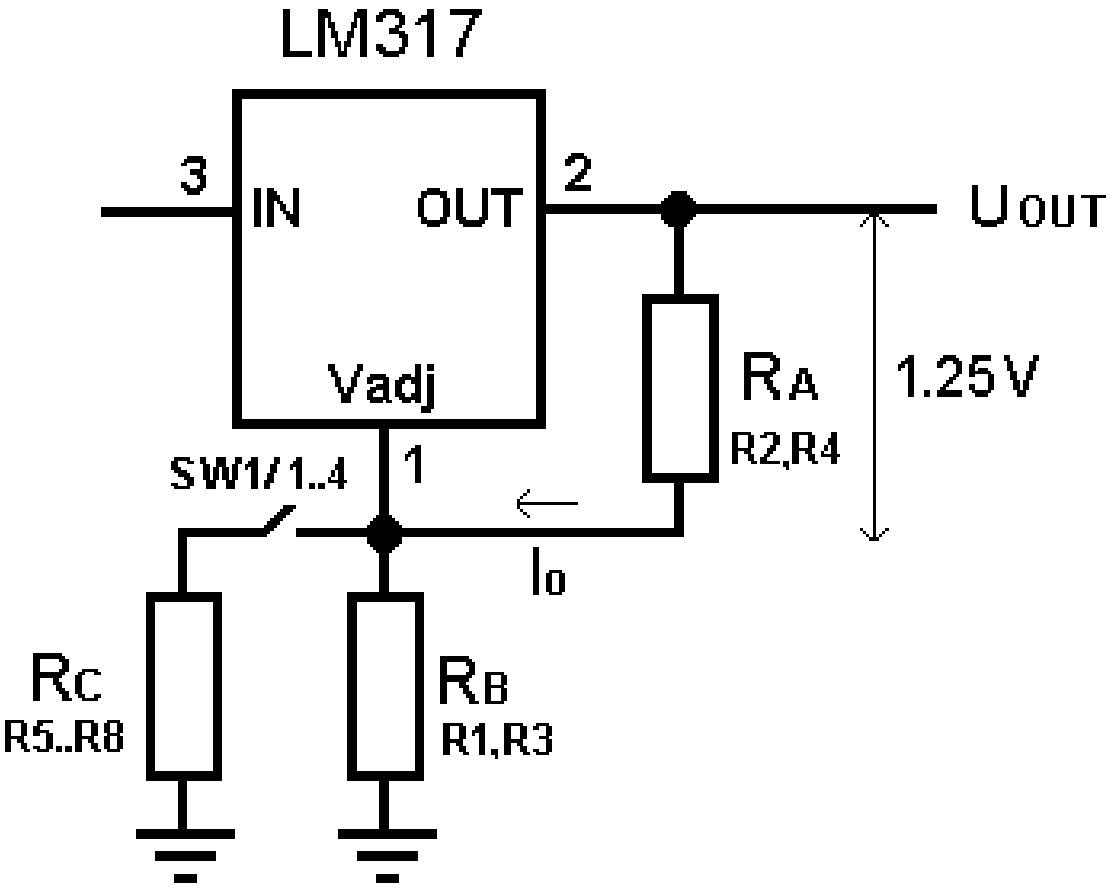


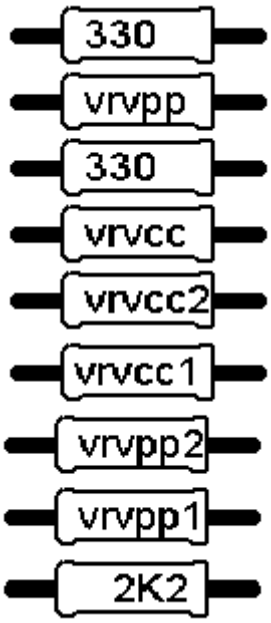
$$U_{OUT} = 1.25 \times \left[1 + \frac{R_B}{R_A}\right] = 1.25 + I_o \times R_B$$

$$I_o = \frac{1.25}{R_A} \qquad R_B = \frac{U_{OUT\ MAX} - 1.25}{I_o}$$

$$R_{B1} = \frac{U_{OUT1} - 1.25}{I_o} \qquad R_{B1} = R_C /\!/ R_B = \frac{R_B \times R_C}{R_B + R_C}$$

$$R_C = \frac{R_B \times R_{B1}}{R_B - R_{B1}} \qquad U_{OUT1} = 1.25 + I_o \times R_{B1}$$

