CoDeSys Development Software

Developing motion control and I/O programming using a standard set of software tools streamlines software development and creates application programs that are more effective and easier to support in the field.

The CoDeSys Development Software utilizes standard IEC 61131-3 programming and PLCopen motion function blocks to provide proven, open standard tools for developing application programs for motion control and I/O control -- running on a single controller.

IEC 61131-3 Programming

The key advantage of IEC 61131-3 is that it provides *an integrated set of software tools and graphical interfaces* to meet a wide range of software development needs:

- ✔ Relay Ladder Logic (LD)
- ✔ Structured Text (ST)
- ✔ Sequential Function Chart (SFC)
- ✔ Function Block Diagram (FBD)
- ✔ Instruction List (IL)

Developing application programs using IEC 61131-3 offers the following advantages:

- ✔ Reduces training costs by learning one set of programming languages used by multiple control vendors.
- ✔ Provides flexibility for selecting the best programming approach

Programming tools simplify software development

CoDeSys Development Tools

- ► Program motion control and logic using standard IEC 61131-3 tools
- ► Suite of programming languages and charting tool simplifies machine development and support
- ► Select among graphical and text-based languages -- Relay Ladder Logic, Function Block Diagram, Structured Text, Instruction List, Sequential Function Chart or Continuous Function Chart

PLCopen Motion Control Library

- ► Standard library of motion function blocks which cover all of the IEC 61131-3 languages.

ORMEC Motion Control Extensions

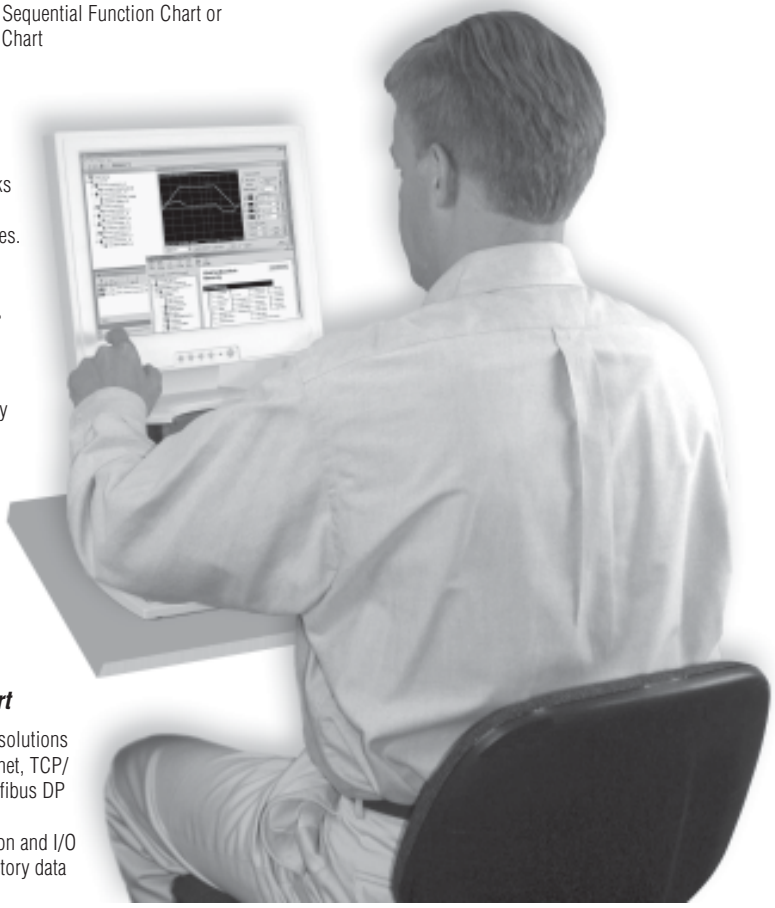
- ► ServoWire Motion Blocks provide enhanced functionality for high performance electronic gearing and coordinated multi-axis control.
- ► Analog feedback control.
- ► Registration control.

Built-in Networking Support

- ► Standard networking solutions and support for Ethernet, TCP/IP, Modbus/TCP, Profibus DP and OPC server.
- ► Connectivity for motion and I/O control, HMIs and factory data networks.

ServoWire Pro

- ► ServoWire Setup: menus and software wizards to simplify configuration of ServoWire SM drives.
- ► ServoWire Monitor: diagnostic utilities for monitoring drive and network performance.
- ► ServoWire Tune: tuning scope optimizes performance.
- ► ServoWire Upgrade: tools for maintaining new firmware.



PLCopen motion control

Administrative		Motion	
Single Axis	**Multiple Axis**	**Single Axis**	**Multiple Axis**
Power	CamTableSelect	MoveAbsolute	CamIn
ReadStatus		MoveRelative	CamOut
ReadAxisError		MoveVelocity	GearIn
ReadParameter		Home	GearOut
ReadBoolParameter		Stop	
WriteParameter		PositionProfile	
WriteBoolParameter			
ReadActualPosition			
Reset			
DigitalCamSwitch			

and methods for specific application tasks and requirements.

- ✔ Offers the ability for the programmer to develop and deploy reusable function blocks which can reduce future software development costs and protect your company's intellectual property.

