ControlPack Controller

Overview

Foreword

User Instruction

As controllers are widely used in automation industry and there must be differences among similar products, any person responsible for applying the equipment must ensure that the equipment shall be used in correct ways.

Under any circumstances, for any indirect or consequential damages caused by any improper operations, Etrol Technologies(USA) Inc. assumes no liability or responsibility.

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We have reviewed the printed manuals to ensure that the contents are consistent with the information of hardware and software. However, deviations cannot be precluded, so we cannot guarantee the entirely consistency between the contents of printed manuals and the information of hardware and software. Data in the prints are reviewed regularly and any necessary corrections will be included in subsequent versions.

Caution and Warning

For your personal safety and to avoid damage to property, please pay attention to the tips in this manual. Tips for protecting personal safety use a warning triangle, and tips for property damage only have no warning triangle. Warnings are stated as follows according to the level of dangers from high to low.

⚠Danger
If corresponding careful measures are not taken, it **will** cause death or serious body injury.

⚠Caution
If corresponding careful measures are not taken, it **may** cause slight body injury.

Note
If corresponding careful measures are not taken, it **may** cause damages to property.

Under the case of multiple risk levels, the highest level of warning shall always be used every time. If a warning triangle indicating the possible body injury appears, the warning covering possible property damage may be attached.

New Information and Update

The manual covers new information and updated ones. Relevant modifications in this version are marked with change bars, as shown in the right side of this paragraph. The following table records the modifications of this version.

Theme	Pages	Version
Initial	All	A/0

About This Manual

Document Scope

This manual is applied to the introduction, installation, wiring, specifications and maintenance service of ControlPack Series product developed by Etrol Technologies(USA) Inc.

For Readers

Reading this manual needs basic automatic knowledge. In this manual, we assume that you already know how to use these products. Otherwise, please read the relevant product publications before using ControlPack LM603 modules.

Related Documents

Resources	Description
ControlPack Configurator User Manual	User manual of Configurator Software Tool
ControlPack LM603 Hardware Manual	Installation, wiring, configuration, and maintenance for LM603 Controller

Please visit http://www.etroltechnologies.com for relevant information.

Application

This manual is applied to:

Model	Hardware (Version)	Firmware (Version)	Software (Version)	Remark
ControlPack LM603	V3.1	FRN2.11	ControlPack Configurator V2.0.0.1	
ControlPack LM312	V2.0	FRN1.00		
ControlPack LM313	V2.0	FRN1.00		
ControlPack LM314	V2.0	FRN1.00		
ControlPack CPU21	V2.1	FRN2.51		
ControlPack AI0801	V2.1	FRN2.00		
ControlPack RTD0401	V2.1	FRN2.00		
ControlPack DI1601	V2.1	FRN2.00		

ControlPack AO0401	V2.1	FRN2.00		
ControlPack DO1601	V2.1	FRN2.00		
ControlPack PI0401	V2.1	FRN2.00		
ControlPack SC01	V1.0	FRN1.05		
ControlPack EC01	V2.1	FRN1.10		

Contents

1. Overview

1.1. Introduction

This document is an introduction to the features and architectures of the ControlPack controller products.

These devices include an extensive set of communications and control facilities for use in telemetry, Supervisory Control and Data Acquisition (SCADA) and process control applications.

1.2. Hardware

The ControlPack controllers are designed for operating in harsh environments and include two categories, compact controller and modular controller.

