Model 5100
Application Reference Guide

The information in this document is current as of the following Hardware and Firmware revision levels. Some features may not be supported in earlier revisions. See www.ctc-control.com for the availability of firmware updates or contact CTC Technical Support.

Model Number	Hardware Revision	Firmware Revision
5101/5102/5103/5104	B, C, and E	4.05

WARNING: Use of CTC Controllers and software is to be done only by experienced and qualified personnel who are responsible for the application and use of control equipment like the CTC controllers. These individuals must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and/or standards. The information in this document is given as a general guide and all examples are for illustrative purposes only and are not intended for use in the actual application of CTC product. CTC products are not designed, sold, or marketed for use in any particular application or installation; this responsibility resides solely with the user. CTC does not assume any responsibility or liability, intellectual or otherwise for the use of CTC products.

TABLE OF CONTENTS

Blank Page

1.0 Introduction

Congratulations on your purchase of CTC's Blue Fusion Model 5100 controller. Due to its multiprocessor architecture and extensive firmware and software features the 5100 is among the most powerful programmable automation controllers available. To help you take full advantage of the many features built into the 5100 CTC has prepared this Application Reference Guide. This guide is a compilation of documents that cover the many firmware and software features of CTC's Model 5100 controllers. It is meant as a supplement to the main programming guides, *Quickstep™ User Guide* (Doc. No. MAN-1000-A) and *Quickstep Language and Programming Guide* (Doc. No. MAN-1010-A), which cover the basic techniques and features used when programming Control Technology Controllers. Details on hardware and connection information can be found in the *Model 5100 Controller Hardware Reference Guide (Doc. No. 950-510002)* and the Installation Guides for specific 5100 modules. Check for these documents as well as updated versions of the material in this guide in the documentation section of CTC's website:

www.ctc-control.com.

1.1 Feature Summary

With the release of the 5100 firmware revision 4.05 and above, a number of new capabilities have been added to the controllers. These features have greatly expanded the communications capability of the controller and added greater programming flexibility and system administration facilities. Additionally many existing capabilities have been improved or extended. A summary of the major new features is given below:

- **Flash Disk**

  The 5100 controllers have built-in non-volatile flash disk storage systems. The flash disk is analogous to a hard disk on a PC, however it is more suitable to industrial environments since it has no moving parts. Some of the capabilities offered by the 5100 flash disk are:

  - PC like file structure
  - Structured support and storage for firmware flash updates
  - Quickstep program storage and dynamic loading.
  - Large Recipe storage area
  - Accessibility via Quickstep, FTP and/or Telnet
  - Standard disk drive utilities
  - Thermocouple table storage allowing for field updates of newly supported thermocouple devices.

- **Virtual I/O Support**

  CTC's 5102 and 5104 controllers are now equipped with a powerful new feature called Virtual I/O. This capability is based on high-speed Ethernet networking technology. Virtual I/O allows a 5102/4 controller (the client) to extend its module bus to that of a second 5102/4 controller (the server). Once connected the client has complete control over all of the I/O as well as the first 96 volatile and the first 96 non-volatile registers in the server controller. These remote resources are added to the resources available to the client controller so that the 'connection' is transparent to the application programmer. Some key features are highlighted below, for more information see chapter 7 of the Communications Guide.

  - Gives a single quickstep program access to 12 module bays
  - Allows physical separation of the client and server controllers by 100m or more.
  - Increased capability for multi-axis motion applications

- **Remote diagnostics and updates**

  New features have been added for better support of deployed controllers. These features are available for CTC support personnel as well as direct use by customers.

