

# HE200 PLC Ladder Editor

## User's Manual

May 14, 1997

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## INTRODUCTION

The HE200 PLC Ladder Editor Programming Software (HEPLC.EXE) allows offline creating, editing, saving and loading of ladder logic programs for Horner APG, LLC. HE200 PLCs. When connected to an HE200 PLC's programming port, or to an HE200 Network Gateway, HEPLC.EXE can download, upload, run and monitor ladder programs.

## HARDWARE REQUIREMENTS

- IBM AT, 386SX or better recommended
- 640K memory with at least 512K available
- EGA graphics with minimum 16 colors and 80 by 25 text support
- MS-DOS Version 3.3 or greater
- Hard disk drive
- Microsoft compatible mouse highly recommended

## Hardware requirements needed to program an HE200 PLC

- 1 RS232 cable
- 1 free serial port (COM1 or COM2)
- 1 RS485 to RS232 converter (HE693SNP232), if connecting to a PLC with an RS485 programming port

## HE200 PLC OVERVIEW

Each HE200 PLC node incorporates the following features:

- 128 rungs of ladder logic
- 8 physical inputs contacts (I1 to I8)
- 8 physical output coils (Q1 to Q8)
- 48 internal output coils (T1 to T48)
- 16 global input contacts (IG1 to IG16)
- 16 global output coils (QG1 to QG16)
- 16 16-bit timers with 10 or 100ms resolution (TMR1 to TMR16)
- Programmable physical input filtering
- Physical output event statistics
- Power-on-self-test diagnostics data
- 1 RS485 programming port
- 1 HE200 Network port

To connect the PC to a PLC; hook up an RS232 cable from the PC's serial port (either COM1 or COM2) to the 9-pin male D connector on the RS232 to RS485 converter. Then plug the converter into the RS485 15-pin female D connector on the HE200 PLC.

Alternatively, the PC can be connected to an HE200CGM200 RS232 to HE200 Network Gateway, by hooking an RS232 cable from the PC's serial port to the 9-pin female D connector on the Gateway.

LADDER LOGIC FUNCTIONS

*** Functions---F1...F10---										
HELP	N.O.	N.C.	Start	Close	Motor	Intern	Short	Open	Global	^
HELP	Switch	Switch	Branch	Branch	Output	Output	Input	Input	Output	v
HELP	-]	[-	-)\[-	+-	-+	-()-	-{-}	o--o	-o o-	-{g}-

*** Functions---F1...F10---										
HELP	On	Off	Up							^
HELP	Timer	Timer	Count							v
HELP	[+TMR]	[-TMR]	[+CTR]							

- Normally Open Switch: Ixx Identified I1 to I8, Q1 to Q8,  
-] [- T1 to T48, S1 to S16, IG1 to  
IG16 or QG1 to QG16.  
Places a normally open switch.
- Normally Closed Switch: Ixx Identified I1 to I8, Q1 to Q8,  
-)\[- T1 to T48, S1 to S16, IG1 to  
IG16 or QG1 to QG16.  
Places a normally closed switch.
- Start Branch: +- This function has no identifier.  
| Starts a vertical branch in the ladder logic.  
+
- Close Branch: +- This function has no identifier.  
| Finishes the last branch started by connecting the lower  
+ horizontal branch to the correct upper horizontal branch.
- Physical Output: Qx Identified Q1 thru Q8.  
-()-

Some HE200 PLCs are specialized for motor control as follows:  
When an odd output (Q1,Q3,Q5,Q7) is ON, the connected motor runs; when OFF, the motor stops with dynamic braking. The even outputs (Q2,Q4,Q6,Q8) determine motor direction.

- Internal Output: Txx Identified T1 thru T48.  
-{-} These outputs can be turned ON or OFF by logic, and are typically used to store intermediate or temporary logic

states.

LADDER LOGIC FUNCTIONS - (cont'd)

- Short Circuit Switch: Ixx  
+ - ] [ - + This function is not identified  
| | specifically, but adds informa-  
+ - - - - + tion to the selected function.

This operation forces the selected input object (I, Q, T, IG, QG, S) to always be in an ON state, and is useful for debugging.

- Open Circuit Switch: Ixx  
+ - ] [ - + This function is not identified  
| | specifically, but adds informa-  
+ o o + tion to the selected function.

This operation forces the selected input object (I, Q, T, IG, QG, S) to always be in an OFF state, and is useful for debugging.

- Global Input: IGxx  
- ] g [ - Identified IG1 through IG16.

This function is entered and acts like a normally open or closed switch, but receives its ON/OFF state from another PLC node, via the HE200 Network. Each Global Input is assigned to another PLC's Global Output.

These assignments are user-defined, in a table accessed by the NET ASSIGNMENTS option under CONFIG in the MAIN MENU. When selected, the NET ASSIGNMENTS command displays the following:

```
+-----Network Assignments-----+
|
| <+> or <-> offset uses relative node addressing
|
|      Default Target PLC:      xxx
|
| INPUT  NODE      QG          INPUT  NODE      QG
| IG1:   YYY      ZZ          IG9:   xxx      ZZ
| IG2:   YYY      ZZ          IG10:  YYY      ZZ
| .
| .
| IG8:   YYY      ZZ          IG16:  YYY      ZZ
|
|                               Press <ESC> to continue
|
+-----+
```

Where: xxx Current ladder program's default Target PLC Network ID for downloading purposes

- yyy            The scanner uses node 64 as a default. The global outputs can change, but 64 is the preferred node default.
  
- zz            QG number from 1 to 16

LADDER LOGIC FUNCTIONS - (cont'd)

- Global Input Example:

Entry in Node 20's Network Assignment Table:

	INPUT	NODE	QG
	IG1:	10	12

Rung in Node 20's Ladder logic:

```

10-12 SW_01                                     MOT_1
--]g[---] [-----]------( )-
IG01 I03                                     Q01

```

This rung of ladder code will turn Node 20's Motor #1 ON, if Node 20's I3 is ON and Node 10's QG12 is ON.

- Global Output:                  QGxx  
                              - {g}-        Identified QG01 through QG16.

This function behaves like an internal output, but is available to other HE200 PLCs on the HE200 Network.

- ON Delay Timer:     S01+-----+        Identified TMR1 through TMR16.  
                              ---|enable|        Two TMR/CNTs cannot share the  
                                  |xxxx.x|        same identification number. This  
                                  -|reset |        function has Enable and Reset  
                                  |ON dly|        inputs, a logical Output, and a  
                                  +-----+        time Delay (Max 3200.9 seconds).

- a. If Reset is ON, the timer's Output is always OFF.
- b. If Reset is OFF, the timer's Output follows the timer's Enable, with a programmable Delay in the OFF to ON edge.

- OFF Delay Timer:     S02+-----+        Identified TMR1 through TMR16.  
                              ---|enable|        Two TMR/CNTs cannot share the  
                                  |xxxx.x|        same identification number. This  
                                  -|reset |        function has Enable and Reset  
                                  |OFFdly|        inputs, a logical Output, and a  
                                  +-----+        time Delay (Max 3200.9 seconds).

- a. If Reset is ON, the timer's Output is always ON.
- b. If Reset is OFF, the timer's Output follows the timer's

Enable, with a programmable Delay in the ON to OFF edge.

#### LADDER LOGIC FUNCTIONS - (cont'd)

- Up Counter:           S03+-----+   Identified CNT1 through CNT16.  
                          ---|clk    |   Two TMR/CNTs cannot share the  
                              |xxxxx |   same identification number. This  
                              -|reset |   function has Clock and Reset  
                              |UP CNT|   inputs, a logical Output, and a  
                              +-----+   Counts value (Max 32767 counts).
- a. If Reset is ON, the counter's Output is always OFF.
- b. If Reset is OFF, the counter increments each time Clock goes from OFF to ON. When the Counts value is reached, the counter's Output goes ON.

Note: The Sxx coil attached to timer or counter blocks represents the internal state of the block and can be used as a referenced as a normally open or closed contact for control.

#### STARTING THE HEPLC EDITOR

The HE200 PLC Ladder Editor is contained in the HEPLC.EXE DOS executable file. The software is easy to learn, and can be operated by using just the keyboard, or by a combination of the keyboard and a Microsoft-compatible mouse.

HEPLC may be started by typing the following at the DOS command prompt:

```
HEPLC           Uses PC's COM1 port to communicate with PLCs,  
                  auto-detects mouse, displays progress messages and  
                  auto-verifies during downloads and beeps on error
```

HEPLC may also be started using one or more optional command line switches, as follows:

```
HEPLC 2           Uses PC's COM2 port to communicate with the PLC.  
HEPLC k           Forces keyboard only mode.  
HEPLC f           Speeds downloading by not pausing for messages.  
HEPLC v           Turns off auto-verify after downloads  
HEPLC s           Turns off error sounds
```

HEPLC file.plc Loads the file 'file.plc' at startup  
Switches must be in lower case and may be combined, for example:

```
HEPLC 2 k        Uses PC's COM2 port to communicate with the PLC  
                  and forces keyboard only mode.
```

NOTE: When using a serial mouse, it must be on a different COM port than the one used to communicate with PLCs. If the mouse is connected to COM1, use "HEPLC 2". If the mouse is connected to COM2, use "HEPLC". To totally disable the mouse, use the "k" switch.