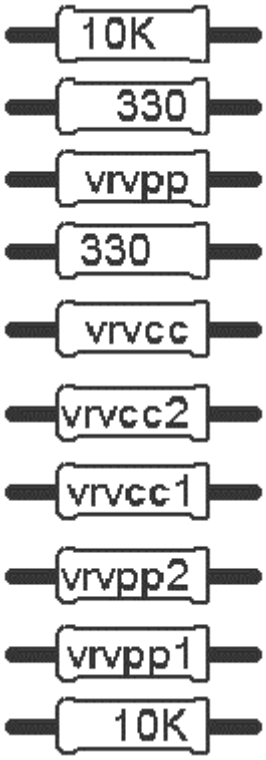
WILLEM 4.1, (WILLEM 4.0)



(10k W4.0)
324 (orange3, red2, yellow4,black0), schematic R4, (Vpp, R_A)
6490 (blue6, yellow4, white9, brown1), vrvpp, schematic R3, (Vpp, R_B)
324 (orange3, red2, yellow4,black0), schematic R2, (Vcc, R_A)
1240 (brown 1, red2, yellow4, brown1), vrvcc, schematic R1, (Vcc, R_B)
910 (white9,brown1, black0, black0), vrvcc2, schematic R8, SW1/4, (Vcc, R_{C2})
4300 (yellow 4,orange3, black0,brown1), vrvcc1, schematic R7,SW1/3, (Vcc,R_{C1})
26100 (red2, blue6, brown1, red2), vrvpp2, schematic R6, SW1/1, (Vpp, R_{C2})
5620 (green5, blue6, red2, brown1), vrvpp1, schematic R5, SW1/2, (Vpp, R_{C1})
2k2 (10k W4.0)

Vpp
$I_0=1.25/R_A=1.25/324=3.858mA$
$Uout=1.25+ I_0*R_B= 1.25+0.003858*6490=26.29V$
$R_{B1}= R_B//R_{C1}=(R_B*R_{C1})/(R_B+R_{C1})=6490*5620/(6490+5620)=3012$ Ohm
$Uout_1= 1.25+ I_0*R_{B1} = 1.25+0.003858*3012=12.87V$
$R_{B2}= R_B//R_{C2}=(R_B*R_{C2})/(R_B+R_{C2})=6490*26100/(6490+26100)=5198$ Ohm
$Uout_2= 1.25+ I_0*R_{B2} = 1.25+0.003858*5198=21.30V$
Vcc
$I_0=1.25/R_A=1.25/324=3.858mA$
$Uout=1.25+ I_0*R_B= 1.25+0.003858*1240=6.03V$
$R_{B1}= R_B//R_{C1}=(R_B*R_{C1})/(R_B+R_{C1})=1240*4300/(1240+4300)=962$ Ohm
$Uout_1= 1.25+ I_0*R_{B1} = 1.25+0.003858*962=4.96V$
$R_{B2}= R_B//R_{C2}=(R_B*R_{C2})/(R_B+R_{C2})=1240*910/(1240+910)=525$ Ohm
$Uout_2= 1.25+ I_0*R_{B1} = 1.25+0.003858*525=3.28V$
Actual voltages (sample W4.1 measured)
26.44V (SW1/1 OFF, SW1/2 OFF), 21.42V (SW1/1 ON, SW1/2 OFF),
12.93V (SW1/1 OFF, SW1/2 ON)
6.05V (SW1/3 OFF, SW1/4 OFF), 4.97V (SW1/3 ON, SW1/4 OFF),
3.27V (SW1/3 OFF, SW1/4 ON)

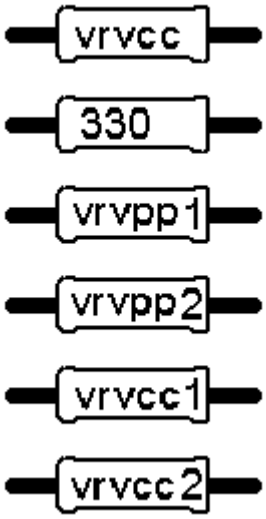
WILLEM 4.0 (old version, sample)



