TMEIC
We drive industry

Solutions for the Global Paper Industry

WWW.TMEIC.COM

JAPAN | NORTH AMERICA | SOUTH AMERICA | EUROPE | SOUTHEAST ASIA | INDIA | CHINA | MIDDLE EAST | AUSTRALIA

About TMEIC

TMEIC is built on the combined and proud heritage of Toshiba, Mitsubishi-Electric (TMEIC) and General Electric in the industrial automation, control and drive systems business. Headquartered in Virginia, USA, TMEIC designs, develops and engineers advanced automation and variable frequency drive systems.

The factory for the World's factories
TMEIC delivers high quality advanced systems and products to factories worldwide, while serving as a global solutions partner to contribute to the growth of our customers.

A Global network
TMEIC's global business employs more than 2,200 employees, with sales exceeding U.S. $2.4 billion, and specializes in Metals, Oil & Gas, Material Handling, Utilities, Cement, Paper and other industrial markets.

Customer Service
We focus on the customer, working to provide superior products and excellent service, delivering customer success every project, every time.

Global Paper Industry

TMEIC is uniquely positioned to meet the challenges facing the global paper industry:

- Research and Development - a large ongoing investment in technology is vital. Remaining competitive in the system drives business requires dedication to research and development.
  - AC drives are a fast-moving technology with dramatic progress being made in control and configuration tools.
  - Master controller technology is also moving quickly, with significant development in local area networks, intelligent I/O, and configuration tools.
  - Operator interface and diagnostic tool development is exploding with an array of new software applications.
- Globalization of Paper Companies – Paper-producing companies and their suppliers have become much more international in scope. For example, companies like Asia Pulp and Paper (APP), Oji Paper, International Paper, Stora Enso, Voith, and Metso are now global organizations.
- Modernization – TMEIC has experience in upgrade and modernization projects:
  - Retrofit projects through Digital Front End (DFE) control retrofits on larger DC drives.
  - Selected DC drive frame upgrades to address incremental power requirements
  - Frequent use of both DC and AC drive technology

Economies of Scale Bring Advantages

TMEIC has achieved the economies of scale required in this market and responded with:

TMdrive®-10e2

TMdrive®-DC

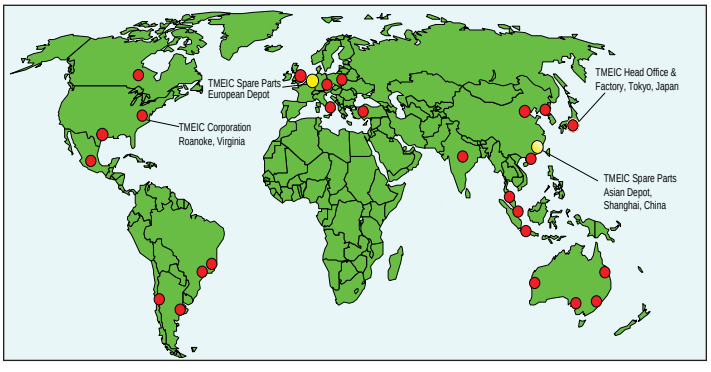
Dura-Bilt5i MV®

Technology Investments

- A family of low voltage AC system drives, including the TMdrive-10e2
- A family of DC system drives, including the TMdrive-DC
- A family of Medium Voltage drives, including the Dura-Bilt 5i MV

A World-Wide Service Organization

A large global service organization covering the Americas, Europe, Africa, Asia, and the Pacific, supported by large system application engineering offices in North America and Japan.

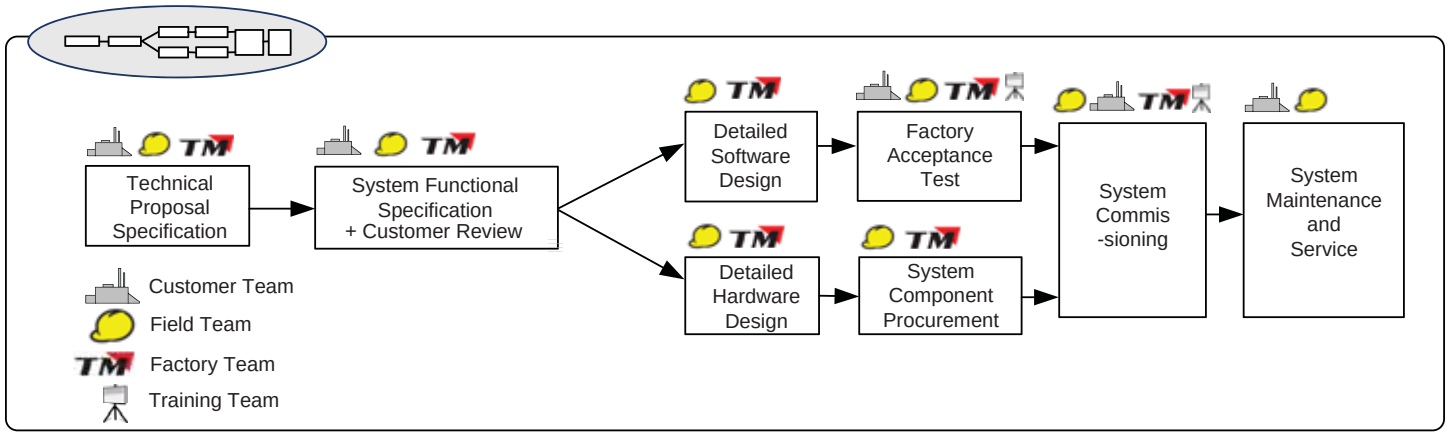


Organization of Document

TMEIC engineers design, test, and commission complete coordinated drive systems for paper machines that include fan pumps, dryers, calenders, winders, and coaters. This document provides an overview of the engineering processes and technology used in these systems. The chart below illustrates these engineering processes and technology.

A Comprehensive Engineering Process

A smooth machine startup in the mill depends on a well-planned and executed engineering process. Starting with the system proposal and specification, TMEIC's application engineers manage the entire project through commissioning. This critical engineering process is illustrated below and detailed in the Project Engineering section. Icons indicate where the various teams of engineers in the mill, factory, and field service organizations are involved in the project.



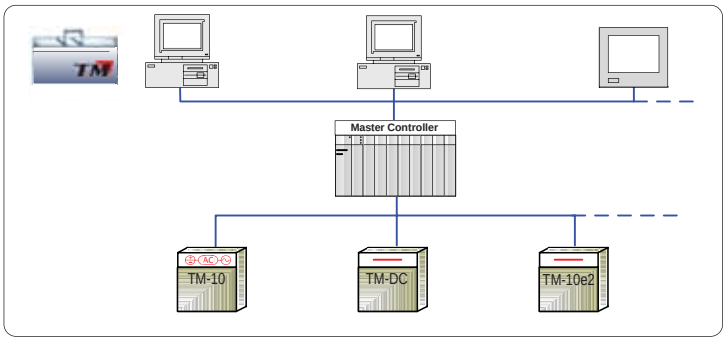
Project Engineering Process

A Flexible System Architecture

The drive system architecture uses a master PLC controller to coordinate all the networked drives, which can be of different types, and to communicate with the operator interfaces, input/output devices, and the mill's distributed control system (DCS).

TMEIC has adopted industry standards to simplify the configuration and integration of complex control systems for your paper machine:

- VME cards and rack for the master controller, allowing seamless integration of third-party systems
- Profibus® and Ethernet® communications between the drives, controller, operator interfaces, and plant control, providing high-speed communication, and low-cost, standard spare parts availability.
- Windows®-based configuration tools, familiar to all users, for all system components.



TMEIC in the Paper Industry

Experience with all types of paper products

The TMEIC team has been building drive systems for the paper industry for over 100 years. We have engineered systems for all types of paper machines, winders, off-machine coaters, and super calenders, and have experience producing a wide range of paper products:

- Coated paper
- Printing grades
- Fine papers
- Tissue and sanitary paper
- Linerboard and fiber board
- Uncoated board and bleached board
- Newsprint and phone book paper
- Corrugated medium
- Paper pulp and Kraft

TMEIC is a Global Paper Supplier

TMEIC 's paper group supplies equipment, service, and engineering to support paper mills. TMEIC has supplied more than 800 drive systems to mills around the World.

A Supplier to the World's Paper Companies

International Paper
Stora Enso
Nippon Paper Industries
Weyerhauser Company
Asia Pulp & Paper
Appleton Papers
Oji Paper
MeadWestvaco
Union Camp Corp.
Georgia Pacific Corp.
Inland Paperboard
St. Mary's Paper
Domtar
Wausau-Mosinee
Oconto Falls
Longview Fibre
Dae Han Paper
Shin Dae Yang

Fu-Fa Machinery
Ambro
SAICA
National Paper
Hadera Paper
Shaniv Paper
PT Kertas & IKPP
Panjapol
Noah's Paper Mills
Visy Paper
Kimberly-Clark Inc.
Proctor & Gamble
Augusta Newsprint
Boise Cascade
Nine Dragons Paper
San-Ei Regurator
AbitibiBowater
Irving Paper

Simpson Paper
RSI
Philip Morris
SAPPI
Cartonajes Estrella
Crisoba
Chuetsu Pulp
Daishower Paper
Ehime Paper
Hokuetsu Paper
Maruzumi Paper
Taio Paper
Toyama Paper
Pratt Industries
P.T. Tjiwi Kima
Smurfit-Stone

TMEIC 's Paper Industry Team

Dedicated Paper Engineering Team

The paper engineering team is dedicated to the paper industry and gained their experience working in field service with mill technicians and mechanical suppliers. This background, coupled with state-of-the-art technology, enables TMEIC to consistently meet the demanding requirements of the paper industry.