## MENUS

There are 2 menus, the OBJECT MODIFICATION MENU and the MAIN MENU, that are used for editing and debugging ladder programs.

When the Object Modification Menu is invoked, a purple arrow appears. The user should make sure this arrow is pointing to the correct object, before proceeding with any modification.

The MAIN MENU can be invoked by pressing the <Alt> key or the right mouse button, and the OBJECT MODIFICATION MENU can be invoked by placing the cursor on the object to be modified and pressing <Enter> or the left mouse button.

Both of these menus are described in detail below.

### OBJECT MODIFICATION MENU

There are 4 commands in the Object Modification Menu: VIEW, MODIFY, INSERT, and DELETE.

VIEW -	DISPLAYS	EXAMPLES
	Type of Function	I, Q, T, S, IG, QG
	Name of Function	Lim_SW_1
	Number of Function	1 to 48
	Node	1 to 253 (IG only)
	QG	1 to 16 (IG only)
	Status of Function	Normal, Shorted, Opened
	State of Function	ON or OFF

If the PC gets disconnected from the HE200 PLC, then the STATE of the function will turn to ???, and an error will be displayed until the connection is re-established.

MODIFY - Display and modify properties of an existing object.

INSERT - Insert an object to the left of selected object.

DELETE - Delete a component, and automatically re-route all the branches correctly.

### MAIN MENU

There are 5 commands under the Main Menu: FILE, EDIT, MODE, CONFIG, and TOOLS. Each of these commands brings up a sub-menu as



described on the following pages.

MAIN MENU - (cont'd)

**FILE Sub-Menu**

- NEW - Starts a new ladder program.
- SAVE - Saves complete or incomplete ladder program to the current working directory.
- LOAD - Loads a previously saved complete or incomplete ladder program from the current working directory.
- LOAD NAMES - Loads just the user I/O Names from a saved ladder program file. This allows adding names to an uploaded program or allows a standard set of names to be "copied" from a saved program.
- DOWNLOAD - Downloads PC's current ladder program to the Target PLC unless one or more rungs are incomplete. The PLC is put in IDLE mode while downloading, and is returned to the previous mode after a successful download. If the download is not successful, the PLC is left in IDLE mode.
- UPLOAD - Uploads ladder program from the Target PLC to the PC for editing or monitoring. Uploaded programs contain all information except the user I/O Names. The I/O names can be loaded separately from a saved file, via the LOAD NAMES option.
- VERIFY - Compares PC's current ladder program to the Target PLC's ladder program. If a verify error is detected, one of three error messages will be displayed:
  - "Verify Failed in Network Info Block" - The PLC and the PC differ in network assignments.
  - "Verify Failed in Timer Info Block" - The PLC and the PC differ in timer settings.
  - "Verify Failed in Code Block" - The PLC and the PC differ in ladder logic.
- PRINT - Prints selected portions of the currently loaded ladder program to the printer connected to the lpt port defined by the PRINTER PORT field. Print options include the range of ladder rungs to print, network assignments, I/O names and timer information.

In addition, either ASCII text or ASCII graphics printing mode may be selected. ASCII graphics mode uses IBM line-drawing graphics characters, supported by many printers, to produce a higher

quality printout.

MAIN MENU - (cont'd)

**FILE Sub-Menu - (cont'd)**

- PRINT (cont'd) - Also, if the editor's Display Filter tool is active when print is selected, the printout will only contain the viewable, filtered rungs. The top of these printouts will label it as a filtered ladder program, and will show the output used to filter the ladder code. See the Display Filter option under the TOOLS Sub-Menu for more details.
- RUN SCRIPT - This feature allows automated ladder program downloading to an entire network of PLCs.

To use this feature, an ASCII script file, named PLC\_LIST.TXT, must be created using an ASCII text editor such as MS-DOS EDIT (type EDIT PLC\_LIST.TXT at the DOS prompt).

The PLC\_LIST.TXT file should contain one line of ASCII text for each download to be performed. Each line starts with a PLC Network ID (1 to 253), followed by spaces or tabs, and then the name of the file (up to 8 characters with no extension; .PLC is assumed) containing the ladder program to be downloaded to the specified PLC, and finally a carriage return.

The following is an example of the required format:

```
1   MERGE
2   DIVERT
3   FILE_3
47  FILE_47
34  MERGE
32  FILE_32
```

After the PLC\_LIST.TXT file has been created, a script download can be started, by selecting RUN SCRIPT from the FILE menu.

When script processing is complete, an ASCII text file named PLC\_LIST.LOG is created or appended, which contains the results of the script download. This file can be viewed with a text editor or by typing TYPE PLC\_LIST.LOG | MORE at the DOS prompt. If a file could not be loaded or downloaded, an error message will be placed in the log file. When a file is successfully loaded and downloaded, the time and date of the download will be listed in the log file.

- QUIT - Return to DOS.

MAIN MENU - (cont'd)

**EDIT Sub-Menu**

- UNDO - Undo last inserted/deleted object.
- DELETE RUNG (CTRL-X) - Deletes the current rung and moves ladder rungs up one rung. Deleted rung is stored in a buffer for later pasting into other places.
- INSERT RUNG (CTRL-I) - Inserts a blank rung before the current rung, if ladder program is not full. Moves current and later rungs down one rung.
- PASTE RUNG (CTRL-V) - Places a previously deleted or copied rung from the paste buffer onto an unused rung. A rung may be pasted multiple times.
- COPY RUNG (CTRL-C) - Copies the current rung into the paste buffer without modifying the current rung.
- FIND (CTRL-F) - Finds the first occurrence in the ladder program, of a user selectable object.  
  
After selecting FIND, enter the TYPE and NUMBER of the object to search for. To search for timers, enter "S" for TYPE followed by the timer NUMBER and limit to "OUTPUTS ONLY".  
  
By default, FIND will search for objects used as either inputs or outputs. Pressing <SPACE> will limit the search to outputs only. Pressing <SPACE> again will toggle back to inputs or outputs. If an object can't be found, an error message is displayed.
- FIND NEXT (CTRL-N) - Finds the next occurrence of the object previously selected via the FIND option.

**MODE Sub-Menu**

- IDLE - Ladder logic stops running. Temporarily enters this mode when downloading ladder logic programs from the PC to the PLC. Outputs Q1 through Q8 may be "forced" ON or OFF in this mode.
- MONITOR - Ladder logic runs with power flow and timer monitoring enabled. Red = object in the OFF state and Green = object in the ON state. When in the Monitor mode, the pull down menu for MODE contains a check next to Monitor.
- RUN - Ladder logic runs with power flow monitoring disabled.

MAIN MENU - (cont'd)

**CONFIG Sub-Menu**

- PC PORT - Choose the PC serial port (COM1 or COM2) or PC internal gateway (HE200CGM302) channel for communication with PLCs. This choice overrides any command line option concerning the PC port.
- PLC INFO - Displays the Target PLC's Model Name, Ladder Execution Engine Firmware Revision, Mode, PLC Scan Rate, I/O Conditioning Settings, Ladder Memory Used, and Self Test Result.
- I/O NAMES - Displays UNUSED I/O as Gray. Displays USED I/O as Yellow if ON, or Red if OFF. If Target PLC becomes disconnected, the display remains unchanged, except that an error is displayed until the connection is re-established.

Internal coils (T1 - T48) will be denoted with an upper case "T" if the coil is used as an output, and a lower case "t" if it is only used as an input, or as a timer reset.

<PAGE DOWN> shows the usage, state, count and set point of all counters and timers. <PAGE UP> returns to the original I/O Names screen.

- NET ASSIGNMENTS - Used to view/change PLC node and QG assigned to each Global Input. Also used to view/change Target PLC assigned to current ladder program.

**TOOLS Sub-Menu**

- SET LOCAL PLC - Views/changes Local PLC's Network ID. The Local PLC is the one whose RS232 or RS485 programming port is connected to the PC's COM port. Note that some HE200 PLC models have rotary switches which set their Network IDs and therefore don't support the SET LOCAL PLC option.
- SET TARGET PLC - Views/changes Network ID of Target PLC. The Target PLC is the one which may be communicated with by HEPLC, for ladder program downloading, monitoring and executing. The Target PLC may be the Local PLC, or another PLC accessed via the HE200 Network through the Local PLC or through an HE200 Network gateway.

MAIN MENU - (cont'd)

**TOOLS Sub-Menu - (cont'd)**

SEARCH NETWORK - Scans HE200 Network and displays current state of all connected PLC nodes. Scanning a network with few connected nodes may take as long as two minutes. Pressing the ESC key will halt the scanning. Pressing the S key after a scan will rescan all nodes. The display shows nodes 1 to 253 with a status to the right as follows:

xxx Represents a node number from 1 to 253

xxx-? Node xxx doesn't exist or is not communicating.

xxx-I Node xxx is in IDLE mode and is communicating.

xxx-M Node xxx is in MONITOR mode and is communicating.

xxx-R Node xxx is in RUN mode and is communicating.

xxx-E Node xxx failed its power-on-self-test.

