PRECISION ENGINEERED

- ABM's expert team of Engineers has spent many hours designing and testing the mechanisms utilized on the Robo Quilter.
- The Robo's gantry robot design utilizes precision-machined linear ball bearing guideways for all axis of motion.
- Due to rigorous stress analysis, we've created the most advanced and efficient system available for quilting today.

QUALITY

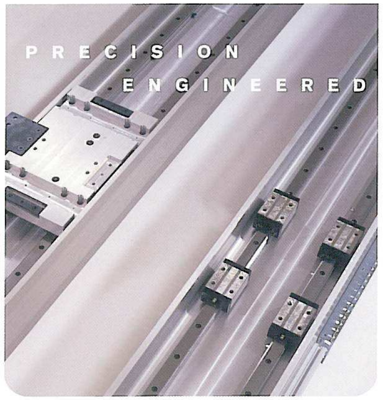
- ABM International, Inc. in Illinois, is a vertically integrated manufacturer with in-house design, programming, welding / fabricating, machining and assembly.
- With over 55 years of experience in manufacturing quilting machines, our highly trained expert staff consistently delivers the quality our customers deserve.

IN-HOUSE MACHINE DESIGN

- ABM's highly trained engineering design team anxiously awaits your projects.
- We are available 24 hours a day for customer service, so you can rest well at night!

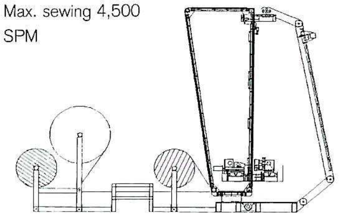
ABM INTERNATIONAL, INC.

ABM International, Inc.
18209 Chisholm Trail #110, Houston, Texas
77060 Phone: 281-443-4440 Fax: 281-443-4404
Website: www.abminternational.com
email: sales@abminternational.com



TECHNICAL DATA

- PC based
- 1.5 gig
- 3.5″ floppy
- Max. 120″ x 110″
- Max. speed 1,000 IPM
- Max. sewing 4,500 SPM
- Weight 10,500 lbs.
- 220 volts three phase, 20 amps
- 100 PSI at 2.5 CFM
- Floor space 5′ x 17′



Robo Quilter is also available with roll feed

SINCE 1947

ABM International, Inc., headquartered in Illinois, has been serving the home furnishing market of the textile industry for over 55 years.

At ABM International, Inc. we are committed to manufacturing excellence and superior customer service. Let us provide you with the highest quality state-of-the-art machinery that will enhance your operations, improve your production, reduce your costs—and ensure your success!

ROBO QUILTER

SINCE 1947

SINCE 1947

ROBO QUILTER

STATE OF THE ART VERTICAL QUILTING

ABM International, Inc. presents the world's first fully automatic vertical quilting machine. The state of the art Robo Quilter uses only 1/6 of the floor space of a conventional panel quilter.

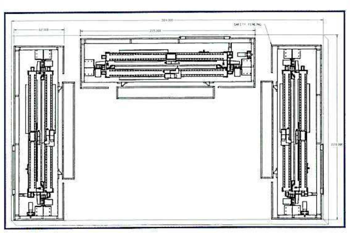
- Save 80% of floor space
- Reduce labor cost 75%
- Increase production 25%

The Robo Quilter automatically grips, stretches and racks the comforter to be quilted. It automatically senses the size of a comforter as it is indexed into the sewing position, systematically scaling the sewing pattern and adjusting the borders.

The Robo Quilter has been designed with our exclusive automatic bobbin changer. These features together allow one operator to run multiple machines simultaneously.

FEATURES & BENEFITS

- The Sewing Head is a full computer controlled quilting system capable of sewing any pattern on your product.
- A color Touch Screen user interface with an advanced computer processor allows for user-friendly operation.
- The Automatic Bobbin Changer is complete with two quick-change carousels that hold up to eight bobbins each. This enables the operator to run multiple machines with less down time wasted during bobbin changes.



A 3-machine configuration efficiently utilizes minimal space

- The Auto Index Conveyor provides hands free positioning of the comforter into the sewing area while stretching.

FULLY AUTOMATIC COMFORTER LOADING

- The Robo Quilter is highly automated and the most user-friendly machine available on the market today.
- Designed with the operator's ergonomic needs in mind, the operator simply attaches the leading edge of the quilt.
- The product automatically indexes into the sewing position.
- The product is measured and the product gripper mechanisms adjust for size changes automatically.
- The grippers then automatically grip and stretch the product, preparing it for quilting.
- Due to the machine's extensive automation, depending upon the pattern, one operator can easily run multiple machines.

SEW HEAD MECHANICS

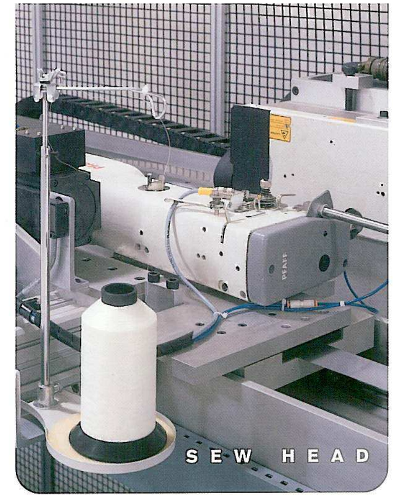
- Many different sewheads are available.
- Pictured here is the Robo equipped with Pfaff 483.
- Sew speeds reach 4,500 SPM.
- Gantry transport speed reaches 1,000 IPM.
- Standard frame size 120˝ x 110˝.

COMPLETED COMFORTER LOAD SEQUENCE

- After the product is indexed into the sewing position, the quilt cycle can begin.
- The machine automatically backtacks at the start and finish of the pattern.
- Many different patterns are available—from simple continuous to complex tack and jump.
- When tack and jump is utilized, the Robo Quilter automatically backtacks and thread trims at every start and stop.
- After the sewing cycle, the product is automatically indexed and folded in half so the operator can remove it effortlessly.

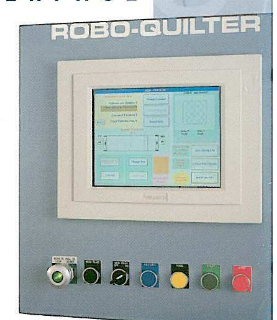
AUTOMATIC BOBBIN CHANGER

- Robo Quilter is the only machine available with a fully automatic bobbin changer.
- The machine keeps track of the number of products that can be sewn per bobbin.
- Every time a bobbin is fully utilized, the machine will automatically remove and discard the empty bobbin while inserting a new full bobbin.
- The changer holds up to eight bobbins.
- When the carousel is emptied, the operator can quickly and easily replace it with a full one.



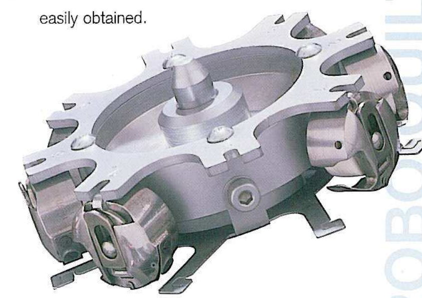
SEW HEAD

INTERFACE



COLOR TOUCHSCREEN OPERATOR INTERFACE

- The Robo Quilter is equipped with an extremely user-friendly color touch screen operator interface.
- It uses a standard PC as a programming computer with a Windows Operating System.
- Standard CAD Systems are available for pattern generation.
- It produces consistent stitch length under all sewing conditions.
- Production data can be easily obtained.



BOBBIN CHANGER

IM-3131

INSTRUCTION MANUAL APRIL 1999

ABM INTERNATIONAL

ROBO

SFO-3221 & SFO-3222

INSTRUCTION MANUAL

INDUSTRIAL INDEXING SYSTEMS, Inc.

Revision - 0
Approved By:

TABLE OF CONTENTS

1. ROBO OPERATING SYSTEM

1.1 The Main Screen

A. Turn on the "Main power".

The Robo operating system will be loaded and the un-initialized *MAIN* screen appears (see **Figure 1.1** below).

Figure 1.1 - The Un-Initialized Main Screen

This screen has the **INITIALIZE** button highlighted. To get to any other screen the Robo system must be initialized. You initialize by selecting the **INITIALIZE** button.

The Initialization process determines the state of the sewing head and the space within which sewing can take place. First the needle is energized and if no fault occurs, the bobbin is energized. If this happens without fault, Robo will check the Sewing Head Initialized box in the *STATUS* screen. Then the sewing head is moved in a diagonal direction to the upper right corner until the top limit sensor and the right limit sensor are tripped. These positions are remembered by Robo as sewing limits for the upper most and right most sewing area. If these limits are sensed without faults, Robo then moves the sewing head in a diagonal direction to the lower left corner to find the bottom and left sewing limits. If this occurs, check the XY Initialize box in the *STATUS* screen.

1.1 The Main Screen - Continued

Robo then determines if the Left Clamp bar can be moved, 1st inward (to the right) to the Zero Revolutions Position of the servo, then outward to the left until the left clamp bar sensors are triggered. Robo will check the Left Clamp Bar box if no faults appear. This process will occur whenever Robo is initially powered up or when Robo looses initialization and forces the operator to re-initialize.

The **STATUS** box contains a **RESET** button and a **STATUS** button and is shown in the lower left corner of the screen. Selecting the **STATUS** button will bring down the *STATUS* screen which will show the current state of the Robo system. This **STATUS** box and the states of Robo will be discussed in **Section 1.5** of this section.

Below, the ABM Logo for the Robo system Version number (3.62) is seen. The far lower right shows internal IIS information for the Visual Basic and MSC portions of the system.

B. Select the INITIALIZE button.

When the Robo system is properly initialized the *MAIN* screen appears as below (see **Figure *1.2***).

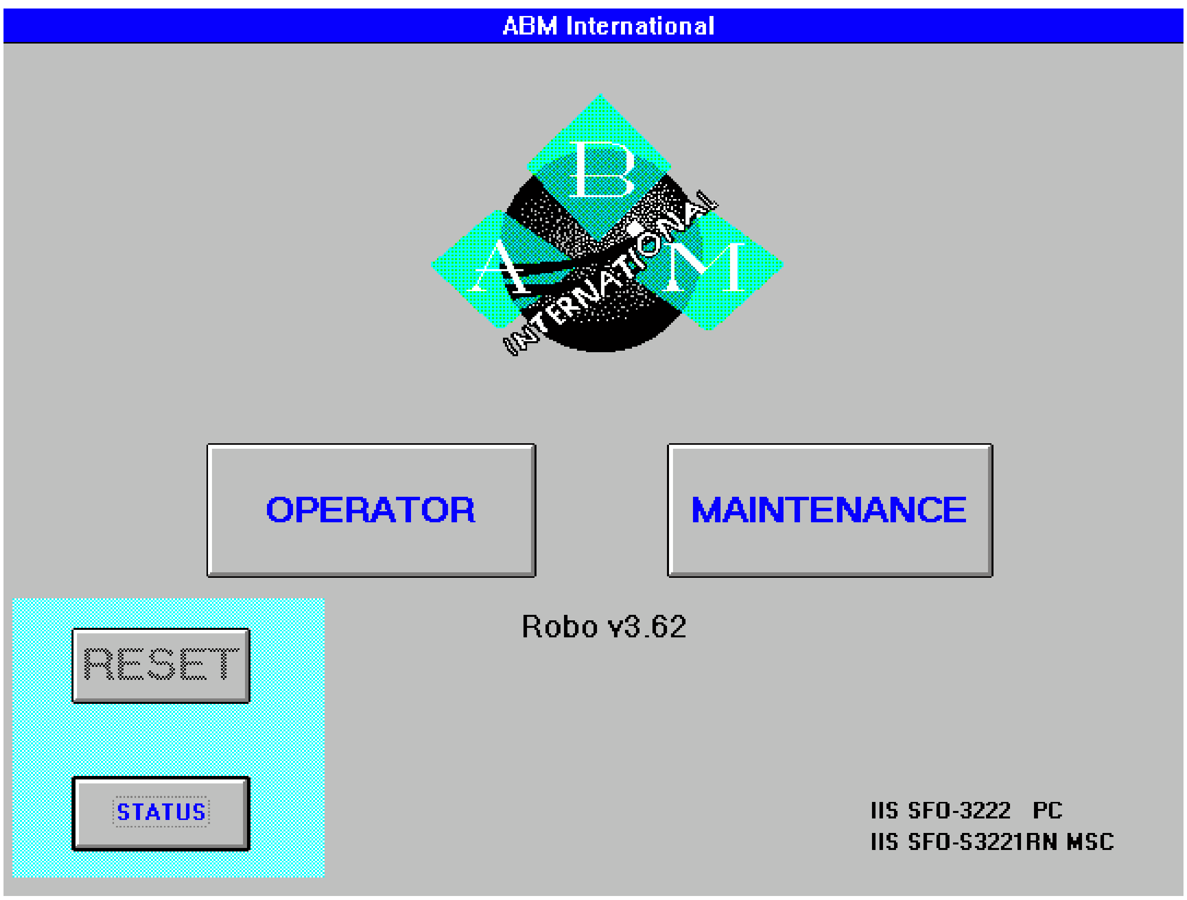


Figure 1.2 - The Initialized Main Screen

1.1 The Main Screen - Continued

This screen shows the **OPERATOR** and **MAINTENANCE** buttons and the **INITIALIZE** button is no longer visible, which means that the Robo system has been properly initialized.

Selecting the **OPERATOR** button will bring up the *OPERATION* screen, which is the normal running screen used for comforter sewing. This screen will be discussed in the **Section 1.2**.

The *MAINTENANCE* screens are password protected and not used for normal operation of the Robo system. They set up operating parameters for the patterns and once set up by the Technical personnel will not have to be changed for normal operation. These screens will be discussed in the **Maintenance** section.

The **STATUS** box is still present and operational.

1.2 The Operation Screen

A. Select the OPERATOR button.

When the **OPERATOR** button has been selected from the *MAIN* screen the *OPERATION* screen appears.

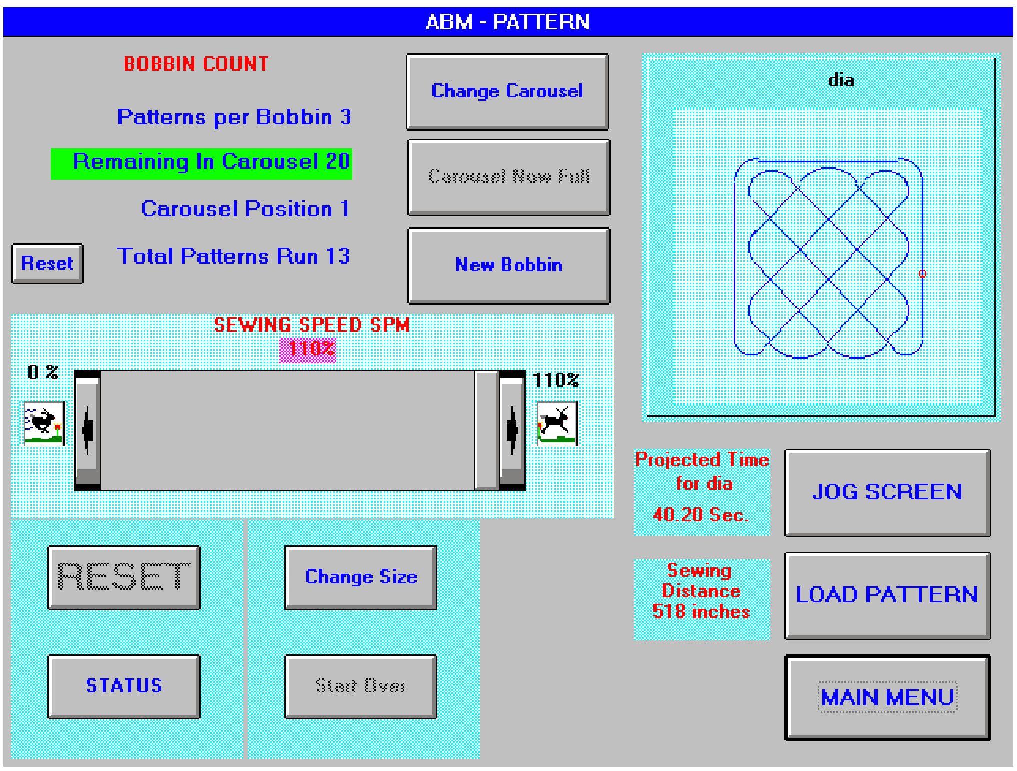


Figure 1.3 - The Operation Screen

1.2 The Operation Screen - Continued

This screen INITIATES all sewing. The **START** button on the operators console has no effect until:

1. The Robo system has been initialized
2. A pattern has been selected
3. Status shows no faults
4. The Carousel shows that patterns can be sewn
5. The *OPERATION* screen has been selected

The currently selected pattern and name is shown in the pattern view area in upper right of the *Operation* screen.

Selecting the **JOG SCREEN** button will select the *JOG* screen where the sewing head and the clamps can be moved. This screen will be discussed in **Section 1.4** of this manual.

Selecting the **LOAD PATTERN** button will select the *LOAD PATTERN* screen. A pattern can then be selected for sewing. This screen will be discussed in **Section 1.3** of this manual.

There are two boxes under the pattern view area that show the projected time for sewing and the sewing distance for the selected pattern. The projected time will change with the sewing speed selected.

Selecting the **MAIN MENU** button will return the operator to the *MAIN* screen .

The Bobbin and Pattern information for the *OPERATION* screen is in the upper left box and contains the following information.

Line 1 Patterns per Bobbin
Count of the patterns per bobbin that can be sewn for the selected pattern. This count is pattern sensitive and needs to be determined.

Line 2 Remaining In Carousel
Count of patterns that can be sewn before the carousel has to be reloaded with new bobbins for the selected pattern.

Line 3 Carousel Position
This points to the selected bobbin (1 of 8 available).

Line 4 Total Patterns Run
For every completed comforter sewn, this count increments by one. The reset button to the left of this line resets the count shown to 0.

1.2 The Operation Screen - Continued

The three buttons between the Bobbin and Pattern Information box and the pattern display are used to select the next bobbin and to load 8 new bobbins in the carousel. They operate as follows:

> The **Change Carousel** button positions the sewing head for safe removal of the carousel. ROBO will then deselect this button and highlight the **Carousel Now Full** button. The carousel can now be removed and the empty bobbins can be replaced with filled bobbins.
>
> When the carousel has been filled and replaced in the sewing machine, the operator selects the **Carousel Now Full** button. Robo then checks the carousel for bobbins in all 8 positions and selects the first bobbin. Robo now deselects this button and makes the **Change Carousel** button available again. The system is now ready for continued comforter sewing.
>
> The **New Bobbin** button selects the next bobbin in the carousel.

There is a **Sewing Speed** scroll bar in the middle left of the screen. This scroll bar varies the sewing speed from the Min- Max value as set in the *PARAMETER* screen for the selected pattern. Again, these values are not selectable by the operator.

The **Change Size** button is used when comforter size is changed. The Robo system needs the positions of the clamp bars for the new size. When the new size comforter is racked and in position, it is clamped by the right clamp. Then the left clamp is moved first inward until the upper servo and lower servo sense the Zero Revolution position, then outward until comforter edge is sensed. In similar fashion, the lower clamp bar goes up first then down till it senses the bottom edge of comforter. Robo will remember the left and bottom clamp bar positions.

The **Start Over** button, when enabled, will reset the Robo System allowing a restart from the very beginning. For example:

> If the thread breaks, selecting the **HOME** button from the **OPERATOR PANEL** positions the sewing head to where the machine can be re-threaded. After re-threading, the **Start Over** button can be selected to start pattern sewing from the beginning. Sewing will begin when the **START** button is selected from the **OPERATOR PANEL**.

When Auto Sequence is selected via the *PARAMETER* screen, a box will appear on the screen just under the right area of the speed scroll bar. This box will flash and will contain the words “AUTO RUN SEQUENCE NOW IN EFFECT”. Just below this message will be an indication of the **INDEX** button status on the **OPERATORS PANEL**. This message will say “INDEX NOT READY” or “INDEX READY”.

1.2 The Operation Screen - Continued

These messages will flash and change color to alert the operator and others nearby to be cautious and alert when near the machine.

When this Auto Run Sequence is in effect and when the operator pushes the **INDEX** button on the **OPERATORS PANEL**, ROBO will rack the comforter and sewing will begin automatically when the comforter is in the correct position and the operator is standing on the mat.

1.3 The Load Pattern Screen

A. Select the Load Pattern button.

Patterns for sewing are selected from the *LOAD PATTERN* screen (see **Figure 1.4** below).

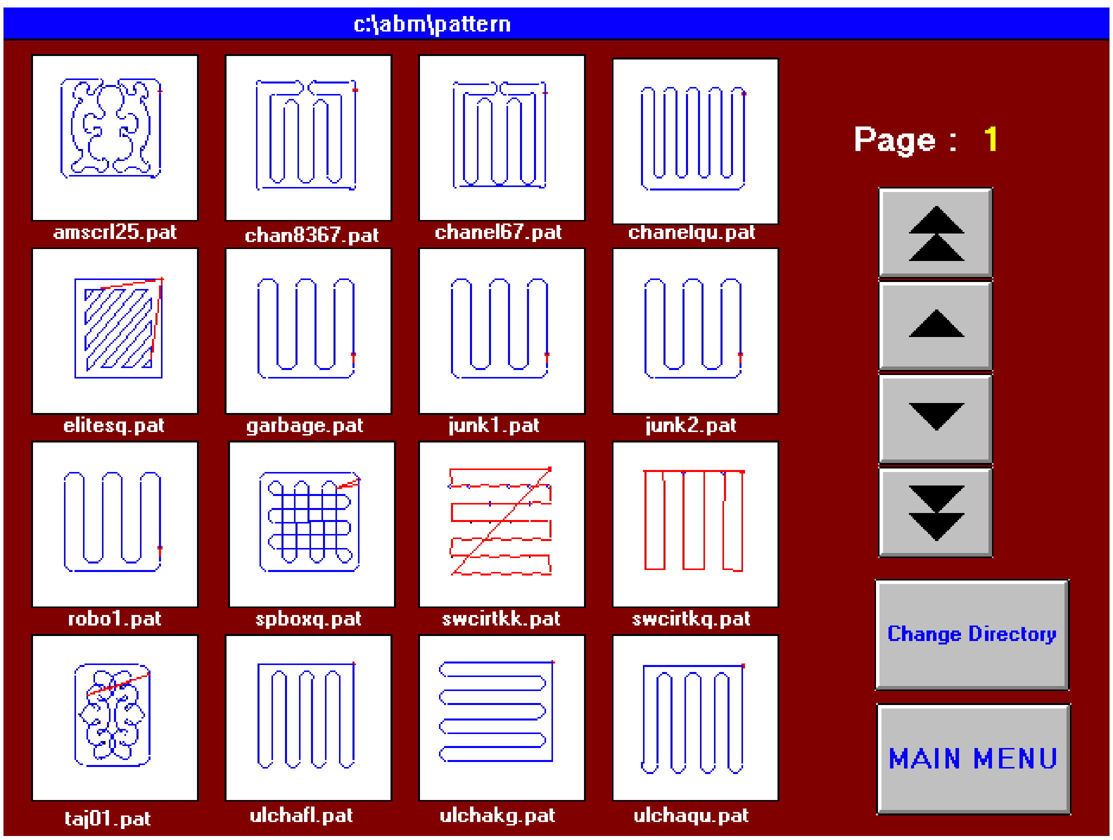


Figure 1.4 - The *LOAD PATTERN* Screen

From this screen, up to sixteen patterns can be viewed. If Robo has other patterns for selection, the arrow keys can be used to select other pages of up to sixteen patterns. Cam elements are generated for the pattern selected. The pattern name and the needed cam elements are downloaded to the IIS macro program for sewing the pattern.

1.3 The Load Pattern Screen - Continued

The selected pattern will also be shown in the picture box on the *OPERATION* screen (see **Figure 1.3** above).

The L*OAD PATTERN* screen has two buttons on the lower right side, the **Change Directory** and the **MAIN MENU** buttons.

The **Change Directory** button allows the operator to select patterns from another directory on the Robo System.

The **MAIN MENU** button takes you back to the *OPERATION* screen.

B. Select a pattern for sewing.

C. Select the MAIN MENU button.

This will return you to the *OPERATION* screen (**Figure 1.3**) where sewing can be started.

Other operating steps will follow in the Operators Panel Section of this manual.

This section will continue with other operating screens needed for proper operation.

1.4 The Jog Screen

To open this screen, press the **JOG SCREEN** button from the *OPERATION* screen (**Figure 1.3**).

The *JOGGING* screen has three buttons, one panel for moving the sewing head, one panel for moving the clamp bars, a scroll bar, and a status box (see **Figure 1.5** below).

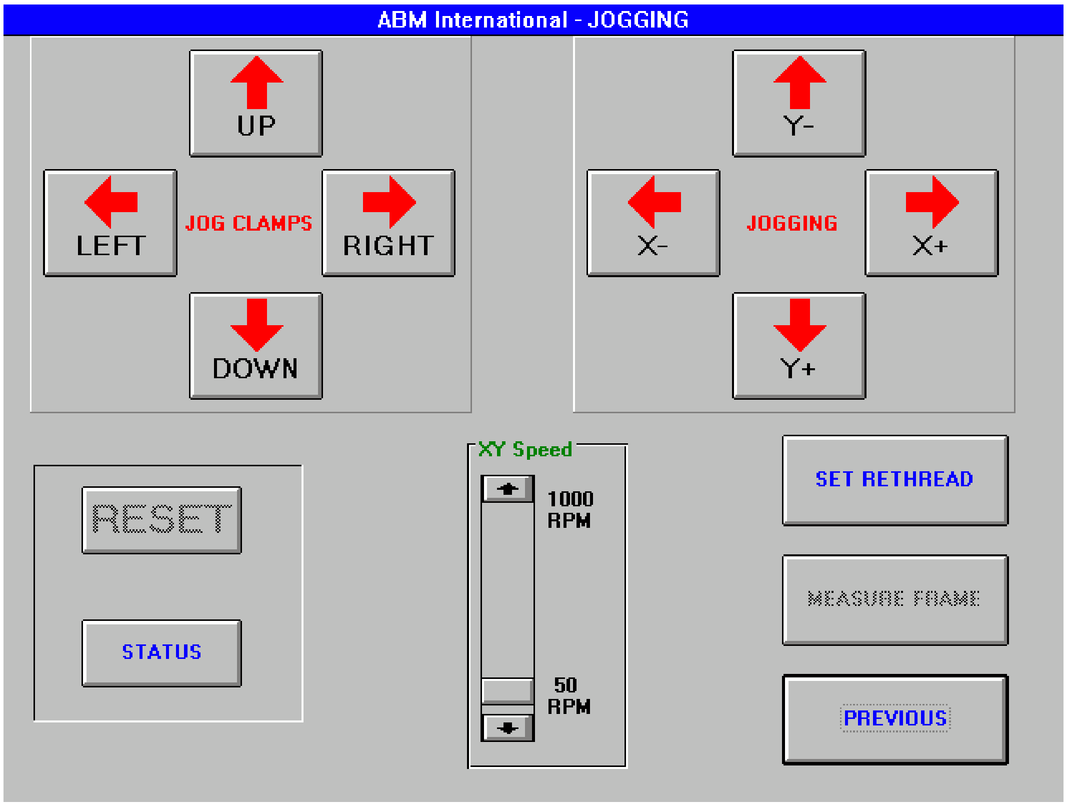


Figure 1.5 - The Jog Screen

The box in the upper right has four jogging buttons, to move the sew head up, or down, left or right. The movement will be performed until the limit sensors are reached. The scroll bar can be used to adjust the speed of movement. Limits are set on the speed adjustment. The operator can adjust the head motion speed from 50 to 1000 rpm.

CAUTION
Do not move the sewing head against the sensor limits at a high speed rate. Lower the speed when nearing these limits.

The panel in the upper left has four buttons which are used to adjust the clamping bars that hold and stretch the comforter. Any adjustments to these bars will highlight the **MEASURE FRAME** button.

1.4 The Jog Screen - Continued

When the **MEASURE FRAME** button is highlighted, you cannot leave the *JOG* screen until the **MEASURE FRAME** button is selected. The IIS macro code needs to know where the clamp bars are positioned. Selecting the **MEASURE FRAME** button will inform the Robo operation system to determine these positions. This must be done every time the clamps are jogged.

The **SET RETHREAD** button will let the IIS macro code know where you want to position the sew head for re-threading. The operator uses the **JOGGING** buttons to position the sew head at this desired position, then selects the **SET RETHREAD** button to tell the IIS macro code that this is the re-thread position. This position must be set once and can be used for all patterns.

The **PREVIOUS** button takes the operator back to the *OPERATION* screen.

1.5 The Status Screen

This screen shows the current state of the Robo system. The systems faults and the systems mode of operation can be determined. The faults and current operating states will be checked when that condition is in effect (see **Figure 1.6** below).

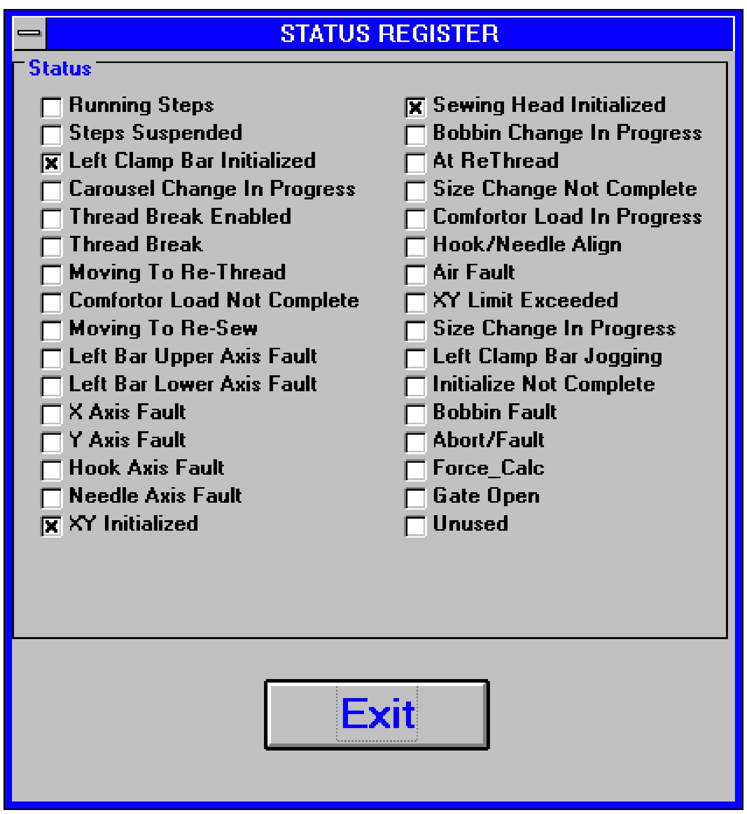


Figure 1.6 - The Status Screen

1.5 The Status Screen - Continued

The figure shows that the system has been properly initialized and there are no faults present. As can be seen from this *STATUS* screen, the system has many states or modes of operation.

Selecting the EXIT button will return you to the screen where status was selected.

The Status and Mode settings are as follows:

Running Steps:
Robo is in a sewing pattern mode. Steps refers to a sewing stitch. The needle goes from one thread position to another.

Steps Suspended:
This happens when Robo is in a Running Steps mode which is stopped prematurely. This can occur when the thread breaks, a sensor is tripped, there is a sudden loss of air, etc.

Left Clamp Bar Initialized:
The Left Clamp Bar is a movable bar which has a limit sensor. The left bar is moved by two servos, one on the top and one on the bottom, to the right to a zero set position then to the left to the sensor limit. When Robo knows this limit, this box is checked. Sewing will not take place until this position is known.

Carousel Change In Progress:
This box is checked when the operator is in the process of removing and inserting carousels.

Thread Break Enabled:
The *PARAMETER* screen has a parameter to set the thread cut delay. The delay can be from 0 to 2000 milli-seconds. If this parameter is not 0, this box becomes checked.

Thread Break:
When Robo senses that the thread has broke it checks this box.

Moving To Re-Thread:
When the operator selects the **HOME** button from the **OPERATORS** panel, Robo will select this box and move the sewing head to the re-thread position.

Comforter Load Not Complete:
Robo selects this box when it is in a racking sequence and the sequence has not completed.

1.5 The Status Screen - Continued

Moving to Re-Sew:
When the operator selects the **RESTART** button from the **OPERATORS** panel, this box is checked. Normally this button is selected after a rethread operation and the operator wants to finish the current pattern.

Left Bar Upper Axis Fault:
The Left Clamp bar is a movable bar that is used to stretch the comforter. There are two servos that are driven in unison to move the bar. One of these servos drives the top of the bar, the other drives the bottom of the bar. When the upper servo faults, this box becomes checked.

Left Bar Lower Axis Fault:
When the servo that drives the lower portion of the Left Clamp bar faults, this box becomes checked.

X Axis Fault:
The sewing head is moved on the horizontal plane by a servo. If this servo faults, this box is checked.

Y Axis Fault:
The sewing head is moved on the vertical plane by a servo. If this servo faults, this box is checked.

Hook Axis Fault:
The bobbin mechanism is controlled by a servo. If this servo faults, this box is checked.

Needle Axis Fault:
The needle also has its separate servo and when it faults, this box becomes checked.

XY Initialized:
When the position of the sensors in the horizontal and vertical planes have been determined, this box becomes checked. Sewing will not take place until these sensor positions are known.

Sewing Head Initialized:
The initialization process attempts to turn the bobbin and to energize the sewing needle. If this process is fault free, this box becomes checked. Sewing will not take place until this box is checked.

Bobbin Change In Progress:
When Robo is in the process of changing bobbins, this box is checked.

1.5 The Status Screen - Continued

At Rethread:

When the operator selects the **HOME** button from the **OPERATORS** panel, Robo will move to the rethread position. When it gets there, this box becomes checked.

Size Change Not Complete:

When the operator selects the **Change Size** button from the *OPERATION* screen, Robo checks this box and moves the Left clamp bar to determine the size of the new comforter. When determined, this box becomes unchecked.

Comforter Load In Progress:

When Robo is in a racking sequence, this box is checked.

Hook/Needle Align:

When maintenance personnel need to perform maintenance and/or alignment of the needle and hook, the servos for the needle and hook must be de-energized. This is done from the *ENCODER* screen by selecting the **Enable Z** button, which will check this box.

Air Fault:

Compressed air is used to move the sewing head in and out, to sequence the bobbin, to activate the thread cutter and to open and close the clamps that hold the comforter. These are I/O outputs that are depicted on the *OUTPUT I/O* screen, Expander B and Expander C.

XY Limit Exceeded:

The sewing head can travel within an area that is limited on the top and bottom by fixed sensors. The same is true for movement in the horizontal plane. If the sewing mechanism attempts to move beyond these limits, an XY Limit Exceeded fault is shown.

Size Change in progress:

The *OPERATORS* screen has a button called **Change Size**. When the operator selects this button, this box becomes checked and will stay checked until the operation change size is complete.

Left Clamp Bar Jogging:

When the operator is on the **Jog** screen and jogs either the Left Clamp bar or the Right Clamp bar, this box is checked. It remains checked as long as the operator has the Left/Right bottoms pushed.

Initialize Not Complete:

When the operators first powers up the MSC, this box is checked. This box remains checked until the complete initialization process is complete. If the MSC loses any of the initialization factors for any reason, this box will again be checked.

1.5 The Status Screen - Continued

Bobbin/Fault:

If the bobbin looses air, becomes misaligned, jams, etc, this box becomes checked.

Abort/Fault:

If any Fault appears, this Box becomes checked.

Force_Calc:

This box becomes checked for the following reasons:

1. If any of the parameters on the *Parameters* screen are changed that are needed for developing the Cam Elements, this box becomes checked. These parameters are:
   - Any of the Border Offsets
   - The state of Auto Border changes
   - The Xborder or Yborder distance changes
   - The Linear Acceleration changes
   - The Minimum Sew Speed changes
2. When the frame of the sewing area changes:
   - When the operator changes the setting of the clamp bars.
     - NOTE: This will force a measure frame situation.
   - When the maintenance personnel enters the I/O screens for any reason
3. When the maintenance personnel changes the X or Y Scaling factors
4. When the maintenance personnel disable/enable the C-axis servos
   - NOTE: This will force a measure frame situation.

Gate Open:

When the gate on the frame guard that surrounds the Robo sewing machine is opened, this box becomes checked.

Unused:

Reserved for future use.

2. MAINTENANCE

The **MAINTENANCE** button can be selected from the *MAIN* screen. An assigned password to proceed further is required. The password procedure has two screens (see **Figures 2.1 and 2.2**).

2.1 Enter Password

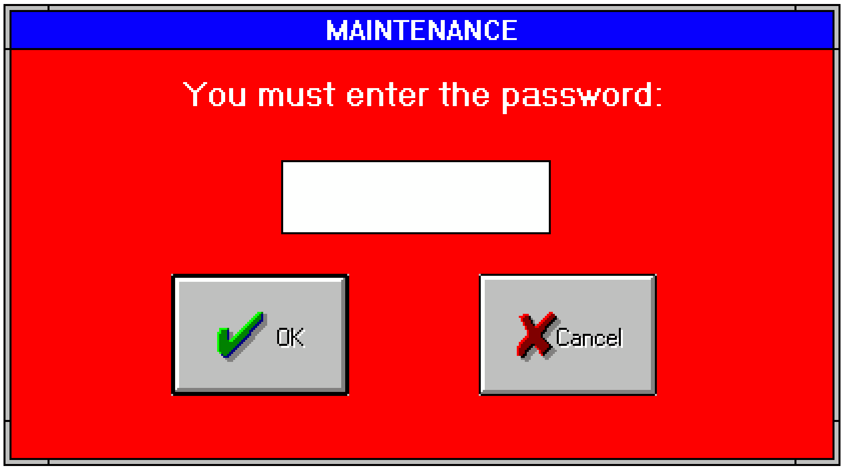


Figure 2.1 - The First Password Screen

Selecting the **Cancel** button will return you to the *MAIN* screen.
Select the empty white box and enter your password.

Selecting the **OK** button will validate a password. You will see a message box showing the result of the validation. If the password is not correct, you will see an "Invalid Password" message.

2.2 Alpha-Numeric Keypad

The *ALPHA-NUMERIC KEYPAD* screen will appear that will allow you to enter alpha numeric keys for password entry (see **Figure 2.2**).

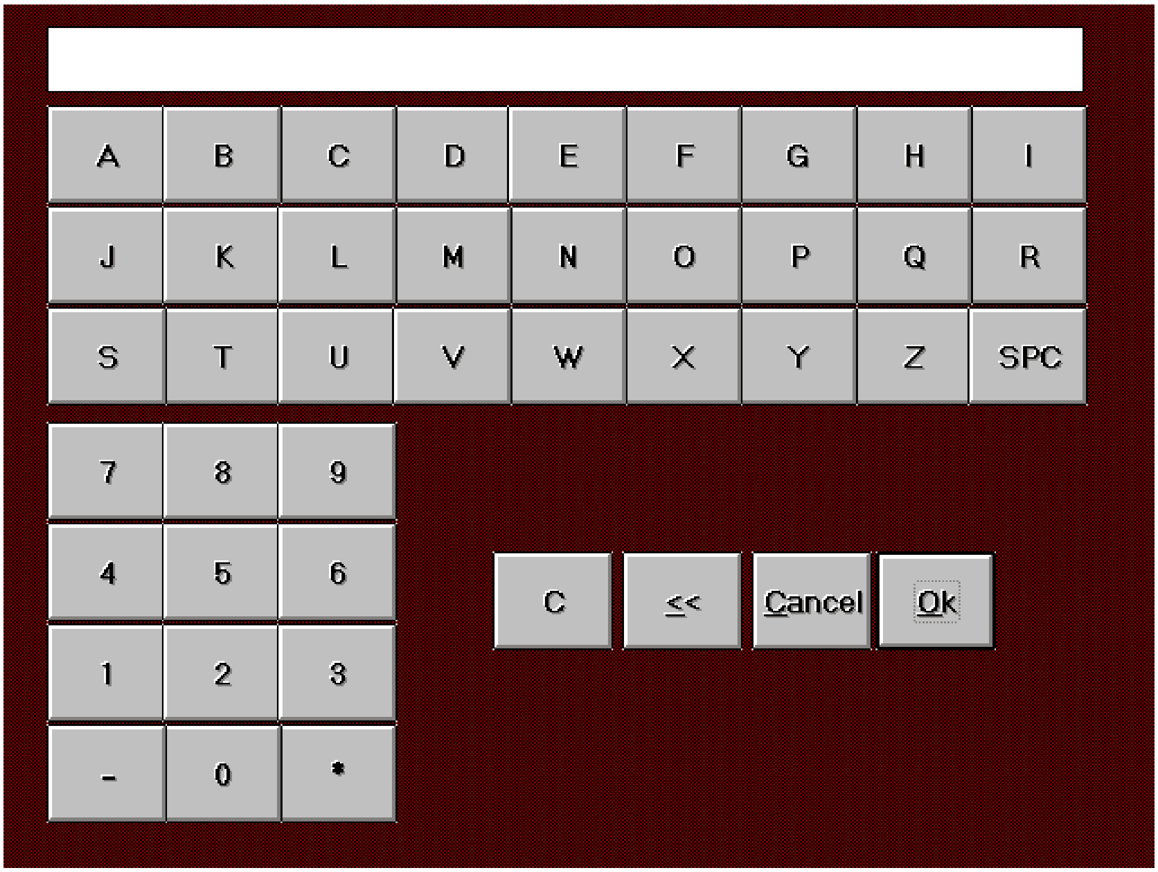


Figure 2.2 - Alpha-Numeric Keypad Screen

When this screen appears you must correctly enter the password . If you make an entry mistake, you can backspace or clear your entry. Selecting the **OK** button will validate your entry.

If your entry is acceptable, the *PARAMETER* screen (**Figure 2.3**) will appear. If your password entry is not valid, you will get the invalid password message and you can retry and attempt to enter a correct password.

2.3 The Parameter Screen

The *PARAMETER* screen allows entry of parameters and variables that both the IIS Macro-Program and the Robo Operating System need for proper sewing of individual comforter patterns. There can be an individual parameter list for the patterns or any pattern can use the default parameters from which custom parameters can be designed (see **Figure 2.3**).

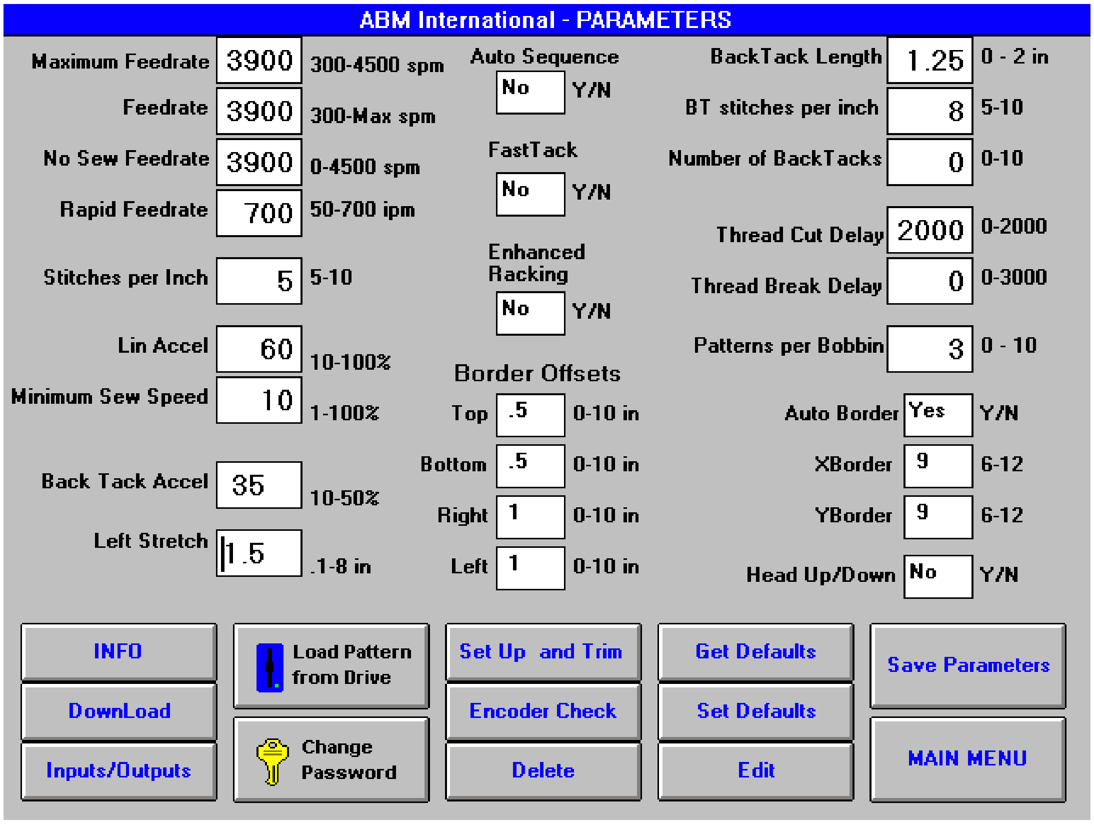


Figure 2.3 - The Parameter Screen

Selecting any parameter box will bring up a keypad that will allow you to enter or change the parameter setting. All of the parameters are range checked and have acceptable values. There are several that only accept a Yes or No value. The rest of the parameters have a minimum and a maximum acceptable value. The keypad will only allow entries within this range. When your parameter changes are complete, select the **Save Parameter** button. This will update or generate custom parameters for the sewing pattern selected.

When the **Set Defaults** button is selected, the parameters displayed will be saved as Default Parameter values. These Default values will be loaded for all selected patterns when the Save Parameters button has not been selected for the pattern.

At any time, you can select the **Get Defaults** button. This will restore all the parameters from the Default saved values. If a parameter is changed that the IIS Macro-Program uses, new Macro-Program elements will be generated. You will see the downloading message box when you select the **MAIN MENU** button to return to the *MAIN* screen.

2.3 The Parameter Screen - Continued

Operating Parameters

Maximum Feedrate:	Limits the fastest sewing speed. The Robo System will not allow a sewing speed more than this value. This is the limit of the speed bar on the *OPERATION SCREEN.* This entry is limited by the internal maximum value limit of the Robo System and is the maximum value of the limit range shown.
Feedrate:	The speed in Inches/Minute of actual sewing. This is the bar position as shown in the *OPERATION SCREEN*. The initial Feedrate can be set here. Changing the bar position changes this value.
No Sew Feedrate:	The speed in Inches/Minute of the Robo system when the sew head button is off.
Rapid Feedrate:	The speed of the system when going HOME or when Tacking.
Stitches per Inch:	The number of stitches sewn per inch of travel. This value accepts tenths of inches within the limits shown.
Lin Accel:	The Linear Acceleration parameter sets the point at which slow down begins around corners. At a setting of 100%, slow down occurs for small changes in direction. At a setting of 50%, the speed decrease begins at an angle of 45 degrees and declines linearly to a 90 degree change in direction. Everything above 90 degrees is sewn at minimum speed.
Minimum Sew Speed:	The percentage of Feedrate used as the minimum sewing speed around sharp corners or reversals in sew direction.
Back Tack Accel:	The acceleration/deceleration the system uses for backtacking.
Left Stretch:	The amount of movement the left bar clamp moves when in the stretch cycle. The system accepts tenths of inches from .1 inch to 8 inches.
Auto Sequence:	This mode works with the Index button on the Operators Panel. When Auto Sequence is selected and the operator selects the Index button to rack a new comforter, and when the racking sequence is complete, sewing will start automatically. The Robo System is in this mode when the parameter is Yes.

2.3 The Parameter Screen - Continued

Operating Parameters - Continued

FastTack:	When selected the system will perform a Fast Tack sequence instead of the normal Tack sequence.
Enhanced Racking:	When selected, allows the system to search for the comforter before clamping. The lower left clamp bar can be moved 2 inches in this search. This allows better sewing of comforters that are not squared properly.
Border Offsets:	These are offset to the currently selected border. They will decrease the sewing area for the pattern by the amount selected.
Back Tack Length:	The length in inches of the Back Tack.
BT stitches per inch:	The number of stitches per inch used in back tacking.
Number of Back Tacks:	The number of back tacks to perform for the Back Tack.
Thread Cut Delay:	The amount of delay in milli-seconds when the needle is positioned to the up position and the thread is cut.
Thread Break Delay:	The amount of delay in milliseconds before faulting the system on a thread break.
Patterns per Bobbin:	The number of patterns that can be run on a bobbin. This value is pattern dependent.
Auto Border:	When selected, enables the Auto Border mode. This mode will produce the borders as selected by Xborder & Yborder parameters.
Xborder:	The Xborder element for Auto Border.
Yborder:	The Yborder element for Auto Border.
Head Up/Down:	This informs the system where to position the sewing head during a Tack and Jump. Keeping the head down will save time.

2.4 The Set Up and Trim Screen

From the *PARAMETER* screen the **Set Up and Trim** button can be selected (see **Figure 2.4** below).

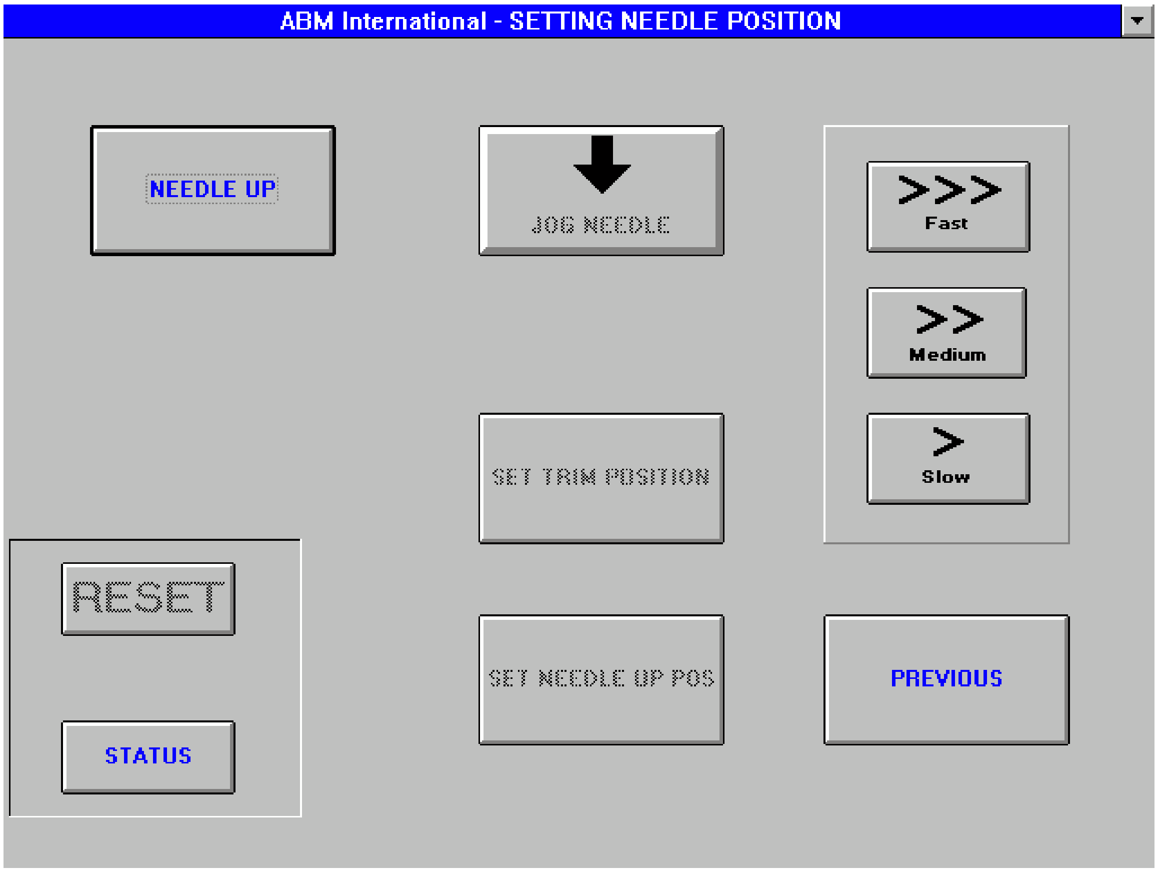


Figure 2.4 - The Set Up and Trim Screen

Selecting the **NEEDLE UP** button will enable the **JOG NEEDLE** button. The **JOG NEEDLE** button moves the needle in and out at a selected jog needle speed. When the needle is in position for trim, the **SET TRIM POSITION** button is selected. This will inform the IIS Macro-Program this is Trim needle position. The set needle up position can also be selected. The needle is again jogged for the desired position and the **SET NEEDLE UP POS** button is selected.

The three buttons **Slow**, **Medium** and **Fast** select the needle jog speed.

Selecting the **PREVIOUS** button will return you to the *PARAMETERS* screen.

2.5 The Encoder Check Screen

Selecting the **Encoder Check** button from the *PARAMETER* screen will bring up the *ENCODER* screen (see **Figure 2.5**).

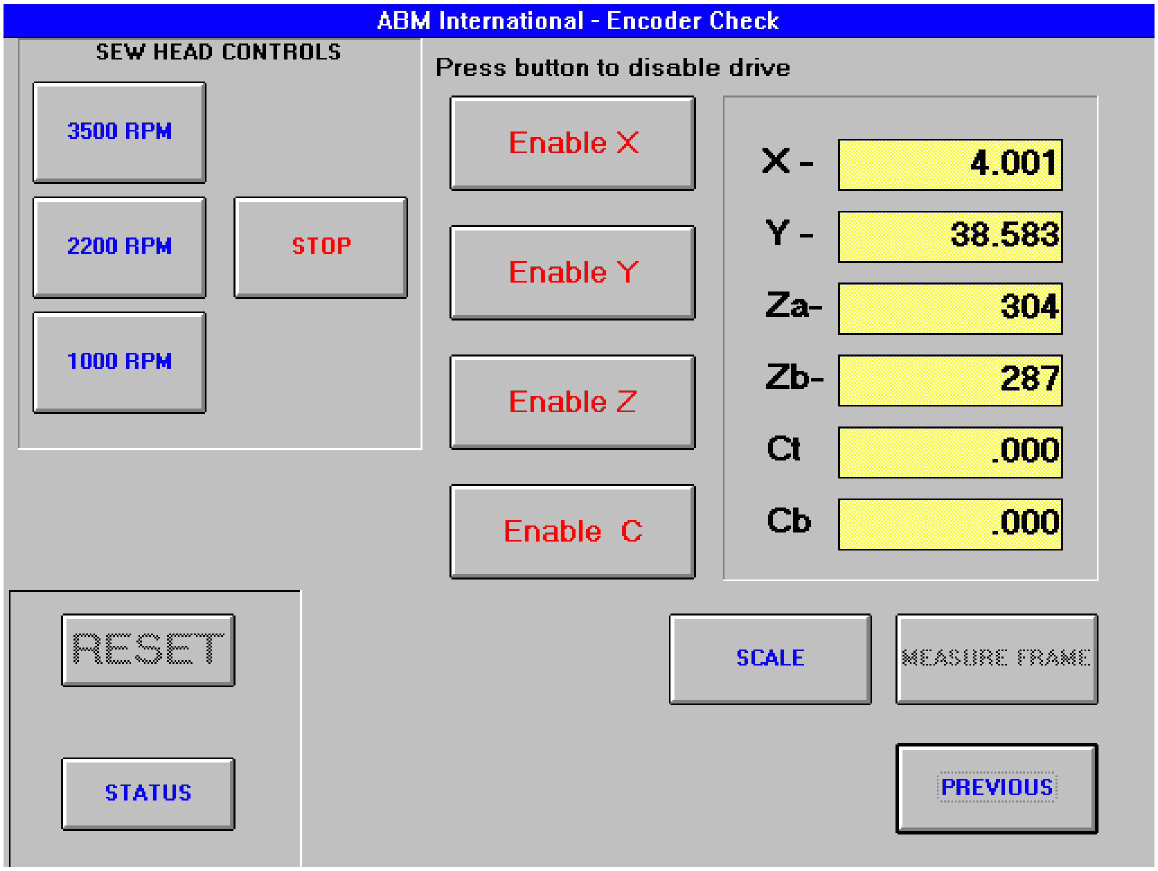


Figure 2.5 - The Encoder Screen

This example screen indicates 4 servo motor controls and 6 read out boxes.

The **Enable X** button will disable/enable the X-axis servo motor. When the button is selected, the X-axis will be disabled and the button will read **Kill X.** Re-selecting the button will enable the X-axis servo. The X encoder position can be read in the **X -** read out box.

The **Enable Y** button will disable/enable the Y-axis servo motor and functions as above.

The **Enable Z** button will disable/enable the Z-axis. The Z-axis servo controls the sewing bobbin position and the needle position. The **Za-** readout shows the sewing needle position and the **Zb-** readout shows the bobbin position. This button needs to be selected before any adjustments to the sewing area can be made or before removing/replacing a needle.

2.5 The Encoder Check Screen - Continued

The **Enable C** button will disable/enable the C-axis servos which control the clamp bars. The **Ct-** readout shows the Top Clamp bar position. The **Cb-** readout shows the Bottom Clamp bar position. Selecting the **Kill C** button to enable the C servo will enable the **MEASURE FRAME** button. You will need to select this button to inform the MSC of any change in the clamp bar positions.

The **SEW HEAD CONTROLS** panel controls the needle speed settings. Selecting a speed will run the needle and selecting the **STOP** button will stop the needle. Selecting any of the speed buttons will disable the Z-axis servo. The Z-axis can be re-enabled by selecting the **STOP** button, then selecting the **Kill Z** button.

Selecting the **PREVIOUS** button will return the Robo system to the *PARAMETER* screen.

The **SCALE** button is password protected with a different password. When selected the *PASSWORD* screens will appear.

2.6 The Scale Screen

When the correct password has been entered, the *SCALE* screen will appear (see **Figure 2.5**).

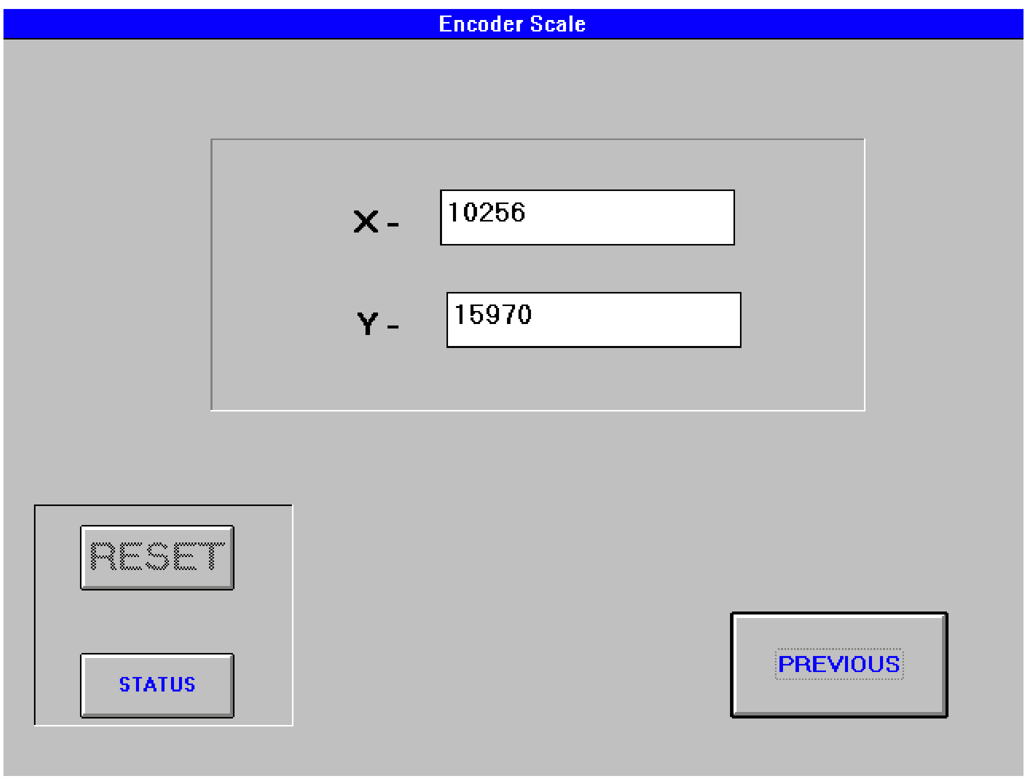


Figure 2.5 - The Scale Screen

2.6 The Scale Screen - Continued

The current X and Y-axis scale factors are shown in the readout boxes. To adjust an encoder scale select the appropriate readout box. A keypad will appear for entry of a new scale factor. These scale factors are range checked and when an entry is selected that is out of range, the original scale factor is maintained.

The scale factor relates to the number of bits needed to travel 1 inch in the plane of travel. The encoder for the X plane is the same as the one for the Y plane but the gearing is different. Each servo has 4096 bits per revolution but to get 1 inch of travel in the X plane requires 10256 bits and to get 1 inch of travel in the y plane requires the Y servo to rotate 15970 bits.

Selecting the **PREVIOUS** button will return to the *ENCODER* screen.

2.7 The Load New Pattern Screen

When the **Load Pattern from Drive** button is selected from the *PARAMETERS* screen (see **Figure 2.6**) the *LOAD NEW PATTERN* screen will appear.

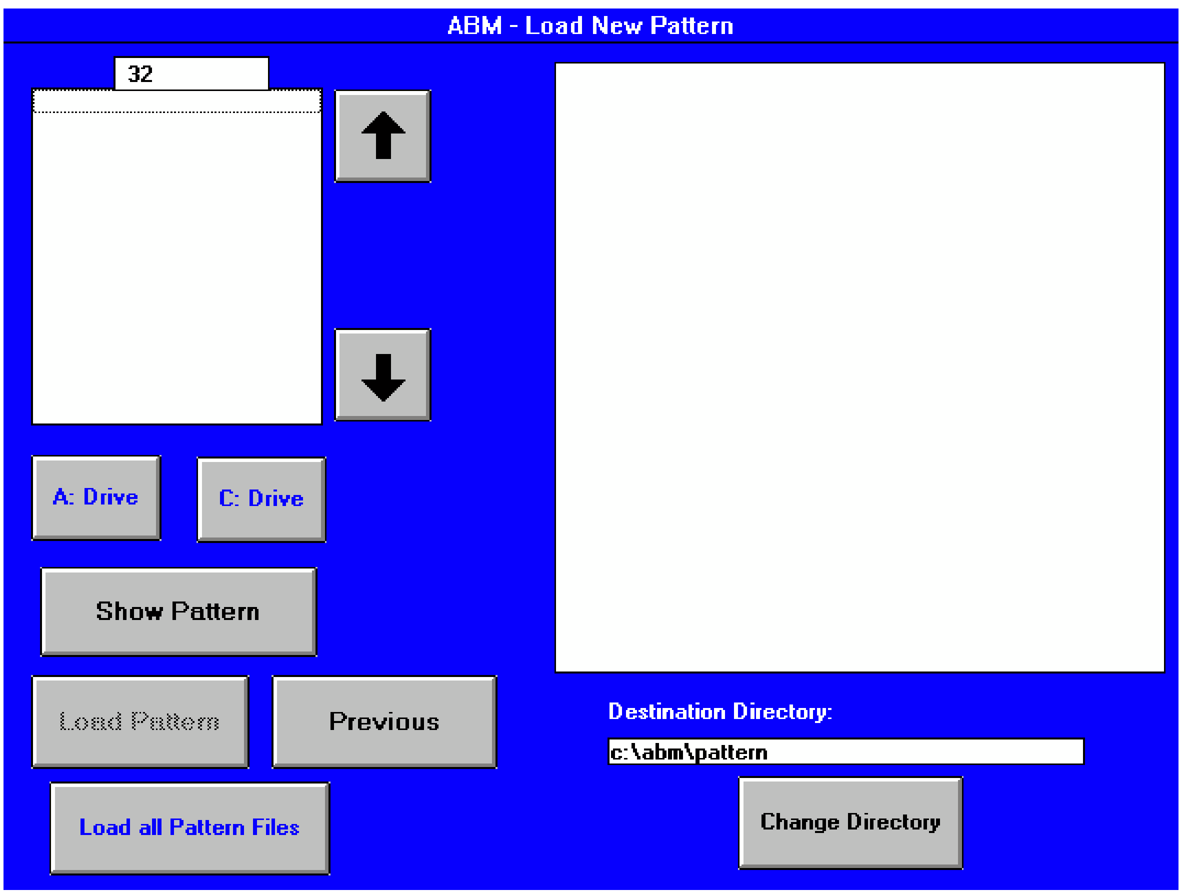


Figure 2.6 - The Load New Pattern Screen

2.7 The Load New Pattern Screen - Continued

New patterns can be entered into the Robo system. They can be selected from the root directory of a diskette in the A: drive or from the C:\abm\edit directory of the C: drive.

Either the **A: Drive** or the **C: Drive** button is selected. The names of the patterns from the selected drive are shown. If the selected drive has no patterns, then no names are shown. That is, if no patterns have been edited and saved, then the C:\abm\edit directory will be empty and no pattern names will be show when drive C: is selected.

To load an individual pattern, select the pattern name. The **Show Pattern** button is then selected and is shown in the display box. Other patterns can be selected and viewed. Select the **Load Pattern** button to install the pattern being viewed. The pattern will be installed in the directory & path as shown in the Destination Directory: box. (See above) This directory can be changed by selecting the Change Directory button (See **Section 2.8 & Figure 2.7**).

The **A: Drive** button must be selected to use the **Load all Pattern Files** button. When selected, the *LOADALL* screen appears. Selecting the **GO** button will load all the patterns (see **Figure 2.6.1**).

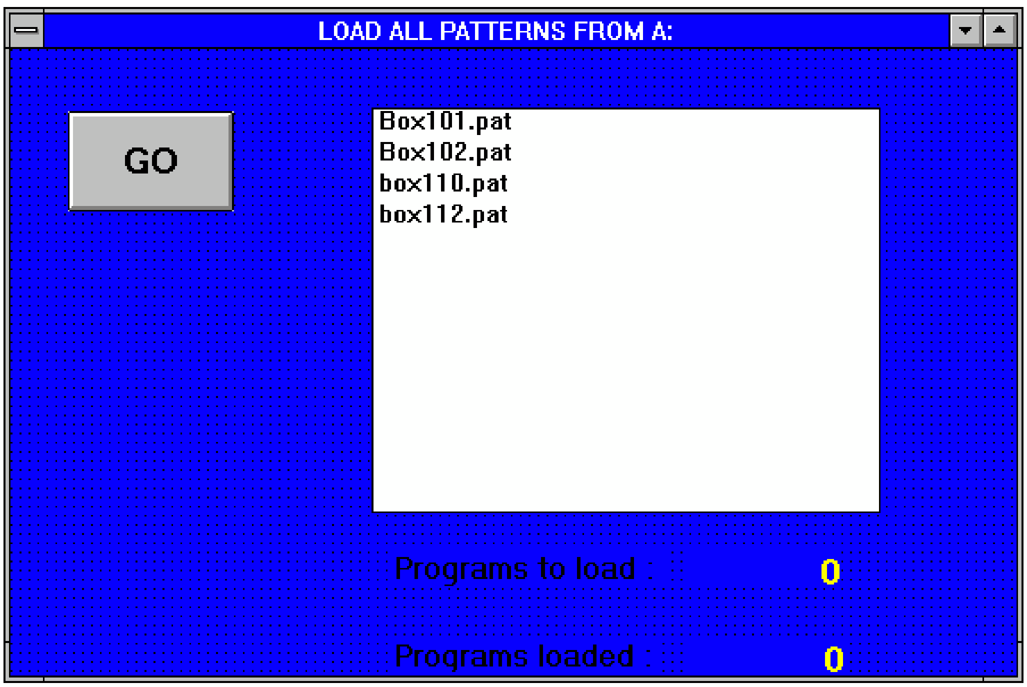


Figure 2.6.1 - The LoadAll Patterns Screen

When all the pattern from the diskette are loaded, a message will appear indicating that the load is complete.

Selecting the **Previous** button from the *Load New Pattern* screen will return you to the *PARAMETERS* screen.

2.8 The Change Directory Screen

When the **Change Directory** button is selected from the *LOAD NEW PATTERN* screen, the *Change Directory* screen will appear (see **Figure 2.7**).

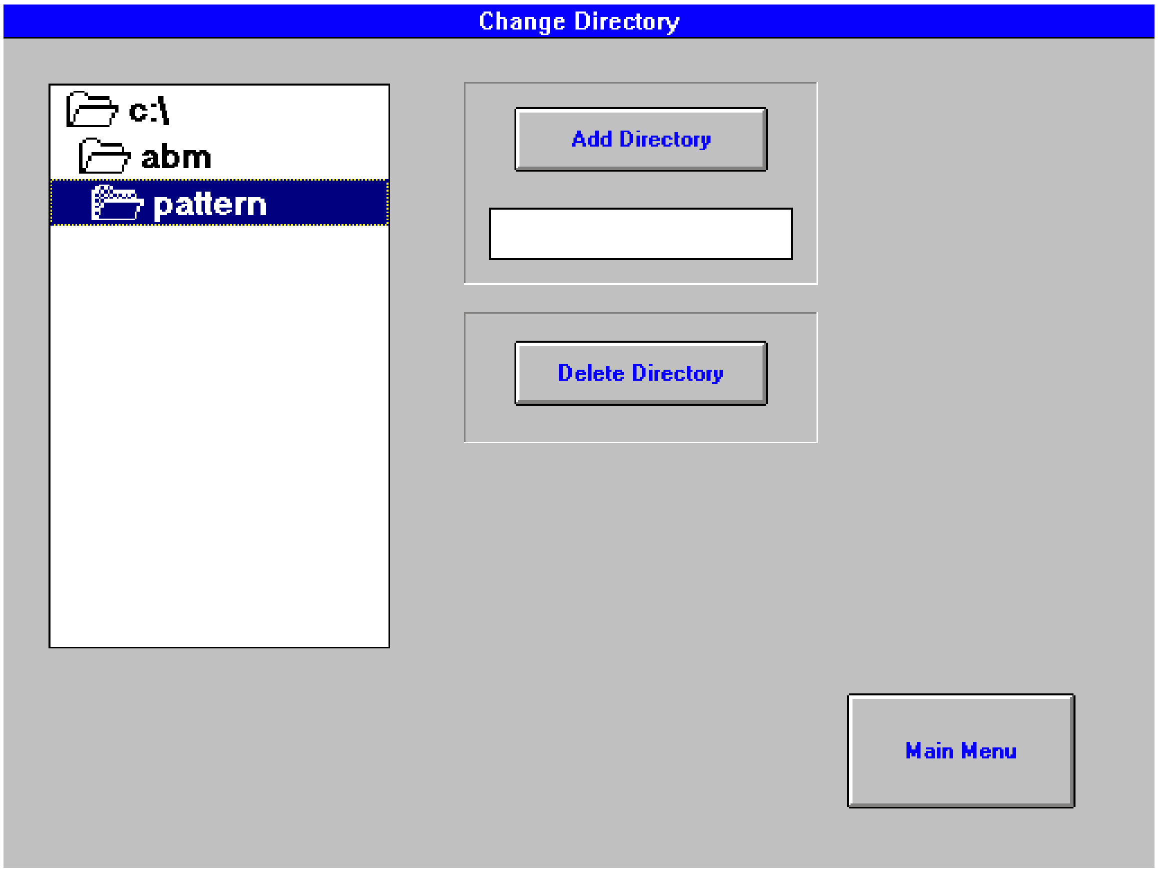


Figure 2.7 - The Change Directory Screen

The directory tree is shown with the normal default directory highlighted. The white box under the Add directory button can be selected to add sub directories under the pattern directory. When selected, a key pad will appear for entry of a sub directory name. When entered, the sub directory will be shown under the pattern directory. Sub directories can only be installed under the pattern directory. Only sub directories can be deleted by the **Delete Directory** button.

The **Main Menu** button will return you to the *LOAD NEW PATTERN* screen . If a sub directory is created and then highlighted before you return, the new Destination Directory will be shown upon return.

2.9 The Change Password Screen

When the **Change Password** button is selected from the *PARAMETERS* screen, the *CHANGE PASSWORD* screen appears (see **Figure 2.8**).

