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Closing The Loop

Hydraulic /Electric Motion Controllers
(Cadillac of Motion Control)



Applications

- ▶ Steels Mills
- ▶ Paper Industry
- ▶ Power Generation
- ▶ Casting / Forging
- ▶ Metal forming / Welding
- ▶ Hydraulic Press brakes
- ▶ Motion Platforms & Entertainment
- ▶ Fatigue / Hydraulic / Structural Testing
- ▶ Aerospace / Automotive Testing
- ▶ Injection & Blow Molding
- ▶ Precision component manufacturing

Motion Platforms



Steel Mills



Paper Pulp Refiner



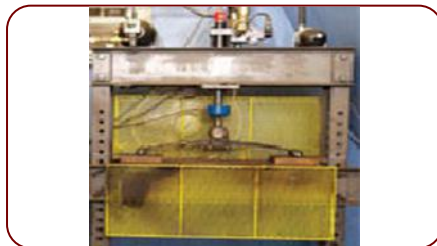
Hydraulic Press Brakes



Roll Forming



Testing



Injection Molding



Fatigue Testing



RMC70
1-2 Axes
Motion Controller



RMC150E
1-8 Axes
Motion Controller



RMC200
1-32 Axes
Motion Controller



RMC100
1-8 Axes
Motion Controller



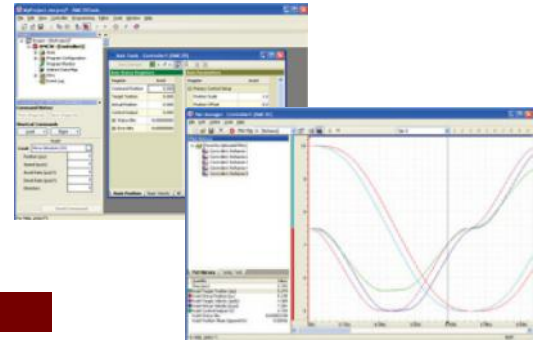
**VC2124 / VC2100
/ VC2100-HS**
Voltage to Current
converters

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RMC70 Series 1-2 Axes Motion Controller



Features

Setup and Programming

- ▶ Command-based minimal program development and maintenance
- ▶ Flexible User Programs advanced step sequencer with user named variables and mathematical expressions
- ▶ Extensive, context sensitive online help

Control Algorithms

- ▶ Position, velocity, pressure, force, position–pressure, position–force, velocity–pressure, velocity–force, active damping
- ▶ Full parameter set supports high performance motion control

Tuning and Diagnostics

- ▶ Powerful motion graphing and event logging for optimizing the entire motion system
- ▶ Event Log shows real-time activity

The RMC70 Series motion controllers offer a valuable combination of performance and ease-of-use for one and two-axis systems. Smooth, precise motion boosts throughput, improves quality, and extends machine life.

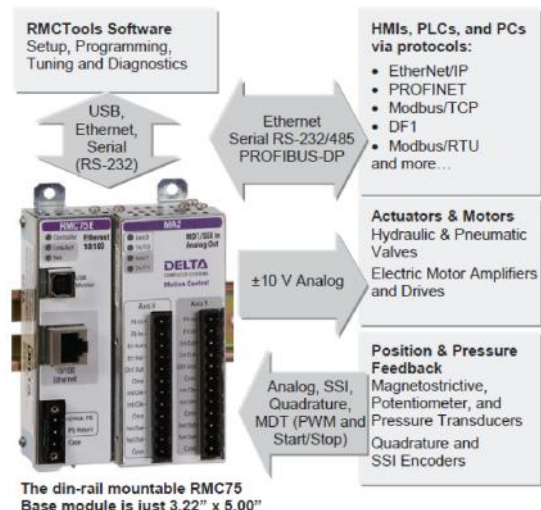
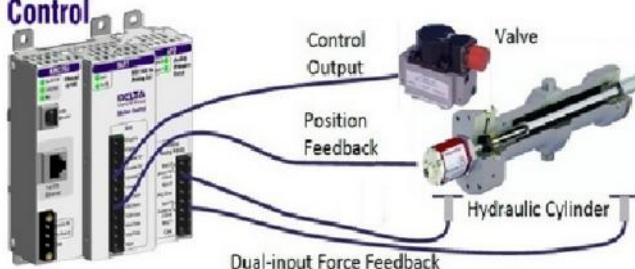
A number of feedback options are available, allowing one controller family to be used in a wide variety of hydraulic, electric, and pneumatic position and position–pressure/force applications.

