Autotech Controls
Allen-Bradley M8000 LBus Cradle
(P/N SAC-M8000-010)
Instruction & Operation Manual

AVG Automation
Autotech Controls
343 St. Paul Boulevard
Carol Stream, IL 60188

Telephone: 630-668-3900
800-TEC-ENGR

FAX: 630-668-4676

MAN-M8000-CRDL
REV 00 07/21/97

1. Allen-Bradley M8000 LBus Cradle

1.1 Introduction

AVG introduces a revolutionary new concept in intelligent PLC plug-in cards. In the world of proprietary PLC racks, the BusModules provide the only "universal" solution. Currently PLC plug-in cards are unique to a PLC and cannot be used with any other PLC. BusModules are changing this scenario.

With BusModules, AVG Automation introduces a series of universal function modules for major PLCs. These modules are universal in the respect that the same module can be used in any of the supported PLC racks. This offers a common user interface (for a function) across different PLCs. In addition, the BusModules provide flexibility to users by allowing them to customize their plug-in cards by mixing and matching the function module with output modules.

The M8000 LBusModule Cradle is a function module interface and is compatible with Allen-Bradley PLCs. It occupies 2 slots in the rack and is addressed as any I/O module. The PLC Processor communicates to the module by sending sets of commands through the output registers assigned to the module's slot. The module replies to the processor through the input registers.

1.2 Specifications

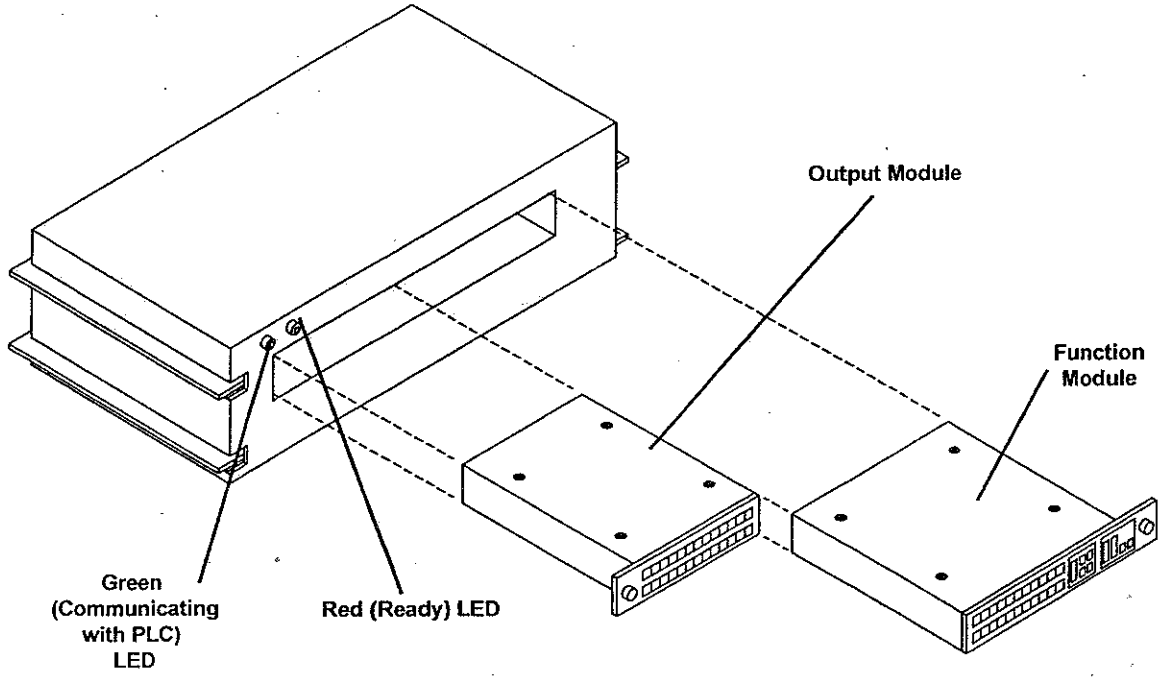
Rack Power: +5 VDC @ 200 MA

Operating Temperature: -10 to 130° F (-23 to 55° C)

1.3 Indicator LEDs

Ready: Red LED, lighted when power is ok and I/Os are enabled.

Communications: Green LED, lighted when the PLC is communicating with the cradle.



A-B M8000 LBus Cradle

2. Programming

2.1 Commands for Programming the M8000 LBusModule

The PLC communicates with the Function Module by reading and writing to the DP RAM. The reading and writing is performed by using commands to the cradle. The M8000 LBusModule Cradle interprets the commands and provides responses to the PLC. The function module continually updates appropriate areas of the DP RAM. Since it can accept any function module, the cradle commands have to be function module independent. The cradle commands, therefore, only allow read/write of memory locations in DP RAM directly. These commands along with the published memory map of each function module gives PLC programmer complete access to a function module.

For M8000 BusModule Cradle commands, we need to define the following commands to allow read and write to the DP RAM:

Terminate/Start command sequence
Start Write and Set address
Start Read and Set Read Count from 0 to 7
Read/Write word data (12 bits)
Read/Write byte (8 bits)
Write Fine Tune Control Word

Since all remote I/0 is asynchronous there must be a way to synchronize the exchange of data between the PLC and M8000 BusModule Cradle while keeping the method as simple and quick as possible.

For this reason the 16 bit output register is defined as follows:

bit 15	Sequence flag to be toggled every other command.
bit 12-14	Command Control Bits
bit 0-11	Data

The 16 bit input register is defined as follows:

bit 15	Sequence flag to be set to sequence flag of outputs
bit 12-14	Data sequence number
bit 0-11	Data

The following will be the function based on the command control bits:

0 Terminate/Start Command Sequence

1 Start Write and Set Address

2 Start Read and Set Read Count from 0 to 7

3 Reserved

4 Reserved

5 Read/Write Word Data (12 bits)

When reading (requires a command 2 first):

— The address is in bits 0–11 of the first received command 5 after a command 2.

— The address is incremented by 2 and the sequence number is incremented by 1 after each read until count is reached then reset to original address and sequence number of zero (no need to change address in the output).

When writing (requires a command 1 first):

—The address is set in command 1.

—The data is in bits 0–11.

—The address is incremented by 2 after each write.

— No data will be written until 8th word or command is terminated by output word of zero.

6 Read/Write Byte (8 bits)

When reading (requires a command 2 first):

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—Data will be returned MSB, LSB
—The address is incremented by 1 and the sequence number incremented by 1 after each read until count is reached then reset to original address and sequence number of zero.

When writing (requires a command 1 first):
—The address set in command 1.
—The data is in bits 0–7.
— The address is incremented by 1 for each command 2.
— Data is to be sent MSB, LSB.
— No data will be written until 16th byte or command is terminated by output word of zero.

7 Write Fine Tune Control Word (requires a command 1 first)
Fine Tune Location is set by address in command 1. Command 7 can be repeated without a command 1 as long as bit 15 is toggled. *Clear all bits before setting any new bits.*

All command sequences must start with command 1 or 2. Command 5, 6, and 7 will not be accepted without first receiving a command 1 or 2. An output value of 0 will terminate all commands. Since it is possible to leave without a command completed or terminated, it is recommended that all sequences start with a zero. It is also recommended that a sequence other than a continuous read also end with a zero, because for some commands this also completes execution of a command sequence.

A read count of zero will start a continuous read. Note that a 12 bit conitnuous read may not be valid in a remote rack because data may be sampled between slots in the rack.

A few examples (for the M8251 PLS function module) may help clarify:

Example 1
To set channel 1, dwell 1, on and off set points to 20 to 30.
Address is 146 hex, on point is 14 hex and the off point is 1E hex.

The words of outputs will be (notice bit 15 is toggled every other word):
0000, 9146, 5014, D01E, 0000
The words of inputs will be (notice bit 15 is equal to bit 15 of the output):
0000, 8000, 0000, 8000, 0000

If dwell 2 is also to be set from 28 hex to 32 hex, the outputs could have been:
0000, 9146, 5014, D01E, 5028, D032, 0000

Example 2
Monitor position.
Address of position is 82 hex, since position will be less than 12 bits (4095) we can use a 12 bit read.
For this example we'll say the position was at 32 (20 hex) the first scan and 34 (22 hex) the next scan.

The words of outputs will be (notice bit 15 is toggled every other word):
0000, A000, 5082, leave the output unchanged
The words of inputs will be (notice bit 15 is equal to bit 15 of the output):
0000, 8000, 0020, 0022, ...

Example 3
Read the two dwells set in example 1.

The words of outputs will be (notice bit 15 is toggled every other word):
0000, A003, 5146, D000, 5000, D000, 0000
The words of inputs will be (notice bit 15 is equal

2. Programming

0000, 8000, 0014, 901E, 2028, B032, 0000

Example 4
Fine tune channel 1, dwell 1, on point by incrementing it by one, twice.
The fine tune location is 146 hex, the control word is 1.

The words of outputs will be (notice bit 15 is toggled every other word):
0000, 9146, 7001, F001,0000
The words of inputs will be (notice bit 15 is equal to bit 15 of the output):
0000, 8000, 0000, 8000,0000

If example 3 was repeated the inputs would be:
0000, 8000, 0016, 901E, 2028, B032, 0000

Example 5
Use the byte read to get the dwells as in example 3. This would be how values greater than 4095 must be read, but it can be used on values less than 4096. Note that the dwell shows the fine tune results.

The words of outputs will be (notice bit 15 is toggled every other word):
0000, A007, 6146, E000, 6000, E000, 6000, E000, 6000, E000, 0000
The words of inputs will be (notice bit 15 is equal to bit 15 of the output):
0000, 8000, 0000, 9016, 2000, B01E, 4000, D028, 6000, F032, 0000

Notice that it takes twice as many transfers and the word is split into two transfers. Byte writes work the same way.

PLC Logic
The following is a sample PLC logic that uses integer file 10 to control I/O transfers. To get the word values a 2 slot rack addressing was used. 1 slot and 1/2 slot address results in the first word being the LSB and the next word the MSB. Note that the PLC must be in Run Mode to transfer data. Also note that the M8000CRDL will alternate between writes and reads so immediate I/O must be done in pairs.

* N10:0/0 is used as a Master Enable and is set when then number of words sent is less than the number to send. See Rung 2:0

* N10:0/1 is an transfer enable and is set when no words have been transfered or when bit 15 of the inputs is the same as bit 15 of the outputs. It will be cleared after the transfer.

* N10:2 will hold the number of transfers sent.

* N10:3 holds the file number that the data is to be transfered from.

* N10:4 holds the element number to transfer. This will be incremented after every transfer.

* N10:5 holds the number of elements to transfer.

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```
Rung 2:0
| +LES------------+                                  N10:0 |
+-+LESS THAN      +-------------------------------( )--+
| |Source A  N10:2|                                    0 |
| |               |                                      |
| |Source B  N10:5|                                      |
| |               |                                      |
| +---------------+                                      |
|
N10:0/0
  -] [-  2:1
  -( )-  2:0
N10:2
  -ADD-  2:3 2:3
  -EQU-  2:1
  -LES-  2:0
N10:5
  -LES-  2:0

Rung 2:1

|N10:0 O:002 I:002                                  N10:0 |
+--] [-+-] [---] [------+-------------------------(L)--+
|     0| 17   17       |                                1 |
|      |O:002 I:002    |                                  |
|      +-]/[---]/[----+|                                  |
|      | 17   17      ||                                  |
|      |+EQU----------+|                                  |
|      ++EQUAL        ++                                  |
|       |Source A    0|                                  |
|       |             |                                  |
|       |Source B N10:2|                                 |
|       |             |                                  |
|       +-------------+                                  |
I:002/17
    -] [-  2:1
    -]/[-  2:1
N10:0/0
    -] [-  2:1
    -( )-  2:0
N10:0/1
    -] [-  2:2 2:3 2:4 2:5
    -(L)-  2:1
    -(U)-  2:5
N10:2
    -ADD-  2:3 2:3
    -EQU-  2:1
    -LES-  2:0
O:002/17
    -] [-  2:1
    -]/[-  2:1
```

2. Programming

```
Rung 2:2
| N10:0                          +-----------------------+
+--] [-------------------------+MOVE                    +-+
|    1                         |Source  N[N10:3] [N10:4]| |
|                              |                        | |
|                              |Destination  O:002      | |
|                              |                        | |
|                              +------------------------+ |
N10:0/1
  -] [- 2:2 2:3 2:4 2:5
  -(L)- 2:1
  -(U)- 2:5
N[N10:3] [N10:4]
  -MOV-  2:2
O:002
  -MOV-  2:2

Rung 2:3
|N10:0                         +ADD--------------------+ |
+--] [-------------------------+ADD                     +-+
|    1                         |Source A              1| |
|                              |                       | |
|                              |Source B          N10:2| |
|                              |                      3| |
|                              |Destination       N10:2| |
|                              |                      3| |
|                              -------------------------+ |
N10:0/1
  -] [-  2:2 2:3 2:4 2:5
  -(L)-  2:1
  -(U)-  2:5
N10:2
  -ADD-  2:3 2:3
  -EQU-  2:1
  -LES-  2:0
```

2. Programming

```
Rung 2:4
| N10:0                              +ADD--------------------+ |
+--] [-----------------------------+ADD                     +-+
|    1                             |Source A              1| | |
|                                  |                       | | |
|                                  |Source B          N10:4| | |
|                                  |                       | | |
|                                  |Destination       N10:4| | |
|                                  |                       | | |
|                                  +-----------------------+ | |
N10:0/1
  -] [-  2:2 2:3 2:4 2:5
  -(L)-  2:1
  -(U)-  2:5
N10:4
  -ADD-  2:4 2:4
  -MOV-  2:2*

Rung 2:5

| N10:0                                                  N10:0 |
+--] [-------------------------------------------------(U)--+
|    1                                                     1 |
N10:0/1
  -] [-  2:2 2:3 2:4 2:5
  -(L)-  2:1
  -(U)-  2:5



Rung 2:6
|                                                            |
+---------------------[END OF FILE]-----------------------+
|                                                            |

