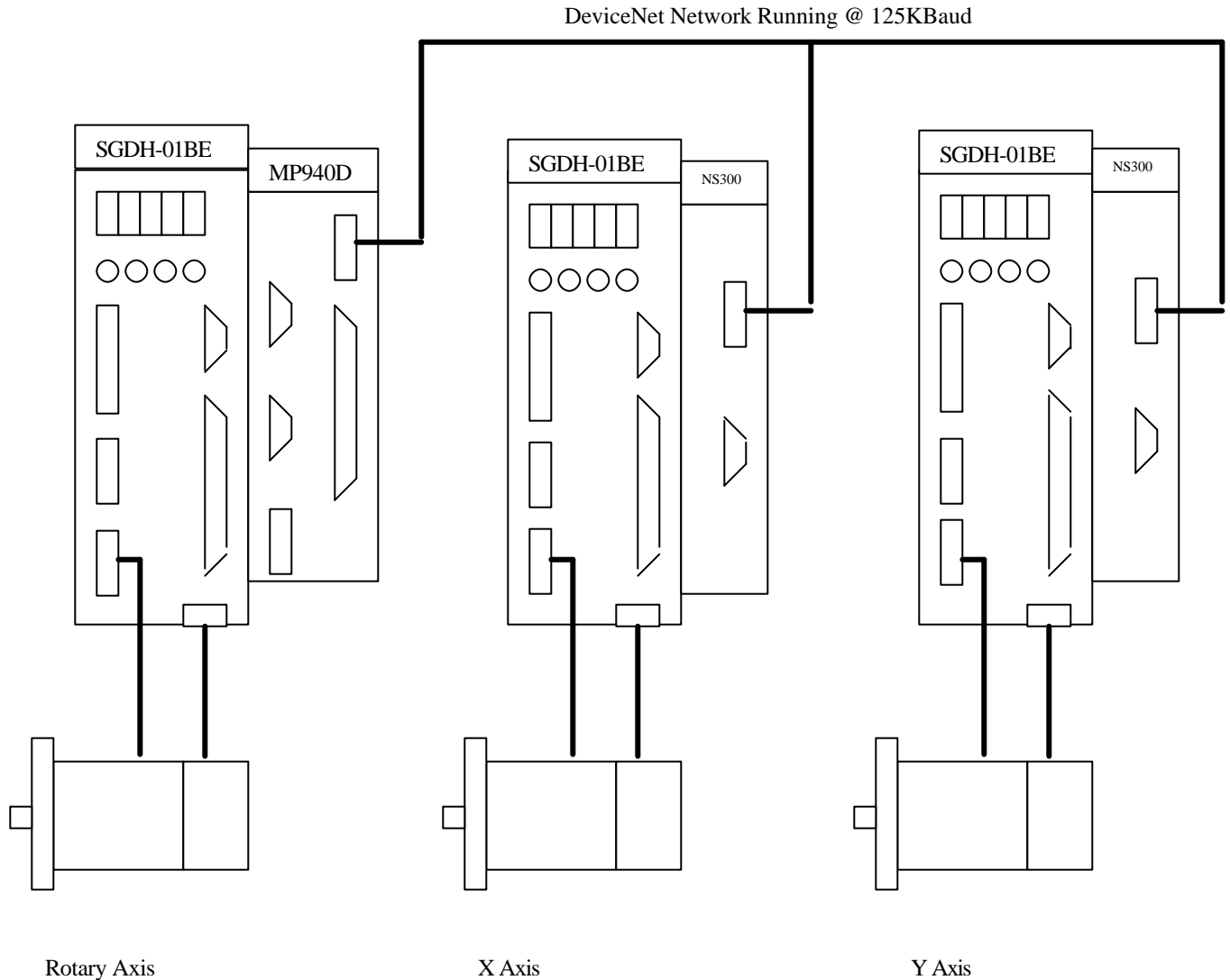


Subject: MP940D to NS300 DeviceNet Communications
Product: MP940D and NS300

Summary:

This documents describes how to setup a DeviceNet Network using a MP940D as Master and 2 NS300s as slaves. For demonstration purposes the MP940D will act as a rotary table and the two NS300s will be the X and Y axis on a pick and place station.

Physical Layout:

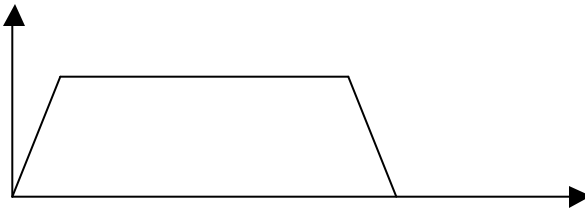


The Application:

The MP940D controls a Rotary Table which Indexes 90° each cycle. The MP940D is also the DeviceNet Master and is in charge of coordinating all motion. The NS300s are used for a pick and place station that operates at variable speed as directed by the Rotary Table.

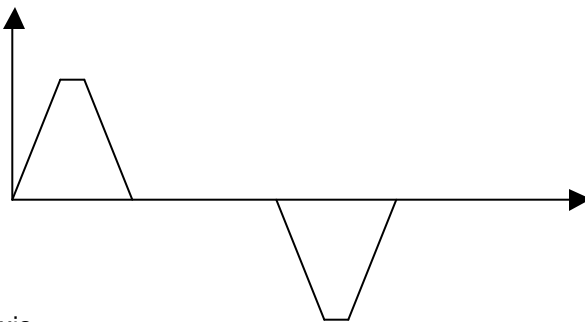
Timing Diagrams

Rotary Table



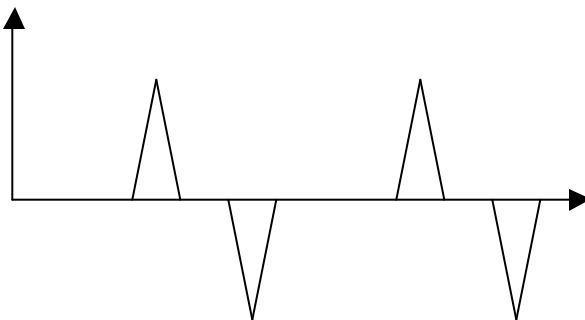
The Rotary Table Indexes 90° and waits for the Pick and Place operation to complete

X Axis



The X Axis Indexes 100mm to the Pick Position and waits for the Y Axis to Pick a part and return. The X Axis then returns to the Place Position.