The RMC70 motion controllers support multiple application types making use of acceleration and velocity feed forwards for controlling motors in velocity or torque mode, and separate directional gains for precise hydraulic control.

Efficient communication to popular PLCs and HMIs the RMC70 mirrors PLC addressing makes system integration quick and easy. For more performance, time-critical sequences can be offloaded from the PLC into the RMC70's

flexible User Programs. Command-based programming eliminates tedious coding, speeds development, and reduces long-term software maintenance. Advanced graphing and diagnostic capabilities can be used to troubleshoot the entire motion system. RMC70Tools software with informative help is downloadable from deltamotion.com.

DELTA
COMPUTER SYSTEMS
Motion Control

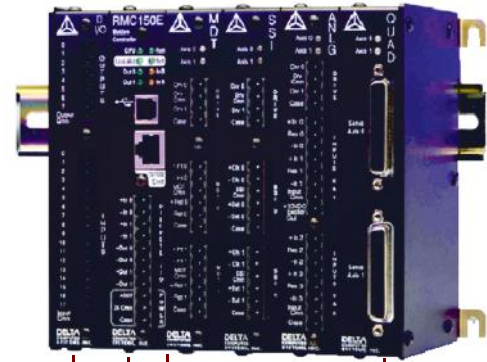
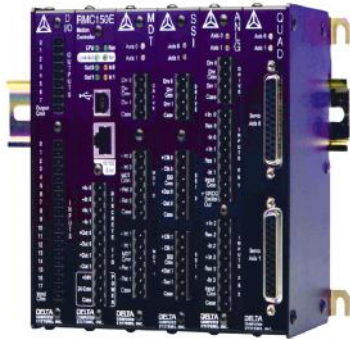


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RMC150/151 Two, Four, Six, Eight Axes Motion Controllers



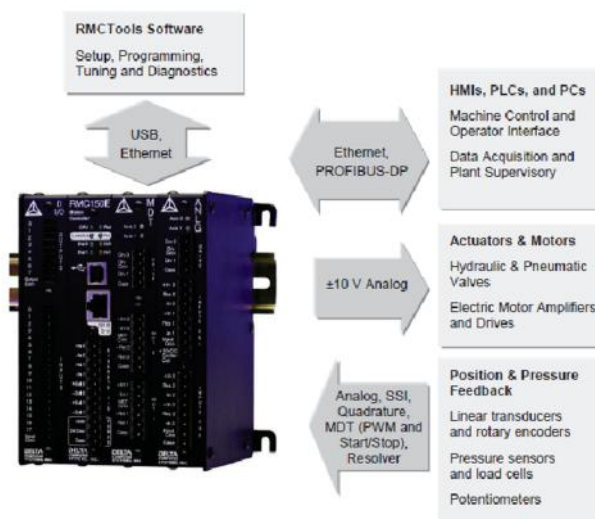
The RMC150/151 delivers high-performance motion control to hydraulic, electric servo, and pneumatic industrial applications. With powerful control modes including dual-loop position-pressure algorithms and connectivity to many transducer types, the RMC provides optimum control for a wide range of motion applications.

As Delta's most advanced motion controller, the RMC150/151 CPU module comes standard with Ethernet, supporting protocols such as EtherNet/IP, PROFINET, and Modbus/TCP, and is designed to integrate easily with your favorite PLCs, PCs and HMIs.

Equipped with excellent graphing features and easy-to-use wizards, the RMCTools software handles setup, programming, tuning and diagnostics for both the RMC150 and RMC70 series controllers.

Flexible Multi-axis Capability

Modules can be "mixed and matched" to support up to 8 control axes for tightly synchronized motion, and additional reference axes up to a total of 16 control, reference or virtual axes.



