

Output Voltage Trimming

For all Rantec HDM DC-DC Converters with Trim Function

General Description

Output voltage trimming allows the user to make small changes to increase or decrease the output voltage of the HDM DC-DC converter module. This is useful when compensating for distribution or connector voltage drops so that the required voltage gets to the load. It is also helpful when checking the system for proper operation at the extremes of the output voltage tolerance range (often called voltage margining).

Implementation

The use of a single fixed value resistor is recommended. This avoids the possibility of future potentiometer maladjustment or voltage changes caused by potentiometer aging or mechanical vibration.

Using a fixed value resistor for permanent output voltage adjustment

The output voltage of a module can be increased (trimmed up) from 1 to 10% using a fixed resistor from the Trim pin to the -Sense pin as shown in Figure 1. The output voltage of a module can be decreased (trimmed down) from 1 to 10% (increased range with reduced specifications) using a fixed resistor from the Trim pin to the +Sense pin as shown in Figure 2.

When selecting a fixed value resistor, use a metal film, one percent tolerance for accuracy and temperature stability. The output voltage accuracy depends on the resistor value accuracy. A resistor power rating of 1/8 watt is generally sufficient.

Refer to the tables on the following pages for general resistance value formulas. The tables are useful for selecting single fixed resistors used to increase or decrease the module output voltage.

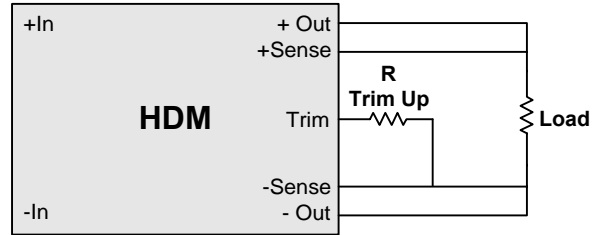


Figure 1. Trim circuit for Increasing the output voltage using a fixed value resistor.

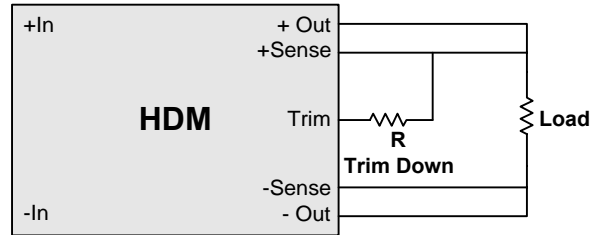


Figure 2. Trim circuit for Decreasing the output voltage using a fixed value resistor.

Using a potentiometer for continuously adjusting trim

Adjustable output voltage trimming can be accomplished with a potentiometer in a resistor divider circuit as shown in Figure 3. Suggested trim values for the 250W HDM single and 325W HDM+ are shown in Table 1.

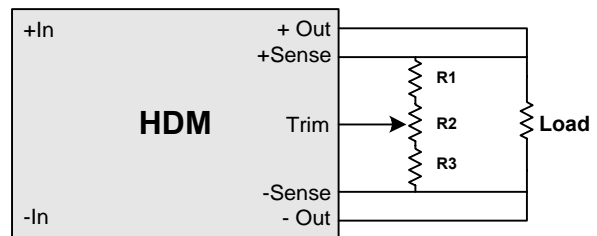


Figure 3. Adjustable trim circuit for increasing or decreasing the output voltage using a potentiometer.



Table with 4 columns: Vout, R1, R2, R3. Rows include output voltages (5.0V, 12V/15V, 24V/28V) and corresponding resistor values (24.3K, 56.2K, 200K, 50K, 9.09K).

Table 1. Recommended trim resistor values for the adjustable trimming circuit shown in Figure 3 (250/325W HDM singles only).

Possible Applications

Eliminating the need for remote sense

Output trimming can be used instead of remote sense when the load current variation is limited and the voltage distribution drop between the HDM module and load is relatively constant.

System testing (margining)

Often it is helpful to test the system operation with the supply voltage - usually the +5V logic voltage - set first at one extreme, then at the other. Any circuitry that fails to perform properly under these manufacturer's test conditions might also fail under conditions found in the user's environment. Margin testing helps ensure trouble-free deployed operation.

Obtaining nonstandard output voltages

When a nonstandard output voltage is necessary, it may be available simply by trimming the output voltage of a module with an output rating close to the desired voltage. Although the published data sheet limits are valid for Vout +/- 10%, lower output voltages are commonly available by using the trim function. Contact the factory for details.

Reducing the number of stocked models

When two output voltages are necessary, such as 24V and 28V, one model may be able to supply both, using the trim function to set the lower voltage.