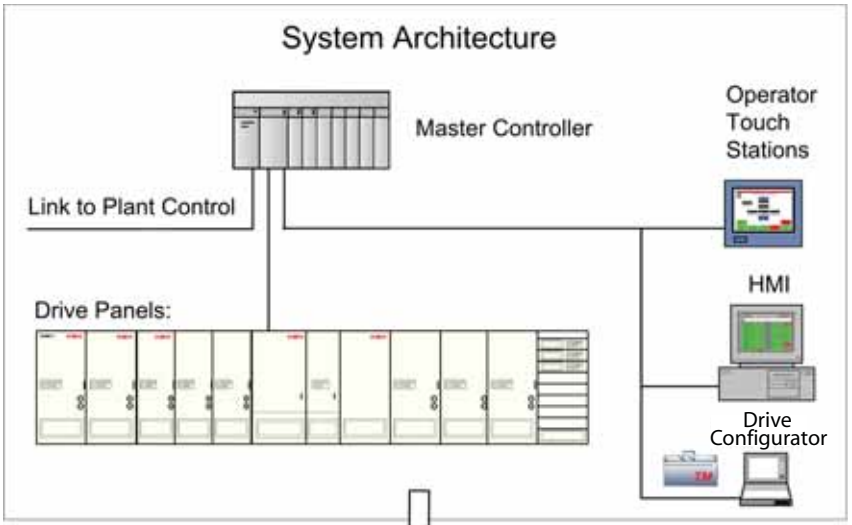
Technical Proposal Specification

During your project planning stage, experienced paper industry drive system application engineers prepare a technical proposal that includes:

- Customized system architecture for your project
- Detailed equipment specifications
- Formal bid documentation

Our application engineers are highly qualified for this proposal work, and several of them have 30+ years of paper industry experience. In addition, they are actively involved in paper industry technical organizations, where they author papers and conduct training seminars:

- TAPPI – Technical Association of the Pulp & Paper Industry
- IEEE – Institute of Electrical & Electronic Engineers
- PAPTEC – Pulp & Paper Technical Association of Canada
- APPITA – Technical Association of the Australian and New Zealand Pulp and Paper Industry, Inc.
- IARPMA – Indian Agro and Recycled Paper Mills Association
- ABTCP – Associagão Brasileria Técnica de Cellulosede Papel



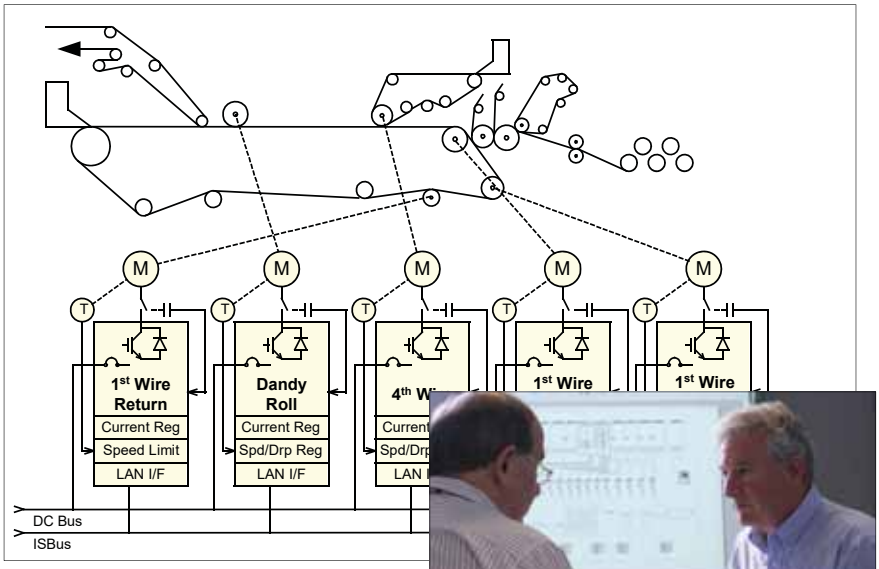
Drive System Equipment Specifications

TMGE Automation Systems LLC		for		USA				Tissue Machine 1					
Machine	Tissue Machine 1	MACHINE DATA:	Min	Max			PANELS:		POWER SYSTEM			
Technology	TMdrive-10	Design Speed			m/min		Panel	Panel	POWER SUPPLIES:		
Proposal	JK110404TM1	Gear-in Speed			m/min		Lineup	Length	Input	Input	Outpt
User		Crepe Ratio						(m)	Vac	Hz	Vac
Location	USA	Accel. Time			sec		PD1	#REF!	480	60	460
Inquiry	TISQN00086	YD Accel. Time			sec		PD2	#REF!	480	60	460
OEM	Paper	YD Sunday Speed			m/min		PD3	#REF!	480	60	460
Product	Tissue papers	Wire Width			mm		PD4	#REF!	120	60	
Engineer	Jiri Kolejka	Width @ Reel			mm						
File	TM1	Basis Weight			g/m^2						
Drv Qty	Drive Name		Roll Diam mm	Indrive Ratio n:1	Indrive Speed rpm	Gearbox Ratio n:1	Motor Gear-in rpm	NRL kW	RDC kW	Motor Rated HP	Motor Base r/min	Motor Encl	Motor Adds	P.S. Frame Size

System Functional Specification

After project approval, our application engineers prepare a technical specification that includes:

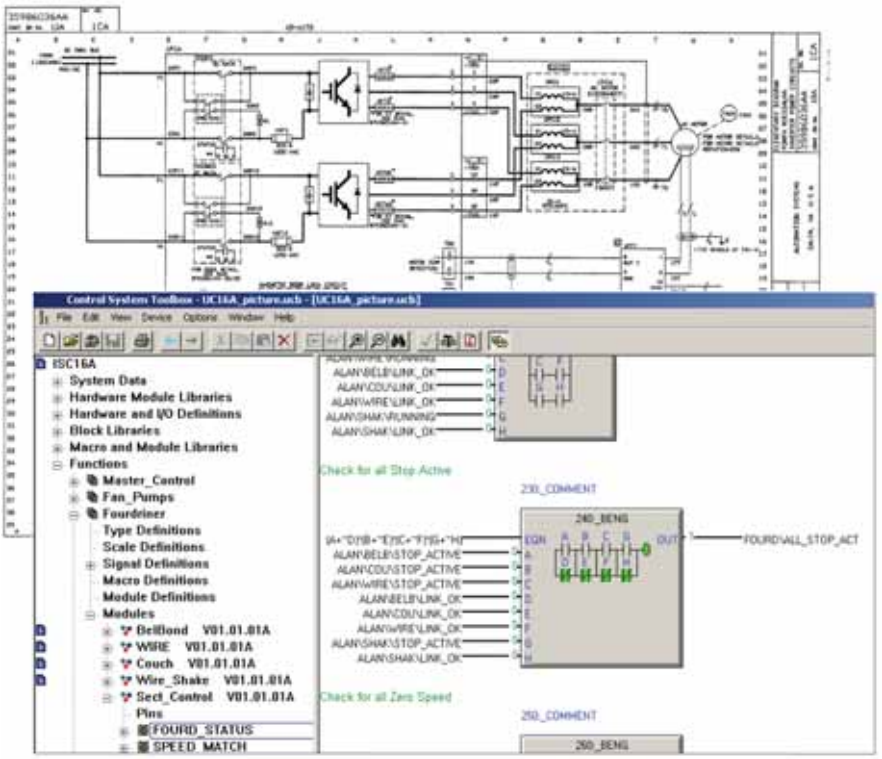
- Customized system architecture with an electro-mechanical one-line diagram for your project as shown in the illustration
- Detailed equipment specification:
  - Drives
  - Master Control
  - I/O devices and modules
  - Motors
- Complete operational description.
  To ensure we meet your requirements, a thorough review of the specification is held at your facility with your project team.



Detailed Hardware/Software Design & Procurement

Based on the functional specification, the project engineering team proceeds with three main tasks:

- **Software Design**
  Master Controller software designed for ease of maintainability. The adjacent illustration shows a typical function block diagram with logic in relay format.
- **Hardware Design**
  All equipment is specified per the project requirements, and a complete set of elementary diagrams, layout and outline drawings are created.
- **Component Procurement**
  We work with our parent companies to source the most cost effective system components for your application.



We "Make Paper" in your Factory Acceptance Test

Understanding the importance of a thorough system test, TMEIC has made an investment in technology and equipment. The TMEIC engineering team conducts an exhaustive factory test in a large, fully equipped system test lab, featuring:

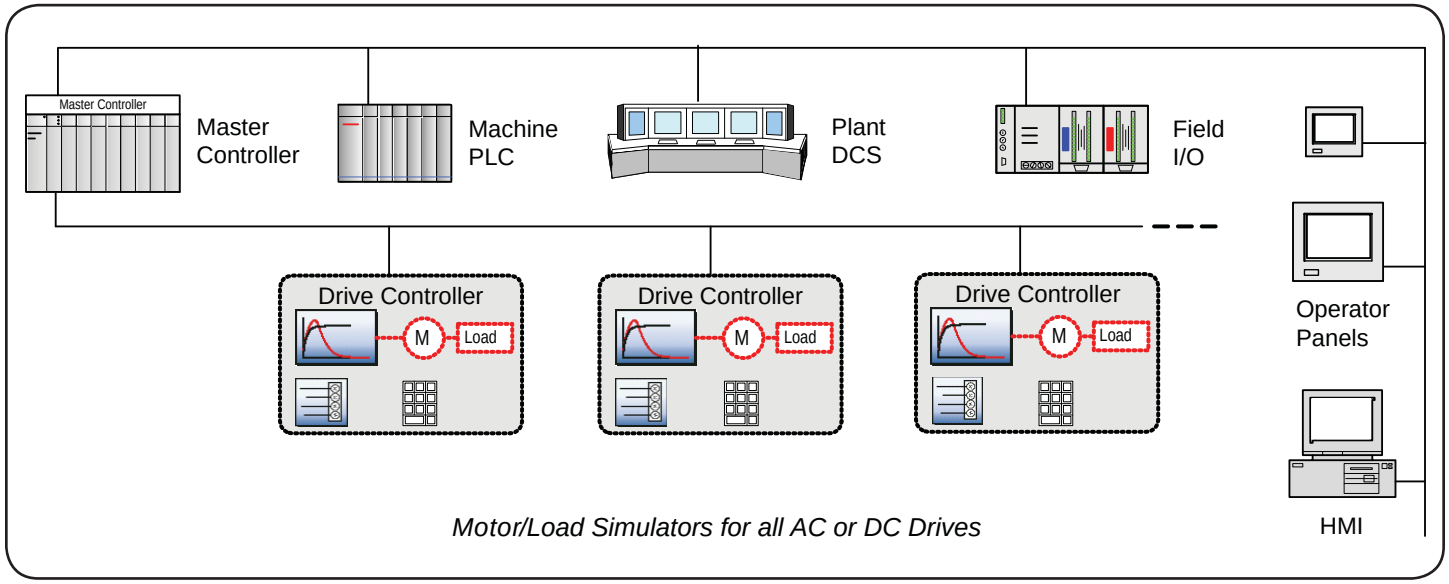
- Complete staging of the system with the controller, HMI system, and all drive controllers, which contain:
  - Controller board set
  - Keypad
  - LAN interface
  - I/O board
- Unique to the industry, the drive controller includes a motor/load simulator (refer to next page for details) allowing lifelike simulation of the paper machine.
- Your operators and the commissioning team are integrated into the factory testing for training and feedback.
- Validation of all network interfaces, including third-party PLCs and DCS systems.

