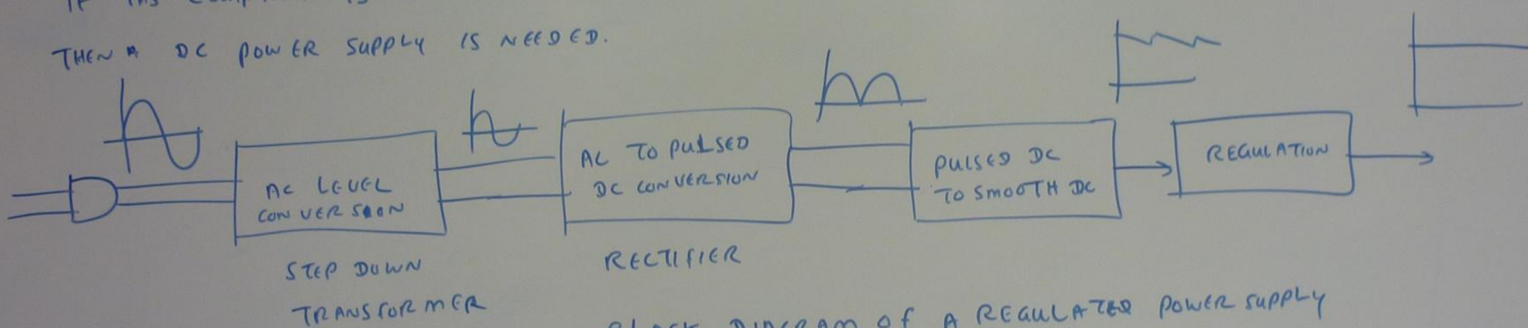
POWER SUPPLIES PART (1)

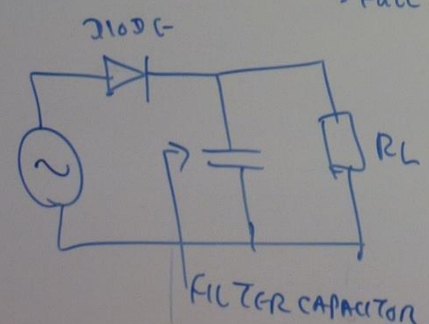
MOST ELECTRONIC EQUIPMENTS REQUIRE SOME FORM OF DC POWER TO OPERATE.
IF THIS EQUIPMENT IS TO BE OPERATED FROM A STANDARD AC OUTLET
THEN A DC POWER SUPPLY IS NEEDED.



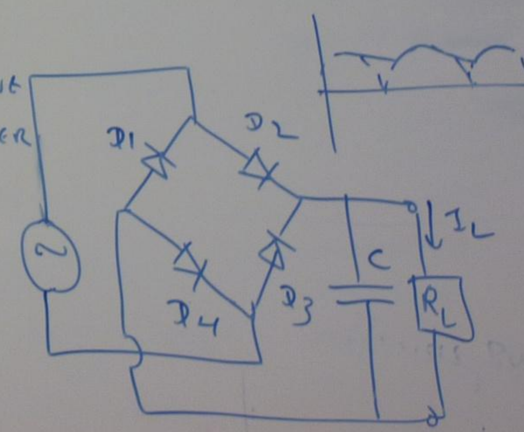
BLOCK DIAGRAM OF A REGULATED POWER SUPPLY

