Table of Contents

PREFACE VII

CHAPTER 1: OVERVIEW 11
Introducing the M90 Micro OPLC 11
Technical Description 12
The M90 12
I/Os 12
Operating Panel 12
Communications 12
I/O Expansion Port 13
Programming 13
PLC Program Properties 13
HMI Program 13
Safety Guidelines 14

CHAPTER 2: MOUNTING THE M90 15
Before You Begin 15
Safety and Environmental Guidelines 16
Mounting 17
Panel Mounting 17
DIN Rail Mounting 18

CHAPTER 3: I/OS 21
Wiring Considerations 21
Connectors 21
I/O Connections 21
Wire Size and Specifications 22
Power Supply 22
Digital Inputs 23
High-Speed Counter/Shaft-encoder 23
Analog Inputs 23
Digital Outputs 24
Analog Outputs 24

CHAPTER 4: COMMUNICATIONS 25
RS232 25
Downloading Your Program 26

Connecting the M90 to the PC 26
CANbus 28

CHAPTER 5: INFORMATION MODE 31
Using Information Mode 32
The Main Menu 32
Inputs/Outputs 34
Analog / Counter 35
MB / MI / SB / SI 36
Timers 38
System 39
Time & Date 40
M90 ID Number 41
U90 Baud 41
CAN Baud 42
Model 43
Version Numbers 43
Reset 43
Clear MB and MI 43
Scan Time 44
Sys Info 44

APPENDIX A: SYSTEM BITS AND INTEGERS 45

APPENDIX B TECHNICAL SPECIFICATIONS 49
Power Supply 49
Onboard I/Os 49
Battery Back-up 50
Display 50
Keypad 50
Program 50
Communication Ports 51
I/O Expansion (except M90-19-B1A) 51
Dimensions 51
Mounting 51
Environment 51
Accessories 51
M90-19-B1A 53
M90-R1 54
M90-R1-CAN 55
M90-R2-CAN 56
M90-T1 57
M90-T1-CAN 58
M90-TA2-CAN 59

APPENDIX C: NEW PLC USERS **61**
Parts of a PLC **61**
Operating Panel 61
Inputs 61
Outputs 61
CPU 61
How PLCs Work **62**

TABLE OF FIGURES **65**

INDEX **67**

Preface

About this Manual

This manual contains information relevant to the M90 micro controller series.

The M90

Chapter 1. Overview

Contains a general description of the M90's form and function.

Chapter 2. Mounting the M90

Describes how to mount the M90 on either panel or DIN rail.

Chapter 3. I/Os

Contains information for the M90 I/Os.

Chapter 4. Communications

Explains communications connections.

Chapter 5. Using Information Mode

Explains how to use the M90 Information Mode via the M90 keypad.

Appendices

Appendix A. System Bits and Integers

Contains tables showing internal system elements.

Appendix B. Technical Specifications

Contains detailed M90 specifications and wiring diagrams.

Appendix C. New PLC Users

Provides information for new PLC users.

Guidelines for user safety and equipment protection

This manual is intended to aid trained and competent personnel in the installation of this equipment as defined by the European directives for machinery, low voltage and EMC. Only a technician or engineer trained in the local and national electrical standards should perform tasks associated with the electrical wiring of M90 controllers.

Symbols are used to highlight information relating to the user's personal safety and protection of the equipment throughout this manual.

When any of the following symbols appear, the associated information must be read carefully and understood fully.

Symbols:

Symbol	Meaning	Description
	Danger-	The identified danger causes physical and property damage.
	Warning-	The identified danger could cause physical and property damage.
Caution	Caution-	Use caution.

Chapter 1: Overview

Introducing the M90 Micro OPLC

The M90 is a micro OPLC[1]; a compact controller that contains a fully integrated operating panel. It is a fine device for simple control tasks, both household and industrial. The M90 comes in different models offering a variety of capabilities, including analog control, CANbus and expansion ports. These M90 features give it the flexibility to control both time and ambient condition based processes.

Figure 1. The M90

The operating panel shown in Figure 1 provides the operator interface. The M90 operating panel contains an LCD text display screen and a keypad. The LCD screen can be used to display operating instructions, a feature that makes the M90 very easy to use. The operator uses the keypad to communicate information to the M90 or to modify existing data. This communication interface between the M90 and operator is referred to as the HMI, or Human Machine Interface, throughout this manual.

The M90 operating panel offers an additional feature called Information Mode. Information Mode allows the operator to view certain types of system data such as input status or timer values.

The M90 web site can be found at www.unitronic.com/m90/index.htm. Check this site frequently for product updates, new M90 applications and programming tips.

[1] Acronym for Operating panel + Programmable Logic Controller.

Technical Description

This is a general description of all current M90 models. Full technical specifications for each M90 model are given in Appendix B.

The M90

- Dimensions: 96 x 96 x 64mm.
- Mounting: either panel or DIN rail mountable.
- Power supply: 24VDC.
- Real time clock (RTC), enabling time and date controlled functions.

Note: The RTC is provided with a 7 year typical battery backup.

I/Os

The M90 series offers digital and / or analog I/Os depending on the specific M90 model.

Operating Panel

The operating panel provides the HMI. It is comprised of:

- An LCD screen that displays one line of text, 16 illuminated characters long.
- A keypad containing 15 sealed membrane keys.

Communications

The M90 series offers two communication ports: RS232 and CANbus. All models have RS232 ports. There are specific M90 models that have CANbus ports.

The M90 RS232 serial port has two functions:

- Downloading programs from a PC.
- Establishing network communications via the appropriate communication protocol.

The CANbus port has three functions:

- Integrating additional M90 units as “Smart Remotes”.
- Centralizing data in a SCADA-run control system.
- Creating a decentralized CANbus network.

I/O Expansion Port

The M90 expansion port enables the addition of up to 8 expansion units totaling up to 64 I/Os. Technical specifications are provided with the I/O expansion unit.

Programming

You create both your M90 PLC and HMI applications on a PC using U90 Ladder software running under either Windows 95, 98, or NT 4.0. The M90 is programmed using Ladder logic.

The PLC application is the program that runs the M90. It enables the M90 to perform its control functions.

The HMI application customizes your M90 operator interface. Use it to:

- Assign functions to the M90 keypad keys.
- To create and display messages on the M90 LCD display.

When your program is complete, you download it to the PLC.

PLC Program Properties

- Size: 2048 words (M90-19-B1A: 1024 words)
- Language: Ladder
- Memory bits (coils): 256
- Memory integers (registers): 256, 16 bit

Memory bits are represented in the M90 program by the symbol MB; memory integers by MI.

System Bits and System Integers are linked to fixed values or functions and are reserved for use by the system. Some of them are available for use in your program.

System Bits are represented in the M90 program by the symbol SB; System Integers by SI. See Appendix A: System Bits and Integers page 45.

HMI Program

Up to 80 HMI displays can be created.

HMI variables are inserted within the fixed text of an HMI display. Such variables are used to display values for the following system elements: bits, integers, timers, times, dates, I/Os and text from the variable text display list.

The types of messages created by the HMI application might be error messages, instructions or requests for the operator to enter information via the M90 keypad.

Safety Guidelines

- Check the user program before running it.
- Do not attempt to use the M90 with voltage exceeding permissible levels. Permissible voltage levels are listed in the technical specifications provided in Appendix B.
- Install an external circuit breaker and take all appropriate safety measures against short-circuiting in external wiring.

- Failure to comply with appropriate safety guidelines can result in severe personal injury or property damage. Always exercise proper caution when working with electrical equipment.

Caution

- Ascertain that terminal blocks are properly secured in place.

Warnings

- Under no circumstances will Unitronics be liable or responsible for any consequential damage that may arise as a result of installation or use of this equipment.
- All examples and diagrams shown in the manual are intended to aid understanding. They do not guarantee operation.
- Unitronics accepts no responsibility for actual use of this product based on these examples.
- Due to the great variety of possible applications for this equipment, the user must assess the suitability of this product for specific applications.
- Make sure to have safety procedures in place to stop any connected equipment in a safe manner if the controller should malfunction or become damaged for any reason.
- Do not replace electrical parts or try to repair this product in any way.
- Only qualified service personnel should open the M90 housing or carry out repairs.
- The manufacturer is not responsible for problems resulting from improper or irresponsible use of this device.
- Please dispose of this product in accordance with local and national standards and regulations.

Chapter 2: Mounting the M90

This chapter gives detailed mounting instructions for both panel and DIN rail mounting.

Before You Begin

Before you begin installation procedures, check the contents of the M90 kit. Standard kits contain the M90, green plastic plug-in connectors and 2 black plastic mounting brackets, each with a screw inserted for panel mounting. These elements are illustrated in Figure 2. The kit also contains a rubber neoprene seal, used for panel-mounting the M90; a CD-ROM containing U90 Ladder software, used to program the M90 and a programming communication cable. These items are not pictured in Figure 2.

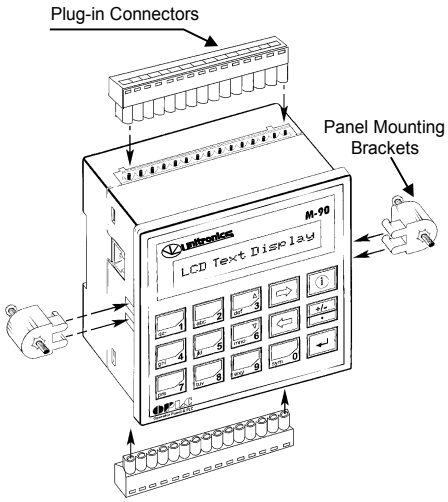


Figure 2 .M90 Standard Kit

Safety and Environmental Guidelines

- Do not install in areas with: excessive or conductive dust, corrosive or flammable gas, moisture or rain, excessive heat, regular impact shocks or excessive vibration.
- Do not place in water or let water leak onto the controller.
- Do not allow debris to fall inside the unit during installation.
- Double-check all the wiring before turning on the power supply.

- Do not touch live wires.
- Stay as far as possible from high-voltage cables and power equipment.
- Leave a minimum of 10mm space for ventilation between the top and bottom edges of the controller and the enclosure walls.

Mounting

You can either panel-mount the M90, or mount it on a DIN rail.

Panel Mounting

Before you begin, note that the panel itself cannot be more than 5 mm thick.

1 Make a panel cut-out that measures 92 x 92 mm.

2 Slide the rubber seal over the back of the unit. The seal must fit snugly against the back rim of the operating panel.

3 Slide the M90 into the cut-out.

4 Push the two black plastic mounting brackets into their slots on the sides of the M90 as shown in Figure 2, page 15.

5 Tighten the bracket screws against the panel as shown in Figure 3.

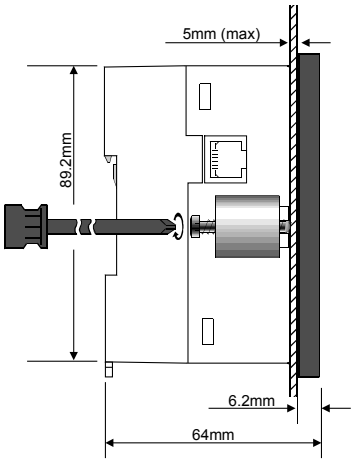


Figure 3. Panel Mounting the M90

When properly mounted, the M90 is squarely situated in the panel cut-out as shown in Figure 4.

