

## 4. FUNDAMENTAL FUNCTION OF MICROWAVE OVEN

### (1) Circuit Descriptions

Figure 48 shows a representative sample of a microwave oven circuit with single power and manual timer controlled microwave oven.

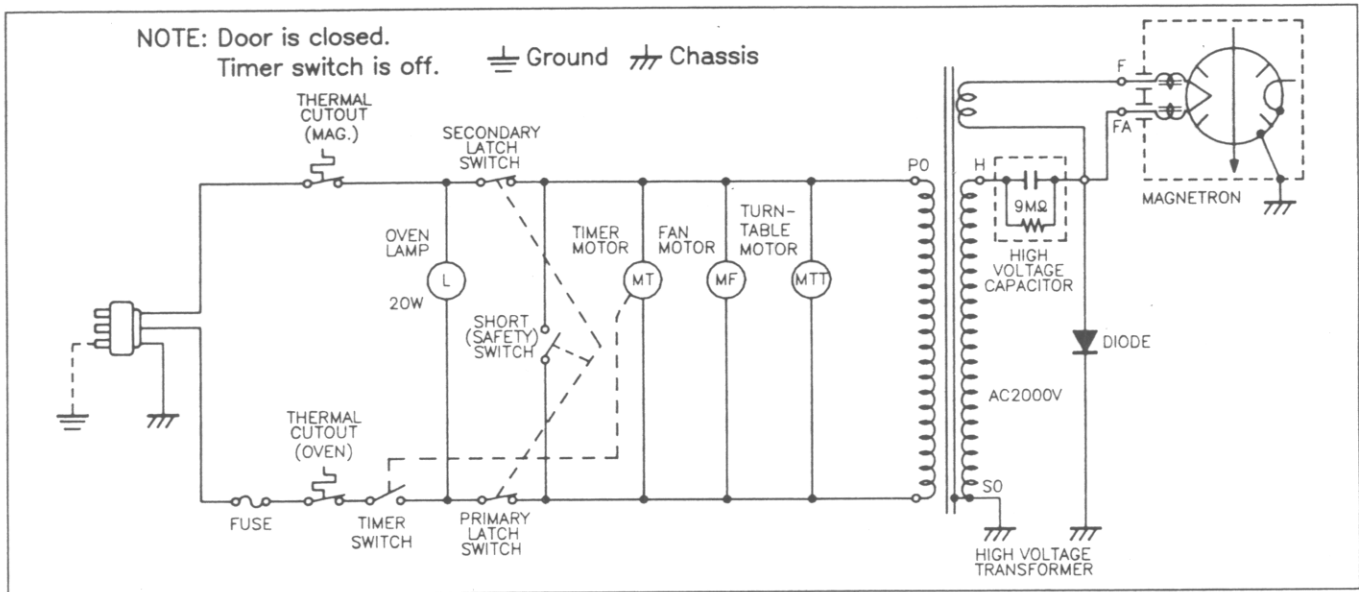


Figure 48

1. When the food is placed inside the oven and the door is closed:
  - (A) The contacts of the Short (safety) switch open.  
This switch creates short circuit to blow line fuse and stops microwave oscillation when the door is opened during operation under abnormal condition as described in the safety switch system.
  - (B) The contacts of interlock switches (primary and secondary) close the circuit by means of door key(es) action(s).
2. When timer is set.
  - (A) The contacts of time switch close the circuit.
  - (B) Oven lamp turns on.
  - (C) Fan motor starts rotating and cools the magnetron by blowing the air coming from the air intake on back panel over the magnetron fins. The fan motor also cools components inside the oven chassis to minimize the components temperature rise.
  - (D) The primary power supply voltage is then applied to the high voltage transformer and generates approximately 2000 volts or more in the secondary winding and 3.3 volts in the filament winding.
  - (E) Magnetron starts oscillation and food is cooked.
3. When cooking time is elapsed.
  - (A) The contacts of time switch open the circuit and a bell, if provided, rings to indicate that cooking has been completed.
  - (B) The oven lamp turns off and fan motor stops rotating.
  - (C) Magnetron stops oscillation.

Above functions are the basic operations of microwave oven. Would it be possible to control the output power of microwave oven as in a conventional oven? The answer is yes and we will study how this is done in the following section.

## (2) Output Power Control of Microwave Oven

There are many types of variable power system available. However they are basically categorized in two groups as follows.

