

Case	Application: Delta C2000 Series AC Motor Drive and AFE2000 Active Front-End Unit for Bridge Crane (Overhead Travelling Crane)				
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Applicable to	C2000 series AC motor drive, AFE2000 series active front-end unit				
Key words	crane, hoist, Delta AC motor drive, high-level field oriented control, built-in PLC, torque control, reliability, AFE2000 active front-end, power quality, power improvement, power factor, harmonics, fast braking, brake resistor, current control PWM converter, switch rectifier, energy-saving				

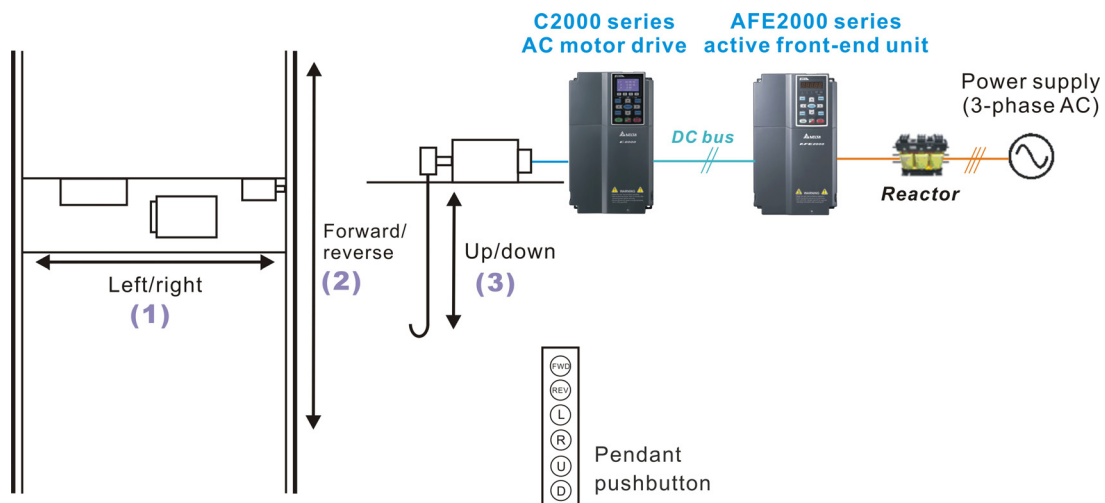
Introduction

A bridge crane (also known as an overhead travelling crane) finds wide application in warehouses, factories, docks, open storage yards, and more. A three-phase induction motor offers many benefits including simple structure, durability, low cost, and easy maintenance. If we employ a Delta AC motor drive to drive the induction motor rather than using a traditional drive, the crane's malfunction rate decreases substantially. Moreover, if Delta's AFE2000 series active front-end unit is employed, it saves the cost of purchasing a brake resistor and excessive energy is transformed into reusable energy through IGBT switch, which is fed back to the mains for other electronic devices. Delta's AC motor drive and AFE2000 is an outstanding combination for bridge cranes.

Application

The bridge crane moves back and forth with four driving and passive wheels, but when the starting load is large, it is common to install more wheels to share the wheel load. An articulated device is needed for bridge cranes with more than four wheels. The device's function is to balance out the load and distribute it evenly to each wheel. The motion is done by three independent pulling systems, as shown in [Figure 1]:

1. Trolley: To execute leftward and rightward movement along the cross-axis bridge (left/right).
2. Endtruck: To execute forward and backward movement along the long-axis runway (FWD, REV).
3. Hoist: To lift and lower the item (up/down).



[Figure 1]

The bridge crane hoist, unlike the trolley and the runway girder, has lower requirements for precision control, and it benefits a lot from the AC motor drive. Different from traditional drives, an AC motor drive offers more thorough

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safety protection and additional features such as large load inertia and 4-quadrant operation. The suggested AC motor drive and the active front-end unit model for the bridge crane are:

- ◆ VFD → VFD110C23A
- ◆ AFE → AFE075A23A + CHOKE: 2.1mH

Application Case



System Solution

For bridge cranes, the Delta C2000 series AC motor drive has taken overload problems and long-term system stability issues as target factors and offers excellent features such as:

1. Full vector control. Supports starting torque up to 150% rated torque at a low frequency of 1Hz in steady motion.
2. Optional braking unit is available to perform 4-quadrant operation.
3. Constant torque at full speed range
4. With AFE2000, regenerative energy is converted by AFE2000 into reusable energy (clean power) and fed back to the mains.