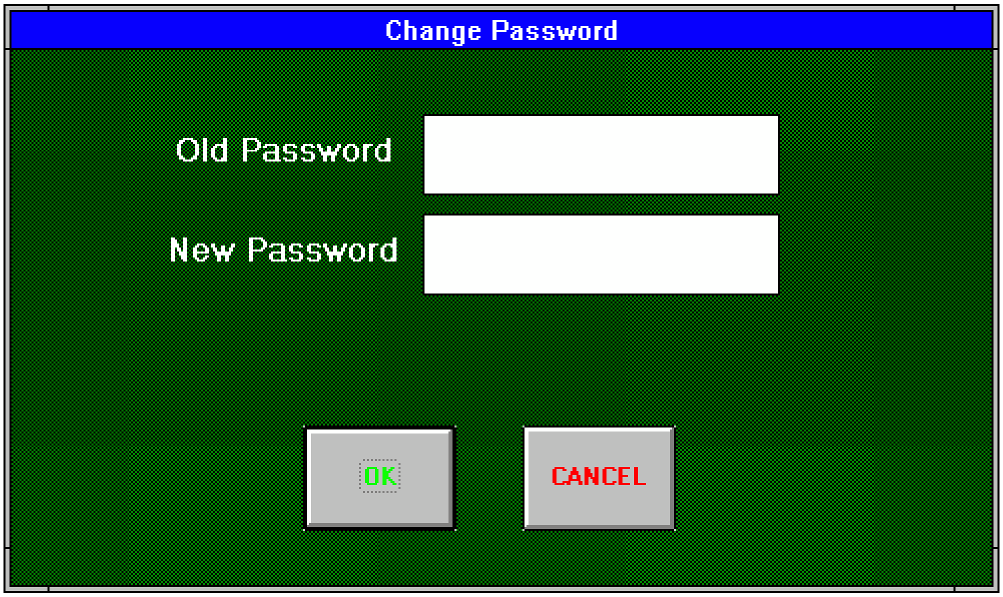


Figure 2.8 - The Change Password Screen

This screen will change the password that the Robo system has stored for entry into the *PARAMETERS* screen. The old password must be correctly entered then the new password can be entered.

Selecting the **OK** button will change the system password.

2.10 Deleting Files

Selecting the **Delete** button from the *PARAMETERS* screen will bring up the *DELETE FILES* screen (see **Figure 2.9**).

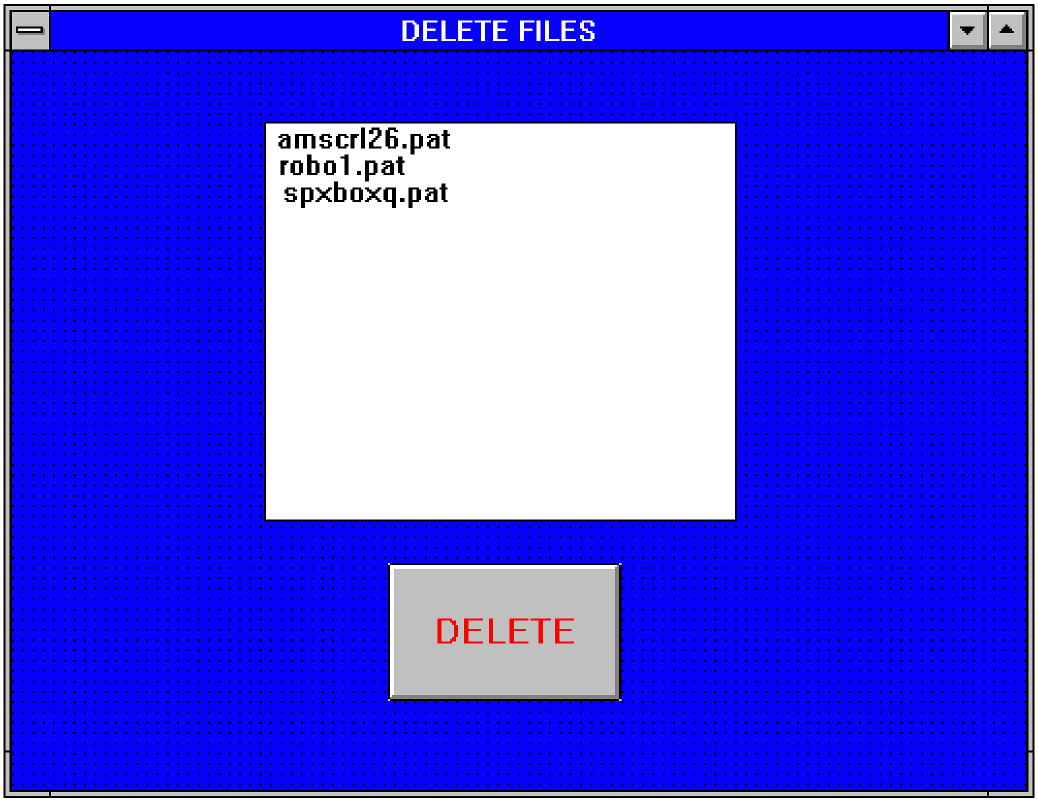


Figure 2.9 - The Delete Files Screen

From this screen you can individually select patterns for deletion. The pattern is selected, then the **DELETE** button is selected. The pattern will be deleted from the C:\ABM\PATTERN file and will no longer be shown for pattern selection in the *LOAD PATTERN* screen.

Select the **Previous** button to return to the *PARAMETERS* screen.

2.11 The Input Screen

Selecting the **Inputs/Outputs** button from the *PARAMETERS* screen will bring up the *INPUTS* screen (see **Figure 2.10**).

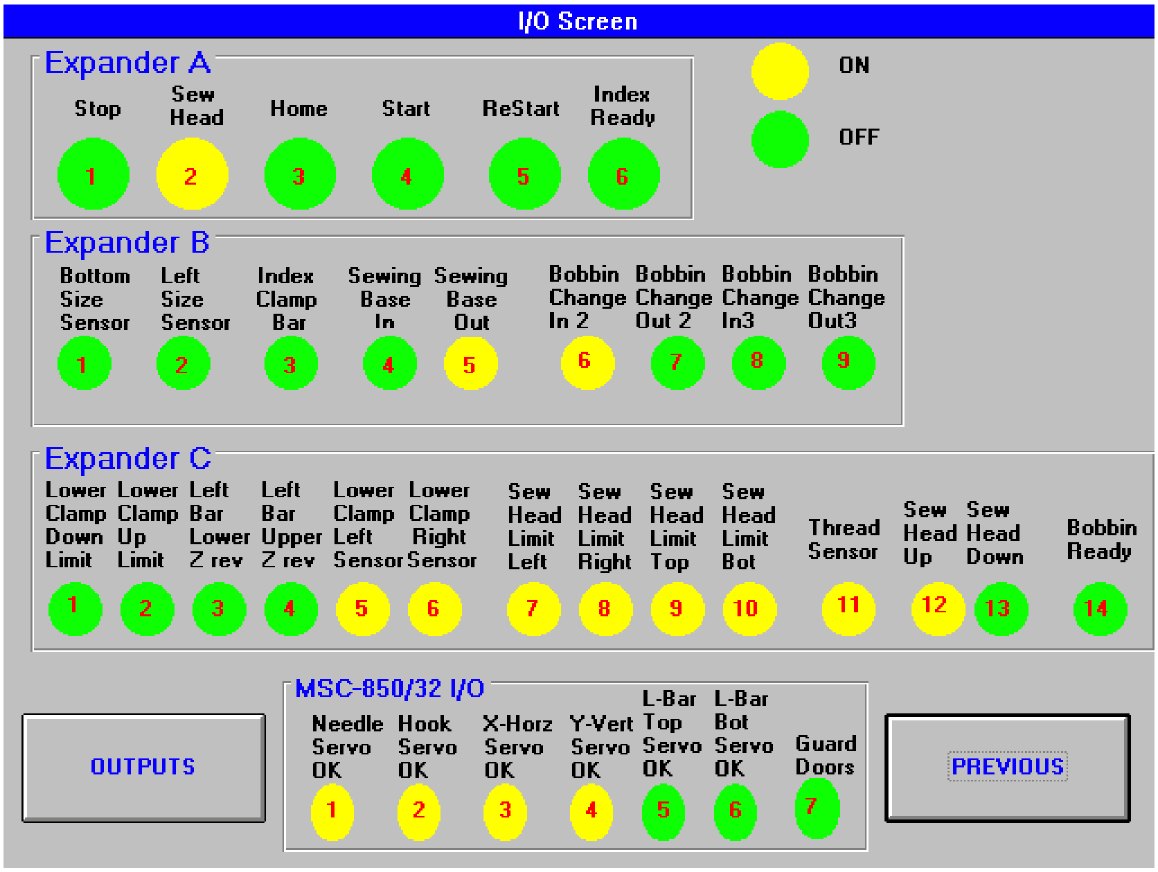


Figure 2.10 - The Input I/O Screen

This screen shows the Inputs for the Robo Operating System by control expander module and by expander position. It also shows the current state of the Inputs. If the input is green, it is off and if the input is yellow, it is on.

Expander A:

These are the buttons on the *OPERATORS* panel.

Stop:

The state of the Stop button. If green, Robo will run when Start is pushed. If yellow, the **Stop button on the *OPERATORS* has been pushed** and Robo has been stopped.

Sew Head:

If green, sewing will not take place when Start is selected, but Robo will move the sewing head around the pattern. If yellow, the Sewing head is in a sew state and Robo will sew the selected pattern.

2.11 The Input Screen - Continued

Home:
If green, Home has been selected. Robo is either going to Home or is at Home. If yellow, Home has not been selected and Robo is currently not at Home.

Start:
If green, Start has not been selected. No sewing or head movement is taking place. If yellow, Start has been selected and Robo has the sewing head in motion or is about to start its motion.

ReStart:
This button is normally used after a thread break to continue sewing after re-threading. If yellow, the button has been selected. If green, the button has not been selected.

Index ready:
This button is selected to index out the comforter just sewn and to Index in a new comforter for pattern sewing. When green, this button has not been selected and Indexing is not taking place. If yellow, this button has been selected and the Indexing process is taking place.

Expander B:

Bottom Size Sensor:
This is the sensor that is used by the bottom clamp bar when a size change is in progress. When green, the comforter is not sensed. When yellow, the comforter is sensed.

Left Size Sensor:
This is the sensor that is used by the left clamp bar when a size change is in progress. When green, the comforter is not sensed. When yellow, the comforter is sensed.

Index Clamp Bar:
This is the sensor that is used in the racking process to indicate that the comforter is in its sewing position. This occurs when the racking sequence is complete. When green, the comforter is not in position. When yellow, the racking sequence is complete and the index clamp bar has been sensed.

Sewing Base In:
This works in conjunction with the Sewing Base Out sensor. When green, the sewing head is not in its sewing position, that is, is not in or not being sensed as in. When yellow, the head is being sensed as in its position for sewing. Normally, when the sewing head is sensed as being in, the sewing base out sensor is off.

Sewing Base Out:
This works in conjunction with the Sewing Base In sensor. When green, the sewing head is not sensed as being in its no sew position or is not out. When yellow, the sewing head is being sensed as being in its no sew position or is in its out position. Normally when the sewing head is sensed as being out, the sewing base in sensor is off.

2.11 The Input Screen - Continued

Bobbin Change In 2:

This depicts the state of the bobbin change arm. If green, the arm is not sensed as being retracted. When yellow, or on, the arm is being sensed as being in the retracted position. This sensor works in conjunction with the Bobbin Change Out 2 sensor. When Bobbin Change In 2 is being sensed, Bobbin Change Out 2 should not be sensed.

Bobbin Change Out 2:

This works with the previous sensor, Bobbin Change In 2. If green, the bobbin arm is not being sensed as being extended. When yellow, or on, the arm is being sensed as being extended.

Bobbin Change In 3:

This works with the following sensor, Bobbin Change Out 3 and senses whether the carousel is indexed or not indexed. When green, or off, the carousel is not being sensed as being indexed. When yellow, the carousel is being sensed as being indexed.

Bobbin Change Out 3:

This works with the previous sensor, Bobbin Change In 3. When green, the carousel is not being sensed as being indexed. When yellow, the carousel is being sensed as being indexed. Normally if this sensor is on, the Bobbin Change In 3 sensor is off.

Expander C:

Lower Clamp Down Limit:

When a size change is in effect, the lower clamp bar is moved first up to a sensor limit, then down until the comforter is no longer being sensed. The movement down is limited by this sensor. When green, the sensor is not sensing the lower clamp bar. When yellow, the sensor is on and the lower clamp bar is being sensed.

Lower Clamp Up limit:

When a size change is an effect, the lower clamp bar is first moved up to a limit sensor. When green, this sensor does not see the clamp bar. When yellow, the lower clamp up limit sensor does sense the lower clamp bar.

Left Bar Lower Z rev:

The left clamp bar is controlled independently by 2 servos, one upper and one lower. During the initialization process and during the size change process, the left clamp bar is moved inward to the servos zero revolutions position. If this sensor is green, the Left Bar Lower Z rev position has not been sensed. When yellow, the lower servo is in its zero revolutions position.

Left bar Upper Z rev:

As above. When green, the upper left bar servo has not sensed its zero revolutions position. When yellow, it has.

Lower Clamp Left Sensor:

When green, the left clamp on the lower clamp bar is open. When yellow, the clamp is closed.

2.11 The Input Screen - Continued

Lower Clamp Right Sensor:
When green, the right clamp on the lower clamp bar is open. When yellow, the clamp is closed.

Sew Head Limit Left:
When green, the left limit sensor for the sewing head has not been detected. When yellow, it has.

Sew Head Limit Right:
When green, the right limit sensor for the sewing head has not been detected. When yellow, it has.

Sew Head Limit Top:
When green, the top limit sensor for the sewing head has not been detected. When yellow, it has.

Sew Head Limit Bot:
When green, the bottom limit sensor for the sewing head has not been detected. When yellow, it has.

Thread Sensor:
When thread is moving through the thread sensor, this sensor will pulse. If steady green, no thread is being sensed. When yellow, thread is sensed but not moving.

Sew Head Up:
When green, the proxy Sew Head Up sensor does not detect the sewing head to be out. When yellow, the sensor detects the head as being out or not in the sewing position. Normally when yellow, the Sew Head Down sensor will be green.

Sew Head Down:
When green, the proxy Sew Head Down sensor does not detect the sewing head to be in. When yellow, the sensor detects the head as being in or in the sewing position. Normally when yellow, the SewHead Up sensor will be green.

Bobbin Ready:
When green, the bobbin is in a fault state or not position correctly or jammed, etc. When yellow the bobbin is in the sewing position.

MSC-850/32 I/O:

Needle Servo OK:
When green, the needle servo detects a fault condition. When yellow, the needle servo is not faulted and is ready for sewing.

Hook Servo OK:
When green, the hook servo detects a fault condition. When yellow, the hook servo is not faulted and is ready for sewing.

X-Horz Servo OK:
When green, the X axis servo detects a fault condition. When yellow, the servo is not faulted and is ready for sewing.

Y-Vert Servo OK:
When green, the Vertical servo detects a fault condition. When yellow, the servo is not faulted and is ready for sewing.

2.11 The Input Screen - Continued

L-Bar Top Servo OK:
When green, the Top servo for the Left Clamp bar detects a fault condition. When yellow, the servo is not faulted and is ready for sewing.
L-Bar Bot Servo OK:
When green, the Bottom servo for the Left Clamp bar detects a fault condition. When yellow, the servo is not faulted and is ready for sewing.
Guard Doors:
When green, the door to the guard that surrounds Robo is open and Robo is in a NO SEW state. When yellow, the guard door is closed and ROBO is in a SEW state.

2.12 The Output Screen

Selecting the **OUTPUTS** button will bring up the *OUTPUT I/O* screen (see **Figure 2.11**).

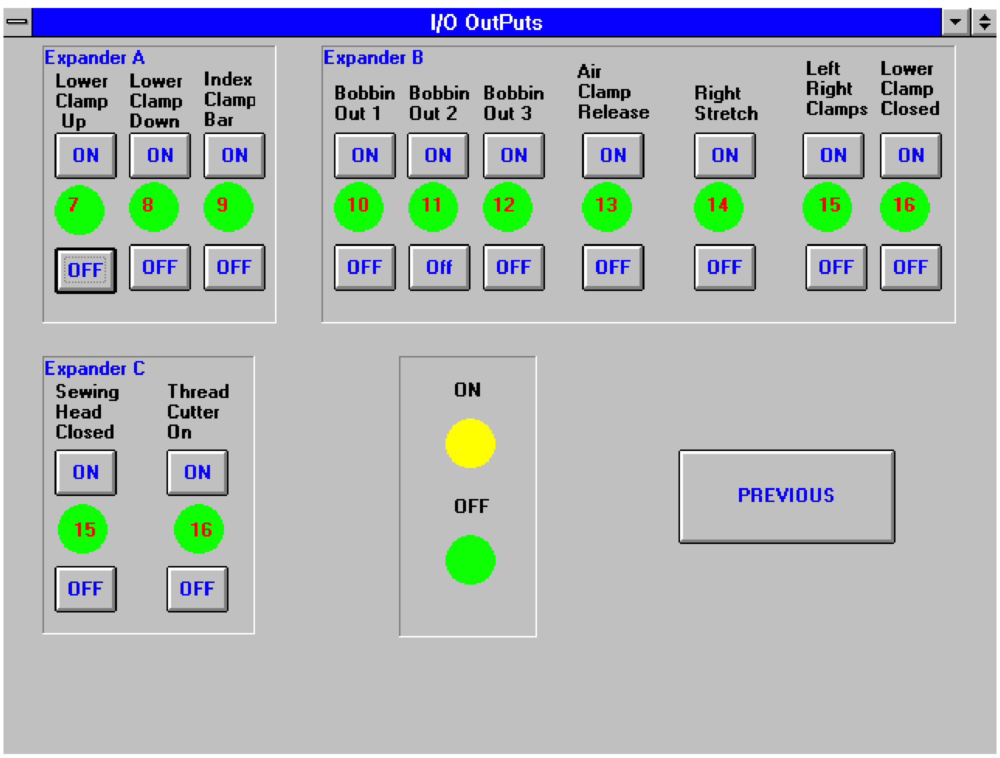


Figure 2.11 - The Output I/O Screen

This screen shows the current state of the outputs for the Robo Operating System. It shows them by expander and expander position. This screen allows you to toggle the output state of a particular output. When an output state is changed, other output states are prohibited from being changed.

Selecting the **PREVIOUS** button will return you to the *INPUT I/O* screen.

2.12 The Output Screen - Continued

Expander A:

Lower Clamp Up:

When ON is selected, the lower clamp bar will move up until the up limit sensor is detected and the indicator will become yellow. When OFF is selected, the lower clamp bar will stop its movement up if the bar is moving up, otherwise, OFF has no effect. If the indicator is yellow, it now becomes green.

Lower Clamp Down:

When ON is selected, the lower clamp bar will move down until the down limit is reached and the indicator will become yellow. When OFF is selected, the lower clamp bar will stop its movement up if the bar is moving up, otherwise, OFF has no effect. If the indicator is yellow, it now becomes green.

Index Clamp Bar:

When ON is selected, the indicator will become yellow, and the Index Clamp Bar will move as if it were racking a comforter. When OFF is selected the indicator becomes green and motion of the Index Clamp Bar will stop if it is in motion.

Expander B:

Bobbin Out 1:

When ON is selected, the indicator will become yellow, the air to the arm turns on and the gripper arm becomes extended. When OFF is selected, the arm is extracted if it is extended and the indicator becomes green.

Bobbin Out 2:

When ON is selected, the indicator will become yellow and the bobbin change process takes place. When OFF is selected, the indicator becomes green and the bobbin change process is stopped if in progress.

Bobbin OUT 3:

When ON is selected, the indicator will become yellow and the carousel advances. It will advance once for every selection of ON. When OFF is selected, the indicator becomes green and the carousel advance process is halted.

Air Clamp Release:

When ON is selected, the indicator becomes yellow and air that energizes the bar clamps on the bar that indexes the comforter is released. When OFF is selected, the indicator becomes green and the clamps become pressurized.

Right Stretch:

When ON is selected, the indicator becomes yellow and the air for the right bar clamps is pressurized. When OFF is selected, the indicator becomes green and the air is de-pressurized.

Left Right Clamps:

When ON is selected, the indicator becomes yellow and the air for the left and right comforter clamps is energized. When OFF is selected, the indicator becomes green and the clamps are de-pressurized.

2.12 The Output Screen - Continued

Lower Clamp Closed:

When ON is selected, the indicator becomes yellow and the air for the Lower clamp is energized. When OFF is selected, the indicator becomes green and the air is de-pressurized.

Expander C:

Sewing Head Closed:

When ON is selected, the indicator becomes yellow and the sewing head moves to the sew position and is held in this position. When OFF is selected, the indicator becomes green and the head is retracted or position to the NO SEW position.

Thread Cutter On:

When ON is selected, the indicator becomes yellow and the Thread cutting mechanism is activated. When OFF is selected, the indicator becomes green and the thread cutter mechanism is de-activated.

2.13 The Info Screen

Selecting the **INFO** button will bring up the *MSC INFORMATION* screen (see **Figure 2.12**).

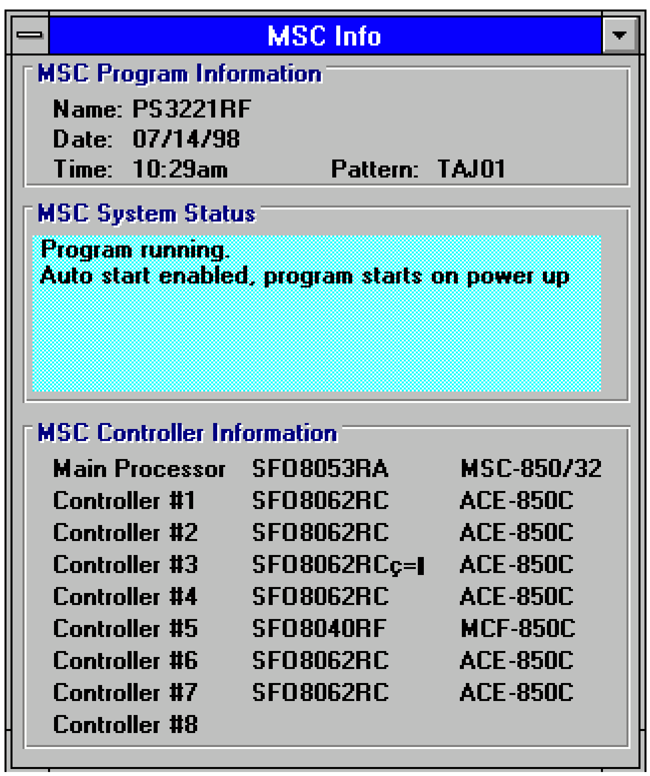


Figure 2.12 - MSC INFORMATION

2.13 The Info Screen - Continued

This screen shows the Name, Date and Time of the Macro-Program that is currently running in the MSC.

It also shows the name of the sewing pattern last loaded to the MSC.

The MSC System Status box shows the current state of the MSC.

The MSC Controller Information lists all the controller cards installed along with the installed firmware revision.

2.14 The DownLoad Screen

Selecting the **DownLoad** button will bring up the *MACROPRO DOWNLOAD* screen (see Figure 2.13).

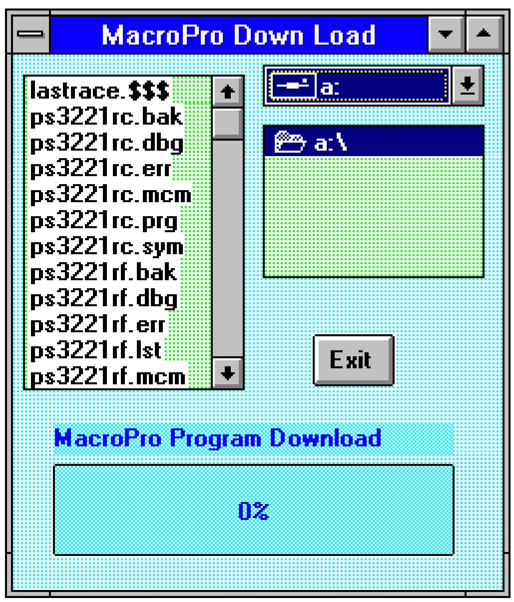


Figure 2.13 - MACROPRO DOWNLOAD Screen

A floppy is needed with the Macro-Program that is to be downloaded. Maintenance personnel selects the proper program from the list by clicking on it and then Macro-Program code is sent to the MSC.

A progress bar will be shown along with several down load messages. When the process is complete, selecting Exit will return you to the *PARAMETERS* screen.

2.15 The Program Edit Screen

Selecting the Edit button from the *PARAMETERS* screen will bring up the *PROGRAM EDIT* screen (see **Figure 2.14**).

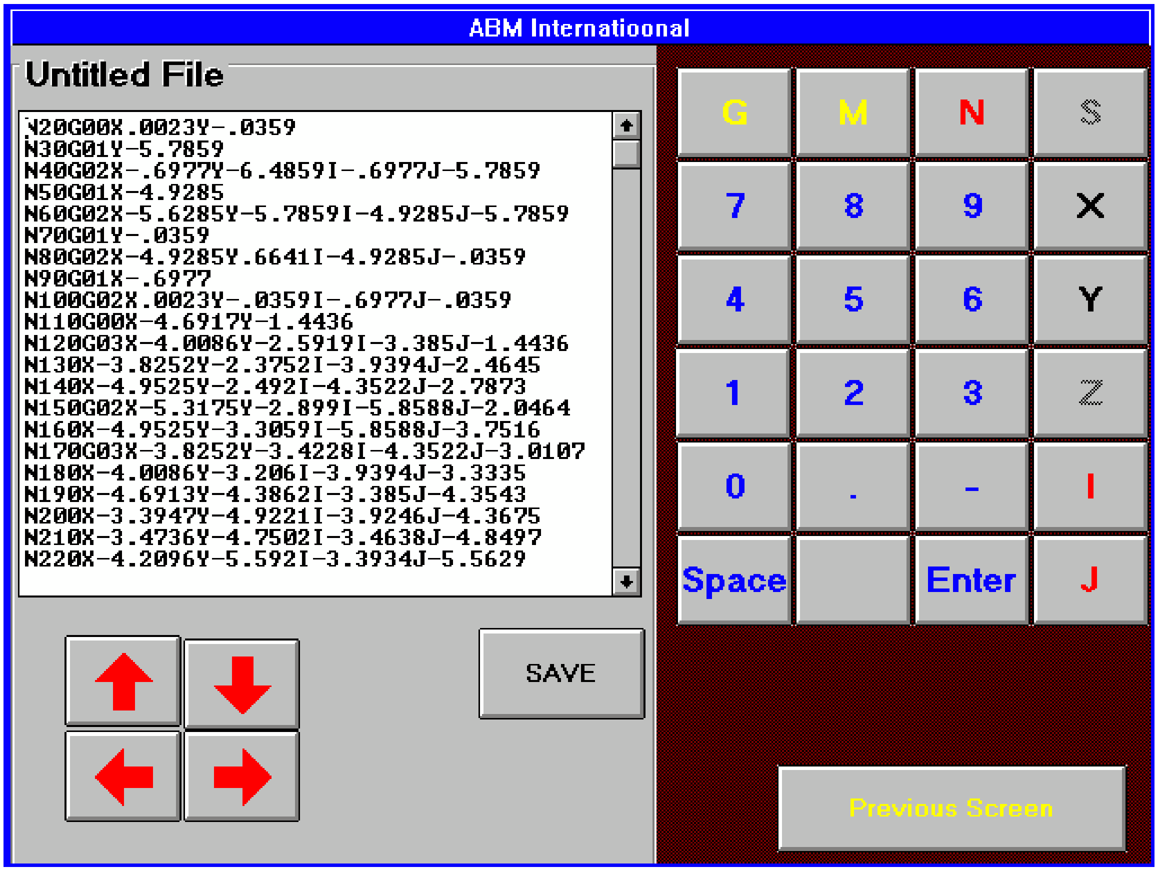


Figure 2.14 - The PROGRAM EDIT Screen

The selected patterns G codes are shown. The cursor can be positioned anywhere in the G code list. The code can be changed in any manor via the keypad. When editing is done selecting the **SAVE** button will save the edited file in a specific directory (C:\ABM\Edit).

Selecting the edited pattern for sewing must be done from the *LOAD NEW PATTERN* screen by selecting the **C: Drive** button and then selecting the pattern from the list of edited patterns.

ROBO COMMERCIAL PARTS		
ITEM DESCRIPTION	**QTY**	**ABM PART #**
PNEUMATICS		
180 Degree Rotary Actuator for product side grippers	8	C-1000-001
40mm Compact Air Cylinder for side product stretch	2	C-1000-002
Double rod clevis for 40mm Compact Air Cylinder	2	C-1000-003
32mm Guided Air Cylinder for bottom gripper	2	C-1000-004
3/4in Air Cylinder for clamp product release system (doffer system)	1	C-1000-005
Oil Injector Pump for sewhead/base assembly	2	C-1000-006
Thread lengthener air cylinder mounted on sewhead	1	C-1000-124
63mm Compact Air Cylinder for push/pull sewhead/base assembly	2	C-1000-007
7 Station Manifold Valve assembly	1	C-1000-008
Straight fitting 1/4 tubing x 1/8 npt male connector (KQ2H07-34S)		C-1000-008A
Straight fitting 1/4 tubing x 10-32 thread male connector (KQ2H07-32)		C-1000-008B
90 Degree fitting 1/4 tubing x 1/8 npt male elbow (KQ2L07-34S)		C-1000-008C
90 Degree fitting 1/4 tubing x 10-32 thread male elbow (KQ2L07-32)		C-1000-008D
Elbow flow control (NAS3201F-N02-07S) for 63mm compact air cylinder	4	C-1000-008E
Inline flow control (NAS2051F-07) 1/4 tubing x 1/4 tubing		C-1000-008F
Branch tee fitting 1/4 tubing x 1/8 npt (KQ2T07-34S) for rotary actuators		C-1000-008G
Union "Y" fitting 1/4 tubing x 1/4 tubing (KQ2U07-00)		C-1000-008H
Coil Tubing 1/4 diameter for rotary actuators C-1000-001 length = 10 feet		C-1000-008I
Tubing 1/4 diameter (TIUB-07-COLOR-20) length = 20 feet		C-1000-008J
Pressure and regulator combo unit	1	C-1000-008K
Air clamps for product loading	20	C-1000-118
SENSORS		
Limit travel sensors		
Right angle photo-sensor mounted on sewhead, normally closed	1	C-1000-016
Right angle photo-sensor, normally opened	4	C-1000-017
Tubular photo-sensor, diffuse type, for product release system	1	C-1000-018
Proximity sensor for all travel limits, normally closed	5	C-1000-019
Quick connect cable length = 30 feet	14	C-1000-020
Retro-reflective tape for photo-sensors length = 100 in.	1	C-1000-021
Custom coil quick connect cable for bottom product sensor	1	C-1000-172
Field wirable black disconnect for air cylinder sensors	3	C-1000-173
Air cylinder sensors		
Sensor for 32mm guided air cylinder (Y59AL)	2	C-1000-016A
Sensor for 63mm compact air cylinder (J79)	4	C-1000-016B
Sensor for bobbin changer air cylinders (SCPD2L-16100)	4	C-1000-016C
Proximity sensor for bobbin changer (TL-W3MC1)	1	C-1000-016D
Misc. sensors		
Pulse output passive thread sensor	1	C-1000-011
Tubular photo-sensor, retro-reflective, for safety operation	2	C-1000-219
POWER TRANSMISSION		
Motors and gear-reducers		
Right angle gearmotor for bottom gripper (clamp)	1	C-1000-023

Right angle gearmotor for racking system (product loading)	1	C-1000-024
Gear reducer for x-axis horizontal motion (steel timing belts drive)	1	C-1000-014
Gear reducer for y-axis vertical motion (bridge drive)	1	C-1000-015
Servo motor for x-axis horizontal motion (steel timing belts drive)	1	C-1000-014A
Servo motor for y-axis vertical motion (bridge drive)	1	C-1000-015A
Servo motor for sewhead/base drive	2	C-1000-014B
Servo motor for left gripper size change assembly (ball-screw drive)	2	C-1000-014C
Sprockets, bearings, timing belts, etc..		
Sprocket for #60 roller chain drive (bridge drive)	6	C-1000-026
Split taper bushing for bottom sprocket 2" dia. main shaft drive (bridge drive)	3	C-1000-027
Split taper bushing for top sprocket 1.5" dia. idler shaft drive (bridge drive)	2	C-1000-028
Split taper bushing for drive sprocket y-axis gear-reducer (C-1000-015)	1	C-1000-029
Sprocket composite (plastic) idler for #40 roller chain (top racking system)	4	C-1000-042
Sprocket for #40 roller chain (bottom drive racking system)	5	C-1000-043
Sprocket for #40 roller chain (motor drive racking system)	1	C-1000-201
Sprocket for #40 roller chain (bottom idler racking system) with C-1000-054	2	C-1000-047
Sprocket for #35 roller chain (bottom gripper drive)	4	C-1000-048
Split taper bushing 7/8" bore for bottom gripper gear-motor	1	C-1000-045
Split taper bushing 7/8" bore for racking system gear-motor	1	C-1000-046
Split taper bushing 1" bore for #40 roller chain sprocket	4	C-1000-044
Split taper bushing 1" bore for #35 roller chain sprocket (bottom gripper drive)	2	C-1000-049
Split taper bushing 5/8" bore for #35 roller chain sprocket (top gripper idler)	2	C-1000-050
Radial ball bearing 1/2" I.D. (racking system)	6	C-1000-051
Radial ball bearing 5/8" I.D. (bottom gripper system)	4	C-1000-052
Radial ball bearing 1" I.D. (racking system and x-axis drive unit)	20	C-1000-053
Flanged frelon bearing for #40 roller chain sprocket (bottom racking system)	2	C-1000-054
Radial ball bearing 3/4 I.D. for x-axis idler unit	4	C-1000-195
Flange pillow block bearing for bridge top drive	4	C-1000-031
Base mount pillow block bearing for bridge bottom drive	8	C-1000-032
Roller chain #60 length = 50 feet (bridge drive)	1	C-1000-036
Roller chain #60 connector link	9	C-1000-037
Roller chain #40 with WA-2 attachments for racking system	4	C-1000-061
Roller chain #40 length = 10 feet	1	C-1000-061A
Roller chain #40 connector link	8	C-1000-194
Roller chain #40 three pitch attachment w/ WA2 for racking system	4	C-1000-204
Roller chain #35 length = 20 feet for bottom gripper system	1	C-1000-063
Roller chain #35 connector link	4	C-1000-064
Timing pulley for sewhead/base drive	4	C-1000-030
Timing belt for sewhead unit drive	1	C-1000-038
Timing belt for sewbase unit drive	1	C-1000-039
Shaft Coupler for x-axis drive unit	1	C-1000-040
Shaft coupler spider for x-axis drive unit w/ C-1000-040	1	C-1000-041
Shaft flexible coupler for ball-screw system (left gripper unit)	2	C-1000-065
Linear motion ball bearings		
Ball screw shaft for left gripper assembly	2	C-1000-093
Ball nut for C-1000-093 assembly	2	C-1000-094
Linear bearing block for vertical y-axis drive assembly	8	C-1000-102
Linear rail for vertical y-axis drive assembly	4	C-1000-103
Linear bearing block for x-axis drive assembly (bridge unit)	8	C-1000-104
Linear rail for x-axis drive assembly	4	C-1000-105

5.16 - ROBO COMMERCIAL PARTS - Continued

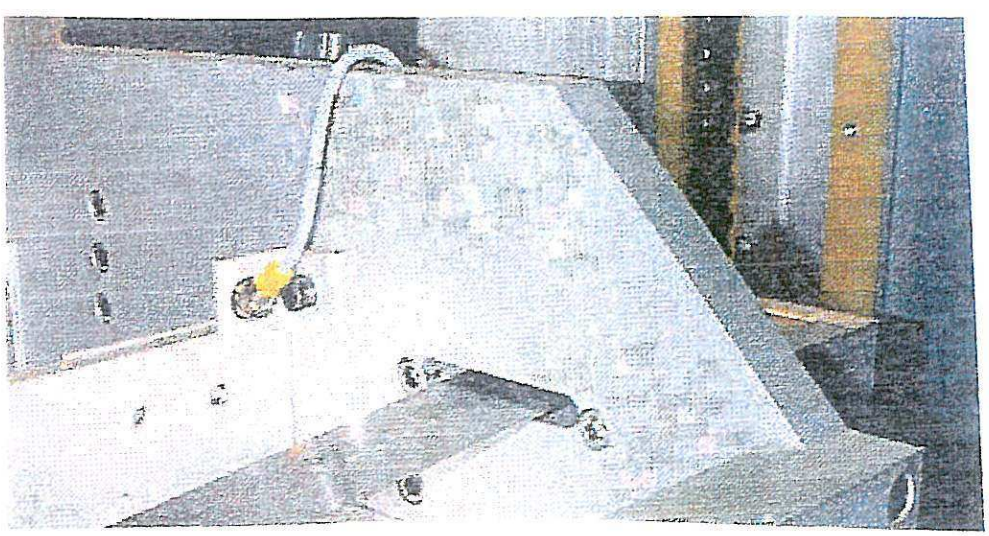
Linear bearing block for bottom gripper assembly (C-1000-004)	4	C-1000-106
Linear rail for bottom gripper assembly (C-1000-004)	2	C-1000-107
Linear bearing full block for sewhead(4) / base(2) assembly	6	C-1000-109
Linear bearing half block for sewbase assembly only	2	C-1000-110
Linear rail for sewhead/base assembly	4	C-1000-111
Miniature Linear bearing block w/rail for left top/bottom ball-screw assembly	4	C-1000-112
Miniature Linear bearing block w/rail for right top/bottom ball-screw assembly	4	C-1000-113
Steel timing belts and pulleys		
Stainless steel timing belts for sewhead/base assembly drive unit	2	M-1000-112
Idler pulleys for steel timing belts for sewhead/base assembly drive unit	2	M-1000-113
Drive pulleys for steel timing belts for sewhead/base assembly drive unit	2	M-1000-114
ELECTRICAL AND MECHANICAL MISC.		
Controller with software	1	C-1000-068
E-Stop button	1	C-1000-069
On/Off main power switch	1	C-1000-070
Variable speed motor inverter for gearmotors C-1000-023 and C-1000-024	2	C-1000-072
Cooling fan for Control box	1	C-1000-073
Touch screen for machine control	1	C-1000-086
Bobbin changer unit	1	C-1000-012
Bobbin case cartridge (carousel)	2	C-1000-013
Bobbin case	14	C-1000-192
L style hook w/ bobbin case	1	C-1000-191

5.17 - PICTURES OF PARTS

LIMIT TRAVEL SENSORS

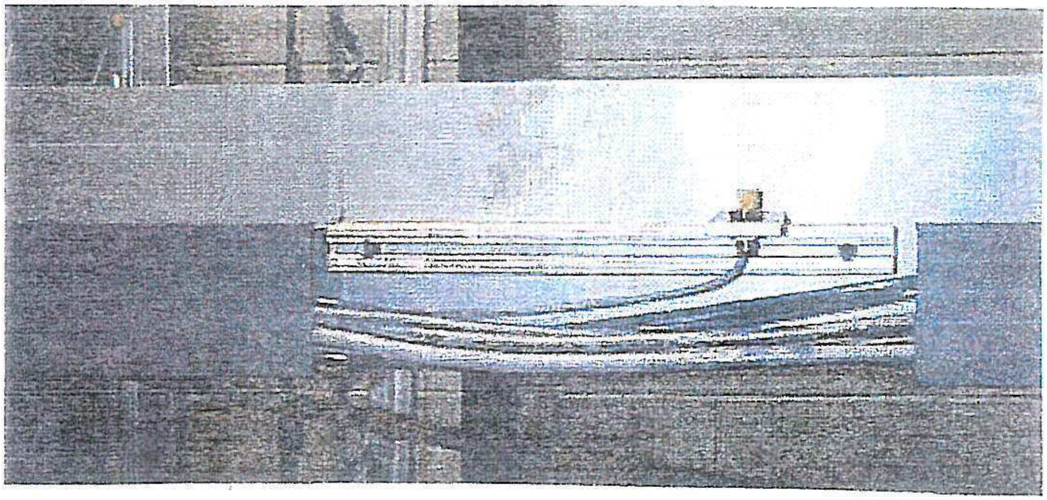
1- Vertical limit travel sensor for top limit. ABM part #C-1000-017

2- Vertical limit travel sensor for lower limit. ABM part #C-1000-017



5.17 - PICTURES OF PARTS - Continued

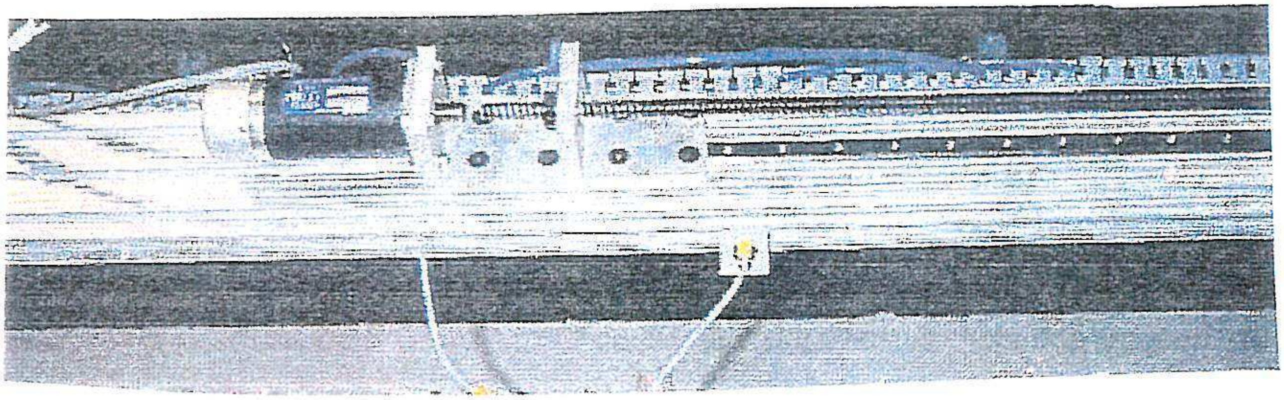
3- Horizontal limit travel sensor for right side limit. ABM part #C-1000-019



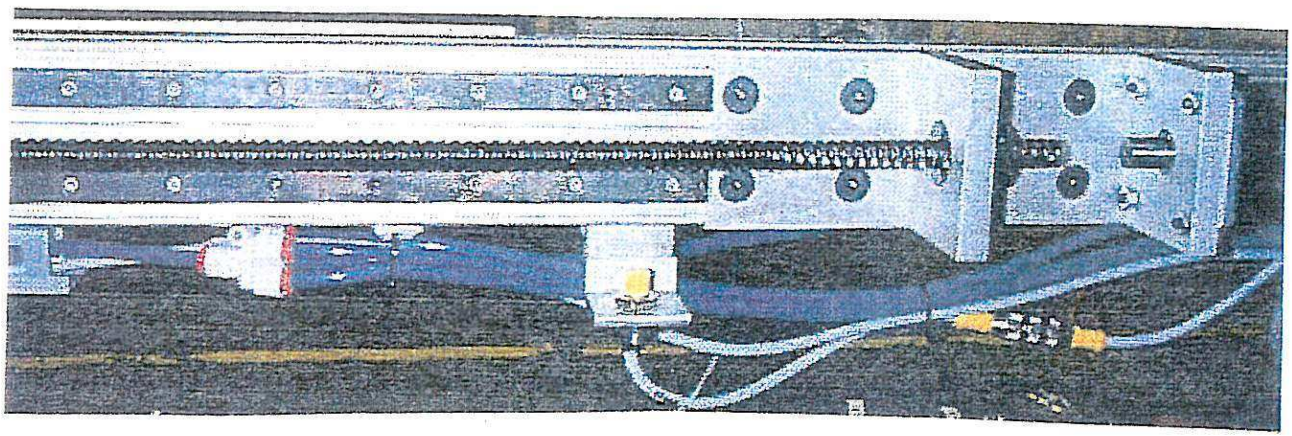
4- Horizontal limit travel sensor for left side limit. ABM part #C-1000-016

5.17 - PICTURES OF PARTS - Continued

5- Top ball-screw assembly home limit sensor for size change. ABM part #C-1000-019



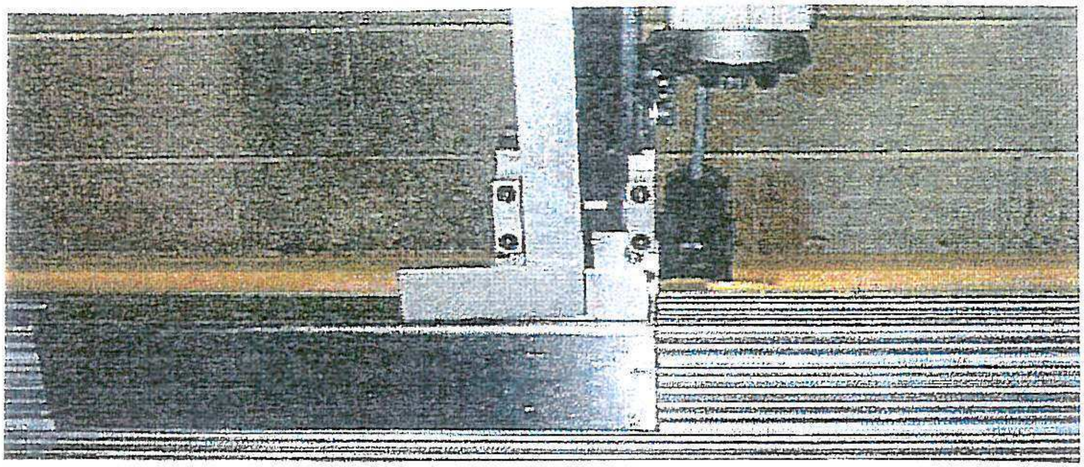
6- Bottom ball-screw assembly home limit sensor for size change. ABM part #C-1000-019



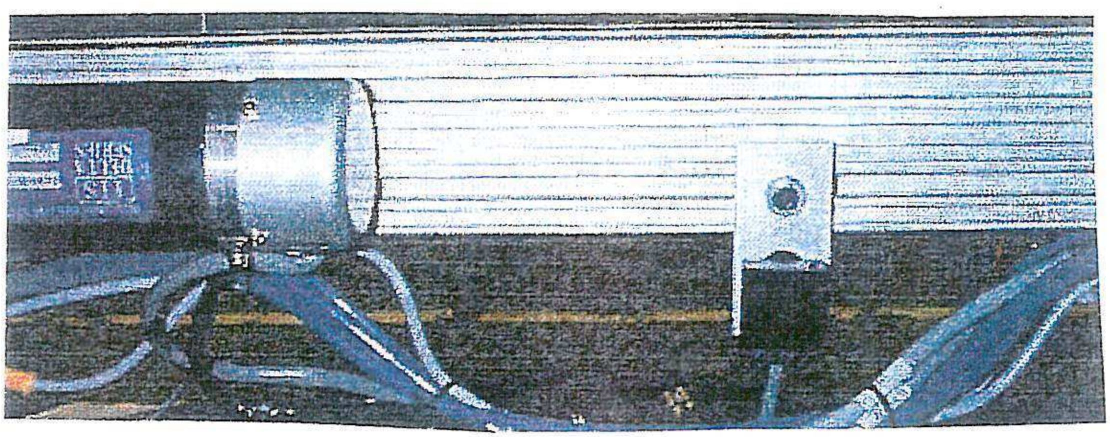
7- Clamp bar index sensor for racking system. ABM part #C-1000-018

5.17 - PICTURES OF PARTS - Continued

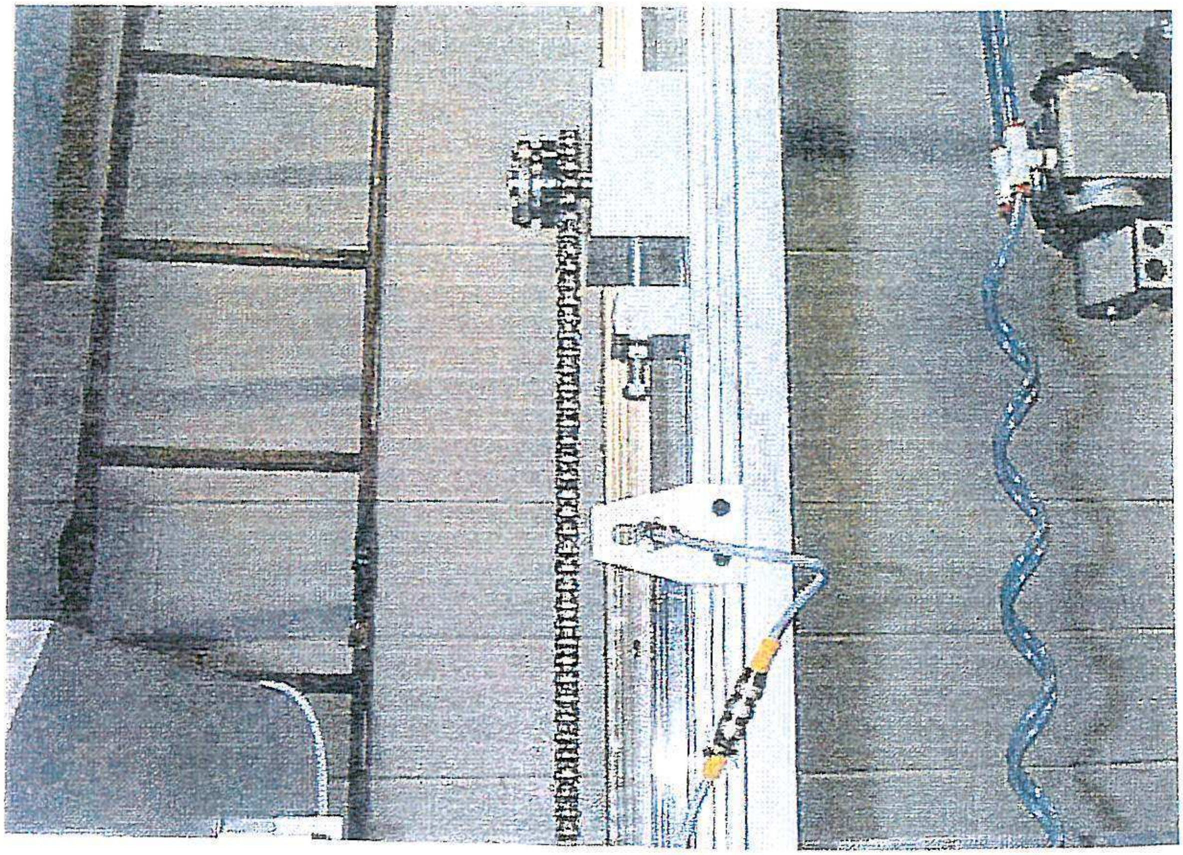
8- Product edge sensor for width size change. ABM #C-1000-017



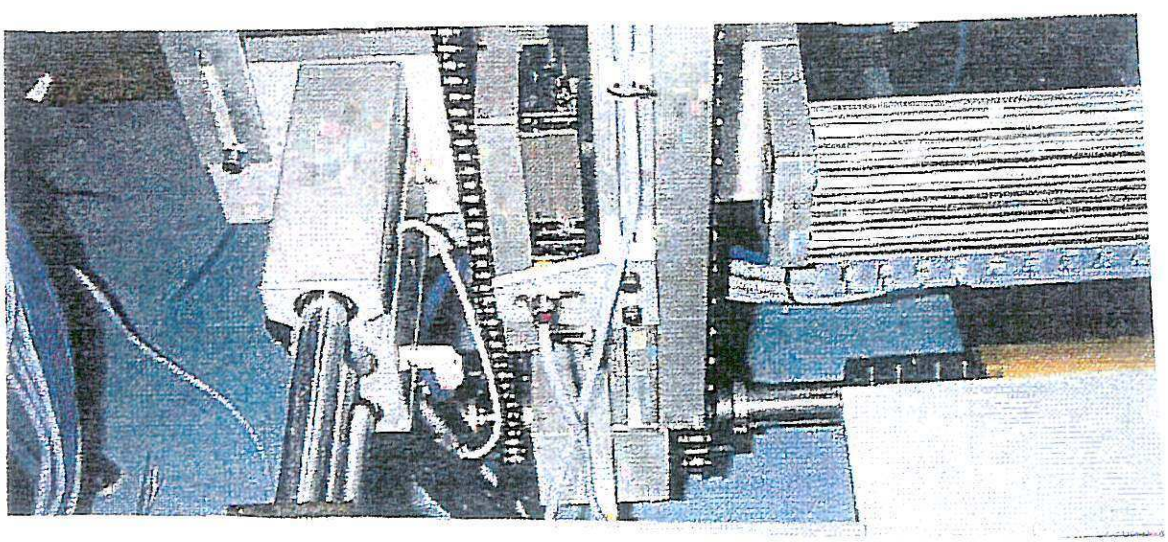
9- Product bottom edge sensor for length size change. ABM #C-1000-017



10- Bottom gripper (clamp) top limit sensor for size change. ABM part #C-1000-019



11- Bottom gripper (clamp) bottom limit sensor for size change. ABM part #C-1000-019



5.18 - CLEANING AND LUBRICATION

CLEANING & LUBRICATING SYSTEMS

1- SEW HEAD AND BASE OIL CONTAINERS MUST BE PERIODICALLY CHECKED AND FILLED WITH #090066-5 OIL TO MAXIMIZE PERFORMANCE AND LONG BEARING LIFE.

2- ALL THK LINEAR BEARING BLOCKS MUST BE FILLED WITH LITHIUM SOAP BASED GREASE NO.2 . REFILL GREASE THROUGH THE GREASE FITTING MAKING USE OF GREASE PUMP. THE GREASE LUBRICATION INTERVAL DEPENDS ON THE CONDITIONS OF USE. AS A GUIDELINE FOR GENERAL OPERATIONS, LUBRICATE THK BEARINGS EVERY TWO MONTHS. SEE FIG.1

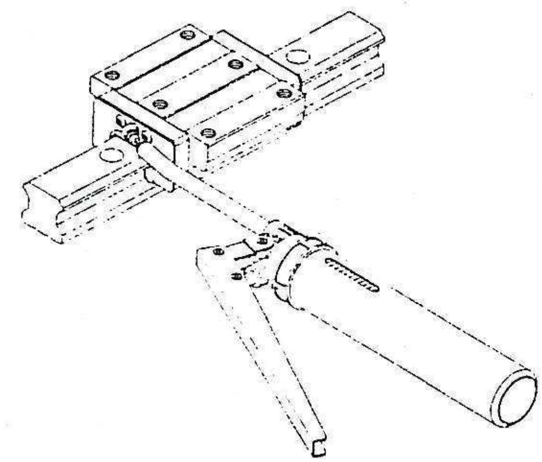


FIG.1

3- USE LITHIUM GREASE TO LUBRICATE ALL BALL BEARINGS INCLUDING: PILLOW BLOCKS, FLANGE BLOCKS, THK BALL-SCREW AND ALL PRESS FIT BEARINGS. SEE FIG.2 .

4- GREASE ALL ROLLER CHAIN ELEMENTS EVERY TWO MONTHS. OIL THE THK LINEAR BEARING X-AXIS AND Y-AXIS RAILS AND BEARING BLOCKS. REMOVE ALL DIRT, DUST AND GRANULATED PARTICLES FROM RAILS. SEE FIG. 3 FOR X-AXIS.

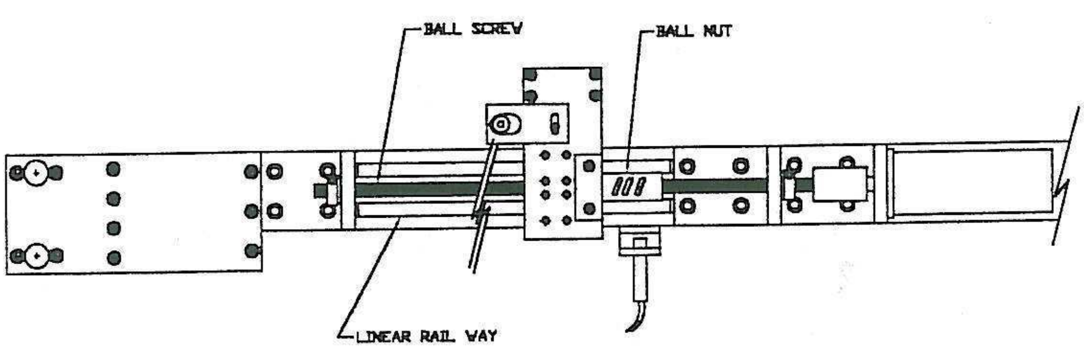


FIG.2

5.18 - CLEANING AND LUBRICATION - Continued

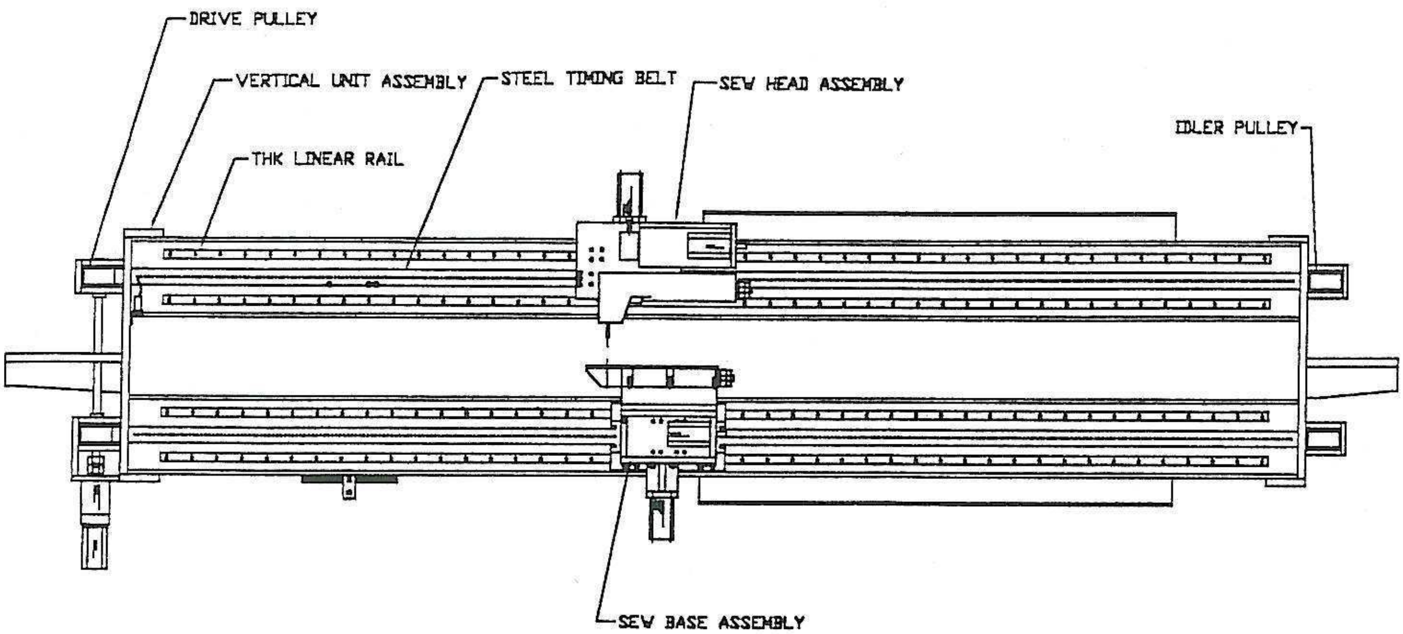


FIG.3

5- AROUND THE HOOK AREA, EXTREME ACCUMULATION OF FINE HAIR OR DUST PARTICLES FROM TOP THREAD AND BOBBIN THREAD TEND TO MIX WITH OIL TO TO CREATE MUD. THIS MUD MATERIAL MAY CAUSE SEWING PROBLEMS; THEREFORE, MAKE USE OF A BRUSH OR AIR JET NOZZLE TO CLEAN THE AREA. CLEAN THIS AREA EVERY FEW HOURS.

6- REMOVE ALL THREAD AND DUST FROM BALL SCREW SEE FIG. 2 . ALSO, REMOVE ALL FOREIGN MATERIAL SUCH AS SCREWS, BOBBIN SHELLS, NEEDLES, THREAD, AND SMALL TOOLS FROM THE MAIN HORIZONTAL AXIS UNIT. SEE FIG. 3 . IF THESE FOREIGN MATERIALS ARE NOT REMOVED FROM MAIN HORIZONTAL UNIT, THE SEW HEAD/BASE UNITS WILL CRASH AND CAUSE STEEL TIMING BELTS FAILURE OR THK BEARING BLOCKS FAILURE. CHECK FOR THESE MATERIALS EVERY FEW HOURS.

7- REMOVE ALL THREAD DUST AND THREAD FROM ALL ROLLER CHAIN ELEMENTS INCLUDING #60 VERTICAL CHAIN, #35 CHAIN, AND #40 CHAIN.

5.19 - PREVENTATIVE MAINTENANCE CHECK LIST

PREVENTATIVE MAINTENANCE CHECK LIST				
FUNCTION	**HOURLY**	**DAILY**	**WEEKLY**	**MONTHLY**
Steel timing belts check for stress on holes (cracks)				x
Check steel timing belts tensioning				x
Steel timing belts check for idler pulley center alignment				x
Check for ware on take up assembly			x	
Check for ware on hook assembly then buff hook		x		
Remove all foreign parts from hook assembly (oil-thread dust)	x			
Lubricate and clean all linear ball bearing blocks				x
Lubricate all roller chain elements			x	
Lubricate bobbin changer bearing surfaces				x
Lubricate clamp bar air cylinder shafts			x	
Lubricate doffer assembly		x		
Lubricate all pillow block, flange, radial bearings				x
Clean all shafts and sprockets from thread dust			x	
Clean and lubricate all cylinder shafts				x
Clean all photo reflective tapes surface			x	
Clean all photo sensors from oil and thread dust			x	
Clean bottom of sew-base unit from oil		x		
Remove all thread from ball bearings, ball-screws and shafts		x		
Install new needle (very 8 hrs.)		x		
Check sew head timing		x		
Check for sew-head unit alignment to sew-base unit			x	
Check for bobbin changer gripper alignment to hook center			x	
Check bobbin case tension		x		
Check tension on all roller chain elements				x
Check valve assembly unit for operation				x
Check for oil level in container for sew-head, base assembly				x
Check for horizontal unit assembly parallelism to base				x
Check for clamp bar parallelism to base				x
Check clamp tension on all shaft couplers				x

5.20 - SETTING THE BOBBIN CHANGER

THIS SECTION WILL INVOLVE PROCEDURES OF ALIGNING THE BOBBIN CHANGER UNIT AND PROPER TENSIONING OF MECHANICAL TIMING ELEMENTS SUCH AS STEEL TIMING BELTS FOR SEW HEAD AND BASE UNITS. ALSO, INCLUDED ROLLER CHAINS. THE FOLLOWING PROCEDURES OF ALIGNING AND TENSIONING OF THESE MECHANICAL ELEMENTS SHOULD BE CONDUCTED ONLY FOR NEW COMPONENT INSTALLATIONS. PLEASE NOTE THAT THESE MECHANICAL ELEMENTS ARE SET PROPERLY AT FACTORY DURING COMPLETE ASSEMBLY OF MACHINE BEFORE SHIPPING.

THE FOLLOWING PROCEDURE WILL INVOLVE PROPER ALIGNMENT OF THE BOBBIN CHANGER GRIPPER UNIT. THE OBJECTIVE IS TO ACHIEVE OVERLAPPING OF GRIPPER CENTER LINE TO HOOK ASSEMBLY SHAFT AXIAL CENTER LINE :

1- THE THREE COMPONENTS TO MOVE TO PROPER ALIGNMENT LOCATION ARE M-1000-143, M-1000-144 AND M-1000-145. SEE FIG.4 FOR ASSEMBLY LAYOUT.

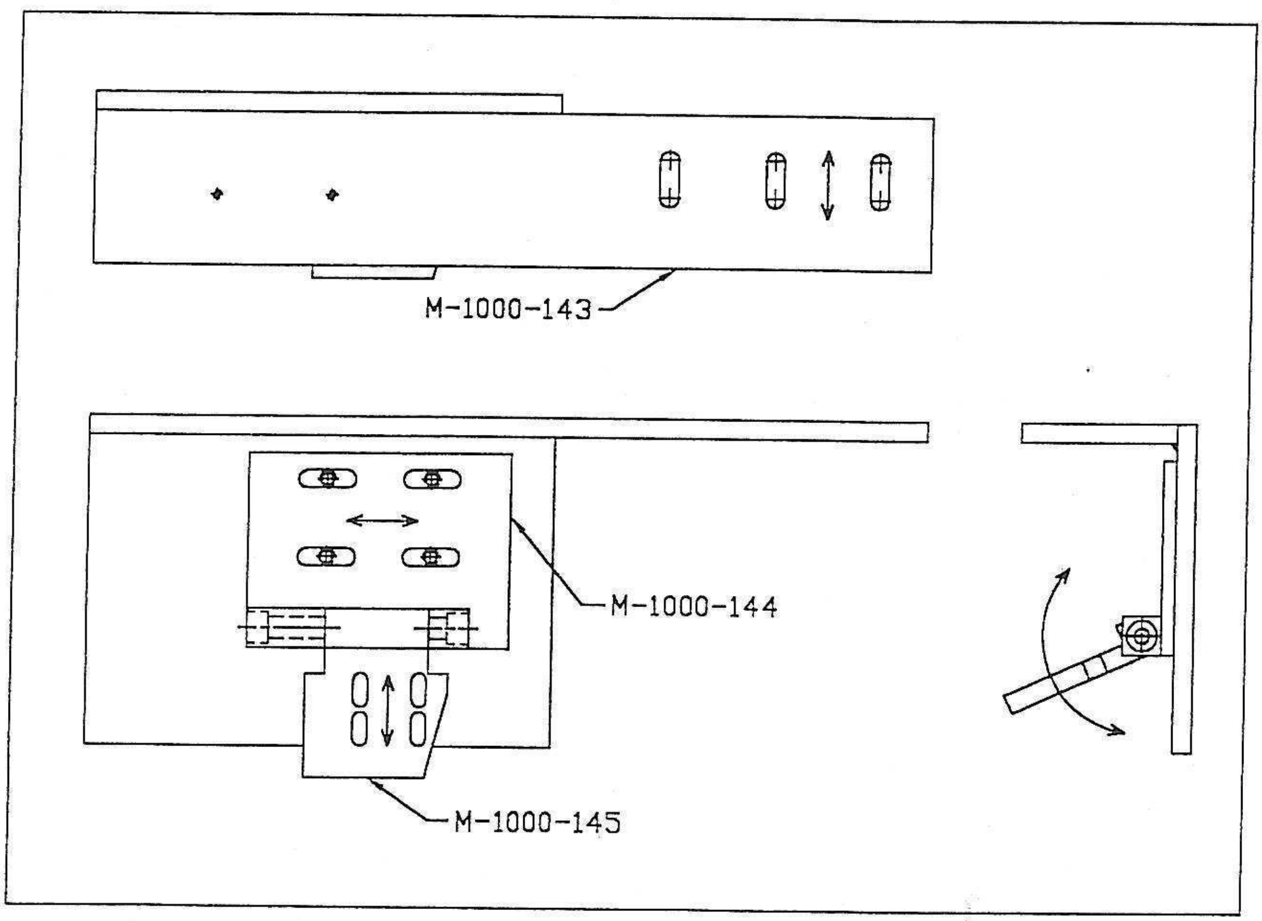


FIG.4

5.20 - SETTING THE BOBBIN CHANGER - Continued

A- PART M-1000-143 SHOULD BE MOVED IN THE DIRECTION OF ARROW MAKING USE OF THREE SLOTS ON TOP. GENERALLY, ENSURE FRONT SURFACE OF M-1000-143 TO BE FLUSH WITH SEW BASE UNIT. THIS AXIS DISPLACEMENT WILL ENSURE PARTIAL CENTER LINE ALIGNMENT.

B- PART M-1000-144 SHOULD BE MOVED IN THE DIRECTION OF ARROW ; GENERALLY, TO THE RIGHT. THIS DISPLACEMENT WILL ENSURE BOBBIN GRIPPER HAVING ENOUGH STROKE TO LOAD BOBBIN INTO HOOK ASSEMBLY.

C- PART M-1000-145 HAS TWO AXIS OF MOTION. ONE BEING THE ROTATION AXIS AS NOTED BY ARROW FROM SIDE VIEW AND THE OTHER BEING LINEAR DISPLACEMENT AXIS. GENERAL ROTATION SHOULD BE AT 15-20 DEGREES FROM 180 DEGREES CENTER AXIS LINE. THE LINEAR DISPLACEMENT SHOULD BE AT CENTER OF FOUR SLOTTED HOLES. THESE TWO AXIS OF MOVEMENT WOULD PLACE THE PARTIAL CENTER LINE OF BOBBIN GRIPPER TO HOOK SHAFT CENTER LINE.

D- AFTER LOCATING ALL GRIPPER AXIS CENTER LINE TO HOOK CENTER LINE, ALL BOLTS MUST THEN BE TIGHTENED.

2- THE LOADING PROCESS OF BOBBIN INTO BOBBIN CASE INVOLVES THREE STEPS. THESE STEPS ENSURE ACCURATE LOADING AND MAY HELP DETECT BAD BOBBINS.

A- CHECK TO SEE IF BOBBIN UNWINDS SMOOTHLY BY PULLING ON LEAD THREAD. THE THREAD SHOULD NOT BE WOUND IN BETWEEN THREAD WINDINGS AND PAPER DISKS. THIS SITUATION WILL CAUSE UNNECESSARY TENSION ON THREAD AND WILL LEAD TO THREAD BREAK.

B- INSERT BOBBIN INTO BOBBIN CASE THEN APPLY TENSION TO BOBBIN BY MAKING USE OF TWO FLAT HEAD SCREWS ON BOBBIN CASE. APPLY EQUAL TENSION ON ALL BOBBIN CASES. IF TENSION VARIES BY A LARGE UNIT NUMBER FROM ONE BOBBIN CASE TO ANOTHER, THEN THIS SITUATION WILL CAUSE THREAD BREAK.

C- AFTER THE LOADING OF BOBBIN INTO BOBBIN CASE, PULL ON THE LEAD THREAD TO CHECK FOR STICKING OR COGGING EFFECTS. CLEARLY, THE BOBBIN SHOULD UNWIND SMOOTHLY INSIDE THE BOBBIN CASE. IF NOT, THEN THE BOBBIN THREAD HAS TOO MUCH GLUE, THE WINDING PROCESS WAS EXTREMELY OVER TENSIONED, OR THE SIDE PAPER DISKS ARE NOT TO RIGHT DIAMETER AND CAUSE UNWANTED FRICTION DURING SEWING PROCESS. SEE FIG. 6 .

