Output Voltage Trimming

Output trimming refers to the increase or decrease of the output voltage of a dc/dc converter. It is used for adjusting the output voltage to a different value from those set at the factory. The general range is ±10% of the factory pre-set values. However, the exact trim range values for each model is different, so please refer to the specifications for each model. For example, IMT200-48-12 has a trim range of -8% to +10%, and the IMT-400-48-5 has a trim range of -40% to +10%. These trim ranges are the manufacturer's specifications, but the converters maybe trimmed to a higher range, however, trim ranges outside the manufacturer's specifications are not recommended.

Output trimming can also be used to compensate for the IR drops, if this IR (voltage drop due to cabling) drop value is a known value. For example, if the cable voltage drop from the load to the output pin is known to be 0.2v, then, the output pin can be trimmed up 0.2v to compensate for this drop without the use of extra wiring for the remote sensing. The remote sense can also accomplish this purpose.

Output Trimming: Power and Current specification.

When performing the trimming of the IMT converters, the maximum power and current specifications must not be exceeded. That is, when output voltage is trimmed up, the maximum current specification must be derated to meet the maximum output power specification. When the voltage is trimmed up, the efficiency of the converter will improve and the output ripple as a percentage of the output voltage will decrease.

On the other hand, if the output voltage is trimmed down, the maximum current can remain the same as recommended in the specification. The efficiency of the converter will be lowered, and the output ripple will be higher as a percentage of the output voltage.

When performing trimming, the first step is to estimate the voltage drop across the connection between the load and the output pins of the dc/dc converter. This is simply done by multiplying the resistance of the cable by the expected output current flowing through these cables. Note that both length (the +positive output pin cable and the length of the return cables from the load to the -negative of the output pin) must be taken into account.

Example 2: Output Voltage Trimming Calculation

The dc/dc output is connected to the load using a pair of 12 inches of AWG #12 wire. It carries 50 amp. From the AWG cable chart (Table 2), the voltage drop per 100ft of round trip cable run is 0.324 ohms/100 ft.

Voltage Drop = 3.24/100 x 50 Amp = 162mV.

AWG	Feet/ohm	ohms/100ft	Ampacity*	mm	M/ohm	ohms/100M
10	490.2	.204	30	2.588	149.5	.669
12	308.7	.324	20	2.053	94.1	1.06
14	193.8	.516	15	1.628	59.1	1.69
16	122.3	.818	10	1.291	37.3	2.68

These Ohms/Distance figures are for a round trip circuit.
Specifications are for copper wire at 77 degrees Fahrenheit or 25 degrees Ceisius.

Table 2: Copper Wire Voltage Drop

Example 3: Output Voltage Trimming Calculation

The dc/dc output pins of the circuit board power plane has lengths of 2 cm each, one for +OUT and one for return. The current is 40 Amps. The copper trace is 4 oz per square feet (Thickness = 140 micro-meter).
The maximum voltage drop must be less than 1%.
Resistivity of Copper is 17.5 micro-ohms/mm.
Voltage drop = I x 2 x (resistivity) x 20 / (0.14) x width.
Minimum Width = 40Amp/ 50mV x 2 x 17.5 micro-ohm/mm x 20 /0.14 micro meter = 4 mm.

Trim up and Trim Down

The trimming schematics and the resistor values are shown in Figure 8 and Table 3 respectively . To trim up the output voltage, a trimming resistor is connected to -S (pin 8) and the T (pin 7) . Note that the trim resistor is connected to the sense line, and not to the load itself or the load line.

To trim DOWN the voltage, a suitable resistor is connected between T (pin 7) and +S (pin 6).Figure 9 and Table 4 show the trimming circuit and the resistor values.

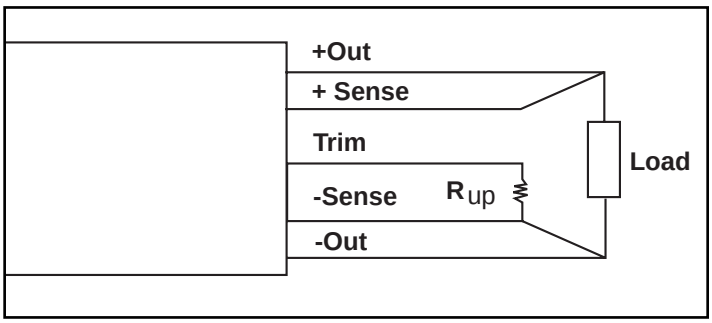

Figure 8. Trim up Circuit

	V nom 2.1V 3	V nom 3V	V nom 5V	V nom 10V	V nom 12V	V nom 15V	V nom 24V
+1%	21.4KΩ	12.2KΩ	5.61KΩ	33.4KΩ	50.9KΩ	78.4KΩ	125.5KΩ
+2%	9.51KΩ	5.41KΩ	2.5KΩ	14.9KΩ	22.6KΩ	34.8KΩ	55.7KΩ
+3%	5.55KΩ	3.15KΩ	1.45KΩ	8.70KΩ	13.2KΩ	20.3KΩ	32.5KΩ
+4%	3.56KΩ	2.03KΩ	936Ω	5.59KΩ	8.50KΩ	13.0KΩ	20.9KΩ
+5%	2.37KΩ	1.35KΩ	623Ω	3.72KΩ	5.66KΩ	8.71KΩ	13.9KΩ
+6%	1.58KΩ	920Ω	415Ω	2.48KΩ	3.77KΩ	5.81KΩ	9.30KΩ
+7%	1.02KΩ	580Ω	267Ω	1.60KΩ	2.42KΩ	3.73KΩ	5.97KΩ
+8%	595Ω	338Ω	156Ω	932Ω	1.41KΩ	2.17KΩ	3.48KΩ
+9%	264Ω	150Ω	69Ω	414Ω	629Ω	968Ω	1.55KΩ
+10%	0.0Ω	0.0Ω	0.0Ω	0.0Ω	0.0Ω	0.0Ω	0.0Ω