Communication Slot

Digital I/O
Profibus-DP
Universal I/O

CPU Slot

Digital I/O
Profibus-DP
Universal I/O

Axis Module Slots

MDT
SSI
Quadrature
Resolver
Analog
Universal I/O
Digital I/O

Communications

- ▶ **Ethernet (10/100 Mbps), built-in on CPU.**
EtherNet/IP, PROFINET, Modbus/TCP, CSP (Allen-Bradley), FINS (Omron), Procedure Exist (Mitsubishi Q-series)
- ▶ **USB Port**
For use with the RMCTools software.
- ▶ **PROFIBUS-DP**

Feedback Types

- ▶ **Magnetostrictive Linear Displacement Transducer (MDT)**
RS-422 Start/Stop and PWM signals
- ▶ **Synchronous Serial Interface (SSI)**
Linear and single- or multi-turn rotary
- ▶ **Analog**
±10 V and 4-20 mA
- ▶ **Quadrature Encoder**
5 V differential only (RS-422)
- ▶ **Resolver**
Wide range of frequencies and ratios

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The RMC200 is Delta's newest high-performance motion control platform for hydraulic, electric servo, and pneumatic industrial applications up to 32 axes. User-swappable modules provide flexibility and connectivity to many transducer types.

The RMC200's CPU module comes standard with Ethernet, supporting protocols such as Ethernet/IP and Modbus/TCP, and is designed to integrate easily with your favorite PLCs, PCs and HMIs. Delta's RMCTools software handles setup, programming, tuning and diagnostics for the RMC200, RMC150 and RMC75 controllers. Excellent graphing features and easy-to-use wizards complement its user programs designed specifically for motion sequences.

Flexible Multi-axis Capability

As Delta's largest and most capable motion controller, a variety of base sizes accommodate modules that can be "mixed and matched" to support up to 32 axes for tightly synchronized motion.

RMC200 Control Features

The RMC200 provides an extensive set of motion commands and programming capability for quick and easy yet flexible motion control for virtually every motion application.

RMC200 Two, Four, Six, Eight, Sixteen & Thirty two Axes

Setup

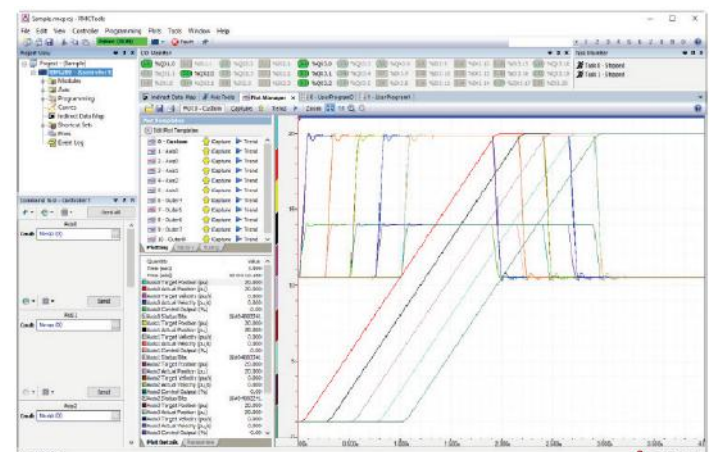
- ▶ **Wizards:** Easy-to-use wizards include New Project, New Controller, Scale & Offset, and Tuning.
- ▶ **Full Parameter Set:** Monitor all axis status registers and modify parameters.

Tuning and Diagnostics

- ▶ **Plots:** Plot any register in the RMC, up to 32 registers per plot, sampled as finely as the control loop resolution.
- ▶ **Tuning Wizard:** Quickly and accurately tune your axes, using a slider bar to choose from a range of gains appropriate for your system.
- ▶ **Event Log:** Speed troubleshooting by recording events such as parameter changes, commands, errors, and communications.

Programming

- ▶ **Commands:** Issue commands directly from RMCTools. Use Shortcut Commands to quickly issue commands to speed the tuning process.
- ▶ **User Programs:** Easily create programs to issue sequences of commands.
- ▶ **Program Triggers:** Start user programs automatically based on user-defined events such as discrete inputs, error conditions, etc.
- ▶ **Mathematical Expressions:** Expressions provide flexible programming capability for advanced calculations and machine control sequences.



Control Modes

Closed Loop Control

Full PID loop control with velocity, acceleration and jerk feed forwards for precise synchronized motion.