FORCE OUTPUTS - Use this to manually force Target PLC's outputs (Q1 to Q8) ON or OFF (IDLE MODE only).

I/O CONDITIONING - HE200 PLC engine firmware version 1.90 and later, supports two adjustable parameters to help when the PLC is used in an environment with excessive electrical noise.

The first setting, "Input filtering", sets the number of PLC scans a physical input (I1 to I8) must remain stable before a state change is accepted. A setting of 0 turns this feature off, which is the default.

The second setting, "Max. network update", sets the maximum time a PLC will wait before sending its global data (QG1 to QG16), and is in multiples of 100 mS. A setting of 0 turns this feature off, which is the default.

MAIN MENU - (cont'd)

**TOOLS Sub-Menu - (cont'd)**

DISPLAY FILTER - Powerful debugging option which allows a programmer to view or print only those rungs that can affect a chosen output.

For example, if Q1 is not behaving as expected, the programmer could enter Q1 as the output to use to filter the display. Now when viewing or printing the rungs only rungs that could possibly change the output Q1 are displayed.

After selecting DISPLAY FILTER option from the TOOLS menu, enter the TYPE and NUMBER of the output object to filter the display for.

Now the word "Filtered", and the output object the filter is based upon, will appear at the top of the ladder program window.

Filtering is removed by choosing the DISPLAY FILTER option again and selecting the cancel option. Starting a new program or loading a new program will also remove the display filtering.

When filtering is performed, the ladder program is checked to make sure that all T, Q and QG objects, which appear as input contacts, also appear as output coils. If this is not the case, a warning screen will list the objects and rung numbers where this occurs. An example of this is when T1 is used as an input somewhere in the ladder code, but is never used as an output. In this case, T1 will always be OFF and therefore cannot cause the rung's output to toggle.

DIAGNOSTICS - This function will display the Target PLC's power-on-self-test results.

EDIT DESCRIPTION - Allows saving, viewing and printing a simple description for the current program.

RUNG COMMENT - Assigns a descriptive comment to the current rung. The comment will appear in the lower right side of the editing window, and will appear below the rung when printing. Comments can be added or modified by left - clicking the comment on the lower right side of the edit window.

ABOUT - Displays software version number and other status information regarding the HE200 PLC Ladder Editor Programming Software (HEPLC).

## EDITING AND CREATING LADDER LOGIC PROGRAMS

USING THE KEYBOARD:

- ESC - Goes back 1 level from any menu. If pressed repeatedly, offers the option to exit to DOS.
- ALT - Brings up the MAIN MENU only when there are no other menus present on the screen.
- CTRL-H - Toggles node ID display and entry format (HEX/DEC)
- Home - Scrolls up the available ladder object functions.
- End - Scrolls down the available ladder object functions.
- U - Scrolls up the branches within a rung.
- D - Scrolls down the branches within a rung.
- PgUp - Scrolls up one rung.
- PgDn - Scrolls down one rung.
- Ctrl-PgUp - Scrolls up ten rungs, if possible.
- Ctrl-PgDn - Scrolls down ten rungs, if possible.
- Cursors - Arrow keys move around on the screen when editing ladder programs, if HEPLC is started with the "k" option.
- F1..F10 - F1 for online help; F2-F10 to select desired function to be placed in the ladder program.
  
- TAB - Move from one field to another in dialog boxes which require user input.
  
- Enter - Fill in identification fields to be placed in the ladder program. Place function selected by function keys into the ladder program.
  
- Ctrl + c - Copy current rung to paste buffer
- Ctrl + d - Download the current ladder program
- Ctrl + f - Find object in ladder program
- Ctrl + h - Toggle HEX / DEC node display
- Ctrl + i - Insert a blank rung
- Ctrl + l - Load a new ladder program
- Ctrl + n - Find next object after current rung
- Ctrl + p - Print the current ladder program
- Ctrl + r - Rung Comment edit and view

- Ctrl + s - Save the current ladder program
- Ctrl + v - Paste rung onto current empty rung
- Ctrl + x - Cuts current rung to paste buffer

**USING THE MOUSE:**

- RIGHT BUTTON - Used to bring up the Main Menu only when there are no other menus present on the screen.
- LEFT BUTTON - Used for scrolling by clicking the appropriate arrows on the screen. Replaces U, D, PgUp, PgDn, Home, and End keys.
- LEFT BUTTON - Used to select desired function by clicking on it. Replaces F1 through F10 keys.
- LEFT BUTTON - Replaces the <Enter> key, except in the IDENTIFICATION FIELDS.

IDENTIFICATION FIELDS

When a function is placed in the ladder logic program, a dialog box pops up, which allows the user to fill in the identification fields. These fields are used by the PC and the PLCs to identify each function.

The user must fill in all the fields except the Name field which is optional in all cases. If a Name is entered or changed at any time, the software updates that Name everywhere that function is present in the entire ladder program when the screen is updated.

To correct any of the fields, TAB over to the appropriate field and enter the new values. The following are field descriptions for some functions:

```

INPUTS
Possible types are:
  Physical Input (I)
  Physical Output (Q)
  Internal Output (T)
  Timer State (S)
  Global Input (IG)
  Global Output (QG)
User enters Type, Number
and optionally Name.

```

INPUTS	+-----INPUT-----+
Normally: Open	
Type: i I, Q, T, S, IG, or QG	
Number: 3 Name: Switch_3	
OK CANCEL	
+-----<SPACE> Toggles OPEN/CLOSED-----+	

```

OUTPUTS
+-----OUTPUT-----+
|
|

```



Possible types are:	Number: Q1	Name: Motor_CW
Physical Output (Q)		
Internal Output (T)		
Global Output (QG)		
User enters Number and optionally Name.	OK	CANCEL

TIMERS	-----TIMER-----	
Possible types are:	Number: 3	Resolution: 100ms
ON Delay (+TMR)	Reset: I 4	Delay before: ON
OFF Delay (-TMR)		Time: 12.4 seconds
User enters timer Number, Reset condition and Time in seconds. Up to 2 decimal places may be entered for Time value. 0 or 1 decimal places selects 100mS timer resolution with a maximum delay of 3200.9 seconds. Typing 2 decimal places selects 10mS resolution with a maximum delay of 320.99 seconds.	OK	CANCEL

IDENTIFICATION FIELDS - (cont'd)

COUNTERS	-----COUNTER-----	
Possible types are:	Number: 3	UP Counter
UP Counter (CNT)	Reset: I 4	Delay before: ON
User enters counter Number, Reset condition and Counts value. Max Counts value is 32767.		Counts: 12
	OK	CANCEL

ERROR MESSAGES, LIMITS AND RESTRICTIONS

**ERROR WINDOW:** Every time an error occurs, whether it is a user error or a system error, an error message will be displayed in RED for 5 seconds in the top middle of the screen, and a BEEP is generated (unless disabled via the "s" command line switch) by the PC speaker. The user should pay close attention to this window.

**BRANCH LIMIT:** Vertical branches may be placed up to 8 levels deep per rung.

**RUNG LIMIT:** There is a rung limit of 128 rungs. Note that only 72 rungs are possible without using an output more than once.

**RUNG OUTPUT:** There must be one and only one output per rung.

**TIMERS /** You may not OR around a timer or counter. A timer

COUNTERS            or counter may not be the leftmost object on a rung. The maximum number of timer and/or counter objects is 16. Each timer and/or counter MUST be assigned a unique number from 1 to 16.

BRANCHES:           All branches must be closed before placing an output.

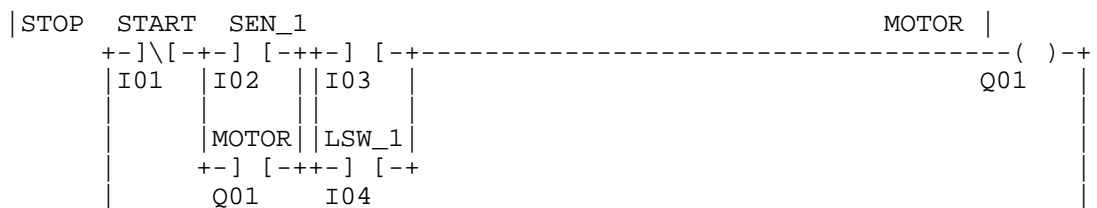
BRANCHING:         To open a branch, press F4 to select start branch, then place the cursor at point you want the branch to be opened, then press enter or click the left mouse button. Similarly, to close a branch, choose close branch by pressing F5, place the cursor at the branch that is to be closed, and press <Enter> or click the left mouse button. To delete a branch, bring up the Object Modification Menu, making sure that the purple arrow is pointing to the branch in question, and then choose DELETE.

MOUSE:              To disable the mouse entirely and use the keyboard by itself, invoke the program using "HEPLC k".

CURSOR KEYS:       If the software does not detect a mouse, it allows use of the arrow keys to move the cursor.

#### TUTORIAL

This tutorial shows how to create the simple ladder program shown below, using the just the keyboard. The program should be invoked using "HEPLC k" to disable the mouse.



