Bit No.	ON (one value) When
1	Memory Protect is ON
2	Last reset caused by memory protect violation
3	Error detected in Logic Solver hardware
4	Programming Panel connected
5	First scan following power failure

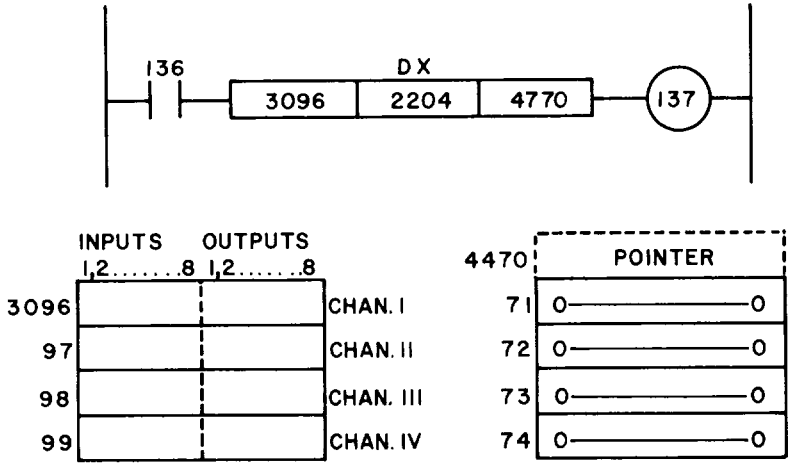

Figure 104. Example I/O Monitoring

3.8 ASCII I/O COMMUNICATIONS (384B)

The 384B Controller has all DX capabilities previously described in paragraphs 3.5, 3.6, and 3.7 for the 184, 384, and 384A Programmable Controllers. In addition, the 384B has the communications capabilities to be utilized with the 1084 Programmable Controller (including 1084 ASCII) as well as its own ASCII driving capability. Refer to the 1084 manual for complete discussion of the 1084 communications. The 384's stand-alone ASCII capability is obtained by adding four DX functions (codes 43XX, 44XX, 45LF and 46XX); these codes are discussed in the following subparagraphs. The 384B's require a TEF10 level executive to utilize the ASCII DX codes; however, they can operate on TEF08 executives if ASCII I/O is not required.

3.8.1 Introduction to ASCII Communications

ASCII I/O is obtained by using the B680 or B684 I/O module (see appendix B). When installed in I/O structure, this B680/B684 requires only one B240 or B241 slot locations. It utilizes two index pin locations, one for input capability and one for output capability, the same location as set by the user. Thus as a maximum, only eight ASCII modules (and no other modules of any type) can be installed in a single I/O channel. If less than eight ASCII modules are installed in a channel, they can be mixed with discrete and/or register I/O. Internally, each ASCII module requires four input registers

(30XX references) and four output registers (40XX references); no other module or I/O slot location should be coded to utilize data in these I/O registers. Thus, if all available register I/O is dedicated to ASCII I/O, up to eight ASCII I/O modules can be accommodated per 384B controller. Traffic cop modifications are required for each I/O slot number into which ASCII I/O modules are to be installed.

Each ASCII module is serviced separately during a 384B scan and thus they all can be active each scan. In addition, separate storage is provided for both input and output transfers, allowing simultaneous transfers (duplex operation) for each ASCII module. These ASCII communications are controlled by DX PRINT logic lines with the DX codes 43XX and 45LF (outputs) or 44XX and 46XX (inputs). As many DX logic lines can be addressed to a single ASCII module as required; however only one input and one output logic line will be actively communicating to an ASCII module at one time.

Similar to the P500 PRINT, when the A element is transistioned from open (not passing power) to closed (passing power), the print line becomes "active" and energizes its coil. If the ASCII module is available, the logic line begins commuication; if the module is already busy with another line, this line's communication is delayed until the module is available. The coil of an ASCII Print line will be energized whenever the A element is closed and de-energized when that ASCII Print operation is complete, regardless of the state of the A element.

NOTE

The A element need be closed for only one scan, and will not restart communications if it remains closed after completion of the line's function.

The first ASCII DX line activated and referenced to an ASCII module will take control of the module. Subsequent lines that are referenced to the same module, will be queued up and serviced by their line number in numerical order following the line that currently controls the ASCII module.

