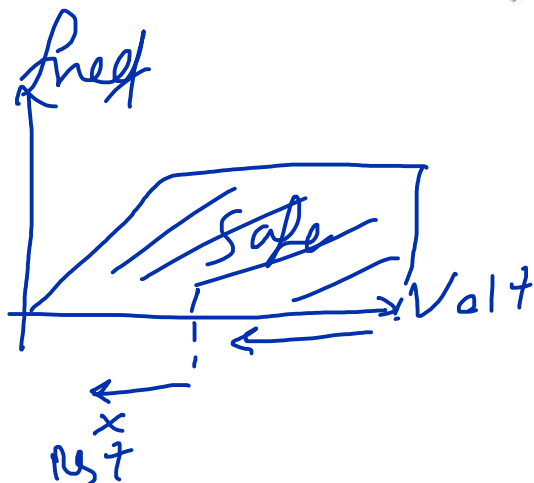
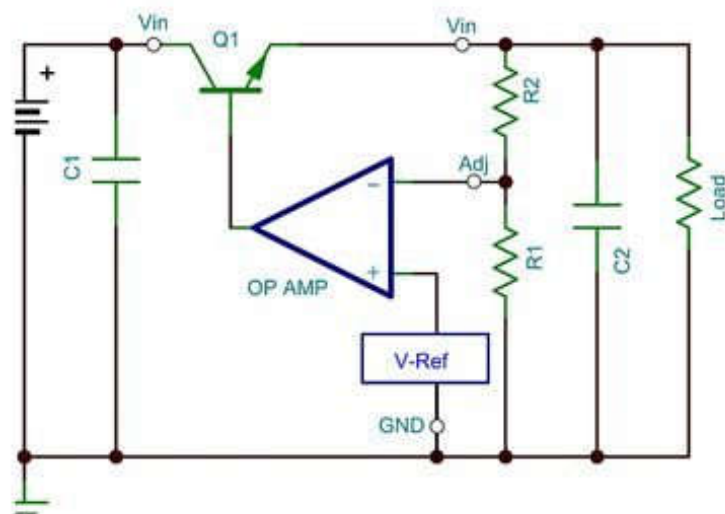
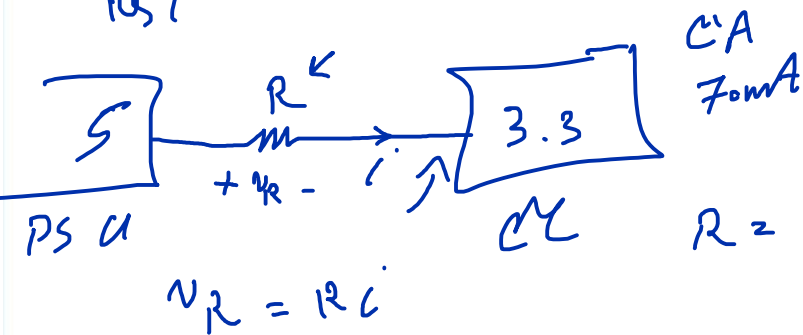


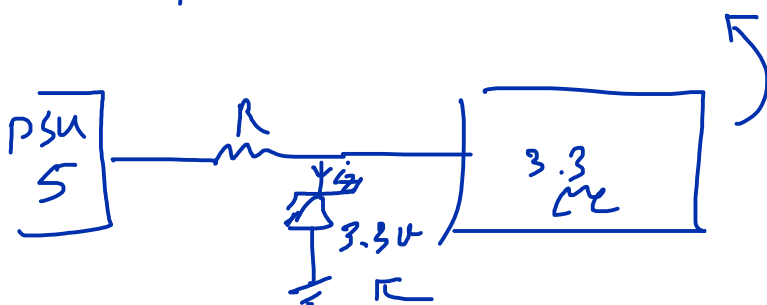
Linear Voltage Regulators



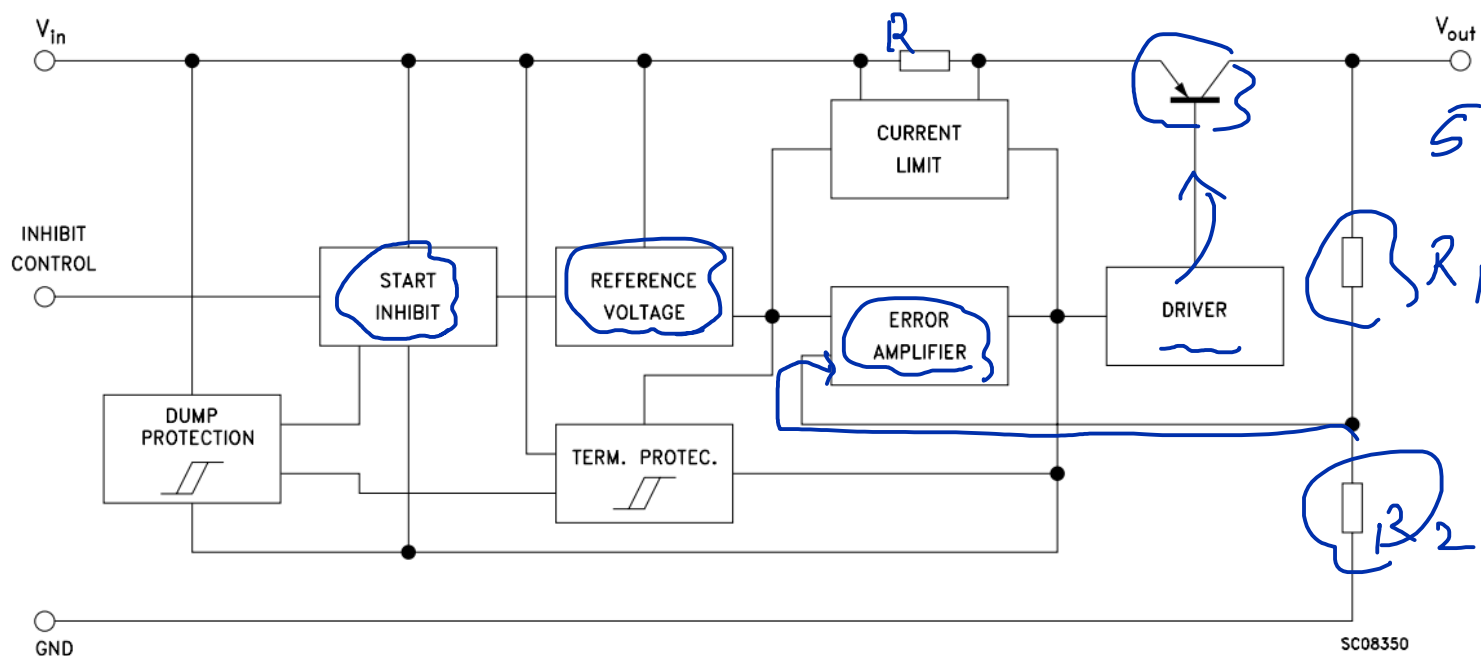
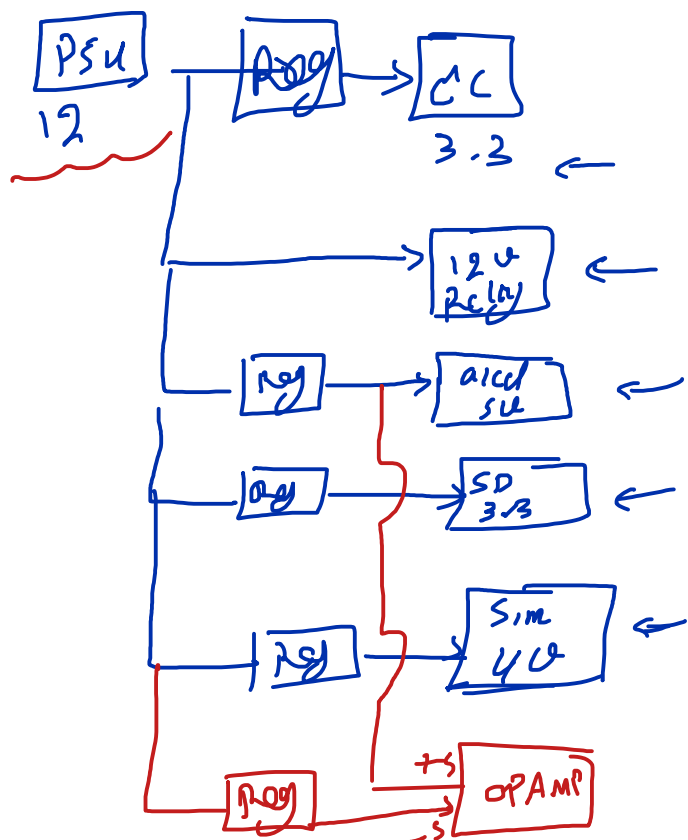
خارجی ← اضافی وولٹیج
Flash ← اضافی وولٹیج
EEPROM
fusebit



