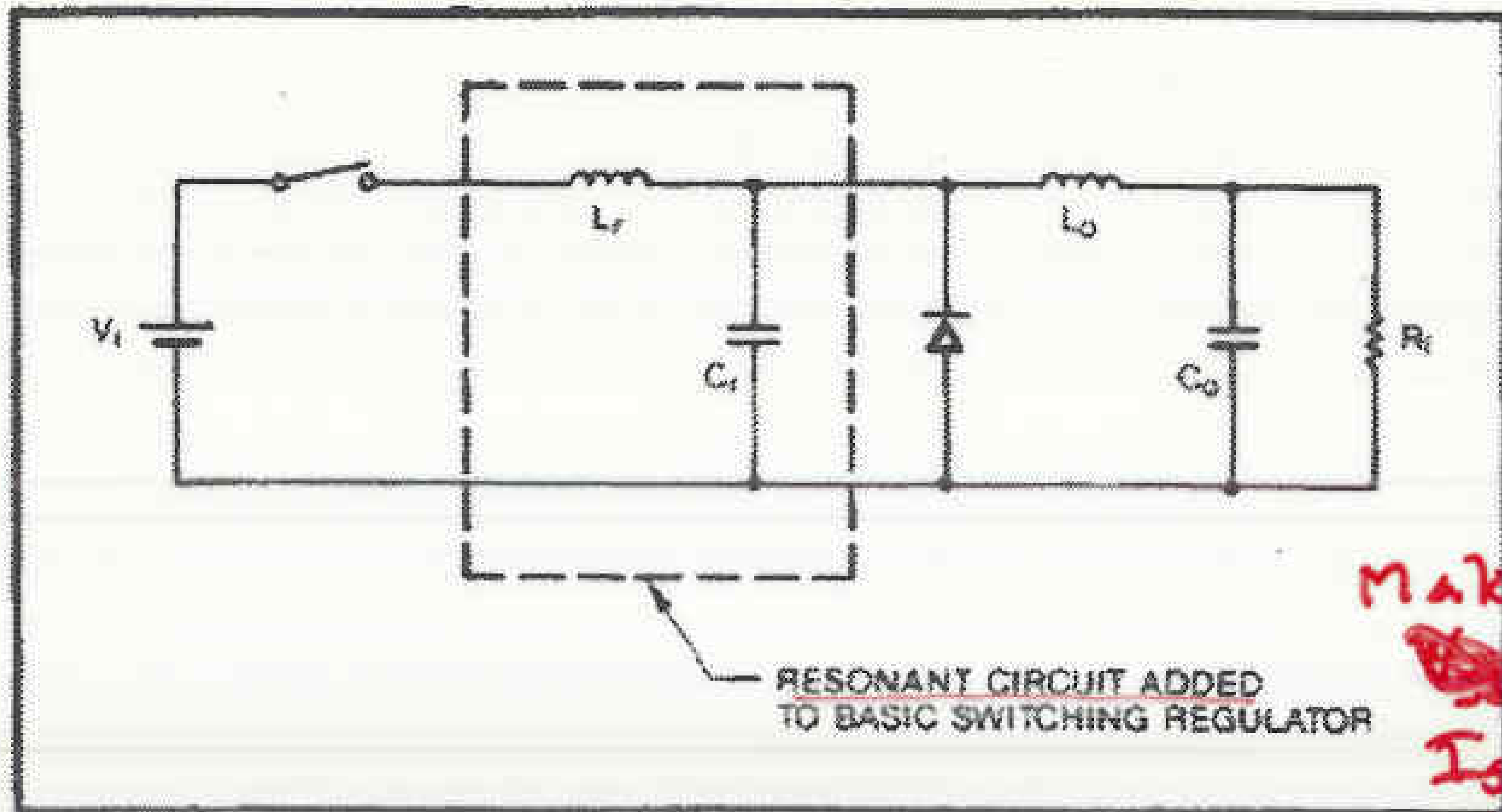


Fig. 3 - Basic Resonant Converter

Makes only I_{sw} sinusoidal vs □-wave

V_{sw} still □-wave

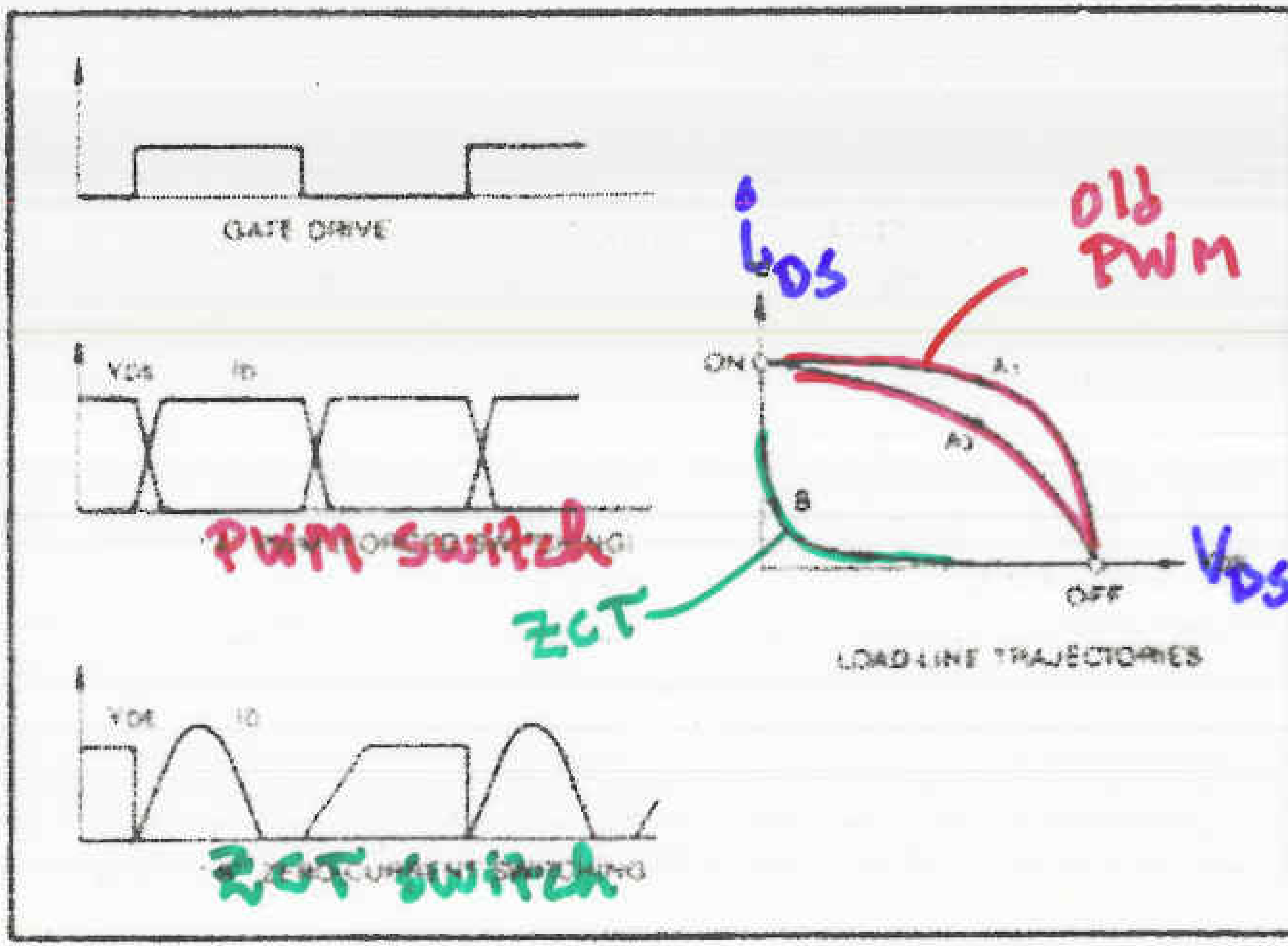


Fig. 6 - Switching Stress and Switching Loss

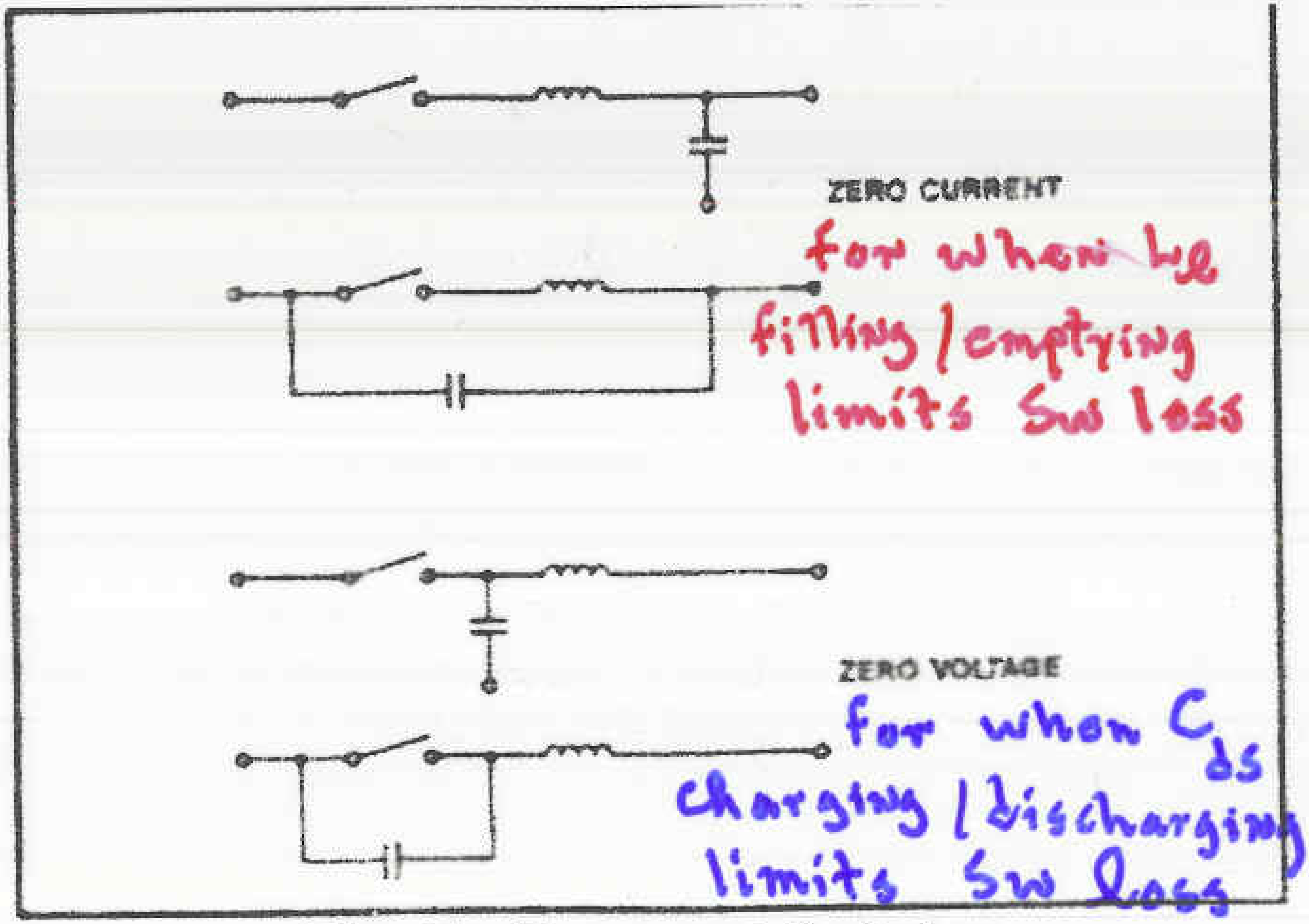


Fig. 7 - Resonant Switches

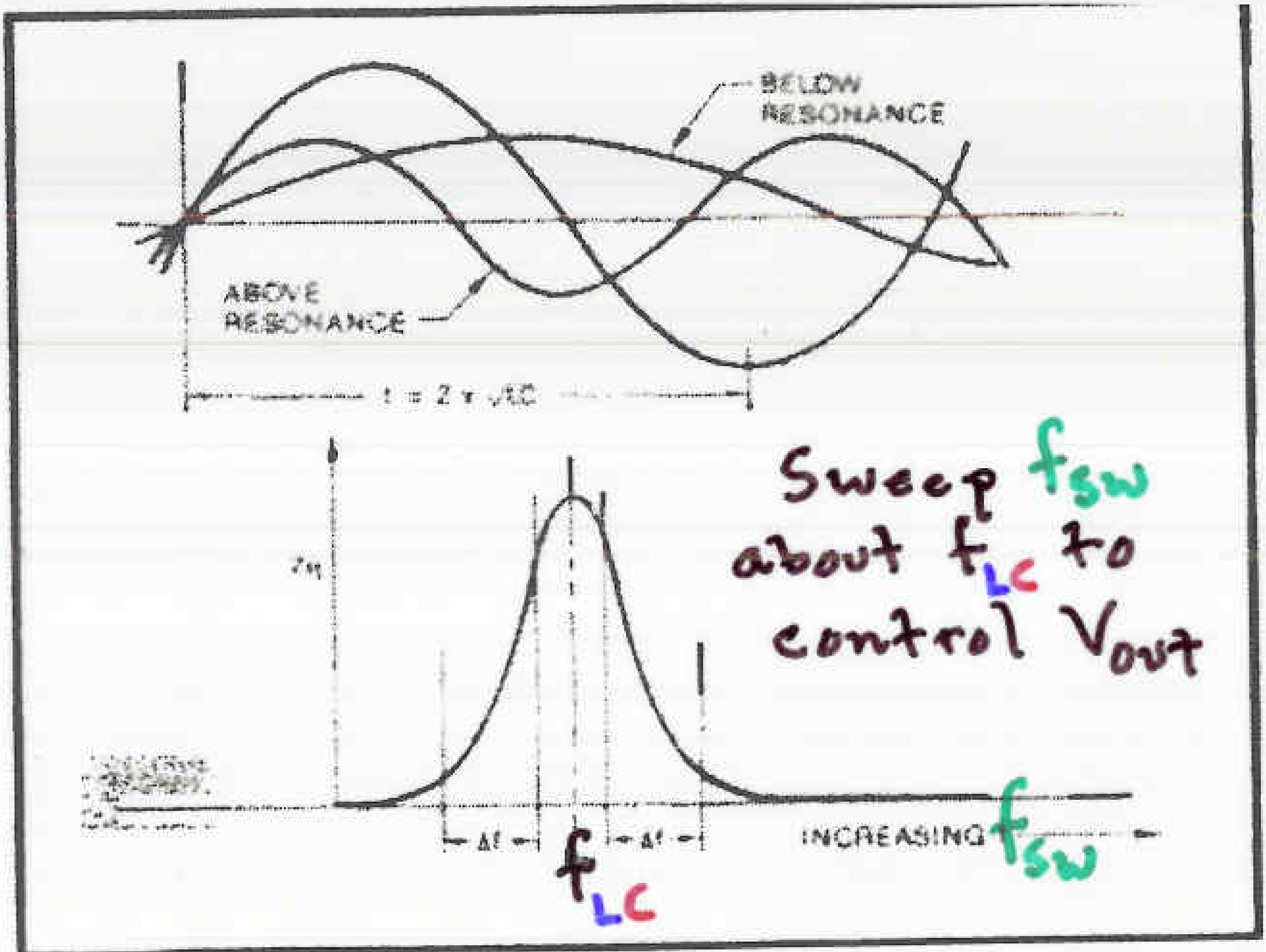


Fig. 11 - Variable Frequency Continuous Resonance

ADVANTAGES:

1. ZERO CURRENT SWITCHING
2. LOW COMPONENT STRESS
3. LOW EMI
4. USEFUL PARASITIC ELEMENTS
5. IMPROVED DIODE RECOVERY

DISADVANTAGES:

1. GREATER COMPLEXITY non-linear control loops
2. HIGHER PEAK CURRENTS as $f_{sw} \rightarrow f_{LC}$
3. NEW TECHNOLOGY LEARNING CURVE

