Ricky's Afterthought:

A "Solid-State" Resurgence

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The holy grail of microwave heating has, for a long time, been whether solid-state devices will ever replace magnetrons as power sources for high-power industrial applications. Nobody disputes the superior performance of transistors as compared to magnetrons in terms of feedback control, heating patterns, life expectancy, and so on. The advantages are numerous, as stated by a number of authors in this Special Issue.

Further, as the Editor commented, and others reiterated in the articles that follow, the introduction of solid-state devices for heating was mooted well over fifty years ago and it was expected that such systems would have made an appearance into the market by the end of the 20th century. Alas this did not happen.

Having attended the IMPI-50 Symposium, it was evident that an enormous effort has been placed in the quest for solid-state devices to enter the heating/drying field of high-power applications, which will no doubt include tempering of foodstuffs, drying, waste reprocessing and rubber vulcanisation. Let us also accept that high-power industrial systems using solid-state devices will outperform current magnetron driven systems and that they are reliable under harsh industrial conditions. Does this mean therefore, that the high-power magnetron is threatened by this resurgence of solid-state devices? For the time being it is not, and the reason is the unit cost of solid-state vs. magnetrons. Name me a manufacturer of high-power microwave equipment who will be willing to make a loss on a new application or conversely a philanthropic industrialist who will be willing to pay much more for a new application if one adopts solid-state transistors rather than the magnetron alternative. As long as the price differential is maintained, magnetrons will still be the preferred option however superior the performance of the solid-state alternative may turn out to be.

It is my firm belief that in the short term the domestic/commercial microwave ovens will be the beneficiaries of such a solid-state resurgence and as production of these transistors increase so the cost will gradually come down to the point where large-scale microwave industrial systems using transistors may become viable.

Four years ago, I witnessed a demonstration of a commercial oven powered by four transistors, each of 250W, cooking a variety of foods from salmon to steak with vegetables, and the results in terms texture and flavour were excellent. I was told that within two years such a system, at the time being tested extensively by a prominent oven manufacturer, will make an appearance in the market. Alas this thus far has not materialised, although I am convinced it is only a question of time, waiting for the right economic conditions and the state of the market.

However, I am bound to reflect that if the penetration of solid-state transistors struggles to compete with magnetron usage in this area, where volumes are extremely high, what hope do these systems have in entering the field of high-power industrial microwave heating? The Editor states, I quote, "may be the good old magnetron, after all, is a more practical solution for basic heating needs". Indeed for the majority of heating applications this is the case. No doubt for a specialised application requiring good control, feedback capability from forward and reversed powers, mode mixing, frequency swapping within the ISM band, the solid-state alternative is a viable proposition, and the user will have to bear the cost differential. But this does not apply to over 95% of the routine industrial microwave heating applications, such as tempering of foodstuffs, rubber curing and drying of pharmaceuticals under vacuum.

So one is bound to ask why such resurgence? Could it be that owing to recent re-structuring of the communication and military industries there is a huge number of highly qualified microwave engineers looking for alternative markets where their expertise will be usefully deployed? I hope not and the drive comes from the belief that solid-state systems offer superior overall performance compared to magnetron driven ones.