NO MORE FILES

|
I:002/17
```

For an example of how to program an M8000 LBus Interface Module, see Appendix A

2. Programming

2.2 Error Codes

The M8000 cradle does not send a response. The programmer must read the Error location in the function module. The PLC programmer can use this information to ensure that he has received the right data. If there is any error in this transaction an, error code is returned in the upper byte of the first word. (Multiplication by 256 effectively puts error code in upper byte of the word.) See the following table for a list of error codes.

Error Code	Description
00	No error
01	Attempt to fine-tune nonexisting dwell
02	New dwell is out of range
03	Programming a parameter during motion (RPM > 0)
04	Value out of range
05	Function module is busy
06	Program enable input is not active
07	Attempt to fine-tune on bad address
08	Access to fine-tune control word is not available
09	Attempt to program higher than first dwell when in time-off mode.

2.3 Fine-Tune (increment or decrement by one) Cradle Command Packet

Fine tuning in this context means the following:

- Increment a value in a location in DP RAM, or
- Decrement a value in a location in DP RAM
- Increment a pair of values (for retarding a dwell)
- Decrement a pair of value in two consecutive locations (for advancing a dwell)

Address of Location to be find tuned: User puts here the address of location in Dual Port Memory map that needs to be fine tuned (set point On or OFF address). For pair of locations (e.g., a dwell) this would be the address of first location. Set with Command 1

Fine Tune Control Word: Bits in Control word indicates the fine tuning action — increment, decrement, etc. The function module scans the bits in the control works from right to left (from least significant to most significant bit) and acts on the first set bit it finds. Other bits, if set, will simply be ignored. Set with command 7.

The Increment/ Decrement functions are assigned to bits in lower byte of Control Words and are as follows.

Increment On Value Once (Bit b0): When set, increment value in addressed location by 1. Function module will clear the bit after one increment. The PLC does not have to clear this bit explicitly to stop increment operation; but the PLC must toggle the bit to continuously increase the value.

Decrement On Value Once (Bit b1): When set, decrement value in addressed location by 1. Function module will clear the bit after one decrement. The PLC does not have to clear this bit explicitly to stop decrement operation; but the PLC must toggle the bit to continuously decrease the value.

Increment On/Off Values Once (Bit b2): When set, increment pair of values by 1 (address of first location in command.) Function module will clear the bit after one increment. The PLC does not have to clear this bit explicitly to stop increment operation; but the PLC must toggle the bit to continuously increase the values.

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Decrement On/Off Value Once (Bit b3): When set, decrement pair of values by 1 (address of first location in command). Function module will clear the bit after one decrement. The PLC does not have to clear this bit explicitly to stop decrement operation; but the PLC must toggle the bit to continuously decrease the values.

Increment On Value Continuously (Bit b4): When set, increment value in addressed location continuously, as long as the bit is set. Function module does not clear this bit. The module will continue to increment the value as long as the bit is set. PLC must explicitly clear this bit to stop incrementing operation.