10k
332 (orange3, orange3, red2, black0), schematic R4, (Vpp, R_A)
N/C (omitted) , vrvpp, schematic R3, (Vpp, R_B)
332 (orange3, orange3, red2, black0), schematic R2, (Vcc, R_A)
1240 (brown 1, red2, yellow4, brown1), vrvcc, schematic R1, (Vcc, R_B)
910 (white9,brown1, black0, black0), vrvcc2, schematic R8, SW1/4, (Vcc, R_{C2})
4320 (yellow 4,orange3, red2, brown1), vrvcc1, schematic R7,SW1/3, (Vcc,R_{C1})
5360 (green5, orange3, blue6, red2), vrvpp2, schematic R6, SW1/1, (Vpp, R_{C2})
3010 (orange3,black0,brown1,brown1), vrvpp1, schematic R5, SW1/2,(Vpp, R_{C1})
10k

Vpp
$I_0=1.25/R_A=1.25/332=3.765mA$
R_B=high impedance, Uout~Uin
$Uout_1= 1.25+ I_0*R_{C1} = 1.25+0.003765*3010=12.58V$
$Uout_2= 1.25+ I_0*R_{C2} = 1.25+0.003765*5360=21.43V$
Vcc
$I_0=1.25/R_A=1.25/332=3.765mA$
Uout max$=1.25+ I_0*R_B= 1.25+0.003765*1240=5.92V$
$R_{B1}= R_B//R_{C1}=(R_B*R_{C1})/(R_B+R_{C1})=1240*4320/(1240+4320)=963$ Ohm
$Uout_1= 1.25+ I_0*R_{B1} = 1.25+0.003765*963=4.88V$
$R_{B2}= R_B//R_{C2}=(R_B*R_{C2})/(R_B+R_{C2})=1240*910/(1240+910)=525$ Ohm
$Uout_2= 1.25+ I_0*R_{B2} = 1.25+0.003765*525=3.23V$
Actual voltages (sample measured)
Uout ~Uin (SW1/1 OFF, SW1/2 OFF), **DON'T USE OPTION WITHOUT vrvpp !**
21.67V (SW1/1 ON, SW1/2 OFF), 12.71V (SW1/1 OFF, SW1/2 ON)
6.01V (SW1/3 OFF, SW1/4 OFF), 4.95V (SW1/3 ON, SW1/4 OFF),
3.27V (SW1/3 OFF, SW1/4 ON)

WILLEM 4.5



1240 (brown 1, red2, yellow4, brown1), vrvcc, schematic R1, (Vcc, R_B)
324 (orange3, red2, yellow4,black0), schematic R2, (Vcc, R_A)
750 (violet7, green5, black0,black0), vrvpp1, schematic R5, SW1/2, (Vcc, R_{C1})
511 (green5,brown1, brown1, black0), vrvpp2, schematic R6, SW1/1, (Vcc, R_{C2})
910 (white9,brown1, black0, black0), vrvcc1, schematic R7, SW1/3, (Vcc, R_{C3})
4300 (yellow 4,orange3, black0,brown1), vrvcc2, schematic R8,SW1/4, (Vcc,R_{C4})

Vcc
$I_0=1.25/R_A=1.25/324=3.858mA$
$Uout=1.25+ I_0*R_B= 1.25+0.003858*1240=6.03V$
$R_{B1}= R_B//R_{C1}=(R_B*R_{C1})/(R_B+R_{C1})=1240*750/(1240+750)=467$ Ohm
$Uout_1= 1.25+ I_0*R_{B1} = 1.25+0.003858*467=3.05V$
$R_{B2}= R_B//R_{C2}=(R_B*R_{C2})/(R_B+R_{C2})=1240*511/(1240+511)=362$ Ohm
$Uout_2= 1.25+ I_0*R_{B1} = 1.25+0.003858*362=2.65V$
$R_{B3}= R_B//R_{C3}=(R_B*R_{C3})/(R_B+R_{C3})=1240*910/(1240+910)=525$ Ohm
$Uout_1= 1.25+ I_0*R_{B1} = 1.25+0.003858*525=3.28V$
$R_{B4}= R_B//R_{C4}=(R_B*R_{C4})/(R_B+R_{C4})=1240*4300/(1240+4300)=962$ Ohm
$Uout_1= 1.25+ I_0*R_{B1} = 1.25+0.003858*962=4.96V$