Fig. 4 - Resonant Converter Advantages

QUASI-RESONANCE = form of DCM where $i \to 0$ each cycle

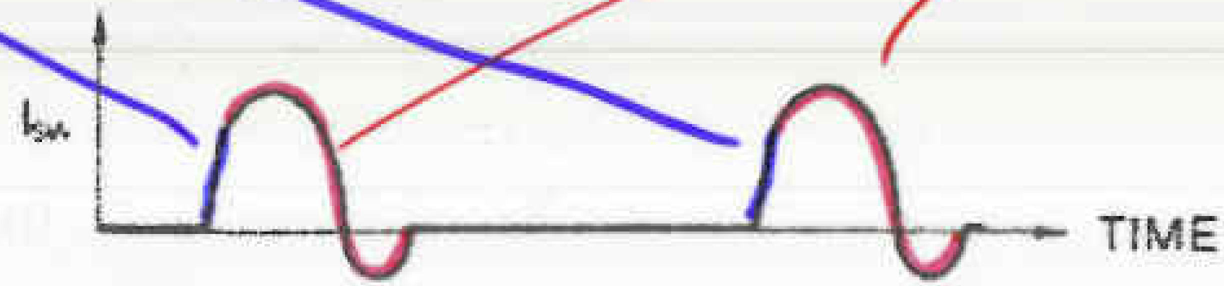
NOT TRUE SINUSOIDAL WAVESHAPE

VARIABLE FREQUENCY,

DISCONTINUOUS RESONANCE

linear $i(t)$

Sinusoidal Portion



QUASI-RESONANCE CAN BE:

PARALLEL OR SERIES LOADED

HALF OR FULL CYCLE CONDUCTION

SWITCHED AT ZERO CURRENT OR VOLTAGE

CAN APPROACH CONTINUOUS RESONANCE AS A LIMIT AT MAXIMUM LOAD.

Fig. 12 - Quasi-Resonance Definition

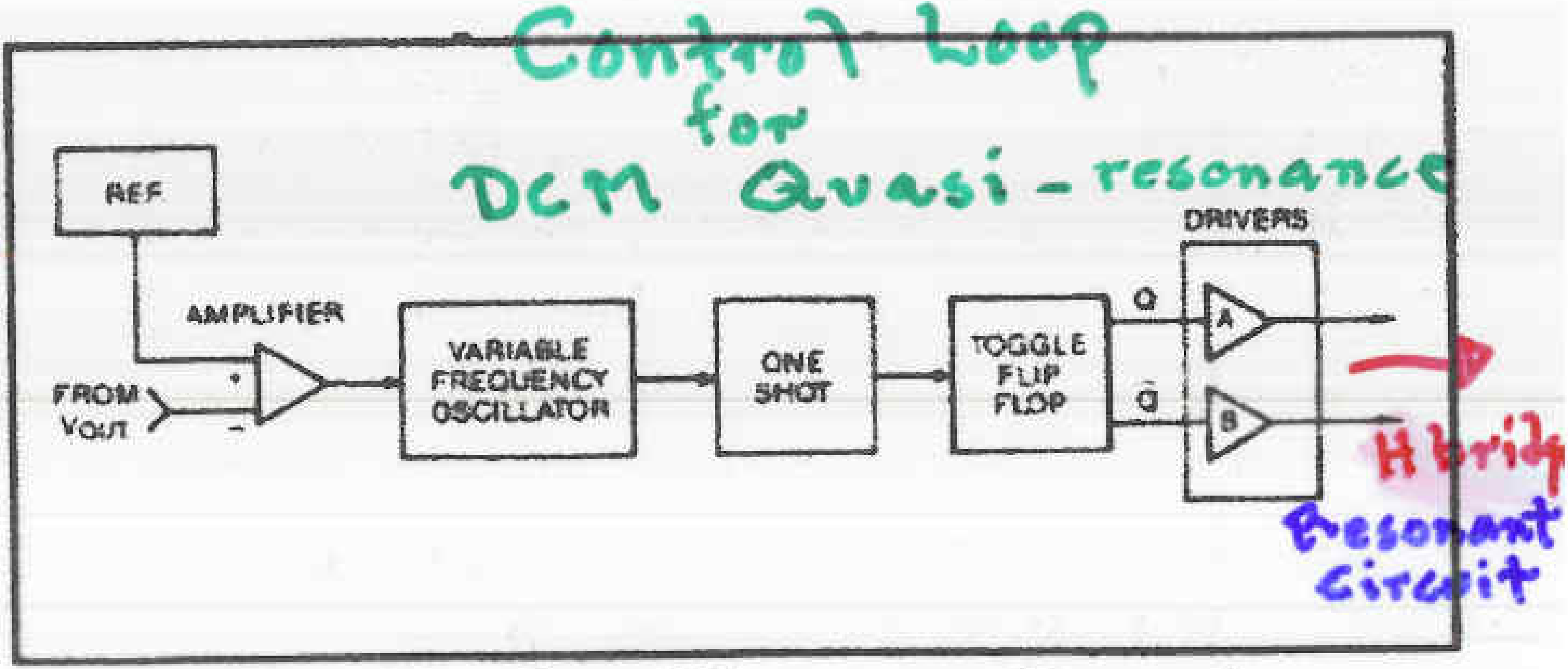
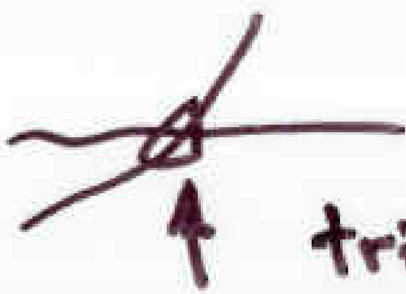