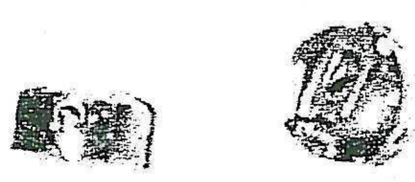


FIG.6

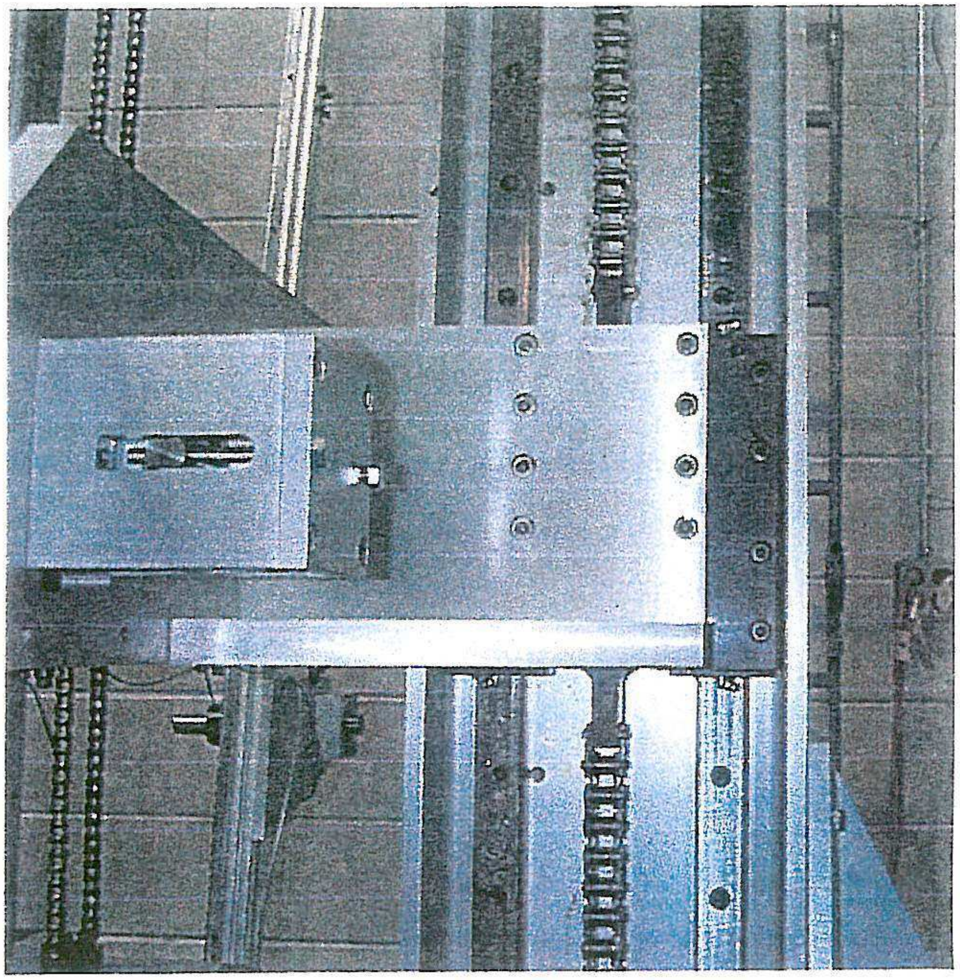


FIG. 5

8- WITH A CLEAN RAG, REMOVE ALL MATERIALS SUCH AS OLD GREASE OR FABRIC DUST FROM LINEAR RAILS AND ROLLER CHAINS. THEN APPLY LITHIUM GREASE ON RAIL SURFACES AND ROLLER CHAIN ELEMENTS. PERFORM THIS STEP EVERY TWO WEEKS. SEE FIG. 5 .

5.21 – TENSIONING THE TIMING BANDS

THE FOLLOWING PROCEDURE WILL INVOLVE ACCURATE TENSIONING AND ALIGNING OF STEEL TIMING BELTS. ON A COMMON DRIVE, THE UNIT LOAD LEVEL AND EQUAL TENSIONING BETWEEN TWO STEEL TIMING BELTS ARE THE MOST IMPORTANT VARIABLES WITH RESPECT TO MECHANICALLY SLAVING SEW HEAD ASSEMBLY TO SEW BASE ASSEMBLY, SEE FIG. 7A. THIS DESIGN ENSURES THE SYSTEM TO BE WITHIN +/- 0.001 IN. DURING NORMAL ACCELERATION AND DECELERATION MOTION. FURTHERMORE, ANOTHER IMPORTANT VARIABLE IS ALIGNMENT OF CENTER LINE OF STEEL BELT TO IDLER PULLEY CENTER LINE, SEE FIG. 7B AND 7C. FOR TENSIONING LAYOUT, SEE FIG. 7D.

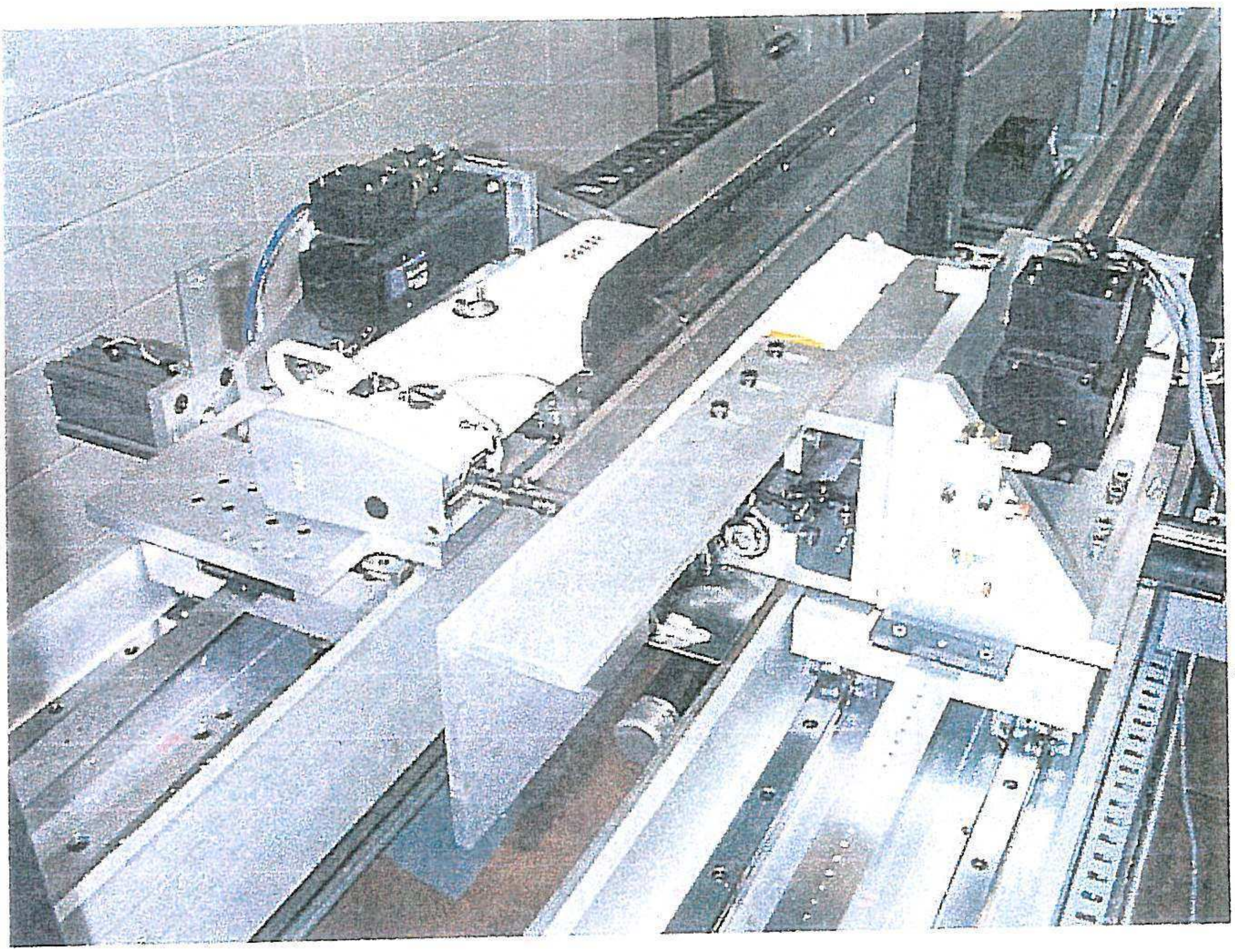


FIG. 7A

5.21 – TENSIONING THE TIMING BANDS - Continued

1- INSTALLING NEW STEEL BELT REQUIRES THE INSERTION OF THE PUNCHED HOLES SECTION OF BELT INTO RIGHT SIDE OF SEW HEAD ASSEMBLY. MAKE USE OF TWO 1/4-20 x 3/4 SHCS AND ONE 6-32 x 1/2 SHCS TO COUPLE BELT TO SADDLE PLATE. SEE FIG. 7A .

2- FEED THE STEEL BELT OVER THE DRIVE PULLEY IN BETWEEN THE SLOTS MACHINED ON THE SIDE PLATES. ENSURE THAT THE BELT IS FED THROUGH THE TOP SLOT FIRST, THEN OVER THE TOOTHED PULLEY; FINALLY, THROUGH BOTTOM SLOT. THEN FEED THE BELT THROUGH OTHER END BOTTOM SLOT, OVER THE IDLER PULLEY AND THROUGH TOP SLOT. INSERT THE NON-HOLE PUNCHED END INTO LEFT HAND SIDE OF SEW HEAD ASSEMBLY. SEE FIG. 7B AND 7C. NOTE THAT BOTH STEEL BELTS HAVE AN ARROW MARK ON THEM. THESE ARROWS MUST POINT TO SAME DIRECTION. THE TWO SIDES OF A STEEL BELT ARE NOT EQUAL IN LENGTH DUE TO HAVING A PROFILE OF A CONE AND NOT A PERFECT CYLINDER.

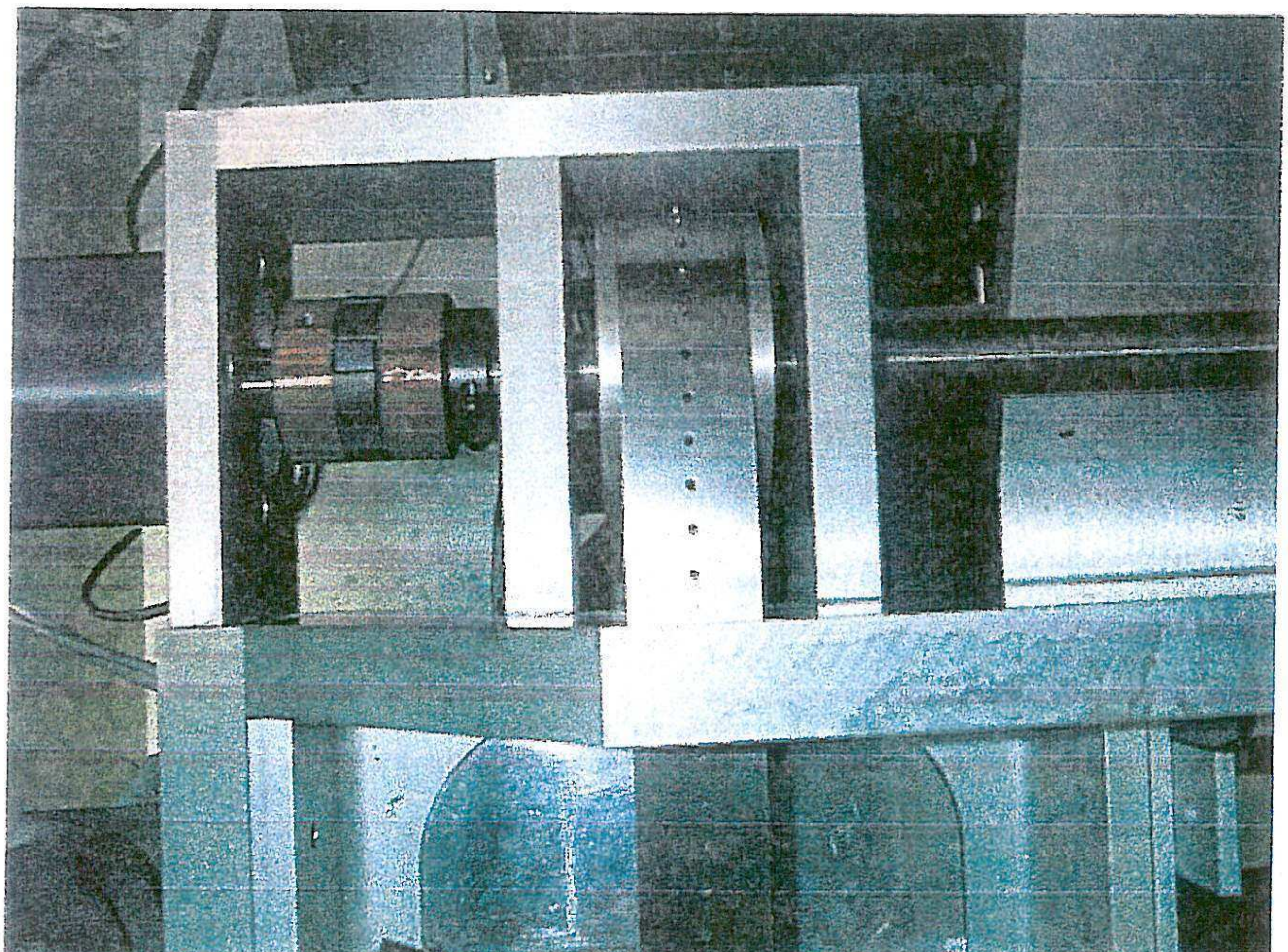


FIG. 7C

5.21 – TENSIONING THE TIMING BANDS - Continued

3- BEFORE PERFORMING STEP #2, ENSURE THAT THE IDLER PULLEY'S TWO 5/16-18 HEX HEAD BOLTS ARE COMPLETELY LOOSE. THESE BOLTS ARE DESIGNED FOR TENSIONING THE SYSTEM. ALSO, MAKE SURE THAT BELT CENTER IS IN LINE WITH IDLER PULLEY CENTER. SEE FIG. 7B.

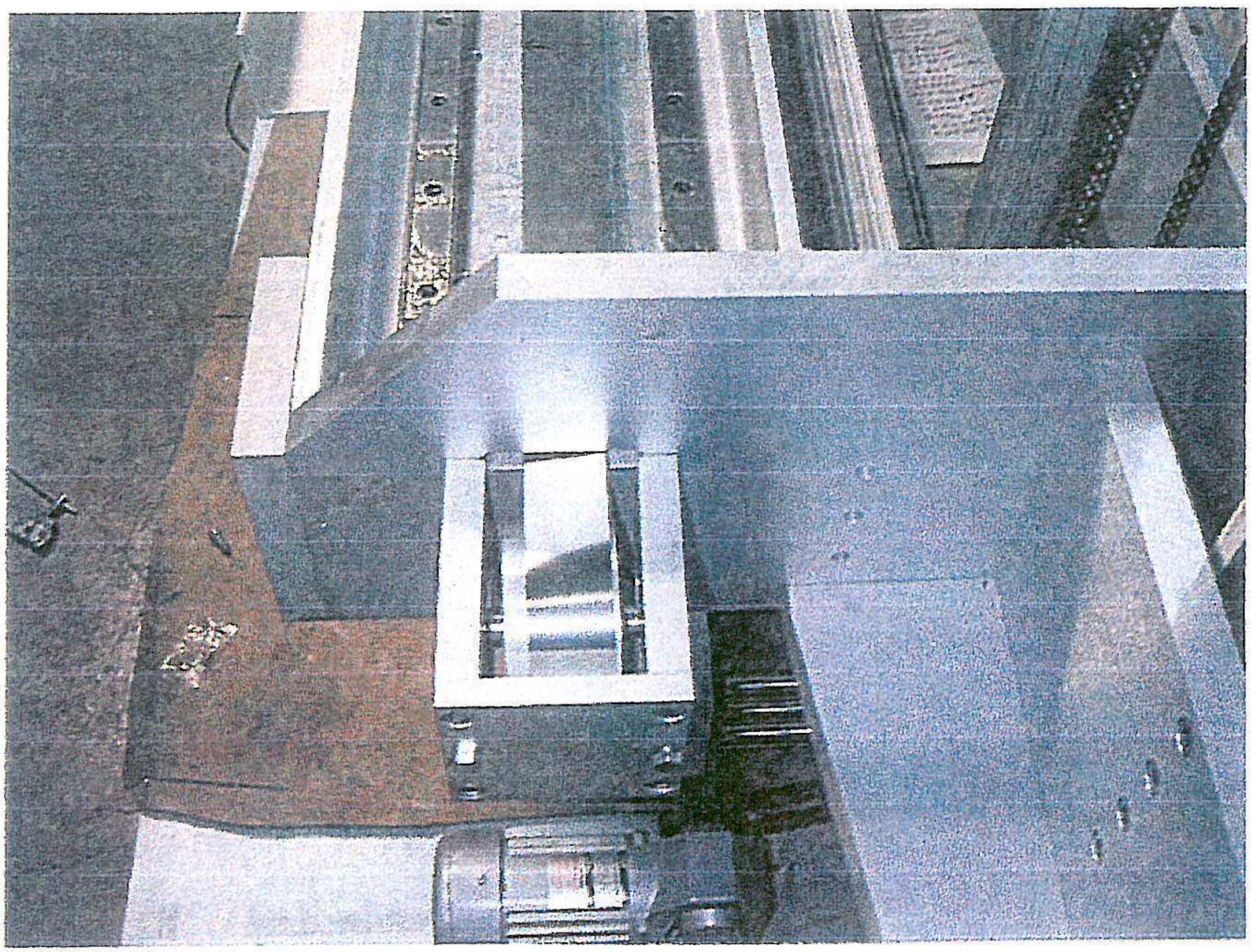


FIG. 7B

4- REPEAT STEPS 1, 2, AND 3 FOR INSTALLING SEW BASE ASSEMBLY STEEL TIMING BELT.

5- AT THIS POINT, ENSURE THAT SEW HEAD ASSEMBLY IS IN LINE WITH SEW BASE ASSEMBLY. THE NEEDLE MUST BE IN THE CENTER OF ALIGNING PLATE HOLE, SEE FIG. 7D. SINCE THE TIMING BELTS ARE LOOSE, CHOOSE ONE OF THE ASSEMBLIES TO MOVE. THE TIMING BELT HOLES SHOULD SKIP OVER THE DRIVE PULLEY TEETH. SEE FIG. 7C.

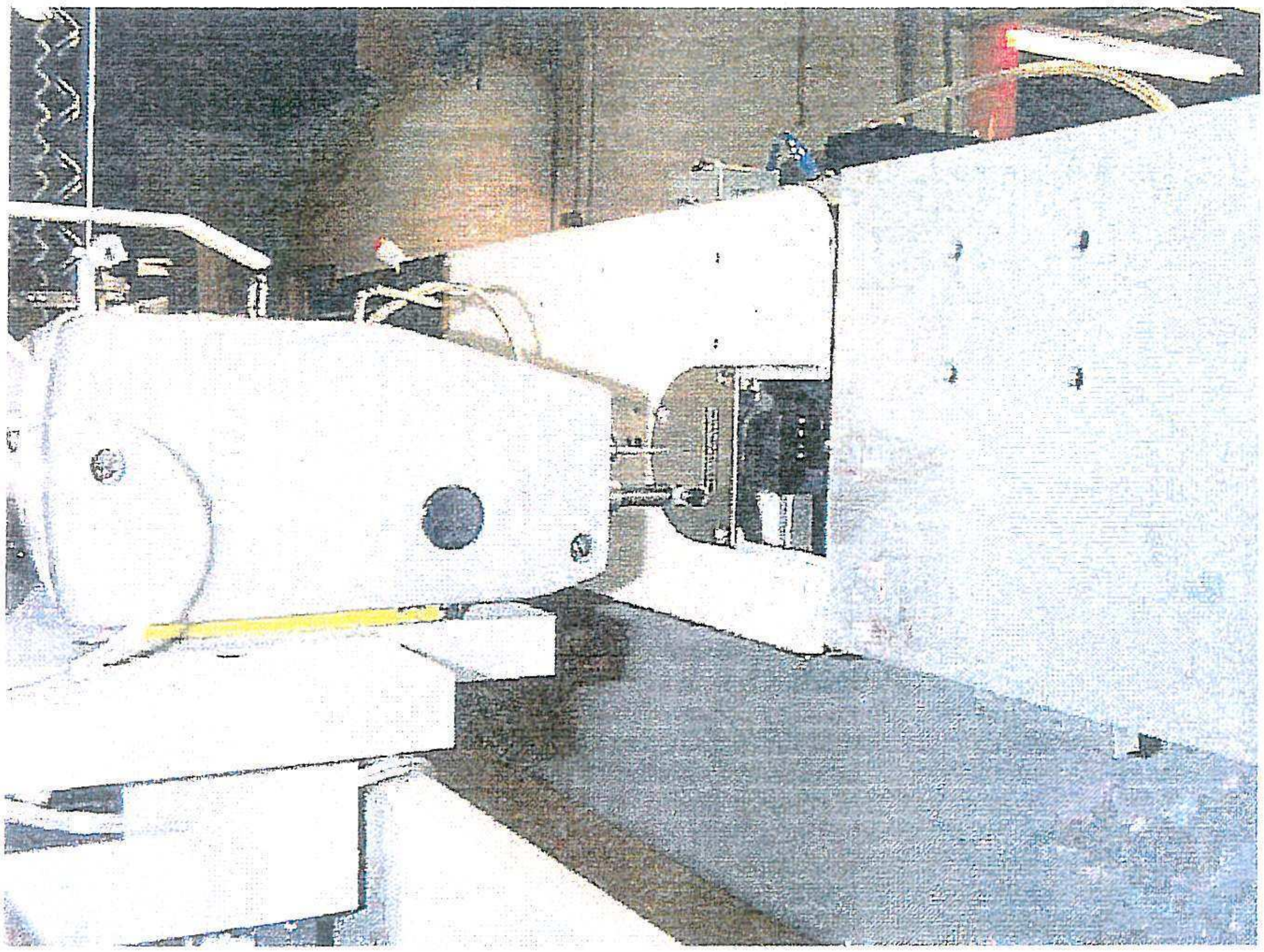


FIG. 7D

6- SEE FIG. 7E FOR LAYOUT. APPLY LITTLE TENSION JUST ENOUGH TO ELIMINATE SOME OF THE SLAG FROM BOTH STEEL TIMING BELTS. MAKE USE OF THE TWO 5/16 HEX HEAD SCREWS. THEN MANUALLY JOG THE SEW BASE ASSEMBLY TO ABOUT 75 IN. FROM DRIVE UNIT SIDE. MEASURE 37.50 IN. FROM SAME SIDE AND APPLY A UNIT FORCE OF ONE POUND ON THE CENTER OF STEEL TIMING BELT. THEN RECORD UNIT MEASUREMENT X-DIM. THIS DIMENSION SHOULD BE WITHIN 1/4 IN. DEFLECTION. APPLY ENOUGH TORQUE ON EACH BOLT TO ACHIEVE THIS DEFLECTION.

7- IT IS EXTREMELY CRITICAL TO HAVE BOTH STEEL TIMING BELTS AT THE SAME DEFLECTION LEVEL. THEREFORE, REPEAT THE STEP #6 FOR SEW HEAD ASSEMBLY. THE ASSUMPTION IS MADE THAT IF AND ONLY IF BOTH STEEL TIMING BELTS HAVE EQUAL DEFLECTION, THEN THEY MUST HAVE EQUAL TENSION. THIS MECHANICAL SLAVING SYSTEM IS A FUNCTION OF EQUAL TENSIONING VARIABLE.

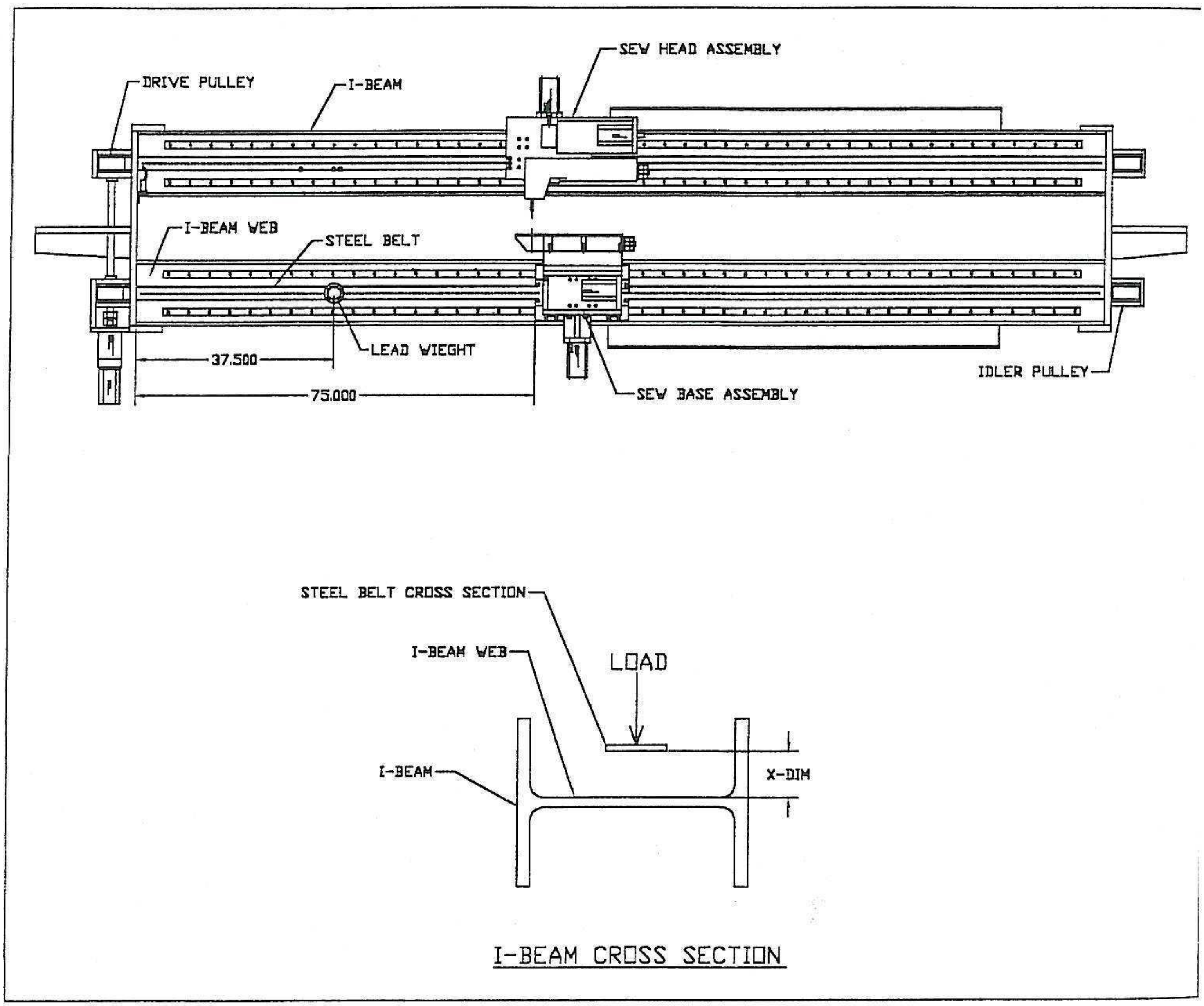


FIG. 7E

8- WHEN THE 1/4" DEFLECTION IS ACHIEVED ON BOTH ASSEMBLIES, THEN JOG THE SYSTEM FORWARD AND BACKWARD FOR ENTIRE STROKE OF THE MACHINE. YOU WILL NOTICE THE STEEL TIMING BELTS SHIFTING ON THE IDLER PULLEYS. THIS IS DUE TO TIMING BELTS FORMING A CONE PROFILE WHERE THE SIDES OF EACH BELT ARE AT DIFFERENT LENGTHS. TO CENTER THE STEEL TIMING BELTS, MAKE USE OF THE TWO 5/16 HEX HEAD SCREWS. SEE FIG. 8.

9- IF THE BELT SHIFTS TO THE RIGHT ON THE IDLER PULLEY, THEN APPLY AN 1/8 OF A TURN CLOCK WISE ON THE RIGHT 5/16 HEX HEAD SCREW OR AN 1/8 OF A TURN COUNTER-CLOCK WISE ON THE LEFT 5/16 HEX HEAD SCREW. THIS PROCESS WILL CENTER THE BELT TO PULLEY. NOTE THAT IF THE BELT IS NOT CENTERED TO PULLEY, THEN THE BELT WILL SHIFT EITHER TO THE FAR RIGHT OR LEFT; FINALLY, CAUSING A GROOVE ON THE SIDE WALLS. THIS WILL LEAD TO UNWANTED EXTERNAL FORCE ON EITHER SEW HEAD OR BASE ASSEMBLY. THIS SITUATION MAY CAUSE TOP THREAD BREAK OR NEEDLE BREAK.

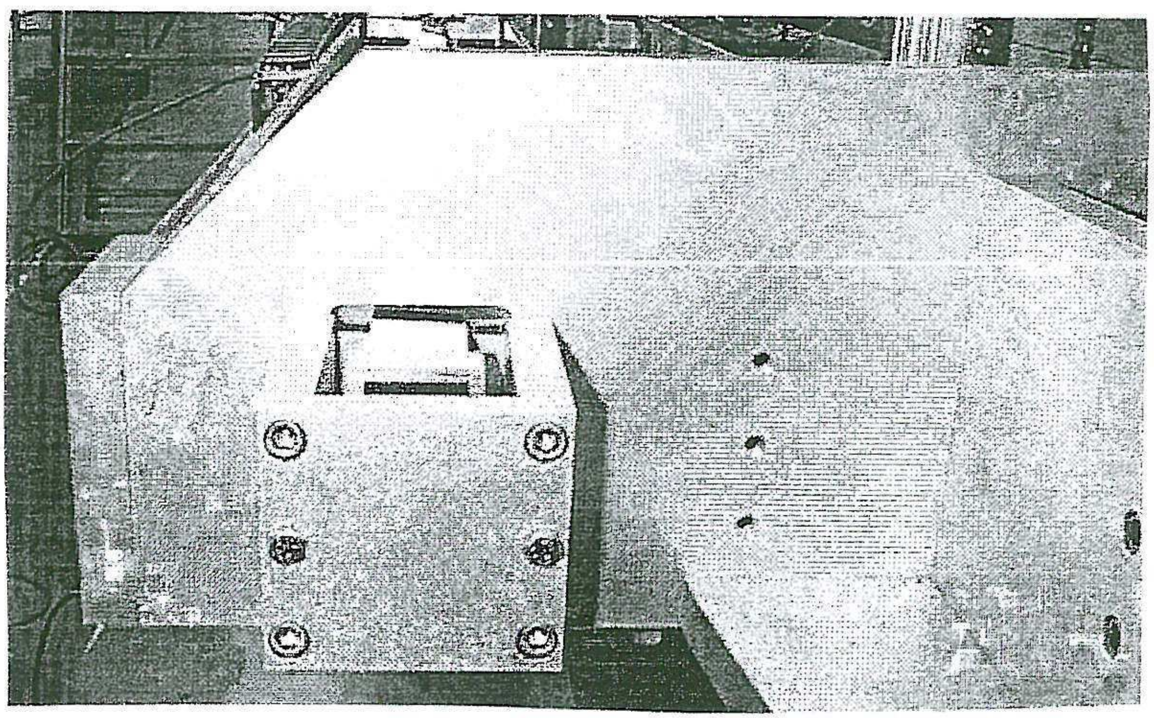


FIG. 8

5.22 - CHANGING Y-DRIVE SPROCKETS

THIS SECTION WILL INVOLVE PROCEDURE TO PROPERLY TENSION #60 ROLLER CHAIN FOR THE VERTICAL I-BEAM DUE TO SPROCKET REPLACEMENT. SEE FIG. 9 AND FIG. 10.

1- THE VERTICAL I-BEAM MECHANISMS SUPPORT AND APPLY MOTION TO THE HORIZONTAL UNIT ASSEMBLY (BRIDGE) IN THE VERTICAL DIRECTION. TO CHANGE THE TOP IDLER SPROCKET, YOU MUST SUPPORT THE BRIDGE BY MAKING USE OF FORK TRUCK. NEVER APPLY FORKS TO THE CENTER OF BRIDGE TO LIFT THE MECHANISM WHEN BOTH ENDS OF BRIDGE ARE FIXED TO VERTICAL I-BEAM SADDLES. ALWAYS SUPPORT BRIDGE FROM EXTREME ENDS. SEE FIG. 9. ALSO, NEVER WALK ON BRIDGE. THE BRIDGE IS HIGHLY PRECISION MACHINED STRUCTURE; THEREFORE, NO EXTERNAL HEAVY LOADS SHOULD BE APPLIED.

FIG. 9

2- THERE ARE FOUR 1/2-20 HEX HEAD SCREWS, TWO 5/16-18 HEX HEAD SCREWS, TWO FLANGE MOUNT PILLOW BLOCK BEARINGS, AND QD SPROCKET. LOOSEN 1/2 HEX SCREWS, THEN LOOSEN 5/16 HEX SCREWS AND SET SCREWS ON PILLOW BLOCK BEARINGS. AT THIS POINT, THE #60 CHAIN IS LOOSE AND ONE END OF BRIDGE IS RESTING ON FORKS. LOOSEN QD SPROCKET, THEN SHIFT THE SHAFT TO ONE END AND REMOVE THE SPROCKET. SEE FIG. 10 .

3- INSTALL A NEW SPROCKET, SHIFT BACK THE SHAFT INTO THE PILLOW BLOCK BEARING. TIGHTEN THE SET SCREWS TO FIX THE SHAFT IN POSITION. LOCATE THE CENTER OF SHAFT AND TIGHTEN THE QD SPROCKET TO CENTER LINE OF MECHANISM. TENSION THE #60 CHAIN BY APPLYING TORQUE CLOCK-WISE ON 5/16 HEX HEAD SCREWS. THE RIGHT TENSION WOULD BE REACHED WHEN THE CENTER OF CHAIN HAS THE FREEDOM TO MOVE SIDE TO SIDE BY 1/2". CENTER OF CHAIN IS DEFINED TO BE FROM TOP SHAFT CENTER TO THE TOP OF VERTICAL I-BEAM SADDLE. SEE FIG. 10.

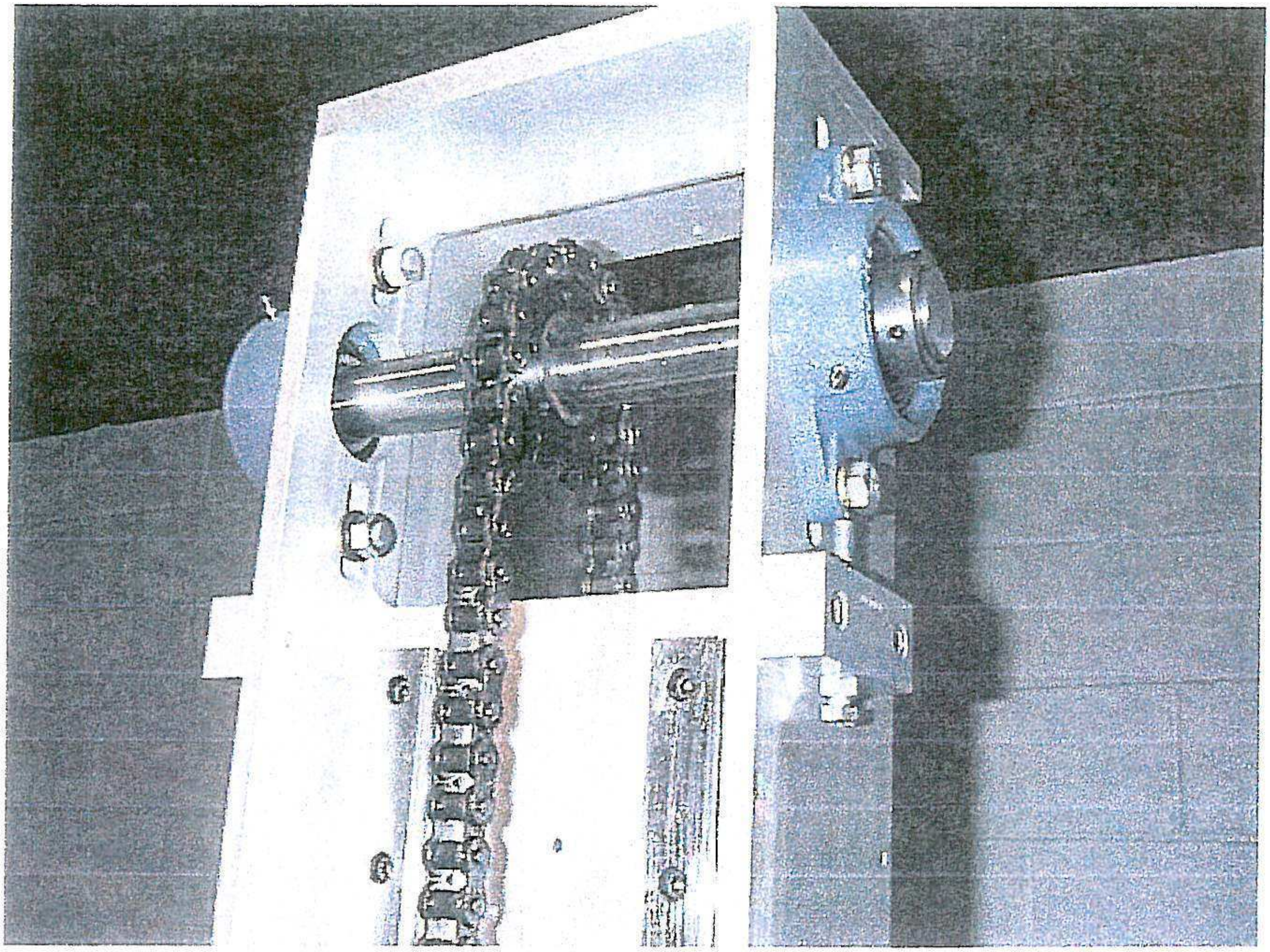


FIG. 10

4- WHEN PROPER CHAIN TENSION IS ACHIEVED, TIGHTEN FOUR 1/2 HEX HEAD SCREWS AND LOCK THE 5/16 SCREWS BY MAKING USE OF LOCK NUT INCLUDED.

5.23 - ALIGNING RACKING SYSTEM

THIS SECTION INVOLVES PROCEDURE TO ALIGN RACKING BAR (CLAMP BAR) TO BE PARALLEL TO ROBO BASE. ALSO, ADJUSTING PROPER TENSION ON RACKING BAR CONVEYOR #40 CHAIN. THIS PROCEDURE SHOULD BE PERFORMED WHEN NEW CHAIN IS REQUIRED OR DURING JAM UP SITUATIONS. SEE FIG. 11

1- DURING NEW INSTALLATION OF NEW CLAMP BAR OR JAM UP SITUATIONS, THE FRONT DRIVE SHAFT COUPLES THE RIGHT SIDE RACKING UNIT WITH LEFT SIDE. THERE ARE TWO SHAFT COUPLERS, ONE ON EACH END, LOOSEN ONLY ONE SIDE MAKING USE OF TWO 1/4-20 SHCS TO DECOUPLE THE TWO RACKING SIDES. SINCE BOTH SIDES ARE NO LONGER MECHANICALLY SLAVED, MEASURE X-DIM FROM BASE TO CLAMP BAR AT BOTH ENDS BEING EQUAL. THIS WILL ENSURE PARALLELISM OF PRODUCT TO ROBO SEWING PLANE OF REFERENCE.

2- AFTER BOTH ENDS HAVE THE SAME X-DIM, THEN TIGHTEN THE TWO 1/4-20 SCREWS ON THE SHAFT COUPLER.

3- TO ENSURE PROPER CHAIN TENSION ON RACKING BAR CONVEYOR CHAIN, LOOSEN GROUP OF FOUR 1/4-20 SCREWS, BOTH ENDS. THEN MOVE BACK THE FRONT SECTION OF RACKING UNIT BY TURNING CLOCK-WISE CENTER SCREW OF PLATE #M-1010-038 AND TURNING COUNTER CLOCK-WISE THE TWO OUTER SCREW. ROTATE SCREWS UNTIL ALL CHAIN DEFLECTION HAS BEEN REMOVED. WHEN PROPER TENSION HAS BEEN REACHED THEN TIGHTEN GROUP OF 4 SCREWS ON BOTH ENDS.

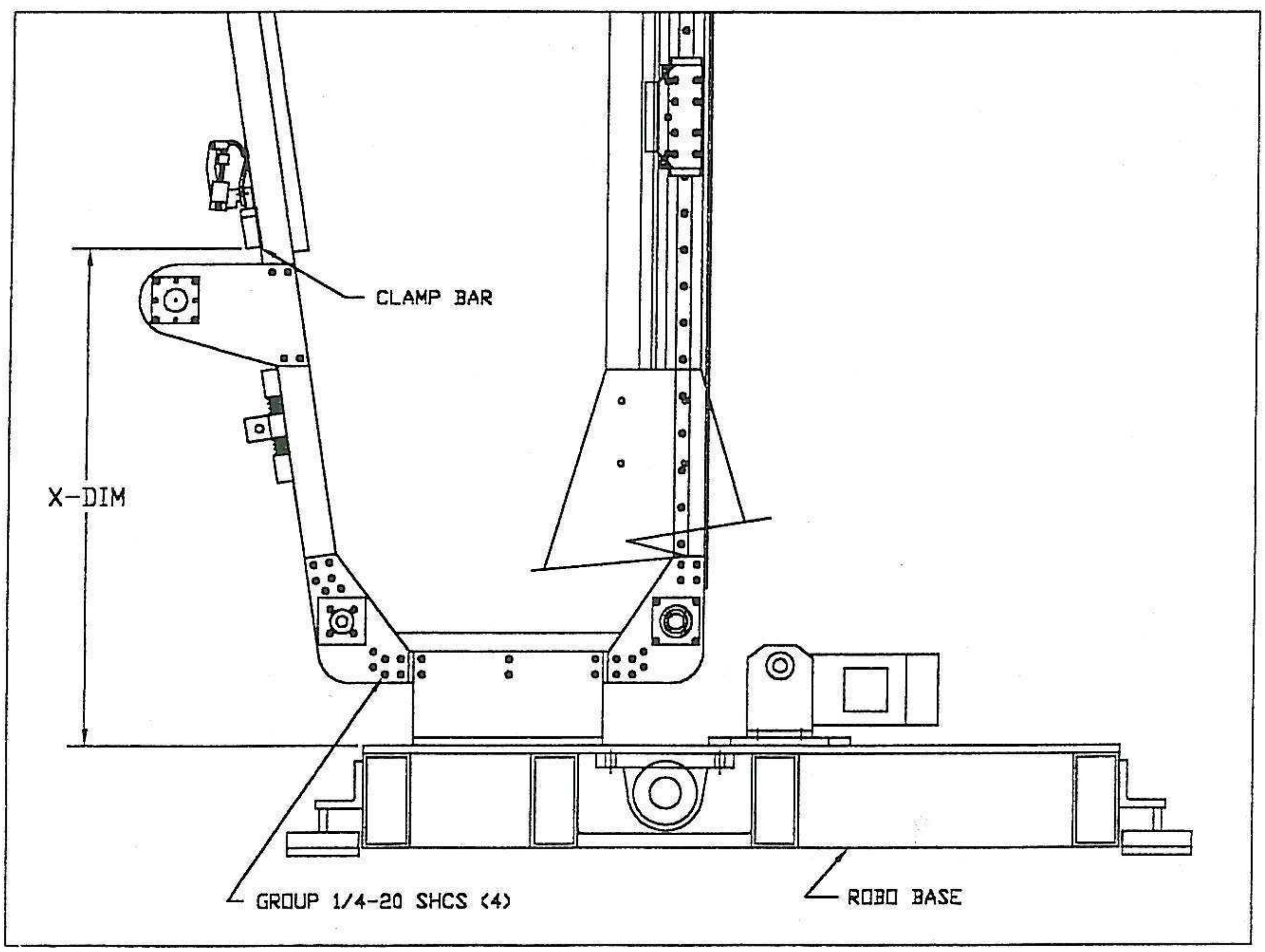


FIG.11

PFAFF 483

As used on 'ROBO' Quilter

SEWING INSTRUCTION

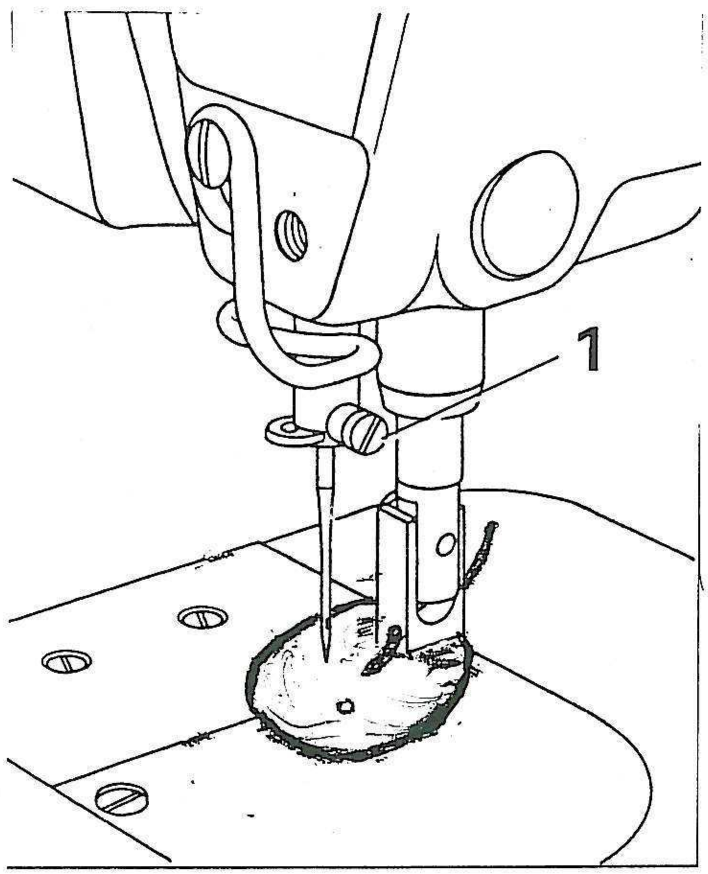
MANUAL

Inserting the needle:

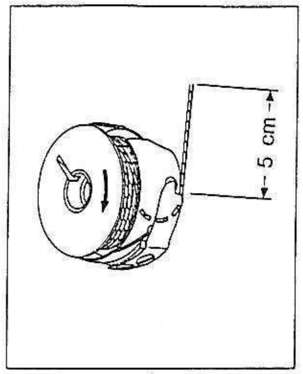
Currently ABM is recommending the use of the Singer MR-4 needle.
Bring the needle bar to its highest point – Note the machine is usually in the needle up position when at the re-threading position.

Loosen the needle set screw 1. Insert the needle and push it up as high as it will go. Tighten the needle securely.

Note:
DO NOT USE A WORN NEEDLE BAR SCREW. Replace the screw when it shows signs of wear. Use only a quality screwdriver to tighten and loosen this screw.



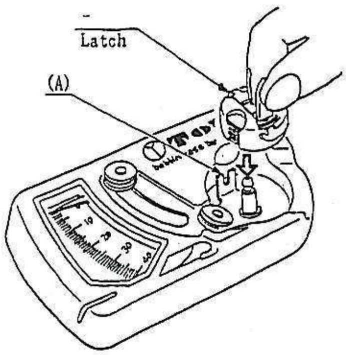
Threading the Bobbin Case:

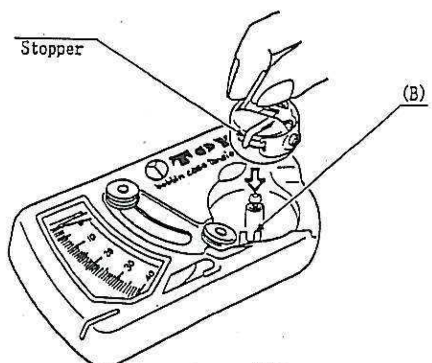


It is recommended that you set the tension using ABM's bobbin case tension guide. See below
A setting of approximately 20 on the scale will suffice for most quilting operations. Adjust as needed and make sure that all the bobbin cases in your machines are set the same.

① Setting of Bobbin case

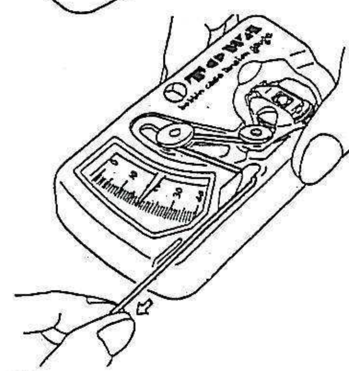
Set threaded bobbin in bobbin case and pull the thread out of the tension spring.
Put the bobbin case on the bobbin case set position.
The pointed-end of the bobbin case Latch or Stopper has to meet the groove (A) or (B) of the Thread Guide.

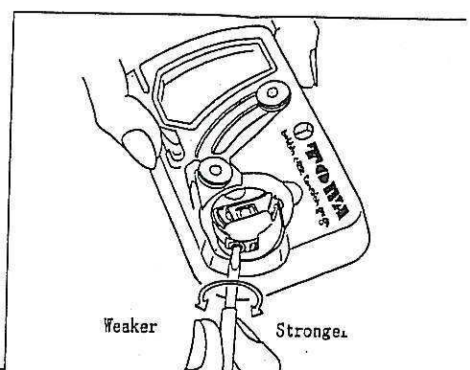




② How to pull the thread

After setting the bobbin case, the instructions are the same for all types.
After threading through No.1 and No.2 pulley, pull the thread lightly to the direction of the ARROW. At the same time check the graduations of the Gauge Indicator.



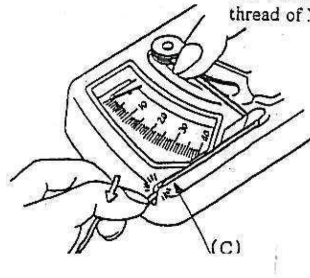


③ Adjustment of thread tension

If the thread tension is too strong or weak, adjust the tension by turning the tension adjusting screw to the right (stronger) or left (weaker).

④ Cutting of odd thread

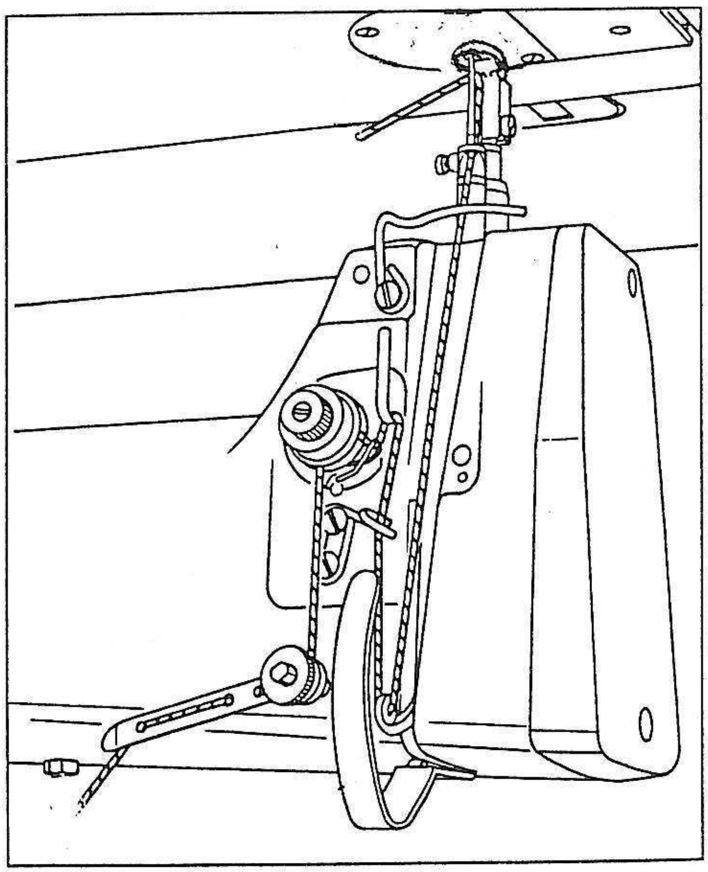
After measuring and adjusting the thread tension, cut out the odd thread with the Thread Cutter (C), pressing the odd thread of No.2 pulley with your finger.



Threading the needle:

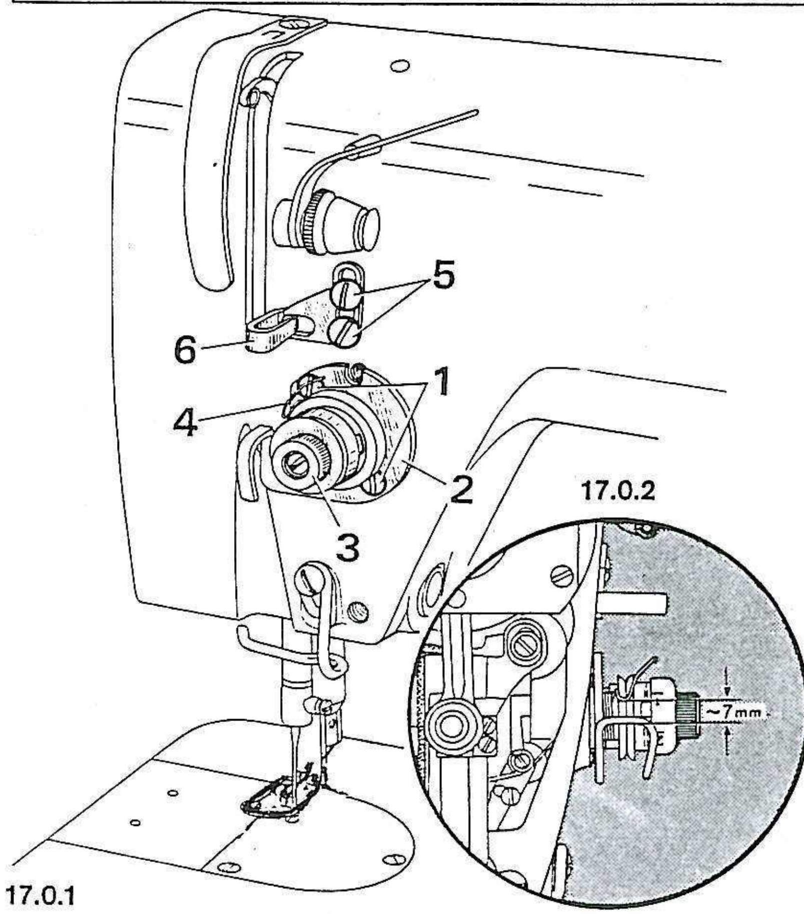
Set the take-up lever to its highest point. This point is usually set automaticaly when the sewing head is in the re-thread position..

Thread the needle, as illustrated in the drawing below. Thread the needle from the right to the left, pulling 6 cm of thread through the needle eye.



Setting the tension and adjusting the check spring:

The stroke of the thread check spring should be 5 to 7 mm (Fig. 17.0.2). This stroke and the position of thread regulator 6 is dependent on the type of thread and material used and should be adjusted according to the appearance of the seam.



17.0.1

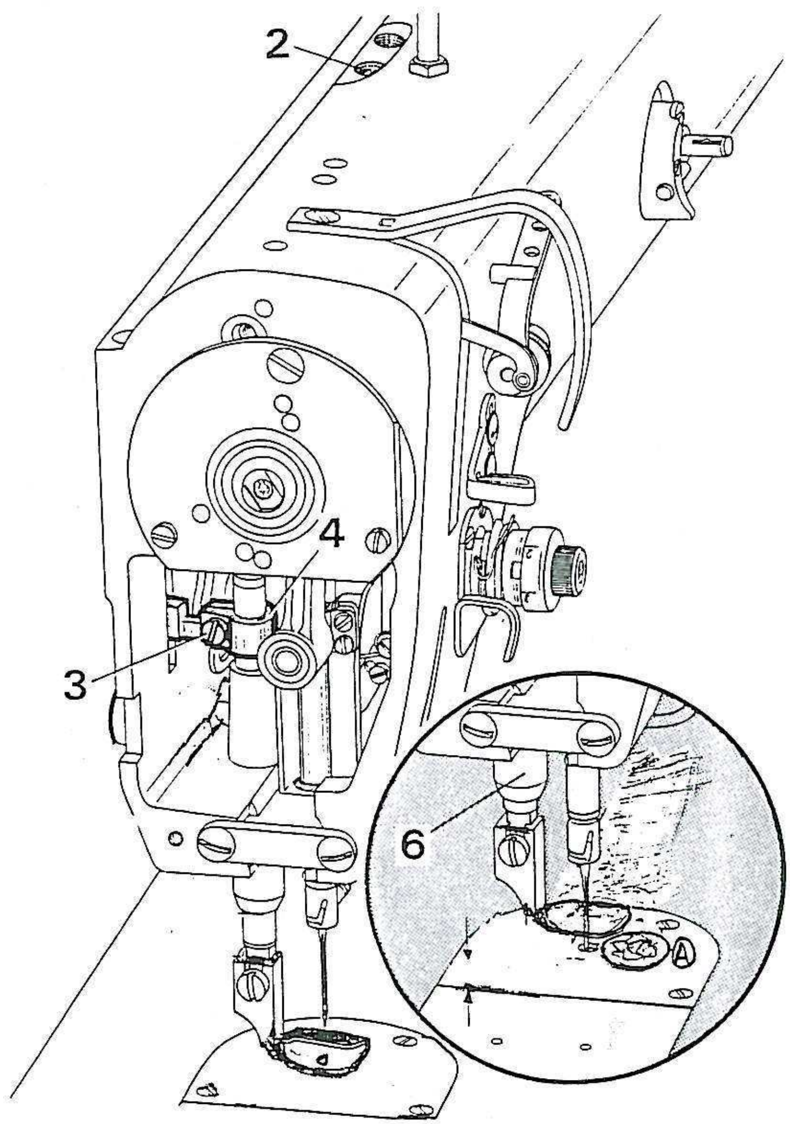
Loosen both screws 1 of thread tension flange 2 just sufficiently to allow tension barrel 3 to be turned in the tension flange.
Turn tension barrel 3 until the stroke of the thread check spring amounts to 5 - 7 mm (Fig. 17.0.2).
In this position, tighten both screws 1 of tension flange 2 evenly (by tightening them alternately). Special sewing operations may make it necessary to set the thread check spring for a shorter or longer stroke.
Check this adjustment (see "Correct setting").
Loosen both screws 5 of thread regulator 6.
Push thread regulator 6 up as far as it will go (Fig. 17.0.1).
In this position, tighten both screws 5. (The position of the thread regulator is dependent on the type of thread and material used and should be adjusted according to the appearance of the seam.)

For most quilting requirements it is usually best to set the check spring at approximately 10:00 position and adjust the tension for the lightest possible consistent with a snappy return when pulled down. The tension should be initially adjusted so as to pull the check spring through its complete arc as the thread is pulled tru the needle eye. Adjust as needed to achieve a good stitch.

Setting the clearance between the needle plate and pressure cup And ADJUSTING THE TENSION:

Place a nickel coin under the pressure cup. See inset (a).
With pressure cup resting on the nickel loosen screw #3 and push the pressure bar holding clamp down until it rests on the pressure bar bushing. Tighten the clamp screw #3.

Adjust the main spring tension for the pressure cup by adjusting the screw #2.
In general a soft spring tension is most desirable. Adjust when sewing to control pleating and skipped stitching.



Setting the needle bar height, hook timing and hook-to-needle clearance:

To make this adjustment easier ABM has made three gauges available:

(a) Special pin gauge used to insert in hole#4 in bearin-plate.

(b) Special needle height setting gauge to determine the needle bars lowest position.

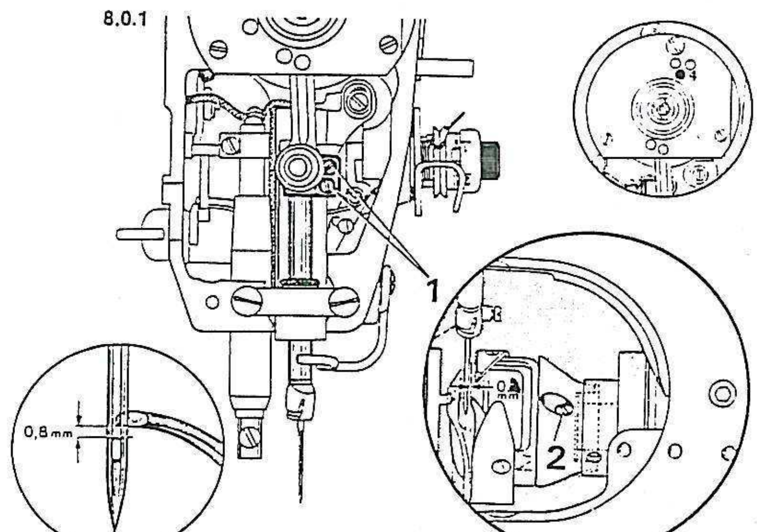
(c) Special plastic shim used to set the needle hook point spacing.

g

To set the lowest position of the needle bar, insert the gauge (b) in place of the bobbin case. Install a new needle. Loosen the screws at #1 to maintain a slight drag on the needle bar.

Rotate the handwheel in the normal direction of travel until the needle touches the gauge. Continue to rotate pushing the needle bar up until the needle bar starts to rise. Tighten the screws #1. If the needle does not touch off the gauge pull the needle bar down a bit and repeat the process above. Remove the gauge. Now insert the gauge pin and follow the direction at 8.1.

Correct setting: When the needle bar is positioned 1.8 mm past the bottom of its stroke (pin in hole 4) the top edge of the needle eye should be positioned 0.8 mm below the bottom edge of the hook point (Fig. 8.0.3). In this position, there should be a max. clearance of 0.1mm between hook point and needle (Fig. 8.0.2).



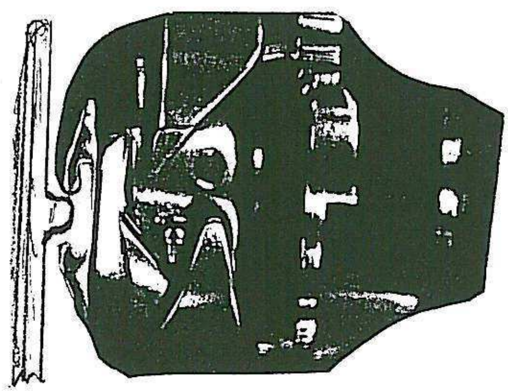
8.0.3 8.0.2

8.1 Position the hook point as shown in **8.0.3.**
Use the plastic shim guide provided in your timing kit to set the needle hook spacing. see 8.0.2
Adjust the sewing hook laterally until there is a smooth slide fit between the hook point and the clearance cut of the needle with your plastic shim.
Gently lock the screw at 2 in **8.0.2.** REMOVE THE TIMING PIN.
Rotate the hook to the next screw and tighten. Rotate back and tighten the first screw.
Note: measurements shown in 8.0.2 and 8.0.3 are for reference only.

This timing set-up is based on the use of an MR4 needle (135x5) length.

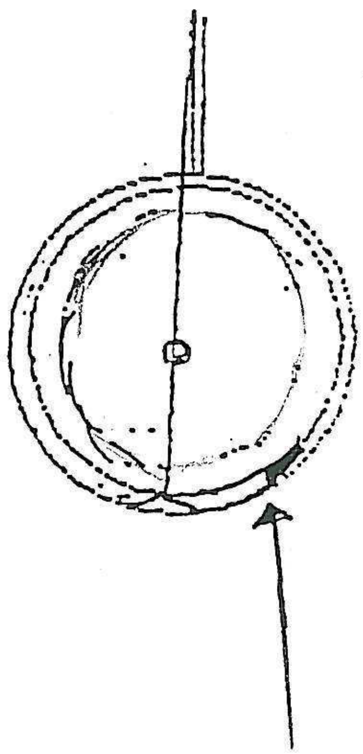
Check this adjustment!

Setting the Hook Finger- Illustrated concept



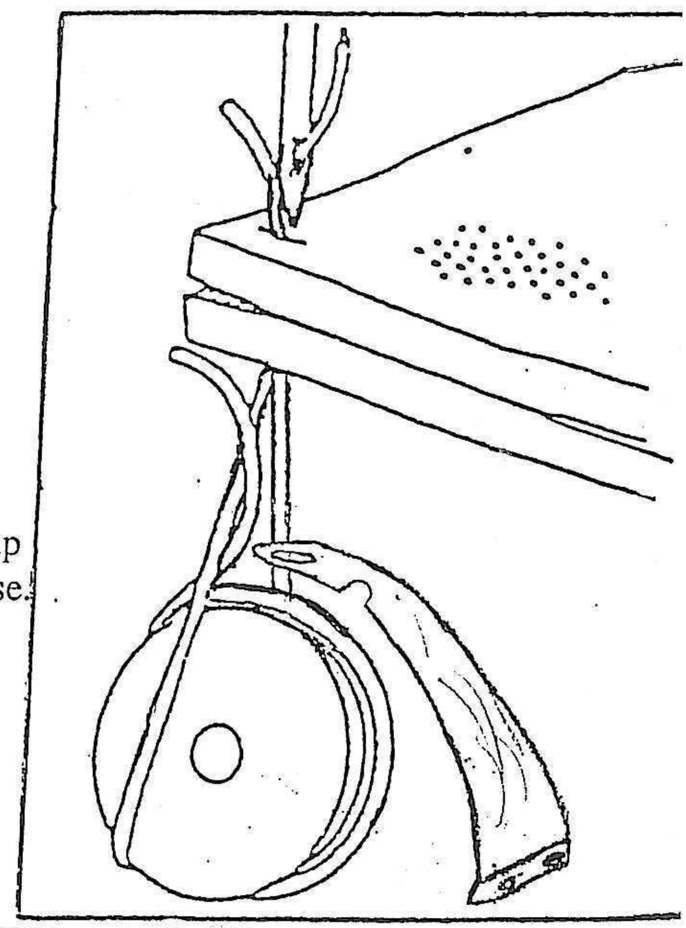
Adjust the bump on the hook finger as shown in the illustration above.

Cutting the threads- illustrated concept



This is the position of the hook point, when the trim position is set.

This hook position relates to the take-up lever at its lowest position just starting to rise.



This sketch shows the threads which are caught in the catcher blades notched hook, prior to being brought back against the cutting blade.

PHAFF 483

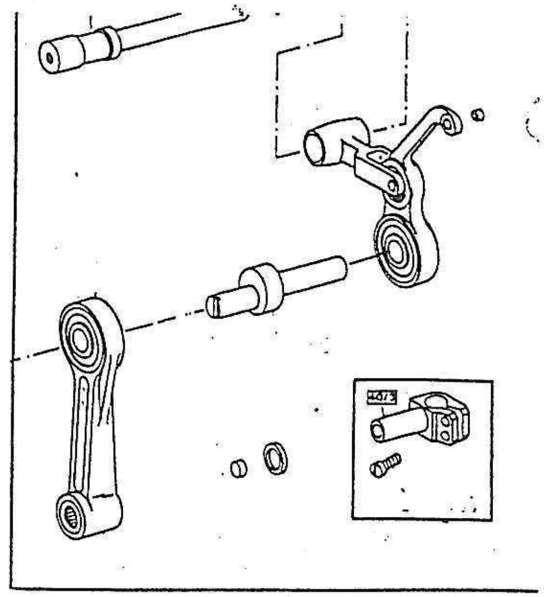
PARTS MANUAL

SERVING INDUSTRY SINCE 1947

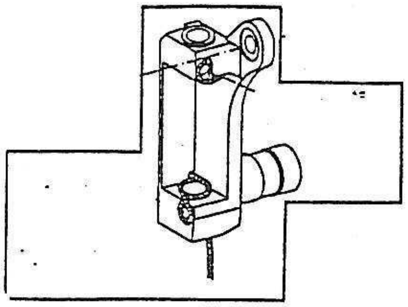
THE STANDARD BY WHICH OTHERS ARE JUDGED

ABM INTERNATIONAL, INC.

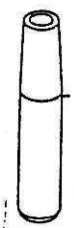
Pf59117468791 Take-up assembly

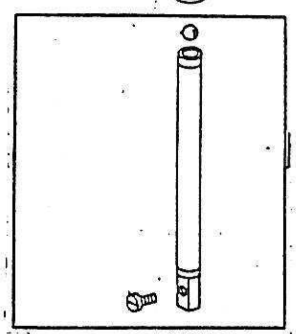


Pf591171018-91 Needle bar bushing



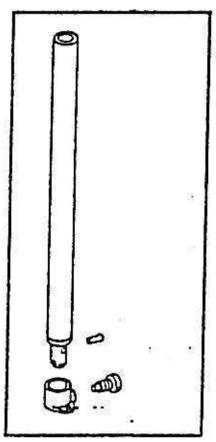
Pf59117103605 Presser bar bushing





Pf59117428401 Presser bar

Pf59117101891 Needle Bar



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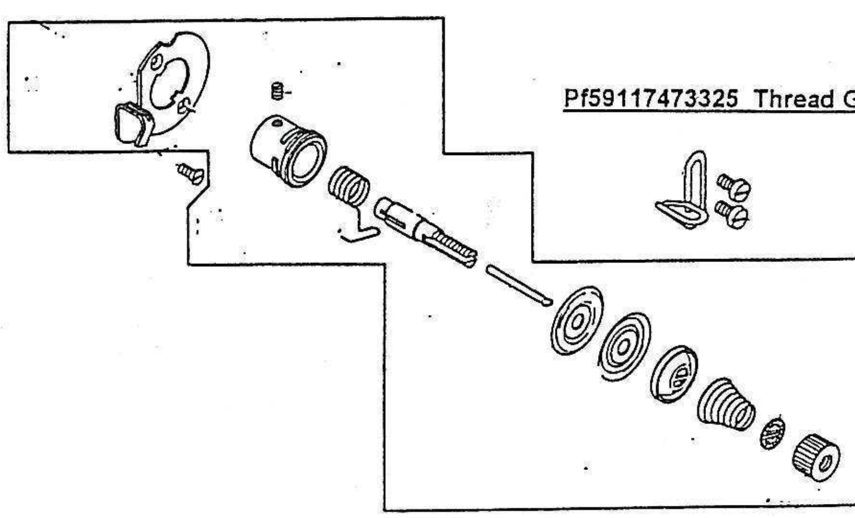
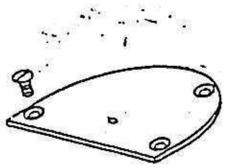
7847 Caldwell • Niles, Illinois 60714
708.581.0011 • Fax: 708.581.0029

Pf59117445491 Tension Assembly

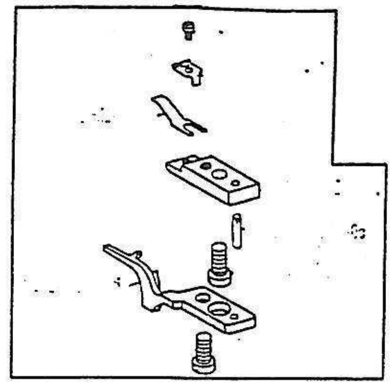


Pf59117473325 Thread Guide

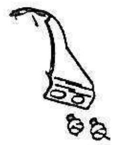


Pf5200045 Throat Plate (no feed-dog)

Pf591171853-15 Knife Blade

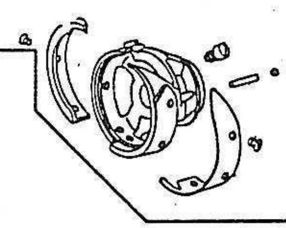


Pf59117554005 Knife thread catcher

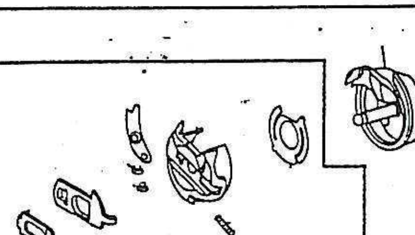


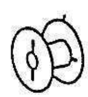
Pf59117185105 Holder - Bobbin Case

Pf59117190991 "Y" hook



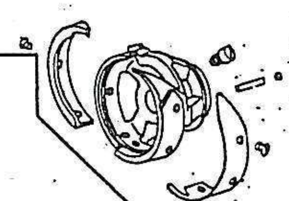
Pf59117495591 "Y" Bobbin Case



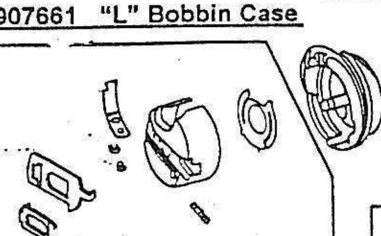


Pf59117448005 "Y" Bobbin Aluminum

Pf59117191091 "L" hook



Pf59100907661 "L" Bobbin Case



Pf59116814405 "L" Bobbin Aluminum

SECTION 3: Preliminary Set-up

3.0 Threading the Sewing head

Begin this procedure by placing a spool of top thread onto the thread stand positioned on the top sew head bearing plate. Check to see that the thread sensor is properly mounted and plugged in. (See figure p.1)

> NOTICE
>
> To achieve maximum machine efficiency and product quality it is recommended that Ultralux Thread be used with the Robo Quilter.

Run the top thread up through the thread guide at the top of the thread stand, down through the thread sensor and through the thread guide located at the front of the Pfaff Sew Head. Then thread the sewing head in the normal manner.

