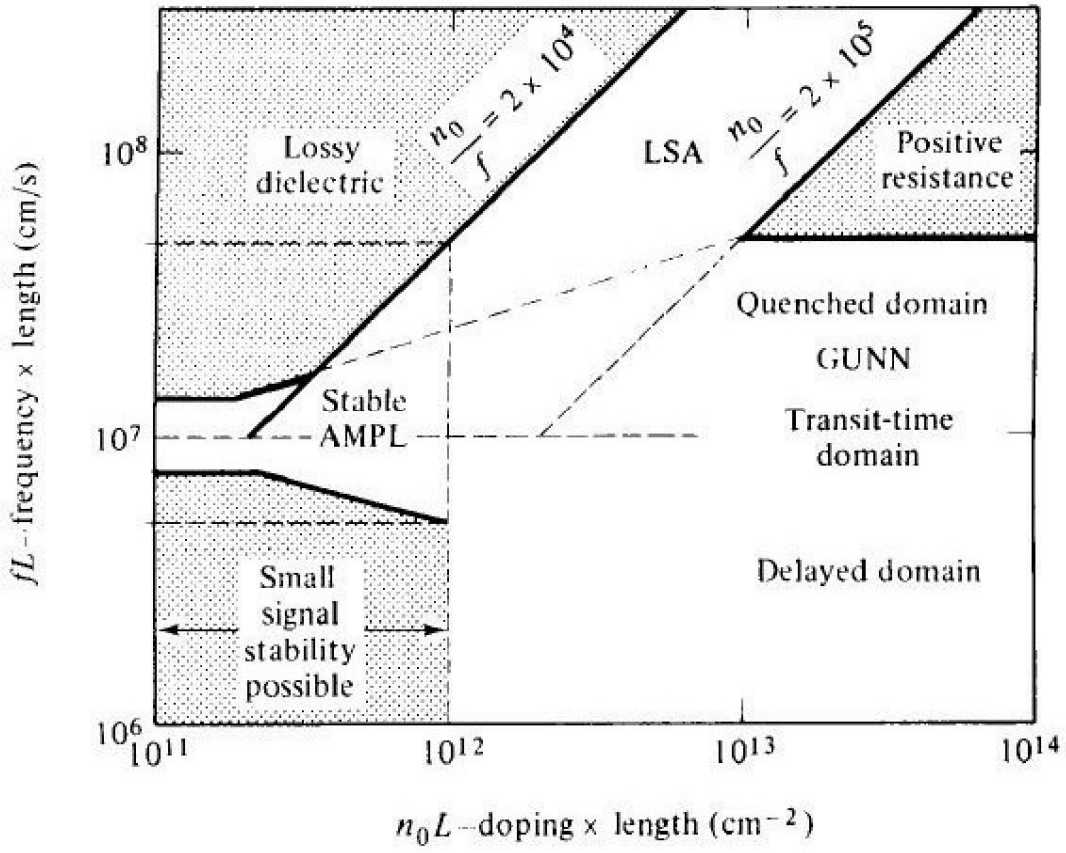
MODES OF OPERATION OF GUNN DIODE:

A gunn diode can operate in four modes:

1. Gunn oscillation mode
2. stable amplification mode
3. LSA oscillation mode
4. Bias circuit oscillation mode

Gunn oscillation mode: This mode is defined in the region where the product of frequency multiplied by length is about 107 cm/s and the product of doping multiplied by length is greater than 1012/cm2.In this region the device is unstable because of the cyclic formation of either the accumulation layer or the high field domain.

When the device is operated is a relatively high Q cavity and coupled properly to the load, the domain I quenched or delayed before nucleating.

