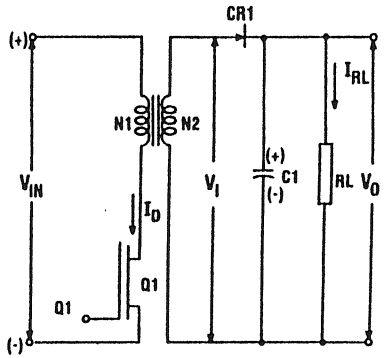
Copy CL13

5

TYPE OF CONVERTER

Flyback

CIRCUIT CONFIGURATION



IDEAL TRANSFER FUNCTION

$$\frac{V_O}{V_{IN}} = \frac{N_2}{N_1}\left(\frac{t_{on}}{T_S - t_{on}}\right) = \frac{N_2}{N_1}\left(\frac{D}{1-D}\right.$$

PEAK DRAIN CURRENT *

$$I_{DMAX} = I_{RL}\left(\frac{N_2}{N_1}\right)\left(\frac{1}{1-D}\right) + \frac{\Delta I_L}{2}$$

PEAK DRAIN VOLTAGE *

$$V_{DS} = V_{IN} + \left(\frac{N_1}{N_2}\right)(V_{OUT} + V_D$$

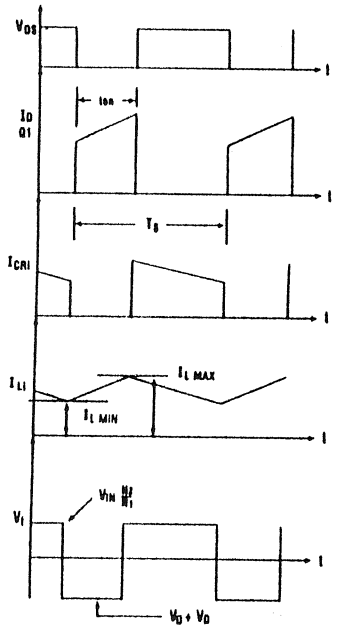
AVERAGE DIODE CURRENTS *

$$I_{CR1} = I_{RL}$$

DIODE VOLTAGES (VRM) *

$$V_{RM} = V_{IN}\left(\frac{N_2}{N_1}\right)$$

VOLTAGE AND CURRENT WAVEFORMS



ADVANTAGES

Drain current reduced by turns ratio of transfor
Low parts count. Isolation. Has no secondary
put inductors.

DISADVANTAGES

Poor transformer utilization. Transformer st
energy. High output ripple. CR1 needs fast re
recovery.

TYPICAL APPLICATIONS

Low output power. Supports multiple outputs

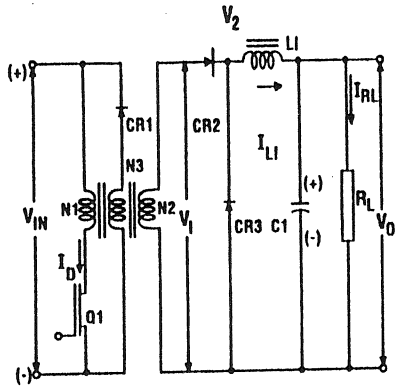
APPLICABLE HARRIS PRODUCTS

HIP5061, ICL7667, HV400

TYPE OF CONVERTER

Forward

CIRCUIT CONFIGURATION



IDEAL TRANSFER FUNCTION

$$\frac{V_O}{V_{IN}} = \frac{N_2}{N_1}\left(\frac{t_{on}}{T_S}\right) = \frac{N_2}{N_1} = (D)$$

PEAK DRAIN CURRENT *

$$I_{DMAX} = \frac{N_2}{N_1}\left(I_{RL} + \frac{\Delta I_{LI}}{2}\right) + \hat{I}_{MAG}$$

($\hat{I}_{MAG}$ = Peak magnetizing current.)

