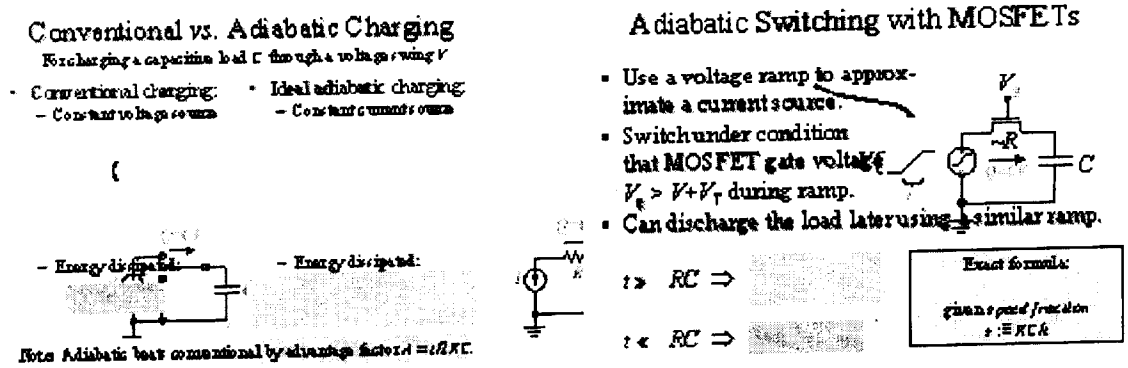

Conventional vs. Adiabatic Charging
Adiabatic Switching with MOSFETs
Use a voltage ramp to approximate a current source.
Switch under condition that MOSFET gate voltage
during ramp.
Can discharge the load later using a similar ramp.
Exact formula:

FIGURE 1

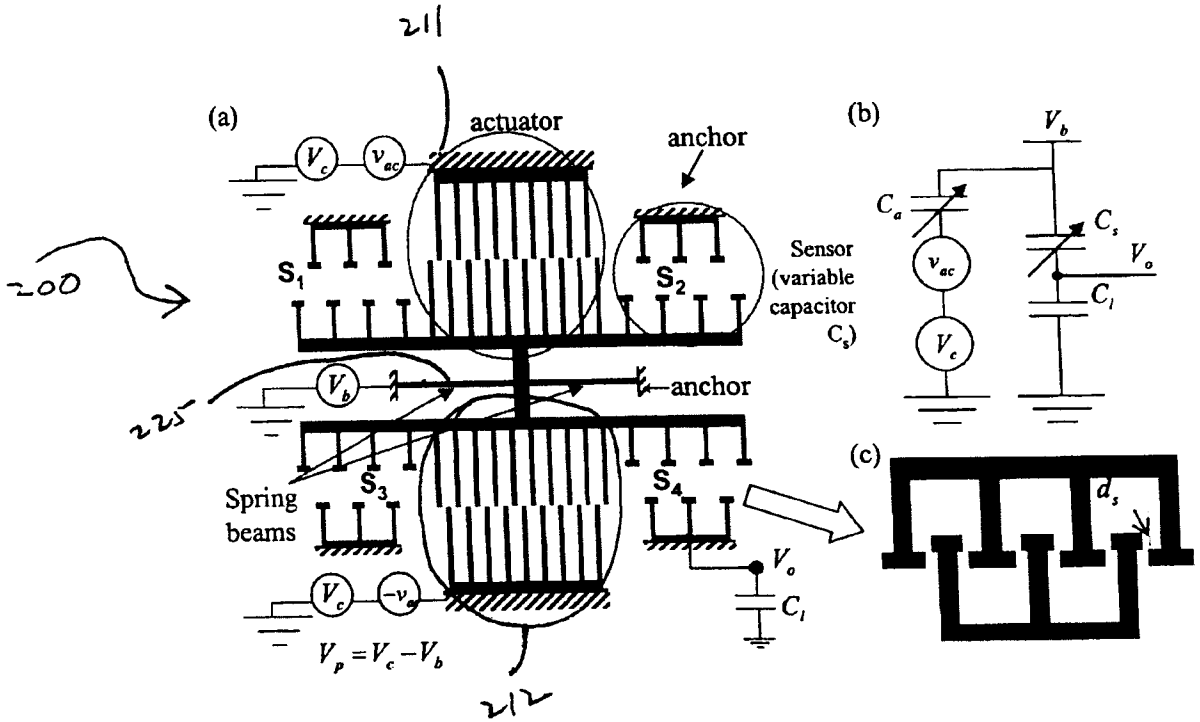
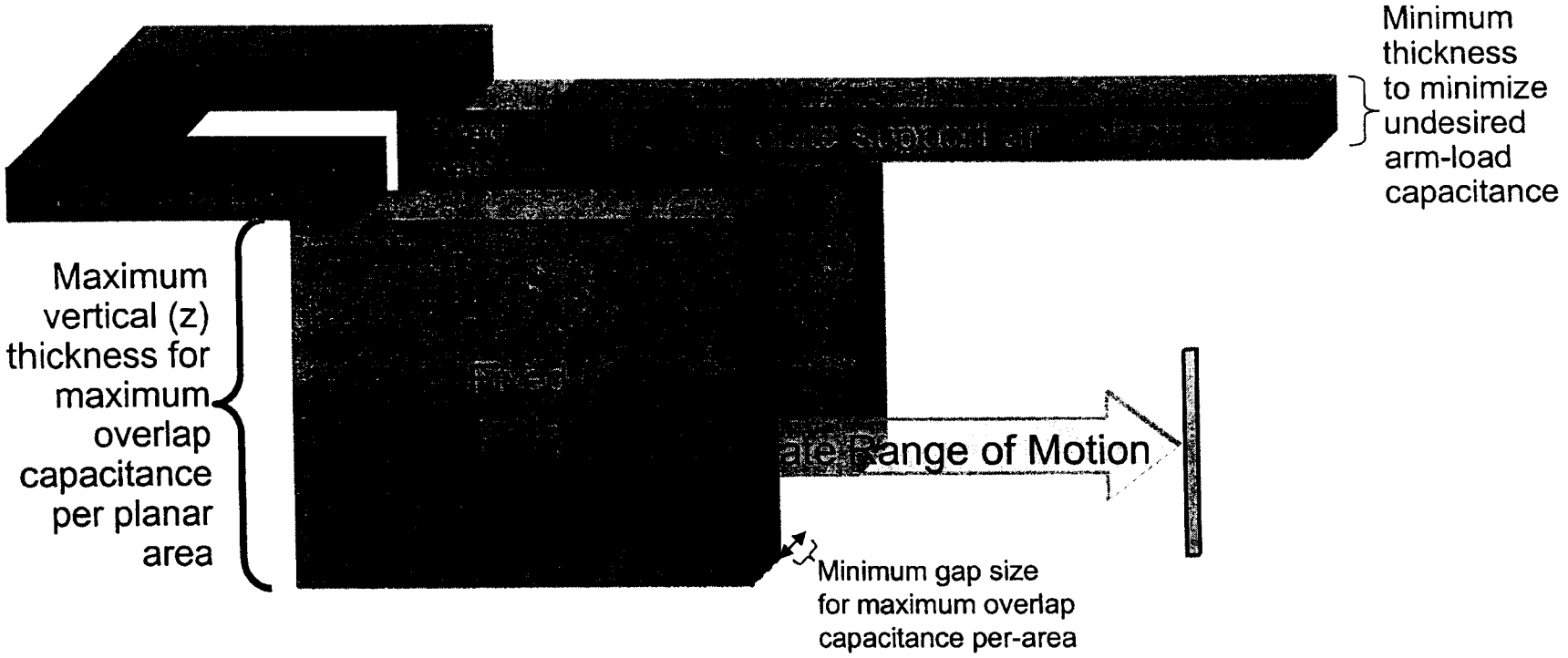

211
(a)
actuator
anchor
200
Sensor
(variable
capacitor
C_s)
S_1
S_2
225
anchor
Spring
beams
S_3
S_4
V_o
C_l
$V_p = V_c - V_b$
212
(b)
V_b
C_a
C_s
V_o
C_l
(c)
d_s

