Three phase inverter schematic

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This page is a quick-start guide to build a 3 phase inverter using imperix’s high-end control hardware for power electronics. It is specifically made to accompany users who want to get familiar with imperix’s solutions and build their first converter with the B-Box RCP using the Simulink blockset. The converter is built using an imperix power electronic bundle, but other equipment configurations can also be used. For details on how to assemble a power converter in an open rack, please refer to How to build a buck converter (PN119).

This guide will focus on the implementation of a 3 phase inverter with open-loop generation of 3 phase sinusoidal currents in a resistive load. The topology of this converter is shown in the following diagram. It is simply made of three half-bridge modules, each connected to an inductor in series with a resistor.

The power electronic bundle contains all the required imperix hardware to build a 3 phase inverter. Alternatively, the individual components are listed below. The list comprises imperix products as well as additional components commonly available in power electronic research laboratories:

Starting on the front face of the bundle, the first step is to connect the ethernet port of the B-Box RCP to the computer’s local network or directly to the PC, to later be able to upload code to the B-Box. Then, as shown in the schematic below, one needs to connect the optical fibers, for PWM signals, from the B-Box RCP to the three modules. The sensors’ measurements are retrieved by connecting RJ45 cables from the modules to the analog inputs of the B-Box RCP. In this case, the DC bus voltage, as well as the three leg currents, are measured.

On the back of the bundle, the power supply is connected to the modules’ DC+ and DC- power terminals. Then, the middle point of each module is wired to an inductor which is then connected to one of the resistors. The three resistors are then connected together in a star configuration.

To be able to properly retrieve the measurements, the analog input channels of the B-Box RCP need to be configured properly (more information on the analog front-end configuration of the B-Box RCP can be found here: Analog front-end configuration on B-Box RCP). The following parameters need to be configured:

Before doing any experiments, it is essential to always properly configure the protection thresholds of the B-Box analog input for safety reasons. Their purpose is to block the PWM outputs which immediately stops the operation of the converter in case of unexpected high voltages or currents.

The equation:(l = s*G*m)is used to compute the analog input threshold, with l being the input"s limit high/low, s the sensor"s sensitivity, G the analog gain, and m the maximum/minimum real current or voltage value. The following table summarizes the measurement ranges (according to the previously defined operating

point) and the sensor"s sensitivity.

The measuring ranges involved allow for an analog input gain of x4 on all of the controller’s channels. Using the aforementioned formula the analog input limits are computed with some margin to avoid unwanted trippings. The chosen maximum output current is then set for 15A meaning a front panel limit of 3V. The DC bus voltage is chosen to be limited to 250V which gives 5V for the front panel limit. The configuration of the four analog input channels is summed up in the table below.

Two pieces of software are required to develop the B-Box control code. The imperix Automated Code Generation Software Development Kit (ACG SDK) can be downloaded here. Besides, a compatible version of Matlab (2016 and newer) is required as well as the following toolboxes:

The control model to implement a simple open-loop control of the output current is given below as well as step-by-step instructions on how to create it. To go further and implement closed-loop current control of the inverter, please refer to TN105.

One could then connect the 3 phase inverter to the grid and replace the DC power supply with a photovoltaic panel with a boost stage, to form a Three-phase PV inverter for grid-tied applications and showcase the great potential of imperix’s solution for modular power converters.

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Web: https://sumthingtasty.co.za/contact-us/
Email: energystorage2000@gmail.com
WhatsApp: 8613816583346