$$R = \frac{5 - 3.3}{I_{out}} = \text{---}$$



$$5 - 0.7 \times 2 = 3.6$$

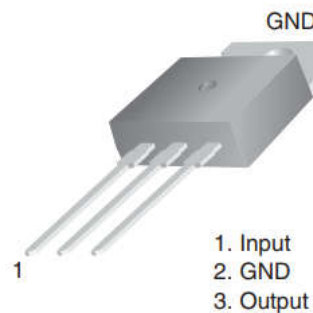


78xx

79xx



TO-220 (Single Gauge)

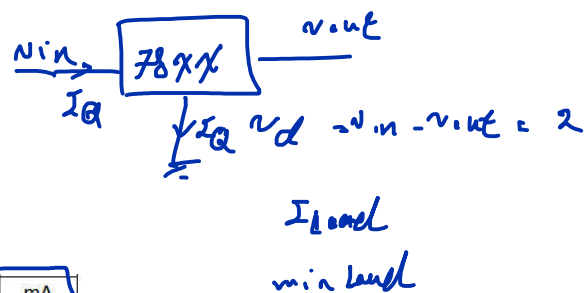


$$I_o \text{ max} = 1A$$

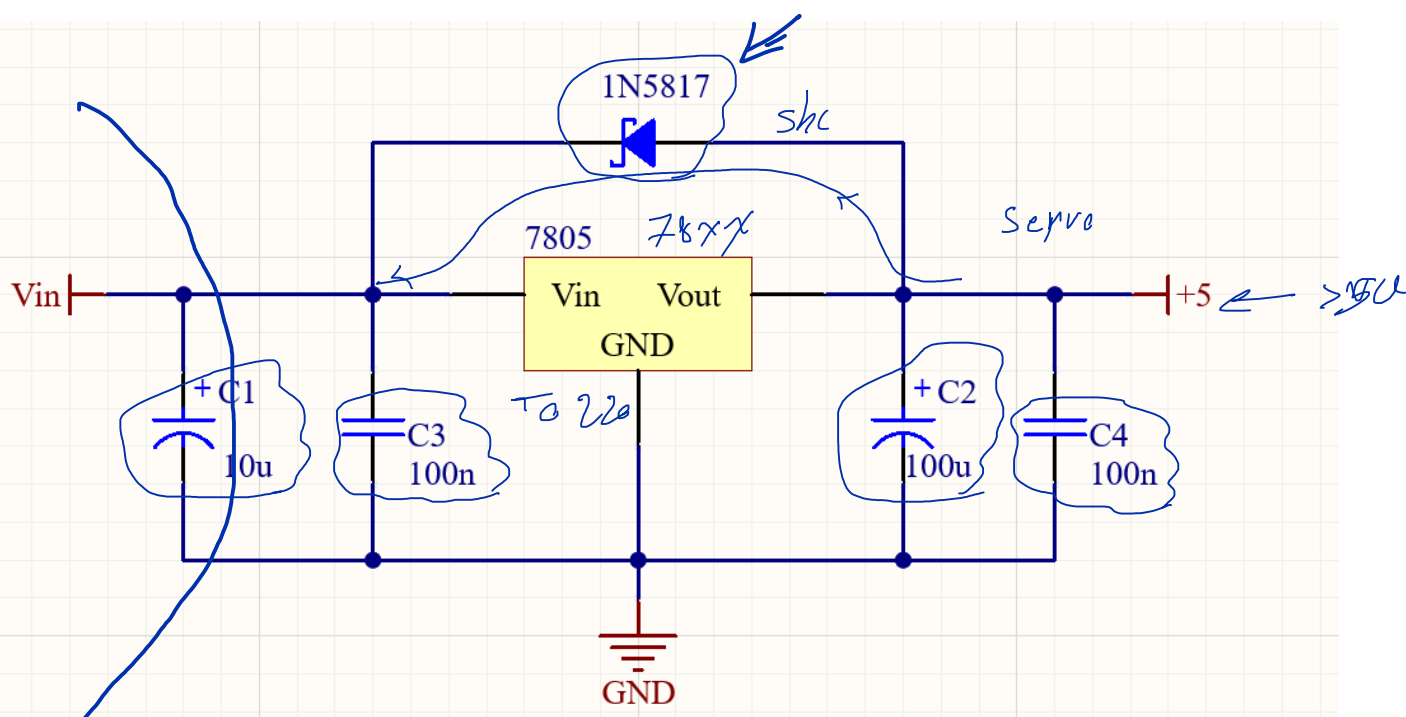
Product Number	Output Voltage Tolerance	Package	Operating Temperature
LM7805CT	±4%	TO-220 (Single Gauge)	-40°C to +125°C
LM7806CT			
LM7808CT			
LM7809CT			
LM7810CT			
LM7812CT			
LM7815CT			
LM7818CT	±2%	TO-220 (Single Gauge)	0°C to +125°C
LM7824CT			
LM7805ACT			
LM7809ACT			
LM7810ACT			
LM7812ACT			
LM7815ACT			

