ASCII Data Transfer to the SLC 500™ BASIC Module (Series B)

Introduction

This application note demonstrates how to transfer ASCII data to an SLC 5/02™ or later processor by using a remote SLC 500 BASIC module. An example shows how to transfer a maximum of 10 ASCII characters to an SLC 5/03™ processor.

General Information

M-files cannot be accessed from a module in a remote I/O chassis. Therefore, the BASIC module (Catalog Number 1746-BAS) is limited to its 8 input and 8 output image words for data transfer between itself and the SLC 5/02 or later processor. The first three words of the I/O image are reserved for handshake bits, status, and character count respectively. So, only 5 input and 5 output words are available for actual data transfers. In addition, since a total of 8 words of image are used, they must be block transferred because they do not fit in the image allocated in the Remote I/O Adapter module (Catalog Number 1747-ASB).

To keep the BASIC programming to a minimum and the throughput to a maximum, CALL 22 is used to transfer data from PRT1 on the BASIC module to the SLC 5/03 processor in this case. CALL 22 operates on an interrupt basis, so the throughput of data from PRT1 to the backplane is 10 ms or less. To calculate overall throughput for your specific system, consult your Remote I/O Adapter User Manual (Publication 1747-6.13) and your Remote I/O Scanner User Manual (Publication 1747-6.6).

If you also wish to transfer data from a SLC 5/02 or later processor to a BASIC module in a remote I/O chassis, please refer to the BASIC Language Reference Manual (Publication 1746-6.3) and refer to the section on CALL 23.

Description of the Application Example

This application example transfers up to 10 ASCII characters to the SLC 5/03 processor. Each data packet less than 10 characters must be terminated with a carriage return character (13 decimal) in order to alert the BASIC module to transfer the data to the backplane. This termination character may actually be any unique character. If you require a different termination character, simply replace the "13" in line 150 of the BASIC program with the decimal equivalent of the new termination character.

Layout

Belden #9463 RIO Cable
10,000 ft. maximum length

Send 1 – 10 characters maximum per packet terminated with <CR>
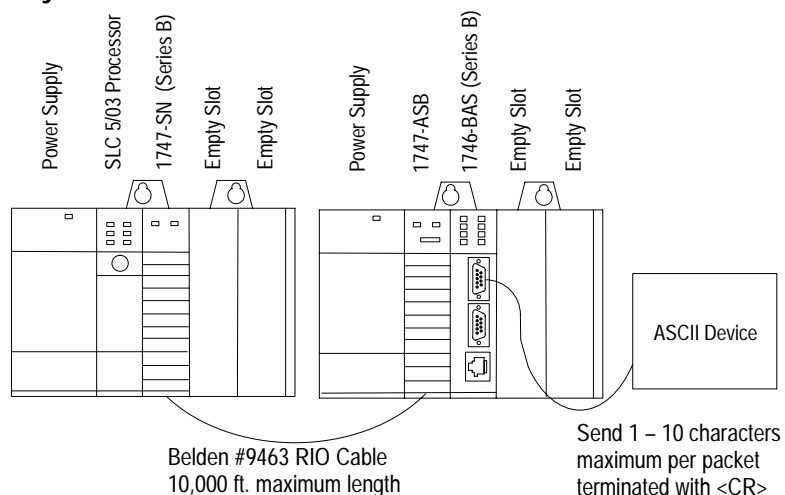
Hardware and Software Configuration Information

N7:50 to N7:52 are the control words for the BTR function. N7:53 to N7:55 are the control words for the BTW function. For this example, the following values must be placed in these words prior to executing the ladder logic program:

- N7:50 – Must set bit 7 of this word to make it a BTR
- N7:51 – BT length, set to decimal 8
- N7:52 – RIO address (R, G, S), set to 100 decimal

- N7:53 – Must be sure bit 7 is a 0 to make it a BTW
- N7:54 – BT length, set to decimal 1 (only one word required to transfer handshake bits).
- N7:55 – RIO address (R, G, S), set to 100 decimal

For this application example, the Remote I/O Adapter module is configured as a logical rack 1, starting group 0, ¼ logical rack size. Also, 1-slot addressing and 57.6K baud is used.

Adapter Module (1747-ASB) Dip Switch Settings

Number	Switches		
	SW1	SW2	SW3
1	ON	ON	OFF
2	ON	ON	ON
3	ON	OFF	OFF
4	ON	ON	OFF
5	ON	ON	ON
6	OFF	ON	OFF
7	ON	ON	OFF
8	ON	ON	ON

Remote I/O Scanner Module (1747-SN, Series B) Dip Switch Settings

Switch	Position
1	ON
2	ON

Remote I/O Scanner module G-File Settings:

- G0: Cannot Manipulate – Set by the scanner module
- G1: 0000 0000 0001 0000 – Rack 1, Starting Group 0
- G2: 0000 0000 0001 0000 – Size = ¼ Logical Rack

The M-files (M0 and M1) for the Remote I/O Scanner module must be set to a length of 300 minimum each for this example, because two block transfers are used (BTR and BTW).

