CHAPTER 4
OPERATION

INTRODUCTION

After completing the installation procedures described in the previous chapter, your Series One Junior PC is ready for operation. This chapter describes the operation of a Series One Junior PC. A description of the features and functions of the programmer are the basis for the information in this chapter. In addition, the last portion of this chapter describes the operation of peripheral devices that can be used with a Series One Junior PC. The information in this chapter will allow you to become familiar with the programmer keys and the keystroke sequences required for the various programmer operations.

PROGRAMMER

The hand-held programmer, when attached to the Series One Junior by one of the three methods described in the previous chapter, can be used for entering a new program, examining a previously entered program, editing (changing) a previously entered program if required, monitoring the status of input or output points, and displaying timer or counter accumulated values. Figure 4.1 is an illustration of the programmer. Its features and functions are described in the following paragraphs. For detailed descriptions of the programming functions, refer to programming, Chapter 5.

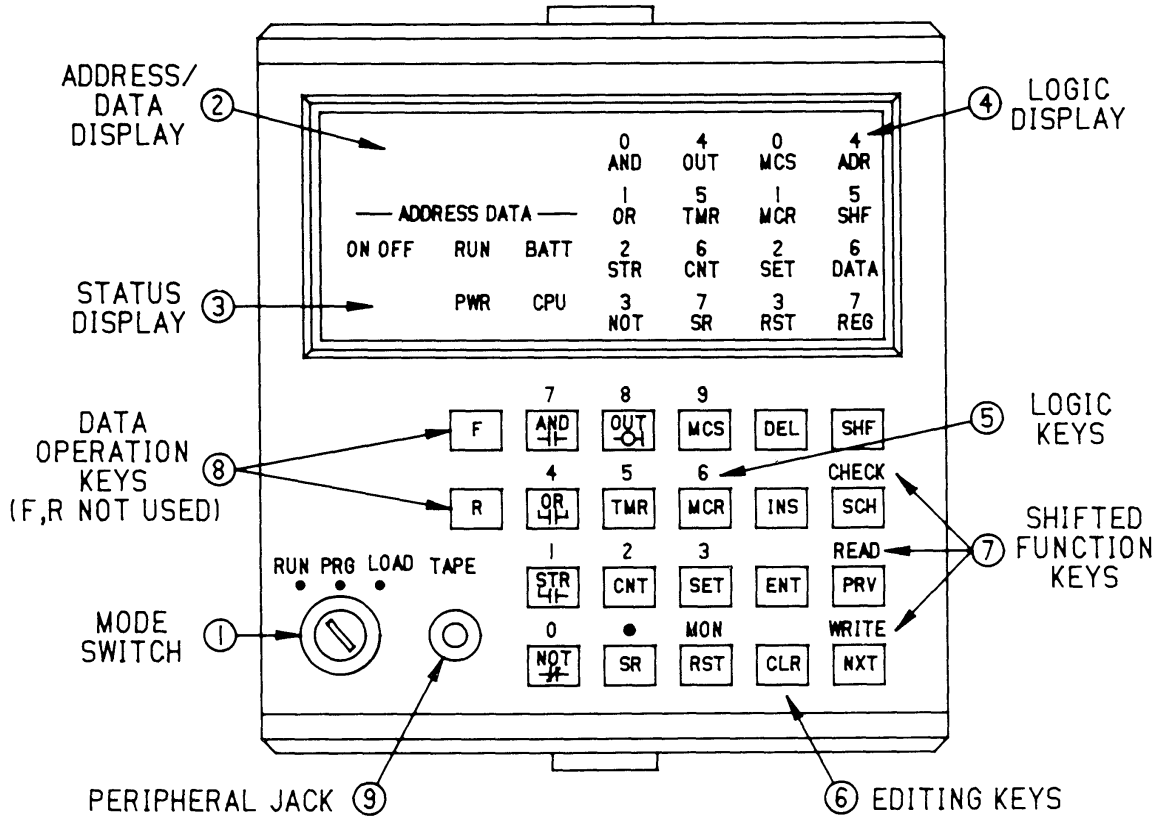


Figure 4.1 PROGRAMMER FEATURES

PROGRAMMER FEATURES

The features of the hand-held programmer shown in the illustration on the previous page are described in this section. The descriptions of the features are keyed to the numbers (1 to 8) next to each feature in the illustration.

1. MODE SWITCH

   This is a three-position keyswitch used for selecting the operating mode of the PC. This switch can be repositioned at any time as necessary without disrupting AC power. The left position (RUN) allows program execution with outputs enabled. The CPU scans its stored logic and allows timer/counter and relay contacts to be displayed. However, in the Run mode, changes to the logic are not allowed. In the center (PRG or Program) position, new programs can be entered and previously entered logic can be altered; however, no solving of the logic is performed. The right (Load) position connects the programmer to an external device such as a tape recorder through the adjacent tape port. Logic is not solved while in the Load position.

   WARNING

   IF A VERSION A OR B (IC610CPU101A OR IC610CPU101B) CPU IS INSTALLED, THE SERIES ONE JUNIOR PROGRAMMABLE CONTROLLER WILL ALWAYS POWER UP IN THE RUN (OPERATING) MODE UNLESS A PROGRAMMER IS CONNECTED AND THE PROGRAMMER IS IN THE PROGRAM OR LOAD MODE.

2. ADDRESS/DATA DISPLAY

   This is a four digit display used to indicate either the address, in decimal format, of where the display is in the user program stored in the PC's memory or reference data used as a part of the logic. To indicate that addresses are being displayed, periods appear near the bottom and to the right of each digit (for example, 0.1.2.3.). The LED to the top right behind ADR will also be lit.

3. STATUS DISPLAY

   These five LEDs are energized to indicate the following functions or status of the Series One:

   ON/OFF — When in the Run mode, this LED indicates the status of discrete references (I/O, internal coils, and shift register stages). It is ON when a reference is energized and OFF when de-energized.

   RUN — ON when in the RUN mode and CPU is solving logic.

   BATT — ON when the voltage of the internal lithium battery, which is used for maintaining the program stored in CMOS memory during no-power conditions, is at a low level and should be replaced within 10 days — see Chapter 7. This LED is OFF when battery voltage is OK, or battery is disconnected.

PWR — ON when the internal power supply is producing DC power. If OFF the Series One Junior's power supply should be checked — see Chapter 7.

CPU — ON when internal error checking has detected a fault in internal hardware — see Chapter 7.

The above four LEDs (RUN, BATT, PWR and CPU) duplicate the operation of the indicators on the CPU when the programmer is installed. The four CPU indicators on the Series One Junior are located in the lower left section of the front panel, directly above the 26-pin connector.

4. LOGIC DISPLAY

These sixteen LEDs are used to indicate the type of logic entered into memory. While being programmed, they reflect the logic selected by the user prior to actual entry into CPU memory. For definition of the first 12 LED's functions, see key definitions under 5 below. The two LED's to the upper right have special functions as follows:

ADR — ON when display is indicating an address value. The address is displayed in decimal notation, beginning at 0000 and ending at the last address in the user program or a maximum of 0700 (maximum number of 16-bit words in memory).

SHF — On when operator has selected the Shift key and is an indication that future key selections will be based upon the upper key labels. Shift function will remain in effect until either the Enter or Clear key is selected.

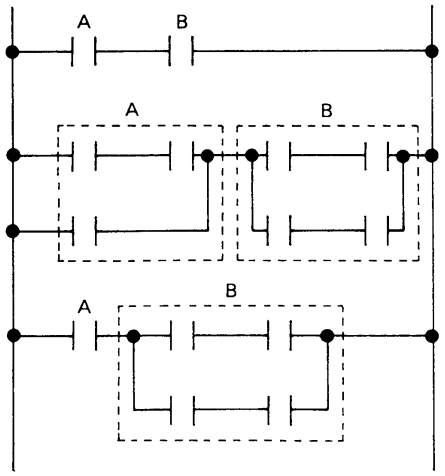
These sixteen LEDs can also indicate the status of 16 consecutive I/O states when used with the monitor function discussed later in this chapter. The numerals above the alphabetical characters are used during this function.

5. LOGIC KEYS

These twelve keys are used to select the required function and enter logic when in the Program mode. The upper labels are used to enter numerical values when preceded by the Shift key. Numerical values, when entered, are viewed in the Address Data display. The decimal point is used only for the entry of timer preset values in tenths of a second. The Monitor function will be discussed below as part of the Upper Case keys. The function of the lower or normal case labels on these keys is described in the following key discussion.

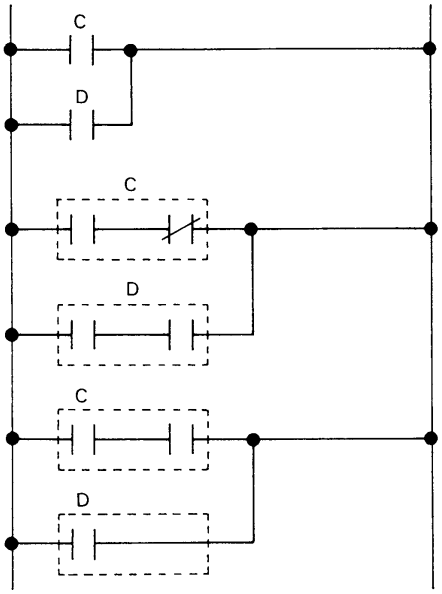
AND — Places logic such as two contacts or two groups of contacts in series (see Figure 4.2). Power flow must be possible through both elements before it will be passed to the next element.

OR — Places logic such as two contacts or two groups of contacts in parallel (see Figure 4.3). Power flow can be possible through either (or both) elements before it will be passed to the next element.



EXAMPLES OF AND (A • B)

Figure 4.2
SERIES LOGIC (AND)



EXAMPLES OF OR (C + D)

Figure 4.3
PARALLEL LOGIC (OR)

STR — Begins (Starts) a new group of logic and stores current logic results into a Last In, First Out (LIFO) pushdown stack.

NOT — Inverts the state of the referenced status to create a normally closed contact. NOT AND results in a normally closed series contact. NOT OR results in a normally closed parallel contact.

OUT — Specifies the end of a string of logic by entering a coil. With a valid reference, such as OUT 19, this coil will reflect the output of the rung of relay logic by turning ON or OFF as dictated by the power flow. Outputs can be paralleled by entering additional OUT functions at the end of a rung of logic.