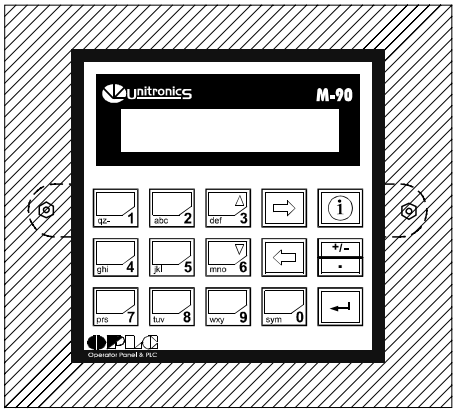


Figure 4. M90 Panel Mounted

DIN Rail Mounting

1 Snap the M90 onto the DIN rail as shown in Figure 5.

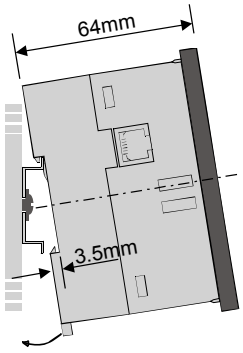


Figure 5. Snapping the M90 to the DIN Rail

When properly mounted, the M90 is squarely situated on the DIN rail as shown in Figure 6.

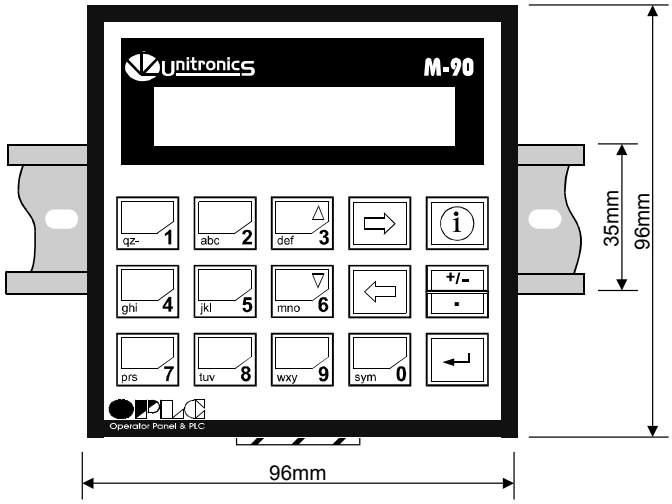


Figure 6. Proper M90 DIN Rail Position

Chapter 3: I/Os

This chapter contains important information for the M90's I/Os. The I/O connection points are provided by external connectors. Please refer to the Appendix B Wiring Diagrams specific to your M90 model.

Wiring Considerations

- The wiring of the M90 has been designed to be safe and easy. A technician or engineer trained in the local and national electrical standards should perform all tasks associated with the electrical wiring of the M90.
- Input or output cables should not be run through the same multicore cable or share the same wire.
- Do not lay input/output cables near high voltage power cables.
- Allow for voltage drop and noise interference with input/output lines used over an extended distance. Please use wire that is properly sized for the current load.
- Double-check all the wiring before turning on the power supply.

Connectors

The M90 has a top and bottom connector. The connectors plug in, enabling quick, easy removal. They provide screw-type connection points for the power source, inputs and outputs. The connection points are clearly labeled on the M90 itself.

The top connector provides connections for the power supply, analog and / or digital inputs and high-speed counter/shaft-encoder.

The bottom connector provides analog and / or digital output connection points.

I/O Connections

1 Strip the wire to a length of 7±0.5mm (0.250–0.300 inches).

2 Unscrew the terminal to its widest position before inserting a wire.

3 Insert the wire completely into the terminal to ensure that a proper connection can be made.

4 Tighten enough to keep the wire from pulling free.

Wire Size and Specifications

- Wire the inputs and outputs using 26-12 AWG wire (0.13 mm ^{2}–3.31 mm^2).
- To avoid damaging the wire, do not exceed a maximum torque of 0.5 N·m (5 kgf·m).
- Do not use tin, solder or any other substance on the stripped wire that might cause the wire strand to break.
- We recommend that you use crimp terminals for wiring.

Power Supply

The M90 requires an external 24VDC power supply. The permissible input voltage range is 20.4–28.8VDC. You must use an external circuit protection device. See specific model wiring diagrams in Appendix B.

When wiring DC supplies, the "positive" cable should be connected to the "+V" terminal and the negative cable should be connected to the "0V" terminal.

- A non-isolated power supply can be used provided that a 0V signal is connected to the chassis.
- Do not connect either the ‘Neutral or ‘Line’ signal of the 110/220VAC to the M90’s 0V pin.
- In the event of voltage fluctuations or non-conformity to voltage power supply specifications, connect the M90 to a regulated power supply

Digital Inputs

Each M90 contains on-board digital pnp inputs. Appendix B contains model-specific digital input information. They can be connected to any 24VDC input device. Note that all inputs relate back to 0V.

Input values are placed in operands represented by the letter "I" when you write your program. They are numbered from 0.

High-Speed Counter/Shaft-encoder

The last input can function as either a high-speed counter or a normal digital input.

The counter itself is actuated at a falling signal edge. The counter value is stored in SI 10.

The next to the last input can function as either the counter reset or a normal digital input. The counter reset is actuated when the signal is positive, equal to logic 1. SB 10 serves as an Enable Reset bit. You also can reset the counter by writing into SI 10 in the program software.

The last two inputs can function together as a shaft-encoder. In SI 14 you indicate how the last two inputs will function:

When SI 14 = 0 the inputs function as Counter + Reset.
When SI 14 = 1 the inputs function as Shaft-encoder x4.
When SI 14 = 2 the inputs function as Shaft-encoder x2.

In shaft-encoder mode there is no counter reset and therefore 0 value is written into SI 10 to reset it.

Analog Inputs

Specific M90 models contain analog inputs. Appendix B contains model-specific analog input information.

The analog input value is from 0-1023 digits. The electric current or voltage is translated into a percentage within this range. The analog value is linked to and stored in SI 20 (analog input 0) and SI 21 (analog input 1).

Note: Shields should be connected at the signal source.

Digital Outputs

Each M90 contains either relay or pnp digital outputs. See Appendix B for model-specific digital output information.

The digital output value is placed in operand "O" when you write your program.

The power supply for transitor outputs require an external circuit protection device. See model specific diagrams in Appendix B.

Relay Contact Protection

To increase the life span of your contacts and protect the M90 from potential damage by reverse-EMF, connect:

- a clamping diode in parallel with each inductive DC load
- an RC snubber circuit in parallel with each inductive AC load.

This is illustrated in Figure 7.

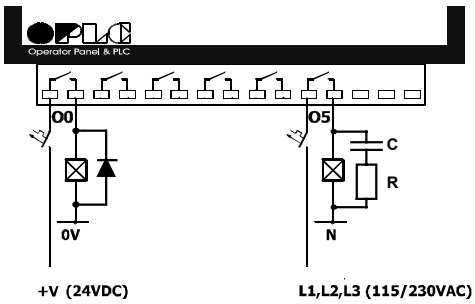


Figure 7. Increase the Contact Life Span

Analog Outputs

The M90-TA2-CAN has one 10-bit analog output operating between 0-10V.

The analog output value is from 0-1023 digits.

Analog output values are stored in SI 28 when you write your program.

Chapter 4: Communications

This chapter contains guidelines for communication connections. The M90 offers various communications options, such as RS232 and RS485 via the appropriate adapters, available separately. Certain M90 models offer CANbus communications.

RS232

The RS232 serial port is used for two different purposes:

- Downloading programs from a PC.
- Establishing communications in conjunction with the appropriate communication protocol.

An RJ-11 type serial port is provided on the side of the M90, as shown in Figure 8. This port provides the communications interface.

Note that a standard telephone cord cannot be used to establish communications.

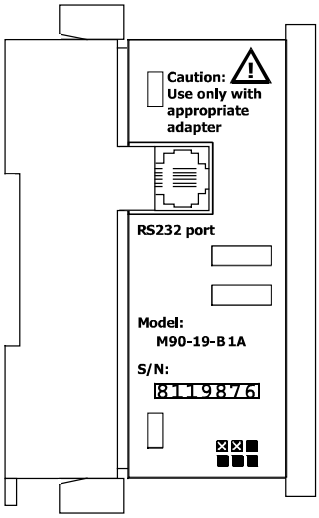
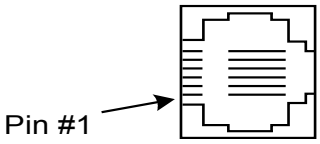


Figure 8. M90 Side View – RS232 Port

Table 1: Pinout for M90 RS232 Port

Diagram	Pin Number	Function
	1	DTR signal*
	2	0V reference
	3	TxD signal
	4	RxD signal
	5	0V reference
	6	DSR signal*

*Standard programming cables do not provide connection points for pins 1 and 6

Caution

- Signals are related to the M90's 0V; this is the same 0V used by the power supply
- The RJ-11 type serial port located on the side of the M90 must always be used in conjunction with an appropriate adapter.
- The RS232 serial port is not isolated.

