2000

Test Stand Drive

UNICO

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Overview

UNICO's Test Stand Drive is an all-digital AC flux vector drive engineered for test stand and dynamometer applications. It consists of a UNICO 2000 Series Performance Vector Drive that incorporates software specifically designed for operating transmission test stands, engine dynamometers, engine test stands, component test stands, emissions dynamometers, and chassis dynamometers. The drive's revolutionary technology and modular design make it the ideal choice where superior performance, flexibility, and ease of operation are desired.

Software Features

Velocity Observer

A software velocity observer determines motor speed and acceleration with or without a motor transducer. When a transducer is not used, the observer estimates speed and acceleration using measured motor currents and voltages. Estimates are based upon a model of the motor and load using information measured automatically during initial drive setup. If a motor-mounted transducer is used, motor velocity and acceleration are measured directly down to zero speed.

Torque Estimator

A torque estimator feature eliminates the need for expensive and mechanically complicated torque-measuring devices. Using motor currents and voltages, the estimator calculates motor electrical torque, which can then be translated into the torque that would be measured by an in-line torque transducer if the appropriate inertia and friction information has been provided. This torque estimate may be output as an analog signal that can be used to replace load cells in many applications. The torque estimator functions down to zero speed.

Deadweight Calibration

For systems that rely on the torque estimator to provide a measure of motor torque, the drive provides the ability to deadweight calibrate the torque estimator output. Deadweight calibration is done by loading an arm attached directly to the motor shaft with calibration weights.

Fast Vector Rotator

A hardware/software option extends the speed range of the drive to accommodate the high motor speeds required by some test stand applications. A second digital signal processor (DSP) is added to the main controller to regulate the vector control of the motor. This enables the drive to update its AC sine wave output to the motor at rates approaching the switching frequency of the IGBTs. Frequency commands as high as 1,000 Hz (60,000 rpm for a two-pole induction motor) can be achieved.

Inertia Simulator

An inertia simulator makes it easy to test a unit under varying inertial conditions without the use of custom inertia wheels. The user specifies the amount of inertia to simulate, and the drive adjusts its torque command to the motor to make it appear as if the requested inertia were present at the motor shaft or at a given reference load point.

Design Features

Motor-Independent Design
A unique design incorporating a proprietary digital current regulator and a state-of-the-art controller allows the drive to operate any AC induction, AC synchronous, or brushless DC motor without the current-loop setup required by conventional drives.

Auto Tuning
Once routine electrical connections have been made, the simple-to-use auto-tuning features adjust virtually all motor and inertial parameters to the given motor and connected load. Simply enter a few values from the motor nameplate, and the advanced setup routines do the rest. The drive is completely tuned within minutes.

Modular Design
A modular bus design provides space, cost, and energy savings in many applications. The drive consists of separate rectifier and inverter units. The rectifier is comprised of a full-wave diode bridge, a bus-charging circuit, a dynamic braking circuit, and a capacitor bank. A fully regenerative front end is available as an option. The inverter consists of a six-IGBT, four-quadrant PWM amplifier that operates from the DC bus of the rectifier unit. High-power inverters are comprised of three separate poles.

Energy Savings
Multiple inverter units can be operated from one rectifier unit. This allows applications that naturally share regenerative energy, such as the power and load sides of a transmission test stand, to reuse the energy, rather than dissipate it as heat through resistors. Consequently, a much smaller rectifier is needed than would be required using two integrated drives. An inverter can be used in place of the rectifier to regenerate power to the power lines.

Power Quality
The drive incorporates a link choke to provide near-unity power factor and low harmonic currents at all motor speeds. A 12-pulse rectifier option is available to further eliminate harmonic currents in critical applications. When a regenerative inverter is used in place of the rectifier, unity power factor is achieved and virtually all harmonic currents are eliminated.

Optically Isolated Digital I/O
All digital inputs and outputs are optically isolated. Depending upon the controller, as many as 32 individually isolated digital I/O are locally provided, each of which can be programmed by the application to be an input or output. The voltage of each can be selected from a wide range of AC/DC values.

Transducer/Transducerless Design
The drive can operate with or without a feedback transducer. Typically, an incremental encoder is used for feedback, although multiturn absolute encoders and single-turn resolvers are also supported. For less demanding velocity-loop applications, the drive offers a transducerless mode of operation.

Application Flexibility
The drive can be configured for torque-, velocity-, and position-control servo applications. Its controller can be customized with analog and digital I/O, feedback, and serial communication options appropriate to the requirements of a system. A programming option allows customization for unique applications using IEC 1131 open-standard ladder diagram, function block diagram, sequential function chart, structured text, and/or instruction list languages.