PLCopen Motion Control Library

PLCopen is an independent, worldwide association promoting IEC 61131-3 that has defined standard motion programming function blocks which cover all the IEC 61131-3 programming languages.

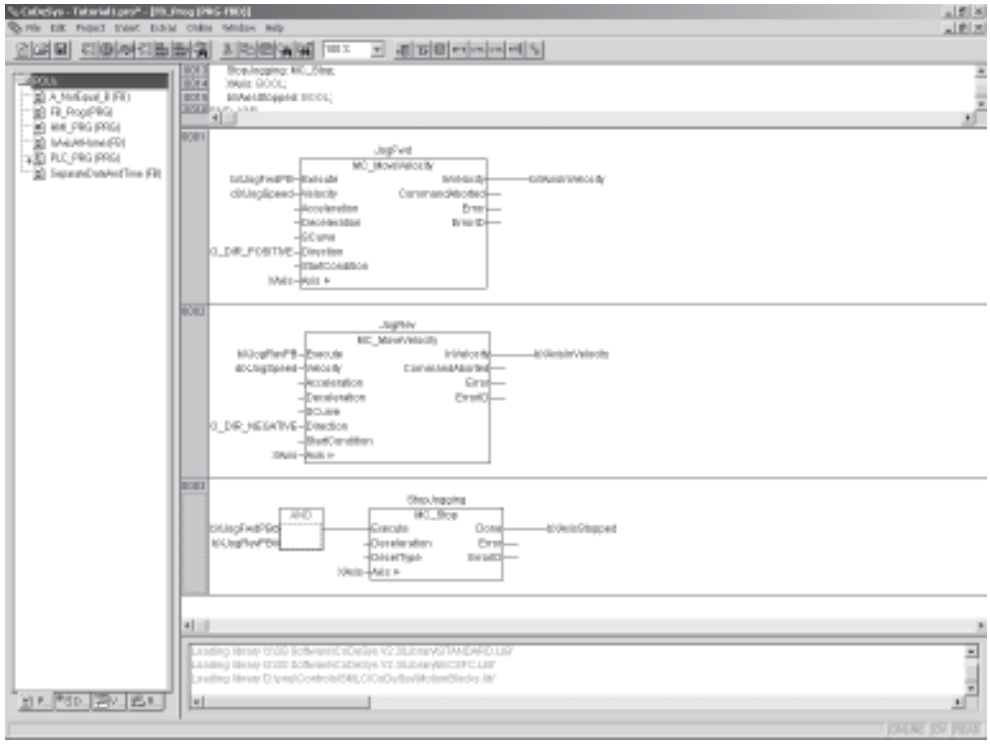
ORMEC's motion programming implementation (ServoWire Motion Blocks) conforms to the PLCopen motion block definitions and provides powerful, flexible functionality beyond that defined in the standard. Using the ServoWire Motion Blocks, a variety of applications can be written in any of the IEC 61131-3 programming languages.

The ServoWire Motion Blocks provide the following enhanced functionality:

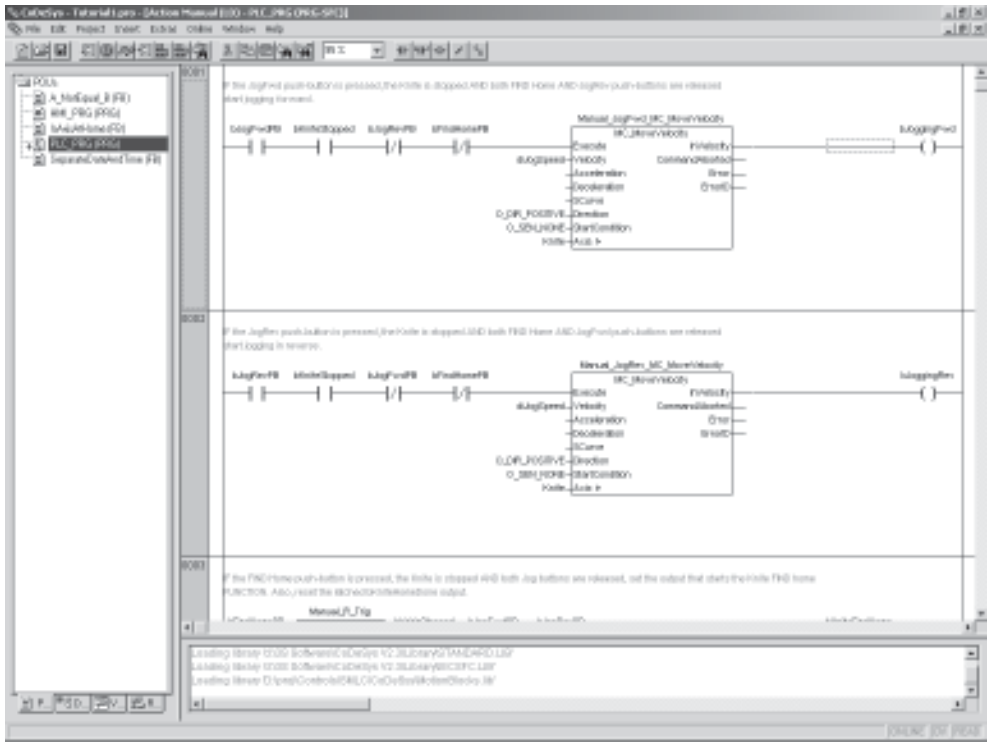
- ✔ Move Relative At Velocity
- ✔ Move Relative In Time
- ✔ Move Absolute At Velocity
- ✔ Move Absolute In Time
- ✔ Gear Relative At Ratio
- ✔ Gear Relative In Master Distance
- ✔ Cam Relative
- ✔ Plus administrative function blocks including enhanced diagnostic capabilities

Move Relative and *Gear Relative* motions can also be "superimposed" on a *Gear In* motion-- ideal for adjusting the phasing of a slave axis relative to the master position axis, as in flying shear, rotary knife and registered labeling applications.