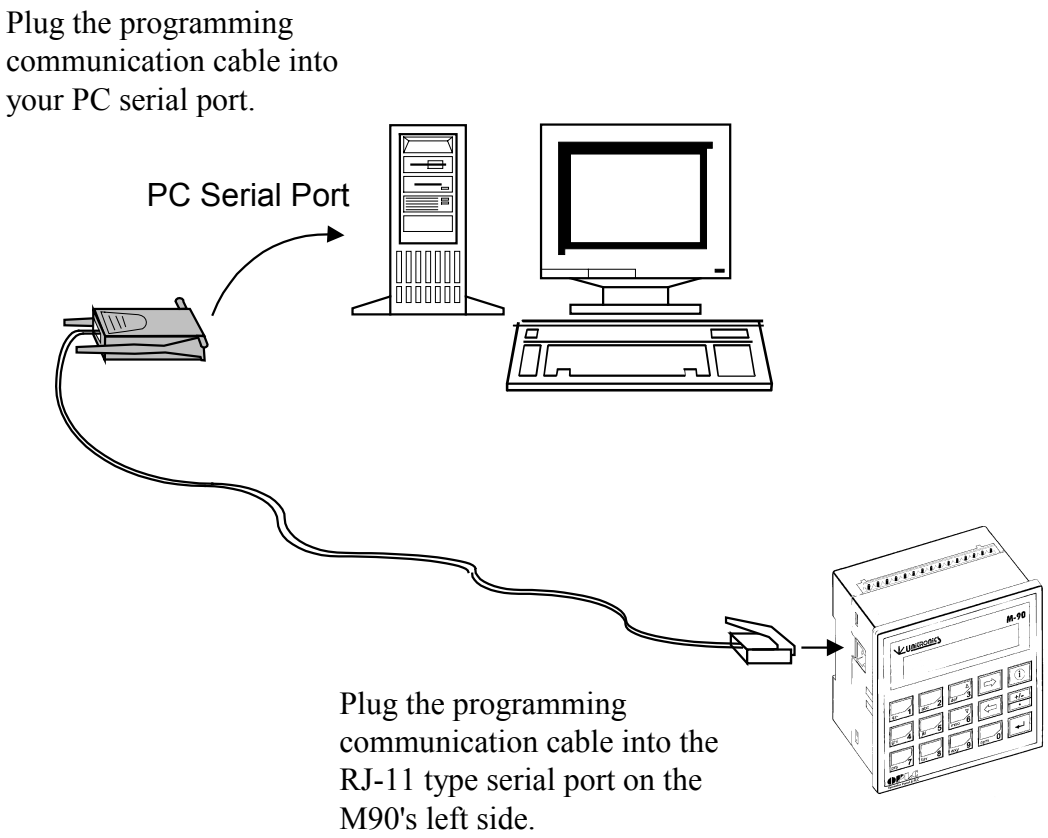
Downloading Your Program

You download programs to the M90 via the programming communication cable. The cable should not exceed 3 meters in length.

Connecting the M90 to the PC

Connect the M90 to your PC using the programming communication cable, as shown in Figure 9, page 27.

Figure 9. M90 – PC Communication



CANbus

A CANbus network decentralizes control in a PLC system allowing for a larger and faster localized control system by distributed real-time control applications. The M90 CANbus port is located on the right side of the controller, as shown in Figure 10.

The Unitronics M90 CANbus network is run by a separate isolated power supply and is not part of the network power supply.

The M90 CANbus communicates through a twisted-pair cable. Unitronics recommends Allen-Bradley's DeviceNet® communication cable for connecting the M90 CANbus.

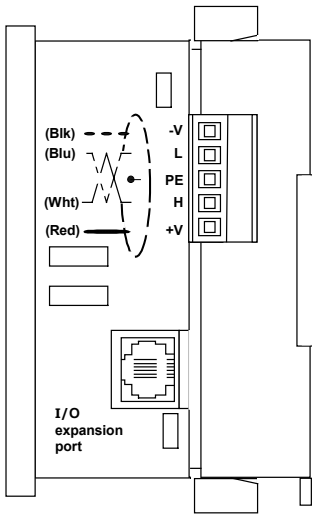


Figure 10. M90 Side View – CANbus & Expansion Port

CANbus Wiring Specifications.

Table 2: CANbus Specifications

Power Requirements: 24 VDC (±4%) 40mA max.

Galvanic Isolation between CANbus and controller: Yes

Max. Cable Length:

1 Mbit/s -	25 m
500 Kbit/s -	100 m
250 Kbit/s -	250 m
125 Kbit/s -	500 m
100 Kbit/s -	500 m
50 Kbit/s -	1000 m
20 Kbit/s -	1000 m
10 Kbit/s -	1000 m

Note: Cable lengths over 500 meters require an additional power supply.

Table 3: Wiring Considerations

- Network terminators must be set at each end of the CANbus network.
- Resistance of network terminators must be set at 1%, 121Ω, 1/4W.
- Up to 63 M90 controllers may be connected in a network.
- CANbus communication is via twisted-pair cable.
- DeviceNet® thick shielded twisted pair cable is recommended for use with M90 CANbus.
- The ground signal should be connected to the earth at only one point near the power supply.
- The network power supply need not be at the end of the network.

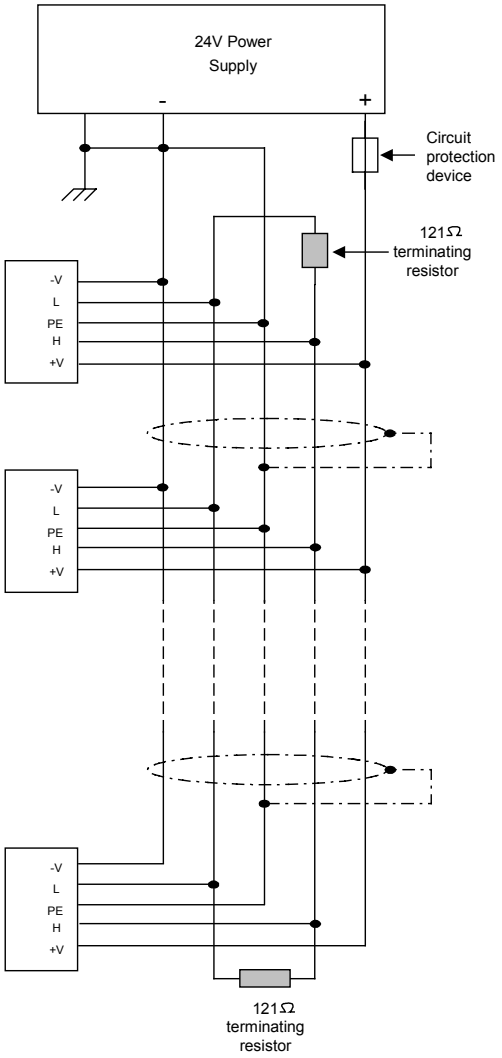


Figure 11. Wiring Diagram

-V	24V common supply for CANbus
L	CAN low
PE	Ground
H	CAN high
+V	24V power supply for CANbus

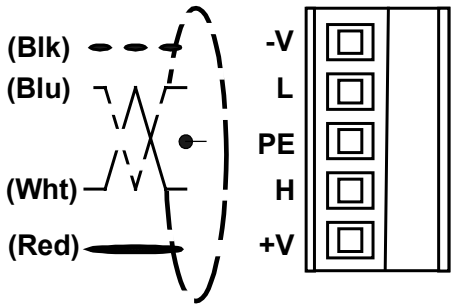


Figure 12. CANbus Connector

Chapter 5: Information Mode

This chapter contains instructions for using the M90 Information Mode to display and edit data and perform certain preset actions. The system data is displayed on the M90 LCD screen and edited via the M90 keypad. You enter Information Mode using the <i> button on the M90 keypad.

You can enter Information Mode at any time, without regard to what is currently displayed on the HMI screen. Viewing data does not affect the M90 program. Note that when you are in Information Mode, the keypad is dedicated to that purpose. The keypad cannot be used for normal application functions until you exit Information Mode.

The list below shows the categories of information that are available for viewing.

Table 5: Information Mode Menu

Category	Type of information displayed
Inputs (I)	Status of inputs, on or off
Outputs (O)	Status of outputs, on or off
Analog Inputs	Operating range and current value
Analog Output	Operating range and current value
Counter	Counter value
MB	Status of Memory Bits, on or off
MI	Integer value currently held in Memory Integers
SB	Status of System Bits, on or off
SI	Integer value currently held in System Integers
Timers	Current timer value, preset value, and timer status
System	This is a set of submenus. Some of the items accessible through this menu can be both viewed and edited. You can also restart your program, as well as initialize MBs and MIs, via the System menu.

Table 6: System Sub-Menu

Category	Type of information displayed
Time & Date	View and edit current time and date
M90 ID Num	View and assign ID number to unit
U90 Baud	View and edit baud rate (for RS232 port)
CAN Baud	View and edit baud rate (for CANbus)
Model	View model name
Version	Provided for technical support professionals
Reset	Restarts program
Clear MB & MI	Restarts program and initializes MB and MI values
Scan Time	Time it takes to run one scan
Sys Info	Provided for technical support professionals

Note that when you are editing a value, you can always exit without saving changes by pressing the <i> key.

Using Information Mode

This section contains illustrated instructions that show you how to use the Information Mode menus.

The Main Menu

To enter the main menu, press the <**i**> key for several seconds. You navigate through the main menu to reach the category of data you want. Selecting a category opens a submenu.

Note that when you enter Information Mode, the M90 keys take on the functions shown below instead of their normal application functions.

Table 7: Menu Keys

Key	Description
	Enter Information Mode and view the main menu. If you are viewing the main menu, press **<i>** to exit information and display the program. If you are viewing the submenu, press **<i>** to move back to the previous menu.
	Move forward through the menu options.
	Move backward through the menu options.
	Select a menu option; enter system changes.

The main menu options are shown in Figure 13.

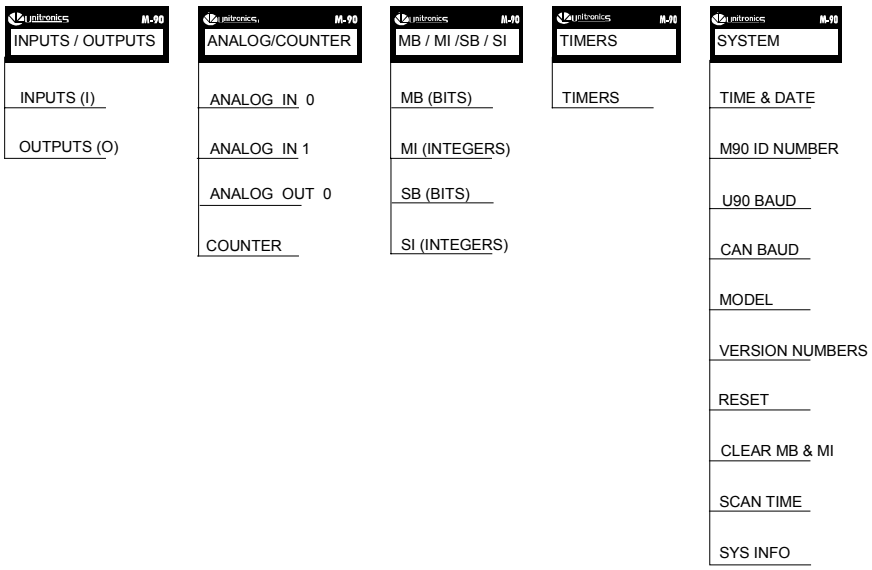


Figure 13. Main Menu

The options available in each main menu category are detailed in the following sections. Note that not all menu options are available in all M90 models.

Inputs/Outputs

This is the first option presented in the main menu. Inputs and outputs are presented on screen as shown in Figure 14. All 256 potential inputs and outputs available for viewing.