The pictures above show one of our test labs in our Virginia, USA, facility, which features:

- 200-plus drive controller simulators comprising the past 20 years of drive products
- 64 HMI and touch-screen operator stations
- Controllers and a range of PLCs

Test Participants include:

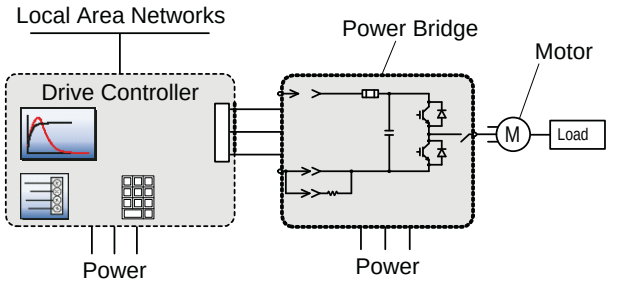
- Customer Operators
- Customer Project and Maintenance Personnel
- OEM Project Engineers
- TMEIC Project Engineer
- Service and Commissioning Engineers

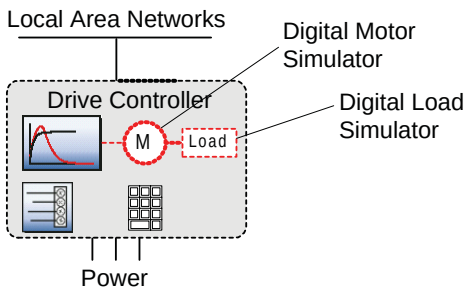


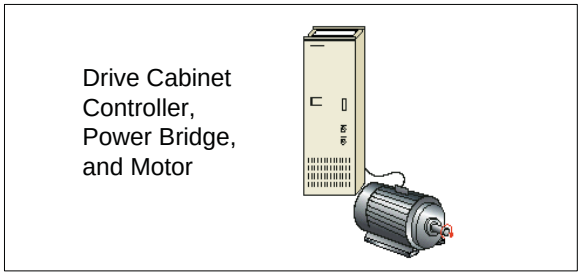
Enabling Technology for Process Simulation in a Factory System Test

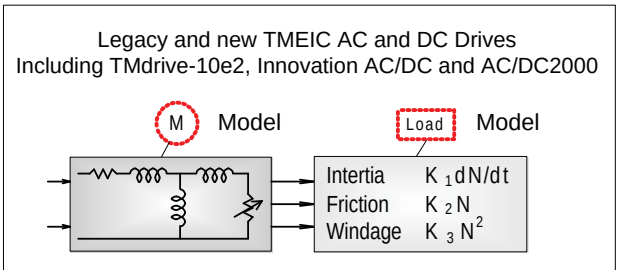
Real-World/Mill Environment

Factory Test Simulation









In the mill, AC and DC Drives Control Motor Speed and Mechanical Load

Each AC drive has a controller with I/O and a gate driver, which controls the power IGBTs in the power bridge. The power bridge generates the adjustable frequency AC voltage supply to the three-phase motor, controlling its speed and torque.

In the case of a DC drive, the power thyristor-based power bridge converts the AC power to a variable DC voltage, which is applied to the motor armature. This controls the DC motor's speed and torque.

In the Factory System Test, the Drives Control a Motor and Mechanical Simulator

Each AC/DC drive in the system has its own digital motor simulator based on a dynamic mathematical model. The drives control the simulators, not real motors. All drive simulators are networked with the master controller and operator stations to test the entire system in real time. Starts, stops, running modes, response to manual inputs, LAN continuity, control interaction, and drive configuration are all validated. This unique capability allows the entire team to obtain an intimate understanding of the system prior to commissioning, ensuring a smooth, on-time startup for your project.

> "Once the design engineer has completed the system software for a paper mill drive system, it is imperative that the software be tested under realistic conditions prior to the commissioning at the site. The software test should consist of a simulation of the process, with inputs, outputs, operator displays, HMIs, maintenance software tools, and any communication data links. A motor/load simulator included in each drive eliminates the need for specially designed software just for the simulation. The user's project, maintenance, and operator personnel should all participate in this system simulation (Customer Acceptance Test). TMEIC realizes the importance of this type of a complete simulation and endeavors to produce a thoroughly tested product on each paper mill drive in order to minimize startup problems."
>
> - **Bill Campbell**
> *Senior Drives & Control Engineer*
> *Manufacturing Technology Center, International Paper*

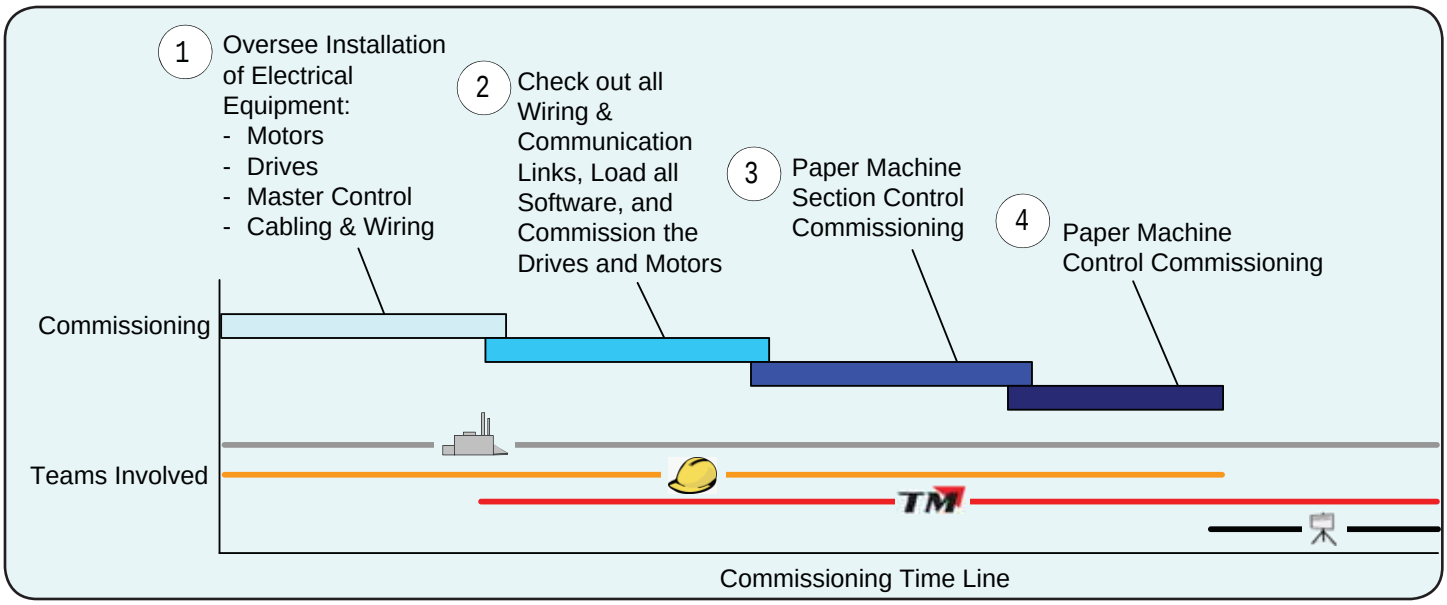
System Commissioning

In the commissioning phase of the project, the TMEIC team includes the local field engineers you know and trust, alongside the factory engineer who designed and tested the system. This overlap of teams between the factory and the mill ensures a smooth and on-schedule startup.

The local service person is part of the project team and participates in the factory system test to become familiar with the system. He then takes responsibility for startup and commissioning, and is available later if any service is required at the mill. The available support for commissioning includes:

- TMEIC factory control engineers
- TMEIC factory service engineers
- Remote diagnostics service
- Local strategic service partner

The commissioning phases are shown below:



TMEIC offers a single source for installation supervision and commissioning. Phases 2, 3, and 4 are compressed by:

- The exhaustive factory acceptance test that includes all drive controllers, master controller, and communication links
- Time-saving commissioning and drive tune-up Wizards
- Training and familiarization of the entire team with the system at the factory

Complete and Detailed Drive System Documentation

Along with the hardware and software, TMEIC delivers complete system documentation:

- An electronic instruction book with all the prints on CD with a hyperlink index
- System configuration on CD and a hard-copy form
- Detailed system manual
- Recommended wiring and grounding procedures
- Renewal parts list
- Standard third-party vendor documentation

Global Customer Support Network

Comprehensive technical service is provided by our Customer Support Organization, staffed by TMEIC service engineers with offices and spare parts depots across the globe.

In North America and South America Customers are supported by the TMEIC Corporation service personnel, design engineers and Spare Parts Depot in Virginia, and the TMEIC Factory in Japan

In Europe
TMEIC service engineers service all drive systems in
Europe, supported by the European TMEIC Spare Parts Depot.

In Asia and the Pacific Rim
TMEIC services drive systems throughout Asia and the Pacific, supported by the TMEIC factory in Japan, and multiple Field Engineers throughout Southeast Asia.