PEAK DRAIN VOLTAGE *

$$V_{DS} = V_{IN}\left(1 + \frac{N_1}{N_3}\right)$$

AVERAGE DIODE CURRENTS *

$$I_{CR1} = \frac{\hat{I}_{MAG}}{2}(D)$$

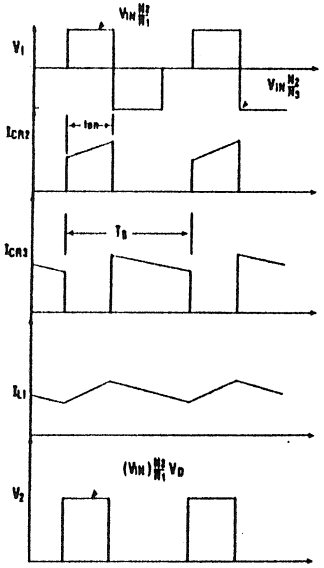
$$I_{CR2} = I_{RL}(D)$$

$$I_{CR3} = I_{RL}(1\text{-}D)$$

DIODE VOLTAGES (VRM) *

$$V_{RM}\begin{cases} V_{CR1} = V_{IN}\left(1 + \frac{N_3}{N_1}\right) \\ V_{CR2} = V_{IN}\left(\frac{N_2}{N_3}\right) \\ V_{CR3} = V_{IN}\left(\frac{N_2}{N_1}\right) \end{cases}$$

VOLTAGE AND CURRENT WAVEFORMS



ADVANTAGES

Drain current reduced by ratio of N_2/N_1. Low output ripple.

DISADVANTAGES

Poor transformer utilization. Poor transient response. Transformer design is critical. Transformer reset limits duty ratio. High voltage required for Q1. High input current ripple.

TYPICAL APPLICATIONS

Low-to-moderate output power. Supports multiple outputs.

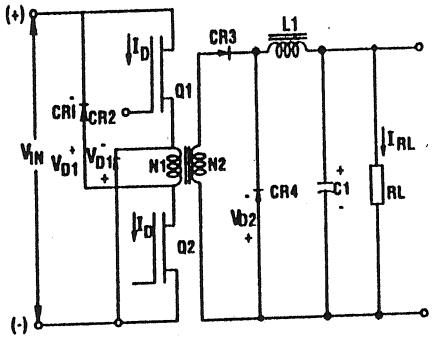
APPLICABLE HARRIS PRODUCTS

HIP5061, ICL7667, HV400

TYPE OF CONVERTER

Two-Switch Forward

CIRCUIT CONFIGURATION



IDEAL TRANSFER FUNCTION

$$\frac{V_O}{V_{IN}} = \frac{N_2}{N_1}\left(\frac{t_{on}}{T_S}\right) = \frac{N_2}{N_1}(D)$$

PEAK DRAIN CURRENT *

$$I_{DMAX} = \frac{N_2}{N_1}\left(I_{RL} + \frac{\Delta I_{L1}}{2}\right) + \hat{I}_{MAG}$$

($\hat{I}_{MAG}$ = Peak magnetizing current.)

PEAK DRAIN VOLTAGE *

$(Q_1 \text{ or } Q_2) \quad V_{DS} = V_{IN} + V_{D1}$

AVERAGE DIODE CURRENTS *

$$I_{CR1,AVE} = I_{CR2,AVE} = \frac{\hat{I}_{MAG}\, D}{2}$$

$$I_{CR3,AVE} = I_{RL} D$$

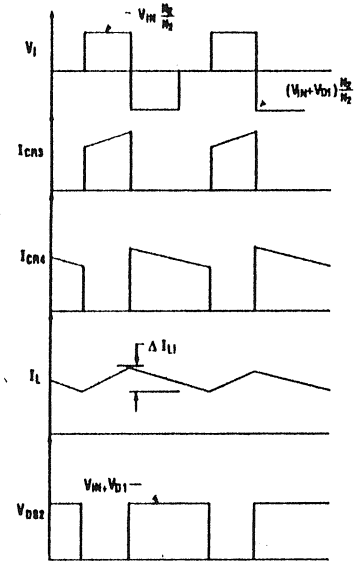
$$I_{CR4,AVE} = I_{RL}(1-D)$$

DIODE VOLTAGES (VRM) *

$$V_{CR1,PK} = V_{CR2,PK} = V_{IN}$$

$$V_{CR3} = V_{CR4} = \left(\frac{N_2}{N_1}\right) V_{IN}$$

VOLTAGE AND CURRENT WAVEFORMS



ADVANTAGES

Drain currents reduced by turns ratio. Lossless snubber recovers energy. Drain voltage 1/2 that of conventional forward converter. Low output ripple.

DISADVANTAGES

Poor transformer utilization, high parts count, high-side switch drive required. Transformer reset limits duty ratio. High input current ripple.

TYPICAL APPLICATIONS

High input voltage, moderate power. Supports multiple outputs.