  - Remote firmware updates via ftp and telnet. All controller and module firmware is field upgradeable.
  - Firmware files support version naming conventions
  - Module firmware can be stored to flash disk for later updates or to allow switching between different firmware levels.
  - Can remotely obtain 5100 module information via telnet, e.g., version control.
  - Low level logging and debug functions for CTC remote field support.
  - User definable 'admin' password system for increased security

Communications

One of the most powerful features of CTC's Blue Fusion controllers has always been its web-enabled features and its ability to communicate with other devices, computers. These features have been significantly expanded in 4.05:

Serial Ports

- 5100 supports up to 7 serial ports, 2 local and 5 virtual TCP to terminal servers or host applications
- The (2) local Serial ports support: CTNet Binary protocol, CTC ASCII Protocol, raw mode, COM1 also supporting the Modbus RTU/ASCII Master and Slave protocols.
- COM1 and COM2 configurable, stop bits, data bits, and parity (COM2 only on manufacturing builds after March 28, 2003).

Modbus

- Modbus is fully supported over both the serial and Ethernet ports
- ASCII or RTU mode selectable on COM1
- Serial Master or Slave support
- Ethernet Modbus/TCP RTU Master and Slave support
- Each port can have its own unique Modbus station number
- Supports up to 65,000 addresses
- Chained register write / single read commands via the ASCII Serial Protocol.

Ethernet

- Telnet Server for remote administration interface
- FTP Server
- UDP Peer to Peer
- TCP client/server raw socket interface, bidirectional
- DHCP support for automatic IP network address assignment
- DNS name registration via DHCP supports addressing controllers by name (e.g. 'Widget Machine Controller' instead of '195.34.143.205')
- SNTP Time Server synchronization for real time clock.
- Virtual IO between (2) controllers over Ethernet (shared IO)
- CTNet Binary protocol

Other Features

- Configurable communication connection throttling to enhance overall system performance
- String formatted output messages with embedded register values from within Quickstep (printf format).
- 'C' Programming for custom protocols

- **Quickstep Programming Enhancements**

  Quickstep on the 5100 has several new control and debugging features. Many of these have been implemented as new registers see the updated 5100 Quick Reference Register guide for details.

  - Network load balancing registers
  - Fault task handler, allows trapping of problems and branching to a specific Quickstep instruction when soft faults occur.
  - Script language integration
  - "C" Language and Quickstep integration (see "C" User Programming)
  - Motion Registration support.
  - Remote IO support using Virtual IO over Ethernet

- **Script language**

  The script language supported on the 5100 controllers is a powerful macro level programming language. The script language provides higher level administrative capabilities to the controller allowing automation of tasks that were previously not possible, or only possible via manual intervention. Some key features are highlighted below:

  - Select, Load, and Run a new Quickstep program from the flash disk
  - Powerful commands to initialize registers, programs, configure the system
  - Save and Restore sets of registers to the flash disk
  - Update / change firmware

  There are several ways that a script can be used:

  - Executable from within a Quickstep program
  - Executable from a telnet or ftp command line
  - Executable at 5100 power up or reset for initialization
  - Executable from within other script files

- **Multi-Tasking ‘C’ User Programming**

  To better address advanced applications support for multi-tasking ‘C’ programs has been added. There is a new dedicated 2 MB memory space that has been set-up for ‘C’ programs. The ‘C’ program has full access to all of the resources (I/O and registers) in the controller and it can run independently and concurrently with Quickstep programs. Advanced users can now elect to use a combination of Quickstep and ‘C’ in the controller. The ‘C’ content can be as little as a simple conversion function, or at the other end of the spectrum the entire application can be written in the ‘C’ language. Some key features are highlighted below:

  - Loadable, compiled ‘C’ program modules to enhance features.
  - Create custom communication protocols
  - Virtual function hooks for
    - Communications protocols
    - User background threads
    - Full register and 5100 resource interface
    - Quickstep tasking control
  - Complex string and algorithm functions
  - Run ‘C’ functions as Quickstep tasks
  - Installable register/resource data filters/conversion for Quickstep access
  - Ideal for automatic user unit conversions
  - Full floating point support.
  - Runs completely in parallel and transparent to Quickstep thereby enhancing its capabilities.