Position Control

- ▶ Point-to-Point moves
- ▶ S-curves
- ▶ Speed at Position
- ▶ Gearing
- ▶ Cyclic Sinusoidal Motion
- ▶ Splines, Cams
- ▶ Rotary motion (incremental and absolute)

Velocity Control

- ▶ Velocity control with position feedback
- ▶ Velocity control with velocity feedback

Pressure and Force Control

- ▶ Pressure sensor, load cell or differential force
- ▶ Linear or S-curve Ramps
- ▶ Gearing
- ▶ Cyclic Sinusoidal Profile
- ▶ Splines, Cams

Position-Pressure and Position-Force Control

- ▶ Transition seamlessly between position control and pressure or force control.
- ▶ Pressure or Force Limit – limit the pressure or force during a position or velocity move.

Active Damping

- ▶ For high-performance control of pneumatics and difficult systems.

Open Loop Control

- ▶ Seamless transition from open loop to closed loop. Ramp Control Output between two values, or ramp based on position for hard-to-control systems.

Quick Move

- ▶ Move in open loop and stop in closed loop for fast,
- ▶ smooth motion with accurate stops.

High level programming

▶ User Programs

Programs are easy-to-understand sequences of commands. Run multiple programs simultaneously to handle axis commands and machine control functions.

▶ Program Triggers

Start user programs automatically based on user defined events such as discrete inputs, error conditions, etc.

▶ Variables

Recipes and other user parameters can be store for use by user programs.

▶ Mathematical Expressions

Expressions provide flexible programming capability for advanced calculations and machine control sequences.

Trouble shooting and monitoring

▶ Plots

Plot any register in the RMC70, up to 16 registers per plot, sampled down to the control loop resolution.

▶ Event Log

Speeds troubleshooting by recording events such as parameter changes, commands, errors

Fault Handling

▶ Closed Loop stops

Ramp speed to zero at specified rate and hold position.

▶ Open Loop stops

Ramp output voltage to zero at specified rate.

▶ Multi-axis (group) stops

A fault on one axis halts multiple axes when configured as a group.

▶ Auto Stops

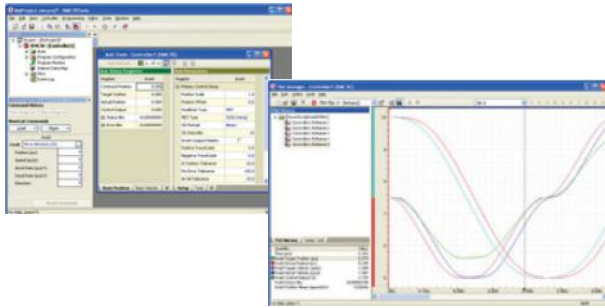
The response of axes to each fault type is easily configurable.

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RMCTools Programming
Software for RMC70 –RMC150/151 &
RMC 200 Controllers



RMCTools Software

RMCTools is a powerful motion control software package for setting up, tuning, troubleshooting, programming, and controlling all features of Delta's multi-axis RMC70 & RMC150/151 controllers from a PC.

Delta's intuitive and easy-to-use RMCTools software features flexible User Programs with extensive commands and the ability to embed mathematical expressions. Setup and tuning wizards reduce startup times, and the graphical diagnostics tools speed troubleshooting of the entire motion system. Extensive, context sensitive help is included in RMC Tools, giving you the information you need at your fingertips.

Communication Software

RMCLink ActiveX Control and .NET Assembly

RMCLink enables full monitoring and control of RMC70 & RMC150/151 motion controllers via Ethernet communications from custom applications on Windows®-based PCs. RMCLink supports numerous languages, such as Visual Basic, C++, C#, VBScript, VBA (Microsoft Excel®), LabVIEW.

RMCLink comes with fully-functioning sample projects to help you get up and running quickly. The help includes detailed walkthroughs and numerous code snippets.

Instrument Driver for Use with LabVIEW

Vis created by Delta for use with LabVIEW software provide full fledged examples including plot uploading and trending. The Vis are available from the Instrument Driver portion of National Instruments' website.



RMCTools Features

Delta's powerful RMCTools software makes setup, tuning, and troubleshooting motion systems easier than ever.

Setup

▶ Wizards

Easy-to-use wizards include New Project, New Controller, Scale & Offset, and Auto tuning.

▶ Full Parameter Set

Monitor all axis status registers and modify parameters. Tuning and Diagnostics

▶ Plots

Plot any register in the RMC, up to 16 registers per plot, sampled as fine as the control loop resolution.