Program Information

BASIC Program

```
  0 REM*********************************************************
 10 REM** Program to demonstrate CALL 22 functionality for    **
 20 REM** channel 1 using the input image  ********************
 30 REM*********************************************************
 40 REM Set port parameters for PRT1
 50 MODE(PRT1,9600,N,8,1,N,R)
 60 REM Clear input and output buffers at power-up
 70 PUSH 2
 80 CALL 96
 90 REM Initialize CALL 22 for PRT1
100 REM PRT1
110 PUSH 1
120 REM Maximum character count (includes termination character)
130 PUSH 10
140 REM Carriage return for termination character (13 decimal)
150 PUSH 13
160 REM Destination file is input image
170 PUSH 0
180 REM Word offset (must be 2 for the input image)
190 PUSH 2
200 REM String not used
210 PUSH 0
220 REM Enable byte swapping
230 PUSH 1
240 CALL 22
250 REM CALL 22 status
260 POP S
270 REM After CALL 22 is setup, simply loop waiting for data
280 GOTO 280
```

Data Table

```
Address Data (Radix = Hex)
 N7:0    0000 0000 000A 3132 3334 3536 3738 390D 0000 0000
 N7:10   0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
 N7:20   0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
 N7:30   0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
 N7:40   0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
 N7:50   8080 0008 0064 0000 0001 0064 0000 0000 0000 0000
 N7:60   4400 0000 0064 0000 0000 0001 0064 0000 0000 0000
 N7:70   0100 0000 000A 3132 3334 3536 3738 390D
```