Decrement On Value Continuously (Bit b5): When set, decrement value in addressed location continuously, as long as the bit is set. Function module does not clear this bit. The module will continue to decrement the value as long as the bit is set. PLC must explicitly clear this bit to stop decrementing operation.

Increment On/Off Value Continuously (Bit b6): When set, increment pair of values continuously (address of first location in command) as long as the Bit is set. Function module does not clear this bit. The module will keep on incrementing the values as long as the bit is set. PLC must explicitly clear this bit to stop incrementing operation.

Decrement On/Off Value Continuously (Bit b7): When set, decrement pair of values by 1 (address of first location in command), as long as the bit is set. Function module does not clear this bit. The module will keep on decrementing the values as long as the bit is set. PLC must explicitly clear this bit to stop decrementing operation.

Increment Off Value Once (Bit b8): When set, increment value in addressed location by 1. Function module will clear the bit after one increment. The PLC does not have to clear this bit explicitly to stop increment operation; but the PLC must toggle the bit to continuously increase the value.

Decrement Off Value Once (Bit b9): When set, decrement value in addressed location by 1. Function module will clear the bit after one decrement. The PLC does not have to clear this bit explicitly to stop decrement operation; but the PLC must toggle the bit to continuously decrease the value.

Increment Off Value Continuously (Bit b10): When set, increment value in addressed location continuously, as long as the bit is set. Function module does not clear this bit. The module will continue to increment the value as long as the bit is set. PLC must explicitly clear this bit to stop incrementing operation.

Decrement Off Value Continuously (Bit b11): When set, decrement value in addressed location continuously, as long as the bit is set. Function module does not clear this bit. The module will continue to decrement the value as long as the bit is set. PLC must explicitly clear this bit to stop decrementing operation.

3. Wiring

See applicable Output and Function Module Manuals for wiring information.

4. Installation Instructions

The M8000 LBusModule Cradle occupies two slots in Allen-Bradley's 1771 I/O Rack.

4.1 Function Module Installation

a. With the card edge fingers of the module aligned with the TOP edge connector of the cradle, insert the function module.

b. Push the module firmly into the edge connector.

c. Secure the module with the retention screw. ***Do not over-tighten.***

4.2 Output Module Installation

a. With the card edge fingers of the module aligned with the BOTTOM edge connector of the cradle, insert the function module.

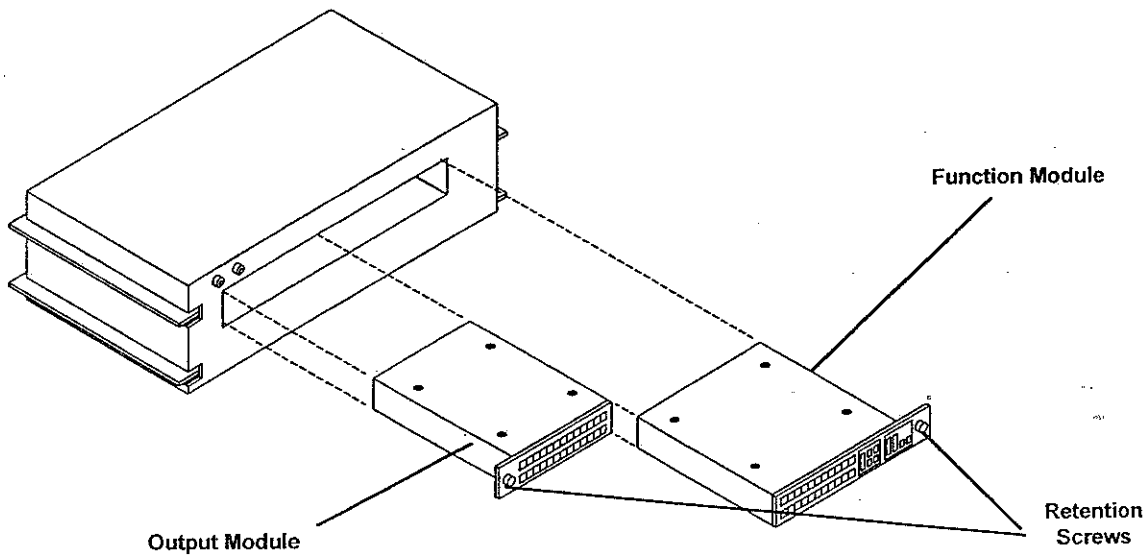
b. Push the module firmly into the edge connector.

c. Secure the module with the retention screw. ***Do not over-tighten.***

4.3 Module Removal

a. Loosen retention screw of the module being removed.

b. Firmly grasp module and remove from edge connector and cradle.



5 How to Order

1. Rack

SAC-M8000-010 ..... Allen-Bradley 1771 I/O Rack (PLC-5 family)

2. LBus Modules

ASY-M8251-010 ..... 3 Digit, 16 PLS Module, 1 motion and 1 fault outputs
ASY-M8350-010 ..... 12-bit, Single-turn Resolver Decoder (Fully Absolute)

3. Output Modules

ASY-M8250-NOUT .....N-Channel (Sinking) Transister Outputs