ServoWire Motion Blocks can be inserted into relay ladder logic or function block diagrams to coordinate motion with I/O updates. Optional parameters allow motions to be triggered at the position command update rate using high-



Function block diagrams provide a graphical tool for creating effective motion control and I/O programming. Pre-defined function blocks can be easily configured and combined in a logical program flow which makes the application program both easier to understand and "self-documenting" for plant personnel.



Using ServoWire motion blocks in ladder logic makes application software both simpler to develop and easier to support in the factory. Ladder logic provides a graphical, power flow for viewing program structure and execution.

speed drive inputs, and *automatically repeated* independent of, and faster than the I/O updates. This motion command flexibility allows an SMLC system to meet the high performance requirements of demanding automation applications.

IEC 61131-3 Development Tools

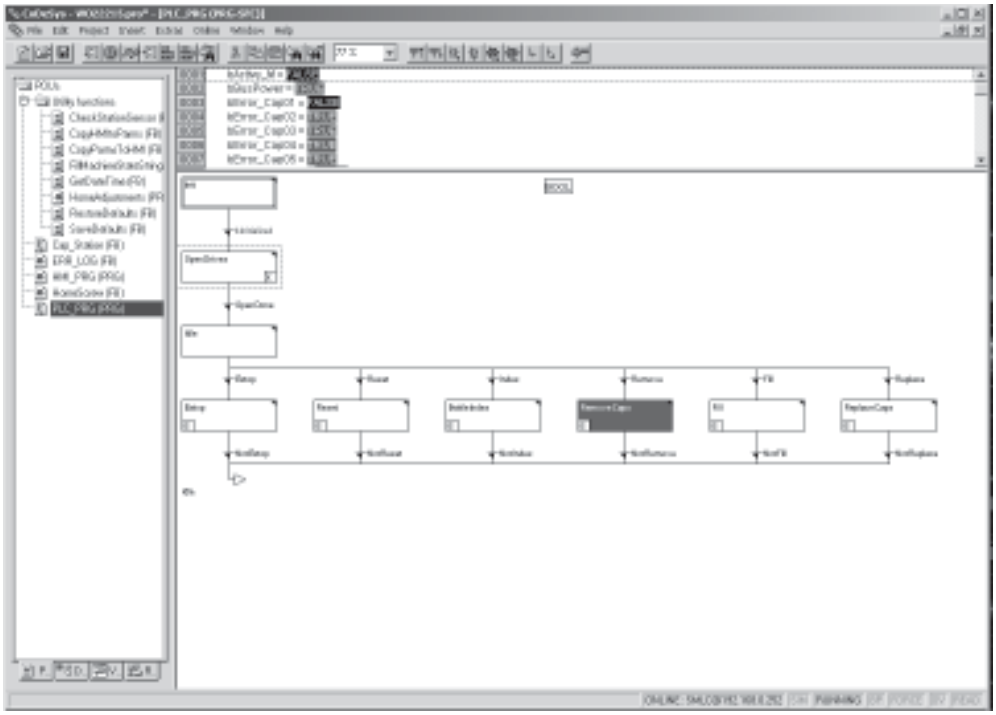
Powerful IEC 61131-3 development tools are provided for writing, debugging and maintaining application programs. This development environment will assist you in writing your application program by providing automatic variable declaration, automatic code formatting, syntax coloring and global search/replace functionality. There are tools for importing and exporting code modules, and a Library Manager for adding additional system libraries to your project.

The Input Assistant identifies possible entries for input variables, function calls and IEC keywords. A simulation mode is available for testing your program logic without needing the controller and other hardware.