Features

- High density compact design
- Expandable module I/O configurations
- Wide operating temperature range
- Isolated input power supply
- Isolated Analog Input and Analog Output channels
- Isolated Digital Input and Digital Output channels
- Pulse inputs on some Digital Input channels
- All Inputs/Outputs channels are protected by TVS
- Super capacitor power supply voltage and core-board environment temperature monitoring
- Supporting local/remote re-programming of Operating System Firmware
- Serial communication ports
- Ethernet communication ports
- CAN 2.0B interface for expansion I/O
- DNP3 standard communications
- MODBUS Master & Slave communications support MODBUS RTU/ASCII protocol
- MODBUS TCP client & server communications

- IEC61131-3 programming

1.2.1. Compact Controller

Main controller

- *LM603*

Expansion I/O

- *LM312*
- *LM313*
- *LM314*

ControlPack LM603 **ControlPack LM31X**

ContolPack LM603 Specification

Controller board	
CPU	32-bit ARM9 processor Up to 400MHz
Memory	128KB FRAM 16MB NOR FLASH 32MB SDRAM 256MB NAND FLASH
Data logging	Up to 65,535 data recordings in total
Modbus data points	4096 Coil Registers 4096 State Registers 4096 Input Registers 9999 Hold Registers
Environmental requirements	-40 ~ 70°C (-40 ~ 158°F) operating temperature -40 ~ 80°C (-40 ~ 176°F) storage temperature 5 to 95% relative humidity, non-condensing
Communications	
Serial ports	2 RS232 2 RS485
Ethernet ports	2 10/100M BASE-T
CAN port	1 (For connecting to expansion I/O)

Serial protocols		Modbus RTU/ASCII in slave or master mode
IP protocols		DNP3 level 2 in TCP slave mode DNP3 in point-to-point mode DNP3 in point-to-multipoint mode (up to 4 multipoint) Modbus TCP in server or client mode Modbus RTU in TCP server mode Modbus RTU in UDP server mode
CAN protocols		Customized
Inputs and outputs		
Digital inputs (DI)	Channels	8
	ON Voltage Level	8 ~ 24VDC
	OFF Voltage Level	0 ~ 4VDC
Digital outputs (DO)	Channels	4
	Output Range	0~24VDC
	Output Rate	200mA in each channel; Max. 3.0 A in total for each module
Analog inputs (AI)	Channels	8
	A/D Resolution	16 bits
	Rated signal range	4~20mA
Analog outputs (AO)	Channels	2
	D/A Resolution	16 bit
	Output Range	4~20mA
Pulse Inputs (PI)	Channels	3
	Input Type	Unipolar pulse signal
	Input Range	5~24VDC
	Input Frequency	0~10KHz
	Input Current	>8mA
I/O Expansion		Connecting to ControlPack LM312, LM313 and LM314 module through CAN port (up to 4 modules)

ContolPack LM312 Specification

General		
CPU		32-bit ARM7 processor Up to 48MHz
Memory		128KB Program FLASH 64KB SDRAM
Environmental requirements		-40 ~ 70°C (-40 ~ 158°F) operating temperature -40 ~ 80°C (-40 ~ 176°F) storage temperature 5 to 95% relative humidity, non-condensing
Communications		
Serial ports		1 RS485
CAN port		1 (For connecting to LM603 module)
Serial protocols		Modbus RTU/ASCII in slave mode
CAN protocols		Customized
Inputs and outputs		
Analog inputs	Channels	4
	A/D	16 bits

(AI)	Resolution	
	Rated signal range	4~20mA
Analog outputs (AO)	Channels	2
	D/A Resolution	16 bit
	Output Range	4~20mA

ContolPack LM313 Specification

General		
CPU		32-bit ARM7 processor Up to 48MHz
Memory		128KB Program FLASH 64KB SDRAM
Environmental requirements		-40 ~ 70°C (-40 ~ 158°F) operating temperature -40 ~ 80°C (-40 ~ 176°F) storage temperature 5 to 95% relative humidity, non-condensing
Communications		
Serial ports		1 RS485
CAN port		1 (For connecting to LM603 module)
Serial protocols		Modbus RTU/ASCII in slave mode
CAN protocols		Customized
Inputs and outputs		
Digital inputs (DI)	Channels	4
	ON Voltage Level	8 ~ 24VDC
	OFF Voltage Level	0 ~ 4VDC
Digital outputs (DO)	Channels	4
	Output Range	0~24VDC
	Output Rate	Max. 200mA in each channel;