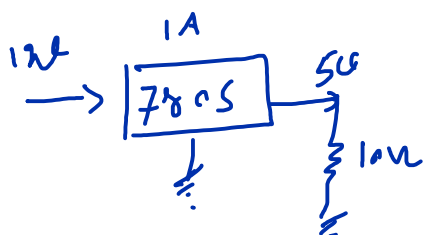
78xx

Symbol	Parameter	Value	Unit
V_i	Input Voltage	$V_O = 5V \text{ to } 18V$ $V_O = 24V$	V
$R_{\theta JC}$	Thermal Resistance, Junction-Case (TO-220)	5	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-Air (TO-220)	65	°C/W
T_{opr}	Operating Temperature Range	LM78xx: -40 to +125 LM78xxA: 0 to +125	°C
T_{stg}	Storage Temperature Range	-65 to +150	°C



I_Q	Quiescent Current	$T_J = +25^\circ\text{C}$	5.0	8.0	mA
V_{DROP}	Dropout Voltage	$T_J = +25^\circ\text{C}, I_O = 1A$	2.0		V





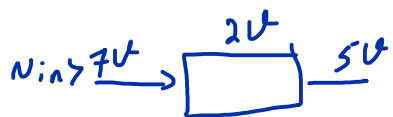
$$\Delta\theta = 12 - 5 = 7V$$

$$P_{loss} = 7 \times 0.5 = 3.5W$$

$$\mu_b = 10^{-6} \times$$

$$\min V_{in} \times$$

$$I_{out} \leftarrow \times$$



$\Delta\theta <$

$$I_{Load} = \frac{S}{T_{on}} = 0.5A$$

$$\Delta\theta = 3.5 \times \frac{6s}{1} \Rightarrow \Delta\theta = 217.5^\circ$$