Remote Drive Diagnostics
TMEIC Corporation supports drive customers through the ***Remote Connectivity Module (RCM)***, a remote diagnostic service link with the TMEIC design and service engineers in Roanoke, Virginia. The RCM enables seamless integration between your drives and our engineers.

Remote System Diagnostics
TMEIC's remote system diagnostics tool, included in level 1 software, offers a quick path to problem resolution. System faults are automatically identified, and provide an integrated view of product, process and system information. TMEIC design and service engineers in Roanoke, Virginia, can analyze the data and provide steps for resolution.

Remote Diagnostic Service Reduces Mean Time to Repair
Remote Connectivity Module (RCM) offers protection for your investment, by reducing downtime, lowering repair costs and providing peace of mind. RCM requires an internet connection between your plant and TMEIC Corporation for retrieval of fault logs and files to diagnose drive issues.

Features	Benefits
• **Reduced downtime and Mean-Time-to-Repair**	**Quick support saves thousands of $ in lost production** TMEIC engineers can quickly connect* to the drive and diagnose many issues in a matter of minutes.
• **Secured connection***	**Customer-controlled access** All remote activity is conducted with permission of the customer. Drive start/stop is not permitted remotely.
• **Fault Upload Utility**	**Proprietary Traceback Upload Software** Historical drive faults are identified; TMEIC design and service engineers can analyze the issue resulting in the fault and provide a solution.

TMEIC Provides Superior Training

Customer engineers, maintenance and operations personnel are trained on the drives and control system at the TMEIC Training Center in Virginia. This world-class facility includes large classrooms and fully-equipped training labs.

Classroom and hands-on training consists of 50% class time and 50% hands-on lab time. Topics include:

- Overview of the drive system
- Function of the main assemblies
- Technical details of the components
- Drive and control system tools
- System diagnostics and service

Training at the Mill

As an alternative to the traditional factory training in Virginia, TMEIC can offer a course tailored to your project at the mill. In this case, a TMEIC project engineer and a local service engineer train your operators, maintenance technicians, and engineers at your site.

Paper Mill Engineer's School - A Long Tradition

The popular Paper Mill Engineer's School has been offered to customers since 1968. Over the past 25 years, 75 schools have been held, with more than 2000 customer graduates worldwide. The free five-day school is primarily for engineers and technicians from pulp and paper mills, corporate engineering headquarters, consulting engineers, and OEMs. Drive selection, control, motor sizing, and electrical power requirements are some of the important topics.

The well-regarded schools are held at the TMEIC headquarters in North America, as well as around the world. Taught by experienced TMEIC Application Engineers, the school presents technical information in a generic manner. Instructors have extensive technical expertise in the paper industry.

Virginia PMES Attendees - 2010

First Paper Mill School Attendees - 1968

"This class is designed for the paper mill engineer who needs to understand the how and why of drive selection, control and electrical power requirements. Needless to say, I think this class is a worth-while venture. I found it very informative and entertaining. Anyone who really wants a solid ground in drive applications specific to the paper industry, please consider this class.

Among the instructors are giants of the industry such as Jiri Kolojka, Walt Jones and Bill Thompson. These folks each have a long career as developers, application engineers and teachers."

Low Voltage System Drive Overview

TMdrive®-10e2

The family of low voltage AC system drives has an integral DC bus structure with a wide variety of inverters (DC to AC) and converters (AC to DC) to match virtually any application in the paper industry.

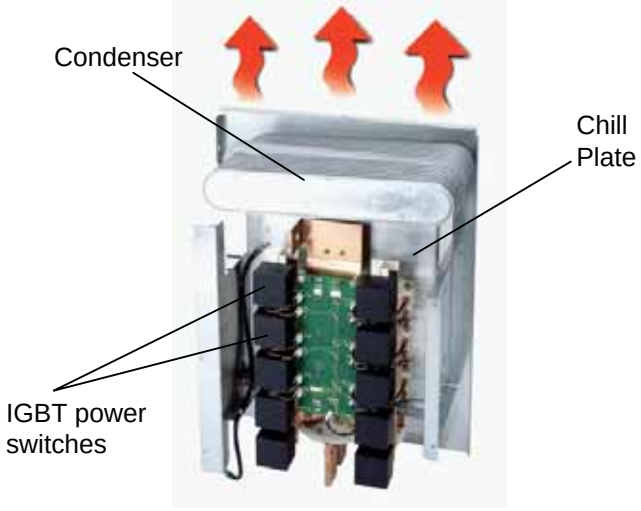
- 400, 460, 575, or 690 volt operation
- Motor power up to 1,949 kW
- Regenerative converter option

Draw-Out Style Inverters

For applications up to 193 kW (249 hp), draw-out style inverters are available in a very compact package.

Draw-out inverters are mounted on heavy-duty slides with staggered dc bus connectors on the back that connect with the bus when slid into the cabinet.

Motor cables are terminated at a common terminal block in the bottom of the cabinet.



Heat Pipe Cooling Technology

The use of heat pipe technology provides a dramatic advance in power bridge cooling, including a significant reduction in the footprint of the power bridge, and fewer fans lower the audible noise.

The Thermal Cycle

1 **Condensate to Vapor**
IGBT's are mounted to the multi-channeled chill plate which cools them. Heat generated by the IGBTs vaporizes the refrigerant, moving it upwards through the chill plate to the finned condensing unit.

2 **Vapor To Condensate**
Cooling air is pulled up through the IGBTs and the condensing unit, and cools the refrigerant, which condenses back to liquid.

3 **Return of Condensate**
The condensed refrigerant returns to the bottom of the chill plate to start the thermal cycle over again.

TMdrive-10e2 Operator Interfaces

Cabinet Enclosure Displays

Three-digit display alternates between speed and current while running, or a fault code when there is an error.

Standard Display

RJ-45 Ethernet port is used for local tool connection

Interlock button disables the drive

LEDs give a quick indication of the status of the unit.

LED indication

Ready	On when the unit is ready to run
Running	On when the unit is running
Alarm/Fault	Blinking LED indicates alarm condition, while solid LED indicates a fault
DC Bus	On when DC Bus is Discharged

Optional Enhanced Keypad

Navigation
Allows adjustment of drive parameters from the front of the equipment

Controls
Allow the equipment to be controlled in local mode from the front of the equipment.

- Reset faults, reverse direction, inc./dec. speed, jog, run and stop are available.
- Switch to local mode to allow operation at this control panel.

Optional analog meters can be supplied in addition to either the standard or enhanced display. Standard inverter I/O includes meter driver outputs that are +/- 10 V with 10-bit resolution. For cabinet style equipment, four meters are provided. For draw-out style, two meters are provided for each inverter.

Draw-out Enclosure Displays

LEDs give a quick indication of the status of the unit.

LED indication

DC Bus	On when the DC Bus is discharged
Ready	On when the unit is ready to run
Running	On when the unit is running
Alarm/Fault	Blinking LED indicates alarm condition, while solid LED indicates a fault
DC Bus	On when DC Bus is discharged
Discharged	Discharged

TMdrive®-DC System Drive Overview

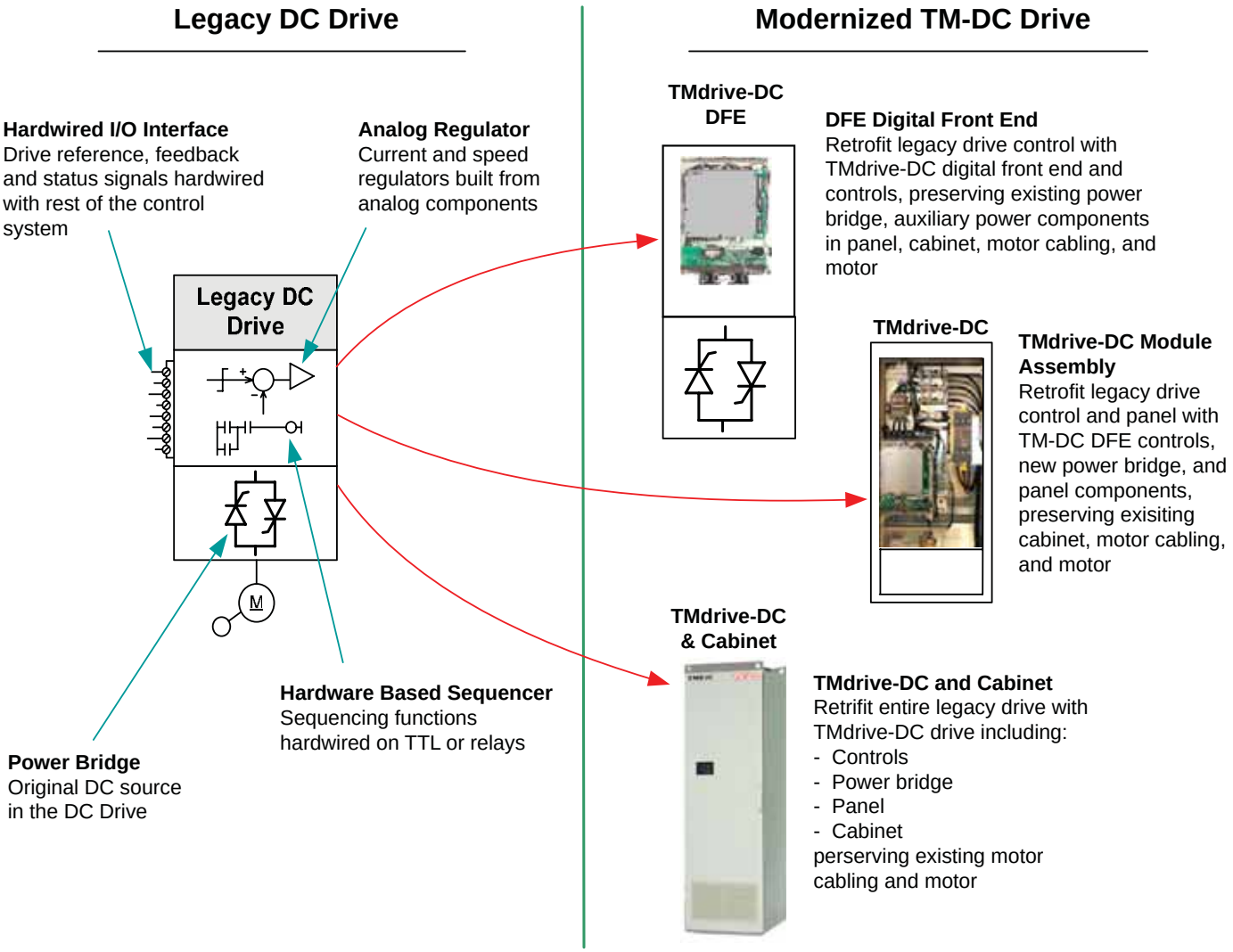
The TMdrive-DC family of system drives share numerous components with the TMdrive-10e2 AC products and are composed of several frames offered in any combination of four form factors (digital front end (DFE) control retrofits, frame assemblies, module assemblies, complete cabinet assemblies).

