GETTING NON-NOMINAL OUTPUT VOLTAGES FROM THE XTR75011 WITH NO EXTRA COMPONENTS

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ABSTRACT

This Application Note describes how to obtain non-nominal output voltages from XTR75011 parts of the XT75010 family.
This allows the final user to obtain a large set of additional output voltages from the XTR7501 and being able to include it in a wider range of applications at no extra cost.
Here we present the basis of how these output voltages are obtained and how other voltages can be added to the extensive list. The method described shows that no trimming is needed and that no additional components must be added to the system. The different output voltages can be obtained by simply shorting two consecutive pins of the XTR75011.
This application note also references a spreadsheet implementing all equations, where the user only needs to provide the desired output voltage and the spreadsheet provides the two closest possible values (one below and one above).

INTRODUCTION

The ten possible nominal output voltages of the XTR75011 are obtained by changing the multiplication factor of the internal voltage reference. This is done by changing one resistor in the feedback loop of a non-inverting amplifier implemented with the output buffer.

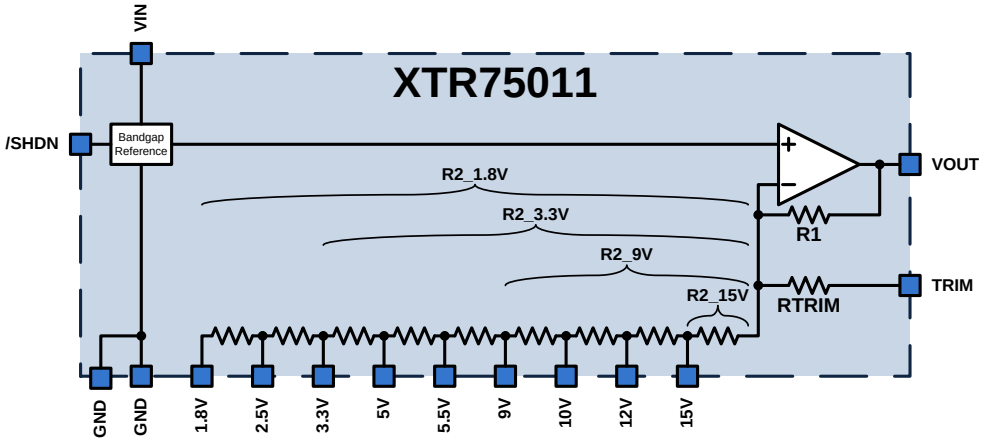

Figure 1. Simplified block diagram of the XTR75011 showing internal feedback network.

From Figure 1, neglecting the offset voltage and the finite gain of the error amplifier, the nominal output voltage can be obtained from

$$V_{OUT\_NOM} = V_{REF\_NOM} \cdot \left(1 + \frac{R_1}{R_{2\_VOUT}}\right) \quad (1)$$

where V_{OUT_NOM} is the nominal (ideal) output voltage, V_{REF_NOM} represents the nominal (ideal) reference voltage 1.2V and R_1 (ideally 100kOhm) together with R_{2_VOUT} are the feedback resistive network determining the reference multiplying factor to get the desired V_{OUT_NOM}.

As it can be seen in Figure 1, the value of R_2 to obtain a given nominal output voltage, for R_1 fixed and equal to 100kOhm (ideally), depends on which resistor tap is connected to GND. The following table shows the equivalent value of R_2 as a function of the obtained nominal output voltage for R_1=100kOhm. The nominal value of R_{TRIM} is 10kOhm.

Nominal Output Voltage (V)	Ideal Equivalent R2 for an Ideal R1 of 100kOhm (Ohm)
1.2	Infinite (open)
1.8	200000
2.5	92308
3.3	57143
5	31579
5.5	27907
9	15385
10	13636
12	11111
15	8696

GETTING NON-NOMINAL OUTPUT VOLTAGES

The method we show here allows obtaining output voltages above 1.2V and is based in the schematic of Figure 2.

