☐ The article, "RF Heating in the Ham Bands," which appeared in *QST* for June, 1978, includes some statements which, in light of extensive experiments performed in our research laboratories, are not correct. Although Dr. Ruderman properly warns amateurs to use caution to avoid unnecessary exposures, the power-density levels he quotes are too high to be realistic. At a distance of 10 meters from a half-wavelength 10-meter dipole connected to a one-kilowatt output source, the power density in the horizontal direction is about 0.08 mW/cm^2, not 0.8 mW/cm^2 as stated by the author. This last value would be found at a distance of 10 meters in the bore sight direction of a 10-dB-gain beam antenna.

Turning to the vhf bands, Dr. Ruderman states that a mobile installation transmitting 10 watts effective radiated power (erp) from an antenna mounted on the left fender, less than one meter from the driver (how much less isn't specified), could expose him to a power density of 10 mW/cm^2. This value is not corroborated by experimentation. Some research departments at Motorola, Inc., have conducted careful measurements of power density inside the cabins of cars equipped with mobile transmitters. The Narda model 8310 radiation monitor, calibrated for vhf operation, was used. In the situation described by Dr. Ruderman, at a distance of 1.1 m between driver and antenna, the maximum power density measured was 0.05 mW/cm^2, substantially lower (23 dB) than the 10 mW/cm^2 level quoted by Ruderman. The 0.05 mW/cm^2 level is slightly less than the power density one would find in free space (in the direction of maximum gain) at about one meter from a vhf dipole connected to a 10-watt output source.

In the matter of portable transmitters, Dr. Ruderman states that 30-40 mW/cm^2 power densities exist in the immediate vicinity of a 144-MHz antenna connected to a 1-watt-output transmitter. These values are not supported by experimental evidence either. First of all, it is difficult to define, let alone measure, power density so close to an rf source. At a point near the radiator, different parts of an antenna contribute fields propagating in completely different directions, precluding any obvious definition of power flow. In these conditions, one can measure only energy density (mJ/cm^3), by separately evaluating the E and H fields with appropriate instrumentation. In the near field, however, the electromagnetic energy density does not have a simple relationship to power flow. Unlike the far-field case, part of the energy is stationary (static type) and part is propagated. To avoid these difficulties, we measured power deposited in simulated humans, by operating 6-watt-output 150-MHz portable radios equipped with helical antennas. Helices were selected because they caused much higher energy density readings in field probes than did quarter-wavelength telescopic antennas. The results of these measurements were presented in a recent paper.[4] The experiments have shown that, at vhf, electromagnetic energy in the immediate proximity of a portable radio antenna does not penetrate into muscle or brain tissue of the human body. There is energy deposition only in the very surface fatty layers. In addition, it was found that if a user operates a 1-watt portable radio with the case 0.2 inch (5 mm) from his mouth, the maximum absorbed power density (which can be measured from heating effects) is less than 0.2 mW/cm^2. This value is much lower than the deposition levels (8-10 mW/cm^2), due to an incident power level of 30-40 mW/cm^2 which, Dr. Ruderman states, exist near a portable transceiver.

I would like to reassure radio amateurs of the absence of any detected thermal radiation hazard from commercially available mobile and portable radio transmitters, if such equipment is properly installed and operated in accordance with simple common sense. — *Quirino Balzano, Ph.D., Manager, Antenna Systems Research Laboratory, Communications Division, Motorola, Inc., 8000 West Sunrise Blvd., Ft. Lauderdale, FL 33322*

[4] Balzano, et al, "Heating of Biological Tissue in the Induction Field of Vhf Portable Radio Transmitters," *IEEE Transactions on Vehicular Technology,* Vol. VT-27, No. 2, May, 1978.

COLOR TVI

☐ I would like to call your attention to a TVI phenomenon that has been in existence for years, yet which has never received much publicity. It is a "color TVI" problem since it results in colored hash marks on color TV programs only. There are absolutely no signs of interference on black-and-white pictures.

For the past few years, a number of amateurs in the Detroit area have been experiencing color TVI on channel 4. While I have been successful in pinpointing the cause, I have had no success in trying to cure it. Color TVI occurs when a harmonic from an amateur transmitter beats against, or heterodynes with, the chrominance subcarrier frequency transmitted by the TV station. The color subcarrier is a comparatively weak signal which rides piggy-back on the main picture carrier. It is 4.83 MHz above the lower frequency limit of the TV channel (see Fig. 4).