Y Axis



The Y Axis Indexes 50mm to the Pick Position and waits for the 'Gripper' to get a part. The Y Axis then returns to the Place Position. Once the X Axis is in the Place position and the Table is in position the Y Axis Places the part and returns.

Setting up the NS300:

Set DR Rotary switch to position 0 (125 KBaud Transmission Rate)

Set Address Rotary switches to unique value 0-63 (X Axis = 1, Y Axis = 2)

Use NSxxx software to set the following parameters in the NS300s

| Parameter | Description | Value |
|-----------|--|--------------|
| 800 | Homing Method | 3 |
| 810 | Electronic Gear Ratio (Numerator) | 8192 |
| 811 | Electronic Gear Ratio (Denominator) | 10000 |
| 81B | Emergency Input Function Selection | 0 |
| 821 | Feed Speed for Positioning | 24000 mm/Min |
| 822 | Acceleration Time Constant for Positioning | 1 mSec |
| 823 | Deceleration Time Constant for Positioning | 1 mSec |
| 844 | Travel Distance 1 for Stepping | *Ref Units |

*Parameter 844 should be set to 100000 for the X Axis and 50000 for the Y Axis.

Setting up the MP940D:

Set DR0 and DR1 to Off (125 KBaud Transmission Rate)

Set Address Rotary switches to unique value 0-63 (Rotary Axis = 0)

Use MotionWorks+ software to set the following parameters in the MP940D

Network Object:

| Property Name | Value |
|---------------|-----------|
| Enabled | True |
| Function | Master |
| Refresh Rate | Low |
| Slave Nodes | 2 |
| Type | DeviceNet |

Node 1 Object:

| Property Name | Value |
|---------------|--------|
| Input Bytes | 8 |
| Name | X_Axis |
| Node | 1 |
| Output Bytes | 8 |

Node 2 Object:

| Property Name | Value |
|---------------|--------|
| Input Bytes | 8 |
| Name | Y_Axis |
| Node | 2 |

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| | |
|--------------|---|
| Output Bytes | 8 |
|--------------|---|

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The MP940 Network Object Parameter for Refresh Rate should be set to Low scan. Each DeviceNet request/reply packet pair takes less than 2mS to complete but the total network time is also a function of the number of slaves. Setting the Refresh Rate to Low reduces the burden on the microprocessor to complete a High Scan in less than the High Scan setting of 2mS.

See Appendix for a list of Network Variables to create MotionWorks+

Powering Up:

Power up the 2 NS300s and the MP940D. All DeviceNet LEDs should be steady green. In MotionWorks+, create a data watch with X_SVON, Y_SVON, X_HOME, Y_HOME X_HOME_P & Y_HOME_P.

Set the SVON Bits TRUE and verify both servos are enabled. Check the Homing sequence for each axis by toggling the HOME bit and verifying that the HOME_P bit is TRUE after Homing.

Set the HOME bits FALSE and set the STEP bits TRUE. This will cause the X Axis to rotate 10 revs (100mm) at 2400 RPM (24000 mm/Min). The Y Axis will rotate 5 revs (50mm) at 2400 RPM (24000 mm/Min).

Set the STEP bit FALSE and set the DIR bit TRUE. Then set the STEP bit TRUE. The X Axis will rotate -10 revs (100mm) at 2400 RPM (24000 mm/Min). The Y Axis will rotate -5 revs (50mm) at 2400 RPM (24000 mm/Min).

Set all but SVON bits FALSE. Create a data watch with X_MOD, X_CCW0, X_CCW3, X_C_START, X_Axis_Output_Command_Number, X_Axis_Output_Command_Data & X_Axis_Input_Response_Data.

Parameter Read:

Set the X_MOD and X_CCW3 bits TRUE, Set X_Axis_Output_Command_Number to 2081 (821hex). Pn821 is Feed Speed for Positioning (Stepping Speed). Set the X_C_START bit TRUE and observe X_Axis_Input_Response_Data. The response should be 24000, which is what we set Pn821 to using NSxxx software earlier.

Parameter Write:

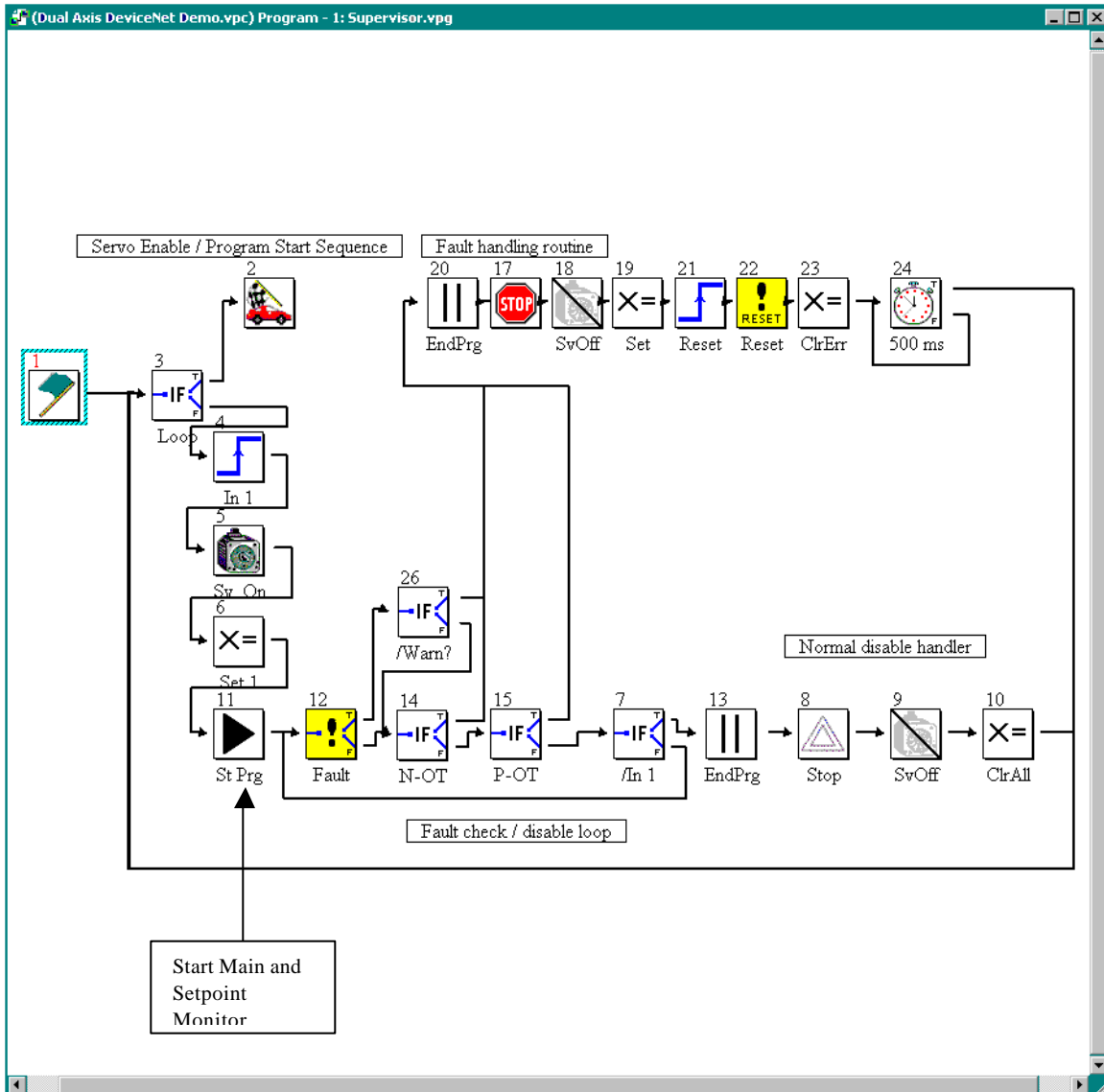
Set the X_C_START bit FALSE and the X_CCW0 bit TRUE. Set X_Axis_Output_Command_Data to 50000. Then set the X_C_START bit TRUE. This will temporarily change Pn821 to 50000. Once power is cycled, Pn821 reverts back to 24000.

MotionWorks+ Application:

Supervisor Program (High Scan, Active & Auto Start)

This is the standard Supervisor Program available on the FTP site.

<ftp://motion:controls@ftp.yaskawa.com/Applications/MP940/DEMO/>



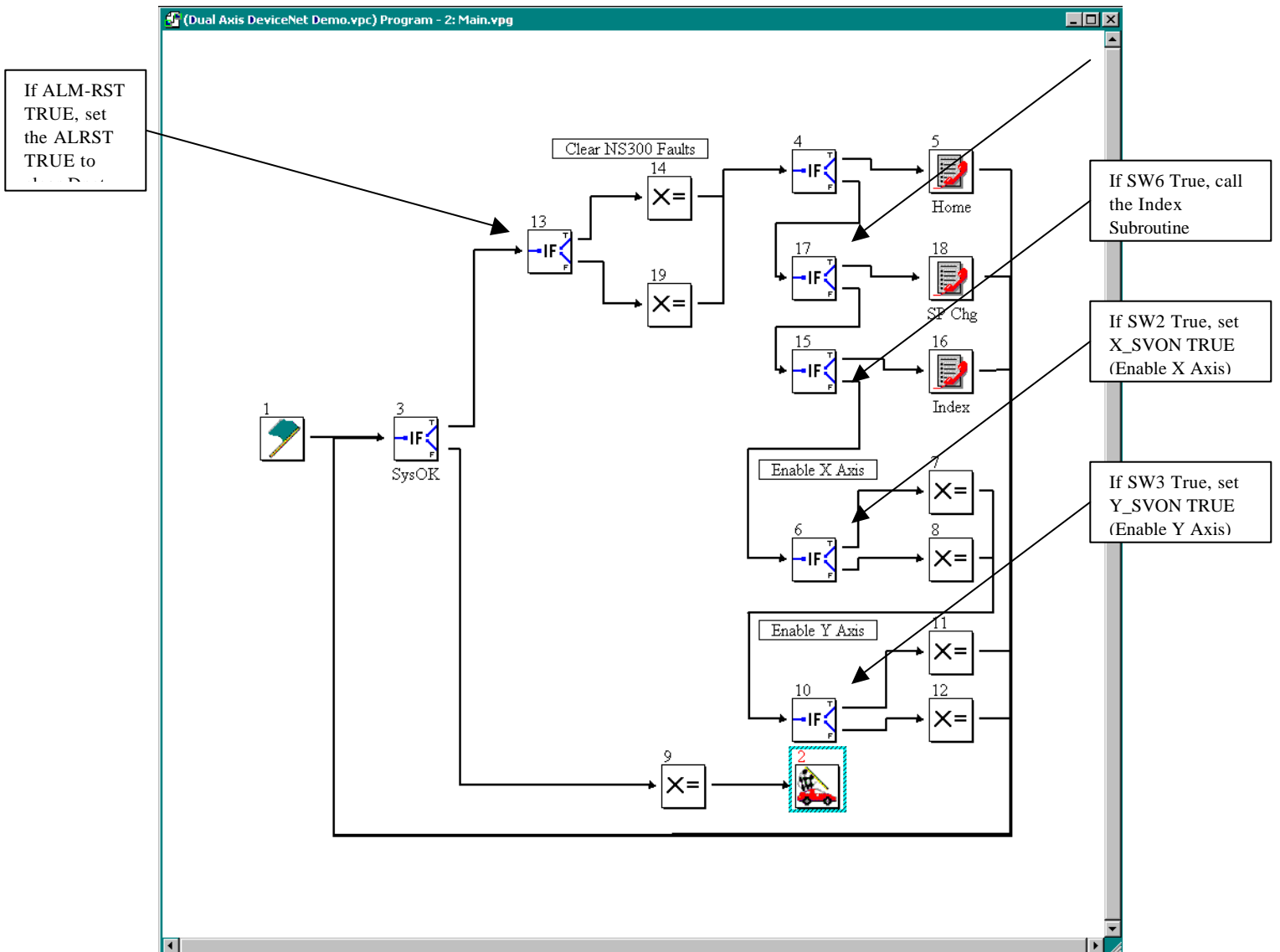
Main Program (Low Scan & Active)