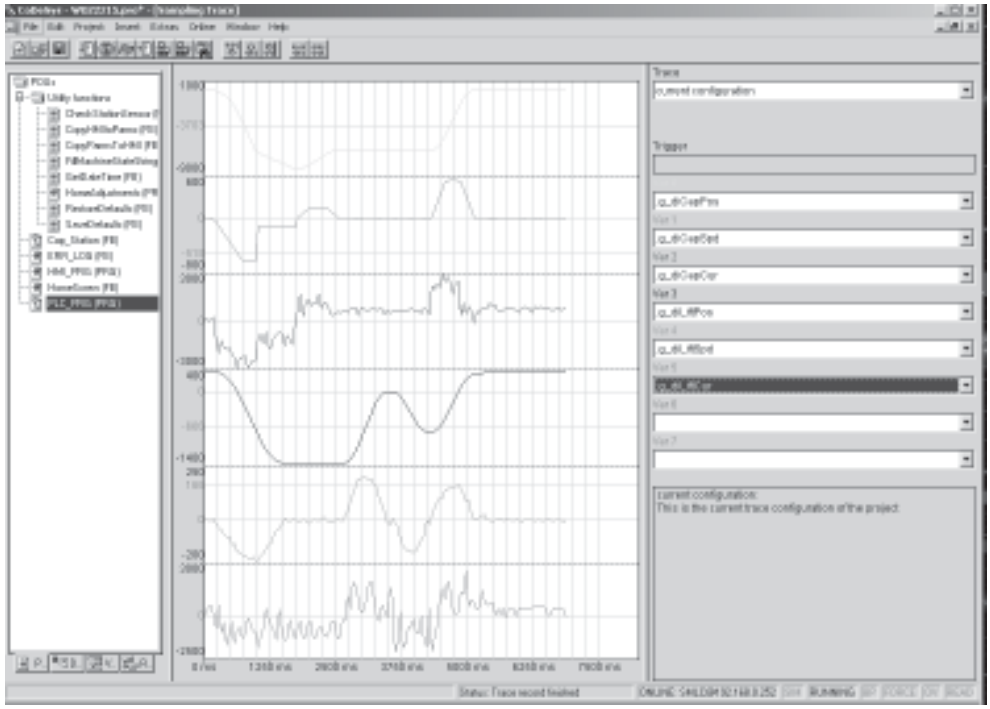
To debug your application, a *watch window* is provided for monitoring and writing variable values, along with tools for setting real-time program breakpoints -- single stepping or single cycling through the program. To monitor your machine during operation, a digital storage scope provides cyclic or single-shot storage and can display up to eight program variables.

The CoDeSys development environment provides tools for creating visualizations which can be used to build operator entry and diagnostic displays useful for testing and debugging the application.

When your application program is complete, all the source and supporting files can be downloaded to the SMLC. Application program source files can be password protected to limit access to authorized personnel only, and the controller acts as a storage medium for the application software, making field maintenance a snap.



Sequential Function Chart provides a graphical flow charting tool that illustrates the program flow and structure of the user's application program. SFC makes it easy to view a multi-layered, graphical model of the program and provides excellent tools for application development and maintenance.



The Sampling Trace tool can be used to trigger and view eight program variables with up to 500 data points for each variable. It is useful for application debugging, monitoring performance and capturing process information.

ORDERING GUIDE

CoDeSys Development Software

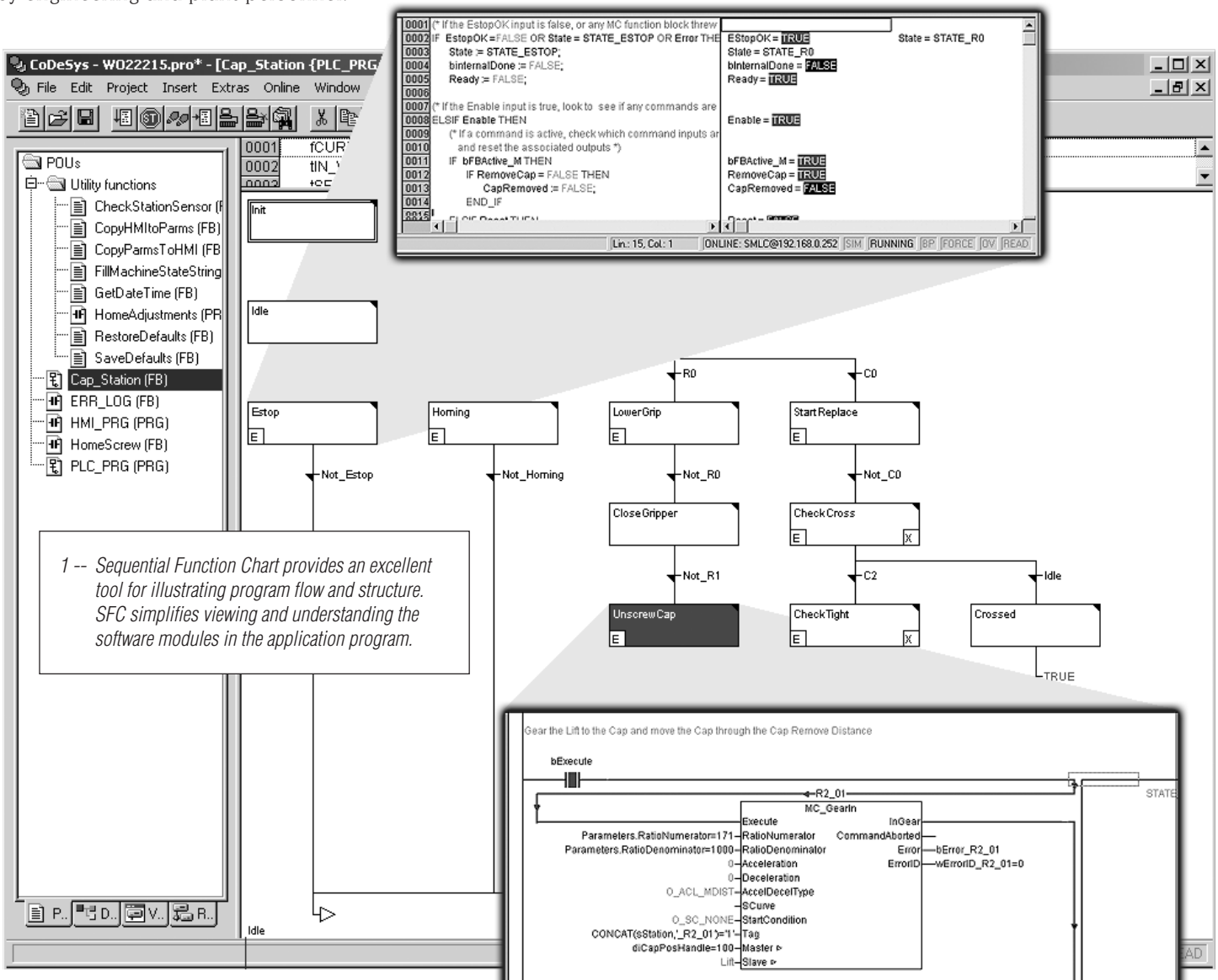
CDS-SDK/C	CoDeSys Developers Kit (one seat), CD-ROM, incl. ServoWire Pro, serial cable and one year of maintenance & support
CDS-SDK-MAINT	CoDeSys SDK Annual Maintenance & Support Contract Renewal

