Value for Money?

When contemplating the purchase of new amateur band transmitting equipment most operators do take the power rating into consideration — but what do all the figures mean? Which rig is the most powerful? "200W" or "100 watts output"? Are the printed figures there to enlighten your mind, or lighten your pocket? Whatever the intentions, the net result is confusion, and I honestly doubt if some makers even know what the figures used in their specifications are supposed to mean!

by Harry Leeming G3LLL

Ham radio equipment power levels in the UK have for many years been stipulated on the basis of DC input power to the final amplifier. On most amateur bands the maximum allowed was 150 watts input, and so if the final amplifier was a valve and was supplied with 1000 volts, the maximum current it could legally be run at would be 150 milliamps (P = V x I = 1000 x 150/1000 = 150 watts). This is not really a fully satisfactory way of rating a radio transmitter, as strength of signal is dependent upon the output power and not its input power. In the 1920s, however, when the regulations were drawn up, the measurement of input power was probably the only practical way to legislate amateur power levels, as few hams (or Post Office inspectors for that matter) had any simple method of accurately measuring radio frequency power. Technology does advance rather faster than officialdom (they have only just taken the reference to spark transmitters out of the licence!), so whilst since World War II there has been no need to retain rather archaic methods of measurement, the UK, and many other countries until recently have still based their amateur licence conditions on DC input power.

The latest UK licence write up (or 'cockup' dependent on your point of view) does regulate power expressed in decibels above one watt 'dBW'. How this can logically be enforced when commercial power meters are scaled in straightforward watts and the RAE syllabus has never previously required a knowledge of dBs is one of life's mysteries. (Perhaps the guy at the Home Office who has never heard of front end or masthead preamp overload and thinks 934MHz will cause less TVI than 200MHz dreamed this one up as well.) In reality the new licence is a straight translation of the old one into 'dBW Output', allowing for normal efficiency in the PA stage.

Input power measurements have the advantage of simplicity where AM or CW transmitters are concerned, but caused a problem upon the advent of SSB. A single sideband transmitter running in class AB1 or B has an input power which is controlled by the loudness of the speech with which it is being modulated. The DC input power, therefore, is continuously changing thousands of times per second, and the power amplifier current meter can only give an average input current reading dependent upon the peak-to-trough ratio of the operator's voice. Whilst this meter can give an experienced operator a good indication of the current operation of his equipment it *cannot* measure SSB input power.

The relationship of SSB and AM ratings

Fig. 1A and **Fig. 1B** respectively show the familiar patter of an unmodulated, and then modulated 100% by an audio tone. We will presume that this is the output of a 150 watt transmitter operating at average efficiency (usually 60 — 70%) giving an output power of, say, 100 watts into a 100 ohm dummy load. The RMS voltage of the wave form shown at A will be 100 volts and the current into the dummy load 1 amp, RMS. In **Fig. 1B** it will be seen that at audio peaks the voltage is doubled to 200 volts RMS. When the voltage doubles, by Ohm's Law so does the current; (hence the formula $P = V^2/R$.) 2 amps. at 200 volts produces 400 watts RMS and so to use SSB terminology, 400 watts peak envelope power (PEP) is produced.

This shows the sense behind the Home Office ruling that SSB output has to be limited to 400 watts PEP on the bands licensed for 150 watts DC input power. 400 watts PEP is the output power that an average efficiency 150 watt fully modulated AM transmitter might be expected to give when operated at 60 — 70% efficiency.

The quoted figures?

Thirty years ago a '150 watt' AM transmitter weighed several hundred weights, an *FT101E* 250W PEP transmitter with built-in DC and AC power supplies is portable — what's the difference? Technology marches on, yes; miniaturisation, yes; no high level modulator, and now a solid state PSU, yes; but quite apart from all this the 150W input transmitter of the early 1950's had to operate continuously on AM and produced a 100W carrier and 400W PEP output power. The *FT101E* has a maximum PEP input power of 250W and produces a PEP output power of around 150W. The *FT101* like all modern SSB ham rigs is not rated continuously at 250W input (note the 10 second maximum tune-up warning in the instructions), and it is intended to be run at full power