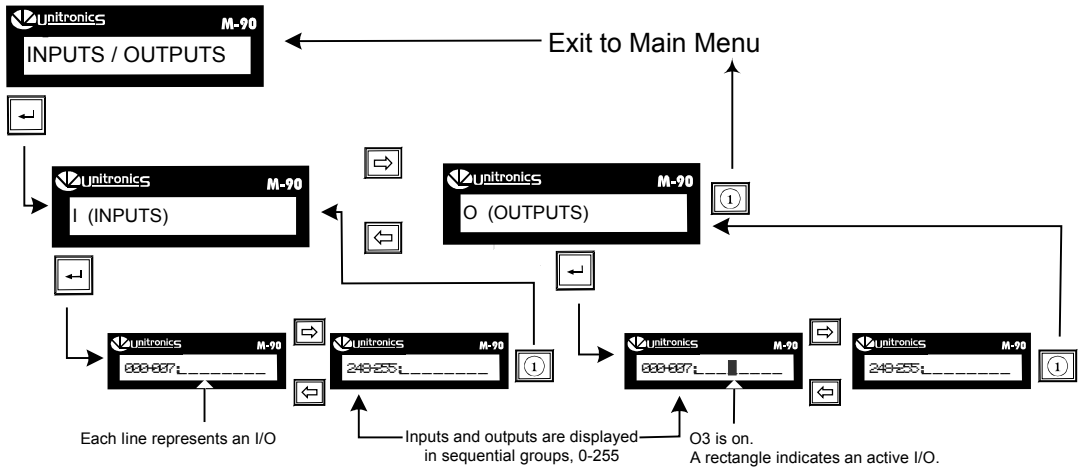


Figure 14. Inputs and Outputs

Analog / Counter

This second menu option displays the analog I/Os and counter values. Selecting the analog option displays the digital value as well as all analog ranges of each analog I/O specific to the M90 model as shown in Figure 15. In models without an analog I/O, only the counter option is displayed. Selecting the counter option displays the counter value.

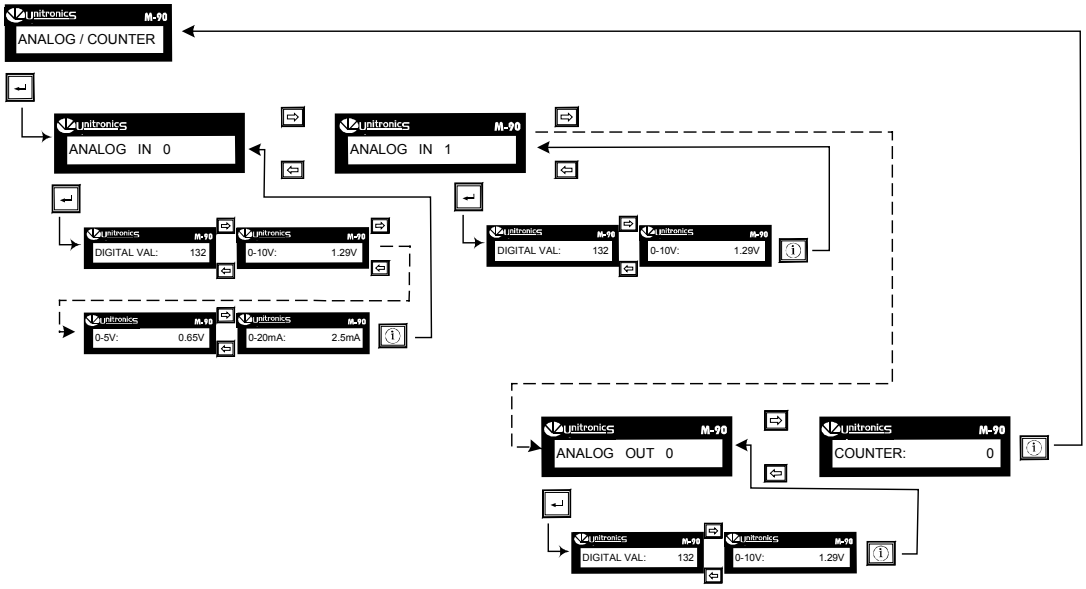


Figure 15. Analog Inputs and Counter Values

MB / MI / SB / SI

Selecting the MB or SB option displays the Memory Bits and System Bits in sequential groups. You move between the groups using the arrow keys. Bit status is represented in the same manner as inputs and outputs. The presence of a highlighted rectangle indicates that the bit status is currently positive (on).

Selecting the MI or SI option displays the Memory Integers and System Integers in sequential groups shown in Figure 16, page 37. You can view the current value of any MI by entering its number via the M90's numerical keys and then pressing the < ↵ > key. Edit your entry by using the left pointing arrow <⇦> key to move the entry field. You can revert to your previous entry by using the right pointing arrow <⇨> key.

Once an MI or SI value has been selected, you can scroll between the integers using the arrow keys. A list of System Bits and Integers appears in Appendix A: System Bits and Integers , page 45.

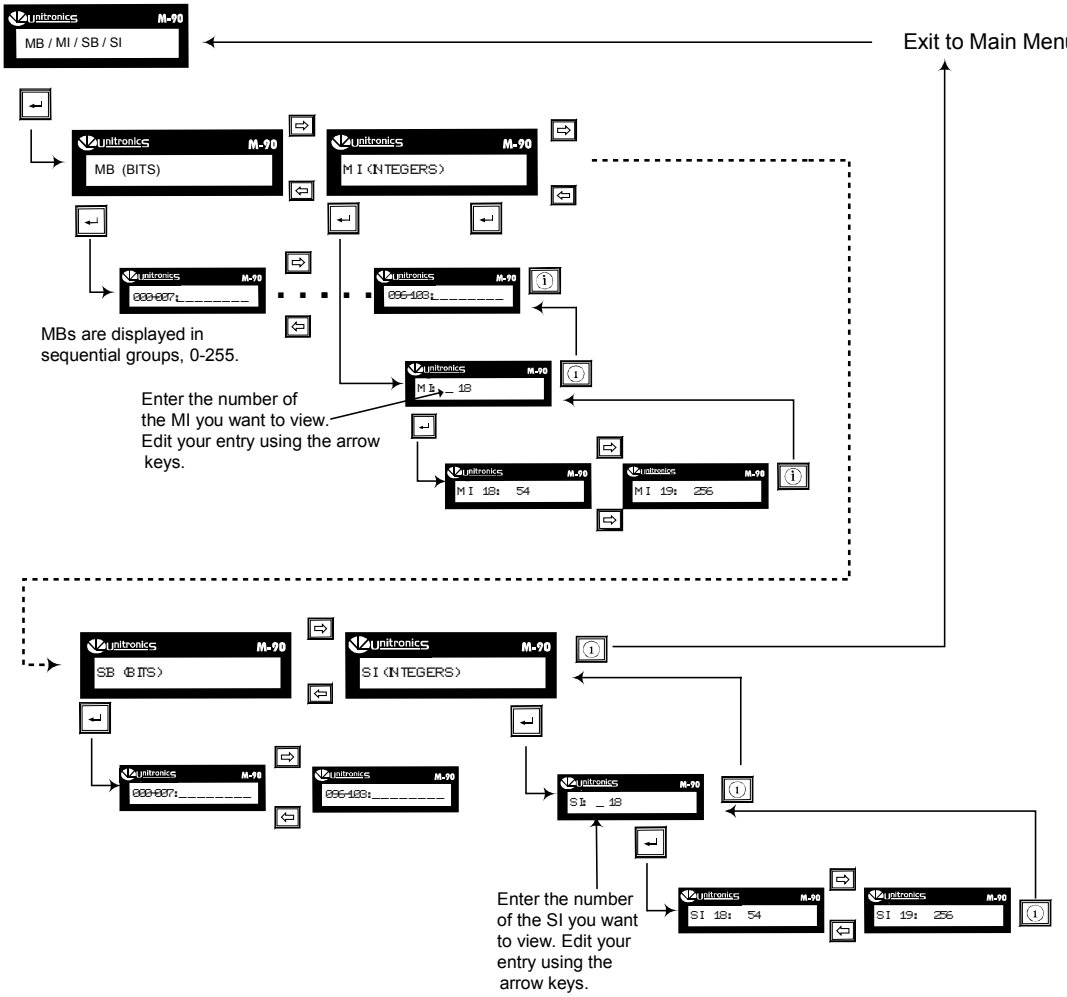


Figure 16. MB, MI and SB, SI

Timers

Selecting the Timers option displays fill-in fields as shown in Figure 17. You can view the current status of any timer by entering its number via the M90's numerical keys and then pressing the <↵> key. Edit your entry by using the left pointing arrow <⇦> key to move the entry field. You can revert to your previous entry by using the right pointing arrow <⇨> key.

Once a timer has been selected, you can scroll between the timers using the arrow keys.

Timers have both a preset value and a current, running value. You toggle between them by using the up/down directional arrows found on keys # 3 and #6.

Each timer also has a bit operand value, on or off. In Figure 17, the lowest right-hand display shows a line at the right of the timer value. The presence of a lighted rectangle on this line indicates that the timer is on. Its absence indicates that the timer is off.

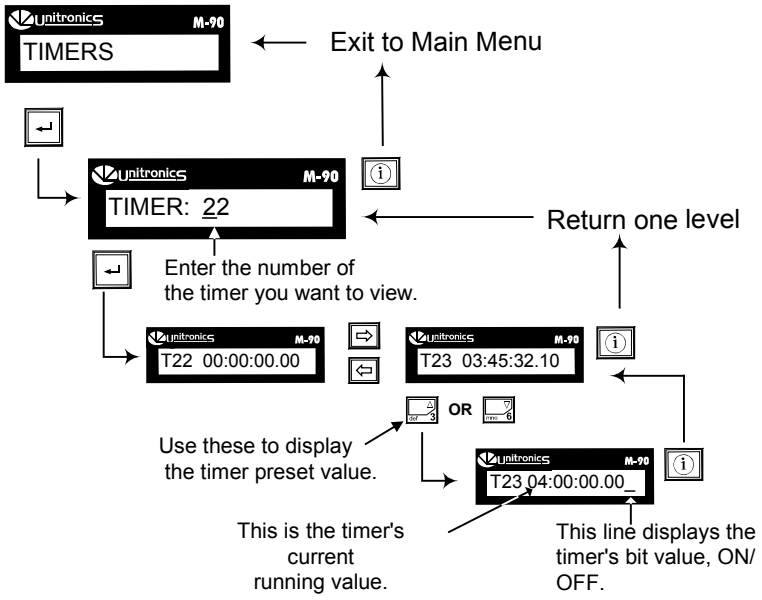


Figure 17. Timers

System

Selecting the system option gives you access to the system menu as shown in Figure 18. Some of the items accessible through this menu can be both viewed and edited. Note that when you are editing a value, you can always exit without saving changes by pressing <**i**>.