NOTE

Servicing these queued lines begins at the line following the currently controlling line *NOT* Line number one.

Each ASCII module in the I/O structure is provided with four consecutive output registers (40XX) for storing ASCII characters prior to their delivery to the ASCII device, and a similar number of input registers (30XX) for receipt of characters from the ASCII device. These two buffers have completely independent control and storage and can be accessed by any properly programmed logic line in the 384B controller. The only similarity is that the last two digits of the register references will be the same (i.e., 3001-3004 and 4001-4004).

NOTE

Since Traffic Cop modifications are required for all ASCII modules, it is convenient, but not necessary, to leave the normal 30XX and 40XX references to BCD/Binary numerical I/O (i.e., 3001-3016 and 4001-4016), and establish other references for the ASCII modules. Suggested references are:

MODULE	INPUTS	OUTPUTS
1	3017-3020	4017-4020
2	3021-3024	4021-4024
3	3025-3028	4025-4028
4	3029-3032	4029-4032

If more than four ASCII modules are utilized, some (or all) of the normal register I/O will be required.

The input or output buffer (four registers) are utilized in a similar operation as follows:

POINTER		Register 1
Status	Char 1	Register 2
Char 2	Char 3	Register 3
Char 4	Char 5	Register 4

The first register contains the line number which currently controls that ASCII module buffer (either input or output, but not both). A pointer of zero indicates no line has control over the buffer, it is available for use. The remaining three registers are divided in halves, and contain status relative to communication to the ASCII module or characters in the process of being transferred.

NOTE

Upon power failure, all DX ASCII PRINT logic lines have their coils de-energized, and Buffer Pointers set to zero. To abort an ASCII output, bit 1 of register 1 should be set. As long as this bit is set to a one state, all outputs to this ASCII device, will be terminated. ASCII inputs cannot be aborted.

When a properly referenced ASCII DX line is activated, it looks at the pointer (register 1) to determine if the buffer is available. If it is, it places its line number into the pointer, and loads/obtains from the buffer up to five characters. Every scan, the DX line monitors the status area and refills/empties the buffer with up to five characters if the buffer is empty/full. When the DX line has completely transferred its quantity of ASCII characters to/from the buffer, the DX line de-energizes its coil and clears the buffer pointer (register 1) to zero. The next active line referenced to this ASCII module can now take control of the buffer.

When the scan services the I/O slot to which an ASCII module is referenced, up to five characters can be transmitted to/receive from the B680/B684 I/O module. Less than five characters will be transmitted/received if the buffer is only partially full or if the B680/B684 has space for less than five characters. For example, if the scan rate of the 384B controller is 50 msec (20 scans per second), up to 100 characters can be sent/received per second. This converts to 1100 baud at eleven bits per ASCII character, (eight data, two stop, one start bits). This transmission rate is fully duplex and applies to all ASCII devices connected to the 384B controller, since each is serviced independently.

NOTE

Baud rates are a function of scan time which can depend also upon number of ASCII devices active at one time.

3.8.2 Programming DX ASCII Functions

43XX-ASCII Output

This function code copies ASCII characters stored in holding registers and provides them to a single ASCII device. The characters are assumed to be packed two per register and can be any legal ASCII character. Referring to figure 105 (line 167) the A element is a relay contact that controls when the ASCII Output is to be activated. The A element can be referenced to any line coil, discrete input, or latch reference. The B element is a pointer which indicates how many characters (NOT registers) have been provided to the output buffer; the table of registers that contain the ASCII characters must follow this register in ascending order. The B element must be a holding register (4XXX).

NOTE

The contents of the pointer will be reset to zero when the ASCII output is completed.

The C element is the DX code (43XX) where XX is replaced with the number of registers in the B element table (excluding the pointer). Thus, the maximum number of ASCII characters accessed by a 43XX DX line will be twice the XX value. The D element is the output register (40XX) to which the ASCII module is indexed. In all cases, four consecutive output registers starting at the D element register are assigned as this ASCII module's output buffer.

NOTE

No other output modules or I/O slot locations should be addressed to any of these output registers.

The coil indicates this line is busy providing ASCII characters to that particular B680/B684 module. The coil is energized when the A element is closed, and de-energized whenever the transfer to the output buffer is complete. The transfer is complete whenever the end of the table as defined by the DX code is reached or a special delimiter is encountered in the table.