Ladder Logic Program

```
Rung 2:0
Configure the BT operation type, length, and RIO address (R, G, S in decimal) at
power-up.  N7:50/7 must be set to a "1" to indicate a BTR.  N7:53/7 must be a
logical "0" to indicate a BTW operation.
|                                                                              |
|                                                                              |
|                                                                              |
| POWER-UP                                           BTR                       |
| BIT                                                CONTROL                   |
|    S:1                                          +COP--------------+          |
|----] [------------------------------------------+-+COPY FILE       +-+-|
|     15                                          | |Source     #N7:50| | |
|                                                 | |Dest    #M0:1.100| | |
|                                                 | |Length          3| | |
|                                                 | +-----------------+ | |
|                                                 |                     | |
|                                                 |                     | |
|                                                 |                     | |
|                                                 |      BTW            | |
|                                                 |      CONTROL        | |
|                                                 | +COP--------------+ | |
|                                                 +-+COPY FILE       +-+ |
|                                                   |Source     #N7:53|   |
|                                                   |Dest    #M0:1.200|   |
|                                                   |Length          3|   |
|                                                   +-----------------+   |
Rung 2:1
Copy the BTR status area to an integer file only when a BTR is in progress.     |
This status data is used throughout the program to limit the number of M-file   |
accesses.                                                                       |
|                                                                              |
|                                                                              |
|                                                                              |
|   BTR                                                                        |
|   PENDING                                          BTR STATUS                |
|     B3                                          +COP--------------+          |
|-+----] [-----+----------------------------------------+COPY FILE       +-|
| |     0      |                                   |Source    #M1:1.100|   |
| |            |                                   |Dest        #N7:60|   |
| |            |                                   |Length           4|   |
| |            |                                   +-----------------+     |
| |            |                                                           |
| | CHECK BTR  |                                                           |
| | STATUS     |                                                           |
| |    B3      |                                                           |
| +----] [-----+                                                           |
|      2                                                                   |
```
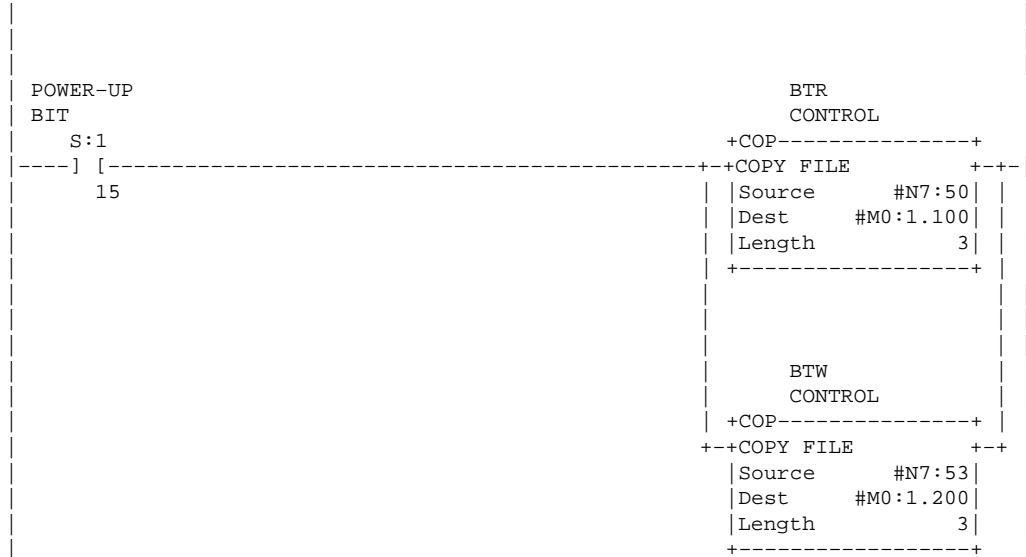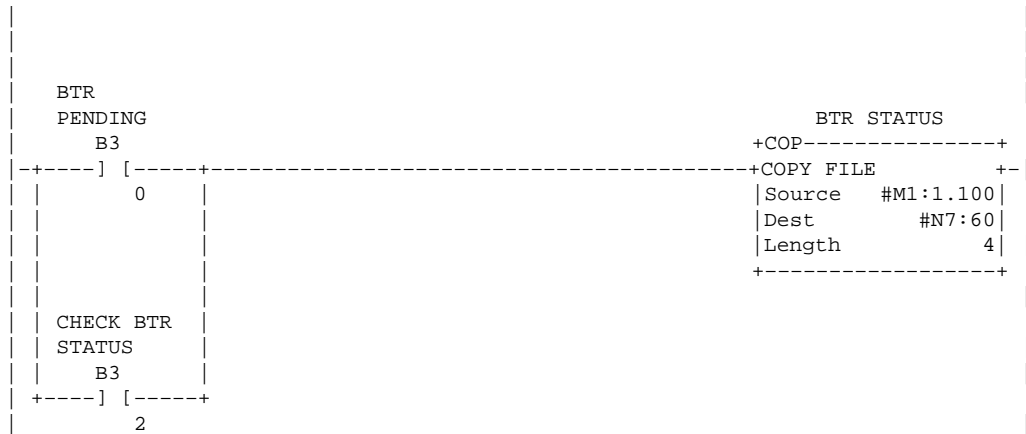
```
Rung 2:2
Unlatch the bit that continues to check the BTR status.  When a BTR is complete,
the Done or Error bit is set.  The ladder program must then unlatch the Enable
bit, then wait for the SN module to turn off the Done/Error bit before another
BTR to the same M-file location can be initiated.  This is one complete BTR cycle.
|                                                                               |
|                                                                               |
|   VIRTUAL                                                                      |
|   BTR DONE                                                          CHECK BTR  |
|   BIT                                                               STATUS     |
|     N7:60                                                              B3      |
|-+----]/[-----+-------------------------------------------------------(U)-----|
| |      13    |                                                         2       |
| |           |                                                                 |
| |           |                                                                 |
| | VIRTUAL   |                                                                 |
| | BTR ERROR |                                                                 |
| | BIT       |                                                                 |
| |   N7:60   |                                                                 |
| +----]/[-----+                                                                 |
|       12                                                                       |
Rung 2:3                                                                         |
Copy the BTW status area to an integer file only when a BTW is in progress.      |
This status data is used throughout the program and will limit the M-file        |
accesses.                                                                        |
|                                                                               |
|                                                                               |
|                                                                               |
|   BTW                                                               BTW        |
|   PENDING                                                           STATUS     |
|      B3                                                         +COP--------------+ |
|-+----] [-----+---------------------------------------+COPY FILE        +-|
| |       1    |                                       |Source   #M1:1.200| |
| |           |                                        |Dest        #N7:64| |
| |           |                                        |Length           4| |
| |           |                                        +-----------------+ |
| |           |                                                                 |
| | CHECK BTW |                                                                 |
| | STATUS    |                                                                 |
| |    B3     |                                                                 |
| +----] [-----+                                                                 |
|        3                                                                       |
Rung 2:4                                                                         |
Unlatch the bit that continues to check the BTW status.  When a BTW is           |
complete, the Done or Error bit is set.  The ladder program must then unlatch    |
the Enable bit, then wait for the SN Module to turn off the Done/Error bit       |
before another BTW to the same M-file location can be initiated.  This           |
completes one BTW cycle.                                                         |
|                                                                               |
|                                                                               |
|   VIRTUAL                                                                      |
|   BTW DONE                                                          CHECK BTW  |
|   BIT                                                               STATUS     |
|     N7:64                                                              B3      |
|-+----]/[-----+-------------------------------------------------------(U)-----|
| |      13    |                                                         3       |
| |           |                                                                 |
| |           |                                                                 |
| | VIRTUAL   |                                                                 |
| | BTW ERROR |                                                                 |
| | BIT       |                                                                 |
| |   N7:64   |                                                                 |
| +----]/[-----+                                                                 |
|       12                                                                       |
```