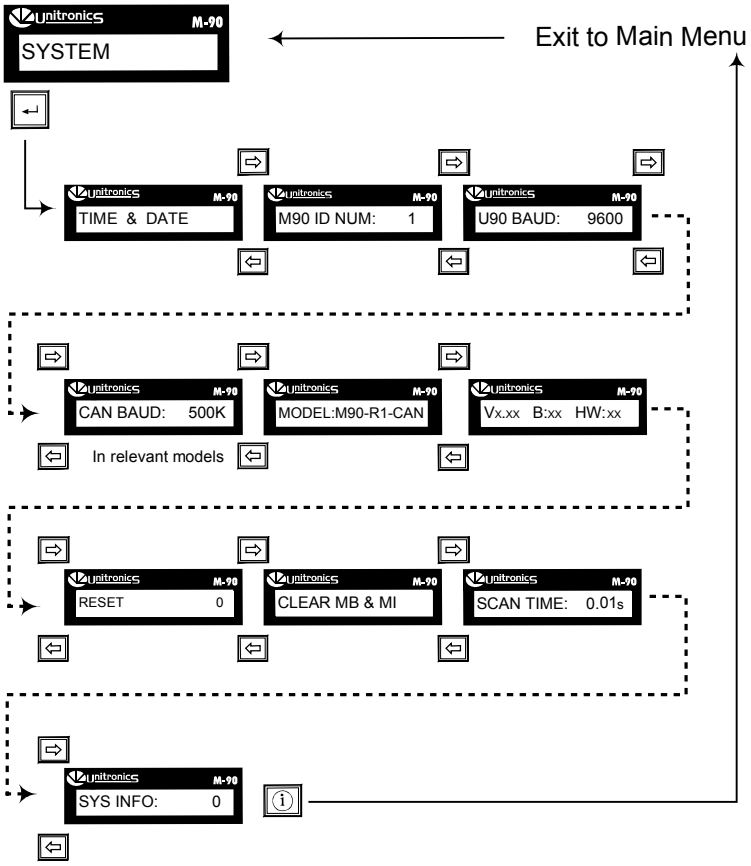


Figure 18. System Menu

Time & Date

Selecting Time & Date enables you to both view and change the current time and date as shown in Figure 19. These values are the real-time clock settings; the actual basis for the M90's time and date controlled functions. Note that when you are editing these settings, your changes are entered immediately into the system when you press the <↵> key. Before you press the <↵ > key, you can exit without saving changes by using the <**i**> key.

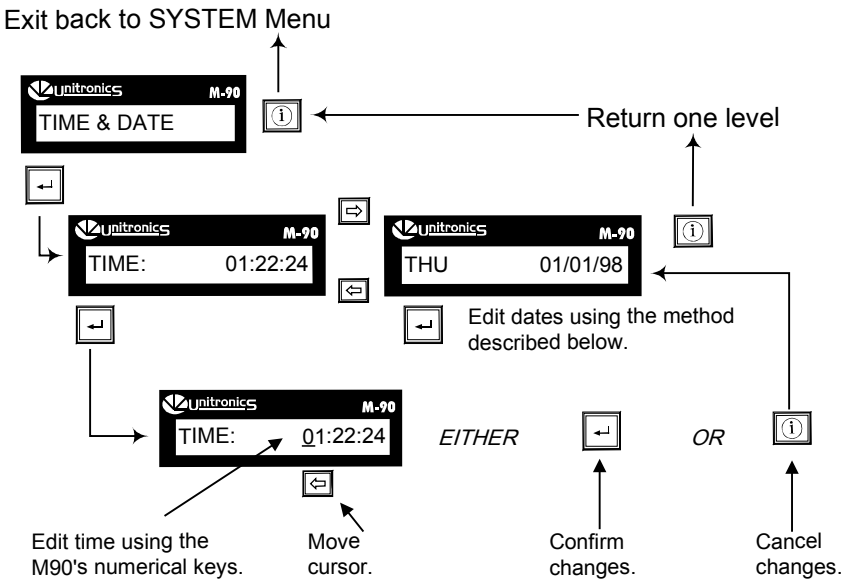


Figure 19. Editing Time and Date

M90 ID Number

Selecting M90 ID Number enables you to view and assign a new ID number to the M90 unit, as shown in Figure 20. This number is used to identify the M90 unit if it is integrated into a communications network.

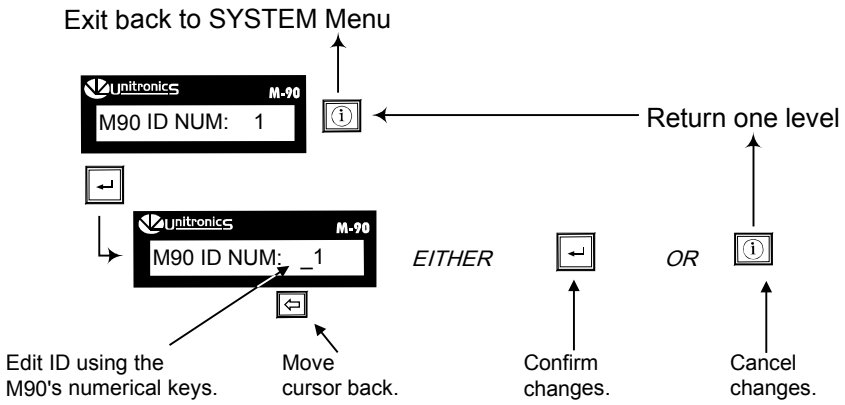


Figure 20. Assigning an ID Number

U90 Baud

Selecting U90 Baud enables you to view and change the current RS232 serial port baud rate, as shown in Figure 21, page 42. You may choose between the preset baud rates; 9600, 19200, 38400 or 57600 bps; by using the up/down directional arrows found on keys #3 and #6.

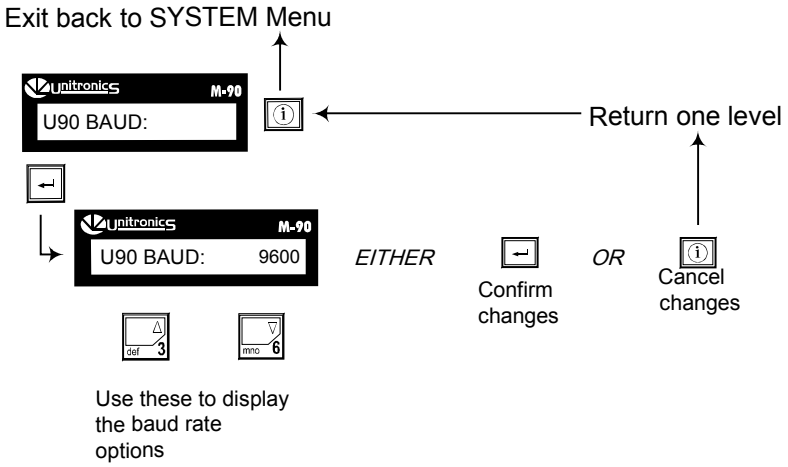


Figure 21. U90 Baud

CAN Baud

Selecting CAN Baud enables you to view and change the current CANbus port baud rate as shown in Figure 22.

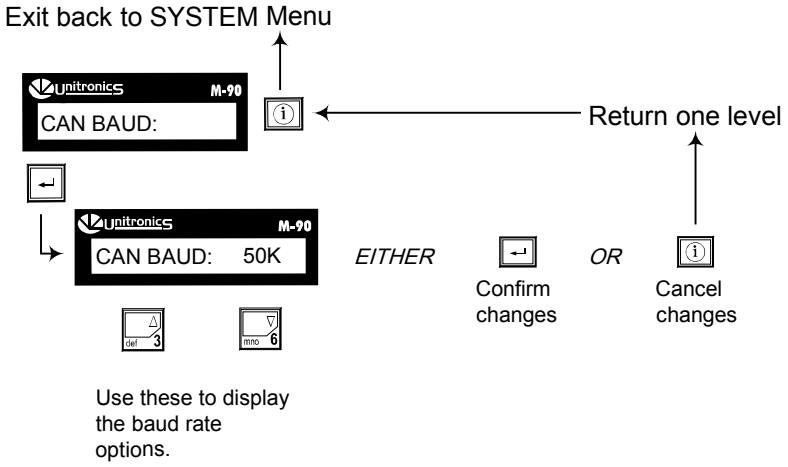


Figure 22. CAN Baud

Model

Selecting Model enables you to view the model name of your M90 unit.

Version Numbers

The Version Numbers are provided for the information of technical support professionals.

Reset

Selecting the Reset option shown in Figure 23 restarts your program; restoring 0 values to all MBs and MIs **except** for those protected by the battery memory backup; MB 0-15, and MI 0-15.

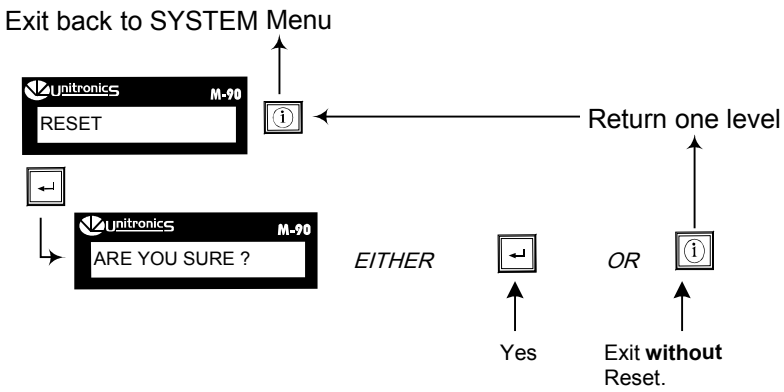


Figure 23. Reset

Clear MB and MI

Selecting Clear MB and MI restarts your program and initializes all values, restoring 0 values to all MBs and MIs. The principles of use shown in Figure 23 apply here as well.

Scan Time

Selecting scan time displays the amount of time required for the entire M90 program to complete a cycle.

Sys Info

System information is for technical support professionals.

Appendix A: System Bits and Integers

The M90 operating system – user program interface includes a configuration of system bits (SB) and system integers (SI). Specific SBs and SIs are linked to fixed parameters and are read-only by the user program. Example: SB 2 – Power-up bit. Those fixed parameter SBs and SIs are listed in the following tables.

Within those fixed parameter SBs and SIs, there are certain SBs and SIs that you may also write into. Example: SI 14 – High Speed Counter Mode. You may write into those listed SBs and SIs marked with an asterisk (*). All SBs and SIs not listed are reserved for use by the system.

Use of any SB or SI reserved for use by the system, and therefore not listed below may severely damage the controller.

Table 9: System Bit Functions

System Bits (SB)	Function
0	Always 0
1	Always 1
2	Power-up bit
3	1 second pulse
4	Divide by zero
5	Output(s) short circuit
6	Keyboard is active
10*	High Speed Counter Reset enable
30	HMI keypad entries completed
31	HMI Var 1 keypad entry completed
32	HMI Var 2 keypad entry completed
33	HMI Var 3 keypad entry completed
34	HMI Var 4 keypad entry completed
40-53	Keypad keys (see the following table)
80*	Activate linear function
200*-215*	M90 network operands
220*-227*	Remote: transmitted bits

System Bits (SB)	Function
228-235	Remote: received bits
236	M90 network/remote communication error
237*	M90 network disable
238	Remote: master is active

Table 10: Keypad System Bit Functions

System Bit (SB)	Keypad Key
SB 40	
SB 41	
SB 42	
SB 43	
SB 44	
SB 45	
SB 46	
SB 47	
SB 48	
SB 49	
SB 50	
SB 51	
SB 52	
SB 53	

Table 11: System Integer Functions.

