Introduction to Simulation Model - Infineon Designer

Embedded Power TLE986x_7x Charge Pump

About this document

Scope and purpose

This document outlines Embedded Power TLE986x_7x Charge Pump block main features by means of its digital twin, referred to as simulation model, in typical application setups aiming to be an easy, time efficient and cost reduction solution for exploring device capabilities and integration in complex applications.

Information covered in this document does not substitute datasheet content and shall be regarded as complementary to it. For a more precise description of the device and its features, please consult the datasheet.

Intended audience

This application note along with the simulation model itself offers an interactive solution targeted for anybody who aims to explore the functionality and “what if” scenarios for TLE986x_7x Charge Pump block.

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1 Embedded Power TLE986x_7x Charge Pump

Infineon has combined its wealth of experience in motor control drivers for automotive applications with all the benefits of an industry-standard core. The unique result, our 3rd Generation Embedded Power IC based on ARM® Cortex®-M cores, addresses a wide range of smart 3-phase brushless DC motor control applications like fuel pumps, HVAC fans, engine cooling fans, electrical water pumps. The TLE987x family offers scalability in terms of flash memory sizes and MCU system clock frequency supporting a wide range of motor control algorithms, either sensor-based or sensor-less. It uses the same MCU and peripherals as the TLE986x family, 2-phase driver, enabling design synergies between DC and BLDC motor control applications.

The available online circuits are listed below:

- 12V Automotive – Motor Control – Embedded Power IC TLE986_7x (Embedded Power) – supply and load transients

Click here to open the circuits.

2 Simulation model features

- Perform transient simulations: observe and analyze transient device response to different stimuli. The number of stimuli and probes is unlimited.
- Measure the device electrical parameters in typical conditions with increased precision at small resolution (e.g. 100 ns/1 µV/1 µA).
- Integrate the simulation model in complex application and explore new possibilities.
- Explore main features of the real device (for more details consult the datasheet): shortest time to obtain results, zero error cost (no harm to physical components), can be done by anyone (engineers, students, etc.):
    - Output voltage of the charge pump dependency with load current and supply voltage modeled within the nominal datasheet range
    - Spread spectrum modulator and dithering parameters to control the internal frequency can be adjusted from model parameters FCP_DITH_LOWER and FCP_DITH_UPPER
    - Change the charge pump output voltage setting between 9V and 14V
        - VCP9V_SET=0 for 14V
        - VCP9V_SET=1 for 9V
    - Adjust fSYS clock frequency via FCP_CLK parameter; range 5MHz - 40MHz
    - Enable/disable internal clock via CPCLK_EN logic pin: 0V for disable, 1V for enable
    - Efficiency dependency with load current and supply voltage modeled within the nominal datasheet range
    - Output voltage ripple variation with different charge pump capacitors values
- Simulation model does not cover all features of the real device in order to keep the usability and simulation speed in a reasonable range:
    - No thermal behavior implemented
    - No ESD, EMC, AC and Monte Carlo analysis simulation capability
    - Possible convergence issues for using DC sources, steep ramps or high frequency sources within the setup.

Details on the implementation

Internal registers controlling different features have been emulated with either voltage sources available as virtual pins on the symbol or global parameters available attached to the symbol. The binary value associated to each register is given directly in decimal value.

For exact register name and values for parameters configuration, please consult the TLE986x/7x User Manual available on product web site.

3 Model performance

3.1 Line voltage and load current variations – transient

This test bench is configured to test the charge pump reaction to different combinations of supply voltage and load current. Battery voltage and load current is changed during time between different levels and with certain slew rates while the VCP output voltage reached steady state.