REGULATED POWER SUPPLY → HALF WAVE RECTIFIER
REGULATED POWER SUPPLY → FULL WAVE RECTIFIER

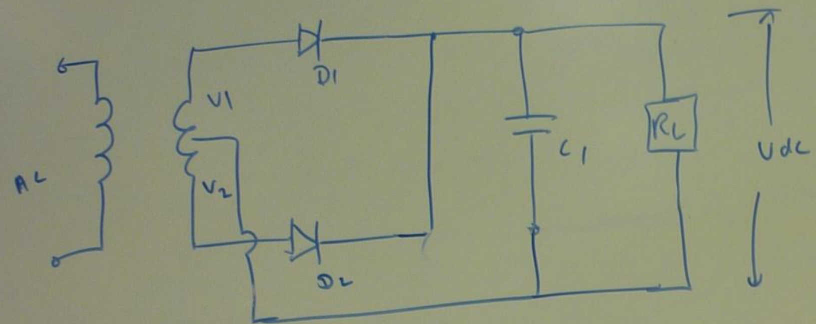
HALF WAVE RECTIFIER



FULLWAVE RECTIFIER



THE CENTRE TAPPED FULL WAVE RECTIFIER



$$V_1 = V_2$$

$$V_{dc} = V_r \; f_r \; R_L \; C$$

V_{dc} = DC OUTPUT VOLTAGE

V_r = PEAK TO PEAK RIPPLE VOLTAGE

f_r = RIPPLE FREQUENCY

C = CAPACITANCE

R_L = LOAD SEEN BY CAPACITOR

Q) CALCULATE THE LOAD RESISTANCE AND CAPACITOR SIZE OF A FULL WAVE RECTIFIER THAT SUPPLIES A 40V DC WITH 2% RIPPLE VOLTAGE (PEAK TO PEAK) AT 250 mA TO A RESISTIVE LOAD. ASSUME THE RECTIFIER IS SUPPLIED WITH 50 HZ AC.

$$R_L = \frac{V_0}{I_L} = \frac{40}{250 \times 10^{-3}} = 160\,\Omega$$

V_r = 2% × DC VOLTAGE

$$= \frac{2}{100} \times 40 = 0.8\,V$$

$$\boxed{\begin{aligned} f_r &= 2 f_{supply} \\ f_r &= 2 \times 50 \\ &= 100\,Hz \end{aligned}}$$

$$V_{DC} = V_r \; f_r \; R_L \; C$$

$$40 = 0.8 \times 100 \times 100 \times C$$

$$C = \frac{40}{0.8 \times 100 \times 100} = 3125 \times 10^{-6}\,F$$

$$= 3125\,\mu F$$

CIRC

1/2 WAVE

BRID

C.T FU WAVE

CIRCUIT	V_{DC}	RIPPLE FREQUENCY
½ WAVE	U_{max}	f_{supply}
BRIDGE	U_{max}	$2f_{supply}$
C.T FULL WAVE	V_{max}	$2f_{supply}$

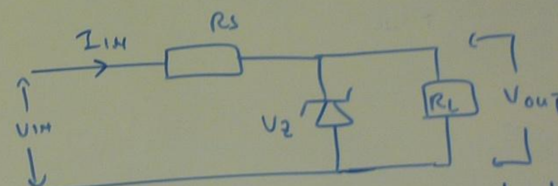
LOAD REGULATION

$$\% \text{ LOAD REGULATION} = \frac{V_{dc(\text{NO LOAD})} - V_{dc(\text{FULL LOAD})}}{V_{dc(\text{FULL LOAD})}} \times 100$$

POWER SUPPLIES – PART (2)

THE PURPOSE OF VOLTAGE REGULATION IS TO MAINTAIN A CONSTANT VOLTAGE ACROSS A LOAD REGARDLESS OF ANY CHANGE IN LOAD CONDITION OR SUPPLY VOLTAGE.

THE BASIC REGULATING DEVICE IS ZENER DIODE.



THE OUTPUT VOLTAGE ACROSS LOAD L IS EQUAL TO ZENER VOLTAGE V_Z.

THE OUTPUT VOLTAGE IS KEPT CONSTANT DESPITE THE CHANGES IN V_{IN} AND I_L BECAUSE THE ZENER CURRENT VARIES TO CHANGE THE VOLTAGE ACROSS THE SERIES RESISTOR R_S TO COMPENSATE.