TMR — Specifies a timer function to end a rung of logic. The timer requires a unique 6XX reference for storage. Two types can be programmed (seconds and tenths of seconds) depending upon the numerical preset (with or without decimal point) entered after the 6XX reference. For example, 0.9 or 9.0 seconds can be programmed, depending on the decimal point.

CNT — Specifies a counter function to end two logic rungs. The two logic rungs required by this function are count and reset. Count, being the top rung of conditional logic. When all programmed conditions permit power flow, the counter will begin counting. The bottom rung is the reset rung and is programmed with the conditional logic required for resetting the counter. The counter also requires a unique 6XX reference for storage. Transition detection is a standard built-in function.

PC-S1-83-0029
PC-S1-83-0057

SR — Specifies a Shift Register function to end three logic rungs (input, clock, and reset). The reference used with SR (for example, SR 150) is the first stage of this shift register. The last stage must be entered immediately after the SR and its reference. A shift register can contain a total of 155 steps or several shift registers can be programmed, each with a different number of steps, as long as the total of 155 steps is not exceeded.

MCS — The MCS (Master Control Start) key specifies the beginning of a Master Control relay function. This provides an efficient method of programming for controlling large quantities of coils if a specific permissive condition is not satisified.

MCR — The MCR (Master Control Reset) key specifies the end of a Master Control relay function. A similar number of MCRs must be entered to terminate, one at a time, the Master Control Start functions entered. One MCR terminates only one previous MCS function.

SET — Used with latches, shift registers, and coils. It specifies where latches are to be turned ON (set), shift register stages set to the ON state, or coils to be turned ON and not affected by internal reference 376 (disable all outputs).

RST — Performs functions similar to the SET key for latches, shift registers, and coils, except it specifies when these references will be turned OFF (reset).

6. EDITING KEYS

These eight keys select the action required to modify either the stored logic within the CPU or the logic address being displayed. Those keys that can modify previously entered logic (that is, Delete and Insert) require a confirming key operation to ensure that the operation is to be executed.. Thus, if they are accidentally depressed, the error can be corrected by depressing the CLR (Clear) key without actually affecting any entered logic. A description of each editing key is as follows:

DEL — When logic is being displayed, this key (Delete) when included as the first keystroke of a two key sequence, will cause that single function to be removed (deleted) from the CPU memory. To be effective, after depressing Delete, the PRV (Previous) key must be depressed, which executes the delete operation.

INS — This key (Insert) allows logic functions to be inserted between existing logic functions. The function or its address that is after the location at which the new function is to be placed, is displayed. Then the new logic is built followed by the Insert key (not the Enter key) and the confirming NXT (Next) key. The new logic that is inserted by this key sequence will be placed in memory immediately before the displayed function or address.

ENT — The ENT (Enter) key is used to complete the entry of logic when initially building the CPU program or to replace an entire single word function. Logic functions are entered typically at the end of the existing logic.

CLR — The CLR (Clear) key, when selected, clears the programmer of previously entered commands. If error codes are displayed, this key will acknowledge the error and return the programmer to its normal (cleared) function. When monitoring a program, depressing Clear will cause the display to indicate the memory address in lieu of logic functions. When the key sequence CLR, SHF, 3, 4, 8, DEL, NXT is entered, the entire contents of memory will be cleared.

NOTE

This key sequence should be used with caution, be sure that you want to clear the entire program. Remember, if single functions or groups of functions are to be cleared, the DEL key, followed by PRV should be selected for each function to be cleared.

SHF — This key (Shift) locks all other keys to their shifted (upper label) functions and causes the SHF LED to be lit in the display area. The shift operation is ended by selecting the keys Clear or Enter. The SHF key must precede a numerical key or a group of numerals before selecting the numerical keys. For example to enter an open contact with input reference 12 as the first contact in a rung of logic, the key sequence would be STR, SHF, 1, 2, ENT.

SCH — This key (Search) allows the entire program to be searched for specific logic functions. The logic function is defined by the logic keys (without Enter), then Search is selected. The memory will be searched from the current location until either a match is found or all memory is searched. Successive depressions of this key will cause repeated searches with memory wrap-around. An unsuccessful search results in error code E99 being displayed.

PRV — When displaying logic or monitoring I/O state, selecting the PRV (Previous) key causes the previous logic function or I/O status to be displayed. Additional depressions of this key cause the display to decrement until memory address zero is reached.

NXT — When displaying logic or monitoring I/O state, selecting the NXT (Next) key causes the next logic function or I/O status to be displayed. Additional depressions of this key cause the display to increment until end of memory is reached.

7. SHIFTED FUNCTIONS

The Shift key, when selected, causes most keys to change their function to those marked on the face of the programmer directly above the corresponding keys. Normal unshifted functions are as placed on the keys themselves. Most of the shifted functions are used when entering numerical values (digits 0-9 plus the decimal point). When entering a program, the unshifted functions must be selected first (AND, OR, NOT, OUT, TMR, etc.), then the SHF is selected to enter the numerical portion of the program. The use of the other four shifted functions are as follows:

MON

When in the Run mode, this function allows the user to monitor the status of I/O references in two successive groups of 8. The specified I/O reference is used to select the first 8 references and the next group in numerical sequence is also shown to provide a total of 16 real time statuses. The specified reference should be the first reference in a group of 8, for example, specify 10 to monitor the I/O group 10 to 17. If a reference other than the first one in a group is specified, monitoring of the I/O will default to the first reference in the group. After the reference (for example 043) is entered and displayed (for example 040) as data, the status of the 8 references in that group (for example 040-047) are displayed by the first 8 LED's (AND, OR, STR, etc) in the logic display.

The next 8 references (e.g. 050) are also displayed and their status is indicated by the last 8 LED's (MCS, MCR, SET, etc). These 16 LED's will be ON or OFF as the I/O assigned to these references is energized or de-energized. As the I/O changes, the state of the LEDs changes.

To display another group of I/O references, the PRV or NXT key can be selected to decrement (40, 30, 20, etc.) or increment (50, 60, 70, etc) the group number and its associated references. References up to 577 can be displayed; there is automatic wrap-around from 570 to 000 (NXT) or 000 to 570 (PRV). The current values of timers and counters can also be monitored by entering TMR or CNT, 6XX (timer or counter reference) followed by MON (the Monitor Key).

WRITE

This function operates with an audio tape cassette recorder or certain other peripherals to effect a transfer of the CPU's logic to the peripheral. Connect the device to the tape port with the audio cable supplied with each programmer or peripheral. Set the mode switch to LOAD and turn the device ON. To begin the transfer, select the WRITE key. This starts the writing of the CPU logic onto the cassette or other peripheral. For more detailed information on transferring data to peripheral devices, refer to the discussion of each peripheral.

READ — This function operates with the audio tape cassette recorder or other peripheral to load a CPU's memory from the cassette or other storage device. Connect the device to the tape port with the audio cable supplied with each programmer or peripheral. Set the mode switch to LOAD and select the READ key. To begin the CPU loading, turn the device ON. This starts the reading of the tape and the loading of the stored program into the CPU memory.

CHECK — This function operates with the audio tape recorder or other peripheral to verify proper program transfer. After a transfer is made, it should be read back similar to the READ above; however, the CHECK key must be selected instead of READ. The Check operation does not alter either the CPU logic nor the data in the peripheral. A data compare is made between the two sources of information to ensure that there has been no error in the recording process.

NOTE

The F and R keys and the DATA and REG notation in the Logic Display are not used with a Series One Junior.

PROGRAM CHECKING AND ERROR CODES

When entering ladder logic programs with the programmer, the CPU automatically performs many checks on the data and operations selected by the programmer. Functions entered are checked for proper key sequence, proper range of references entered, etc. Errors detected during these checks are indicated in the data display by the letter E followed by a two digit code (01-99). The CPU also performs the program error check any time that the PC is switched to the RUN mode.

Table 4.1 summarizes the meaning of each error code, its cause, and possible methods of clearing the error. The use of the programmer to enter logic is documented in Chapter 5 as part of programming. However, there are many other valuable functions it provides which are shown in the following Table:

Table 4.1 ERROR CODE DEFINITIONS

Code	Applicable Mode			Significance	Cause	Corrective Action
	Run	Prog	Load			
E1	X	X	X	Incorrect Operation	Operator attempted to perform illegal operation such as changing program in RUN mode.	Examine operation. Depress CLR. Reinitiate proper function.
E2	X			Fault in Program structure.	CPU Has detected error in program when placed into RUN Mode. Example: Input module reference used as coil.	Go to Program mode. Depress CLR. Address of faulty logic will be shown. Depress NXT to display content.
E3	X			Stack Capacity Exceeded.	More than eight status levels attempted to be stored in push-down stack.	Go to Program mode. Depress CLR. Programmer will display location of first 9th STR error. Examine logic and reprogram as necessary.
E5	X			Duplicate Coil Reference.	Coil (output, internal, timer, or counter) used as an OUT more than once.	Go to Program mode. Depress CLR. Programmer will display location of second coil of pair using same reference. Enter another coil reference.
E6	X			Incomplete Master Control	More MCR references than MCS in program.	Go to Program mode. Depress CLR. Programmer will display first unmatched MCR. Correct program by deleting MCR or adding MCS.
E7	X			Incomplete Counter or Shift Register.	All control lines not provided to one or more Counters and/or Shift Registers.	Go to Program mode. Depress CLR. Programmer will display errant function. Add required reset, clock or clear lines.
E8		X		Missing Numerical Value	No preset entered for timer or counters, or shift register stage reference.	Depress CLR. Programmer will display errant time, counter, or shift register. Add required value.
E9	X			Incomplete Logic	Relay ladder line not connected to coil; relay contact(s) left incomplete or hanging.	Go to Program Mode. Depress CLR. Programmer will display first unfinished logic element. Add logic to tie this element into stored logic, or delete element(s) to remove incomplete logic.