The following are descriptions of some of the keys used:

- <tab> = TAB key
- <F?> = Function key (F2...F10)
- <up> = Up arrow cursor key
- <right> = Right arrow cursor key
- <down> = Down arrow cursor key
- <cr> = Enter key

NOTE: Mouse users may click the left mouse button at appropriate screen locations, to emulate the TAB, F2...F10, and arrow keys.

#### CREATING THE LADDER PROGRAM

1. STOP Switch Input:  
`<F3> <cr> I <tab> 1 <tab> STOP <tab> <cr>`
2. START BRANCH:  
`<right> <right> <right> <F4> <cr>`
3. START Switch Input:  
`<right> <F2> <cr> I <tab> 2 <tab> START <tab> <cr>`
4. MOTOR Contact:  
`<down> <down> <down> <F2> <cr> Q <tab> 1 <tab> MOTOR <tab> <cr>`
5. CLOSE BRANCH:  
`<right> <right> <F5> <cr>`
6. START BRANCH:  
`<up> <up> <up> <right> <right> <F4> <cr>`
7. SENSOR 1 Switch Input:  
`<F2> <cr> I <tab> 3 <tab> SEN_1 <tab> <cr>`

#### CREATING THE LADDER PROGRAM - (cont-d)

8. LIMIT SWITCH 1 Switch Input:  
`<down> <down> <down> <F2> <cr> I <tab> 4 <tab> LSW_1 <tab> <cr>`
9. CLOSE BRANCH:  
`<right> <right> F5 <cr>`
10. MOTOR Output:  
`<up> <up> <up> <right> <right> <F6> <cr> 1 <tab> MOTOR <tab> <cr>`

After creating a ladder program, it may be inspected by placing the cursor on each function individually, and then pressing Enter or the left mouse button to bring up the Object Modification Menu and choosing VIEW. Alternatively, select I/O NAMES under CONFIG in the MAIN MENU, which can be brought up by pressing the ALT key or the right mouse button.

#### SAVING THE LADDER PROGRAM

The program can be saved by choosing SAVE under FILE in the MAIN MENU, and similarly the program can be reloaded by choosing LOAD.

#### EDITING THE LADDER PROGRAM

After a rung is complete, ladder objects within the rung may be viewed, modified, inserted, or deleted by using the Object Modification Menu.

If a ladder object is inserted or deleted by mistake, select the UNDO command under EDIT in the MAIN MENU.

Finally, the other EDIT commands allow deleting, inserting, pasting, and copying of complete rungs.

## APPENDIX A - The HE200 Network

### **BACKGROUND ON THE HE200 NETWORK**

The HE200 Network is based on CAN (Controller Area Network), which is widely used for automotive and more recently industrial control applications. Data is passed at 125,000 bits per second using a differential pair of wires, plus a ground. The CAN implementation in HE200 PLC controllers, allows up to 64 controllers to be networked with no additional hardware, and up to 253 with three CAN repeaters (HE200CGM100).

For the ladder programmer, little knowledge of the networking procedures is needed, however for trouble shooting and optimizing, the following information can be helpful. Because the network does not use master/slave or token passing, the hardware self-arbitrates based on Network ID. PLCs with lower Network ID numbers are given higher priority.

When a PLC needs to send data over the network it first waits for the network to be idle (currently a maximum of 400 uS). If two PLCs start "talking" at the same time, the "self-arbitration" causes the PLC with the greater Network ID number to stop, without affecting the other PLC's started message.

In applications with a large number of networked PLCs, better results may be achieved by assigning lower Network IDs to PLCs that have more critical network data than other PLCs. Similarly, by assigning higher Network IDs to PLCs that are expected to produce many network updates, these PLCs are prevented from monopolizing the bus time.

Each PLC has 16 global output bits (QGs), which are periodically broadcast to the other PLCs on the network. QG1 to QG16 may be used in ladder logic like any coil.

All 16 global outputs are broadcast to the network each time one of them changes state. In addition, if a PLC has not transmitted its global data for a while, the PLC's programmable network timer may expire, which in turn causes a global data broadcast. Finally, as part of its power-up initialization sequence, another PLC can explicitly request a PLC to broadcast its global data.

In addition to global data, the HE200 Network is used to exchange data between a PLC on the network and a PC-based Host Supervisory Tool, such as the HEPLC Ladder Editor, or an OEM-specific cell controller.

Refer to the "HE200 Network Protocol" document for details on the CAN Message Encoding and Host Supervisory Tool Protocol used to accomplish HE200 Network communication.

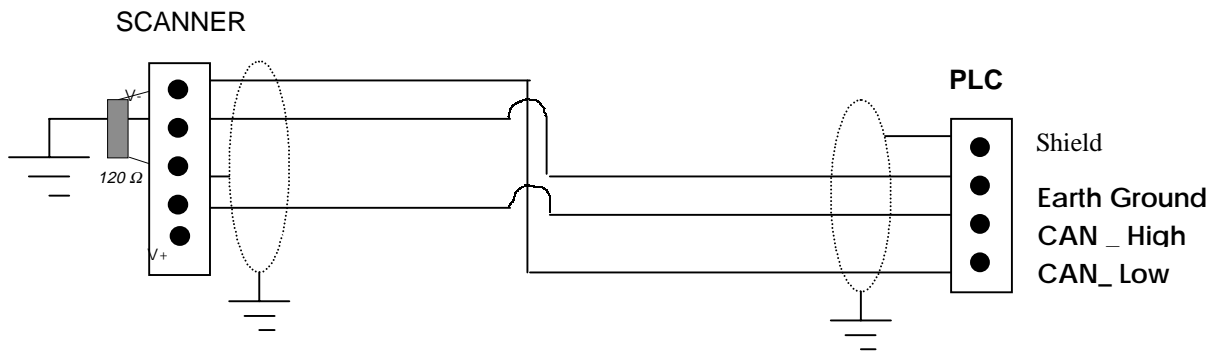
## PHYSICAL CONNECTIONS

Wire type, gauge and terminators should comply with current specifications for CAN inter-connections, based on length and required noise immunity.

The HE200 PLC connector, has four screw terminal connections labeled 1 through 4 as follows:

Terminal	Description
1	Ground return for terminals 2 and 3
2	CAN DATA +
3	CAN DATA -
4	Cable shield

The following diagram shows how to properly wire multiple nodes together on an HE200 Network:



## WIRING RULES

1. An HE200 Network should be wired in a daisy-chained fashion, such that there are exactly two physical endpoints on the network.
2. The two nodes at the physical endpoints, should have 120 $\Omega$  terminating resistors connected across terminals 2 and 3.
3. The data conductors (terminals 2 and 3) should be a 24 AWG shielded twisted pair, with 120 $\Omega$  characteristic impedance.
4. Notice that for a section of cable between two nodes, the cable shield is connected to terminal 4 at one end only.
5. An HE200 Network (without repeaters) should be limited to 64 nodes with a maximum cable length of 1500 ft.
6. Up to four HE200 Network segments, which adhere to the above five rules, may be connected together using three CAN repeaters (HE200CGM100). In this manner, a CAN network may be extended to 253 nodes with a total cable distance of 6000 ft.
7. Each HE200 PLC unit is assigned a unique Network ID by the HEPLC programming software via the RS485 port.

## APPENDIX B - HE200 PLC BIOS Firmware Ver 1.53

### INTRODUCTION

This document describes the (normally invisible) BIOS firmware programmed into EPROM in HE200 PLCs.

Normally, when the controller powers up, the BIOS firmware just starts the HE200 PLC ladder execution engine, which in turn executes ladder code if the engine is not in IDLE mode.

When activated, the BIOS firmware displays a menu which can be used to perform basic tests of the controller board's hardware, and can load the latest PLC ladder execution engine into non-volatile memory on the controller board.

The operator interface to the BIOS menu, consists of a PC/AT running a dumb terminal program (TERM.EXE) while connected to the controller board's main serial port via an RS232 to RS485 adapter.

### ACTIVATING THE BIOS MENU

Before using the BIOS menu as described above, it must first be activated as follows:

1. Connect a PC/AT to board's main serial port via an RS232 to RS485 adapter (HE693SNP232).
2. Run the TERM.EXE program set for 9600 Baud, no parity, 1 stop bit, XON / XOFF handshaking and ANSI display mode.
3. While holding down the PC's spacebar, power up the HE200 PLC. BIOS Ver 1.53 and above is compatible with the standard IBM keyboard repeat rate (10 cps) or faster.
4. The following menu should now be displayed on the PC:

```
-----  
| HE200xxxxxxx BIOS Menu V 1.53 |  
-----
```

P = Show menu on PC.	R = Receive messages.
W = Show menu on WY-30.	S = Send message.
L = Load new software.	M = Multiple transmit.
V = Verify software.	T = Test I/O points.
E = Erase Flash EPROM.	X = Exit BIOS menu.

## USING THE BIOS MENU

As the menu shows, the BIOS supports 10 commands which may be selected by the operator.

