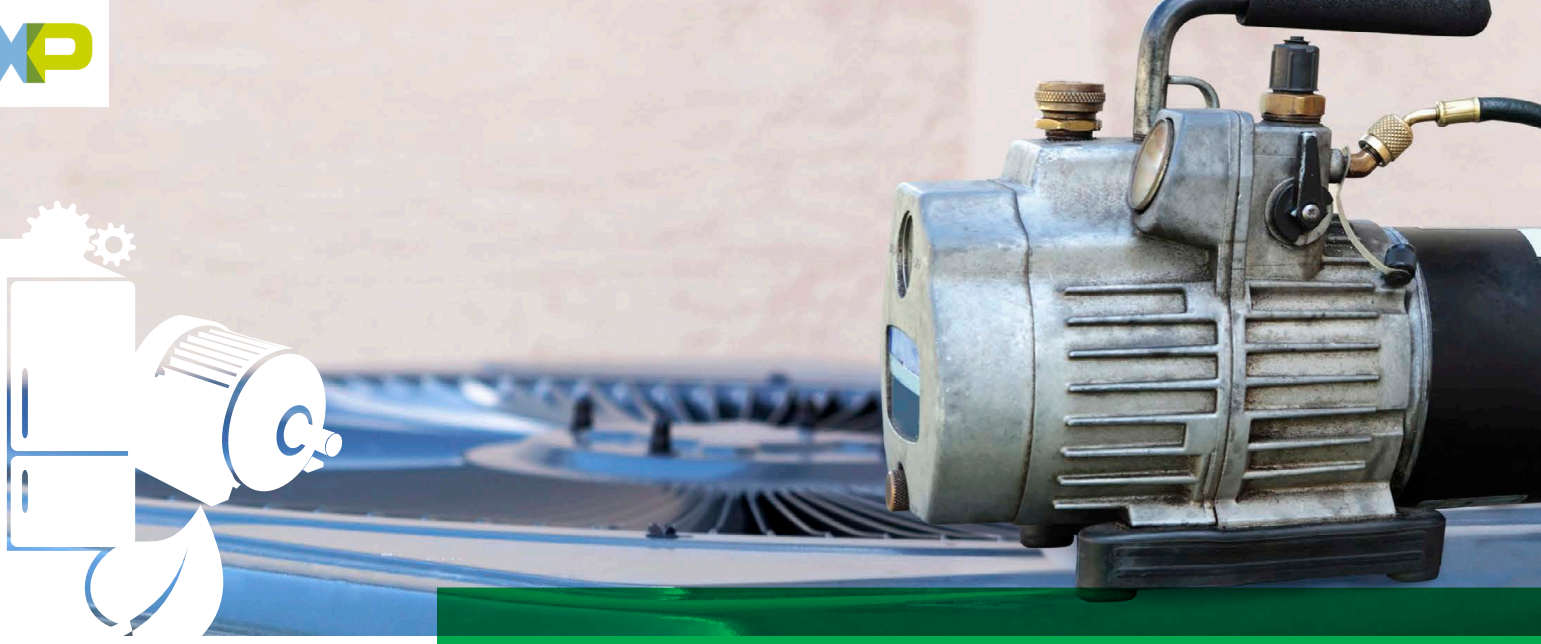


Fact Sheet

Dual Sensorless PMSM FOC with PFC Reference Design

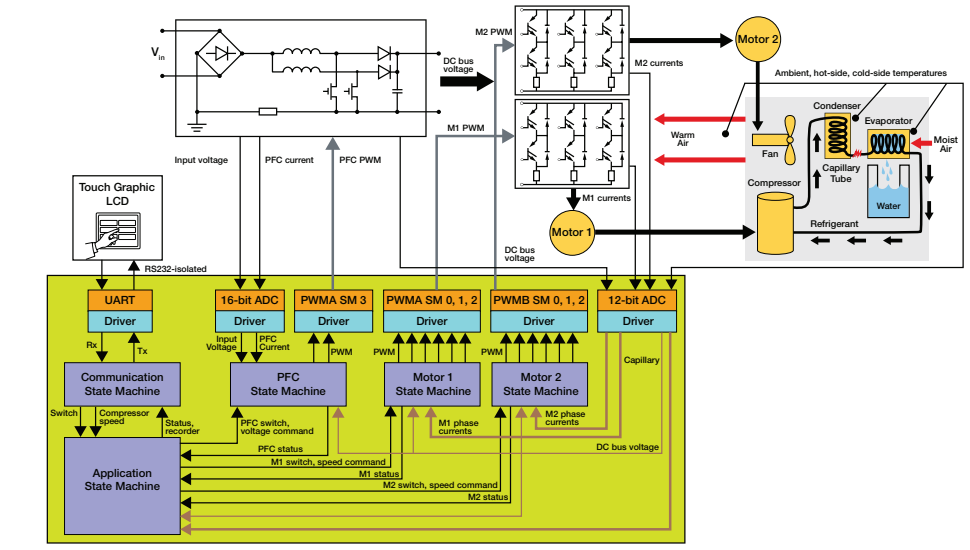
Target Applications

- Refrigeration systems
- Air conditioning

Overview

Advancements in motor control require new techniques for increased efficiency and increased integration to reduce costs. This reference design provides a three-in-one solution with advanced motor algorithms, running both a compressor motor and a fan motor with power factor correction (PFC)—all in a single MCU.

Dual Sensorless PMSM FOC with PFC Reference Design



Freescale Technology

Features

- Vector control of sensorless PMSM
- Vector control with speed-closed-loop
- Rotation in one direction (possible for both)
- Start from any motor position with rotor alignment
- Four-quadrant operation
- Sensorless position and speed estimation
- Three-shunt current sensing
- Wide speed range
- Interleaved PFC control
- Serial inter-board communication
- Touch graphic LCD control interface
- Application monitoring speed, voltage, current, temperature and three-phase current scope

Dual Sensorless Motor Control

Freescale's digital signal controllers (specifically MC56F84789) provide enough timing channels and ADCs to operate two 3-phase motors simultaneously while executing a back EMF algorithm that is tailored to both the compressor and the fan, enabling sensorless control. This removes the need for a position sensor and an additional MCU and reduces the overall cost of the solution.

Power Factor Correction (PFC)

Typically PFC is a function handled by an additional external IC, however this reference design has integrated the function into the digital signal controller due to its outstanding performance capabilities. The PFC profiles the consumed current to be sinusoidal in phase with the power line voltage.

Field-Oriented Control (FOC)