Table 4.1 ERROR CODE DEFINITIONS (CONTINUED)

Code	Applicable Mode			Significance	Cause	Corrective Action
	Run	Prog	Load			
E11		X		Memory Full	Operator attempting to add logic to CPU already at limit.	Depress CLR. Restructure program so that logic limits will not be exceeded.
E13		X		Maximum number of High Speed Counter preset points exceeded.	Operator attempted to enter more than 20 High Speed Counter preset points.	In Program mode depress CLR. Examine logic and reprogram as necessary.
E21	X	X		Parity Failure.	CPU has detected a fault in the parity structure of its internal memory.	Go to Load Mode. Depress CLR. Reload memory from previously recorded tape or clear entire memory and reload manually. If BATT light not ON and fault can not be cleared, replace CPU module.
E25			X	Faulty Comparison	External device such as tape cassette has content that does not agree with CPU memory.	Depress CLR. Verify correct program number or tape. If correct, either rerecord tape or reload CPU.
E28			X	Weak Record Signal	Playback Signal level, such as from tape recorder, is below acceptable level.	Adjust volume level on tape recorder or other peripheral device. If ON steady for extended period of time, restart function to obtain reliable operation.
E30		X		Communications lost between PC and expansion rack. CPU stops, outputs turn off.	Cable connection broken between PC and expansion rack or power loss in expansion rack.	Check cable, I/O expansion module and expansion rack power. Fix problem. Cycle system power off and on or attach programmer and switch From RUN to PRG to RUN.
E31	X			Framing error between PC and expansion rack. CPU stops, outputs turn off.	Communications lost or interrupted between PC and expansion rack.	Check cable, I/O expansion module and expansion rack power. Fix problem. Cycle system power off and on or attach programmer and switch From RUN to PRG to RUN.

Table 4.1 ERROR CODE DEFINITIONS (CONTINUED)

Code	Applicable Mode			Significance	Cause	Corrective Action
	Run	Prog	Load			
E32	X			Parity error between PC and expansion rack. CPU stops, outputs turn off.	Communications interrupted between PC and expansion rack.	Check cable, I/O expansion module and expansion rack power. Fix problem. Cycle system power off and on or attach programmer and switch From RUN to PRG to RUN.
E33	X			Expander rack does not respond to CPU's I/O configuration request during power-up sequence.	Expansion rack does not have power.	Cycle basic unit power off and on. Ensure that power is applied to expansion rack.
E99	X	X		Unsuccessful Search	Search function has reviewed all memory and has not located required function.	Depress CLR. To cause an additional search, re-enter function and restart.

OPERATION SEQUENCES

An understanding of the basic PC operation sequences is necessary in order to effectively and efficiently enter ladder diagram programs. You should be familiar with the use of each key, alone and in sequence with other keys. The programmer is an excellent tool for program entering, editing and monitoring. Table 4.2 lists the various operations, the keystrokes required to enter those operations, and the mode or modes in which the operation can be performed. Each of the modes is indicated by a letter; R (RUN), P (PROGRAM), or L (LOAD).

Table 4.2 PC OPERATION SEQUENCES

OPERATION	KEYSTROKES	MODE R	P	L
Clear all memory	CLR SHF 3 4 8 DEL NXT		X	
Display present address	CLR	X	X	
Display present function	NXT	X	X	
Next function	NXT	X	X	
Previous function	PRV	X	X	
Go to first function in program memory	SHF NXT	X	X	
Go to specific address	SHF (address) NXT	X	X	
Search for a specific function	(Function) SHF (Ref. No.) SCH NXT	X	X	
Search for a specific reference number	SHF (Ref. No.) SCH NXT	X	X	
Insert function before the displayed function (or address)	(Function) SHF (Ref. No.) INS NXT		X	
Monitor a group of 8 consecutive references (I/O, internal coils, Shift Register coils)	SHF (Beginning Ref. No.) MON	X		
Monitor Timer or Counter accumulated value	SHF (T/C No.) MON	X		
Force a reference ON (will be overridden by user logic)	SET SHF (Ref. No.) ENT	X		
Force a reference OFF (will be overridden by user logic)	RST SHF (Ref. No.) ENT	X		

Table 4.2 (Continued)

OPERATION	KEYSTROKES	MODE R	MODE P	MODE L
Enter a function into program memory	(Function) SHF (Ref. No.) ENT			X
Transfer data to tape, printer, or PROM writer	(Optional program ID) WRITE			X
Load program memory from tape	(Optional program ID) READ			X
Verify data on tape or in PROM writer RAM against program memory	(Optional program ID) CHECK			X

The above table provides a convenient reference to the programmer keystrokes required for the various PC operations. A more detailed description of each operation is provided in the following discussion.

Monitor CPU Logic — This sequence of operation provides the steps required in order to observe the contents of user memory. You can either step forward or backward in user memory. With the Programmer installed and the mode switch in the Run or PRG (Program) position, observe or perform the following actions:

1. The programmer will display address zero indicated by four zero digits in the display with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Depress the NXT key, the logic content of memory location zero will be shown (beginning of memory or scan).
3. Successive depressions of the NXT key will cause the programmer to step through the stored program in the order that the program is scanned, from address 0.0.0.0. to the last address in the program. At any time, the CLR key can be depressed to display the address of the logic then being viewed.
4. An additional depression of the NXT key will restore the display to the logic content.
5. At any time, depressing PRV will cause the logic of the previous (closer to zero) memory location to be displayed.
6. Successive depressions of PRV will cause the programmer to step backwards through the stored program in reverse of the order that the program is scanned. At location 0.0.0.0., PRV has no effect.
7. If by successive depressions of NXT, the end of the actual program is passed, the display will show End. With each successive selection (with the NXT or PRV keys) of an unprogrammed or empty memory word, the address of the new location will flash in the display for 1/4 to 1/3 of a second prior to going to End.

SEARCH CPU LOGIC — In the event that you wish to quickly find a particular logic element (programming step) in user memory, this sequence of operation allows you to do so. After installing the programmer, with the mode switch in the RUN or PRG position, observe or perform the following actions:

1. The programmer will display address zero indicated by four zero digits in the display, decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.

2. Enter the logic function whose location is to be searched for. For example, select AND, SHF, 1, 0, 5 (AND 105). Do not select ENT key.

3. Select the SCH key to begin the search. If the logic function is not found, error code E99 will be displayed.

4. If a match is found, the display will indicate the first memory address containing the desired function. Depressing NXT will cause the logic at that address to be displayed.

5. Successive depression of SCH, while the memory address is being displayed, will cause additional searches to occur from the current location.

6. As long as one match is found, the search will not stop at the end of memory, but will continue with memory address zero until a match (possibly the same location) is again detected.

7. To find the first empty memory word, depress CLR to obtain an address location. Then select SCH (search for zero content) to begin the search for the first available location.

ALTER ONE LOGIC ELEMENT — This sequence of operation allows you to change the contents of a particular location in user memory. After installing the programmer, place the mode switch in the PRG position. Observe or perform the following actions:

1. The programmer will display address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.

2. Move the display to the element to be altered using the NXT or PRV key or Search function.

3. Enter the new logic element, for example: OR, SHF, 2, and 5 (OR 25).

4. Select the Enter (ENT) key to cause the change to occur. The new logic element you have entered will take the place of the previous logic at that memory location. The next address will be automatically displayed.

5. If the new element is not to be entered or an error has been made in its construction, depressing the Clear (CLR) key will cancel the new logic and return the display to the address of the examined element.

DELETE ONE LOGIC ELEMENT — This sequence of operation allows you to remove one logic element from the program in user memory. After installing the programmer, place the mode switch in the PRG postion. Observe or perform the following actions:

1. The programmer will display address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.

2. Move the display to the element to be deleted using the NXT or PRV key or the Search function.

3. Select the DEL key. Notice that the Address/Data display has a small "d" in the left digit of the display.

4. To confirm that the Delete operation is to be executed, select the PRV key. The next address will be displayed after the Delete is performed. The remaining user logic will automatically move back one address location (nearer to 0.0.0.0.) to fill the empty memory.

5. To cancel the Delete operation, select the CLR key (before selecting DEL). The display will revert to the element being considered for deletion.

CLEAR ALL MEMORY — This programming sequence should only be used when the entire contents of logic memory are to be cleared. After installing the programmer, place the mode switch in the PRG position. Observe or perform the following actions:

1. The programmer will display address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.

2. Select the key sequence CLR, SHF, 3, 4, 8.

3. Select the DEL key; the display will change to

4. To execute the clear function and cause all logic elements to be removed from user memory, depress the NXT key.

5. To cancel the clear function, the CLR key can be depressed before depressing NXT.

INSERT ONE LOGIC ELEMENT — This sequence of operation allows you to insert one logic element between two existing program steps in the user program. After installing the programmer, place the mode switch in the Program position. Observe or perform the following actions:

1. The programmer will display address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.

2. Move the display to the element that will be after the location at which the new element is to be entered. This can be done by using the NXT or PRV key or the Search function.

3. Enter the new logic element, for example; AND, SHF, 1, 0, and 4 (AND 104).

4. Select the Insert (INS) key to cause the change to occur. Notice that the address display has a small "i" in the left digit of the display.

5. A confirming keystroke is required to ensure that the insert action by the operator is valid. To confirm the insert, select the NXT key. After the insert is performed, the display will show the address of the next logic element.

MONITOR I/O STATUS — This operation sequence allows you to monitor the status (ON or OFF) of references. A total of 16 I/O references can be monitored at any one time, beginning with the lowest address in the group with the reference selected by the operator. Each reference is within a group of 8 references. The I/O status of the group containing the selected reference, plus the next higher group of 8, is displayed. After installing the programmer, place the mode switch in the RUN position. Observe or perform the following actions:

1. The programmer will display the address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.

2. Enter any reference to be monitored. For example, to monitor the real time status of references 020-027, or any one reference within that group, the following keys can be selected: SHF, 2 and 0.

3. Select the Monitor function (MON). Note that the shift is still in effect (selected in previous step) causing the RST key to select the monitor function.

4. The display will revert to I followed by the lowest reference (e.g. 020) in that group. If the I/O references to be monitored are assigned to a module located in a 5 or 10-slot expansion rack, the references can be for a 4, 8, or 16 point module. If the module is a 4-point module, the status of the first 4 I/O points are real world outputs and their operating status will be displayed. The 4 higher references cannot be used as real world outputs, but can be assigned to internal coils. The 4 monitor LEDs normally assigned to the 4 higher references in this group will always be OFF.

