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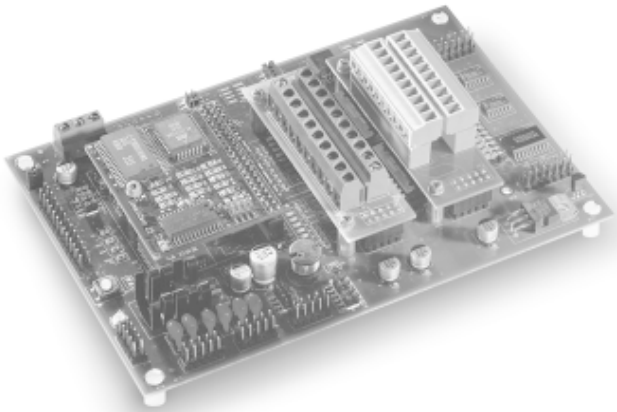
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# **BL1700**

**C-Programmable Controller**

## **User's Manual**

019-0048 • 020415-G



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# BL1700 User's Manual

Part Number 019-0048 • 020415-G • Printed in U.S.A.

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**Schematics**



# ABOUT THIS MANUAL

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This manual provides instructions for installing, testing, configuring, and interconnecting the Z-World BL1700 controller. Instructions are also provided for using Dynamic C functions.

## Assumptions

Assumptions are made regarding the user's knowledge and experience in the following areas:

- Ability to design and engineer the target system that a BL1700 will control.
- Understanding of the basics of operating a software program and editing files under Windows on a PC.
- Knowledge of the basics of C programming.



For a full treatment of C, refer to the following texts.

*The C Programming Language* by Kernighan and Ritchie  
*C: A Reference Manual* by Harbison and Steel

- Knowledge of basic Z80 assembly language and architecture.



For documentation from Zilog, refer to the following texts.

*Z180 MPU User's Manual*  
*Z180 Serial Communication Controllers*  
*Z80 Microprocessor Family User's Manual*



# Acronyms

Table 1 lists and defines the acronyms that may be used in this manual.







**Table 1. Acronyms**

Acronym	Meaning
EPROM	Erasable Programmable Read-Only Memory
EEPROM	Electrically Erasable Programmable Read-Only Memory
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
NMI	Nonmaskable Interrupt
PIO	Parallel Input/Output Circuit (Individually Programmable Input/Output)
PRT	Programmable Reload Timer
RAM	Random Access Memory
RTC	Real-Time Clock
SIB	Serial Interface Board
SRAM	Static Random Access Memory
UART	Universal Asynchronous Receiver Transmitter

# Icons

Table 2 displays and defines icons that may be used in this manual.

**Table 2. Icons**

Icon	Meaning	Icon	Meaning
	Refer to or see		Note
	Please contact	<b>Tip</b>	Tip
	Caution		High Voltage
	Factory Default		

# Conventions

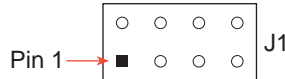
Table 3 lists and defines the typographic conventions that may be used in this manual.

**Table 3. Typographic Conventions**

Example	Description
<b>while</b>	Courier font (bold) indicates a program, a fragment of a program, or a Dynamic C keyword or phrase.
// IN-01...	Program comments are written in Courier font, plain face.
<i>Italics</i>	Indicates that something should be typed instead of the italicized words (e.g., in place of <i>filename</i> , type a file's name).
<b>Edit</b>	Sans serif font (bold) signifies a menu or menu selection.
...	An ellipsis indicates that (1) irrelevant program text is omitted for brevity or that (2) preceding program text may be repeated indefinitely.
[ ]	Brackets in a C function's definition or program segment indicate that the enclosed directive is optional.
< >	Angle brackets occasionally enclose classes of terms.
a   b   c	A vertical bar indicates that a choice should be made from among the items listed.

## Pin Number 1

A black square indicates pin 1 of all headers.



## Measurements

All diagram and graphic measurements are in inches followed by millimeters enclosed in parenthesis.





