2.5GHz power source

The fruits of research into applying microwaves to geological samples, this pulsed 2.5GHz power source is very inexpensive relative to laboratory sources since it uses mass-produced parts, as John Share and John Hakes demonstrate.

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Generating significant power at microwave frequencies is inherently expensive. Producing 500W at 2.5GHz was, for us, prohibitively costly. Fortunately, mass production of a domestic appliance has resulted in 600W, 2.5GHz generators with integral power supplies being available for very little financial outlay. Second-hand units are readily available at even lower cost.

At first glance, a domestic microwave oven may not seem a likely candidate for conversion. One manufacturer suggested that the demise of the magnetron would be the inevitable result.

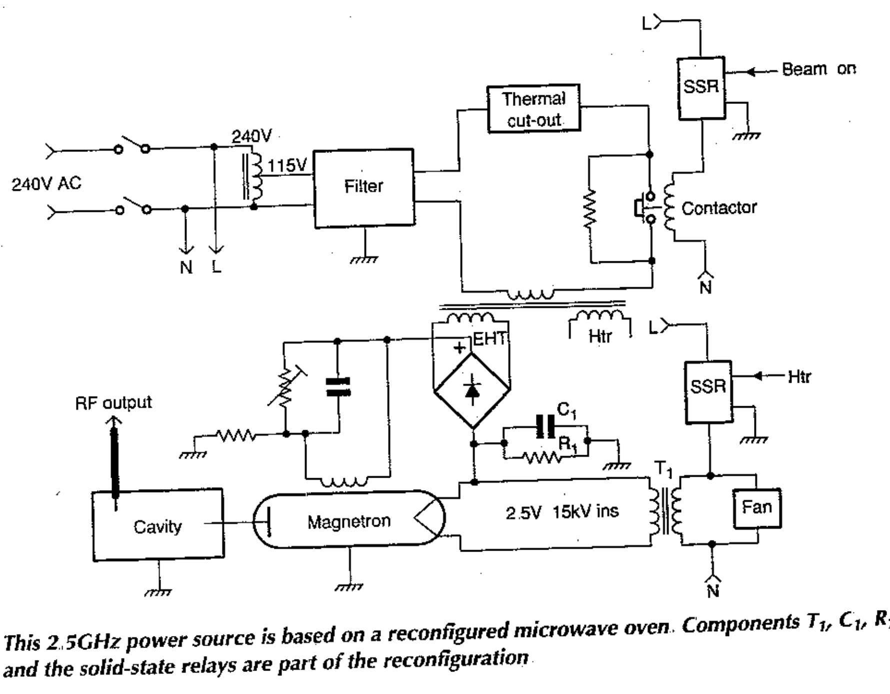
Essentially, the design of a domestic microwave oven consists of a magnetron, a cavity assembly, for the anode tuned circuit, an eht power supply interlocked with a heater supply and a blower. It also includes various control and timer circuits.

Operating frequency is governed by three factors – dimensions of the cavity, the magnetic field applied to the magnetron, and the actual value of the eht. Varying any one of these causes the frequency to alter. Significant changes will result in the magnetron ceasing to function.

Starting at component level without considerable expertise would be foolhardy. However, the conversion of a domestic microwave oven into a microwave power source is relatively straightforward.

Mechanical modification requires extracting the entire magnetron/cavity assembly from its domestic usage enclosure. This reveals that the oven space and the anode cavity are two separate items, and that there is an aperature between the two to allow coupling.

The first stage is to remove the oven with a hacksaw and fit a plate over the aperture. A sheet of thin metal and numerous self-tapping



This 2.5GHz power source is based on a reconfigured microwave oven. Components T_1, C_1, R_1 and the solid-state relays are part of the reconfiguration

Warning

Very serious hazards exist both within this apparatus, due to the presence of lethal power supplies, and from biological damage caused by the microwave energy generated. Duplication of this research work must not be undertaken by anyone who does not fully understand the dangers of microwaves and very high voltages. Extreme caution must be exercised during development and operation. Access to a certificated microwave radiation detector is absolutely essential.

screws – no more than 2cm apart – will ensure a tight rf seal The signal is extracted into RG8U by a quarter-wave E-probe, installed precisely on the centre line of the cavity at a distance of a quarter wavelength, i.e. 3 33cm, from the end wall.

Initial trials using N connectors and a probe, soft-soldered to the socket, resulted in numerous flashovers and carbon tracking. By drilling out the socket and arranging the plug so that the centre insulator and conductor of the RG8U coax passed directly into the cavity, far greater reliability was achieved Trimming the projection to obtain maximum power output was then a very simple cut-and-try procedure

A variable vane within the cavity was obviously intended by the manufacturer to compensate for manufacturing tolerances. This was reused to compensate for the presence of ıe new coupling

In its original form, the heater winding was included on the eht transformer assembly and inevitably there was an indeterminate delay between operating the unit and the appearance of rf output. Our specific requirement was that the unit would produce bursts of rf under computer control for programmable periods of one to ten seconds duration.

An additional heater transformer, T_1, was required so that the rf output could be controlled by application of the eht. As with many high-frequency devices, the anode is external and is usually connected to the metalwork to assist cooling. This requires elevating the cathode by several kilovolts, and the heater supply must of necessity also be at several kilovolts, relative to ground. Suitable transformers are available as surplus; however, custom-built transformers are not out of the question.

Interlocked with a blower and thermal trip circuitry from the original unit, the heater supply remains active continuously while the eht can be controlled by solid-state switching of the transformer primary.

Interfacing to a pc-compatible used a commercial parallel i/o card and some custom-designed logic using 74-series devices. This operated the solid-state relays and provided interlocks and safety cutout features to provide automated software control.

Spectral purity of the output is not as horrendous as we first feared; in fact, it is surprisingly clean, but frequency modulation due to eht ripple was very evident Adding smoothing, namely C_1 and R_1 resulted in a significant improvement – an 8μF paper capacitor and 1MΩ glass-encased high-tension resistor were available, but these values do not seem to be critical.

The purpose of this system was to excite spin waves in rock samples. For this, it is necessary to achieve maximum current coupling into the rock sample. A coaxial cavity was used to achieve this. Such passive devices offer exceptional selectivity – even when crudely made to modest workshop machining tolerances.

The system was operated without failure for more than two years, and has only been made redundant by advances in experimental techniques and knowledge of the magnetic structures of the rock samples themselves, necessitating higher frequencies of excitation. ■

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