This flexibility of form factors and commonality with the TMdrive-10e2 AC products suits the current modernization project trends in the paper industry:

- Digital Front End (DFE) control retrofits on larger DC drives, saving the expense of replacing the existing power bridge and motor.
- Selected DC drive frame upgrades to address incremental power requirements.
- Frequent use of both DC and AC drive technology in projects.

Featuring Flexible Mechanical Design

TMdrive-DC's flexibility in packaging allows it to meet virtually any new or retrofit application. Three of the more common applications are illustrated below.



nvController

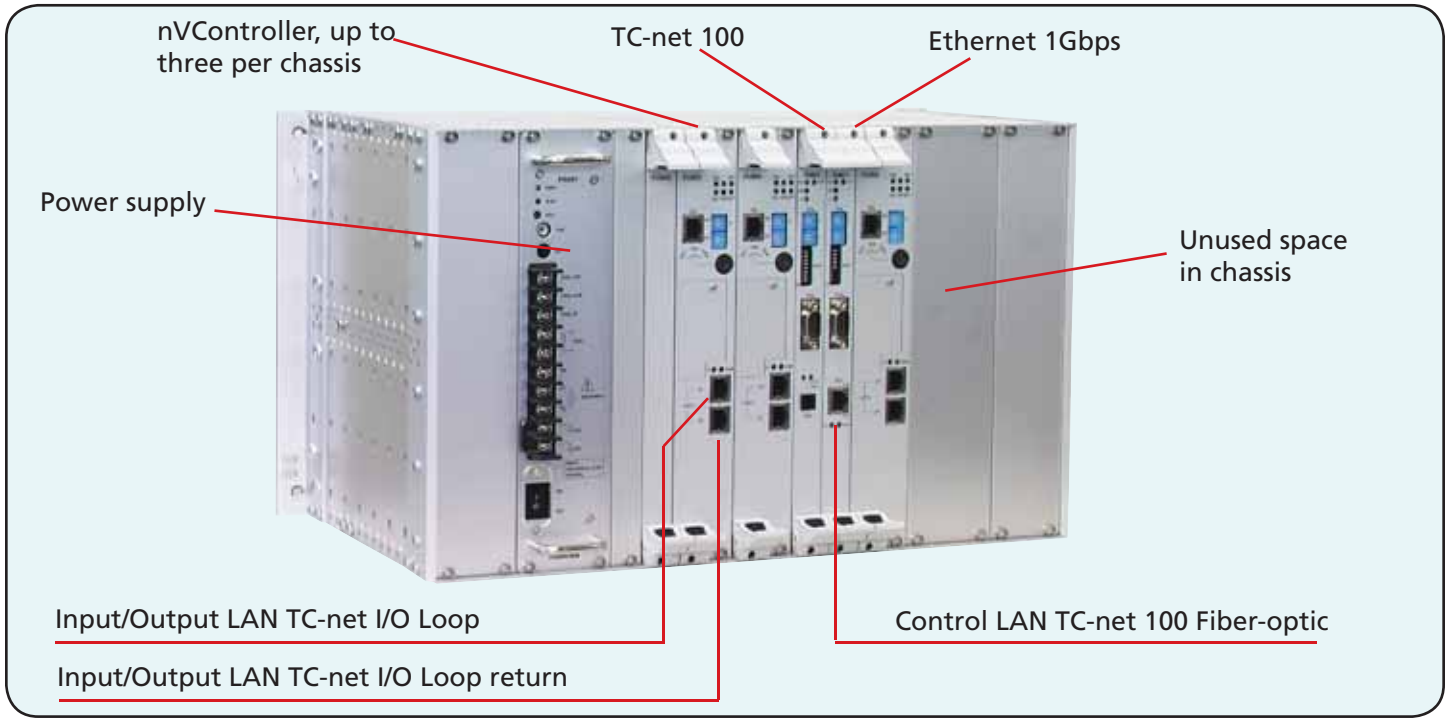
The nvController is a high-performance, large capacity controller designed for industrial applications. The capabilities include sequencing, coordinated motor speed control, and continuous control. The main nvController features are:

Controller

- High-speed processing, 20 ns per basic instruction word, 100 ns per floating decimal point
- Control cycle 0.5 msec to 1000 msec
- Program capacity 256 K steps
- Data capacity 256 K words, 16,384 16-bit I/O words
- ECC (Error Check and Correction) memory
- Multi-controller compatible, up to three CPUs per chassis
- Multi-scan tasks, high-speed scan as fast as 0.5 msec per program
- Total of 18 interrupt Tasks

Communication

- Ethernet Global Data (EGD)
- TC-net 100 control LAN Links the controllers:
  - Star type optical network
  - 2 km between nodes, overall length 12 km
  - Transmission rate 100 Mbps; 1 millisecond update
  - Dual transmission cable option for redundancy
- Field mounted I/O modules and the drives are on TC-net I/O, an electro-optical LAN:
  - Loop type network
  - Transmission rate 100 Mbps
  - Overall length 100 m (electrical), 4 km (optical)



Controller Configuration Tool

Tools for configuring the controller are contained in the engineering Tool software, TMEIC's innovative selection of software tools for configuring the system. These tools have the same "look and feel" with similar screens and user actions, thus simplifying the control engineer's programming task.

The Engineering Tool controller software offers all four IEC81131.3 standard logic control programming languages:

- RLD Relay Ladder Diagrams
- FBD Function Block Diagrams
- SFC Sequential Function Charts
- ST Structured Text

The TMdrive-Navigator is used to configure and monitor the drives. This software provides search technology linking signal lists, block diagrams, product documentation, change history, and user notes. High speed data is automatically captured and saved in the event of a drive fault, or on user trigger conditions. High resolution real-time trending shows and compares multiple drive variables.

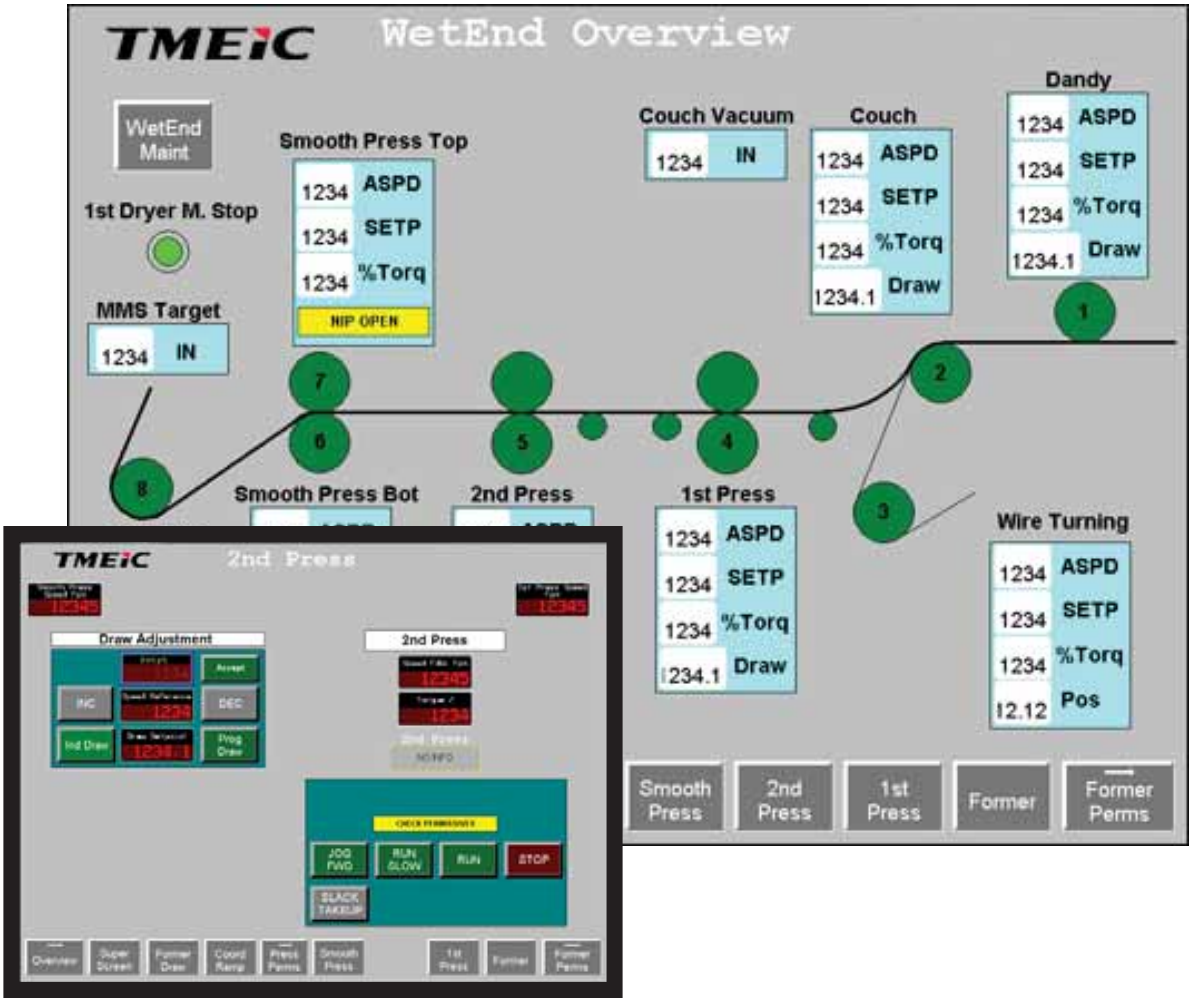
Live block diagrams provide real-time graphical views of the drive functions, and functions can be configured directly from the graphical view.