   The status of an 8 point module (for example, 030 to 037) is indicated by the first 8 LED's (AND, OR, STR, ... SR) and the next module's status, if an 8 point (for example, 040-047) will be indicated by the last 8 LEDs (MCS, MCR, SHF. . . . 7). In the case of a 16-point module, the status of all 16 points will be consecutively displayed (030 to 037 and 130 to 137)). Note that this is the only valid 16-point reference that can be used with a Series One Junior PC.

5. Depressing the NXT or PRV keys will cause the address display to increment or decrement to the next or previous group of 8 statuses or module, if in an expansion rack. All discrete references can be examined. The display returns to zero after the highest reference has been examined.

MONITOR TIMER OR COUNTER STATUS — This operation sequence allows an operator to monitor the current accumulated value of a timer or counter. After installing the programmer, place the mode switch in the RUN position. Observe or perform the following actions:

1. The programmer will display the address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Enter the timer or counter reference to be monitored. For example, to monitor the operating status of timer 601, enter SHF, 6, 0, 1). If a counter had been assigned reference 601, you would then be monitoring the status of counter 601. The valid references for timers or counters are 600 to 624 The high speed counter reference is 624. References 620, 621, 622, and 623 are reserved for future use. Remember, each valid reference can be assigned to only 1 timer or 1 counter.
3. Select the Monitor function (MON). Note that the shift selected in the previous step is still in effect causing the RST key to select the monitor function. If the selected reference is not used in the program, error code E01 will be displayed.
4. The display will contain the current content (accumulated value) of the selected timer or counter. Timer values will be displayed in tenths from 000.1 up to 999.9 and counter values will be 0001 to 9999. The Logic Display will also show the two least significant digits of the timer or counter reference (for example, 01 for timer or counter 601).
5. The NXT and PRV keys move the display to adjacent timer or counters. Any timer or counter not actually used in the logic cannot be displayed.

DISPLAY A SPECIFIC ADDRESS — This operation sequence allows you to select and display a specific memory address (location) and the logic content of that address. After installing the programmer, place the mode switch in the RUN or PRG position. Observe or perform the following actions:

1. The programmer will display the address zero indicated by four zero digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.
2. Enter the memory address to be observed. For example, if the logic contained in address 36 is to be observed, SHF, 3 and 6 would be selected.
3. The NXT key is then selected and the display will contain the selected address. To display the content of this memory address, the NXT key is depressed a second time.
4. At any time, selecting SHF then NXT will cause the display to go to address 0.0.0.0.

FORCING I/O REFERENCES — The operation sequences described in this paragraph allow you to force an Input or Output reference either on or off. Forcing the state of I/O references provides a convenient method of testing the operation of field devices and debugging the logic in the user program. If an input or output is forced on or off, it will remain in the forced state for 1 scan of the CPU. The programmer must be in the RUN mode to force I/O. After installing the programmer, place the mode switch in the RUN position. Perform the following to force I/O references.

1. The programmer will display address zero indicated by four digits in the display, with decimal points to the right of each digit (0.0.0.0.), and the ADR LED lit.

2. Enter one of the following sequences to force an I/O reference either on or off as required:

   - To force a specific I/O reference ON, enter the sequence:
     SET, SHF, XXX (I/O reference), ENT

   - To force a specific I/O reference OFF, enter the sequence:
     RST, SHF, XXX (I/O reference), ENT

3. Repeat the above operation for other I/O references to be forced.

WARNING

WHEN FORCING INPUT POINTS WITH THE SET SEQUENCE, WHICH FORCES THE INPUT TO THE ON STATE, THE PHYSICAL STATE OF THE INPUT MAY BE OVERRIDDEN. IF THE FORCED SET OCCURS IN THE USER LOGIC PROGRAM BEFORE THE INPUT IS CHECKED IN THE SAME I/O SCAN, THE SET STATE WILL TAKE PRECEDENCE AND COULD CAUSE AN OUTPUT TO BE TURNED ON AT THE WRONG TIME.

OPERATION WITH PERIPHERAL DEVICES

Several peripheral devices are available for use with the Series One Junior PC. The Programmer is required for operation with the tape recorder, when recording user programs. The tape recorder connects to the Programmer through the Programmer's tape port. The tape port is located to the right of the mode switch and is labeled TAPE. The rest of this chapter describes the operation of these peripherals, which are listed below:

Audio Tape Recorder	Various models
Printer Interface Unit	Catalog Number IC610PER151
Plug-on PROM Writer	Catalog Number IC610PER154

TAPE RECORDER OPERATION

Most audio tape recorders with auto-level control can be used with the Series One Junior PC. It is recommended that the recorder also be equipped with a counter to allow multiple programs to be recorded on tape. Units such as General Electric model 3-5158A have been tested and found fully compatible with the Series One Junior. The tape recorder allows three functions to be performed: (1) record a program onto tape, (2) load a CPU or peripheral from tape, and (3) verify the content of a tape. The operation of each of these functions is described below in a step-by-step manner. All 700 words of logic memory are recorded on tape.

A 2.5 foot (0.75 meter) audio cable (Catalog number IC610CBL151), which is gray with a red tracer, is supplied with the programmer. This cable is used only with a tape recorder and connects it to the tape port on the programmer. A solid gray cable is supplied with the stand-alone Printer and the stand-alone PROM Writer for connecting those devices to the tape port.

Recording A Program

1. Install the Programmer and apply AC power to the Series One Junior PC.
2. Turn the mode switch on the Programmer to the LOAD position.
3. Apply AC power to the tape recorder. Verify presence of the write protect tab on a cassette and insert the cassette. If the write protect tab is not in place, data entered on the tape may be inadvertently erased.
4. Adjust the tone control to its highest position.
5. Connect the Programmer (TAPE port) to the tape recorder (MIC input) with the 2.5 ft (0.75 m) audio cable (gray with red tracer).
6. Rewind tape to the beginning or to the desired record position if multiple programs are to be placed on one tape. Programs require approximately 1.5 minutes (700 words) of tape per program.
7. For identification of a program, if desired, enter a four digit number (0000-9999) on the Programmer. When tape is accessed later to load the CPU, this number can be used to identify the correct program prior to altering CPU data. If a program number is not as expected, the operator can terminate the load operation and get the correct tape without loss of existing program nor delay incurred by loading a wrong program. However, this identification number is optional.

8. Begin the tape recorder operation by depressing the RECORD button (and PLAY if required by the tape recorder).

9. Depress the WRITE key on the Programmer. The record operation will now begin.

10. If after following all instructions, reliable operation cannot be obtained, try operating the recorder with batteries.

11. When the record is complete, the Programmer will display End in the Address/Data display and the ON/OFF LED will be off. Stop the recorder and note the counter position so that the amount of tape used for that program can be determined.

12. Depress the CLR (Clear) key on the Programmer to end the record operation.

13. It is recommended that the tape be rewound to where the record began and that the Verify operation described below be performed to ensure data integrity.

Verifying A Program

1. Install the Programmer and apply AC power to the Series One Junior PC.

2. Turn the mode switch on the Programmer to the LOAD position.

3. Apply AC power to the tape recorder and insert the cassette containing the program to be verified.

4. Adjust the tape recorder's volume control to the maximum setting. Adjust the tone control to its highest setting.

5. Connect the Programmer (TAPE port) to the tape recorder (EAR input) with the audio cable (gray with red tracer).

6. Rewind the tape to the beginning of the previously recorded program. The tape can also be on the blank area prior to the program, but not on another program. Enter the program identification number (if previously recorded).

7. Depress the CHECK key on the Programmer to select the verify operation.

8. Start the tape recorder by depressing the PLAY button. The verify operation now begins.

9. Any errors detected during the verify operation are indicated by an error code being displayed on the Programmer's Address/Data display. Error code E21 indicates that the tape has an internal parity error. E25 indicates a mismatch between the content of the tape and the CPU logic memory. E28 indicates that the play level is wrong and the verify operation should be stopped, volume adjusted, and the operation restarted (from step 6 above).

10. Setting of the volume control is critical for proper operation. The error code displayed for an incorrect (low) volume control setting is E28. Figure 4.4 illustrates the area of the volume control available for a proper setting.

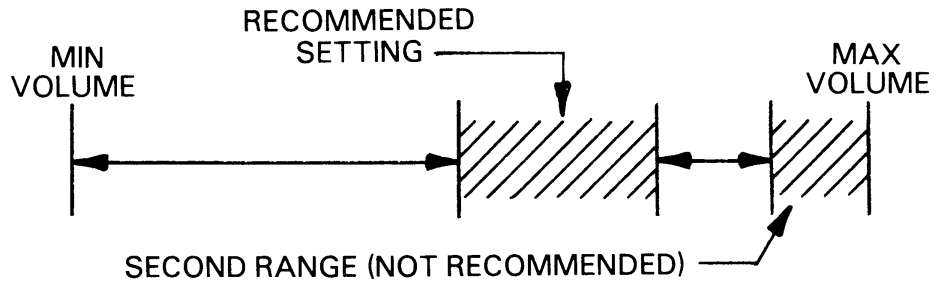


Figure 4.4 VOLUME CONTROL RANGE SETTING

With some recorders, there are two ranges where the signal level appears to be acceptable, one near the middle and one near maximum volume. The setting near maximum volume should not be used. The CPU will indicate that it is acceptable; however, an unacceptable amount of clipping distortion may occur in this area with some recorders.

11. Find the correct position for the mid-range of the acceptable volume control during the beginning or header portion of the tape. Some experimenting may be necessary. The duration of time for the header is about 12 seconds. It is important to choose the lower of the two ranges for the volume control setting if they both exist (see 10 above). For the recommended General Electric recorder this is at about 80% of the full maximum setting. Mark the proper setting with paint or some other method of identification.

12. If the volume control has been correctly set before the end of the header, the programmer display will be blank, and the lower right number 7 LED will turn on dimly. Before the end of the header the LED will turn off. A few seconds later, F will be displayed, indicating that the program has been found.

13. During the adjusting process in 11 above, the data from the tape may not be valid if the adjustment is not performed quickly enough. The tape loading should be repeated with the correct volume control setting. To clear the CPU to restart the loading, it is necessary to either power-down the CPU or remove the Programmer from the CPU, then reattach and depress the Clear key.