System Integer	Function
0	Scan Time (msec)
1	10 ms Counter
2*	Current HMI display
4	Divide remainder
6	Current key pressed
10*	High Speed Counter value
14*	High Speed Counter mode
20	Analog in 0 value
21	Analog in 1 value
28*	Analog out 0 value
30	Current second—according to RTC
31	Current time—according to RTC
32	Current date—according to RTC
33	Current year— according to RTC
80*	Linear conversion: x1 value
81*	Linear conversion: x2 value
82*	Linear conversion: y1 value
83*	Linear conversion: y2 value
84*	Linear conversion: X (input) value
85	Linear conversion: Y (result) value
200*-201*	M90 network operands
230*-231*	Remote: transmitted integers
232	Remote: received integer
233*	Remote: control mask
236	M90 network/remote communication error code
237	M90 network: failed unit ID

Appendix B Technical Specifications

The following specifications apply to each M90 model. Model–specific specifications begin with M90-19-B1A, page 53.

Power Supply

Input voltage	24VDC
Permissible range	20.4 to 28.8VDC

Onboard I/Os

Digital Inputs

Operand symbol	I
Input type	pnp (source)
Galvanic isolation	None
Nominal input voltage	24VDC
Input voltage	< 5VDC for Logic '0' >15VDC for Logic '1'
Input current	3mA @ 24VDC
Input impedance	8.4kΩ
Response time:	(except last two inputs)
'0' to '1' '1' to '0'	5 mS 10 mS
Input cable length	Up to 100 meters, unshielded

High Speed Counter / Shaft-Encoder (all models)

Last digital input can be used as either a digital input or as a counter.
Next-to-last digital input can be used as either a digital input or as a counter reset.
Last two digital inputs can also be used as a shaft encoder.

Resolution	16-bit
Input frequency	Last two digital inputs: 5kHz maximum
Minimum pulse width	Last two digital inputs: 80μs

Analog Inputs

Conversion method	Successive approximation
Input impedance	>100kΩ at voltage 250Ω at current
Galvanic isolation	None
Resolution (except 4-20mA)	10-bit (1024 units)
Resolution at 4-20mA	204 to 1024 (820 units)
Conversion time	Synchronized to scan time
Absolute max. rating	± 15V
Full scale error	± 2 LSB
Linearity error	± 2 LSB

Digital Outputs

Operand symbol	O
Relay output models	
Output type	SPST-NO relay; 230VAC / 24VDC
Type of relay	Takamisawa JY-24H-K or NAIS (Matsushita) JQ1AP-24V or OMRON G6B-1114P-24VDC
Isolation	By relay
Output current	5A max. (resistive load) 1A max. (inductive load)
Maximum frequency	10Hz
Contact protection	External Precautions Required
PNP (source) output models	
Output type	P-MOSFET (open drain); 24VDC
Isolation	None
Output current	0.5A max. total current: 3A max.
Maximum frequency	1kHz (resistive load) 0.5Hz (inductive load)
Short circuit protection	Yes

Analog Output

Output range	0-10V
Load impedance	1kΩ minimum
Galvanic isolation	None
Resolution	10 bit (1024 units)
Conversion time	Synchronized to scan time
Overall error	±3%

Battery Back-up

7 year typical battery back-up for real-time clock (RTC), MB 0-15 and MI 0-15

Display

Type	STN, LCD display
Illumination	LED yellow-green backlight
Display size	1 line, 16 characters long
Character size	5 x 7 matrix, 3.07 x 5.73 mm

Keypad

Number of Keys	15
Key type	Sealed membrane

Program

PLC program size (except M90-19-B1A) M90-19-B1A	2048 words 1024 words
Bits (coils) Operand symbol	256 MB

Integers (Registers)	256
Operand symbol	MI
Timers	64
Operand symbol	T
Execution time	12 μsec. for bit operation
HMI displays	80 user-designed displays
HMI variables	50 variables to conditionally modify text, numbers, dates, times & timer values. User can create up to 120 text displays up to 2K.

Communication Ports

RS232

Isolation	No
Voltage limits	±20V

CANbus

Nodes	Up to 64
Baud rate range	10 Kbit/s – 1Mbit/s
Cable length	25m – 1000m

I/O Expansion (except M90-19-B1A)

Expansion port	Up to 64 additional I/Os (digital & analog I/Os, RTD and more)

Dimensions

Size	96 mm x 96 mm x 64 mm (3.8” x 3.8” x 2.5”)

Mounting

DIN-mounted	Snaps onto 35mm DIN rail
Panel-mounted	Cut-out size is 92mm x 92mm in accordance with DIN 43700

Environment

DIN rail mounted	IP20
Panel mounted	IP65
Operational temperature	0 to 50ºC
Storage temperature	-20 to 60ºC

Accessories

- Programming cable
- 15 pin I/O connector plug
- 5 pin CANbus connector plug
- Mounting brackets (x2)
- Rubber seal
- U90 Ladder Software

On the casing of each M90 are representative connector diagrams as shown in the following two figures.

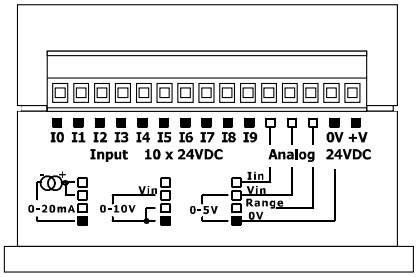


Figure 24. M90-19-B1A Top View – Inputs

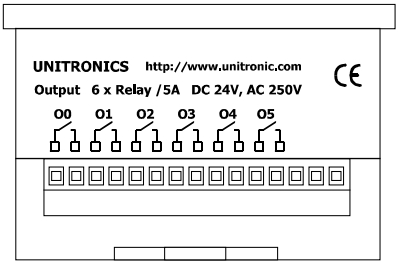
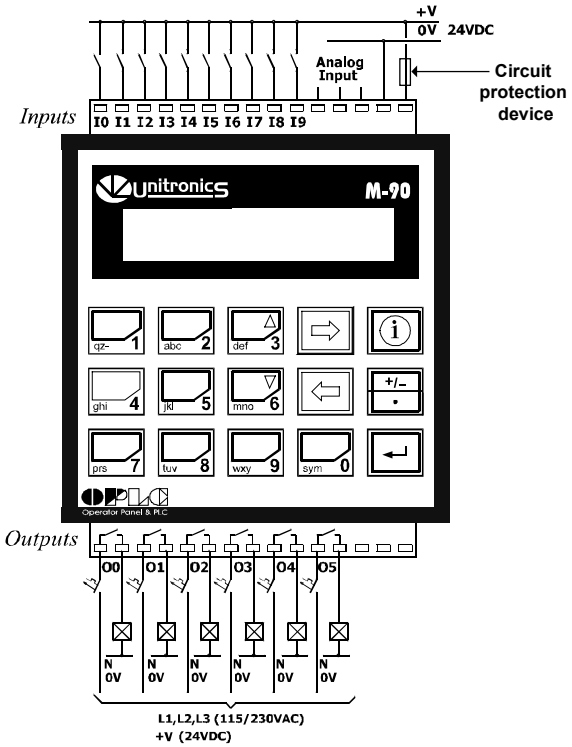


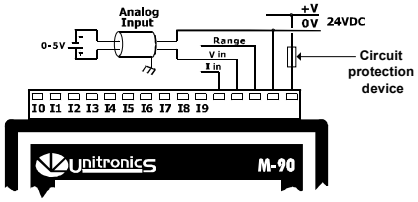
Figure 25. M90-19-B1A Bottom View – Outputs

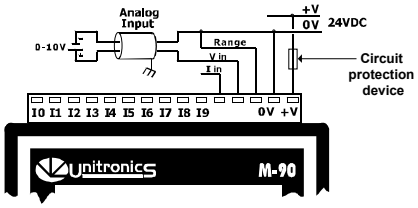
M90-19-B1A

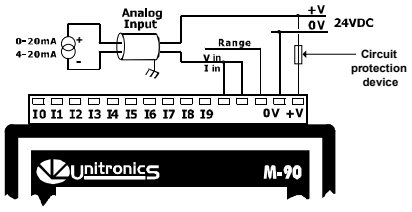
Power Supply	24 VDC
Max. current consumption	140mA @ 24VDC
Typical power consumption	3.2W @ 24VDC
Digital Inputs	10 pnp (source) inputs
Analog Input	One 10 bit multi-range
Analog input range	0-5V; 0-10V; 0-20mA 4-20mA
Digital Outputs	6 relay; 230VAC/24VDC
I/O Expansion Port	No
CANbus	No
Weight	280g (9.8 oz)



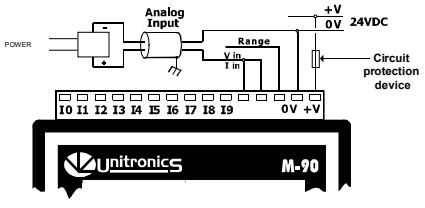
I/O Wiring







Transmitter Current Connection: 2 wire

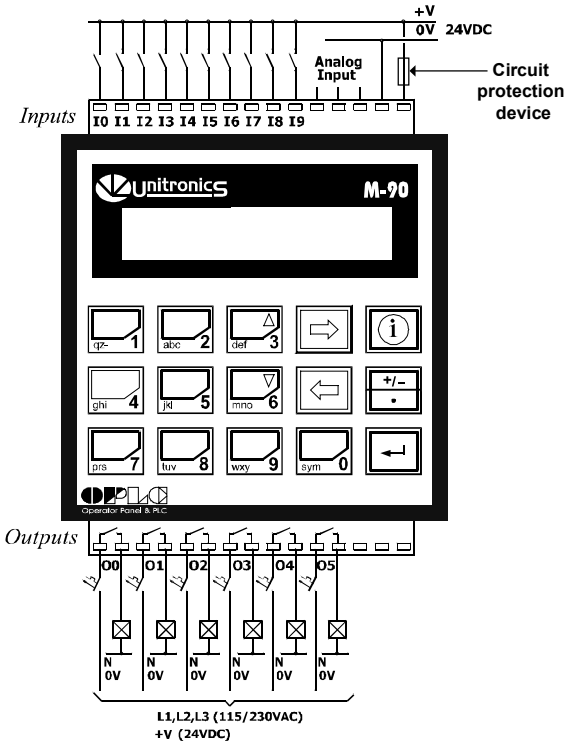


Active Current Connection: 4 wire

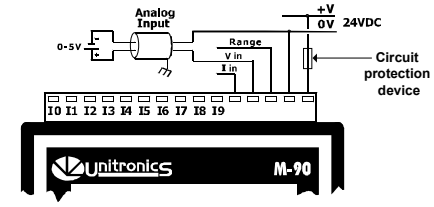
Analog-In Wiring

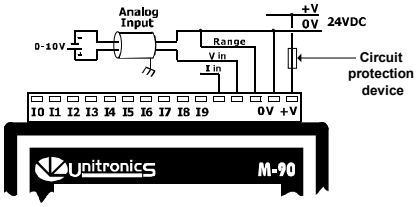
M90-R1

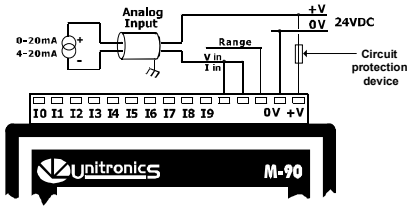
Power Supply	24 VDC
Max. current consumption	140mA @ 24VDC
Typical power consumption	3.2W @ 24VDC
Digital Inputs	10 pnp (source) inputs
Analog Input	One 10 bit multi-range
Analog input range	0-5V; 0-10V; 0-20mA 4-20mA
Digital Outputs	6 relay; 230VAC/24VDC
I/O Expansion Port	Yes
CANbus	No
Weight	280g (9.8 oz)