This program is responsible for issuing SVON commands to the NS300s and to call the subrouth as needed.

If SW4 True, call the Home All Axis Subroutine

If X Speed Change Flag TRUE OR Y Speed Change Flag TRUE, call the Setpoint Change

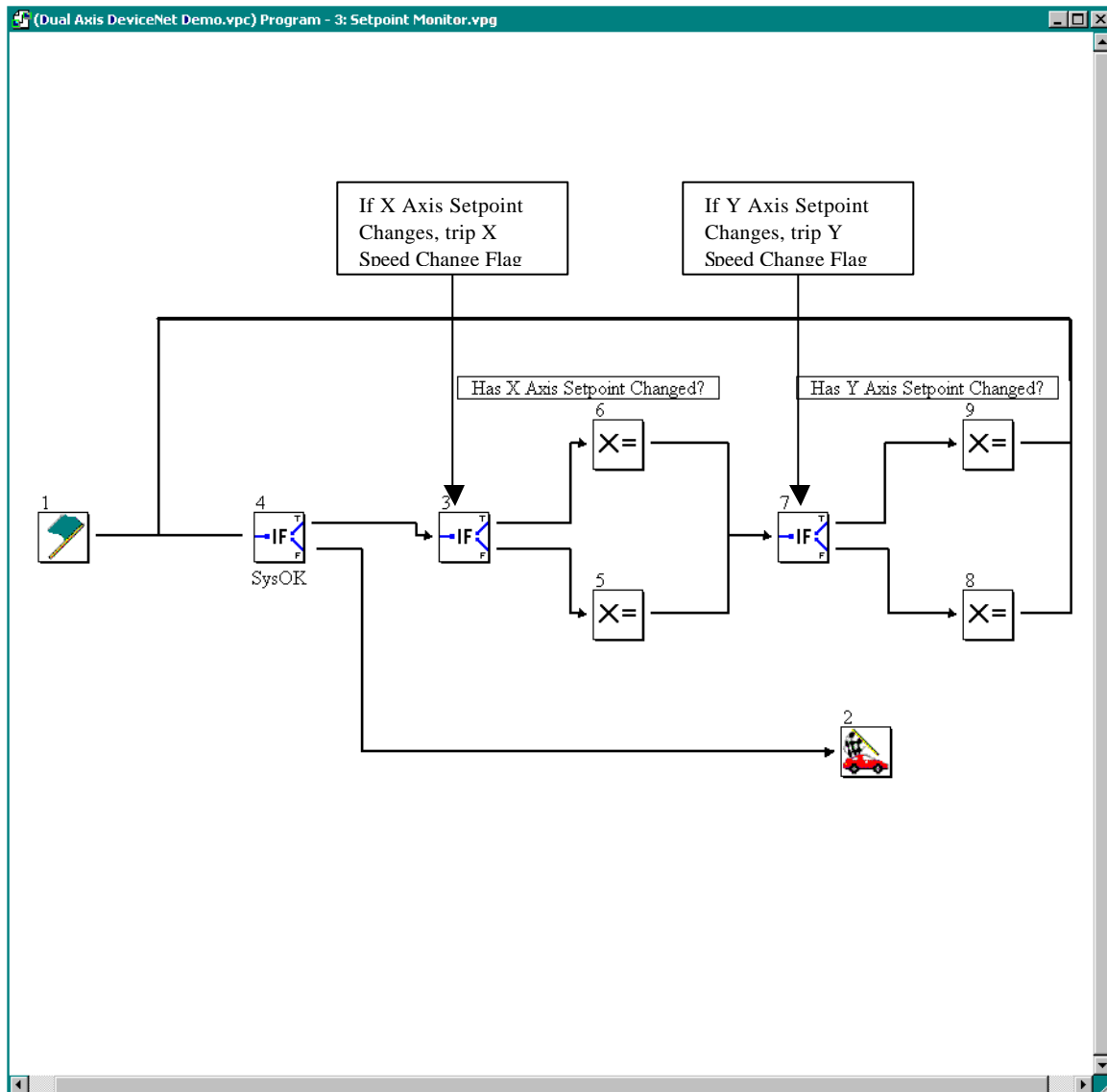
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Setpoint Monitor Program (High Scan & Active)

This program is responsible for monitoring the speed setpoints for each axis and tripping the setpoint change flags.