Precautions

Connect trim resistors to sense, not to output

The trim resistor(s) should be connected to the SENSE leads, not to the output leads or to the load. Otherwise, load current changes could cause the HDM module's trimmed output voltage to vary.

Noise Sensitivity

The TRIM pin is noise sensitive. External resistors (either fixed or variable) should be located within one cm of the HDM module.

Output power, output current

If the output voltage is increased, output current must be derated to avoid exceeding the module's maximum output power rating. If the output voltage is decreased, the output current is limited to the maximum specified current rating of the module.

Adjustability range limits

In some cases the output voltage can be trimmed lower than - 10%. However, the data sheet specifications are only valid for the trim range specified in the data sheet.

Effect of Trimming on Module Performance

Output voltage trimming will affect several of the module performance parameters. Specifications that will be affected and are of primary concern are: efficiency, output ripple, and output OVP.

Efficiency: The efficiency of an HDM module will decrease with a lower output voltage and increase with a higher output voltage.

Output Ripple: The output ripple, as a percentage of the output voltage, will increase with a voltage decrease and decrease with a voltage increase.

Over Voltage Protection (OVP): The OVP set point is a fixed voltage, independent of output trimming. This is generally fixed by the module design at about 120% of the nominal rated output voltage of the module.

Table 2 - General Resistance Value Formulas
250W & 325W HDM Singles and HDM Triples

Module Output Voltage	Trim Direction + / -	Trim Formula "R="
3.3V	Voltage Increase	$R=29.69 / (1.57V - 5.18)$
3.3V Triple	Voltage Increase	$R= 2.03 / (2.53V - 8.35)$
3.7V	Voltage Increase	$R=20.95 / (1.11V - 4.107)$
5V	Voltage Increase	$R=20.70 / (2.434V - 12.17)$
5V Triple	Voltage Increase	$R= 0.71 / (0.451V - 2.25)$
8V	Voltage Increase	$R= 17.822 / (1.123V-8.98)$
12V	Voltage Increase	$R= 83.4 / (2.875V - 34.50)$
15V	Voltage Increase	$R = 68.62 / (2.30V - 34.50)$
24V	Voltage Increase	$R = 146.71 / (2.76V - 66.24)$
28V	Voltage Increase	$R = 99.14 / (1.58V - 44.24)$
3.3V	Voltage Decrease	$R =(21.88V - 32.89) / (5.74 - 1.74V)$
3.3V Triple	Voltage Decrease	$R =(1.113V - 1.67) / (6.864 - 2.08V)$
3.7V	Voltage Decrease	$R =(13.97V - 20.95) / (4.107 - 1.11V)$
5V	Voltage Decrease	$R =(9.20V - 13.80) / (8.11 - 1.62V)$
5V Triple	Voltage Decrease	$R =(0.315V - 0.473) / (1.50 - 0.30V)$
8V	Voltage Decrease	$R= (20.28V - 30.41) / (15.36 - 1.92V)$
12V	Voltage Decrease	$R =(37.133V - 55.7) / (23.04 - 1.92V)$
15V	Voltage Decrease	$R =(30.43V - 45.65) / (22.95 - 1.53V)$
24V	Voltage Decrease	$R =(65.206V - 97.81) / (44.16 - 1.84V)$
28V	Voltage Decrease	$R =(99.14V - 148.72) / (66.36 - 2.37V)$

R = KΩ; V = Desired Output Voltage

NOTE:

- Not valid for values less than 1% deviation from module output voltage
- Data Sheet Specifications are only valid within +/- 10% deviation



**Table 3 - Selected 1% Resistance Values for Various Trimmed Output Voltages
250 & 325 W HDM Singles and HDM Triples**

Module Output Voltage	Desired Output Voltage	Trim Resistor (KΩ)
3.3V	3.00	63.4
3.3V	3.15	140
3.3V	3.45	12.4
3.3V	3.60	63.4
<hr/>		
3.3V Triple	3.00	2.67
3.3V Triple	3.15	5.90
3.3V Triple	3.45	5.36
3.3V Triple	3.60	2.67
<hr/>		
5V	4.50	34.0
5V	4.75	71.5
5V	5.25	34.0
5V	5.50	16.9
<hr/>		
5V Triple	4.50	6.34
5V Triple	4.75	13.7
5V Triple	5.25	6.04
5V Triple	5.50	3.09
<hr/>		
8V	7.00	57.6
8V	7.50	127
8V	8.50	31.6
8V	9.00	15.8
<hr/>		
12V	10.0	82.5
12V	11.0	182
12V	12.5	57.6
12V	13.2	24.3
<hr/>		
15V	13.5	158
15V	14.25	340
15V	15.75	40.2
15V	16.5	20.0
<hr/>		
24V	20.0	165
24V	22.0	365
24V	25.0	53.6
24V	26.0	26.7
<hr/>		
28V	26.0	511
28V	27.0	1070
28V	29.0	63.4
28V	30.0	31.6