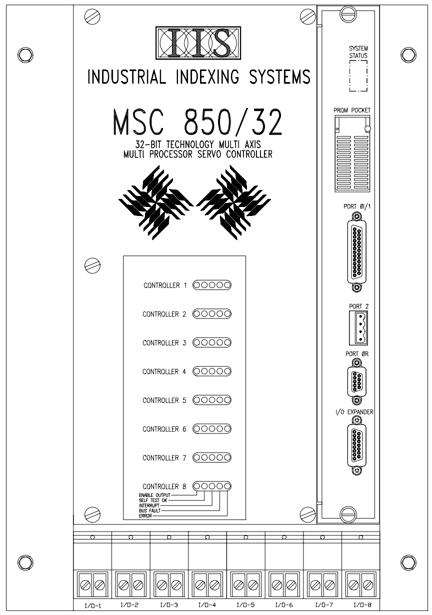
> NOTICE
>
> When the thread sensor is working properly, the red light will flash as the thread passes through.

Lastly, insert 7 bobbins into 7 bobbin cases, as seen in figure p.2 . Then load the bobbin cases into the carousel as seen in figure p.3. When the carousel is properly loaded insert the carousel into the Bobbin Changer as seen in figure p.4






MOTION CONTROL SYSTEMS, MSC-SERIES **DECEMBER 1992**



MSC-850/32 SYSTEM UNIT

INSTRUCTION BOOK

INDUSTRIAL INDEXING SYSTEMS, Inc.

Revision - 0

Approved By:

ER-6025

ERRATA SHEET, IB-11B014 MAY 1997

Date	Rev.	ECN No.	DR	CHK	CHK
1/16/96	0	ECN-96-003 (See Note 1)	KY		
5/19/97	A	ECN-97-160 (See Note 2)	KY		

Notes:

1) Pages 0-2, 5-2, 7-1 & 7-3, dated January 1996, supercedes Pages 0-2, 5-2, 7-1 & 7-3, dated December 1992.

2) Page 6-3, dated May 1997, supercedes Page 6-3, dated December 1992.

INDUSTRIAL INDEXING SYSTEMS, Inc.
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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

1.0 INTRODUCTION

1.1 About this Instruction Book

This document is a part of a series of books that support Industrial Indexing Systems' MSC-850/32 based Motion Control System. It provides product information about the MSC-850/32 System Unit including; general description, product specifications, installation instructions, controls, indicators, and electrical connection diagrams.

1.2 Product Overview

An MSC-850/32 System Unit consists of the ENC-850 Unit Enclosure and the MAC-850/32 Main Processor utilizing 32-bit technology (Figure 1-1). The MSC-850/32 System Unit is the heart of the Motion Control System. The System Unit houses the electronics that perform the central processing control functions and I/O functions of the Motion Control System.

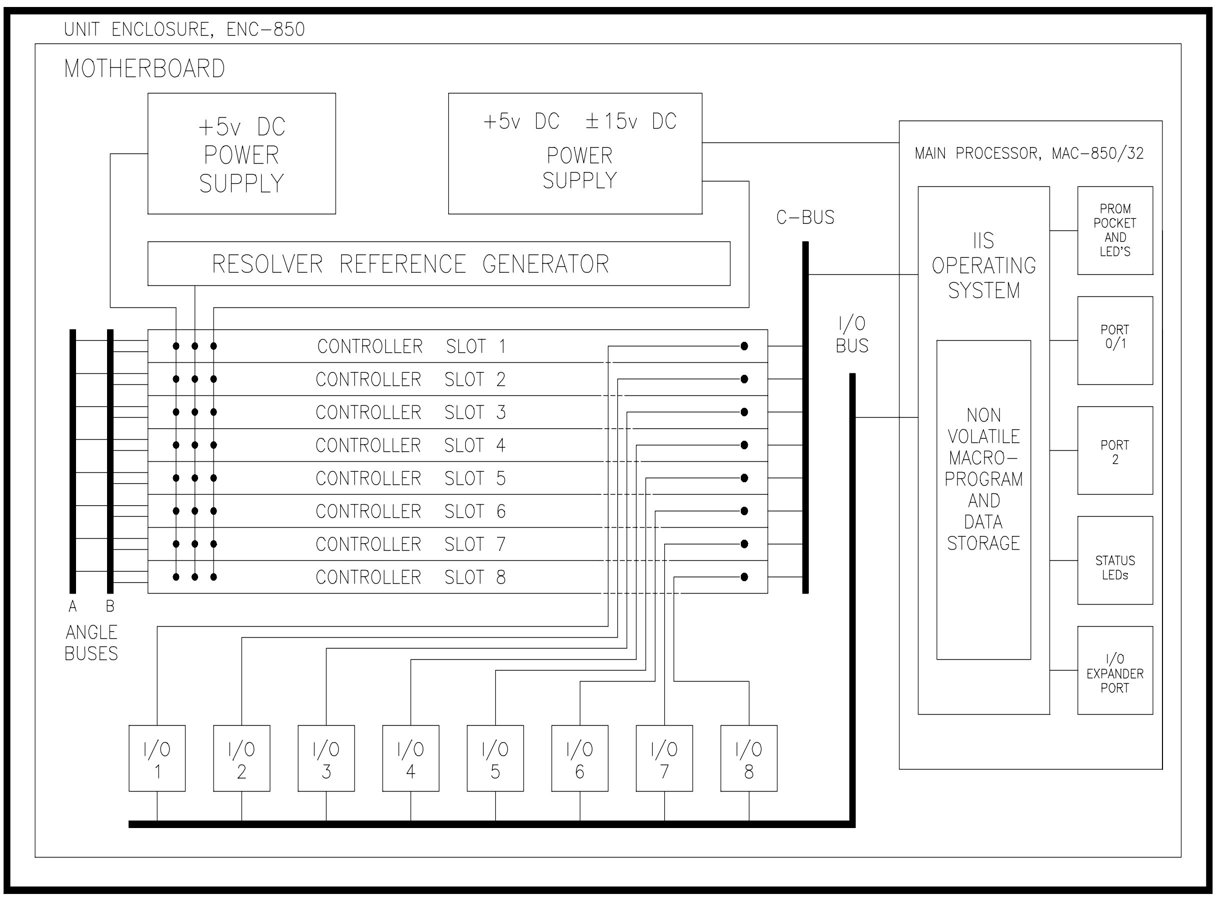


Figure 1-1 MSC-850 System Unit Internal Architecture

2.0 DESCRIPTION

2.1 The ENC-850 Unit Enclosure

The ENC-850 Unit Enclosure (Figure 2-1) consists of a forced-air ventilated metal cabinet and a motherboard to support the functional boards of the Motion Control System.

The Unit Enclosure comprises a Command Bus (C-BUS), 8 controller slots, connections for up to 8 On-board I/O Modules, a Resolver Reference Generator, 2 Angle Buses, an I/O Bus, and 2 Power supplies.

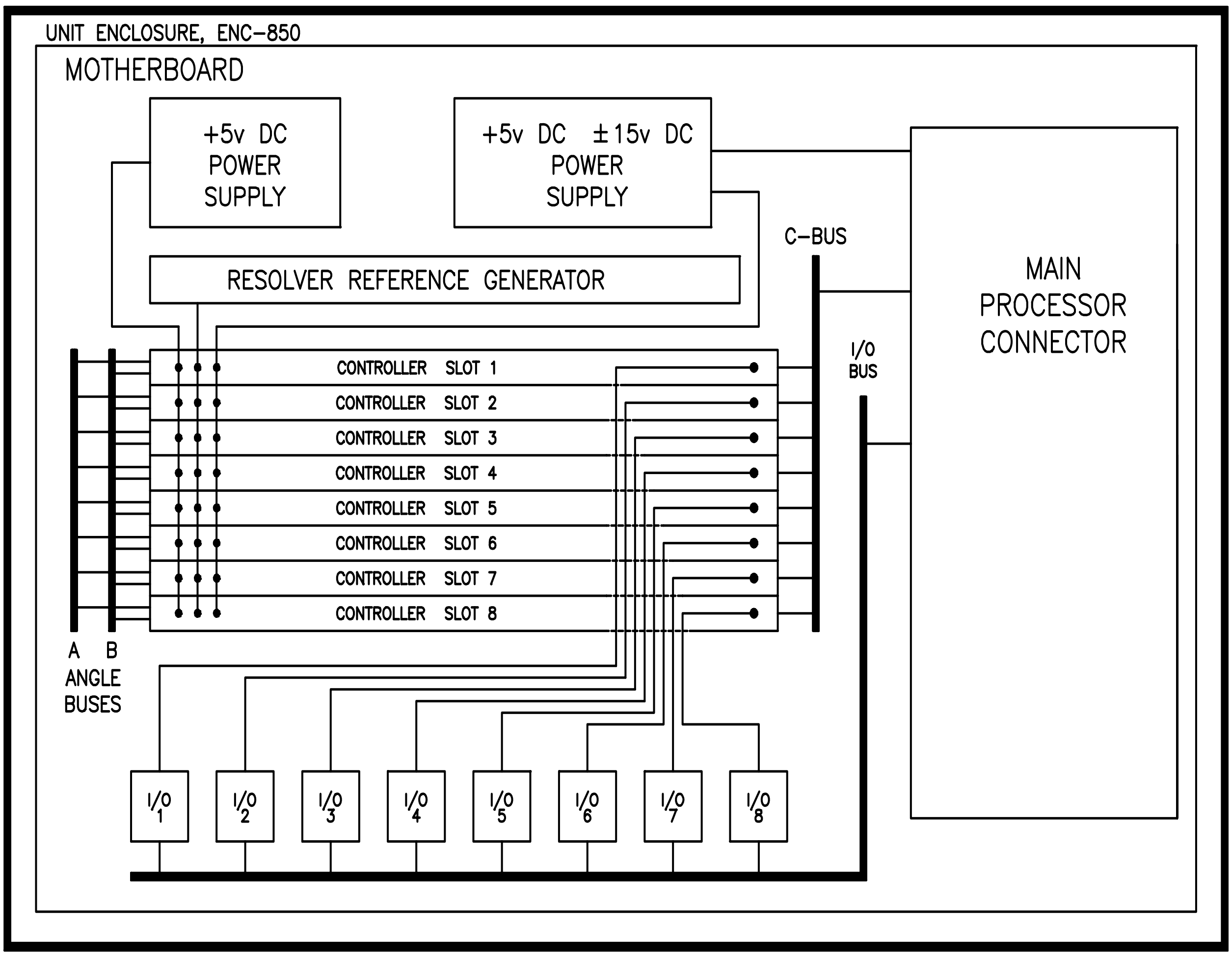


Figure 2-1 The ENC-850 Unit Enclosure

2.1.1 Command Bus

The Command Bus (C-BUS) (Figure 2-2) is a parallel digital communications bus connecting the Main Processor to the controllers. The C-BUS runs under a protocol established by a unique Industrial Indexing Systems' operating system and is accessed by the user's Macroprogram.

The C-BUS allows Macroprogram commands to be sent from the Main Processor to the controllers. It also allows data to be exchanged between the Main Processor and the controllers.

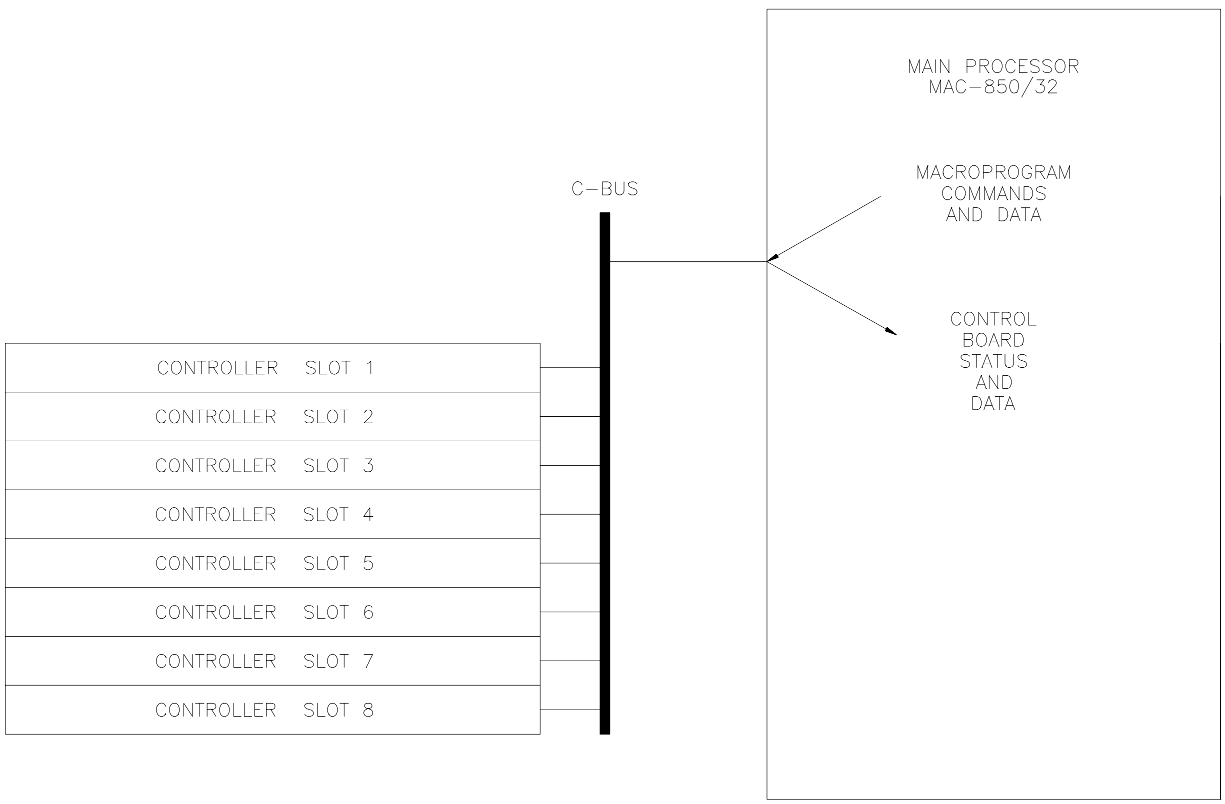


Figure 2-2 The Command Bus

2.1.2 Controller Slots

The 8 controller slots (Figure 2-3) accept any controller in any combination. The controllers are; ACR-850 Resolver Axis Controller, ACE-850 Encoder Axis Controller, MCF-850 Multifunction Controller, HPL-850 High Performance Limit Switch Controller, or ACM-850 Analog Controller.

The controller slots are connected to 2 Angle Buses, On-board Input Modules, and the C-BUS. Power is supplied to the controllers through the controller slots. A 2.6KHz Resolver Reference signal is supplied through the controller slots to the ACR-850 Resolver Axis Controllers.

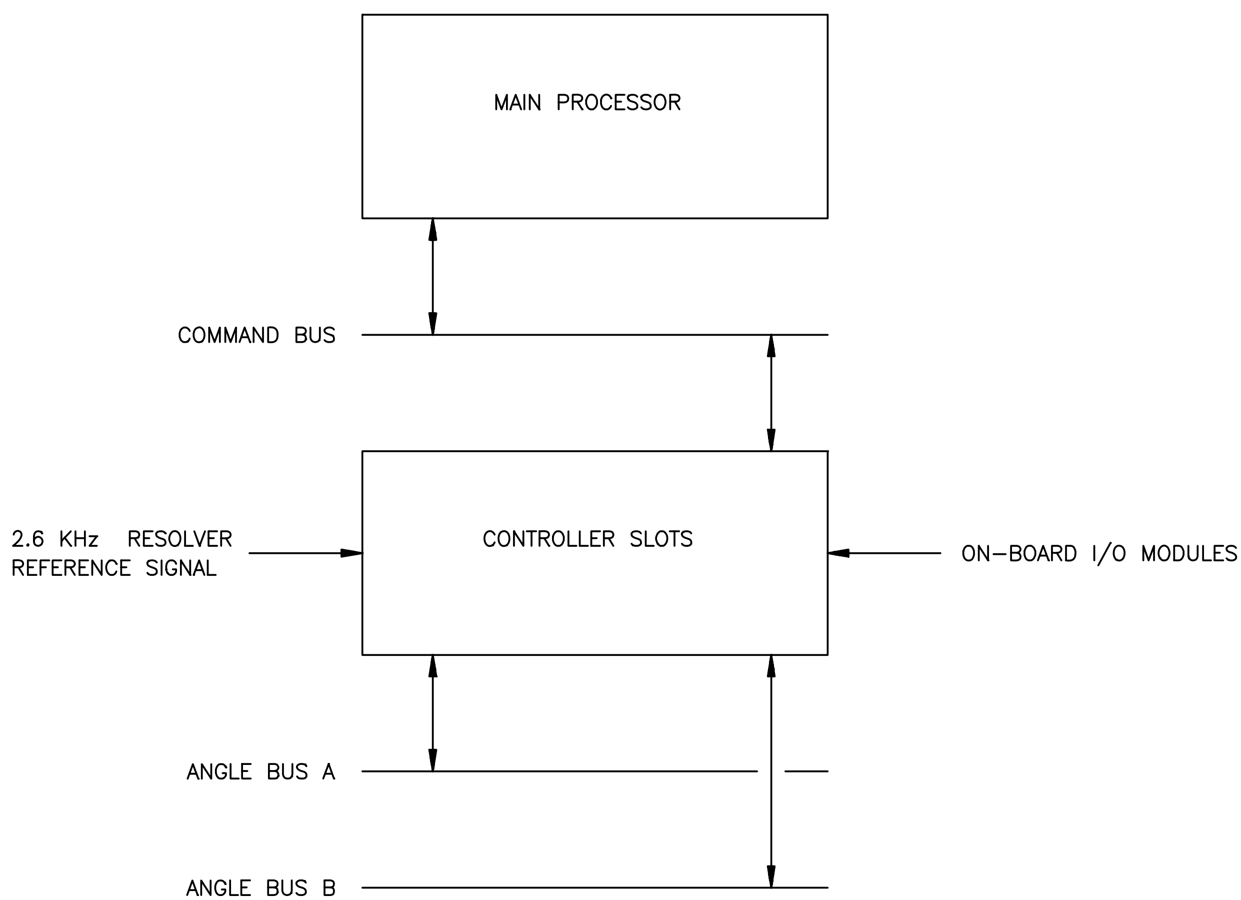


Figure 2-3 The Controller Slots

2.1.3 On-Board I/O Modules

The connections for the eight On-board I/O modules (Figure 2-4) allow process inputs to be connected directly to the controllers. They also connect process inputs and outputs to the Main Processor by way of the I/O Bus. The input and output modules can be either AC or DC. The IIS part numbers for the six different plug-in modules are listed in Table 2-1 below.

Table 2-1 On-Board I/O Modules

FUNCTION	PART #
DC Input, high speed	HSI-850
DC Input	S410
DC Output	S430
AC Input, low voltage	S420
AC Input, high voltage	S421
AC Output	S440

Each On-Board I/O Module Connects to both the Main Processor and a corresponding controller (e.g. I/O Module 1 connects to the controller in slot 1, I/O Module 2 connects to the controller in slot 2, etc..).

The Main Processor can read inputs and set outputs. Inputs are used by the control programs to monitor the status of external devices. Outputs allow the control programs to affect the status of external devices.

The controllers can read inputs from On-Board Input Modules. These inputs are used with control program functions to provide fast hardware interrupts, typically used to initiate a motion or motion related event.

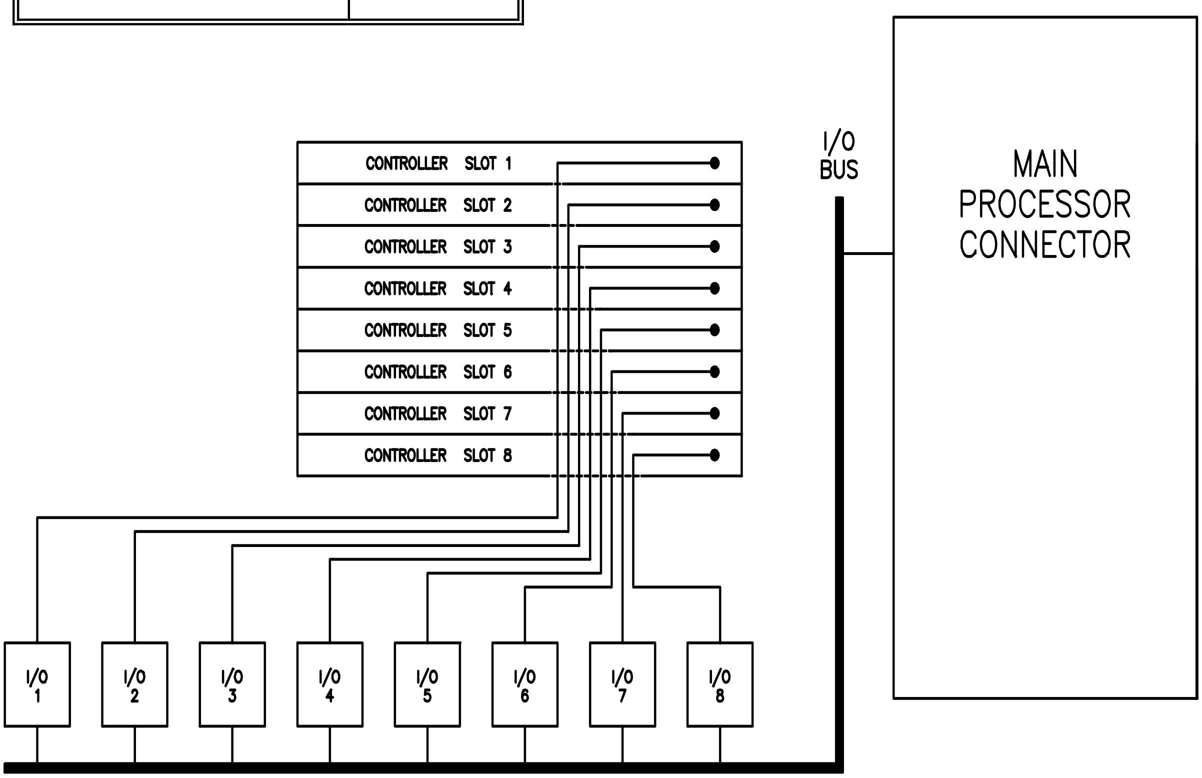


Figure 2-4 The On-Board I/O Module Connectors

2.1.4 Angle Buses

The 2 Angle Buses (Figure 2-5) are serial digital communication buses that interconnect the controllers through their controller slots.

These buses allow each of two master axis controllers per System Unit to transmit its absolute master angle position on one of the master angle buses.

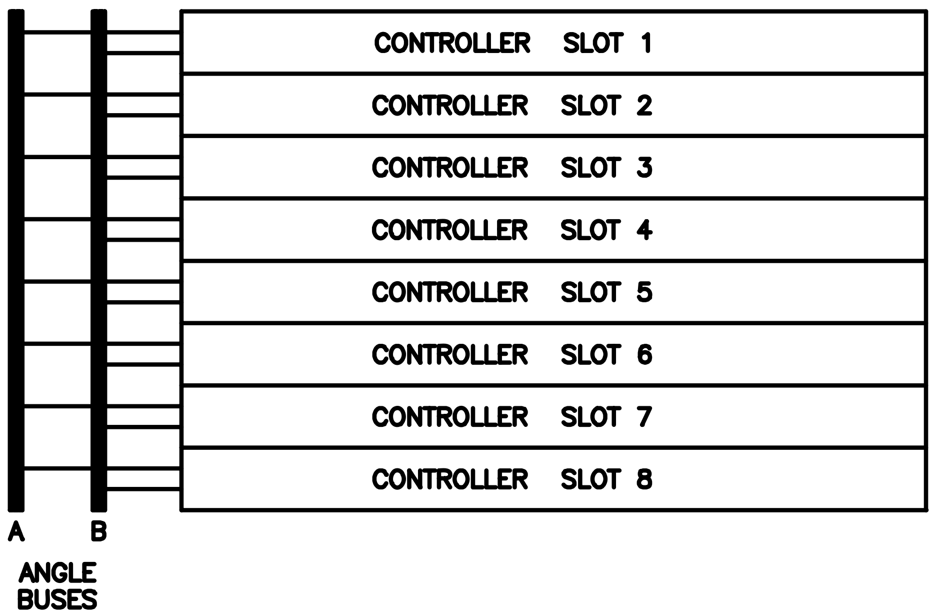


Figure 2-5 The Two Angle Buses

2.1.5 Power Distribution

System Unit Power Distribution (Figure 2-6) provides power for the Main Processor, controllers, and Resolver Reference Generator. A +5v DC Power Supply and a +5v DC, $\pm$15v DC Power Supply convert the 110v AC line voltage into the required voltages for the controllers and the Main Processor.

Power is supplied to the controllers through the controller slots and the Main Processor through the Main Processor connector. Both power supplies are of the linear type. This feature provides extensive incoming line noise filtering and high capacity voltage storage to produce a stable supply of power with very high fault tolerance.

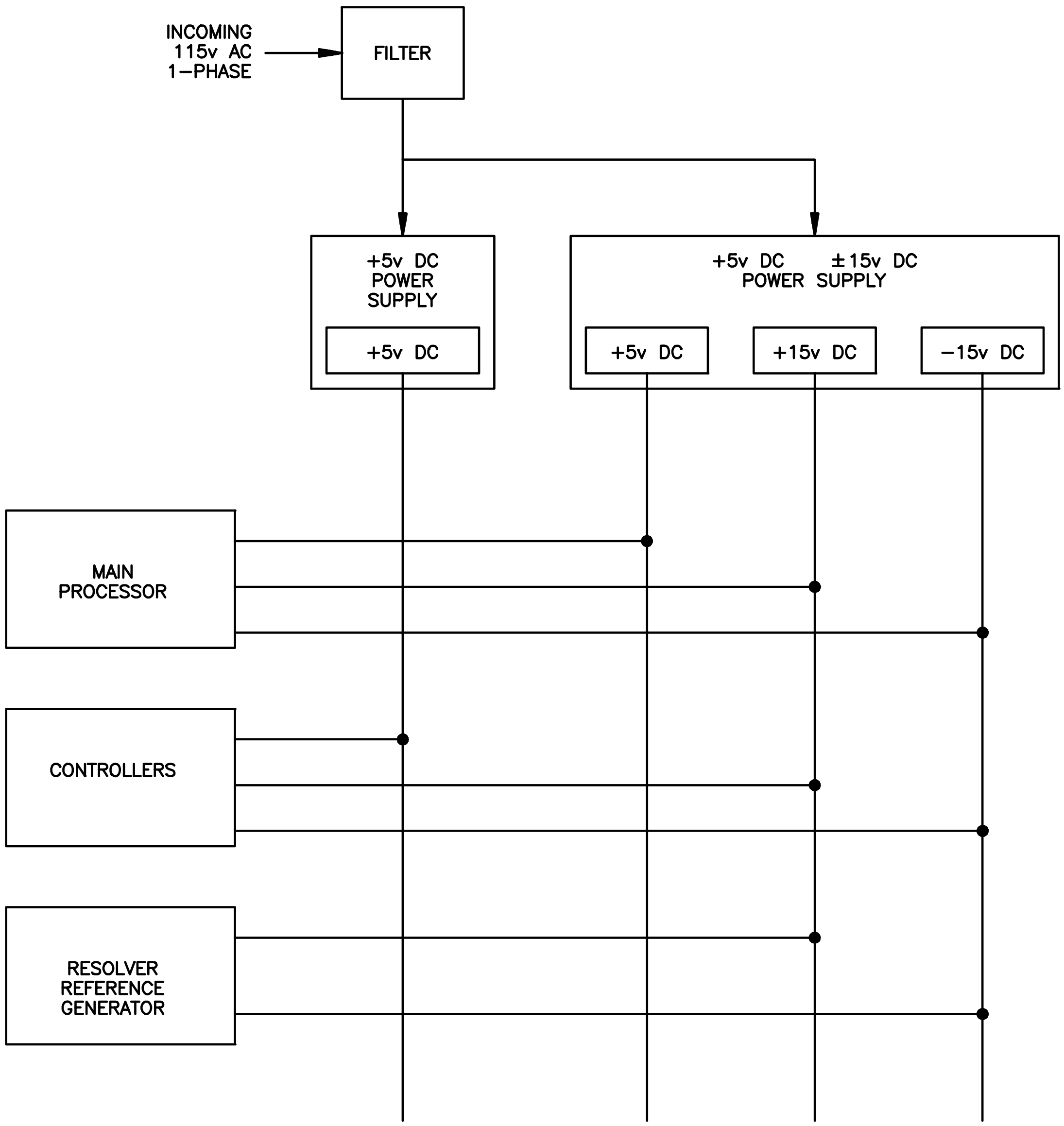


Figure 2-6 System Unit Distribution

2.1.6 Resolver Reference Generator

The Resolver Reference Generator (Figure 2-7) consists of a reference oscillator and amplifier. The reference oscillator generates a 2.6KHz Sine wave signal. The reference signal is amplified by a linear power amplifier which produces an 8v AC output capable of driving 8 resolvers. The amplifier's output is hard-wired to all of the controller slots.

The 2.6KHz Sine wave signal is used by the resolver-to-digital (R/D) converter as a reference signal. Resolver Axis Controllers also provide the reference signal to drive resolvers through their interface connectors.

The ACE-850 Encoder Axis Controller can provide the reference signal to any servo drive requiring a 2.6KHz signal.

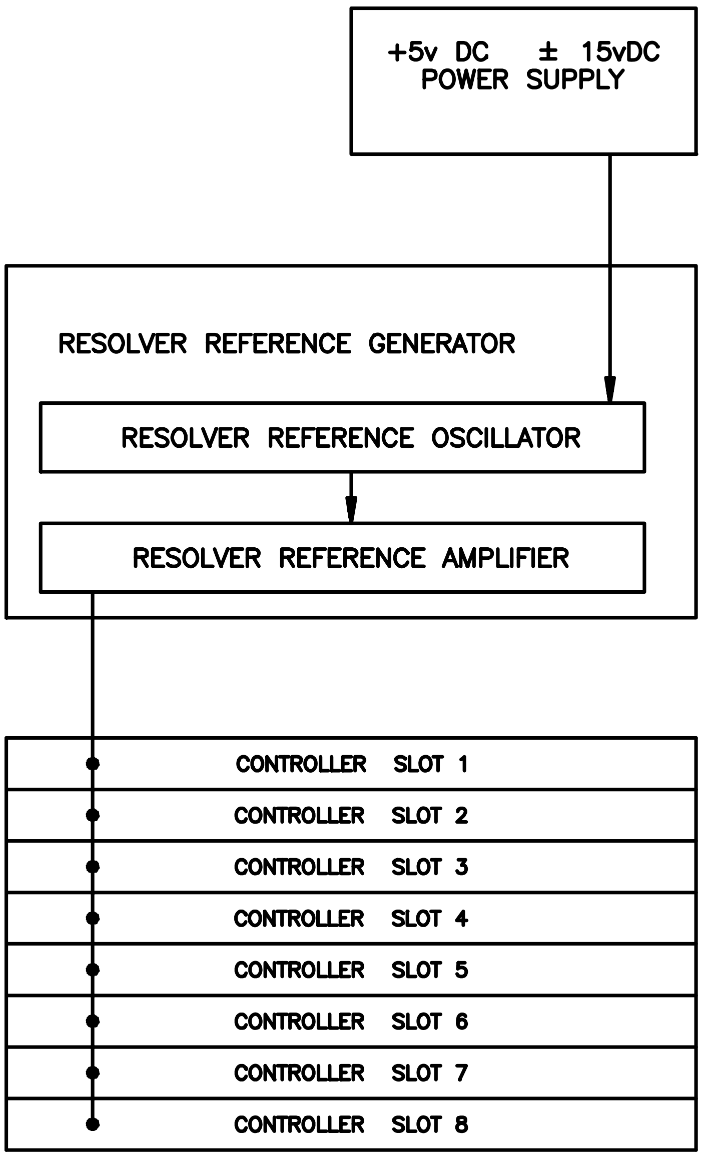


Figure 2-7 The Resolver Reference Generator

2.2 The MAC-850/32 Main Processor

The central processing functions of the Motion Control Systems are performed by the MAC-850/32 Main Processor (Figure 2-8). The Industrial Indexing System's operating system in conjunction with the user's control program utilize the central processing facilities to provide the system control functions.

The Main Processor also provides several external interface ports. The external interface ports allow the Main Processor to integrate external system components, such as, external PROMs, operator interfaces, and I/O expanders with the System Unit.

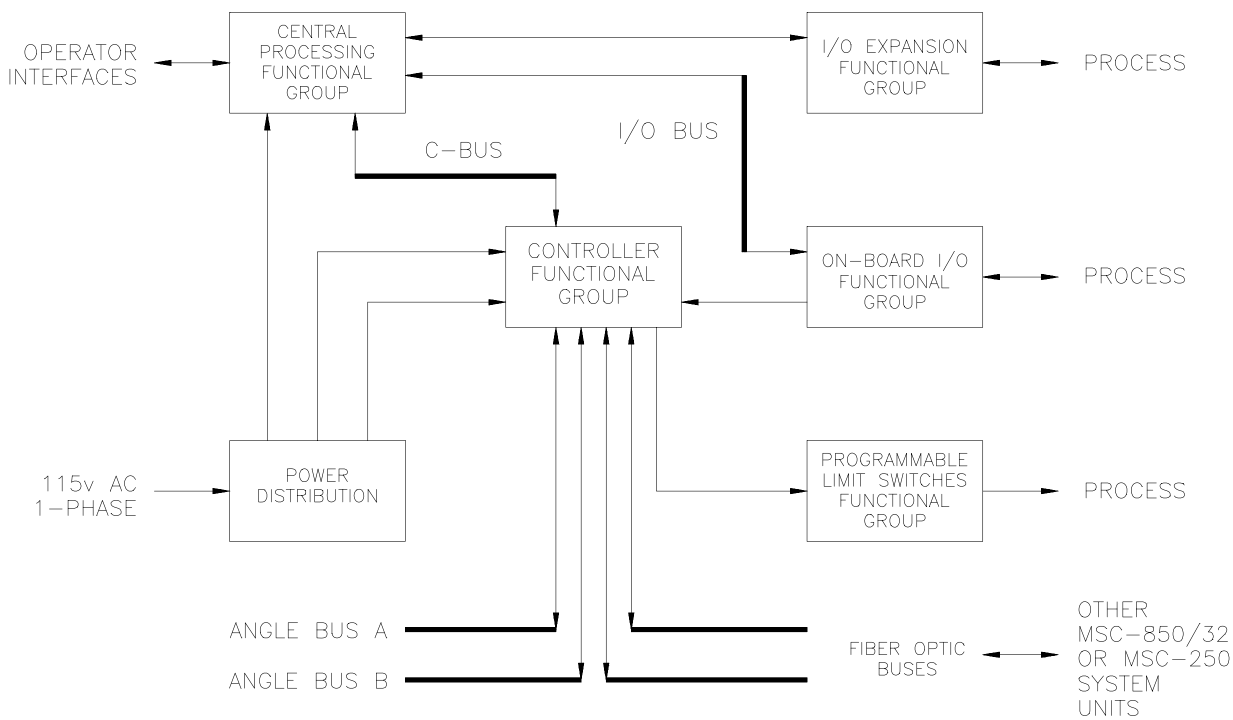


Figure 2-8 System Unit Functional Block Diagram

2.2.1 Operating System Firmware

The operating system is a 192K embedded software package residing in on- board firmware. The operating system firmware also provides access to 128K of nonvolatile memory for Macroprogram and data storage. Figure 2-9 illustrates the internal and external exchange of information being handled by the Main Processor.

The external interface ports (Figure 2-10) provide the Main Processor with an executive port, operator interface ports, an I/O expander port and an external PROM Pocket.

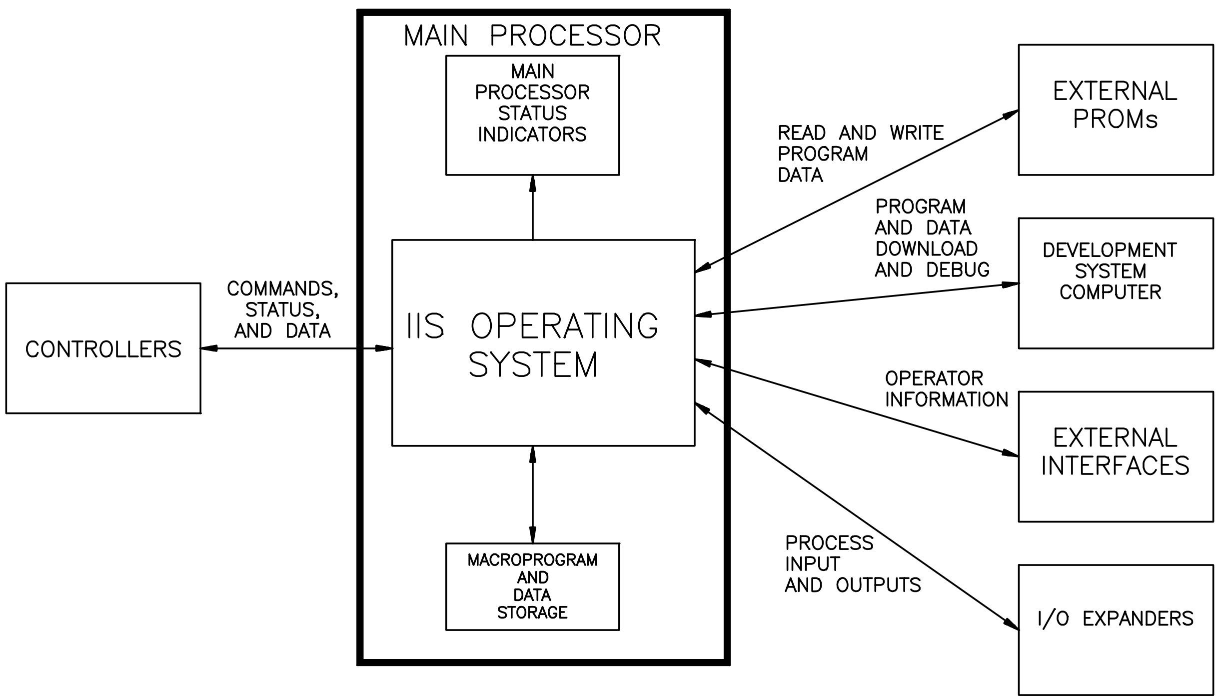


Figure 2-9 Main Processor Information Exchange

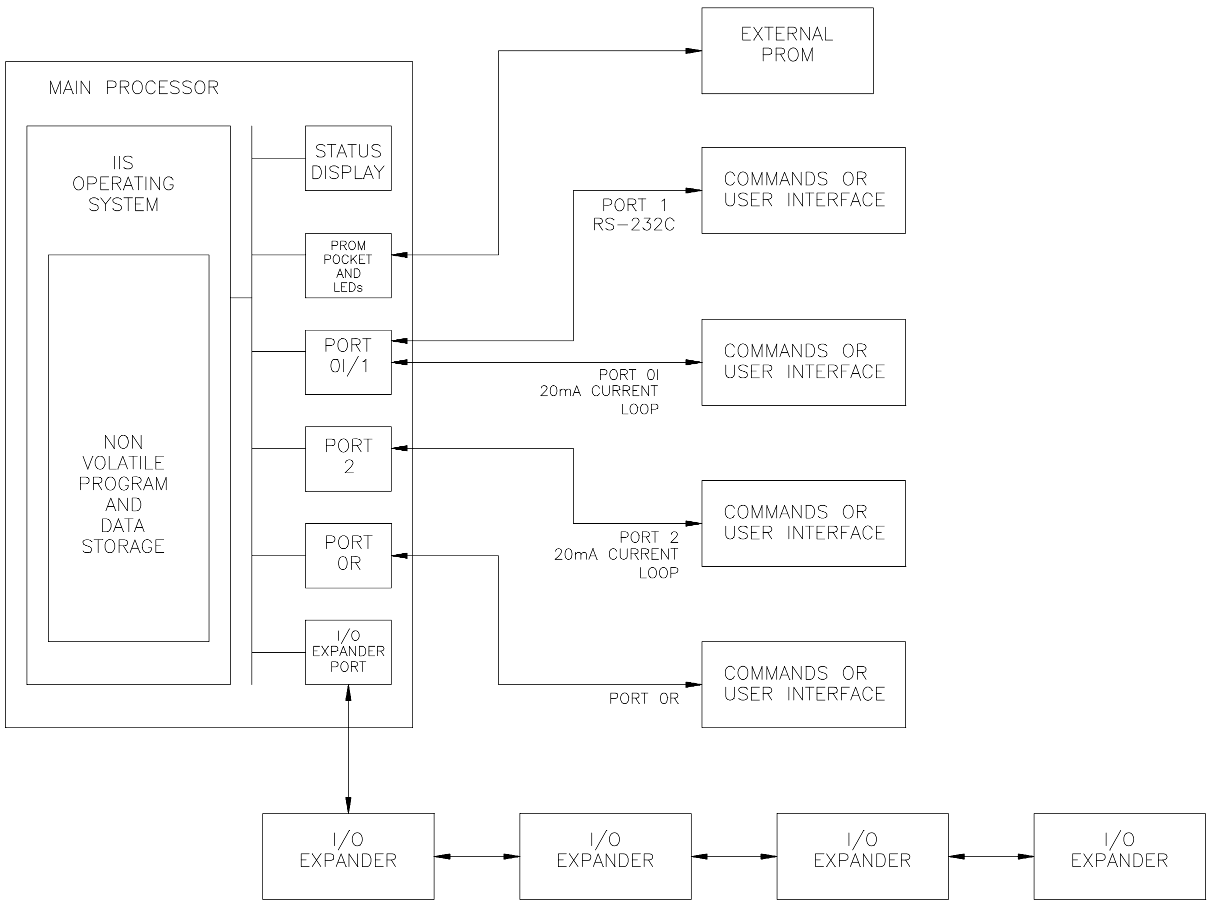


Figure 2-10 Main Processor External Interfaces

2.3 Connectors

Port 0 is configurable between 20mA current loop (Port 0I) or RS232C (Port 0R) using Macroprogram commands.

PORT 0I: This port uses the same 25-pin D-connector as PORT 1 (see PORT 1 below). This port is also configurable to be either an active or passive serial current loop.

PORT 0R: This port is a 9-pin D-connector RS232C serial communications port. It is accessible through the Macroprogram language for sending and receiving data and commands. (Refer to "Section 6" for proper cable pin-outs for this port.)

PORT 1: This 25-pin serial communications port can use either an RS-232C serial communications protocol or an RS-485 multidrop addressable protocol. It is used for communications with the computer using the MSC Tool Kit program. The SW2 switch on the printed circuit board must be set to allow proper communications. (Refer to "Section 6" for proper cable pin-outs for this port.)

PORT 2: This 20 mA current-loop serial port is used for communication with the Industrial Indexing Systems' OPI-1 and similar current-loop communications devices. It is accessible through the Macroprogram language for sending and receiving data and commands. (Refer to "Section 6" for proper cable pin-outs for this port.)

NOTE

An RS-232C to 20 mA converter is available from Industrial Indexing Systems, Inc. This converter allows the user to take advantage of the high-isolation characteristics of the 20 mA current-loop communications protocol.

I/O Expander Assemblies allow 64 discrete inputs or outputs to be connected to the Main Processor. The I/O expander port is a 15-pin connector dedicated to connecting an IOE-850 I/O Expander Assembly to the Main Processor. Three other IOE-850 I/O Expander Assemblies can be daisy-chain connected to the same I/O Expander port. The I/O scan time is increased to 1.2msec in Hi-Scan mode and 12msec in normal mode for each I/O Expander Assembly.

The I/O scan time defaults to 12msec for each I/O Expander Assembly. The Hi-Scan mode is enabled or disabled using the set_hi_scan and clr_hi_scan macro instructions.

External PROMs allow for up to 32K bytes of nonvolatile program/data storage. The PROM Pocket allows an Intel 27256-1 E-PROM or compatible to be connected to the Main Processor. Programs and data can be written to and read from the PROM with the Macroprogram Development System. Macroprogram commands can save and load programs, and write and read data from the PROM. The PROM Pocket has a write-protect feature which is controlled by an automatic write protect feature.

3.0 SPECIFICATIONS

3.1 Functional Characteristics

Serial Communication

Port 0:			
	Port 0I	20mA Current Loop	ASCII Programmable
	Port 0R	RS232C	ASCII Programmable
Port 1		RS-232C or RS-485 (Packet Protocol)	9600 Baud 1 Stop Bit 8 Data Bits No Parity
Port 2		20mA Current Loop	ASCII Programmable

Memory

Operating System	192K bytes
Program nonvolatile RAM	64K bytes
Data nonvolatile RAM	64K bytes
External EPROM	32K bytes

I/O Interface

On-Board, Discrete	8 Positions
Expansion, Discrete	64 Positions

Controller Slots 8 Positions

3.2 Performance Characteristics

System Unit

Input Power

Voltage	100v to 130v AC
Frequency	48Hz to 62Hz
Current	2A Maximum

Environmental

Operating Temp.	32° to 140° F (0° to 60° C)
Operating Humidity	30 to 90% (Non-condensing)

On-Board I/O Modules

Interrupt Response Time

Hardware	less than 1msec.
Software	less than 5msec.

S410

Type	DC Input
Voltage Range	10v to 32v DC
OFF Voltage	1v DC Minimum
ON Current	25mA @ 32v DC
OFF Current	0.8mA Maximum

S420

Type	AC Input
Voltage Range	90v to 135v AC
OFF Voltage	30v AC Minimum
On Current	15mA @ 120v AC
Input Impedence	10KΩ Nominal

S421

Type	AC Input
Voltage Range	180v to 270v AC
OFF Voltage	60v AC Minimum
On Current	15mA @ 240v AC
Input Impedence	10KΩ Nominal

S430

Type	DC Output
Voltage Range	10v to 55v DC
ON Current	2.75A Maximum
Voltage Drop (on-state)	2v DC Maximum
OFF Current (leakage)	10mA Maximum @ 55v DC

S440

Type	AC Output
Voltage Range	30v to 140v AC
ON Current	2.00mA Maximum
Voltage Drop (on-state)	1.5v AC Maximum
OFF Current (leakage)	4mA Maximum @ 140v AC

3.3 Physical Characteristics

Dimensions	
Height	15 $^{13}/_{16}$ in. (402 mm)
Width	11 in. (279 mm)
Depth	9 in. (51 mm)
Weight	15 lbs. (6.8 Kg.)
Mounting	Panel
Power Cable	6 foot cord (C-800006)

4.0 INSTALLATION

4.1 General

This section contains the specific information needed to properly install the MSC-850/32 System Unit. For maximum performance, it is recommended that the System Unit be installed in a NEMA 12 type enclosure and certain other criteria be met.

4.2 Enclosure Cabinet Requirements

Ideally, the System Unit, along with other related electronic components, should be mounted on a panel housed in a NEMA 12 enclosure. The enclosure should be mounted as far away as practical from noise generating devices, such as; SCR equipment, but should be within 100 feet (30 meters) of the drive motors being controlled.

4.3 Mounting The System Unit

The MSC-850/32 System Unit is designed for mounting on a grounded panel, and is secured to the panel with four #10 screws. Figure 4-1 gives the dimensions and screw hole locations.

Be sure to provide adequate space around the System Unit for ease of maintenance and proper ventilation. Typically, wire ways can be located up to 3 inches (76 mm) from the edge of the System Unit back plate. Figure 4-2 illustrates an example of the arrangement.

4.4 Cable Isolation Requirements

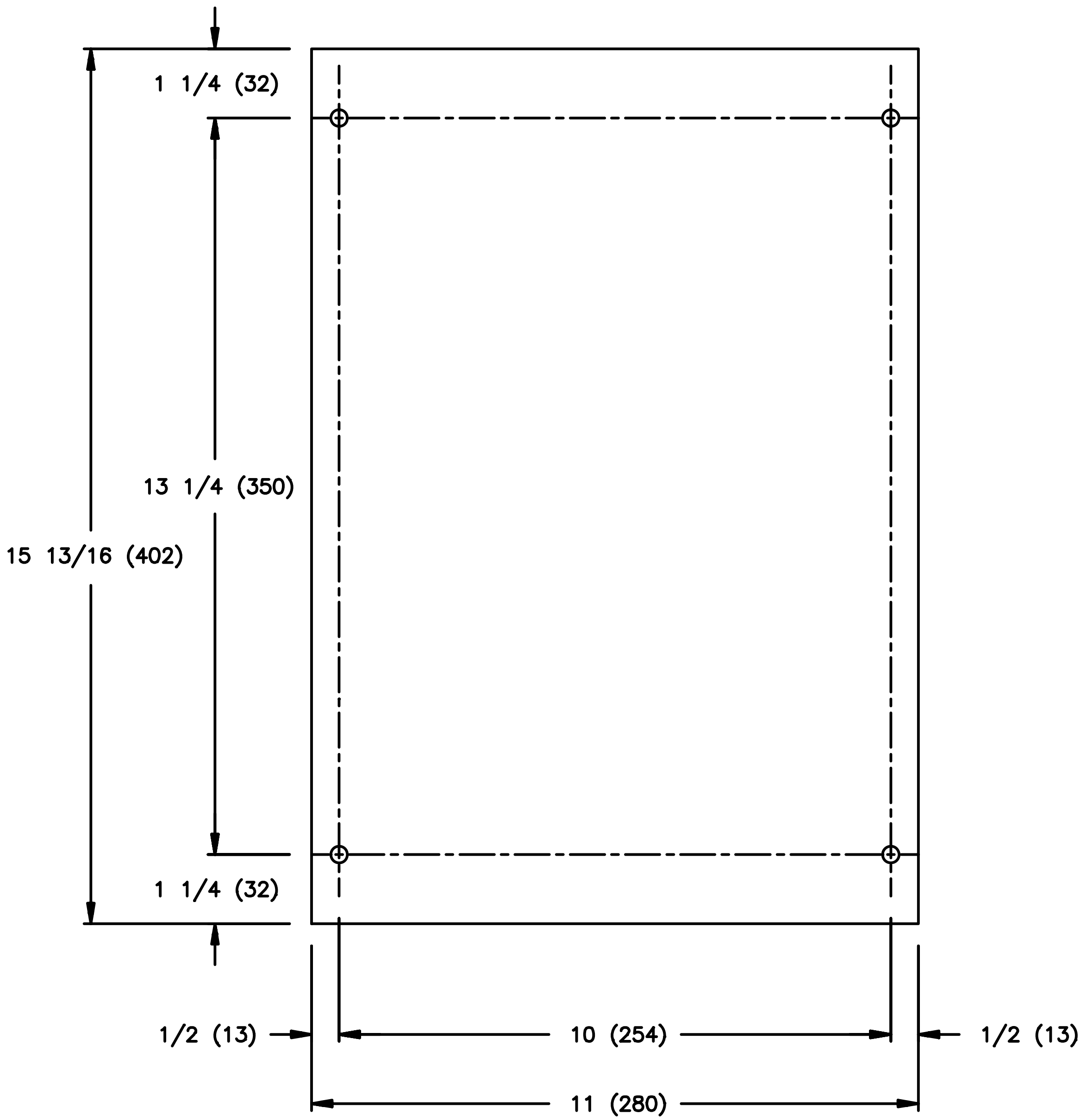
It is imperative that any low-voltage signal conductors, such as resolvers, encoders, drive commands, or communications, (15v or less) be routed in conduits or wire ways separate from high-voltage, such as motor cables, transformer lines, and I/O signal lines (100v or more). This will insure that electromagnetic fields produced by high power transmission do not corrupt the low level signals.

4.5 Grounding Requirements

The site must have a suitable earth ground rod and ground bus installed. The NEMA 12 enclosure, wire ways, conduits, and machine frame must be connected directly to this ground bus. All shields and other earth grounds must be connected to the MSC Ground Strip installed on the panel (Figure 4-2).

4.6 Power Isolation

The System Unit requires 115v AC, 1-phase power and is equipped with a line filter, fuse, and transient protection device. It is recommended that an isolating transformer be installed between the main power source and the outlet servicing the input power cord to the System Unit. The isolation transformer must be dedicated to the motion control system components. Other devices, such as; switched I/O, air conditioners, fans, and lighting, even though these devices are tied to the motion control system, must be powered by a separate AC power source.



Dimensions shown in inches (millimeters)

Mounting holes should be sized for #10 screws

Figure 4-1 Panel Mounting Dimensions for the System Unit

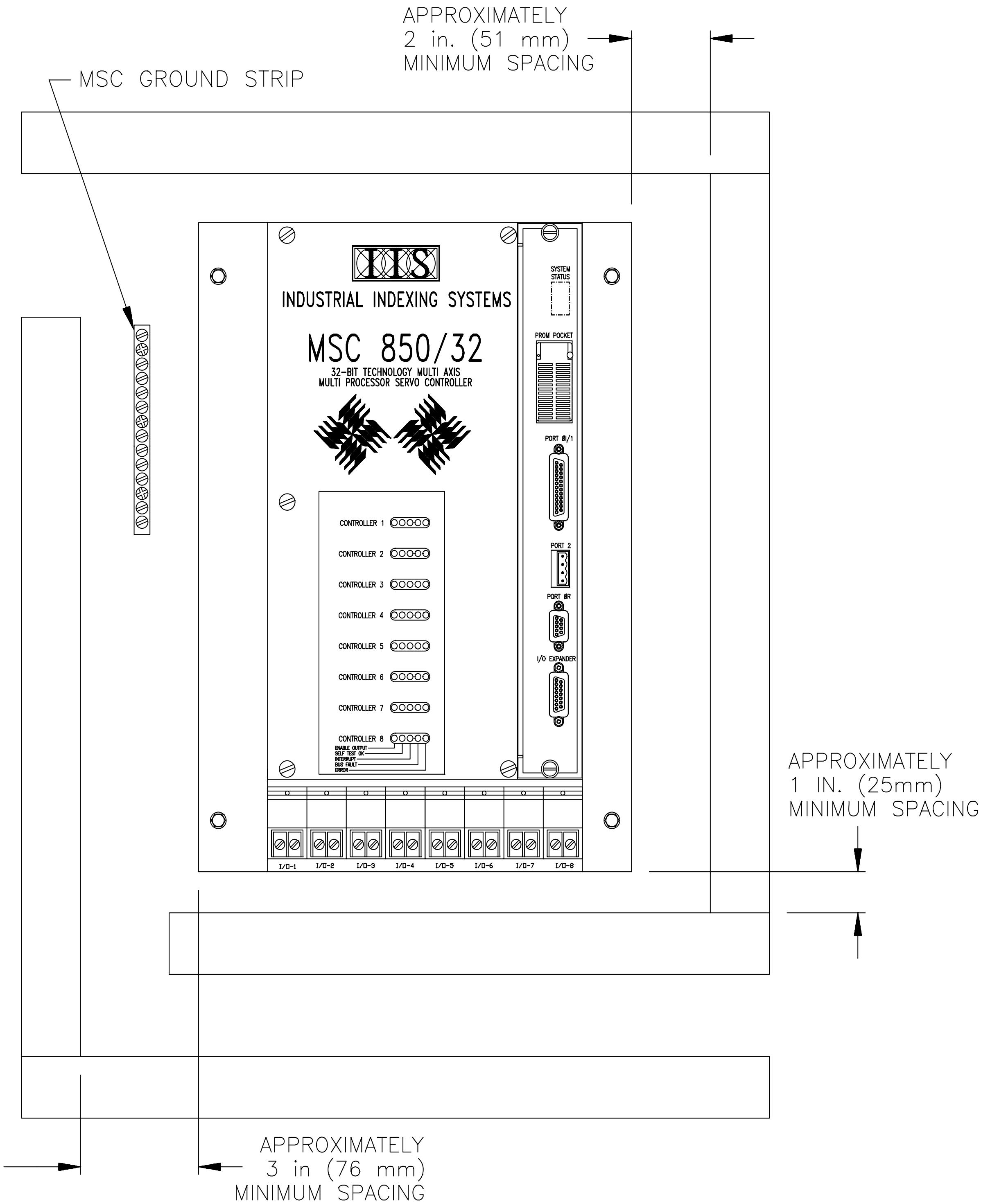


Figure 4-2 Typical Mounting of the System Unit

4.7 Installing The Face-plate

The face-plate is held on by five self-retaining screws. The face-plate is required for proper ventilation and also secures the controllers in their slots.

CAUTION

Proper installation of the face-plate is necessary for ventilating the System Unit. Be sure the face-plate has been properly installed before powering the System Unit.

To remove the face-plate, proceed as follows:

1. Hold the face-plate in place and loosen the five self-retaining screws.

2. Carefully pull the face-plate straight out from the System Unit.

To replace the face-plate, proceed as follows:

1. Set the face-plate in place and move it up and down to seat the controllers in the plastic spacers on the back of the face-plate.

2. Hand tighten the five self-retaining screws.

5.0 CONTROLS AND INDICATORS

5.1 General

The MSC-850/32 System Unit has a seven segment system status indicators on the face-plate of the Main Processor (see Figure 5-1). The status indicators of the controllers are visible through cutouts on the face-plate of the Unit Enclosure.

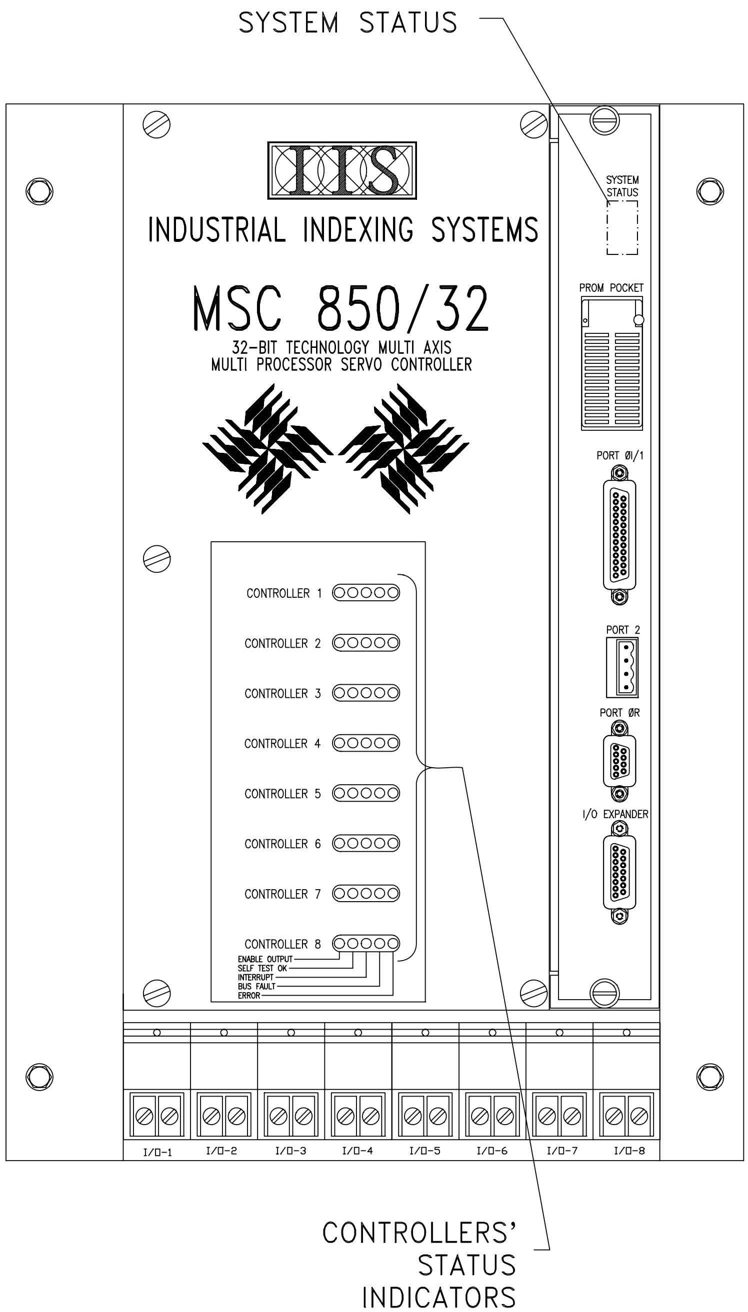


Figure 5-1 MSC-850/32 Status Indicators

5.2 Selector Switches

There are two 16-position rotary selector switches on the MAC-81X circuit board (see Figure 5-2).

MODE (SW1) - This selector switch is used to determine the operating mode of the controller.

Normal Operation = Port 0, 1, & 2 default to 9600 Baud - Packet Protocol.

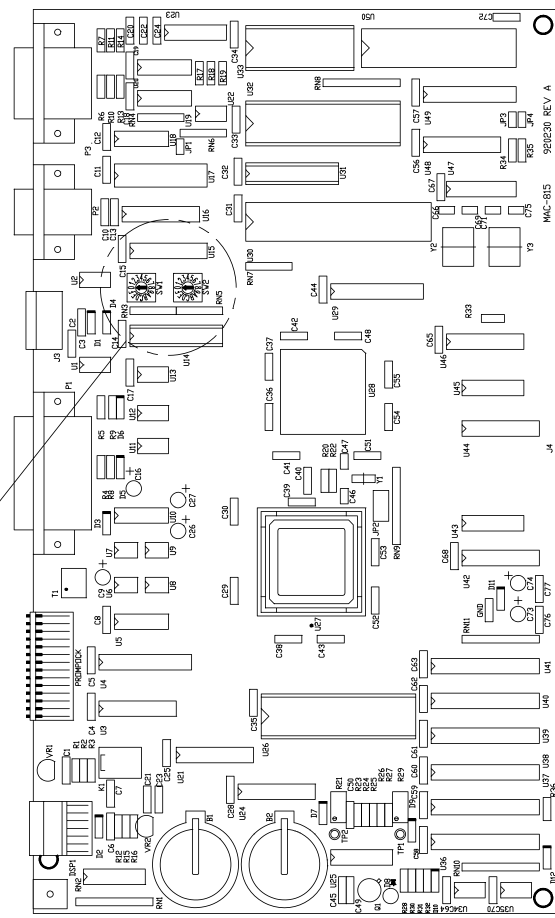
Position 0 =Normal Operation, Port 0I enabled
Position 1 =Test Mode 1
Position 2 =Test Mode 2
Position 3 =Test Mode 3
Position 4 - 9 = Reserved

The Ports not mentioned in the following setting definitions stay at their "Normal Operation" defaults.

Position A	=	Normal Operation, Port 0R enabled
Position B	=	ort 3 = 19200 Baud - Packet Protocol.
Position C	=	Port 3 = 38400 Baud - Packet Protocol.
Position D	=	Port 1 = 19200 Baud - Packet Protocol.
Position E	=	Port 1 = 38400 Baud - Packet Protocol.
Position F	=	Reserved

These above port settings are only power up defaults, and can be changed by the users' Macroprogram at any time.

ADDRESS (SW2) - This selector switch is used in conjunction with communications Port 1. If this switch is in the "0" position, the port will communicate using the RS-232C serial communications protocol. Any of the other positions - 1 through F - are used to designate the node number of the controller when it is used for RS-485 serial communications.



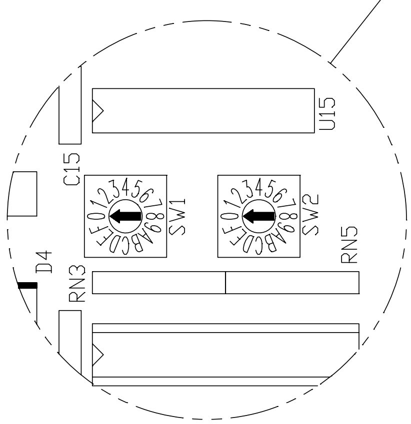


Figure 5-2 MAC-81X Selector Switch Locations

5.3 Indicators

The indicators located on the Main Processor (Table 5-1) of the System Unit provide status indication of various operating conditions. The status indicators of the controllers are desribed in the individual controller instruction books.

The indicator on an Output Type Module is illuminated when the MSC-850/32 System Unit turns the module on.

The indicator on an Input Type Module is illuminated when a user connected activating device turns the module on.

Table I - Main Processor System Status Indicator

SYSTEM STATUS		SYSTEM ERRORS	
A	NORMAL	0	FIBER OPTIC
L	PROGRAM LOAD	1	COM PORT 1
C	SYSTEM RESET	2	COM PORT 2
-	LOW POWER	3	COM PORT 3
P	PROM READ	4	PROM WRITE
U	PROM WRITE	5	PROM READ
H	TEST MODE	6	I/O EXPANSION
		7	AXIS TIMEOUT

PROGRAM ERRORS		SYSTEM FAULTS	
$\overline{\text{i}}$	ILLEGAL COMMAND	8.	SYSTEM HARDWARE RESET
$\overline{\text{o}}$	STACK OVERFLOW	E	NV MEMORY LOSS
$\overline{\text{u}}$	STACK UNDERFLOW	F	AXIS PROCESSOR
$\overline{\text{n}}$	SYS_FAULT	9	SYSTEM PROCESSOR
$\overline{\text{r}}$	SYS_RETURN		
$\overline{\text{L}}$	ILLEGAL ARGUMENT		

6.0 CONNECTION DIAGRAMS

6.1 General

This section contains the electrical connection diagrams for wiring the On-board I/O Modules and the pin-connectors for ports 0, 1, and 2.

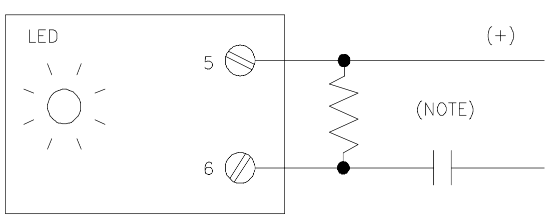
6.2 On-board I/O Modules

Figures 6-1 to 6-6 show the wiring of the six kinds of On-board I/O Modules.

NOTE

Some difficulty may arise when driving high impedence input modules with solid state outputs. The OFF State leakage current of the Output device can be enough to keep the Input Modules OFF Voltage too high. This can in result intermittent false triggers or failure to be able to turn the Input Module OFF. It is suggested that the Input Modules OFF State voltage be checked when using this configuration. These OFF State voltages should be no greater than;

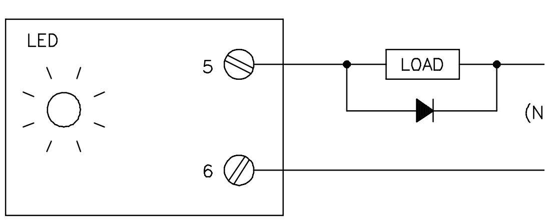
- 30v AC for AC Input Modules.
- 1v DC for DC Input Modules.



VOLTAGE RANGE: 10v to 32v DC
OFF VOLTAGE: 1v DC Min.
ON CURRENT: 25mA @ 32v DC
OFF CURRENT: 0.8mA Max.

NOTE: Higher voltages must be shunted with a resistor. Nominal value:
1K□, 1 WATT.

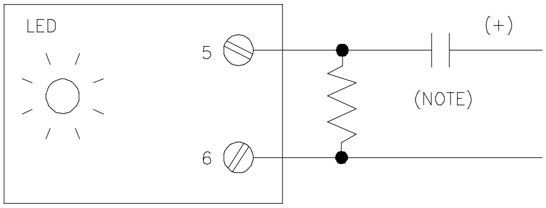
Figure 6-1 DC Input Module S410



VOLTAGE RANGE: 10v to 55v DC
ON CURRENT: 2.75A Max.
VOLTAGE DROP: 2v DC Max.
OFF CURRENT: 10mA Max.

NOTE: Diode Required for Inductive load.

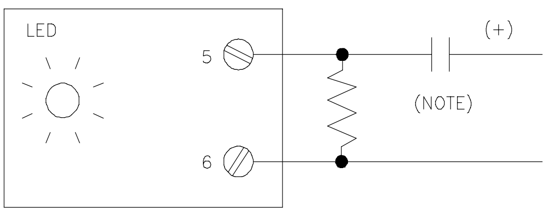
Figure 6-2 DC Output Module S430



VOLTAGE RANGE: 90v to 135v AC
OFF VOLTAGE: 30v AC Min.
ON CURRENT: 15mA
INPUT IMPEDANCE: 10K□ Nominal

NOTE: Higher voltages must be shunted with a resistor. Nominal Value: 3K□, 5 WATT.

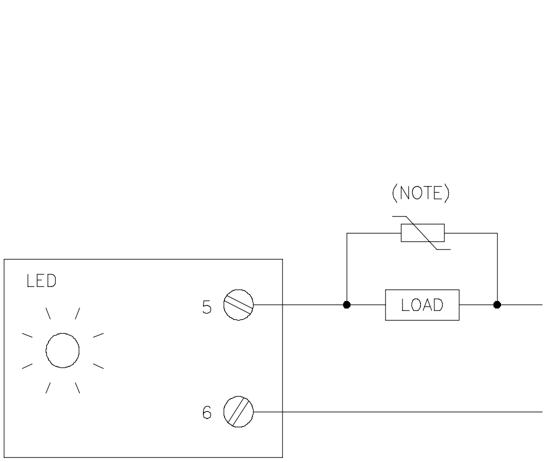
Figure 6-3 AC Input Module S420



VOLTAGE RANGE: 180v to 270v AC
OFF VOLTAGE: 60v AC Min.
ON VOLTAGE: 15mA @ 240v AC
INPUT IMPEDANCE: 10K Nominal

NOTE: Higher voltages must be shunted with a resistor. Nominal value: 6K□, 10 WATT.

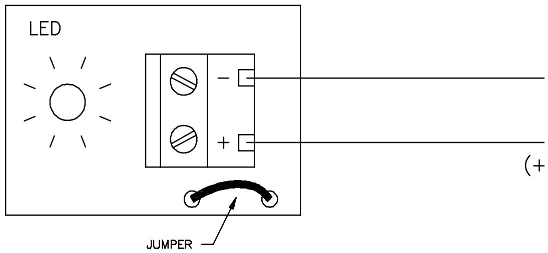
Figure 6-4 AC Input Module S421



VOLTAGE RANGE: 30v to 140v AC
ON CURRENT: 2.00A Max.
VOLTAGE DROP: 1.5v AC Max.
OFF CURRENT: 4mA Max.

NOTE: Required (use GE Transient Suppressor V150LA20A or equivalent).

Figure 6-5 AC Output S440



ON VOLTAGE:	12v to 24v DC Jumper cut
	5v Jumper installed
OFF VOLTAGE:	2v DC Max.
INPUT CURRENT:	20mA Max.

Figure 6-6 High Speed DC Input Module HSI-850

6.3 PORT 0 (0I/0R)

Port 0 is configurable between 20mA current loop (Port 0I) or RS232C (Port 0R) using Macroprogram commands.

Port 0I is a 20mA current loop port configurable for passive or active operation. Figures 6-7 and 6-8 show their respective connections.

Port 0R is a RS232C serial port. Figure 6-11 shows the connections for Port 0R.

6.4 PORT 1

Port 1 (Figure 6-9) is an executive port for the Macroprogram Development System or a host computer using RS-232C standard interface with Packet Protocol.

6.5 PORT 2

Port 2 (Figure 6-10) is a 20mA current loop port dedicated to passive operation.

NOTE
All ports on power-up will support Packet Protocol communications until re-configured by the user's macroprogram.

