MicroController XC05ix

A Taste of the future!

- ✓ **Robust Adaptive control**
- ✓ **Modelica simulation**
- ✓ **Graphical programming**
- ✓ **Automatic code generator**
- ✓ **Prepared for IoT**
- ✓ **Linux based**

Compact size 128 x 80 x 65 mm

A Super-intelligent control system in a small box

First Control introduce a new type of control system where all the normal disciplines used in the design of control systems are integrated into one standard compact box . Unlike all other control systems on the market, we have added robust adaptive regulators, process model Modelica simulation, graphical programming and safe IoT connection. The purpose is to reduce engineering costs and improve the process control. The XC05ix control system has the same capacity as a large system and can therefore be used in different ways:

- ✓ **General Automation**. The system is based on a full scale control system we have used in many years in steel mills and energy plants and have all the safety protection that is required in such systems. Programming will be much faster – and simpler- than with conventional PLC systems If you want to optimze the performance you can use the built-in adaptive control package and process simulation based on the Modelica standard.
- ✓ **Embedded Application.** The unit contains all the functions you may need in a system design. The library includes about 160 modules for logics, mathematical calculation, statistics, signal filtering, database handling, classical regulators, adaptive regulators, signal filtering, communication etc. We can easily add more objects at request.
- ✓ **Education and Reaearch.** You can simulate your process or machine in real time. Any model expressed in the commonly used Modelica language is accepted. Students can run classical regulators and adptive regulators in a realistic training setup before they apply it to a to a physical process by adding IO units.

Since the system is based on low-cost standard hardware we can offer a very competitive price.

About First Control

First Control is a leading company in using general adaptive techniques with industrial robustness for which we recieved the IEEE CSS Award. So far most of our installations have been made in Sweden. In order to make our adaptive control technology available to a larger public, we have transported the full-size adaptive control system into a small low-cost box which can be used by any engineer. For the moment there are more than 500 self-tuning regulators running somewhere, installed by First Control and others.

This is what you get with XC05:

The XC05 contains a number of advanced features which are not found in any other PLC systems. More such features will be developed soon and offered to users.

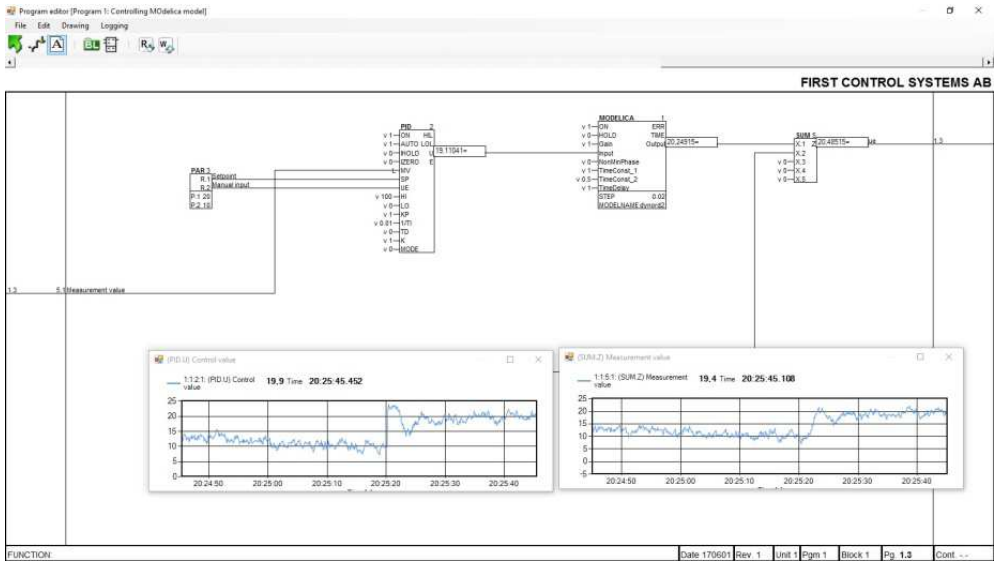
Adaptive techniques

The diagram shows the improvement in an old cold rolling mill when First Control introduced the adaptive techniques. Each point in the diagram shows the average value of max strip thickness deviations during one month. The final result is considerably better than achieved today in completely new mills with conventional model based control methods.