Rung 2:5
When a BTR successfully completes, buffer the BTR data and unlatch both the BTR
virtual Enable bit and the BTR Pending bit. Also, latch the bit that continues
checking the BTR status until the SN Module turns off the Done bit.

```
|                                                                            |
|                                                                            |
| VIRTUAL                                                                    |
| BTR DONE                                                                   |
| BIT                                               BTR DATA                 |
|   N7:60                                          +COP--------------+       |
|----] [------------------------------------------+-+COPY FILE       +-+-|
|       13                                         | |Source   #M1:1.110| | |
|                                                  | |Dest          #N7:0| | |
|                                                  | |Length            8| | |
|                                                  | +------------------+ | |
|                                                  |                      | |
|                                                  | BTR                  | |
|                                                  | PENDING              | |
|                                                  |    B3                | |
|                                                  +----(U)--------------+ |
|                                                  |         0            | |
|                                                  |                      | |
|                                                  | VIRTUAL              | |
|                                                  | BTR ENABLE           | |
|                                                  | BIT                  | |
|                                                  |   N7:50              | |
|                                                  +----(U)--------------+ |
|                                                  |        15            | |
|                                                  |                      | |
|                                                  | CHECK BTR            | |
|                                                  | STATUS               | |
|                                                  |    B3                | |
|                                                  +----(L)--------------+ |
|                                                           2                |
|                                                                            |
```
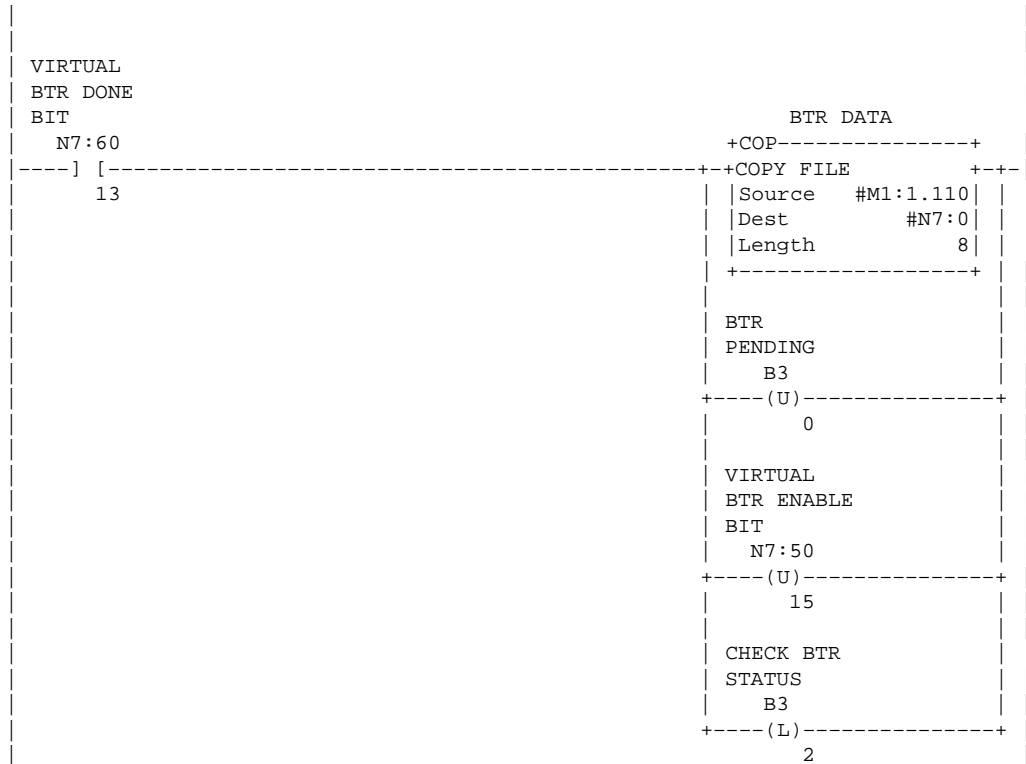
Rung 2:6
When the BASIC Module CALL 22 Handshake bit is set to a "1", the BTR data is
valid. Buffer the data (or use it based on your application) and set the
output Handshake bit to let the BASIC Module know that the data was received.

```
| BASIC                                                                      |
| MODULE /                                                                   |
| CALL 22                                                                    |
| INPUT HANDSHAKE                                    VALID BTR               |
| BIT                                                  DATA                  |
|   N7:0                                            +COP--------------+      |
|----] [------------------------------------------+-+COPY FILE       +-+-|
|       8                                          | |Source        #N7:0| | |
|                                                  | |Dest         #N7:70| | |
|                                                  | |Length            8| | |
|                                                  | +------------------+ | |
|                                                  | BASIC                | |
|                                                  | MODULE /             | |
|                                                  | CALL 22              | |
|                                                  | OUTPUT HANDSHAKE     | |
|                                                  | BIT                  | |
|                                                  |   N7:10              | |
|                                                  +----(  )--------------+ |
|                                                           8                |
|                                                                            |
```
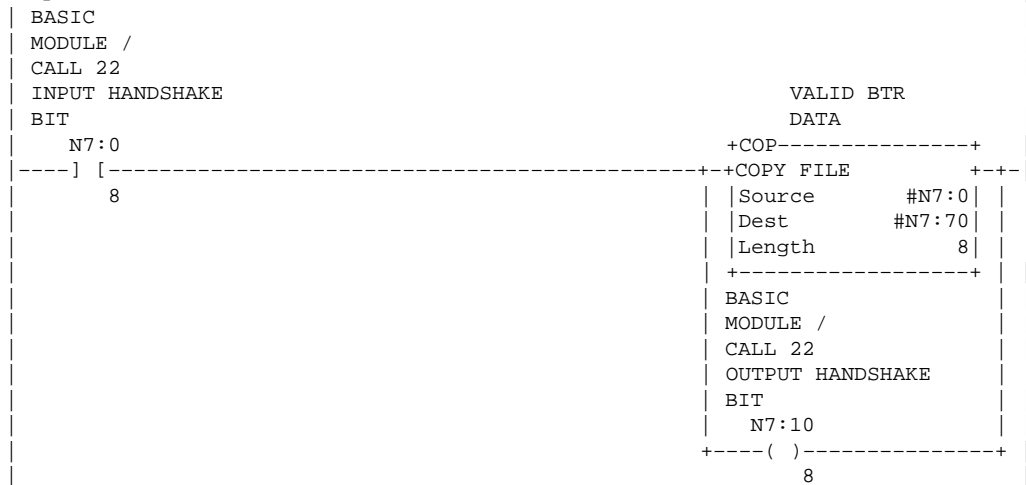
```
Rung 2:7
When a BTR unsuccessfully completes, buffer the BTR error code and unlatch the
BTR Enable bit and the BTR Pending bit.  Also, latch the check BTR Status bit
in order to continue reading the status information from the scanner until it
turns the Error bit off, completing the hand-shake process.
|                                                                             |
|                                                                             |
| VIRTUAL                                                                     |
| BTR ERROR                                             BTR ERROR             |
| BIT                                                   CODE                  |
|   N7:60                                              +MOV--------------+    |
|----] [----------------------------------------------+-+MOVE          +-+-|
|      12                                              | |Source   M1:1.103| | |
|                                                      | |               *| | |
|                                                      | |Dest       N7:21| | |
|                                                      | |              0| | |
|                                                      | +----------------+ | |
|                                                      |                    | |
|                                                      | BTR                | |
|                                                      | PENDING            | |
|                                                      |   B3               | |
|                                                      +----(U)-------------+ |
|                                                      |    0               | |
|                                                      |                    | |
|                                                      | VIRTUAL            | |
|                                                      | BTR ENABLE         | |
|                                                      | BIT                | |
|                                                      |   N7:50            | |
|                                                      +----(U)-------------+ |
|                                                      |    15              | |
|                                                      |                    | |
|                                                      | CHECK BTR          | |
|                                                      | STATUS             | |
|                                                      |   B3               | |
|                                                      +----(L)-------------+ |
|                                                      |    2               | |
```