ContolPack LM314 Specification

General		
CPU		32-bit ARM7 processor Up to 48MHz
Memory		128KB Program FLASH 64KB SDRAM
Environmental requirements		-40 ~ 70°C (-40 ~ 158°F) operating temperature -40 ~ 80°C (-40 ~ 176°F) storage temperature 5 to 95% relative humidity, non-condensing
Communications		
Serial ports		1 RS485
CAN port		1 (For connecting to LM603 module)
Serial protocols		Modbus RTU/ASCII in slave mode
CAN protocols		Customized
Inputs		
RTD	Channels	4
	Input signal	RTD PT100

Inputs	Input Range	80.30~175.8Ω (-50~200℃)
	A/D Resolution	16 bits

1.2.2. Modular Controller

The ControlPack Modular Controller can be configured according to a custom application and allows up to 48 IO modules to be connected to a controller.

ControlPack Modular Controller

- Controller module
  - CPU21 2 Ethernet, 10M/100M RJ45 Port ,1 RS232, 1 RS232/RS485
- Input modules
  - AI0801 Analog Input (AI), 8-channel, 4~20 mA
  - DI1601 Digital Input (DI), 16-channel, 0~24VDC
  - PI0401 Pulse Input (PI), 4-channel, 5~24V, pulse
  - RTD0401 Resistance Temperature Detector (RTD) , 4-channel Pt100
- Output modules
  - AO0401 Analog Output (AO), 4-channel, 4~20 mA
  - DO1601 Digital Output (DO), 16-channel, 0~24VDC, FET
- Communication modules
  - SC01 Serial communication module, 2 RS232/RS485 and 1 RS485
  - EC01 Ethernet communication module, 2 Ethernet ports for client server
- Power Supply modules
  - PS01 24VDC input, 5VDC output
  - PS02 85～220VAC input, 5VDC and 24VDC output

General Specification

Item	Specifications
IO Module Terminals	3×9-bit, 12～22AWG, contact current 15AMP
Dimensions	118×43×92（mm） (PS02: 164×60×112 (mm))
Operating temperature and humidity	-40~70℃ 5~90% relative humidity, non-condensing
Storage temperature and humidity	-50~80℃ 5~95% relative humidity, non-condensing

ContolPack CPU21

Item	Specifications
Model	CPU21
Module Power	5VDC±2%@500mA
User memory	1M
Communication Port	2 Ethernet, 10M/100M RJ45 Port 1 RS232, DB9-M Port 1 RS232 / RS485, DB9-M Port
Max. Number of I/O Modules	48
Digital input, Max Digital output, Max Analog Input, Max Analog output,Max Pulse,Max RTD, Max	512 512 256 128 128 64
Clock	Hour/Min/Sec
Calendar	Year/Month/ Day/Week
IP protocols	DNP3 level 2 in TCP slave mode DNP3 in point-to-point mode DNP3 in point-to-multipoint mode (up to 4 multipoint) Modbus TCP in server mode

ContolPack AI0801

Item	Specifications
Model	AI0801
Number of input channels	8
Rated input range	4~20mA
Permissible input range	1~22.5mA (over range test)
A/D Resolution	16 bits
Sampling Rate	100 ms per 8 channels
Calibration	Factory Calibrated. Data is stored in non-volatile memory.
Rated Accuracy	±0.1% full scale (25℃) ±0.3% full scale (over full temperature range)
Withstand voltage	1K VDC between signal line and ground
Module Power	5VDC±2%@95mA
External Power Supply	24VDC ±10%@50mA

ContolPack DI1601

Item	Specifications
Model	DI1601

Number of input channels	16
ON Voltage Level	8 ~ 24VDC
OFF Voltage Level	0 ~ 4VDC
Input Impedance	2.4kΩ
Input Responding Time	10ms
Withstand voltage	1K VDC between signal line and ground
Module power	5VDC ±2%@90mA
External Power Supply	24VDC ±10%@100mA