System Features

- ◆ SVC control

The Delta C2000 provides sensorless vector control (SVC) to perform a nearly close-loop control function which saves from purchasing an encoder and lowers maintenance cost. In addition, it overcomes activation difficulties, and is capable of initiating a start-up under full load and short-term over-load conditions.

- ◆ Braking process control

Prevention of sudden drops and jerky movements is an important factor in overall bridge crane system design. The coordination between the AC motor drive and the mechanical control should be rigid to prevent sudden drops and jerking, especially when lifting or lowering a heavy load and when stopping a heavy load in mid-air. The Delta C2000 series offers a special set of parameters and multiple output commands to promptly solve the problem.

- ◆ Overload capacity

Normal load: rated output current 120%/min; Heavy load: rated output current 150%/min. This offers sufficient start-up torque and maintains the DC Bus voltage at 730VDC when torque decreases and it will not trigger OU alarm. The test report reveals the system allows the bridge crane to operate long-term

- ◆ Soft-start, soft-stop, wide speed range and precise positioning.

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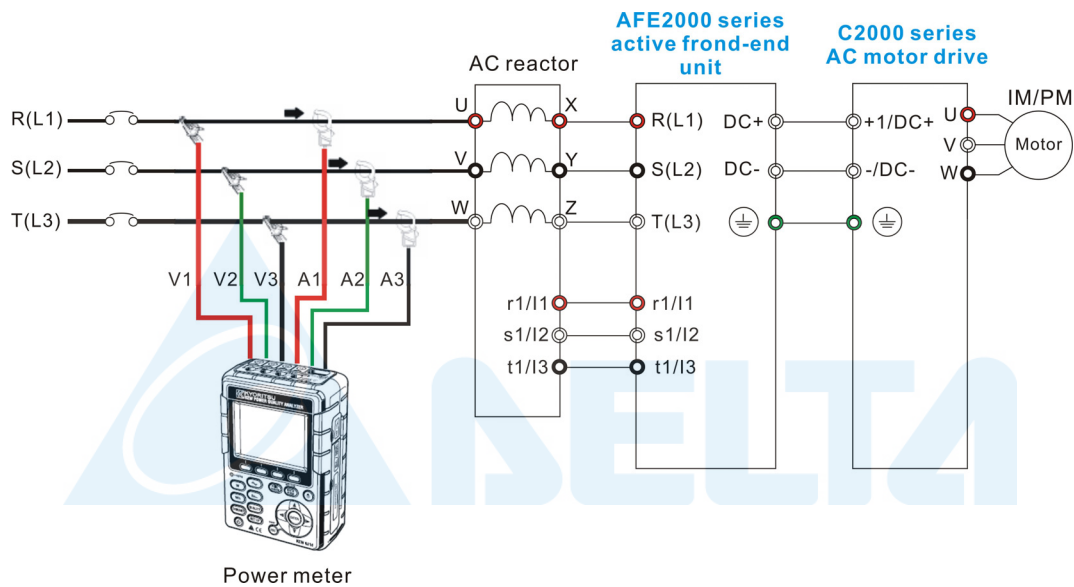
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- ◆ Full torque output at zero-speed. No sudden drops or jerky movements when the braking unit is not working, which ensures safety and system reliability.
- ◆ Quick dynamic response, no sudden drops or jerky movements
- ◆ Modular design of force-cooling fan for heat dissipation. The modular design makes it easy for fan cleaning and replacement.
- ◆ Active Front End Unit



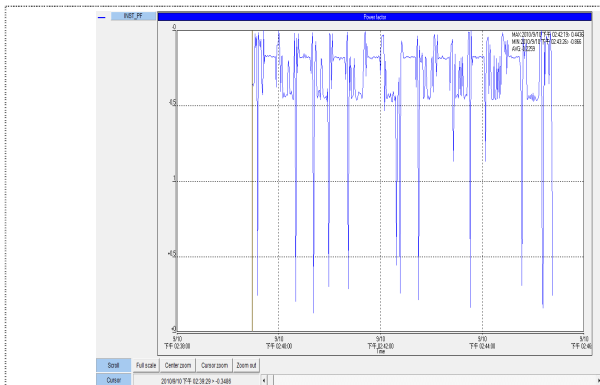
The Delta AFE2000 series is a substitute for traditional heat dissipation methods. It converts regenerative energy into reusable power and feeds it back to the mains, and allows the AC motor drive to operate in four quadrants to decrease power consumption. It provides innovative, clean and efficient energy solutions for a better tomorrow.