$$\theta_R = \theta_a + \Delta\theta = 25 + 217.5 = 242.5^\circ$$

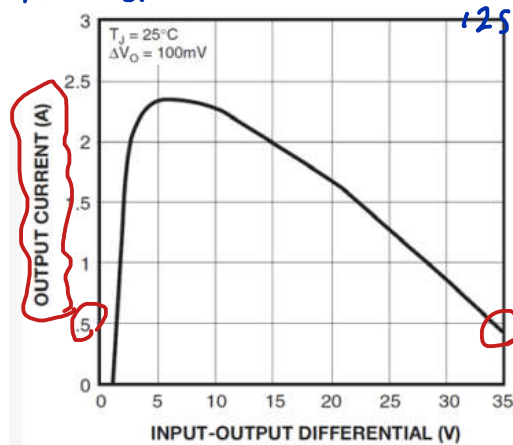


Figure 3. Peak Output Current

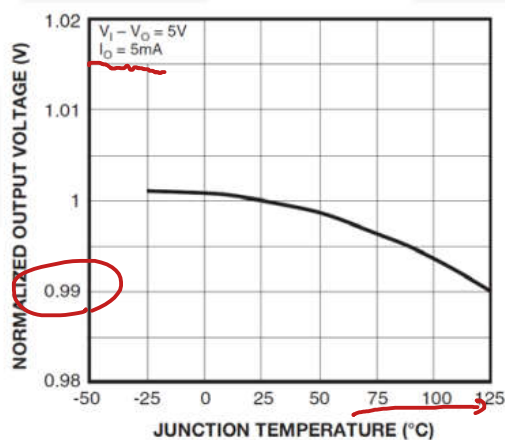


Figure 4. Output Voltage

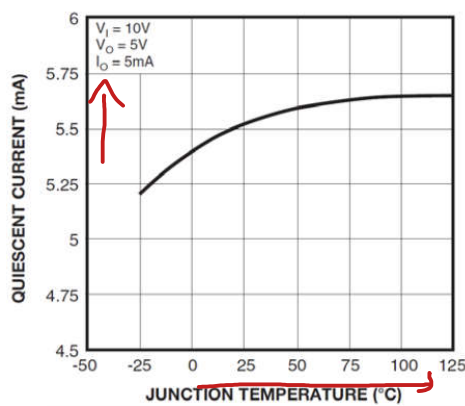


Figure 2. Quiescent Current

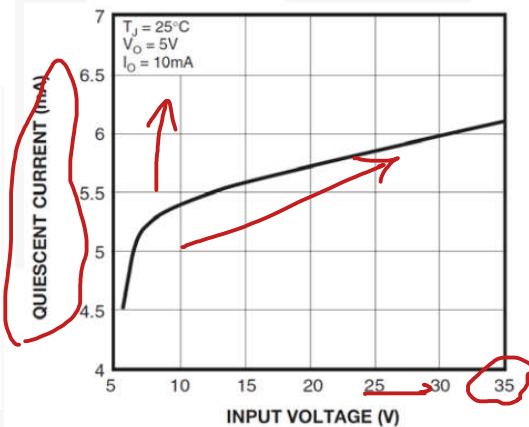
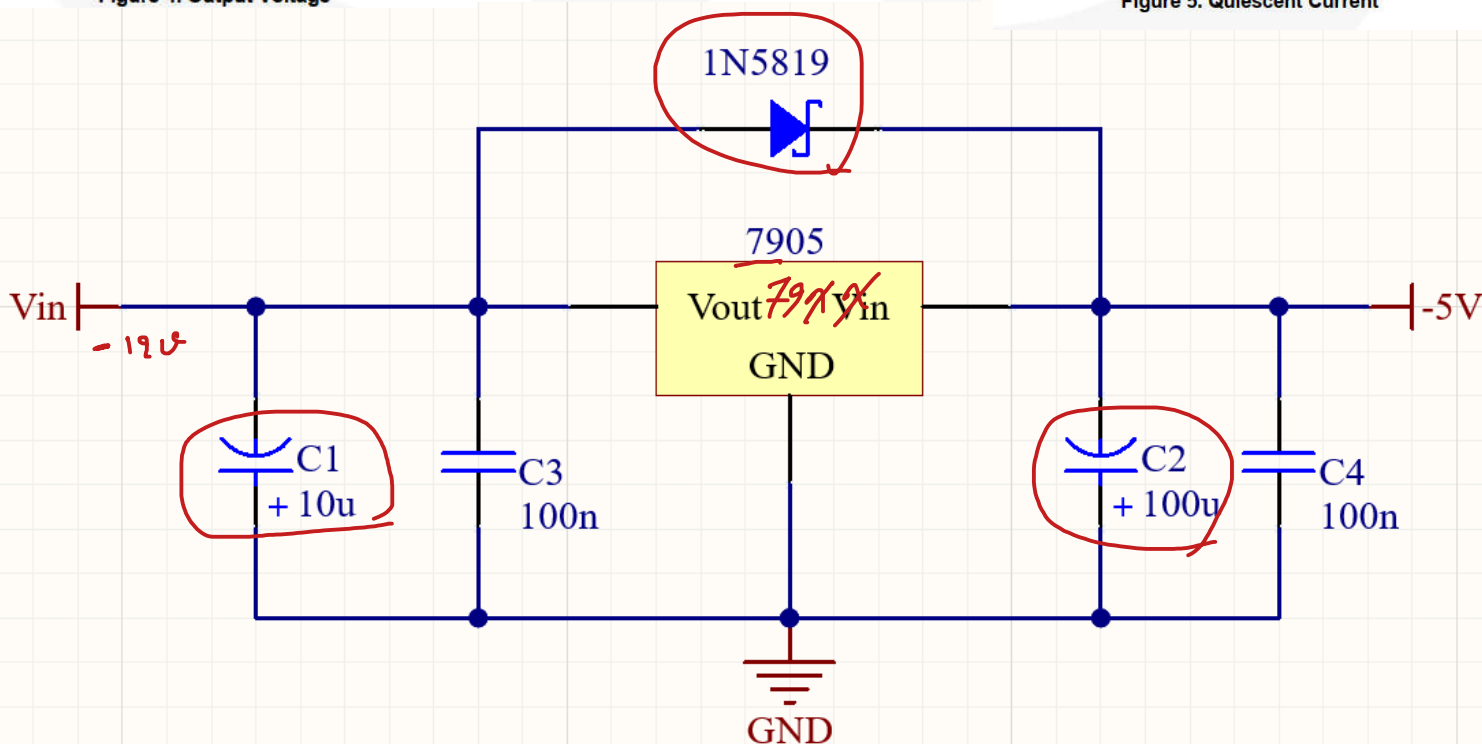
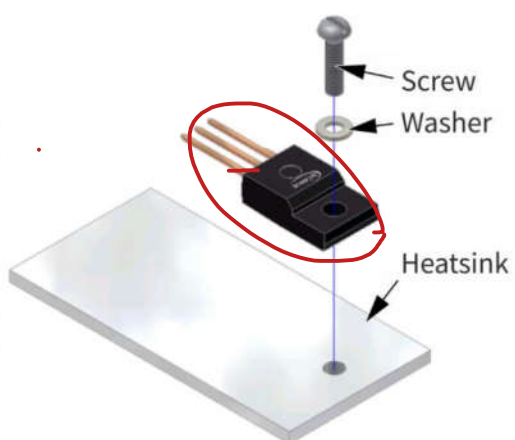
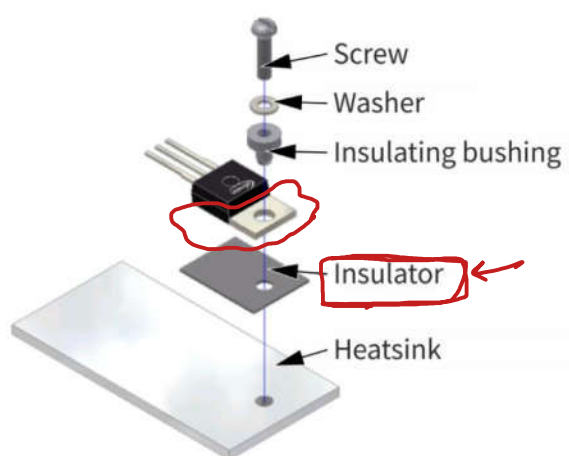
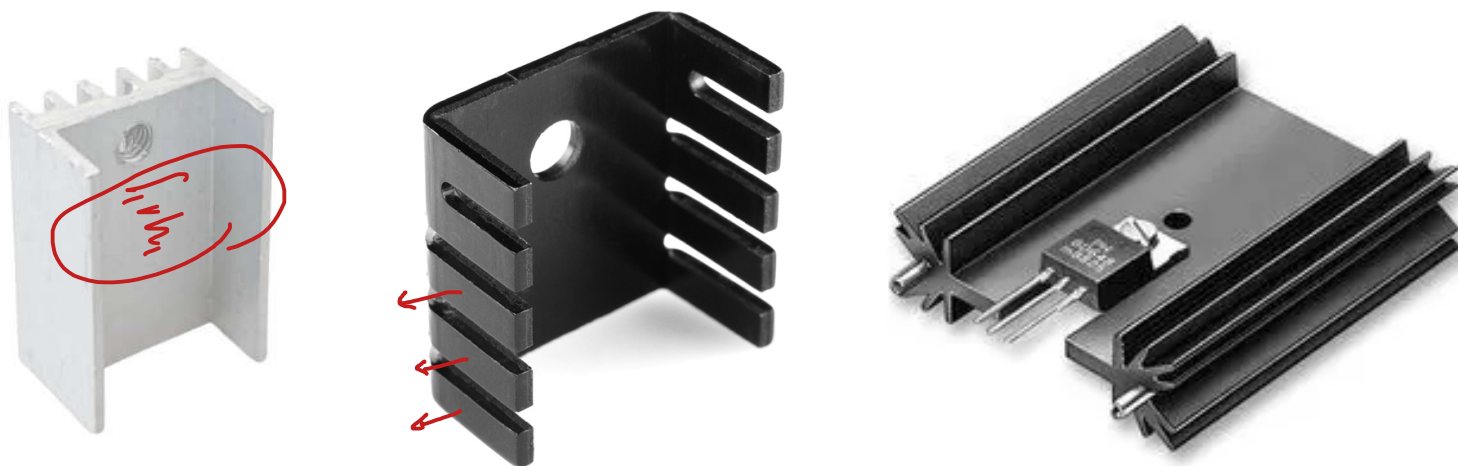
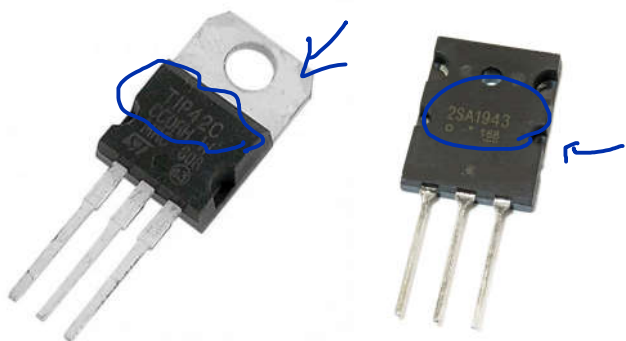