▶ Auto tuning Wizard

Quickly and accurately tune your axes, using a slider bar to choose from a range of gains appropriate for your system.

▶ Event Log

Speed troubleshooting by recording events such as parameter changes, commands, errors, and communications.

▶ Program Monitor

Monitor User Program execution and variables.

Programming

▶ Commands

Issue commands directly from RMCTools. Use Shortcut Command Sets to quickly issue commands to speed the tuning process.

▶ User Programs

Easily create programs to issue sequences of commands.

▶ Program Triggers

Start user programs automatically based on user-defined events such as discrete inputs, error conditions, etc.

▶ Mathematical Expressions

Expressions provide flexible programming capability for advanced calculations and machine control sequences.

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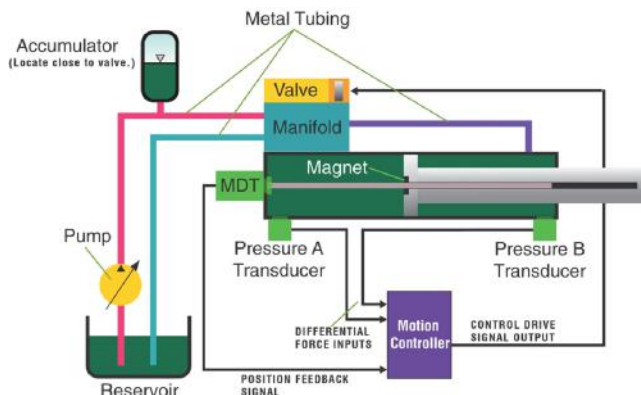
RMC100/101 Two, Four, Six, Eight Axes Motion Controllers



The RMC100 series brings the benefits of modular, high performance motion control to a wide range of industrial applications. Communication options ranging from high speed fieldbuses to discrete I/O make these controllers an excellent choice for large and small systems. Transducer types can be combined to control any hydraulic, electric, and pneumatic system. Powerful control modes including position/pressure control, synchronized moves, gearing, splines, and teach mode provide optimum control for your motion applications.

Applications

- ▶ Presses
- ▶ Injection/RIM/blow molding
- ▶ Packaging equipment
- ▶ Indexing/transfer lines
- ▶ Edger's / head rigs / veneer lathes
- ▶ Pinch rollers/winders/wrappers
- ▶ Casting/forging
- ▶ Palletizers/stackers
- ▶ Flying cutoff/curve sawing
- ▶ Cyclic testing
- ▶ Robotics/animatronics
- ▶ Pneumatic press rolls
- ▶ Tube bending/forming



Features

- ▶ Two to eight axes of position or speed control
- ▶ Isolated power input, drive outputs, discrete and analog I/O, and communications
- ▶ RS-232 port for RMCWin and the RMCCOM ActiveX Control
- ▶ Full PID with velocity and acceleration feed-forwards
- ▶ Motion and pressure profiles can be changed on-the-fly
- ▶ 256K bytes FLASH memory for field upgrades and parameter storage
- ▶ Trapezoidal, S-curve, and spline profiling
- ▶ Teach mode
- ▶ Synchronization of 2-8 axes
- ▶ Electronic gearing
- ▶ Compact DIN-rail mount package

Communications

- ▶ PROFIBUS-DP
- ▶ Ethernet
- ▶ Modbus Plus
- ▶ Discrete I/O – 20 inputs, 10 outputs
- ▶ Serial (RS-232/422/485)

Feedback Types

- ▶ Magnetostrictive Transducers – Start/Stop, PWM, and SSI
- ▶ Analog Transducers – 16 bit
- ▶ Quadrature Encoders
- ▶ Absolute encoders and resolvers with Synchronous Serial Interface

Drive Outputs

- ▶ All feedback interfaces are available with analog ± 10 Volt outputs
- ▶ Quadrature and SSI feedback interfaces are available with stepper output

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Voltage to Current Converters VC2124 / VC2100 / VC2100-HS