FIGURE 2

New Comb Finger Shape I

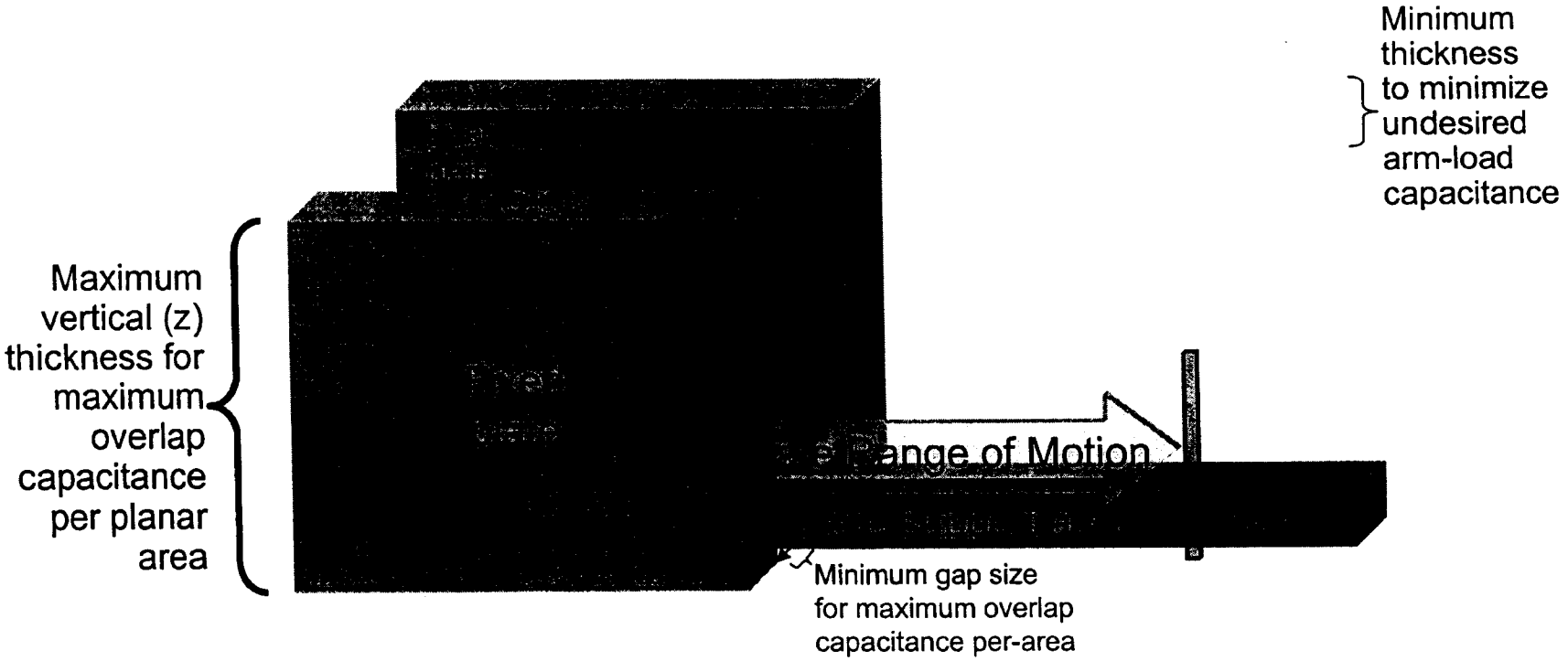


Note that the new configuration increases the magnitude of the capacitance variation while reducing the magnitude of departures from the desired trapezoidal wave shape.

Color key:

FIGURE 3A

New Comb Finger Shape II

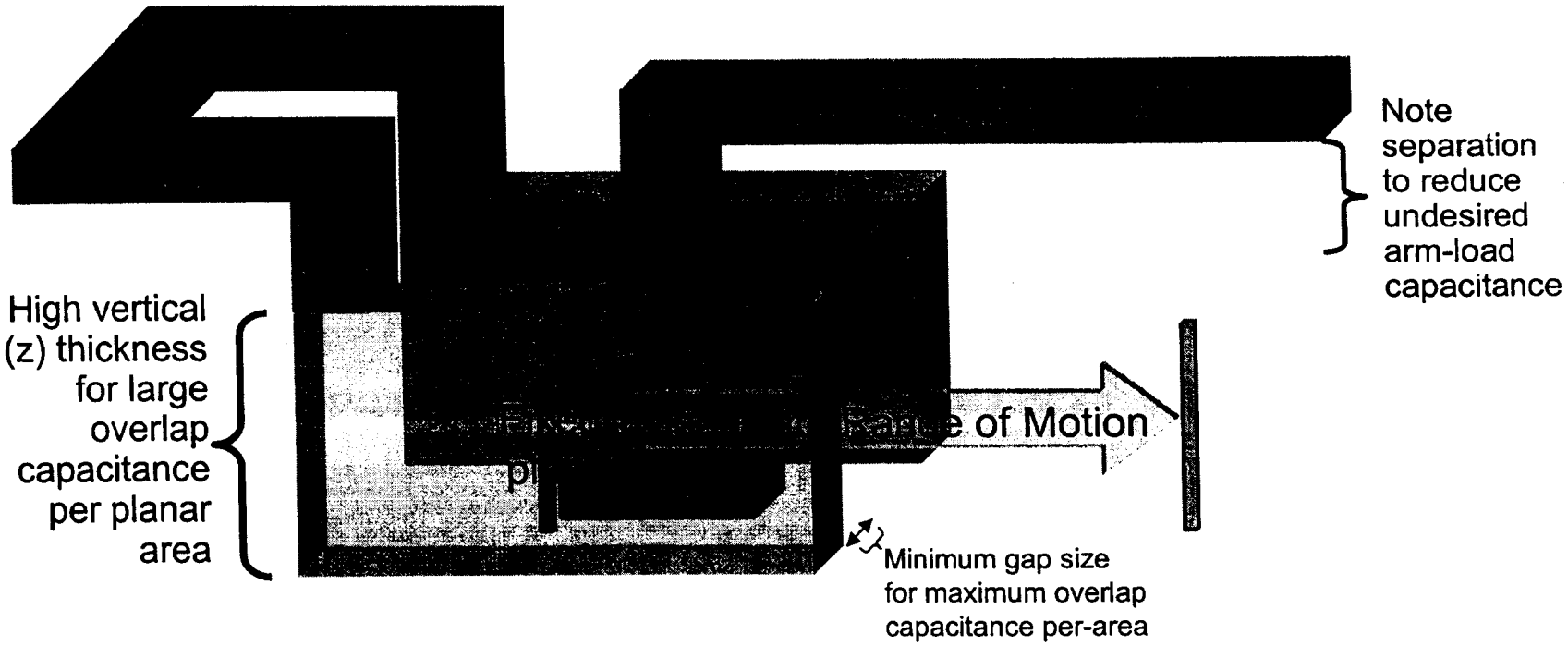


Note that the new configuration increases the magnitude of the capacitance variation while reducing the magnitude of departures from the desired trapezoidal wave shape.
In addition, the structures are made of silicon

Color key:

FIGURE 3B

New Comb Finger Shape III

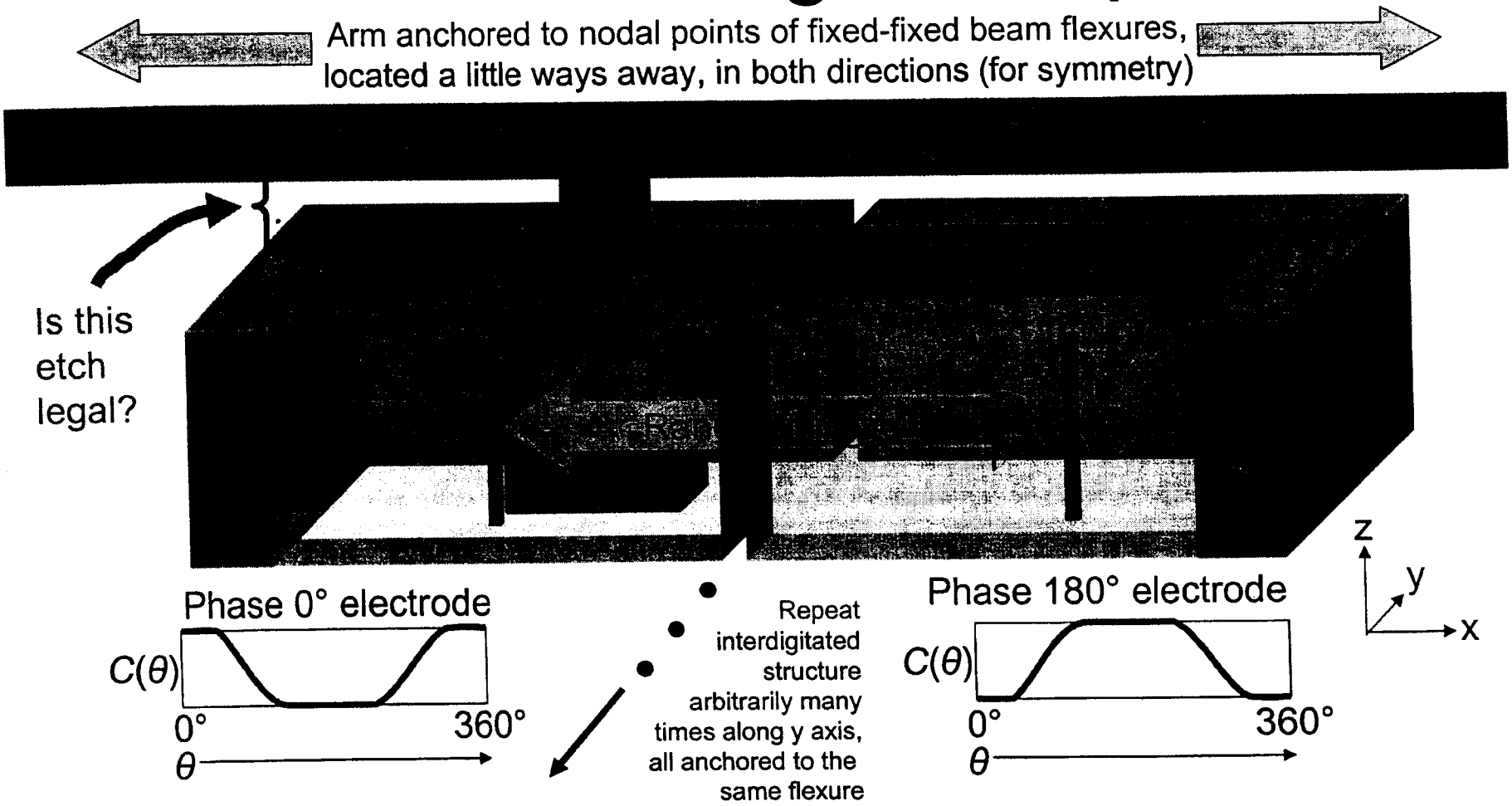


Note that the new configuration increases the magnitude of the capacitance variation while reducing the magnitude of departures from the desired trapezoidal wave shape.

Color key:

FIGURE 3C

New Comb Finger Shape IV



Or, if we can do the structure on the previous slide, then why not this one too? Or, will there be a problem etching the intervening silicon out from in between the metal/oxide layers and the bulk substrate?