Fig. 13 - Quasi-Resonant Control

H Bridge: Sense for zero crossing of I or V to switch



trigger for H-bridge transition

L_e is an issue C_{ds} of Q an issue

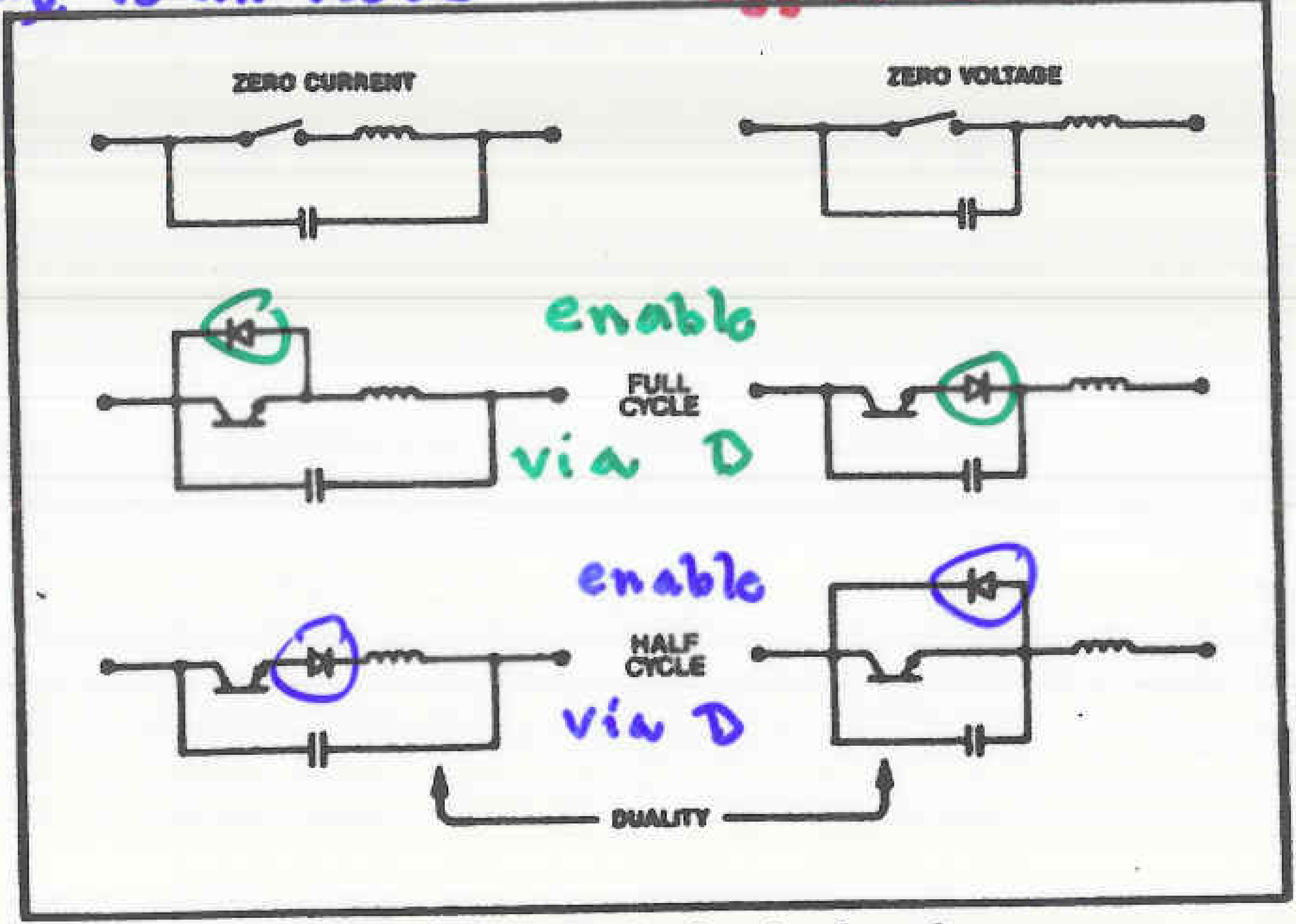


Fig. 14 - Switch Activation

CHARACTERISTIC	ZERO-CURRENT SWITCH	ZERO-VOLTAGE SWITCH
CONTROL	CONSTANT ON-TIME	CONSTANT OFF-TIME
SWITCH VOLTAGE WAVEFORM	≈ SQUARE	≈ SINUSOIDAL
SWITCH CURRENT WAVEFORM	≈ SINUSOIDAL	≈ SQUARE
LOAD RANGE	Rmin → ∞	0 → Rmax
SWITCH LIMITATIONS	PEAK ON CURRENT	PEAK OFF VOLTAGE

ZERO-VOLTAGE USAGE:

1. VERY HIGH FREQUENCIES WHERE SWITCH PARASITIC CAPACITANCE WOULD CAUSE EXCESSIVE POWER LOSS AT SWITCHING

Due to sine

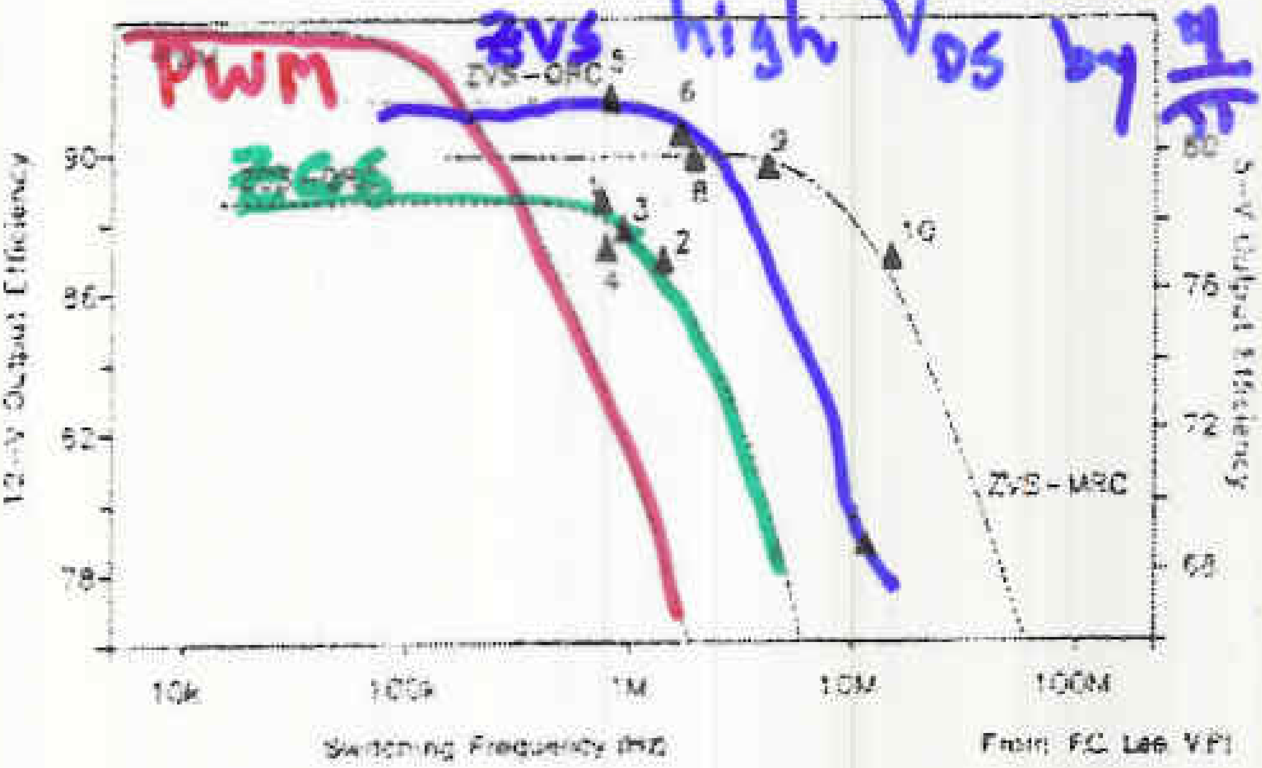


Fig. 15 - Switching Techniques Compared

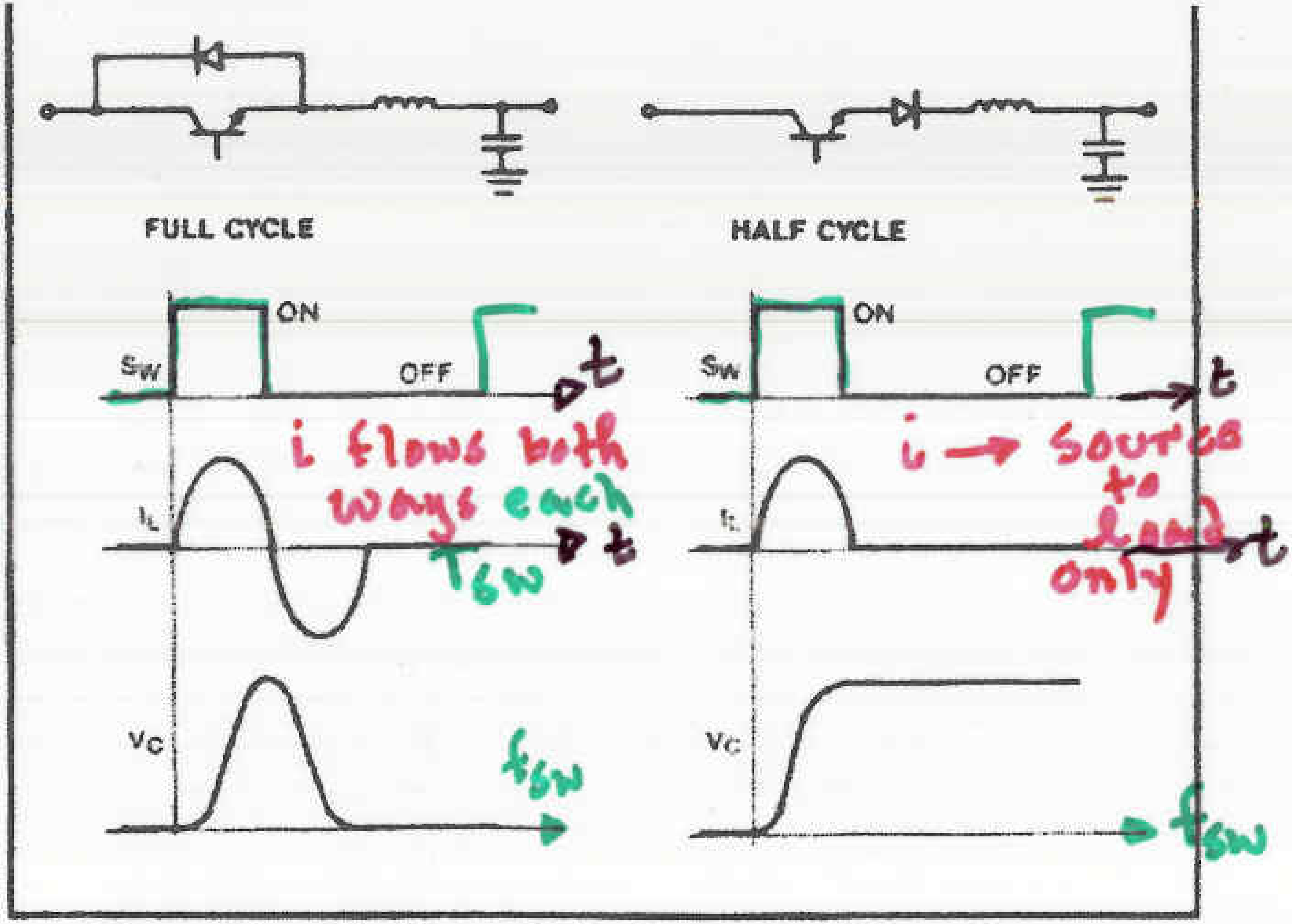


Fig. 16 - Half and Full Cycle Waveforms with Unloaded Resonant Switch

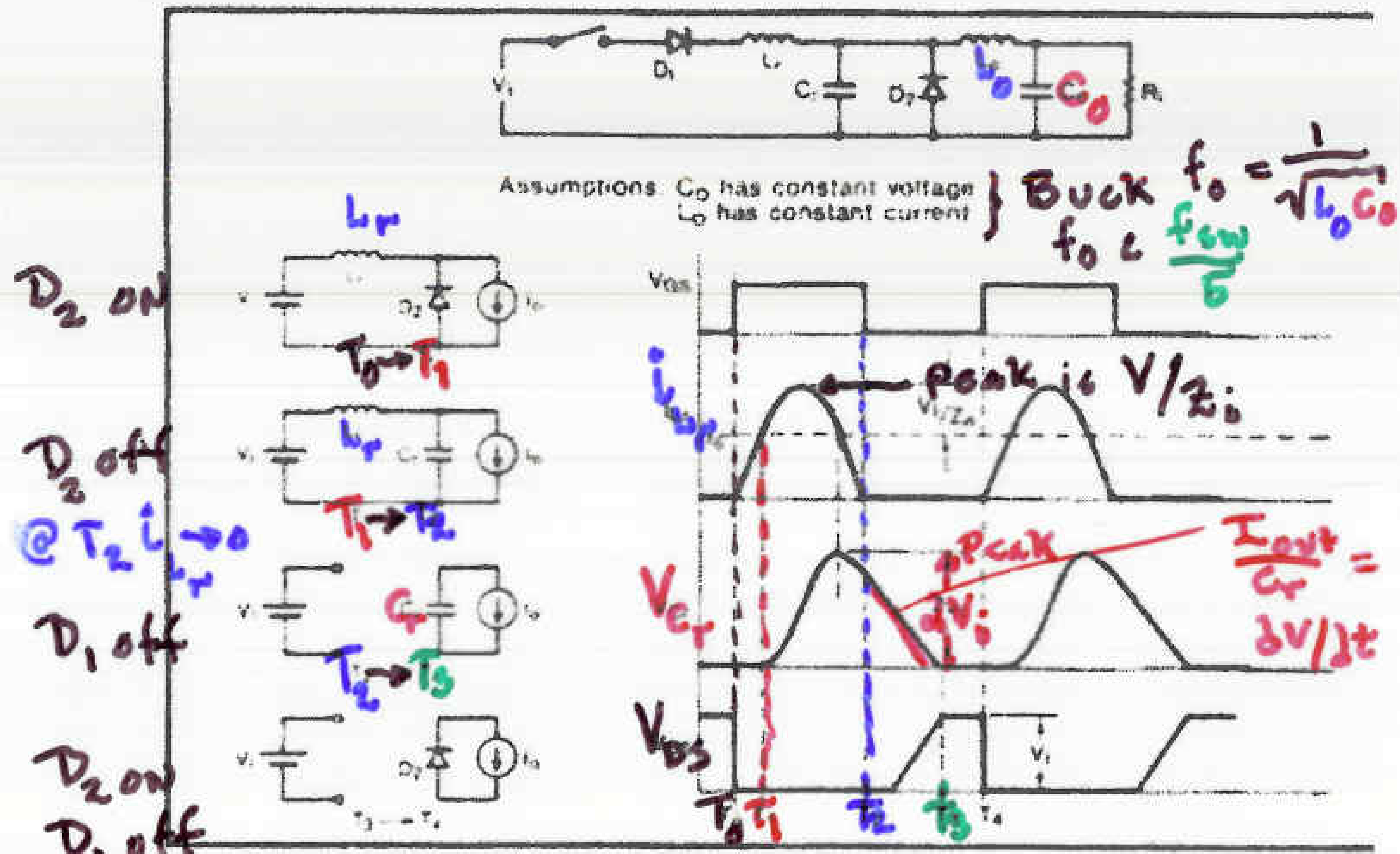


Fig. 17 - Quasi-Resonant Switching Operation

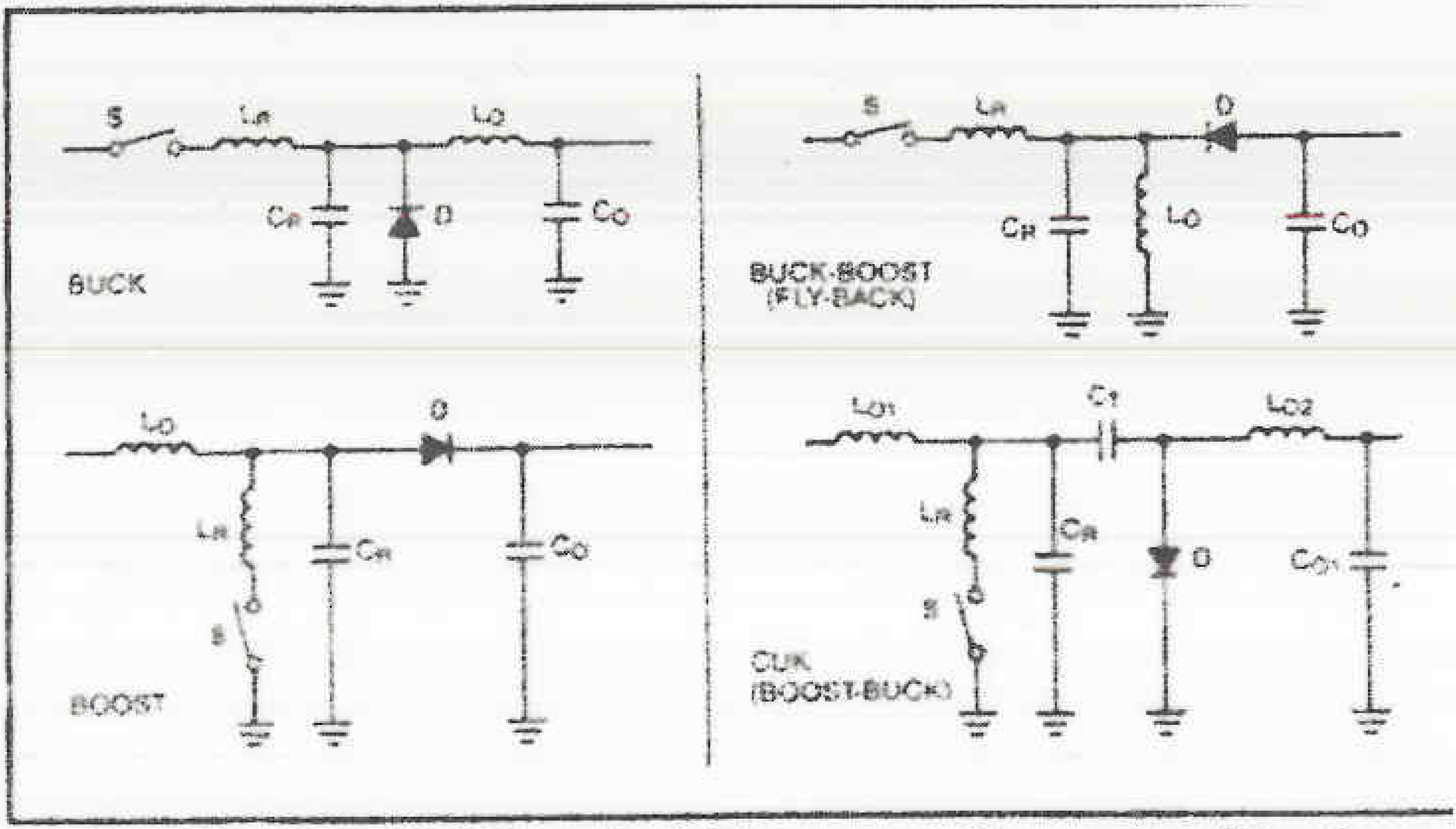


Fig. 18 - Parallel-Loaded Resonant Converter Versions of Square-Wave Power Conversion Topologies