ASY-M8250-POUT.....P-Channel (Sourcing) Transister Outputs
ASY-M8250-FIL .....Filler Module

Compatible Transducer/Resolvers

Please see appropriate Function Module Manual (MAN-M8251-010 or MAN-M7350-000) and the Position Transducer Manual (MAN-ROXDU, MAN-E1/9R-000, MAN-RL500-000 or MAN-RL501-000) for complete ordering information on resolvers, cables, and appropriate accessories.

Cable *(See appropriate Function Module or Position Transducer Manual for ordering cable)*

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Appendix A
Example Program

AVG-AUTOTECH
8000 SERIES BUS INTERFACE MODULE
FOR ALLEN-BRADLEY'S 1771 I/O RACK

This Program Is An Example Of How To Program A M8000 Bus Interface Module. This Program Is Designed To Operate In A PLC5 System Using Allen-Bradley's 1771 I/O Rack Using Single Slot Addressing.

Integer File N49:0 Controls The Operation Of This Program.

Bit 0 = Start A Function
Bit 1 = Continuous Read (12 bit Or Greater Than 12 bit)
Bit 2 = Move Continuous Read Data To N50:1 Thru N50:8 (12 Bit) And Convert And Move Continuous Read Data To N50:11 Thru N50:14 (Greater Than 12 Bit Data)
Bit 4 Thru 7 = Not Used
Bit 8 Thru 15 = Function Select

The Following Is A List Of Functions Available:

1. Read RPM
2. Read Position
3. Read I/O Status *
4. Read Outputs *
5. Read Scale Factor
6. Read Offset
7. Read Hi Motion Limit
8. Read Lo Motion Limit
9. Read Program Number
10. Read Danger Limit
11. Read Caution Limit
12. Read Baud Rate *
13. Read Station Number
14. Read Scale Factor
15. Write Offset
16. Write Hi Motion Limit
17. Write Lo Motion Limit
18. Write Program Number
19. Write Danger Limit
20. Write Caution Limit
21. Write Baud Rate *
22. Write Station Number
23. Fine Tune
24. Write Base Setup Parameters
25. Write Setpoints 1 & 2 In Channels 1 Thru 16 And Leading-Edge Speed Compensation For Channels 1 Thru 4
26. Consecutive Reads (12 Bit)
27. Consecutive Reads (Greater Than 12 Bit) *

* Denotes Functions That Require More Than 12 Bits

1. Use N49:0 Bits 8-15 To Select The Function To Be Performed. Set N49:0/0 To On To Perform The Function. (This Will Not Perform Functions That Require More Than 12 Bits Or Multiple Reads) Data May Be Read From N20:1 (Note: PLC Must Be In Run Mode For The M8000 To Operate)
2. For Functions Greater Than 12 Bits, Select The Function, Set N49:0/2 To On, Then Set N49:0/0 To On, Data May Be Read From N50:11.
3. For Consecutve Read Functions, Select The Function, Set N49:0/1 To On, Set N49:0/2 To On, Set N49:0/0 To On. If 12 Bit, Data Maybe Read From N50:1 Thru N50:8. If Greater Than 12 Bit, Data May Be Read From N50:11 Thru N50:14.
4. When Function Is Complete, Turn N49:0/0 Off.

NOTE: N48:0 IS USED TO HOLD THE STARTING ADDRESS FOR CONSECUTIVE READ FUNCTIONS. IT IS ALSO USED TO HOLD THE ADDRESS FOR FINE TUNING INSTRUCTIONS.

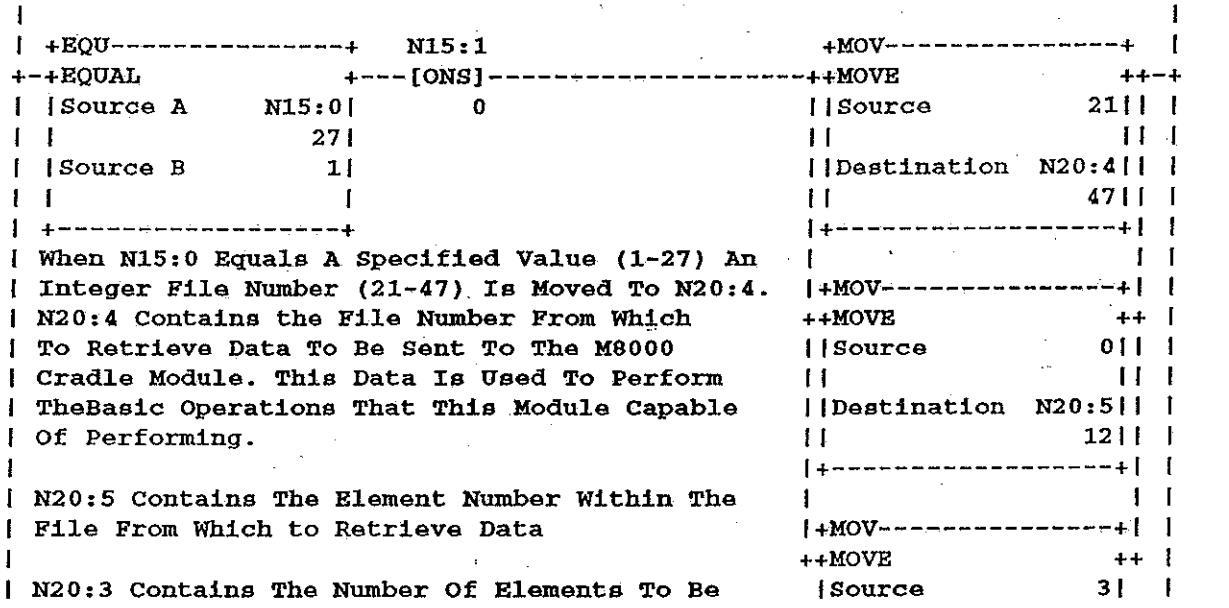
NOTE: N51:0 IS USED TO CONTAIN THE FINE TUNING MODE SELECT.

Bit 0 = Increment On Value Once
Bit 1 = Decrement On Value Once
Bit 2 = Increment On And Off Value Once
Bit 3 = Decrement On And Off Value Once
Bit 4 = Increment On Value Continuously
Bit 5 = Decrement On Value Continuously
Bit 6 = Increment On And Off Value Continuously
Bit 7 = Decrement On And Off Value Continuously
Bit 8 = Increment Off Value Once
Bit 9 = Decremnet Off Value Once
Bit 10 = Increment Off Value Continuously
Bit 11 = Decrement Off Value Continuously

<u>Caution DO NOT Set More Than One Bit At A Time</u>

N49:0 is the basic control register for this file. Bits 8(LSB) - 15(MSB) determine the binary value that will be inserted into N15:0. This value determines what function will be performed by this program.