Table3. Trimming Up Resistor Values

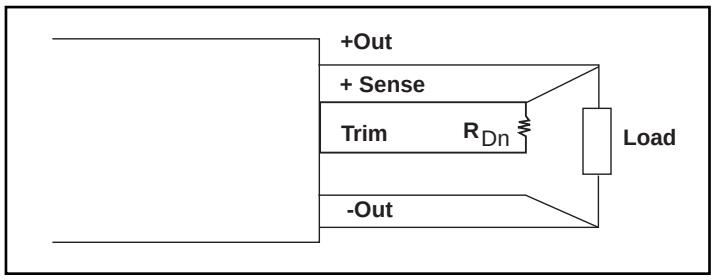

Figure 9. Trim Down Circuit

Model	V nom 2.1V	V nom 3.3V	V nom 5V	V nom 10V	V nom 12V	V nom 15V	V nom 24V
-1%	26.4KΩ	61.7KΩ	28.4KΩ	169.8KΩ	258.0KΩ	397.1KΩ	635.4KΩ
-2%	11.6KΩ	29.8KΩ	13.7KΩ	82.0KΩ	124.5KΩ	191.7KΩ	306.7KΩ
-3%	6.78KΩ	19.1KΩ	8.82KΩ	52.7KΩ	80.1KΩ	123.2KΩ	197.0KΩ
-4%	4.36KΩ	13.8KΩ	6.37KΩ	38.0KΩ	57.8KΩ	89.0KΩ	142.4KΩ
-5%	2.90KΩ	10.6KΩ	4.93KΩ	29.3KΩ	44.5KΩ	68.4KΩ	109.5KΩ
-6%	1.93KΩ	8.51KΩ	3.92KΩ	23.4KΩ	35.6KΩ	54.7KΩ	87.6KΩ
-7%	1.24KΩ	6.99KΩ	3.22KΩ	19.2KΩ	29.2KΩ	45.0KΩ	72.0KΩ
-8%	726Ω	5.85KΩ	2.70KΩ	16.1KΩ	24.4KΩ	37.6KΩ	60.2KΩ
-9%	323Ω	4.96KΩ	2.28KΩ	13.7KΩ	20.7KΩ	31.9KΩ	51.1KΩ
-10%	0.0Ω	4.25KΩ	1.96KΩ	11.7KΩ	17.8KΩ	27.4KΩ	43.8KΩ
-11%	-	3.67KΩ	1.69KΩ	10.1KΩ	15.4KΩ	23.6KΩ	37.8KΩ
-12%	-	3.19KΩ	1.47KΩ	8.78KΩ	13.3KΩ	20.5KΩ	32.8KΩ
-13%	-	2.78KΩ	1.28KΩ	7.65KΩ	11.6KΩ	17.9KΩ	28.6KΩ
-14%	-	2.43KΩ	1.12KΩ	6.69KΩ	10.2KΩ	15.6KΩ	25.0KΩ
-15%	-	2.12KΩ	980Ω	5.85KΩ	8.9KΩ	13.7KΩ	22.0KΩ
-16%	-	1.86KΩ	858Ω	5.12KΩ	7.78KΩ	12.0KΩ	19.1KΩ
-17%	-	1.62KΩ	749Ω	4.47KΩ	6.8KΩ	10.4KΩ	16.7KΩ
-18%	-	1.41KΩ	653Ω	3.9KΩ	5.93KΩ	9.12KΩ	14.6KΩ
-19%	-	1.23KΩ	567Ω	3.39KΩ	5.15KΩ	7.92KΩ	12.7KΩ
-20%	-	1.06KΩ	490Ω	2.92KΩ	4.44KΩ	6.84KΩ	11.0KΩ
-21%	-	911Ω	420Ω	2.51KΩ	3.81KΩ	5.88KΩ	9.36KΩ
-22%	-	774Ω	356Ω	2.13KΩ	3.23KΩ	4.97KΩ	7.96KΩ
-23%	-	648Ω	298Ω	1.78KΩ	2.70KΩ	4.16KΩ	6.66KΩ
-24%	-	532Ω	245Ω	1.46KΩ	2.22KΩ	3.42KΩ	5.47KΩ
-25%	-	425Ω	196Ω	1.17KΩ	1.78KΩ	2.74KΩ	4.39KΩ
-26%	-	327Ω	151Ω	901Ω	1.37KΩ	2.10KΩ	3.37KΩ
-27%	-	236Ω	109Ω	650Ω	988Ω	1.52KΩ	2.43KΩ
-28%	-	152Ω	70Ω	418Ω	636Ω	978Ω	1.56KΩ
-29%	-	73Ω	34Ω	202Ω	307Ω	472Ω	755Ω
-30%	-	0.0Ω	0.0Ω	0.0Ω	0.0Ω	0.0Ω	0.0Ω

Table 4. Trimming Down Resistor Values

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