CoDeSys Programming Example

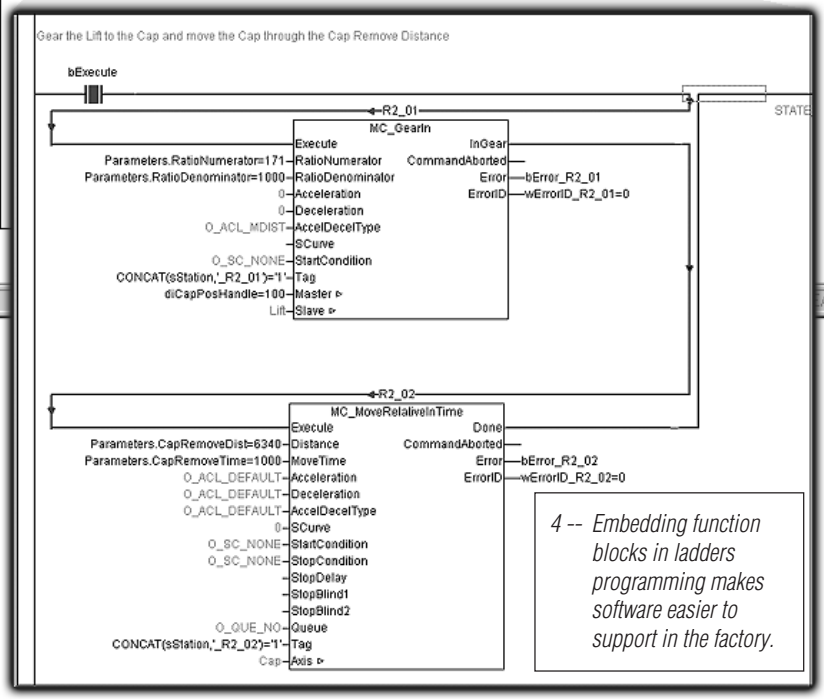
Programming languages and graphical tools work together to simplify software development

A key strength of the CoDeSys development environment is the different types of graphical and text-based programming tools it provides for a particular job -- simplifying both the software development process and support of the machine by engineering and plant personnel.

3 -- Structured text programming is easily integrated into the programming structure and flow, simplifying development and support. CoDeSys support for a variety of programming techniques provides a range of effective tools for creating powerful yet manageable application programs.



1 -- Sequential Function Chart provides an excellent tool for illustrating program flow and structure. SFC simplifies viewing and understanding the software modules in the application program.



2 -- By writing your program as a state machine in SFC, each individual state can contain only a few rungs of Ladder Logic. Instead of hundreds or thousands of continguous lines of ladder logic programming, this structured approach makes programs easier to develop, understand and maintain.

4 -- Embedding function blocks in ladders programming makes software easier to support in the factory.

Registration Control

Software tools to implement electronic gearing and registration control applications

Specialized software for registration control makes it easy to implement advanced electronic gearing and synchronization between multiple axes in registration applications. Typical applications include:

- ❒ Rotary Die
- ❒ Rotary Knife
- ❒ Registered Flying Shear
- ❒ Printing
- ❒ Labelling including continuous feed labelling

The combination of an SMLC system and the CoDeSys software provides a powerful, easy to use registration control solution. High speed sensors on the drives can capture real-time axis position within one microsecond of assertion, and initiate motion on the next position loop update (between 0.4 and 1.0 msec delay depending on the loop rate).

Built-in Registration Support

Standard software tools provided make it simple to keep an axis in register or synchronized with a key feature of the material under control, typically using a high speed sensor. To keep an axis in register, motion of the axis must be continually adjusted based on measurements from a sensor that detects a mark on the material. Two types of corrections, trending and instantaneous, provide solutions for distinct application requirements.

Axis motion compensates for variations in the actual distance between features on the material, pitch length (for trending corrections), variations in the desired axis position relative to the material, or the phase between the axis and material (instantaneous corrections).