Experiment Results

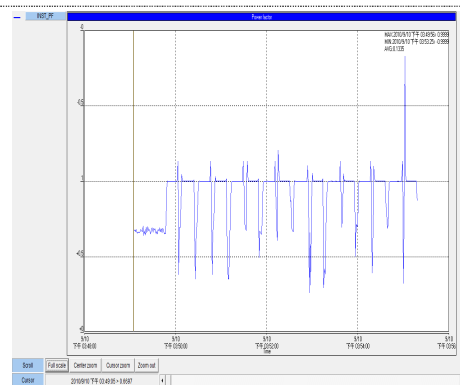


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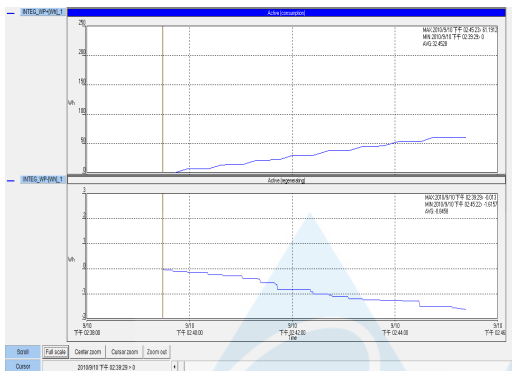
$$\text{Energy Saved} = \frac{(10,000\text{VA} - 3,000\text{VA})}{10,000\text{VA}} \times 100\% = 40\%$$



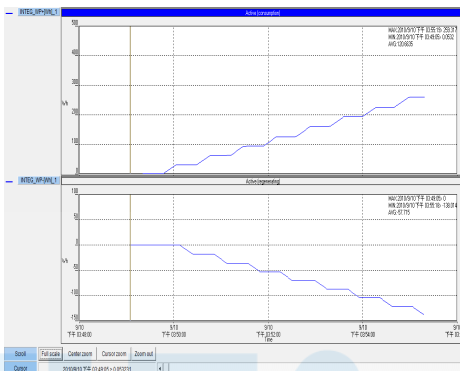
PF = 0.2 ~ 0.4



PF = 0.99



WP+ = 61.1912Wh
WP- = 0.0133Wh



WP+ = 259.317Wh
WP- = 138.014Wh

Delta's intelligent C2000 AC motor drive and AFE2000 active front-end unit with their larger power and energy-saving ability offer stunning performance for bridge crane applications.

Delta has built an excellent reputation in the industrial automation market for its AC motor drive technology and continuous innovation. We have successfully developed our newest AC motor drive, the C2000 series. The bridge crane application shows the C2000's SVC control using the auto-tuning function to accurately obtain the motor's inductance value and resistance value. Precise calculation of slip deviation enables larger torque output for heavy loads. Also, system stability is easily attained without speed sensors which makes the wiring for motor and drive less complicated, and the control ratio is up to 1:100 (if the rated speed is 60Hz, the best speed control range is 0.6 ~ 60Hz). This function is applicable to the treadmills, elevator doors, circular knitting machines and cranes.

The Delta C2000 provides sensorless vector control (SVC) to perform a nearly close-loop control function which saves on purchasing an encoder and lowers maintenance cost. Compared with the traditional V/f control, the SVC offers better performance for low speed operation, larger starting torque, and speed response to load increases and decreases is faster. All these benefits allow cranes to activate easier for high friction and inertia load conditions. The SVC control technology has been widely adopted for constant torque application. The Delta C2000 series AC motor drive provides you with SVC control to overcome difficult crane start-ups at full load conditions.

Delta's AFE2000 series active front-end unit not only improves electricity supply quality but also generates re-usable energy to slow down global energy consumption. Delta's mission has always been to provide innovative, clean and efficient energy solutions for a better tomorrow. We are proud to launch our AFE2000 series which can help you save up to 40% in energy use.

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Product Application

Industrial Automation BU, Delta Electronics, Inc.

Delta's professionalism and rich experience in industrial applications provides users with easy maintenance, a low failure rate and self-diagnosis features at a reasonable price, which enhances users' competitive advantage in the market.

For more information on Delta AC motor drives, please visit our website at:

http://www.delta.com.tw/product/em/drive/ac_motor/ac_motor_main.asp



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