The BIOS commands fall into the following three categories:

CATEGORY	COMMANDS
Utility	P, W
Hardware Testing	R, S, M, T
PLC Engine Maintenance	L, V, E, X

### UTILITY COMMANDS

P or W is pressed on the keyboard to "repaint" the BIOS menu using ANSI PC or WYSE WY-30 screen control codes respectively.

Note that if a WYSE terminal is used instead of a PC, all menu items except L and V are available.

### HARDWARE TESTING

In addition to hardware testing, the R, S and M command may be used as HE200 Network debug tools during ladder program development.

The R command displays network messages received from other PLCs until ESC is pressed. If the optional node address is entered, only messages sent by that node will be received. To receive all messages, just press enter when prompted for node address.

Received messages are displayed in the following format:

```
Node address: nnn Message type: t Data: lo hi
```

Where nnn is the sender's node address (0 to 253 decimal), and t is message type (S, R, H or N). For type S messages, lo is the low global data byte (QG1 to QG8), and hi is the high global data byte (QG9 to QG16). Global data is displayed in hexadecimal.

The S command sends a network message to other PLCs. The user is prompted for the node address, message type (S or R), low global data byte (QG1 to QG8) and high global data byte (QG9 to QG16).

The M command continuously sends the last message sent via the S command, until the user presses ESC. The user is prompted for an inter-message delay value from 0 to 9999, in units of 750 ns.

The T command continuously copies all 8 physical inputs to all 8 physical outputs until the user presses ESC.

### PLC ENGINE MAINTENANCE

When a new version of the PLC execution engine becomes available, it may be downloaded into the controller board's non-volatile memory chip via the L menu selection, along with the F2 download function of the TERM.EXE program.

When the L command is selected, the following message will be displayed:

Loading new software ...

At this point, press the F2 function key, and enter the proper filename to start the download. The filename to enter depends on the model number of the PLC being updated, and the new engine's version number as follows:

PLC Model	Filename	
HE200PLC044	PLC088.ver	
HE200PLC084	PLC084.ver	[Note that ver is the 3 digit
HE200PLC088	PLC088.ver	version number of the engine
HE200PLC188	PLC188.ver	being installed.]
HE200UCN014	UCNX14.ver	
HE200UCN114	UCNX14.ver	

During download, an automatic verify is performed and, if all goes well, the display should read:

Loading new software ... Done.

The V command is used in the exact same manner as L, except that instead of downloading a new execution engine, it simply compares the specified file with the engine currently residing in the controller's non-volatile memory.

The E command erases the entire non-volatile memory chip. This command will be rarely used. Normally, it should NOT be necessary to run the E command prior to running the L command.

The X command causes a hardware reset to be performed, which in turn starts up the PLC execution engine, if one has been previously loaded into non-volatile memory (via the L command).

**IMPORTANT NOTE:** Some PLC models, such as the HE200PLC188 and the HE200UCNx14, have software-controlled non-volatile memory write-protection. For these models, the UNLOCK.HEX file must be downloaded to the PLC (via the L command), before a new engine can be downloaded.

## APPENDIX C - HE200 PLC BIOS Firmware Ver 3.00

### **INTRODUCTION**

This document describes the (normally invisible) BIOS firmware programmed into EPROM in HE200 PLCs and HE200CGM301/302 Gateways.



HE200 BIOS Firmware Version 3.00 represents a major update, in that it allows HE200 PLC and HE200CGM301/302 Gateway engine maintenance via the HE200 (CAN) Network, instead of requiring direct connection.

This engine maintenance is performed using the HE200 BIOS Access Utility (HEBIOS.EXE) which assumes that all devices on the network (PLCs and Gateways) contain BIOS EPROMS Version 3.00 or later. It is also assumed that all devices either have empty (erased) non-volatile memory (Flash EPROMS) or are running engine software Version 3.00 or later.

Normally, when an HE200 PLC powers up, the BIOS firmware just starts the HE200 PLC ladder execution engine, which in turn executes ladder code if the engine is not in IDLE mode.

When an HE200CGM301/302 Gateway powers up, its BIOS firmware normally just starts the HE200 Gateway execution engine.

When "activated" however, the BIOS firmware displays a menu, which can be used to perform basic tests of the PLC or Gateway's hardware, and which can load the latest execution engine into non-volatile memory.

The operator interface to the BIOS menu, consists of a PC/AT running the HE200 BIOS Access Utility (HEBIOS.EXE).

#### **ACTIVATING THE BIOS MENU**

Before using the BIOS menu as described below, it must first be activated as follows:

1. Physically attach the PC/AT to an HE200 Network in one of the following ways:
  - a. Connect the PC's COM1 or COM2 RS232 port to an HE200 PLC's programming port. This allows HEBIOS.EXE to access the PLC's BIOS menu, or the BIOS menu of any node attached to the PLC's CAN port. If the PLC's programming port is a 15-pin RS485 connector, use an RS232 to RS485 adapter (HE693SNP232).
  - b. Connect the PC's COM1 or COM2 RS232 port to an HE200 Network Serial Gateway (HE200CGM200). This allows HEBIOS.EXE to access the BIOS menu of any node attached to the Serial Gateway's CAN port B.
  - c. Install an HE200CGM301 (single) or HE200CGM302 (dual) HE200 Network Gateway Interface Board into the PC's ISA bus. This allows HEBIOS.EXE to access the Gateway's BIOS menu, or the BIOS menu of any node attached to the Gateway's CAN port A or B. Note that port B is not available on the HE200CGM301.
2. Run the HEBIOS.EXE program by typing the following at the DOS prompt:

```
HEBIOS [port]
```

where port is an optional parameter indicating what type of connection was used to attach the PC to the HE200 Network.

A port value of 1 or 2 assumes that the PC's COM1 or COM2 port is attached.

If an HE200CGM301 or HE200CGM302 is being used, the port value should be the Gateway's dual-port RAM segment address, as determined by its DIP switch setting (factory default port values are D000 for CAN port A and D040 for CAN port B).

If the port parameter is omitted, HEBIOS.EXE assumes COM1.

3. Press F3 and type in the Target Node address (in decimal) of the PLC or Gateway whose BIOS you want to activate.
4. Press F1 to start the Target Node's BIOS menu.
5. The BIOS menu should now be displayed on the PC.

#### THE BIOS MENU

When a PLC or Gateway's BIOS menu is activated, the following is displayed:

```
-----  
| HE200xxxxxxx BIOS Menu V 3.00 |  
-----
```

P = Show menu on PC.	R = Receive messages.
W = Show menu on WY-30.	S = Send message.
L = Load new software.	M = Multiple transmit.
V = Verify software.	T = Test I/O points.
E = Erase Flash EPROM.	X = Exit BIOS menu.

Node Address: hh Hex ddd Dec

Note that the displayed Node Address should match the value previously entered via the F3 function key.

#### USING THE BIOS MENU

As the menu shows, the BIOS supports 10 commands which may be selected by the operator.

The BIOS commands fall into the following three categories:

CATEGORY	COMMANDS
Utility	P, W
Hardware Testing	R, S, M, T
PLC Engine Maintenance	L, V, E, X

## UTILITY COMMANDS

P or W is pressed on the keyboard to "repaint" the BIOS menu using ANSI PC or WYSE WY-30 screen control codes respectively.

Note that if a WYSE terminal is used instead of a PC, all menu items except L and V are available.

## HARDWARE TESTING

In addition to hardware testing, the R, S and M command may be used as HE200 Network debug tools during ladder program development. Also, the R, S and M commands may not be used remotely. In other words, they are available only when a HE200CGM302/301's BIOS menu or a direct-connected PLC's BIOS menu is active.

### HARDWARE TESTING - (cont'd)

The R command displays network messages received from other PLCs until ESC is pressed. If the optional node address is entered, only messages sent by that node will be received. To receive all messages, just press enter when prompted for node address.

Received messages are displayed in the following format:

```
Node address: nnn Message type: t Data: lo hi
```

Where nnn is the sender's node address (0 to 253 decimal), and t is message type (S, R, H or N). For type S messages, lo is the low global data byte (QG1 to QG8), and hi is the high global data byte (QG9 to QG16). Global data is displayed in hexadecimal.

The S command sends a network message to other PLCs. The user is prompted for the node address, message type (S or R), low global data byte (QG1 to QG8) and high global data byte (QG9 to QG16).

The M command continuously sends the last message sent via the S command, until the user presses ESC. The user is prompted for an inter-message delay value from 0 to 9999, in units of 750 nS.

The T command continuously copies all 8 physical inputs to all 8 physical outputs until the user presses ESC. Note that this command is only available on PLC BIOS menus, as HE200CGM301/302 Gateways have no physical I/O to test.

## PLC ENGINE MAINTENANCE

When a new version of the PLC or Gateway execution engine becomes available, it may be downloaded into the PLC or Gateway's non-volatile memory chip via the L menu selection, along with the F2 download function of the HEBIOS.EXE program.

When the L command is selected, the following message will be

displayed:

Loading new software ...

At this point, press the F2 function key, and enter the proper filename to start the download.