Rung 2:0 - Read Resolver RPM

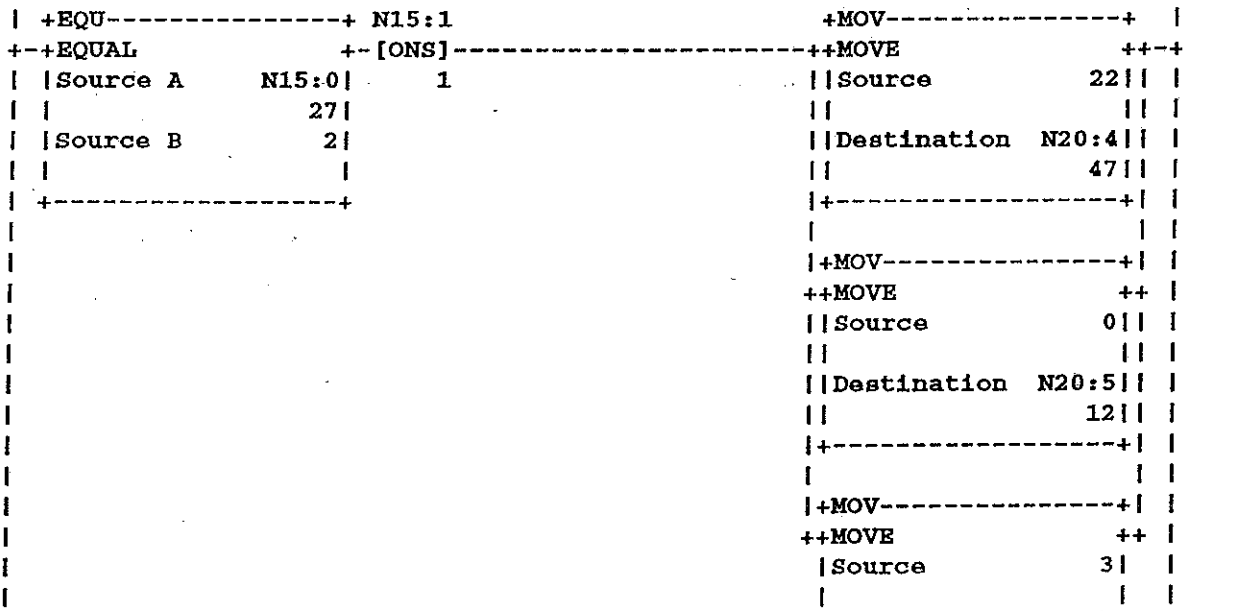


When N15:0 Equals A Specified Value (1-27) An Integer File Number (21-47) Is Moved To N20:4. N20:4 Contains the File Number From Which To Retrieve Data To Be Sent To The M8000 Cradle Module. This Data Is Used To Perform TheBasic Operations That This Module Capable Of Performing.

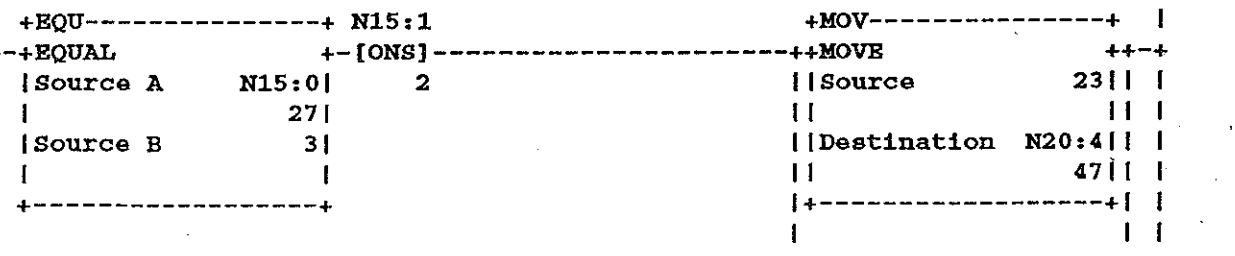
N20:5 Contains The Element Number Within The File From Which to Retrieve Data

N20:3 Contains The Number Of Elements To Be Transfered To Perform The Requested Function

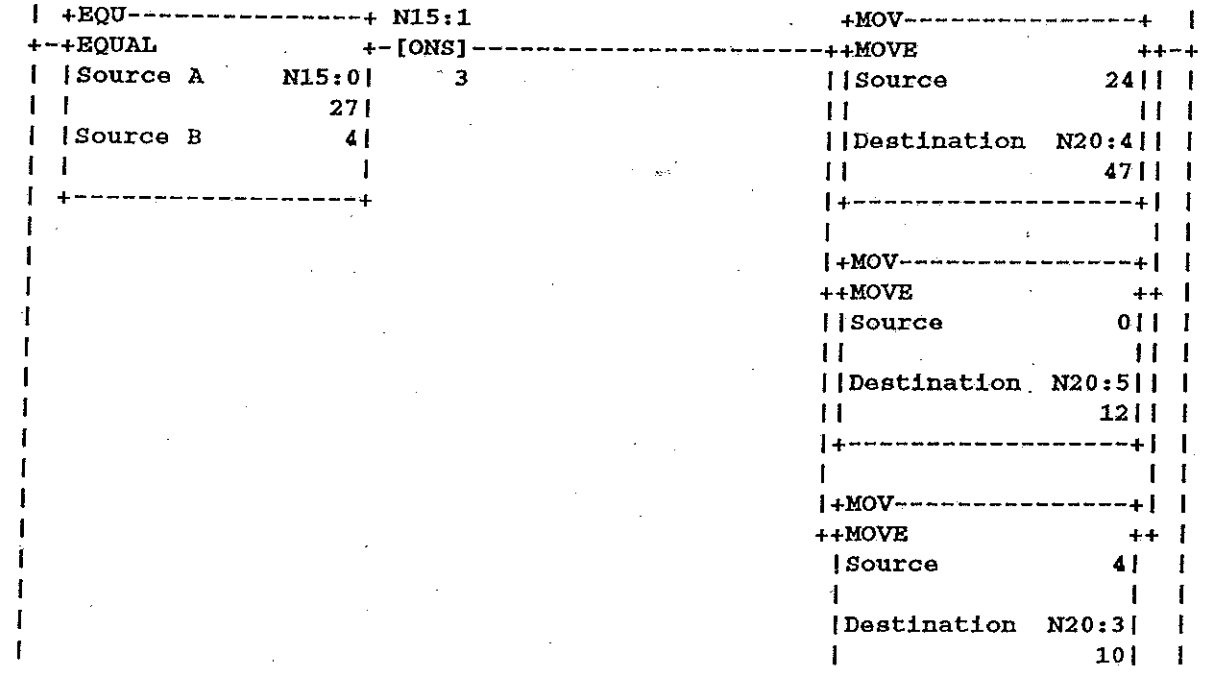
Rung 2:1 - Read Resolver Position



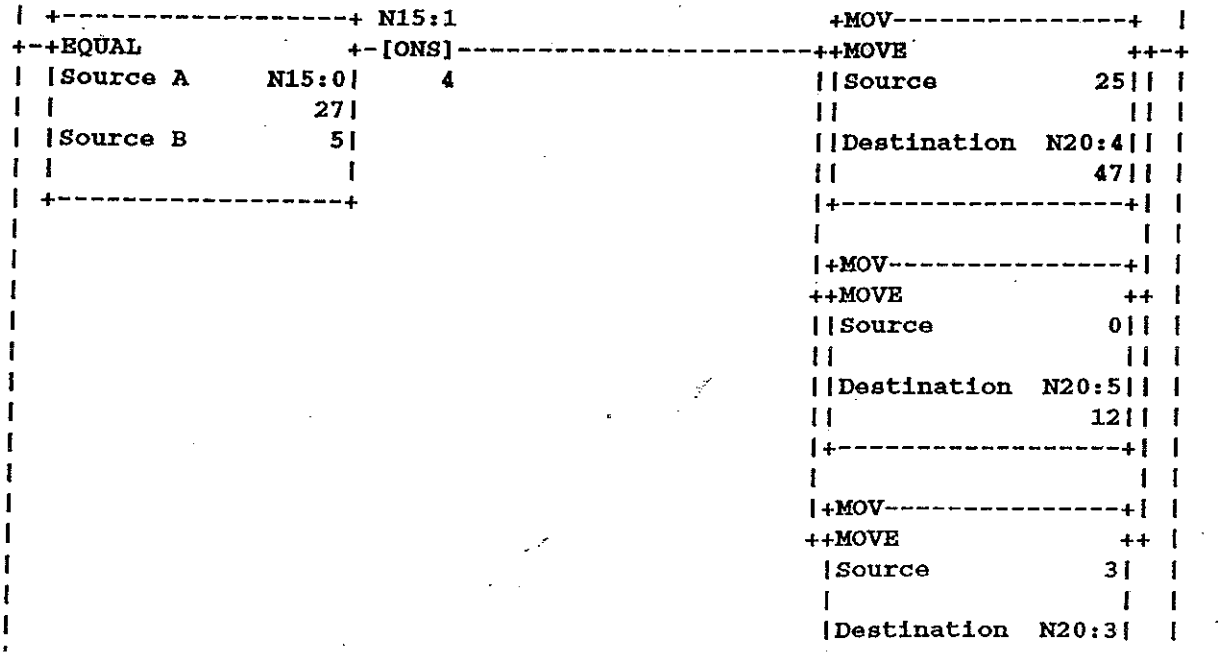
Rung 2:2 - Read I/O Status



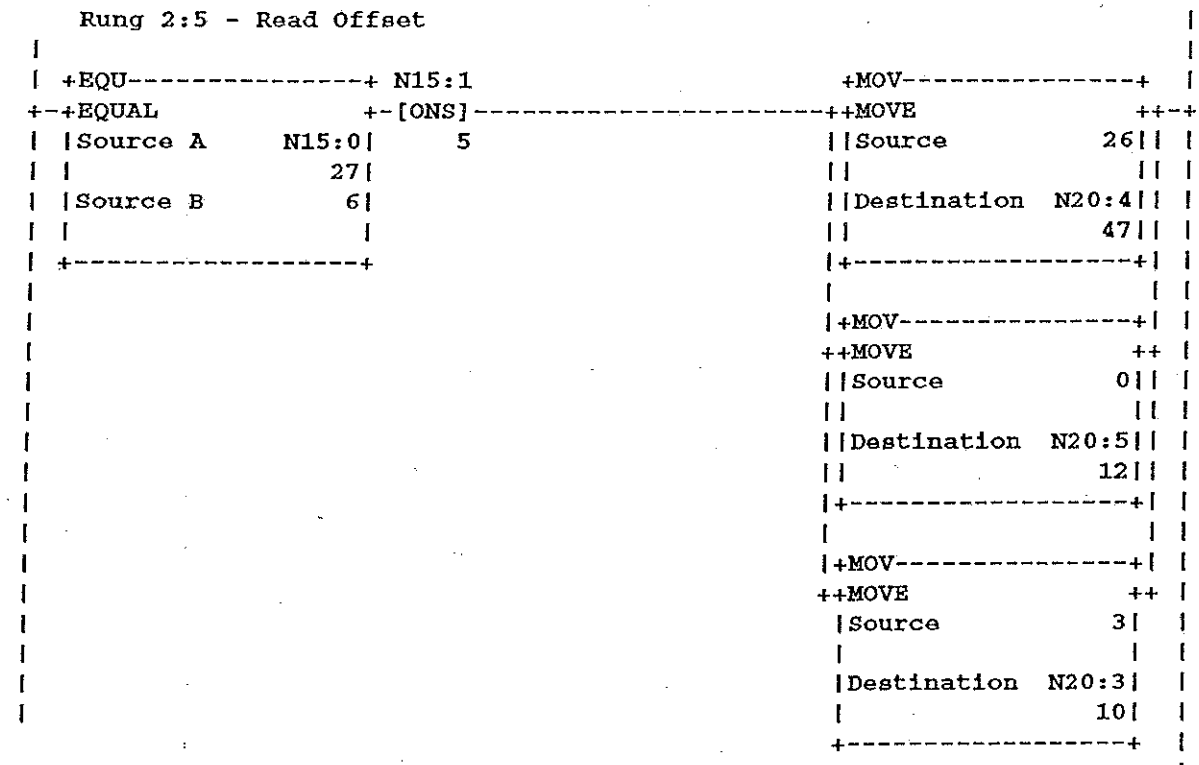
Rung 2:3 - Read Outputs



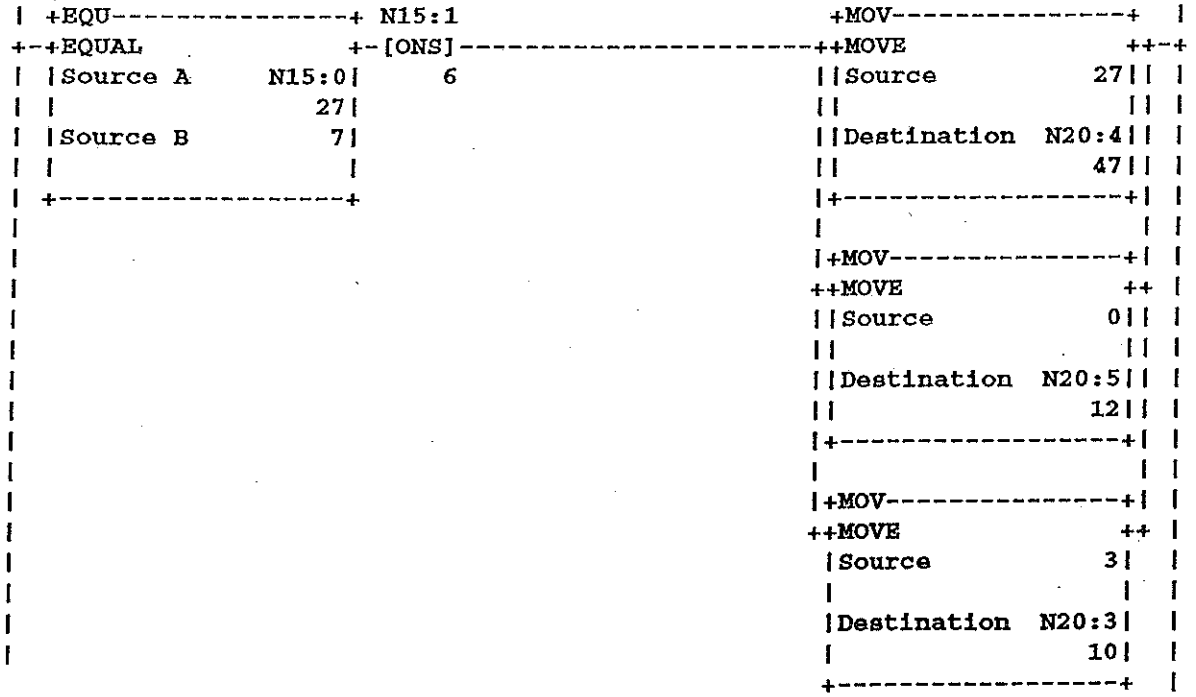
Rung 2:4 - Read Scale Factor



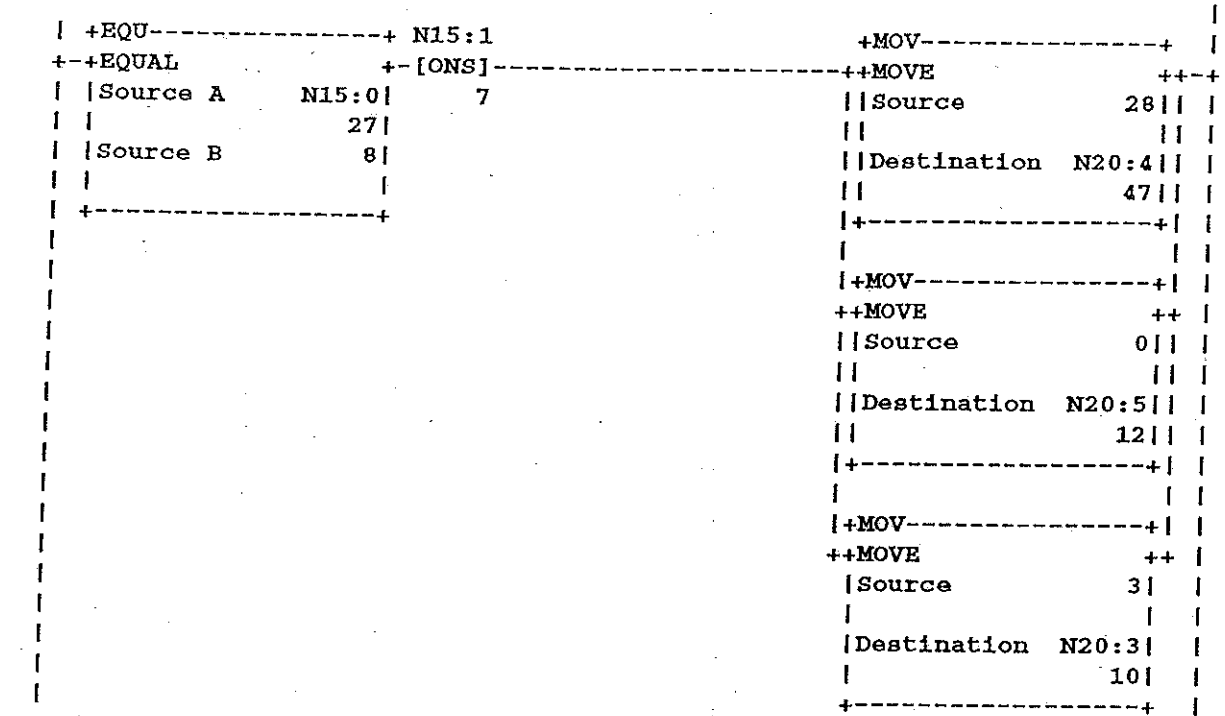
Rung 2:5 - Read Offset



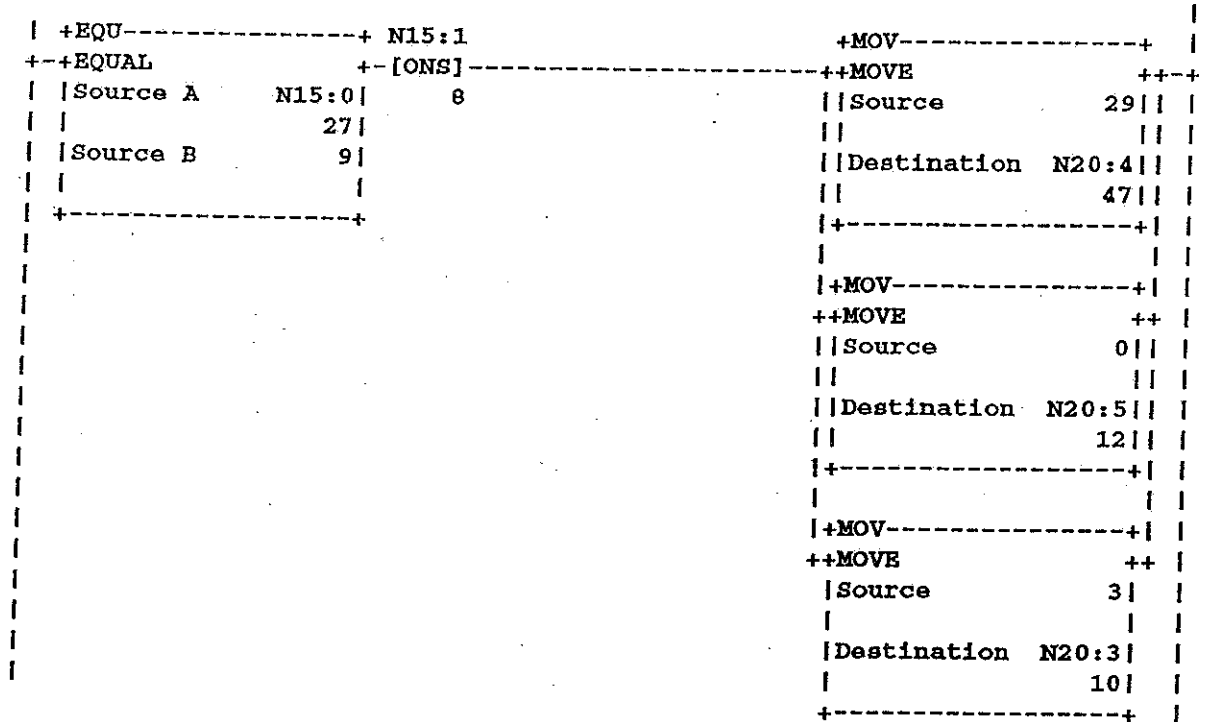
Rung 2:6 - Read Hi Motion Limit



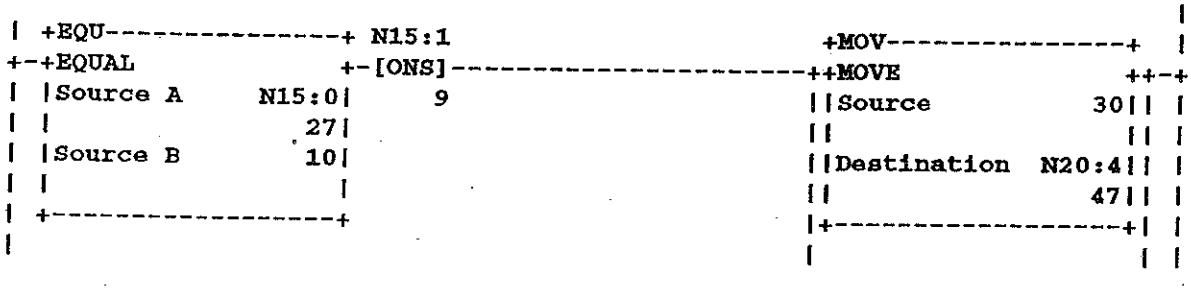
Rung 2:7 - Read Lo Motion Limit

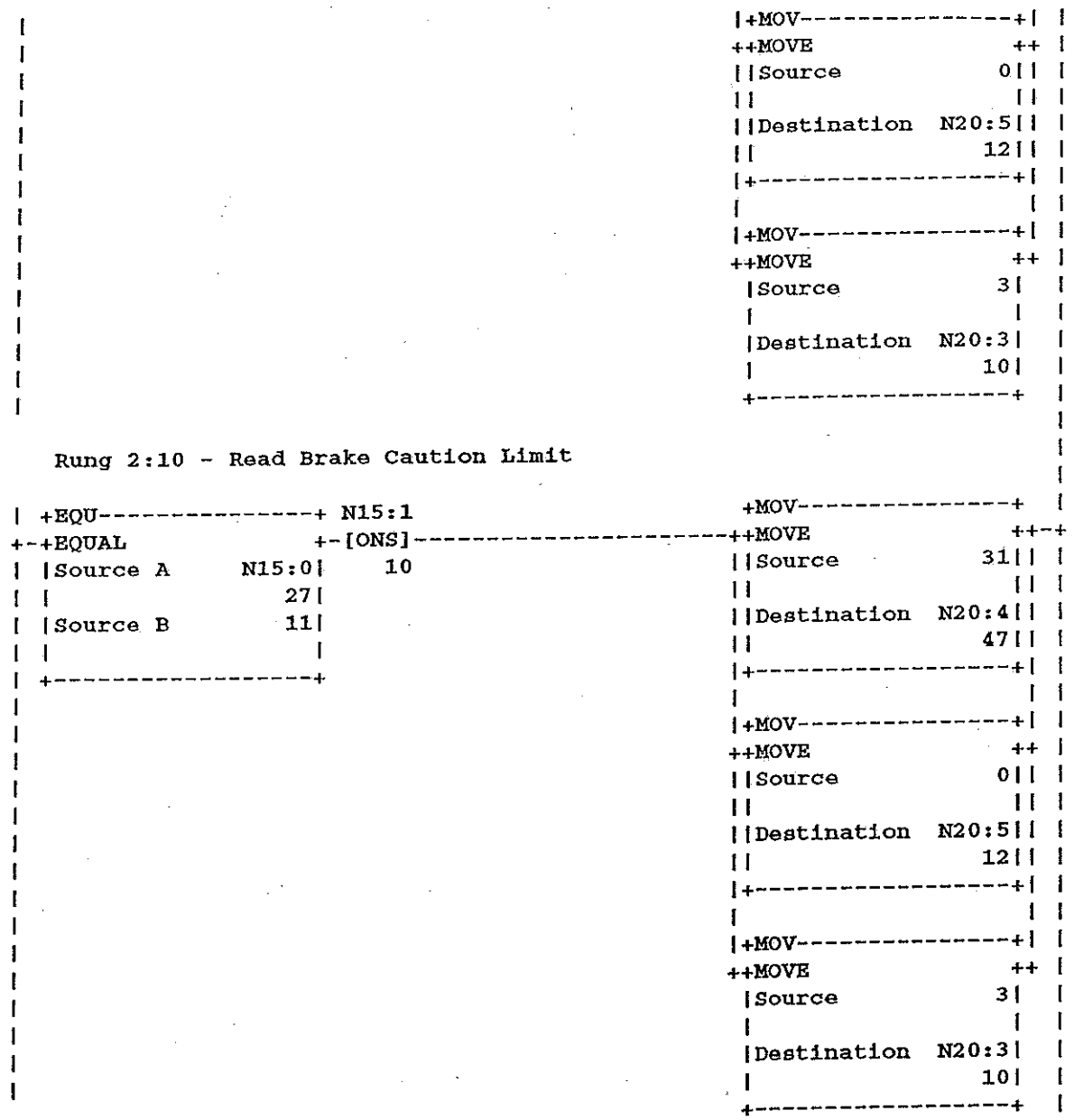


Rung 2:8 - Read Program Number



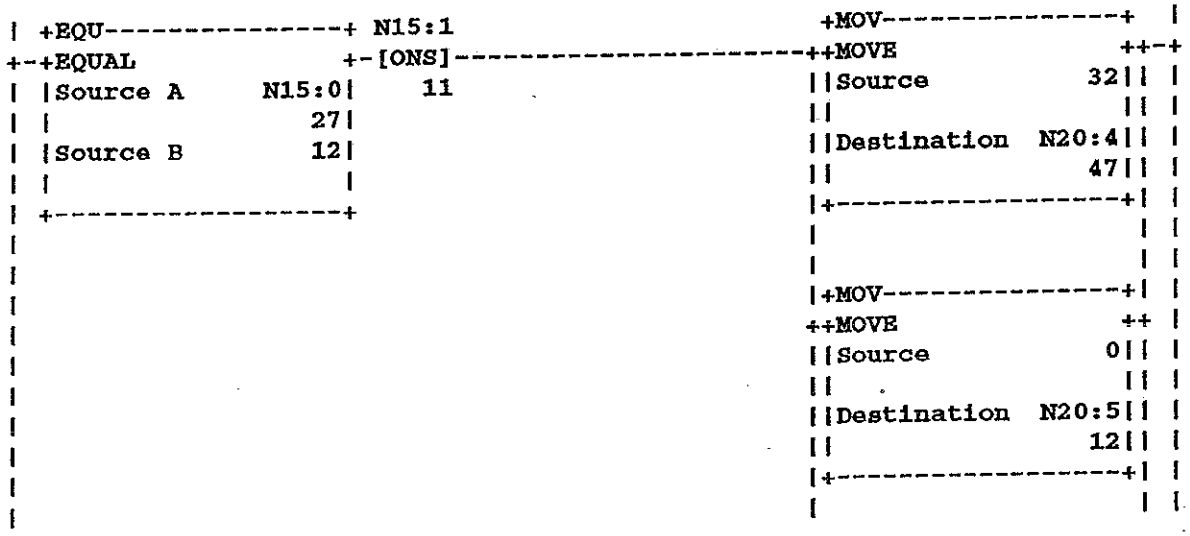
Rung 2:9 - Read Brake Danger Limit

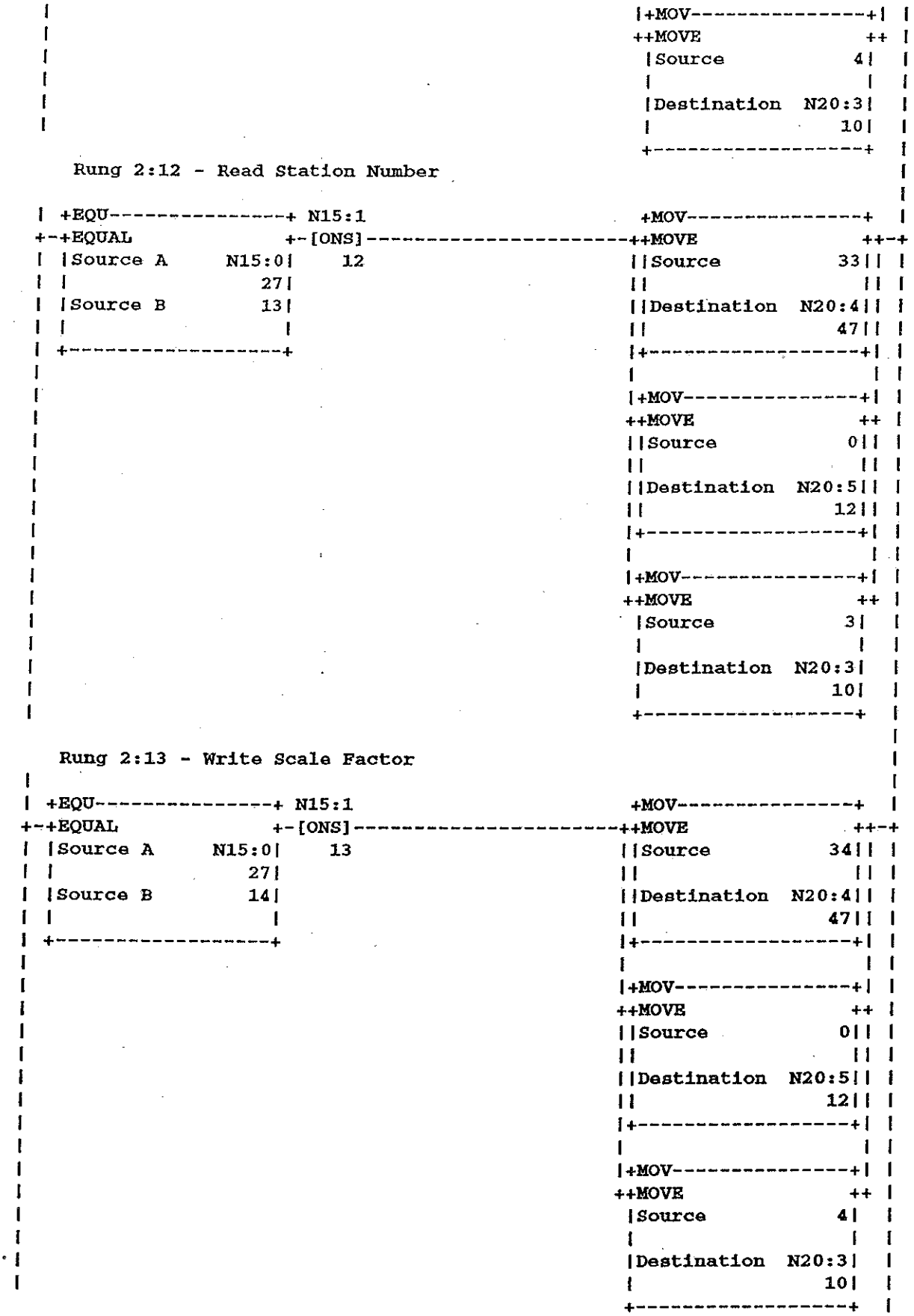




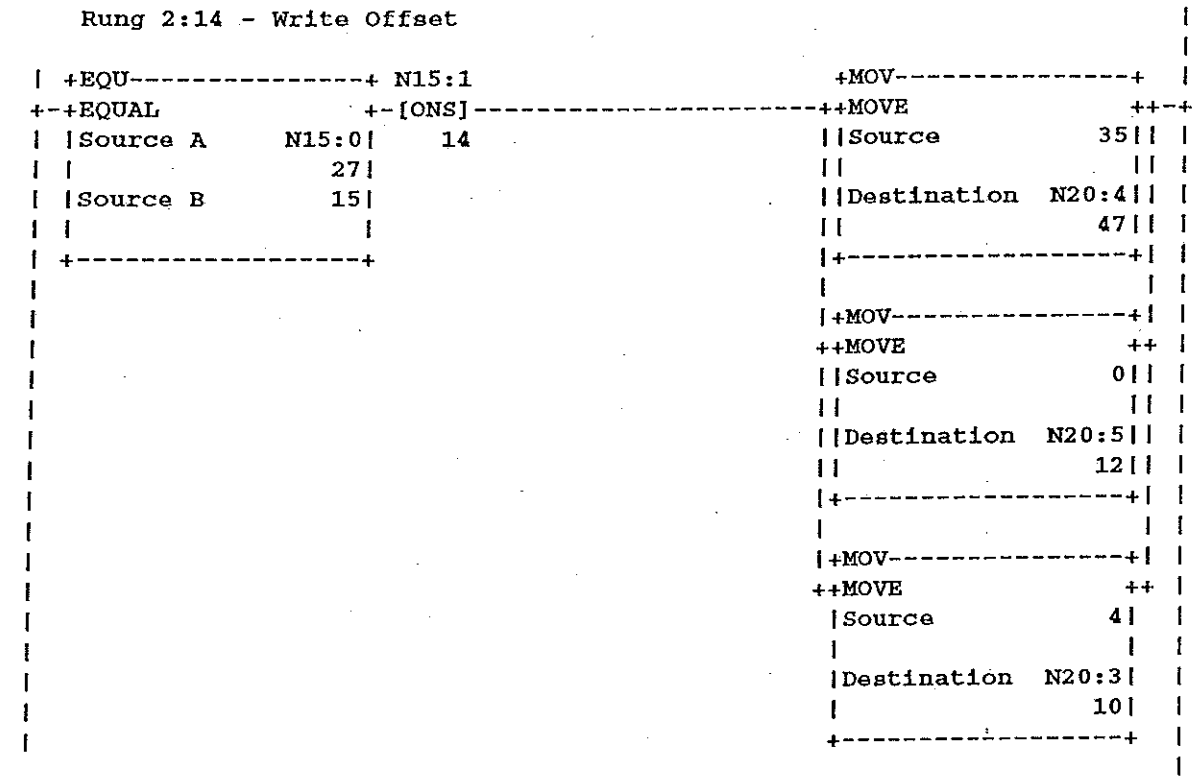
Rung 2:10 - Read Brake Caution Limit

Rung 2:11 - Read Baud Rate

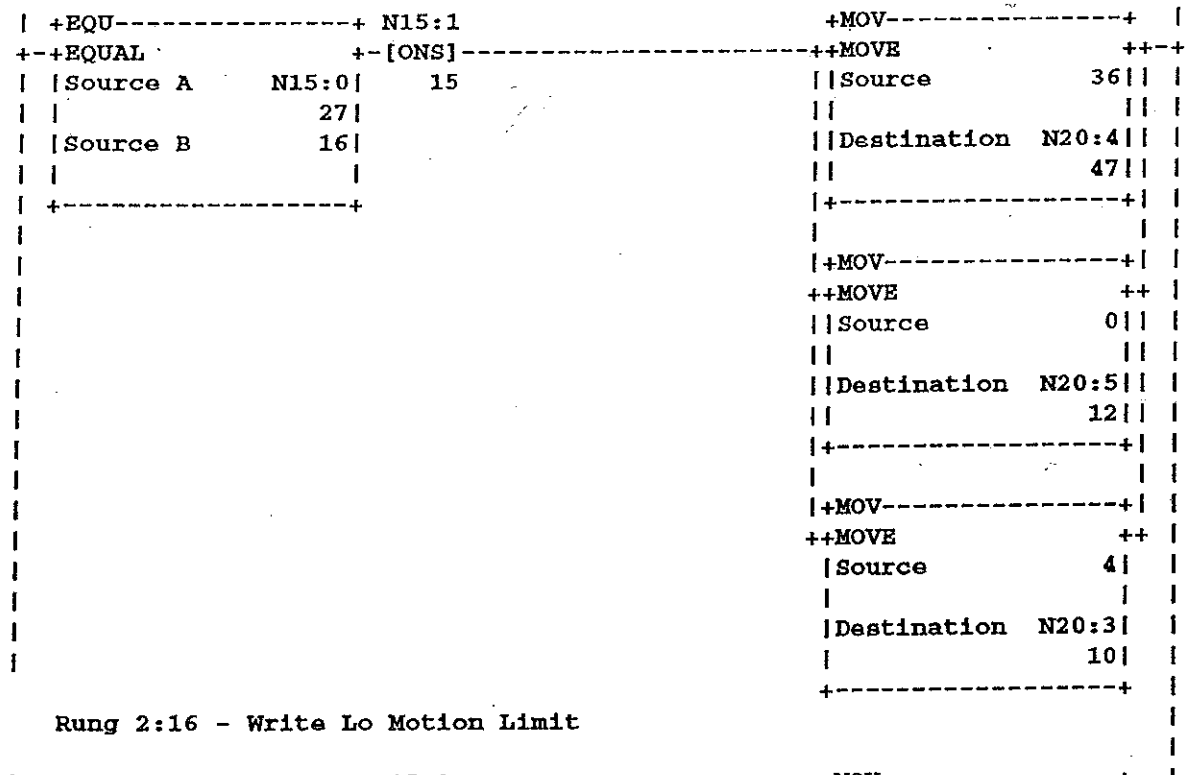



Rung 2:12 - Read Station Number
+EQU
+EQUAL
Source A N15:0
27
Source B 13
N15:1
[ONS]
12
+MOV
+MOVE
Source 33
Destination N20:4
47
+MOV
+MOVE
Source 0
Destination N20:5
12
+MOV
+MOVE
Source 3
Destination N20:3
10
Rung 2:13 - Write Scale Factor
+EQU
+EQUAL
Source A N15:0
27
Source B 14
N15:1
[ONS]
13
+MOV
+MOVE
Source 34
Destination N20:4
47
+MOV
+MOVE
Source 0
Destination N20:5
12
+MOV
+MOVE
Source 4
Destination N20:3
10

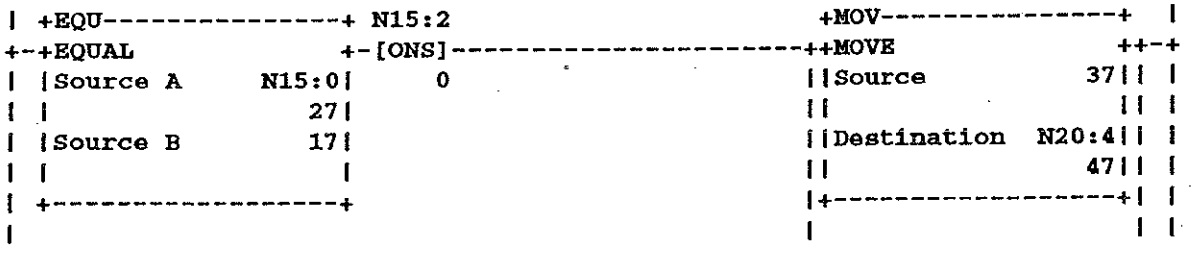
Rung 2:14 - Write Offset

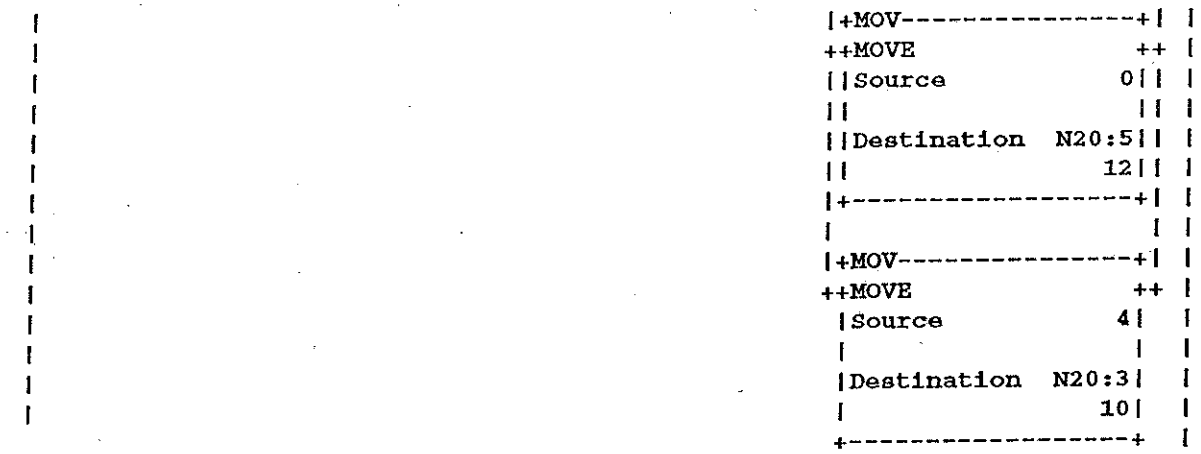


Rung 2:15 - Write Hi Motion Limit

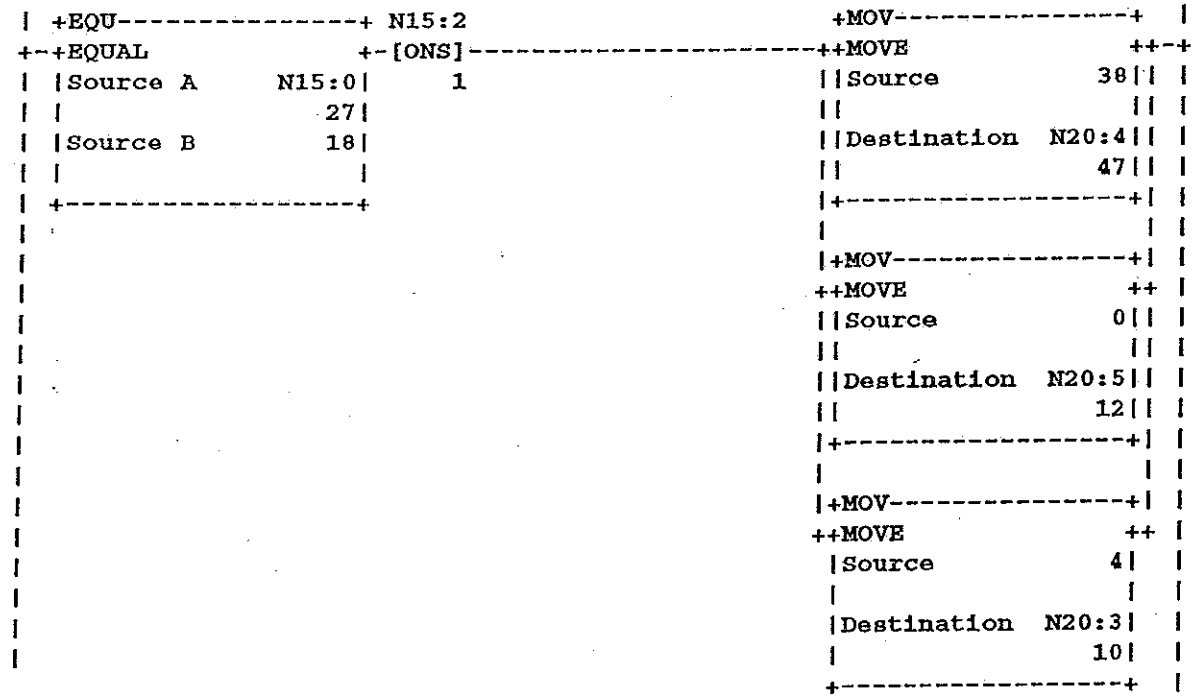


Rung 2:16 - Write Lo Motion Limit

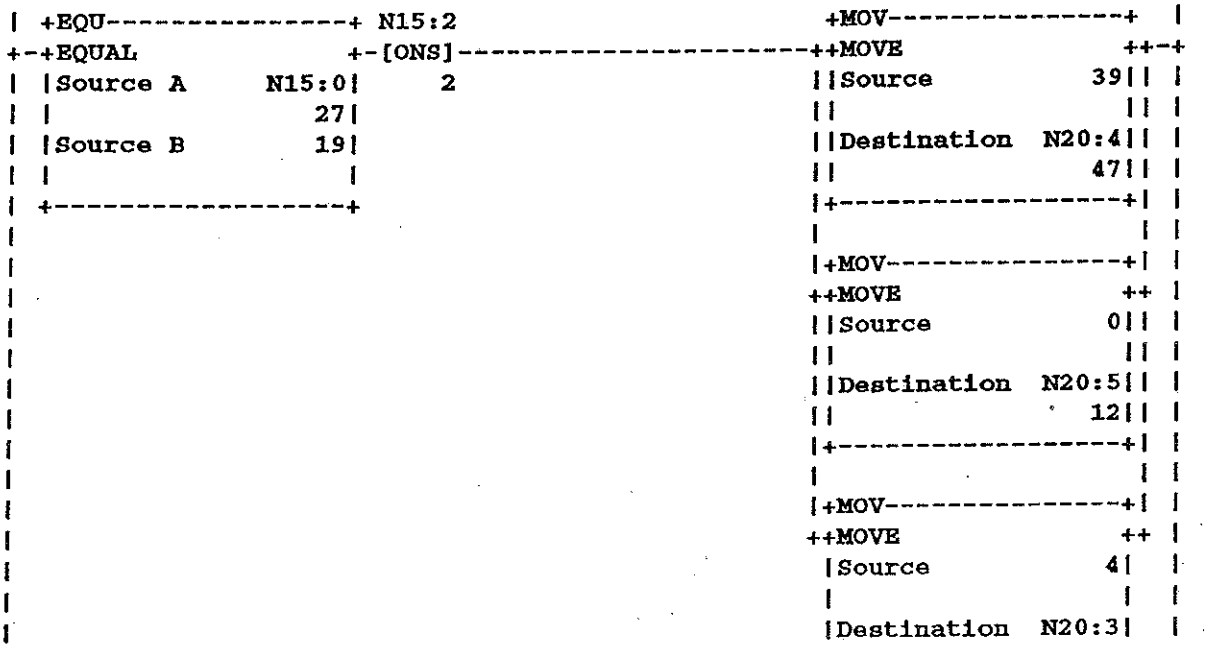




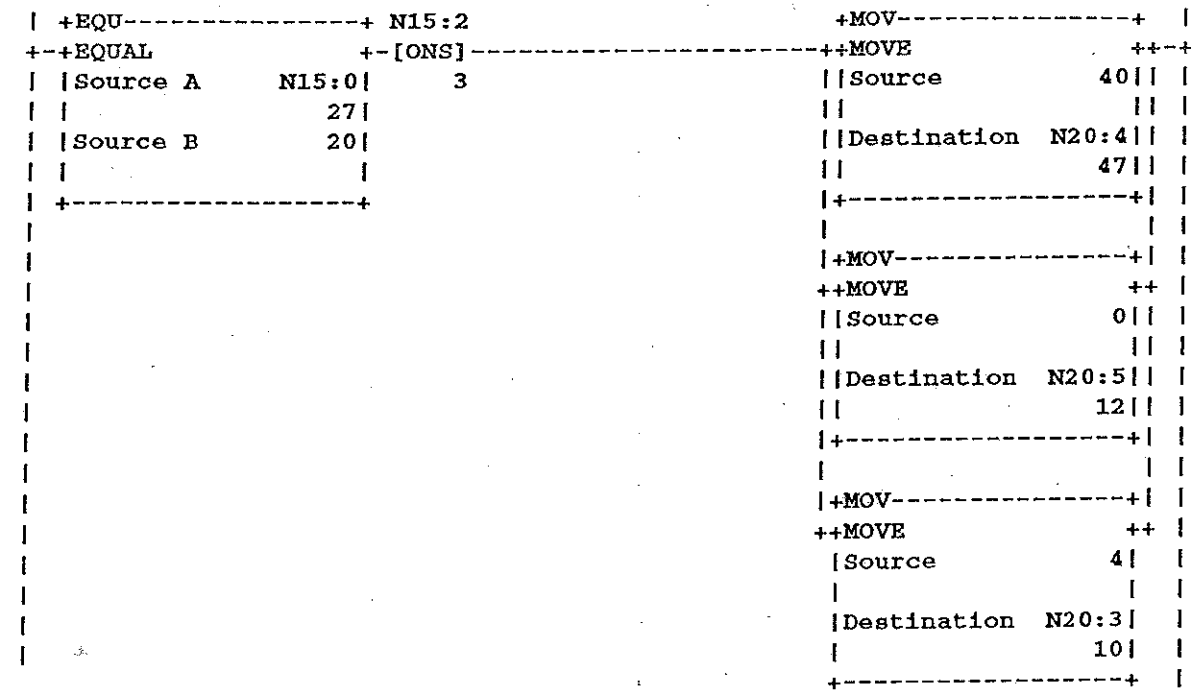
Rung 2:17 - Write Program Number



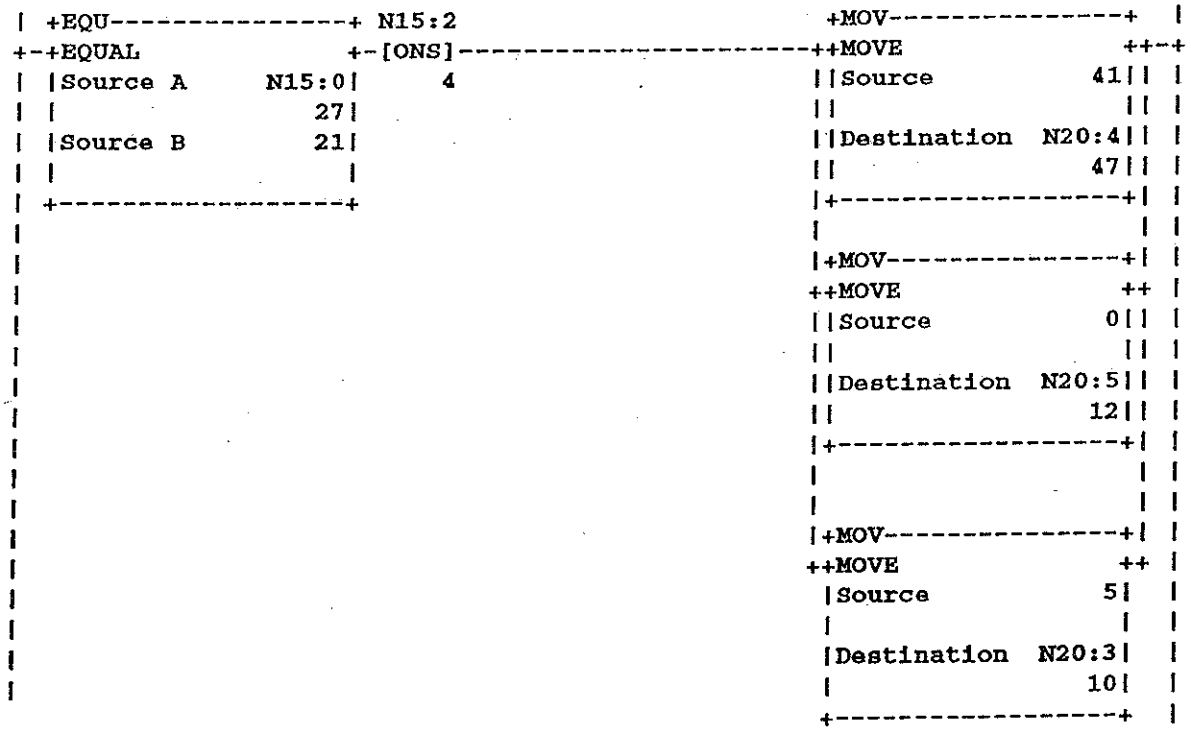
Rung 2:18 - Write Brake Danger Limit



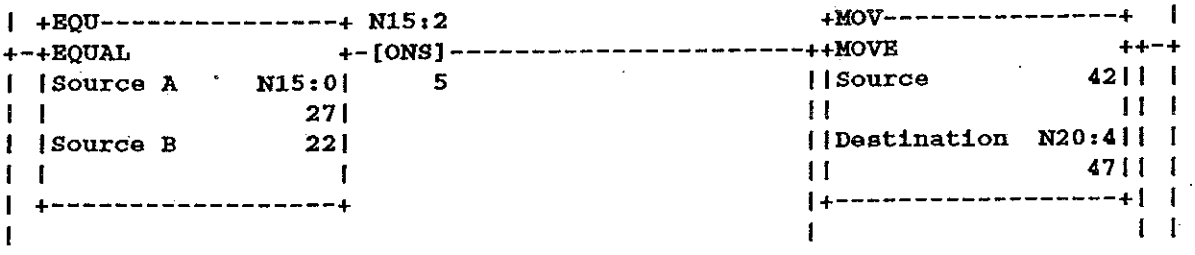
Rung 2:19 - Write Brake Caution Limit



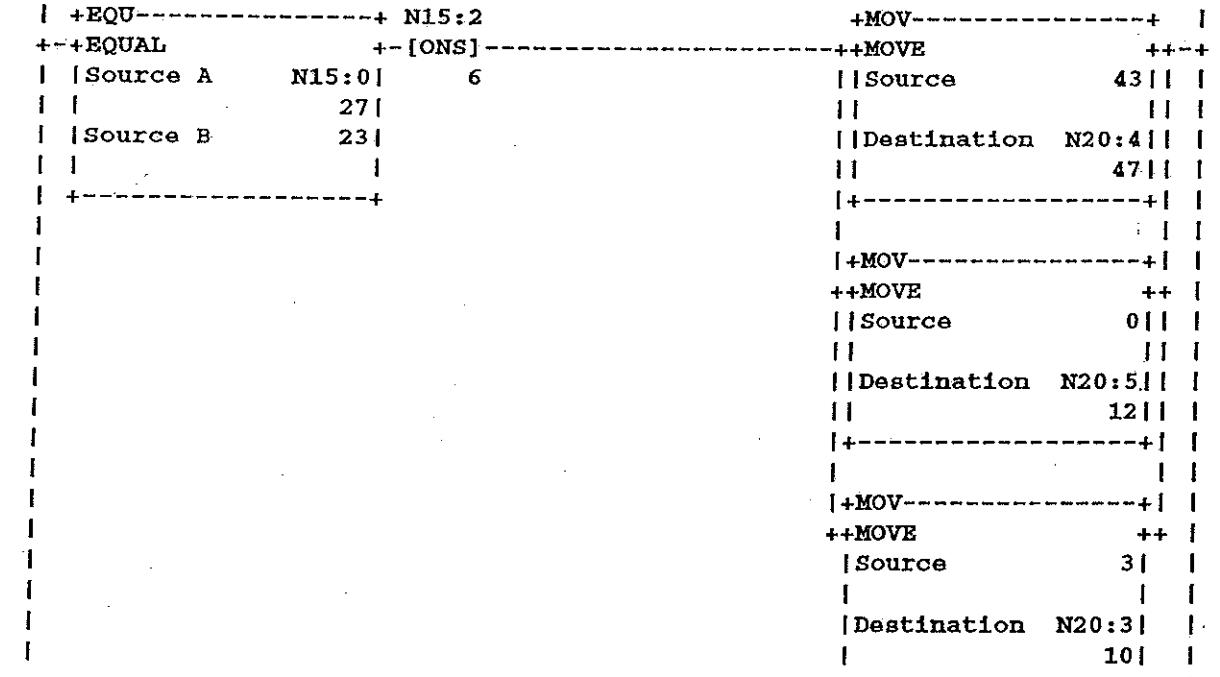
Rung 2:20 - Write Baud Rate



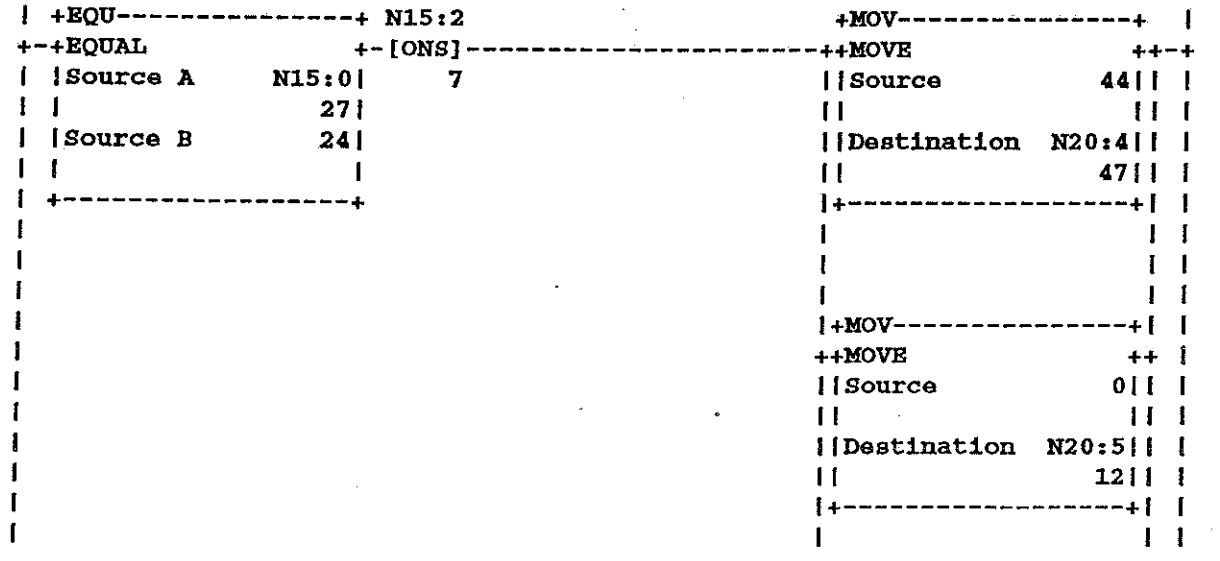
Rung 2:21 - Write Station Number

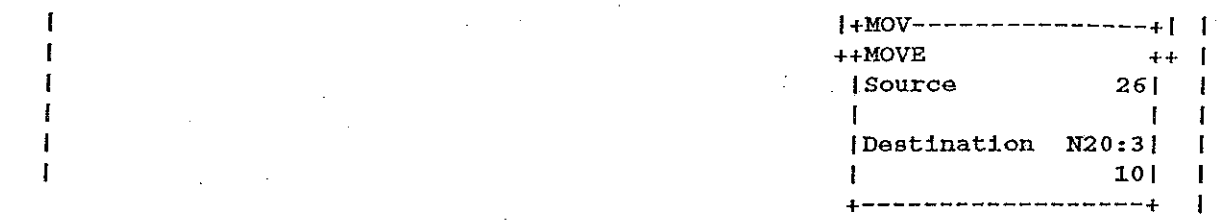


Rung 2:22 - Fine Tune Setpoints

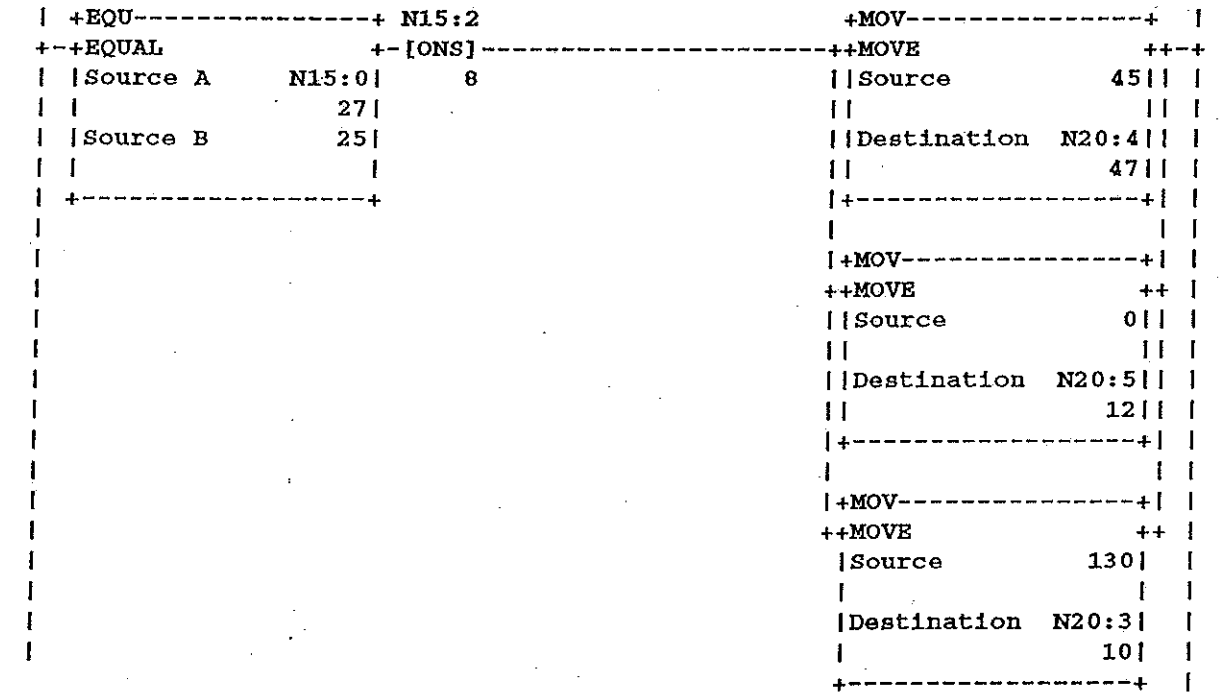


Rung 2:23 - Write Base Setup Parameters



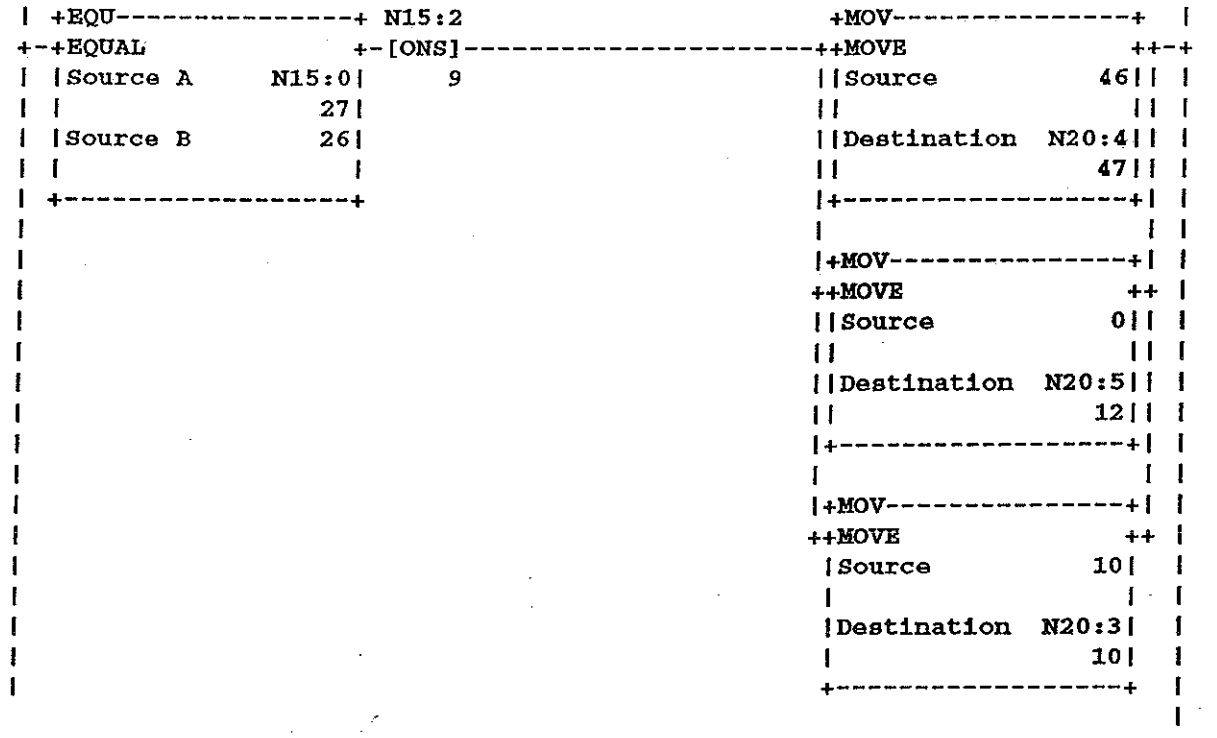


Rung 2:24 - Write Speed Compensation and Setpoints 1 & 2
For Channels 1 Thru 16



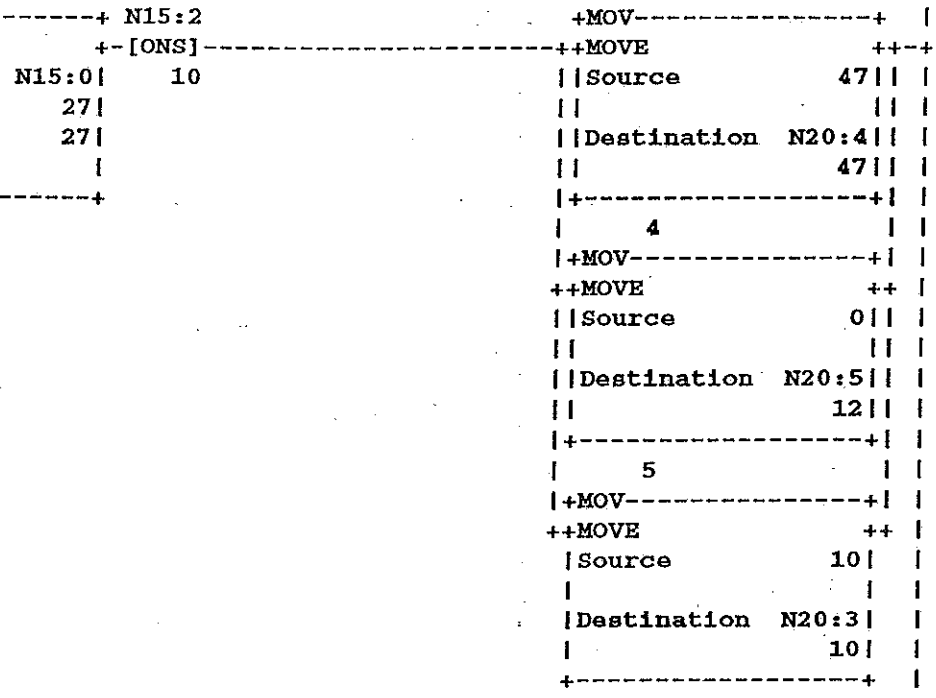
Rung 2:25 - Read 8 Consecutive Registers (12 bit data)

Note: Set The Address To Be Read In N48:0



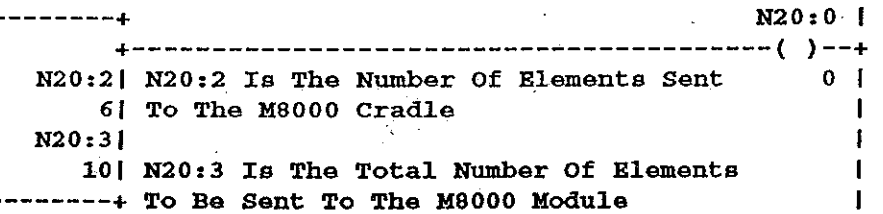
Rung 2:26 - Read 8 Consecutive Registers (Greater Than 12 Bits)

Note: Set The Address To Be Read In N48:0



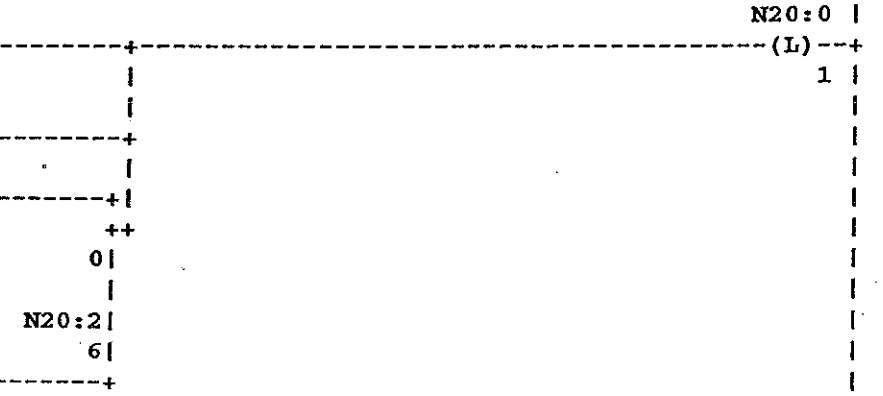
When N49:0/0 Switches From Off To On
The Choosen Function Is Performed.
N20:0 Is Used As An Enable And Is Set
When The Number Of Elements Sent Is
Is Less Than The Number To Be Sent.

Rung 2:27



N20:0/1 Is Used As A Transfer Enable And Is Set When No Elements Have Been Transfered Or When Bit 7 Of The Inputs Is The Same As Bit 7 Of The Outputs. N20:0/1 Will Be Cleared After A Transfer.

Rung 2:28