VC2124

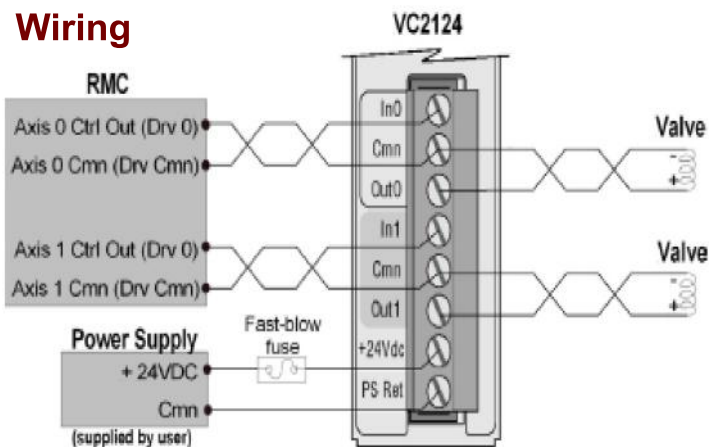
The VC2124 voltage-to-current converter transforms $\pm 10V$ signals into current signals capable of driving hydraulic servo valves or similar loads. It also provides a convenient way to set the full scale current to match valve requirements, limit maximum current, or set optimum working ranges.



Features

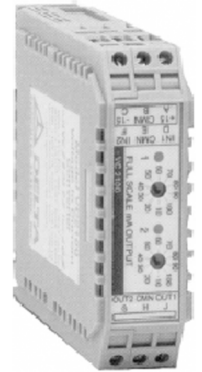
- ▶ Two channels of voltage-to-current conversion
- ▶ Full scale output current switch-selectable from $\pm 10mA$ to $\pm 100mA$ in 10mA steps (each channel set independently)
- ▶ Inputs and outputs can be paralleled for output current up to $\pm 200mA$
- ▶ Dual-color LEDs indicate input polarity and amplitude
- ▶ LEDs indicate output saturation (typically caused by loss of connection to the valve or excessively high load resistance)
- ▶ Outputs protected against inductive voltage spikes and short circuits
- ▶ Compact DIN-rail mount package
- ▶ Powered by single 24V supply
- ▶ 24V power supply isolated from inputs and outputs

Wiring



VC2100 / VC2100-HS

The VC2100 voltage-to-current converter transforms $\pm 10V$ signals into current signals capable of driving hydraulic servo valves or similar loads. It also provides a convenient way to set the full scale current to match valve requirements, limit maximum current, or set optimum working ranges.

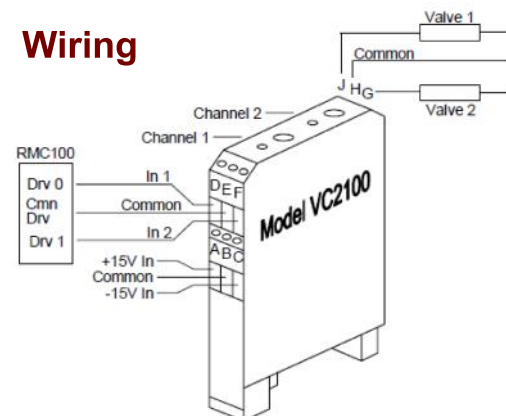


The VC2100-HS is a high-speed version of the VC2100, providing a response time of 15 kHz, compared to 1.4 kHz for the VC2100. In all other respects, these two versions share the same specifications.

Features

- ▶ Two channels of voltage-to-current conversion
- ▶ Full scale output current switch selectable from $\pm 10mA$ to $\pm 100mA$ in 10mA steps (each channel set independently)
- ▶ Inputs and outputs can be paralleled for output current up to $\pm 200mA$
- ▶ Dual-color LEDs indicate input polarity and amplitude
- ▶ Outputs protected against inductive voltage spikes and short circuits
- ▶ Compact DIN-rail mount package
- ▶ Use with $\pm 12V$ to $\pm 15V$ power supplies

Wiring

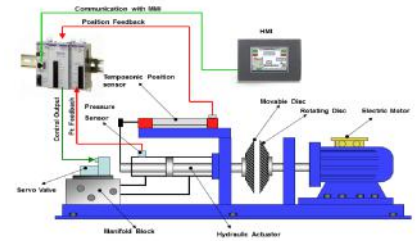


Pulp Refiner Plates Gap Control

The **Mechanical pulp refining** process involves the fibrillation of wood chips between grooved metal plates in a succession of refiners to produce developed fibers. Each refiner uses a movable plate and a fixed plate. The movable plate is driven by a high power electric motor and is held against the fixed plate by hydraulic servo actuator as the force of the conveyed chips tries to push the plates apart. The control process is complex because the intensity of refining varies according to the size and grade of the wood chips, as well as wood species.