#### **PLC ENGINE MAINTENANCE - (cont'd)**

The filename to enter depends on the model number of the PLC or Gateway being updated, and the new engine's version number as follows:

Model	Filename	
HE200CGM301	CGM302.ver	
HE200CGM302	CGM302.ver	
HE200PLC044	PLC088.ver	
HE200PLC084	PLC084.ver	[Note that ver is the 3 digit
HE200PLC088	PLC088.ver	version number of the engine
HE200PLC188	PLC188.ver	being installed.]
HE200PLC288	PLC188.ver	
HE200UCN014	UCNX14.ver	
HE200UCN114	UCNX14.ver	

During download, an automatic verify is performed and, if all goes well, the display should read:

Loading new software ... Done.

The V command is used in the exact same manner as L, except that instead of downloading a new execution engine, it simply compares the specified file with the engine currently residing in the controller's non-volatile memory.

The E command erases the entire non-volatile memory chip. This command will be rarely used. Normally, it should NOT be necessary to run the E command prior to running the L command.

The X command exits the BIOS menu and starts up the PLC or Gateway execution engine (if one has been previously loaded into non-volatile memory via the L command).

#### **IMPORTANT NOTES**

Since HEBIOS.EXE was designed specifically for HE200 PLCs and Gateways, it is no longer necessary to download the UNLOCK.HEX file before engine updating. This function is now handled automatically.

Because of the communications overhead required for engine downloading, the L and V commands may fail when attempting to update an engine via the CAN network, if the network has other traffic on it. For this reason, the F5 function key may be used to put all PLCs in IDLE mode. Then, when engine maintenance is complete, use the F5 function key again to put all PLCs in MONITOR or RUN mode.

While a BIOS menu is active, the F3, F5 and F10 function keys are disabled. You must exit the active BIOS menu by typing X, before setting a new Target Node, globally controlling PLCs, or quitting.

#### WHAT'S NEW IN HEPLC VERSION 1.8?

- Network - Added TOOLS menu item to "attach" to Target PLCs via the HE200 Network. Added TOOLS menu item to change Local PLC's Network ID. Added status display for Local PLC, Target PLC, and Target PLC's state on main screen. Can now download and monitor remote PLCs via the HE200 Network.
- Power Monitoring - when in the Monitor mode the PC constantly requests and displays the status of objects on the currently displayed rung. Red = object in the OFF state and Green = object in the ON state. When in Monitor mode, the pull down menu for MODE contains a check next to Monitor.
- Downloading - Changed order and display so PC automatically attaches to Target PLC before download.
- File loading - PC attempts to automatically attach to the files Target PLC during file loading.
- Filename - The currently loaded file's name now appears along side the current rung number on the editing screen. This filename is the default when loading and saving files. When printing files in the LoQ or HiQ format the filename now appears with the page, time and date stamp. If no filename is assigned to the current program, the editing screen displays the filename as UNNAMED. The printout of a UNNAMED file will contain the time, date, and page stamp, but no filename.
- Delete - completed. New coding prevents corruption for all cases. Allows deleting of first and last object, with error checking for timers and outputs, that require a specific context.
- Modify - completed. Allows user to modify the properties defined for the object. Upon selecting modify, a set of data fields is displayed, with the known fields filled.
- Editing fields - redesigned so a valid character starts the replacement of the current field with the entered characters.
- Menu operations - the main menu and any of the sub menus may be closed by clicking the left mouse button on any portion of the screen that does not contain an active menu item. Along with this change some minor menu handling bugs were fixed that caused first menu items to be selected when the mouse was clicked in an inactive menu area.
- Function scrolling - when selecting Page-Up or Page-Down for selecting the function set, the functions wrap around.
- Communications timing - improved timing for many communications functions to reduce errors and increase speed.

#### WHAT'S NEW IN HEPLC VERSION 1.9?

- MODIFY - When modifying a non-global input object, the object can now be changed between normally open and normally closed. This is done by pressing the <F1> key any time a field is not being edited (cursor is small "\_" not big "Ü"). The object is updated upon exit of the modify window.
- INSERT - in the object modification menu, insert now allows inserting inputs and timers into existing ladder code. When inserting, the user will be prompted to select the object to be inserted. The object's familiar entry fields are displayed. Selecting cancel exits the insert process, and returns to the edit screen. If an unwanted object is inserted, undo returns the ladder code to its previous state. Note: timers can't be inserted as the leftmost object and or in a position which is Red around.
- DELETE RUNG - Now moves all rungs below the current rung up one. This function also stores the deleted rung in a buffer to allow pasting into other locations.
- INSERT RUNG - Inserts a blank rung, if the ladder is not full, before the current rung. The previous current rung, and all other rungs below, move down one rung.
- PASTE RUNG - Places a previously deleted rung from the paste buffer onto a unused rung. A rung may be pasted multiple times to allow easy paste/modify editing.
- PRINTING - When printing, the network map is now printed, as well as the ladder code. Additional checking was also added to prevent off-line, disconnected, or faulty printers from causing errors. When a problem with the printer is found, an error is shown, and printing is discontinued.
- SEARCH NETWORK - added utility under the TOOLS menu. This utility will use the PLC physically connected to the PC to check every PLC on the HE200 Network. Nodes that are found to be connected to the network are polled to find their current state. Scanning a network with few connected nodes may take as long as two minutes. Pressing the ESC key will halt the scanning. Pressing the <S> key after a scan will rescan all nodes. The display shows nodes 1 to 253 with a status to the right.

xxx Represents a node number from 1 to 253

xxx-? Node xxx doesn't exist or is not communicating.

xxx-R Node xxx is in RUN mode and is communicating.

xxx-M Node xxx is in MONITOR mode and is communicating.

xxx-I Node xxx is in IDLE mode and is communicating. This node will be flashing.

#### WHAT'S NEW IN HEPLC VERSION 2.0?

- FILE Menu - VERIFY Command - Allows comparing Ladder code in the

PLC memory to that in the HEPLC editor.

- FILE Menu - PRINT Command - Enhancements have been made to the printing interface to allow more selective printing of ladder code and its associated network and name information. Now a single PRINT selection exist under the FILE menu.
- EDIT Menu - The pop-up menu system has been enhanced by adding an EDIT menu to provide a faster, more logical arrangement of command functions.

The EDIT menu contains all the edit features previously found under the TOOLS menu. The copy rung function is now available from the EDIT menu selection.

- CONFIG Menu - The "PLC Info" menu selection no longer brings up a secondary menu. Selecting "PLC Info" now displays information about the currently attached PLC. The "Net Assignments" former secondary menu item is now available as a separate menu item under "Config". "Force Outputs" has been moved to the "Tools" menu.
- RELATIVE NETWORK ADDRESSING - This feature allows a single ladder program to be used on multiple PLC network nodes. Specifically, when assigning an IG network input to another PLC's QG network output, the user can optionally specify the other PLC's Network ID as a relative offset from the current PLC's Network ID.
- GLOBAL OUTPUTS - QG outputs may now be used as normally closed or open inputs in ladder code. This is done simply by using an input object and entering "QG" as the type of input.
- OBJECT NAMES - The alias name searching has been improved to allow objects of different types to be assigned the same name.
- NOISE FILTERING - HE200 PLC Engine firmware version 1.90 and later have two adjustable parameters to help when the PLC is used in noisy conditions. The "TOOLS" menu now contains a selection called "Set Anti-Noise".

#### WHAT'S NEW IN HEPLC VERSION 2.1?

- Communications - The HE200 PLC has outgrown its simplistic method of PC to PLC communications. This version uses packaged communication with error detection and requires PLC Engine Version 2.01 or later. This change provides faster, more reliable communication, and allows "Cell Controller" type Host Supervisory Tools to be created.
- Update Comm - this menu selection was added to the "TOOLS" menu to force a communication update.
- Timers - Now when adding timers in the editor, the system prevents two timers with the same number being entered. If a timer number is entered that has already been entered an error message will alert the user and give the first timer number that has not been used, if possible.
- IG Viewing - Now when viewing an IG input, the network assignment

is also displayed. This information is in the form "Node: XXX" and "QG: YY". Relative addressing is in the standard form where offset is used for Relative Network ID number.

- Printing - When printer ladder code, rungs are now not split between pages and each rung is properly labeled for page number.
- File Loading - the file loading process has been enhanced to make loading faster and easier for the user.
- Script Downloads - This feature allows automated ladder logic file downloading to an entire network of PLCs.

#### WHAT'S NEW IN HEPLC VERSION 2.20?

- Ladder display - Output objects now display properly. Previously a double image would appear when in monitor mode. Global object display errors were also corrected.
- Downloading - Corrected error caused by downloading an empty ladder program.
- Deleting Branches - An error occurring when trying to delete three possible arrangements of branches was fixed.
- IG objects - May now be normally open or normally closed. This is selected when entering or modifying an IG object. Pressing the <F1> key will toggle between the normally open or closed state. Note: A normally closed IG will appear as a normally closed object, not a global object. -)\[-
- Object Modification Menu - Any input object may now be changed to an I, Q, T, IG, or QG and may be specified as normally open or closed.
- Insert Branch - A branch can now be inserted by:
  1. Select the object to start the branch. The branch will open at the left of this object. If the object is an open branch or will be an extension to an existing open branch, HEPLC will automatically find the best way to add the open branch.
  2. Select branch from the list of objects to add. If you have selected a starting point that would OR around a timer or would be out of syntax with another branch, the program will alert you with an error.
  3. Select the object where the branch should end. The close branch will be placed to the left of this selected object. If this branch path would cause an error because of a timer, output, or another branch, the program will alert you to the error.
  4. Now two blinking branches should appear in the approximate places where the branch will be formed. You will be prompted for an initial object to be placed in the branch. Note: This can not be a timer or an additional branch.
  5. After filling the information fields for the inserted object,



the rung will be rebuilt with the inserted branch.