ContolPack PI0401

Item	Specification
Model	PI0401
Number of Input Channels	4
Input Range	5~24VDC
Input Frequency	0~10KHz
Input Current	>8mA
Input Impedance	10KΩ
Withstand Voltage	1K VDC between signal line and ground
Module Power	5VDC ±2% @110mA
External Power Supply	24VDC ±10% @100mA

ContolPack RTD0401

Item	Specifications
Model	RTD0401
Number of Input Channels	4
Input Signal	RTD PT100
Signal Input Range	80.30~175.8Ω (-50~200℃)
A/D Resolution	16 bits
Sampling Rate	100ms per 4 channels
Rated Accuracy	±0.1% Full Scale (25℃) ±0.5% Full Scale (over full temperature range)
Module Power	5VDC±2%@85mA
External Power Supply	24VDC ±10%@60mA

ContolPack AO0401

Item	Specifications
Model	AO0401
Number of Output Channels	4
Rated output Range	4~20mA
Output range	1~22.5mA (over range test)
Resolution	16 bits
Data Response Time	10ms
Allowable load resistance	Load<700Ω
Accuracy	±0.3% Full Scale (25℃) ±0.5% Full Scale (over full temperature range)
Calibration	Factory Calibrated. Data is stored in non-volatile memory.
Withstand Voltage	1K VDC between signal line and ground
Module Power	5VDC±2%@100mA
External Power Supply	24VDC ±10%@200mA

ContolPack DO1601

Item	Specifications

Model	DO1601
Number of Output Channels	16
Output Vltage	0~24VDC
Maximum Load Current	200mA in each channel; Max. 3.0 A in total for each module
Maximum Leak Current at Output off Status	<1uA at 24V
Output Response Time	10ms
Withstand Voltage	1K VDC between signal line and ground
Module Power	5VDC ±2% @95mA
External Power Supply	24VDC±10% @3200mA (Max.)

ContolPack SC01

Item	Specifications
Model	SC01
Communication Port	1 RS485 Port 2 RS232/RS485 Ports
Baud Rate	2400~115200 bps
Communication Mode	Full/Half Duplex
Protocol	Modbus RTU/ASCII
Protocol mode	Master, Slave, Store/Forward
Module Power	5VDC±2%@240mA

ContolPack EC01

Item	Specifications
Model	EC01
Communication Ports	2 Ethernet, 10M/100M RJ45 Port 1 RS232, DB9-M Port 1 RS232 / RS485, DB9-M Port
Serial Port Baud rates	2400~115200 bps
Transmission mode	full-duplex or half-duplex
Protocol	Modbus RTU/ASCII, Modbus-TCP/IP
Protocol mode	Master or slave(Client/Server)
Module power	5VDC±2%@500mA

ContolPack PS01

Item	Specifications
Model	PS01
Input	24VDC±10%
Output	5VDC ±2%
Max. Output current	3A
Input to Output Isolation	250VACrms
Work Temperature	-40~70℃

ContolPack PS02

Item	Specifications
Model	PS02
Input	85～220VAC±10%
Output	5VDC ±2% / 24VDC±2%/
Output Current	3A
Dimension	164×60×112 (mm)

1.3. Operation

Communication

ControlPack controller support connection to a wide range of communication interfaces and protocols, including:

- Connection to I/O expansion modules
- Connection to other peripheral devices for gathering data or sending controls
- Connection to SCADA Master Station for reporting current status and receiving controls.
- With other RTUs, via communication networks, for coordinating distributed control
- Wide area communication networks, such as leased line, leased digital services, data radio, GSM modem, GPRS modem, wireless transferring module etc.
- Local area communication networks such as RS232,RS485, Ethernet
- Industry standard protocol support is provided including DNP3, MODBUS RTU/ASCII, MODBUS TCP, MODBUS in TCP, MODBUS in UDP