The self-tuning regulators are based on techniques developed by researchers at Lund Institute of Technology under the leadership of the legendary Professor Karl Johan Åström. The role of First Control has been to make the general self-tuning regulators robust enough for industrial use and understandable for normal engineers not familiar with adaptive control.

The improvements First Control has achieved in metallurgical processes are remarkable and has been in the area of 50-75% less variations in controlled variables compared to conventional non-adaptive techniques. The same improvements can be expected in other areas. To this date there are more than 500 self-tuning controllers installed in various processes.

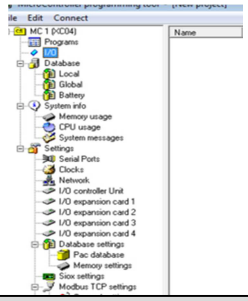
Real-time simulation with Modelica



In the example above we are using a dynamical system of second order with a time delay controlled by a simple PID regulator. To make it more realistic, a measurement noise is added to the measuremen value. The system creates a graphical object ”Modelica” with inputs and outputs, which is connected to the control with drag-and drop method . The signal vakues are shown in curves selectable on-line, in this case a step resonse in the set point.

Any process model created with the Modelica language can be loaded into the XC05 unit for real-time simulation. The model may run at the same time as the unit is controlling a physical process. The user can thus verify his control strategy with the model before he applies it to the real process. He can also construct his own control object as long as it is expressed in the Modelica language. The simulation capacity is very large, e.g. a Boiler model with about 100 internal states could be run down to about 3 msec cycling.

Graphical programming on-line

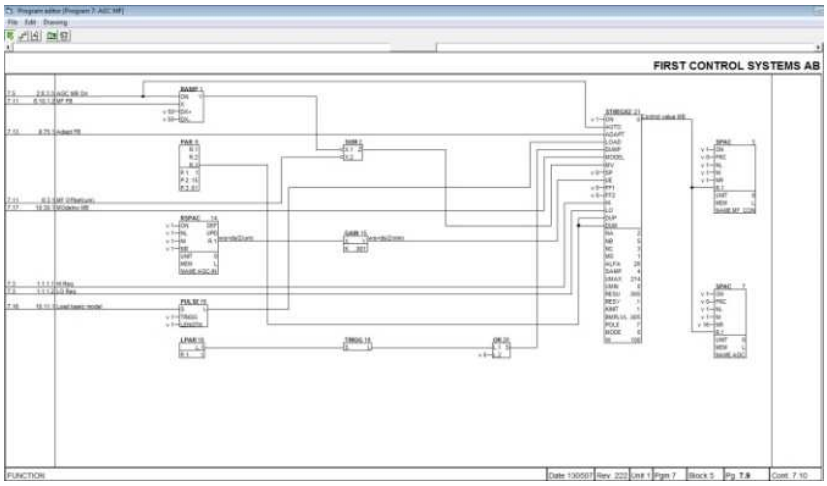


All programming and configuration is controlled by a project tree which describes all running data.

First Control introduces a new principle of programming control systems that will heavily reduce engineering time. The principle is based on a target system where you immediately see the effects of what you are doing. The target system may be a physical target as an XC05 or an emulated version installed on your PC.

At the same moment you open an application program or a configuration page, it is updated from the target system. The programming you make will be directly alive in the target and the documentation is updated automatically. Every change you make will in principle be alive momentarily in the target without disturbing the running functions.

Automatic code generation



In the example above, which describes a page with an adaptive regulator, the objects are sorted and will be executed from left to right in the order decided by the resolver.