Figure 5. Quiescent Current







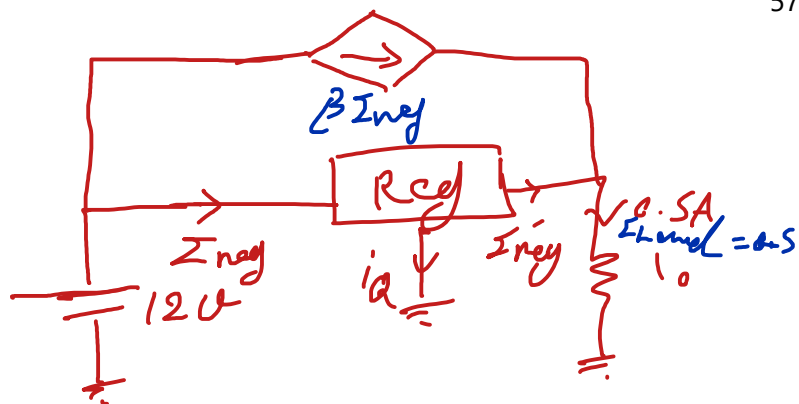
PNP



$$i_e = (1 + \beta) i_b$$

$$i_c = \beta i_b$$

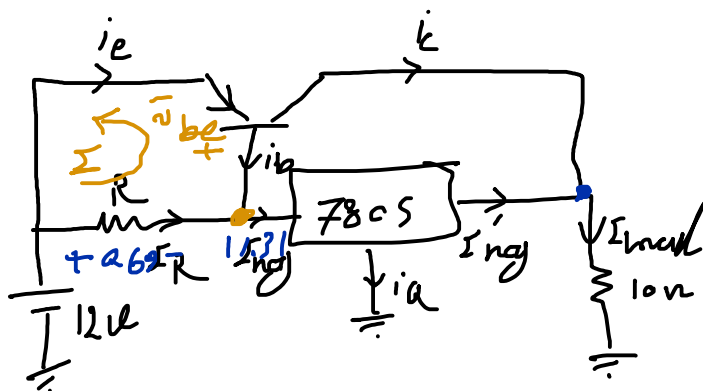
$$i_e = i_c$$



$$I_{neg} = I_{ic} + I'_{neg}$$

$$5 \text{ mA} \Rightarrow I_{neg} \approx I'_{neg}$$

$$I_L = I'_{neg} + \beta I_{neg}$$



$$\begin{cases} R I_R + v_{be} = 0 \\ I_R + i_b = I_{neg} \end{cases} \Rightarrow \boxed{I_R = I_{neg} - i_b}$$

$$\Rightarrow R(I_{neg} - i_b) + v_{be} = 0$$

$$\Rightarrow R = \frac{-v_{be}}{I_{neg} - i_b} \Rightarrow \boxed{R = \frac{v_{be}}{i_b - I_{neg}}}$$

$$I_{load} = I'_{neg} + i_c$$

$$i_c = \beta i_b$$

$$I_R = I_{neg} - i_b$$

$$I_L = i_c + I'_{neg} \Rightarrow \boxed{i_c = I_L - I'_{neg}}$$

$$i_c = \beta i_b \Rightarrow \boxed{i_b = \frac{i_c}{\beta}}$$

$$R = \frac{v_{be}}{\frac{i_c}{\beta} - I_{neg}} = \frac{v_{be}}{\frac{I_L - I'_{neg}}{\beta} - I_{neg}} \Rightarrow R = \frac{v_{be}}{\frac{I_L - I'_{neg}}{\beta} - \frac{\beta}{\beta} I_{neg}}$$

$$\Rightarrow R = \frac{\beta V_{be}}{I_L - I_{neg} - \beta I_{neg}}$$

$$\Rightarrow R = \frac{\beta V_{be}}{I_L - (1 + \beta) I_{neg}}$$

$$R = \frac{30(-0.7)}{0.5 - (1 + 30)(0.05)} \xrightarrow{\text{solve}} R = 20\Omega \downarrow$$

$$T_{IP42C} \begin{cases} \beta = 30 \\ V_{be} = -0.7 \\ I_{neg} = 0.05 = 5 \text{ mA} \end{cases}$$

$$\underline{\text{SFD}} \Rightarrow R = 18\Omega$$

$$i_b = \frac{i_c}{\beta} = \frac{0.5}{30} \xrightarrow{\text{calc}} i_b = 16.667 \text{ mA}$$

$$I_R = I_{neg} - i_b = 5 \text{ mA} - 16.667 \text{ mA} \Rightarrow I_R = 38.33 \text{ mA}$$

$$I_{neg} = I_{neg} + i_Q = 5 \text{ mA} + 5 \text{ mA} = 10 \text{ mA}$$

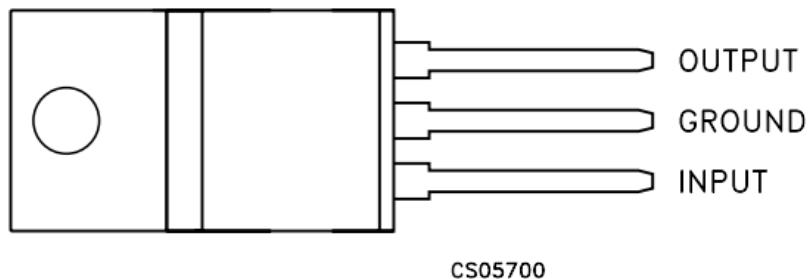
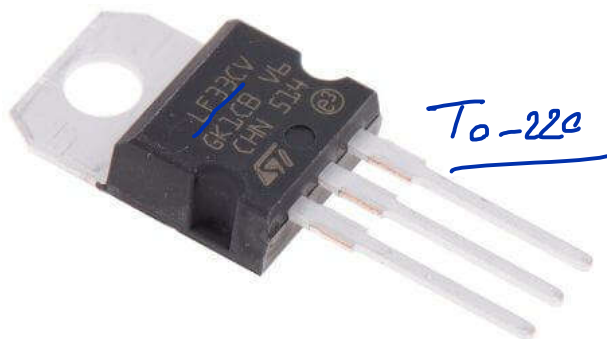
$$P_R = R i_R^2 = 18 \times (38.33 \times 10^{-3})^2 \Rightarrow P_R = 26.45 \text{ mW}$$

$$R = 18\Omega, \quad 25 \text{ mW}$$

$$V_R = R \cdot i_R = 18 \times 38.33 \times 10^{-3} \Rightarrow V_R = 0.69 \text{ V} \quad \frac{1}{4} \text{ W}$$

$$P_{neg} = (11.31 - 5) \times 0.055 \Rightarrow P_{neg}^{\text{new}} = 0.347 \text{ W} \times \frac{65^\circ}{1 \text{ W}} \Rightarrow T_R = 22.5$$