14. When the verify is complete without error, the Programmer will display End in the Address/Data display.

15. Stop the recorder and depress the CLR (Clear) key on the Programmer to end the verify operation.

16. The verify operation will require approximately the same time as the record operation, which is about 1.5 minutes.

Loading A Program

1. Install the Programmer and apply AC power to the Series One Junior PC.

2. Turn the mode switch on the Programmer to the LOAD position.

3. Apply AC power to the tape recorder and insert the cassette containing the required program.

4. Adjust the volume control to the setting determined during the verify operation. Adjust the tone control to its highest setting.

5. Connect the Programmer (TAPE port) to the tape recorder (EAR input) with the audio cable (gray with red tracer).

6. Rewind the tape to the beginning of a previously recorded program. Tape can also be on the blank area prior to the program, but not on another program. Enter the program identification number (if previously recorded).

7. Select the READ key on the Programmer to establish the load operation.

8. Start the tape recorder by depressing the PLAY key. The load operation now begins.

   If the CPU detects a program number different than the one entered in step 6, the programmer will beep and the display will show PA⊏ ⊏.

9. If the wrong program has been selected, the load operation can be aborted by stopping the recorder and powering-down the CPU or remove the programmer from the CPU, then reattach and depress the CLR key.

10. Any errors detected during the load operation are indicated by an error code being displayed on the Programmer's Address/Data display. Error code E21 indicates the tape has an internal parity error. A steady E28 indicates the play level is wrong and the load should be stopped, volume adjusted, and the operation restarted (step 6 above).

11. When the load is complete with no errors, the Programmer will display End in the Address/Data display and the ON/OFF LED will be off. Stop the recorder and depress the CLR (Clear) key on the Programmer to end the load operation.

12. The load operation will require approximately the same time as the record operation, which is about 1.5 minutes.

PRINTER INTERFACE UNIT

The Printer Interface Unit (catalog number IC610PER151) provides an interface between the Series One Junior PC and a printer for the purpose of providing a convenient means of obtaining a hard-copy printout of the program residing in the PC's user memory. It can also be used with a Series One PC. The format of the printout is switch selectable and can be either Boolean (mnemonic) or ladder diagram format. Many readily available, inexpensive printers, including those commonly used with personal computers can be used with the Printer Interface Unit for the printout.

A 6' (2m) Printer Interface cable and an external power supply cable are included with the Printer Interface Unit. Printer Interface Unit Specifications are listed below in Table 4.4

Table 4.4 PRINTER INTERFACE UNIT SPECIFICATIONS

Operating Temperature	0° to 60° C (32° to 140° F)
Storage Temperature	−10° to 70° C (14° to 158° F)
Humidity (non-condensing)	5 to 95%
Required Operating Power	+5 V dc ± 5%, 300 mA (minimum) (Supplied either internally from the CPU or from an external power supply)
Dimensions	5.7" x 4.7" x 1.5" (145 x 120 x 38mm)
Weight	11.68 oz (330 g)
Printer Interface	Centronics (Parallel)
Printing Capacity (maximum)	Ladder Diagram Listing 13 contacts and 1 coil per line 16 lines per page Boolean Listing 200 steps per page (4 lines with 50 steps in each line). 700 steps maximum

Table 4.5 lists the requirements that a printer must meet for use with the Printer Interface Unit.

Table 4.5 PRINTER REQUIREMENTS

- Must have a Centronics interface
- Capable of generating ASCII character code 7C H (Hexadecimal) as a " / ".
- Must respond to control codes:
  - 0E H (SO) — Expanded print ON
  - 0F H (SI) — Compressed print ON
  - 12 H (DC2) — Compressed print OFF
  - 14 H (DC4) — Expanded print OFF
- Must be capable of printing 132 columns; however, if an 80 column printer can respond to the SI (0F H) control code to allow 132 or more characters per line, it can be used. This type of printer, when used with the Printer Interface Unit, will print compressed characters. A choice of either normal (132 column) print or compressed (80 column) print is switch selectable.

- The following printers have been tested for operation and can be used with the Printer Interface Unit.

  General Electric Personal Computer Printer, model 3-8100
  Epson model RP-100
  Hewlett Packard Thinkjet, model HP 2225C
  IBM Personal Computer Graphics Printer
  Seiko model GP-500

HARDWARE DESCRIPTION

The Printer Interface Unit is a self-contained unit that attaches to the Series One Junior PC. Electrical and physical connections to the PC are made through a 26-pin connector, located on the back of the Printer Interface Unit. The Printer Interface Unit is attached to the PC by placing its 26-pin connector directly over the mating connector on the PC and gently pushing down on the unit until it is securely in place.

Connection from the Printer Interface Unit to the selected printer is made through the Printer Interface Cable, IC610CBL152A to a 24-pin connector on the front of the unit. Power to the unit can be supplied directly through the rear panel connector from the CPU power supply or from an external power source capable of supplying +5 V dc @ 300 mA. The power source, either internal (INT) or external (EXT) is selected by a 2-position switch located on the rear panel. Connection to an external power source is made through a 3-wire cable supplied with the Printer Interface Unit.

The sequence for operation of the Printer Interface Unit is initiated by depressing pushbutton switches on the front panel. Two indicator lights on the front panel provide a visual status of the Printer Interface Unit operation. There are also 2 indicators that provide operating status of the PC. Figure 4.5 is an illustration of the Printer Interface Unit showing the features mentioned above.

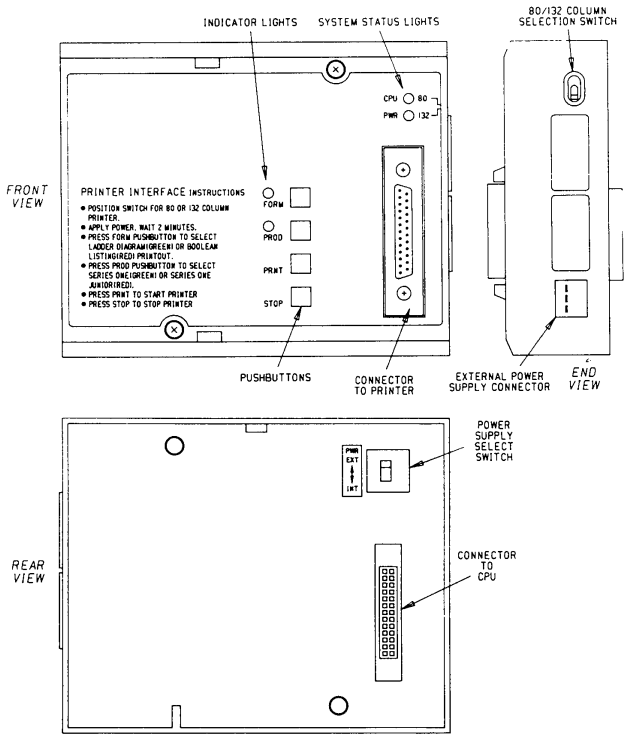


Figure 4.5 FRONT, SIDE, AND REAR VIEWS OF PRINTER INTERFACE UNIT

TPK.C.40505

HARDWARE FEATURES

The Printer Interface Unit front panel has two LEDs located in the upper right corner used for visual indication of system status. The purpose of the indicators is described below.

CPU — The red CPU LED is an indication of the status of the CPU in the PC. This is identical to the CPU LED on the Series One Junior.

ON — CPU failure has been detected.
OFF — CPU operation is normal.

PWR — The green PWR LED is an indication of the status of dc power being supplied to the Printer Interface Unit.

ON — If power is being supplied by the Series One Junior's internal power supply, this indicates that +5 V dc is being produced by the supply. If the Printer Interface Unit is being powered from an external source, the +5 V dc being supplied is within the specified tolerance.

OFF — 5 V dc not being supplied or not in tolerance.

The 24-pin connector located on the lower right of the front panel, provides a connection from the Printer Interface Unit to the selected printer through the Printer Interface cable, IC610CBL152A.

Immediately to the left of the connector are 4 pushbuttons used to initiate operation of the Printer Interface Unit to get a hard copy printout. There are also 2 LEDs used as status indicators during the set-up procedure

FORM — This pushbutton is used to select the format of the printout, either a ladder diagram or Boolean listing of the user program. The pushbutton is an alternate function switch. Each time it is depressed, the selected printout format will change.

As the pushbutton is depressed, the color of the LED will alternate between green and red. The LED, when green, indicates a ladder diagram printout; when red, indicates a Boolean listing printout.

PROD — This pushbutton is also an alternate function switch. Each time it is depressed, either a Series One Junior or Series One PC is alternately selected as the program listing source. The selection must agree with the PC to which the Printer Interface Unit is attached.

As this pushbutton is depressed, the color of the LED will alternate between green and red. The LED, when red, indicates selection of Series One Junior; when green, indicates selection of Series One.

PRNT — When depressed, this pushbutton causes the printer to begin printing the user program in the selected formats.

STOP — When depressed, this pushbutton causes the printing operation to stop.

80/132 COLUMN SELECTION SWITCH

On the right side-panel is a 2-position toggle switch used for selection of either 80 column printing format (compressed print) or 132 column printing format (normal print). The 80 column compressed print format is typically used with printers designed for use with personal computers. The selected printer column format corresponding with the switch position is printed on the right edge of the front panel, either 80 (towards the top of the unit) or 132 (towards the bottom of the unit). If desired, the 80 column compressed print format can be selected for use with a 132 column printer. The unused space to the right, beyond the 80th column, could be used for adding comments.

EXTERNAL POWER SUPPLY CONNECTOR

A connector located on the lower right side of the unit provides the connections to an external power supply. A mating 3-pin connector with attached wires which are 3 feet (1m) in length, is provided with the Printer Interface Unit for connection to the external supply. The color code for the external power supply cable and specifications for the power supply are as follows:

White	+5 V dc, ± 5% (rated at 300 mA minimum)
Black	Power supply logic ground
Green	Common system ground

POWER SUPPLY SELECT SWITCH

This is a two-position switch located on the bottom of the unit, directly above the 26-pin connector. This switch is used for selection of either internal or external dc power for the Printer Interface Unit. The top switch position is labeled EXT (External) and the bottom position is labeled INT (Internal). When used with a Series One Junior, the Printer Interface Unit should be powered by an external +5 V dc power supply and the Power Supply Select switch set to EXT.

SEQUENCE OF OPERATION

As a convenience to the user, instructions for using the Printer Interface Unit are printed on the front panel of the unit. The sequence of operation is described below.