## *CHAPTER 1: OVERVIEW*

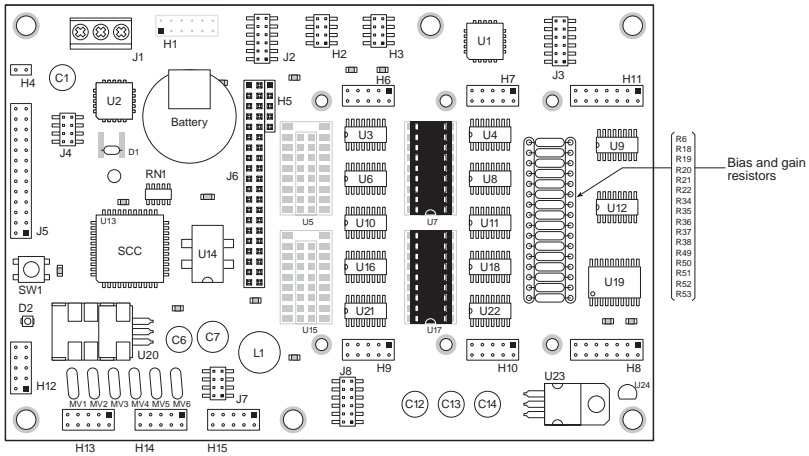
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Chapter 1 provides an overview and a brief description of the BL1700 features.

# Overview

The BL1700 is a feature-rich controller with modular digital and analog I/O that allows easy custom modification. The BL1700 is programmed using Dynamic C, Z-World's version of the C programming language designed for embedded control.

Figure 1-1 illustrates the BL1700 board layout.



**Figure 1-1. BL1700 Board Layout**

## Features

The BL1700 includes the following features.

- **Core Module**

The BL1700 uses a core module (Z-World part number 129-0099) designed for easy, in-system programming. The core module includes the CPU, RAM, flash EPROM, real-time clock, and microprocessor watchdog circuitry.

- **I/O**

Serial channels—Four full-duplex serial channels interface directly with serial I/O devices. RS-232 and RS-485 signal levels are supported.

Digital inputs—Up to 32 protected digital inputs capable of detecting logic level or high-voltage signals.

Digital outputs—Up to 32 high-voltage, high-current outputs capable of driving resistive and inductive loads.

Pulse-width modulated outputs—Up to 7 digital outputs can provide pulse-width modulation.

Analog inputs—Eight conditioned analog inputs, each with user-configurable bias and gain, interface directly with many sensors. Two unconditioned analog inputs which allow for custom signal conditioning circuitry or direct interfacing.

Expansion bus—I/O expansion via built-in PLCBus. The PLCBus uses inexpensive off-the-shelf Z-World expansion boards.

- **Additional Features**

Field Wiring Terminals—Removable field wiring terminals in several configurations are available for the digital and analog I/O ports.

Compact form factor—Compatible with standard 100 mm wide DIN mounting products.

LED—A general-purpose, user-programmable LED is included.

DIN Rails—The BL1700 may be mounted in 110 mm DIN rail trays.



Appendix B provides detailed specifications for the BL1700.



See Appendix C, “Field Wiring Terminals (FWT) and DIN Rails,” for more information on FWTs and DIN rail mounting.

# Flexibility and Customization

The BL1700 was designed with customization in mind. The design was optimized for cost effective, quick-turn, custom manufacturing. Surface mount technology was used extensively in order to reduce both size and cost while providing the flexibility to meet individual design needs. For quantity orders, the BL1700 can be customized to better meet the needs of your application.

## Standard Models

The BL1700 Series of controllers currently has four versions. Table 1-1 lists the standard features for these versions.

**Table 1-1. BL1700 Series Features**

Model	Features
BL1700	18.432 MHz clock, 16 protected digital inputs, 16 high-voltage sinking outputs, 4 full-duplex serial channels, 10 A/D channels, PLCBus expansion port.
BL1710	BL1700 without A/D channels.
BL1720	BL1700 with two serial channels instead of four.
BL1730	BL1700 with two serial channels instead of four and 9.216 MHz clock.

## Customization Options

The BL1700 can be customized for individual applications. The options include the following configurations.

- Core module configuration—CM7100 and CM7200 core modules can be used on the BL1700. Customization options include RAM size, flash EPROM size, EPROM size, clock speed, and real-time clock option.



CM7100 and CM7200 core modules must have a 5-pin header installed at H1, and the BIOS must be customized for these core modules to be used on the BL1700.

- Digital I/O configuration—optional TTL level I/O.
- Analog input configuration—gain and offset configuration.
- Serial channel configuration—two or four serial ports.