$$T_{neg} = T_R + T_a = 22.5 + 25 \Rightarrow T_{neg} = 47.55^\circ \text{C}$$



- OUTPUT VOLTAGES OF 1.25; 1.5; 1.8; 2.5; 2.7; 3; 3.3; 3.5; 4; 4.5; 4.7; 5; 5.2; 5.5; 6; 8; 8.5; 9; 12V

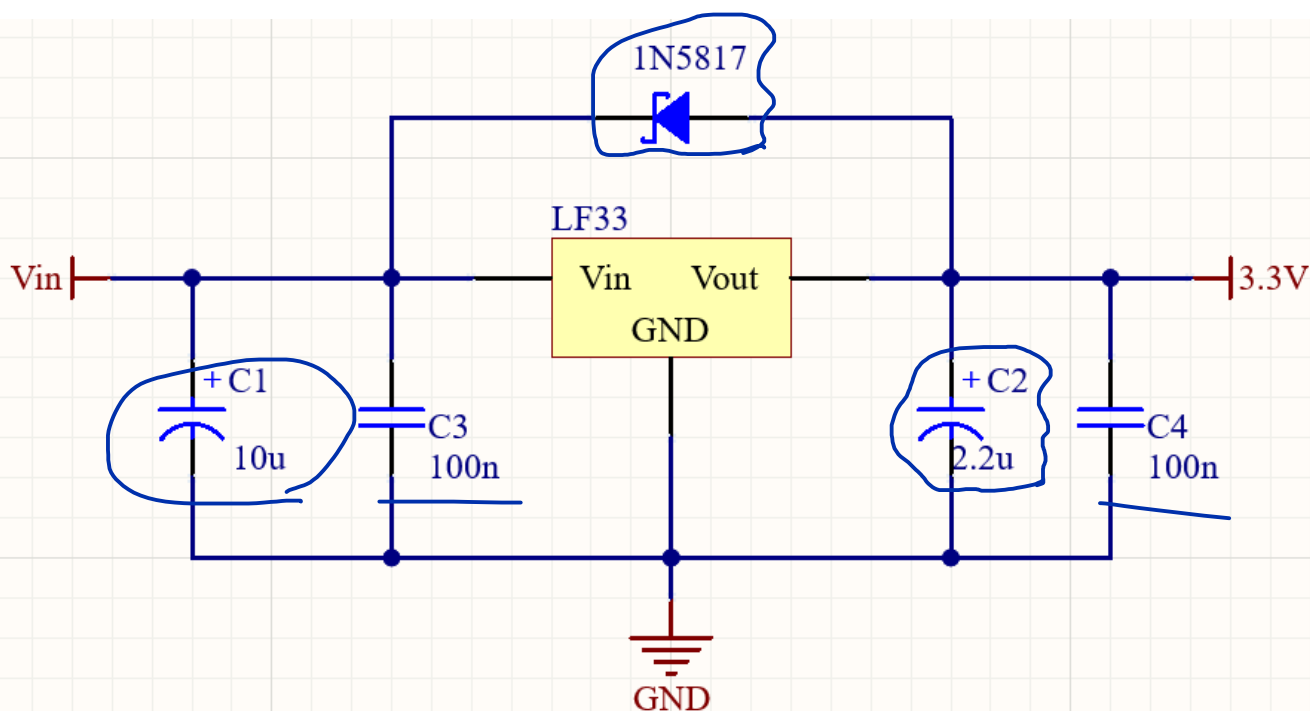
78xx

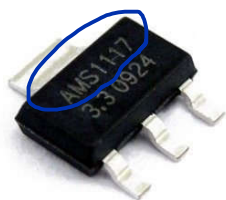
7805, LF50

V_I	DC Input Voltage	-0.5 to 40 (*)				V
V_O	Output Voltage	$I_O = 50 \text{ mA}, V_I = 5.3 \text{ V}$	3.267	3.3	3.333	V
		$I_O = 50 \text{ mA}, V_I = 5.3 \text{ V}, T_a = -25 \text{ to } 85^\circ\text{C}$	3.234		3.366	
I_d	Quiescent Current	$V_I = 4.3 \text{ to } 16 \text{ V}, I_O = 0 \text{ mA}$	ON MODE	0.5	1	mA
		$V_I = 4.6 \text{ to } 16 \text{ V}, I_O = 500 \text{ mA}$			12	
		$V_I = 6 \text{ V}$	OFF MODE	50	100	μA
V_d	Dropout Voltage	$I_O = 200 \text{ mA}$		0.2	0.35	V
		$I_O = 500 \text{ mA}$		0.4	0.7	

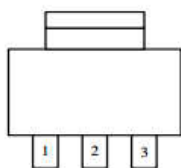
5mA - 8mA

2V





SOT-223 Top View



- 1- Ground/Adjust
2- V_{OUT}
3- V_{IN}

- Three-terminal adjustable or fixed low dropout
1.2V, 1.5V, 1.8V, 2.5V, 2.85V, 3.3V, 5V. Regulators

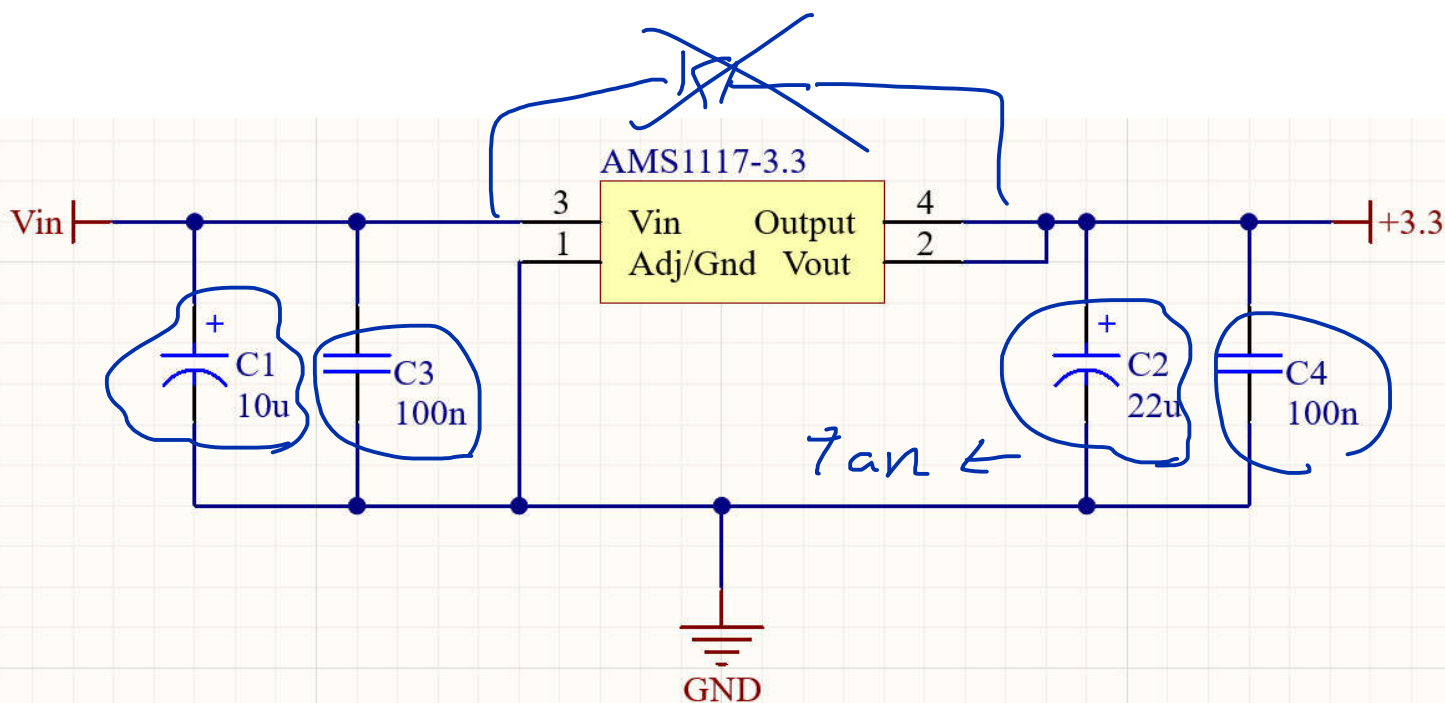
48 → 5
sw

Input Supply Voltage	V_{IN}	18	V
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<u>AMS1117-3.3,</u> $I_{OUT}=10mA$, $V_{IN}=5V$, $T_J=25^{\circ}C$, $0 \leq I_{OUT} \leq 1A$, $4.75V \leq V_{IN} \leq 10V$	3.250	3.300	3.349	V
	3.235	3.300	3.365	

<u>Dropout Voltage</u>	V_{drop}	$I_{OUT}=100mA$	--	1.00	1.20	V
		$I_{OUT}=500mA$		1.05	1.25	
		$I_{OUT}=1A$		1.20	1.30	

Quiescent Current	I_q	$4.25V \leq V_{IN} \leq 6.5V$	--	5	10	mA
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LD0

XC6209F33



XC6209

SOT-25
2Q ↓

Maximum Output Current

150mA

(300mA=XC6209 E to H types)

Dropout Voltage

60mV @ 30mA

200mV @ 100mA

Maximum Operating Voltage

2.0V ~ 10V

Output Voltage Range

0.9V ~ 6.0V(0.05V increments)

Highly Accurate

±2% (VOUT>1.5V)

±30mV (VOUT≤1.5V)

Low Power Consumption

25 μA (TYP.)