Rung 2:8
When a BTW successfully or unsuccessfully completes, unlatch the BTW Enable
bit and the BTW Pending bit to complete a BTW sequence. Also, latch the bit
that continues checking the BTW status until the SN Module turns the
Done/Error bit off.

```
|                                                                           |
|                                                                           |
|   VIRTUAL                                                                 |
|   BTW DONE                                          BTW                    |
|   BIT                                               PENDING                |
|    N7:64                                             B3                    |
|-+----] [-----+------------------------------------+----(U)---------------+-|
| |      13    |                                    |      1              | |
| |           |                                    |                     | |
| |  VIRTUAL  |                                    |  VIRTUAL            | |
| |  BTW ERROR|                                    |  BTW ENABLE         | |
| |  BIT      |                                    |  BIT               | |
| |   N7:64   |                                    |   N7:53            | |
| +----] [-----+                                   +----(U)---------------+ |
|       12                                         |      15              | |
|                                                  |                     | |
|                                                  |  CHECK BTW          | |
|                                                  |  STATUS             | |
|                                                  |    B3               | |
|                                                  +----(L)---------------+ |
|                                                  |      3              | |
|                                                  |                     | |
|                                                  |    BTW ERROR        | |
|                                                  |    CODE             | |
|                                                  | +MOV--------------+ | |
|                                                  +-+MOVE           +-+ |
|                                                  |Source    M1:1.203|   |
|                                                  |                 *|   |
|                                                  |Dest        N7:22|   |
|                                                  |                 0|   |
|                                                  +-----------------+    |
|                                                                           |
```
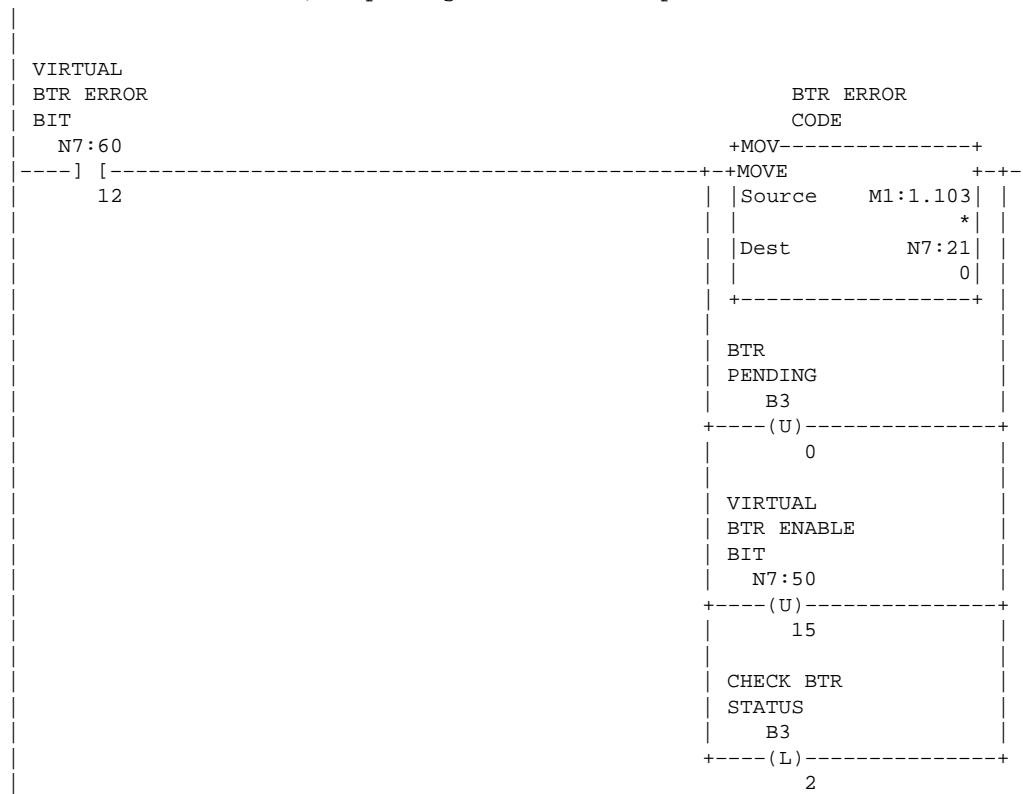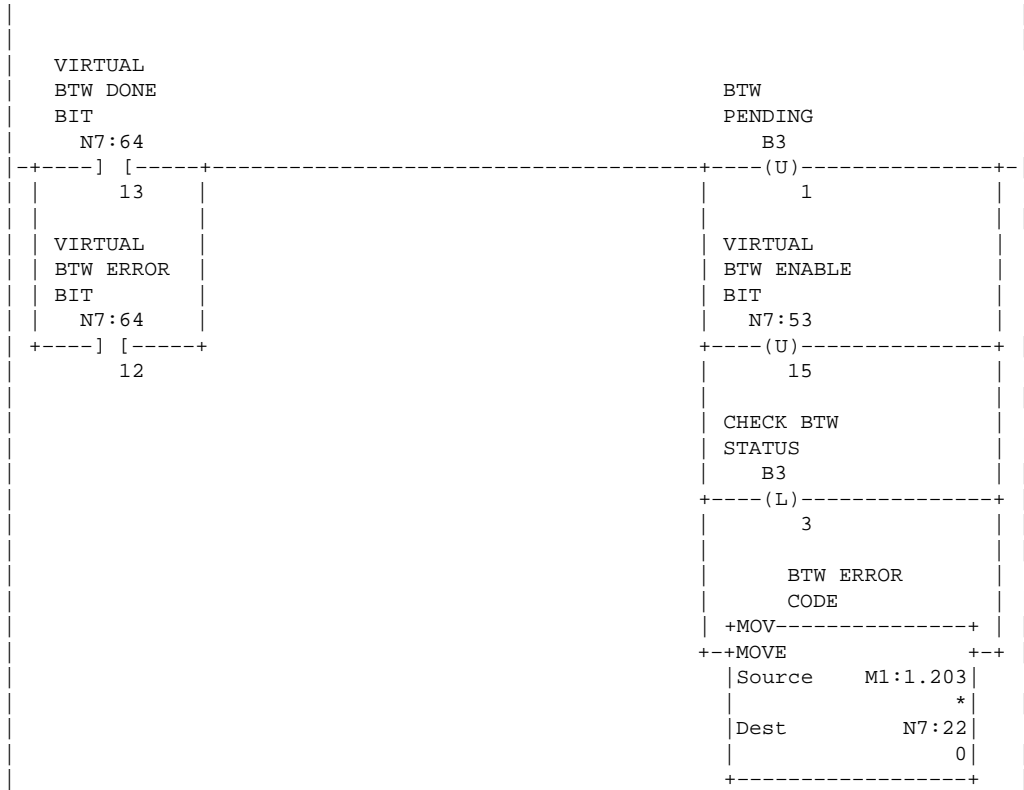
```
Rung 2:9