Vector control (also called field-oriented control) is an elegant method to control a PMSM, where field-oriented theory is used to control space vectors of magnetic flux, current and voltage. It is possible to set up the system coordinates to decompose the vectors into a magnetic field-generating part and a torque-generating part. The structure of the motor controller is then almost the same as a separately excited DC motor, which simplifies the control of a PMSM. This technique, used with a properly designed motor, provides improved efficiency and quieter operation than traditional implementations.

Permanent Magnet Synchronous Motors (PMSM)

PMSMs are desirable due to their higher efficiency and better power density compared to traditional motors. There is no excitation needed because the motor magnetic flux is generated by permanent magnets placed on the rotor.

Freescale Embedded Software and Motor Control Libraries

Most dedicated algorithms such as transformations, PI controllers and space vector modulation are implemented using Freescale Embedded Software Libraries (FSLESL). These libraries provide a jump-start for designers implementing their control architecture.

Touch Graphic LCD

The reference design has added an HMI interface using Freescale's Kinetis K70 MCU with full capacitive touch and an integrated LCD controller, providing the framework for the consumer's next-generation, cost-effective, high-efficiency, low-noise, variable-power advanced refrigeration system.

Software Tools

FreeMASTER is a free debugging tool used to evaluate variables while the motors operate and also supports the Motor Control Application Tuning (MCAT) tool that enables the control parameters of the application to be set up easily. Using this tool, the user can modify the parameters of control loops which change the properties of the control process. The control reaction for these parameter changes can be triggered and visualized using the FreeMASTER recorder functionality.

For current information about Freescale motor control products and documentation, please visit freescale.com/motorcontrol

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