Actual voltages (sample measured)
6.05V (SW1/1 OFF, SW1/2 OFF, SW1/3 OFF, SW1/4 OFF),
4.97V (SW1/1 OFF, SW1/2 OFF, SW1/3 OFF, SW1/4 ON),
3.26V (SW1/1 OFF, SW1/2 OFF, SW1/3 ON, SW1/4 OFF)
3.05V (SW1/1 OFF, SW1/2 ON, SW1/3 OFF, SW1/4 OFF),
2.64V (SW1/1 ON, SW1/2 OFF, SW1/3 OFF, SW1/4 OFF)

Create own resistor set for Willem 4.1

Selected Vpp= 26.0, 21.5, 12.8 V
R_A= R4 =324 (original precise resistor)
Io=1.25/324=0.003858 A
Uout max=Vpp=26.0V
R_B= (Uout max-1.25)/Io = (26.0-1.25)/0.003858=6415 Ohm
Place generic resistors vrvpp=R3= 6k2+220 (6420) , check output voltage.
Adjust 220 Ohm if required (200…240) to have closest 26.0V voltage.
Calculate real summar resistor value from measured Uout, R_B=(Uout-1.25)/Io, (6420)
U_{out2}=Vpp=21.5V
R_{B2}= (U_{out2}-1.25)/Io = (21.5-1.25)/0.003858=5249 Ohm
R_{C2}= R_B* R_{B2} / (R_B-R_{B2}) = 6420*5249 / (6420-5249)=29764 Ohm
Place generic resistors vrvpp2=R6= 27k+2k7 .
SW1/1 ON, SW1/2 OFF, check output voltage.
Adjust 2k7 if required (2k…3k3) to have closest 21.5V voltage.
U_{out1}=Vpp=12.8V
R_{B1}= (U_{out1}-1.25)/Io = (12.8-1.25)/0.003858=2994 Ohm
R_{C1}= R_B* R_{B1} / (R_B-R_{B1}) = 6420*2994 / (6420-2994)=5610 Ohm
Place generic resistors vrvpp1=R5= 5k1+510 .
SW1/1 OFF, SW1/2 ON, check output voltage.
Adjust 510 if required (470…560) to have closest 12.8 voltage.

Selected Vcc= 5.9, 5.05, 3.3 V
R_A= R2 =324 (original precise resistor)
Io=1.25/324=0.003858 A
Uout max=Vcc=6.0V
R_B= (Uout max-1.25)/Io = (6.0-1.25)/0.003858=1231 Ohm
Place generic resistors vrvcc=R1= 1k1+130 (1230) , check output voltage.
Adjust 130 Ohm if required (100…150) to have closest 6.0V voltage.
Calculate real summar resistor value from measured Uout, R_B=(Uout-1.25)/Io, (1230)
U_{out1}=Vcc=5.05V
R_{B1}= (U_{out1}-1.25)/Io = (5.05-1.25)/0.003858=985 Ohm
R_{C1}= R_B* R_{B1} / (R_B-R_{B1}) = 1230*985 / (1230-985)= 4945 Ohm
Place generic resistors vrvcc1=R7= 4k7+240
SW1/3 ON, SW1/4 OFF, check output voltage.
Adjust 240 if required (200…300) to have closest 5.05 V voltage.
U_{out2}=Vcc=3.3V
R_{B2}= (U_{out2}-1.25)/Io = (3.3-1.25)/0.003858=531 Ohm
R_{C2}= R_B* R_{B2} / (R_B-R_{B2}) = 1230*531 / (1230-531)= 934 Ohm
Place generic resistors vrvcc2=R8= 820+110
SW1/3 OFF, SW1/4 ON, check output voltage.
Adjust 110 if required (91…130) to have closest 3.3 V voltage.