Additional objects may be inserted after the initial branch is built. Any time during the insert branch process, the escape key will abort the insert process. If the insert is complete and the branch is not wanted, the undo options will restore the rung to its previous state.

#### WHAT'S NEW IN HEPLC VERSION 2.20? - (cont'd)

- Error beep - The "beeps" from an error now only occur if the command line switch "s" is used. This allows new users to be notified with a beep when an error or event has occurred, but the experienced user can work without audible interruption.

Diagnostics - Certain diagnostic information can be obtained, by pressing Shift-F1 or Shift-F2 as follows:

##### Shift-F1 Host-to-PLC Communication Diagnostics

Packets Transmitted - shows total number of packets sent to the PLC

Timeout Errors - shows the number of times HEPLC gave up while waiting for a response from the PLC

Checksum Errors - shows the number of packets received with errors in the checksum field

Data Errors - shows the number of packets where the data received does not fit the expected values

##### Shift-F2 Target PLC Self-Diagnostics

Start up tests - shows if the PLC passed or failed the power-up test

Watch dog reset - shows the number of times the PLC was reset by its watch dog timer (normally 0)

CAN bus off - shows number of times the PLC's HE200 Network interface was reset due to a network error (normally 0)

CPU stack left - shows the number of extra bytes available for CPU stack operations (normally greater than 0)

Logic stack left - shows the number of extra bytes available for PLC logic stack operations (normally greater than 0)

#### WHAT'S NEW IN HEPLC VERSION 2.30?

- Online Help - Pressing <F1> or clicking on the HELP function brings up context sensitive online help.
- Diagnostics - New TOOLS menu option which will display the target PLC's power-on-self-test results.

- Upload - Ladder programs can now be uploaded from any PLC on the HE200 Network to the PC for editing or monitoring.
- Loading Files - When loading files, the mouse can now be used to select the file to be loaded. A single mouse click, while the cursor is on the file name, will load the selected file. Also, the number of listed files has been expanded to 30.
- Load Names - New FILE menu option which loads just the user I/O Names from a saved ladder program file.
- Verify on Download - By default, ladder downloading now performs an automatic verify.
- Number of Rungs - Maximum number of rungs was increased from 64 to 128.
- Find - New EDIT menu option which finds the first occurrence of a selectable object in the ladder program.
- Find Next - New EDIT menu option which finds the next occurrence of the object previously selected by Find.
- Display Filter - New TOOLS menu option which allows a programmer to view or print only those rungs that would affect a chosen output.
- Timer Display - When in monitor mode the current count of the displayed timer(s) is shown above the gray set point.
- I/O Names Screen - Now distinguishes between internal coils (T1 - T48) which are used as outputs and internal coils which are only used as an inputs, or timer resets. Also, a 2nd page was added containing timer information.
- Printing I/O Names - Distinguishes internal coils in the same way as I/O Names Screen described above.
- Printing Timer Info - When printing ladder code, a new option is available to print the timer usage information.
- Printing Filtered Ladder Code - If the editor's Display Filter tool is active when print is selected, the printout will only contain the viewable, filtered rungs.

#### WHAT'S NEW IN HEPLC VERSION 2.30?

- Setting Local PLC Node - Now clicking of the Local PLC number displayed in the upper left corner of the screen will allow the user to change the number of the local PLC node.
- Setting Target PLC Node - Clicking on the Target PLC number displayed in the upper left corner of the screen will allow the user to change the number of the target PLC node.
- Object Selection - Changing rungs no longer changes the selected ladder object. For example, if you select the open branch object,

changing rungs will leave open branch selected.

- Input Objects - Previously <F1> was used to toggle between normally open and closed inputs. Because of the addition of on-line help, <SPACE> has been assigned to toggle the normally open or closed option.
- Global Input Objects - The separate function has been eliminated. IGs can now be entered by selecting a normally open or closed input.
- Sound on/off - The default was changed to produce sound on error. Sound may be disabled by starting Ladder Editor with the "s" option.
- Changed startup routine to prevent "dead time" while the software tries to establish communication when no PLC is connected.
- Menu Items - Now menu items change to caps when selected. This should make operation on a monochrome monitor or laptop screen much easier.
- PLC Info - Additional information has been added to the PLC INFO option under the CONFIG menu option. Also changed the PLC Info display format for easier viewing.
- Insert Object - Objects are now inserted to the left of a branch on the UPPER level.
- Open and Short Display - An error when displaying OPEN or SHORT objects after a redraw or reload was corrected.
- IG Monitoring - A display problem when monitoring normally closed IG objects was corrected.
- Branching - An error was corrected relating to the display of branches that have been extended by placing a branch inside the first.
- Logic Generation - An error when generating OR terms in logic was corrected.

#### WHAT'S NEW IN HEPLC VERSION 2.31?

- Timers - 10 mS timers have been added to version 2.31 of Ladder Editor and will only work in engine versions 2.04 and later. Older engines will not be affected.

The timer dialogue box has changed slightly. When first entering a timer no resolution will be indicated. When the time is entered in the correct field, the resolution will be based on the fractions of a second entered. For example, "1.20 seconds" will be assigned a 10 millisecond timer, and "1.2 seconds" will be assigned a 100 millisecond timer.

- Dialogue box entering and editing - now closer to common graphical user interface conventions. <TAB> will move to the next field, <ENTER> will confirm entry and move to the next field if appropriate. <SPACE> will toggle or selection options.

When editing a longer field such as a file or I/O name, pressing the <RIGHT ARROW> will allow editing the previous value, typing any other character will delete the previous value and start entering a new value for the field.

- Power flow monitoring - Reverse video is used for objects in the active state for easier viewing.
- <PAGE UP> and <PAGE DOWN> now move between rungs.
- <END> and <HOME> change the function toolbar.
- Fixed an error where using the mouse to select CANCEL if the cursor was on OK did not cancel.
- Fixed changing field size when entering network information.

#### WHAT'S NEW IN HEPLC VERSION 2.40?

- Added counter ladder logic element function.
- Added S1 to S16 internal input contacts which represent the ON/OFF states of the 16 timer/counters.
- Modified timer reset function to force output OFF (ON if OFF delay), and clear time accumulator.

#### WHAT'S NEW IN HEPLC VERSION 2.50?

- PLC INFO now supports serial and ISA gateway units.
- Support for switchable hexadecimal or decimal entry and display of node IDs. Toggling is accomplished by pressing CTRL-H or using the mouse to click on the HEX/DEC indicator at the lower left corner of the edit window.
- The HEX or DEC mode is saved in the HEPLC.INI file every time it is changed. The mode will remain unchanged between editing sessions.
- The following major areas now support hexadecimal display and/or entry of node IDs depending on the mode selected.

Network connectivity display in the upper left of the screen.

Setting the target and local node IDs.

The DIAGNOSTIC information.

When viewing an IG, the node assigned to the IG will be displayed with the correct mode.

Network assignments will be printed in hexadecimal with an "h" following the node number if the mode is set to "HEX".

Network assignments can be entered or displayed based on the

HEX/DEC mode.

When doing a "NETWORK SEARCH" the node numbers are displayed according to the set mode.

IMPORTANT: Scripts must still list the node number in decimal.

#### WHAT'S NEW IN HEPLC VERSION 2.52?

- Fixed an entry error in the networks assignments.
- Fixed a download error that occurred when the ladder program size was an exact multiple of 64.
- Added the ability to switch DEC/HEX mode while entering data in the network assignments window. CTRL-H will toggle the mode, update the display and save the change to the heplc.ini file. Note the network connectivity display will not be updated until the entry window is exited. The mode cannot be changed in the middle of editing an item, which is indicated by the thicker cursor.

#### WHAT'S NEW IN HEPLC VERSION 2.62?

##### Corrected Problems:

- Fixed a problem which occurred when Modifying an existing contact object (I, Q, T, S, IG or QG). Pressing Space to change the Normally Closed/Open field made the Type field unavailable unless TABed around to again.
- Fixed a problem which caused a Verify to be executed when Cancel was selected from Download.
- Many additional minor fixes

##### Modified Functions:

- When inserting, IG no longer appears as separate object type. IGs are now inserted just like any other Normally Open or Closed contact.
- All displays and printouts which convey information about a timer or counter, are now labeled with the timer or counter's S contact value. The label will appear as Sxx where xx is the timer or counter number.
- Arrow keys may now be used to select OK for file over-write.