Because of the low level of this signal, it is extremely susceptible to interference. The interference increases as the color brilliance level is increased. The number, width and angle of the stripes vary in relation to the difference between the heterodyne and the 15,734.264-Hz horizontal oscillator frequency. On 20 meters, the stripes appear to make a 360-degree rotation about every 3.15 kHz (fifth harmonic of 3.147 kHz ≈ 15,734) across the interfering range. The following TV channels will be susceptible to interference from amateur transmitters:

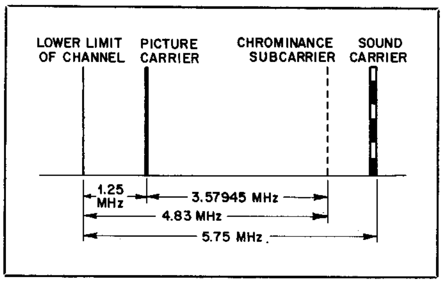
Channel 2: Interference range 29.3-29.5 MHz. The second harmonic of 29.415 MHz = 58.83 MHz, the color subcarrier frequency.

Channel 4: Interference range 14.1-14.25 MHz. The fifth harmonic of 14.17 MHz = 70.83 MHz, the color subcarrier frequency.

Channel 6: Interference range 28.8-29.0 MHz. The color subcarrier frequency is 86.83 MHz, the third harmonic of 28.94 MHz.

A number of tests have been made from seven amateur stations located as close as two miles (3.2 km) to the channel 4 transmitter. All stations produced color TVI on channel 4 when operating on 20-meter sideband between 14.2 and 14.25 MHz. Several makes of amateur and television equipment were used. Various types of low-pass filters were tried without improvement. All TV receivers had outdoor antennas and were equipped with high-pass filters. I'd appreciate hearing from anyone who has solved this problem. — *Ralph A. Dage, W8PHZ, 8078 Lochdale, Dearborn Heights, MI 48127*

Fig. 4 — Diagram showing the relative positions of the video carrier, chrominance subcarrier, and audio carrier in a broadcast TV signal. In practice, the actual position of the video carrier may be offset by ± 10 kHz. The frequency of the chrominance subcarrier, which is a modulation of the video carrier, is considered to be 3.57945 MHz. When the harmonic of a transmitted signal falls near the position of this subcarrier in the signal, a heterodyne is generated. This beat frequency generates bars which appear on the screen of a color TV set.



ON "PREDICTING RADIO HORIZONS AT VHF"

☐ I read Walker's article (*QST,* June, 1978, page 28) with interest. However, I noticed two errors related to the 33-percent additional distance factor mentioned by the author.

This adjustment factor serves to account for atmospheric *refraction,* as Walker correctly states on page 28. It is *not* related to *diffraction,* as discussed on page 29. The 33-percent factor is incorrectly used. In the equations used to calculate distance to the horizon, the radius of the earth should be increased by one-third. The amount of atmospheric refraction, or bending, depends upon the rate of change of the *index of refraction* with respect to height. At vhf and uhf, the index is a function of atmospheric pressure, temperature and water vapor content of the air. For average conditions the curvature is on the order of $3.9 \times 10^{-5}\ \mathrm{km}^{-1}$, although it may vary greatly from this figure with time. Curvature of the earth is about $15.7 \times 10^{-5}\ \mathrm{km}^{-1}$. This represents a radius of curvature of

$$\frac{1}{13.8 \times 10^{-5}}$$

or 7246 km, a value *33 percent larger* than that of earth. Solving for the distance to the horizon (x), we find it is related to the radius of the earth (R) and antenna height (h), as $x = \sqrt{2Rh}$, for $h << R$. For the optical horizon, R is approximately equal to the radius of the earth, 6370 km. For the vhf radio horizon, R should be increased by 33 percent, so that

$$x = \sqrt{(2)(1.33)(6.37 \times 10^{-6})(h)}$$
$\approx 4120\sqrt{h}$, where distances are in meters.

Note that this increases the distance to the radio horizon by a factor of $\sqrt{1.33}$, or 1.15 times the distance to the optical horizon. This equation is essentially the same as one appearing on page 11 of the *Antenna Book* (13th ed.), which was, in part, the basis for Fig. 1-6 on page 12 of that edition. The radio horizon is about 15 percent farther from the observer than the optical distance. Fig. 2 of Walker's article gives distances which are about 15 percent too high. — *Russ Lee, WA4VLE, 933 Bluestone Rd., Durham, NC 27713*

[Editor's Note: *We* goofed, not Mr. Walker, the author. His original information presented data based on the optical horizon only, and we supplemented it during editing to provide data on the radio horizon.]