Final Report Page

Table of Contents

Conops

FSR

ICD

Schedule/Validation

Subsystem reports

Mackenszie

Drew

Aidan

Ryan

Subsystem Report Page (Power Subsystem)

Table of Contents

List of Tables

List of Figures

Introduction

The power subsystem of the VFD motor control is responsible for supplying power to both an AC induction motor and the entire system. It is designed to operate with 208 VAC three-phase power and has been tested to ensure safe and reliable performance. The following sections present an analysis of the subsystem's operation and validation.

Rectifier + DC Link

Operation

A rectifier converts AC to DC, while a DC link filters the output. In Figure #, the rectifier schematic is shown. First, a power input connector receives the desired three-phase power. Next, a set of capacitors in parallel with varistors is connected across each phase. The capacitors filter the voltage to reduce noise, and the varistors provide protection against voltage surges. Finally, a full-wave rectifier converts the AC to DC.

Figure #. Rectifier Schematic

In Figure #, the dc link schematic is shown. First, a fuse provides protection against overcurrent. Next, a varistor in parallel with a set of capacitors is connected to ground. The varistor provides protection against voltage surges, and the capacitors filter the voltage to reduce noise.

Figure #. DC Link Schematic

Validation

The rectifier and DC link were validated by supplying an input AC voltage and measuring the output DC voltage, as shown in Figure #. While the integrated system is designed to operate at 208 VAC, the validation testing was conducted at 10 VAC. The three-phase AC was generated using three waveform generators, with phase A and phase B values in Figure # and phase C values in Figure #. An amplitude of 3.536 Vrms was used per Equation # to produce the desired voltage. Additionally, each phase was offset by 120 degrees to simulate a three-phase system, with phase C further adjusted due to the waveform generators not being synchronized.

Figure #. Rectifier + DC Link Picture

Figure #. Input Phase A and Phase B

Figure #. Input Phase C

Upon measuring the input AC waveforms shown in Figure #, the green (phase A), blue (phase B), and purple (phase C) sinusoidal waves demonstrate a phase shift of 120 degrees and an amplitude of 10 VAC. Furthermore, the measured DC output is 9.6 VDC with 600 mV of noise. This differs slightly from the expected output of # VDC calculated using equation #. This discrepancy can be attributed to the forward voltage drop across the rectifier diodes and losses within the rectifier and DC link circuitry. Despite these factors, the measured value remains within an acceptable range for the system's operation.

Figure #. o-scope input 3 phase and output dc

To verify these findings the test was repeated at an amplitude of

Figure #. multimeter at different voltage

Power Control

Operation

Validation

Power Conversion: 3.3V/iso5V

Operation

The 3.3 V to Iso-5 V power converter converts 3.3 VDC to isolated 5 VDC. In Figure #, the 3.3V/ISO\_5V converter schematic is shown. First, an input connector receives the input 3.3 V. Next, a set of capacitors in parallel is connected to ground to filter the voltage and reduce noise. Then, a power converter steps up and isolates the 3.3 V to 5 V. Finally, another set of capacitors in parallel is connected to ground to filter the voltage and reduce noise.

The 3.3 V to Iso-5 V power converter was validated by supplying an input voltage and measuring the output voltage, as shown in Figure #. The validation testing was conducted at the operating voltage of 3.3 V and was generated using a DC power supply with the values in Figure #. The amperage of 0.04 A was used per the average operating current in the datasheet.

Upon measuring the input 3.3 V shown in Figure #, the green horizontal line shows an amplitude of 3.2 V with 400 mV of noise. Furthermore, the measured output is 200 mV with 400 mV of noise. This differs greatly from the expected output of 5 V. This discrepancy can be attributed to a missing trace between the converter pin 3 and ground.

The 15 V to Iso-15 V power converter converts 15 VDC to Isolated 15 VDC. In Figure #, the 15V/ISO\_5V converter schematic is shown. First, an input connector receives the input 15 V. Next, a set of capacitors in parallel is connected to ground to filter the voltage and reduce noise. Then, a power converter steps up and isolates the 15 V to 15 V. Finally, another set of capacitors in parallel is connected to ground to filter the voltage and reduce noise.

The 15 V to Iso-5 V power converter was validated by supplying an input voltage and measuring the output voltage, as shown in Figure #. The validation testing was conducted at the operating voltage of 15 V and was generated using a DC power supply with the values in Figure #. The amperage of 0.11 A was used per the average operating current in the datasheet.

Upon measuring the input 15 V shown in Figure #, the green horizontal line shows an amplitude of 15.1 V with 600 mV of noise. Furthermore, the measured output is 15.3 V with 800 mV of noise. This aligns greatly with the expected output of 15 V. To further validate the power converter, its performance was measured across its full range. In Table #, the current was kept constant while the voltage was incrementally increased. In Table #, the voltage was kept constant while the current was incrementally increased. The power converter behaved as expected for its full range of voltage and current values.

Validation

Power Conversion: 15V/iso15V

Operation

Validation

Conclusion