XC05 is programmed graphically in a way that is much simpler than conventional programming - and much safer. The role of the user is to draw the function by selecting objects from the local function library and connect them together using a drag-and-drop procedure to form the control scheme you want. All objects are then automatically loaded in a correct execution order by the local resolver depending how they are connected to each other.

Logical connection errors and impossible (non-causal) solutions are safely blocked by the resolver.

System data

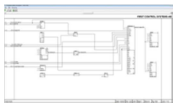
Hardware

CPU	R900MHz quad-core ARM Cortex-A7 CPU	
Internal memory	1 GB Ram	
Storing memory	8-32 GB Flash	Micro SD card
Housing	Protective aluminium box	
Status indications	Led Runing=green/Error=red	Indications on the top
IO port J1	USB-Rs485 converter	Port nr 2 in application program
IO port J2	USB-Can converter	Dedicated for IO cards
IO port J3	USB-Rs485 converter	Port nr3 i n application program
IO port J4	Not used	Spare
IO port J5	Ethernet	100 Mbit/s
IO port J6	Micro USB power	220 VAC or24VDC
Tiime	RTC clock	Year/month/day/time/sec
Mounting	DIN rail or freely on a table	
Dimension	128 x 80 x 65 mm	
Certification	CE , FCC	

Software

Operative	Linux	
Program method	Function objects connected to each other	Drawing using mouse pointer
Program clock	Internal	Can be set down to 0.5msec
Programs	Tasks automatically created on-line	Max 255program tasks
Program priority	10 different priority levels	
Program structure	Program, block, module	
Program volume	More than 15.000 objects (modules)	Mixed objects in application
Object execution	Automatic execution order	Two levels block/module
Module library	About 160 different objects stored locally	
Control objects	Adaptive regulators, PID regulators	
Signal conditioning	Low pass filter up to 4:th order	ITAE, Butterworth, Bessel
Set point control	S-curve, Ramps, Multiswitches	
Curve adaption	Tables 1-2 dimension	
Staistical functions	According to SPC standard	Max, min, mean v., standard dev.
Other functions	Logics, computation, communication	
Signal types	Real, integer, logics	
Database	Signal List, Signal Pac	Reals, Logics, Integers
Signal names	Tag name/Description	Import Excel or in project tree
Ethernet 1 protocol	FirstPublic	FirstOpNet, FirstGraph
Ethernet 2 protocol	Modbus TCP/UDP master/slave	External systems, IO systems
CAN	Dedicated protocol	IO cards KX3, SCC
RS485 protocol	Modbus RTU master/slave	External system
Safety	Internal system supervision	Go to safe state at errors

Auxiliary items

	**FirstOpNet operator platform** Operator platform for Windows 7,8,10 with Replay function. All design tools are included. The station can be used to display real time data or data afterwards by replay function.
	**FirstGraph programming tool** Graphical programming tool for Windows 7,8,10 to be used with XC05
	**KX3 IO expansion card** 32/16 Analog inputs single/diff, 16 bit, 0-10V, 0-20mA 12 Analog outputs, 12 bit, 0-10V, 0-20mA 12 Digital inputs, 24VDC 20 Digital outputs, 24 VDC 1 SIOX field bus for distributed IO. **SCC IO expansion card** 16/8 Analog inputs single/diff, 12 bit, 0-10V, 0-20mA 2 Thermocoupler inputs for temp. measurement 1 Pt100 input for temp. measurement 6 Analog outputs, 12 bit, 0-10V, 0-20mA 2 Pulse inputs, max 200kHz 16 Digital inputs, 24VDC 8 Digital outputs, 24 VDC 8 Digital outputs, Relay
	**External IO suppliers** You can also use IO units form most standard suppliers with a Modbus TCP/UDP connection, e.g. from Phoenix or Wago. The software for Modbus communication is included in the operative.
	**USB-CAN converter**
	**USB-R485 converter**