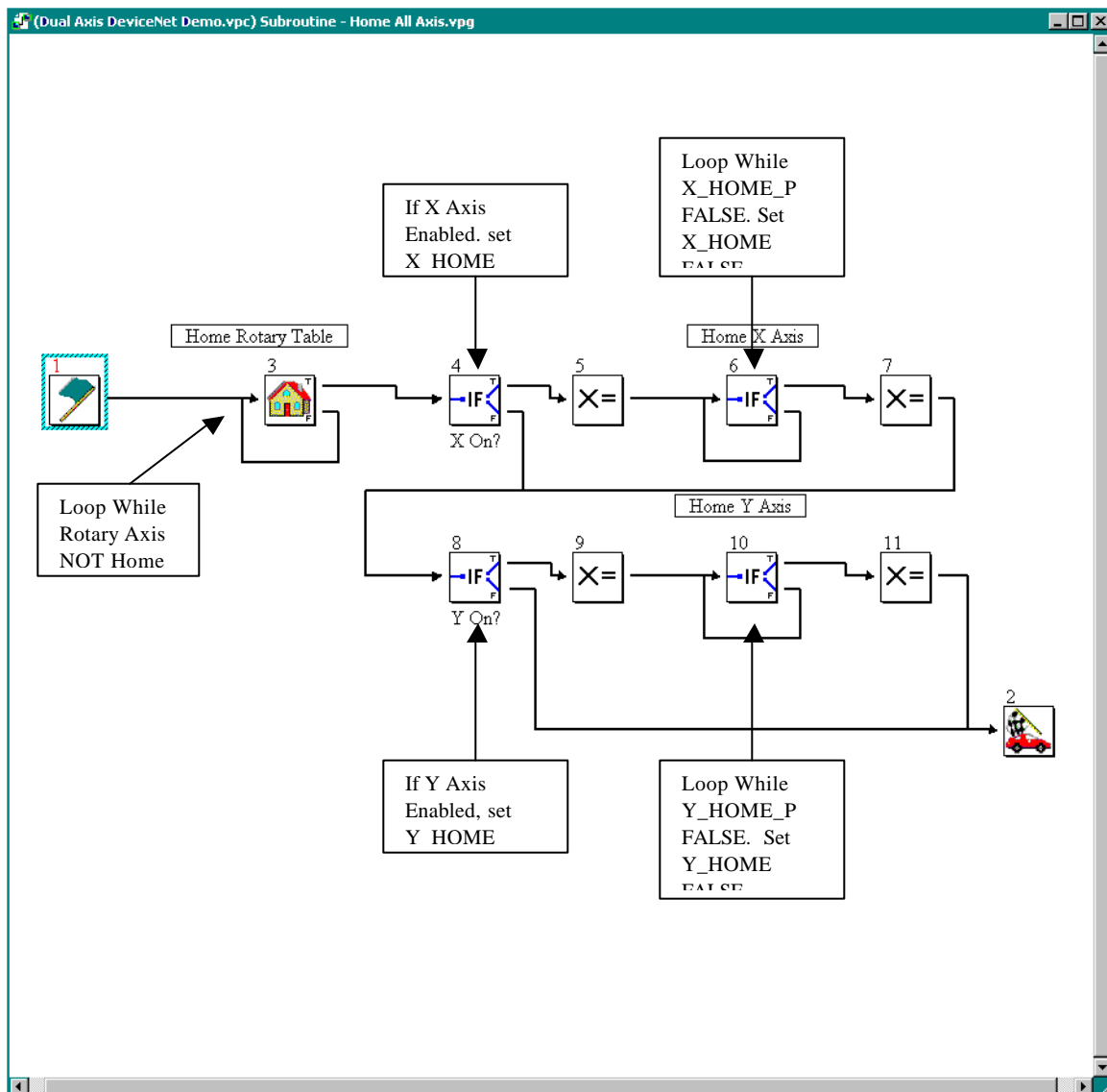
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Home All Axis Subroutine (Called by Main)

This subroutine is responsible for Homing the Rotary Table Axis and once complete setting the HOME bit TRUE for each NS300.