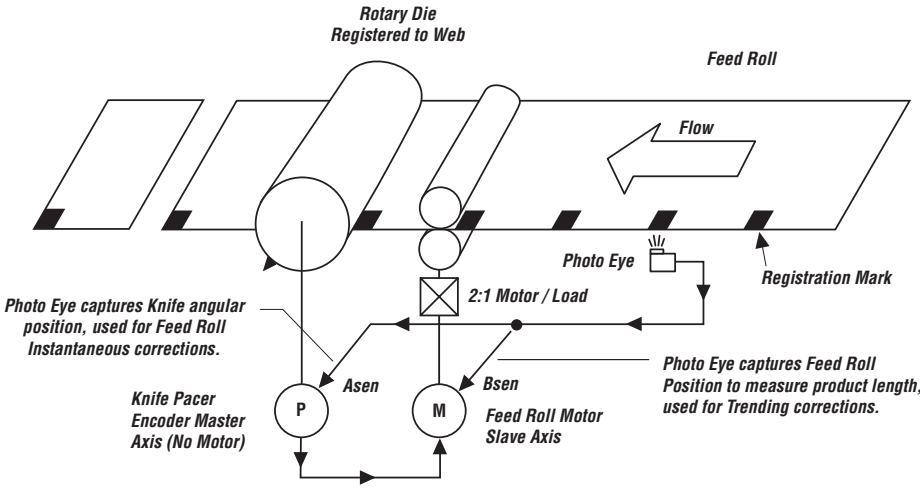
Trending Registration

With trending corrections, the registered axis is electronically geared to another axis using a base gear ratio. The registration sensor captures the position of the axis feeding the material, and is compared to the previously captured position to determine the pitch length between marks. Each measurement is compared to the nominal pitch length, and is used to adjust the base gear ratio and maintain precise synchronization between the two axes.

Instantaneous Registration

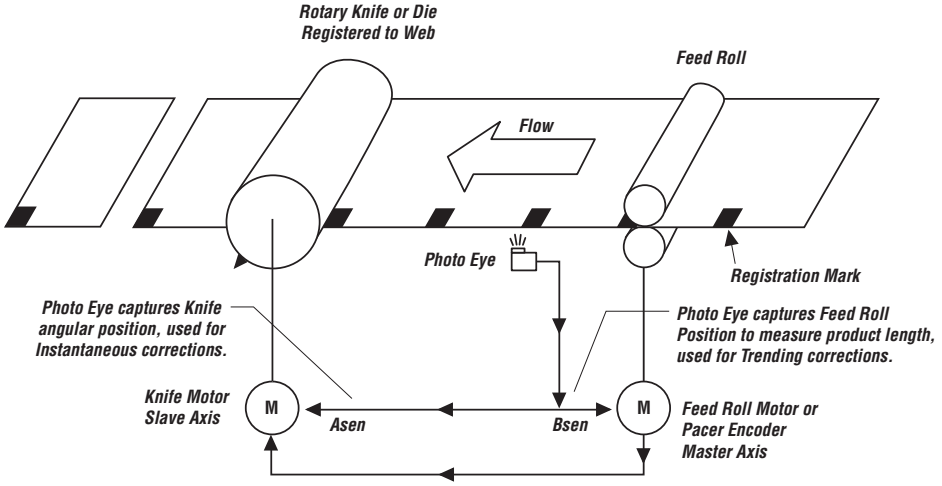
With instantaneous corrections, the registration sensor captures the position of the registered axis at the instant the mark is detected. Captured position is compared to a set point which defines where the registered axis should be when the mark is detected. The difference between the set point and captured position is used to adjust the position of the axis in real-time.

Feed Roll Registered to Knife Pacer Encoder



A feed roll and knife pacer encoder are electronically geared to feed one product pitch for each revolution of the knife. A photo eye captures the knife and feed roll positions once per product pitch. Captured knife position is used for instantaneous corrections, while feed roll position measures product pitch used in trending corrections.

Rotary Knife or Die Registered to Feed Roll



A single blade rotary knife/die and feed roll are electronically geared to complete one revolution for each web product pitch. A photo eye captures knife and feed roll positions once per product pitch. Captured knife position is used for instantaneous corrections. Feed roll position measures product pitch used in trending corrections.

Analog Feedback Control

Programming software, function blocks to implement tension control

Standard software for analog feedback control makes it easy to control motion based on an analog input signal, and effectively control web tension, dancer position, pressure, force and more. Typical applications include:

- ❒ Web control for tensioning/nip, unwind and rewind applications
- ❒ Press applications
- ❒ Crane applications
- ❒ Servo valve control: flow & pressure

Simplifies Programming

Using the SMLC for analog feedback control eliminates the need for users to develop their own application code. Once configured using the setup screen in ServoWire Pro, operation takes place in the background. Analog feedback can be based on multiple inputs that can be shared among axes and scaled based on user-supplied algorithms.

The SMLC also provides flexibility for using a variety of analog input options. Supported I/O modules from WAGO include 12, 14 and 16-bit analog inputs offering a variety of signal types (±10V, 0 to 10V, RTD, 4-20 mAmps, thermocouples) plus an SSI interface for Temposonics transducers. A digital encoder can measure dancer position.