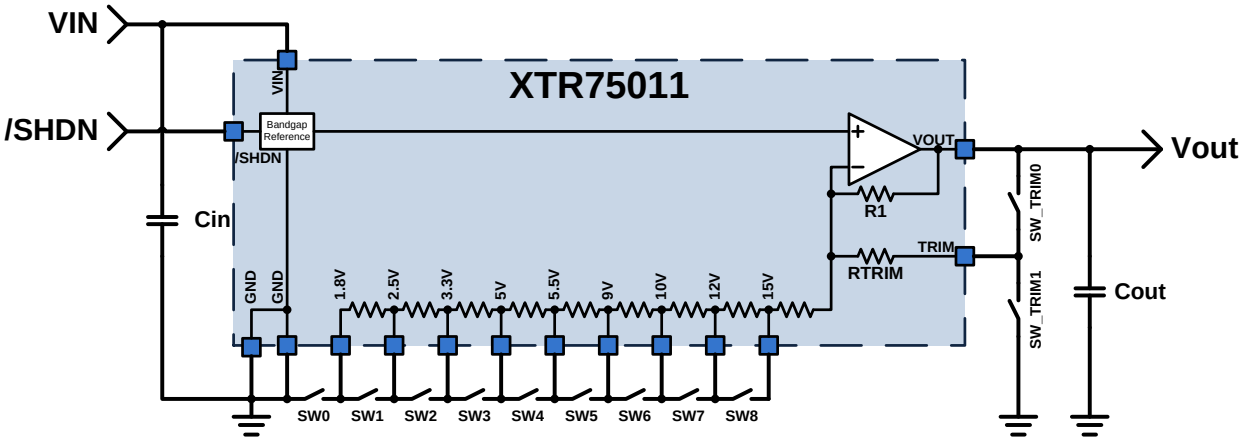

Figure 2. Conceptual schematic to get non-standard output voltages from the XTR75011.

This schematic uses nine switches to short the R2 resistors among the voltage setting terminals (1.8V to 15V) and two switches allowing to connect the TRIM terminal to VOUT or to GND. Notice that the switches connecting TRIM to either or GND cannot be closed simultaneously, however they can be simultaneously open.

Switches shown in Figure 2 can be straightforward implemented in the final system by shorting the contiguous pins in the PCB or by wiring to isolated islands at hybrid level.

From Figure 2, depending on the status of switches SW_TRIM0 and SW_TRIM1, there exist three different cases:

- TRIM floating
- TRIM connected to VOUT
- TRIM connected to GND

The three previous cases lead to three different equations giving the following output voltages (as a function of the effective R2):

- TRIM floating $$V_{OUT\_NOM} = V_{REF\_NOM} \cdot \left(1 + \frac{R_1}{R_{2\_VOUT}}\right) \quad (2)$$
- TRIM connected to VOUT $$V_{OUT\_NOM} = V_{REF\_NOM} \cdot \left(1 + \frac{R_1 // R_{TRIM}}{R_{2\_VOUT}}\right) \quad (3)$$
- TRIM connected to GND $$V_{OUT\_NOM} = V_{REF\_NOM} \cdot \left(1 + \frac{R_1}{R_{2\_VOUT} // R_{TRIM}}\right) \quad (4)$$

In the previous equations, R_{2_VOUT} is the effective R2 value connected between the inverting terminal of the error amplifier to GND.

Based on the previous equations, many useful different output voltages can be obtained. The following table presents a less than exhaustive list of achievable values (besides the standard ones: 1.2V, 1.8V, 2.5V, 3.3V, 5.0V, 5.5V, 9V, 10V, 12V and 15V).

Desired Output Voltage	Accuracy of the actually obtained output voltage
1.25	<0.5%
1.3	<0.5%
1.4	<0.1%
1.5	<0.5%
1.6	<0.1%
1.7	<1%
1.9	<0.2%
2.0	<0.1%
2.048	<0.1%
2.1	<0.1%
2.2	<0.1%
2.7	<0.2%
2.8	<0.2%
2.9	<0.5%
3.0	<0.1%
3.6	<0.1%
3.8	<0.2%
3.9	<0.5%
4.5	<1%
5.25	<1%
6.0	<0.5%
11	<1%
14	<0.1%
16	<0.1%

Accuracies shown in the previous table must be added to the intrinsic accuracy of the XTR75011 (±2%).