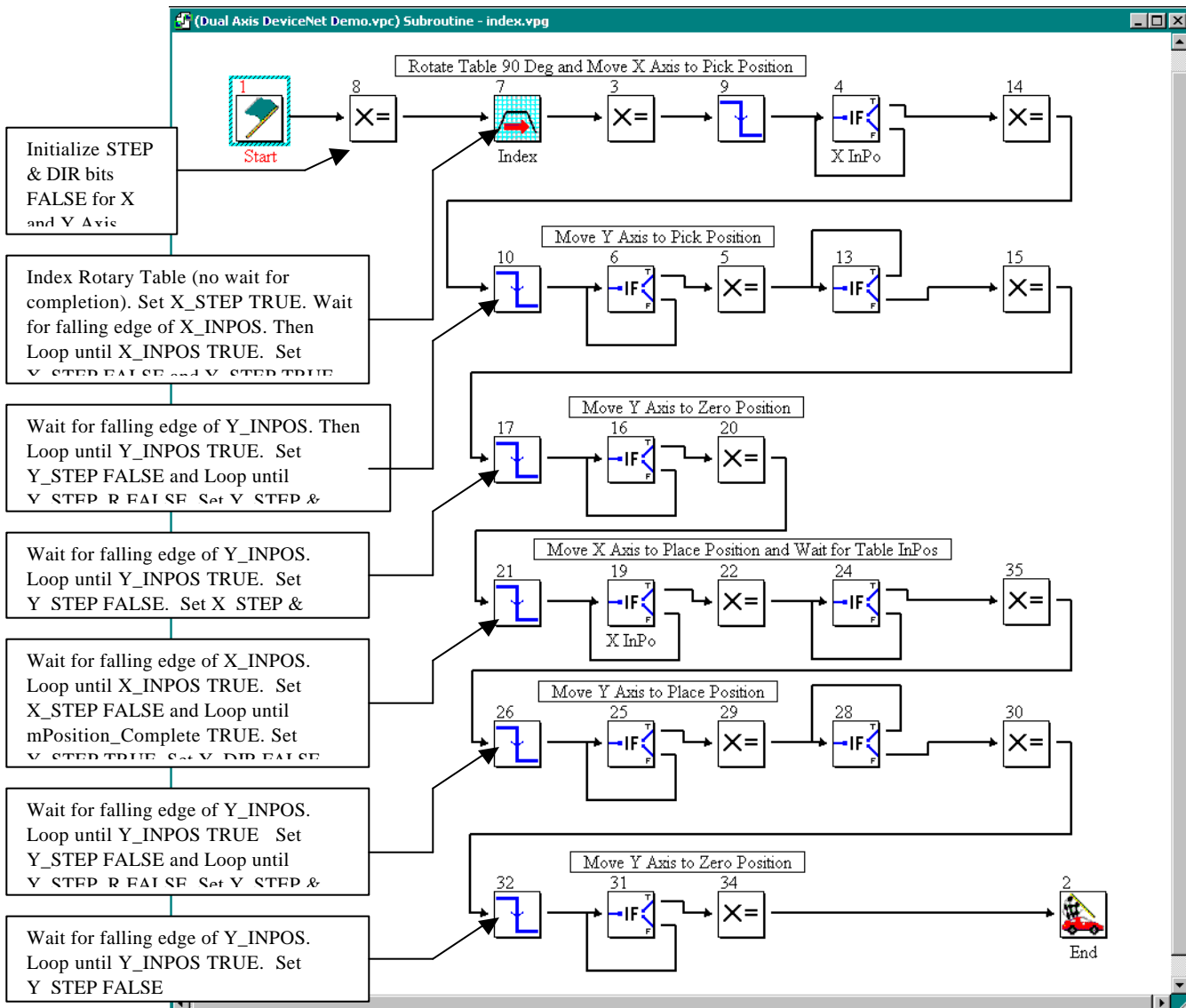
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Index Subroutine (Called by Main)

This subroutine is responsible for Indexing the Rotary Axis and Setting the appropriate DeviceNet Bits for Indexing the NS300s.

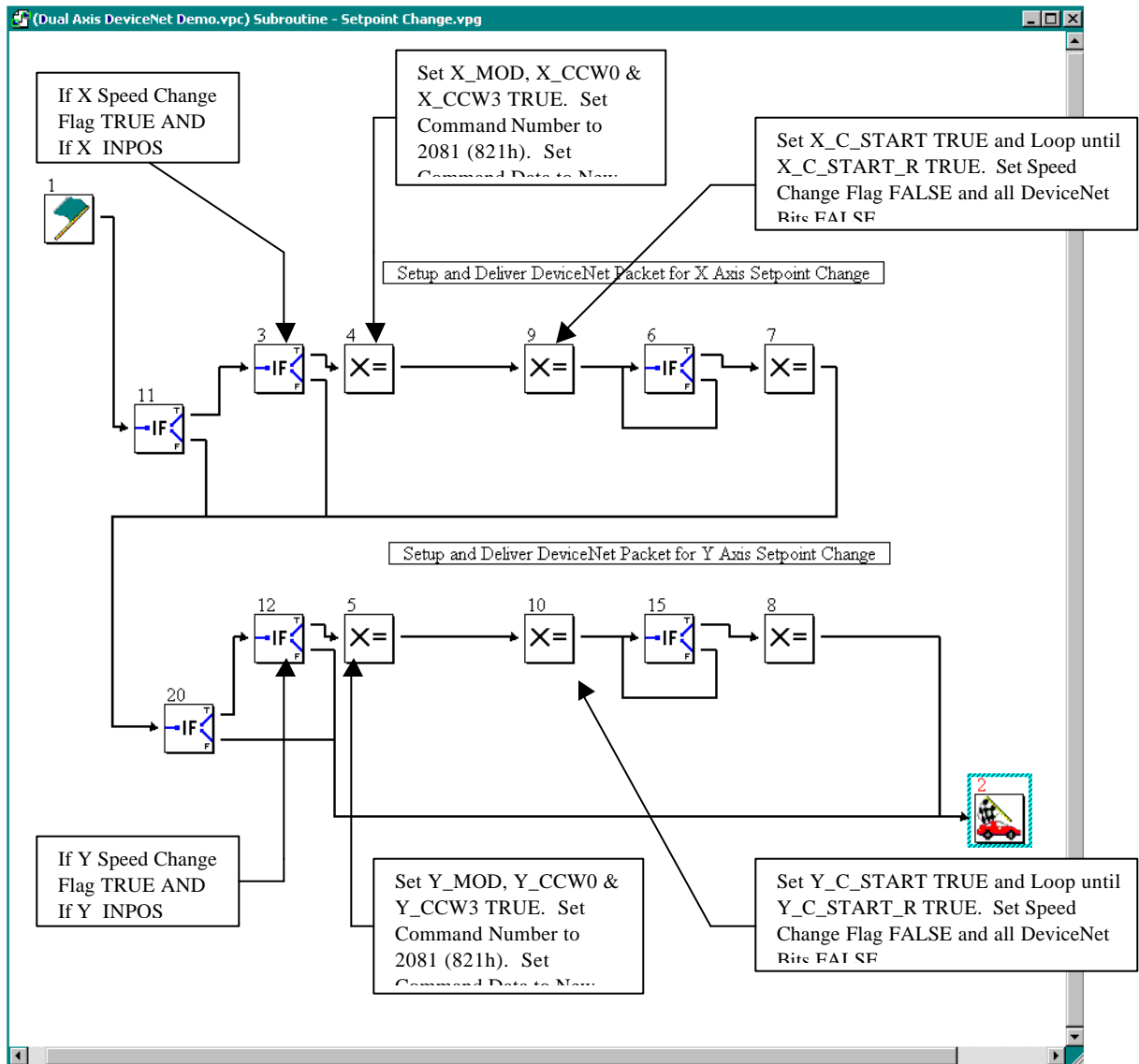
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Setpoint Change Subroutine (Called by Main)

This subroutine is responsible for writing the new Index Speed setpoints to the NS300s.