Implementing Analog Feedback

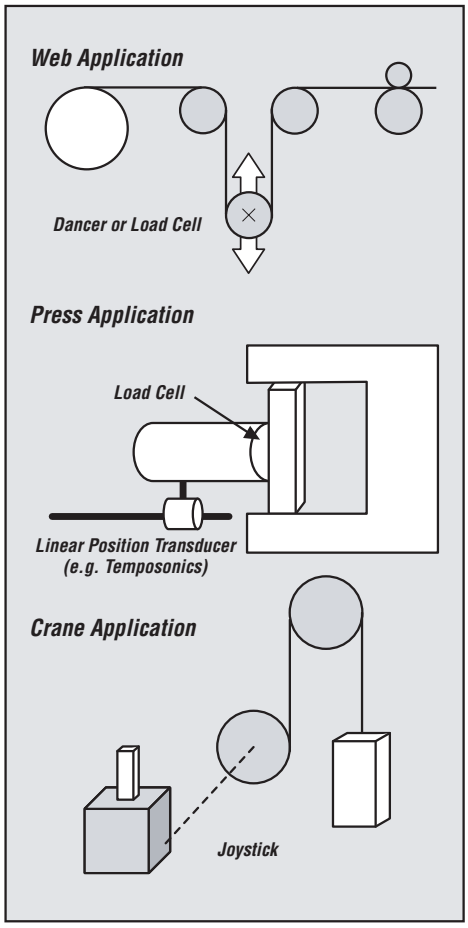
The ability to configure individual axes in an SMLC system and actively control tension by closing the servo loops around a tension transducer eliminates complicated programming and simplifies setup and operation.

Axis properties can be easily configued one time in the ServoWire Pro development software to specify limits, optimal loop gains, feedback source and optional low pass filter and correction direction (speeding up or slowing down). User units make it simple to define the ratio or raw tension transducer units to tension user units.

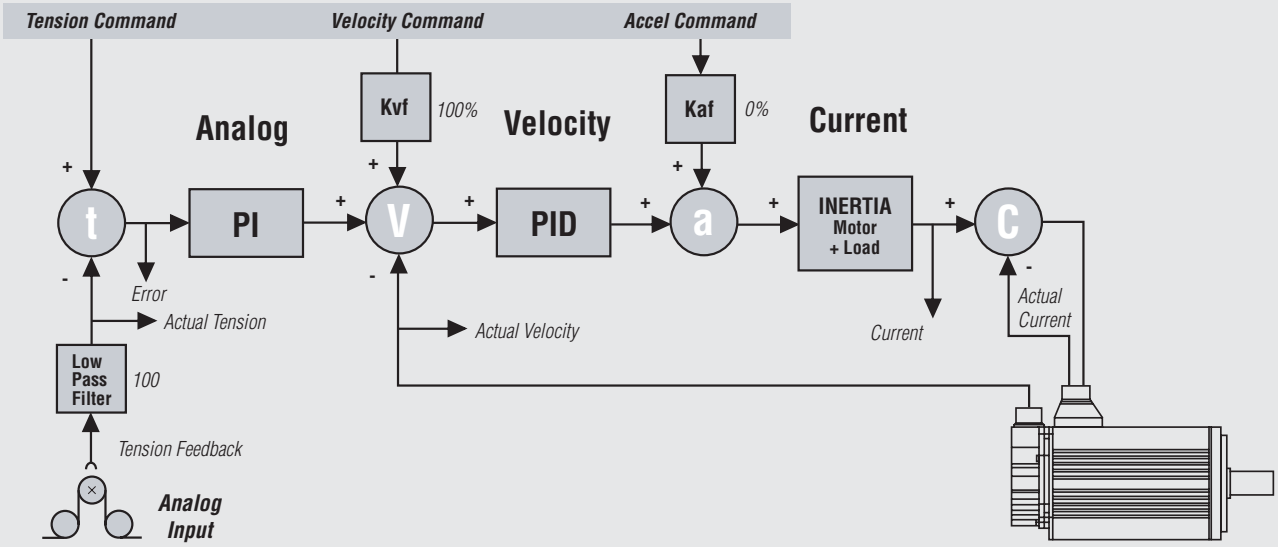
How It Works

In an analog feedback application, the application program reads the analog feedback transducer and stores the value in the appropriate value during the I/O scan. In the background, the SMLC sends the feedback value to the drive during the next isochronous loop update. The ServoWire SM drive then compares the feedback value to the command value, and adjusts motor motion to compensate for any difference.