This rung and the next rung will toggle between executing a BTR and a BTW while
the user supplied BT Precondition bit (B3:0/11 is used in this example) is true.
|              |          |          |          |                                    |
|              |          |          |          |                                    |
| BT           |VIRTUAL   |VIRTUAL   |VIRTUAL   |VIRTUAL                             |
| PRECONDI-    |BTR ENABLE|BTW ENABLE|BTR DONE  |BTR ERROR        BTR               |
| TION BIT     |BIT       |BIT       |BIT       |BIT              PENDING           |
|    B3        N7:50     N7:53      N7:60      N7:60                 B3             |
|----] [--------]/[--------]/[--------]/[--------]/[------------+----(L)-----+-|
|     11          15         15         13         12           |       0    | |
|                                                               |            | |
|                                                               | VIRTUAL    | |
|                                                               | BTR ENABLE | |
|                                                               | BIT        | |
|                                                               |   N7:50    | |
|                                                               +----(L)-----+ |
|                                                                     15        |
|                                                                              |
Rung 2:10                                                                      |
|              |          |          |          |                             |
|              |          |          |          |                             |
| BT           |VIRTUAL   |VIRTUAL   |VIRTUAL   |VIRTUAL                      |
| PRECONDI-    |BTR ENABLE|BTW ENABLE|BTW DONE  |BTW ERROR                    |
| TION BIT     |BIT       |BIT       |BIT       |BIT              BTW DATA     |
|    B3        N7:50     N7:53      N7:64      N7:64    +COP---------------+   |
|----] [--------]/[--------]/[--------]/[--------]/[--+-+COPY FILE        +-+-|
|     11          15         15         13         12 | |Source    #N7:10| | |
|                                                     | |Dest   #M0:1.210| | |
|                                                     | |Length         1| | |
|                                                     | +----------------+ | |
|                                                     |                    | |
|                                                     | VIRTUAL            | |
|                                                     | BTW ENABLE         | |
|                                                     | BIT                | |
|                                                     |   N7:53            | |