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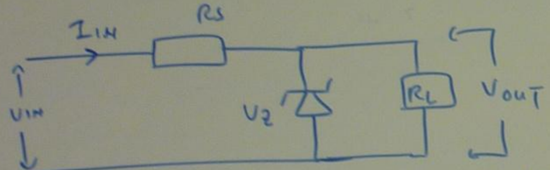

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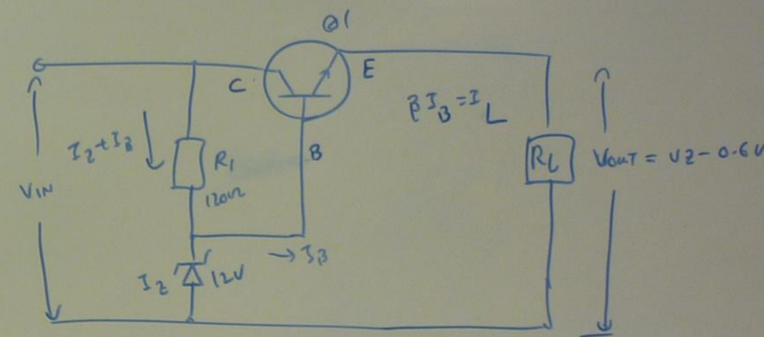
SERIES TRANSISTOR REGULATOR

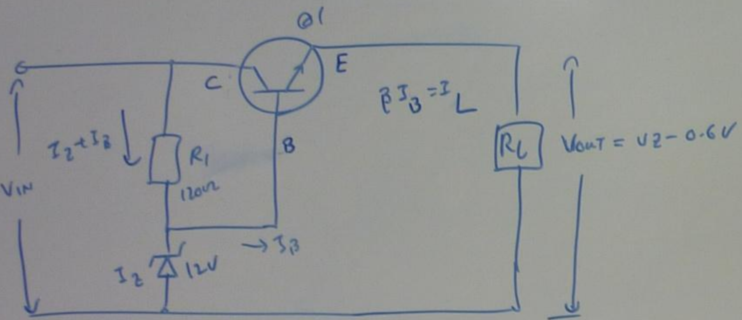


AN INCREASE IN THE LOAD CURRENT WILL CAUSE THE ZENER CURRENT TO REDUCE AS MORE BASE CURRENT IS REQUIRED BY THE TRANSISTOR.

IF THE INPUT VOLTAGE CHANGES, THE ZENER CURRENT WILL ALSO CHANGE, BUT THE ZENER VOLTAGE WILL REMAIN CONSTANT KEEPING THE OUTPUT CONSTANT.

THE INPUT VOLTAGE MUST BE HIGHER THAN REQUIRED OUTPUT VOLTAGE BY AT LEAST 2V.

SERIES TRANSISTOR REGULATOR



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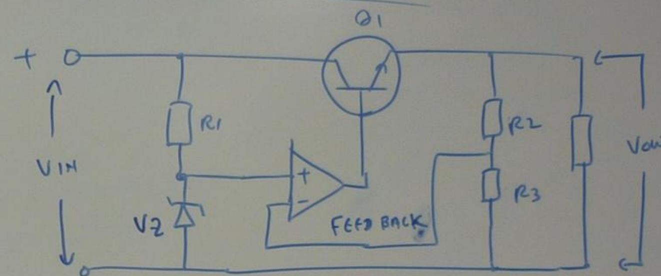
REGULATOR WITH FEEDBACK