In Olden days the pulp refiner machines were built using analog controllers which is very difficult to tune and troubleshoot. The refiner disc gap control is very critical application where damage of the discs can occur if discs are allowed to collide. With the analog control cards it is very difficult for the operator to know the system status and the actual disc gap.

To overcome these problems the RMC70 motion controller by Delta computer System was implemented. The RMC70 obtains continuous information on the position of the movable refiner plate from Magnetostrictive Displacement Transducer (MTS Temposonic). The MDT is mounted next to the hydraulic positioning cylinder and provides cylinder position information to motion controller. RMC70 motion controller performs closed loop control, monitoring the data from the MDTs up to 2000 times per second and then operating the Servo hydraulic valve, moving the piston to make the actual position match the target position. A servo valve is used so that small changes in valve position can instigate very precise hydraulic motion. The RMC70 controller communicates with Koyo make HMI through EtherNet Link. The HMI provides the refiner plate position set point. The EtherNet link carries status from the controller back to HMI.



Roll Forming

Roll forming is a continuous bending operation in which a long strip of sheet metal (typically coiled steel) is passed through sets of rolls mounted on consecutive stands, each set performing only an incremental part of the bend, until the desired cross-section profile is obtained. Roll forming is ideal for producing constant-profile parts with long lengths and in large quantities.

The roll forming process requires the precise setting of gap between two profiled rolls. In olden days the gap setting was done manually where the process consumes more time to precisely set the gap which in turn increases the setup time and decreases machine productivity. The new generation machines use Hydraulic Servo Actuators with inbuilt position feedbacks and Servo valves. The Servo actuators are controlled by motion controllers where the gap setting and control process is carried out just by click of a button.

The motion controller plays an important role in increasing the machine productivity. As productivity demands increase, more and more applications and processes require more sophisticated closed loop controllers. The new generation multi axes RMC150E motion controller from Delta Computer Systems was selected for this application. The RMC150E controller is a programmable motion controller where the machine operation sequences can be easily lined up.



The Servo Actuator consists of inbuilt high resolution (up to 0.5 microns) Temposonic position sensor. The High response Servo valve is used to drive the Servo Actuator. The operator sets the roll gap set point through the HMI. The RMC150E motion controller continuously reads position information (2000 reads / sec) from inbuilt position sensor for precise monitoring and control of servo actuator position. The motion controller drives the hydraulic servo actuator by sending analog signals to a Servo valve capable of making precise adjustments of flow controlling cylinder /roll position.

The main reasons for using RMC150E closed-loop motion controller is flexibility, accuracy, speed and the ability to maintain precision with changing conditions (Loads)

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DELTA RMC70 /RMC150E Motion Controller Applications

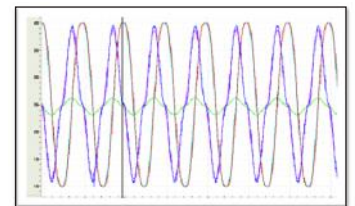
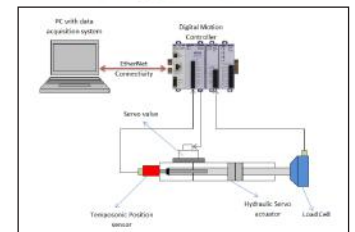
Dynamic Testing

Closed Loop motion control offers precise, smooth motion control in the field of **Dynamic testing application**. The control system consists of a PC based Data acquisition system, Man Machine Interface software, Motion controller & Servo actuator with inbuilt load cell, Temposonic position sensor and Servo valve. The Man Machine interface software loaded into the PC allows the user to set the desired motion patterns and acquires the system data from various sensors for user display, plotting and report generation. The motion pattern or command set by the Man Machine interface software will be fed into the Digital RMC70 motion controller for the execution.

The Servo Actuator consists of inbuilt high resolution (up to 0.5 μ m) position sensor and Load Cell. The High response Servo valve is used to drive the Servo Actuator. The RMC70 motion controller continuously reads position / force information (2000 reads / sec) from inbuilt position sensor and load cell for precise monitoring and control of servo actuator position / force. The designed servo actuator is capable of moving at a rate up to 10Hz.