All Vcc voltages are a bit too low (for example Willem 4.0 with R2=332)

Existing results
R_A=R2=332 Ohm
Io=1.25/332=0.003765 A
R_{B1}= R_B//R_{C1}=(R_B*R_{C1})/(R_B+R_{C1})=1240*4320/(1240+4320)=963 Ohm
U_{out1}= 1.25+ I_0*R_{B1} = 1.25+0.003765*963=4.88V

Increase U_{out1} from 4.88V to 5.0V
I_{o1}= (U_{out1}-1.25)/ R_{B1}= (5.0-1.25)/963=0.003894 A
R_{A1}=1.25/ I_{o1}= 1.25/0.003894=321 Ohm
R_A* =332*321 / (332-321)= 9688 Ohm
Place 10k parallel to R_A=R2 and check voltages 5.0 / 6.0 / 3.3 V

R_{A1}= 10000*332/(10000+332)=321 Ohm
Io=1.25/321=0.003894 A
Uout max=1.25+ I_0*R_B= 1.25+0.003894*1240= 6.08V (ex 5.92V)
U_{out1}= 1.25+ I_0*R_{B1} = 1.25+0.003894*963= 5.00V (ex 4.88V)
U_{out2}= 1.25+ I_0*R_{B2} = 1.25+0.003894*525= 3.29V (ex 3.23V)

Adjust particular Vcc or Vpp

Adjusted Vout max (Vpp~26V, Vcc~6.0V) with R_A (324, 332 or parallel resistor) or R_B (vrvpp, vrvcc), all other resistors (vrvpp1,vrvpp2, vrvcc1,vrvcc2) should be recalculated !
Any other voltage (Vcc/Vpp - Vout1, Vout2) can be adjusted individually .

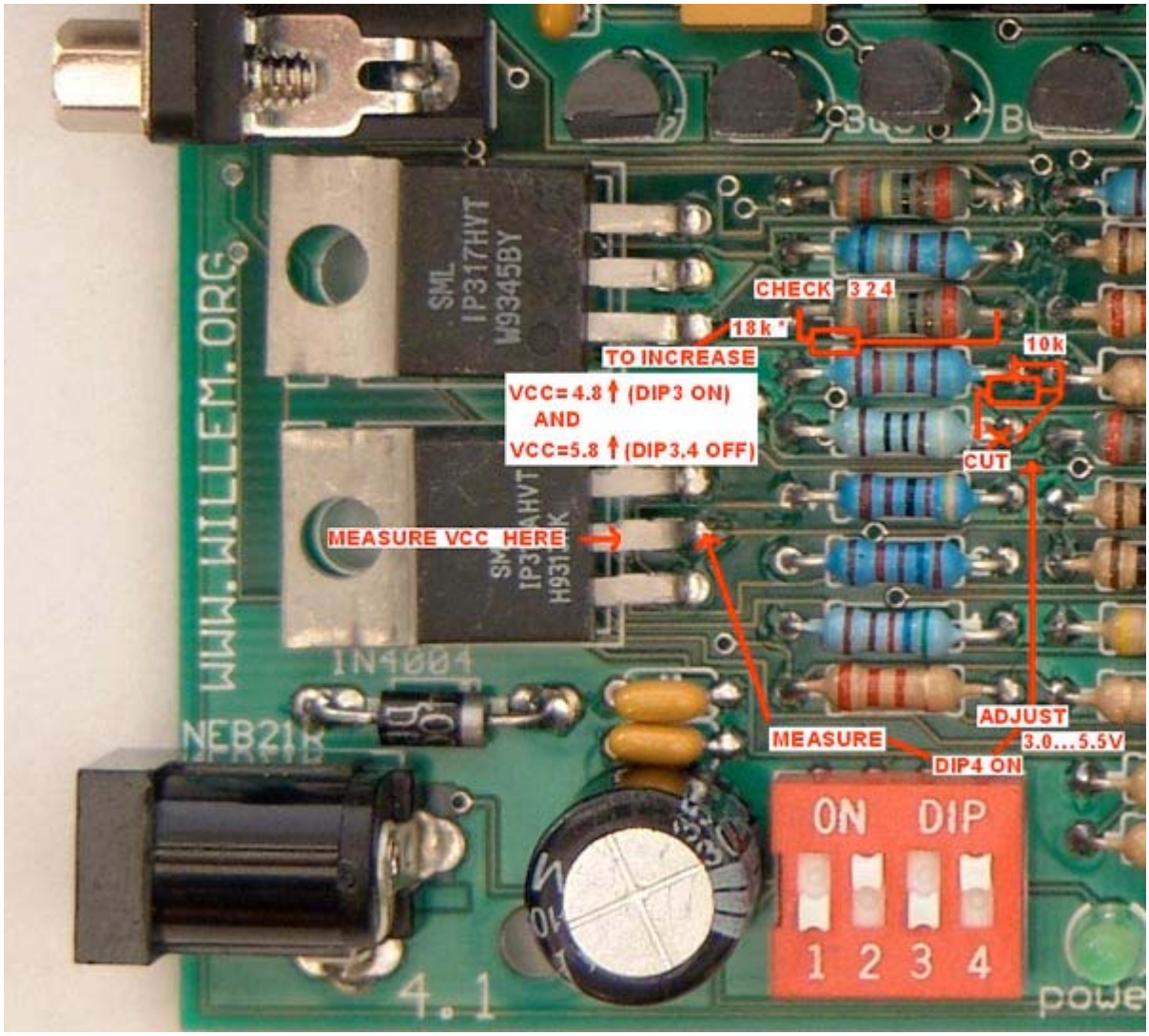
For example Willem 4.0 with R2=332, R_A=R2=332 Ohm
Io=1.25/332=0.003765 A
R_{B1}= R_B//R_{C1}=(R_B*R_{C1})/(R_B+R_{C1})=1240*4320/(1240+4320)=963 Ohm
U_{out1}= 1.25+ I_0*R_{B1} = 1.25+0.003765*963=4.88V