For ordering information, or for more details about the various options and prices, call your Z-World Sales Representative at (530) 757-3737.



## Development and Evaluation Tools

The BL1700 is supported by a Development Kit that includes everything you need to start development with the BL1700.

### ***Development Kit***

The Development Kit includes these items.

- Manual with schematics.
- Programming cables and adapter.
- 24 V DC wall-mount power supply.
- Field wiring terminals.
- Sourcing high-voltage driver ICs.

An optional Serial Interface Board (SIB) allows full access to all serial ports during development.

### ***Software***

The BL1700 is programmed using Z-World's Dynamic C, an integrated development environment that includes an editor, a C compiler, and a debugger. Library functions provide an easy and robust interface to the BL1700.



Z-World's Dynamic C reference manuals provide complete software descriptions and programming instructions.

## CE Compliance

The BL1700 has been tested by an approved competent body, and was found to be in conformity with applicable EN and equivalent standards. Note the following requirements for incorporating the BL1700 in your application to comply with CE requirements.



- The power supply provided with the Development Kit is for development purposes only. It is the customer's responsibility to provide a clean DC supply to the controller for all applications in end-products.
- Fast transients/burst tests were not performed on the BL1700. Signal and process lines that are longer than 3 m should be routed in a separate shielded conduit.
- The BL1700 has been tested to Light Industrial Immunity standards. Additional shielding or filtering may be required for an industrial environment.
- The BL1700 has been tested to EN55022 Class A emission standards. Additional shielding or filtering may be required to meet Class B emission standards.



Visit the "Technical Reference" pages of the Z-World Web site at <http://www.zworld.com> for more information on shielding and filtering.



## CHAPTER 2: **GETTING STARTED**

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Chapter 2 provides instructions for connecting the BL1700 to a host PC and running a sample program. The following sections are included.

- Development Kit Packing List
- Connecting the BL1700 to Your PC
- Establishing Communication with the BL1700
- Running a Sample Program

## Development Kit Packing List

The BL1700 Development Kit includes the following items.

- Two serial cables with DB-9 and 10-pin header connectors.
- DB-25 to DB-9 serial adapter.
- 24 V DC wall-mount power transformer.
- Two FWT-50 field wiring terminals.
- One FWT-A/D field wiring terminal.
- Two 2985 high-voltage driver ICs.
- BL1700 User's Manual (this document).

## Connecting the BL1700 to a Host PC

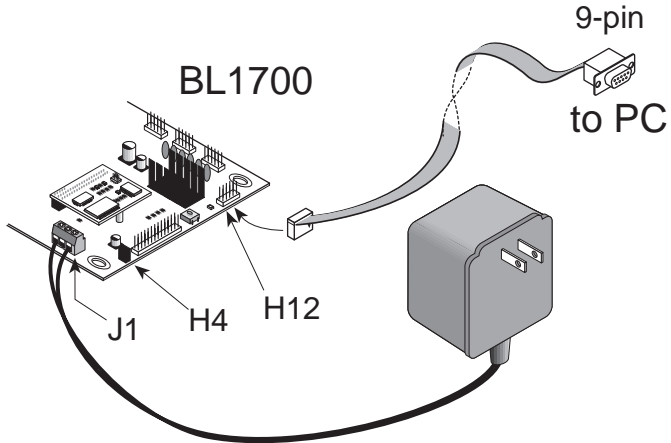
The BL1700 can be programmed using a PC through an RS-232 port with the programming cable provided in the Developer's Kit. You can also use Z-World's SIB2 to program the BL1700. Using the SIB2 frees all of the serial channels for the application during development. The SIB2 is not part of the standard Developer's Kit, and must be purchased separately. Both programming methods are described below.



For ordering information, call your Z-World Sales Representative at (530) 757-3737.

**Connecting the BL1700 to a PC using the serial port.**

1. Make sure that Dynamic C is installed on your system as described in the Dynamic C *Technical Reference* manual.
2. Connect the 10-pin programming cable from H12 on the BL1700 to the appropriate COM port of your computer as shown in Figure 2-1. Make sure that pin 1 on the ribbon cable connector (indicated by a small triangle on the connector) matches up with pin 1 on H12 (indicated by a small white circle near the corner of the connector).