Specifications

Electrical

Input Supply

Voltage:	200 to 240, 380 to 480, or 500 to 600 V AC, three-phase
Voltage tolerance:	–10% of minimum, +10% of maximum
Frequency:	47 to 63 Hz
Power factor:	Displacement: 0.99 at all loads and speeds Overall: 0.94 at rated load

Output Rating

Voltage:	Zero to input voltage, three-phase
Frequency:	Zero to 1,000 Hz with transducer Zero to 120 Hz without transducer
Switching frequency:	Programmable from 1 to 16 kHz
Overload current:	Constant torque: 150% of rated for 1 min; maximum of 200% of rated Variable torque: 120% of rated for 1 min; maximum of 150% of rated Extended torque: 110% of rated for 1 min; maximum of 125% of rated

Conversion

Rectifier unit:	Six-pulse standard, 12-pulse and IGBT input optional
Inverter unit:	Six-IGBT, four-quadrant, PWM
Regeneration:	Dynamic braking transistor with resistors, capacitor bank energy storage, or regenerative inverter

Environmental

Operating temperature:	Less than 125 hp (CT): 32° to 131° F (0° to 55° C) 125 hp (CT) or more: 32° to 104° F (0° to 40° C)
Storage temperature:	5° to 158° F (–15° to 70° C)
Relative humidity:	95% maximum, noncondensing
Altitude:	To 3,300 ft. (1,000 m) without derating

Performance

Speed Range	8 poles	6 poles	4 poles	2 poles
Transducer based (1,000 Hz):	15,000 rpm	20,000 rpm	30,000 rpm	60,000 rpm
Transducerless (120 Hz):	1,800 rpm	2,400 rpm	3,600 rpm	7,200 rpm

Position Control

Bandwidth:	100 Hz
Settle time:	5 ms

Velocity Control

Bandwidth:	200 Hz with transducer 10 Hz without transducer
Regulation:	±0.001% of base speed with transducer ±0.50% of base speed without transducer

Torque Control

Bandwidth:	600 Hz
Regulation:	±0.1% of maximum torque with torque transducer ±2.0% of maximum torque without transducer
Response:	125 µs, typical (excluding motor)

Control Modules

The 2400 can be configured with either a Standard or Expandable Control Module, depending upon the requirements of the application. Additional capabilities can be provided with an optional communication module (described on the next page).

Common Features:

- Three ±10 V or 4-20 mA 12-bit analog inputs
- Two ±10 V 12-bit analog outputs
- Two reserved contact outputs
- Clock synchronization channel
- RS-422/485 synchronous serial port for drive control at 1 Mbaud
- RS-232/422/485 asynchronous serial port for general communication up to 57.6 kbaud
- One optional communication interface provision

Standard Control Module:

- Eight optional isolated I/O points
- One optional feedback interface provision

Expandable Control Module:

- Two reserved isolated inputs
- 32 optional isolated I/O points
- One incremental encoder interface
- Two optional feedback interface provisions

Specifications
(continued)

Communication Modules

Six optional communication modules are available:

Serial Communications:
- Two isolated RS-232/422/485 synchronous/ asynchronous serial ports for drive control and general communications up to 1 Mbaud

Fiber-Optic Communications:
- One isolated fiber-optic synchronous/asynchronous serial port for drive control or general communications up to 1 Mbaud
- One RS-232/422/485 synchronous/ asynchronous serial port for drive control or general communications up to 1 Mbaud

Remote I/O Communications:
- Dual Remote I/O interface

Modbus Plus Communications:
- Modbus Plus interface

ControlNet Communications:
- ControlNet interface

Profibus Communications:
- Profibus DP interface

Transducer Options

Several types of motor-mounted transducers are available to provide feedback of motor position, velocity, and acceleration.