- (A) To vary the high voltage potential to the magnetron
- (B) To interrupt the microwave oscillation intermittently within a specific duty cycle and vary an average output power of the microwave oven

A method is commonly used for models with limited power select modes such as only "High" and "Low" output power. The basic idea of this power control system is to change the high voltage potential to the magnetron by means of switching the capacitors, which are connected in parallel in the high voltage circuit, to either high or low and oscillate the magnetron at full power (high) or low power. This system does not require any associated control circuitry but a mechanical switch and therefore requiring lower cost however, the variations of power controls will be limited. Figure 49 shows a common circuitry of this system.

1. When select switch is closed:

The high voltage produced in the high voltage transformer is charged by capacitors A and B at first positive half cycle and combined voltages of the transformer, capacitors A and B are applied to the magnetron during the negative half cycle so as magnetron oscillates at full power.

2. When select switch is open:

The high voltage produced in the transformer will be charged only by capacitor A during first positive half cycle and therefore a lower potential will be applied to the magnetron during the negative half cycle resulting lower output power.

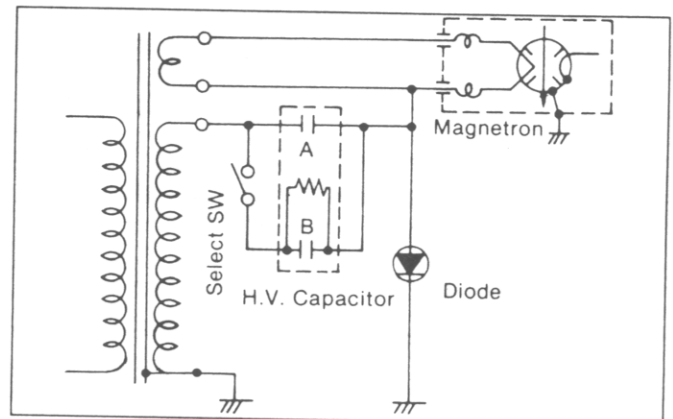


Figure 49

## (3) Power Control with Magnetron Duty Control Circuit

There are basically two types of magnetron duty control system available in the field. They are:

- \* To control the ON-OFF time of magnetron in the primary circuit
- \* To control the ON-OFF time of magnetron in the secondary circuit

### A. Primary Duty Control Circuit

This circuit controls the duty cycle of magnetron in the primary circuit. Figure 50 shows some common circuits with primary duty control circuit of magnetron.

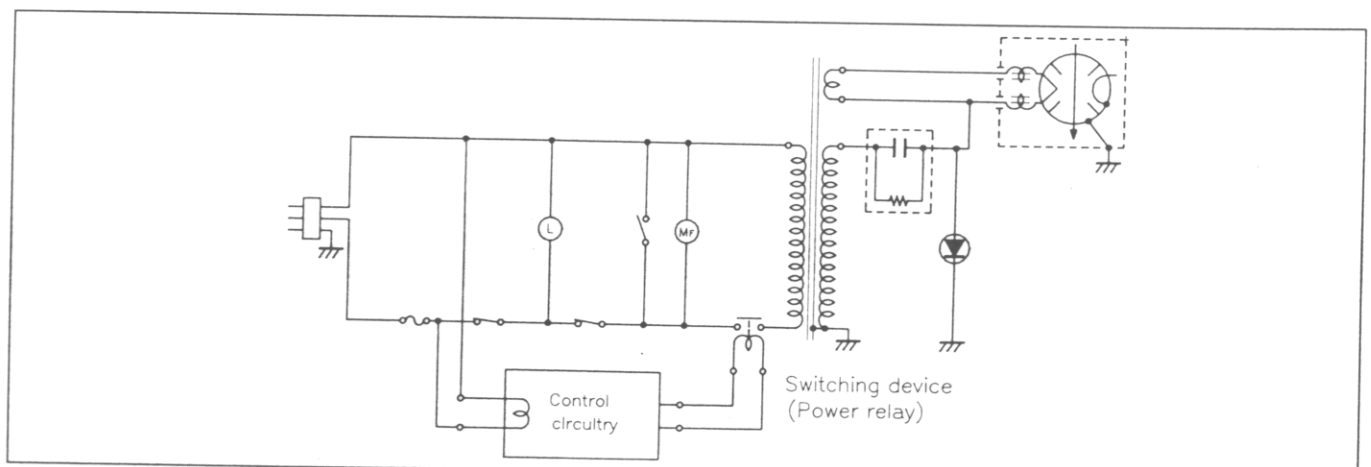


Figure 50

As shown in above figure, the primary power supply to the high voltage transformer is interrupt intermittently by means of a control circuitry and a switching device. The switching device may be either a power relay or triac as shown. The control circuitry controls the interrupting periods of the magnetron within a specified duty cycle and varies the average output power of the microwave oven.