```
Rung 2:29

| N20:0                                                +MOV--------------------+ |
+--] [-------------------------------------------------+MOVE                   +-+
|    1                                                 |Source  N[N20:4][N20:5]| |
|                                                      |                      0| |
| N20:0/1 Is A Transfer Enable That Is Used            |Destination       O:001| |
| To Transfer Data To The First Slot Of The            |                      0| |
| The M8000 Cradle Module                              +-----------------------+ |
| N20:4 Contains The File Number To Retrieve To Retrieve Data From               |
| N20:5 Contains The Element Within The File To Retrieve Data From               |
| O:001 Is The First Slot Of The M8000 Cradle (LSB)                              |
|                                                                                |

Rung 2:30

| N20:0                                                  +ADD---------------+    |
+--] [--------------------------------------------------++ADD               ++-+
|    1                                                  ||Source A         1|| |
|                                                       ||                  || |
| When Data Is Retrieved From An Element N20:5 Is       ||Source B    N20:5|| |
| Incremented By One                                    ||                12|| |
|                                                       ||Destination N20:5|| |
|                                                       ||                12|| |
|                                                       |+-----------------+| |
|                                                       |             N20:0| |
|                                                       +--------------( )-+ |
|                                                                      2     |

Rung 2:31

 N20:0                                                 +MOV--------------------+ |
+--] [-------------------------------------------------+MOVE                   +-+
|    2                                                 |Source  N[N20:4][N20:5]| |
|                                                      |                      0| |
| N20:0/2 Is A Transfer Enable That Is Used To         |Destination       O:002| |
| Transfer Data To The Second Slot Of The              |                    224| |
| M8000 Cradle Module (O:002 MSB)                      +-----------------------+ |

Rung 2:32

| N20:0                                                    +ADD---------------+ |
+--] [-----------------------------------------------------+ADD               +-+
|    2                                                     |Source A         1| |
|                                                          |                  | |
| When Data Is Retrieved From An Element N20:5 Is          |Source B    N20:5| |
| Incremented By One                                       |                12| |
|                                                          |Destination N20:5| |
|                                                          |                12| |
                                                           +------------------+ |

Rung 2:33

| N20:0                                                    +ADD---------------+ |
+--] [-----------------------------------------------------+ADD               +-+
|    1                                                     |Source A         1| |
|                                                          |                  | |
| N20:0/1 Increments N20:2 For Every Other                 |Source B    N20:2| |
| Transfer Of Data To The M8000 Cradle Module              |                 6| |
|                                                          |Destination N20:2| |
|                                                          |                 6| |
                                                           +------------------+ |
```

```
   Rung 2:34                                                              |
                                                                          |
 | N49:0 +EQU---------------+                   +MOV---------------+  |
 +--] [--+EQUAL             +-------------------++MOVE             ++-+
 |      1 |Source A      N20:2|                  ||Source           3||  |
 |        |                  6|                  ||                  ||  |
 |        |Source B          8|                  ||Destination  N20:2||  |
 |        |                   |                  ||                  6||  |
 |        +-------------------+                  |+------------------+|  |
 |                                               |                   |  |
 | N49:0/1 Is Used To Enable Continuous Reads    |+MOV---------------+|  |
 | Of Eight Consecutive Registers (Function 25 - ++MOVE             ++  |
 | 12 Bit) Or Four Consecutive Registers          |Source           6|   |
 | (Function 26 - 8 Bit)                          |                  |   |
 |                                                |Destination  N20:5|   |
 | In Continuous Read Mode N20:2 And N20:5        |                12|   |
 | Are Reset With New Element Numbers So That     +------------------+   |
 | The Read Sets In A Loop And Reads Continuously                         |
                                                                          |
   Rung 2:35                                                              |
                                                                          |
 | N20:0                                                          N20:0 |
 +--][-------------------------------------------------------------(U)--+
 |    1                                                               1 |
 |  Increments Transfers To The M8000 Cradle Module Until The Requested  |
 |  Number Of Elements Have Been Transfered                               |
                                                                          |
   Rung 2:36                                                              |
                                                                          |
 | N49:0                                           +MOV---------------+  |
 +--]/[------------------------------------------++MOVE             ++-+
 |     0                                          ||Source           0||  |
 |                                                ||                  ||  |
 |  When N49:0/0 Is Switched From On To Off The   ||Destination  N20:5||  |
 |  Element Control Registers And Output Registers||                12||  |
 |  Are Cleared                                   |+------------------+|  |
 |                                                |+MOV---------------+|  |
 |                                                ++MOVE             ++  |
 |                                                ||Source           0||  |
 |                                                ||                  ||  |
 |                                                ||Destination  N20:2||  |
 |                                                ||                 6||  |
 |                                                |+------------------+|  |
 |                                                |+MOV---------------+|  |
 |                                                ++MOVE             ++  |
 |                                                ||Source           0||  |
 |                                                ||                  ||  |
 |                                                ||Destination  O:001||  |
 |                                                ||                 0||  |
 |                                                |+------------------+|  |
 |                                                |                   |  |
 |                                                |+MOV---------------+|  |
 |                                                ++MOVE             ++  |
 |                                                 |Source           0|   |
 |                                                 |                  |   |
 |                                                 |Destination  O:002|   |
 |                                                 |               224|   |
 |                                                 +------------------+   |
                                                                          |
```

Rung 2:37

This Rung Transfers The Data From The M8000 Cradle (I:001 - LSB / I:002 - MSB

Data From I:001 And I:002 Is Combined To Form A Single 16 Bit Word At N20:1