POWER-UP SEQUENCE

The following power-up sequence should be followed after the Printer Interface Unit has been properly configured.

1. Power to be supplied by an external power supply.
2. Place EXT/INT switch in the EXT position.
3. Turn off power to the Series One Junior PC.
4. Mount Printer Interface Unit onto the PC.
5. Attach Printer Interface cable from connector on front panel of unit to printer.
6. Turn on power to the Series One Junior PC.
7. Turn on power to the external power supply.

USER PROGRAM TRANSFER FROM PC TO PRINTER INTERFACE UNIT

Immediately after the power-up sequence has been completed, the user program stored in the PC's user memory will automatically begin transferring to a buffer memory in the Printer Interface Unit. This program transfer will take about 1.5 minutes. When the program has been successfully transferred, the FORM and PROD LED indicators will turn on green. If the program transfer is not successfull, the LED indicators will either flicker on and off red or neither LED will illuminate. If after 2 minutes, neither LED turns on, repeat the power-up procedure from the beginning of the sequence.

SELECTION OF PRINTOUT FORMAT AND TYPE OF PC.

Select the printout format, either ladder diagram or Boolean, and the PC model, either Series One Junior or Series One, by depressing the FORM and PROD switches as shown in the following table.

Table 4.6 FORMAT AND PC SELECTION

FORM		PROD	
PRINTOUT TYPE	**LED ON**	**PC**	**LED ON**
Ladder	Green	Series One	Green
Ladder	Green	Series One Junior	Red
Boolean	Red	Series One	Green
Boolean	Red	Series One Junior	Red

START PRINTER OPERATION

Depress PRNT pushbutton. The ladder diagram or Boolean program listing will begin to print and continue printing until the complete program has been listed or has been stopped by the operator.

If at any time, the program listing is to be stopped, depress the STOP switch. When this is done during a ladder diagram printout, the printout will stop. When the STOP switch is depressed during a Boolean listing printout, the Boolean listing printout will stop, the printer will formfeed, and the complete OUTPUTS USED TABLE will be printed in its entirety.

PRINTING OF ERROR MESSAGES DURING LADDER DIAGRAM LISTING.

If any errors in the printing process are detected by the Printer Interface Unit during printing of a ladder diagram listing, an error message will be printed and the printing may stop, depending on the type of error. Table 4.7 lists the error messages and their definitions.

Table 4.7 LADDER DIAGRAM LISTING ERROR MESSAGES AND DEFINITIONS

ERROR MESSAGE	DEFINITION
ROW OVER	One rung of logic exceeds 16 lines.
COLUMN OVER	More than 13 circuit elements in line
STACK ERROR (SR)	Clock or Reset line not programmed in Shift Register logic.
STACK ERROR (CNT)	Reset line not programmed in Counter logic.
STACK OVER	Pushdown stack using AND STR and OR STR functions exceeds 8 levels.
STACK OVER (MCS)	Levels of MCS control exceed 8.
MC ERROR	MCR functions exceed MCS functions.
PROGRAM ERROR	Any error not listed in this table.

NOTE

When the ROW OVER or COLUMN OVER error messages are printed, the printout of the ladder diagram will continue. When any of the other error messages are printed, a PRINT STOP message will be printed, the paper will feed and the printing operation will stop.

PRINTING OF ERROR MESSAGES DURING BOOLEAN LISTING

If any errors in the printing process are detected by the Printer Interface Unit during printing of a Boolean program listing, an error message will be printed and the printing may stop, depending on the type of error. Table 4.8 lists the Boolean listing error messages and their definitions.

Table 4.8 BOOLEAN LISTING ERROR MESSAGES AND DEFINITIONS

ERROR MESSAGE INSTRUCTION OPERAND	DEFINITION
ERROR	Not a valid instruction
???	Incorrect operand

CROSS REFERENCE PRINTOUT

When the ladder diagram or Boolean printout of the user program listing has been completed, the printer will formfeed and then begin to print a cross reference printout of all outputs. The heading of this printout is, OUTPUTS USED TABLE. The outputs referenced in the user program (real world outputs, internal relays, shift registers and timers/counters) will have an annotation mark to the right of the reference number.

The OUTPUTS USED TABLE will continue printing until all output references have been printed. This printout cannot be stopped, as can the ladder diagram and Boolean listing printouts.

EXPANDED PRINT FORMAT

When a more complex ladder diagram, using MCS and MCR functions, is to be printed out, an expanded print format is used. The starting point of each MCS function is denoted by a letter, the first is A, then B, etc. The letter is carried through to the end of each page and the beginning of the next page, providing a ready reference to the continuation of the ladder logic within the bounds of each MCS/MCR control. As multiple MCS functions and the logic under their control are printed, each succeeding group of logic is shifted to the right. When a group of logic under MCS/MCR control is ended by an MCR function, (MCR) is printed in the last column to the right and the letter corresponding to that MCS/MCR logic to its right.

PRINTOUT ANNOTATION EXPLANATION

Several items appearing on the printouts in Figures 4.6 and 4.7 are explained for clarification. The ladder diagram printout in Figure 4.6 has a circled number (1-5) next to each annotation, which corresponds to the number preceding the explanation of each annotation. The circled number 6 appears before an annotation on the Boolean printout in Figure 4.7. The circled numbers (1-6) are for discussion purposes only and do not normally appear on a printout.

(1) The type of printout on each page appears on this line, either LADDER DIAGRAM PRINTOUT, BOOLEAN PRINTOUT, or CROSS REFERENCE PRINTOUT.

(2) This annotation, V X.X, is the version of the system operating software contained in PROM memory in the Printer Interface Unit.

(3) The model of PC selected by the user as the program listing source will be on this line. The annotation will be either SERIES ONE JR/SR-10 for a Series One Junior PC or SERIES ONE/SR-20 for a Series One PC.

(4) The page number of the ladder diagram printout or Boolean printout will appear here as a 4-digit decimal number, starting with PAGE 0001.

(5) Refers to ladder diagram printout only. This 4-digit decimal number is the user program memory address at the start of each rung of logic. The first element in the rung is stored at that address. In the example in Figure 4.6, the memory address of the start of the first rung is 0000. The first element in that rung is a normally open contact referenced as 000 (reference number is printed directly above the contact). The memory address at the start of the second rung is 0014, the first element in this rung is a normally open contact referenced as 010.

(6) Refers to Boolean printout only (Figure 4.7). The # sign immediately preceding a numerical value in the Boolean printout listing, indicates that the value is a reference assigned to an element at the end of a rung.

Additional explanation for annotation not shown on the examples.

Boolean printout for Series One Junior only. An (E) preceding a Timer or Counter reference (620, 621, 622 or 623) indicates that the reference is for a Timer or Counter having preset values provided by an external thumbwheel unit. A (Z) precedes the built-in High Speed Counter reference, 624.

SAMPLE PRINTOUT

Sample of each of the previously described printouts is shown in the following group of figures. For this group of printouts, a simple program was entered into the Series One Junior PC.