HOW TO SELECT YOUR DESIRED OUTPUT VOLTAGE

In order to make your voltage selection easy, we have made available online a spreadsheet which provides the switch configuration to be used in order to get any given output voltage. This spreadsheet shows the four closest values (two under and two above) to the desired output voltage, the nominal error in percentage and the configuration (open or shorted) of each switch shown in Figure 2.

Getting Non-nominal Output Voltages from the XTR75011 with No Extra Components
v1.0

INTRODUCTION

This spreadsheet is related to AN-00169-12 allowing to obtain non-standard output voltages from the XTR75011 by shorting or leaving open the feedback resistors.

VOLTAGE SELECTION

Enter desired output voltage (1,2V ≤ VOUT ≤ 16V)

1,9

CONFIGURATION

Closest Values	Error	SW_TRIM1	SW_TRIM0	SW8	SW7	SW6	SW5	SW4	SW3	SW2	SW1	SW0
1,898	-0,1%	OPEN	OPEN	SHORTED	OPEN	OPEN	OPEN	OPEN	SHORTED	OPEN	OPEN	SHORTED
1,898	-0,1%	OPEN	OPEN	OPEN	SHORTED	OPEN	OPEN	OPEN	SHORTED	OPEN	OPEN	SHORTED
1,903	0,1%	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	SHORTED	SHORTED	OPEN	OPEN	SHORTED
1,905	0,3%	OPEN	OPEN	SHORTED	OPEN	SHORTED	OPEN	OPEN	SHORTED	OPEN	OPEN	SHORTED

Figure 3. Example using the spreadsheet to determine the switches configuration to get 1.9V out of the XTR75011.

From Figure 3, we have selected the switch configuration of the second line for the implementation of the 1.9V voltage regulator. The schematic implementation is shown in Figure 4.

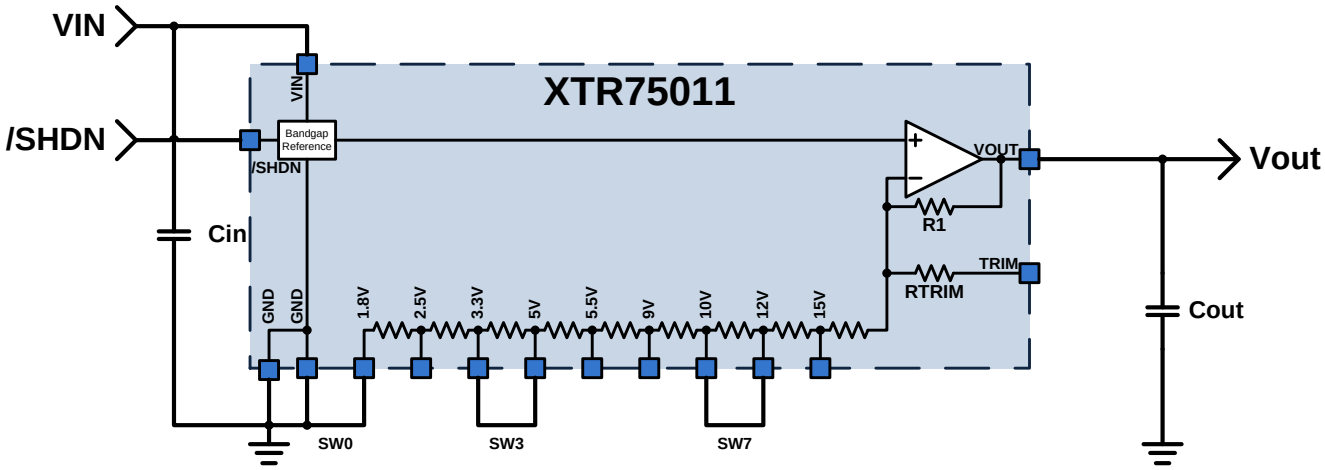

Figure 4. Schematic implementation of the 1.9V regulator with the XTR75011.

The method presented here can be pushed even farther by having the R2 resistors folded into several sections. This way many other output voltage values can be obtained.

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