Application Program

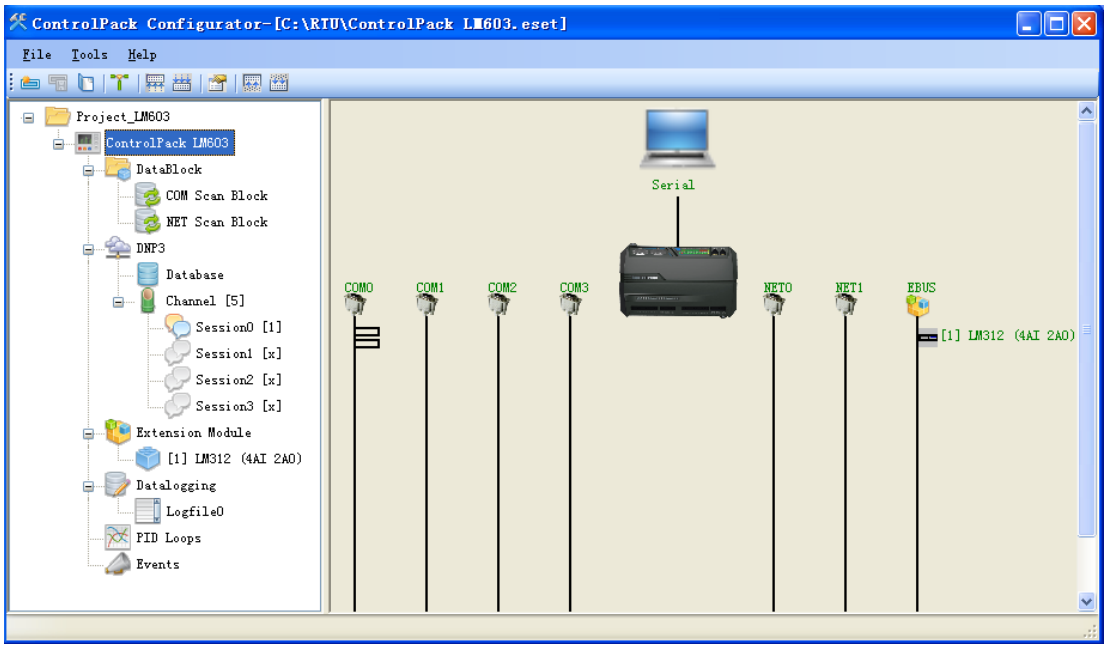
Support fully IEC61131-3 compliant for five programming languages including LD、FBD、IL、ST、SFC. also including floating point mathematics, PID control.

Configuration

Operations that can be carried out locally, such as configuration, programming, debugging, diagnosis, and firmware upgrades can also be carried out remotely through wide area and local area communication networks.

1.4. ControlPack Configurator

The ControlPack Configurator software is a tool which running on a PC under Microsoft Windows XP, Windows Server 2003,Windows Server 2008, or Windows 7, with graphical user interfaces for configuring and diagnosing the controllers. The ControlPack Configurator can create and modify device configurations online, or offline and saving the configurations for downloading later. The configurations can also be uploaded anytime when connected.

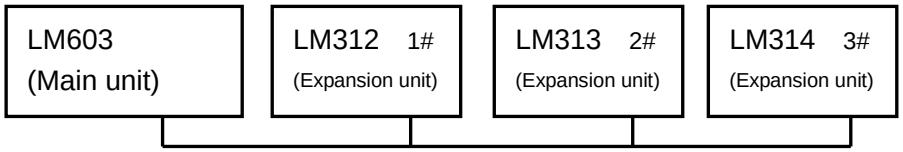

ControlPack Configurator-[C:\RTU\ControlPack LM603.eset]
File
Tools
Help
Project_LM603
ControlPack LM603
DataBlock
COM Scan Block
NET Scan Block
DNP3
Database
Channel [5]
Session0 [1]
Session1 [x]
Session2 [x]
Session3 [x]
Extension Module
[1] LM312 (4AI 2AO)
Datalogging
Logfile0
PID Loops
Events
Serial
COM0
COM1
COM2
COM3
NET0
NET1
EBUS
[1] LM312 (4AI 2AO)