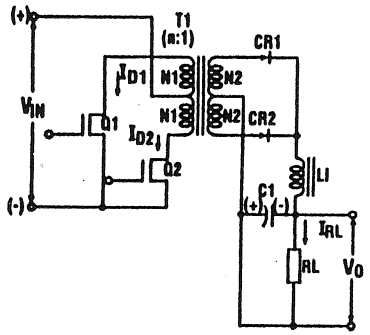
APPLICABLE HARRIS PRODUCTS

HIP2500, HV400

TYPE OF CONVERTER

Push-Pull

CIRCUIT CONFIGURATION



IDEAL TRANSFER FUNCTION

$$\frac{V_O}{V_{IN}} = 2\frac{N_2}{N_1}\left(\frac{t_{on}}{T_S}\right) = 2\frac{N_2}{N_1}(D)$$

* PEAK DRAIN CURRENT

$$I_{DMAX} = \frac{N_2}{N_1}\left(I_{RL} + \frac{\Delta I_{LI}}{2}\right) + \hat{I}_{MAG}$$

($\hat{I}_{MAG}$ = Peak magnetizing current.)

* PEAK DRAIN VOLTAGE

$$V_{DS} = 2\ V_{IN}$$

* AVERAGE DIODE CURRENTS

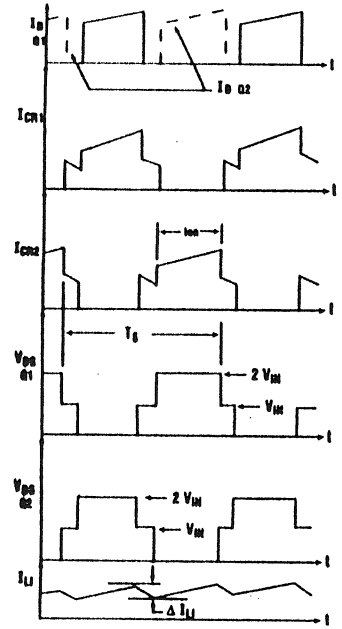
$$I_{CR1} = \frac{I_{RL}}{2}$$

$$I_{CR2} = \frac{I_{RL}}{2}$$

* DIODE VOLTAGES (VRM)

$$V_{RM}\begin{cases} V_{CR1} = 2V_{IN}\left(\frac{N_2}{N_1}\right) \\ V_{CR2} = 2V_{IN}\left(\frac{N_2}{N_1}\right) \end{cases}$$

VOLTAGE AND CURRENT WAVEFORMS



ADVANTAGES

Good transformer utilization. Drain current reduced as a function of N_2/N_1. Good at low values of V_{IN}. Low output ripple.

DISADVANTAGES

Cross conduction of Q1 and Q2 possible, high parts count. Transformer design critical. High voltage required for Q1 and Q2. High input current ripple.

TYPICAL APPLICATIONS

Low input voltage.

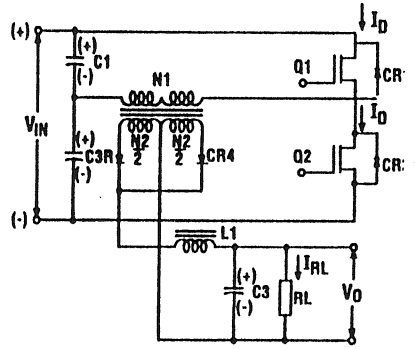
APPLICABLE HARRIS PRODUCTS

HIP5062, HIP5061

TYPE OF CONVERTER

Half Bridge

CIRCUIT CONFIGURATION



IDEAL TRANSFER FUNCTION

$$\frac{V_O}{V_{IN}} = \frac{N_2}{N_1}\left(\frac{t_{on}}{T_S}\right) = \frac{N_2}{N_1}(D)$$

PEAK DRAIN CURRENT *

$$I_{DMAX} = \frac{N_2}{N_1}\left(I_{RL} + \frac{\Delta I_{L1}}{2}\right) + \hat{I}_M$$

($\hat{I}_{MAG}$ = Peak magnetizing current.)

