APPLICATION NOTE

AN-00170-12

REFERENCE DESIGN OF A STEP-DOWN DC-DC CONVERTER BASED ON THE XTR30011

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ABSTRACT

This application note describes a reference design demo board implementing a step-down (buck) DC-DC converter based on the XTR30011 PWM controller and on power N-MOS transistors with drivers of the XTR20410 family. The implemented reference design can be adapted for other parts of the family, such as XTR30012 and XTR30015.

In this application note it is presented a general schematic as well as values for each device. How to size those devices derive from the general theory of step-down converters and is covered in another datasheet. General documentation about the sizing of step-down DC-DC converters can also be found on the web.

INTRODUCTION

The purpose of this document is to present an implementation of a voltage mode DCDC buck converter. The controller is based on the XTR-30011 PWM controller and the power part (driver & power MOSEFTs) is chosen from the XTR20410 or XTR20810 families.

The purpose is not to explain how to size each element, but to give information for the board implementation and for the test of such board.

BUCK CONVERTER SCHEMATIC AND CRITICAL POINTS

Schematic

Figure 1 shows the schematic of the proposed DC-DC Buck converter. It is based on a XTR30011 PWM controller and two XTR2041x N-MOS power transistors with integrated driver. All other components are passive parts. The shown schematic supposes a maximum input voltage of 30V, but it can be extended to 50V provided XTR2081x devices are used as power elements.

The choice of the specific XTR2041x part used depends on the required output current range. As they all have the same pinout and package size, the PCB will be sized for the highest voltage & current level.

This demonstrator allows different operation mode thanks to the terminals SYNC, PSkipTh and DCLimit as well as settings on switches controlling ENABLE, PSkipEn, AsyncEn and LPMode, together with several optional passive components (represented in green and orange in Figure 1). See XTR30010 datasheet for an explanation on each functional feature.

The demonstrator also gives access to circuit outputs (PGood, CKOUT) as well as several test points (in dark red) to monitor the good operation of the converter.

The schematic shown in Figure 1 shows optional passive components in different colors. **Orange** devices must be shorted if not present. **Green** devices must be left open if not used.

Table 1 at the end of this document provides typical values for each passive element required for this board.

General Recommendations

Printed Circuit Board

- High temperature compliant (Polyimide or Rogers, Tg=260°C or higher)
- Use four (4) copper layers for routing with intermediate GND plane. The second inner layer should be used for VIN and VDD distribution.
- Copper thickness 35µm.
- Be careful with vias at high temperature when more than 2 layers. These vias could deteriorate when soldering components (i.e. bad contact if connected to middle layer).
- Implement wo ground planes (GND & PGND) that will have to be connected only in one point (with a zero resistor that can sustain large current). Outside of this common point, the PCB can include the possibility to connect several decoupling capacitance between both half ground planes GND & PGND.
- Add various GND and PGND test points all over the board for easy connection of a probe grounds.
- The PCB can see DC & switched voltages up to 80V.
- Use of labels on the PCB to clearly identify tespoints.
- For EMI considerations, avoid loops and be very clean with ground planes.
- Prefer SMD components whenever possible
- For through hole parts, consider soldering on both sides.
- Give flexibility on the PCB for Lout and Cout (several fingerprints).
- Think about the possibility to relax thermal/mechanical constraints on the PCB.
- Keep distance between wires that are at very different voltage level.
- No soldering of passive element under the ICs.
- Finishing of the outermost copper layers should be NiAu or other high temperature compatible finishing.

Specific Nodes

- The PCB lines corresponding to thick lines in the schematic must be large enough for the output current level required.
- The source and drain terminals of the XTR20401x devices must be sized according this current level.
- Pay special attention to the routing and laying out of the SW node. This node see high dV/dt and dI/dt giving rise to high current and voltage spikes if the parasitic capacitor and inductance are large. The life of the output transistors and drivers strongly depend on how neat this node is laid out.
- The PVDD and PGND terminals of the XTR30011 must be compatible with peak currents of 1A and minimize parasitic inductance in series with these terminals.
- The recommendation just above applies also for signals HDrv and LDrv.