**Figure 2-1. BL1700 Programming Connections**



Use only the transformer and programming cable supplied by Z-World.

3. Make sure that the Run/Program jumper on header H4 is installed.
4. Connect the 24 V DC transformer as follows.
  - Connect the lead with the red sleeve to the screw terminal (J1) labeled DCIN on the BL1700.
  - Connect the other lead to the screw terminal (J1) labeled GND.
5. Plug the transformer into a wall socket.

## Connecting the BL1700 to your PC using the SIB2.

1. Make sure that Dynamic C is installed on your system as described in the *Dynamic C Technical Reference* manual.
2. Disconnect power from the BL1700. Connect an RJ-12 cable between the RJ-12/DB-9 adapter attached to the PC and the SIB2.
3. Plug the SIB2's 8-pin connector onto header JP1 located on the CM7200 core module (mounted on the BL1700), as shown in Figure 2-2. Make sure that pin 1 on the ribbon cable connector (on the striped side) matches up with pin 1 on JP1 (indicated by a small white circle next to the header).

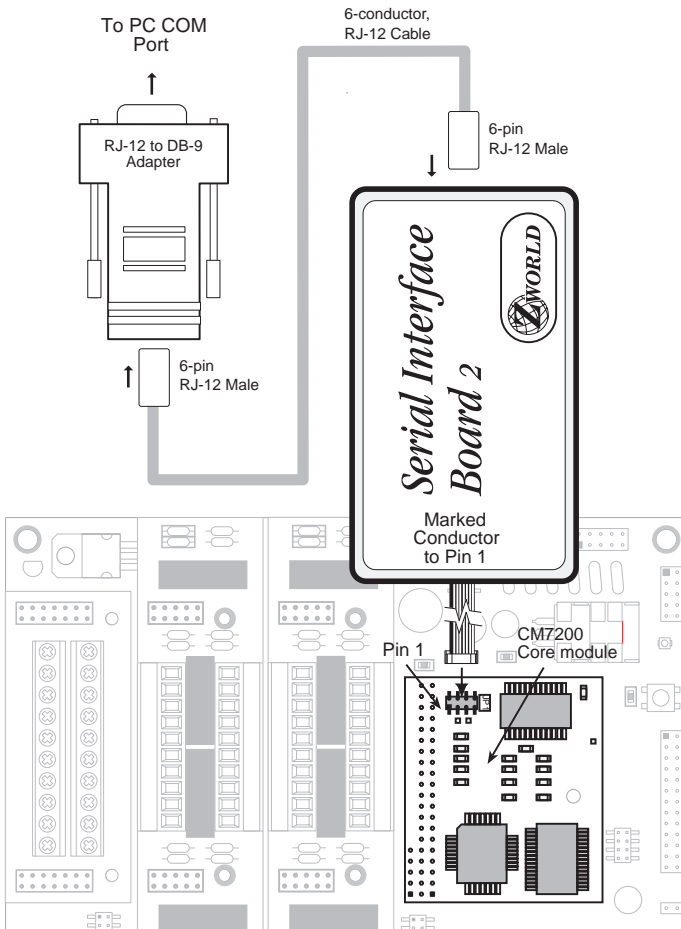


Figure 2-2. SIB2 Connection (BL1700 Top View)



Use only the transformer and programming cable supplied by Z-World.



Observe the polarity of the cable and the 8-pin connector. Attach the connector to JP1 exactly as shown in Figure 2-2.

4. Make sure that the Run/Program jumper on header H4 is installed.
5. Connect the 24 V DC transformer as follows.
  - Connect the lead with the red sleeve to the screw terminal (J1) labeled DCIN on the BL1700.
  - Connect the other lead to the screw terminal (J1) labeled GND.
6. Plug the power supply into a wall socket.

## Establishing Communication with the BL1700

1. Double-click the Dynamic C icon to start the software. Note that communication with the BL1700 is attempted each time you start Dynamic C.
2. If the communication attempt is successful, no error messages are displayed.



See Appendix A, “Troubleshooting,” if an error message such as **Target Not Responding** or **Communication Error** appears.



Once the necessary changes have been made to establish communication between the host PC and the BL1700, use the Dynamic C shortcut **<Ctrl Y>** to reset the controller and initiate communication.