Innovation Series Controller

The VME controller rack contains the power supply, controller board, and spare slots for various communication cards.

Controller Features	Benefits
LAN Options All controllers have connectivity to a wide range of Local Area Networks and I/O device networks: • All TMEIC and legacy drives, I/O, HMIs • Allen-Bradley PLCs, ControlNet™, DH+, and Panel View • Siemens PLCs via Profi bus • DeltaV controller via Profi bus	**Seamlessly Integrates with Other Control Systems** LAN connectivity options provide seamless integration with the rest of the mill, regardless of the legacy and third-party equipment already installed. Either Ethernet or ISBus can be used to provide configuration/diagnostic support with the Windows-based toolbox.
Special Permissive Functions Control system diagnostics uses function blocks and operator interface tools (Diagnose)	**Reduces Downtime** Quickly identify permissive faults on the machine from the operator interface so repairs can be made
Multi-Tasking Preemptive, multi-tasking controller allowing functions with various scan rates to run concurrently	**Performs More Control** Performs high-speed control functions together with low-speed functions without overloading the controller

Operator and Technician Interfaces



Panel-Mounted Local Operator Interface and HMI Technician Interface

Features	Benefits
Panel-Mounted Touch Screen Mounted close to the machinery, the touch screen is easy to use and fast-acting.	**Convenient, Reliable Machine Control Panel** Panel-mounted close to the machine, the touch screen provides an intuitive display and hardwired-like control action allowing machine jogging. The rugged industrial computer stands up to the mill environment.
Machine Permissive Diagnostics The Boolean logic block with diagnostics indicates in red the contact preventing the machine sequencing.	**Faster Operator Response** Reduces the time to resolve permissive and/or operator training issues.
HMI Trend Recorder High-speed real-time and historic data from the control system and drives is available on the HMI trend screen.	**Convenient Drive and Machine Diagnostics** The high-resolution HMI screen trends live data from the controller, and data from drive capture buffers at rates up to 0.5 ms, for convenient drive and machine performance analysis, and for diagnostics.

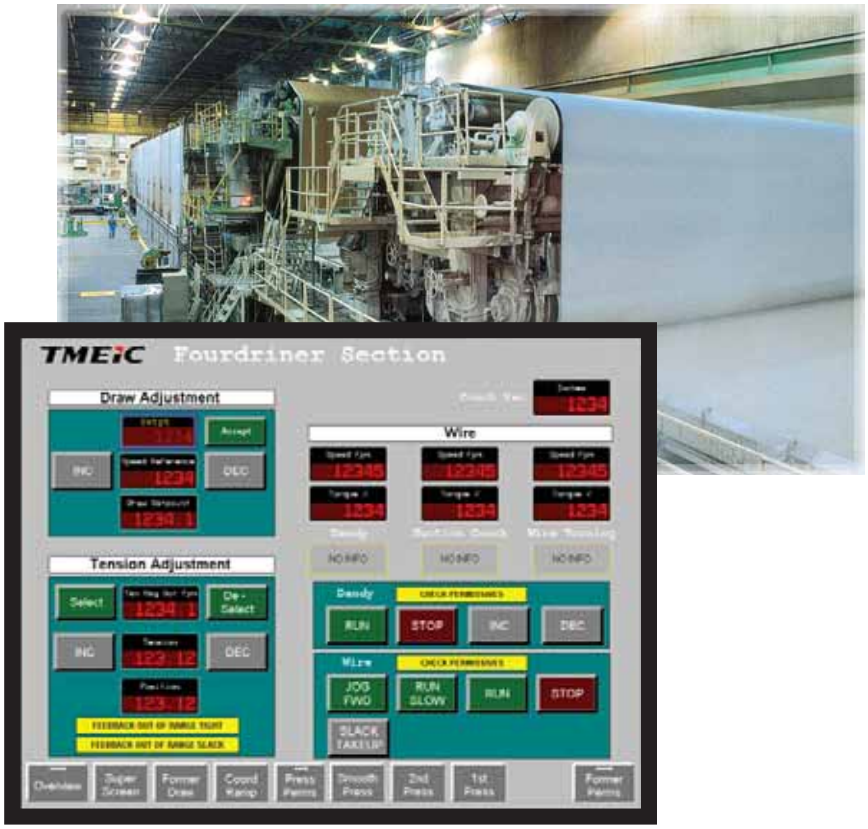
What Differentiates TMEIC's Operator Touch Screen?

TMEIC differentiates its touch screen from the competition by providing an intuitive screen design and fast-acting response to operator inputs by:

- Bringing the operator into the screen design process to ensure a good layout and simple screen navigation

- Applying a special Ethernet communication protocol optimized for the maximum data transfer and the lowest turnaround time at each end

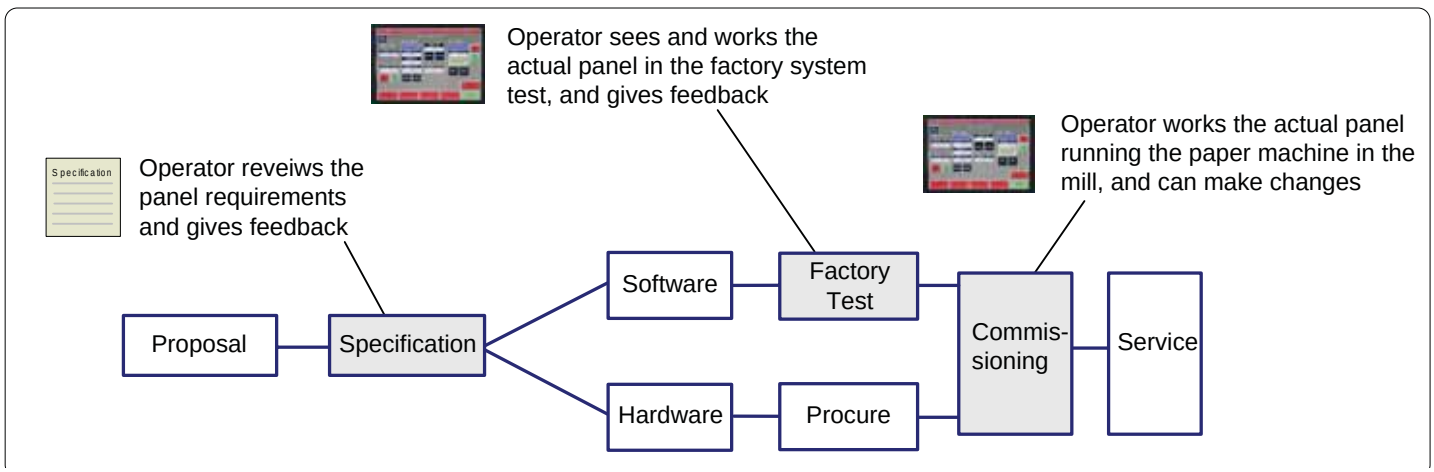
This combination of technology and engineering practices separates our offering from the others.



Operators Design the Best Touch Screen Layouts

Good touch screen design is achieved with an iterative process that includes the operators in each step. The design process provides three opportunities for the operator to participate in the screen design:

- At the beginning, during review of the system specification
- In Virginia, during the factory test, before the pressure of the mill startup begins
- In the mill during commissioning, to comment on the operation of the actual panel and system

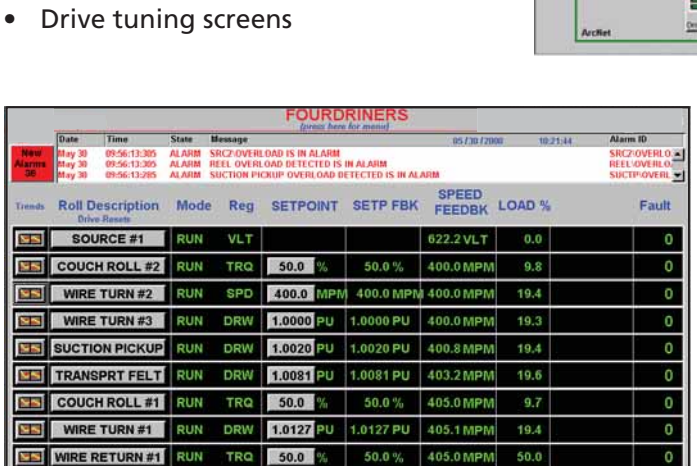


Three Operator Inputs to the Screen Design

The HMI, the Technician and Maintenance Interface

The HMI provides technicians and maintenance personnel with a clear window into the operation of the drive system, displaying:

- All real-time machine control and drive data
- Alarms and operator control
- Real-time and historic trending
- Permissive diagnostic displays
- System Overview provides access to the control program files
- Toolbox software for drive system configuration
- Drive tuning screens



The HMI Super Screen (opposite) is an operator overview of the drive system, with control by touch screen or mouse, and color-coded for fast operator recognition. Real-time data is listed for each drive:

- Drive run mode with active regulator type – Speed, Torque, Draw
- Operator's setpoint value, and setpoint feedback from the drive
- Speed feedback derived from a tachometer signal or sensorless algorithm
- Load % in terms of torque
- Buttons to call up trend data, and to reset a drive
- Drive fault information