2. I/O Expansion

2.1. Expansion For ControlPack LM603

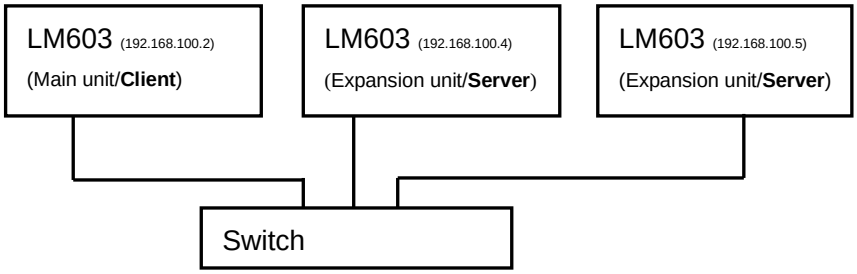
ControlPack LM603 module has up to 25 physical I/O points. However, If more I/O points are required, there are several ways to choose.

- Connect I/O expansion modules through the CAN port. Up to 4 I/O modules can be added to a LM603 module



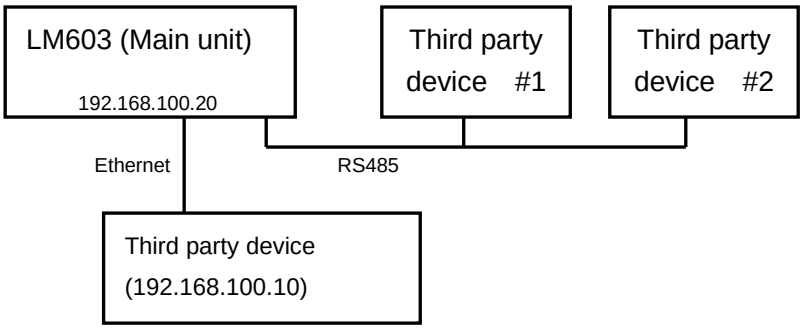
Using expansion I/O module

- Connect several LM603 through Ethernet. One LM603 is configured as client and the others are configured as server.



Using multiple LM603 modules

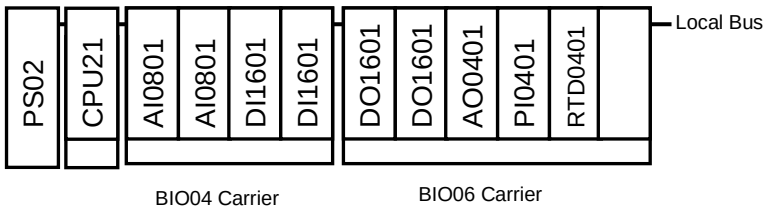
- Connected to third party devices through RS485 port or Ethernet port. The third party devices must support standard Modbus protocol.



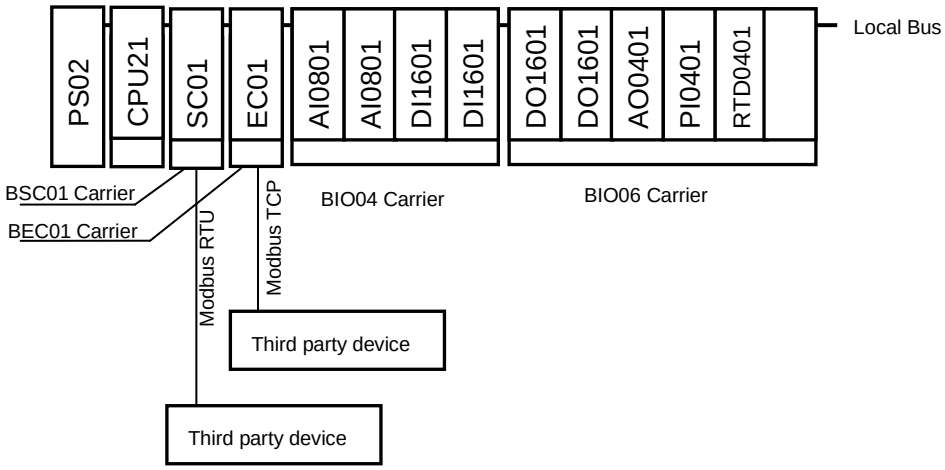
Using third party devices

2.2. Expansion For ControlPack CPU21

The ControlPack modular controller is capable to connect up to 48 modules, including I/O modules and communication modules, through the internal communication bus.