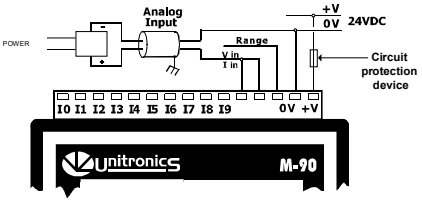
I/O Wiring







Transmitter Current Connection: 2 wire

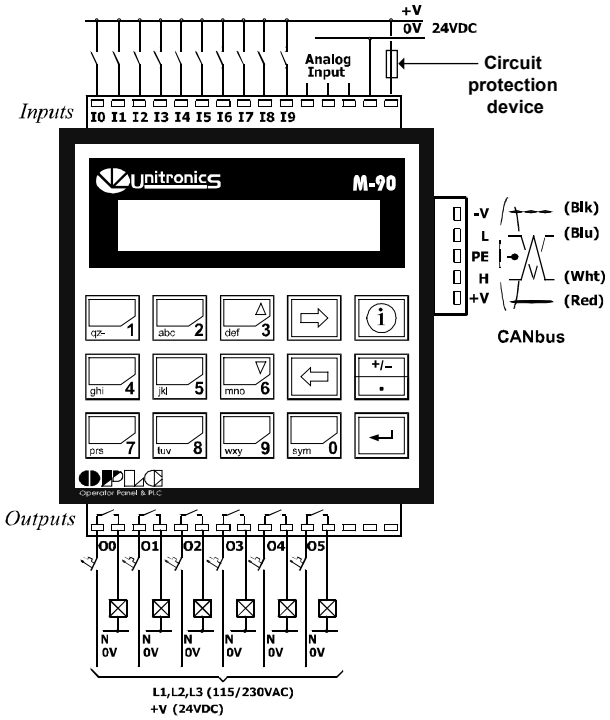


Active Current Connection: 4 wire

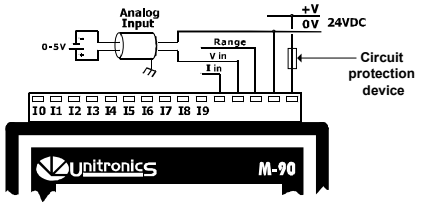
Analog-In Wiring

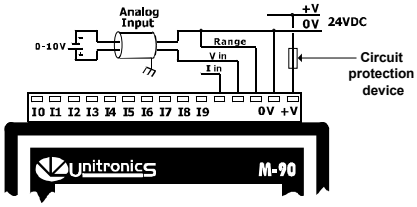
M90-R1-CAN

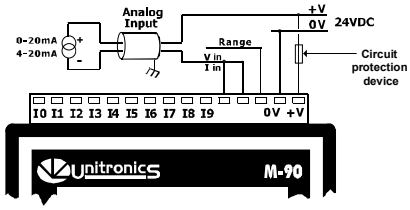
Power Supply	24 VDC
Max. current consumption	140mA @ 24VDC
Typical power consumption	3.2W @ 24VDC
Digital Inputs	10 pnp (source) inputs
Analog Input	One 10 bit multi-range
Analog input range	0-5V; 0-10V; 0-20mA 4-20mA
Digital Outputs	6 relay; 230VAC/24VDC
I/O Expansion Port	Yes
CANbus	Yes
Weight	280g (9.8 oz)



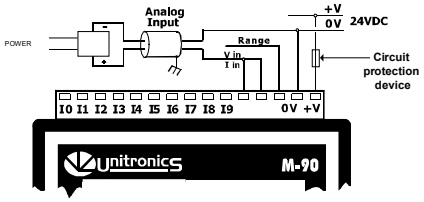
I/O Wiring







Transmitter Current Connection: 2 wire

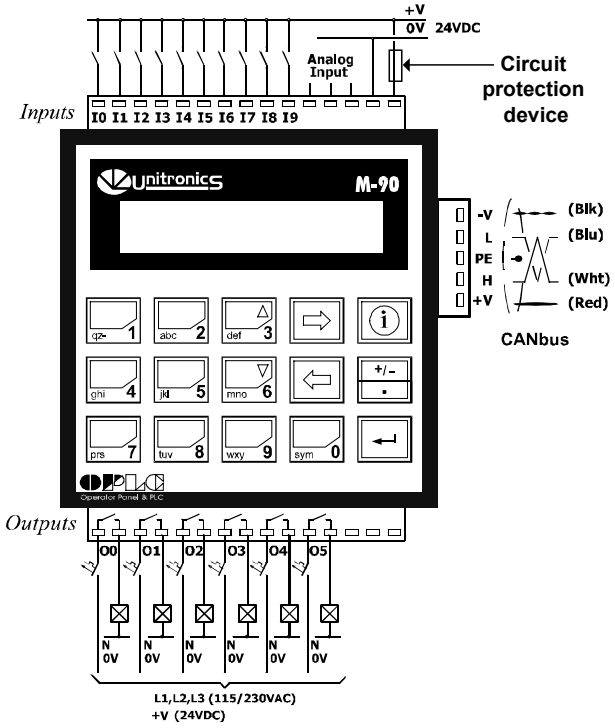


Active Current Connection: 4 wire

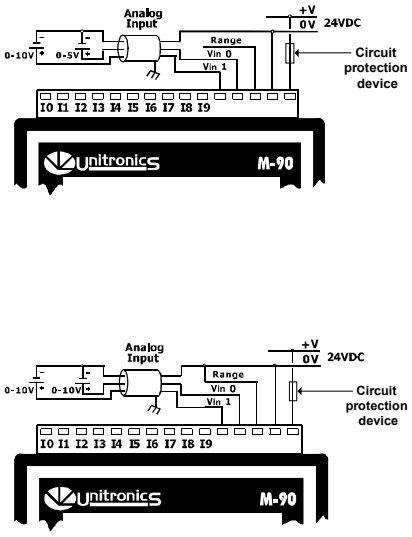
Analog-In Wiring

M90-R2-CAN

Power Supply	24 VDC
Max. current consumption	140mA @ 24VDC
Typical power consumption	3.2W @ 24VDC
Digital Inputs	10 pnp (source) inputs
Analog Inputs	Two 10 bit
Analog input range	0-5V or 0-10V for Vin0 0-10V for Vin1
Digital Outputs	6 relay; 230VAC/24VDC
I/O Expansion Port	Yes
CANbus	Yes
Weight	280g (9.8 oz)



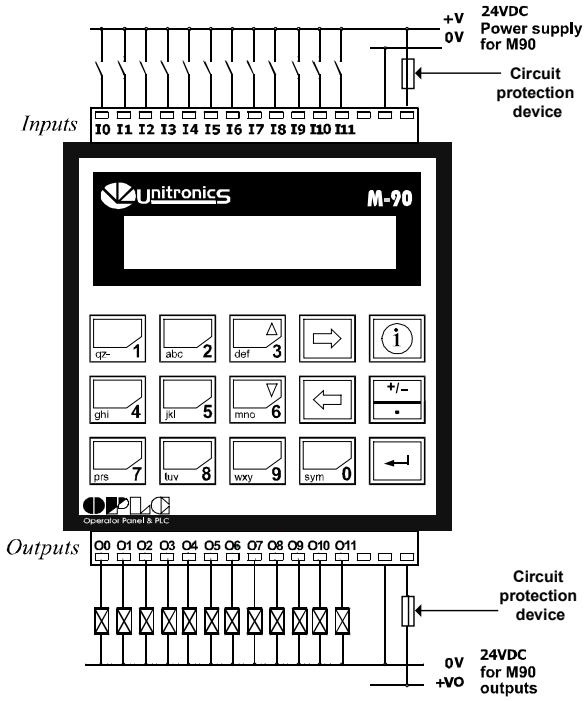
I/O Wiring



Analog-In Wiring

M90-T1

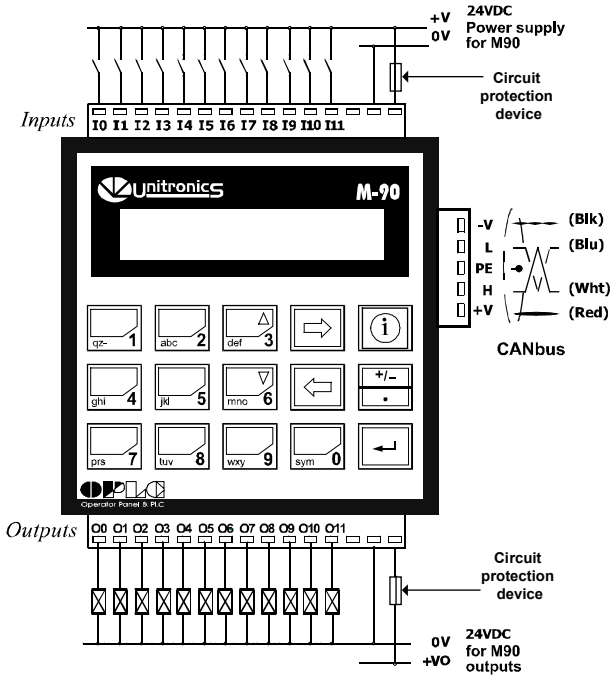
Power Supply	24 VDC
Max. current consumption	90mA @ 24VDC
Typical power consumption	2W @ 24VDC
Digital Inputs	12 pnp (source) inputs
Digital Outputs	12 pnp (source), 24VDC
I/O Expansion Port	Yes
CANbus	No
Weight	260g (9.1 oz)



