

# Software Solution for Variable Speed Control Drives

**Client:** Manufacturer of HVAC products  
**Location:** USA

## Client Description

The client is a Fortune 500, full-line, global manufacturer of heating, ventilating, air conditioning and refrigeration (HVAC&R) products. The company is the third largest manufacturer and marketer of such products in USA and one of the leaders in the HVAC&R industry internationally.

## Business Need

The move towards increasing the power efficiency of HVAC equipment has driven manufacturers towards use of Variable Speed Drives to control the motors in their equipment. The client wanted to design and develop the hardware and software for a Variable Speed Drive. The software was to include a Closed-Loop-Control system for the boost rectifier and an Open-Loop-Control System for the Inverter sections of the Drive. To further improve on the operating characteristics, the advanced Space Vector Modulation (SVM) algorithm was to be used instead of traditional PWM methods.

## Solution Offered

Blue Star Infotech's (BSI) project team utilized its Integrated Product Development Methodology that would allow the client to develop the hardware while BSI developed the software.

BSI worked jointly with the client in the selection of the DSPs for this system.

The testing strategy involved testing the various algorithms, and complex closed loop control routines. BSI tested the system using a 3 tier approach: testing on evaluation board, testing on target hardware board using test boxes (closed and Open loop) and testing on actual control systems driving the HVAC motor.

The heart of the system is the Texas Instruments Digital Signal Processor (DSP-TMS320LF2407A). The BSI team relied on its domain knowledge in control systems and DSP to develop the DSP based software to control the Variable Speed Drive systems of a HVAC motor. The software implemented various features in addition to controlling the speed of the motor. The features included fault protection, fault diagnostic, surge detection and parameter display on the micro panel.

Fast execution speed was one of the very critical elements in this system; the VSD hardware system was designed using two DSP processors because of their high processing speed. The inputs to the DSP were from external ADC and CPLDs used. The software was designed with the entire Closed Loop Control executing from main DSP and Open Loop Control executing from second DSP. The communication between the two DSP was established using the synchronous channel. The Micropanel communication was established using the MODBUS protocol.

A key performance requirement was to execute all the complex algorithms required for Closed Loop Control within 100µs since the switching frequency for the power circuitry was 5khz as per client design. Based on its analysis, BSI implemented the closed loop module using assembly language and this significantly improved the execution speed.

## TECHNOLOGY

- Micropanel communication using MODBUS
- Target Board based on two TI TMS320LF2407A DSP
- XDS510 JTAG ICE development and debugging tool
- Code Composer Studio
- Two Evaluation boards from Texas Instruments

## Benefits to the Client

- The implementation of new modulation techniques contributed to energy savings of nearly 30% to the client's end customers.
- The algorithms that were developed could be re-used across other variable speed drive products resulting in significant cost and time savings for developing solutions for other VSD products.

### For more information about Blue Star Infotech:

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