

2000

Test Stand Drive



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 AC 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 2,000 Hz (120,000 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.

2000

Test Stand
Drive

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

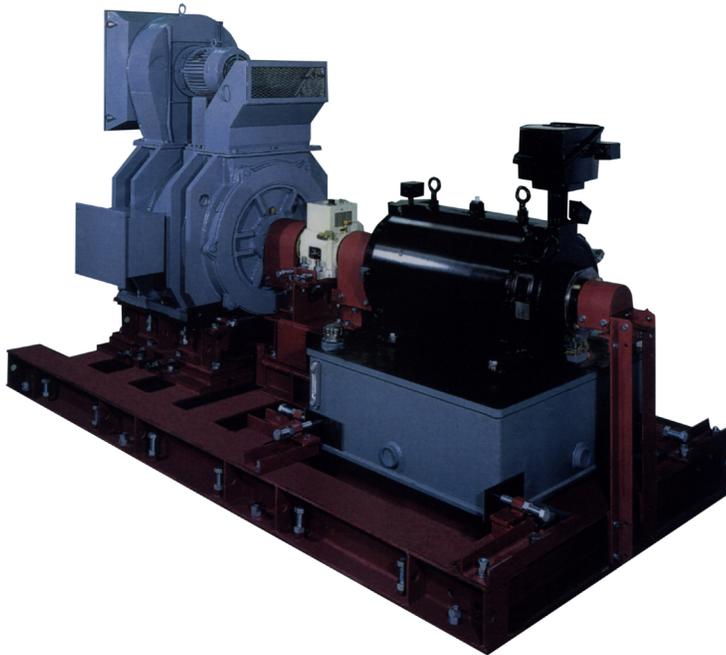
All digital inputs and outputs are optically isolated. Depending upon the controller, as many as 32 individually isolated digital I/O are locally provided, each of which can be programmed by the application to be an input or output. The voltage of each can be selected from a wide range of AC/DC values.

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 and/or function block diagram languages.



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

2000

Test Stand Drive

Specifications **Electrical**

Input Supply

| | |
|--------------------|--|
| Line voltage: | 200 to 240, 380 to 480, 500 to 600, or 600 to 690 V AC, three-phase |
| Voltage tolerance: | Phase sequence insensitive –10% of minimum, +10% of maximum |
| Frequency: | 47 to 63 Hz |
| Power factor: | Displacement: 1.00 at all loads and speeds Overall: 0.94 at rated load (1.00 with active front end) |

Output Rating

| | |
|----------------------|---|
| Voltage: | Zero to input voltage, three-phase |
| Frequency: | Zero to 2,000 Hz with transducer Zero to 500 Hz without transducer |
| Switching frequency: | Programmable from 1 to 30 kHz |

Service Conditions

| | |
|-------------------|--|
| Efficiency: | 97% nominal at rated switching frequency |
| Overload current: | <i>Torque Overload (1 min) Maximum</i> Constant 150% to 200% of rated 200% of rated Variable 120% to 150% of rated 140% to 160% of rated Extended 110% to 120% of rated 120% to 140% of rated |

Conversion

| | |
|-----------------|--|
| Converter unit: | Six-pulse standard; six- or 12-pulse (150 hp CT or more) |
| Inverter unit: | Six-IGBT, four-quadrant, PWM |
| Regeneration: | Dynamic braking transistor with resistors, capacitor bank energy storage, or regenerative inverter |

Environmental

| | |
|------------------------|--|
| Operating temperature: | Control section: 32° to 131° F (0° to 55° C) Heat sink: 32° to 131° F (0° to 55° C) through 100 hp CT, 32° to 104° F (0° to 40° C) 125 hp CT or more |
| Storage temperature: | –40° to 158° F (–40° 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 (2,000 Hz): | 30,000 rpm | 40,000 rpm | 60,000 rpm | 120,000 rpm |
| Transducerless (500 Hz): | 3,750 rpm | 7,500 rpm | 15,000 rpm | 30,000 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

Common Features:

- Three ±10 V DC or 0 to 20 mA 12-bit analog inputs
- Two ±10 V DC 12-bit analog outputs
- Two programmable contact outputs
- Fiber-optic high-speed synchronous/asynchronous serial port with clock synchronization up to 1 Mbaud
- Fiber-optic synchronous serial port with clock synchronization at 2 Mbaud
- Three optional communication interface provisions (one Command Module and two AnyBus-S interfaces)

Standard Control Module:

- Eight optional configurable I/O points
- One optional feedback interface provision
- One RS-422/485 asynchronous serial port up to 115.2 kbaud

Expandable Control Module:

- Two programmable isolated inputs
- 16 or 32 optional configurable I/O points
- One incremental encoder interface
- Two optional feedback interface provisions
- Two RS-422/485 asynchronous serial ports up to 115.2 kbaud

Specifications

(continued)

Operator Interface

Integral Keypad/Display:

- 16-key keypad, two-line display

Optional Interfaces:

- Remote keypad with two-line display
- Remote keypad with multiline color graphics display
- PCTerm drive communications software
- UEdit® and UEdit® Lite drive programming and diagnostics software
- Custom HMI software also available

Communication Modules

Multiple 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

Command Module Options:

- Serial, fiber-optic, Modbus Plus, ControlNet, Profibus, Ethernet, EtherCat, Remote I/O

AnyBus-S Module Options:

- CANopen, CC-Link, ControlNet, DeviceNet, Ethernet IP, EtherCat, Interbus, Lonworks, Modbus Plus, Modbus TCP, Profibus DPV1, Profibus Master, Profinet

Transducer Options

A variety 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
Up to 14-bit resolution

Single-Turn Resolver:

Up to 14-bit resolution

Multiturn Absolute Encoder:

24-bit resolution with RS-422/485 synchronous serial communication

SinCos Encoder:

Support for EnDAT, Hiperface, or TTL interface on absolute channel
Optional repeater for incremental channels

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 undervoltage
- Excessive position error
- Uncommanded motion
- Motor overspeed
- Feedback transducer failure
- Memory malfunction
- Processor not 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 1/2-4000 hp (1.1-3000 kW) | 2-4400 hp (1.5-3300 kW) | — |
| 460 V AC | 1 1/2-4000 hp (1.1-3000 kW) | 2-4400 hp (1.5-3300 kW) | 25-4800 hp (18-3600 kW) |
| 575 V AC | 1 1/2-4000 hp (90-3000 kW) | 2-4400 hp (1.5-3300 kW) | 25-4800 hp (18-3600 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.

2000

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Unico is a leading global innovator of motion-control solutions for industry. Founded in 1967, the company develops, manufactures, and services variable-speed drives, application-engineered drive products, integrated drive systems, and ancillary products that improve operations by increasing productivity, safety, and equipment life while lowering energy and maintenance costs.

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