|                                                     +----(L)---------------+ |
|                                                     |     15             | |
|                                                     |                    | |
|                                                     | BTW               | |
|                                                     | PENDING           | |
|                                                     |    B3             | |
|                                                     +----(L)---------------+ |
|                                                     |     1             |
|                                                                              |
```
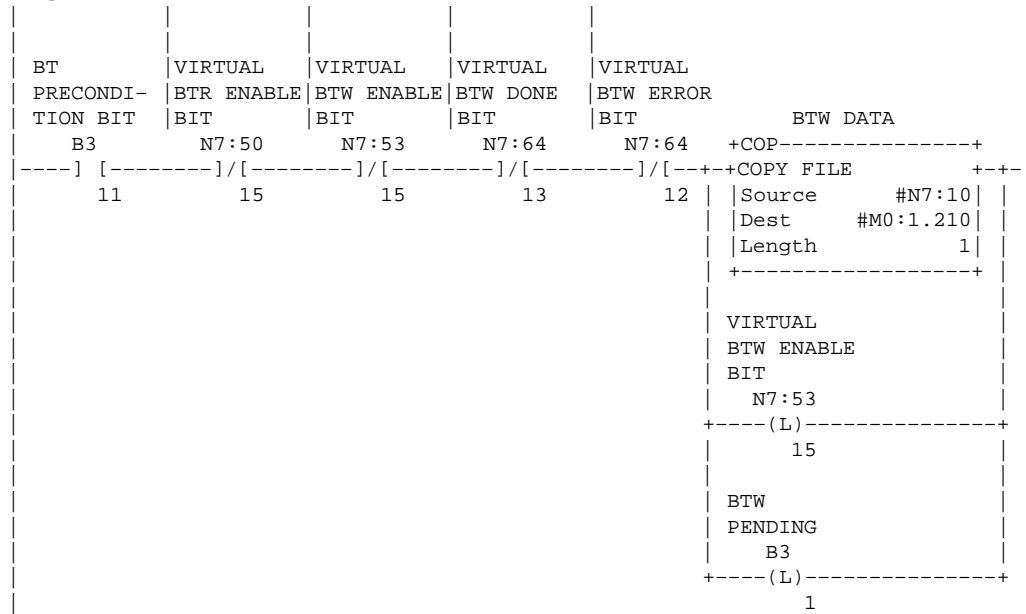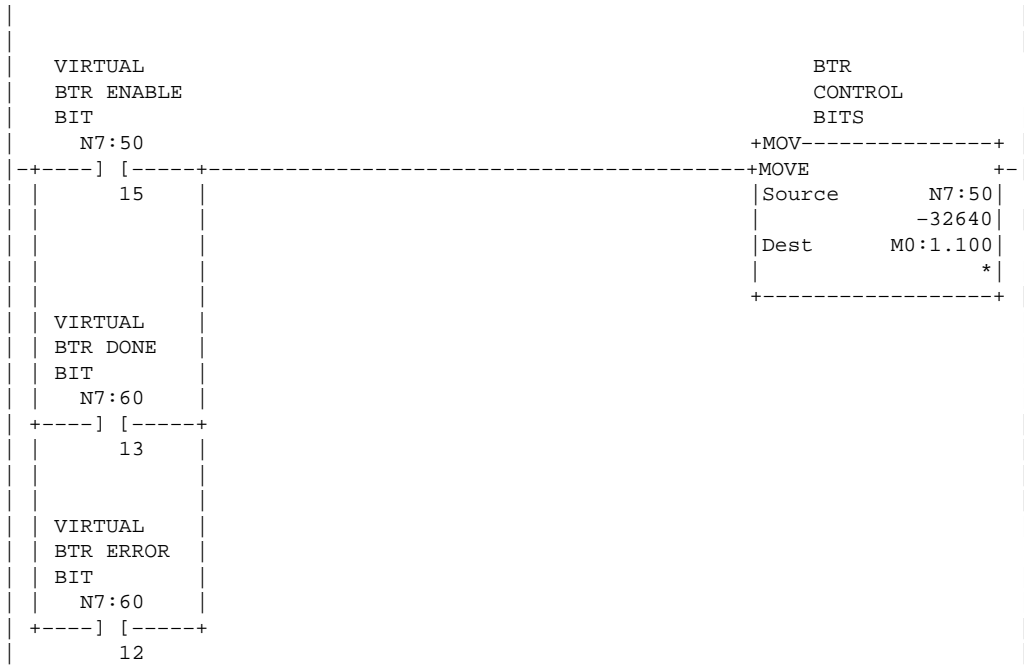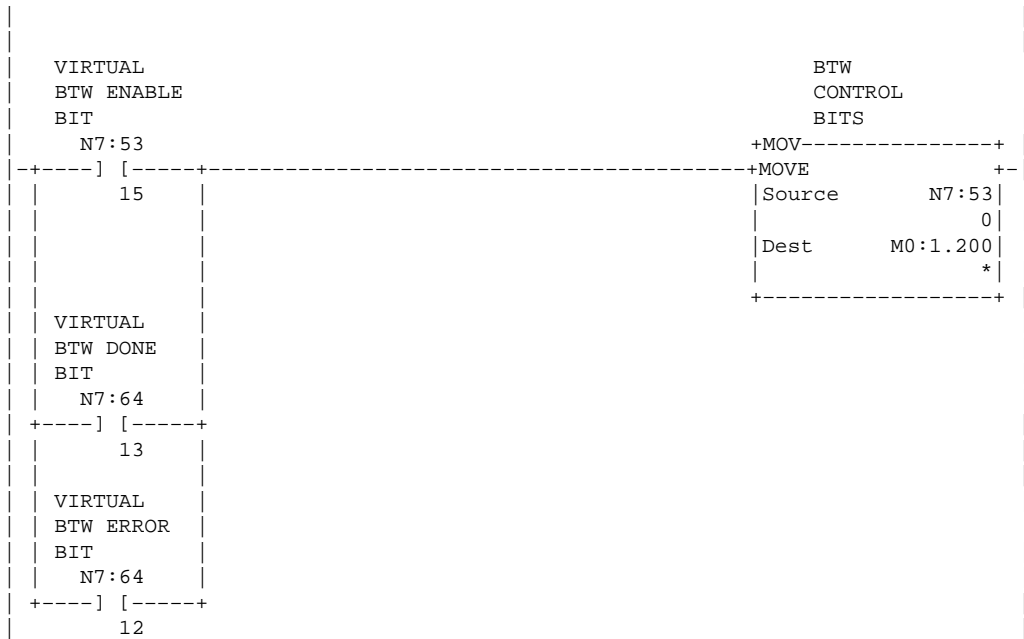
```
Rung 2:11
Move the virtual BTR control word to the M0 file for the SN Module while a
BTR is in progress, and continue doing so until the Enable, Done, and Error bits
are all turned off.
|                                                                              |
|                                                                              |
|    VIRTUAL                                           BTR                      |
|    BTR ENABLE                                        CONTROL                  |
|    BIT                                               BITS                     |
|      N7:50                                          +MOV--------------+ |
|-+----] [----+----------------------------------------+MOVE            +-|
| | |      15 |                                        |Source      N7:50| |
| | |         |                                        |            -32640| |
| | |         |                                        |Dest     M0:1.100| |
| | |         |                                        |               *| |
| | |         |                                        +-----------------+ |
| | | VIRTUAL |                                                              |
| | | BTR DONE|                                                              |
| | | BIT     |                                                              |
| | |   N7:60 |                                                              |
| +----] [-----+                                                             |
| | |      13 |                                                              |
| | |         |                                                              |
| | |         |                                                              |
| | | VIRTUAL |                                                              |
| | | BTR ERROR|                                                             |
| | | BIT     |                                                              |