FIGURE 3D

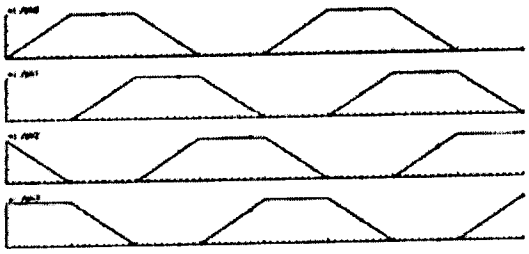


FIGURE 4

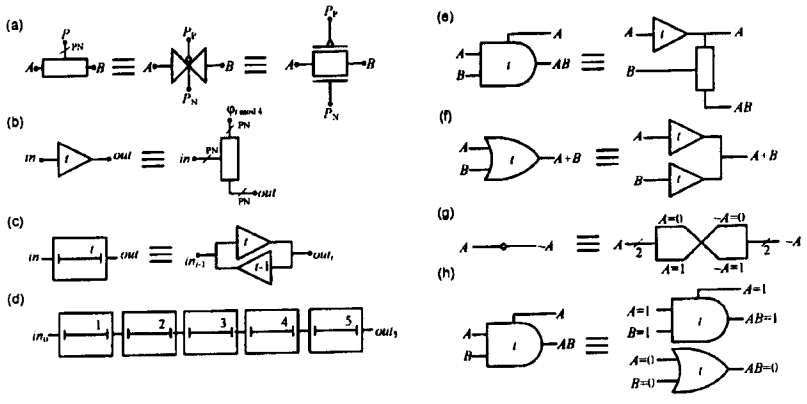


FIGURE 5

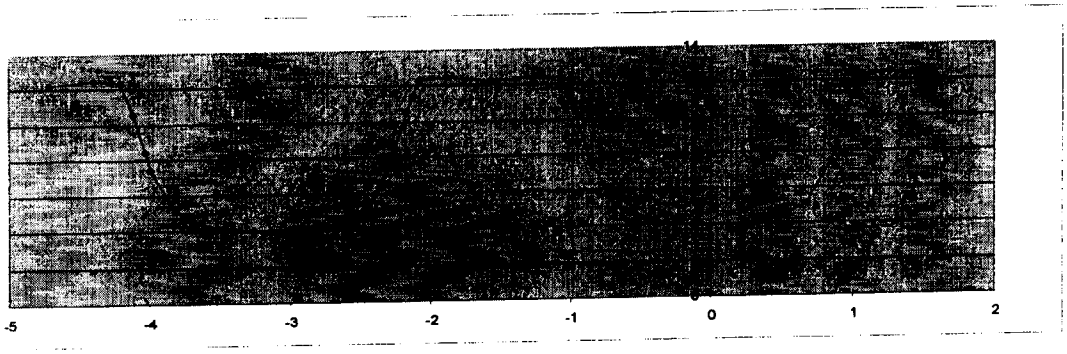


FIGURE 6

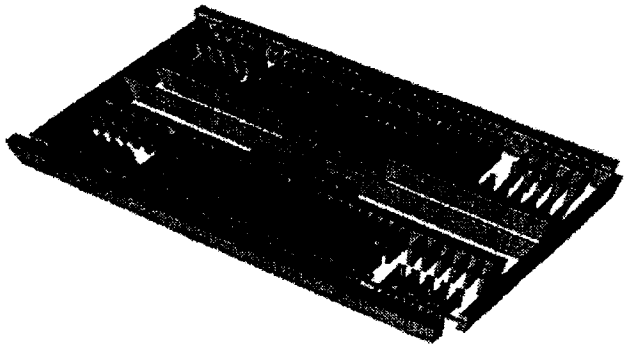


FIGURE 7

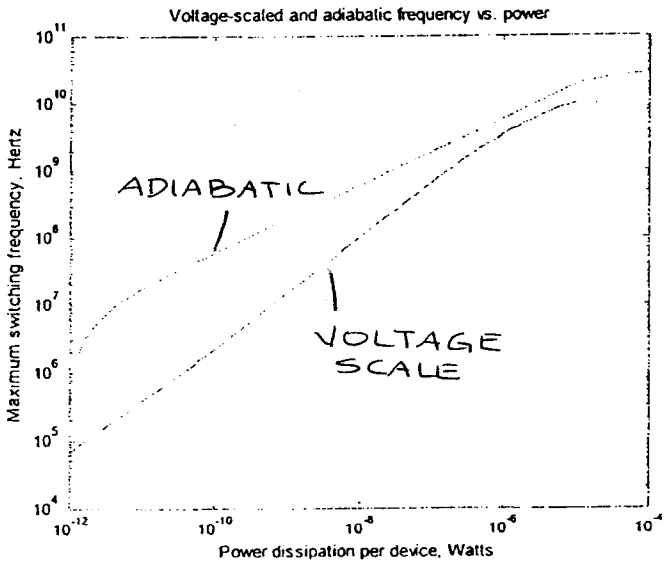

Voltage-scaled and adiabatic frequency vs. power
Maximum switching frequency, Hertz
Power dissipation per device, Watts
ADIABATIC
VOLTAGE SCALE
10^{11}
10^{10}
10^{9}
10^{8}
10^{7}
10^{6}
10^{5}
10^{4}
10^{-12}
10^{-10}
10^{-8}
10^{-6}
10^{-4}

FIGURE 8