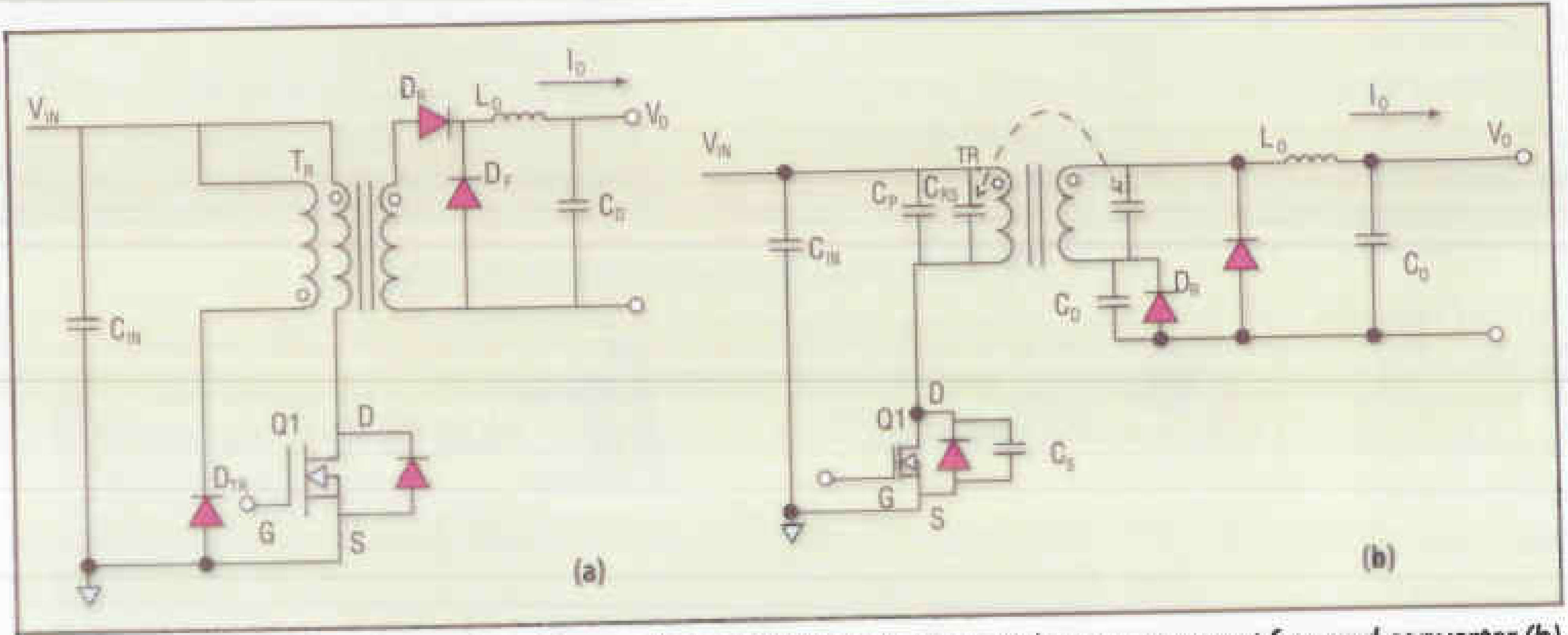
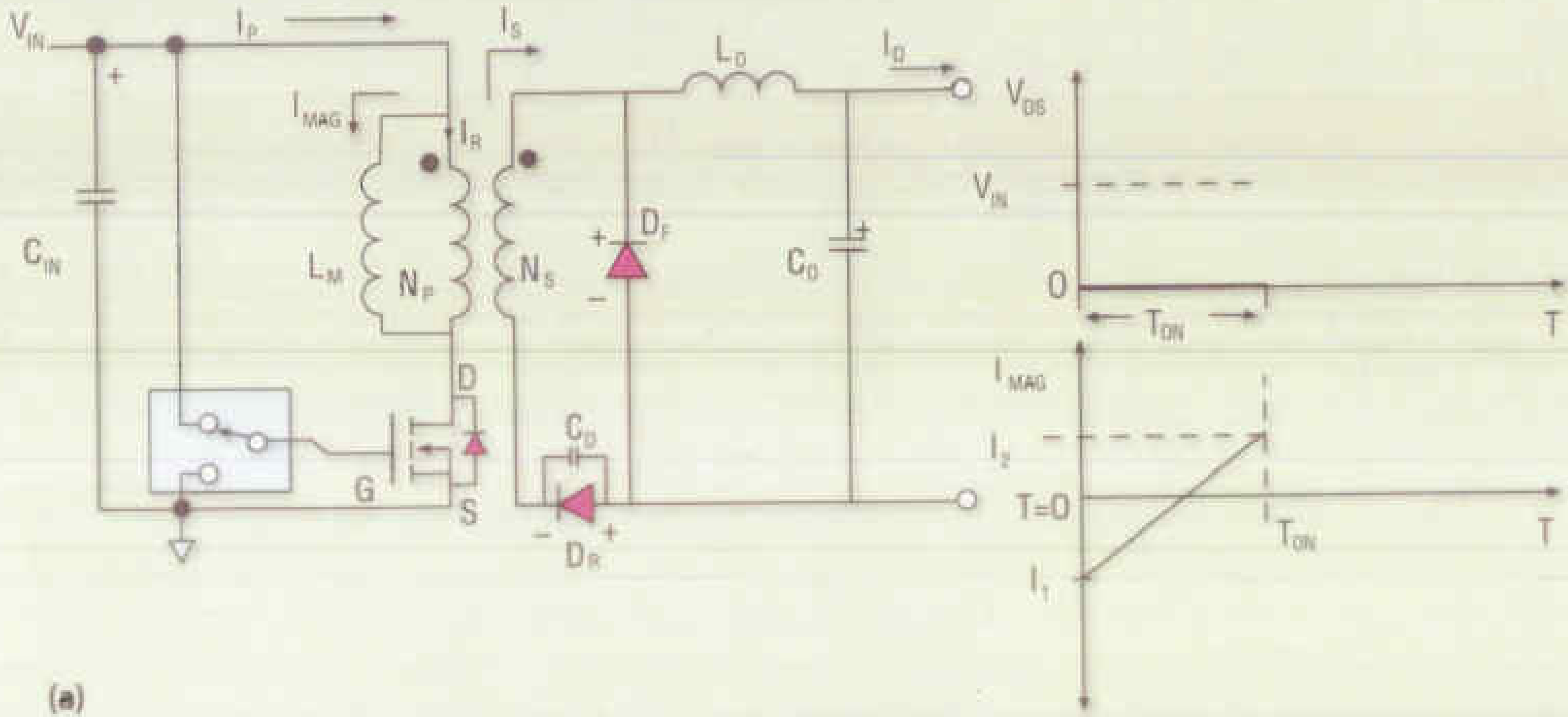
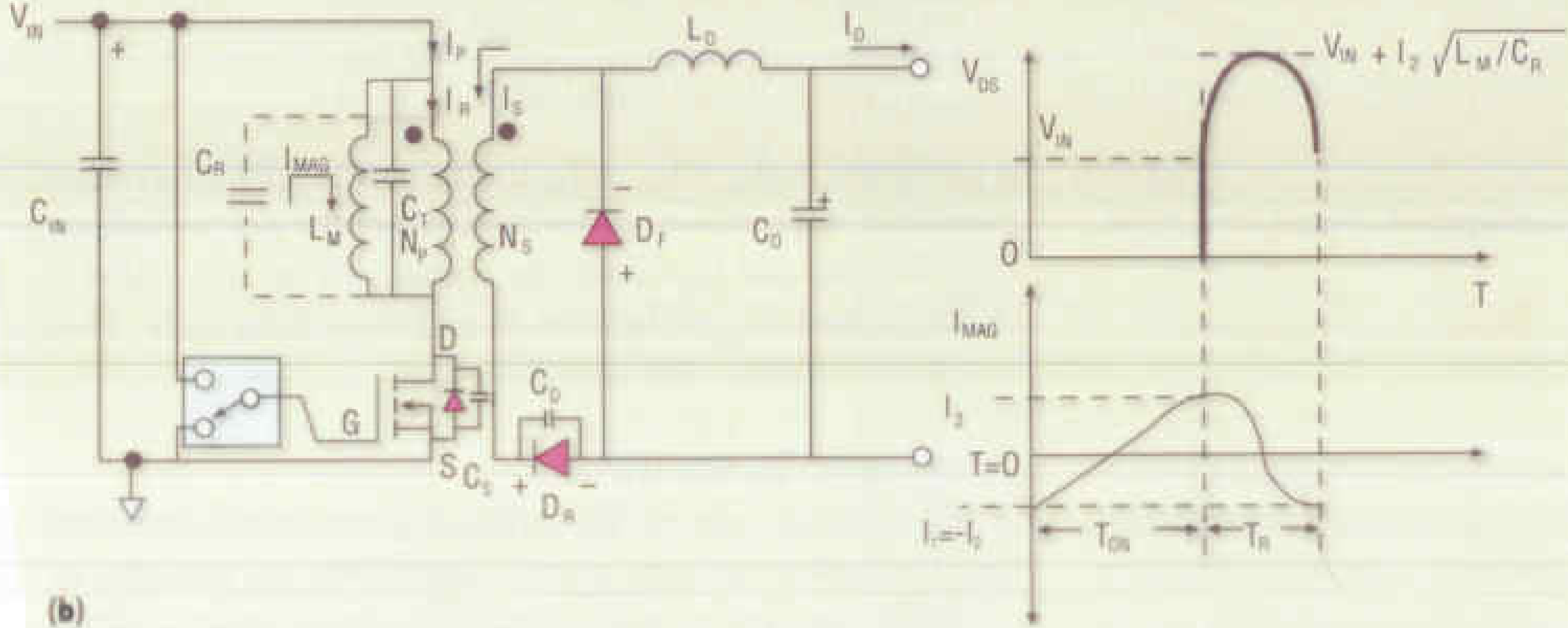