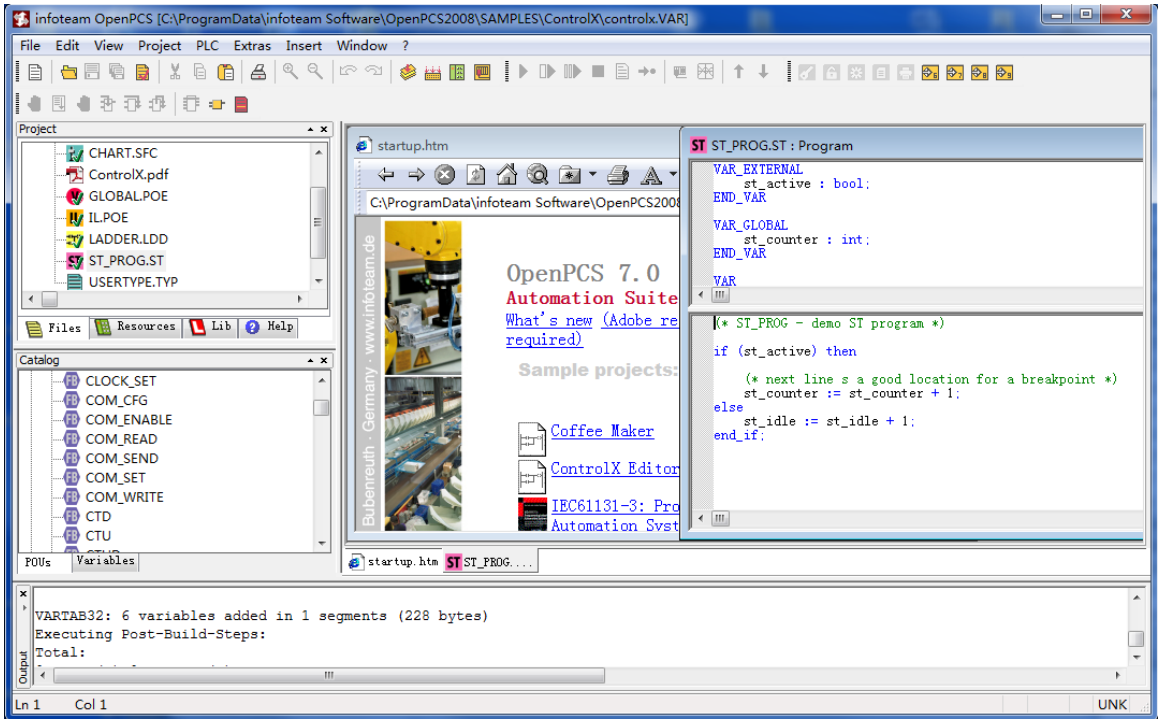


The ControlPack modular controller can be connected to third party devices through communication modules SE01 or EC01, which has the RS232/RS485 ports or Ethernet ports. The third party devices must support standard Modbus protocol



3. Programming Platform

ControlPack controllers use OpenPCS as the programming platform. OpenPCS is a software product of Inforteam. It provides the five IEC61131-3 standard PLC programming languages for users to develop application programs, manage and simulate applications. The OpenPCS Software also provides on-line application debugging facilities and operates with ControlPack controllers via Ethernet or serial port connections.



4. DNP3

DNP3 is an industry communications protocol and widely used in SCADA system providing features such as polling, controls, and report by exception. For further information see the DNP Users Group Web Site at www.dnp.org.