I/O Wiring

M90-T1-CAN

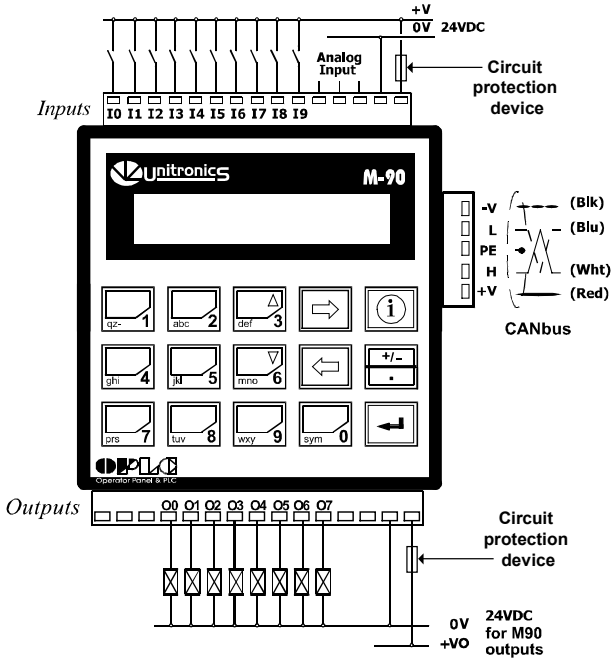
Power Supply	24 VDC
Max. current consumption	90mA @ 24VDC
Typical power consumption	2W @ 24VDC
Digital Inputs	12 pnp (source) inputs
Digital Outputs	12 pnp (source), 24VDC
I/O Expansion Port	Yes
CANbus	Yes
Weight	260g (9.1 oz)



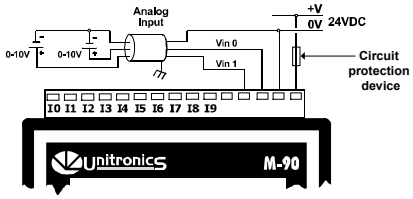
I/O Wiring

M90-TA2-CAN

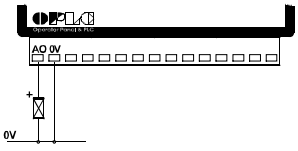
Power Supply	24 VDC
Max. current consumption	140mA @ 24VDC
Typical power consumption	3.2W @ 24VDC
Digital Inputs	10 pnp (source) inputs
Analog Inputs	Two 0-10V inputs
Digital Outputs	8 pnp (source), 24VDC
Analog Output	0-10V output
I/O Expansion Port	Yes
CANbus	Yes
Weight	280g (9.8 oz)



I/O Wiring



Analog-In Wiring



Analog-Out Wiring

Appendix C: New PLC Users

This section is provided to help M90 users with little or no experience in using PLCs.

PLCs, or programmable logic controllers, are electronic control systems based on microprocessors. A PLC performs control functions in accordance with its software program of external automated equipment.

Parts of a PLC

The M90 PLC is composed of 4 parts:

Operating Panel

The operating panel provides what is called the HMI, or Human Machine Interface, between you and the M90. The panel is composed of an LCD screen and a customizable keypad. The LCD screen displays messages to the user. You assign functions to the keys when you write your software program.

Inputs

Inputs receive signals from external devices such as switches, push buttons and variable voltage signals from potentiometers into the M90. The M90 inputs convert the received voltages to signals that the M90 can process.

Outputs

Outputs send signals from the M90 to external devices such as lights or contactor coils. Outputs convert M90 program results into signals that these external devices can process.

CPU

The Central Processing Unit is the brain of the PLC. It executes the control program.

How PLCs Work

Figure 18 shows the PLC cycle. This cycle is called a scan. The scan cycle is performed continuously.

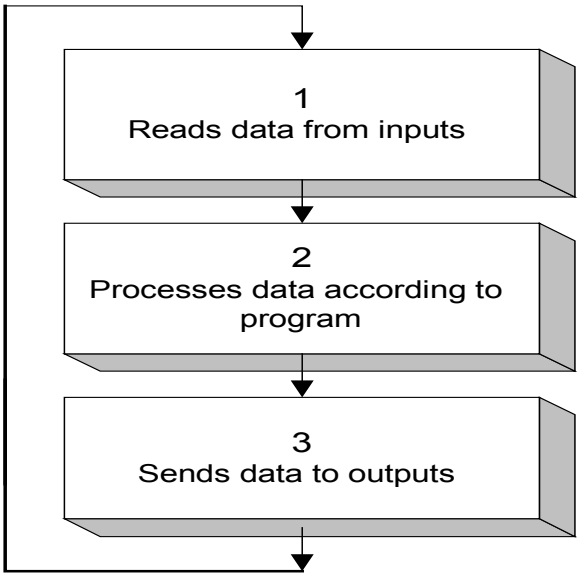


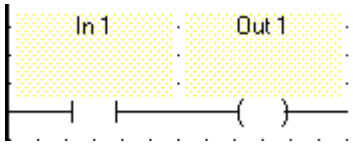
Figure 18. PLC Scan

First, the input data is read at the beginning of each scan. The data has two sources: the M90's physical inputs, and data that are entered via the M90's keypad.

Next, the program is executed. The user creates the M90 control program. The program is composed of instructions that are written in the Ladder language, and is written using the M90's proprietary software. All program instructions are executed in each scan cycle.

Last, the outputs are updated with the new data.

The sample program below causes an alarm, connected to output #1, to actuate whenever a gate, connected to input #1, opens.



The command means that the status of the gate is checked at the beginning of each scan. When the gate is open, the value in the operand is 1 or on. When the gate is closed, the value in the operand is 0 or off.

The command controls the alarm. When the value in contact 1 is found to be 1, the alarm is switched on. When the value is 0, the alarm switches off.

Table of Figures

FIGURE 1.	THE M90	11
FIGURE 2 .	M90 STANDARD KIT	15
FIGURE 3.	PANEL MOUNTING THE M90	17
FIGURE 4.	M90 PANEL MOUNTED	18
FIGURE 5.	SNAPPING THE M90 TO THE DIN RAIL	18
FIGURE 6.	PROPER M90 DIN RAIL POSITION	19
FIGURE 7.	INCREASE THE CONTACT LIFE SPAN	24
FIGURE 8.	M90 SIDE VIEW – RS232 PORT	25
FIGURE 9.	M90 – PC COMMUNICATION	27
FIGURE 10.	M90 SIDE VIEW – CANBUS & EXPANSION PORT	28
FIGURE 11.	WIRING DIAGRAM	29
FIGURE 12.	CANBUS CONNECTOR	30
FIGURE 13.	MAIN MENU	33
FIGURE 14.	NPUTS AND OUTPUTS	34
FIGURE 15.	ANALOG INPUTS AND COUNTER VALUES	35
FIGURE 16.	MB, MI AND SB, SI	37
FIGURE 17.	TIMERS	38
FIGURE 18.	SYSTEM MENU	39
FIGURE 19.	EDITING TIME AND DATE	40
FIGURE 20.	ASSIGNING AN ID NUMBER	41
FIGURE 21.	U90 BAUD	42
FIGURE 22.	CAN BAUD	42
FIGURE 23.	RESET	43
FIGURE 24.	M90-19-B1A TOP VIEW – INPUTS	52
FIGURE 25.	M90-19-B1A BOTTOM VIEW – OUTPUTS	52

Index

A

About this Manual, 7
Analog, 35
Analog input, 23
Analog/counter, 35
Appendix A
  System bits and integers, 45
Appendix B
  Technical Specifications, 49

B

Baud, 41
Bits and integers, 45
Bottom connector, 21

C

CANbus, 28
  wiring specifications, 29
CANbus & Expansion port, 28
Cautions
  safety, 8
Clear MB and MI, 43
Communications, 12, 25
Communications connections, 25
Connecting to a PC, 26
Connectors, 21
  bottom, 21
  top, 21
Contacts
  life span, 24
  maintenance, 24
Counter, 35

D

Date, 40
Digital inputs, 23
DIN rail
  mounting, 15
Downloading your program, 26

E

Encoder, 23

G

Getting started, 61
Guidelines
  safety, 8

H

Hardware reset, 43
High-speed counter/shaft-encoder, 23
HMI
  general functions, 13
  uses, 13
HMI (Human Machine Interface), 11
HMI Program, 13
How PLCs work, 62

I

I/Os, 21
ID number, 41
Information
  categories, 31
Information Mode, 31
  analog, 35
  analog/counter, 35
  baud, 41
  clear MB and MI, 43
  counter, 35
  date, 40
  hardware reset, 43
  ID number, 41
  inputs, 34
  inputs/outputs, 34
  M90 ID number, 41
  main menu, 32
  MB, 36
  memory bits, 36
  MI, 36
  MI/MI/SB/SI, 36
  model, 43
  outputs, 34
  SB, 36
  scan time, 44
  sequential groups, 36
  SI, 36
  sys info, 44
  system, 39
  time & date, 40

timers, 38
U90 baud, 41
using, 32
version numbers, 43
Input
analog, 23
digital, 23
Inputs, 34
Inputs/outputs, 34
Introduction, 11
Introduction to PLC, 61

K

Keypad system bit functions, 46

M

M90
connecting to PC, 26
diagram, 11
external view, 11
ID number, 41
introduction, 11
mounting, 15
operating panel, 12
software, 13
technical description, 12
technical specifications, 12
M90 web site, 11
M90-R1
wiring, 54
M90-R1-CAN
wiring, 55
M90-R2-CAN
wiring, 56
M90-T1
wiring, 57
M90-T1-CAN
wiring, 58
M90-TA2-CAN
wiring, *59*
Main menu, 32
Manual
about, 7
MB, 36
Memory bits, 36
MI, 36
Model, 43
Mounting the M90, 15

N

New PLC Users, 61

O

Operating panel, 11, 12
OPLC
definition, 11
Output, 24
Outputs, 34

P

Parts of PLC, 61
PC connection, 26
PLC, 61
parts, 61
PLC application
general, 13
PLC program properties, 13
Power supply, 22
Precautions
safety, 8
Preface, 7
Program
downloading, 26
properties, 13
Programming, 13
general, 13

S

Safety guidelines, 8
SB, 36
Scan time, 44
Sequential groups, 36
Shaft encoder, 23
SI, 36
Software, 13
Specifications, 12
wiring, 22
Sys info, 44
System, 39
baud, 41
clear MB and MI, 43
date, 40
hardware reset, 43
ID, 41

M90 ID number, 41
model, 43
scan time, 44
sys info, 44
time & date, 40
U90 baud, 41
version numbers, 43
System bits, 45
System bits and integers, 45
System integers, 45
System Integers, 47
user-available, 47
System interger functions, 47
Sytem bit functions, 45

T

Technical description, 12
Technical specifications
Appendix B, 49
Time & date, 40
Timers, 38
Top connector, 21

U

U90 baud, 41
User safety, 8
User-available System Integers, 47
Using a PLC, 61

V

Version numbers, 43

W

Warnings, 9
Wiring
M90-19-B1A, 53
M90-R1, 54
M90-R1-CAN, 55
M90-R2-CAN, 56
M90-T1, 57
M90-T1-CAN, 58
M90-TA2-CAN, 59
Wiring considerations, 21
Wiring specifications, 22
Wiring Specifications
CANbus, 29