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Appendix:

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NS300 DeviceNet Basics:

The NS300 Receives and Transmits the following 8 Byte packets.

Move Commands MOD Bit = 0

Command (From MP940D)

Response (From NS300)

| | | |
|---------------|----------------------|--|
| 0 | General Command Bits | |
| Response Type | Command Code | |
| Command Bits | | |
| Command Data | | |

| | | |
|---------------|---------------------|--|
| 0 | General Status Bits | |
| Response Type | Command Code | |
| Status | | |
| Response Data | | |

The Command (Request) from the Master:

The General Command Bits Byte can be expanded as follows. (Bits from MP940D)

| | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|--------|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| MOD | | ALRST | ESTP | | | SVON | C_STRT |

The Command Codes. (Bits from MP940D)

| Bit 3 | Bit 2 | Bit 1 | Bit 0 | Description |
|-------|-------|-------|-------|---------------------------------------|
| 0 | 0 | 0 | 0 | No Operation |
| 0 | 0 | 0 | 1 | Simple Positioning |
| 0 | 0 | 1 | 0 | External Positioning |
| 0 | 0 | 1 | 1 | Positioning with Notch Signal Outputs |
| 0 | 1 | 0 | 0 | Multi-Speed Positioning |

The Response Types. (Bits from MP940D)

| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Description |
|-------|-------|-------|-------|--------------------|
| 0 | 0 | 0 | 0 | Command Position |
| 0 | 0 | 0 | 1 | Current Position |
| 0 | 0 | 1 | 0 | Position Error |
| 0 | 0 | 1 | 1 | Command Speed |
| 0 | 1 | 0 | 0 | Current Speed |
| 0 | 1 | 0 | 1 | Torque Ref |
| 1 | 0 | 1 | 0 | Station Number |
| 1 | 0 | 1 | 1 | Point Table Number |

The Command Bits Bytes can be expanded as follows. (Bits from MP940D)

| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|-------|-------|-------|-------|-------|-------|-------|--------|
| HOME | PTBL | STNT | STEP | FEED | | HOLD | CANCEL |
| | | | | | | DIR | INC |

The Command Data Bytes can be expanded as follows. (Double Integer value from MP940)

| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|-------|-------|-------|-------|-------|-------|-------|
| Payload of Packet is a Double Integer value (4 Bytes) | | | | | | | |

The Response from the Slave:

The General Status Bits Byte can be expanded as follows. (Bits from NS300)

| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|-------|-------|--------|--------|-------|-------|--------|----------|
| MOD_R | READY | PWRONT | ESTP_R | ALRM | WARN | SVON_R | C_STRT_R |

The Command Code and Response Type Bits are simply echoed back by the slave. (Bits from NS300)

The Status Bytes can be expanded as follows. (Bits from NS300)

| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|--------|--------|--------|--------|--------|-------|--------|-------|
| HOME_R | PTBL_R | STN_RT | STEP_R | FEED_R | | HOLD_R | PRGS |
| POT | NOT | INPOS | NEAR | HOME_P | | DIR_R | INC_R |

The Response Data Bytes can be expanded as follows. (Double Integer value from NS300)

| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|--|-------|-------|-------|-------|-------|-------|-------|
| Payload of Packet is a Double Integer value (4 Bytes) | | | | | | | |
| This will contain the data requested in the Response Type bits of the Command Packet | | | | | | | |

Set/Read Commands MOD Bit = 1

Command (From MP940D)

Response (From NS300)

| | |
|----------------|----------------------|
| 1 | General Command Bits |
| 0 | Command Code |
| Command Number | |
| Command Data | |

| | |
|----------------|---------------------|
| 1 | General Status Bits |
| 0 | Command Code |
| Command Number | |
| Response Data | |

The Command (Request) from the Master:

The General Command Bits Byte can be expanded as follows. (Bits from MP940D)

| | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|--------|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| MOD | | ALRST | ESTP | | | SVON | C_STRT |

The Command Codes. (Bits from MP940D)

| Bit 3 | Bit 2 | Bit 1 | Bit 0 | Description |
|-------|-------|-------|-------|----------------------|
| 0 | 0 | 0 | 0 | No Operation |
| 1 | 0 | 0 | 0 | Read Parameter |
| 1 | 0 | 0 | 1 | Write Parameter |
| 1 | 0 | 1 | 0 | Set Current Position |
| 1 | 0 | 1 | 1 | Set Zero Position |
| 1 | 1 | 0 | 0 | Read Alarm |
| 1 | 1 | 1 | 0 | Reset Unit |

The remaining 4 bits from the second byte are all 0s.

