2. This value greatly exceeds the 10 mW/cm^2 exposure standard. Measurements based on the penetrating effects at the same point indicate a maximum power flow density in tissue of 2.8 mW/cm^2. On 450 MHz, with the same spacing from the 1/4-wavelength *whip* antenna (Fig. 3), a maximum radiated intensity of 16 mW/cm^2 was found. Power-flow density was only 2.5 mW/cm^2. The radiation meter indicates a hazardous condition, while actual measurement of the effects shows this is not the case. Power *absorption* in all cases was less than 1mW/cm^2.

IR thermograms did not detect any unusual hot spots. A health hazard exists when the tip of the antenna is close to the eye (within 0.2 inch or 5 mm) and the transmitter is operated. In this case, an rf burn will result on the cornea. The thick plastic cap on the tip of the antenna makes this unlikely to occur. When the radios are held in the normal position for use, no eye hazard exists.

While these tests were performed at 150 and 450 MHz, I think it is safe to assume we need not fear our portable 220-MHz rigs either. These tests point out the fallacy of using radiated field intensity as a criterion of safety. Some consumer publications have begun to measure the field strength radiated from CB radios. Consumers have been warned not to stand close to the mobile whip while a 5-watt CB transmitter is operating, due to the high field strength! These papers have shown that radiated power may greatly exceed that which is absorbed and converted into heat. Amateurs should continue to exercise prudence when using uhf and microwave equipment, of course. It does seem that our portable transceivers pose no threat to our health. — *J. E. Kearman, W1XZ, RFD, Collinsville, CT 06022*

[1]Balzano, Garay and Steele, "Energy Deposition In Biological Tissue Near Radio Transmitters At Vhf And Uhf," *IEEE 1977 Conference Record of Vehicular Technology Group,* March, 1977. Experiments at 150 and 450 MHz.

[2]Balzano, et al, "A Comparison Of The Energy Deposition Between Portable Radio Transmitters At 900 And 450 MHz," *IEEE 1978 Conference Record of Vehicular Technology Group,* March, 1978.

[3]Balzano, et al, "Heating of Biological Tissue in the Induction Field of VHF Portable Radio Transmitters," *IEEE Transactions On Vehicular Technology,* May, 1978. Results of experiments at 150 MHz.

Fig. 1 — This drawing shows the position of the 6-watt 150-MHz radio in relation to the head of the dummy. In this configuration, with the transmitter operated for 60 seconds, the temperature increases noted were observed.

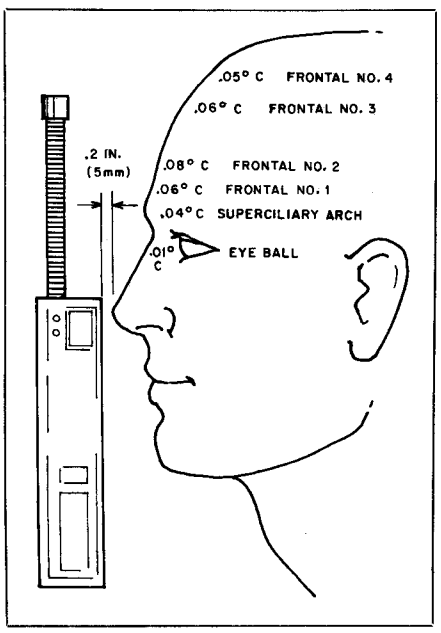

Fig. 2 — Position and thermal effects of a 6-watt, 450-MHz radio equipped with a helical or "rubber duck" antenna. A "hot spot" exists near the tip of this antenna. The eyeball is shadowed in its recess and receives very little exposure.

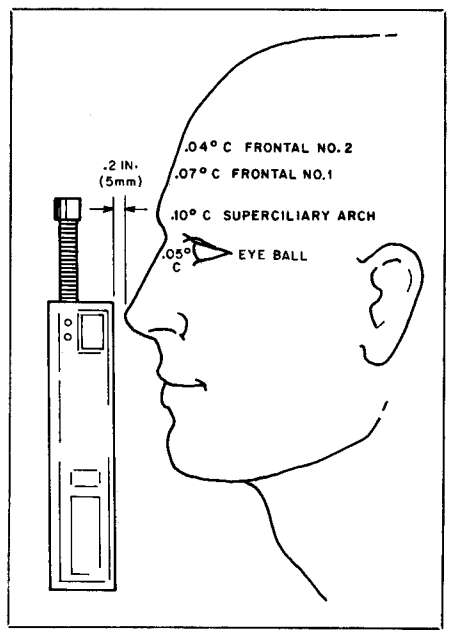

Fig. 3 — The same 450-MHz rig, this time with a 1/4-wavelength whip installed. Power density in the eye is greater, but still very low.