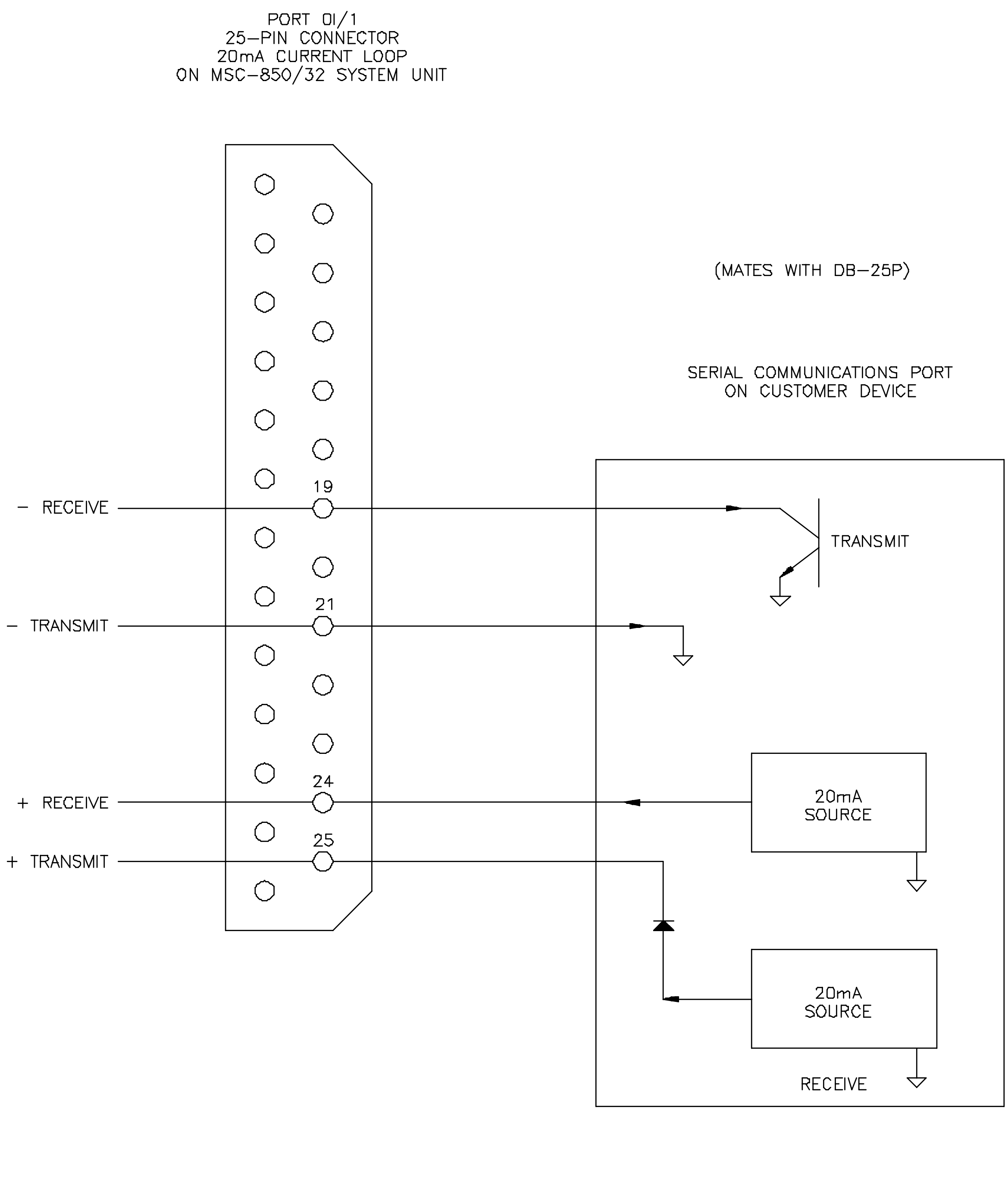


Figure 6-7 Port 0I Typical Passive Configuration

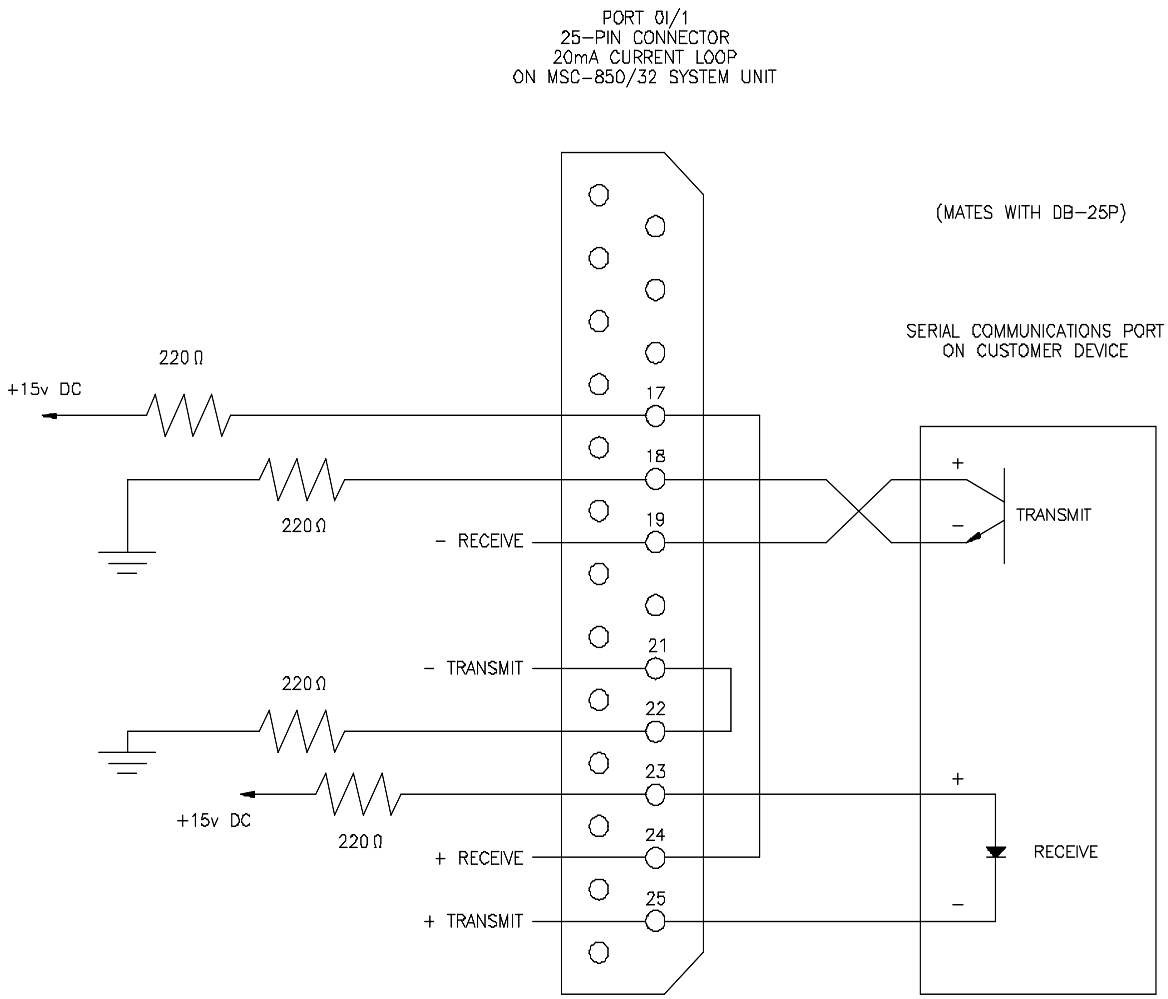


Figure 6-8 Port 0I Typical Active Configuration

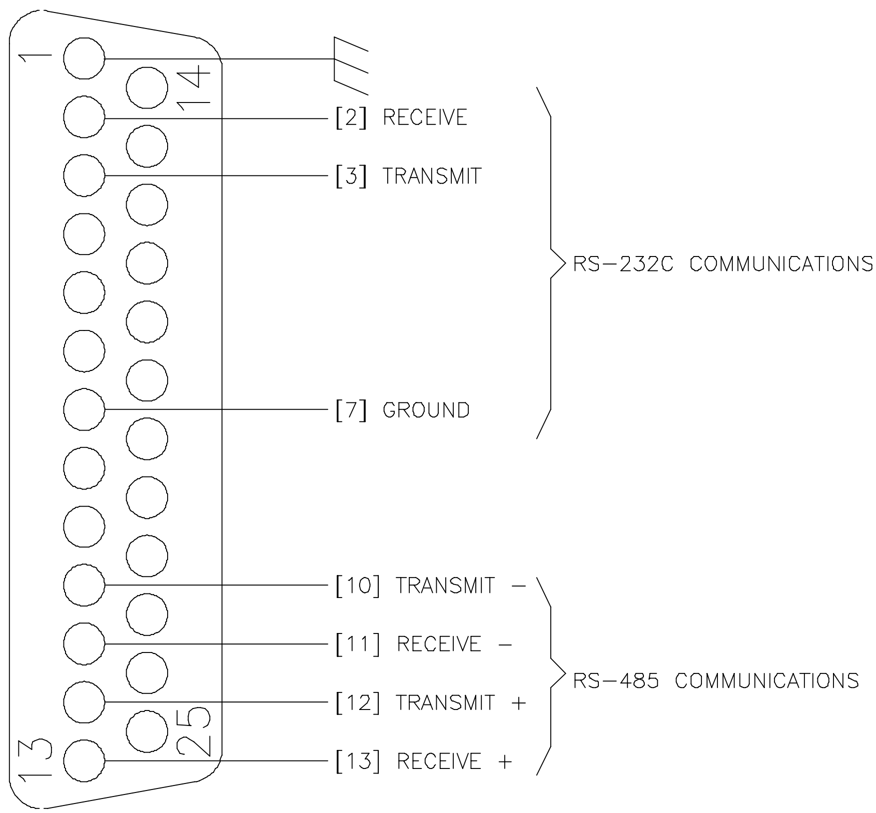


Figure 6-9 Port 1, RS-232C Host Computer Connections

> **NOTE**
> **The last device in an RS-485 multidrop communications chain must have a 62 , ¼ watt terminating resistor connected between "Receive -" and "Receive +".**

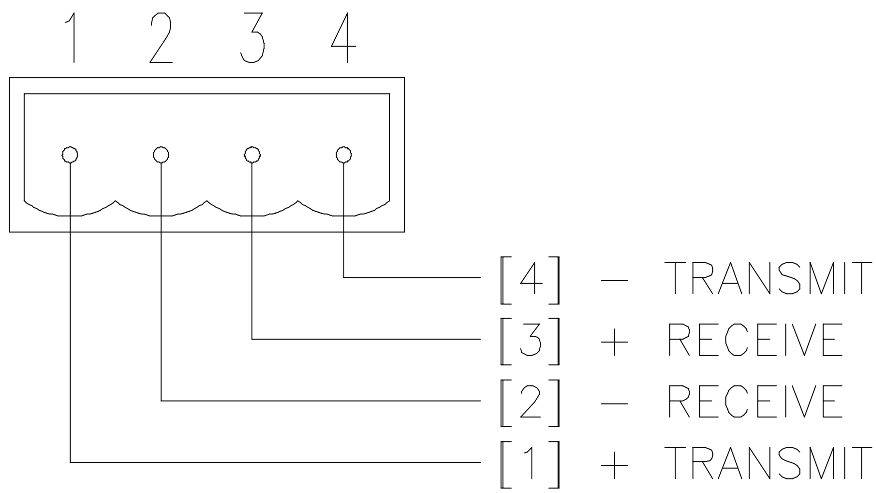


Figure 6-10 Port 2 Typical Connections

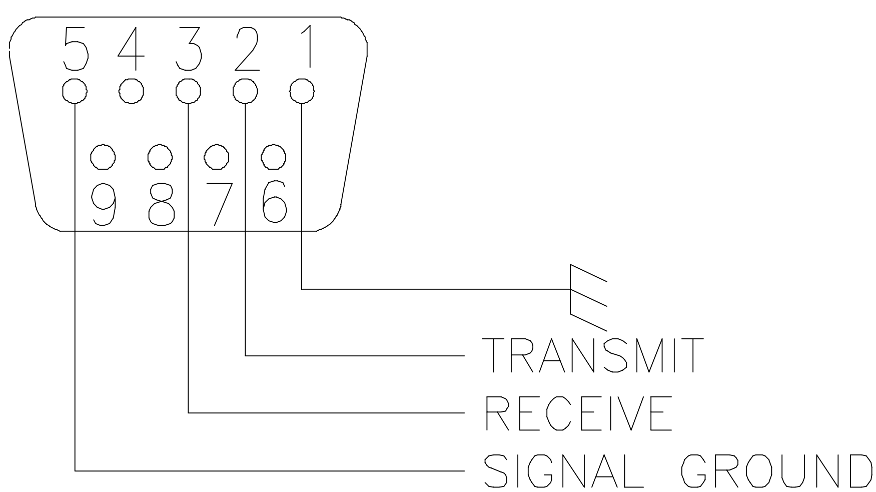


Figure 6-11 Port 0R Typical Connections

7.0 MAINTENANCE

WARNING

DISCONNECT ALL POWER AND FOLLOW PROPER LOCK-OUT PROCEDURES BEFORE ATTEMPTING REPAIRS OR ADJUSTMENTS TO THIS EQUIPMENT. ALLOW ONLY PROPERLY TRAINED PERSONNEL TO SERVICE THIS EQUIPMENT.

7.1 COMPONENT REPLACEMENT

Components which may require replacement on the MAC-81X include the batteries and the firmware. The batteries which protect the non-volatile memory must be replaced whenever the battery voltage drops below 2.6 V. This battery is located at the upper left of the MAC-81X circuit board (refer to Figure 7.1).

Industrial Indexing Systems, Inc. is continuously working to improve its products. Occasionally, these improvements are significant enough to warrant upgrades to existing controllers. These upgrades are supplied in the form of new firmware chips which must be replaced by the customer.

7.1.1 BATTERY REPLACEMENT

CAUTION

WHEN THE BATTERY IS REMOVED FROM THE CONTROLLER WITH ALL POWER TURNED OFF, ANY MACROPROGRAM STORED IN MEMORY WILL BE LOST. MAKE SURE THE MACROPROGRAM HAS BEEN BACKED UP ON A PROM OR CAN BE RESTORED FROM A PERSONAL COMPUTER BEFORE REMOVING THE BATTERY FROM THE CONTROLLER.

1. Turn off all power to the controller and open the cover.

2 .Locate the batteries on the circuit board and note the orientation of the positive and negative contacts of the battery.

3. Gently lift the metal spring clip which holds the battery in place and remove the old battery from the circuit board. **DO NOT FORCE THE SPRING CLIP UP TOO HIGH OR IT MAY BE DAMAGED.**

4. Gently lift the spring clip and replace with a similar type battery. Make sure the contacts are properly oriented.

7.1.2 FIRMWARE REPLACEMENT

1. Each firmware EPROM is located in LIF (Low Insertion-Force) sockets on the controller circuit board (refer to Figure 7.1).

> **NOTE**
>
> **When shipped, the EPROM chips will be labeled as SFO8045R for the main firmware or SFO8046R for the I/O co-processor firmware where the " " position represents a revision number. Each chip must be replaced in its proper socket. The main firmware is located in socket U26 and the I/O co-processor firmware is located in socket U33 (refer to Figure 7.1). If the wrong firmware is in the socket, a fault code will be displayed on the Status Display.**

2. Note the location of the #1 pin on the socket as indicated on the old EPROM chip in the socket.

3. Carefully remove the old processor chip by pulling straight up out of the socket so all sides of the chip move away from the socket evenly. Use of a properly-sized chip removal tool is recommended. **DO NOT PULL UP AT AN ANGLE OR UNEVENLY! DO NOT ROCK THE CHIP TO REMOVE IT FROM THE SOCKET!**

4. Gently set the new chip on the LIF socket making sure the #1 pin is aligned in the correct socket.

5. Check to make sure all pins of the chip are started in the holes in the socket. **DOUBLE CHECK!**

6. Gently press the chip straight down into the socket. **DO NOT ROCK THE CHIP TO INSERT IT OR PRESS IN AT AN ANGLE!**

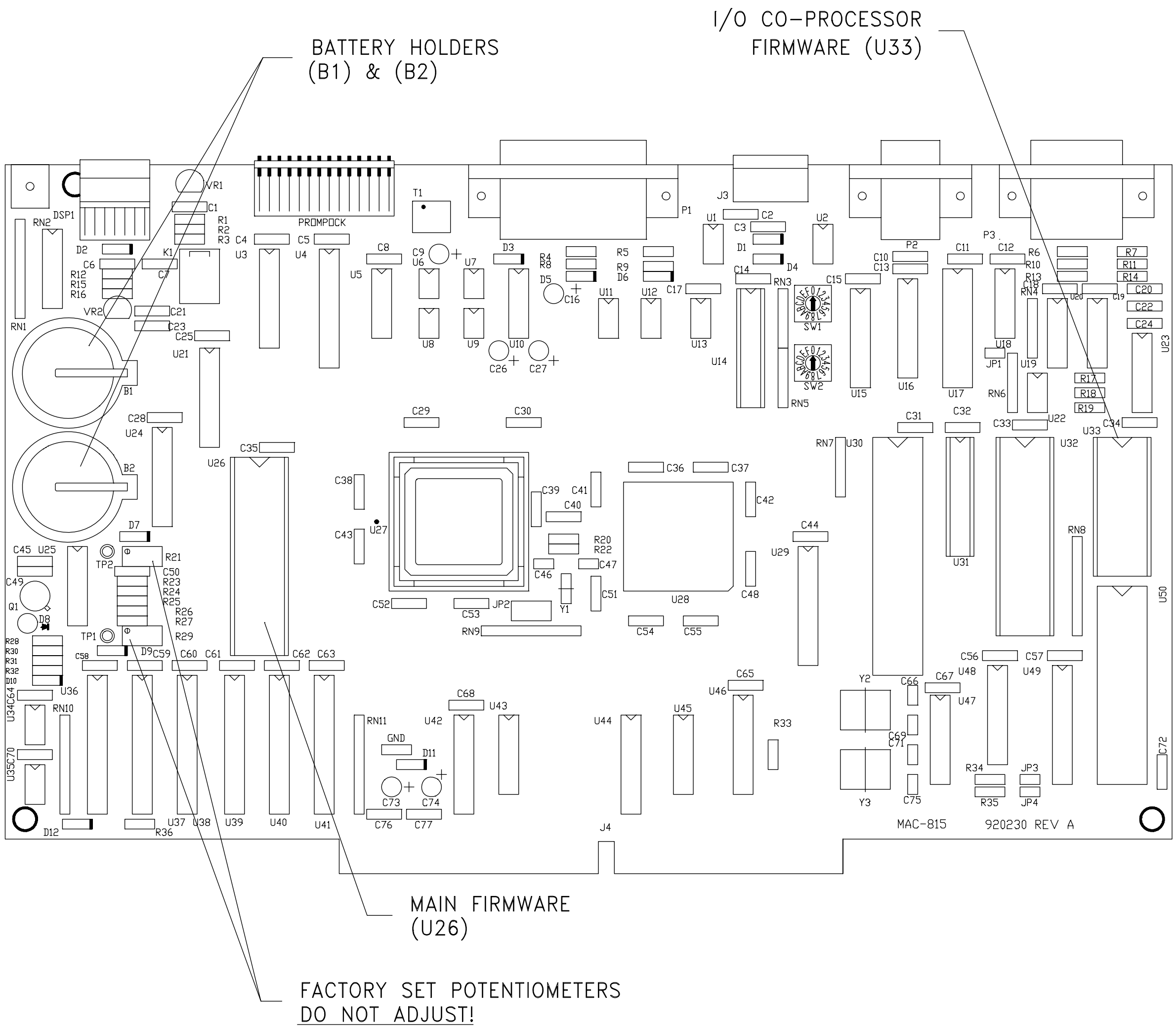


Figure 7.1 - MAC-81X Firmware and Battery locations

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- Macroprogram Development System
- MSC-850/32 Motion Control System Unit

The following trademarks of other companies are used in this publication:

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- GE is a trademark of the General Electric Company, Inc.

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DELTA MOTOR

&

DELTA DRIVER

INSTRUCTION BOOK

INDUSTRIAL INDEXING SYSTEMS, Inc.

Revision - J
Approved By:

ER-6027

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Date	Rev.	ECN No.	DR	CHK	CHK
9/3/03	0	ECN-03-392 (See Note 1)	KY	CD	
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06/04/04	C	ECN-04-216 (See Note 4)	KY	ELS/MH	
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9/23/05	E	ECN-05-260 (See Note 6)	KY	KY	
3/9/06	F	ECN-06-007 (See Note 7)	KY	KY	
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Notes:

1) Appendix A, page A-4, dated September 2003, supersedes Appendix A, page A-4, dated June 2003.

2) Appendix B, page B-2, dated October 2003, supersedes Appendix B, page B-2, dated June 2003.

3) Section 5, page 5-9, dated March 2004, supersedes Section 5, page 5-9, dated June 2003. Section 8, page 8-3, dated March 2004, supersedes Section 8, page 8-3, dated June 2003.

4) Section 5, page 5-9, dated June 2004, supersedes Section 5, page 5-9, dated March 2004. Appendix B, pages B-4 and B-5, dated June 2004, supersedes Appendix B, pages B-4 and B-5, dated June 2003. C-329YYY supersedes C-320YYY. DINT-350 revision N supersedes DINT-350 revision K.

5) Appendix B, dated November 2004, supersedes Appendix B, dated June 2003.

6) Table of Contents, page vi dated August 2005, supersedes Table of Contents, page vi, dated June 2003. Section 5, page 5-9 dated August 2005, supersedes Section 5, page 5-9, dated June 2003. Appendix A, added DBM120 series motors. Appendix B, added cables for the DBM120 series motors.

7) Section 5, page 5-9, dated March 2006, supersedes Section 5, page 5-9, dated August 2005.

8) Appendix B, DINT-300 drawing, Revision M, supersedes Appendix B, DINT-300, Revision L.

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INTRODUCTION

Thank you for selecting Industrial Indexing Systems' Delta Series products. You join many other companies around the world in your choice of these powerful, flexible motion control products.

The small, lightweight Delta Drivers combine the latest in all-digital electronic design, SMT circuit board construction and clever engineering to deliver high performance, advanced features and reasonable cost. Compact, high power density motors provide low rotor inertia, making them the logical choice for positioning and indexing applications.

Delta Drivers have a wide array of features, including a powerful embedded high speed 32-bit RISC processor, membrane keypad, high visibility 5-digit LED display, built-in RS-232 port, 8 optically isolated inputs, 8 optically isolated outputs, S-curve profiling, auto servo tuning, fault history log and many more. Dozens of operational parameters can be programmed, either through the front panel or using your IBM-compatible computer. And the PC software allows quick set-up, a full range of diagnostics and PC oscilloscope functions to display speed and current waveforms on your computer.

High-resolution resolver feedback is standard on Delta products. Other available choices include encoder feedback and Power Off absolute feedback.

SECTION 1 - OVERVIEW

This manual is organized so that information is easy to find and easy to use. It begins by detailing how to identify the basic electrical characteristics of Delta Drivers and Delta Motors, and provides comprehensive product specifications.

The six available Modes of Operation are then described, complete with signal wiring and parameter set up. Sections on Power and Driver Wiring, Regen Resistor selection and Dynamic and Mechanical Braking follow. A Troubleshooting section can aid you in the unlikely event that anything goes wrong.

Motor and Driver Speed/Torque Curves follow this preliminary information, allowing you to match Drivers and Motors to your specific applications. A final section which contains cables and various Mechanical Drawings round out this manual.

1.1 IDENTIFYING DELTA PACKAGES

Delta packages can be identified as follows.

Your Delta package model number uses this designation:

DELTA-XYYYYABCD,

WHERE:
X = motor series
  Blank = standard
  A = A series
  B = B series
  C = Custom
  D = D series
  E = E series
YYYY = is the rated mechanical output wattage of the package
A = H = 3000 rpm rated motor
  M = 2000 rpm rated motor
  L = 1500 rpm rated motor
  C = custom speed
B = R = resolver based system
  RA = absolute resolver sensor based system
  E = encoder based system
  EA = absolute encoder sensor based system
C = A = 220 VAC system, single or three phase
  B = 120 VAC system, single phase (only for smallest drive and only up to 200 watts)
D = motor and driver options where
  B = integral brake option
  I = 14 bit analog input
  J = Sourcing I/O Expansion Board
  K = Sinking I/O Expansion Board
  1X = 1 cycle resolver
  others as defined in future

Example: A Delta package designated DELTA-120HRB is a 120-watt motor, with a 3000 rpm rated motor, a resolver based system, 120 VAC system. If this same package was equipped with an integral brake, it would be designated DELTA-120HRBB.

1.2 IDENTIFYING DELTA DRIVES

Delta Drivers can be identified as follows. This information is on the Driver label:

Your Delta Driver model number uses this designation:

DSD-CURRENT/ZYX,

WHERE:
CURRENT = Peak Driver Current in amps (rms)
Z = feedback method:
R = resolver feedback
E = encoder feedback
RA = absolute resolver feedback
EA = absolute encoder feedback
Y = input voltage:
A = 220 VAC input (single or three phase)
B = 115 VAC input (single phase) - only available up to 200 watts
X = option:
I = 14 bit analog input A & D converter
J = Sourcing I/O Expansion Board
K = Sinking I/O Expansion Board

Example: A Delta Driver designated DSD-8.5/RB has a peak current rating of 8.5 A rms, resolver feedback, and 115 VAC 1∅ input voltage.

1.3 IDENTIFYING DELTA MOTORS

Delta Motors can be identified as follows. This information is on the Motor label:

Your Delta Motor model number uses this designation:

DBM-SERIES WATTAGE/SPEED YZ,

WHERE:
SERIES = Motor series
Blank = standard
A = A series
B = B series
C = Custom
D = D series
E = E series
WATTAGE = Rated Motor Power in watts
SPEED = Rated Motor Speed in hundreds of RPMs
Y = feedback method:
R = resolver feedback
E = encoder feedback
RA = absolute resolver feedback
EA = absolute encoder feedback
Z = B for a motor with an integral brake
T for windings with “Tropical” fungus protection
W for washdown sealing
1X = 1 cycle resolver

Example: A Delta Motor designated DBM-120/30R is a 120-watt motor with a 3000 rpm rated speed and resolver feedback. If this same motor were equipped with an integral brake, it would be designated DBM-120/30RB. If the same motor was equipped with “Tropical” fungus protection, it would be designated DBM-120/30RT and with a brake, it would be designated DBM-120/30RBT.

SECTION 2 - SPECIFICATIONS

2.1 DRIVER SPECIFICATIONS

Delta Driver	DSD-1.5/RB	DSD-1.5/RA	DSD-4.25/RB	DSD-4.25/RA
Weight	3.3 lb 1.5 kg	3.3 lb 1.5 kg	3.3 lb 1.5 kg	3.3 lb 1.5 kg

Delta Driver	DSD-8.5/RB	DSD-8.5/RA	DSD-17.5/RA	DSD-35/RA	DSD-50/RA	DSD-70/RA	DSD-115/RA
Weight	3.3 lb 1.5 kg	3.3 lb 1.5 kg	5.5 lb 2.5 kg	10 lb 4.5 kg	10 lb 4.5 kg	24 lb 11 kg	35 lb 16 kg

2.1.1 MOTOR OUTPUT

Delta Driver	DSD-1.5/RB	DSD-1.5/RA	DSD-4.25/RB	DSD-4.25/RA
Motor Output	PWM, 3 Phase, sine wave			
Continuous Output Current	1.0 A rms	1.0 A rms	2.8 A rms	2.8 A rms
Max. Output Current See **Figure 2.1**	1.5 A rms	1.5 A rms	4.25 A rms	4.25 A rms
Motor Ripple Frequency	20 kHz	20 kHz	20 kHz	20 kHz

Delta Driver	DSD-8.5/RB	DSD-8.5/RA	DSD-17.5/RA	DSD-35/RA	DSD-50/RA	DSD-70/RA	DSD-115/RA
Motor Output	PWM, 3 Phase, sine wave						
Continuous Output Current	2.1 A rms	3.4 A rms	5.7 A rms	14.1 A rms	18.4 A rms	28.3 A rms	56.6 A rms
Max. Output Current See **Figure 2.1**	8.5 A rms	8.5 A rms	17.5 A rms	35.0 A rms	50.0 A rms	70.0 A rms	115.0 A rms
Motor Ripple Frequency	20 kHz	20 kHz	20 kHz	20 kHz	20 kHz	10 kHz	10 kHz

2.1.2 POWER SUPPLY

Delta Driver	**DSD-1.5/RB**	**DSD-1.5/RA**	**DSD-4.25/RB**	**DSD-4.25/RA**
Main Bus Power Supply Voltage	1 Phase, Nominal: 110 VAC, Max Range: 85-126 VAC, 50/60 Hz	1 Phase, Nominal: 220 VAC, Max Range: 170-264 VAC, 50/60 Hz	1 Phase, Nominal: 110 VAC, Max Range: 85-126 VAC, 50/60 Hz	1 Phase, Nominal: 220 VAC, Max Range: 170-264 VAC, 50/60 Hz
Main Supply Capacity	350 VA	350 VA	350 VA	350 VA
Control Voltage	Powered by main circuit supply			
Control Capacity	Powered by main circuit supply			
Main Circuit Heat Loss	17 W	17 W	17 W	17 W
Control Circuit Heat Loss	23 W	23 W	23 W	23 W
Regeneration Absorption Capacity	13 W + 17 J	13 W + 17 J	13 W + 17 J	13 W + 17 J

Delta Driver	**DSD-8.5/RB**	**DSD-8.5/RA**	**DSD-17.5/RA**	**DSD-35/RA**	**DSD-50/RA**	**DSD-70/RA**	**DSD-115/RA**
Main Bus Power Supply Voltage	1 Phase, Nominal: 110 VAC, Max Range: 85-126 50/60 Hz	1 Phase, Nominal: 220 VAC, Max Range: 170-264 VAC, 50/60 Hz		3 Phase, Nominal: 220 VAC, Max Range: 170-264 VAC, 50/60 Hz			
Main Supply Capacity	570 VA	1.2 KVA	2.5 KVA	5.3 KVA	6.7 KVA	13 KVA	25 KVA
Control Voltage	Powered by main circuit supply			Single phase, 170-264 VAC, 50/60 Hz			
Control Capacity	Powered by main circuit supply			70 VA		80 VA	110 VA
Main Circuit Heat Loss	20 W	27 W	47 W	110 W	130 W	250 W	400 W
Control Circuit Heat Loss	23 W	23 W	23 W	26 W	26 W	30 W	60 W
Regeneration Absorption Capacity	17 W + 17 J	24 W + 17 J	37 W + 22 J	160 W + 38 J	180 W + 54 J	300 W + 94 J	480 W + 188 J

2.1.3 CONTROL PERFORMANCE

Feedback	Resolver
Feedback Resolution	12000 bits/rev * number of resolver cycles ie. 2X resolver = 2*12000 bits/rev = 24000 bits/rev. See motor drawings in **Appendix A.6** for resolver type.
Feedback Accuracy	18 arc minutes spread for motors with 95 mm mounting face or smaller ±20 arc minutes for B series motors 8 arc minute spread for all other motors
Current Loop Update Rate	100 μsec
Velocity Loop Update Rate	400 μsec
Position Loop Update Rate	800 μsec
Speed Regulation	Load (0%-100%): ±0.02% Power (85-126 VAC or 170-264 VAC): ±0.02% Temperature (0-55°C/32-131°F): ±0.2%
Torque Regulation	Power (85-126 VAC or 170-264 VAC): ±2% Temperature (0-55°C/32-131°F): ±2%

Feedback	Encoder
Feedback Resolution	See motor/driver speed torque curves in **Appendix A.4** for encoder resolution.
Feedback Accuracy	Less than 2 arc minutes
Current Loop Update Rate	100 μsec
Velocity Loop Update Rate	400 μsec
Position Loop Update Rate	800 μsec
Speed Regulation	Load (0%-100%): ±0.02% Power (85-126 VAC or 170-264 VAC): ±0.02% Temperature (0-55°C/32-131°F): ±0.2%
Torque Regulation	Power (85-126 VAC or 170-264 VAC): ±2% Temperature (0-55°C/32-131°F): ±2%

2.1.4 ENVIRONMENT

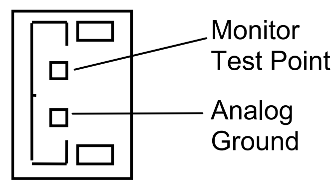
Storage Temperature	-10 to 70°C/14-158°F
Operating Temperature	0 to 55°C/32-131°F
Humidity	35 to 90% Relative Humidity, non-condensing
Shock and Vibration	1 G or less
Operating Conditions	Free of dust, liquids, metallic particles and corrosive gases. Use in a pollution degree 2 environment.
Drive Enclosure	The drive is rated as "open type equipment" by Underwriters Laboratories, Inc.

2.1.5 I/O CONTROL SIGNALS

Standard Sinking I/O	Control Input	24 VDC 8 ma: common to +24V, optically isolated
	Control Output	24 VDC 40 ma: common to 24G, optically isolated
Optional Sinking I/O DINT-300K	Control Input	24 VDC 6 ma: common to +24V, optically isolated
	Control Output	24 VDC 400 ma: common to 24G, optically isolated
Optional Sourcing I/O DINT-300S	Control Input	24 VDC 6 ma: common to 24G, optically isolated
	Control Output	24 VDC 400 ma: common to +24V, optically isolated
Internal Power Supply	24 VDC ± 15% 100 ma maximum, ground isolated	
External Power Supply	24 VDC ± 15%	

2.1.6 ANALOG I/O SIGNALS

REF1 and REF2	Maximum Input Voltage: ± 10 VDC Input Impedance: 18 kΩ A/D resolution: 1/1024 at ±10V (10 bit Standard, 14 bit Optional) Scaleable with setup parameter
Monitor Output	Maximum Voltage Swing: ± 3 VDC at 1 ma Output Impedance: 330 Ω Accuracy: ±8% Monitor Scaling Speed: 3V equals motor rated speed Torque: 3V equals motor peak torque C-722006 Monitor Cable Available



2.1.7 HIGH SPEED DIGITAL I/O SIGNALS

Command Pulse FMA and /FMA FMB and /FMB	On voltage: 5 VDC ± 5% at 17 ma maximum Off voltage: 1 VDC ± 5% less than 1 ma 200 KHz maximum frequency in pulse-pulse or pulse-direction modes 50 KHz in AB quadrature mode Optically isolated
Pulse Output APD and /APD BPD and /BPD ZPD and /ZPD	RS422 output: AM26LS31 or equiv. 400 kHz maximum frequency

2.1.8 PROTECTION

Fault Checks	Under Voltage, Over Voltage, Motor Short, Output Short, Feedback Loss, Regeneration Resistor Over Temperature and Malfunction, Driver Over Temperature, Motor rms Torque (motor overheat) Driver Rated Current, Over Speed, Motor Stall, Dynamic or Mechanical Brake Failure, Following Error, Internal Watchdog Timer, Processor Diagnostics
Output Short Circuit Protection	The drives are suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 240 volts maximum when protected by a circuit breaker having an interrupting rating not less than 5000 rms symmetrical amperes, 240 volts maximum.

2.2 MOTOR SPECIFICATIONS

2.2.1 GENERAL

Duty	Continuous at rated speed and rated torque
Type	Permanent magnet synchronous
Insulation	Class F
Sealing	See motor drawings in **Appendix A.6, A.7 & A.8**
Storage Temperature	-10 to +70ºC/14 to 158ºF
Ambient Operating Temperature	-10 to +40ºC/14 to 104ºF
Shock and Vibration	2 G's
Mounting	Motor can be mounted in any position

2.2.2 FEEDBACK DEVICE

Type: Resolver	Resolver control transformer See motor drawings in **Appendix A.6, A.7 & A.8**
Type: Encoder	ABZ plus UVW 5V line driver

2.2.3 OTHER

Weight Shaft Loading Brake Specifications Dimensions	See motor drawings in **Appendix A.6, A.7 & A.8**
Torque Ratings Speed Torque Curves	See specifications in **Appendix A.4**

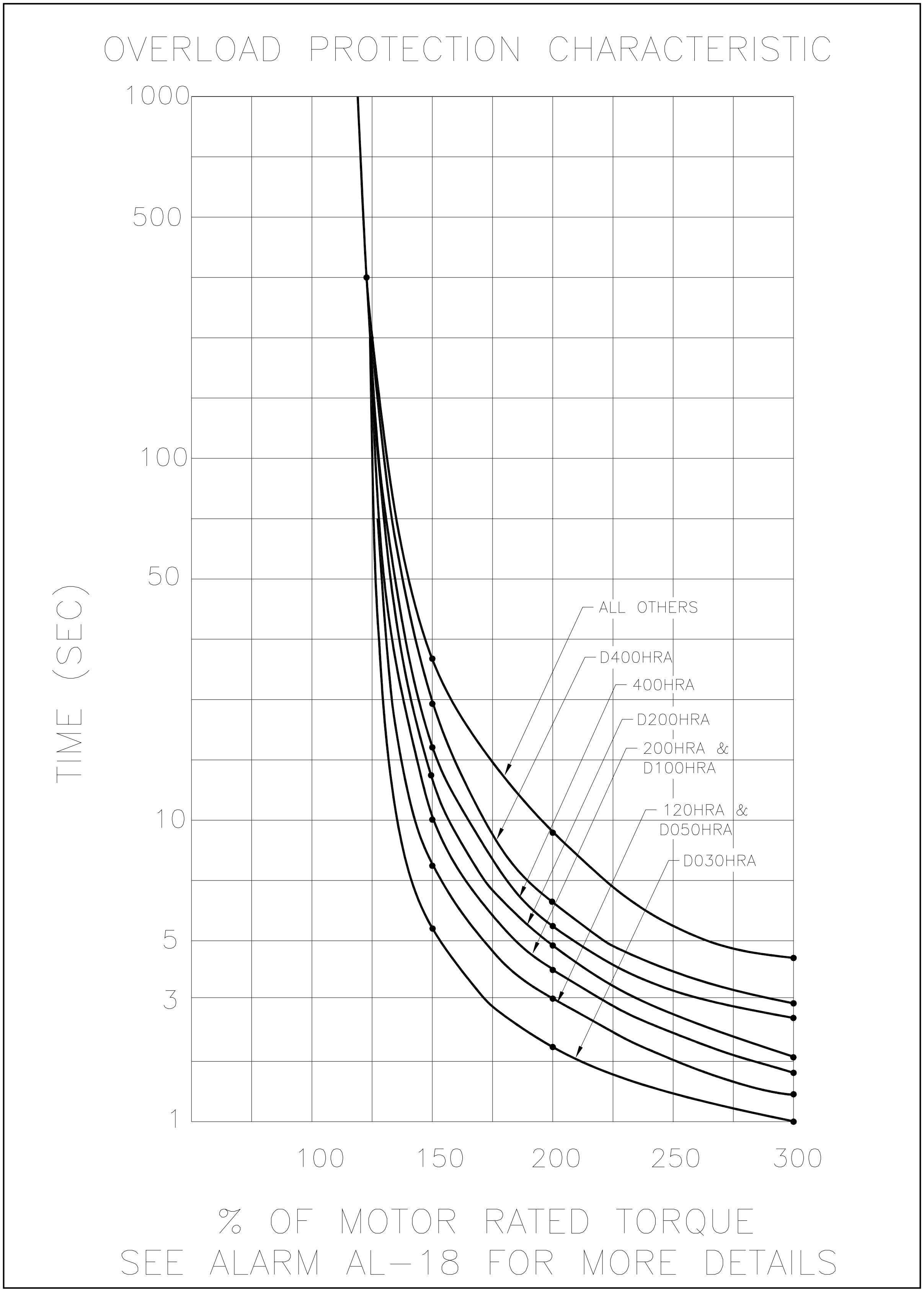


Figure 2.1 - Delta Overload Protection Characteristic

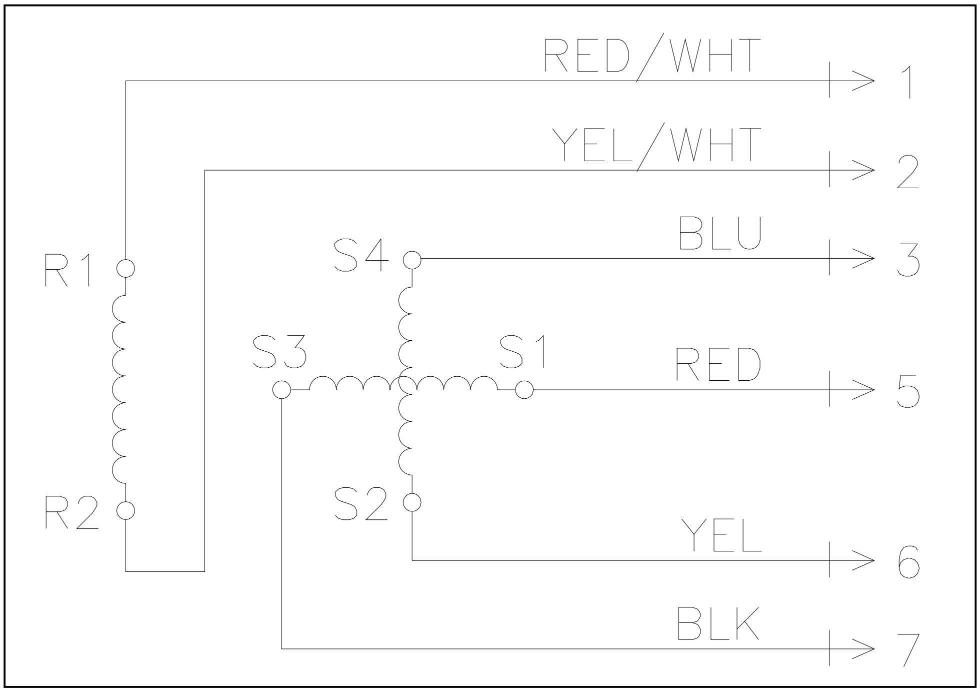


Figure 2.2 - Standard Resolver Wiring Connections for DBM-XXX/15R, DBM-500/30R and Larger

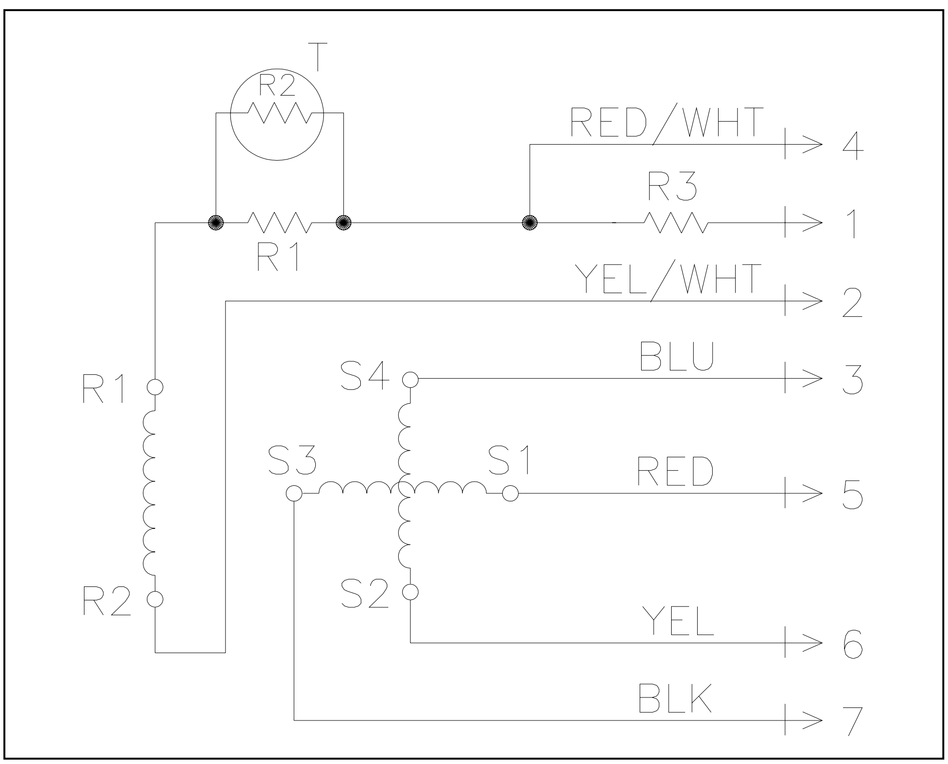


Figure 2.3 - Alternate Resolver Wiring Connections for DBM-XXX/15R, DBM-500/30R and Larger

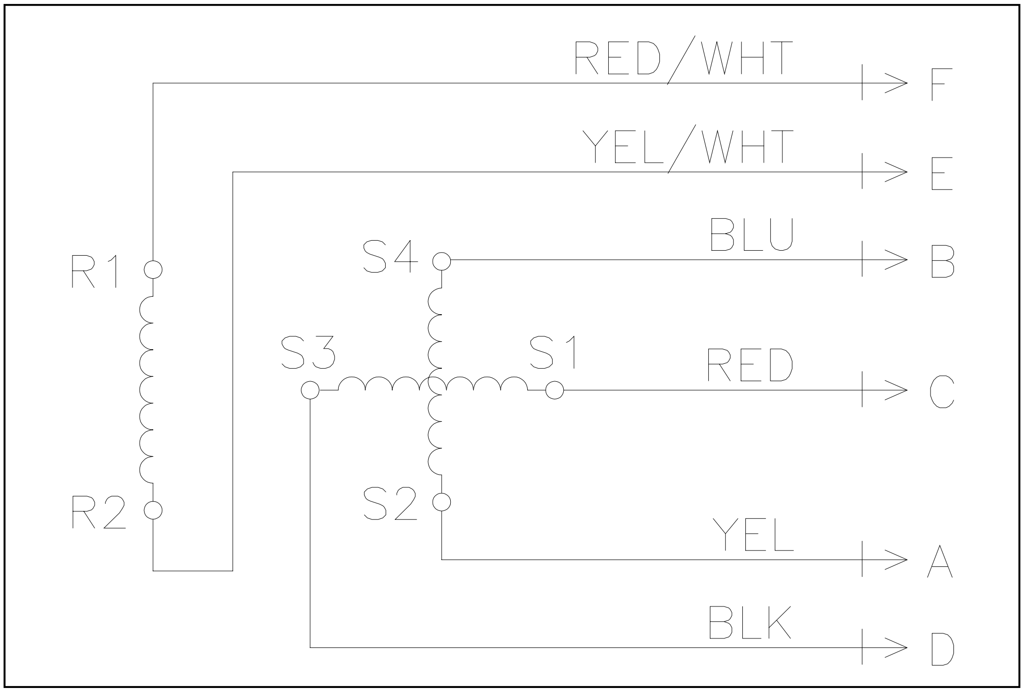


Figure 2.4 - Standard Resolver Wiring Connections for DBM-120/30R, DBM-200/30R, DBM-400/30R, DBM-BXXX/30R, DBM-D30/30R and DBM-D50/30R

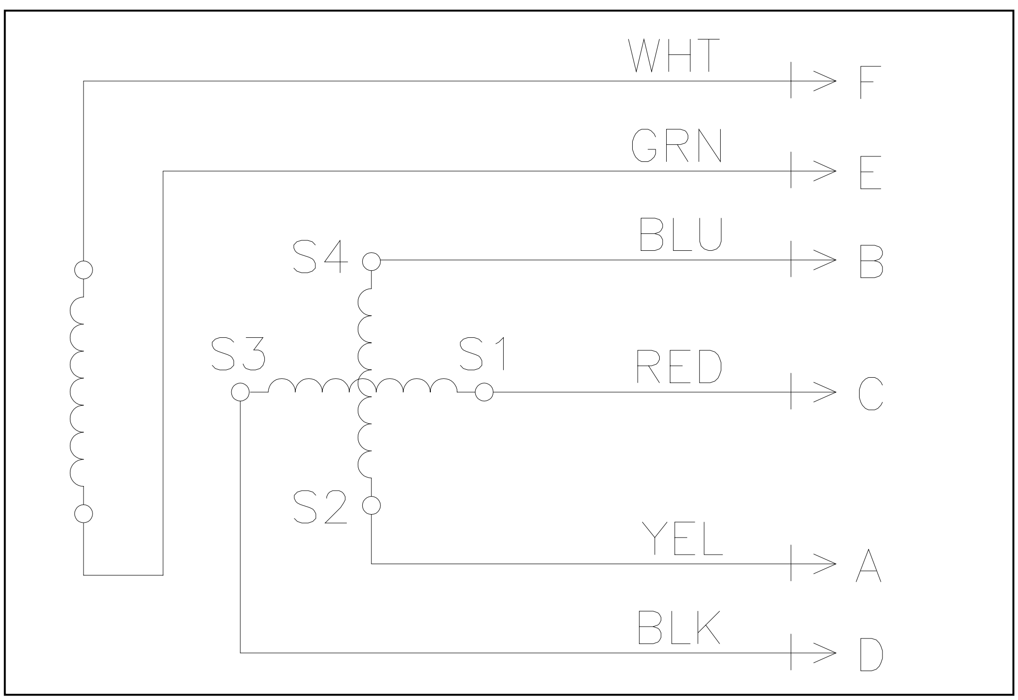


Figure 2.5 - Alternate Resolver Wiring Connections for DBM-120/30R, DBM-200/30R and DBM-400/30R

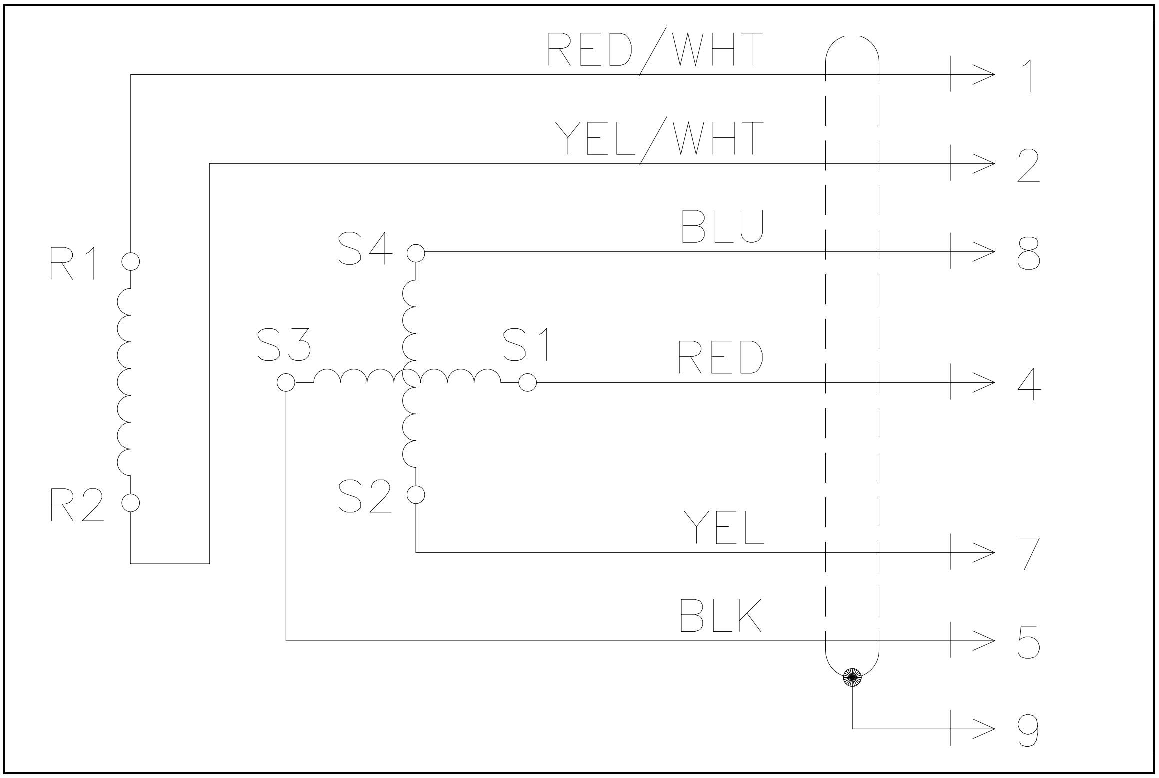


Figure 2.6 - Standard Resolver Wiring Connections for DBM-D100/30R Through DBM-D800/30R

SECTION 3 - PROGRAMMING THE DELTA DRIVER

The Delta Driver is a fully digital driver that has a rich set of motion control building blocks that are configurable using the driver's software. A built in keypad and display are used to set internal parameters that configure the driver's software building blocks into user defined motion functions.

An easy to use menu scheme allows the user to:

- Set the basic mode of operation
- Activate optional features
- Define I/O functions
- Monitor key parameters and alarms
- Adjust driver parameters
- Manual or automatic tuning of the motor and driver
- Manual testing of driver operation

The drivers keypad and display are shown in Figure 3.1. The functions are as follows:

- **LED DISPLAY** is a 5-digit unit that displays coded messages, alarms and parameter values. Messages are displayed in coded bit patterns, hexadecimal, decimal and coded letters.
- **UP-ARROW** is used to navigate around the minor menu loops, to increase the value of a parameter and in combination with other keys for special functions.
- **DOWN-ARROW** is used to navigate around the minor menu loops, to decrease the value of a parameter and in combination with other keys for special functions.
- **SELECT** SEL is used to identify which digit of the display is selected for modification (flashing). This key is also used in combination with the **CONFIRM** key to prepare a parameter for modification.
- **MODE** MODE is used to navigate the main menu loop and to return to the main menu loop from the minor loops.
- **CONFIRM** is used to confirm a parameter value and to set into non-volatile memory and to reset alarms. This key is also used in combination with the **SELECT** SEL key to prepare a parameter for modification.
- **FLASHING DECIMAL POINT** indicates that an alarm is active.

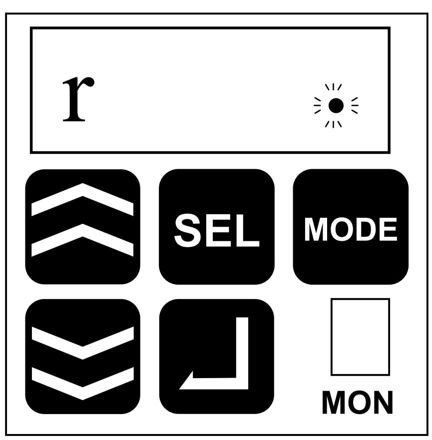


Figure 3.1 - Delta Driver Keypad and Display

3.1 NAVIGATING THE DRIVER'S MENU

The menu structure for programming the driver consists of a main menu loop with several minor menu loops and the Special Menu. The main menu loop and partial sections of the minor loops are shown in **Figure 3.2** below.

The major loop is shown vertically on the left side of the diagram. There are four major items on the main menu loop. Each of these items is the starting point for minor menu loops.

- **STATUS DISPLAY** minor menu loop contains drive and motor status displays such as motor speed, motor position, following error, etc.
- **DIAGNOSTIC DISPLAY** minor menu loop provides diagnostic information such as I/O status, alarms and alarm history.
- **ADJUST PARAMETER** minor menu loop contains parameters that are typically adjusted by the user. Parameters include speed scaling, servo tuning values and load inertia setting.
- **USER PARAMETER** minor menu loop contains basic configuration parameters that are usually set once per application such as control mode, motor type, electronic gear ratio and analog polarity.
- **HP PARAMETER** is a sub-menu loop from the **USER PARAMETER** minor menu. This sub-menu loop also contains configuration parameters that are less frequently used or modified.

The [MODE] key is used to move around the main menu loop. Once the main menu is positioned on the first parameter of a minor loop the [▲] and [▼] keys are used to move around the minor menu loop. When in the minor menu loop the [↵] and [▲] or the [↵] and [▼] keys move through the parameters in jumps of 10 rather then 1. The [MODE] mode key can be used to move from anywhere in the minor menu back to the main menu loop.

The HP parameter sub-menu is entered by putting the main menu loop on UP-01 and pressing and holding the [SEL] key then pressing both the [▲] and [▼] keys. Once in the HP sub-menu the [▲] and [▼] keys are used to move around the sub-menu. The [MODE] must be pressed twice quickly to move from the HP sub-menu back to the UP minor menu.

The Special Function Menu is used for Auto Tuning, manual jogging of the motor and forcing outputs. **Section 3.3** describes the Special Function Menu.

3.1 NAVIGATING THE DRIVER'S MENU (cont'd)

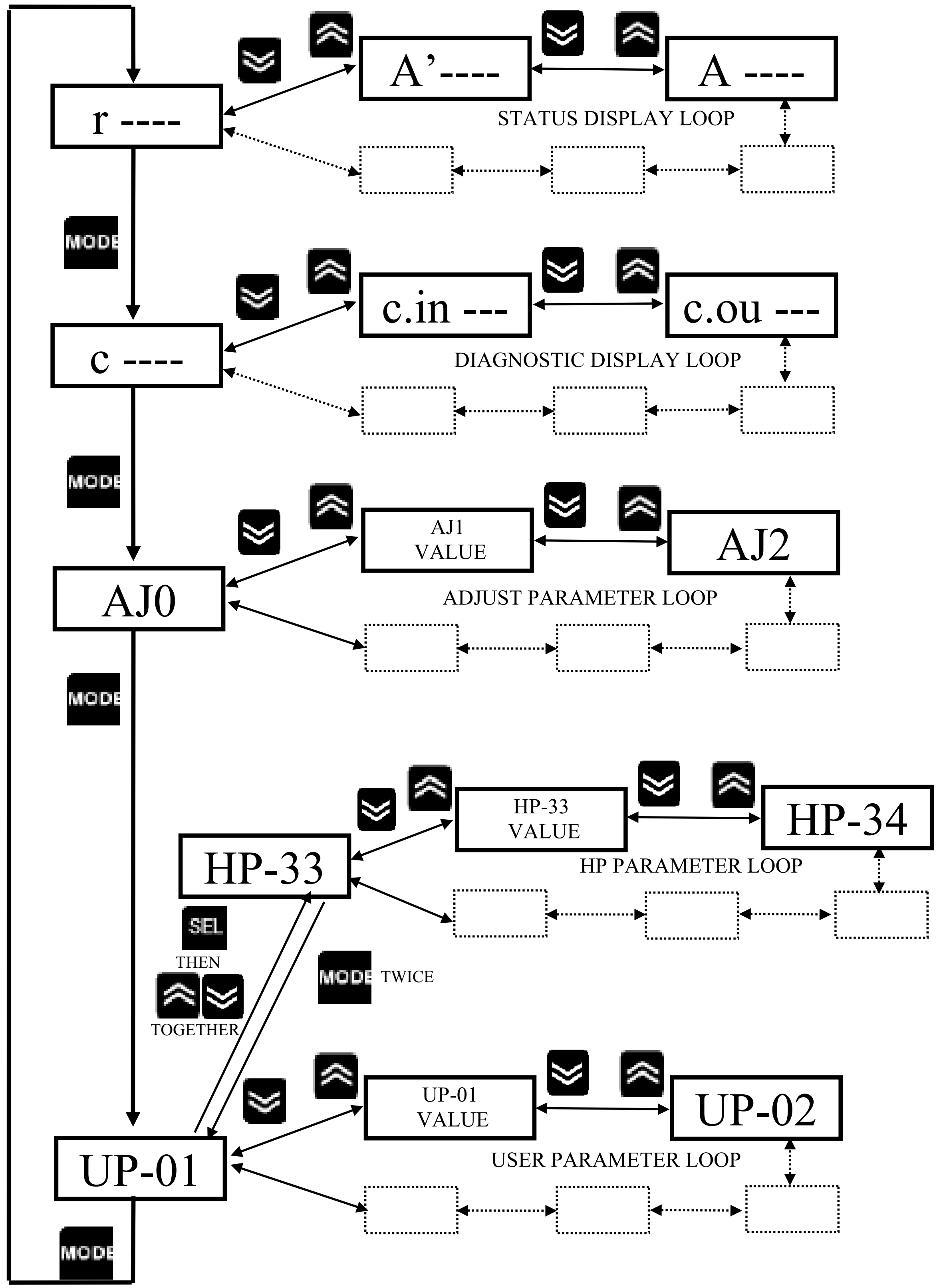


Figure 3.2 - Main Menu Loop and Minor Loops

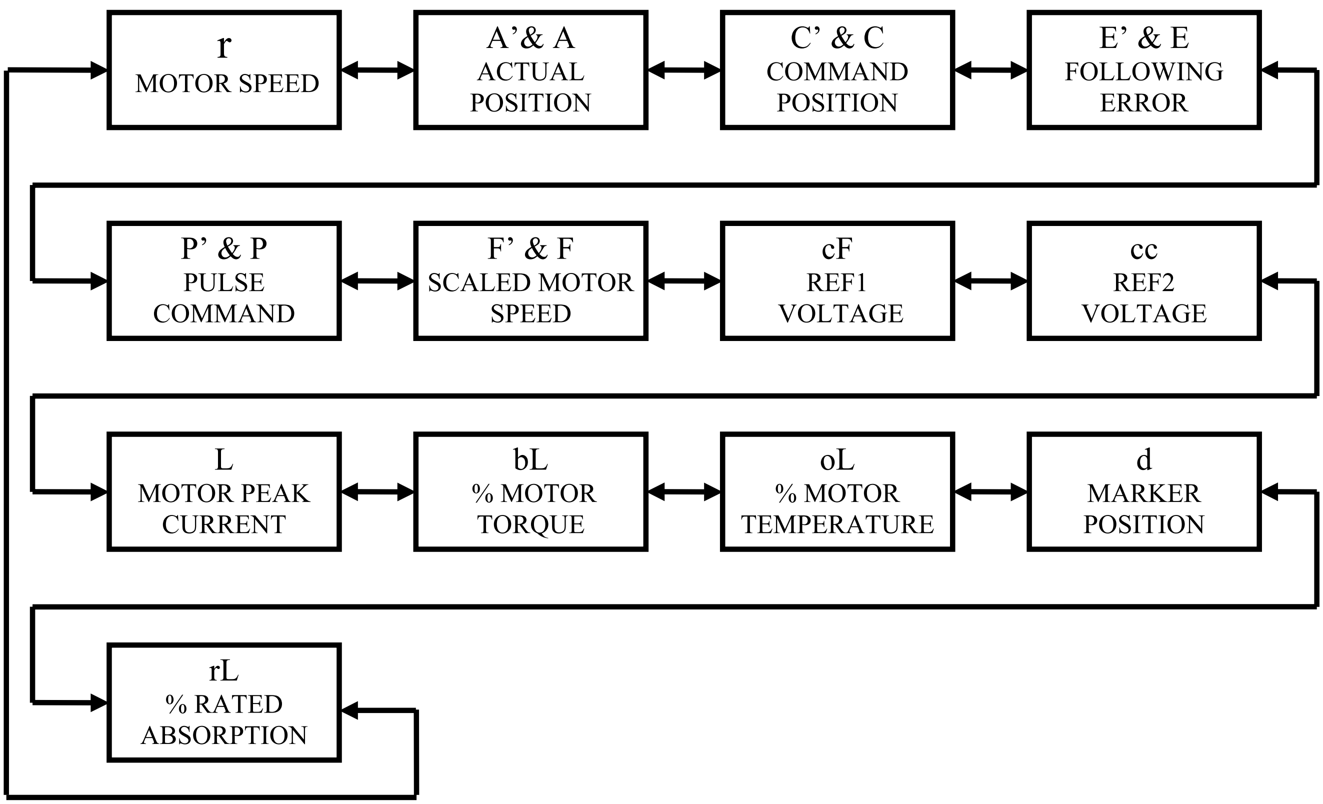
3.1.1 STATUS DISPLAY MENU LOOP

The Status Display Menu Loop provides a real time display of motor and driver status. The display format uses the left most digits for a coded message of the item to be displayed and the right most digits are the value. The coded item on the left will flash indicating negative (-) value. The sign convention is (+) is CCW and (-) is CW.

Some of the display values, such as A' & A, are too large for a single display so they are broken into two sections and are displayed on two successive menu displays. The prime (') symbol indicates the upper four (4) digits or most significant section and the non-prime symbol indicates lower four (4) digits. For example, if successive displays reads [A' 1466] and [A 6789], the ACTUAL POSITION is 14666789.

Parameters can only be read in the Status Display Menu. The driver is set to the (r) Motor Speed at power application. Any alarm will overwrite the display.

The Status Display Menu is organized as follows:



3.1.1 STATUS DISPLAY MENU LOOP (cont'd)

Status Display Descriptions:

DISPLAY ITEM	SYMBOL	RANGE & UNITS	CONTENTS
Motor rpm	**r**	±4000 RPM	Displays the speed of motor.
Actual Position	**A' A**	±9999999 Bits	Displays the actual position of the motor scaled by UP-05/UP-04 * 24000 bits/rev (driver is always 24000 bits/rev internally). With resolver feedback, the 0.0 position at power up is referenced to the nearest resolver 0.0. The Delta motors have a 2X resolver, and have two 0.0 points or markers per motor shaft rotation. When the count exceeds display range, 9999999 appears.
Command Position	**C' C**	±9999999 Bits	Displays the command position of the driver (scaled by UP-05/UP-04 similar to A' A above). When the count exceeds display range, 9999999 appears.
Following Error	**E' E**	±9999999 Bits	Displays the difference between command position and actual position (scaled by UP-05/UP-04 similar to A' A above). Used in position control modes only.
Pulse Command	**P' P**	+32767~ 32768 Pulses	Displays the pulse command input register in position control mode. This counter is a signed 16 bit counter with a range of +32767 to -32768. Counter rolls over when it reaches the maximum count (ring counter).
Scaled Motor Speed	**F' F**	±9999999 RPM	Displays the speed of the motor scaled by HP-41/HP-42. This used typically used to display "machine speed" if the speed exceeds display range, 9999999 appears.
REF1 Voltage	**cF**	±10.0 V	Displays the input voltage REF1 (speed command or speed limit depending on mode of operation).
REF2 Voltage	**cc**	±10.0 V	Displays the input voltage REF2 (torque command, torque limit or speed command depending on mode of operation).
Motor Peak Current	**L**	±160.0 A (peak)	Displays the output current to motor. "A (peak)" shows the peak value of AC current.
% Motor Torque	**bL**	0~255%	Displays the load ratio (output torque/rated torque) * 100%. The time constant for calculating this ratio is set by HP-33.
% Motor Temperature	**oL**	0~110%	Displays calculated motor temperature as a % of the maximum rating. The electronic motor thermal limit alarm activates at 110% (AL-17). **oL** initializes to 90% at power on.

3.1.1 STATUS DISPLAY MENU LOOP (cont'd)

Status Display Descriptions (cont'd):

DISPLAY ITEM	SYMBOL	RANGE & UNITS	CONTENTS
Marker Position	**d**	0~359.9 deg	Displays the motor shaft angle from the motor marker ZPD position. The driver has N marker ZPD positions depending on the resolver/encoder installed in the motor. (i.e. a motor with a 2X resolver has 2 ZPD positions per motor revolution, see motor drawings in **Appendix A.6, A.7 & A.8**). If the motor has 3X resolver and 3 ZPD positions, this display will go from 0.0 to 359.9 degrees 3 times per motor rotation.
% Rated Absorption	**rL**	0~100%	For DSD-1.5, DSD-4.25, DSD-8.5 and DSD-17.5 the display is (motor absorption torque/motor rated torque) * 100%. For DSD-35 and up the display is % rating of the regeneration resistor capacity (UL-31).

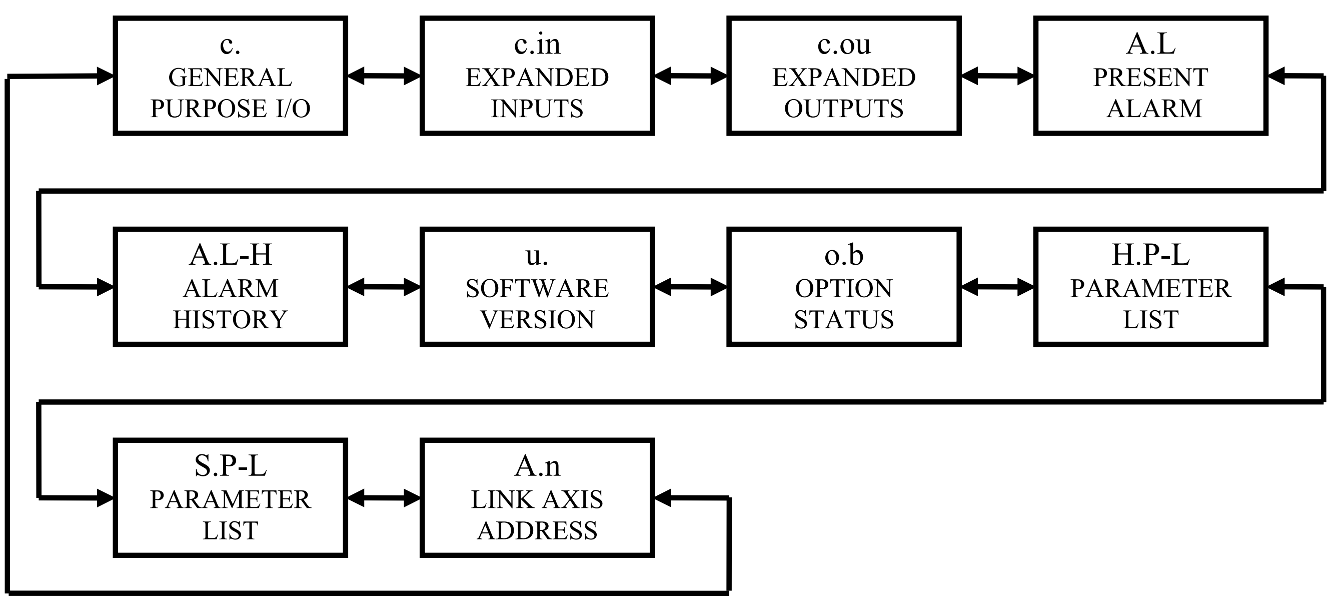
3.1.2 DIAGNOSTIC DISPLAY MENU LOOP

The Diagnostic Display Menu Loop provides a real time display of I/O points, alarms, alarm history and driver configurations. The display format uses the left most digits for a coded message of the item to be displayed and the right most digits are the value.

Some of the display values, such as A.L-H ALARM HISTORY require additional keystrokes to view the complete status. The additional keystrokes are described in the individual display descriptions.

Parameters can only be read in the Diagnostic Display Menu, with the exception that the ALARM HISTORY can be cleared.

The Diagnostic Display Menu Loop is organized as follows:



3.1.2 DIAGNOSTIC DISPLAY MENU LOOP (cont'd)

Diagnostic Display Descriptions:

DISPLAY ITEM	SYMBOL	CONTENTS
General purpose I/O	**c.**	Displays the current I/O status using the vertical segment bars in the display. The top half of the segment bar are inputs and the bottom half are outputs. The right most vertical bar is IN0 (top half) and OUT0 (bottom half). The vertical bar just to the right of the **c.** is IN7 (top half) and OUT7 (bottom half). When the bar is illuminated the I/O point is ON. The I/O point can be inverted using HP-44 & HP-45. See the individual signal level I/O diagrams in Section 4. IN7 ▌ ▌ ▌ ▌ ▌ ▌ ▌ ▌ IN0 OUT7 ▌ ▌ ▌ ▌ ▌ ▌ ▌ ▌ OUT0
General Purpose Input	**c.in**	Not used for the modes described in the manual.
General Purpose Output	**c.out**	Not used for the modes described in the manual.
Alarm	**A.L**	Displays the current alarm if present. **A.L** with no numbers indicates that there is no current alarm. **A.L #** indicates a current alarm code **#**. Most alarms can be reset with the key. See Section 10 for alarm code descriptions and reset method.
Alarm History	**A.L-H** **0-E**	Displays the alarm history log for the previous 15 alarms. When SEL key and key are concurrently pressed, the **AL-H** display changes to **N.- #**, where **N** is the position of the alarm in the history log (0 most current, E oldest) and **#** is the alarm code. The history log can be scrolled forward and backward using the and keys. The MODE key returns to the **A.L-H** display. Clearing the complete alarm history is possible with software revision 10 and above. To clear the alarm history, use the MODE keys to navigate the menu until the A.L-H is in the display. • Concurrently press the and SEL keys and the display changes to N.- #. • Concurrently press the and keys while holding down the SEL key and the display changes to AHcLr. • Concurrently press the and SEL and the display starts flashing indicating alarm clearing, then press to complete the clearing procedure. Double clicking MODE goes back to 0. - and another press of MODE returns to A.L-H.
Software Version	**u.**	Displays the revision of the operating system software.