Incremental encoder: Two quadrature channels with marker pulse operating up to a maximum frequency of 750 kHz per channel

Single-turn resolver: Up to 14-bit resolution

Multiturn absolute encoder: 24-bit resolution with RS-422/485 synchronous serial communication

Inputs and Outputs

Reserved I/O: Inputs: 3.3-32 V DC @ 34 mA or 90-280 V AC @ 10 mA
Outputs: Relay contacts rated for a resistive load of 5 A @ 24 V DC, 5 A @ 120 V AC, or 3 A @ 240 V AC

Optional I/O: Inputs: 3.3-32 V DC @ 34 mA or 90-280 V AC @ 10 mA
Outputs: 3-60 V DC @ 3 A or 24-280 V AC @ 3.5 A

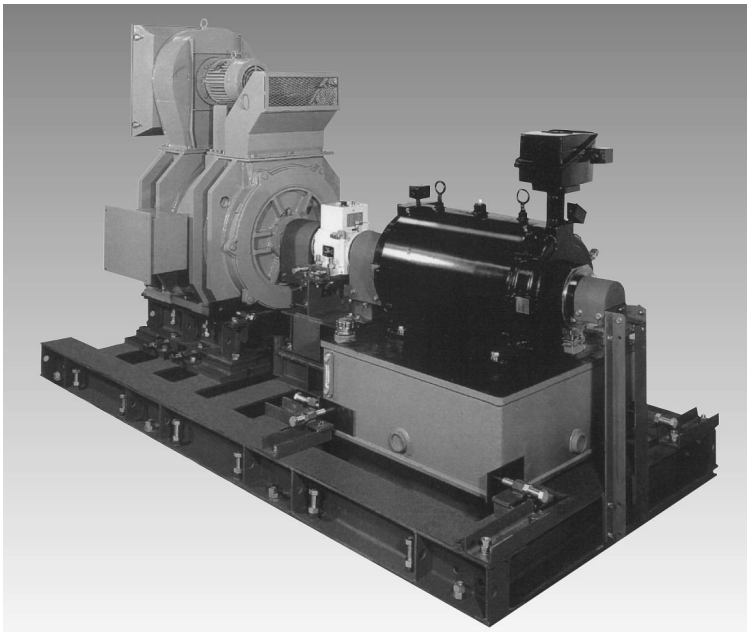
Protection

- Ground fault
- Drive thermal overload
- Software circuit breaker
- DC bus overvoltage
- DC bus undervoltage
- DC bus fuse and blown fuse
- Instantaneous overcurrent
- Motor thermal overload
- Braking unit overcurrent
- Heat sink overtemperature
- Phase loss
- Power transistor fault
- Control power undervoltage
- Excessive position error
- Uncommanded motion
- Motor overspeed
- Feedback transducer failure
- Memory malfunction
- Processor running fault
- Serial communication error

Power Range

Input Voltage	Constant-Torque Applications	Variable-Torque Applications	Extended-Torque Applications
230 V AC	1 1/2-75 hp (1.1-55 kW)	2-100 hp (1.5-75 kW)	—
380 V AC	1 1/2-1000 hp (1.1-750 kW)	2-1100 hp (1.5-825 kW)	—
460 V AC	1 1/2-1000 hp (1.1-750 kW)	2-1100 hp (1.5-825 kW)	25-1200 hp (18-900 kW)
575 V AC	1 1/2-1000 hp (1.1-750 kW)	2-1100 hp (1.5-825 kW)	25-1200 hp (18-900 kW)
690 V AC	*Consult factory*	*Consult factory*	*Consult factory*

Consult factory for other powers. Other voltages require appropriate derating or adjustment of the switching frequency.



UNICO's Test Stand Drive is engineered specifically for test stand and dynamometer applications.

Features & Benefits

General

- All-digital control for zero drift and repeatable motor operation
- 24-bit DSP computational power for fast, dynamic response
- High-switching-frequency IGBT devices for quiet operation
- Digital current loop regulator for fast response
- Flux vector control for full torque from zero to rated speed
- Servo loop operation for precise velocity, position, or torque control
- Field weakening at constant horsepower up to four times base speed

Ease of Installation, Setup, and Maintenance

- Complete, self-contained package requires few option boards
- Identical control boards across full power range reduces spare parts
- Snap-in signal connections for ease of wiring
- Automated setup feature requires no chart recorders or meters
- Software calibration and adjustment eliminates tuning components
- Software input and output scaling eliminates potentiometers
- Automated hardware configuration check

Ease of Use

- Full keypad for easy entry of application-specific setup adjustments
- Two line by 24-character/line descriptive, plain-English display
- Process variable display in bar graph and engineering units
- Comprehensive plain-language, self-diagnostic message display
- Real-time motion information and historical fault log
- RS-232/422/485 for communication with process controllers

Reliable Operation

- Tolerant of AC line fluctuations
- Extensive electronic protection circuits reduce failures
- Optically isolated signals for high noise immunity
- S-curve acceleration reduces shock and extends equipment life
- Fiber-optics for noise-free serial communication
- Designed to meet or exceed accepted international standards

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