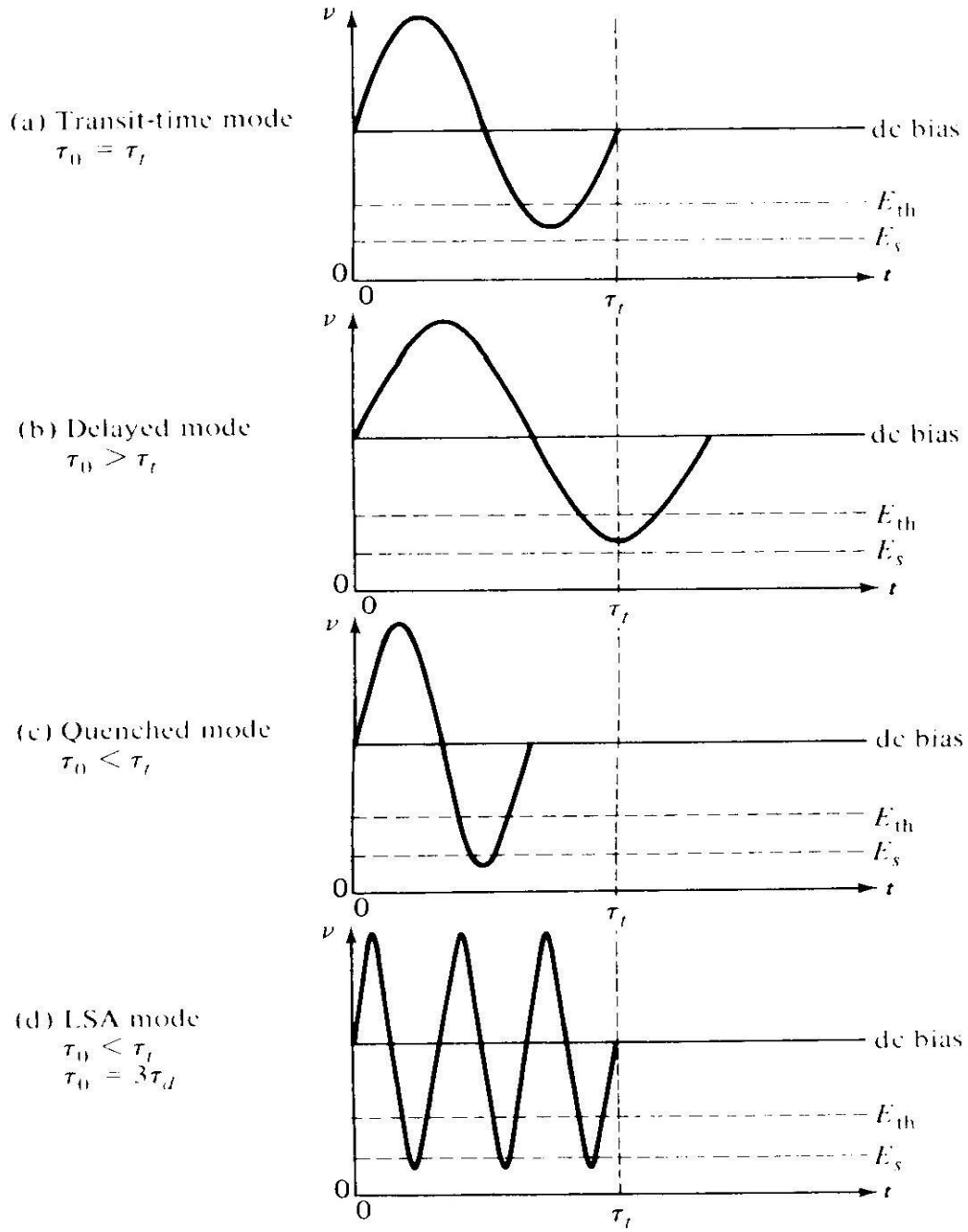


2.Stable amplification mode: This mode is defined in the region where the product of frequency times length is about 107 *cmls* and the product of doping times length is between $l0^{11}$and *1O*^{12}*/cm2*

.**3. LSA oscillation mode**: This mode is defined in the region where the product of frequency times length is above 10^7 *cmls* and the quotient of doping divided by frequency is between 2 x 10^4 and 2 x 10^5.

4. Bias-circuit oscillation mode: This mode occurs only when there is either Gunn or LSA oscillation. and it is usually at the region where the product of frequency times length is too small to appear in the figure. When a bulk diode is biased to threshold. the average current suddenly drops as Gunn oscillation begins.

The drop in current at the threshold can lead to oscillations in the bias circuit that are typically 1 kHz to 100 MHz .



Delayed domain mode (106 cm/s < *fL* < 107 cm/s). When the transit time is Chosen so that the domain is collected while *E* < Eth as shown in Fig. 7-3-4(b), a

new domain cannot form until the field rises above threshold again. In this case, the oscillation period is greater than the transit time-that is, *To* > *T,*. This delayed mode is also called *inhibited mode.* The efficiency of this mode is about 20%.

Quenched domain mode (fL > 2 X 107 cm/s).

If the bias field drops below the sustaining field *Es* during the negative half-cycle as shown ,the domain collapses before it reaches the anode. When the bias field swings back above threshold ,a new domain is nucleated and the process repeats. Therefore the oscillations occur at the frequency of the resonant circuit rather than at the transit-time frequency, It has been found that the resonant frequency of the circuit is several times the transit-time frequency, since one dipole does not have enough time to readjust and absorb the voltage of the other dipoles . Theoretically, the efficiency of quenched domain oscillators can reach 13%

LSA MODE

When the frequency is very high, the domains do not have sufficient time to form While the field is above threshold. As a result, most of the domains are maintained In the negative conductance state during a large fraction of the voltage cycle. Any Accumulation of electrons near the cathode has time to collapse while the signal is Below threshold. Thus the LSA mode *is* .the simplest mode of operation.

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