## Running a Sample Program

1. Open the sample program **BL17FLSH.C** located in the Dynamic C **SAMPLES\BL17XX** directory. This program flashes the onboard LED.
2. Compile the program by pressing **F3** or by choosing **Compile** from the **Compile** menu. Dynamic C compiles and downloads the program into the BL1700's flash memory.

During compilation, Dynamic C rapidly displays several messages in the compiling window. This condition is normal.



See Appendix A, “Troubleshooting,” if an error message such as **Target Not Responding** or **Communication Error** appears.

3. Run the program by pressing **F9** or by choosing **Run** from the **Run** Menu.
4. To halt the program, press **<Ctrl Z>**. This action halts program execution.
5. To restart program execution, when required, press **F9**.



## CHAPTER 3: **BL1700 HARDWARE**

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Chapter 3 describes the BL1700 hardware subsystems. The following sections are included.

- Operating Modes
- BL1700 Subsystems Overview
- Microprocessor Core Module
- Serial Communications Channels
- High-Voltage Digital Outputs
- Protected Digital Inputs
- Analog Inputs
- PLCBus Expansion Port

# Operating Modes

The BL1700 has two mutually exclusive operating modes, run mode and program mode. Each mode is explained in detail below.

- **Program Mode**

In program mode, the BL1700 controller runs under the control of your PC that is running Dynamic C. The BL1700 must be in this mode to compile a program to the BL1700 or debug a program.



- In program mode, the BL1700 matches the baud rate of the PC COM port up to 57,600 bps.
- USER LED is “ON” in program mode.

- **Run Mode**



In run mode, the BL1700 controller runs standalone. At power-up, the BL1700 checks to see if its onboard memory contains a program. If a program exists, the BL1700 controller executes the program immediately after power-up.



- In run mode, the BL1700 does not respond to Dynamic C running on the PC. A program cannot be compiled or debugged when the BL1700 is in run mode.
- USER LED D2 is under the control of the application on the BL1700 when the BL1700 is in run mode.

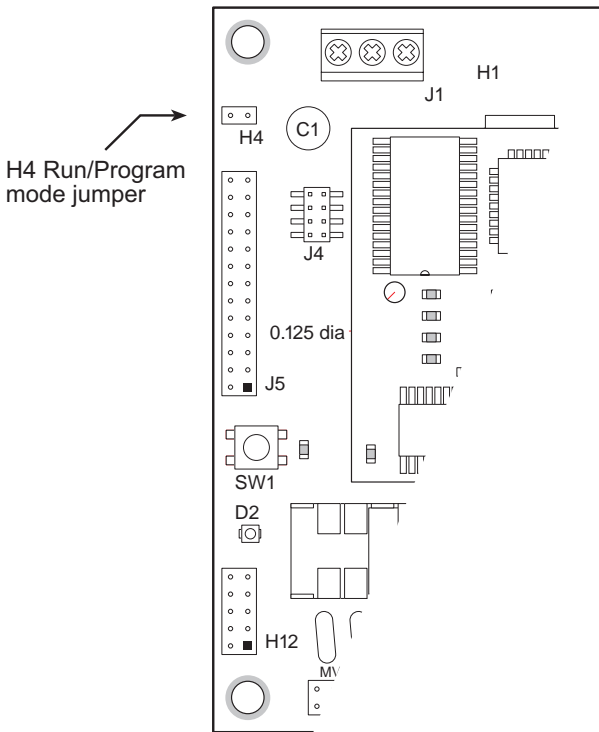
Table 3-1 shows the jumper settings for the program and run modes.

**Table 3-1. BL1700 Jumper Settings for Run/Program Modes**

Operating Mode	Header H4	Permissible Activities
Program Mode		<ul style="list-style-type: none"><li>• Compile a program.</li><li>• Run a program under debugger control.</li><li>• Run a program without “polling.” See your Dynamic C manuals for a description of program polling.</li></ul>
Run Mode		Run application.

## Changing the Operating Mode

1. Locate the **Run/Program** jumper on header H4. Figure 3-1 shows the location of header H4.



**Figure 3-1. H4 Run/Program Jumper Location**

2. Select the desired operating mode.
  - Install jumper on header H4 to select program mode.
  - Remove jumper on header H4 to select run mode.
3. Press the reset switch SW1 to switch the BL1700 to the selected mode.



Be sure careful when installing or removing the H4 jumper if power is connected to the BL1700.