The Command Number Bytes can be expanded as follows. (Integer value from MP940)

| | | | | | | | |
|--|-------|-------|-------|-------|-------|-------|-------|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| Parameter to be read/written Integer value (2 Bytes) | | | | | | | |

The Command Data Bytes can be expanded as follows. (Double Integer value from MP940)

| | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|

Payload of Packet is a Double Integer value (4 Bytes)
 This is where the new value for stepping speed is placed to pass it to NS300

The Response from the Slave:

The General Status Bits Byte can be expanded as follows. (Bits from NS300)

| | | | | | | | |
|-------|-------|--------|--------|-------|-------|--------|----------|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| MOD_R | READY | PWRONT | ESTP_R | ALRM | WARN | SVON_R | C_STRT_R |

The Command Code Bits and the Command Number are simply echoed back by the slave. (from NS300)

The Response Data Bytes can be expanded as follows. (Double Integer value from NS300)

| | | | | | | | |
|---|-------|-------|-------|-------|-------|-------|-------|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| Payload of Packet is a Double Integer value (4 Bytes) The NS300 will echo the value passed in the Command Data Bytes (Command Payload) | | | | | | | |

Create the following Network Variables:

| Network Variable | Address |
|----------------------------|----------------|
| X_C_STRT_R | IB01000 |
| X_SVON_R | IB01001 |
| X_WARN | IB01002 |
| X_ALRM | IB01003 |
| X_ESTP_R | IB01004 |
| X_PWRON | IB01005 |
| X_READY | IB01006 |
| X_CCR0 | IB01008 |
| X_CCR1 | IB01009 |
| X_CCR2 | IB0100A |
| X_CCR3 | IB0100B |
| X_RTR0 | IB0100C |
| X_RTR1 | IB0100D |
| X_RTR2 | IB0100E |
| X_RTR3 | IB0100F |
| X_C_STRT | OB01800 |
| X_SVON | OB01801 |
| X_ESTP | OB01804 |
| X_ALRST | OB01805 |
| X_MOD | OB01807 |
| X_CCW0 | OB01808 |
| X_CCW1 | OB01809 |
| X_CCW2 | OB0180A |
| X_CCW3 | OB0180B |
| X_RTW0 | OB0180C |
| X_RTW1 | OB0180D |
| X_RTW2 | OB0180E |
| X_RTW3 | OB0180F |
| X_Axis_Input_Response_Data | IL0102 |
| X_Axis_Output_Command_Data | OL0182 |
| X_PRGS | IB01010 |
| X_HOLD_R | IB01011 |
| X_FEED_R | IB01013 |
| X_STEP_R | IB01014 |
| X_STN_R | IB01015 |
| X_PTBL_R | IB01016 |
| X_HOME_R | IB01017 |

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| | |
|-------------------------|----------------|
| X_INC_R | IB01018 |
| Network Variable | Address |
| X_DIR_R | IB01019 |
| X_HOME_P | IB0101B |
| X_NEAR | IB0101C |
| X_INPOS | IB0101D |
| X_POT | IB0101E |
| X_NOT | IB0101F |
| X_CANCEL | OB01810 |
| X_HOLD | OB01811 |
| X_FEED | OB01813 |
| X_STEP | OB01814 |
| X_STN | OB01815 |
| X_PTBL | OB01816 |
| X_HOME | OB01817 |
| X_INC | OB01818 |
| X_DIR | OB01819 |
| Y_C_STRT_R | IB01040 |
| Y_SVON_R | IB01041 |
| Y_WARN | IB01042 |
| Y_ALRM | IB01043 |
| Y_ESTOP_R | IB01044 |
| Y_PWRON | IB01045 |
| Y_READY | IB01046 |
| Y_CCR0 | IB01048 |
| Y_CCR1 | IB01049 |
| Y_CCR2 | IB0104A |
| Y_CCR3 | IB0104B |
| Y_RTR0 | IB0104C |
| Y_RTR1 | IB0104D |
| Y_RTR2 | IB0104E |
| Y_RTR3 | IB0104F |
| Y_PRGS | IB01050 |
| Y_HOLD_R | IB01051 |
| Y_FEED_R | IB01053 |
| Y_STEP_R | IB01054 |
| Y_STN_R | IB01055 |
| Y_PTBL_R | IB01056 |
| Y_HOME_R | IB01057 |
| Y_INC_R | IB01058 |
| Y_DIR_R | IB01059 |
| Y_HOME_P | IB0105B |

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| | |
|------------------------------|----------------|
| Y_NEAR | IB0105C |
| Network Variable | Address |
| Y_INPOS | IB0105D |
| Y_NOT | IB0105E |
| Y_POT | IB0105F |
| Y_C_STRT | OB01840 |
| Y_SVON | OB01841 |
| Y_ESTP | OB01844 |
| Y_ALRST | OB01845 |
| Y_MOD | OB01847 |
| Y_CCW0 | OB01848 |
| Y_CCW1 | OB01849 |
| Y_CCW2 | OB0184A |
| Y_CCW3 | OB0184B |
| Y_RTW0 | OB0184C |
| Y_RTW1 | OB0184D |
| Y_RTW2 | OB0184E |
| Y_RTW3 | OB0184F |
| Y_CANCEL | OB01850 |
| Y_HOLD | OB01851 |
| Y_FEED | OB01853 |
| Y_STEP | OB01854 |
| Y_STN | OB01855 |
| Y_PTBL | OB01856 |
| Y_HOME | OB01857 |
| Y_INC | OB01858 |
| Y_DIR | OB01859 |
| Y_Axis_Input_Response_Data | IL0106 |
| Y_Axis_Output_Command_data | OL0186 |
| X_Axis_Input_Commmand_Number | IW0101 |
| X_Axis_Output_Command_Number | OW0181 |
| Y_Axis_Input_Commmand_Number | IW0105 |
| Y_Axis_Output_Command_Number | OW0185 |

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Further Documentation:

For additional detailed information, please refer to the following documents:

- SIE-C718-6 "DeviceNet Interface Unit"
- YEA-SIA-C887-1.5D "MotionWorks+ Windows Software"

Support Files:

| File/Folder Name | Description |
|---|---------------------------------|
| Dual Axis NS300 Controlled by MP940D Demo.zip | Master File |
| DeviceNet | MotionWorks+ Project Folder |
| X Axis.prm | NSxxx Parameter File for X Axis |
| Y Axis.prm | NSxxx Parameter File for Y Axis |