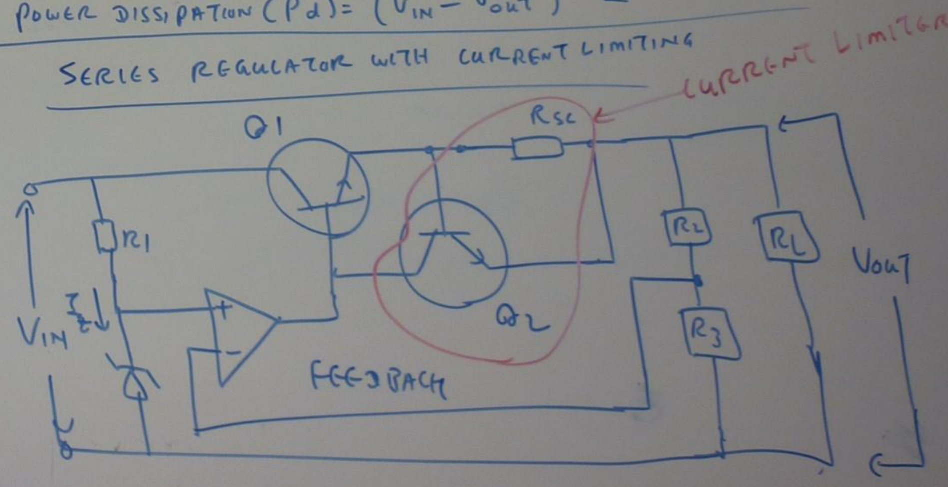


$$V_{OUT} = \left(\frac{R_2}{R_3} + 1 \right) \times V_{REF}$$

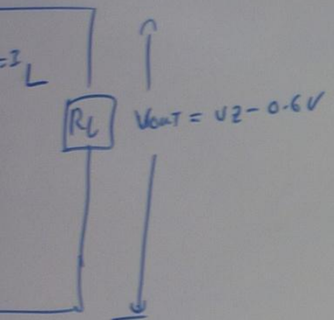
$$V_{REF} = V_Z$$

$$\text{POWER DISSIPATION } (P_d) = (V_{IN} - V_{OUT})\, I_L$$

SERIES REGULATOR WITH CURRENT LIMITING



R



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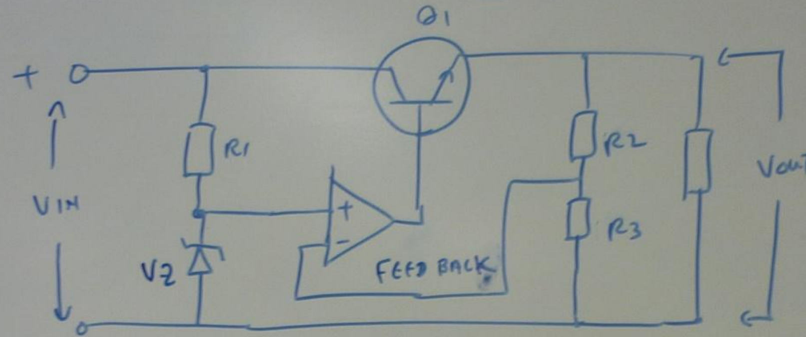
BY THE TRANSISTOR.
LES, THE ZENER
BUT THE ZENER
TANT KEEPING
HIGHER THAN
BY AT LEAST 2V.