```
+BTD---------------+
+BIT FIELD DISTRIB ++
|Source       I:002|
|                 0|
|Source bit       0|
|Destination  N20:1|
|                 0|
|Destination bit  8|
|Length           4|
+------------------+
+BTD---------------+
+BIT FIELD DISTRIB ++
|Source       I:001|
|                 0|
|Source bit       0|
|Destination  N20:1|
|                 0|
|Destination bit  0|
|Length           8|
+------------------+
```

Rung 2:38

This Rung Moves The Value Of N49:0 Bits 8-15 (These Bits Are Used For The Function Select) To N49:0 Where They Are Used To Select Which Function To Perform

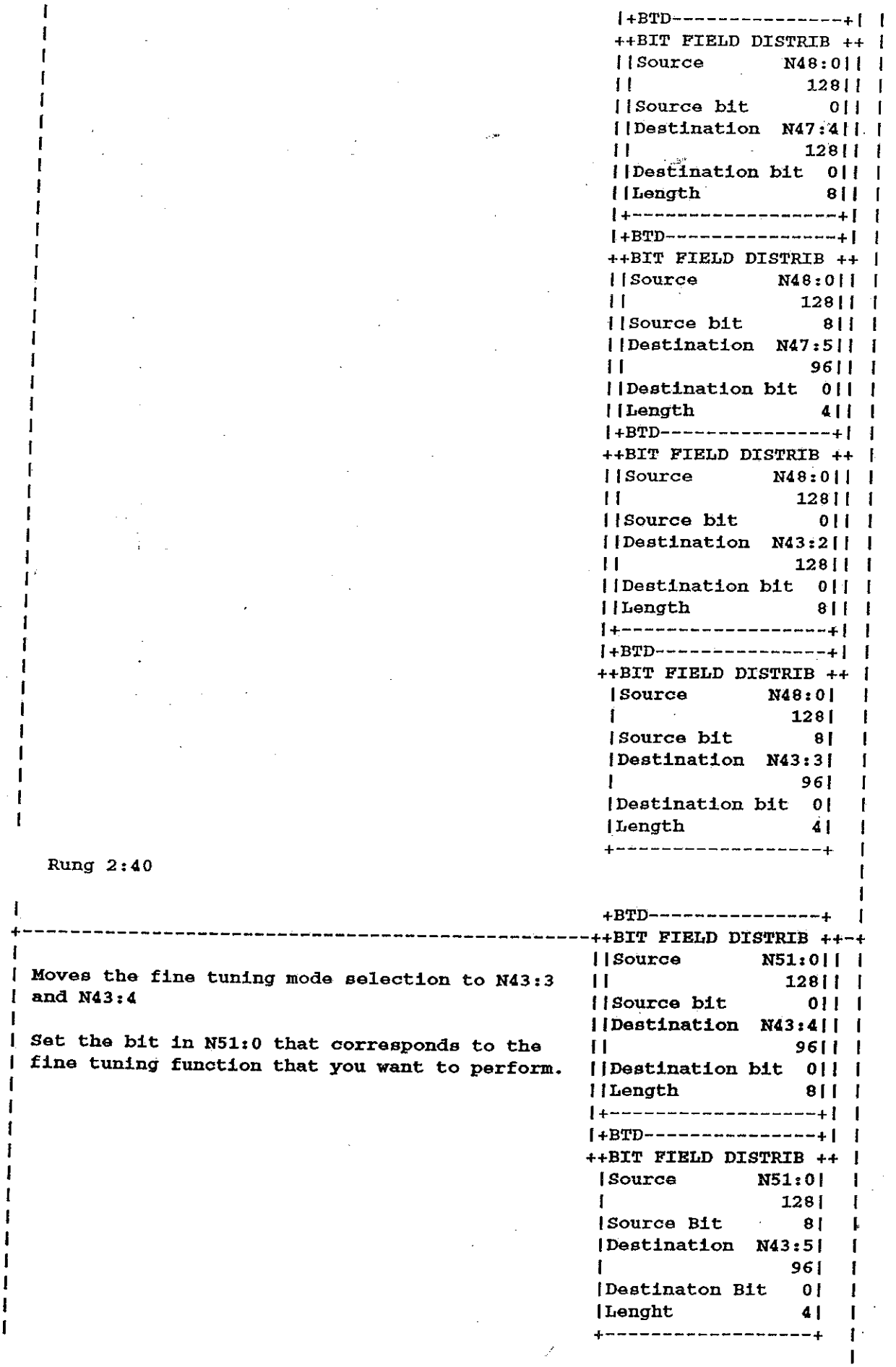
```
+BTD---------------+
+BIT FIELD DISTRIB +-+
|Source       N49:0| |
|                 0| |
|Source bit       8| |
|Destination  N15:0| |
|                27| |
|Destination bit  0| |
|Length           8| |
+------------------+ |
```

Rung 2:39

N48:0 Is The Starting Address Location Used When Performing Functions 26 & 27.
To Perform Continuous Reads Insert The Starting Address In N48:0. This Address Is Moved To The Intger Files Used To Preform Functions 26 & 27.

N48:0 Is also used as the source for the fine tuning address. Insert the dual port ram address of the setpoint to be fine tuned at this location.