#### B. Secondary Duty Control Circuit

As opposed to the primary duty control circuit, this circuit controls the duty cycle of the magnetron in the secondary circuit. Figure 51 shows a common circuitry of the secondary duty control circuit.

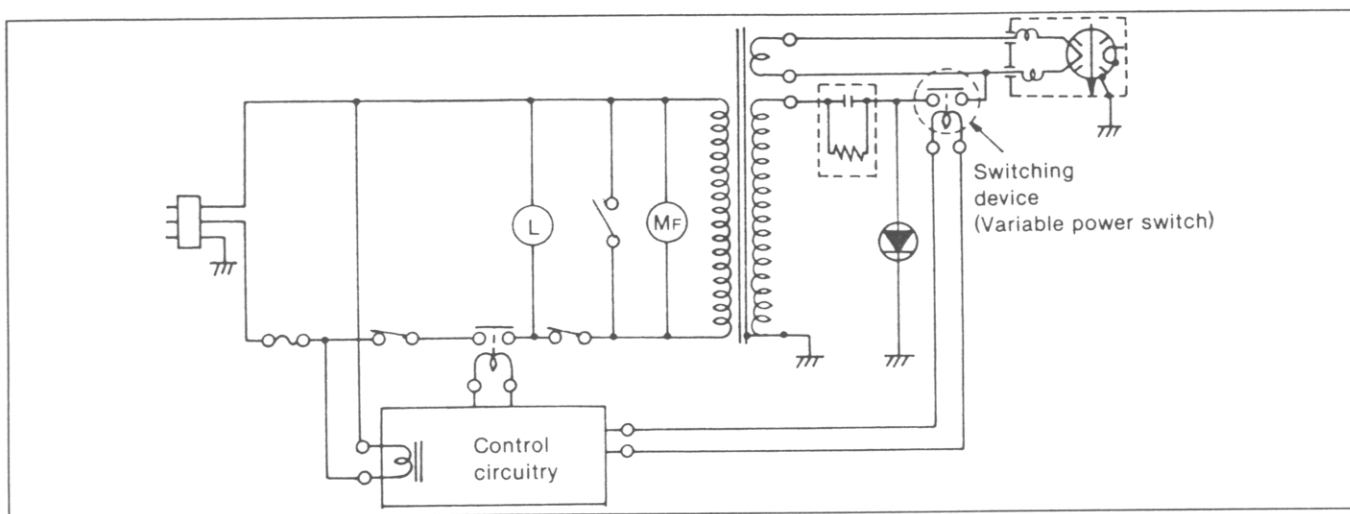


Figure 51

As shown, the high voltage to the magnetron is interrupted intermittently by means of an associated control circuitry and a switching device. The control system of the magnetron duty cycle is equivalent to the primary duty cycle control circuit except that the switching device is in the secondary circuit.

As shown in Figure 51, when the power selection is set at any power setting other than high power, the variable power switch (switching device) is energized intermittently by signals from the variable power control circuit. The variable power control circuit controls the ON-OFF time of the variable power switch contacts within a specified duty cycle. With most of our microwave ovens, one complete duty cycle is 22 seconds. Figure 52 shows the relationship between the output power of microwave oven and the corresponding duty ratio.

Assuming the full power of the microwave oven is 700 watt, the average output power at medium power setting is therefore approximately 477 watts.

Assuming the full power of the microwave oven is 600 watt, the average output power of medium power setting is therefore approximately 409 watts.

In this way, the output power of the microwave oven be varied to any desired power setting by changing the duty cycle ratio.

| INDICATION | OUTPUT POWER AGAINST HIGH POWER | ON. OFF TIME ON VARIABLE POWER SWITCH |
|------------|---------------------------------|---------------------------------------|
| High       | 22/22 (100%)                    | 22(S) ON 22(S) ON                     |
| Med        | 15/22 (68%)                     | 15(S) ON 7(S) OFF 15(S) ON 7(S) OFF   |
| Low        | 9/22(41%)                       | 9(S) ON 13(S) OFF 9(S) ON 13(S) OFF   |
| Warm       | 2/22(10%)                       | 2(S) ON 20(S) OFF 2(S) ON 20(S) OFF   |
| Defrost    | 10/22(45%)                      | 10(S) ON 12(S) OFF 10(S) ON 12(S) OFF |

Figure 52