Adjust U_{out1}= 4.88V >> 5.0V
R_{B1}=(U_{out1}-1.25)/Io=(5.0-1.25)/0.003765=996 Ohm
R_{C1}= R_B* R_{B1} / (R_B-R_{B1})= 1240*996/(1240-996)= 5061 Ohm
Replace vrvcc1=R7 from 4320 to 4k7+360 and check voltage.
Adjust 360 if required (300…430) to have closest 5.0 V voltage.

Add variable Vcc option , for example to get Vcc=4.5V (eprom erase verify)

Willem 4.1 modification described in picture:
1) check Vcc related R2=324
2) add 18k parallel R2 to increase all Vcc voltages (if R2=332 used)
3) cut resistor vrvcc2=R8 910 and add serial variable resistor 10k

SW1/3 OFF, SW1/4 ON
Fixed voltage Uout2 ~3.3V comes variable in range 3.3…5.5V with variable resistor now.



Add Vpp=14V support for electrically erasable eproms W27E/C256….040

Existing Willem programmers 4.0/4.1 don't support Vpp=14V required to erase electrically erasable eproms W27E256..040 (Jp6/2-3 SF erase)
Vpp=14.7V+-0.5V required, 0.7V drop on diod D9.

Selected modification:
SW1/1 OFF, SW1/2 OFF , Vpp=25V;
SW1/1 ON, SW1/2 OFF , Vpp=21V;
SW1/1 OFF, SW1/2 ON , Vpp=14.7V;
SW1/1 ON, SW1/2 ON , Vpp=12.8V

Change resistor vrvpp1= R5 from 5620 to 6k8+470 (7270)
Check voltages in both ranges Vpp=14.7 and Vpp=12.8
Adjust resistor 470 if required (390….560) to keep both voltages in acceptable range.

Vpp
$I_0=1.25/R_A=1.25/324=3.858mA$
$U_{out}=1.25+ I_0*R_B= 1.25+0.003858*6490=26.29V$
$R_{B2}= R_B//R_{C2}=(R_B*R_{C2})/(R_B+R_{C2})=6490*26100/(6490+26100)=5198$ Ohm
$U_{out2}= 1.25+ I_0*R_{B2} = 1.25+0.003858*5198=21.30V$
$R_{B1}= R_B//R_{C1}=(R_B*R_{C1})/(R_B+R_{C1})=6490*7270/(6490+7270)=3429$ Ohm
$U_{out1}= 1.25+ I_0*R_{B1} = 1.25+0.003858*3429=14.48V$
$R_{B3}= R_B//R_{C1}//R_{C2}=(R_{B1}*R_{C2})/(R_{B1}+R_{C2})=3429*26100/(3429+26100)=3031$ Ohm
$U_{out3}= 1.25+ I_0*R_{B3} = 1.25+0.003858*3031=12.94V$