Load Commutated Inverter (LCI)

Medium Voltage Drive
2000/4000 Series Product Guide
Rugged, Reliable, Proven Performance
For High Power Drive Applications
The LCI drive is ideal for any high power synchronous motor application for which adjustable speed operation or soft starting is needed.

Adjustable speed operation allows optimal efficiency (energy saving) and improved process accuracy. Typical adjustable speed applications include:

- Compressors for air or petrochemical processes
- ID fans for coal-fired boilers
- Grinding mills
- Rod and bar mills
- Marine Propulsion

Soft-starting reduces the mechanical stress on the motor and driven equipment as well as eliminating electrical starting surges on the ac power system. The rating of the starting system depends on the power required to drive the load at synchronous speed. However, because many driven machines can be arranged for reduced load operation during starting, power rating of the starting equipment can be greatly reduced. An output transformer permits the LCI drive to operate with any motor voltage. The LCI drive has a closed transition for synchronizing/de-synchronizing function that means no other synchronizing equipment is needed to smoothly start multiple large motors.
The LCI drive's robust power bridge design and long years of proven operational reliability make it the ideal solution for your high horsepower compressor applications. One application uses LCIs and electric motors to replace gas turbine drives to eliminate emissions, reduce noise, reduce maintenance and increase operational efficiency and control.

The LCI drive can be seamlessly integrated with the rest of your pump or compressor station control system. Supporting a variety of Local Area Networks (LAN) and hardwired I/O allows you the flexibility necessary for remote and even un-manned operations.

The LCI has been used to power many types of grinding mill applications. It can be used to start multiple mills or function as a dedicated power supply to a mill for optimal process control and variability.

Traditional mechanical methods for controlling airflow are inefficient and require considerable maintenance. The LCI provides more accurate and energy efficient control of airflow while eliminating the maintenance associated with dampers or vanes. Any large fan application, like a cement or utility ID fans, will benefit from using the LCI for controlling its synchronous motor.

In the configuration, start-up, and maintenance of large drive systems like ship propulsion, a PC-based programming tool is essential. The LCI utilizes many parts of the TMEIC Control System Toolbox software package. This package is shared across a number of drive platforms and results in reduced customer training time.
The LCI Drive is Designed to Specifications and Requirements To Meet Your Most Demanding Applications

Differentiating Features:
- Compact design saves valuable floor space
- High reliability, high efficiency design
- User friendly and easy to maintain

Simple, Flexible Controls
- VME Rack mounted cards
- Extensive Diagnostics
- Supports OnSite remote diagnostics services
- User friendly displays
- Ethernet and other LAN’s

Configurable Input/Output
- VersaMax I/O modules
- Easy customer access for wiring

Input Transformer Options
- Oil Filled or Dry
- Outdoor or Indoor

Integral Field Excitation
Package for ac Brushless exciters. Optional external exciter control for “across the line” motor operation.

Source Bridge Panel (Doors Open Showing SCR Cells)

Water Cooled Power Bridge
- Design allows quick replacement of SCR devices without disturbing cooling system

DC Link Reactor Options
- Outdoor or Indoor
- Air or Iron Core Construction

Control Panel

Control Panel (Doors Open Showing SCR Cells)
High Reliability, Water Cooled Drive Benefits
- High power in a small footprint
- Removing >90% of drive heat allows low HVAC load, saving money over 20+ yr. life
- Quiet – less than 70 dBA

High Reliability Power Bridges
- Identical Source and Load Bridge
- Full Voltage rated devices
- True N+1 SCR Redundancy
- Diagnostics down to the cell level
- Optical gating insures isolation of medium voltage and low voltage sections

Heat Exchanger Options Include
- Water to Air (shown)
- Water to Water
- Redundant Heat Exchanger Fans (shown)

Redundant Cooling System
- Pump auto-change over
- Maintenance Free Stainless Steel hose clamps
- Pump, deionizer, and filter can be changed while running
Drive Commissioning with an Integrated Trend Window

For knowledge management inside the LCI, the Control System Toolbox provides animated graphic displays of control logic as well as an integrated window for the trending of drive and related process variables. This tool features ease of configuration and data analysis.

**Trend Configuration**

- Define a trend with drag and drop of variables from function block diagrams or select variables from a pick list
- Conduct online real-time trending with the drive or upload the capture buffers in the drive for trending. For historical trending, define a link with an integrated historian database.

**Display/Analysis**

- Quickly define a display with the auto-scaling toolbar button
- Analyze a specific time frame with the zoom in/out toolbar buttons
- Create different views using variable hiding
- Analyze specific times with a crosshair
- Perform frequency-based analysis of the trend using the fast fourier transform (FFT) function
Knowledge Management Options
Bring Productivity to Your Operation

Plant Operations
Key system operating parameters and diagnostic information can be presented to your operations team.