Table 4 - General Resistance Value Formulas
HDM-LP Modules

Module Output Voltage	Trim Direction + / -	Trim Formula "R="
3.3V	Voltage Increase	$R = 6.703 / (V - 3.3)$
5V	Voltage Increase	$R = 12.58 / (V - 5)$
12V	Voltage Increase	$R = 41.8 / (V - 12)$
15V	Voltage Increase	$R = 51.93 / (V - 15)$
24V	Voltage Increase	$R = 104.4 / (V - 24)$
3.3V	Voltage Decrease	$R = (5.406 * (1.24 - V)) / (V - 3.3)$
5V	Voltage Decrease	$R = (5.03 * (2.5 - V)) / (V - 5)$
12V	Voltage Decrease	$R = (16.72 * (2.5 - V)) / (V - 12)$
15V	Voltage Decrease	$R = (20.77 * (2.5 - V)) / (V - 15)$
24V	Voltage Decrease	$R = (41.76 * (2.5 - V)) / (V - 24)$

R = KΩ; V = Desired Output Voltage

NOTE:

- Not valid for values less than 1% deviation from module output voltage
- Data Sheet Specifications are only valid within +/- 10% deviation



**Table 5 - Selected 1% Resistance Values for Various Trimmed Output Voltages
HDM-LP Modules**

Module Output Voltage	Desired Output Voltage	Trim Resistor (K Ω)
3.3V	3.00	31.6
3.3V	3.15	68.1
3.3V	3.45	44.2
3.3V	3.60	22.1
5V	4.50	20.00
5V	4.75	45.3
5V	5.25	49.9
5V	5.50	24.9
12V	10.00	63.4
12V	11.00	143
12V	12.50	84.5
12V	13.20	34.8
15V	13.50	154
15V	14.25	324
15V	15.75	69.8
15V	16.50	34.8
24V	20.00	182
24V	22.00	402
24V	25.00	105
24V	26.00	52.3



Table 6 - General Resistance Value Formulas
HDM-200 Modules

Module Output Voltage	Trim Direction + / -	Trim Formula "R= (Kohms)"
3.3V	Voltage Increase	$= (2.431 / (v - 3.301)) - 4.75$
5V	Voltage Increase	$= (5.55 / (v - 5)) - 7.5$
12V	Voltage Increase	$= (32.361 / (v - 11.994)) - 16.5$
15V	Voltage Increase	$= (50.64 / (v - 15.003)) - 24$
28V	Voltage Increase	$= (297.025 / (v - 28.005)) - 61.9$
3.3V	Voltage Decrease	$= (((1.5 * v) - 2.431) / (3.301 - v)) - 4.75$
5V	Voltage Decrease	$= (((2.26 * v) - 5.555) / (5 - v)) - 7.5$
12V	Voltage Decrease	$= (((5.49 * v) - 32.36) / (11.944 - v)) - 16.5$
15V	Voltage Decrease	$= (((6.81 * v) - 50.64) / (15.003 - v)) - 24$
28V	Voltage Decrease	$= (((20.5 * v) - 297.025) / (28.005 - v)) - 61.9$

R = KΩ; V = Desired Output Voltage

- NOTE:**
- Not valid for values less than 1% deviation from module output voltage
 - Data Sheet Specifications are only valid within +/- 10% deviation



**Table 7 - Selected 1% Resistance Values for Various Trimmed Output Voltages
HDM-200 Modules**

Module Output Voltage	Desired Output Voltage	Trim Resistor (KΩ)
3.3V	3.00	0.825
3.3V	3.15	9.09
3.3V	3.45	10.7
3.3V	3.60	2.37
5V	4.50	0.715
5V	4.75	12.1
5V	5.25	14.0
5V	5.50	2.74
12V	11.00	5.90
12V	11.50	39.2
12V	12.50	42.2
12V	13.00	10.0
15V	13.50	1.87
15V	14.25	38.3
15V	15.75	35.7
15V	16.50	3.92
28V	26.00	41.2
28V	27.00	178
28V	29.00	232
28V	30.00	76.8