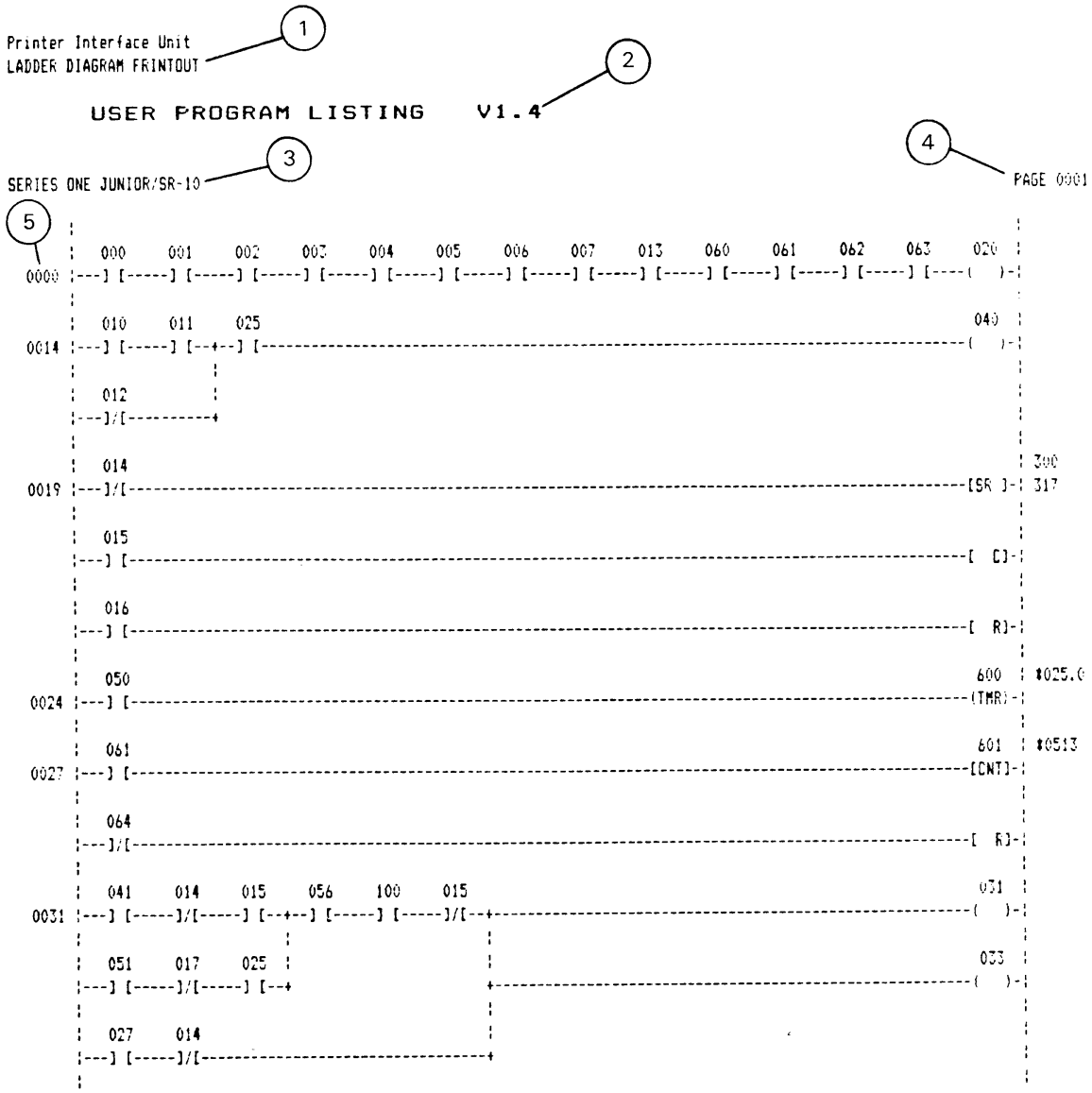


Figure 4.6 SAMPLE LADDER DIAGRAM PRINTOUT

Printer Interface Unit
BOOLEAN PRINTOUT

USER PROGRAM LISTING V1.4

SERIES ONE JUNIOR/SR-10 PAGE 0001

0000: STR 000	0050: -	0100: -	0150: -
0001: AND 001	0051: -	0101: -	0151: -
0002: AND 002	0052: -	0102: -	0152: -
0003: AND 003	0053: -	0103: -	0153: -
0004: AND 004	0054: -	0104: -	0154: -
0005: AND 005	0055: -	0105: -	0155: -
0006: AND 006	0056: -	0106: -	0156: -
0007: AND 007	0057: -	0107: -	0157: -
0008: AND 013	0058: -	0108: -	0158: -
0009: AND 060	0059: -	0109: -	0159: -
0010: AND 061	0060: -	0110: -	0160: -
0011: AND 062	0061: -	0111: -	0161: -
0012: AND 063	0062: -	0112: -	0162: -
0013: OUT # 020	0063: -	0113: -	0163: -
0014: STR 010	0064: -	0114: -	0164: -
0015: AND 011	0065: -	0115: -	0165: -
0016: OR NOT 012	0066: -	0116: -	0166: -
0017: AND 025	0067: -	0117: -	0167: -
0018: OUT # 040	0068: -	0118: -	0168: -
0019: STR NOT 014	0069: -	0119: -	0169: -
0020: STR 015	0070: -	0120: -	0170: -
0021: STR 016	0071: -	0121: -	0171: -
0022: SR # 300	0072: -	0122: -	0172: -
0023: 317	0073: -	0123: -	0173: -
0024: STR 050	0074: -	0124: -	0174: -
0025: TMR # 600	0075: -	0125: -	0175: -
0026: $025.0	0076: -	0126: -	0176: -
0027: STR 061	0077: -	0127: -	0177: -
0028: STR NOT 064	0078: -	0128: -	0178: -
0029: CNT # 601	0079: -	0129: -	0179: -
0030: # 0513	0080: -	0130: -	0180: -
0031: STR 041	0081: -	0131: -	0181: -
0032: AND NOT 014	0082: -	0132: -	0182: -
0033: AND 015	0083: -	0133: -	0183: -
0034: STR 051	0084: -	0134: -	0184: -
0035: AND NOT 017	0085: -	0135: -	0185: -
0036: AND 025	0086: -	0136: -	0186: -
0037: OR STR	0087: -	0137: -	0187: -
0038: STR 056	0088: -	0138: -	0188: -
0039: AND 100	0089: -	0139: -	0189: -
0040: AND NOT 015	0090: -	0140: -	0190: -
0041: AND STR	0091: -	0141: -	0191: -
0042: STR 027	0092: -	0142: -	0192: -
0043: AND NOT 014	0093: -	0143: -	0193: -
0044: OR STR	0094: -	0144: -	0194: -
0045: OUT # 031	0095: -	0145: -	0195: -
0046: OUT # 033	0096: -	0146: -	0196: -
0047: -	0097: -	0147: -	0197: -
0048: -	0098: -	0148: -	0198: -
0049: -	0099: -	0149: -	0199: -

Figure 4.7 SAMPLE BOOLEAN PRINTOUT

Printer Interface Unit
CROSS REFERENCE PRINTOUT

OUTPUTS USED TABLE V1.4

SERIES ONE JUNIOR/SR-10

OUTPUT

000:	010:	020: *	030:	040: *	050:
001:	011:	021:	031: *	041:	051:
002:	012:	022:	032:	042:	052:
003:	013:	023:	033: *	043:	053:
004:	014:	024:	034:	044:	054:
005:	015:	025:	035:	045:	055:
006:	016:	026:	036:	046:	056:
007:	017:	027:	037:	047:	057:

060:	070:	100:	110:	120:	130:
061:	071:	101:	111:	121:	131:
062:	072:	102:	112:	122:	132:
063:	073:	103:	113:	123:	133:
064:	074:	104:	114:	124:	134:
065:	075:	105:	115:	125:	135:
066:	076:	106:	116:	126:	136:
067:	077:	107:	117:	127:	137:

INTERNAL RELAY

140:	150:	160:	170:	200:	210:	220:	230:	240:	250:
141:	151:	161:	171:	201:	211:	221:	231:	241:	251:
142:	152:	162:	172:	202:	212:	222:	232:	242:	252:
143:	153:	163:	173:	203:	213:	223:	233:	243:	253:
144:	154:	164:	174:	204:	214:	224:	234:	244:	254:
145:	155:	165:	175:	205:	215:	225:	235:	245:	255:
146:	156:	166:	176:	206:	216:	226:	236:	246:	256:
147:	157:	167:	177:	207:	217:	227:	237:	247:	257:

260:	270:	300: *	310: *	320:	330:	340:	350:	360:	370:
261:	271:	301: *	311: *	321:	331:	341:	351:	361:	371:
262:	272:	302: *	312: *	322:	332:	342:	352:	362:	372:
263:	273:	303: *	313: *	323:	333:	343:	353:	363:	373:
264:	274:	304: *	314: *	324:	334:	344:	354:	364:	374:
265:	275:	305: *	315: *	325:	335:	345:	355:	365:	375:
266:	276:	306: *	316: *	326:	336:	346:	356:	366:	376:
267:	277:	307: *	317: *	327:	337:	347:	357:	367:	377:

Figure 4.8 SAMPLE OUTPUTS USED TABLE PRINTOUT

```
Printer Interface Unit
CROSS REFERENCE PRINTOUT

        OUTPUTS USED TABLE        V1.4


SERIES ONE JUNIOR/SR-10


TIMER/COUNTER

    600: *     610:       620:
    601: *     611:       621:
    602:       612:       622:
    603:       613:       623:
    604:       614:       624:
    605:       615:
    606:       616:
    607:       617:
```

Figure 4.9 SAMPLE OUTPUTS USED TABLE PRINTOUT (CONTINUED)

PROM WRITER UNIT

The plug-on PROM Writer unit (catalog number IC610PER154) is a compact, easy to use device that connects directly to and mounts on a Series One Junior or Series One PC. When mounted on the Series One Junior, the PROM Writer unit is used to write the contents of user memory to a 2732A-2 PROM, thereby providing a non-volatile means of user program storage. After being written to, the PROM can be installed in any Series One Junior PC as required. Programs stored in PROM memory will not be lost during no-power conditions.

An additional feature of PROM memory is that different programs can be stored on individual PROMS for use as required by various applications. Another function of the PROM Writer unit is to transfer the user memory contained in a PROM to the CMOS memory in a Series One Junior.

On the Series One Junior, the PROM Writer unit physically mounts on the lower left of the front panel, in the same manner as the programmer. A connector on the lower left rear of the PROM Writer unit attaches to the connector on the lower left of the front panel on a Series One Junior. When used with a Series One Junior, the PROM Writer unit *must* be powered by an external power supply. The source of power for the PROM Writer unit is switch selectable. Figure 4.10 is an illustration of the PROM Writer showing the location of its features, which are described in the text following the illustration.

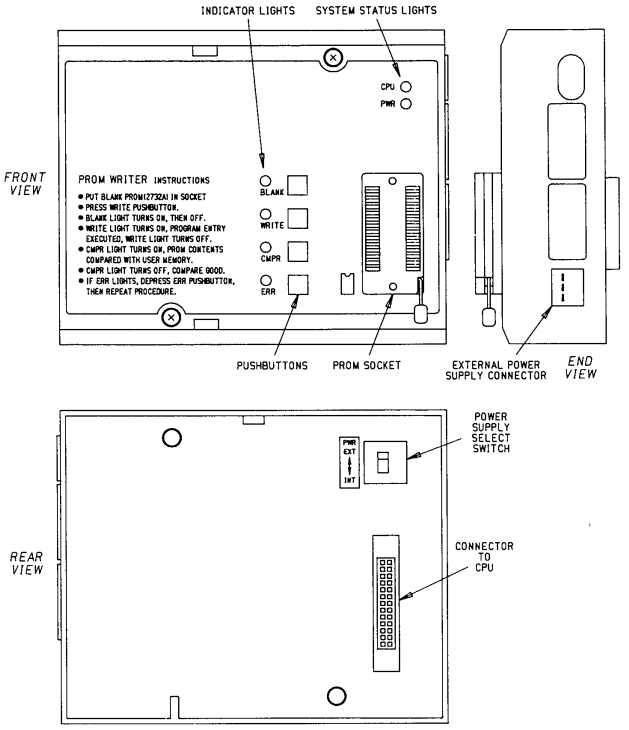


Figure 4.10 PLUG-ON PROM WRITER UNIT FEATURES

FRONT PANEL FEATURES

The front panel has two LEDs in the upper right corner which are visual indicators of system status. The purpose of the each indicator is described below.

PWR	The green PWR LED monitors the status of dc power being supplied to the PROM Writer unit.
ON	If power is being supplied by the CPU rack, this indicates that +5 V dc is being produced by the supply. If the PROM Writer unit is being powered from an external source, the +5 V dc being supplied is within the specified tolerance.
OFF	5 V dc not being supplied or not in tolerance.
CPU	The red CPU LED monitors the operating status of the CPU module. Identical to the CPU LED on the Series One Junior or a Series One CPU module.
ON	CPU failure has been detected.
OFF	CPU operation is normal.

The socket on the lower right of the panel is used to contain the PROM being written to. The socket is a zero insertion force socket. To insert a PROM into the socket, push the locking handle up, insert the PROM, then lock the PROM in place by moving the handle down to the horizontal position. The PROM should be placed in the socket with the notch towards the end of the socket closest to the PWR LED as indicated by the figure on the panel next to the socket. Even though the spacing of the slots in the socket allows easy insertion of a PROM, care should be taken to ensure that leads on the PROM are not damaged.