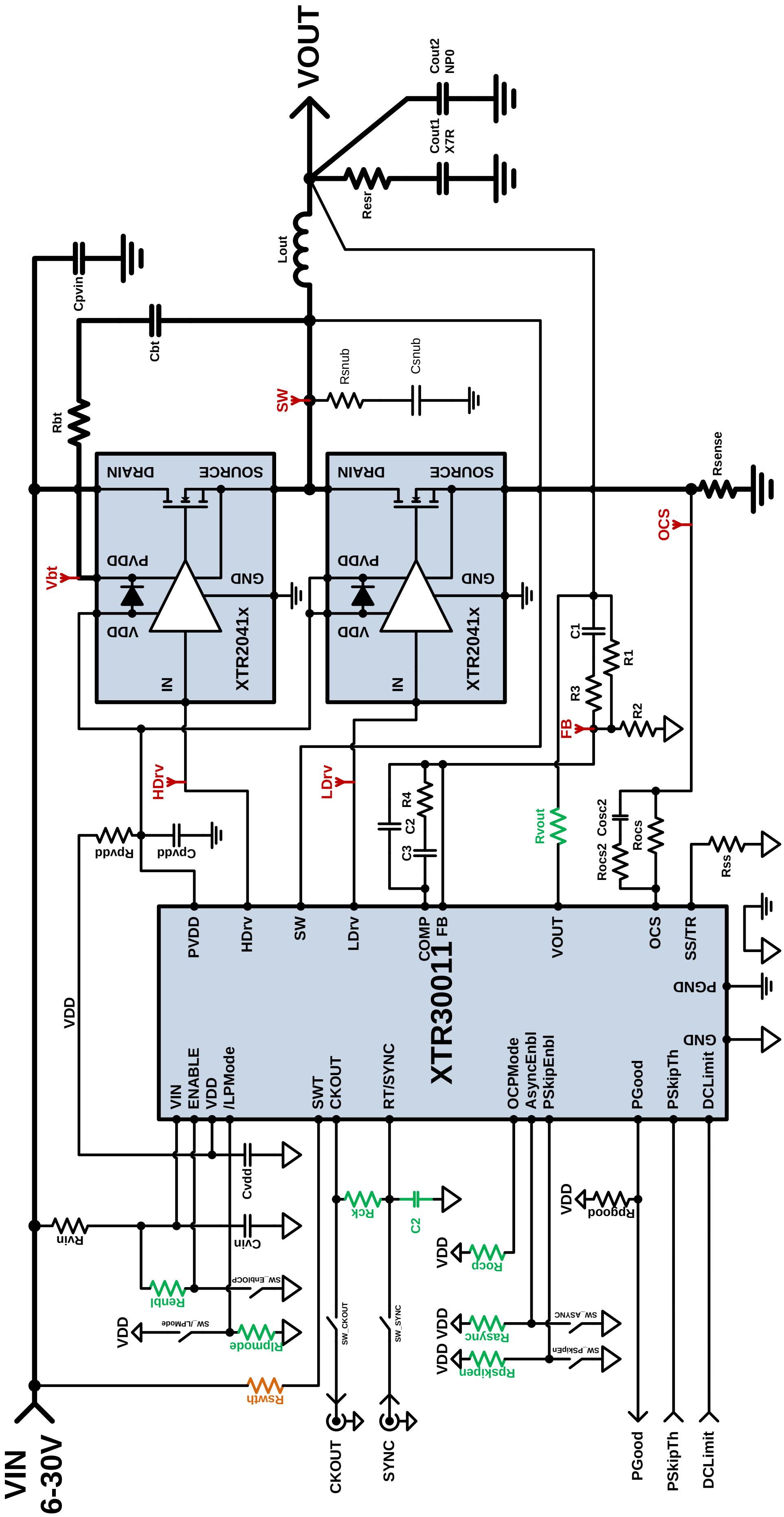

Figure 1. : Implementation of a Buck converter based on XTR30011 & XTR2041x

Name	Typ. value	Rating	Comments
Rvin	10	0.25W	
Rswt	TBD	0.25W	An external resistor can be added in series with the internal 150kOhm.
Rck	TBD	0.25W	Used to increase the frequency of the internal oscillator. Left open if not used.
Rpskipth	0	0.25W	Left open if not used.
Rpvdd	10	0.25W	
Rocs	2.4k	0.25W	For a current limit of 1.2A
Rocs2	0	0.25W	To be increased based on the time response of the signal on the OCS node.
Rbt	1	0.25W	Low inductance.
Rsnub	680	0.25W	Low inductance.
Resr	0	0.5W	Low inductance.
Rsense	0.1	2W	Low inductance.
R1	100k	0.25W	
R2a	27k	0.25W	
R2b	4.7k	0.25W	
R3	5.6k	0.25W	
R4	33k	0.25W	
Renbl	100k	0.25W	Used to reinforce internal pull-up in case of noisy board. Left open if not used.
Rpskipen	100k	0.25W	Used to reinforce internal pull-up in case of noisy board. Left open if not used.
Rasyncen	100k	0.25W	Used to reinforce internal pull-up in case of noisy board. Left open if not used.
Rocp	100k	0.25W	Used to reinforce internal pull-up in case of noisy board. Left open if not used.
Rlpmode	100k	0.25W	Used to reinforce internal pull-down in case of noisy board. Left open if not used.
Cvin	220n	100V, X7R	
Cvdd	2.2u	7V, X7R	
Cpvdd	100n	7V, X7R	
Cpvin	10u	100V, X7R	
Cbt	100n	10V, X7R	
Csnub	47p	100V, X7R	
Cout1	10u	7V , X7R	
Cout2	100n	7V, NP0	
Cck	TBD	7V, NP0	Used to decrease the frequency of the internal oscillator. Left open if not used.
Cocs	47p-100p	7V, NP0	PCB layout dependent. To be optimized based on actual the signal measured on the OCS node.
C1	120p	7V, NP0	
C2	0	7V, NP0	
C3	330p	7V, NP0	
Lout	10u	10A-20A	

Table 1 : Passive components description for the Buck DCDC demonstrator

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