NOTE

The standard delimiter is *LF* and can be altered by a Traffic Cop type change. The delimiter is outputted to the ASCII device.

When the A element of line 167 (see figure 105) is closed, coil 167 is energized. If the output buffer is available (register 4021 contains zero), the line's number is loaded into register 4021 and the first five ASCII characters are loaded from the table starting at register 4371 into the output buffer. If register 4021 did not contain zero, outputting ASCII characters is delayed until all ASCII Outputs prior to line 167 that are addressed to register 4021 are completed. Every scan when line 167 is solved, the output buffer status (bits 1-8 of register 4022) is examined until the buffer is empty. When empty, line 167 transmits the last five ASCII characters into the output buffer, de-energies its coil, and clears register 4021. If the A element is closed when its coil is de-energized, no further outputs will be commanded by line 167.

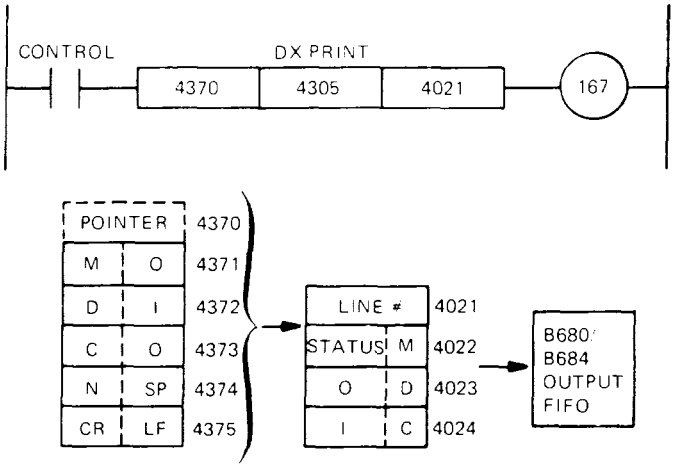

Figure 105a. ASCII Output

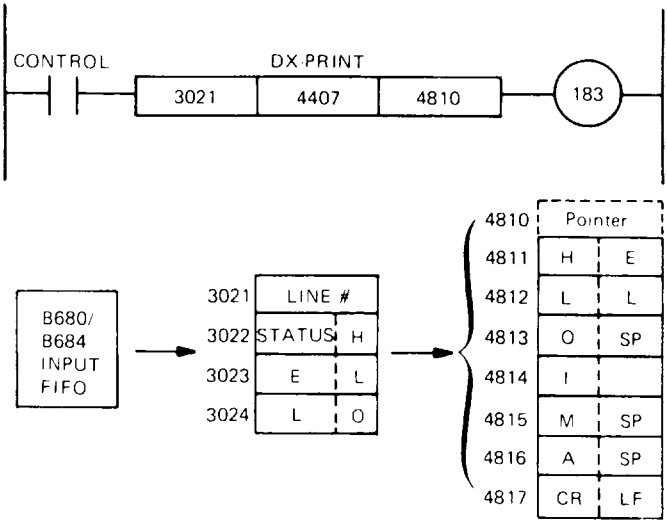

Figure 105b. ASCII Input

NOTE

If the quantity of the last set of ASCII characters loaded into the buffer is less than five (e.g., three), the status area will insure only the new characters are sent to the B680/B684 I/O module.

44XX - ASCII Input

This function code receives ASCII characters from a single ASCII device and stores them in a table of holding registers. The ASCII characters are automatically packed two per register and can be any legal ASCII character. Referring to figure 105, (line 183), the A element is a relay contact that controls when the ASCII Input is to be activated. The A element can be referenced to any line coil, discrete input, or latch reference. The B element is the input register (30XX) to which the ASCII module is indexed. In all cases, four consecutive input registers starting at the B element register are assgned as this ASCII module's input buffer.

NOTE

No other input module or I/O slot locations can be addressed to any of these input registers.

The C element is the DX code (44XX) where XX is replaced with the number of registers in the D element table (excluding the pointer). Thus the maximum number of ASCII characters loaded by a 44XX DX line will be twice the XX value. The D element is a pointer which indicates how many characters (NOT registers) have been loaded from the input buffer; the table of registers that are loaded by this line must follow this register in ascending order. The D element must be a holding register (4XXX).

NOTE

The contents of the pointer will be reset to zero when the ASCII input is completed.