3.1.2 DIAGNOSTIC DISPLAY MENU LOOP (cont'd)

Diagnostic Display Descriptions (cont'd):

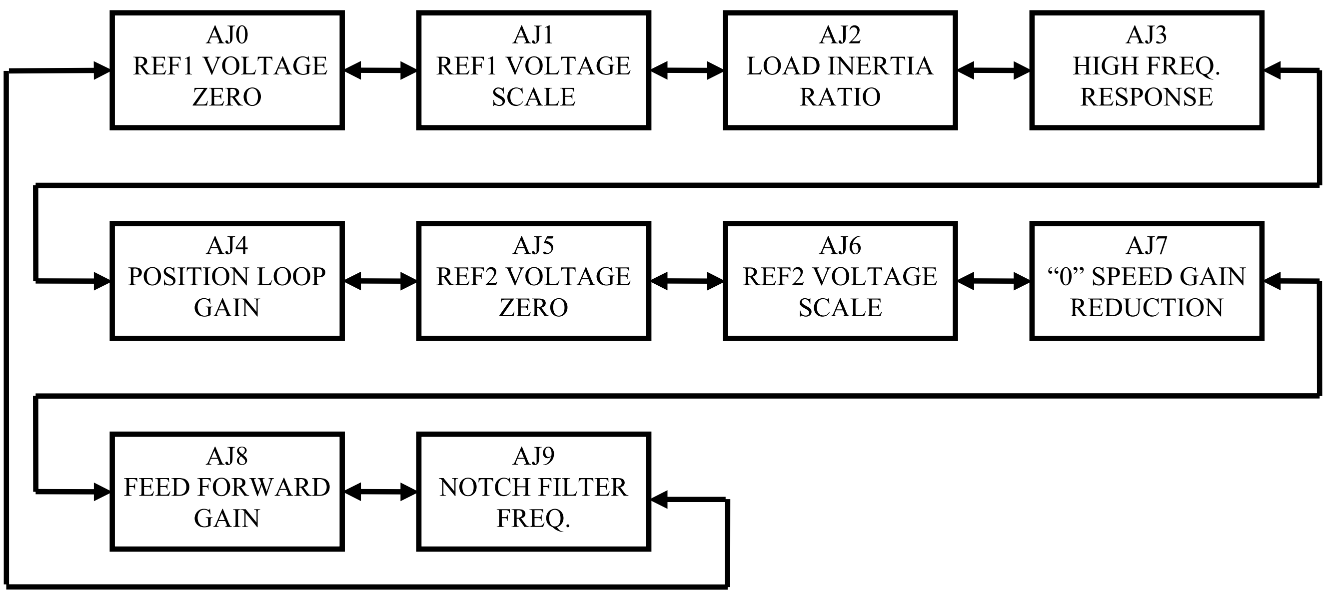
DISPLAY ITEM	SYMBOL	CONTENTS
Option Status	**o.b**	Displays the status of any option modules installed. 00: No options 02: 14 bit A/D converter
HP Parameter Change History	**H.P-L**	Displays a history of the HP parameters that have been changed. When  key and  key are concurrently pressed the display changes to a list of HP-# parameters that have been changed. The history log is 65 deep. The history log can be scrolled forward and backward using the  and  keys.
SP Parameter Change List	**S.P-L**	Displays a history of the SP that have been changed. When  key and  key are concurrently pressed the display changes to a list of SP-# parameters that have been changed. The history log is 65 deep. The history log can be scrolled forward and backward using the  and  keys.
Link Axis No.	**A.n**	N/A to the Delta driver without option module.

3.1.3 ADJUSTMENT PARAMETER MENU LOOP

The Adjustment Parameter Menu Loop provides access to setup and tuning parameters that are commonly used. Each parameter is displayed in two successive displays. The coded parameter name appears on the first display and the parameter value appears on the second display. The  key will always move from the parameter-coded name to the parameter value. The  key will always move from the parameter value to the coded parameter name. If the parameter value is negative, a (-) sign appears in the left most digit of the display.

Parameters can be read or written in the Adjust Parameter Menu Loop. The procedure to write into a parameter is found in **Section 3.2**.

The Adjustment Parameter Menu Loop is organized as follows:



The Adjustment Parameters have different meaning and content depending on the mode of operation of the driver. The detailed descriptions of the Adjustment Parameters are listed in **Section 4** of this manual as part of the description of each of the individual modes.

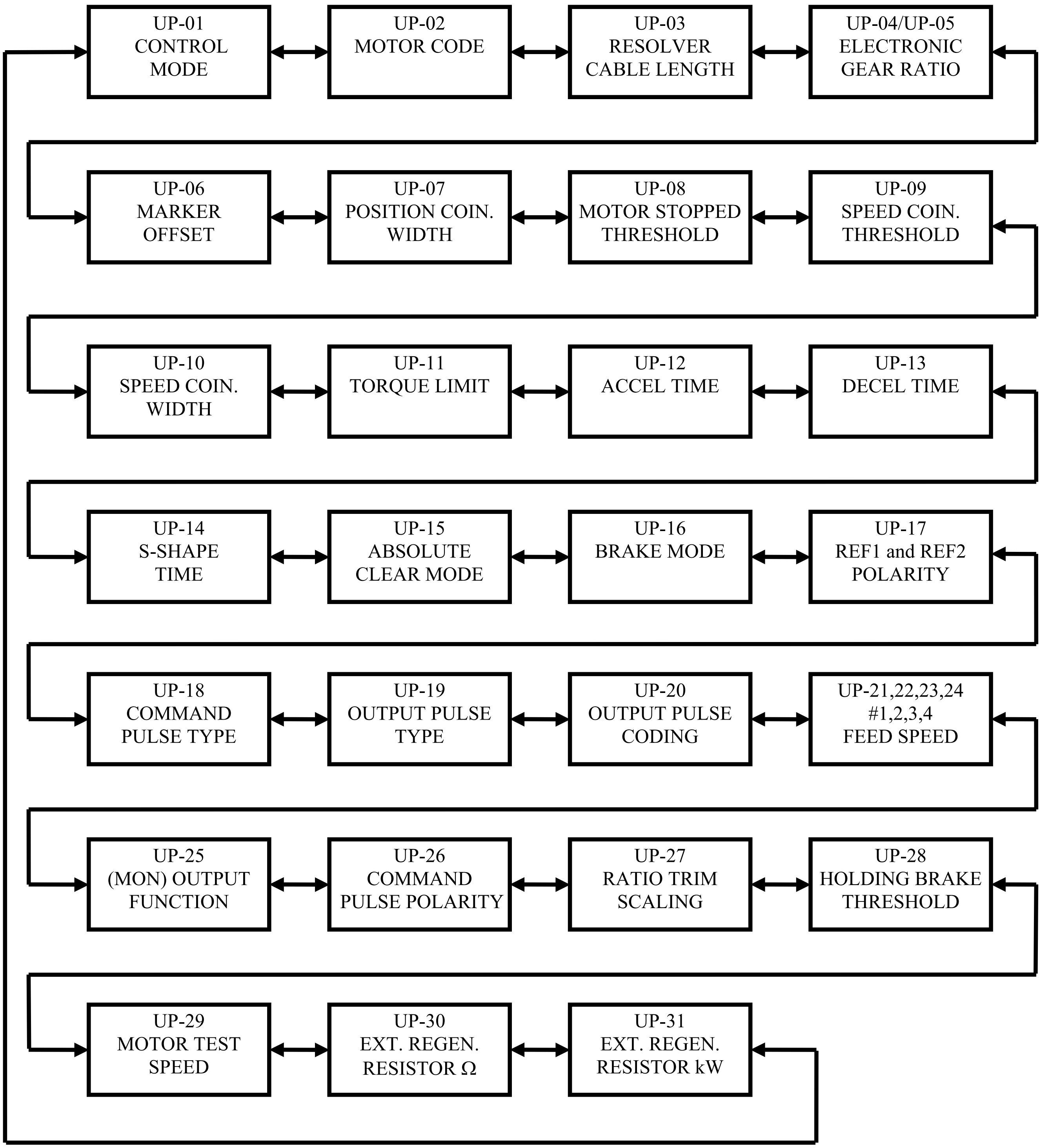
3.1.4 USER PARAMETER MENU LOOP

The User Parameter Menu Loop provides access to basic setup parameters that are commonly used. Each parameter is displayed in two successive displays. The coded parameter name appears on the first display and the parameter value appears on the second display. The key will always move from the parameter-coded name to the parameter value. The key will always move from the parameter value to the coded parameter name.

Parameters can be read or written in the User Parameter Menu Loop. The procedure to write into a parameter is found in **Section 3.2**.

3.1.4 USER PARAMETER MENU LOOP (cont'd)

The User Parameter Menu Loop is organized as follows:

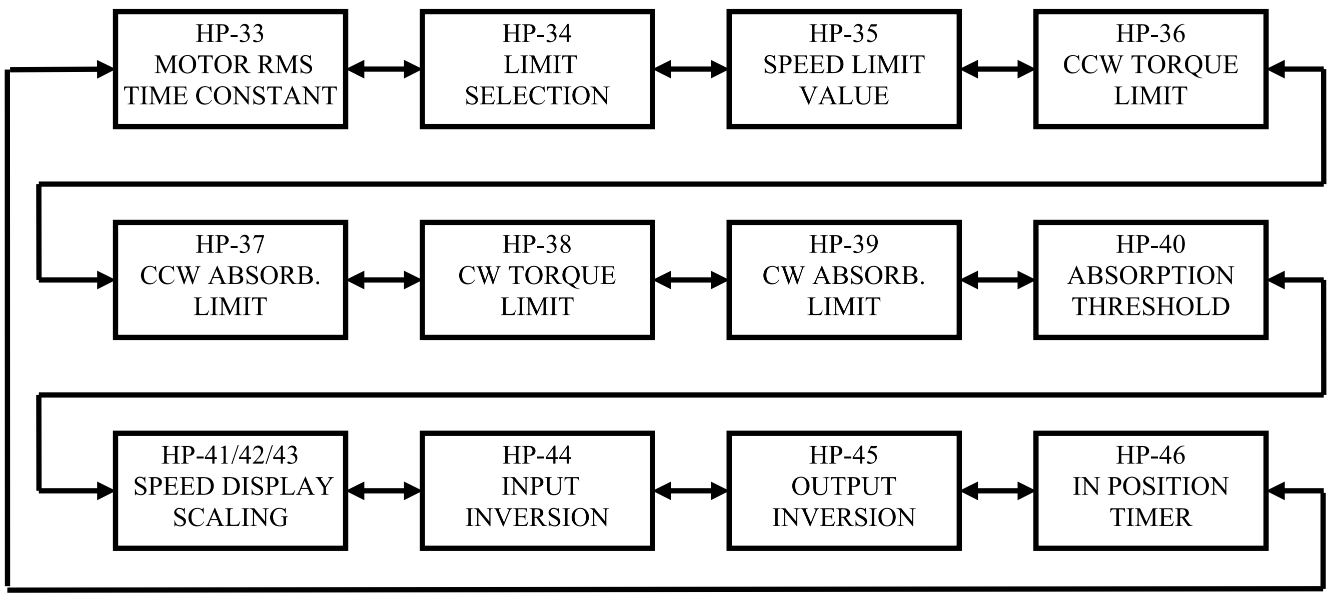


3.1.5 HP PARAMETER MENU LOOP

The HP Parameter Menu Loop provides access to basic setup parameters that are less commonly used. Each parameter is displayed in two successive displays. The coded parameter name appears on the first display and the parameter value appears on the second display. The key will always move from the parameter-coded name to the parameter value. The key will always move from the parameter value to the coded parameter name.

Parameters can be read or written in the HP Parameter Menu Loop. The procedure to write into a parameter is found in **Section 3.2**.

The HP Parameter Menu Loop is organized as follows:



3.2 WRITING NEW VALUES IN READ/WRITE PARAMETERS

Many parameters require adjustment or modification to properly configure the Delta driver. These parameters include AJ, UP and HP. The procedure for changing these parameters is the same and is described in this section. Although the parameter is changed in the display, pressing the key is required to log the new parameter value in the driver's non-volatile memory.

To change a parameter:

- Navigate the main menu using the MODE keys to get the parameter name to be changed in the display. See **Figure 3.2**.
- Press the key to get the parameter value in the display.
- Concurrently press the SEL and keys to prepare the parameter for change. The least significant digit in the display will now be flashing, indicating that the least significant digit can be increased or decreased with the keys.
- Use the SEL key to move the flashing digit to the left to prepare another digit in the display for change. When the flashing digit reaches the left most position one more SEL key press will return the flashing digit to the right most position.
- Repeating the above steps, change the display to the new desired value.
- Press the to log the new parameter setting in the Delta driver's non-volatile memory.
- The MODE keys can again be used to navigate the main menu.

Changes in the AJ parameters take effect when the parameter is changed using the keys. The UP and HP parameters require pressing the key to have the parameter change take effect.

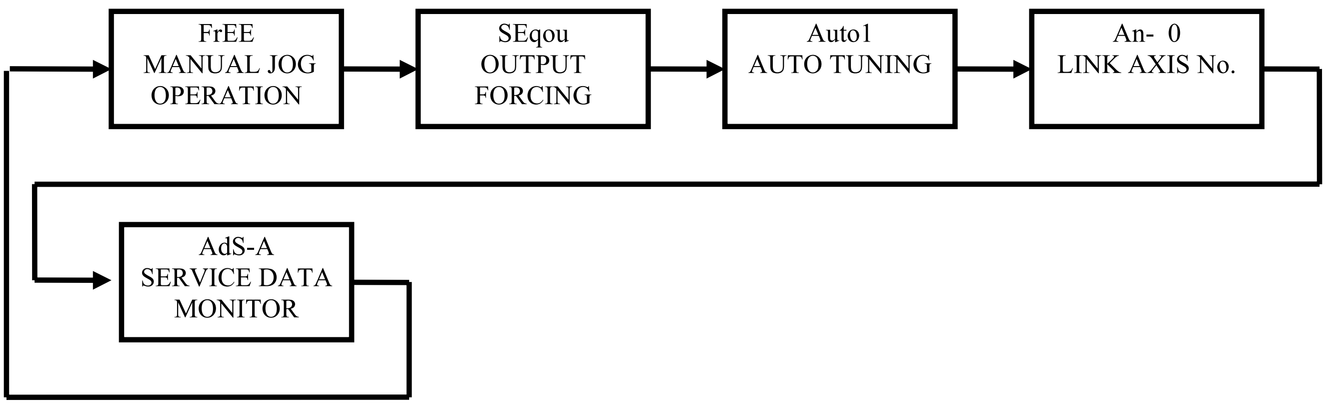
The following parameters require a power OFF, power ON cycle to have the parameter take effect:
AJ-9, UP-01, UP-02, UP-03, UP-04, UP-05 & UP-16.

3.3 NAVIGATING THE SPECIAL FUNCTION MENU LOOP

The Special Function Menu Loop provides special diagnostic and setup functions. Enter the Special Function Menu by concurrently pressing the keys for 5 seconds while the Main Menu status display shows motor speed [r 0]. The special menu will appear with the display showing [FrEE]. To exit the Special Function Menu double click the MODE key.

Once in the Special Menu the SEL key is used to move around the menu loop.

The Special Menu Loop is organized as follows:



3.3.1 MANUAL JOG OPERATION

The driver can be jogged manually using the front panel keyboard switches. The jog speed is set by UP-29 and the acel/decel rate is set by UP-12, UP-13 or UP-14. The normal brake sequencing of BRAKE OUTPUT and BRAKE CONFIRM must be observed during jog operation.

Caution should be used when manually jogging the motor. Be sure all personnel are clear of moving parts and that the motor' s movement is not restricted by ancillary moving mechanisms.

- Use the SEL key to locate the FrEE menu display in the Special Menu.
- Activate the servo by pressing key. The display shows the current jog speed [L 0]
- Jog the motor CCW using the key or CW by using the key. The motor continues to run as long as the key is held down.
- Pressing the SEL keys together latches the motor in jog CCW until the or key is momentarily pressed to unlatch the jog operation and stop the motor. The SEL keys provide similar latched jog operation in the CW direction.
- Deactivate the servo by pressing key. The display returns to [FrEE].

3.3.2 OUTPUT FORCING FUNCTION

The Delta driver has 8 outputs that are controlled by the driver. The functions of these outputs in normal operation are described in **Section 4**. The normal ON/OFF state of these outputs can by forced using the Output Forcing Function in the Special Menu.

Caution should be used when forcing output states. The outputs may activate ancillary equipment or cause other motion or events to occur. Forcing the output may create a danger to personnel or equipment.

- Use the SEL key to locate the SEqou menu display in the Special Menu.
- Outputs maintain their current state coming into the Output Forcing Function.
- Activate the Output Forcing Function by concurrently pressing SEL ↵ keys. The display shows [50x.-y] where x is the bit number of the output to be forced ON or OFF and y is the current state of the output where 1 = ON and 0 = OFF. The bit number x corresponds to the output number 0->7. The bit number can be changed using the ⇓ ⇑ keys.
- The selected bit number output is forced to toggle state with successive presses of the ↵ key.
- Pressing the MODE key returns to the Special Function Menu and the display reads [SEqou]. The active outputs return to their normal state rather than the forced state. Outputs that have no active function in the current driver mode of operation are left in the state set by the Output Forcing Function.

3.3.3 AUTO TUNING

The Delta provides an automatic servo parameter tuning function. Auto Tuning is accessed via the Special Function Menu. **Section 6** of this manual is dedicated to auto and manual tuning of the driver parameters. See **Section 6** for Auto Tuning procedure.

3.3.4 LINK AXIS NUMBER

The Link Axis Number is only used when the Delta Driver is fitted with the Link Axis option. See the appropriate technical manual for this option.

3.3.5 SERVICE DATA MONITOR

The Delta Driver contains detailed service information. The Service Data Monitor contains detailed coded information meant for a qualified IIS Technician. There is no user serviceable information in this menu item. Contact IIS for any service related issues.

SECTION 4 - DRIVER OPERATION MODES

The Delta Driver is programmable to work in six (6) different operating modes. The mode of operation is programmed into the driver using the keypad and display. The six (6) modes are:

The following sections describe the basic operation, the I/O functions and the programming parameters for each of the six (6) modes of operation.

4.1 SPEED CONTROL MODE 1

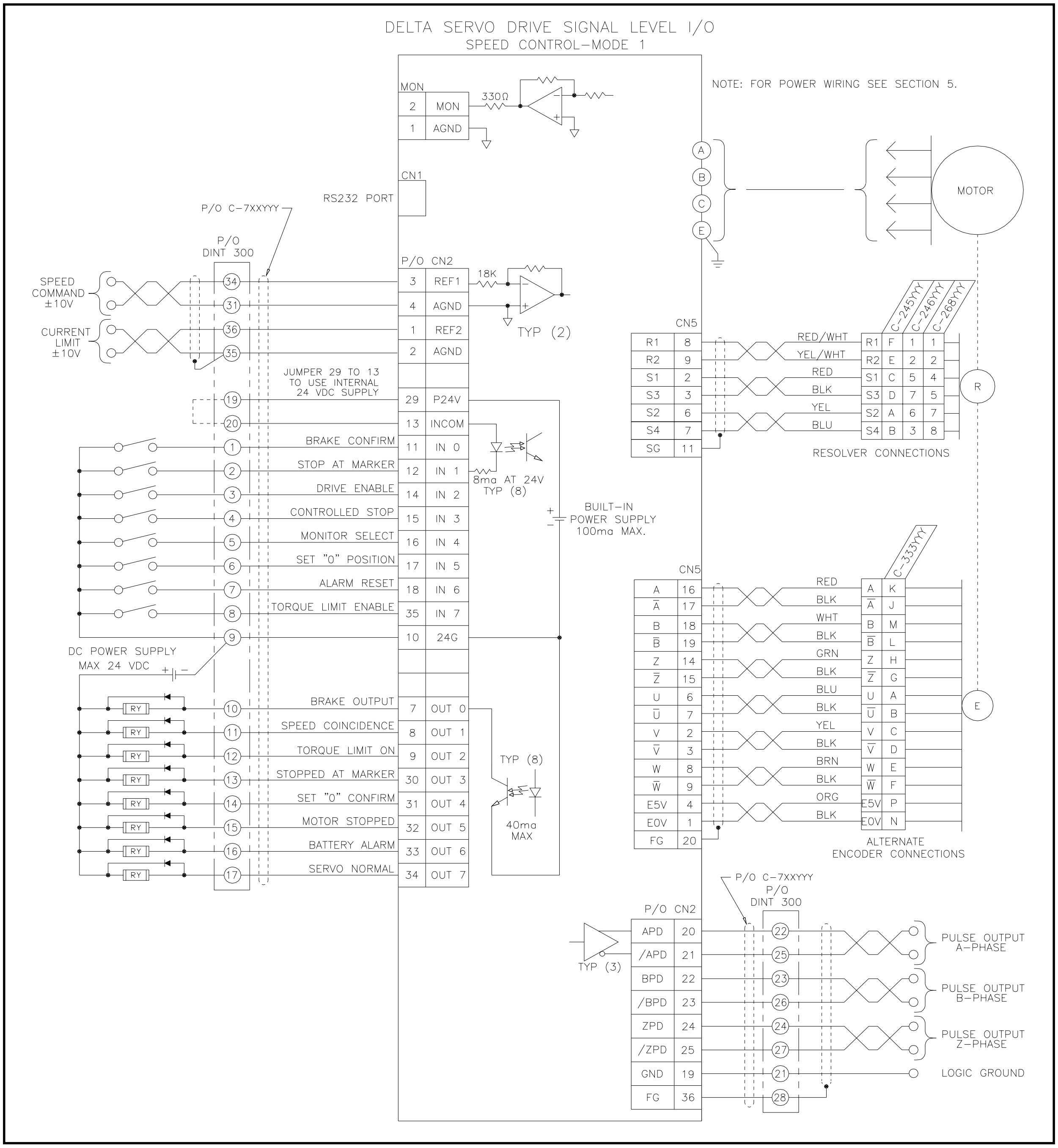
PRIMARY MOTION CONTROL FEATURES

- In the Speed Control Mode, the driver is a precision speed regulator that receives the speed command from an external analog source.
- The scaling and polarity of the analog speed command is fully programmable.
- The acceleration and deceleration used for changes in motor speed can be programmed to be either linear or S-shaped minimum jerk. The time to change speeds and the amount of S-shape rounding is programmable.

SECONDARY MOTION CONTROL FEATURES

- The torque of the motor can be limited via a second external analog voltage or by an internal parameter.
- The motor can be stopped and position locked at the current position or at the motor's marker pulse using an I/O point.

4.1.1 SIGNAL WIRING



4.1.2 SPEED CONTROL INPUT/OUTPUT

TYPE	NAME	FUNCTION
Analog Input	SPEED COMMAND (REF1)	SPEED COMMAND +/-10V input. Rotation is CCW for (+) voltage and CW for (-) voltage. Motor speed is directly proportional to voltage. • Direction of rotation is set with UP-17 • Acceleration/deceleration is set with UP-12, 13 &14 • Scaling of speed vs. voltage is set with AJ1 • Zero adjustment is set with AJO • SPEED COMMAND (REF1) voltage monitor on the status display "cF---"
	CURRENT LIMIT (REF2)	TORQUE LIMIT 0-10V input. The peak motor torque is limited proportionally with this voltage. • Scaling of torque vs. voltage is set with AJ6 • Zero adjustment is set with AJ5 • The method to cause limiting is set with HP-34 • TORQUE LIMIT (REF2) voltage monitor on the status display "cc---"
24V Input	BRAKE CONFIRM (IN0)	This input is a confirmation of the release of either a dynamic or static mechanical brake. See **Sections 8 & 9** for details of brake operation. • Brake modes of operation are set with UP-16 & UP-28
	STOP AT MARKER (IN1)	When this input is turned ON, the motor stops next motor MARKER or home position. There are two MARKERS per motor rotation located 180° apart. • Deceleration time is fixed at 0 time • Marker position can be shifted up to 180° using UP-6 • Driver switches to position control with position gain set by AJ4
	DRIVE ENABLE (IN2)	When this input is turned ON, the driver becomes operational if there are no faults and the BRAKE CONFIRM (IN0) input is correctly sequenced. • Brake output also is turned ON/OFF with this signal subject to settings of UP-16 and UP-28
	CONTROLLED STOP (IN3)	When this input is turned ON, the motor is decelerated to 0 speed ignoring the SPEED COMMAND (REF1) input. • Deceleration time is set by UP-13 & UP-14 • Driver switches to position control with position gain set by AJ4
	MONITOR SELECT (IN4)	When this input is turned ON, the monitor voltage output (MON) and PULSE OUTPUT change function. • MON function is set by UP-25 to speed or torque • PULSE OUTPUT function set by UP-20
	SET "0" POSITION (IN5)	When this input is turned ON for 30 ms or more, the driver internal position registers are set "0". • With an absolute system the home position setting is subject to UP-15
	ALARM RESET (IN6)	When this input is turned ON for 30 ms or more, all alarms are reset. • AL1 (driver overheated) and AL17 (motor overload) cannot be reset until the temperature drops to acceptable level • AL26 cannot be reset until power is cycled

4.1.2 SPEED CONTROL INPUT/OUTPUT (cont'd)

TYPE	NAME	FUNCTION
24V Input	TORQUE LIMIT ENABLE (IN7)	When this input is turned ON and HP-34 is set to 0X or 1X, the torque limit operates. • If HP-34 is set to 0X, the torque is limited by the TORQUE LIMIT (REF2) input voltage • If HP-34 is set to 1X, the torque limit is set by UP-11 • If HP-34 is set to 2X, the torque limit is on regardless of state of this input with the limit set by UP-11
24V Output	BRAKE OUTPUT (OUT0)	This output controls the operation of the dynamic brake or holding brake. • Brake modes of operation are set with UP-16 & UP-28
	SPEED COINCIDENCE (OUT1)	This output turns ON when the actual speed of the motor reaches the target speed. • Target speed can be set to a preset speed or the commanded speed with UP-09 • Detection width is be set with UP-10
	TORQUE LIMIT ON (OUT2)	This output turns ON when the motor torque is limited. The limit could be the peak torque limit of the motor or a lower valve causes by the following conditions. • HP-34 and TORQUE LIMIT ENABLE (IN7) input set the conditions for torque limiting • UP-11 or HP-36, HP-37, HP-38, HP-39 are the internal preset limit values
	STOPPED AT MARKER (OUT3)	This output turns ON when the motor completes the sequence initiated by the STOP AT MARKER (IN1) input.
	SET "0" CONFIRM (OUT4)	This output turns ON confirming that the SET "0" POSITION (IN5) input has been recognized and the internal position registers have been cleared.
	MOTOR STOPPED (OUT5)	This output turns ON when the motor speed drops below the internal preset speed set in UP-8.
	BATTERY ALARM (OUT6)	This output turns ON when the battery of absolute system drops below 3.2V. This output is a warning and the battery should be replaced promptly.
	SERVO NORMAL (OUT7)	This output turns ON 1.6 sec. after AC power ON and there are no alarms. • Does not turn OFF in the case of an AL24 (BATTERY ALARM)
Differen-tial Output	PULSE OUTPUT (APD/APD) (BPD/BPD) (ZPD(/ZPD)	Programmable pulse train output from the driver. • Type of data output is set by UP-20 • Encoder equivalent output is set by UP-19 with scaling set by UP-04 & UP-05 • External display device with various driver data set by UP-20 • Motor absolute position if an absolute system is used • Motor position register is monitored with the status display "A'---" & "A---"

4.1.3 SPEED CONTROL PARAMETER SETUP

4.1.3.1 SPEED CONTROL ADJUSTMENT PARAMETERS

ADJUSTMENT PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
SPEED COMMAND ZERO (REF1)	**AJ0**	±10.00 V	Factory Preset	Sets the zero offset of the SPEED COMMAND (REF1) input. It can be set in two ways: 1. Automatically: by concurrently pressing [SEL] ↵ (all digits flash) and then pressing ↵. The driver will read the analog voltage REF1 and create an offset equal and opposite to the analog voltage present at the time. To get a true 0.00 offset, short REF1 to analog ground before doing the auto zero procedure. 2. Manually: by concurrently pressing [SEL] ↵ (all digits flash) and then concurrently pressing ⇑ [SEL]. Then adjust the individual digits with ⇑ ⇓.
SPEED COMMAND SCALE (REF1)	**AJ1**	3~40.00 V	10.00V	Sets the SPEED COMMAND (REF1) scaling. The value set in this parameter is the voltage needed at REF1 to bring the motor to the rated speed. For example, if the motor must turn at rated speed with 4.5 VDC input voltage (REF1), set AJ1 to 4.50.
LOAD INERTIA RATIO	**AJ2**	0~100.0	1.0 Times	Sets the baseline frequency response of the driver using the ratio of the load inertia/motor inertia for a rigidly coupled load. If the load is not rigidly coupled, the value entered may vary from the calculated value. If the value is set too high, the motor and driver may become unstable and oscillate. This parameter is set automatically during auto tuning.
HIGH FREQUENCY RESPONSE	**AJ3**	0.1~20.0	1.0	Sets the high frequency response of the driver. The higher the number the more responsive. If the value is set too high, the motor & driver may become unstable & oscillate. The value in AJ3 is unit less and works in concert with AJ2. This parameter is set automatically during auto tuning.
POSITION LOOP DC GAIN	**AJ4**	1~200	30	Sets the DC gain of the position control loop. A higher value in AJ4 results in stiffer, faster response. If the value is set too high, the motor & driver may become unstable & oscillate. This parameter is set automatically during auto tuning.

4.1.3.1 SPEED CONTROL ADJUSTMENT PARAMETERS (cont'd)

ADJUSTMENT PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
TORQUE COMMAND ZERO (REF2)	**AJ5**	±10.00 V	Factory Preset	Sets the zero offset of the TORQUE COMMAND (REF2) input. It can be set in two ways: 1. Automatically: by concurrently pressing SEL ↵ (all digits flash) and then pressing ↵**.** The driver will read the analog voltage REF2 and create an offset equal and opposite to the analog voltage present at the time. To get a true 0.00 offset, short REF2 to analog ground before doing the auto zero procedure. 2. Manually: by concurrently pressing SEL ↵ (all digits flash) and then concurrently pressing ⇑ SEL. Then adjust the individual digits with ⇑ ⇓.
TORQUE COMMAND SCALE (REF2)	**AJ6**	3~40.00 V	10.00V	Sets the TORQUE COMMAND (REF2) scaling. The value set in this parameter is the voltage needed at REF2 for the motor to develop maximum torque. For example, if it is required to have the maximum torque with 4.5 VDC input voltage (REF2), set AJ5 to 4.50.
ZERO SPEED GAIN REDUCTION	**AJ7**	0~10000	0	Sets the amount of gain reduction at zero speed. The gain is reduced when the motor is below the speed set in UP-08 and at the set values when the speed is above UP-08.
NOTCH FILTER FREQUENCY	**AJ9**	400~20000 rad/s	6000 rad/s	Sets the notch frequency of a velocity loop anti-resonance filter. This filter can be used to cancel machine or servo resonance. Power must be turned OFF then ON for this parameter to take effect.

4.1.3.2 SPEED CONTROL USER PARAMETERS

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
CONTROL MODE	**UP-01**	00~FF	00	Sets the control mode of operation for the driver as follows: 1 = Speed 2 = Torque 3 = Pulse Position 4 = Speed/Torque/Position 5 = Speed Preset 6 = Electronic Gearing The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
MOTOR CODE	**UP-02**	0000~FFFF	0000	Sets the internal driver parameters corresponding to the motor code. See **Appendix A** for motor codes. The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
RESOLVER CABLE LENGTH N/A FOR ENCODER	**UP-03**	1~120M	5M	Sets the driver resolver cable length compensation. The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
ELECTRONIC GEAR RATIO NUMERATOR	**UP-04**	1~32767	1	The COMMAND PULSE (FMA and FMB) input is multiplied by the ratio of UP-04/UP-05 before being processed by the driver. The driver internal command resolution is equal to the number of resolver cycles times 12000 bits/rev or the PPR of the encoder. (i.e. a motor with a 2X resolver has an internal resolution of 24000 bits/rev, see motor drawings in **Appendix A.6, A.7 & A.8**.) For example if a COMMAND PULSE INPUT of 1000 bits/rev is required with a 2X resolver, set UP-04=24000 and UP-05=1000. Power must be turned OFF then ON for this parameter to take effect. See **Application Note Section 13**.

4.1.3.2 SPEED CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
ELECTRONIC GEAR RATIO DENOMINATOR	**UP-05**	1~32767	1	The driver internal feedback resolution is multiplied by the ratio of UP-05/UP-04 before being sent to OUTPUT PULSE (APD and BPD). The driver internal resolution is equal to the number of resolver cycle times 12000 bits/rev. (i.e. a motor with a 2X resolver has an internal resolution of 24000 bits/rev, see motor drawings in **Appendix A.6, A.7 & A.8**.) For example if an OUTPUT PULSE of 1000 bits/rev is required with a 2X resolver, set UP-04=24000 and UP-05=1000. Power must be turned OFF then ON for this parameter to take effect. See **Application Note Section 13**.
MARKER OFFSET **RESOLVER ONLY	**UP-06**	0~11999 pulses	0 pulses	The electrical ZERO can be shifted with respect to the mechanical shaft position using UP-06. The Delta driver produces N number of ZERO states per motor rotation where N is equal to the number of resolver cycles. (i.e. a motor with a 2X resolver has 2 ZERO/rev. see motor drawings in **Appendix A.6, A.7 & A.8**.) To shift the electrical ZERO place the motor shaft at the desired electrical ZERO position. Read the status display "d" parameter in degrees and set UP-06="d"*12000/360. The electrical ZERO affects the ZPD output pulse and the STOP AT MARKER input stopping position.
MOTOR STOPPED THRESHOLD	**UP-08**	1~4000 r/min	50 r/min	When the motor is rotating at less than the speed set into UP-08, the MOTOR STOPPED output will be on.
SPEED COINCIDENCE THRESHOLD	**UP-09**	0~4000 r/min	0 r/min	If UP-09 is non-zero, the SPEED COINCIDENCE output comes on when the actual motor speed reaches the value set in UP-09. If UP-09 is zero, the SPEED COINCIDENCE output comes on when the actual motor speed reaches the commanded speed.
SPEED COINCIDENCE WIDTH	**UP-10**	1~4000 r/min	20 r/min	Sets the width of the sensing window allowable to get the SPEED COINCIDENCE output.
TORQUE LIMIT	**UP-11**	0~100.0%	100%	When the torque limit is applied, the motor torque is limited to the value set in UP-11. UP-11 is % of motor peak torque. See **HP-34** for torque limit method.
ACCEL TIME	**UP-12**	0~32.76 sec	0 sec	Sets the time from zero to rated speed with a linear acceleration profile. Ignored if UP-14 is not equal to 0.0.

4.1.3.2 SPEED CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
DECEL TIME	**UP-13**	0~32.76 sec	0 sec	Sets the time from rated speed to zero speed with a linear deceleration profile. Ignored if UP-14 is not equal to 0.0.
S-SHAPED TIME	**UP-14**	0~32.76 sec	0 sec	Sets the acel and decel time from the current speed to the new command speed using an S-shaped minimum jerk profile.
ABSOLUTE CLEAR MODE	**UP-15**	0~2	0	Selects the type of home 0.00 processing for absolute systems when the SET "0" POSITION input is energized or upon startup. 0: Makes current position of motor equal to 0.00. 1: Makes the current motor shaft rotation the 0 rotation while preserving the MARKER OFFSET. 2: No effect retains absolute position.
BRAKE MODE	**UP-16**	0~2	0	Selects the type of brake sequencing to be used when the driver ENABLE is turned OFF. Brake is applied immediately in the case of an alarm. 0: No brake or dynamic brake. If no brake, the motor will coast to a stop. If dynamic brake relay is installed, the motor and load will dynamically brake to a stop. 1: Mechanical holding brake is applied when the motor reaches the speed set in UP-28. The deceleration rate is controlled by UP-13 & UP-14. When the speed in UP-28 is reached, the driver applies maximum electronic braking torque for 200 ms. 2: Mechanical holding brake is applied when the motor reaches the speed set in UP-28. The driver applies maximum electronic breaking torque to decelerate the motor to the speed set in UP-28. Power must be turned OFF then ON for this parameter to take effect.
REF1 and REF2 POLARITY	**UP-17**	00~11	0 0	Sets the polarity of the analog reference inputs. 00: Both REF1 and REF2 normal 01: REF1 inverted, REF2 not inverted 10: REF1 not inverted, REF2 inverted 11: Both REF1 and REF2 inverted

4.1.3.2 SPEED CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
OUTPUT PULSE TYPE	**UP-19**	00~11	01	Sets the type of pulse output sequence and polarity of the PULSE OUTPUT. UP-20 must be set to xxxo for the PULSE OUTPUT to represent incremental actual position. 00: Pulse, Pulse encoding where APD pulses when the actual position increments and BPD pulses when the actual position decrements. 01: Quadrature encoding of APD and BPD with APD leading BPD for incrementing actual position. Each edge of the two pulse trains is counted as an output bit change. 10: Pulse, Pulse encoding where BPD pulses when the actual position increments and APD pulses when the actual position decrements. 11: Quadrature encoding of APD and BPD with BPD leading APD for incrementing actual position. Each edge of the two pulse trains is counted as an output bit change.
OUTPUT PULSE CODING	**UP-20**	0000~5533	0000	The first digit of UP-20 selects the parameter to be put on the driver external display when MONITOR SELECT I/O is OFF. Coding is as follows: 0: Motor speed in RPM 1: Actual motor position 2: Motor current 3: Calculated motor temperature 4: Motor distance to marker (°) 5: Machine speed in RPM The second digit of UP-20 selects the parameter to be put on the display when MONITOR SELECT I/O is ON. Coding is the same as the first digit above. The third digit selects the type of electronic coding for the OUTPUT PULSE when an absolute system is configured. This digit is only effective when the fourth digit is set to 3 or absolute motor position. The coding is as follows: 0: 32 bits 1: 23 bits + parity 2: 24 bits + parity 3: 31 bits + parity

4.1.3.2 SPEED CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
OUTPUT PULSE CODING (cont'd)	**UP-20** (cont'd)			The fourth digit sets the basic function of the OUTPUTS PULSES. The coding is as follows: 0: Incremental position as defined in UP-19 1: Output to optional drive display DPA-70 2: Output to optional drive display DPA-80 3: Absolute motor position
MONITOR OUTPUT FUNCTION	**UP-25**	000~111	010	Selects SPEED or TORQUE output and polarity of the MON test point. The first digit selects the MON output function when the MONITOR SELECT I/O is ON. 0: TORQUE 1: SPEED The second digit selects the MON output function when the MONITOR SELECT I/O is OFF. 0: TORQUE 1: SPEED The third digit selects the polarity of the MON output. 0: Normal 1: Invert
HOLDING BRAKE THRESHOLD	**UP-28**	0~100.0%	100%	When UP-16 is set to 0, UP-28 has no effect. When UP-16 is set to 1 or 2, the mechanical brake is applied when the motor speed falls below the value set in UP-28. The value in UP-28 is % of rated speed.
MOTOR TEST SPEED	**UP-29**	1~4000 r/min	50 RPM	The driver can be jogged manually by using the keypad. The jog speed is set with UP-29.
EXTERNAL REGEN RESISTOR VALUE (Software version 10 and above)	**UP-30**	0~100.0 ohms	0.0 ohms	Value of the optional external regen resistor. When external regen resistor is used, the value of the resistor is entered to allow the driver to calculate average power into the regen resistor. When the internal regen is used, enter 0.0. Power must be turned OFF then ON for this parameter to take effect. See **Section 7** for details on Regen Resistor selection. This parameter is used with DSD-35 and larger drivers.

4.1.3.2 SPEED CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
EXTERNAL REGEN RESISTOR WATTAGE (Software version 10 and above)	**UP-31**	0~327.67 Kw	0.0 Kw	Power rating of the optional external regen resistor. When external regen resistor is used, the power rating in Kw of the resistor is entered to allow the driver to calculate average power into the regen resistor. When the internal regen is used enter 0.0. Power must be turned OFF then ON for this parameter to take effect. See **Section 7** for details on Regen Resistor selection. This parameter is used with DSD-35 and larger drivers.

4.1.3.3 SPEED CONTROL SETUP PARAMETERS

SETUP PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
MOTOR RMS TORQUE TIME CONSTANT	**HP-33**	1~60 sec	30 sec	Sets the time constant for calculating motor rms torque that is displayed as parameter bL. Time constant should be set to approximately twice as long as the machine cycle.
TORQUE LIMIT SELECTION	**HP-34**	00~21	11	First digit is torque limit method: 0: Limited with REF2 analog input when TORQUE LIMIT ENABLE I/O is ON. 10V = Peak torque 1: Limit set by parameter UP-11 or HP-36 through HP-39 when UP-11=0 and when TORQUE LIMIT ENABLE I/O is ON. 2: Limit set by parameter UP-11 or HP-36 through HP-39 when UP-11=0 regardless of the state of the TORQUE LIMIT ENABLE I/O. Second digit is speed limit method: 0: N/A 1: N/A
CCW ROTATION TORQUE LIMIT	**HP-36**	0~100.0%	100%	Limits CCW rotation torque. 100% = Peak Torque See **HP-34**
CCW ROTATION ABSORPTION TORQUE LIMIT	**HP-37**	0~100.0%	100%	Limits CCW rotation absorption (braking) torque. 100% = Peak Torque See **HP-34**
CW ROTATION TORQUE LIMIT	**HP-38**	0~100.0%	100%	Limits CW rotation torque. 100% = Peak Torque See **HP-34**
CW ROTATION ABSORPTION TORQUE LIMIT	**HP-39**	0~100.0%	100%	Limits CW rotation absorption (braking) torque. 100% = Peak Torque See **HP-34**

4.1.3.3 SPEED CONTROL SETUP PARAMETERS (cont'd)

SETUP PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
SPEED DISPLAY ELECTRONIC RATIO NUMERATOR	**HP-41**	1~32767	1	Parameters HP-41/HP-42 form a fraction that is used to scale the scaled Motor Speed display "F". The motor speed is multiplied by the fraction then put on the display. This allows a speed display that is scaled to the speed of the actual machine rather than the speed of the motor. The scaling can also allow the driver to display speed in different units such as in/sec rather than the default motor RPM. Scales the driver display and optional external display if used.
SPEED DISPLAY ELECTRONIC RATIO DENOMINATOR	**HP-42**	1~32767	1	
SPEED DISPLAY DECIMAL POINT POSITION	**HP-43**	0~7	0	HP-43 sets the position of the decimal point in the optional external speed display. 0: No decimal point 1: Least significant digit ... 7: Most significant digit
INPUT INVERSION	**HP-44**	00~1FF	00	This parameter forms a hexadecimal bit mask that inverts the input when the bit is set to 1 and does not invert the input when the bit is 0. The LSB is for IN0 and so on. (i.e. HP-44=8C inverts inputs IN7, IN3 & IN2)
OUTPUT INVERSION	**HP-45**	00~FF	00	This parameter forms a hexadecimal bit mask that inverts the output when the bit is set to 1 and does not invert the output when the bit is 0. The LSB is for OUT0 and so on. (i.e. HP-45 = 4A inverts outputs OUT6, OUT3 & OUT1)

4.2 TORQUE CONTROL MODE 2

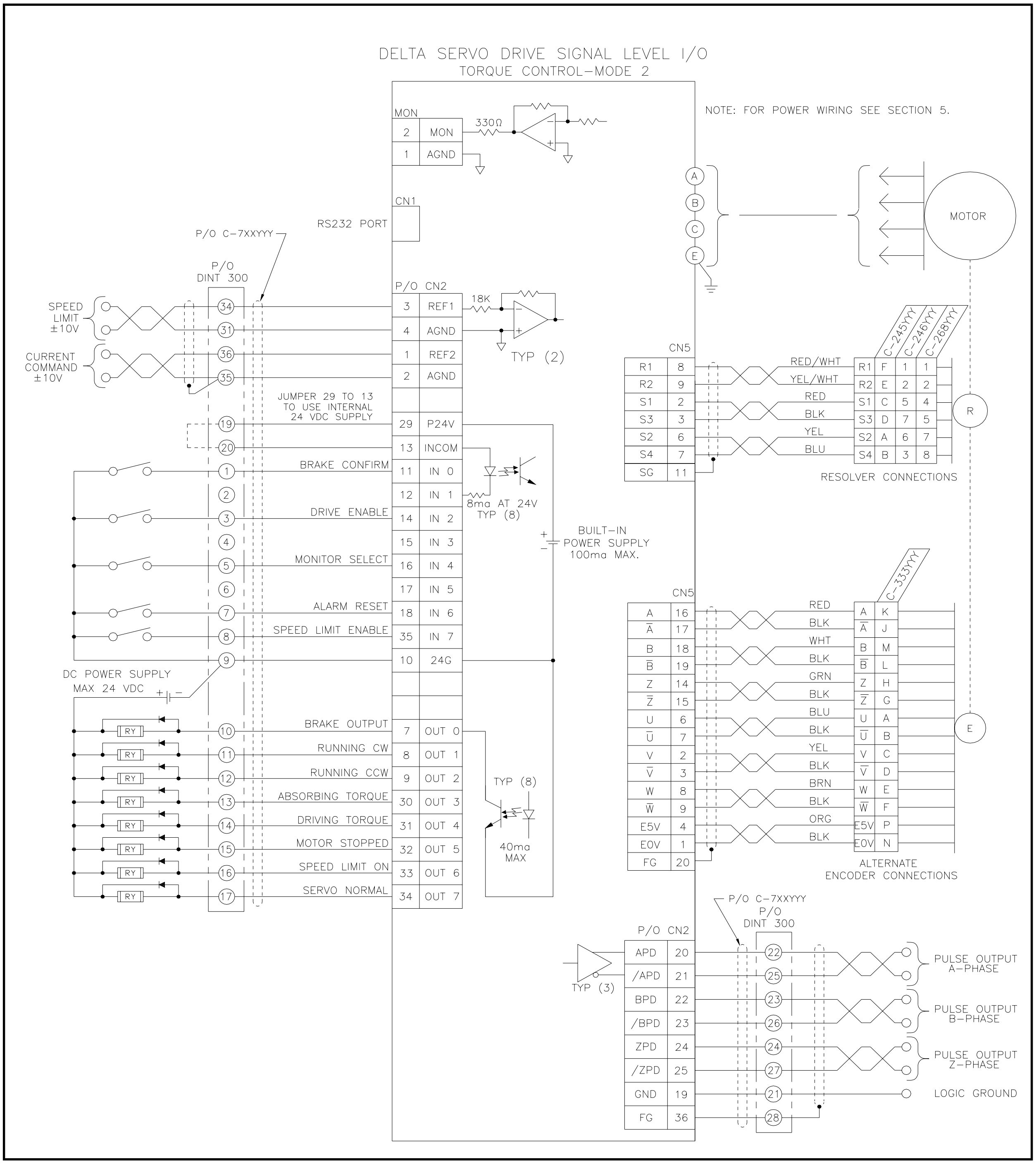
PRIMARY MOTION CONTROL FEATURES

- In the Torque Control Mode, the driver is a precision torque regulator that receives the torque command from an external analog source.
- The scaling of and polarity of the analog torque command is fully programmable.

SECONDARY MOTION CONTROL FEATURES

- The speed of the motor can be limited using a second external analog voltage or by an internal parameter.

4.2.1 SIGNAL WIRING



4.2.2 TORQUE CONTROL INPUT/OUTPUT

TYPE	NAME	FUNCTION
Analog Input	SPEED LIMIT (REF1)	SPEED LIMIT 0-10V input. The motor speed is limited proportionally with this voltage. • Scaling of speed vs. voltage is set with AJ1 • Zero adjustment is set with AJ0 • The method to cause limiting is set with HP-34 • SPEED LIMIT (REF1) voltage monitor on the status display "cF---".
	TORQUE COMMAND (REF2)	TORQUE COMMAND +/-10V input. Torque is applied CCW for (+) voltage and CW for (-) voltage. Motor torque is directly proportional to voltage. • Direction of torque is set with UP-17 • Scaling of torque vs. voltage is set with AJ6 • Zero adjustment is set with AJ5 • TORQUE COMMAND (REF2) voltage monitor on the status display "cc---".
24V Input	BRAKE CONFIRM (IN0)	This input is a confirmation of the release of either a dynamic or static mechanical brake. See **Sections 8 & 9** for details of brake operation. • Brake modes of operation are set with UP-16 & UP-28
	DRIVE ENABLE (IN2)	When this input is turned ON, the driver becomes operational if there are no faults and the BRAKE CONFIRM (IN0) input is correctly sequenced. • Brake output also is turned ON/OFF with this signal subject to settings of UP-16 and UP-28
	MONITOR SELECT (IN4)	When this input is turned ON, the monitor voltage output (MON) and PULSE OUTPUT change function. • MON function is set by UP-25 to speed or torque • PULSE OUTPUT function set by UP-20
	ALARM RESET (IN6)	When this input is turned ON for 30 ms or more, all alarms are reset. • AL1 (driver overheated) and AL17 (motor overload) cannot be reset until the temperature drops to acceptable level • AL26 cannot be reset until power is cycled
	SPEED LIMIT ENABLE (IN7)	When this input is turned ON and HP-34 is set to X0 or X1, the speed limit operates. • If HP-34 is set to X0, the speed is limited by the SPEED LIMIT (REF1) input voltage • If HP-34 is set to X1, the speed limit is set by HP-35
24V Output	BRAKE OUTPUT (OUT0)	This output controls the operation of the dynamic brake or holding brake. • Brake modes of operation are set with UP-16 & UP-28
	RUNNING CW (OUT1)	This output turns ON when the motor is rotating CW above the stop detection speed set in UP-8.
	RUNNING CCW (OUT2)	This output turns ON when the motor is rotating CCW above the stop detection speed set in UP-8.

4.2.2 TORQUE CONTROL INPUT/OUTPUT (cont'd)

TYPE	NAME	FUNCTION
24V Output (cont'd)	ABSORBING TORQUE (OUT3)	This output turns ON when the motor is absorbing torque from the load (braking) and the level of absorption is above the value set in HP-40 and motor speed is above stop detection UP-08.
	DRIVING TORQUE (OUT4)	This output turns ON when the motor is driving torque into the load and the level of absorption is above the value set in HP-40 and motor speed is above stop detection UP-08.
	MOTOR STOPPED (OUT5)	This output turns ON when the motor speed drops below the internal preset speed set in UP-8.
	SPEED LIMIT ON (OUT6)	This output turns ON when the motor speed is limited to less than the peak rating of the motor. • HP-34 and SPEED LIMIT ENABLE (IN7) input set the conditions for speed limiting • HP-35 is the internal preset limit value
	SERVO NORMAL (OUT7)	This output turns ON 1.6 sec. after AC power ON and there are no alarms. • Does not turn OFF, in the case of an AL24 (BATTERY ALARM)
Differen-tial Output	PULSE OUTPUT (APD/APD) (BPD/BPD) (ZPD(/ZPD)	Programmable pulse train output from the driver. • Type of data output is set by UP-20 • Encoder equivalent output is set by UP-19 with scaling set by UP-04 & UP-05 • External display device with various driver data set by UP-20 • Motor absolute position if an absolute system is used • Motor position register is monitored with the status display "A'---" & "A---"

4.2.3 TORQUE CONTROL PARAMETER SETUP

4.2.3.1 TORQUE CONTROL ADJUSTMENT PARAMETERS

ADJUSTMENT PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
SPEED LIMIT ZERO (REF1)	**AJ0**	±10.00 V	Factory Preset	Sets the zero offset of the SPEED LIMIT (REF1) input. It can be set in two ways: 1. Automatically: by concurrently pressing (all digits flash) and then pressing . The driver will read the analog voltage REF1 and create an offset equal and opposite to the analog voltage present at the time. To get a true 0.00 offset, short REF1 to analog ground before doing the auto zero procedure. 2. Manually: by concurrently pressing (all digits flash) and then concurrently pressing . Then adjust the individual digits with .
SPEED LIMIT SCALE (REF1)	**AJ1**	3~40.00 V	10.00V	Sets the SPEED LIMIT (REF1) scaling. The value set in this parameter is the voltage needed at REF1 to limit the motor speed to the rated speed. For example, if the motor speed is to be limited to rated speed with 4.5 VDC input voltage (REF1), set AJ1 to 4.50.
TORQUE COMMAND ZERO (REF2)	**AJ5**	±10.00 V	Factory Preset	Sets the zero offset of the TORQUE COMMAND (REF2) input. It can be set in two ways: 1. Automatically: by concurrently pressing (all digits flash) and then pressing . The driver will read the analog voltage REF2 and create an offset equal and opposite to the analog voltage present at the time. To get a true 0.00 offset, short REF2 to analog ground before doing the auto zero procedure. 2. Manually: by concurrently pressing (all digits flash) and then concurrently pressing . Then adjust the individual digits with .

4.2.3.1 TORQUE CONTROL ADJUSTMENT PARAMETERS (cont'd)

ADJUSTMENT PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
TORQUE COMMAND SCALE (REF2)	**AJ6**	3~40.00 V	10.00V	Sets the TORQUE COMMAND (REF2) scaling. The value set in this parameter is the voltage needed at REF2 for the motor to develop maximum torque. For example, if it is required to have the maximum torque with 4.5 VDC input voltage (REF2), set AJ5 to 4.50.
NOTCH FILTER FREQUENCY	**AJ9**	400~20000 rad/s	6000 rad/s	Sets the notch frequency of a velocity loop anti-resonance filter. This filter can be used to cancel machine or servo resonance. Power must be turned OFF then ON for this parameter to take effect.

4.2.3.2 TORQUE CONTROL USER PARAMETERS

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
CONTROL MODE	**UP-01**	00~FF	00	Sets the control mode of operation for the driver as follows: 1 = Speed 2 = Torque 3 = Pulse Position 4 = Speed/Torque/Position 5 = Speed Preset 6 = Electronic Gearing The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
MOTOR CODE	**UP-02**	0000~FFFF	0000	Sets the internal driver parameters corresponding to the motor code. See **Appendix A** for motor codes. The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
RESOLVER CABLE LENGTH N/A FOR ENCODER	**UP-03**	1~120M	5M	Sets the driver resolver cable length compensation. The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.

4.2.3.2 TORQUE CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
ELECTRONIC GEAR RATIO NUMERATOR	**UP-04**	1~32767	1	The COMMAND PULSE (FMA and FMB) input is multiplied by the ratio of UP-04/UP-05 before being processed by the driver. The driver internal command resolution is equal to the number of resolver cycles times 12000 bits/rev or the PPR of the encoder. (i.e. a motor with a 2X resolver has an internal resolution of 24000 bits/rev, see motor drawings in **Appendix A.6, A.7 & A.8**.) For example if a COMMAND PULSE INPUT of 1000 bits/rev is required with a 2X resolver, set UP-04=24000 and UP-05=1000. Power must be turned OFF then ON for this parameter to take effect. See **Application Note Section 13**.
ELECTRONIC GEAR RATIO DENOMINATOR	**UP-05**	1~32767	1	The driver internal feedback resolution is multiplied by the ratio of UP-05/UP-04 before being sent to OUTPUT PULSE (APD and BPD). The driver internal resolution is equal to the number of resolver cycle times 12000 bits/rev. (i.e. a motor with a 2X resolver has an internal resolution of 24000 bits/rev, see motor drawings in **Appendix A.6, A.7 & A.8**.) For example if an OUTPUT PULSE of 1000 bits/rev is required with a 2X resolver, set UP-04=24000 and UP-05=1000. Power must be turned OFF then ON for this parameter to take effect. See **Application Note Section 13**.
MARKER OFFSET **RESOLVER ONLY	**UP-06**	0~11999 pulses	0 pulses	The electrical ZERO can be shifted with respect to the mechanical shaft position using UP-06. The Delta driver produces N number of ZERO states per motor rotation where N is equal to the number of resolver cycles. (i.e. a motor with a 2X resolver has 2 ZERO/rev. see motor drawings in **Appendix A.6, A.7 & A.8**.) To shift the electrical ZERO place the motor shaft at the desired electrical ZERO position. Read the status display "d" parameter in degrees and set UP-06="d"*12000/360. The electrical ZERO affects the ZPD output pulse and the STOP AT MARKER input stopping position.
MOTOR STOPPED THRESHOLD	**UP-08**	1~4000 r/min	50 r/min	When the motor is rotating at less than the speed set into UP-08 the MOTOR STOPPED output will be on. Software Version 13 and above.

4.2.3.2 TORQUE CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
ABSOLUTE CLEAR MODE	**UP-15**	0~2	0	Selects the type of home 0.00 processing for absolute systems when the SET "0" POSITION input is energized or upon startup. 0: Makes current position of motor equal to 0.00. 1: Makes the current motor shaft rotation the 0 rotation while preserving the MARKER OFFSET. 2: No effect retains absolute position.
BRAKE MODE	**UP-16**	0~2	0	Selects the type of brake sequencing to be used when the driver ENABLE is turned OFF. Brake is applied immediately in the case of an alarm. 0: No brake or dynamic brake. If no brake, the motor will coast to a stop. If dynamic brake relay is installed, the motor and load are dynamically braked to a stop. 1&2:Mechanical holding brake is applied when the motor reaches the speed set in UP-28. The deceleration rate is an uncontrolled coast of the motor and load. Power must be turned OFF then ON for this parameter to take effect.
REF1 and REF2 POLARITY	**UP-17**	00~11	0 0	Sets the polarity of the analog reference inputs. 00: Both REF1 and REF2 normal 01: REF1 inverted, REF2 not inverted 10: REF1 not inverted, REF2 inverted 11: Both REF1 and REF2 inverted
OUTPUT PULSE TYPE	**UP-19**	00~11	01	Sets the type of pulse output sequence and polarity of the PULSE OUTPUT. UP-20 must be set to xxxo for the PULSE OUTPUT to represent incremental actual position. 00: Pulse, Pulse encoding where APD pulses when the actual position increments and BPD pulses when the actual position decrements. 01: Quadrature encoding of APD and BPD with APD leading BPD for incrementing actual position. Each edge of the two pulse trains is counted as an output bit change. 10: Pulse, Pulse encoding where BPD pulses when the actual position increments and APD pulses when the actual position decrements.

4.2.3.2 TORQUE CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
OUTPUT PULSE TYPE (cont'd)	**UP-19** (cont'd)			11: Quadrature encoding of APD and BPD with BPD leading APD for incrementing actual position. Each edge of the two pulse trains is counted as an output bit change.
OUTPUT PULSE CODING	**UP-20**	0000~5533	0000	The first digit of UP-20 selects the parameter to be put on the driver external display when MONITOR SELECT I/O is OFF. Coding is as follows: 0: Motor speed in RPM 1: Actual motor position 2: Motor current 3: Calculated motor temperature 4: Motor distance to marker (°) 5: Machine speed in RPM The second digit of UP-20 selects the parameter to be put on the display when MONITOR SELECT I/O is ON. Coding is the same as the first digit above. The third digit selects the type of electronic coding for the OUTPUT PULSE when an absolute system is configured. This digit is only effective when the fourth digit is set to 3 or absolute motor position. The coding is as follows: 0: 32 bits 1: 23 bits + parity 2: 24 bits + parity 3: 31 bits + parity The fourth digit sets the basic function of the OUTPUTS PULSES. The coding is as follows: 0: Incremental position as defined in UP-19 1: Output to optional drive display DPA-70 2: Output to optional drive display DPA-80 3: Absolute motor position

4.2.3.2 TORQUE CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
MONITOR OUTPUT FUNCTION	**UP-25**	000~111	010	Selects SPEED or TORQUE output and polarity of the MON test point. The first digit selects the MON output function when the MONITOR SELECT I/O is ON. 0: TORQUE 1: SPEED The second digit selects the MON output function when the MONITOR SELECT I/O is OFF. 0: TORQUE 1: SPEED The third digit selects the polarity of the MON output. 0: Normal 1: Invert
HOLDING BRAKE THRESHOLD	**UP-28**	0~100.0%	100%	When UP-16 is set to 0, UP-28 has no effect. When UP-16 is set to 1 or 2, the mechanical brake is applied when the motor speed falls below the value set in UP-28. The value in UP-28 is % of rated speed.
MOTOR TEST SPEED	**UP-29**	1~4000 r/min	50 RPM	The driver can be jogged manually by using the keypad. The jog speed is set with UP-29 in RPM.
EXTERNAL REGEN RESISTOR VALUE (Software version 10 and above)	**UP-30**	0~100.0 ohms	0.0 ohms	Value of the optional external regen resistor. When external regen resistor is used, the value of the resistor is entered to allow the driver to calculate average power into the regen resistor. When the internal regen is used, enter 0.0. Power must be turned OFF then ON for this parameter to take effect. See **Section 7** for details on Regen Resistor selection. This parameter is used with DSD-35 and larger drivers.
EXTERNAL REGEN RESISTOR WATTAGE (Software version 10 and above)	**UP-31**	0~327.67 Kw	0.0 Kw	Power rating of the optional external regen resistor. When external regen resistor is used, the power rating in Kw of the resistor is entered to allow the driver to calculate average power into the regen resistor. When the internal regen is used, enter 0.0. Power must be turned OFF then ON for this parameter to take effect. See **Section 7** for details on Regen Resistor selection. This parameter is used with DSD-35 and larger drivers.

4.2.3.3 TORQUE CONTROL SETUP PARAMETERS

SETUP PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
MOTOR RMS TORQUE TIME CONSTANT	**HP-33**	1~60 sec	30 sec	Sets the time constant for calculating motor rms torque that is displayed as parameter bL. Time constant should be set to approximately twice as long as the machine cycle.
SPEED LIMIT SELECTION	**HP-34**	00~21	11	First digit is not used: 0: N/A 1: N/A 2: N/A Second digit is speed limit method: 0: Limited with REF1 analog input when SPEED LIMIT ENABLE I/O is ON. 10V = Peak speed 1: Limit set by parameter HP-35. When speed limit enable I/O is on.
SPEED LIMIT VALUE	**HP-35**	0~4000 r/min	4000 r/min	Sets the speed limit in RPM when speed limit is active.
ABSORPTION THRESHOLD	**HP-40**	0~100.0%	5%	Sets the absorption (braking) torque detection level to turn on the ABSORBING TORQUE output. 100% = peak torque
SPEED DISPLAY ELECTRONIC RATIO NUMERATOR	**HP-41**	1~32767	1	Parameters HP-41/HP-42 form a fraction that is used to scale the scaled Motor Speed display "F". The motor speed is multiplied by the fraction then put on the display. This allows a speed display that is scaled to the speed of the actual machine rather than the speed of the motor. The scaling can also allow the driver to display speed in different units such as in/sec rather than the default motor RPM. Scales the driver display and optional external display if used.
SPEED DISPLAY ELECTRONIC RATIO DENOMINATOR	**HP-42**	1~32767	1	
SPEED DISPLAY DECIMAL POINT POSITION	**HP-43**	0~7	0	HP-43 sets the position of the decimal point in the optional external speed display. 0: No decimal point 1: Least significant digit ... 7: Most significant digit
INPUT INVERSION	**HP-44**	000~1FF	000	This parameter forms a hexadecimal bit mask that inverts the input when the bit is set to 1 and does not invert the input when the bit is 0. The LSB is for IN0 and so on. (i.e. HP-44=8C inverts inputs IN7, IN3 & IN2)

4.2.3.3 TORQUE CONTROL SETUP PARAMETERS (cont'd)

SETUP PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
OUTPUT INVERSION	**HP-45**	00~FF	00	This parameter forms a hexadecimal bit mask that inverts the output when the bit is set to 1 and does not invert the output when the bit is 0. The LSB is for OUT0 and so on. (i.e. HP-45=4A inverts outputs OUT6, OUT3 & OUT1)

4.3 PULSE POSITION CONTROL MODE 3

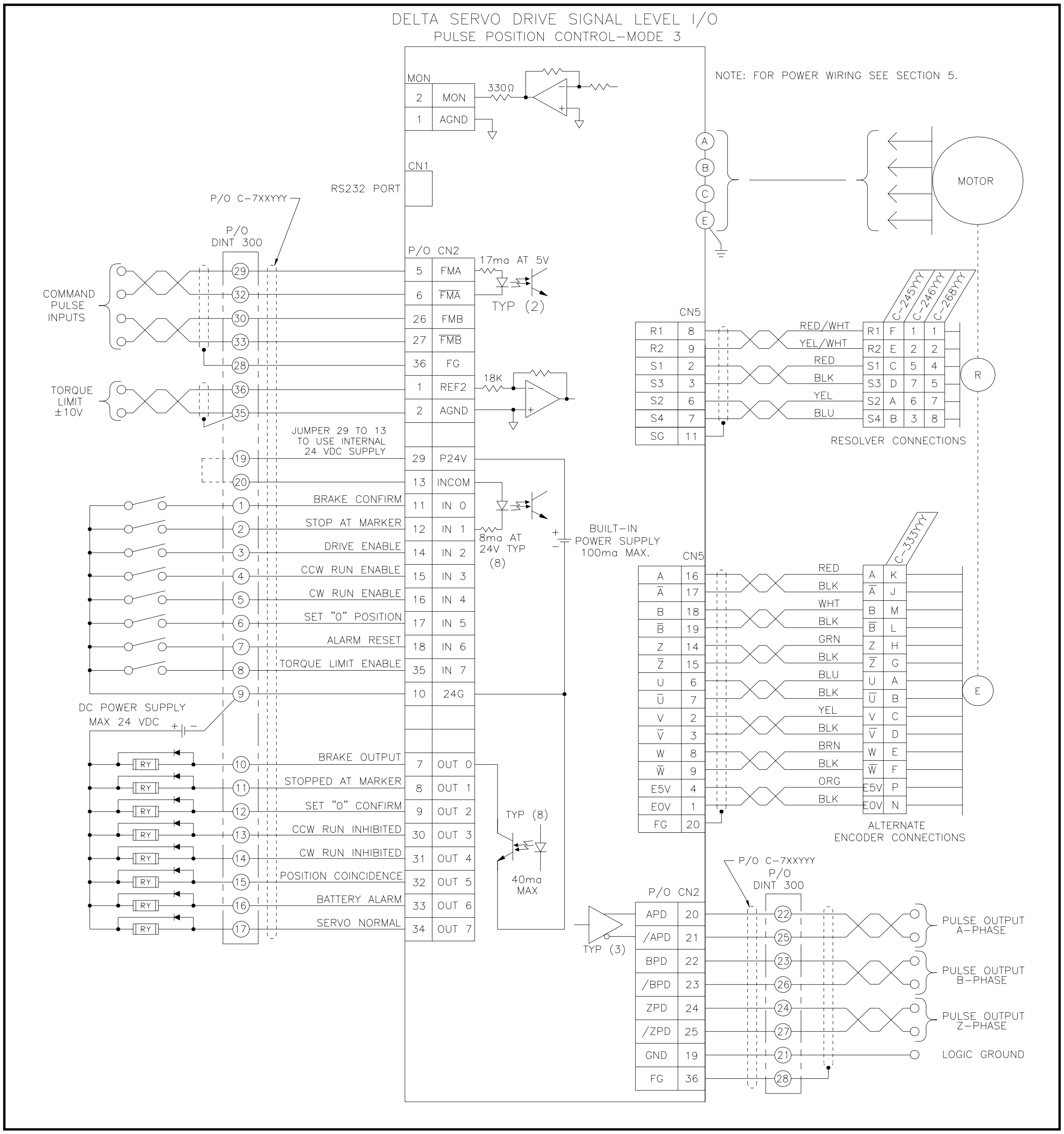
PRIMARY MOTION CONTROL FEATURES

- In the Pulse Position Mode, the driver is a position controller that receives position commands from a digital pulse train.
- The scaling, direction and type of input pulse train are programmable with internal parameters.

SECONDARY MOTION CONTROL FEATURES

- The torque of the motor can be limited via an external analog voltage or by an internal parameter.
- The motor can be stopped and position locked at the motor's marker pulse using an I/O point.
- CW and CCW direction limit I/O points are available to limit the mechanical motion of the mechanism.

4.3.1 SIGNAL WIRING



4.3.2 PULSE POSITION CONTROL INPUT/OUTPUT

TYPE	NAME	FUNCTION
5V Input	COMMAND PULSES (FMA/FMA) (FMB/FMB)	These two pulse trains inputs are the command for motor motion. • The pulse trains are interpreted in 3 possible ways set by UP-18 • The scaling of the pulse to motor movement is set with UP-04 & UP-05 • Command pulse register is monitored with the status display "P'---" & "P---".
24V Input	BRAKE CONFIRM (IN0)	This input is a confirmation of the release of either a dynamic or static mechanical brake. See **Sections 8 & 9** for details of brake operation. • Brake modes of operation are set with UP-16 & UP-28
	STOP AT MARKER (IN1)	When this input is turned ON, the motor stops next motor MARKER or home position. There are two MARKERS per motor rotation located 180° apart. • Deceleration time is fixed at 0 time • Marker position can be shifted up to 180° using UP-6 • Driver switches to position control with position gain set by AJ4
	DRIVE ENABLE (IN2)	When this input is turned ON, the driver becomes operational if there are no faults and the BRAKE CONFIRM (IN0) input is correctly sequenced. • Brake output also is turned ON/OFF with this signal subject to settings of UP-16 and UP-28
	CCW RUN ENABLE (IN3)	When this input is ON, the motor is enabled to run CCW if commanded by the COMMAND PULSES input. (Normally closed CCW direction limit)
	CW RUN ENABLE (IN4)	When this input is ON, the motor is enabled to run CW if commanded by the COMMAND PULSE input. (Normally closed CW direction limit)
	SET "0" POSITION (IN5)	When this input is turned ON for 30 ms or more, the driver internal position registers are set "0". • With an absolute system the home position setting is subject to UP-15
	ALARM RESET (IN6)	When this input is turned ON for 30 ms or more, all alarms are reset. • AL1 (driver overheated) and AL17 (motor overload) cannot be reset until the temperature drops to acceptable level • AL26 cannot be reset until power is cycled
	TORQUE LIMIT ENABLE (IN7)	When this input is turned ON and HP-34 is set to 0X or 1X, the torque limit operates. • If HP-34 is set to 0X, the torque is limited by the TORQUE LIMIT (REF2) input voltage • If HP-34 is set to 1X, the torque limit is set by UP-11 • If HP-34 is set to 2X, the torque limit is on regardless of state of this input with the limit set by UP-11

4.3.2 PULSE POSITION CONTROL INPUT/OUTPUT (cont'd)

TYPE	NAME	FUNCTION
24V Output	BRAKE OUTPUT (OUT0)	This output controls the operation of the dynamic brake or holding brake. • Brake modes of operation are set with UP-16 & UP-28
	STOPPED AT MARKER (OUT1)	This output turns ON when the motor completes the sequence initiated by the STOP AT MARKER (IN1) input.
	SET "0" CONFIRM (OUT2)	This output turns ON confirming that the SET "0" POSITION (IN5) input has been recognized and the internal position registers have been cleared.
	CCW RUN INHIBITED (OUT3)	This output turns on when CCW RUN ENABLE (IN3) is off causing CCW COMMAND PULSES to be inhibited.
	CW RUN INHIBITED (OUT4)	This output turns on when CW RUN ENABLE (IN4) is off causing CW COMMAND PULSES to be inhibited.
	POSITION COINCIDENCE (OUT5)	This output turns ON when the actual position of the motor equals commanded position of the motor. • Detection width is set with UP-7
	BATTERY ALARM (OUT6)	This output turns ON when the battery of absolute system drops below 3.2V. This output is a warning and the battery should be replaced promptly.
	SERVO NORMAL (OUT7)	This output turns ON 1.6 sec. after AC power ON and there are no alarms. • Does not turn OFF in the case of an AL24 (BATTERY ALARM)
Differen-tial output	PULSE OUTPUT (APD/APD) (BPD/BPD) (ZPD(/ZPD)	Programmable pulse train output from the driver. • Type of data output is set by UP-20 • Encoder equivalent output is set by UP-19 with scaling set by UP-04 & UP-05 • External display device with various driver data set by UP-20 • Motor absolute position if an absolute system is used • Motor position register is monitored with the status display "A'---" & "A---"

4.3.3 PULSE POSITION CONTROL PARAMETER SETUP

4.3.3.1 PULSE POSITION CONTROL ADJUSTMENT PARAMETERS

ADJUSTMENT PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
LOAD INERTIA RATIO	**AJ2**	0~100.0	1.0 Times	Sets the baseline frequency response of the driver using the ratio of the load inertia/motor inertia for a rigidly coupled load. If the load is not rigidly coupled, the value entered may vary from the calculated value. If the value is set too high, the motor and driver may become unstable and oscillate. This parameter is set automatically during auto tuning.
HIGH FREQUENCY RESPONSE	**AJ3**	0.1~20.0	1.0	Sets the high frequency response of the driver. The higher the number the more responsive. If the value is set too high, the motor and driver may become unstable and oscillate. The value in AJ3 is unit less and works in concert with AJ2. This parameter is set automatically during auto tuning.
POSITION LOOP DC GAIN	**AJ4**	1~200	30 Rad/sec	Sets the DC gain of the position control loop. A higher value in AJ4 results in stiffer, faster response. If the value is set too high, the motor and driver may become unstable & oscillate. This parameter is set automatically during auto tuning.
TORQUE LIMIT ZERO (REF2)	**AJ5**	±10.00 V	Factory Preset	Sets the zero offset of the TORQUE LIMIT (REF2) input. It can be set in two ways: 1. Automatically: by concurrently pressing SEL ↵ (all digits flash) and then pressing ↵. The driver will read the analog voltage REF2 and create an offset equal and opposite to the analog voltage present at the time. To get a true 0.00 offset, short REF2 to analog ground before doing the auto zero procedure. 2. Manually: by concurrently pressing SEL ↵ (all digits flash) and then concurrently pressing ⇑ SEL. Then adjust the individual digits with ⇑ ⇓.