| | |   N7:60 |                                                              |
| +----] [-----+                                                             |
|         12                                                                  |
Rung 2:12
Move the virtual BTW control word to the M0 file for the SN Module while a     |
BTW is in progress, and continue doing so until the Enable, Done, and Error    |
bits are all turned off.                                                       |
|                                                                              |
|                                                                              |
|    VIRTUAL                                           BTW                      |
|    BTW ENABLE                                        CONTROL                  |
|    BIT                                               BITS                     |
|      N7:53                                          +MOV--------------+ |
|-+----] [----+----------------------------------------+MOVE            +-|
| | |      15 |                                        |Source      N7:53| |
| | |         |                                        |               0| |
| | |         |                                        |Dest     M0:1.200| |
| | |         |                                        |               *| |
| | |         |                                        +-----------------+ |
| | | VIRTUAL |                                                              |
| | | BTW DONE|                                                              |
| | | BIT     |                                                              |
| | |   N7:64 |                                                              |
| +----] [-----+                                                             |
| | |      13 |                                                              |
| | |         |                                                              |
| | | VIRTUAL |                                                              |
| | | BTW ERROR|                                                             |
| | | BIT     |                                                              |
| | |   N7:64 |                                                              |
| +----] [-----+                                                             |
|         12                                                                  |
Rung 2:13                                                                      |
|                                                                              |
|-----------------------------------+END+--------------------------------------|
|                                                                              |
```
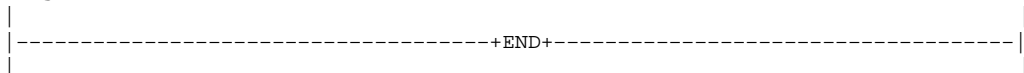
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