

Application Note | BEN Series

TRIM: Trim resistor calculation for output voltage adjustment

1. Possible models

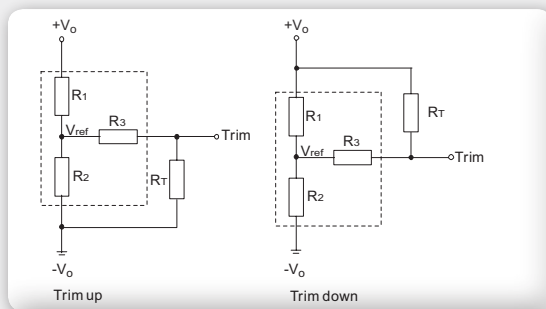
- BEN(D)-20 all models
- BEN-40 all models
- BEN-60 all models

2. Description

Trim function is to adjust the output voltage $\pm 10\%$ of the rated value. The total output power of the converter should be limited to its maximum specified output power.

3. How to connect the additional external resistor

The below figure shows how to connect an external trim resistor. To trim up the output voltage, the external resistor has to be connected between $-V_o$ pin and Trim pin. To trim down the output voltage, the external resistor has to be connected between $+V_o$ and Trim pin. The part in broken line shows the interior of the power modules.



4. Formula for calculation the additional external resistor

$$\begin{aligned} \text{up: } R_T &= \frac{aR_2}{R_2 - a} - R_3 & a &= \frac{V_{ref}}{V_o - V_{ref}} \cdot R_1 \\ \text{down: } R_T &= \frac{aR_1}{R_1 - a} - R_3 & a &= \frac{V_o - V_{ref}}{V_{ref}} \cdot R_2 \end{aligned}$$

Note: Value for R1, R2, R3, and Vref refer to the following table.
RT: Resistance of Trim

5. Values for the formula

BEN(D)-20

Vo(V) \ Resistance	5	12	15	24
R1(KΩ)	3.3	3.8	7.5	8.6
R2(KΩ)	3.3	1	1.5	1
R3(KΩ)	1	1	1	1
Vref(V)	2.5	2.5	2.5	2.5
Vo (V)	Output voltage of Trim, variation $\leq \pm 10\%$			

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BEN-40

Vo(V)	5	12	15	24
Resistance				
R1(KΩ)	3.3	3.83	4.99	8.66
R2(KΩ)	3.3	1	1	1
R3(KΩ)	1	1	1	1
Vref(V)	2.5	2.5	2.5	2.5
Vo (V)	Output voltage of Trim, variation ≤ ±10%			

BEN-60

Vo(V)	5	12	15	24
Resistance				
R1(KΩ)	3.3	3.83	7.5	8.66
R2(KΩ)	3.3	1	1.5	1
R3(KΩ)	1	1	1	1
Vref(V)	2.5	2.5	2.5	2.5
Vo (V)	Output voltage of Trim, variation ≤ ±10%			

6. Calculation example

If the customer uses a BEN-2005, but wants to get 5.4 V output, an additional resistance is necessary. Firstly, please choose the value for every parameter from the charts of point 5. Afterwards please insert the chosen values into the formula.

BEN-2005, R1=3.3 KΩ, R2=3.3 KΩ, R3=1 KΩ, Vref=2.5 V, Vo=5.4 V

$$\alpha = \frac{V_{ref}}{V_o - V_{ref}} \times R_1 = \frac{2.5}{5.4 - 2.5} \times 3.3 = 2.845$$

$$R_T = \frac{\alpha \times R_2}{R_2 - \alpha} - R_3 = \frac{2.845 \times 3.3}{3.3 - 2.845} - 1 = 19.63 \text{ K}\Omega$$

The customer needs to connect a resistance with 19.63 KΩ between -Vo and Trim pin.