#### WHAT'S NEW IN HEPLC VERSION 2.65?

- Find now supports S objects.

- Find using "S" objects will now locate "S" contacts or their associated timers or counters. If the find is selected for INPUTS/OUTPUTS, find will locate the next contact or timer/counter object fitting the supplied description. If OUTPUTS ONLY is selected, find will locate the first timer or counter object since only timers or counters can provide outputs for "S" objects.
- Minor problem involving deleting objects or rungs was corrected.
- Now when a ladder file is modified from the original uploaded or loaded version, the word MODIFIED is placed in the bottom right portion of the edit window. When a file is loaded, uploaded, or saved the word UNMODIFIED is placed in the lower right corner until it is modified. If quit is selected and a modified file is still in memory, the dialog box will indicate the modified file has not been saved.

#### WHAT'S NEW IN HEPLC VERSION 2.70?

- Added key assignments for saving, loading, printing and downloading
 

Ctrl + s	save current ladder program
Ctrl + l	load new ladder program
Ctrl + d	download the current ladder program
Ctrl + p	print the current ladder program
- Added the key assignments to the menus for all file and edit functions supported by key assignments.
- Added support for multiple printer ports. The print dialog box now contains an option for printer port. This number specifies the LPT port used to print the ladder program. This option is saved in "heplc.ini" file so the option is "remembered" between sessions.
- The load dialog now allows viewing of all .PLC files in the current directory, PAGE DOWN and PAGE UP now can scroll through the list of available ladder programs. The mouse can also be used for paging through the list of filenames by clicking the left mouse button on the <PAGE UP> or <PAGE DOWN> text at the bottom of the dialog box.
- When starting HEPLC.EXE the name of a ladder program can be passed to the editor to start the editor with the supplied file loaded. For example, "heplc demo.plc" will start the editor with the ladder program "demo.plc" loaded at startup.

Note: The ladder program should be in the same directory where heplc is started. Any directories before the filename are removed.

- When the MODE of the connectivity status, in the upper right corner, is selected with the mouse, a dialog box appears to allow quick changing of the target PLC's mode. For example, if the status appears as:  
 0 -> 123(I)  
 Clicking on the "I" will offer the option to change the mode of PLC number 123.

- Added program description. This allows a general description of each program to be saved with the ladder program on the PC's disk.
- Added rung comments. This allows comments about the current ladder rung to be viewed, edited, or printed. The comments are displayed at the bottom right of the edit window. The comments can be edited three ways:
  - 1) Clicking the mouse on the comment
  - 2) Selecting Rung Comment from the TOOLS menu
  - 3) Pressing CTRL+r, the key assignment for comments
- Many additional fixes

Note: This version slightly changes the file format to include descriptions and rung comments. Version 2.70 can read ladder programs created by all previous versions of this editor. Previous versions are designed to prevent the loading of ladder programs they do not understand. For example, version 2.60 will not read a file created with version 2.70 of the editor.

#### WHAT'S NEW IN HEPLC VERSION 2.72?

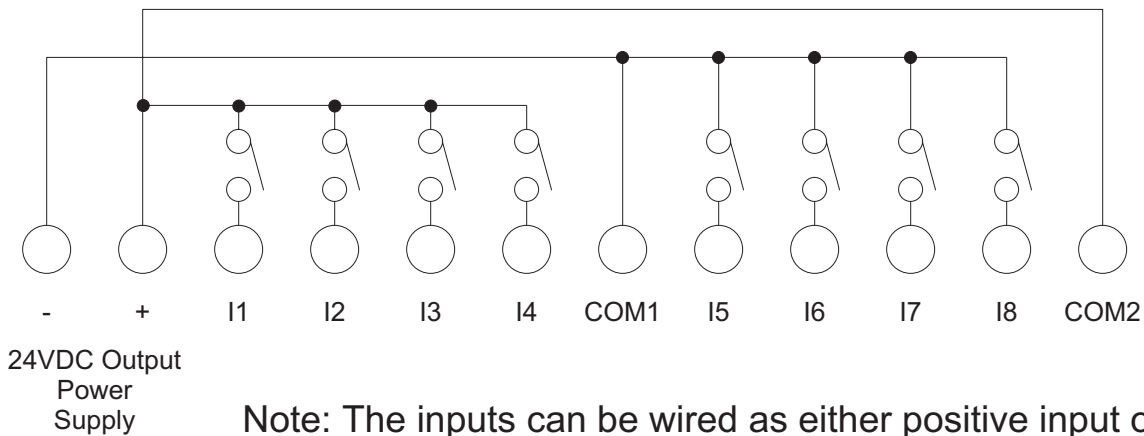
- Monitor now updates the states and timer values ever 150 milliseconds. Previously the editor updated the screen every 100 milliseconds. When monitoring PLCs with scan rates over 25 milliseconds this caused the editor to spend excessive time waiting for the PLC to respond.

#### WHAT'S NEW IN HEPLC VERSION 2.80?

- The editor is functionally the same, but the saved file format now includes the binary download data for use with custom file management utilities.

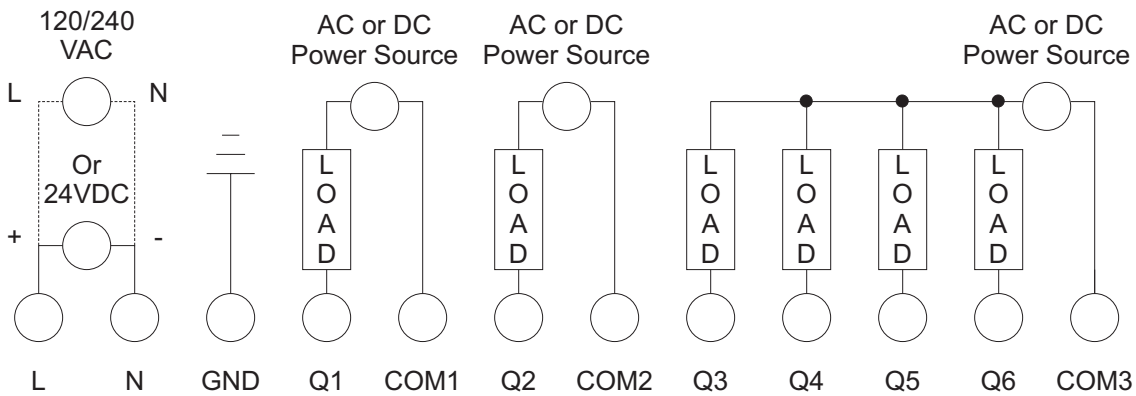
Note: This version changes the file format. Version 2.80 can read ladder programs created by all previous versions of this editor. Previous versions are designed to prevent the loading of ladder programs they do not understand. For example, version 2.70 will not read a file created with version 2.80 of the editor.

# Input Wiring

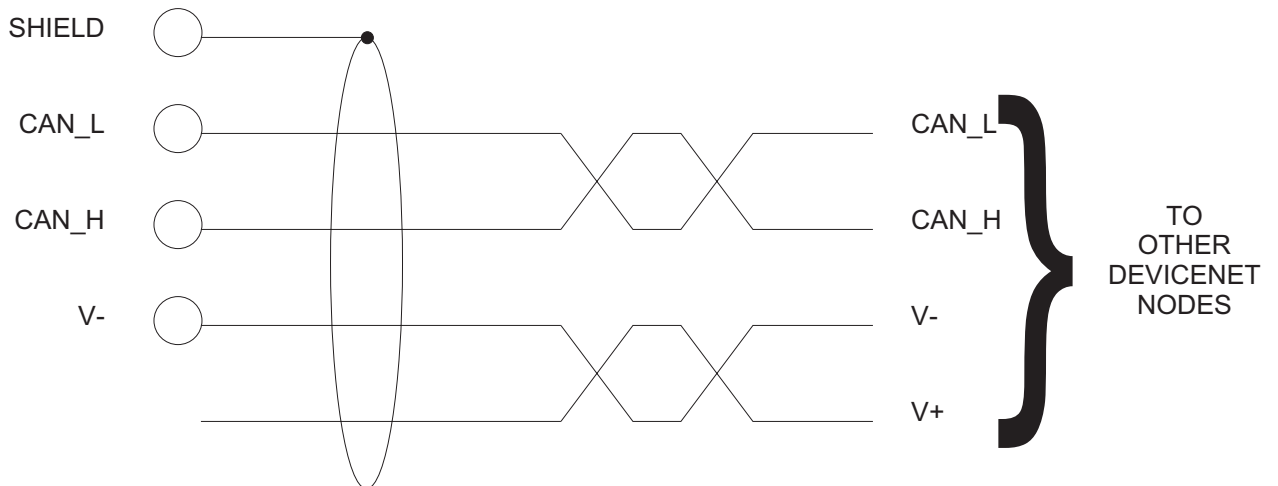


Note: The inputs can be wired as either positive input or negative input. I1-4 are shown above as positive, and I5-8 negative.

# Power & Output Wiring



# DeviceNet Network Wiring



Note: The DeviceNet Micro does not use V+, it is internally generated. For complete DeviceNet wiring instructions, including wire selection and termination, see the appropriate DeviceNet documentation.