Analog Feedback Control Applications



Analog Feedback Loop Diagram



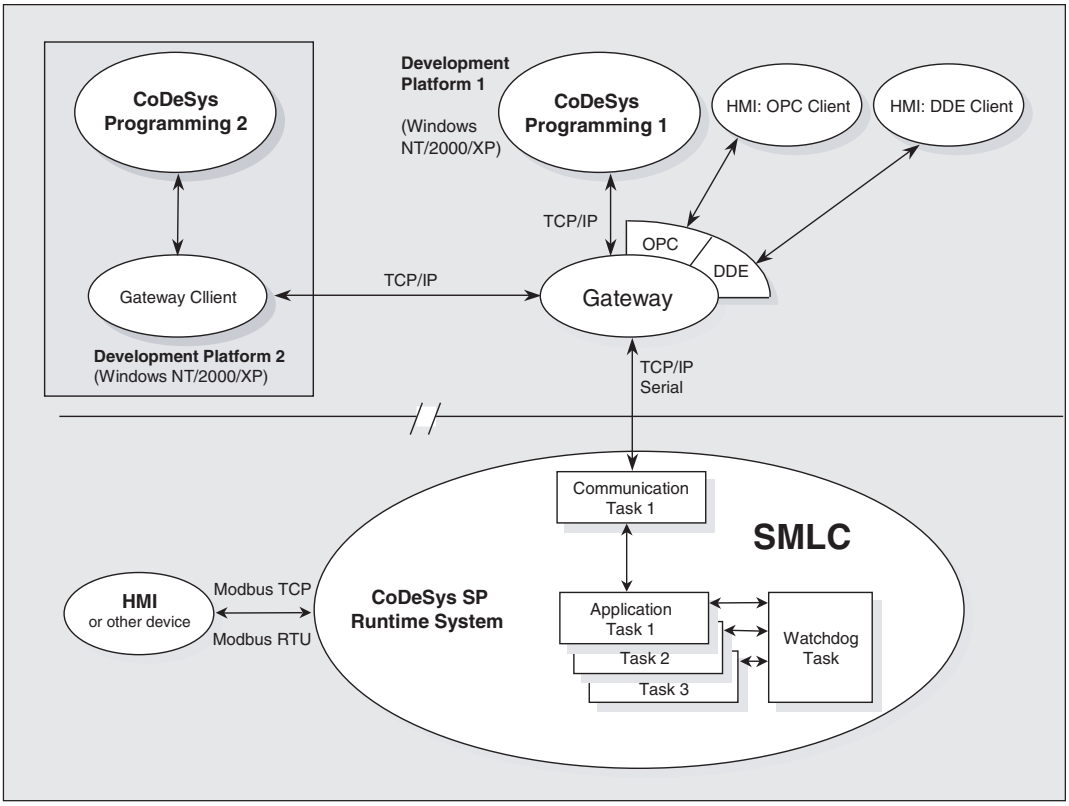
The SMLC uses proportional and integral control algorithms to implement analog feedback control using a wide variety of analog feedback devices.

Networking Solutions

Built-in networking options provide solutions for factory automation.

The SMLC and CoDeSys Development software combine to provide flexible and effective networking solutions for interfacing machine I/O, HMIs and factory data networks.

Support for open technologies such as Ethernet, TCP/IP, Modbus/TCP and OPC provide a wide range of application solutions. Plus the CoDeSys development software includes a CoDeSys Gateway which controls communications with the SMLC at no additional charge. The CoDeSys Gateway includes OPC and DDE servers, and is installed on a PC connected to the SMLC.



The CoDeSys gateway communication server insures communication between the CoDeSys development software running on a development PC and the run-time system on the SMLC. This gateway enables the user to gain access to the data from the CoDeSys application with different external tools via standardized interfaces such as OPC server and DDE links. Because the gateway is accessed via TCP/IP, remote access to the SMLC via the internet is also possible.

Ethernet and TCP/IP

The SMLC includes one standard Ethernet port and an expansion slot to provide connectivity to I/O, HMIs, PLCs, factory and enterprise networks. CoDeSys includes all the software necessary for communications via Ethernet and TCP/IP, enabling easy access to the SMLC from any system connected to the network. This capability allows users to easily implement remote debug and diagnostics capabilities without the need to purchase additional software.

OPC (OLE for Process Control)

OPC is open, interoperable connectivity for automation and the enterprise systems used in industrial applications. Interoperability is assured by creation and maintenance of open standards and specifications by an independent organization that includes both users and manufacturers of industrial automation equipment.

The CoDeSys OPC Server is included with CoDeSys at no additional charge and includes tools for assigning the SMLC name and IP address, selecting the groups of variables to be accessible through the server, refresh properties, etc. A wide variety of data acquisition and HMI software packages are available that include OPC clients, as well as ActiveX controls for adding OPC support to VisualBasic and C++ applications.

Steps For Setting Up the OPC Server

1) Install the CoDeSys OPC Server on the PC connected to the SMLC
2) Configure the OPC Server using the CoDeSys OPC Configurator, assigning the SMLC name and IP address
3) Enable groups of variables in CoDeSys that will share their data with the OPC Server
4) Export the OPC symbol table using the utility provided in CoDeSys
5) Run the OPC Server and log into it using the Client application
6) Select the variables you want to use and write your application program. All the communications takes place in the background with no further programming required.

Modbus/TCP

Modbus/TCP is the most widely accepted open Ethernet communications protocol used in industry today, allowing users to easily pass I/O as well as register data between control devices.

The SMLC can be configured as a Modbus/TCP Server, allowing Modbus clients to easily read and write integer, floating, string and bit data. As with OPC, there are a wide variety of data acquisition and HMI software packages available that support Modbus/TCP, as well as ActiveX controls for adding Modbus/TCP support to VisualBasic and C++ applications.