The coil indicates this line is busy receivig ASCII characters from that particular B680/B684 module. The coil is energized when the A element is

closed, and de-energized whenever the transfer from the input buffer is complete. The transfer is complete whenever the end of the table as defined by the DX code is reached or a special delimiter is received from the ASCII device.

NOTE

The standard delimiter is *CR* and can be altered by a Traffic Cop type change. The delimiter is stored in the table.

When the A element of line 183 (see figure 105) is closed, coil 183 is energized. If the input buffer is available (register 3021 contains zero), register 3021 is loaded with the line's number (i.e., 183), and any ASCII characters in the buffer (up to five) are loaded into the table starting at register 4811. If register 3021 did not contain zero, receiving ASCII characters is delayed until all ASCII inputs prior to line 183 that are addressed to register 3021 are completed. Every scan when line 183 is solved the input buffer status (bits 1-8 of register 3022) is examined to determine when new input data is available. Up to five ASCII characters are received every scan; the buffer does not have to be full to be acted upon by the DX 44XX logic line. After fourteen characters are received in this particular example (DX code 4407), line 183 will de-energize its coil and clear register 3021. If the A element is closed when its coil is de-energized no further inputs will be commanded by line 183.

45LF-ASCII Numerical Output

This function code operates similar to function code 43XX, except that the data to be outputted is four BCD numerical digits per register. The content of each register of the B element table is automatically converted from binary to BCD, and each resultant BCD digit is provided to the ASCII module as an ASCII character. Digits are provided first from the high order (1000's) digit.

The format of outputting data is controlled by the L and F characters of the DX code. The L character specifies the number of lines to be outputted (1 to 9) each followed by a single carriage return and a line feed. The content of each line is controlled by the F or format character as follows:

F Code	Digits Per Column	Number of Columns	Spaces Between Columns	Registers Per Line	Characters Per Line
0	4	1	0	1	4
1	8	1	0	2	8
2	4	2	8	2	16
3	8	2	8	4	24
4	4	4	8	4	40
5	8	4	4	8	44
6	4	8	4	8	60
7	8	8	2	16	78
8	4	12	2	12	70
9	4	16	1	16	79

NOTE

Sufficient registers must be provided to support the content of the format specified.

If a line quantity of zero is specified, the ASCII output line will provide to the output buffer a single carriage return followed by the number of line feeds specified by the F character (0-9). Any spaces, carriage returns, or line

feeds required by the format of numerical ASCII output is automatically generated by DX function and does not require register storage.

NOTE

The B element register is not utilized with DX codes 450F and can be any legal register value.

The first four registers in the table associated with the BCD values to be outputted, are utilized by the ASCII output for internal statuses. These registers are not included in the table length as defined by the L and F digits of the DX code. The first register records the number of registers that have been converted to BCD values and then to ASCII characters. The second register stores various status information about the transfers and when to generate spaces or line feeds. The remaining two registers temporarily store ASCII characters after conversion and prior to their delivery to the output buffer. These registers must be allocated to the ASCII Print line, cannot be used elsewhere in the program, and must not be altered by the user.

As an example, refer to figure 106, line 362. When line 278 energizes its coil, line 362 also energizes its coil and monitors register 4025. If register 4025 contains a zero (buffer available), line 362 takes control of the buffer and begins to output the ASCII data. Since there are three lines required, each with four registers content separated by eight spaces (DX code 4534), a total of 16 (12+4 internals) registers is required in the B element table. Thus, this line provides to the ASCII device the content of registers 4235-4246 separated by appropriate spaces and line feeds. Line 266 of figure 106 will cause a single carriage return and two line feeds to be generated when line coil 283 is energized.