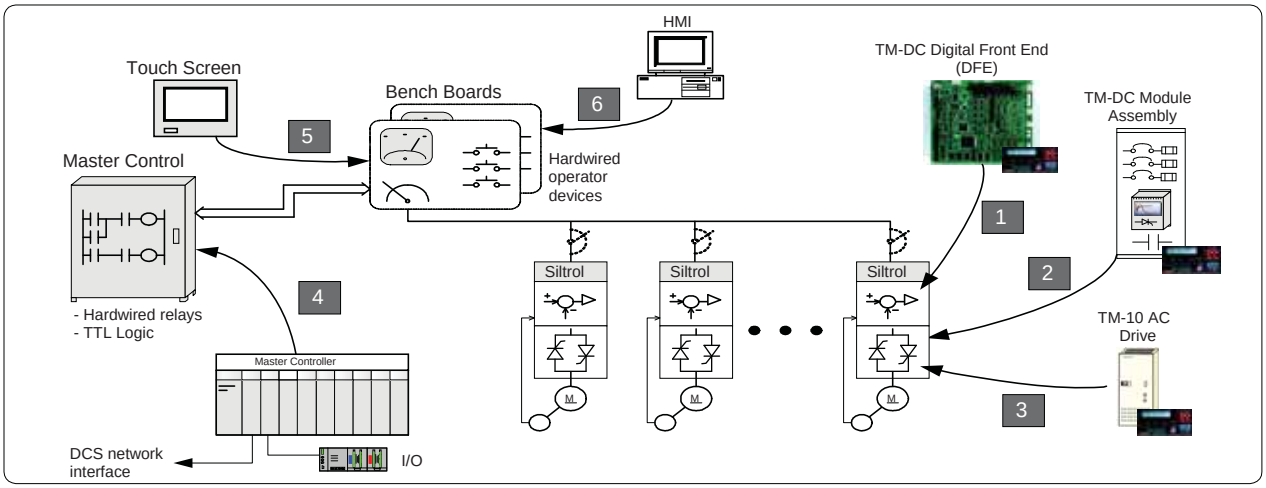
Data analysis is simplified using the Trend Recorder shown on the right, which displays real-time and historical data. Multiple signal traces are selected by dragging and dropping variables from the block diagram view. The recorder shows:

- Live data from the controller, trended as fast as every 20 ms
- High-speed data from capture buffers in the drive, trended every 1 ms or faster
- Movable cursors to read out values of the trends shown at the bottom of the screen

System Modernization

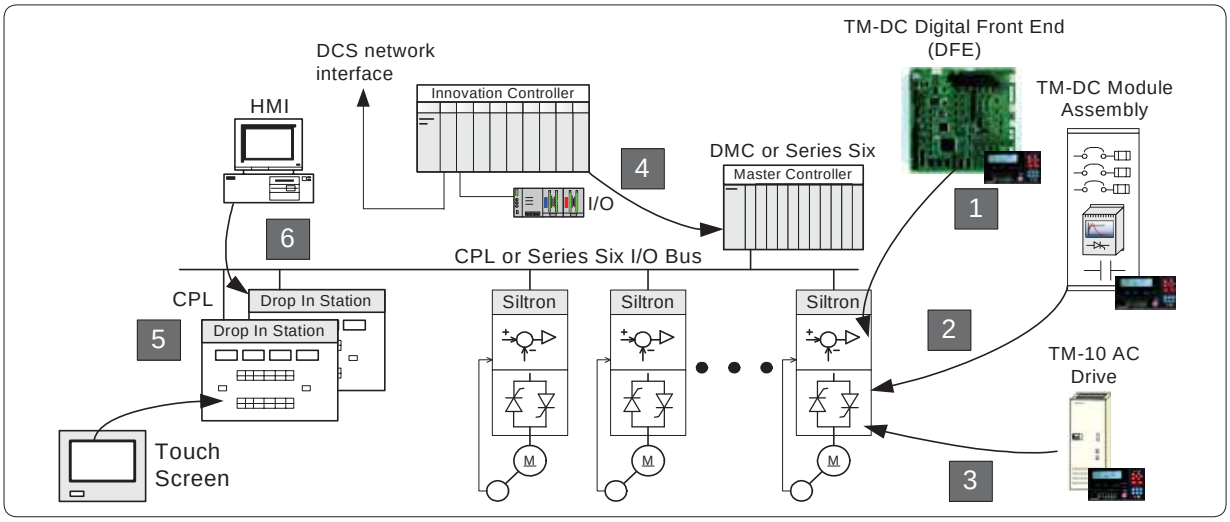
When it's time to modernize your drive system, who better to trust than the people who built the original system? TMEIC has the technology and project engineering team to provide a smooth migration path forward. The following pages chronicle the system architectures over the years and your options going forward. Please locate your system and explore the opportunities for modernization.

1970's System Architecture



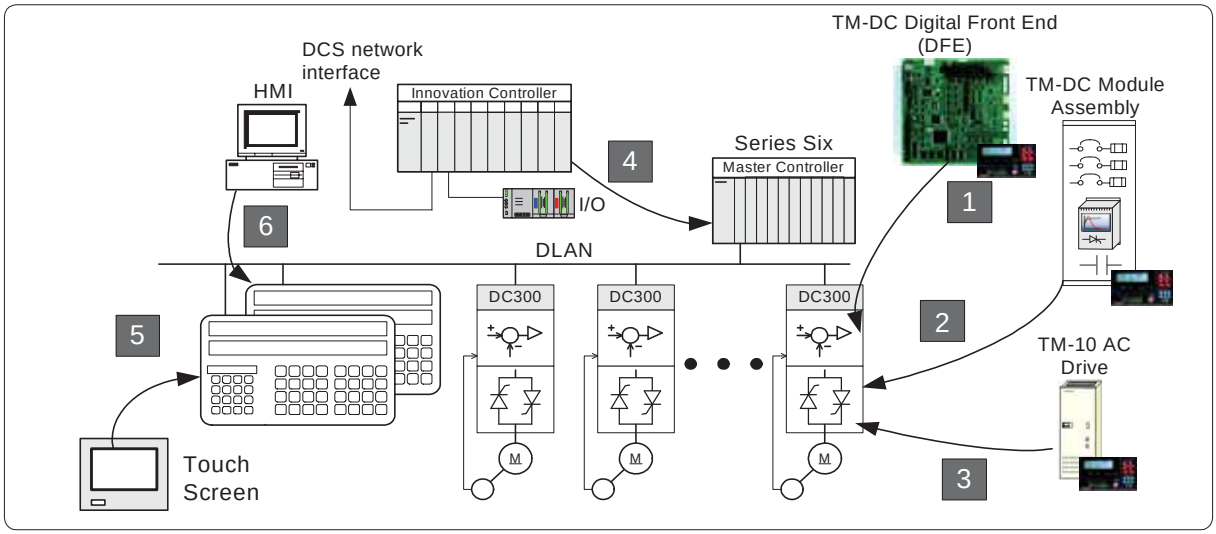
Item	Equipment Notes	Benefits
1 2 3	**Drive Modernization** - Modernize your Siltrol drives with the TM-DC or TM-10 AC drives. The DC modernization can occur at one of three levels: • Digital Front End (DFE) • Panel with DFE • Completely replace drive - Both the TM-DC and TM-10 drives can be controlled from I/O or one of several local area networks (ISBus™, Profibus-DP™, DeviceNet™, TOSLINE-S20™) - Configuration of the control is done from the Control System Toolbox	- More precise and consistent control with the digital regulators - The local area network interface between the drives and master control provides for a more precise speed reference distribution to the drives - With the TM-10 and TM-DC sharing common control hardware components, spare part costs are minimized in AC-DC hybrid systems
4	**Master Control Modernization** - Replace the electromechanical relay and TTL logic with a VME rack-based Innovation Series Controller and associated I/O - The VME rack allows a wide variety of third-party modules to interface with virtually any industrial LAN	- Digital solid state electronics are far more reliable and precise than electromechanical relay and TTL logic - The open architecture of a VME rack provides a seamless interface with the rest of your control system
5	**Color Touch Screen Operator Interface** - Graphical touch screens for operator control of the drives - Hardwired-like performance using a high-speed Ethernet communications link	- Vast improvement in flexibility of the design, allowing the interface to evolve without impacting hardware - Diagnostic data for both machine operation and drive status
6	**Human Machine Interface (HMI)** - Graphical overview of drive system status and diagnostic information - Integral historian provides flight-recorder-like functionality	- Intuitive interface for system status and diagnostic tools - Historian provides powerful insight into machine events