4.3.3.1 PULSE POSITION CONTROL ADJUSTMENT PARAMETERS (cont'd)

ADJUSTMENT PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
TORQUE LIMIT SCALE (REF2)	**AJ6**	3~40.00 V	10.00V	Sets the TORQUE LIMIT (REF2) scaling. The value set in this parameter is the voltage needed at REF2 for the motor to be limited to maximum torque. For example, if it is required to have the maximum torque with 4.5 VDC input voltage (REF2), set AJ5 to 4.50.
ZERO SPEED GAIN REDUCTION	**AJ7**	0~10000	0	Sets the amount of gain reduction at zero speed. The gain is reduced when the motor is below the speed set in UP-08 and at the set values when the speed is above UP-08.
FEED FORWARD GAIN	**AJ8**	0~2.0 Times	0 Times	Sets the feed forward gain in the position loop. A value of 1.0 results in 0.0 following error. Less than 1.0 will produce a lag between the actual motor position and the commanded position and greater than 1.0 produces a lead. The lead or lag will be proportional to speed at non 1.0 settings.
NOTCH FILTER FREQUENCY	**AJ9**	400~20000 rad/s	6000 rad/s	Sets the notch frequency of a velocity loop anti-resonance filter. This filter can be used to cancel machine or servo resonance. Power must be turned OFF then ON for this parameter to take effect.

4.3.3.2 PULSE POSITION CONTROL USER PARAMETERS

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
CONTROL MODE	**UP-01**	00~FF	00	Sets the control mode of operation for the driver as follows: 1 = Speed 2 = Torque 3 = Pulse Position 4 = Speed/Torque/Position 5 = Speed Preset 6 = Electronic Gearing The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
MOTOR CODE	**UP-02**	0000~FFFF	0000	Sets the internal driver parameters corresponding to the motor code. See **Appendix A** for motor codes. The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.

4.3.3.2 PULSE POSITION CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
RESOLVER CABLE LENGTH N/A FOR ENCODER	**UP-03**	1~120M	5M	Sets the driver resolver cable length compensation. The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
ELECTRONIC GEAR RATIO NUMERATOR	**UP-04**	1~32767	1	The COMMAND PULSE (FMA and FMB) input is multiplied by the ratio of UP-04/UP-05 before being processed by the driver. The driver internal command resolution is equal to the number of resolver cycles times 12000 bits/rev or the PPR of the encoder. (i.e. a motor with a 2X resolver has an internal resolution of 24000 bits/rev, see motor drawings in **Appendix A.6, A.7 & A.8**.) For example if a COMMAND PULSE INPUT of 1000 bits/rev is required with a 2X resolver, set UP-04=24000 and UP-05=1000. Power must be turned OFF then ON for this parameter to take effect. See **Application Note Section 13**.
ELECTRONIC GEAR RATIO DENOMINATOR	**UP-05**	1~32767	1	The driver internal feedback resolution is multiplied by the ratio of UP-05/UP-04 before being sent to OUTPUT PULSE (APD and BPD). The driver internal resolution is equal to the number of resolver cycle times 12000 bits/rev. (i.e. a motor with a 2X resolver has an internal resolution of 24000 bits/rev, see motor drawings in **Appendix A.6, A.7 & A.8**.) For example if an OUTPUT PULSE of 1000 bits/rev is required with a 2X resolver, set UP-04=24000 and UP-05=1000. Power must be turned OFF then ON for this parameter to take effect. See **Application Note Section 13**.
MARKER OFFSET **RESOLVER ONLY	**UP-06**	0~11999 pulses	0 pulses	The electrical ZERO can be shifted with respect to the mechanical shaft position using UP-06. The Delta driver produces N number of ZERO states per motor rotation where N is equal to the number of resolver cycles. (i.e. a motor with a 2X resolver has 2 ZERO/rev. see motor drawings in **Appendix A.6, A.7 & A.8**.) To shift the electrical ZERO place the motor shaft at the desired electrical

4.3.3.2 PULSE POSITION CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
MARKER OFFSET **RESOLVER ONLY (cont'd)	**UP-06 (cont'd)**	0~11999 pulses	0 pulses	ZERO position. Read the status display "d" parameter in degrees and set UP-06="d"*12000/360. The electrical ZERO affects the ZPD output pulse and the STOP AT MARKER input stopping position.
POSITION COINCIDENCE WIDTH	**UP-07**	0~32767 pulses	50 pulses	Sets the width of the sensing window allowable to get the POSITION COINCIDENCE output. Pulse scaling in internal resolution or 12000* Resolver cycles.
MOTOR STOPPED THRESHOLD	**UP-08**	1~4000 r/min	50 r/min	When the motor is rotating at less than the speed set into UP-08 the MOTOR STOPPED output will be on. Software Version 13 and above.
TORQUE LIMIT	**UP-11**	0~100.0%	100%	When the torque limit is applied the motor torque is limited to the value set in UP-11. UP-11 is % of motor peak torque. See **HP-34** for torque limit method.
ABSOLUTE CLEAR MODE	**UP-15**	0~2	0	Selects the type of home 0.00 processing for absolute systems when the SET "0" POSITION input is energized or upon startup. 0: Makes current position of motor equal to 0.00. 1: Makes the current motor shaft rotation the 0 rotation while preserving the MARKER OFFSET. 2: No effect, retains absolute position
BRAKE MODE	**UP-16**	0~2	0	Selects the type of brake sequencing to be used when the driver ENABLE is turned OFF. Brake is applied immediately in the case of an alarm. 0: No brake or dynamic brake. If no brake, the motor will coast to a stop. If dynamic brake relay is installed, the motor and load are dynamically braked to a stop. 1&2: Mechanical holding brake is applied when the motor reaches the speed set in UP-28. The driver applies maximum electronic breaking torque to decelerate the motor to the speed set in UP-28. Power must be turned OFF then ON for this parameter to take effect.

4.3.3.2 PULSE POSITION CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
REF1 and REF2 POLARITY	**UP-17**	00~11	0 0	Sets the polarity of the analog reference inputs. 00: Both REF1 and REF2 normal 01: REF1 inverted, REF2 not inverted 10: REF1 not inverted, REF2 inverted 11: Both REF1 and REF2 inverted
COMMAND PULSE TYPE	**UP-18**	00~12	0 0	Sets the type of pulse sequence and polarity of the COMMAND PULSE inputs. 00: Pulse, Pulse decoding where FMA increments command position and FMB decrements command position. 01: Quadrature decoding of FMA and FMB with FMA leading FMB for incrementing command position. Quadrature decoding effectively multiplies the input frequency by 4 times. 02: Pulse and direction decoding where FMA is pulse train and FMB is direction. FMB OFF increments command position and ON decrements command position. 10: Pulse, Pulse decoding where FMB increments command position and FMA decrements command position. 11: Quadrature decoding of FMA and FMB with FMB leading FMA for incrementing command position. Quadrature decoding effectively multiplies the input frequency by 4 times. 12: Pulse and direction decoding where FMA is pulse train and FMB is direction. FMB ON increments command position and OFF decrements command position.
OUTPUT PULSE TYPE	**UP-19**	00~11	01	Sets the type of pulse output sequence and polarity of the PULSE OUTPUT. UP-20 must be set to xxxo for the PULSE OUTPUT to represent incremental actual position. 00: Pulse, Pulse encoding where APD pulses when the actual position increments and BPD pulses when the actual position decrements.

4.3.3.2 PULSE POSITION CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
OUTPUT PULSE TYPE (cont'd)	**UP-19** (cont'd)			01: Quadrature encoding of APD and BPD with APD leading BPD for incrementing actual position. Each edge of the two pulse trains is counted as an output bit change. 10: Pulse, Pulse encoding where BPD pulses when the actual position increments and APD pulses when the actual position decrements. 11: Quadrature encoding of APD and BPD with BPD leading APD for incrementing actual position. Each edge of the two pulse trains is counted as an output bit change.
OUTPUT PULSE CODING	**UP-20**	0000~5533	0000	The first digit of UP-20 selects the parameter to be put on the driver external display. Coding is as follows: 0: Motor speed in RPM 1: Actual motor position 2: Motor current 3: Calculated motor temperature 4: Motor distance to marker (°) 5: Machine speed in RPM The second digit of UP-20 is not used. The third digit selects the type of electronic coding for the OUTPUT PULSE when an absolute system is configured. This digit is only effective when the fourth digit is set to 3 or absolute motor position. The coding is as follows: 0: 32 bits 1: 23 bits + parity 2: 24 bits + parity 3: 31 bits + parity The fourth digit sets the basic function of the OUTPUTS PULSES. The coding is as follows: 0: Incremental position as defined in UP-19 1: Output to optional drive display DPA-70 2: Output to optional drive display DPA-80 3: Absolute motor position

4.3.3.2 PULSE POSITION CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
MONITOR OUTPUT FUNCTION	**UP-25**	000~111	010	Selects SPEED or TORQUE output and polarity of the MON test point. The first digit is not used. The second digit selects the MON output function. 0: TORQUE 1: SPEED The third digit selects the polarity of the MON output. 0: Normal 1: Invert
COMMAND PULSE POLARITY	**UP-26**	0~1	0	0: Move CCW with increment of command position 1: Move CW with increment of command position
HOLDING BRAKE THRESHOLD	**UP-28**	0~100.0%	100%	When UP-16 is set to 0, UP-28 has no effect. When UP-16 is set to 1 or 2, the mechanical brake is applied when the motor speed falls below the value set in UP-28. The value in UP-28 is % of rated speed.
MOTOR TEST SPEED	**UP-29**	1~4000 r/min	50 RPM	The driver can be jogged manually by using the keypad. The jog speed is set with UP-29 in RPM.
EXTERNAL REGEN RESISTOR VALUE (Software version 10 and above)	**UP-30**	0~100.0 ohms	0.0 ohms	Value of the optional external regen resistor. When external regen resistor is used, the value of the resistor is entered to allow the driver to calculate average power into the regen resistor. When the internal regen is used, enter 0.0. Power must be turned OFF then ON for this parameter to take effect. See **Section 7** for details on Regen Resistor selection. This parameter is used with DSD-35 and larger drivers.
EXTERNAL REGEN RESISTOR WATTAGE (Software version 10 and above)	**UP-31**	0~327.67 Kw	0.0 Kw	Power rating of the optional external regen resistor. When external regen resistor is used, the power rating in Kw of the resistor is entered to allow the driver to calculate average power into the regen resistor. When the internal regen is used, enter 0.0. Power must be turned OFF then ON for this parameter to take effect. See **Section 7** for details on Regen Resistor selection. This parameter is used with DSD-35 and larger drivers.

4.3.3.3 PULSE POSITION CONTROL SETUP PARAMETERS

SETUP PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
MOTOR RMS TORQUE TIME CONSTANT	**HP-33**	1~60 sec	30 sec	Sets the time constant for calculating motor rms torque that is displayed as parameter bL. Time constant should be set to approximately twice as long as the machine cycle.
TORQUE LIMIT SELECTION	**HP-34**	00~21	11	First digit is torque limit method: 0: Limited with REF2 analog input when TORQUE LIMIT ENABLE I/O is ON. 10V = Peak torque 1: Limit set by parameter UP-11 or HP-36 through HP-39 when UP-11 = 0 and when TORQUE LIMIT ENABLE I/O is ON. 2: Limit set by parameter UP-11 or HP-36 through HP-39 when UP-11 = 0 regardless of the state of the TORQUE LIMIT ENABLE I/O. Second digit is speed limit method: 0: N/A 1: N/A
CCW ROTATION TORQUE LIMIT	**HP-36**	0~100.0%	100%	Limits CCW rotation torque. 100% = Peak Torque See **HP-34**
CCW ROTATION ABSORPTION TORQUE LIMIT	**HP-37**	0~100.0%	100%	Limits CCW rotation absorption (braking) torque. 100% = Peak Torque See **HP-34**
CW ROTATION TORQUE LIMIT	**HP-38**	0~100.0%	100%	Limits CW rotation torque. 100% = Peak Torque See **HP-34**
CW ROTATION ABSORPTION TORQUE LIMIT	**HP-39**	0~100.0%	100%	Limits CW rotation absorption (braking) torque. 100% = Peak Torque See **HP-34**
SPEED DISPLAY ELECTRONIC RATIO NUMERATOR	**HP-41**	1~32767	1	Parameters HP-41/HP-42 form a fraction that is used to scale the scaled Motor Speed display "F". The motor speed is multiplied by the fraction, and then put on the display. This allows a speed display that is scaled to the speed of the actual machine rather than the speed of the motor. The scaling can also allow the driver to display speed in different units such as in/sec rather than the default motor RPM. Scales the display driver and optional external display if used.
SPEED DISPLAY ELECTRONIC RATIO DENOMINATOR	**HP-42**	1~32767	1	

4.3.3.3 PULSE POSITION CONTROL SETUP PARAMETERS (cont'd)

SETUP PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
SPEED DISPLAY DECIMAL POINT POSITION	**HP-43**	0~7	0	HP-43 sets the position of the decimal point in the optional external speed display. 0: No decimal point 1: Least significant digit ... 7: Most significant digit
INPUT INVERSION	**HP-44**	000~1FF	000	This parameter forms a hexadecimal bit mask that inverts the input when the bit is set to 1 and does not invert the input when the bit is 0. The LSB is for IN0 and so on. (i.e. HP-44=8C inverts inputs IN7, IN3 & IN2)
OUTPUT INVERSION	**HP-45**	00~FF	00	This parameter forms a hexadecimal bit mask that inverts the output when the bit is set to 1 and does not invert the output when the bit is 0. The LSB is for OUT0 and so on. (i.e. HP-45=4A inverts outputs OUT6, OUT3 & OUT1)
IN POSITION TIMER	**HP-46**	0~200 ms	20 ms	Sets the minimum width of the POSITION COINCIDENCE output.

4.4 SPEED/TORQUE/POSITION CONTROL MODE 4

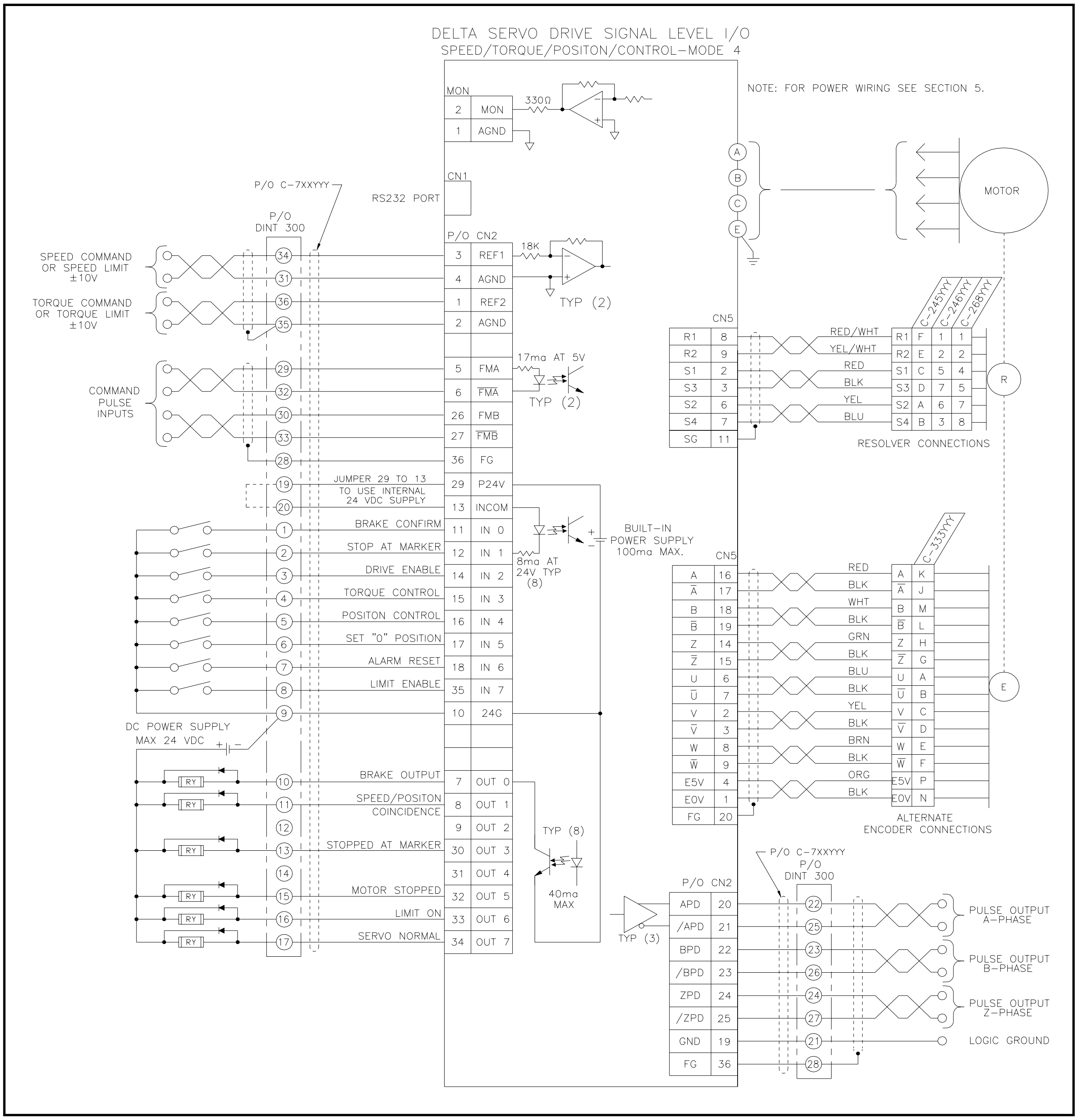
PRIMARY MOTION CONTROL FEATURES

- In the Speed/Torque/ Position Mode, the driver can be switched between the three previously described control modes with two (2) I/O points.
- In the speed and position mode, the torque of the motor can be limited via an external analog voltage or by an internal parameter.
- In the torque mode, the speed of the motor can be limited using an external analog voltage or by an internal parameter.

SECONDARY MOTION CONTROL FEATURES

- The motor can be stopped and position locked at the motor's marker pulse using an I/O point.

4.4.1 SIGNAL WIRING



4.4.2 SPEED/TORQUE/POSITION CONTROL INPUT/OUTPUT

TYPE	NAME	FUNCTION
Analog Input	SPEED COMMAND (REF1) or (Selected by IN3 & IN4)	SPEED COMMAND +/-10V input. Rotation is CCW for (+) voltage and CW for (-) voltage. Motor speed is directly proportional to voltage. • Direction of rotation is set with UP-17 • Acceleration/deceleration is set with UP-12, 13 &14 • Scaling of speed vs. voltage is set with AJ1 • Zero adjustment is set with AJO • SPEED COMMAND (REF1) voltage monitor on the status display "cF---"
	SPEED LIMIT (REF1)	SPEED LIMIT 0-10V input. The motor speed is limited proportionally with this voltage. • Scaling of speed vs. voltage is set with AJ1 • Zero adjustment is set with AJ0 • The method to cause limiting is set with HP-34 • SPEED LIMIT (REF2) voltage monitor on the status display "cF---".
	TORQUE COMMAND (REF2) or (Selected by IN3 & IN4)	TORQUE COMMAND +/-10V input. Torque is applied CCW for (+) voltage and CW for (-) voltage. Motor torque is directly proportional to voltage. • Direction of torque is set with UP-17 • Scaling of torque vs. voltage is set with AJ6 • Zero adjustment is set with AJ5 • TORQUE COMMAND (REF2) voltage monitor on the status display "cc---".
	TORQUE LIMIT (REF2)	TORQUE LIMIT 0-10V input. The peak motor torque is limited proportionally with this voltage. • Scaling of torque vs. voltage is set with AJ6 • Zero adjustment is set with AJ5 • The method to cause limiting is set with HP-34 • TORQUE LIMIT (REF2) voltage monitor on the status display "cc---".
5V Input	COMMAND PULSE (FMA/FMA) (FMB/FMB)	These two pulse trains inputs are the command for motor motion. • The pulse trains are interpreted in 3 possible ways set by UP-18 • The scaling of the pulse to motor movement is set with UP-04 & UP-05 • Command pulse register is monitored with the status display "P'---" & "P---".

4.4.2 SPEED/TORQUE/POSITION CONTROL INPUT/OUTPUT (cont'd)

TYPE	NAME	FUNCTION
24V Input	BRAKE CONFIRM (IN0)	This input is a confirmation of the release of either a dynamic or static mechanical brake. See **Sections 8 & 9** for details of brake operation. • Brake modes of operation are set with UP-16 & UP-28
	STOP AT MARKER (IN1)	When this input is turned ON, the motor stops next motor MARKER or home position. There are two MARKERS per motor rotation located 180° apart. • Deceleration time is fixed at 0 time • Marker position can be shifted up to 180° using UP-6 • Driver switches to position control with position gain set by AJ4
	DRIVE ENABLE (IN2)	When this input is turned ON, the driver becomes operational if there are no faults and the BRAKE CONFIRM (IN)) input is correctly sequenced. • Brake output also is turned ON/OFF with this signal subject to settings of UP-16 and UP-28
	TORQUE CONTROL (IN3)	When this input is ON, the motor is torque control mode. • When both this input and POSITION CONTROL (IN4) are OFF, the motor is in speed control mode
	POSITION CONTROL (IN4)	When this input is ON and TORQUE CONTROL (IN3) is OFF, the motor is in position control mode. • When both this input and TORQUE CONTROL (IN3) are OFF, the motor is in speed control mode
	SET "0" POSITION (IN5)	When this input is turned ON for 30 ms or more, the driver internal position registers are set "0". • With an absolute system, the home position setting is subject to UP-15
	ALARM RESET (IN6)	When this input is turned ON for 30 ms or more, all alarms are reset. • AL1 (driver overheated) and AL17 (motor overload) cannot be reset until the temperature drops to acceptable level • AL26 cannot be reset until power is cycled
	LIMIT ENABLE (IN7)	When in speed control mode or position control mode, this input is turned ON and HP-34 is set to 0X or 1X, the torque limit operates. • If HP-34 is set to 0X, the torque is limited by the TORQUE LIMIT (REF2) input voltage • If HP-34 is set to 1X, the torque limit is set by UP-11 • If HP-34 is set to 2X, the torque limit is on regardless of state of this input with the limit set by UP-11 When in torque control mode, this input is turned ON and HP-34 is set to X0 or X1, the speed limit operates. • If HP-34 is set to X0, the speed is limited by the SPEED LIMIT (REF1) input voltage • If HP-34 is set to X1, the speed limit is set by HP-35

4.4.2 SPEED/TORQUE/POSITION CONTROL INPUT/OUTPUT (cont'd)

TYPE	NAME	FUNCTION
24V Output	BRAKE OUTPUT (OUT0)	This output controls the operation of the dynamic brake or holding brake. • Brake modes of operation are set with UP-16 & UP-28
	SPEED/POSITION COINCIDENCE (OUT1)	In speed control mode, this output turns ON when the actual speed of the motor reaches the target speed. • Target speed can be set to a preset speed or the commanded speed with UP-09 • Detection width is be set with UP-10 In position control mode, this output turns ON when the actual position of the motor equals commanded position of the motor. • Detection width is set with UP-7
	STOPPED AT MARKER (OUT3)	This output turns ON when the motor completes the sequence initiated by the STOP AT MARKER (IN1) input.
	MOTOR STOPPED (OUT5)	This output turns ON when the motor speed drops below the internal preset speed set in UP-8.
	LIMIT ON (OUT6)	In speed control mode, this output turns ON when the motor torque is limited to less than the peak rating of the motor. • HP-34 and LIMIT ENABLE (IN7) input set the conditions for torque limiting • UP-11 is the internal preset limit value In torque control mode, this output turns ON when the motor speed is limited to less than the peak rating of the motor. • HP-34 and LIMIT ENABLE (IN7) input set the conditions for speed limiting • HP-35 is the internal preset limit value
	SERVO NORMAL (OUT7)	This output turns ON 1.6 sec. after AC power ON and there are no alarms. • Does not turn OFF in the case of an AL24 (BATTERY ALARM)
Differen-tial output	PULSE OUTPUT (APD/APD) (BPD/BPD) (ZPD(/ZPD)	Programmable pulse train output from the driver. • Type of data output is set by UP-20 • Encoder equivalent output is set by UP-19 with scaling set by UP-04 & UP-05 • External display device with various driver data set by UP-20 • Motor absolute position if an absolute system is used • Motor position register is monitored with the status display "A'---" & "A---"

4.4.3 SPEED/TORQUE/POSITION CONTROL PARAMETER SETUP

4.4.3.1 SPEED/TORQUE/POSITION CONTROL ADJUSTMENT PARAMETERS

ADJUSTMENT PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
SPEED COMMAND (LIMIT) ZERO (REF1)	**AJ0**	±10.00 V	Factory Preset	Sets the zero offset of the SPEED COMMAND (REF1) input. It can be set in two ways: 1. Automatically: by concurrently pressing SEL ↵ (all digits flash) and then pressing ↵. The driver will read the analog voltage REF1 and create an offset equal and opposite to the analog voltage present at the time. To get a true 0.00 offset, short REF1 to analog ground before doing the auto zero procedure. 2. Manually: by concurrently pressing SEL ↵ (all digits flash) and then concurrently pressing ▲ SEL. Then adjust the individual digits with ▲ ▼.
SPEED COMMAND (LIMIT) SCALE (REF1)	**AJ1**	3~40.00 V	10.00V	Sets the SPEED COMMAND (REF1) scaling. The value set in this parameter is the voltage needed at REF1 to bring the motor to the rated speed. For example, if the motor must turn at rated speed with 4.5 VDC input voltage (REF1), set AJ1 to 4.50.
LOAD INERTIA RATIO	**AJ2**	0~100.0	1.0 Times	Sets the baseline frequency response of the driver using the ratio of the load inertia/motor inertia for a rigidly coupled load. If the load is not rigidly coupled, the value entered may vary from the calculated value. If the value is set too high, the motor and driver may become unstable and oscillate. This parameter is set automatically during auto tuning.
HIGH FREQUENCY RESPONSE	**AJ3**	0.1~20.0	1.0	Sets the high frequency response of the driver. The higher the number the more responsive. If the value is set too high, the motor and driver may become unstable and oscillate. The value in AJ3 is unit less and works in concert with AJ2. This parameter is set automatically during auto tuning.

4.4.3.1 SPEED/TORQUE/POSITION CONTROL ADJUSTMENT PARAMETERS (cont'd)

ADJUSTMENT PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
POSITION LOOP DC GAIN	**AJ4**	1~200	30 Rad/sec	Sets the DC gain of the position control loop. A higher value in AJ4 results in stiffer, faster response. If the value is set too high, the motor and driver may become unstable and oscillate. This parameter is set automatically during auto tuning.
TORQUE COMMAND (LIMIT) ZERO (REF2)	**AJ5**	±10.00 V	Factory Preset	Sets the zero offset of the TORQUE COMMAND (REF2) input. It can be set in two ways: 1. Automatically: by concurrently pressing SEL ↵ (all digits flash) and then pressing ↵. The driver will read the analog voltage REF2 and create an offset equal and opposite to the analog voltage present at the time. To get a true 0.00 offset, short REF2 to analog ground before doing the auto zero procedure. 2. Manually: by concurrently pressing SEL ↵ (all digits flash) and then concurrently pressing ⇑ SEL. Then adjust the individual digits with ⇑ ⇓.
TORQUE COMMAND (LIMIT) SCALE (REF2)	**AJ6**	3~40.00 V	10.00V	Sets the TORQUE COMMAND (REF2) scaling. The value set in this parameter is the voltage needed at REF2 for the motor to develop maximum torque. For example, if it is required to have the maximum torque with 4.5 VDC input voltage (REF2), set AJ5 to 4.50.
ZERO SPEED GAIN REDUCTION	**AJ7**	0~10000	0	Sets the amount of gain reduction at zero speed. The gain is reduced when the motor is below the speed set in UP-08 and at the set values when the speed is above UP-08.
FEED FORWARD GAIN	**AJ8**	0~2.0 Times	0 Times	Sets the feed forward gain in the position loop. A value of 1.0 results in 0.0 following error. Less than 1.0 will produce a lag between the actual motor position and the commanded position and greater than 1.0 produces a lead. The lead or lag will be proportional to speed at non 1.0 settings.
NOTCH FILTER FREQUENCY	**AJ9**	100~20000 rad/s	6000 rad/s	Sets the notch frequency of a velocity loop anti-resonance filter. This filter can be used to cancel machine or servo resonance. Power must be turned OFF then ON for this parameter to take effect.

4.4.3.2 SPEED/TORQUE/POSITION CONTROL USER PARAMETERS

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
CONTROL MODE	**UP-01**	00~FF	00	Sets the control mode of operation for the driver as follows: 1 = Speed 2 = Torque 3 = Pulse Position 4 = Speed/Torque/Position 5 = Speed Preset 6 = Electronic Gearing The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
MOTOR CODE	**UP-02**	0000~FFFF	0000	Sets the internal driver parameters corresponding to the motor code. See **Appendix A** for motor codes. The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
RESOLVER CABLE LENGTH N/A FOR ENCODER	**UP-03**	1~120M	5M	Sets the driver resolver cable length compensation. The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
ELECTRONIC GEAR RATIO NUMERATOR	**UP-04**	1~32767	1	The COMMAND PULSE (FMA and FMB) input is multiplied by the ratio of UP-04/UP-05 before being processed by the driver. The driver internal command resolution is equal to the number of resolver cycles times 12000 bits/rev or the PPR of the encoder. (i.e. a motor with a 2X resolver has an internal resolution of 24000 bits/rev, see motor drawings in **Appendix A.6, A.7 & A.8**.) For example if a COMMAND PULSE INPUT of 1000 bits/rev is required with a 2X resolver, set UP-04=24000 and UP-05=1000. Power must be turned OFF then ON for this parameter to take effect. See **Application Note Section 13**.

4.4.3.2 SPEED/TORQUE/POSITION CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
ELECTRONIC GEAR RATIO DENOMINATOR	**UP-05**	1~32767	1	The driver internal feedback resolution is multiplied by the ratio of UP-05/UP-04 before being sent to OUTPUT PULSE (APD and BPD). The driver internal resolution is equal to the number of resolver cycle times 12000 bits/rev. (i.e. a motor with a 2X resolver has an internal resolution of 24000 bits/rev, see motor drawings in **Appendix A.6, A.7 & A.8**.) For example if an OUTPUT PULSE of 1000 bits/rev is required with a 2X resolver, set UP-04=24000 and UP-05=1000. Power must be turned OFF then ON for this parameter to take effect. See **Application Note Section 13**.
MARKER OFFSET **RESOLVER ONLY	**UP-06**	0~11999 pulses	0 pulses	The electrical ZERO can be shifted with respect to the mechanical shaft position using UP-06. The Delta driver produces N number of ZERO states per motor rotation where N is equal to the number of resolver cycles. (i.e. a motor with a 2X resolver has 2 ZERO/rev. see motor drawings in **Appendix A.6, A.7 & A.8**.) To shift the electrical ZERO place the motor shaft at the desired electrical ZERO position. Read the status display "d" parameter in degrees and set UP-06="d"*12000/360. The electrical ZERO affects the ZPD output pulse and the STOP AT MARKER input stopping position.
POSITION COINCIDENCE WIDTH	**UP-07**	0~32767 pulses	50 pulses	Sets the width of the sensing window allowable to get the POSITION COINCIDENCE output. Pulse scaling in internal resolution or 12000* Resolver cycles.
MOTOR STOPPED THRESHOLD	**UP-08**	1~4000 r/min	50 r/min	When the motor is rotating at less than the speed set into UP-08 the MOTOR STOPPED output will be on.
SPEED COINCIDENCE THRESHOLD	**UP-09**	0~4000 r/min	0 r/min	If UP-09 is non-zero, the SPEED COINCIDENCE output comes on when the actual motor speed reaches the value set in UP-09. If UP-09 is zero, the SPEED COINCIDENCE output comes on when the actual motor speed reaches the commanded speed.
SPEED COINCIDENCE WIDTH	**UP-10**	1~4000 r/min	20 r/min	Sets the width of the sensing window allowable to get the SPEED COINCIDENCE output.

4.4.3.2 SPEED/TORQUE/POSITION CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
TORQUE LIMIT	**UP-11**	0~100.0%	100%	When the torque limit is applied the motor torque is limited to the value set in UP-11. UP-11 is % of motor peak torque. See **HP-34** for torque limit method.
ACCEL TIME	**UP-12**	0~32.76 sec	0 sec	Sets the time from zero to rated speed with a linear acceleration profile. Ignored if UP-14 is not equal to 0.0.
DECEL TIME	**UP-13**	0~32.76 sec	0 sec	Sets the time from rated speed to zero speed with a linear deceleration profile. Ignored if UP-14 is not equal to 0.0.
S-SHAPED TIME	**UP-14**	0~32.76 sec	0 sec	Sets the acel and decel time from the current speed to the new command speed using an S-shaped minimum jerk profile.
ABSOLUTE CLEAR MODE	**UP-15**	0~2	0	Selects the type of home 0.00 processing for absolute systems when the SET "0" POSITION input is energized or upon startup. 0: Makes current position of motor equal to 0.00. 1: Makes the current motor shaft rotation the 0 rotation while preserving the MARKER OFFSET. 2: No effect retains absolute position.
BRAKE MODE	**UP-16**	0~2	0	If operating in Speed control, see **UP-16 in Section 4.1.3.2**. If operating in Torque control, see **UP-16 in Section 4.2.3.2**. If operating in Position control, see **UP-16 in Section 4.3.3.2**.
REF1 and REF2 POLARITY	**UP-17**	00~11	0 0	Sets the polarity of the analog reference inputs. 00: Both REF1 and REF2 normal 01: REF1 inverted, REF2 not inverted 10: REF1 not inverted, REF2 inverted 11: Both REF1 and REF2 inverted
COMMAND PULSE TYPE	**UP-18**	00~12	0 0	Sets the type of pulse sequence and polarity of the COMMAND PULSE inputs. 00: Pulse, Pulse decoding where FMA increments command position and FMB decrements command position. 01: Quadrature decoding of FMA and FMB with FMA leading FMB for incrementing command position. Quadrature decoding effectively multiplies the input frequency by 4 times.

4.4.3.2 SPEED/TORQUE/POSITION CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
COMMAND PULSE TYPE (cont'd)	**UP-18 (cont'd)**			02: Pulse and direction decoding where FMA is pulse train and FMB is direction. FMB OFF increments command position and ON decrements command position. 10: Pulse, Pulse decoding where FMB increments command position and FMA decrements command position. 11: Quadrature decoding of FMA and FMB with FMB leading FMA for incrementing command position. Quadrature decoding effectively multiplies the input frequency by 4 times. 12: Pulse and direction decoding where FMA is pulse train and FMB is direction. FMB ON increments command position and OFF decrements command position.
OUTPUT PULSE TYPE	**UP-19**	00~11	01	Sets the type of pulse output sequence and polarity of the PULSE OUTPUT. UP-20 must be set to xxxo for the PULSE OUTPUT to represent incremental actual position. 00: Pulse, Pulse encoding where APD pulses when the actual position increments and BPD pulses when the actual position decrements. 01: Quadrature encoding of APD and BPD with APD leading BPD for incrementing actual position. Each edge of the two pulse trains are counted as an output bit change. 10: Pulse, Pulse encoding where BPD pulses when the actual position increments and APD pulses when the actual position decrements. 11: Quadrature encoding of APD and BPD with BPD leading APD for incrementing actual position. Each edge of the two pulse trains is counted as an output bit change.

4.4.3.2 SPEED/TORQUE/POSITION CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
OUTPUT PULSE CODING	**UP-20**	0000~5533	0000	The first digit of UP-20 selects the parameter to be put on the driver external display. Coding is as follows: 0: Motor speed in RPM 1: Actual motor position 2: Motor current 3: Calculated motor temperature 4: Motor distance to marker deg) 5: Machine speed in RPM The second digit of UP-20 is not used. The third digit selects the type of electronic coding for the OUTPUT PULSE when an absolute system is configured. This digit is only effective when the fourth digit is set to 3 or absolute motor position. The coding is as follows: 0: 32 bits 1: 23 bits + parity 2: 24 bits + parity 3: 31 bits + parity The fourth digit sets the basic function of the OUTPUTS PULSES. The coding is as follows: 0: Incremental position as defined in UP-19 1: Output to optional drive display DPA-70 2: Output to optional drive display DPA-80 3: Absolute motor position
MONITOR OUTPUT FUNCTION	**UP-25**	000~111	010	Selects SPEED or TORQUE output and polarity of the MON test point. The first digit is not used. The second digit selects the MON output function. 0: TORQUE 1: SPEED The third digit selects the polarity of the MON output. 0: Normal 1: Invert
COMMAND PULSE POLARITY	**UP-26**	0~1	0	0: Move CCW with increment of command position 1: Move CW with increment of command position.

4.4.3.2 SPEED/TORQUE/POSITION CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
HOLDING BRAKE THRESHOLD	**UP-28**	0~100.0%	100%	When UP-16 is set to 0, UP-28 has no effect. When UP-16 is set to 1 or 2, the mechanical brake is applied when the motor speed falls below the value set in UP-28. The value in UP-28 is % of rated speed.
MOTOR TEST SPEED	**UP-29**	1~4000 r/min	50 RPM	The driver can be jogged manually by using the keypad. The jog speed is set with UP-29 in RPM.
EXTERNAL REGEN RESISTOR VALUE (Software version 10 and above)	**UP-30**	0~100.0 ohms	0.0 ohms	Value of the optional external regen resistor. When external regen resistor is used, the value of the resistor is entered to allow the driver to calculate average power into the regen resistor. When the internal regen is used, enter 0.0. Power must be turned OFF then ON for this parameter to take effect. See **Section 7** for details on Regen Resistor selection. This parameter is used with DSD-35 and larger drivers.
EXTERNAL REGEN RESISTOR WATTAGE (Software version 10 and above)	**UP-31**	0~327.67 Kw	0.0 Kw	Power rating of the optional external regen resistor. When external regen resistor is used, the power rating in Kw of the resistor is entered to allow the driver to calculate average power into the regen resistor. When the internal regen is used, enter 0.0. Power must be turned OFF then ON for this parameter to take effect. See **Section 7** for details on Regen Resistor selection. This parameter is used with DSD-35 and larger drivers.

4.4.3.3 SPEED/TORQUE/POSITION CONTROL SETUP PARAMETERS

SETUP PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
MOTOR RMS TORQUE TIME CONSTANT	**HP-33**	1~60 sec	30 sec	Sets the time constant for calculating motor rms torque that is displayed as parameter bL. Time constant should be set to approximately twice as long as the machine cycle.
SPEED/TORQUE LIMIT SELECTION	**HP-34**	00~21	11	First digit is torque limit method: 0: Limited with REF2 analog input when TORQUE LIMIT ENABLE I/O is ON. 10V = Peak torque 1: Limit set by parameter UP-11 or HP-36 through HP-39 when UP-11 = 0 and when TORQUE LIMIT ENABLE I/O is ON.

4.4.3.3 SPEED/TORQUE/POSITION CONTROL SETUP PARAMETERS (cont'd)

SETUP PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
SPEED/TORQUE LIMIT SELECTION (cont'd)	**HP-34** (cont'd)			2: Limit set by parameter UP-11 or HP-36 through HP-39 when UP-11 = 0 regardless of the state of the TORQUE LIMIT ENABLE I/O. Second digit is speed limit method: 0: Limited with REF1 analog input when SPEED LIMIT ENABLE I/O is ON. 10V = Peak speed 1: Limit set by parameter HP-35. Regardless of limit enable input.
SPEED LIMIT VALUE	**HP-35**	0~4000 r/min	4000 r/min	Sets the speed limit in RPM when speed limit is active.
CCW ROTATION TORQUE LIMIT	**HP-36**	0~100.0%	100%	Limits CCW rotation torque. 100% = Peak Torque See **HP-34**
CCW ROTATION ABSORPTION TORQUE LIMIT	**HP-37**	0~100.0%	100%	Limits CCW rotation absorption (braking) torque. 100% = Peak Torque See **HP-34**
CW ROTATION TORQUE LIMIT	**HP-38**	0~100.0%	100%	Limits CW rotation torque. 100% = Peak Torque See **HP-34**
CW ROTATION ABSORPTION TORQUE LIMIT	**HP-39**	0~100.0%	100%	Limits CW rotation absorption (braking) torque. 100% = Peak Torque See **HP-34**
SPEED DISPLAY ELECTRONIC RATIO NUMERATOR	**HP-41**	1~32767	1	Parameters HP-41/HP-42 form a fraction that is used to scale the scaled Motor Speed display "F". The motor speed is multiplied by the fraction, and then put on the display. This allows a speed display that is scaled to the speed of the actual machine rather than the speed of the motor. The scaling can also allow the driver to display speed in different units such as in/sec rather than the default motor RPM. Scales the driver display and optional external display if used.
SPEED DISPLAY ELECTRONIC RATIO DENOMINATOR	**HP-42**	1~32767	1	
SPEED DISPLAY DECIMAL POINT POSITION	**HP-43**	0~7	0	HP-43 sets the position of the decimal point in the optional external speed display. 0: No decimal point 1: Least significant digit ... 7: Most significant digit
INPUT INVERSION	**HP-44**	000~1FF	000	This parameter forms a hexadecimal bit mask that inverts the input when the bit is set to 1 and does not invert the input when the bit is 0. The LSB is for IN0 and so on. (i.e. HP-44=8C inverts inputs IN7, IN3 & IN2)

4.4.3.3 SPEED/TORQUE/POSITION CONTROL SETUP PARAMETERS (cont'd)

SETUP PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
OUTPUT INVERSION	**HP-45**	00~FF	00	This parameter forms a hexadecimal bit mask that inverts the output when the bit is set to 1 and does not invert the output when the bit is 0. The LSB is for OUT0 and so on. (i.e. HP-45=4A inverts outputs OUT6, OUT3 & OUT1)
IN POSITION TIMER	**HP-46**	0~200 ms	20 ms	Sets the minimum width of the POSITION COINCIDENCE output. Available in software version 009 and above.

4.5 SPEED PRESET CONTROL MODE 5

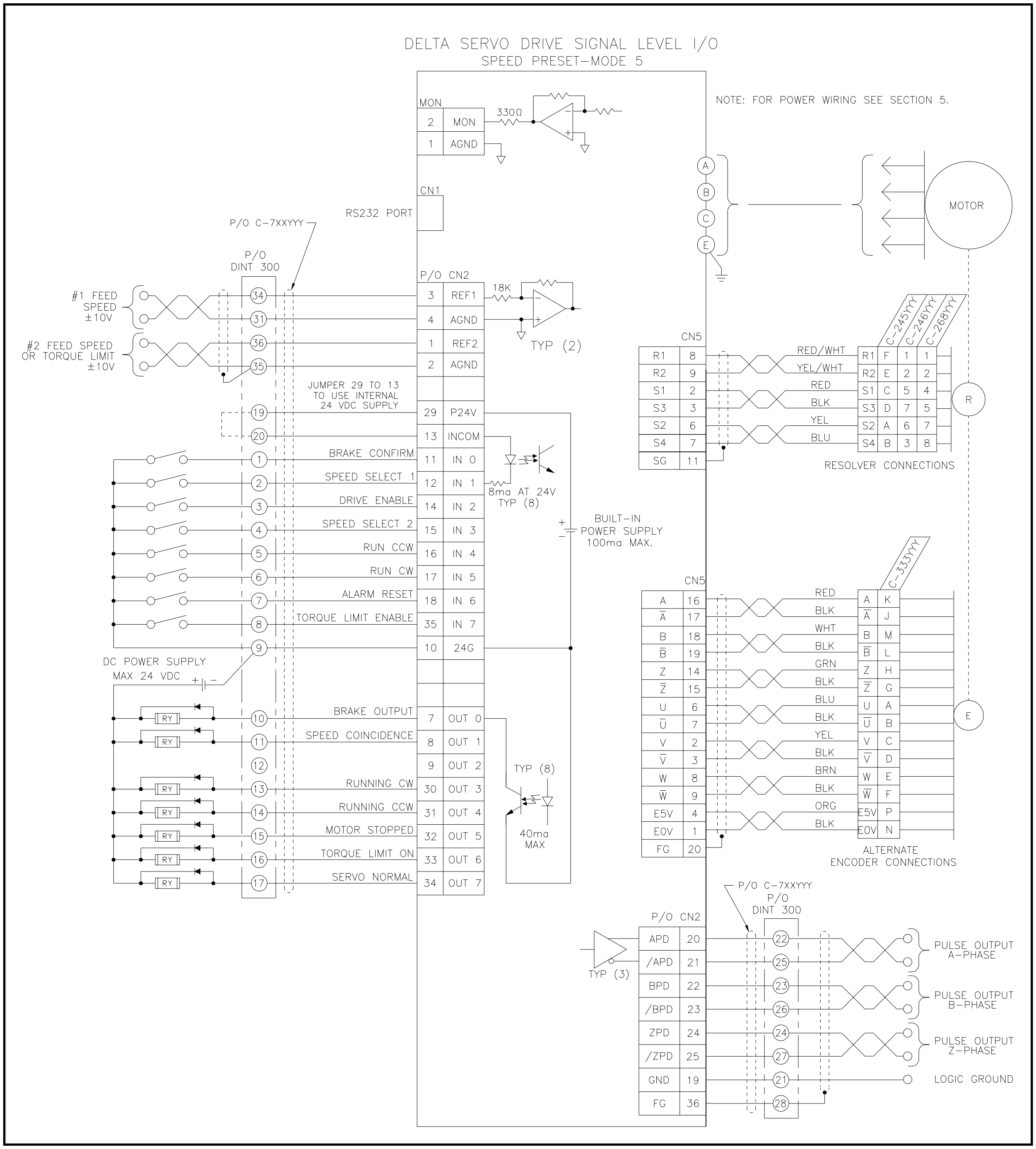
PRIMARY MOTION CONTROL FEATURES

- In the Speed Preset Control Mode, the driver is a precision speed regulator that receives the speed command from an external analog source or from internal speed presets selected by two (2) I/O points.
- The scaling and polarity of the analog speed command is fully programmable and the preset speeds are programmed into internal driver parameters.
- Two(2) I/O points are used to start the motion and set the CW or CCW direction of rotation.
- The acceleration and deceleration used for changes in motor speed can be programmed to be either linear or S Shaped minimum jerk. The time to change speeds and the amount of S Shape rounding is fully programmable.

SECONDARY MOTION CONTROL FEATURES

- The torque of the motor can be limited via an external analog voltage or by an internal parameter.

4.5.1 SIGNAL WIRING



4.5.2 SPEED PRESET CONTROL INPUT/OUTPUT

TYPE	NAME	FUNCTION
Analog Input	#1 FEED SPEED (REF1)	#1 FEED SPEED +/-10V input is active if UP-21=0 and SPEED SELECT 1 (IN1) & SPEED SELECT 2 (IN3) are both OFF. • Rotation is CCW for (+) voltage and CW for (-) voltage. Motor speed is directly proportional to voltage. • Direction of rotation is set with UP-17 • Acceleration/deceleration is set with UP-12, 13 &14 • Scaling of speed vs. voltage is set with AJ1 • Zero adjustment is set with AJO • #1 FEED SPEED (REF1) voltage monitor on the status display "cF---".
	#2 FEED SPEED (REF2) or (Selected by IN7)	#2 FEED SPEED +/-10V input is active if UP-22=0 and SPEED SELECT 1 (IN1) is ON & SPEED SELECT 2 (IN3) is OFF. • Rotation is CCW for (+) voltage and CW for (-) voltage. Motor speed is directly proportional to voltage. • Direction of rotation is set with UP-17 • Acceleration/deceleration is set with UP-12, 13 &14 • Scaling of speed vs. voltage is set with AJ6 • Zero adjustment is set with AJ5 • SPEED COMMAND (REF1) voltage monitor on the status display "cc---".
	TORQUE LIMIT (REF2)	TORQUE LIMIT 0-10V input. The peak motor torque is limited proportionally with this voltage. • Scaling of torque vs. voltage is set with AJ6 • Zero adjustment is set with AJ5 • The method to cause limiting is set with HP-34 • TORQUE LIMIT (REF2) voltage monitor on the status display "cc---".
24V Input	BRAKE CONFIRM (IN0)	This input is a confirmation of the release of either a dynamic or static mechanical brake. See **Sections 8 & 9** for details of brake operation. • Brake modes of operation are set with UP-16 & UP-28
	SPEED SELECT 1 (IN1)	<table><tr><td></td><td>#1</td><td>#2</td><td>#3</td><td>#4</td></tr><tr><td>FEED SELECTION</td><td>FEED UP-21</td><td>FEED UP-22</td><td>FEED UP-23</td><td>FEED UP-24</td></tr><tr><td>SPEED SELECT 1</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr><tr><td>SPEED SELECT 2</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr></table>
	DRIVE ENABLE (IN2)	When this input is turned ON, the driver becomes operational if there are no faults and the BRAKE CONFIRM input is correctly sequenced. • Brake output also is turned ON/OFF with this signal subject to settings of UP-16 and UP-28.
	SPEED SELECT 2 (IN3)	Feed speed selection, see (IN1) above.

4.5.2 SPEED PRESET CONTROL INPUT/OUTPUT (cont'd)

TYPE	NAME	FUNCTION
24V Input (cont'd)	RUN CCW (IN4) RUN CW (IN5)	These inputs initiate motor motion of the selected FEED SPEED in the direction specified by these two inputs. • If both inputs are OFF, the motor is in position mode at 0 speed with the position loop gain AJ4 • If No.1 or No.2 FEED SPEED is selected and the analog REF1 or REF2 is used, the direction of rotation from these two inputs can be reversed by the analog voltage polarity. No.1 FEED SPEED can also be reversed with UP-17.
	ALARM RESET (IN6)	When this input is turned ON for 30 ms or more, all alarms are reset. • AL1 (driver overheated) and AL17 (motor overload) cannot be reset until the temperature drops to acceptable level • AL26 cannot be reset until power is cycled
	TORQUE LIMIT ENABLE (IN7)	When this input is turned ON and HP-34 is set to 0X or 1X, the torque limit operates. • If HP-34 is set to 0X, the torque is limited by the TORQUE LIMIT (REF2) input voltage • If HP-34 is set to 1X, the torque limit is set by UP-11 • If HP-34 is set to 2X, the torque limit is on regardless of state of this input with the limit set by UP-11
24V Output	BRAKE OUTPUT (OUT0)	This output controls the operation of the dynamic brake or holding brake. • Brake modes of operation are set with UP-16 & UP-28
	SPEED COINCIDENCE (OUT1)	This output turns ON when the actual speed of the motor reaches the target speed. • Target speed can be set to a preset speed or the commanded speed with UP-09 • Detection width is be set with UP-10
	RUNNING CW (OUT3)	This output turns ON when the motor is rotating CW above the stop detection speed set in UP-8.
	RUNNING CCW (OUT4)	This output turns ON when the motor is rotating CCW above the stop detection speed set in UP-8.
	MOTOR STOPPED (OUT5)	This output turns ON when the motor speed drops below the internal preset speed set in UP-8.
	TORQUE LIMIT ON (OUT6)	This output turns ON when the motor torque is limited. The limit could be the peak torque limit of the motor or a lower valve causes by the following conditions. • HP-34 and TORQUE LIMIT ENABLE (IN7) input set the conditions for torque limiting • UP-11 or HP-36, HP-37, HP-38, HP-39 are the internal preset limit values
	SERVO NORMAL (OUT7)	This output turns ON 1.6 sec. after AC power ON and there are no alarms. • Does not turn OFF in the case of an AL24 (BATTERY ALARM)

4.5.2 SPEED PRESET CONTROL INPUT/OUTPUT (cont'd)

TYPE	NAME	FUNCTION
Differen-tial output	PULSE OUTPUT (APD/APD) (BPD/BPD) (ZPD(/ZPD)	Programmable pulse train output from the driver. • Type of data output is set by UP-20. • Encoder equivalent output is set by UP-19 with scaling set by UP-04 & UP-05. • External display device with various driver data set by UP-20 • Motor absolute position if an absolute system is used. • Motor position register is monitored with the status display "A'---" & "A---".

4.5.3 SPEED PRESET CONTROL PARAMETER SETUP

4.5.3.1 SPEED PRESET CONTROL ADJUSTMENT PARAMETERS

ADJUSTMENT PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
SPEED COMMAND ZERO (REF1)	**AJ0**	±10.00 V	Factory Preset	Sets the zero offset of the SPEED COMMAND (REF1) input. It can be set in two ways: 1. Automatically: by concurrently pressing [SEL] [↵] (all digits flash) and then pressing [↵]. The driver will read the analog voltage REF1 and create an offset equal and opposite to the analog voltage present at the time. To get a true 0.00 offset, short REF1 to analog ground before doing the auto zero procedure. 2. Manually: by concurrently pressing [SEL] [↵] (all digits flash) and then concurrently pressing [⇑] [SEL]. Then adjust the individual digits with [⇑] [⇓].
SPEED COMMAND SCALE (REF1)	**AJ1**	3~40.00 V	10.00V	Sets the SPEED COMMAND (REF1) scaling. The value set in this parameter is the voltage needed at REF1 to bring the motor to the rated speed. For example, if the motor must turn at rated speed with 4.5 VDC input voltage (REF1), set AJ1 to 4.50.
LOAD INERTIA RATIO	**AJ2**	0~100.0	1.0 Times	Sets the baseline frequency response of the driver using the ratio of the load inertia/motor inertia for a rigidly coupled load. If the load is not rigidly coupled, the value entered may vary from the calculated value. If the value is set too high, the motor and driver may become unstable and oscillate. This parameter is set automatically during auto tuning.

4.5.3.1 SPEED PRESET CONTROL ADJUSTMENT PARAMETERS (cont'd)

ADJUSTMENT PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
HIGH FREQUENCY RESPONSE	**AJ3**	0.1~20.0	1.0	Sets the high frequency response of the driver. The higher the number the more responsive. If the value is set too high, the motor and driver may become unstable and oscillate. The value in AJ3 is unit less and works in concert with AJ2. This parameter is set automatically during auto tuning.
POSITION LOOP DC GAIN	**AJ4**	1~200	30 Rad/sec	Sets the DC gain of the position control loop. A higher value in AJ4 results in stiffer, faster response. If the value is set to high the motor and driver may become unstable and oscillate. This parameter is set automatically during auto tuning.
TORQUE COMMAND ZERO (REF2)	**AJ5**	±10.00 V	Factory Preset	Sets the zero offset of the TORQUE COMMAND (REF2) input. It can be set in two ways: 1. Automatically: by concurrently pressing SEL ↵ (all digits flash) and then pressing ↵. The driver will read the analog voltage REF2 and create an offset equal and opposite to the analog voltage present at the time. To get a true 0.00 offset, short REF2 to analog ground before doing the auto zero procedure. 2. Manually: by concurrently pressing SEL ↵ (all digits flash) and then concurrently pressing ⇑ SEL. Then adjust the individual digits with ⇑ ⇓.
TORQUE COMMAND SCALE (REF2)	**AJ6**	3~40.00 V	10.00V	Sets the TORQUE COMMAND (REF2) scaling. The value set in this parameter is the voltage needed at REF2 for the motor to develop maximum torque. For example if it is required to have the maximum torque with 4.5 VDC input voltage (REF2) set AJ5 to 4.50.
ZERO SPEED GAIN REDUCTION	**AJ7**	0~10000	0	Sets the amount of gain reduction at zero speed. The gain is reduced when the motor is below the speed set in UP-08 and at the set values when the speed is above UP-08.
NOTCH FILTER FREQUENCY	**AJ9**	400~20000 rad/s	6000 rad/s	Sets the notch frequency of a velocity loop anti-resonance filter. This filter can be used to cancel machine or servo resonance. Power must be turned OFF then ON for this parameter to take effect.

4.5.3.2 SPEED PRESET CONTROL USER PARAMETERS

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
CONTROL MODE	**UP-01**	00~FF	00	Sets the control mode of operation for the driver as follows: 1 = Speed 2 = Torque 3 = Pulse Position 4 = Speed/Torque/Position 5 = Speed Preset 6 = Electronic Gearing The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
MOTOR CODE	**UP-02**	0000~FFFF	0000	Sets the internal driver parameters corresponding to the motor code. See **Appendix A** for motor codes. The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
RESOLVER CABLE LENGTH N/A FOR ENCODER	**UP-03**	0~120M	5M	Sets the driver resolver cable length compensation. The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
ELECTRONIC GEAR RATIO NUMERATOR	**UP-04**	1~32767	1	The COMMAND PULSE (FMA and FMB) input is multiplied by the ratio of UP-04/UP-05 before being processed by the driver. The driver internal command resolution is equal to the number of resolver cycles times 12000 bits/rev or the PPR of the encoder. (i.e. a motor with a 2X resolver has an internal resolution of 24000 bits/rev, see motor drawings in **Appendix A.6, A.7 & A.8**.) For example if a COMMAND PULSE INPUT of 1000 bits/rev is required with a 2X resolver, set UP-04=24000 and UP-05=1000. Power must be turned OFF then ON for this parameter to take effect. See **Application Note Section 13**.

4.5.3.2 SPEED PRESET CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
ELECTRONIC GEAR RATIO DENOMINATOR	**UP-05**	1~32767	1	The driver internal feedback resolution is multiplied by the ratio of UP-05/UP-04 before being sent to OUTPUT PULSE (APD and BPD). The driver internal resolution is equal to the number of resolver cycle times 12000 bits/rev. (i.e. a motor with a 2X resolver has an internal resolution of 24000 bits/rev, see motor drawings in **Appendix A.6, A.7 & A.8**.) For example if an OUTPUT PULSE of 1000 bits/rev is required with a 2X resolver, set UP-04=24000 and UP-05=1000. Power must be turned OFF then ON for this parameter to take effect. See **Application Note Section 13**.
MARKER OFFSET **RESOLVER ONLY	**UP-06**	0~11999 pulses	0 pulses	The electrical ZERO can be shifted with respect to the mechanical shaft position using UP-06. The Delta driver produces N number of ZERO states per motor rotation where N is equal to the number of resolver cycles. (i.e. a motor with a 2X resolver has 2 ZERO/rev. see motor drawings in **Appendix A.6, A.7 & A.8**.) To shift the electrical ZERO place the motor shaft at the desired electrical ZERO position. Read the status display "d" parameter in degrees and set UP-06="d"*12000/360. The electrical ZERO affects the ZPD output pulse and the STOP AT MARKER input stopping position.
MOTOR STOPPED THRESHOLD	**UP-08**	1~4000 r/min	50 r/min	When the motor is rotating at less than the speed set into UP-08 the MOTOR STOPPED output will be on.
SPEED COINCIDENCE THRESHOLD	**UP-09**	0~4000 r/min	0 r/min	If UP-09 is non-zero, the SPEED COINCIDENCE output comes on when the actual motor speed reaches the value set in UP-09. If UP-09 is zero, the SPEED COINCIDENCE output comes on when the actual motor speed reaches the commanded speed.
SPEED COINCIDENCE WIDTH	**UP-10**	1~4000 r/min	20 r/min	Sets the width of the sensing window allowable to get the SPEED COINCIDENCE output.
TORQUE LIMIT	**UP-11**	0~100.0%	100%	When the torque limit is applied, the motor torque is limited to the value set in UP-11. UP-11 is % of motor peak torque. See **HP-34** for torque limit method.

4.5.3.2 SPEED PRESET CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
ACCEL TIME	**UP-12**	0~32.76 sec	0 sec	Sets the time from zero to rated speed with a linear acceleration profile. Ignored if UP-14 is not equal to 0.0.
DECEL TIME	**UP-13**	0~32.76 sec	0 sec	Sets the time from rated speed to zero speed with a linear deceleration profile. Ignored if UP-14 is not equal to 0.0.
S-SHAPED TIME	**UP-14**	0~32.76 sec	0 sec	Sets the acel and decel time from the current speed to the new command speed using an S-shaped minimum jerk profile.
ABSOLUTE CLEAR MODE	**UP-15**	0~2	0	Selects the type of home 0.00 processing for absolute systems when the SET "0" POSITION input is energized or upon startup. 0: Makes current position of motor equal to 0.00. 1: Makes the current motor shaft rotation the 0 rotation while preserving the MARKER OFFSET. 2: No effect retains absolute position.
BRAKE MODE	**UP-16**	0~2	0	Selects the type of brake sequencing to be used when the driver ENABLE is turned OFF. Brake is applied immediately in the case of an alarm. 0: No brake or dynamic brake. If no brake, the motor will coast to a stop. If dynamic brake relay is installed, the motor and load are dynamically braked to a stop. 1: Mechanical holding brake is applied when the motor reaches the speed set in UP-28. The deceleration rate is controlled by UP-13 & UP-14. When the speed in UP-28 is reached, the driver applies maximum electronic braking torque for 200 ms. 2: Mechanical holding brake is applied when the motor reaches the speed set in UP-28. The driver applies maximum electronic breaking torque to decelerate the motor to the speed set in UP-28. Power must be turned OFF then ON for this parameter to take effect.

4.5.3.2 SPEED PRESET CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
REF1 and REF2 POLARITY	**UP-17**	00~11	0 0	Sets the polarity of the analog reference inputs. 00: Both REF1 and REF2 normal 01: REF1 inverted, REF2 not inverted 10: REF1 not inverted, REF2 inverted 11: Both REF1 and REF2 inverted
OUTPUT PULSE TYPE	**UP-19**	00~11	01	Sets the type of pulse output sequence and polarity of the PULSE OUTPUT. UP-20 must be set to xxxo for the PULSE OUTPUT to represent incremental actual position. 00: Pulse, Pulse encoding where APD pulses when the actual position increments and BPD pulses when the actual position decrements. 01: Quadrature encoding of APD and BPD with APD leading BPD for ncrementing actual position. Each edge of the two pulse trains are counted as an output bit change. 10: Pulse, Pulse encoding where BPD pulses when the actual position increments and APD pulses when the actual position decrements. 11: Quadrature encoding of APD and BPD with BPD leading APD for incrementing actual position. Each edge of the two pulse trains is counted as an output bit change.
OUTPUT PULSE CODING	**UP-20**	0000~5533	0000	The first digit of UP-20 selects the parameter to be put on the driver external display. Coding is as follows: 0: Motor speed in RPM 1: Actual motor position 2: Motor current 3: Calculated motor temperature 4: Motor distance to marker deg 5: Machine speed in RPM The second digit of UP-20 is not used. The third digit selects the type of electronic coding for the OUTPUT PULSE when an absolute system is configured. This digit is only effective when the fourth digit is set to 3 or absolute motor position. The coding is as follows: 0: 32 bits 1: 23 bits + parity 2: 24 bits + parity 3: 31 bits + parity

4.5.3.2 SPEED PRESET CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
OUTPUT PULSE CODING (cont'd)	**UP-20 (cont'd)**			The fourth digit sets the basic function of the OUTPUTS PULSES. The coding is as follows: 0: Incremental position as define in UP-19 1: Output to optional drive display DPA-70 2: Output to optional drive display DPA-80 3: Absolute motor position
No. 1 FEED SPEED	**UP-21**	0~200.00%	100%	Sets the speed of the motor when SPEED SELECT 1 & 2 I/O are OFF. If UP-21 = 0, the speed is set with analog input REF1. If UP-21 is non-zero, the speed is equal to % of rated speed.
No. 2 FEED SPEED	**UP-22**	0~200.00%	50%	Sets the speed of the motor when SPEED SELECT 1 is ON & SPEED SELECT 2 is OFF. If UP-22 = 0, the speed is set with analog input REF2. If UP-22 is non-zero, the speed is equal to % of rated speed.
No. 3 FEED SPEED	**UP-23**	0~200.00%	25%	Sets the speed of the motor when SPEED SELECT 2 is ON & SPEED SELECT 1 is OFF. The speed is equal to % of rated speed set in UP-23.
No. 4 FEED SPEED	**UP-24**	0~200.00%	12.5%	Sets the speed of the motor when SPEED SELECT 2 is ON & SPEED SELECT 1 is ON. The speed is equal to % of rated speed set in UP-24.
MONITOR OUTPUT FUNCTION	**UP-25**	000~111	010	Selects SPEED or TORQUE output and polarity of the MON test point. The first digit is not used. The second digit selects the MON output function. 0: TORQUE 1: SPEED The third digit selects the polarity of the MON output. 0: Normal 1: Invert
HOLDING BRAKE THRESHOLD	**UP-28**	0~100.0%	100%	When UP-16 is set to 0, UP-28 has no effect. When UP-16 is set to 1 or 2, the mechanical brake is applied when the motor speed falls below the value set in UP-28. The value in UP-28 is % of rated speed.
MOTOR TEST SPEED	**UP-29**	1~4000 r/min	50 RPM	The driver can be jogged manually by using the keypad. The jog speed is set with UP-29 in RPM.

4.5.3.2 SPEED PRESET CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
EXTERNAL REGEN RESISTOR VALUE (Software version 10 and above)	**UP-30**	0~100.0 ohms	0.0 ohms	Value of the optional external regen resistor. When external regen resistor is used, the value of the resistor is entered to allow the driver to calculate average power into the regen resistor. When the internal regen is used, enter 0.0. Power must be turned OFF then ON for this parameter to take effect. See **Section 7** for details on Regen Resistor selection. This parameter is used with DSD-35 and larger drivers.
EXTERNAL REGEN RESISTOR WATTAGE (Software version 10 and above)	**UP-31**	0~327.67 Kw	0.0 Kw	Power rating of the optional external regen resistor. When external regen resistor is used, the power rating in Kw of the resistor is entered to allow the driver to calculate average power into the regen resistor. When the internal regen is used, enter 0.0. Power must be turned OFF then ON for this parameter to take effect. See **Section 7** for details on Regen Resistor selection. This parameter is used with DSD-35 and larger drivers.

4.5.3.3 SPEED PRESET CONTROL SETUP PARAMETERS

SETUP PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
MOTOR RMS TORQUE TIME CONSTANT	**HP-33**	1~60 sec	30 sec	Sets the time constant for calculating motor rms torque that is displayed as parameter bL. Time constant should be set to approximately twice as long as the machine cycle.
TORQUE LIMIT SELECTION	**HP-34**	00~21	11	First digit is torque limit method: 0: Limited with REF2 analog input when TORQUE LIMIT ENABLE I/O is ON. 10V = Peak torque 1: Limit set by parameter UP-11 or HP-36 through HP-39 when UP-11 = 0 and when TORQUE LIMIT ENABLE I/O is ON. 2: Limit set by parameter UP-11 or HP-36 through HP-39 when UP-11 = 0 regardless of the state of the TORQUE LIMIT ENABLE I/O. Second digit is speed limit method: 0: N/A 1: N/A

4.5.3.3 SPEED PRESET CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
CCW ROTATION TORQUE LIMIT	**HP-36**	0~100.0%	100%	Limits CCW rotation torque. 100% = Peak Torque See **HP-34**
CCW ROTATION ABSORPTION TORQUE LIMIT	**HP-37**	0~100.0%	100%	Limits CCW rotation absorption (braking) torque. 100% = Peak Torque See **HP-34**
CW ROTATION TORQUE LIMIT	**HP-38**	0~100.0%	100%	Limits CW rotation torque. 100% = Peak Torque See **HP-34**
CW ROTATION ABSORPTION TORQUE LIMIT	**HP-39**	0~100.0%	100%	Limits CW rotation absorption (braking) torque. 100% = Peak Torque See **HP-34**
SPEED DISPLAY ELECTRONIC RATIO NUMERATOR	**HP-41**	1~32767	1	Parameters HP-41/HP-42 form a fraction that is used to scale the scaled Motor Speed display "F". The motor speed is multiplied by the fraction then put on the display. This allows a speed display that is scaled to the speed of the actual machine rather than the speed of the motor. The scaling can also allow the driver to display speed in different units such as in/sec rather than the default motor RPM. Scales the driver display and optional external display if used.
SPEED DISPLAY ELECTRONIC RATIO DENOMINATOR	**HP-42**	1~32767	1	
SPEED DISPLAY DECIMAL POINT POSITION	**HP-43**	0~7	0	HP-43 sets the position of the decimal point in the optional external speed display. 0: No decimal point 1: Least significant digit ... 7: Most significant digit
INPUT INVERSION	**HP-44**	00~FF	00	This parameter forms a hexadecimal bit mask that inverts the input when the bit is set to 1 and does not invert the input when the bit is 0. The LSB is for IN0 and so on. (i.e. HP-44=8C inverts inputs IN7, IN3 & IN2)
OUTPUT INVERSION	**HP-45**	00~FF	00	This parameter forms a hexadecimal bit mask that inverts the output when the bit is set to 1 and does not invert the output when the bit is 0. The LSB is for OUT0 and so on. (i.e. HP-45=4B inverts outputs OUT6, OUT3 & OUT1)

4.6 ELECTRONIC GEARING CONTROL MODE 6

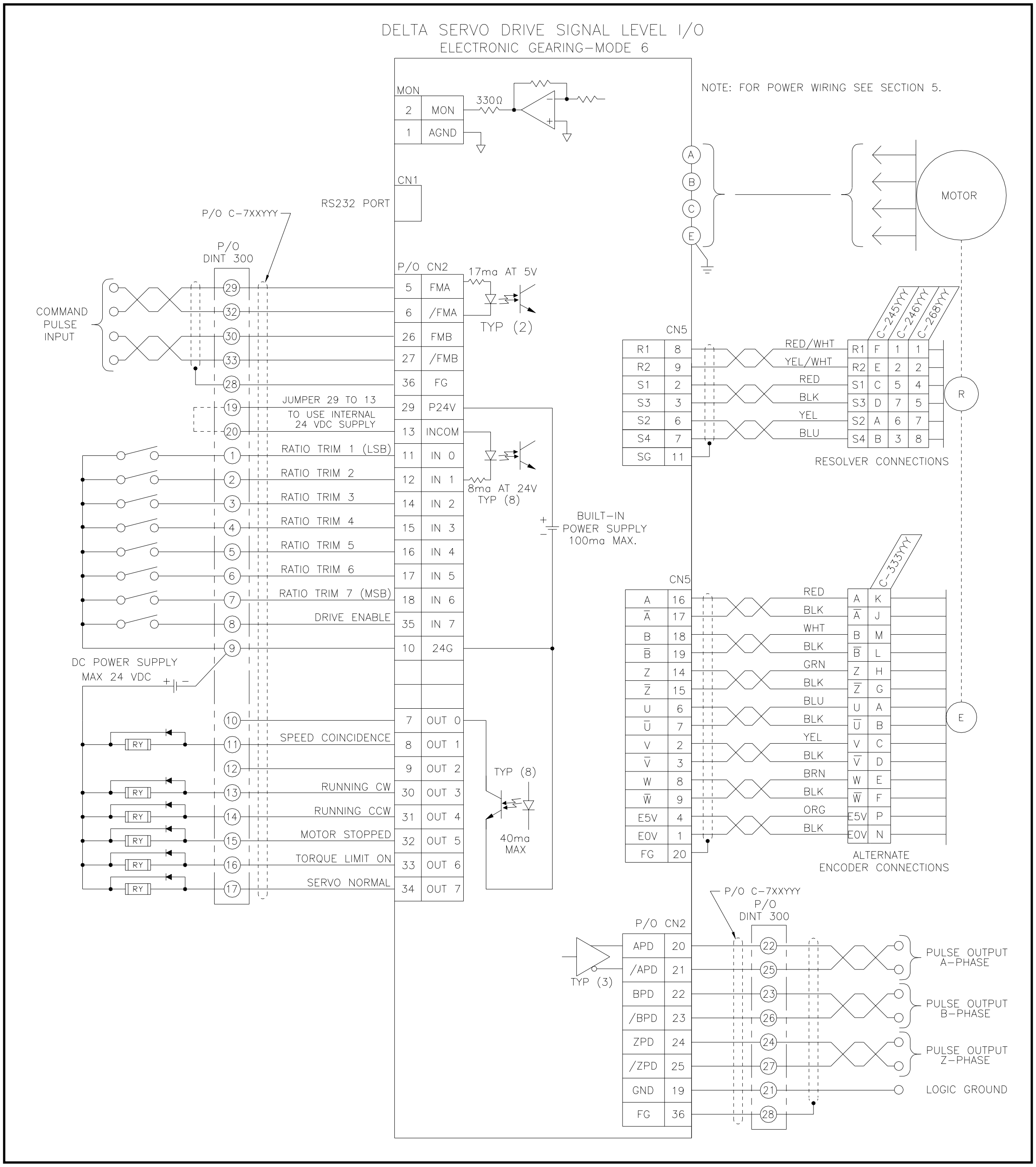
PRIMARY MOTION CONTROL FEATURES

- In the Electronic Gearing Mode, the driver is a follower type position controller that receives position commands from a digital pulse train.
- The electronic ratio, direction and type of input pulse train are programmable with internal parameters.
- The electronic ratio of the input pulse train can be trimmed with seven (7) I/O points that form a signed binary number.