```
+BTD---------------+
++BIT FIELD DISTRIB ++-+
||Source       N48:0|| |
||                128|| |
||Source bit        0|| |
||Destination  N46:4|| |
||                128|| |
||Destination bit   0|| |
||Length            8|| |
|+------------------+| |
|                    | |
|+BTD---------------+| |
++BIT FIELD DISTRIB ++ |
||Source       N48:0|| |
||                128|| |
||Source bit        8|| |
||Destination  N46:5|| |
||                 80|| |
||Destination bit   0|| |
||Length            4|| |
|+------------------+| |
|                    | |
```


BTD
BIT FIELD DISTRIB
Source N48:0
128
Source bit 0
Destination N47:4
128
Destination bit 0
Length 8
BTD
BIT FIELD DISTRIB
Source N48:0
128
Source bit 8
Destination N47:5
96
Destination bit 0
Length 4
BTD
BIT FIELD DISTRIB
Source N48:0
128
Source bit 0
Destination N43:2
128
Destination bit 0
Length 8
BTD
BIT FIELD DISTRIB
Source N48:0
128
Source bit 8
Destination N43:3
96
Destination bit 0
Length 4
Rung 2:40
BTD
BIT FIELD DISTRIB
Source N51:0
128
Source bit 0
Destination N43:4
96
Destination bit 0
Length 8
BTD
BIT FIELD DISTRIB
Source N51:0
128
Source Bit 8
Destination N43:5
96
Destinaton Bit 0
Lenght 4
Moves the fine tuning mode selection to N43:3 and N43:4
Set the bit in N51:0 that corresponds to the fine tuning function that you want to perform.

Rung 2:41

N49:0
2

When Performing Consecutive Reads Set N49:0/2. This Moves The Read Count To N50/0. This Count Is Used To Determine Which Register To Move The Current Data To From The M8000 Module.

(Set For Functions 27 & 28)

BTD BIT FIELD DISTRIB
Source I:002 0
Source bit 4
Destination N50:0 7
Destination bit 0
Length 3

Rung 2:42

N49:0 EQU EQUAL
2
Source A N50:0 7
Source B 0

When Read Count Equals Zero Data IS Moved To N50:1

BTD BIT FIELD DISTRIB
Source I:001 0
Source bit 0
Destination N50:1 0
Destination bit 0
Length 8

BTD BIT FIELD DISTRIB
Source I:002 0
Source bit 0
Destination N50:1 0
Destination bit 8
Length 4

Rung 2:43

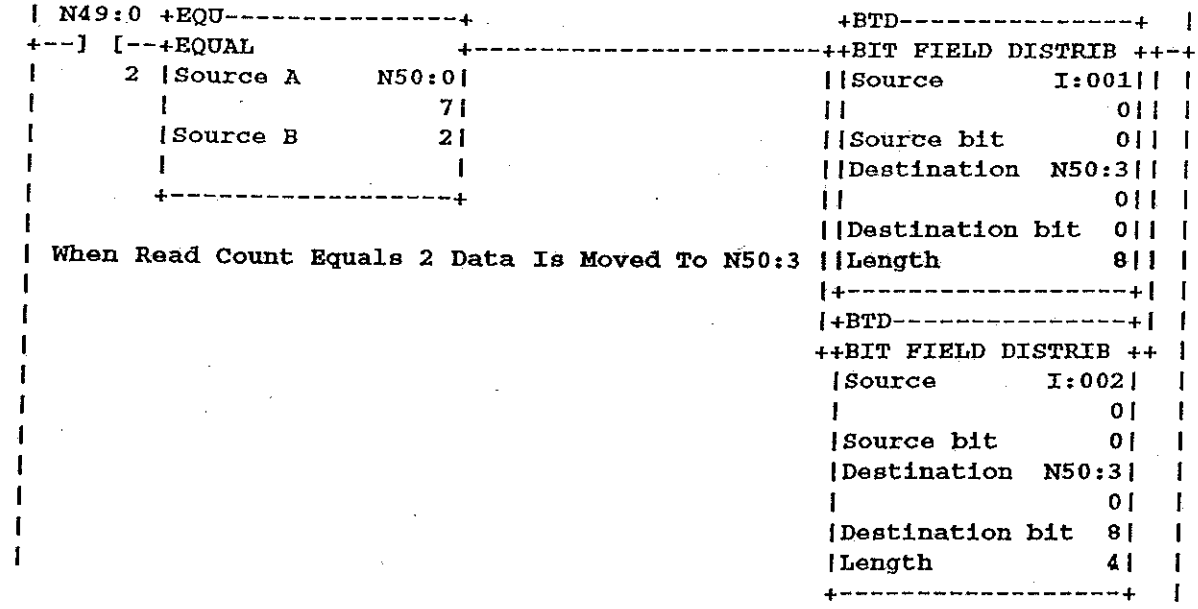
N49:0 EQU EQUAL
2
Source A N50:0 7
Source B 1

When Read Count Equals 1 Data Is Moved To N50:2

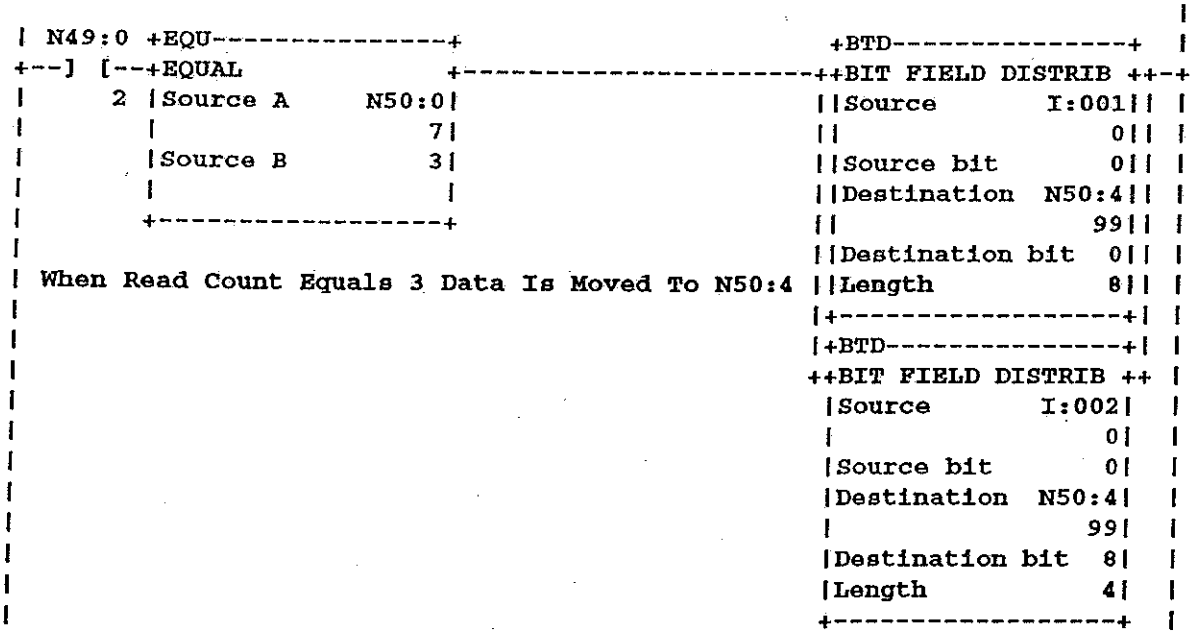
BTD BIT FIELD DISTRIB
Source I:001 0
Source bit 0
Destination N50:2 23
Destination bit 0
Length 8

BTD BIT FIELD DISTRIB
Source I:002 0
Source bit 0
Destination N50:2 23
Destination bit 8
Length 4

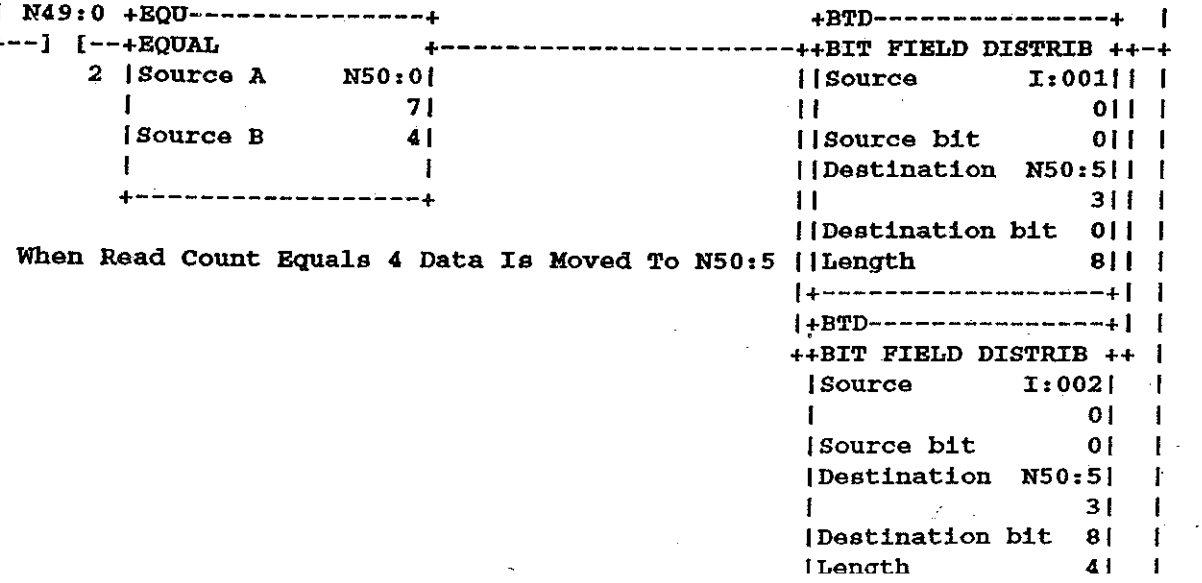
Rung 2:44



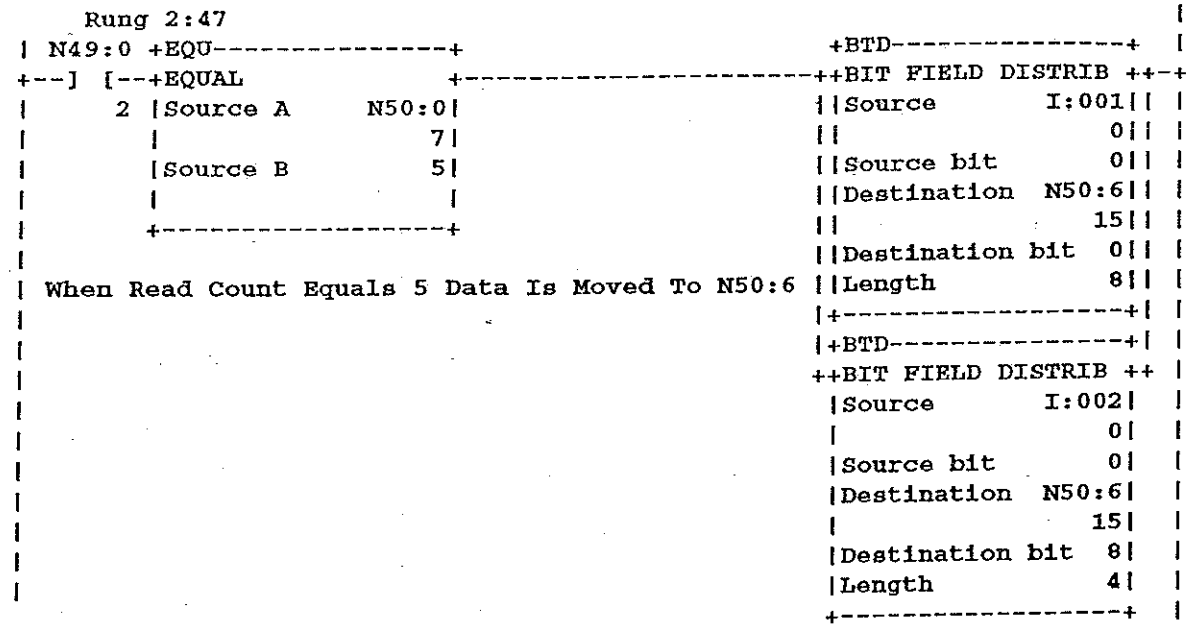
Rung 2:45



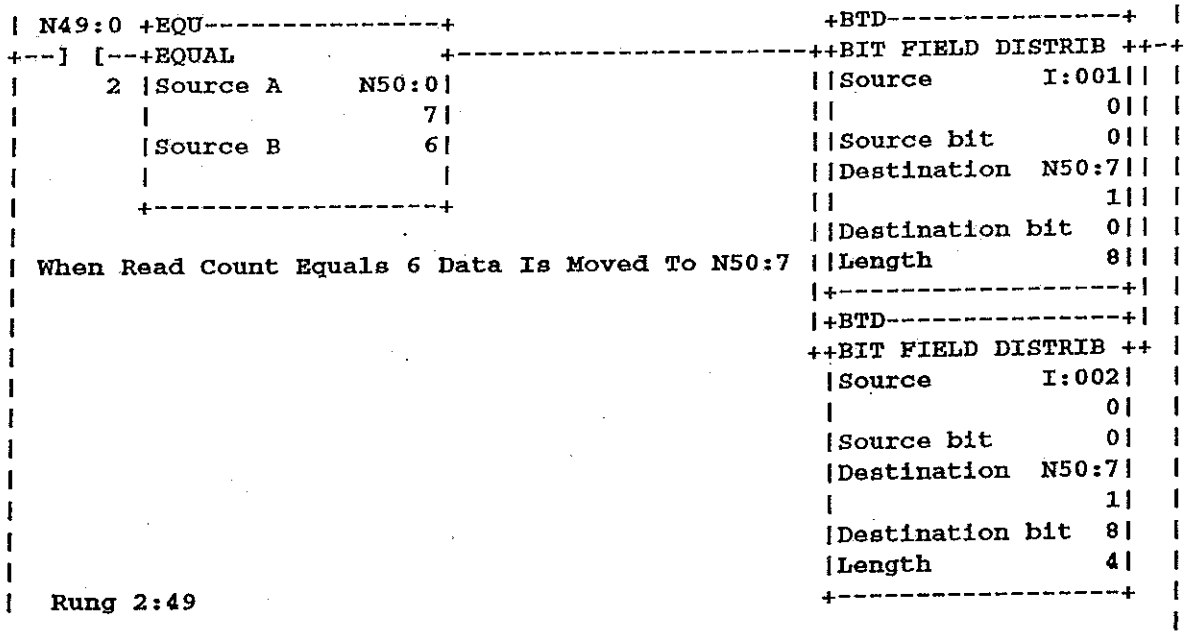
Rung 2:46



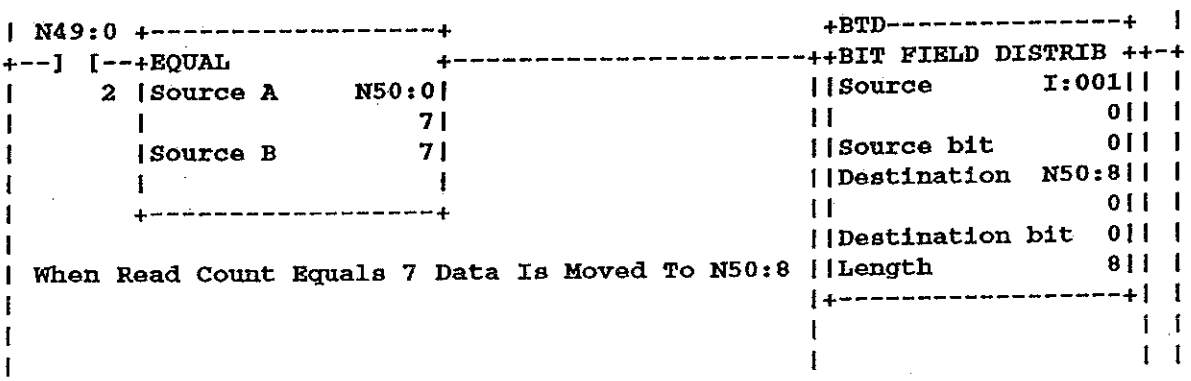
Rung 2:47

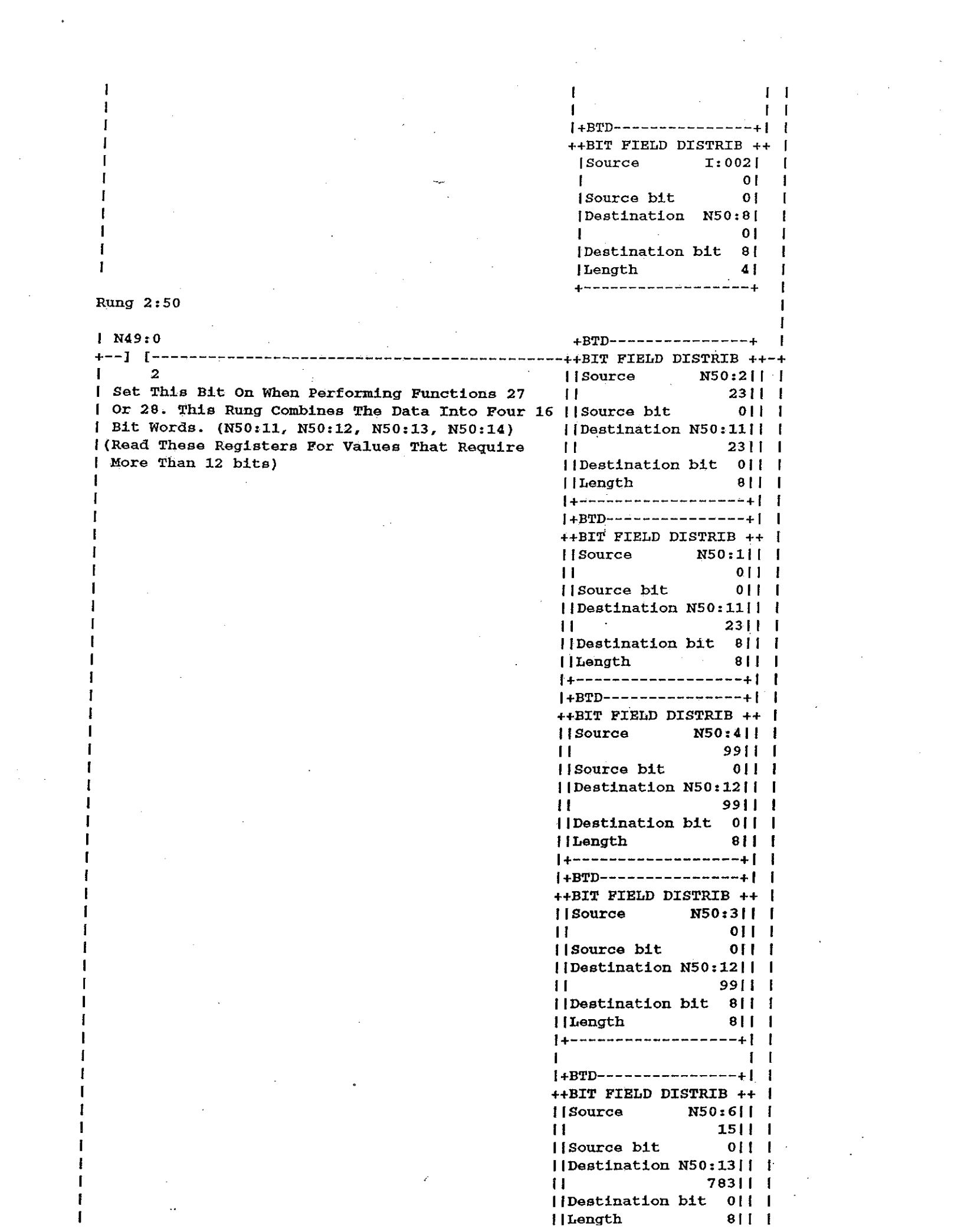


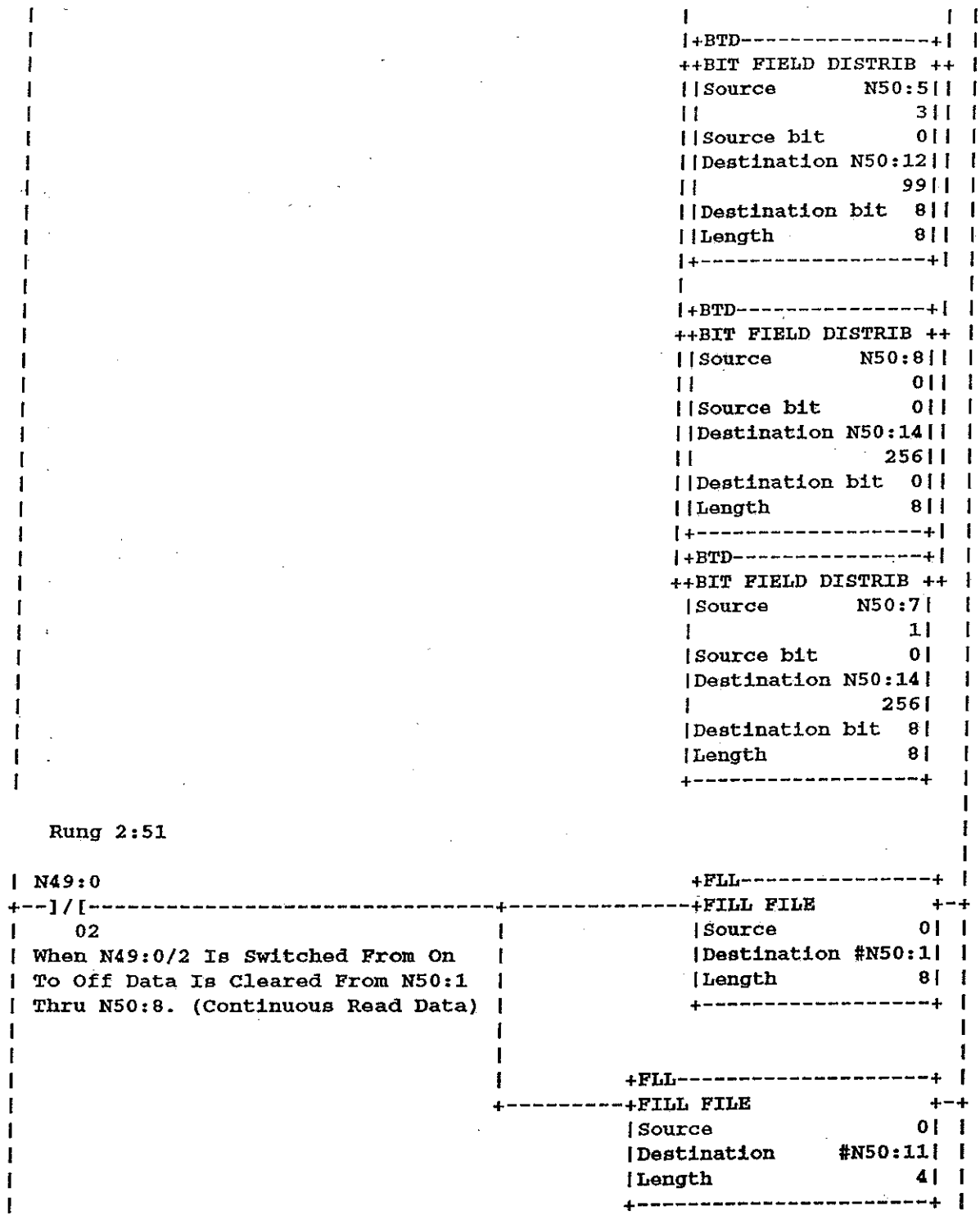
Rung 2:48



Rung 2:49




Rung 2:50
N49:0
2
Set This Bit On When Performing Functions 27 Or 28. This Rung Combines The Data Into Four 16 Bit Words. (N50:11, N50:12, N50:13, N50:14)
(Read These Registers For Values That Require More Than 12 bits)
BTD
BIT FIELD DISTRIB
Source I:002 0
Source bit 0
Destination N50:8 0
Destination bit 8
Length 4
Source N50:2 23
Source bit 0
Destination N50:11 23
Destination bit 0
Length 8
Source N50:1 0
Source bit 0
Destination N50:11 23
Destination bit 8
Length 8
Source N50:4 99
Source bit 0
Destination N50:12 99
Destination bit 0
Length 8
Source N50:3 0
Source bit 0
Destination N50:12 99
Destination bit 8
Length 8
Source N50:6 15
Source bit 0
Destination N50:13 783
Destination bit 0
Length 8


BTD
BIT FIELD DISTRIB
Source N50:5
3
Source bit 0
Destination N50:12
99
Destination bit 8
Length 8
BTD
BIT FIELD DISTRIB
Source N50:8
0
Source bit 0
Destination N50:14
256
Destination bit 0
Length 8
BTD
BIT FIELD DISTRIB
Source N50:7
1
Source bit 0
Destination N50:14
256
Destination bit 8
Length 8
Rung 2:51
N49:0
02
When N49:0/2 Is Switched From On
To Off Data Is Cleared From N50:1
Thru N50:8. (Continuous Read Data)
FLL
FILL FILE
Source 0
Destination #N50:1
Length 8
FLL
FILL FILE
Source 0
Destination #N50:11
Length 4

Function 13 = Read Station Number

Address	0	1	2	3	4	5
N33:0	0000	0000	0000	00A0	0024	0051

Function 14 = Write Scale Factor

Address	0	1	2	3	4	5	6	7
N34:0	0000	0000	0002	0091	0067	0051	0000	00000

Function 15 = Write Offset

Address	0	1	2	3	4	5	6	7
N35:0	0000	0000	0004	0091	0000	0050	0000	0000

Function 16 = Write Hi Motion Limit

Address	0	1	2	3	4	5	6	7
N36:0	0000	0000	0006	0091	00F4	0051	0000	0000

Function 17 = Write Lo Motion Limit

Address	0	1	2	3	4	5	6	7
N37:0	0000	0000	0008	0091	0014	0050	0000	0000

Function 18 = Write Program Number

Address	0	1	2	3	4	5	6	7
N38:0	0000	0000	000A	0091	0001	0050	0000	0000

Function 19 = Write Brake Danger Limit

Address	0	1	2	3	4	5	6	7
N39:0	0000	0000	000C	0091	0026	0052	0000	0000

Function 20 = Write Brake Caution Limit

Address	0	1	2	3	4	5	6	7
N40:0	0000	0000	000E	0091	005E	0051	0000	0000

Function 21 = Write Baud Rate

Address	0	1	2	3	4	5	6	7
N41:0	0000	0000	0022	0091	0025	0060	0080	00E0

Function 22 = Write Station Number

Address	0	1	2	3	4	5	6	7
N42:0	0000	0000	0024	0091	0001	0050	0000	0000

Function 23 = Fine Tune Setpoints

Address	0	1	2	3	4	5
N43:0	0000	0000	0046	0091	0001	0070

Function 24 = Write Base Setup Parameters

Address	0	1	2	3	4	5	6	7	8	9
N44:0	0000	0000	0002	0091	0067	0051	007B	00D0	00F4	0051
N44:10	000A	00D0	0001	0050	00FA	00D0	0096	0050	0000	00D0
N44:20	0000	0050	0000	00D0	0000	0050	0000	00D0	0000	0050
N44:30	0000	00D0	0000	0050	0000	00D0	0000	0000	0022	0091

Data Tables

Address	0	1	2	3	4	5	6
N20:0	0000	0000	0000	0000	0000	0000	0000

Function 1 = Read Resolver RPM

Address	0	1	2	3	4	5
N21:0	0000	0000	0000	00A0	0080	0050

Function 2 = Read Resolver Position

Address	0	1	2	3	4	5
N22:0	0000	0000	0000	00A0	0082	0050

Function 3 = Read I/O Status

Address	0	1	2	3	4	5	6	7
N23:0	0000	0000	0001	00A0	0084	0060	0000	00E0

Function 4 = Read Outputs

Address	0	1	2	3	4	5	6	7
N24:0	0000	0000	0001	00A0	0086	0060	0000	00E0

Function 5 = Read Scale Factor

Address	0	1	2	3	4	5
N25:0	0000	0000	0000	00A0	0002	0051

Function 6 = Read Offset

Address	0	1	2	3	4	5
N26:0	0000	0000	0000	00A0	0004	0051

Function 7 = Read Hi Motion Limit

Address	0	1	2	3	4	5
N27:0	0000	0000	0000	00A0	0006	0051

Function 8 = Read Lo Motion Limit

Address	0	1	2	3	4	5
N28:0	0000	0000	0000	00A0	0008	0051

Function 9 = Read Program Number

Address	0	1	2	3	4	5
N29:0	0000	0000	0000	00A0	000A	0051

Function 10 = Read Brake Danger Limit

Address	0	1	2	3	4	5
N30:0	0000	0000	0000	00A0	000C	0051

Function 11 = Read Brake Caution Limit

Address	0	1	2	3	4	5
N31:0	0000	0000	0000	00A0	000E	0051

Funtion 12 = Read Baud Rate

Address	0	1	2	3	4	5	6	7
N32:0	0000	0000	0001	00A0	0022	0061	0000	00E0

N44:40	0025	0060	0080	00E0	0000	0000	0024	0091	0010	0050
N44:50	0000	0000								

Function 25 = Write Speed Compensation For Channels 1 Thru 4 and Setpoints 1 and 2 For Channels 1 Thru 16

Address	0	1	2	3	4	5	6	7	8	9
N45:0	0000	0000	0040	0091	0002	0050	0000	00D0	0000	0050
N45:10	000A	00D0	0014	0050	00AA	00D0	00B4	0050	0062	0091
N45:20	000A	0050	0000	00D0	0000	0050	0014	00D0	001E	0050
N45:30	00B4	00D0	00BE	0050	0084	0091	0005	0050	0000	00D0
N45:40	0000	0050	001E	00D0	0028	0050	00BE	00D0	00C8	0050
N45:50	00A6	0091	000F	0050	0000	00D0	0000	0050	0028	00D0
N45:60	0032	0050	00C8	00D0	00D2	0050	00C8	0091	0000	0050
N45:70	0000	00D0	0000	0050	0032	00D0	003C	0050	00D2	00D0
N45:80	00DC	0050	00EA	0091	0000	0050	0000	00D0	0000	0050
N45:90	003C	00D0	0046	0050	00DC	00D0	00E6	0050	000C	0092
N45:100	0000	0050	0000	00D0	0000	0050	0046	00D0	0050	0050
N45:110	00E6	00D0	00F0	0050	002E	0092	0000	0050	0000	00D0
N45:120	0000	0050	0050	00D0	005A	0050	00F0	00D0	00FA	0050
N45:130	0050	0092	0000	0050	0000	00D0	0000	0050	005A	00D0
N45:140	0064	0050	00FA	00D0	0004	0051	0072	0092	0000	0050
N45:150	0000	00D0	0000	0050	0064	00D0	006E	0050	0004	00D1
N45:160	000E	0051	0094	0092	0000	0050	0000	00D0	0000	0050
N45:170	006E	00D0	0078	0050	000E	00D1	0018	0051	00B6	0092
N45:180	0000	0050	0000	00D0	0000	0050	0078	00D0	0082	0050
N45:190	0018	00D1	0022	0051	00D8	0092	0000	0050	0000	00D0
N45:200	0000	0050	0082	00D0	008C	0050	0022	00D1	002C	0051
N45:210	00FA	0092	0000	0050	0000	00D0	0000	0050	008C	00D0
N45:220	0096	0050	002C	00D1	0036	0051	001C	0093	0000	0050
N45:230	0000	00D0	0000	0050	0096	00D0	00A0	0050	0036	00D1
N45:240	0040	0051	003E	0093	0000	0050	0000	00D0	0000	0050
N45:250	00A0	00D0	00AA	0050	0040	00D1	004A	0051	0000	0000

Function 26 = Read 8 Consecutive Registers (12 Bit Data)

Address	0	1	2	3	4	5	6	7	8	9
N46:0	0000	0000	0007	00A0	0080	0050	0000	00D0	0000	0050
N46:10	0000	00D0	0000	0050	0000	00D0	0000	0050	0000	00D0

Funtion 27 = Read Consecutive Registers (8 Bit Data)

Address	0	1	2	3	4	5	6	7	8	9
N47:0	0000	0000	0007	00A0	0080	0060	0000	00E0	0000	0060
N47:10	0000	00E0	0000	00E0	0000	00E0	0000	00E0	0000	00E0

NO MORE FILES