XC6209①②③④⑤⑥⑦

DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
①	Type of Regulator CE Pin Logic	A	150mA, Active High, Pull-down resistor built-in ^{(*)2} (Semi-custom)
		B	150mA, Active High, No pull-down resistor (Standard)
		C	150mA, Active Low, Pull-up resistor built-in ^{(*)2} (Semi-custom)
		D	150mA, Active Low, No pull-up resistor (Semi-custom)
		E	300mA ^{(*)1} , Active High, Pull-down resistor built-in ^{(*)2} (Semi-custom)
		F	300mA ^{(*)1} , Active High, No pull-down resistor (Standard)
		G	300mA ^{(*)1} , Active Low, Pull-up resistor built-in ^{(*)2} (Semi-custom)
		H	300mA ^{(*)1} , Active Low, No pull-up resistor (Semi-custom)
②③	Output Voltage	09~60	Output Voltage Range: 0.9V~6.0V e.g.: 3.0V⇒②=3, ③=0
		30~60	For 1% product, output voltage range is 3.0V~6.0V.
④	Output Voltage Accuracy	2	0.1V increments, Accuracy: ±2% ^{(*)3} e.g.: 2.80V⇒②=2, ③=8, ④=2
		1	0.1V increments, Accuracy: ±1% e.g.: 3.00V⇒②=3, ③=0, ④=1
		A	0.05V increments, Accuracy: ±2% ^{(*)3} e.g.: 2.85V⇒②=2, ③=8, ④=A
		B	0.05V increments, Accuracy: ±1% e.g.: 3.05V⇒②=3, ③=0, ④=B
⑤⑥⑦ ^{(*)4}	Packages (Order Unit)	MR	SOT-25 (3,000/Reel)
		MR-G	SOT-25 (3,000/Reel)
		PR	SOT-89-5 (1,000/Reel)
		PR-G	SOT-89-5 (1,000/Reel)
		DR	USP-6B (3,000/Reel)
		DR-G	USP-6B (3,000/Reel)

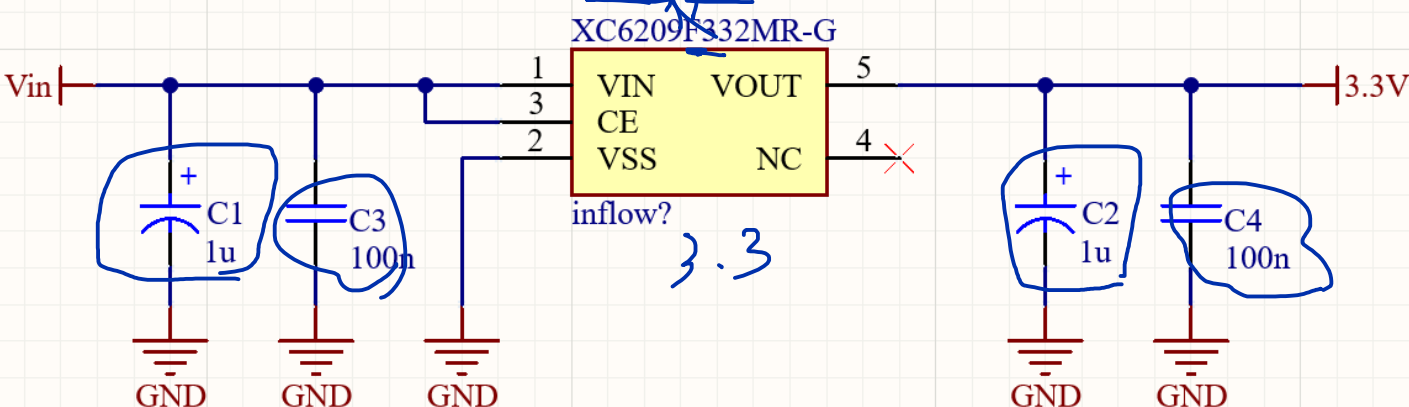
$$\frac{100\mu A}{5\mu A} = 20 \times 2 = 40$$

$$\frac{100\mu A}{25\mu A} = 1600\mu A$$

$$4.40 - 3.3 = 1.1$$

$$3.70 - 3.3 = 0.4$$

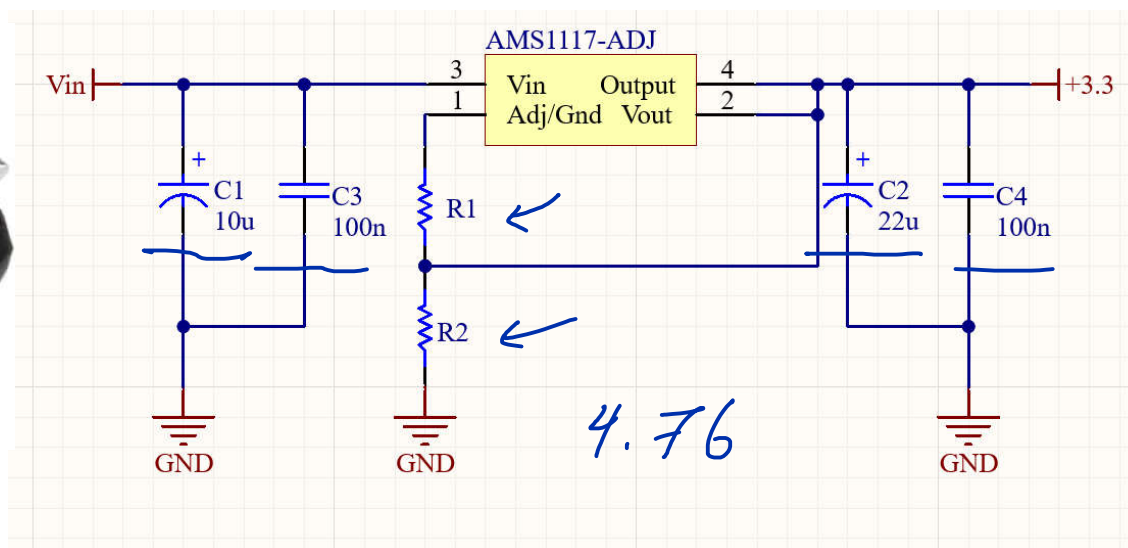
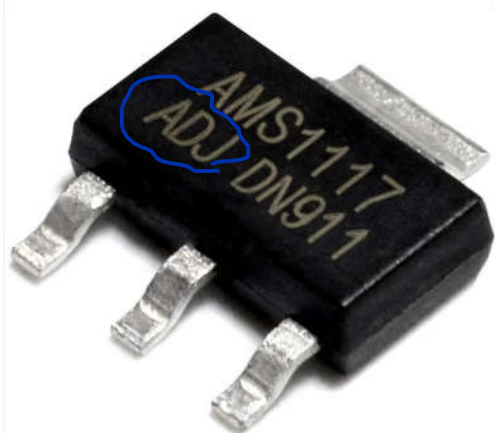
LD0