Early 1980's System Architecture



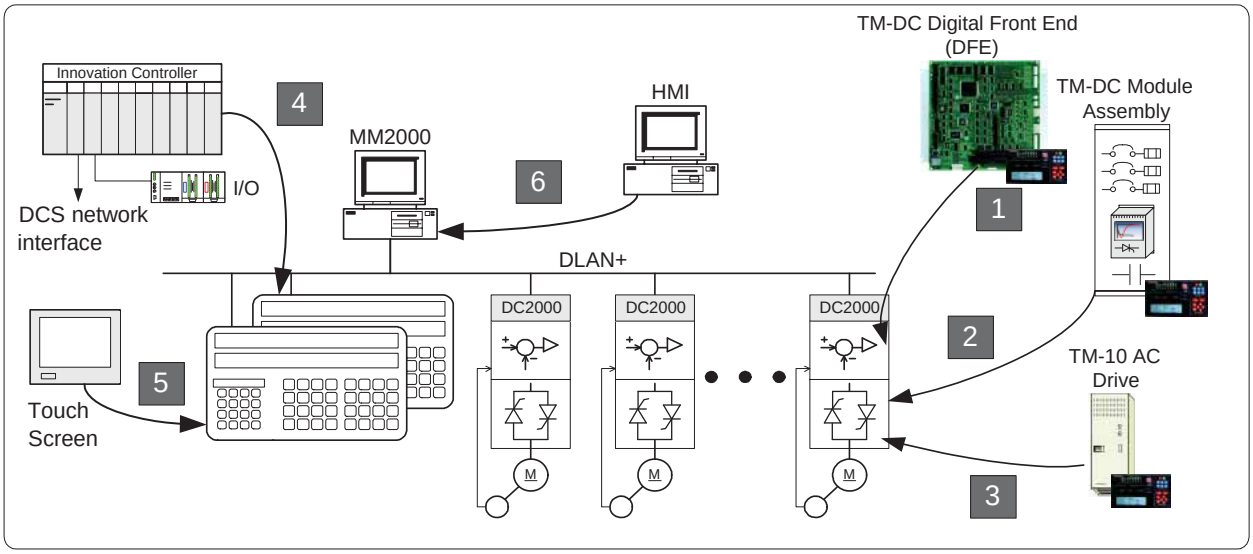
Item	Equipment Notes	Benefits
1	**Drive Modernization** - Modernize your Siltron drives with the TM-DC or TM-10 AC drives. The DC modernization can occur at one of three levels: • Digital Front End (DFE) • Panel with DFE • Completely replace drive - Both the TM-DC and TM-10 drives can be controlled from I/O or one of several local area networks (ISBus, Profibus-DP, DeviceNet, TOSLINE-S20) - Control can operate with a digital tachometer or without a tachometer - Configuration of the control is from the Control System Toolbox	- Siltron drives transitioned to AC technology will eliminate the periodic expense of DC motor maintenance - Drives modernized with TM-DC controls provide more precise control and improved diagnostic data - With the TM-10 and TM-DC sharing common control hardware components, spare part costs are minimized in AC-DC hybrid systems
4	**Master Control Modernization** - Replace the dated Series Six™ and/or DMC with a VME rack-based Innovation Series Controller and associated I/O - The VME rack allows wide variety of third-party modules to interface with virtually any industrial local area network - Controller is programmed in function block language using the Control System Toolbox	- Open architecture of VME rack provides a seamless interface with the rest of your control system - The Control System Toolbox provides a common application for both the controller and all of TM-GE's system drives
5	**Color Touch Screen Operator Interface** - Graphical touch screens for operator control of the drives - Hardwired-like performance using a high-speed Ethernet communications link	- Vast improvement in flexibility of the design, allowing the interface to evolve without impacting hardware - Diagnostic data for both machine operation and drive status
6	**Human Machine Interface (HMI)** - Graphical overview of drive system status and diagnostic information - Integral historian provides flight-recorder-like functionality	- Intuitive interface for system status and diagnostic tools - Historian provides powerful insight into machine events

Late 1980's System Architecture



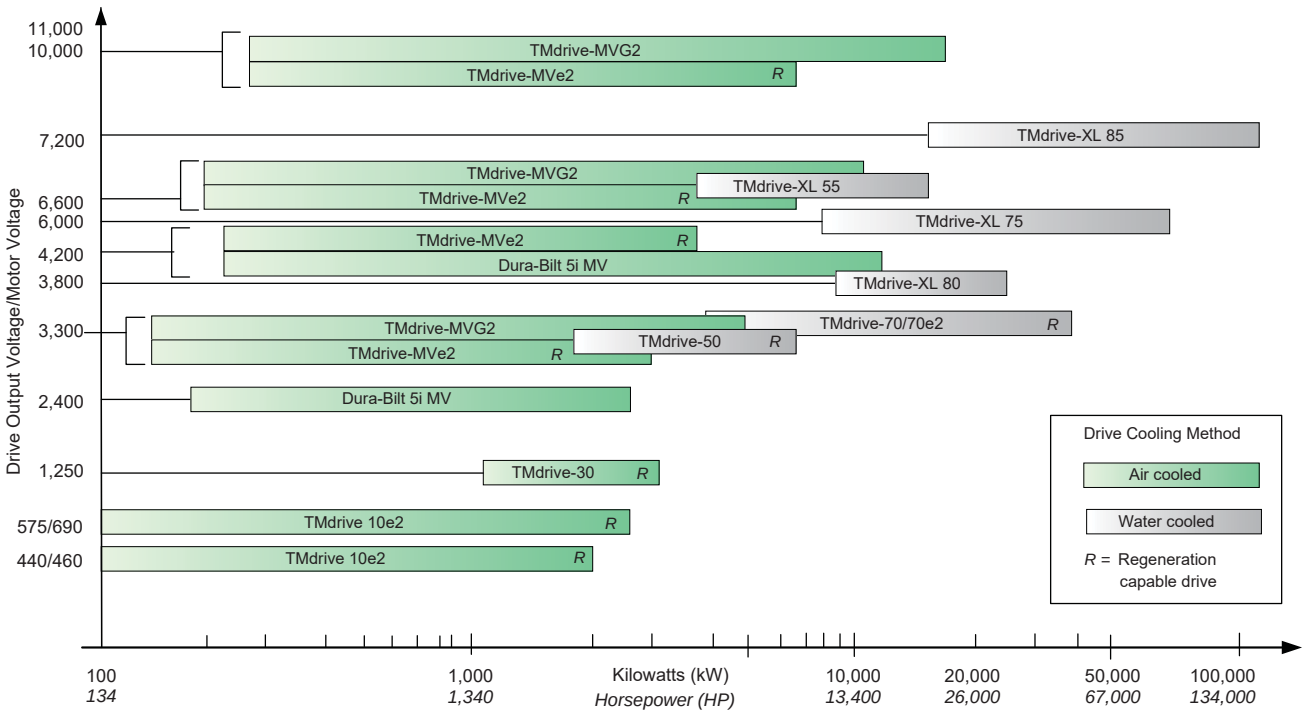
Item	Equipment Notes	Benefits
1 2 3	**Drive Modernization** - Modernize your DC300 drives with the TM-DC or TM-10 AC drives. The DC modernization can occur at one of three levels: • Digital Front End (DFE) • Panel with DFE • Completely replace drive - Both the TM-DC and TM-10 drives can be controlled from I/O or one of several local area networks (ISBus, Profibus-DP, DeviceNet, TOSLINE-S20) - Control can operate with or without a digital tachometer - Configuration of the control is from the Control System Toolbox	- DC300 drives transitioned to AC technology will eliminate the periodic expense of DC motor maintenance - Drives modernized with TM-DC controls provide more precise control and improved diagnostic data - With the TM-10 and TM-DC sharing common control hardware components, spare part costs are minimized in AC-DC hybrid systems
4	**Master Control Modernization** - Replace the dated Series Six with the VME rack-based Innovation Series Controller and associated I/O - The VME rack allows wide variety of third-party modules to interface with virtually any industrial local area network - Controller is programmed in function block language using the Control System Toolbox	- Open architecture of VME rack provides a seamless interface with the rest of your control system - The Control System Toolbox provides a common application for both the controller and all of TM-GE's system drives
5	**Color Touch Screen Operator Interface** - Graphical touch screens for operator control of the drives - Hardwired-like performance using a high-speed Ethernet communications link	- Vast improvement in flexibility of the design, allowing the interface to evolve without impacting hardware - Diagnostic data for both machine operation and drive status
6	**Human Machine Interface (HMI)** - Graphical overview of drive system status and diagnostic information - Integral historian provides flight-recorder-like functionality	- Intuitive interface for system status and diagnostic tools - Historian provides powerful insight into machine events

Early 1990's System Architecture



Item	Equipment Notes	Benefits
1	**Drive Modernization** - Modernize your DC2000 drives with the TM-DC or TM-10 AC drives. The DC modernization can occur at one of three levels: • Digital Front End (DFE) • Panel with DFE • Completely replace drive	- DC2000 drives transitioned to AC technology will eliminate the periodic expense of DC motor maintenance - Drives modernized with TM-DC controls provide more precise control and improved diagnostic data
2		
3	- Both the TM-DC and TM-10 drives can be controlled from one of several local area networks (ISBus, Profibus-DP, DeviceNet, TOSLINE-S20) - Configuration of the control is from the Control System Toolbox	- With the TM-10 and TM-DC sharing common control hardware components, spare part costs are minimized in AC-DC hybrid systems
4	**Master Control Modernization** - Replace the dated IOS's with a VME rack based Innovation Series Controller and associated I/O - The VME rack allows wide variety of third party modules to interface with virtually any industrial local area network - Controller is programmed in function block language using the Control System Toolbox	- Open architecture of VME rack provides a seamless interface with the rest of your control system - The Control System Toolbox provides a common application for both the controller and all of TM-GE's system drives
5	**Color Touch Screen Operator Interface** - Graphical touch screens for operator control of the drives - Hardwired-like performance using a high-speed Ethernet communications link	- Vast improvement in flexibility of the design, allowing the interface to evolve without impacting hardware - Diagnostic data for both machine operation and drive status
6	**Human Machine Interface (HMI)** - Graphical overview of drive system status and diagnostic information - Integral historian provides flight-recorder-like functionality	- Intuitive interface for system status and diagnostic tools - Historian provides powerful insight into machine events

TMEIC AC Drives offer complete coverage



Global Office Locations:

TMEIC Corporation
Roanoke, Virginia, USA
Tel: +1-540-283-2000
Email: paper@tmeic.com
Web: www.tmeic.com

Toshiba Mitsubishi-Electric Industrial Systems Corp. (TMEIC)
Tokyo, Japan
Tel: +81-3-5444-3828
Web: www.tmeic.co.jp

TMEIC Europe Limited
West Drayton, Middlesex, United Kingdom
Tel: +44-870-950-7212
Email: info@tmeic.eu
Web: www.tmeic.com

TMEIC Industrial Systems India Private Limited
Andhra Pradesh, India
Tel +91-40-4034-0000
Email: india_inquiry@tmeic.com
Web: www.tmeic.com

Toshiba Mitsubishi-Electric Industrial Systems Corp.
Beijing, China
Tel +86-10-5873-2277
Email: sales@tmeic-cn.com
Web: www.tmeic-cn.com

Toshiba Mitsubishi-Electric Industrial Systems Corp.
Shanghai, China
Tel: +86-21-6236-0588
Email: sales@tmeic-cn.com
Web: www.tmeic-cn.com

TMEIC Asia Company Ltd.
Kowloon Bay, Hong Kong
Tel: +852-2243-3221
Web: www.tmeic.com

TMEIC Asia Company, Ltd. Rep. Office
Kaohsiung, Taiwan
Tel: +886-7-223-9425
Web: www.tmeic.com

TMEIC Asia Company, Ltd.
Singapore Branch
Tel: +65-6292-7226
Web: www.tmeic.cn

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