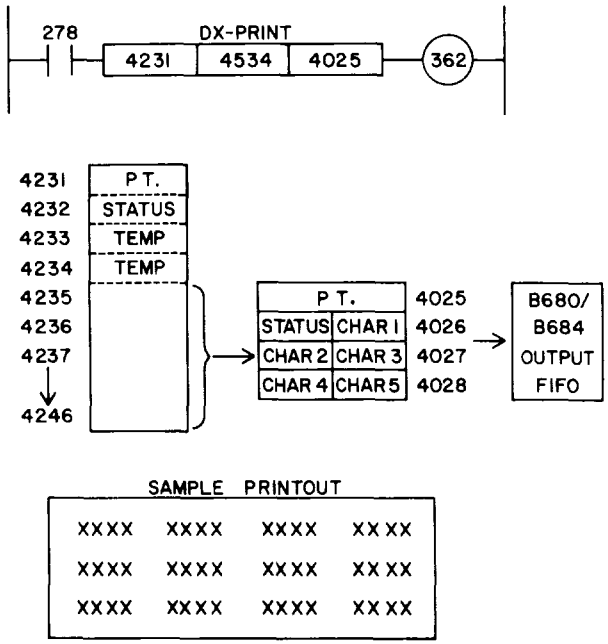

Figure 106a. ASCII Numerical Output

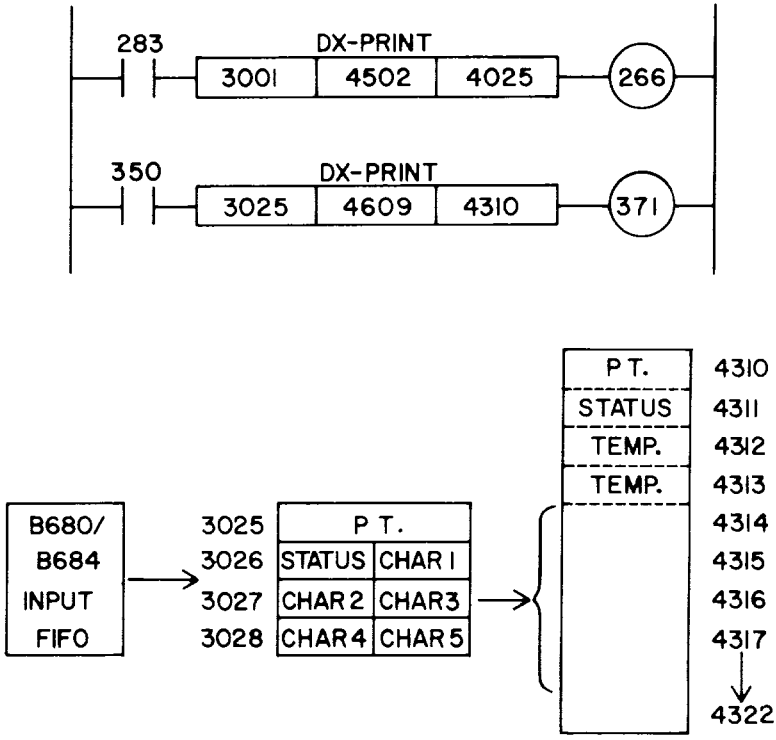

Figure 106b. ASCII Numerical Input

46XX-ASCII Numerical Input

This function code operates similar to function code 44XX except that the data received is packed up to four BCD numerical digits per register. ASCII characters other than numerical values, space, or a delimiter (carriage return) will be ignored and not effect the ASCII inputting via the 46XX code. Digits are stored in registers with each new digit causing previous digits stored in the register to be shifted to left (higher order). After four digits are received, the next register in the D element table is loaded with the next numerical character. If a space character is received after a register contains at least one BCD digit, loading that register is stopped and the next register is accessed. The loading of this table is terminated whenever the end of the table as defined by the XX of the DX code is reached, or if the delimiter is detected (CR).

As an example, refer to line 371 of figure 106. When line 350 energizes its coil, line 371 also energizes its coil and monitors register 3025. If register 3025 contains a zero (buffer available), line 371 takes control of the buffer and begins to input the ASCII data. Since there are nine registers in the D element table (plus 4 internal), up to 36 numerical digits (including zeros), can be received. The pointer in register 4310 contains the number of

registers in the table that have been loaded. The content of all registers loaded by this DX line (e.g., 4314-4322) is automatically converted to binary after all digits for that register are received.

Delimiters

There are two separate delimiters in each 384B controller; one operating on ASCII inputs and the other on ASCII outputs. The same delimiters are used for both 1084 ASCII communications as well as DX (stand-alone) ASCII. Each delimiter can be altered from the Service Center similar to changing the Traffic Cop. Unless otherwise requested, delimiters will be a Carriage Return (CR) for inputting and Line Feed (LF) for outputting. Delimiter for numerical ASCII (45LF and 46XX) can NOT be changed.