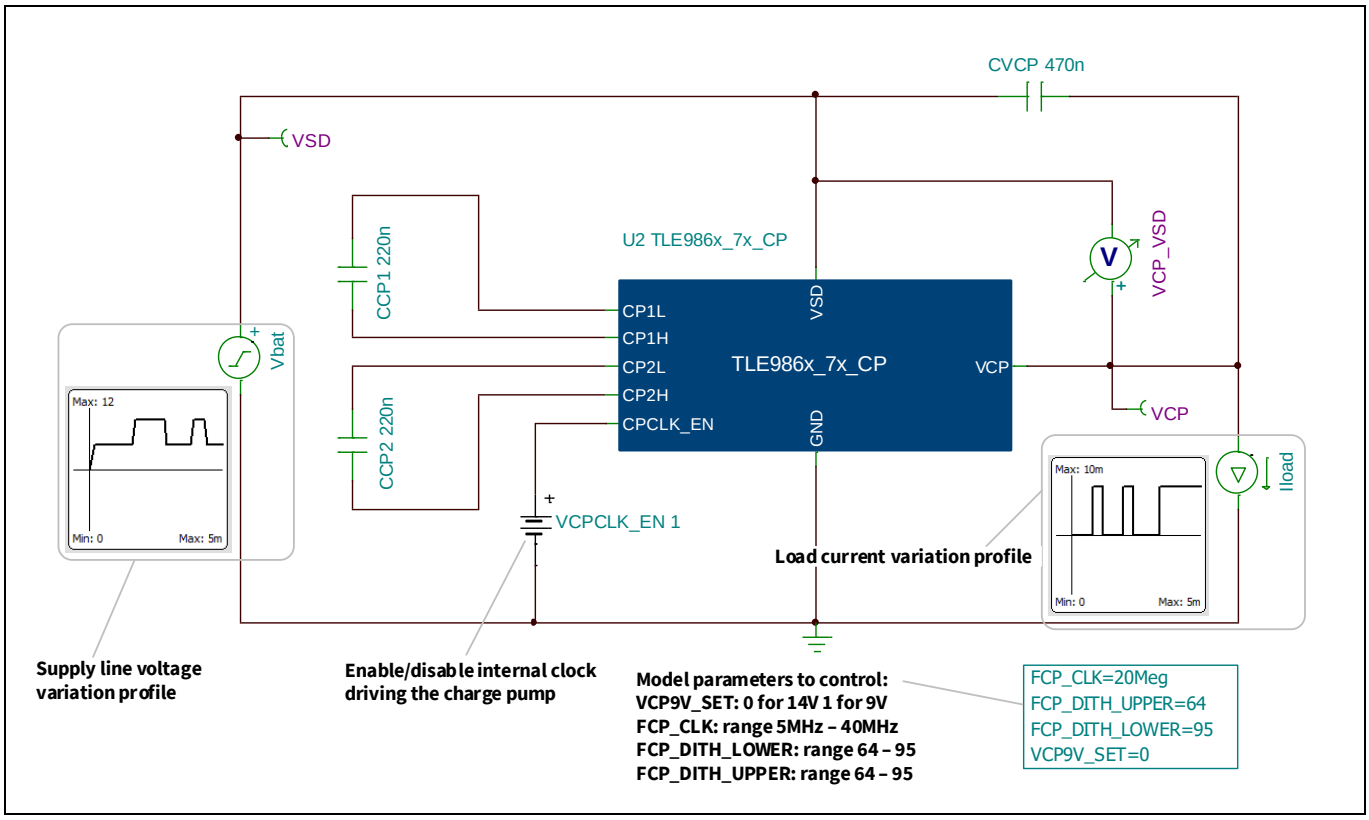

Figure 1 Test setup for PWM mode click to open

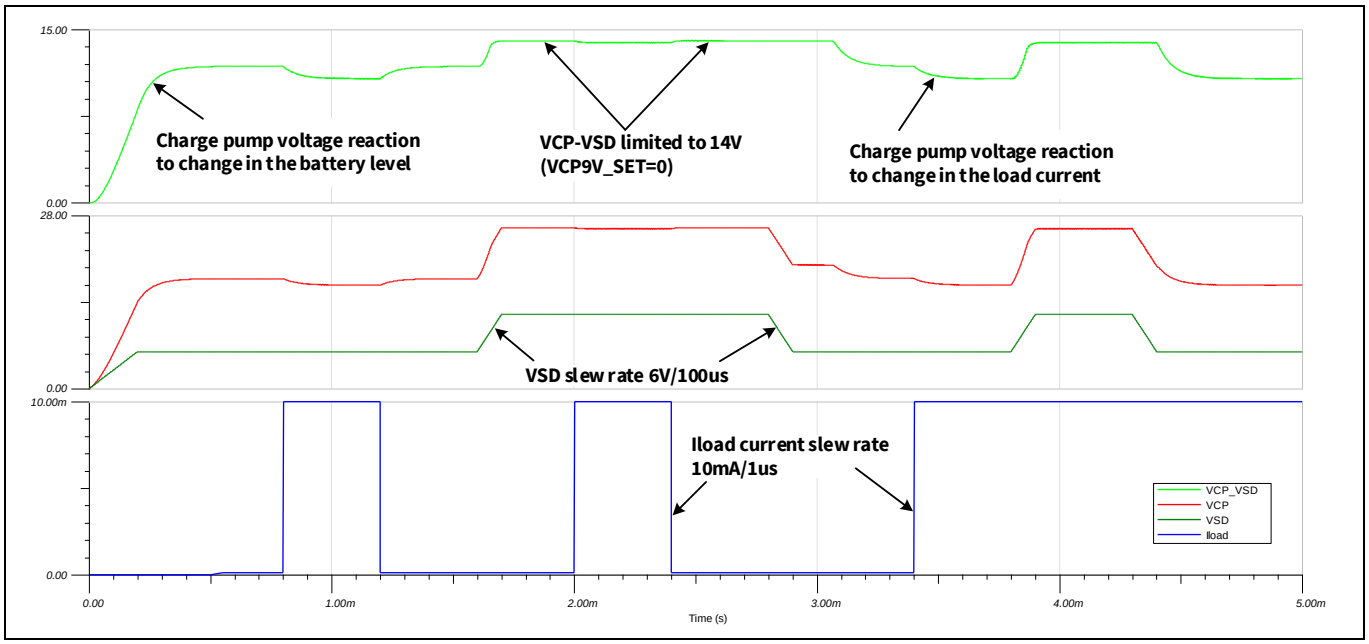

Figure 2 Simulation results

4 Revision history

Document version	Date of release	Description of changes
Rev.1.00	2020-07-29	Initial version created

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