Immediately to the left of the socket are 4 pushbuttons and their associated LED indicators. These pushbuttons are used to initiate operation of the PROM Writer unit and the LEDs are indicators for each part of the operation.

BLANK	When depressed, initiates checking of the PROM inserted in the socket for verification that the PROM does not have any information written into it. To initiate a blank check, the pushbutton is depressed. The light will turn on, then off, indicating a successful blank check. If the light remains on, and the ERR light turns on, the PROM needs to be erased. The BLANK light will also turn on, then off during the normal operation of writing to a PROM as indicated by the instructions printed on the lower left of the unit.
WRITE	When depressed, the WRITE pushbutton initiates the sequence of events that causes the user program in the Series One Junior CMOS memory to be written to the PROM. When the WRITE pushbutton is depressed, the BLANK light will turn on, then off. Next, the WRITE light turns on, program entry is executed, then the WRITE light turns off. A blank check and verify are performed automatically when the WRITE push-

CMPR — During the sequence for writing to a PROM, this light will turn on while the contents of the PROM are being compared to the contents of user memory in RAM. The CMPR light turns off when the compare is completed and is good. If the compare is not good, the CMPR light will remain on and the ERR light will turn on. In addition, the contents of a PROM inserted in the PROM Writer unit socket can be compared to the contents of user memory, whenever the CMPR pushbutton is depressed.

ERR — This light is a visual indication that the PROM writing operation has not been successful. If the light turns on during any portion of the operation, an error has occured. If this does happen, depress the ERR pushbutton and repeat the procedure.

As a convenience to the user, the PROM Writer unit instructions for writing the contents of user memory to a PROM are printed on the lower left of the unit.

SEQUENCE OF OPERATION

The sequence of operation for writing the contents of user RAM memory to PROM memory is as follows:

WRITE OPERATION SEQUENCE	INDICATION
Depress WRITE pushbutton	WRITE light turns on
Blank check performed	WRITE light turns off BLANK light turns on
Write to PROM	BLANK light turns off WRITE light turns on
Verify contents of PROM with contents of RAM memory	WRITE light turns off CMPR light turns on
Write sequence sucessful	CMPR light turns off

The sequence of operation for transferring the contents of PROM memory to CMOS memory is as follows (the CMOS memory should be cleared first):

PROM TO RAM OPERATION SEQUENCE	INDICATION
Depress WRITE and CMPR pushbutton at the same time. Contents of PROM will be transferred to RAM memory in the PC.	WRITE light and CMPR light will turn on.
Contents of PROM and RAM memory are compared.	WRITE light turns off.
Compare good. Sequence of operation complete.	CMPR light turns off *

*If an error is detected during the compare operation, the CMPR light will remain on and the ERR light will turn on. The error can be cleared by depressing the ERR pushbutton. When this is done, the ERR and CMPR lights will turn off. If an error is indicated, repeat the operation.

EXTERNAL POWER SUPPLY CONNECTOR

A connector located on the right side of the PROM Writer unit provides the connections to an external power supply. A mating 3-pin connector with attached wires 3 feet (1m) in length, is provided with the PROM Writer unit for connection to the external supply. The color code for the external power supply cable and specifications for the power supply are as follows:

White	+5 V dc, ± 5% (rated at 0.5 amps)
Black	Power supply logic ground
Green	Common system ground

POWER SUPPLY SELECT SWITCH

This is a two-position switch located on the bottom of the PROM Writer unit, directly above the 26-pin connector. The switch is used for selection of either internal or external dc power for the PROM Writer unit. The top switch position is labeled EXT (External) and the bottom position is labeled INT (Internal). When used with the Series One Junior, the PROM Writer unit *must* be powered by an external +5 V dc power supply and the Power Supply Select Switch set to EXT. When used with a Series One PC mounted in a high-capacity rack, power can be supplied internally and the Power Supply Select Switch is set to INT.

TIMER/COUNTER SETPOINT UNIT

The Timer/Counter Setpoint Unit (IC609TCU100) provides an alternative method of entering a preset value for a timer or counter. A Timer/Counter Setpoint Unit mounts on a Series One Junior basic unit and plugs into the same connector as does the hand-held programmer. The Timer/Counter Setpoint Unit can also be connected remotely by using the 5 foot (1.5m) remote programmer cable, IC610CBL102. With the unit mounted on the PC, the hand-held programmer can then be mounted on top of the Timer/Counter Setpoint Unit, thereby providing a convenient way to monitor the operation of timers or counters. The physical size of the unit is the same as the Data Communications Unit, Printer Interface Unit and the PROM Writer Unit.

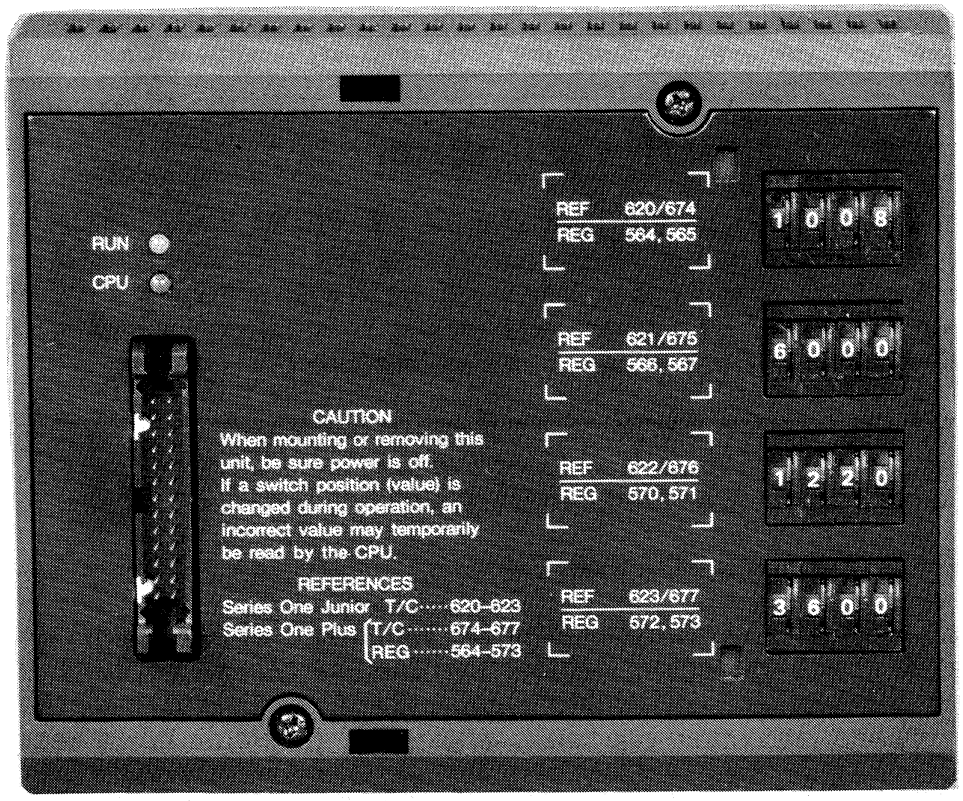


Figure 4.11 TIMER/COUNTER SETPOINT UNIT

There are four 4-digit thumbwheel switches on the unit, which provides a convenient means of entering a 4-digit BCD value into each of 4 specific internal locations in the Series One Junior PC for use as Timer/Counter preset values. When the BCD preset values have been entered into the PC, they are retained in the PC's memory as presets, even though power is removed from the PC and the unit is removed.

TIMER/COUNTER SETPOINT UNIT SPECIFICATIONS

The following table contains general specifications for the Timer/Counter Setpoint Unit.

Table 4.9 TIMER/COUNTER SETPOINT SPECIFICATIONS

Number of Circuits	4 (4 BCD digits per circuit)
Timer/Counter References	620, 621, 622, 623
Preset Values	Timer: 0.1 to 999.9 seconds Counter: 1 to 9999 events
Ambient Temperature	0° to 50°C (32° to 122°F)
Storage Temperature	−20° to 85°C (−4° to 185°F)
Humidity (non-condensing)	5% to 95%
Operating Power	Supplied internally from the PC
Environment Considerations	No corrosive gases

TPK.A.41673

REMOTE MOUNTING OF TIMER/COUNTER UNIT

A Unit Mounting Bracket, IC61 0ACC1 90, is available which allows mounting of the Timer/Counter Setpoint Unit on the outside of a panel or console. The Unit Mounting Bracket consists of a mounting bracket, connector clamp and a cable clamp. The Timer/Counter Setpoint Unit mounts on the bracket, secured by two captive screws on the unit, The unit connects to a Series One Junior PC through the round 5 foot (1 .5m) remote programmer cable, IC61 0CBL1 02.

REFERENCES FOR THE TIMER/COUNTER SETPOINT UNIT

The Timer/Counter references for the memory locations into which the BCD values are entered in the Series One Junior are 620, 621, 622 and 623. Each of the references refer directly to a memory location in the CPU that accepts one 4-digit BCD value as it is entered with each 4-position thumbwheel switch. Each thumb-wheel position represents one BCD digit, with the least significant digit being the position to the right.

Since all four BCD values are read into the PC each scan, discretion must be exercised when changing any values when the PC is running, since undesired intermediate values could be read by the CPU and used during one or several scans. It is recommended that the following CAUTION be followed.

CAUTION

WHEN MOUNTING OR REMOVING THE TIMER/COUNTER SETPOINT UNIT, BE SURE THAT POWER IS TURNED OFF. IF A SWITCH POSITION (VALUE) IS CHANGED DURING OPERATION, AN INCORRECT VALUE MAY TEMPORARILY BE READ INTO THE CPU.

EXAMPLE OF USING THUMBWHEEL INPUTS

The following example of a ladder diagram rung shows how the Timer/Counter Setpoint Unit is used to enter a preset value into a Timer.

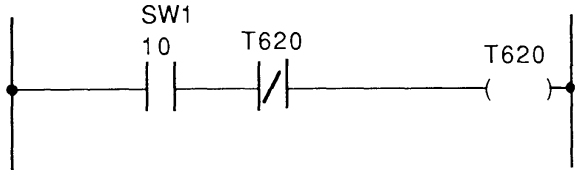


Figure 4.12 EXAMPLE OF LADDER LOGIC FOR TIMER/COUNTER SETPOINT UNIT

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