Fix

7805

LF33
3.3



$$V_o = V_{ref} \left(1 + \frac{R_2}{R_1}\right) + I_{adj} R_2$$

$$3.3 = 1.25 \left(1 + \frac{R_2}{R_1}\right)$$

$$3.3 = 1.25 \left(1 + \frac{R_2}{100}\right)$$

Solve \Rightarrow

$$R_2 = 164$$

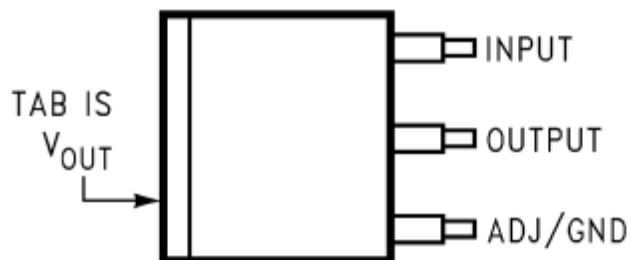
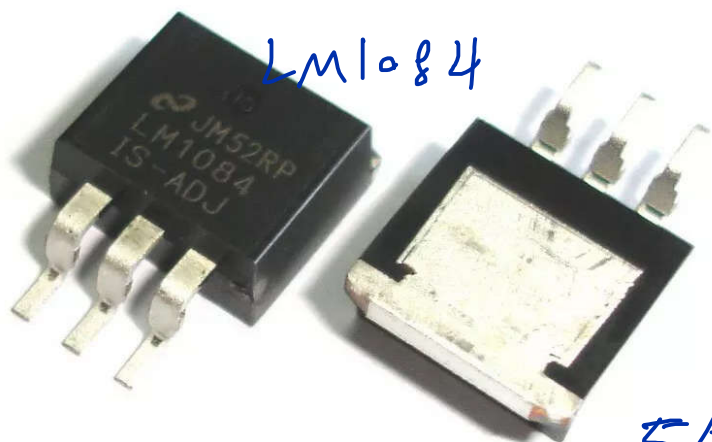
$$V_{ref} = 1.25V$$

$$I_{adj} = 50\mu A$$

$$R_1 \approx 100\Omega$$

2A

LM1084



- Available in 3.3-V, 5.0-V, and Adjustable Versions

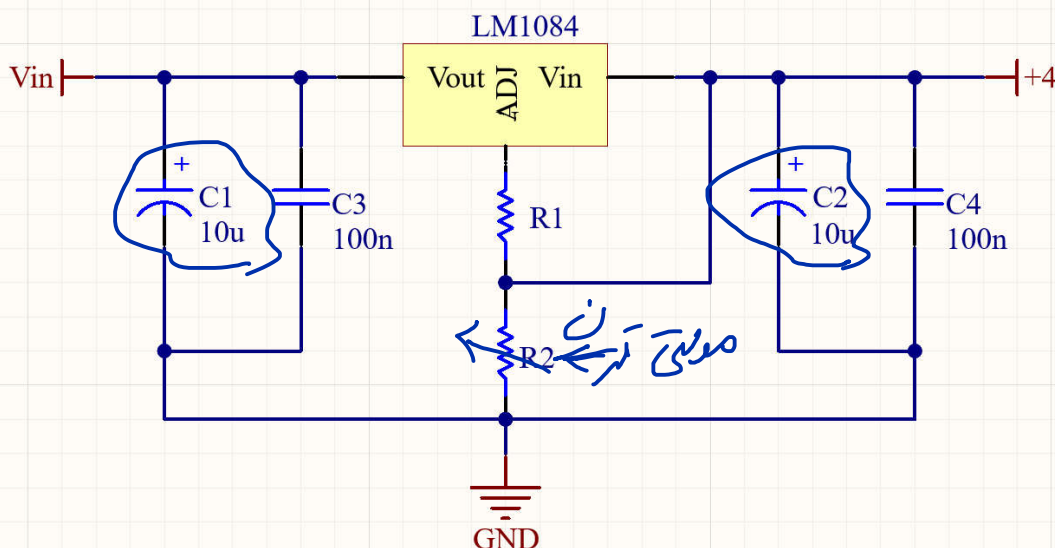
5A

Maximum Input to Output Voltage Differential			
LM1084-ADJ	29	V	
LM1084-3.3	27	V	
LM1084-5.0	25	V	

Dropout Voltage ⁽⁵⁾	LM1084-ADJ, 3.3, 5, 12, ΔV_{REF} , $\Delta V_{OUT} = 1\%$, $I_{OUT} = 5A$, $-40^\circ C \leq T_J \leq 125^\circ C$	1.3	1.5	V
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V _{OUT}	Output Voltage ⁽³⁾	LM1084-3.3, $I_{OUT} = 0\text{ mA}$, $V_{IN} = 8\text{ V}$, $0 \leq I_{OUT} \leq I_{FULL}$ LOAD, $4.8\text{ V} \leq V_{IN} \leq 15\text{ V}$			V
		3.270	3.300	3.330	
		3.235	3.300	3.365	
		LM1084-3.3, $I_{OUT} = 0\text{ mA}$, $V_{IN} = 8\text{ V}$, $0 \leq I_{OUT} \leq I_{FULL}$ LOAD, $4.8\text{ V} \leq V_{IN} \leq 15\text{ V}$, $-40^\circ C \leq T_J \leq 125^\circ C$			
		LM1084-5.0, $I_{OUT} = 0\text{ mA}$, $V_{IN} = 8\text{ V}$, $0 \leq I_{OUT} \leq I_{FULL}$ LOAD, $6.5\text{ V} \leq V_{IN} \leq 20\text{ V}$			V
		4.950	5.000	5.050	
		LM1084-5.0, $I_{OUT} = 0\text{ mA}$, $V_{IN} = 8\text{ V}$, $0 \leq I_{OUT} \leq I_{FULL}$ LOAD, $6.5\text{ V} \leq V_{IN} \leq 20\text{ V}$, $-40^\circ C \leq T_J \leq 125^\circ C$			
		4.900	5.000	5.100	

Quiescent Current	LM1084-3.3, $V_{IN} = 18\text{ V}$	5.0	10.0	mA
	LM1084-5.0, $V_{IN} \leq 20\text{ V}$	5.0	10.0	mA



$$V_o = V_{ref} \left(1 + \frac{R_2}{R_1}\right)$$

$$\mu_{ref} = 1.25$$

$$V = 1.25 \left(1 + \frac{R_2}{R_1}\right)$$

$$R_1 = 10\text{ k}\Omega$$

$$R_2 = 22\text{ k}\Omega$$