REGULATOR WITH FEEDBACK



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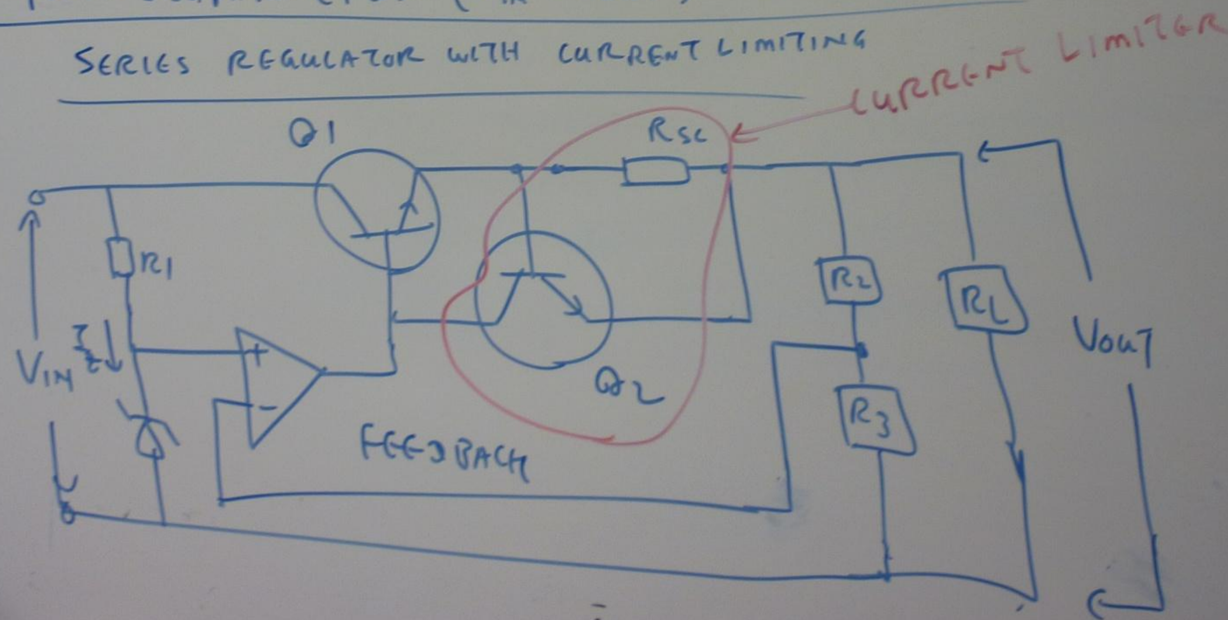


