Power Measurements

Aim: To learn the power measurement techniques and sensors used for power measurement in microwave engineering

objective: To study the techniques of power measurement

* Power :-
* Quantity of energy dissipated or stored per time.
* Average power is measured while propagation in trxn medium.
* Unit of power at microwaves is dBm

$$P(dBm) = 10\log \frac{P(mW)}{1mW}$$

Categories of Power Measurement:

i) Measurement of Low powers (less than 10mW)

ii) Measurement of medium power (from 10mW to 10W)

iii) High power (>10W)

* Power meter consists of a power sensor - converts the microwave power into heat energy.
* Corresponding temp. rise provides a change in the electrical parameters — output current in the low freq. circuitry
* indicates the power

Sensors used (Low microwave power)

* Schottky barrier diode
* bolometer
* thermocouple

* Resistance changes with applied vtg. (microwatts)

(High freq power)

* Calorimeter

* Temp. rise of load provides a direct measure of power absorbed by the load.

* Schottky Barrier Diode Sensor - square law detector

o/p proportional to the input power

detectors measure power levels as low as 70 dBm

* Bolometer Sensor - Baretter and thermistor

* Thermocouple Sensor - (Junction of two dissimilar metals or semiconductors)

- absorption of microwaves in a thin film tantalum-nitride resistive load.

Calorimetric:

* microwave energy is converted into heat, absorbing this heat in a fluid (usually water) and then measuring the temperature rise of the fluid.

Types: Direct Heating & Indirect heating method.

* Static calorimeter: 50 ohm coaxial cable filled by dielectric load

Avg. power i/p $P = \frac{4.187\ mC_pT}{t}$ watts

m - Mass of thermometric medium in gms

Cp - Specific heat in cal/gms

T - Temp. rise in °C

t - Time in sec

* Circulating calorimeter: calorimeter fluid constantly flowing thro' a water load. Exit temp higher than i/p Temp.

Avg. power $P = 4.187\ VdC_pT$ watts.

V - Rate of flow of calorimeter fluid in cc/sec

d - Specific gravity of fluid in gm/cc

T - Temp. rise °C

Cp - Specific heat cal/gm

Outcome:

Able to learn the power measurement techniques and sensors used in microwave frequencies.

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