ControlPack controllers support DNP3 Subset Level 2 protocol and provide the following facilities for use of DNP3:

- Polling, Report by Exception, Unsolicited Response transmission to SCADA Master
- DNP3 Multi-Master support (up to 4 Masters)
- Wide range of DNP3 data objects including:
  - ✓ integer and floating point analog objects
  - ✓ binary objects
  - ✓ binary counter objects
  - ✓ file identifier object

5. Communications

5.1. Device Communication Interface

ControlPack controllers can communicate with peripheral devices, such as PLCs, RTUs and intelligent instruments via serial ports or Ethernet ports.

Refer to table 5.1 for the available communication mode for each controller and communication modules.

Table 5.1 Communication Mode

Communication Mode	Controller	Description
MODBUS Slave Operation	LM603/CPU21	Support communications using MODBUS RTU/ASCII Slave protocol
MODBUS Master Operation	LM603/SC01 module	Operate as a Master when communicating with PLCs ,RTUs or peripheral devices using standard MODBUS RTU/ASCII Master protocol .
MODBUS TCP Client Operation	LM603/EC01 module	Using the Net Scan Data Block feature to read data from, or write data to Modbus TCP Ethernet PLCs or RTUs.
MODBUS TCP Server Operation	LM603/CPU21/ EC01 module	Allows ControlPack controller data points to be available to MODBUS TCP client devices such as a local SCADA master station, or Ethernet PLCs,RTUs.
MODBUS RTU in TCP Server Operations	LM603	Allows ControlPack controller data points to be available to MODBUS in TCP or MODBUS in UDP client devices such as a local SCADA master station, or Ethernet PLCs, RTUs.
MODBUS RTU in UDP Server Operations	LM603	

5.2. DNP3 Communication Interfaces

Communication with ControlPack controller using DNP3 can be accomplished through several physical interfaces:

- ✓ Direct physical interfaces,
- ✓ Multi-drop physical interfaces,
- ✓ Modem interface,
- ✓ Ethernet interface.

Port interface types using direct communication interfaces(Point-to-Point) include RS232, dial-up Modem and GPRS. Port interface types using multi-drop

communication interfaces(Point-to-multipoint) include RS485 and Ethernet.

Multiple interfaces couldn't be used simultaneously on the same device. only one type of interface can be used at the same time.

The ControlPack LM603 support IP communication through mobile IP technology such as GSM/GRPS (over GSM cellular communication networks), you should provide an external GSM/GRPS module connecting through RS232, Point-to-Point communication between controller and SCADA Master.

6. Data Log

The ControlPack controller are capable of logging I/O data with time stamping and stored into a data file by running a Datalog Server.

Use the datalog configuration windows in the ControlPack Configurator to Enable/Disable data log feature, define the record structures, and how many records to be stored.

The datalog file can be read by ControlPack Configurator software on a Windows computer, where you can view and export as “CSV” format file.

Appendix

Terms and Abbreviations

This section describes terms and abbreviations used throughout this documentation.

Terms	Definition
MODBUS	A communications protocol

Abbreviations	Definition
AI	Analog Input
AO	Analog Output
CAN	Controller Area Network
DI	Digital Input
DNP3	Distributed Network Protocol
DO	Digital Output
FBD	Function Block Diagram, Programming language
FTP	File Transfer Protocol (TCP/IP application layer file transfer)
GPRS	General Packet Radio Service
IEEE	Institution of Electrical & Electronics Engineers (standards organization)
IEC	International Electro-technical Committee(standards organization)
ICMP	Internet Control Message Protocol
I/O	Input and Output
IP	Internet Protocol
IL	Instruction List, Programming language
LD	Ladder Diagram, Programming language
PI	Pulse Input
PLC	Programmable Logic Controllers
RTU	Remote Terminal Unit
SCADA	Supervisory Control And Data Acquisition
SFC	Sequential Function Chart, Programming language
ST	Structured Text, Programming language
TCP	Transmission Control Protocol

Feedback

Your suggestions will help us improve our documents and better meet your needs. If you have any suggestions for improving this document, please send emails to support@etroltechnologies.com.