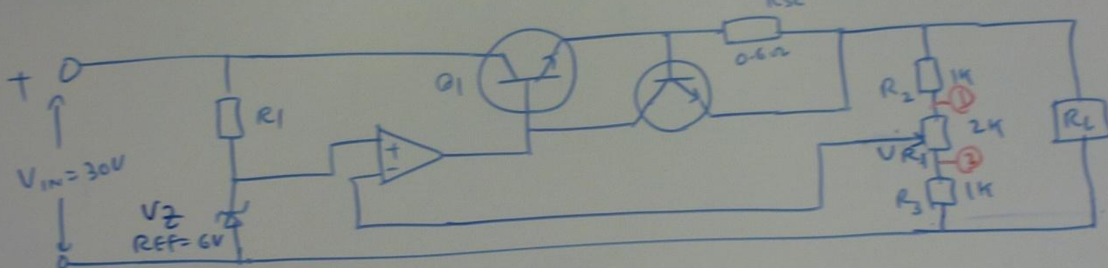
Pb

FOR THE GIVEN CIRCUIT, CALCULATE

(a) THE MAXIMUM AND MINIMUM OUTPUT VOLTAGES

(b) THE CURRENT THAT WILL FLOW IF THE OUTPUT IS SHORT CIRCUITED

(c) THE POWER DISSIPATED BY Q_1 IF THE OUTPUT IS SHORT CIRCUITED



$$V_{OUT} = \left(\frac{R_2}{R_3} + 1\right) \times V_{REF}$$

$$V_{REF} = V_Z = 6V$$

V_{R_1} AT POSITION 1 $\quad R_2 = 1K\Omega,\ R_3 = 3K\Omega$

$$V_{OUT} = \left(\frac{1}{3} + 1\right) \times 6 = 8V$$

V_{R_1} AT POSITION 2 $\quad R_2 = 3K \quad R_3 = 1K$

$$V_{OUT} = \left(\frac{3}{1} + 1\right) \times 6 = 24V$$

$$I_{SC} = \frac{0.6}{R_{SC}}$$

$$= \frac{0.6}{0.6}$$

(MAXIMUM POW

$$P_d = (V_{IN} -$$

$$= (30 - 0$$

$$= 30W$$

THREE TERM

78XX,

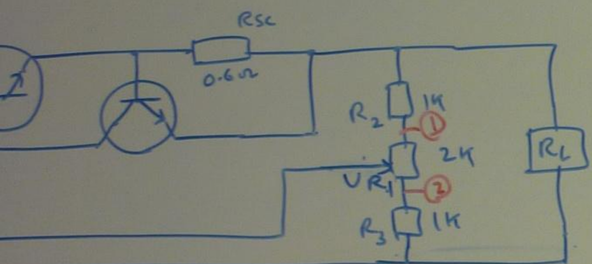
LM317

ULATE

PUT VOLTAGES

IF THE OUTPUT IS SHORT CIRCUITED

IF THE OUTPUT IS SHORT CIRCUITED



$\times V_{REF}$

$V_{REF} = V_Z = 6V$

$R_2 = 1k\Omega,\ R_3 = 3k\Omega$

$+1) \times 6 = 8V$

$R_2 = 3k \quad R_3 = 1k$

$+1) \times 6 = 24V$

$$I_{sc} = \frac{0.6}{R_{sc}}$$

$$= \frac{0.6}{0.6} = 1A$$

(MAXIMU POWER DISSIPATION → OUTPUT SHORT CIRCUIT

$V_{OUT} = 0,\ I_{SC} = I_L$

$$P_d = (V_{IN} - V_{OUT}) \times I_{SC}$$

$$= (30 - 0) \times 1$$

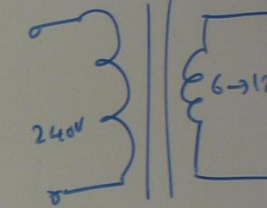
$$= 30W$$

THREE TERMINALS REGULATORS

78XX, 79XX, 78H05

LM317

5 V



1 — INPUT

2 — COMMON

3 — OUTPUT

MAXIMUM R

INPUT VO

OUTPUT

POWER DIS

$$I_{sc} = \frac{0.6}{R_{sc}}$$

$$= \frac{0.6}{0.6} = 1A$$

(MAXIMUM POWER DISSIPATION → OUTPUT SHORT CIRCUIT

$V_{OUT} = 0, \; I_{sc} = I_L$

$$P_d = (V_{IN} - V_{OUT}) \times I_{sc}$$

$$= (30 - 0) \times 1$$

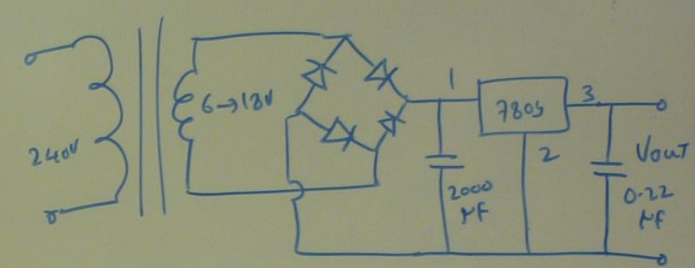
$$= 30W$$

THREE TERMINALS REGULATORS

78XX, 79XX, 78H05

LM317

5V POWER SUPPLY



1 — INPUT

2 — COMMON

3 — OUTPUT

MAXIMUM RATINGS

INPUT VOLTAGE = 35V

OUTPUT CURRENT = 1A

POWER DISSIPATION — INTERNALLY LIMITED.

Pb/ CALCULA…

SIZE OF A FU…

40V DC WIT…

AT 250 mA …

RECTIFIER IS …

$R_L = $ …

$V_r = 2$ …

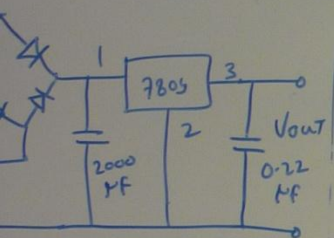
$=$ …

$V_{DC} = $ …

$40 = $ …

$C = $ …

...ER SUPPLY



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...NT = 1A

...ON – INTERNALLY LIMITED.

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CIRCUIT	V_{DC}	RIPPLE FREQUENCY
1/2 WAVE	V_{max}	f_{supply}
BRIDGE	V_{max}	$2 f_{supply}$
C.T FULL WAVE	V_{max}	$2 f_{supply}$

LOAD REGULATION

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