2.0 Documentation

For simplification this Guide is a collection of several related documents. A description of these documents is given below. This approach provides easy access to the appropriate information and makes updates easier to maintain (be sure to check www.ctc-control.com often to be sure you have the latest updates). It is recommended that you review each of the documents in detail prior to beginning a programming task on the 5100 to achieve a full understanding of its potential and flexibility.

2.1 Quick Reference Register Guide

The Quick Reference Register Guide provides a fast way to determine the functionality of most registers used by the 5100. All known registers that can be used by an application program are included. For further detailed programming information refer to the appropriate programming guide, below.
(Document # 951-510006).

2.2 Model 5100 Remote Administration Guide

The Remote Administration Guide reviews the use of FTP and Telnet while interacting with the 5100, in addition to a resident flash disk. FTP can be used to transfer files, update firmware revisions, and provide administrative functions. Telnet provides full remote administration allowing an administrator to access registers within the controller, check firmware revisions, perform advanced diagnostics, check error logs, and execute any of the Script Language commands from a command line interface. *(Document # 951-510001).*

2.3 Model 5100 Communications Guide

The Communications Guide reviews many of the extensive features available within the 5100 and how to enable and interact with them from a programming perspective. Some of these features include, raw TCP sockets, Virtual IO, Modbus TCP and ASCII/RTU Serial Master/Slave, peer to peer interaction, SNTP, configuring DHCP, serial ports, IP addresses, and Fault Task Handlers. *(Document # 951-510002).*

2.4 Model 5100 Script Language Guide

The Script Language Guide reviews an administrative command language that is available for execution by a batch resident on the flash disk and/or the Telnet command line. This command language allows you to store register contents to a file to be loaded back later, view administrative settings and modify them, modify registers, perform low level diagnostics, load and run different programs, including those of both Quickstep and ‘C’, among many other features.
(Document # 951-510003).

2.5 Model 5100 ‘C’ Users Programming Guide

The ‘C’ Users Programming Guide reviews the low level API available to a ‘C’ programmer to run tasks programmed in ‘C’ parallel to Quickstep tasks. ‘C’ programs can interact with Quickstep or run independently. Features such as data

filters, automatic data conversion, PID loops, among many others may be implemented. Instructions on installing the MicroCross GNU 'C' compiler is also included. *(Document # 951-510004).*

2.6 Model 5100 Analog Modules Application Guide

The Analog Modules Application Guide provides information on how to access the numerous module features from within a Quickstep program and/or through register access. Details of available modules, both analog input and output, along with the use of supported thermocouples, are included. *(Document # 951-510007).*

2.7 Model 5100 Motion Modules Applications Guide

The Motion Modules Applications Guide reviews how to write Quickstep programs for 5100 series controllers containing Model SS, Dual Servo Motor Controllers, and/or Model TT, Dual Stepper Motor Controllers. *(Document # 951-510011).*

2.8 Model 5100 Bootloader Installation Guide

The Bootloader Installation Guide reviews how to install a Bootloader/Monitor and Quickstep in a 5100 should a re-flash operation fail during the middle of operation, generally caused by a power failure. When this occurs special software is required should the Bootloader become corrupted. Information on this procedure is provided. *(Document # 951-510005).*

3.0 Related Documentation

(not included in this document)

3.1 Model 5100 Controller Hardware Reference Guide

This document includes detailed data sheets covering all of the hardware characteristics as well as suggested interface circuitry and wiring configurations for the 5100 controllers and modules. (Document # 950-510002)

3.2 Quickstep™ User Guide

Introduction to CTC's Quickstep logic control programming environment. Quickstep is an easy to use state-based language that simplifies application design. (Document # MAN-1000-A)

3.3 Quickstep Language and Programming Guide

Detailed programmer's reference guide for Quickstep. This document covers the quickstep functions, syntax and usage. (Document # MAN-1010-A)