Fig. 1. *A conventional single-transistor forward converter (a). A single-switch, resonant-reset forward converter (b).*


V_IN
C_IN
I_P
I_MAG
I_R
L_M
N_P
I_S
N_S
D
G
S
D_F
C_D
D_R
L_O
I_O
C_O
V_DS
V_IN
0
T_ON
T
I_MAG
I_2
T=0
T_ON
T
I_1
(a)


V_{IN}
C_{IN}
C_R
I_{MAG}
L_M
C_T
N_P
I_P
I_R
I_S
N_S
D
G
S
C_S
C_D
D_R
D_F
L_O
C_O
I_O
V_{DS}
V_{IN}
$V_{IN} + I_2 \sqrt{L_M/C_R}$
O
T
I_{MAG}
I_2
T=0
$I_1=-I_2$
T_{ON}
T_R
(b)

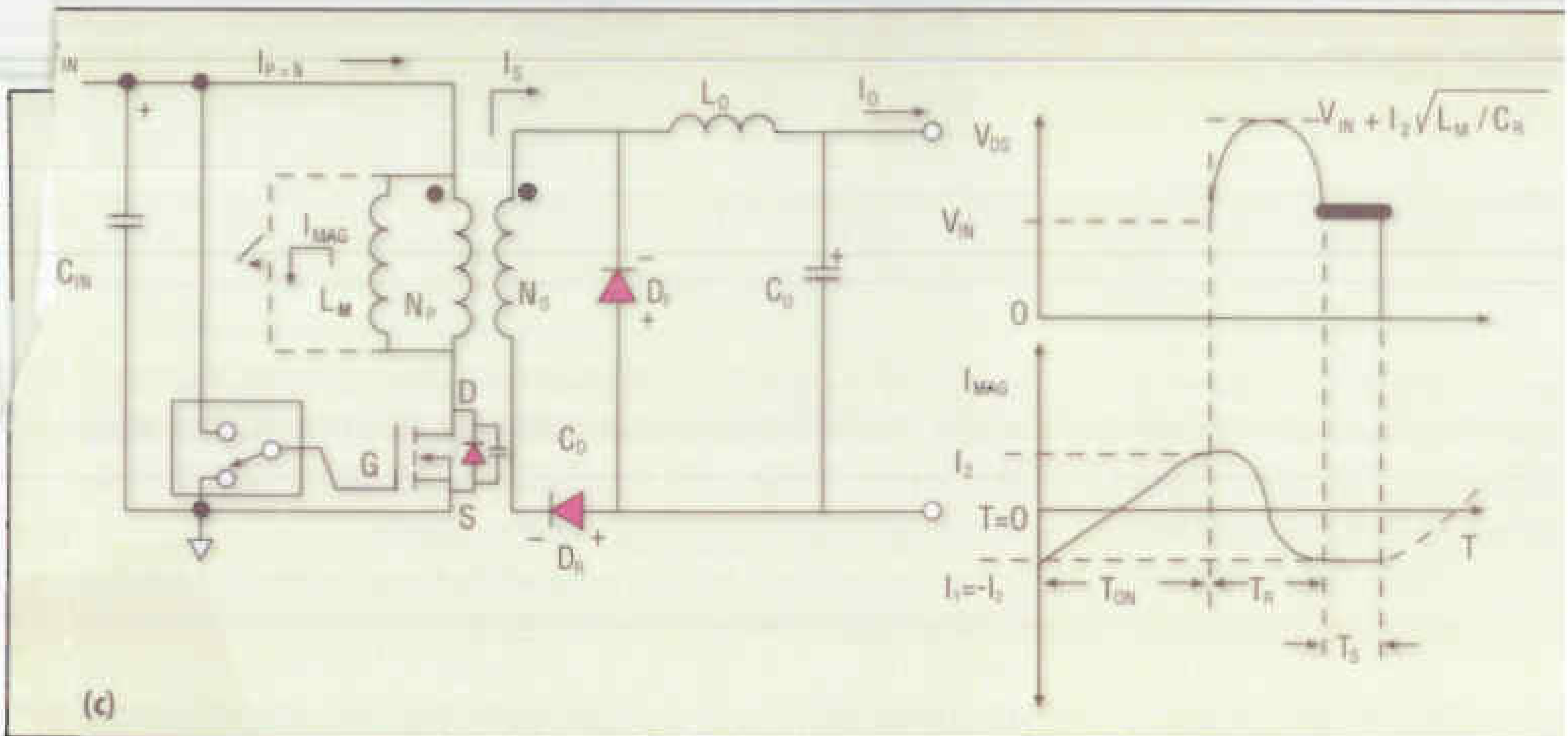


Fig. 2: *From Fig. 1b, an equivalent circuit for the voltage on Q1 and the primary magnetizing-current waveform during Interval 1—not to scale (a). From Fig. 1b, an equivalent circuit for the voltage on Q1 and the primary magnetizing-current waveform during Interval 2—not to scale (b). From Fig. 1b, an equivalent circuit for the voltage on Q1 and the primary magnetizing-current waveform during Interval 3—not to scale (c).*

