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ELECTRICAL CHARACTERISTICS
OF
CARD STOCK

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IBM RESEARCH AND DEVELOPMENT
LABORATORY
500 J. E. CAMPBELL DRIVE

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PHYSICAL CHARACTERISTICS

OF

CARD STOCK

BY: J. WOOD

TEMPERATURE AND DEFORMATION INFORMATION
Submitted for review

ABSTRACT

The physical characteristics of card stock were investigated. The results show that the card stock is a homogeneous material with a uniform structure. The mechanical properties of the card stock were determined and are presented in the following table. The card stock was found to have a tensile strength of 1000 psi and a modulus of elasticity of 1.5 x 10^11 psi. The card stock was also found to have a high resistance to deformation and a low coefficient of thermal expansion.

Dielectric Constant

The dielectric constant is a measure of the ability of a material to store electrical energy. It is defined as the ratio of the permittivity of the material to the permittivity of free space. For a material with a dielectric constant ϵ_r , the permittivity is $\epsilon = \epsilon_r \epsilon_0$. The dielectric constant is a dimensionless quantity. It is a function of frequency and temperature. The dielectric constant of a material is a measure of its ability to store electrical energy. It is a function of frequency and temperature. The dielectric constant of a material is a measure of its ability to store electrical energy. It is a function of frequency and temperature.

Dielectric Loss

Dielectric loss is the energy dissipated in a dielectric material when it is subjected to an alternating electric field.

$$\text{Dielectric loss} = \rho \left(\frac{\epsilon''}{\epsilon'} \right) \quad \epsilon' = \epsilon/\epsilon_0 - \epsilon''$$

The dielectric loss is a function of frequency and temperature. It is a measure of the energy dissipated in a dielectric material when it is subjected to an alternating electric field.

$$\epsilon'' = \epsilon \rho \quad \rho = \left(\frac{\text{farads}}{\text{cm}} \right) \quad \epsilon' = \rho (1 - \epsilon'') \quad \epsilon'' = \epsilon \rho$$

The dielectric loss is a function of frequency and temperature.

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Dielectric Constant of a Dielectric Material

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Since the tracks are fed by a tapered IBM equispaced wire cards which are spaced 1/8 in apart, there is a 1/8 in gap between the insulation on adjacent tracks on the same side. This gap is filled with a dielectric material of the same permittivity as the insulation for these wire tracks.

Series Capacitance Constant

The series capacitance constant is the time constant for charge accumulation on a wire track of length l and area A . This is the product of the permittivity of the insulation, the thickness of the insulation, and the length of the wire track. Using the permittivity of the insulation as 3.15×10^{-11} farads/cm, the length of the wire track as 1.249 in, and the area of the wire track as 0.001 sq. in.

$$C_1 = \frac{\epsilon' \epsilon_0 A}{l} = \frac{3.15 \times 10^{-11} \times 2.54 \times 0.0553 \times 1.249 \times 10^{-2}}{.001}$$

Multiplying the resistance constant by the series of $R_1 C_1$ gives 1

$$1 = R_1 C_1 = 10 \times 10^3 \times 1.25 \times 10^{-12} = 1.25 \times 10^{-8} \text{ sec.}$$

Resistor Time Constant

The resistor time constant is the time constant for the resistor and wire track in parallel. The resistor is 10×10^3 ohms and the wire track is 4.5×10^{12} ohms. The time constant is the product of the resistor and the wire track. Using the resistor as 10×10^3 ohms and the wire track as 4.5×10^{12} ohms.

$$R_2 C_2 = \left(\frac{1}{\frac{1}{10 \times 10^3} + \frac{1}{4.5 \times 10^{12}}} \right) = \frac{R_1 C_1}{1 + \frac{R_1}{R_2}}$$

Using the value of C_1

$$C_2 = \frac{\epsilon' \epsilon_0 A}{l} = \frac{3.15 \times 10^{-11} \times 2.54 \times 0.0553 \times 1.249}{.001} = 0.87 \times 10^{-12} \text{ farads}$$

The resistor R_2 is the resistance of the wire track. The resistor is the resistance of the wire track. The resistor is the resistance of the wire track. The resistor is the resistance of the wire track.

$$R_2 = \frac{\rho l}{A} = \frac{3.1 \times 10^{11} \text{ ohm-cm.} \times 0.032 \text{ in}}{.007 \text{ in} \times .125 \text{ in} \times 2.54 \text{ cm/in}} = 4.5 \times 10^{12} \text{ ohms}$$