PEAK DRAIN VOLTAGE *

$$V_{DS} = V_{IN}$$

AVERAGE DIODE CURRENTS *

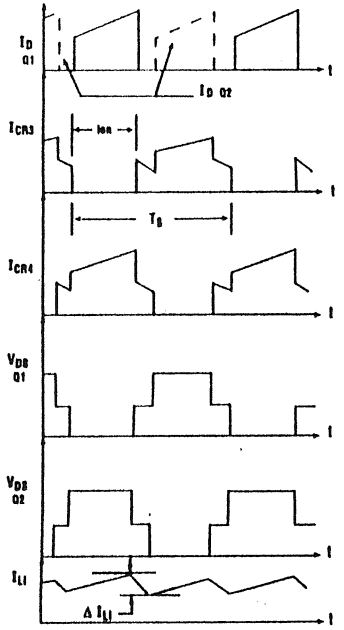
$$I_{CR3} = \frac{I_{RL}}{2}$$

$$I_{CR4} = \frac{I_{RL}}{2}$$

DIODE VOLTAGES (VRM) *

$$V_{RM}\begin{cases} V_{CR3} = V_{IN}\left(\frac{N_2}{N_1}\right) \\ V_{CR4} = V_{IN}\left(\frac{N_2}{N_1}\right) \end{cases}$$

VOLTAGE AND CURRENT WAVEFORMS



ADVANTAGES

Good transformer utilization. Transistors rated at V_{IN}, isolation, multiple outputs. ID reduced as a ratio of N_2/N_1. High power output. Zero voltage switching possible, near D = 1. Low output ripple.

DISADVANTAGES

Poor transient response, high parts count, C1 and C2 have high ripple current. Requires high side switch drive. Cross conduction of Q1 and Q2 possible. High input current ripple.

TYPICAL APPLICATIONS

High input voltage, moderate-to-high power.

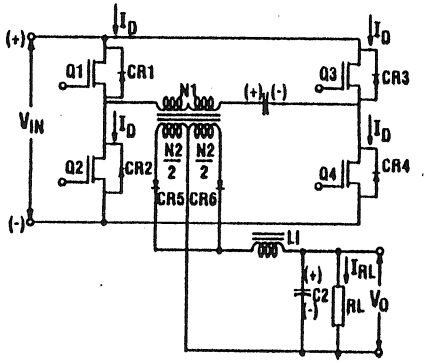
APPLICABLE HARRIS PRODUCTS

HIP2500, HIP5500, HV400

TYPE OF CONVERTER

Full Bridge

CIRCUIT CONFIGURATION



IDEAL TRANSFER FUNCTION

$$\frac{V_O}{V_{IN}} = 2\frac{N_2}{N_1}\left(\frac{t_{on}}{T_S}\right) = 2\frac{N_2}{N_1}(D)$$

PEAK DRAIN CURRENT *

$$I_{DMAX} = \frac{N_2}{N_1}\left(I_{RL} + \frac{\Delta I_{L1}}{2}\right) + \hat{I}_{MAG}$$

($\hat{I}_{MAG}$ = Peak magnetizing current.)

PEAK DRAIN VOLTAGE *

$$V_{DS} = V_{IN}$$

AVERAGE DIODE CURRENTS *

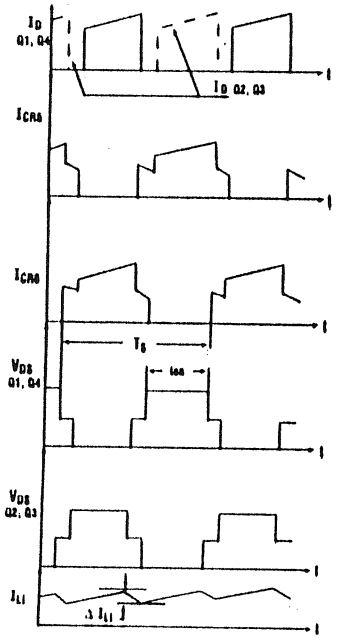
$$I_{CR5} = I_{RL}$$

$$I_{CR6} = I_{RL}$$

DIODE VOLTAGES (VRM) *

$$V_{RM}\begin{cases} V_{CR5} = 2V_{IN}\left(\frac{N_2}{N_1}\right) V_{CR1} = V_{IN} \\ V_{CR6} = 2V_{IN}\left(\frac{N_2}{N_1}\right) V_{CR2} = V_{IN} \end{cases}$$

VOLTAGE AND CURRENT WAVEFORMS



ADVANTAGES

Good transformer utilization, transistors rated at V_{IN}, isolation, multiple outputs. ID is reduced as a ratio of N_2/N_1. Zero voltage switching possible.Low output ripple.

DISADVANTAGES

High parts count. C1 has high ripple current. Requires high side switch drive. Cross conduction of Q1 and Q2 or Q3 and Q4 possible. High input current ripple.

TYPICAL APPLICATIONS

High power, high input voltage.

APPLICABLE HARRIS PRODUCTS

HIP4080/81. HIP2500 HV400