The RMC70 Motion Controller can be programmed to operate in Load control mode (by closing the loop with Load Cell), position/Velocity control mode (by closing the loop with inbuilt position sensor) or both position and force control mode (by closing loop with both Position sensor and Load Cell).

The NDT programs often involves the application of repetitive stress cycles on the device being tested. A motion controller that supports direct execution of cyclic motion operations makes it quick and easy to set up testing profiles. The RMC70 motion controller is capable of generating various motion profiles that includes Sinusoidal, Triangular, Square and Random waveforms. The pattern Frequency, Amplitude and phase parameter can be set online without stopping the test. The RMC70 Motion controller offers online tuning facility where the system gains can be changed while the system is running.



Hose Impulse Testing

Impulse testing is one of the key predictions of hose life. Impulse testing involves the pressurizing or cycling of hose pressure, often times up to 140% of working pressure, at rates up to 1 to 2 cycle per second while the hose is held in either a 90° or 180° configuration. An impulse testing is a very good indicator of assembly robustness.



These applications require the added value pressure control, which is much more sophisticated than what can be provided by the usual pressure relief valve or pressure regulator. The major challenge in this application is pressure cycling, where the pressure and its ramp rate needs to be controlled in a desired manner. As the oil pressure will have more dynamics where pressure spikes and hunting likely to happen, it is essential that the control system design and its component like closed loop motion controller, pressure sensor and servo valve etc. to have high response which will help in controlling the pressure in desired manner. Closed loop control methods are now commonly used to control the pressure accurately by compensating of oil viscosity changes. Field proven PID algorithms are much more sophisticated than the limited proportional control that mechanical devices with springs can provide.

The test system consists of high pressure Hydraulic pump driven by an electric motor which supplies necessary flow of Hydraulic oil at required pressure. The output of Hydraulic pump is fed to high response precision Servo valve which modulates the input pressure and feeds it to test hose. The pressure developed in the hose is sensed by means of pressure transducer installed near to the hose pressure inlet line.

The RMC70 motion controller performs closed-loop control, monitoring the data from the pressure sensor and then operating the Servo valve which modulates the pressure and feeds it to test hose so as to match the target pressure at desired rate. The RMC70 Closed Loop Motion controller offers online tuning facility where the system gains can be changed while the system is working. In addition with pressure PID gains the RMC70 motion controller offers pressure and pressure rate feed forward gains which will help to increase the system dynamics. Online graphing and event log provides easy set up and trouble shooting of the system.

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Allied Products



Servo Actuators with Servo valve, Inbuilt Temposonic Positions sensor and Load cell



Hydraulic Power packs with Optional Electrical control panel



MTS—Temposonic Position sensors



Electromechanical Linear and Rotary Actuators and Drive systems



Closed loop Motion Controllers and controls accessories



Pressure sensors with Digital/Analog outputs



Servo /Proportional & Direct Drive Valves



Mobile Electronics & E-Hydraulics



Custom built Steam Turbine Governor control actuation system



Celesco— Wire/String type position sensors



First Mark— Wire type sensors for Aerospace applications



NACOL—Japan Bladder type accumulators



Veljan Denison Limited—Hydraulic Pumps & Motors



2/3/6 DOF Electro mechanical / Hydraulic Motion Platforms



Structural / Component / Material Test rigs

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SERVOCONTROLS 100% EOU unit in 12 acres of land near Hattargi Belgaum Special economy Zone



SERVICING OF SERVO VALVES

World Class Servo valve Repair, Assembly, Test Lab. All Brands, All Types, All Configurations

We Repair/ service Proportional, Servo Proportional & Servo valves.

Abex, Atchely, Cincinnati, Dowty, Dyval, EMG, Herion, Hydromatic, Kawasaki, LHC, Moog, Star, Oilgear, Olsen, Parker, Pegauses, Plasser, Rexroth-Bosch, Shnieder, Sopelem, Towler, TSS, Ultra, Vickers etc.

SERVICING OF TEMPOSONIC SENSORS

We have dedicated Electronics lab with all necessary instrumentation and inventories for Servicing Temposonic position sensors.

TECHNICAL ALLIANCE PARTNERS



Cat. No. SC10500822

Website: www.servocontrolsindia.com

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