Global Customer Support Network
The 24x7x365 customer service can dramatically reduce downtime for your process by providing the fastest Elapsed Time to Repair.

Process Optimization
Processes cannot be optimized without key information on how the process is currently performing. With the LCI control and optional Human-Machine Interface, key operating drive parameters as well as system performance information are continuously available to plant operations for process optimization.
The LCI operation is simple and reliable. It uses load-commutated, phase-controlled power thyristor technology to supply power to the stator windings of a high efficiency synchronous motor.

The power circuit has a source converter, connected to the power supply and a load converter connected to the motor. When motoring, power flows from the power source to the motor. Regeneration is built in, allowing smooth control of loads in all operations. The LCI controls the motor torque to regulate motor speed. Motor torque is controlled through the DC link current.

The LCI power converter blocks can be paralleled to deliver ratings in excess of 70,000 HP. Multi-channel output gives low harmonics on the motor and gives the opportunity for single channel operation. Consult TMEIC General Industries for custom systems to meet your requirements.

### Power Bridge Building Blocks – Multiple Blocks Combine for High HP Applications

<table>
<thead>
<tr>
<th>Output Voltage</th>
<th>Source, Load Configurations</th>
<th>Power Block Rating – HP</th>
<th>Dimensions – mm (in)</th>
<th>Weight – kg (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2300</td>
<td>6-p, 6-p</td>
<td>7,000</td>
<td>4000 x 1400 x 2500</td>
<td>3400 (7500)</td>
</tr>
<tr>
<td>2300</td>
<td>12-p, 12-p</td>
<td>14,000</td>
<td>5600 x 1400 x 2500</td>
<td>4100 (9000)</td>
</tr>
<tr>
<td>4160</td>
<td>6-p, 6-p</td>
<td>18,000</td>
<td>5600 x 1400 x 2500</td>
<td>4300 (9500)</td>
</tr>
<tr>
<td>4160</td>
<td>12-p, 6-p</td>
<td>18,000</td>
<td>5600 x 1400 x 2500</td>
<td>4300 (9500)</td>
</tr>
</tbody>
</table>

1. Rating is based on 40 °C water.
2. Dimensions based on arrangement with pump panel and control at opposite ends of lineup. Subtract 1200 mm [47 in] from length if pump panel is placed behind control. This arrangement has no space for integrated field exciter.
Control Offerings To Fit Your Application

Digital Inputs
(VersaMax
Input Modules)

- Standard – 8 inputs, 120VAC
- Additional Inputs available as an option

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- Standard – 8 outputs, 120VAC
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Analog Inputs
(VersaMax
Input Modules)

- Standard – 2 inputs, 0-10VDC
- Additional Inputs available as an option

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LAN Interface Options

- DeviceNet™
- Profinet-OP™
- ISBus™
- Other available on request

Optional Speed Feedback Devices

- A quad B with marker
- Maximum frequency of 125 kHz
- Differential 5 or 15 V dc
- 5 or 15 V dc at 200 mA supply

Power System Input and Harmonic Data

- Voltage: 3 phase, ±10%/−5% continuous
- Tolerates power dips to 30% without tripping, complete control power loss ride through of 100 msec with UPS backup available.
- Frequency: 50 or 60 Hz
- Top or Bottom Cable entry

Transformer Options

- Options for future fans
- Outdoor or Indoor
- Aluminum or Copper winding
- Oil filled or Dry Type

Source Bridge Type

- AC fed 6 or 12 pulse SCR, Regenerative, with N+1 devices
- N+1 power devices for added reliability

Load Bridge Type

- 6 or 12 pulse output configurations with N+1 devices
- N+1 power devices for added reliability

Applicable Standards

- UL508C, IEC 146-1-2, NEMA ACS 7-1993, CSA C22.2, UL347A, EN50178

Manufacturing Quality Systems

- ISO9001, ISO9000-3

Safety Features

- Control Optically Isolated from MV circuits for safety
- Pad-lockable Doors
- Short Circuit Bracing for 30,000 amps Symmetrical

Output

- 10 – 160% of Rated Speed Control Range
- Top or Bottom cable entry

Operating Environment

- Temperature: 0 to +50 °C
- Altitude: Up to 14,000’ with only small de-rating
- Pump and Control Power (by user): 7 kva, 460V/380V, 3 phase, 60/50 Hz

Cooling

- Liquid Cooled with De-ionized water
- Redundant cooling pumps with automatic control
- For water/water heat exchangers: 50 °C max inlet water temperature
- For water/air heat exchangers: options for redundant fans