Fig. 3 - Basic Resonant Converter

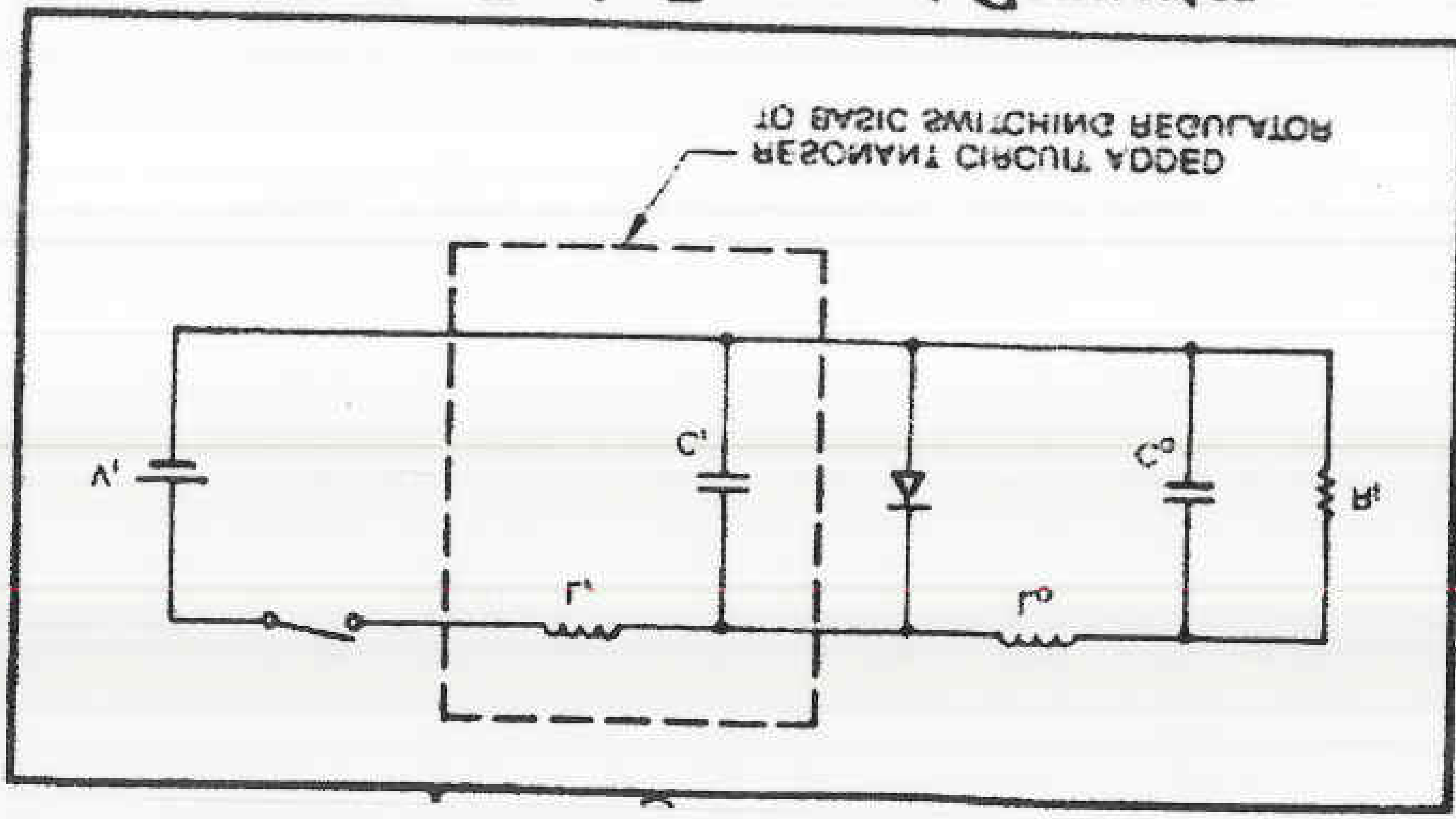
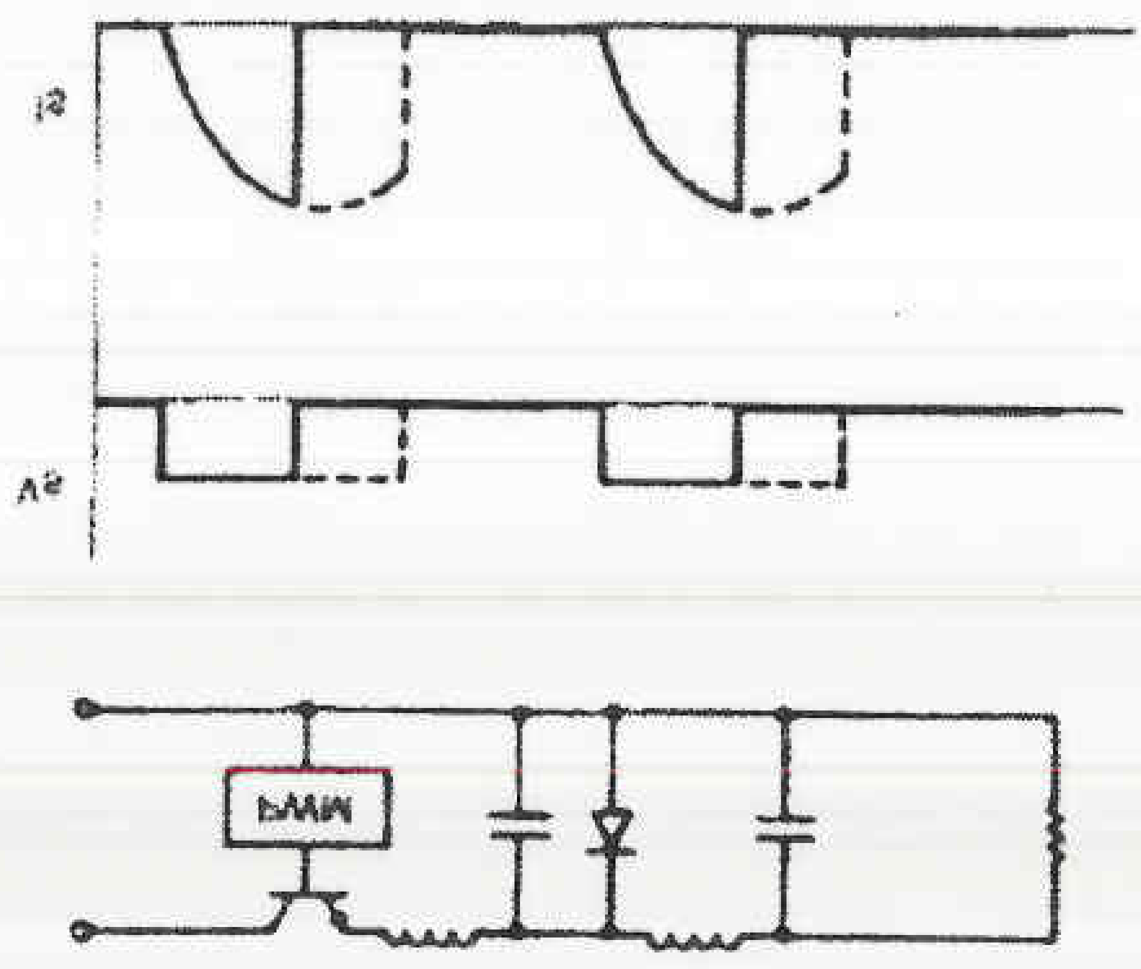
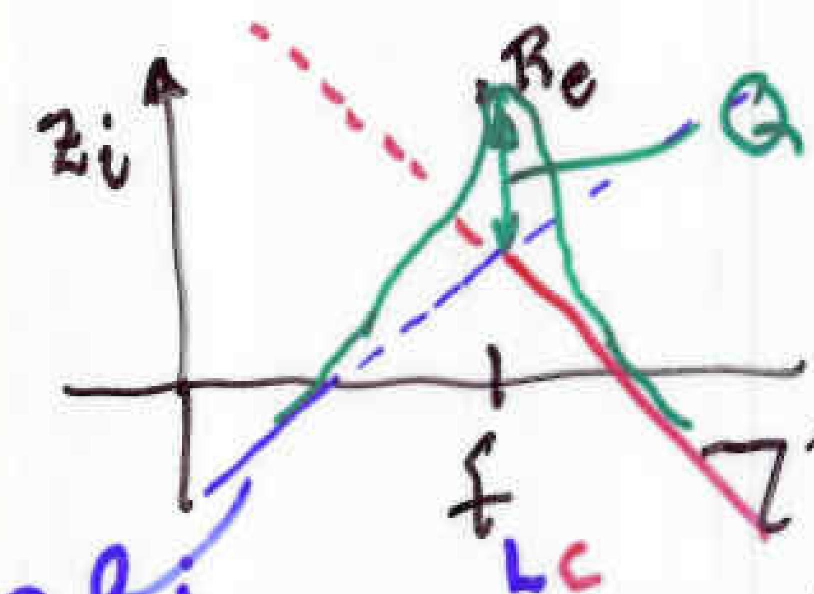


Fig. 10 - Fixed Frequency Resonance





$R_e > \sqrt{L/C}$

$\frac{20\,db}{decade}$

ice
zcs ?

eli
zvs ?

$f < f_{LC}$ → eli zvs ?

$f > f_{LC}$ → ice zcs ?

Q ↑ and make $f_{sw} \approx f_{LC}$

Then for our analysis with these conditions met

1. I_H^{total} is negligable only f_{LC}

2. $i_s(t) \simeq \sin f_{LC}\, t$

$\underbrace{DC - AC}_{\frac{V_{s1}}{V_g}}\ \underbrace{\ - DC}_{\frac{V_{out}^{DC}}{V_{s1}}}$ Converter $= \frac{V_{out}^{DC}}{V_g^{DC}}$