Sound

- Less than 70 dBA at 1 meter from enclosure

Control

- Non-volatile memory for parameters and fault data
- Forced commutation below 10% of rated speed
- Load commutation above 10% of rated speed
- Torque regulated, four quadrant speed control
- Volts/Hz control
- Field Excitation control
- Programmable acceleration/deceleration ramps

Control Accuracy

- No Tach
- Tachometer

- Speed Regulation: 0.1% 0.005%
- Max Starting Torque: 0.75 PU 2.0 PU
- Max Forward Speed: 1.0 PU 1.0 PU
- Max Reverse Speed: 0.5 PU 1.0 PU
- Constant HP Speed Range: Base to Top
- Constant Torque Speed Range: 0.1 PU to Base 1.5Hz to Base

Protective Functions

- Fuse-less design
- Overcurrent
- Overvoltage
- Optional Motor
- Over-temperature
- RTD monitoring

Additional Specifications

- RJ-45 Ethernet™ interface
- 10 Mbps maximum
- ISBus™-Ethernet option using Innovation Series controller as gateway
- Motor current A and B, ±10 V
- Quantity 5 configurable, ±10 V, 8-bit resolution
- Connections via keypad

I/O Interface

- Digital Inputs
(VersaMax
Input Modules)
- Digital Outputs
(VersaMax
Output Modules)
- Analog Inputs
(VersaMax
Input Modules)
- Analog Outputs
(VersaMax
Output Modules)
- LAN Interface Options

- DeviceNet™
- Profinet-OP™
- ISBus™
- Other available on request

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Optional Speed Feedback Devices

- A quad B with marker
- Maximum frequency of 125 kHz
- Differential 5 or 15 V dc
- 5 or 15 V dc at 200 mA supply

- Singled ended A-B
- Maximum frequency of 10 kHz
- External 12-24 V dc is required

Enclosure

- NEMA 1A/IP 21
- Optional Splash-proof louver system
- Allow a minimum of 36° for Rear Access for installation and maintenance
The DIRECTO-MATIC® LCI drive has provided reliable service for more than 20 years. To keep that record intact, TMEIC has developed a control upgrade for the DIRECTO-MATIC drive, while preserving the existing power bridge.

In addition to extending the product life, this modernization program provides significant functional enhancements plus a system condition and capability assessment of your drive system.

### DIRECTO-MATIC Control

- **Proprietary wire wrapped backplane system:**
  - 1980s circuit board technology
  - 80286 processor
  - I/O integrated with control

- **Hardware dependent control:**
  - Limited sequencer
  - Fixed block diagram regulator
  - Terminal emulator

- **Limited control and data interface:**
  - Local control push buttons
  - Printer
  - Meters
  - One serial interface

- **Service options:**
  - DIRECTO-MATIC trained field engineers
  - Local diagnostic tools

### TMEIC LCI Control Upgrade

- **Control Hardware**
  - VME design provides improved reliability and less than half the number of circuit boards
  - 300Mhz Celeron processor
  - Modular I/O improves flexibility and diagnostics
  - Optional Field Exciter control upgrade

- **Control Software Library**
  - Flexible sequencing logic
  - Windows®-based Control System Toolbox
  - Animated graphic displays
  - Integrated trending window
  - Common tool across the TMEIC family of system drives

- **Knowledge Management**
  - Optional local or remote touch screen interface panel
  - Multiple RS-232™ and Ethernet™ ports
  - Drivers for ISBus™, DLAN+, Modbus® SRTP, A-B DH+
  - Custom HMI Screens Available

- **Technical Support Options**
  - Current generation technology and connectivity for remote diagnostics means lower Elapsed Time to Repair

For more details, see “Modernization of Directo-Matic LCI Drive Systems” Brochure
TMEIC brings you a wide variety of Medium Voltage products. Our Dura-Bilt5i drive, for induction or synchronous motors, with industry leading warranty, our high power TMdrive-70 IEGT and TMdrive-30 drives, and our control upgrades for existing legacy LCI drives provide a unique family of drive offerings to serve all your Medium Voltage drive requirements.

LCI Modernization – Control Retrofit Package for extending the life of existing legacy LCI Drive systems.

Dura-BiltSi MV® – Air cooled, MV PWM Drive with integral transformer - 200 to 10,000 HP.

TMdrive®-30 – High performance, air cooled, PWM System Drive – 100 to 4,500 HP.

TMdrive®-70 – High Performance, water cooled, PWM System Drive – 5000 to 35,000 HP.
TMEIC AC Drives Offer Complete Coverage

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