PRIMARY MOTION CONTROL FEATURES

- The torque of the motor can be limited using an internal parameter.

4.6.1 SIGNAL WIRING



4.6.2 ELECTRONIC GEARING CONTROL INPUT/OUTPUT

<table>
<tr><th>TYPE</th><th>NAME</th><th>FUNCTION</th></tr>
<tr><td>5V Input</td><td>COMMAND PULSE
(FMA/FMA)
(FMB/FMB)</td><td>These two pulse trains inputs are the command for motor motion.
• The pulse trains are interpreted in 3 possible ways set by UP-18.
• The scaling of the pulse to motor movement is set with UP-04 & UP-05.
• Command pulse register is monitored with the status display "P'---" & "P---".</td></tr>
<tr><td>24V Input</td><td>RATIO TRIM 1
(IN0)

Through

RATIO TRIM 7
(IN6)</td><td>The RATIO TRIM inputs form a binary code to trim the electronic ration between the PULSE COMMAND inputs and the motor motion.
• Nominal electronic ratio is set by UP-4 & UP-5
• Scaling of RATIO TRIM is set by UP-27
• RATIO TRIM 7 is also used for ALARM RESET
• Input settings
<table>
<tr><th></th><th colspan="7">RATIO TRIM</th></tr>
<tr><th>RATIO TRIM(S)</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th></tr>
<tr><td>+ 63</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>+ 1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>- 1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>- 64</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
0 = OFF 1 = ON
• Ratio of COMMAND PULSES/REV to motor motion (24000/REV) is:
$\text{UP-04/UP-05} * [1 + \frac{\underline{\text{RATIO TRIM}}}{100} * \text{UP-27}]$</td></tr>
<tr><td>24V Input</td><td>DRIVE ENABLE
(IN7)</td><td>When this input is turned ON, the driver becomes operational if there are no faults.</td></tr>
<tr><td>24V Output</td><td>SPEED COINCIDENCE
(OUT1)

RUNNING CW
(OUT3)

RUNNING CCW
(OUT4)

MOTOR STOPPED
(OUT5)</td><td>This output turns ON when the actual speed of the motor reaches the target speed.
• Target speed can be set to a preset speed or the commanded speed with UP-09
• Detection width is be set with UP-10

This output turns ON when the motor is rotating CW above the stop detection speed set in UP-8.

This output turns ON when the motor is rotating CCW above the stop detection speed set in UP-8.

This output turns ON when the motor speed drops below the internal preset speed set in UP-8.</td></tr>
<tr><td>24V Output (cont'd)</td><td>TORQUE LIMIT ON
(OUT6)

SERVO NORMAL
(OUT7)</td><td>This output turns ON when the motor torque is limited. The limit could be the peak torque limit of the motor or a lower valve causes by the following conditions.
• HP-34 and TORQUE LIMIT ENABLE (IN7) input set the conditions for torque limiting
• UP-11 or HP-36, HP-37, HP-38, HP-39 are the internal preset limit values

This output turns ON 1.6 sec. after AC power ON and there are no alarms.
• Does not turn OFF, in the case of an AL24 (BATTERY ALARM)</td></tr>
</table>

4.6.2 ELECTRONIC GEARING CONTROL INPUT/OUTPUT (cont'd)

TYPE	NAME	FUNCTION
Differen-tial output	PULSE OUTPUT (APD/APD) (BPD/BPD) (ZPD(/ZPD)	Programmable pulse train output from the driver. • Type of data output is set by UP-20 • Encoder equivalent output is set by UP-19 with scaling set by UP-04 & UP-05 • External display device with various driver data set by UP-20 • Motor absolute position if an absolute system is used • Command pulse register is monitored with the status display "A'---" & "A---"

4.6.3 ELECTRONIC GEARING CONTROL PARAMETER SETUP

4.6.3.1 ELECTRONIC GEARING CONTROL ADJUSTMENT PARAMETERS

ADJUSTMENT PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
LOAD INERTIA RATIO	**AJ2**	0~100.0	1.0 Times	Sets the baseline frequency response of the driver using the ratio of the load inertia/motor inertia for a rigidly coupled load. If the load is not rigidly coupled, the value entered may vary from the calculated value. If the value is set too high the motor and driver may become unstable and oscillate. This parameter is set automatically during auto tuning.
HIGH FREQUENCY RESPONSE	**AJ3**	0.1~20.0	1.0	Sets the high frequency response of the driver. The higher the number the more responsive. If the value is set too high, the motor and driver may become unstable and oscillate. The value in AJ3 is unit less and works in concert with AJ2. This parameter is set automatically during auto tuning.
POSITION LOOP DC GAIN	**AJ4**	1~200	30 Rad/sec	Sets the DC gain of the position control loop. A higher value in AJ4 results in stiffer, faster response. If the value is set too high, the motor and driver may become unstable and oscillate. This parameter is set automatically during auto tuning.
ZERO SPEED GAIN REDUCTION	**AJ7**	0~10000	0	Sets the amount of gain reduction at zero speed. The gain is reduced when the motor is below the speed set in UP-08 and at the set values when the speed is above UP-08.

4.6.3.1 ELECTRONIC GEARING CONTROL ADJUSTMENT PARAMETERS (cont'd)

ADJUSTMENT PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
FEED FORWARD GAIN	**AJ8**	0~2.0 Times	0 Times	Sets the feed forward gain in the position loop. A value of 1.0 results in 0.0 following error. Less than 1.0 will produce a lag between the actual motor position and the commanded position and greater than 1.0 produces a lead. The lead or lag will be proportional to speed at non 1.0 settings.
NOTCH FILTER FREQUENCY	**AJ9**	400~20000 rad/s	6000 rad/s	Sets the notch frequency of a velocity loop anti-resonance filter. This filter can be used to cancel machine or servo resonance. Power must be turned OFF then ON for this parameter to take effect.

4.6.3.2 ELECTRONIC GEARING CONTROL USER PARAMETERS

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
CONTROL MODE	**UP-01**	00~FF	00	Sets the control mode of operation for the driver as follows: 1 = Speed 2 = Torque 3 = Pulse Position 4 = Speed/Torque/Position 5 = Speed Preset 6 = Electronic Gearing The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
MOTOR CODE	**UP-02**	0000~FFFF	0000	Sets the internal driver parameters corresponding to the motor code. See **Appendix A** for motor codes. The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.
RESOLVER CABLE LENGTH N/A FOR ENCODER	**UP-03**	0~120M	5M	Sets the driver resolver cable length compensation. The driver power must be cycled to register this parameter. Power must be turned OFF then ON for this parameter to take effect.

4.6.3.2 ELECTRONIC GEARING CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
ELECTRONIC GEAR RATIO NUMERATOR	**UP-04**	1~32767	1	The COMMAND PULSE (FMA and FMB) input is multiplied by the ratio of UP-04/UP-05 before being processed by the driver. The driver internal command resolution is equal to the number of resolver cycles times 12000 bits/rev or the PPR of the encoder. (i.e. a motor with a 2X resolver has an internal resolution of 24000 bits/rev, see motor drawings in **Appendix A.6, A.7 & A.8**.) For example if a COMMAND PULSE INPUT of 1000 bits/rev is required with a 2X resolver, set UP-04=24000 and UP-05=1000. Power must be turned OFF then ON for this parameter to take effect. See **Application Note Section 13**.
ELECTRONIC GEAR RATIO DENOMINATOR	**UP-05**	1~32767	1	The driver internal feedback resolution is multiplied by the ratio of UP-05/UP-04 before being sent to OUTPUT PULSE (APD and BPD). The driver internal resolution is equal to the number of resolver cycle times 12000 bits/rev. (i.e. a motor with a 2X resolver has an internal resolution of 24000 bits/rev, see motor drawings in **Appendix A.6, A.7 & A.8**.) For example if an OUTPUT PULSE of 1000 bits/rev is required with a 2X resolver, set UP-04=24000 and UP-05=1000. Power must be turned OFF then ON for this parameter to take effect. See **Application Note Section 13**.
MARKER OFFSET **RESOLVER	**UP-06**	0~11999 pulses	0 pulses	The electrical ZERO can be shifted with respect to the mechanical shaft position using UP-06. The Delta driver produces N number of ZERO states per motor rotation where N is equal to the number of resolver cycles. (i.e. a motor with a 2X resolver has 2 ZERO/rev. see motor drawings in **Appendix A.6, A.7 & A.8**.) To shift the electrical ZERO place the motor shaft at the desired electrical ZERO position. Read the status display "d" parameter in degrees and set UP-06="d"*12000/360. The electrical ZERO affects the ZPD output pulse and the STOP AT MARKER input stopping position.

4.6.3.2 ELECTRONIC GEARING CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
MOTOR STOPPED THRESHOLD	**UP-08**	1~4000 r/min	50 r/min	When the motor is rotating at less than the speed set into UP-08 the MOTOR STOPPED output will be on.
SPEED COINCIDENCE THRESHOLD	**UP-09**	0~4000 r/min	0 r/min	If UP-09 is non-zero, the SPEED COINCIDENCE output comes on when the actual motor speed reaches the value set in UP-09. If UP-09 is zero, the SPEED COINCIDENCE output comes on when the actual motor speed reaches the commanded speed.
SPEED COINCIDENCE WIDTH	**UP-10**	1~4000 r/min	20 r/min	Sets the width of the sensing window allowable to get the SPEED COINCIDENCE output.
TORQUE LIMIT	**UP-11**	0~100.0%	100%	When the torque limit is applied the motor torque is limited to the value set in UP-11. UP-11 is % of motor peak torque. See **HP-34** for torque limit method.
ABSOLUTE CLEAR MODE	**UP-15**	0~2	0	Selects the type of home 0.00 processing for absolute systems when the SET "0" POSITION input is energized or upon startup. 0: Makes current position of motor equal to 0.00. 1: Makes the current motor shaft rotation the 0 rotation while preserving the MARKER OFFSET. 2: No effect, retains absolute position
BRAKE MODE	**UP-16**	0~2	0	Selects the type of brake sequencing to be used when the driver ENABLE is turned OFF. Brake is applied immediately in the case of an alarm. 0: No brake or dynamic brake. If no brake, the motor will coast to a stop. If dynamic brake relay is installed, the motor and load are dynamically braked to a stop. 1&2:Mechanical holding brake is applied when the motor reaches the speed set in UP-28. The driver applies maximum electronic breaking torque to decelerate the motor to the speed set in UP-28.

4.6.3.2 ELECTRONIC GEARING CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
COMMAND PULSE TYPE	**UP-18**	00~12	0 0	Sets the type of pulse sequence and polarity of the COMMAND PULSE inputs. 00: Pulse, Pulse decoding where FMA increments command position and FMB decrements command position. 01: Quadrature decoding of FMA and FMB with FMA leading FMB for incrementing command position. Quadrature decoding effectively multiplies the input frequency by 4 times. 02: Pulse and direction decoding where FMA is pulse train and FMB is direction. FMB OFF increments command position and ON decrements command position. 10: Pulse, Pulse decoding where FMB increments command position & FMA decrements command position 11: Quadrature decoding of FMA and FMB with FMB leading FMA for incrementing command position. Quadrature decoding effectively multiplies the input frequency by 4 times. 12: Pulse and direction decoding where FMA is pulse train and FMB is direction. FMB ON increments command position and OFF decrements command position.
OUTPUT PULSE TYPE	**UP-19**	00~11	01	Sets the type of pulse output sequence and polarity of the PULSE OUTPUT. UP-20 must be set to xxxo for the PULSE OUTPUT to represent incremental actual position. 00: Pulse, Pulse encoding where APD pulses when the actual position increments and BPD pulses when the actual position decrements. 01: Quadrature encoding of APD and BPD with APD leading BPD for incrementing actual position. Each edge of the two pulse trains is counted as an output bit change.

4.6.3.2 ELECTRONIC GEARING CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
OUTPUT PULSE TYPE (cont'd)	**UP-19** (cont'd)			10: Pulse, Pulse encoding where BPD pulses when the actual position increments and APD pulses when the actual position decrements. 11: Quadrature encoding of APD and BPD with BPD leading APD for incrementing actual position. Each edge of the two pulse rains is counted as an output bit change.
OUTPUT PULSE CODING	**UP-20**	0000~5533	0000	The first digit of UP-20 selects the parameter to be put on the driver external display. Coding is as follows: 0: Motor speed in RPM 1: Actual motor position 2: Motor current 3: Calculated motor temperature 4: Motor distance to marker (°) 5: Machine speed in RPM The second digit of UP-20 is not used. The third digit selects the type of electronic coding for the OUTPUT PULSE when an absolute system is configured. This digit is only effective when the fourth digit is set to 3 or absolute motor position. The coding is as follows: 0: 32 bits 1: 23 bits + parity 2: 24 bits + parity 3: 31 bits + parity The fourth digit sets the basic function of the OUTPUTS PULSES. The coding is as follows: 0: Incremental position as defined in UP-19 1: Output to optional drive display DPA-70 2: Output to optional drive display DPA-80 3: Absolute motor position

4.6.3.2 ELECTRONIC GEARING CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
MONITOR OUTPUT FUNCTION	**UP-25**	000~111	010	Selects SPEED or TORQUE output and polarity of the MON test point. The first digit is not used. The second digit selects the MON output function. 0: TORQUE 1: SPEED The third digit selects the polarity of the MON output. 0: Normal 1: Invert
COMMAND PULSE POLARITY	**UP-26**	0~1	0	0: Move CCW with increment of command position 1: Move CW with increment of command position
RATIO TRIM SCALING	**UP-27**	0~2	0	UP-27 sets the scaling of the binary I/O code as follows: 0: scale = 0.01 1: scale = 0.1 2: scale = 1.0 Overall electronic ratio equation is as follows: Ratio of COMMAND PULSES/REV to motor motion (24000/REV) is: $UP\text{-}04/UP\text{-}05*[1+\frac{RATIO\ TRIM}{100}*UP\text{-}27]$ Where I/O is a 6-bit plus sign binary code from I/O points with a range of +/-63. (RATIO TRIM) See **Section 4.6.2**.
HOLDING BRAKE THRESHOLD	**UP-28**	0~100.0%	100%	When UP-16 is set to 0, UP-28 has no effect. When UP-16 is set to 1 or 2, the mechanical brake is applied when the motor speed falls below the value set in UP-28. The value in UP-28 is % of rated speed.
MOTOR TEST SPEED	**UP-29**	1~4000 r/min	50 RPM	The driver can be jogged manually by using the keypad. The jog speed is set with UP-29 in RPM.

4.6.3.2 ELECTRONIC GEARING CONTROL USER PARAMETERS (cont'd)

USER PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
EXTERNAL REGEN RESISTOR VALUE (Software version 10 and above)	**UP-30**	0~100.0 ohms	0.0 ohms	Value of the optional external regen resistor. When external regen resistor is used, the value of the resistor is entered to allow the driver to calculate average power into the regen resistor. When the internal regen is used, enter 0.0. Power must be turned OFF then ON for this parameter to take effect. See **Section 7** for details on Regen Resistor selection. This parameter is used with DSD-35 and larger drivers.
EXTERNAL REGEN RESISTOR WATTAGE (Software version 10 and above)	**UP-31**	0~327.67 Kw	0.0 Kw	Power rating of the optional external regen resistor. When external regen resistor is used, the power rating in Kw of the resistor is entered to allow the driver to calculate average power into the regen resistor. When the internal regen is used, enter 0.0. Power must be turned OFF then ON for this parameter to take effect. See **Section 7** for details on Regen Resistor selection. This parameter is used with DSD-35 and larger drivers.

4.6.3.3 ELECTRONIC GEARING CONTROL SETUP PARAMETERS

SETUP PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
MOTOR RMS TORQUE CALCULATION TIME CONSTANT	**HP-33**	1~60 sec	30 sec	Sets the time constant for calculating motor rms torque that is displayed as parameter bL. Time constant should be set to approximately twice as long as the machine cycle.
SPEED/TORQUE LIMIT SELECTION	**HP-34**	00~21	11	First digit is torque limit method: 0: N/A 1: N/A 2: Limit set by parameter UP-11 or HP-36 through HP-39 when UP-11 = 0. Second digit is speed limit method: 0: N/A 1: N/A
CCW ROTATION TORQUE LIMIT	**HP-36**	0~100.0%	100%	Limits CCW rotation torque. 100% = Peak Torque See **HP-34**
CCW ROTATION ABSORPTION TORQUE LIMIT	**HP-37**	0~100.0%	100%	Limits CCW rotation absorption (braking) torque. 100% = Peak Torque See **HP-34**
CW ROTATION TORQUE LIMIT	**HP-38**	0~100.0%	100%	Limits CW rotation torque. 100% = Peak Torque See **HP-34**

4.6.3.3 ELECTRONIC GEARING CONTROL SETUP PARAMETERS (cont'd)

SETUP PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
CW ROTATION ABSORPTION TORQUE LIMIT	**HP-39**	0~100.0%	100%	Limits CW rotation absorption (braking) torque. 100% = Peak Torque See **HP-34**
SPEED DISPLAY ELECTRONIC RATIO NUMERATOR	**HP-41**	1~32767	1	Parameters HP-41/HP-42 form a fraction that is used to scale the scaled Motor Speed display "F". The motor speed is multiplied by the fraction, and then put on the display. This allows a speed display that is scaled to the speed of the actual machine rather than the speed of the motor. The scaling can also allow the driver to display speed in different units such as in/sec rather than the default motor RPM. Scales the driver display and optional external display if used.
SPEED DISPLAY ELECTRONIC RATIO DENOMINATOR	**HP-42**	1~32767	1	
SPEED DISPLAY DECIMAL POINT POSITION	**HP-43**	0~7	0	HP-43 sets the position of the decimal point in the optional external speed display. 0: No decimal point 1: Least significant digit ... 7: Most significant digit
INPUT INVERSION	**HP-44**	000~1FF	000	This parameter forms a hexadecimal bit mask that inverts the input when the bit is set to 1 and does not invert the input when the bit is 0. The LSB is for IN0 and so on. (i.e. HP-44 = 8C inverts inputs IN7, IN3 & IN2)
OUTPUT INVERSION	**HP-45**	00~FF	00	This parameter forms a hexadecimal bit mask that inverts the output when the bit is set to 1 and does not invert the output when the bit is 0. The LSB is for OUT0 and so on. (i.e. HP-45 = 4A inverts outputs OUT6, OUT3 & OUT1)

SECTION 5 - POWER WIRING

The Delta driver and motors have three basic power wiring configurations. Each of the configurations is shown in the following power wiring diagrams (**Figures 5.4 through 5.6**). Each of the diagrams shows recommended circuit breaker, contactor and wire gauge.

5.1 CIRCUIT BREAKER

It is recommended that each driver be provided with a circuit breaker for protection of the driver and motor. All of the drives are suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 240 vac maximum when protected by a circuit breaker having an interrupting rating not less than 5000 rms symmetrical amperes, 240 volts maximum. Each of the driver wiring diagrams contains a chart of the recommended circuit breaker for each driver size.

The breaker is sized for the worst-case maximum power draw of the driver at the worst-case low line voltage. The charts contain specific vendor and size recommendations. Other types of circuit breakers or fuses may be used provided the continuous ratings are equivalent, the instantaneous rating is 10 to 15 times continuous and can support 3 times continuous for at least 3 seconds.

Lower rating protections devices may be used that are sized for the motor power rating. Contact the IIS factory for specific recommendations.

5.2 CONTACTOR

The DSD-1.5 through DSD-17.5 driver sizes has an internal power bus contactor. The DSD-35 through DSD-115 sizes requires an external power bus contactor. The driver-wiring diagram for the larger size drivers contains a chart of the recommended contactor for each driver size.

The contactor is sized for the worst-case maximum power draw of the driver at the worst-case low line voltage. The charts contain specific vendor and size recommendations. Other types of contactors may be used provided the continuous ratings are equivalent and the maximum instantaneous rating is 10 to 15 times continuous. The driver is equipped with a soft start circuit to limit the contactor inrush current.

The coil voltage should be the same rating as the incoming line. The maximum current draw for the coil cannot exceed 0.25 amps. The contactor coil must be fitted with a transient voltage protection device. An RC type suppression device is preferred.

5.3 WIRE SIZES

It is required that each driver be installed with the appropriate size wire for proper operation. Each of the driver wiring diagrams contains a chart of the recommended wire gauges and terminal connection tightening torques for each driver size.

The wire is sized for the worst-case maximum power draw of the driver at the worst-case low line voltage. The charts contain specific METRIC and AWG size recommendations for stranded wire. Use only copper wire rated for 60/75 degree C or greater. The driver terminals are specifically designed to handle the recommended wire gauge with lug or ferrule terminations. See wiring diagrams for more details.

5.4 TRANSFORMERS

Isolating the driver from the facility power line with a transformer is recommended but not required. A transformer may be required to step down or step up the facility power line to meet the driver voltage specifications in **Section 2**.

If a transformer is used, select a transformer with the following characteristics:

- Isolation type.
- Load regulation less than 10%.
- Ability to provide 3 times rated current for 3 to 5 seconds without saturation.
- Ability to drive load with a power factor of 0.85.
- Primary or secondary taps to provide -10%; nominal; +10%; supply voltage.

To achieve maximum performance from the driver, the power input to the driver should be as close to nominal driver input voltage rating as possible. The facility line voltage varies through wide ranges in many parts of the world and it is recommended to match the nominal facility voltage to the nominal input voltage rating of the driver with a transformer. This gives the system the maximum operating range with facility line voltage fluctuations.

If the line voltage is too low, intermittent under voltage alarms may occur. A high line voltage will result in excessive regeneration dumping or intermittent over voltage alarms.

Buck boost transformers may be used to optimally match the facility line voltage to the driver line voltage rating. Buck boost transformers can be used with or without an isolation transformer. If buck boost transformers are used in conjunction with an isolation transformer, it is best to put the buck boost transformers on the primary side of the isolation transformer.

As a general rule the transformer rating can be calculated using the following formulas:

For single phase transformer:

$$\text{Transformer Capacity (VA)} = \frac{\text{Rated Mechanical Output (Watts)}}{0.7}$$

Where: Rated Mechanical Output is from Delta Package rating.
0.7 = motor/drive efficiency and single phase full wave rectifier factor

Example: Select transformer for a Delta-200HRA motor/drive package

$$\text{Transformer Capacity (VA)} = \frac{200}{0.7} = 285\ \text{VA}$$

For three phase transformer:

$$\text{Transformer Capacity (Watts)} = \frac{\text{Rated Mechanical Output (Watts)}}{0.85}$$

Where: Rated Mechanical Output is from Delta Package rating.
0.85 is motor/drive efficiency and three phase rectifier factor

5.4 TRANSFORMERS (cont'd)

Example: Select transformer for a Delta-6500HRA motor/drive package

$$\text{Transformer Capacity (VA)} = \frac{6500}{0.85} = 7647 \text{ VA}$$

One transformer can supply multiple motor/driver packages. Simply add the rated mechanical output of the motor/driver packages together and use the above formulas. If one transformer is used to supply multiple drivers, be sure to protect each driver with the appropriate circuit breaker or fuse.

IIS offers a full line of transformers for various line voltage and frequencies, enclosed and open frame types. Contact IIS Application Engineering Department for full details.

5.5 BRANCH CIRCUIT PROTECTION FOR CONTROL VOLTAGE R0,S0

The DSD-35 through DSD-115 requires a separate control voltage supply (R0 S0) for proper operation. The R0 S0 circuit is fused internal to the driver and need not be externally fused except to protect the control voltage wiring external to the driver using branch circuit protection guidelines. The control voltage circuit of multiple drivers can be fed from a single branch circuit.

5.6 WIRING PRACTICES AND GROUNDING

All wiring must conform to accept standards such as NEMA and NEC codes. Signal and low voltage I/O wires must be physical separated from high voltage wires by at least 12 inches or separated by a suitable barrier such as steel conduit or wiring trough separator.

The driver must be adequately grounded for proper operation and to provide personnel safety. The proper grounding technique is shown in **Figure 5.1** below.

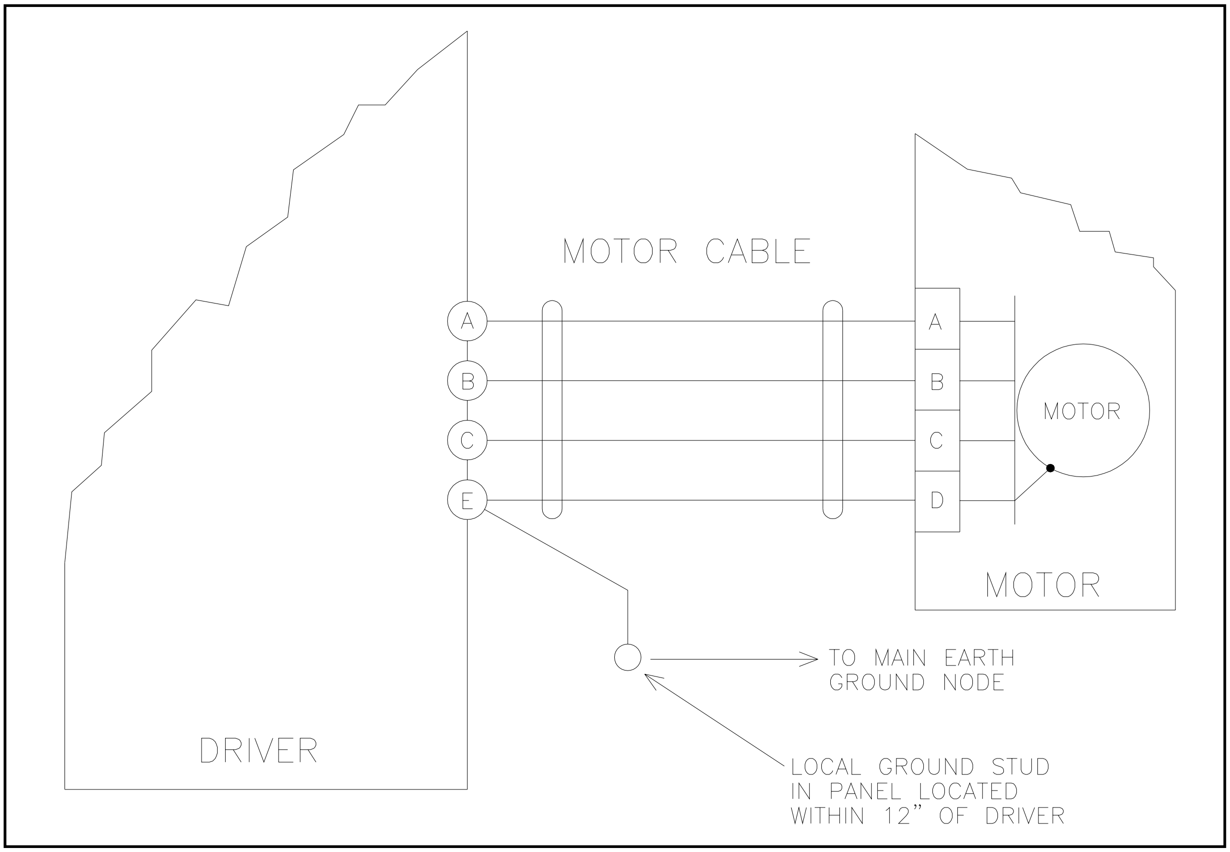


Figure 5.1 - Grounding Technique

****NOTE****

Multiple drivers can share a local ground stud if it is located within 12" of each drivers's E terminal. The ground symbol on each drive indicates that a connection must be made between the E terminal of the drive and earth ground.

5.7 POWER SEQUENCING

The Delta drivers have provisions for power contactor sequencing. The power contactor is internal to the driver for the DSD-1.5, DSD-4.25, DSD-8.5 and DSD-17.5 sizes and external for the larger sizes. The sequencing of the power and control signals is shown in **Figures 5.2 and 5.3**.

If a mechanical brake or dynamic brake is used, the sequencing changes slightly. See **Sections 8 and 9** for details.

5.7 POWER SEQUENCING (cont'd)

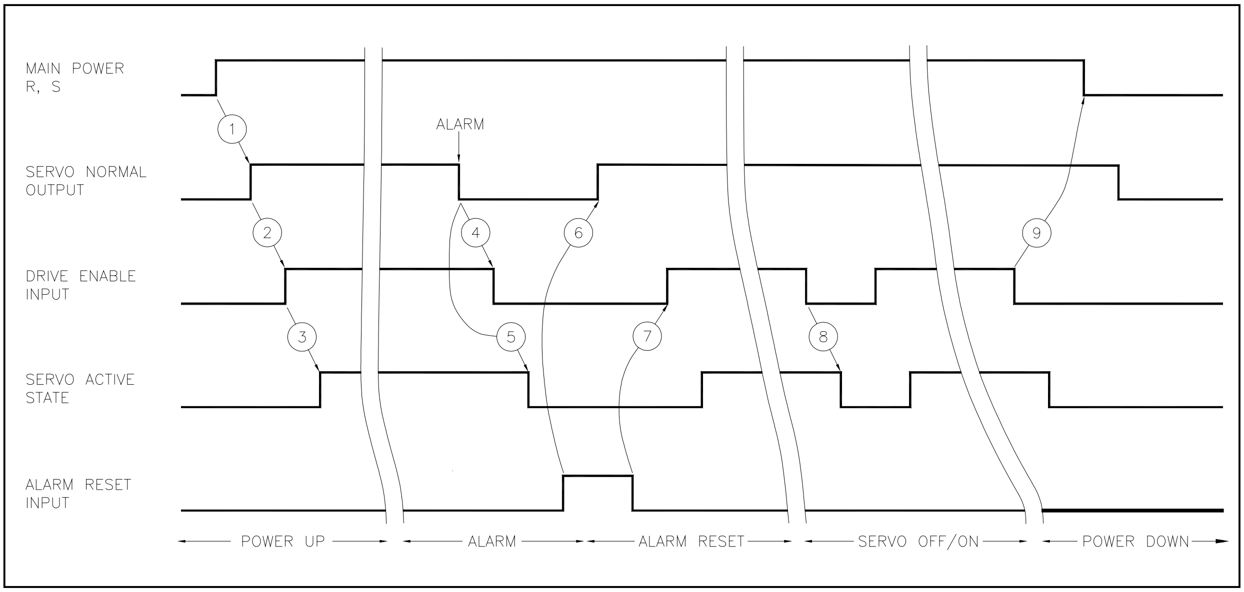


Figure 5.2 - Power and Control Signals for DSD-1.5 Through DSD-17.5 Drivers

1. At power application the driver initializes and does fault checks. If there are no faults, the SERVO NORMAL output will turn ON with a maximum delay of 2.5 seconds.
2. DRIVE ENABLE may be turned ON within 0.6 seconds of SERVO NORMAL.
3. The servo will become active within 800μsec.
4. When an alarm is sensed, the SERVO NORMAL output is turned OFF and the DRIVE ENABLE must be turned OFF before alarm clearing can be accomplished.
5. The servo will become inactive within 800μsec of the alarm.
6. ALARM RESET causes driver to check for clearing of the alarm condition and if all alarm states are clear, the SERVO NORMAL will turn ON within 30 ms.
7. ALARM RESET should be turned off before DRIVE ENABLE is turned ON.
8. The servo will become inactive within 800μsec of DRIVE ENABLE being turned OFF.
9. DRIVE ENABLE should be turned off before the main power is removed to avoid an under voltage alarm, AL-03. Turning off main power while the DRIVE ENABLE is on will not damage the driver.

5.7 POWER SEQUENCING (cont'd)

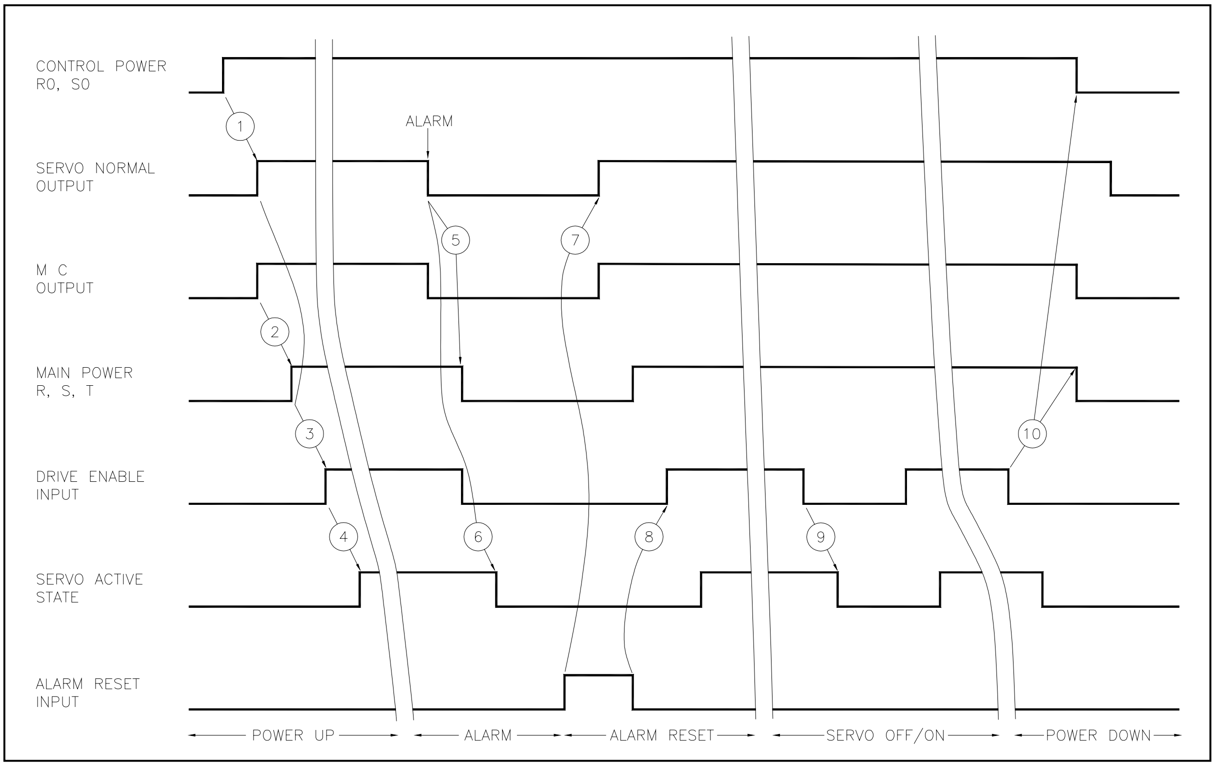
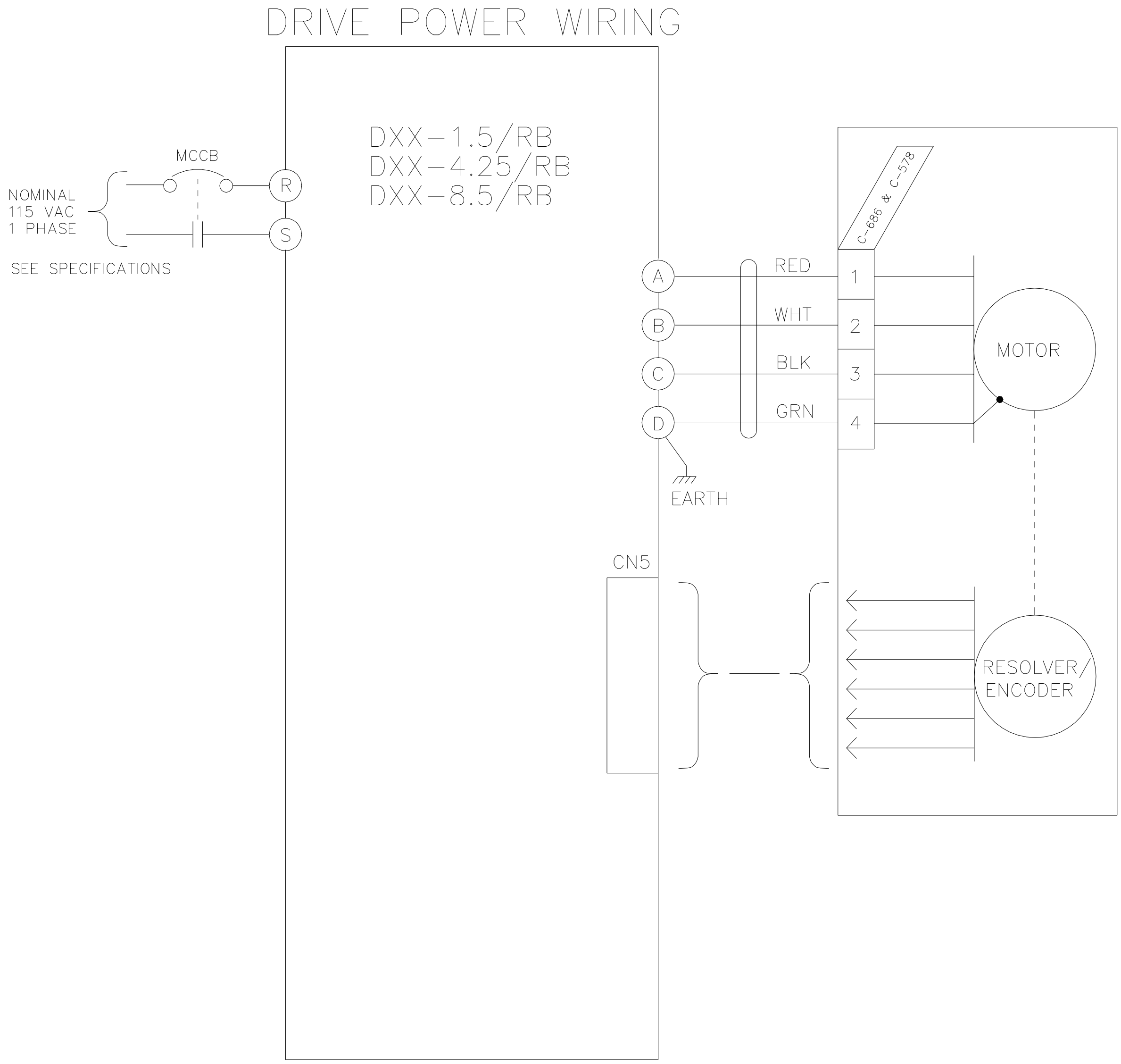


Figure 5.3 - Power and Control Signals for DSD-35 Through 115 Drivers

1. At power application the driver initializes and does fault checks. If there are no faults, the SERVO NORMAL and MC outputs will turn ON with a maximum delay of 2.5 seconds.
2. The main power is applied via the MC contactor.
3. DRIVE ENABLE may be turned ON within 0.6 seconds of SERVO NORMAL.
4. The servo will become active within 800µsec.
5. When an alarm is sensed, the SERVO NORMAL and MC outputs are turned OFF. The DRIVE ENABLE must be turned OFF before alarm clearing can be accomplished.
6. The servo will become inactive within 800µsec of the alarm.
7. ALARM RESET causes driver to check for clearing of the alarm condition and if all alarm states are clear, the SERVO NORMAL will turn ON within 30 ms.
8. ALARM RESET should be turned OFF before DRIVE ENABLE is turned ON.
9. The servo will become inactive within 800µsec of DRIVE ENABLE being turned OFF.
10. DRIVE ENABLE should be turned off before the main power is removed to avoid an under voltage alarm, AL-03. Turning off main power while the DRIVE ENABLE is on will not damage the driver.

5.7 POWER SEQUENCING (cont'd)

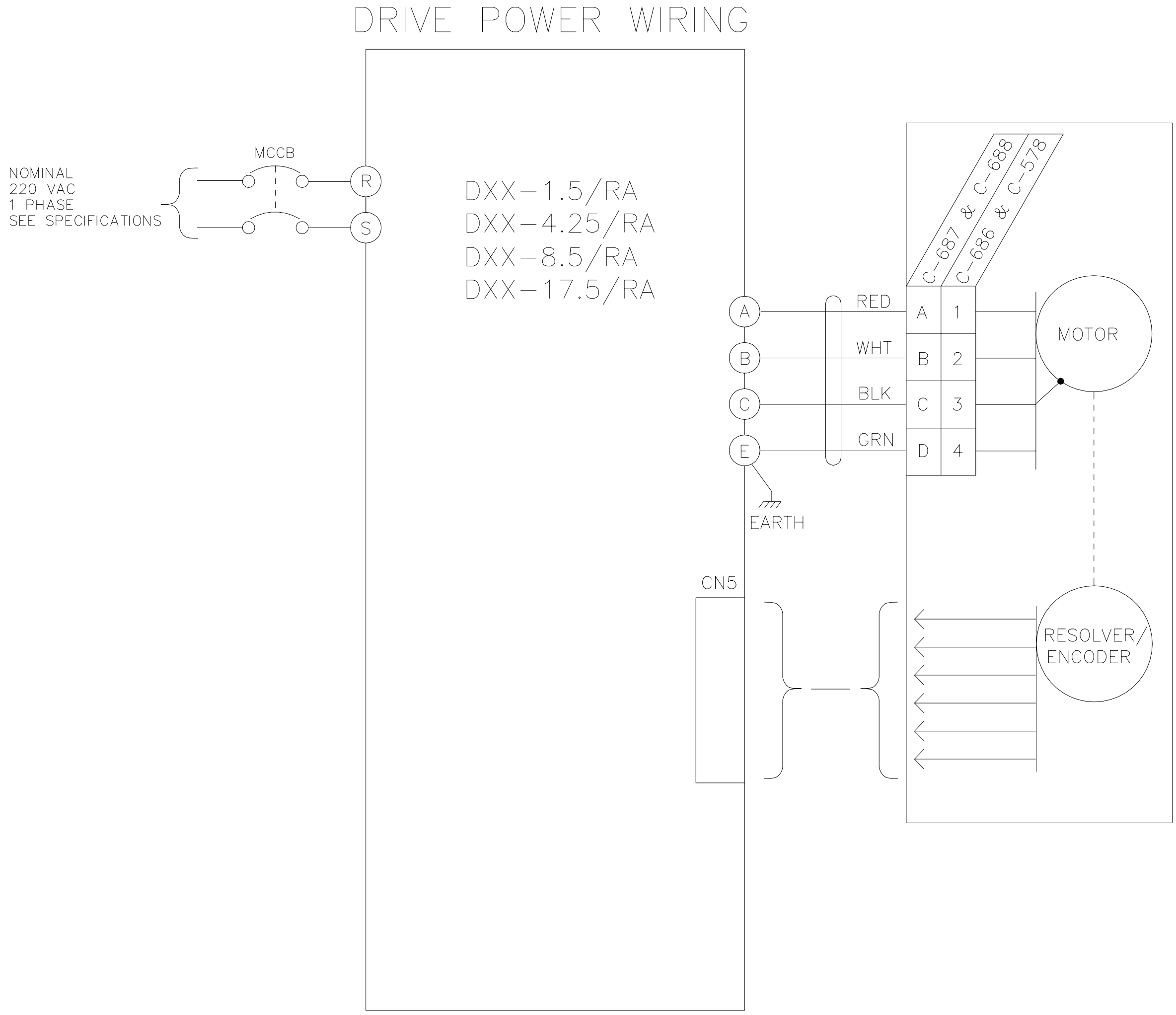


DRIVER	MCCB	R,S & EARTH CIRCUIT WIRE SIZE	REQUIRED TORQUE (LB-IN) ON POWER WIRING TERMINALS
DXX-1.5/RB DXX-4.25/RB	ABB-S271-K4NA 4 AMPS	14 AWG, 1.25 MM^2	12.00**
DXX-8.5/RB	ABB-S271-K8NA 8 AMPS	14 AWG, 1.25 MM^2	12.00**

** Field wiring connection shall be made by a UL LISTED and CSA Certified closed -loop terminal connector sized for the wire gauge involved. Connector must be fixed using the crimp tool specified by the connector manufacturer.

Figure 5.4 - DSD-1.5/RB Through DSD-8.5/RB Power Wiring

5.7 POWER SEQUENCING (cont'd)

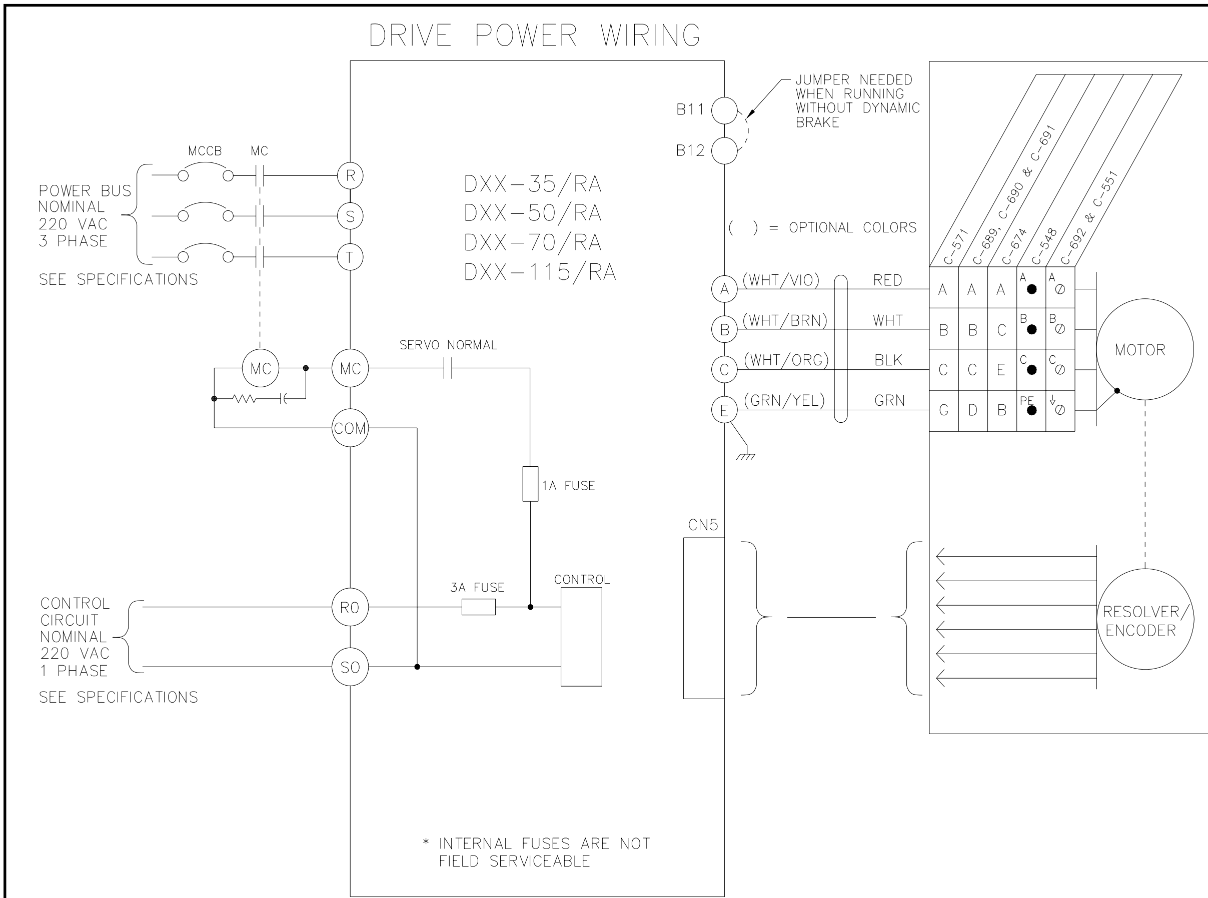


DRIVER	MCCB	R,S & EARTH CIRCUIT WIRE SIZE	REQUIRED TORQUE (LB−IN) ON POWER WIRING TERMINALS
DXX−1.5/RA & DXX−4.25/RA	(ABB) S272−K4	14 AWG, 1.25 MM^2	12.00**
DXX−8.5/RA	(ABB) S272−K8 (SQD) MG24448 8 AMPS	14 AWG, 1.25 MM^2	12.00**
DXX−17.5/RA	(ABB) S272−K16 (SQD) MG24451 16 AMPS	14 AWG, 1.25 MM^2	12.00**

** Field wiring connection shall be made by a UL LISTED and CSA Certified closed -loop terminal connector sized for the wire gauge involved. Connector must be fixed using the crimp tool specified by the connector manufacturer.

Figure 5.5 - DSD-1.5/RA Through DSD-17.5/RA Power Wiring

5.7 POWER SEQUENCING (cont'd)



DRIVER	MCCB	MC	R,S,T & EARTH CIRCUIT WIRE SIZE	RO, SO, MC, COM WIRE SIZE	REQUIRED TORQUE (LB-IN) ON POWER WIRING TERMINALS
DXX-35/RA	(ABB) S273-K16 (SQD) MG24468 16 AMPS	(SQD) LC1D18M7 W/ LAD4RCU	12 AWG, 2 MM^2	14 AWG, 1.25 MM^2	15.50
DXX-50/RA	(ABB) S273-K20 (SQD) MG24469 20 AMPS	(SQD) LC1D25M7 W/ LAD4RCU	12 AWG, 3.5 MM^2	14 AWG, 1.25 MM^2	15.50
DXX-70/RA	(ABB) S273-K32 (SQD) MG24471 30 AMPS	(SQD) LC1D32M7 W/ LAD4RCU	10 AWG, 5.5 MM^2	14 AWG, 1.25 MM^2	17.50**
DXX-115/RA	(ABB) S273-K63 (SQD) MG24474 63 AMPS	(SQD) LC1D65M7 W/ LA4DA2U	8 AWG, 16 MM^2	14 AWG, 1.25 MM^2	17.50**

** Field wiring connection shall be made by a UL LISTED and CSA Certified closed -loop terminal connector sized for the wire gauge involved. Connector must be fixed using the crimp tool specified by the connector manufacturer.

Figure 5.6 - DSD-35/RA Through DSD-115/RA Power Wiring

SECTION 6 - DRIVER TUNING

The Delta driver may be tuned using a built in Automatic Tuning Sequence or manually. The keypad and display are used in both cases to accomplish the tuning. The following parameters are used to tune the driver:

- AJ2 Load Inertia Ratio
- AJ3 High Frequency Response
- AJ4 Position Loop DC Gain

It is important to note that although the driver is the focus of the tuning activity the whole system of driver, motor and mechanical components are being tuned as a system. To be successful the system must be configured complete with all components that move during normal operation.

For the purposes of this section it is assumed that the user is proficient in navigating the Special Function Menu Loop, the Adjustment Parameter Menu Loop and adjusting parameters in those loops (See Section 3).

6.1 AUTO TUNING SEQUENCE

Parameters AJ2, AJ3, and AJ4 are set during the auto tuning sequence. Parameters AJ0 and AJ5, analog reference input offsets, are also set during auto tuning. The REF1 and REF2 analog inputs must be forced to 0.0 volts before executing the auto tuning sequence. During auto tuning the driver reads both REF1 and REF2 and sets the internal offsets AJ0 and AJ5 equal to and opposite to the value read during auto tuning. If the REF1 and REF2 inputs are not 0.0 volts during auto tuning, an unwanted offset will occur in the analog inputs.

The auto tuning sequence causes the motor to sharply rotate back and forth by an amount and at a speed set by the tuning parameters. The desired response is also set in the tuning parameters of the Special Function Menu Loop.

Auto tuning to an excessively high target response may result in unstable operation. Unstable operation will also result if the motor load is not rigidly attached or has backlash. If unstable operation results use the Adjustment Parameter menu to set AJ2, AJ3 and AJ4 back to the default settings. Try the Auto Tuning Sequence again with a lower value of target response.

If the Delta driver is used as a speed regulator (Speed Mode 1) in a system with a external position loop, the position loop must be disabled before driver auto tuning can be used. The gain and frequency response parameters of the external position loop will significantly influence the system response.

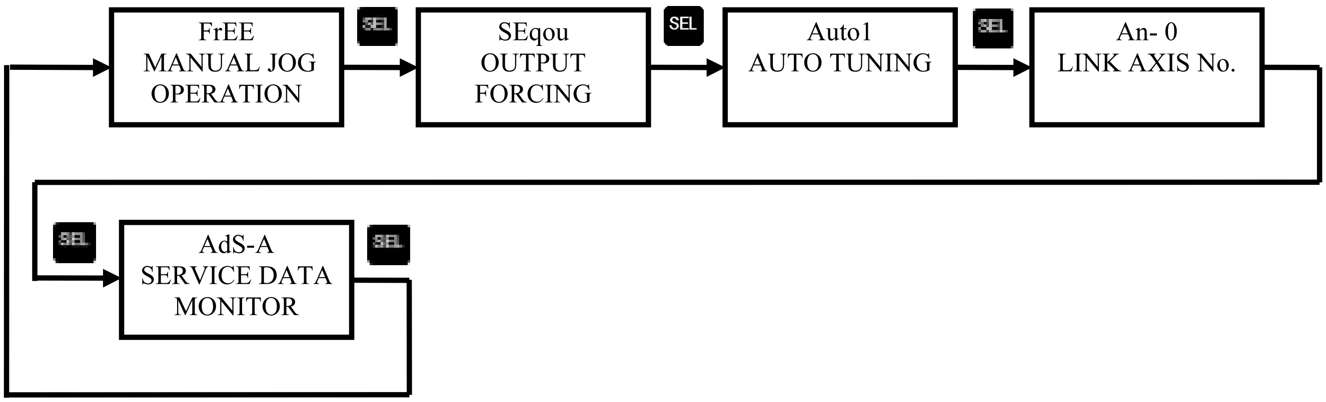
**** CAUTION ****

Must be used when executing the Auto Tuning Sequence. The motor moves through a sequence of reciprocal motions during the auto tuning. Be sure all personnel are clear of moving parts and that the mechanical systems will permit the full range of motion set in the auto tuning parameters Auto1, 2 & 3.

6.1.1 SPECIAL FUNCTION MENU LOOP

Enter the Special Function Menu Loop by concurrently pressing the keys for 5 seconds while the Main Menu status display shows motor speed [r 0]. The special menu will appear with the display showing [FrEE]. To exit the Special Function Menu double click the key.

Once in the Special Function Menu Loop, use the key is used to move to various menu items.



6.1.2 AUTO TUNING SETUP PARAMETERS

Verify the correct setting of the auto tuning setup parameters by using the and keys to navigate the auto menu. The menu loop will display the parameter name followed by the parameter value with successive presses of the key. Use the and keys to select value to be modified. Then use and keys to adjust value, then confirm value with key.

TUNING PARAMETER	SYMBOL	SETTING RANGE	FACTORY SETTING	DESCRIPTION
ROTATION AMOUNT	**Auto1**	0~300 REV	2 REVS	Sets the amount of reciprocal rotation during the auto tuning sequence
TARGET RESPONSE	**Auto2**	1~1000 Hz	40 Hz	Sets the desired frequency response. The auto tuning software uses this value to set the desired response of the system. If the value is too high, unstable operation may result.
MAXIMUM SPEED	**Auto3**	1~4000 RPM	1000 RPM	Sets the speed of the reciprocal rotation during the auto tune sequence.

6.1.3 INITIATE AUTO TUNING

To initiate Auto Tuning use the SEL keys to get [Auto 1] in the display. With [Auto1] in the display press and hold the key followed by the key. The [Auto1] in the display will flash indicating initiation of the Auto Tuning Sequence and the motor will begin the reciprocal rotation. The driver will continuously adjust the tuning parameters while the motor is moving. When the Auto Tuning Sequence is complete the display will stop flashing. The BRAKE CONFIRM input must be functional to initiate the Auto Tuning Sequence.

Exit the Special Function Menu with a double click of the MODE key.

6.2 MANUAL TUNING PROCEDURE

The Delta driver may be tuned manually using the Adjustment Parameter Menu Loop described in **Section 3.1.3**.

AJ2 Load inertia ratio, AJ3 High frequency response and AJ4 Position loop DC gains are the parameters that adjust the response of the driver. A qualified technician using a chart recorder or oscilloscope to view the performance of the system should do adjustment of these parameters.

1. Start the manual adjustment by setting AJ2 to the ratio of the load inertia to the motor rotor inertia. Set AJ3 and AJ4 to the default settings.

2. Connect an oscilloscope or chart recorder to the MON output on the driver front panel. Set UP-25 to 1x0 so the MON output is set to motor speed.

**** CAUTION ****

Must be used when executing the motor motion. Be sure all personnel are clear of moving parts and that the mechanical systems will permit the full range of motion.

3. Cause the system to move through the most aggressive, highest speed and highest acceleration, motion encountered in normal operation. The stimulus for this motion depends on the system configuration.

4. Adjust AJ2, AJ3 and AJ4 for the desired response using the Adjustment Parameter Loop.

Parameter AJ2 primarily provides the damping function in the system response. The larger the system inertia the larger the value of AJ2 required. If the load inertia is not rigidly attached to the motor shaft, the value of AJ2 may be smaller than the calculated value.

Parameter AJ3 sets the frequency of any small oscillations and overshoots that may be present. Too high a value can result in high frequency oscillations. AJ3 also sets the system frequency response to external stimulus.

Parameter AJ4 sets the basic gain of the control loop and should be set as high as practical without causing oscillations. This parameter primarily affects the stiffness of the system response or the conformance of the motor motion to the commanded motion.

6.3 NOTCH FILTER ADJUSTMENT

The Delta driver drive contains a Notch Filter, adjusted by parameter AJ9 that can be used to eliminate system natural resonance frequency oscillations. Natural frequency resonance oscillations can occur with a belt drive, a flexible coupling or any mechanical component that causes flexing or compliance in the motor drive train.

In general, the normal tuning of the driver will not eliminate the natural resonance without lowering the system response to an unacceptable level. If the natural frequency of the system can be determined, the Notch Filter, AJ9, can be set to that frequency to notch out that particular frequency thereby allowing higher gain settings and better response.

SECTION 7 - REGEN RESISTOR SELECTION

7.1 DRIVER REGENERATION CAPACITIES

The Delta motor and driver have the ability to act as a brake for a rotating load. This condition typically occurs during the deceleration of the load or when the system is stopping a vertical load such as an elevator or lift. In both cases, the driver may have to absorb the mechanical and potential energy in the system. The driver must absorb the energy if the energy in the load exceeds to mechanical losses in the system.

The driver has 3 ways to absorb the energy from the load.

- Store the energy by charging the internal main DC bus capacitors (E_C)
- Use the energy internally to power the driver control circuitry (P_D)
- Dissipate the energy using a regeneration resistor (P_R)

The Delta driver energy absorption capacities are as shown in **Table 7.1**.

DRIVER SIZE	**INTERNAL REGEN CAPACITY** (P_R)	**INTERNAL POWER CONSUMPTION** (P_D)	**CHARGING CAPACITY** (E_C)
DSD-1.5/RB	0 W	13	17
DSD-1.5/RA	0 W	13	17
DSD-4.25/RB	0 W	13	17
DSD-4.25/RA	0 W	13	17
DSD-8.5/RA	0 W	24	17
DSD-8.5/RB	0 W	17	17
DSD-17.5/RA	0 W	37	22
DSD-35/RA	80 W	80	38
DSD-50/RA	80 W	100	54
DSD-70/RA	100 W	200	94
DSD-115/RA	180 W	300	188

Table 7.1 - Energy Absorption Capabilities

The Delta drivers are equipped with internal circuitry to detect a rise in the main DC power bus indicating energy absorption. If the DC power bus reaches approximately 400 VDC, the regeneration circuit is turned on to prevent the main DC power bus from rising to 420 VDC which will result in an over voltage alarm AL-02.

7.2 SELECTION OF REGENERATION RESISTOR

The amount of energy stored in the moving components of the system must be calculated and compared to the energy absorption capacity of the driver to determine if an external regeneration resistor is required.

The stored energy is of two basic types, kinetic energy in the form of a moving mass and potential energy of a mass being held against gravity.

$E_k = 0.5 * (J_M + J_L) * (2 * \pi * N / 60)^2$

$E_P = (2 * \pi * N * T_g * t_b / 60)$

Calculate the system losses in the motor, driver and friction.

$E_L = (P_M + P_D + (\pi * N * T_f / 60)) * t_a$

Calculate the regeneration power.

$P_R = (E_k + E_P - E_L - E_C) / t_c$

If regeneration power P_R is greater than 0.0, a regeneration resistor will be needed to prevent the main DC power bus from generating an over voltage alarm AL-02.

Where:

E_k = Net kinetic energy Joules
E_P = Net Potential energy Joules
E_L = Energy loss due to friction Joules
E_C = Driver charging capacity Joules (See **Table 7.1**)
J_M = Motor rotor inertia kg-m^2
J_L = Load inertia kg-m^2
N = Motor speed in RPM
P_M = Motor loss watts (10% of motor rating)
P_D = Driver internal power consumption watts (See **Table 7.1**)
T_f = System friction torque N-m
T_g = Net torque to hold up load against gravity N-m
P_R = Regen power watts (See **Table 7.1**)
t_a = Deceleration time
t_b = Move time
t_c = Cycle time

See **Figure7.1**

* The above equations are reasonable approximations.

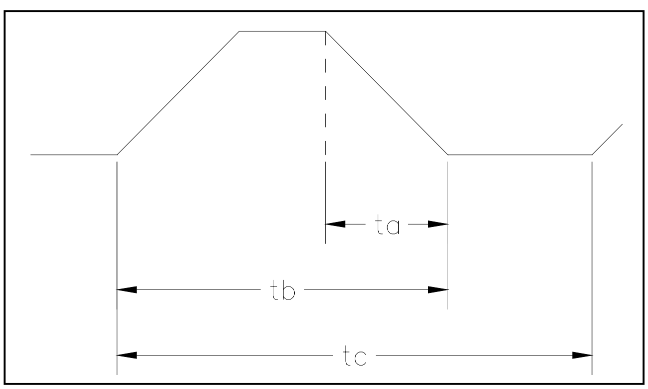


Figure 7.1

7.2 SELECTION OF REGENERATION RESISTOR (cont'd)

Drivers DSD-1.5, DSD-4.25, DSD-8.5 and DSD-17.5 do not contain an internal regeneration resistor. If a regeneration resistor is required, an external resistor with a power rating of at least P_R watts must be connected.

Drivers DSD-35 through DSD-115 contain internal regeneration resistors. If the internal regeneration resistor capacity is greater than P_R watts, no external resistor is needed. If the internal resistor is not large enough, an external resistor with a power rating of at least P_R watts must be connected. If an external regeneration resistor is needed, parameters UP-30 and UP-31 must be set to the values of the external resistor.

**** CAUTION ****

When installing an external regeneration resistor, UP-30 and UP-31 need to be set to the values of the external resistor.

Table 7.2 External resistor specifications.

DRIVER SIZE	RESISTANCE	MAX WATTAGE	WIRE GAUGE
DSD-1.5/RA	30~100 Ohms	300 W	14 AWG 1.25 mm ^{2}
DSD-1.5/RB	30~100 Ohms	300 W	14 AWG 1.25 mm ^{2}
DSD-4.25/RA	30~100 Ohms	300 W	14 AWG 1.25 mm ^{2}
DSD-4.25/RB	30~100 Ohms	300 W	14 AWG 1.25 mm ^{2}
DSD-8.5/RA	30~100 Ohms	300 W	14 AWG 1.25 mm ^{2}
DSD-8.5/RB	30~100 Ohms	300 W	14 AWG 1.25 mm ^{2}
DSD-17.5/RA	30~70 Ohms	400 W	14 AWG 1.25 mm ^{2}
DSD-35/RA	12.5~25 Ohms	2.4 KW	12 AWG 3.5 mm ^{2}
DSD-50/RA	12.5~25 Ohms	3 KW	12 AWG 3.5 mm ^{2}
DSD-70/RA	10~15 Ohms	5.5 KW	10 AWG 5.5 mm ^{2}
DSD-115/RA	6~15 Ohms	11 KW	8 AWG 16 mm ^{2}

Table 7.2 - External Resistor Specifications

Figures 7.2 and **7.3** shows how to connect an external regeneration resistor to the Delta drivers.

7.2 SELECTION OF REGENERATION RESISTOR (cont'd)

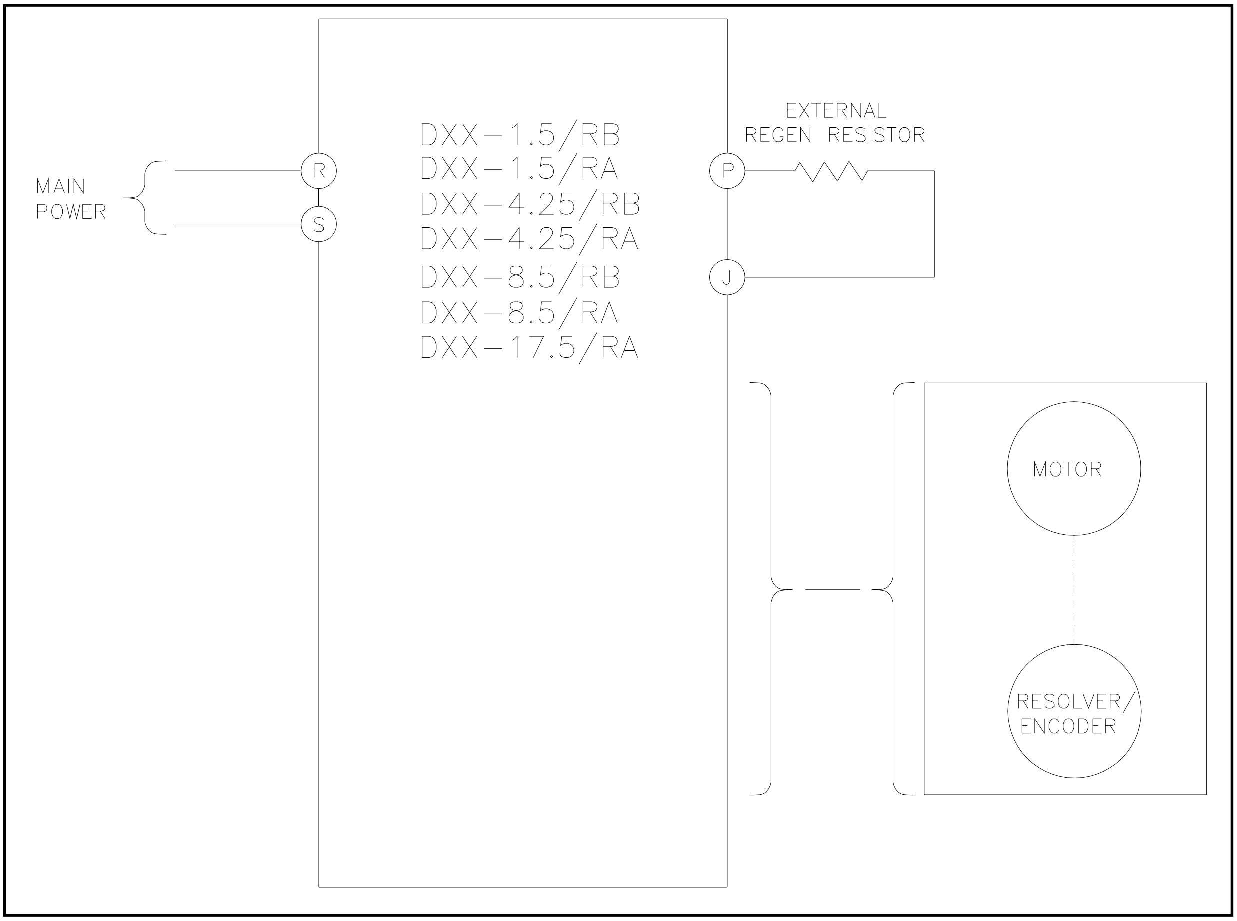


Figure 7.2 - Connection of an External Regen Resistor for Driver Sizes DSD-1.5 Through DSD-17.5

7.2 SELECTION OF REGENERATION RESISTOR (cont'd)

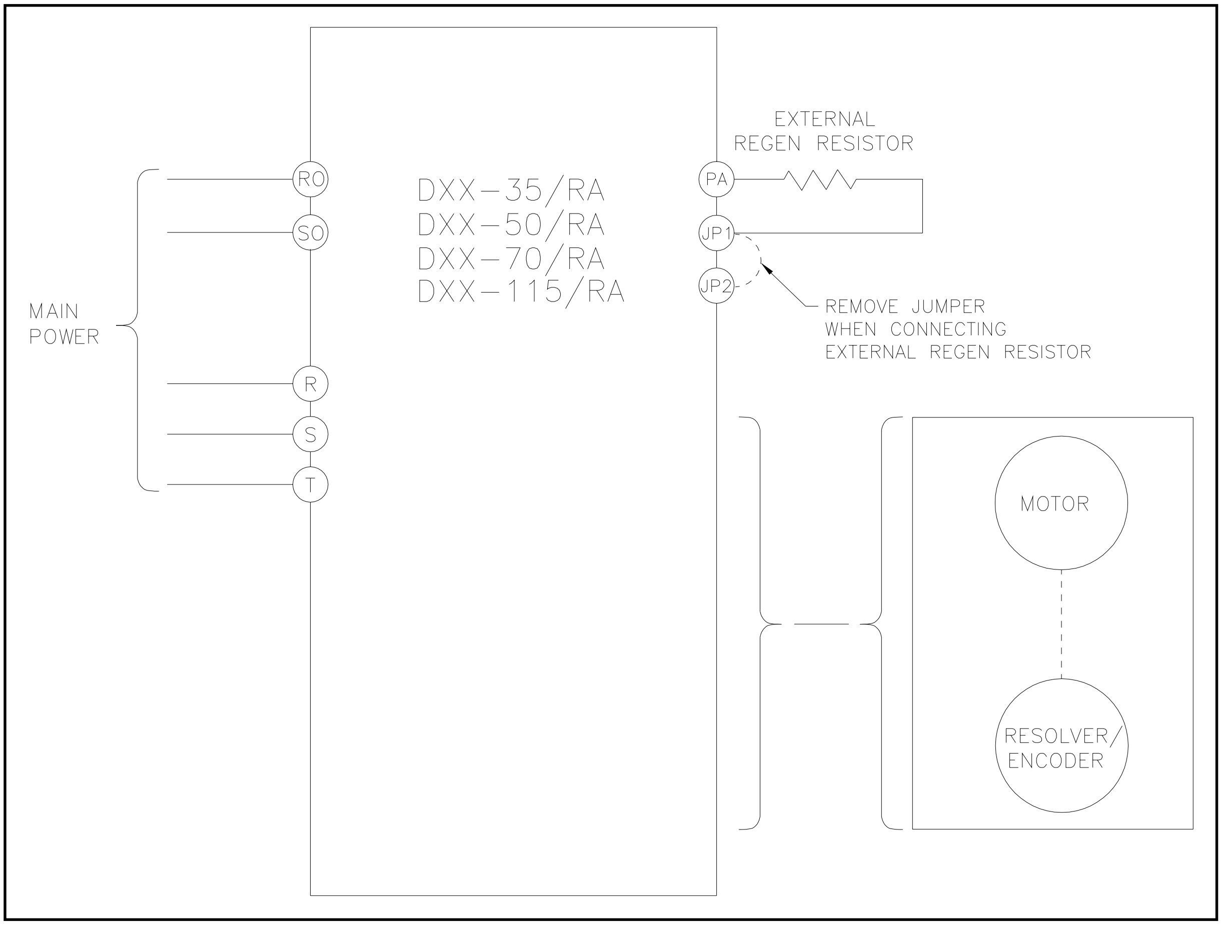


Figure 7.3 - Connection of an External Regen Resistor for Driver Sizes DSD-35 and Larger

The regeneration resistor is subjected to severe peak power loads during regeneration. The driver switches the regeneration resistor across the DC power bus using PWM techniques to regulate the DC power bus voltage during regeneration dumping. When the driver's switch is on the regeneration resistor is subjected to the following peak power:

PEAK POWER = $(400\ \text{VDC})^2$ / RESISTOR VALUE in ohms

Be sure to select a regeneration resistor that can sustain the required peak power and continuous power ratings.

**** CAUTION ****

When installing an external regeneration resistor, UP-30 and UP-31 need to be set to the values of the external resistor.

7.3 STANDARD REGENERATION RESISTOR PACKAGES

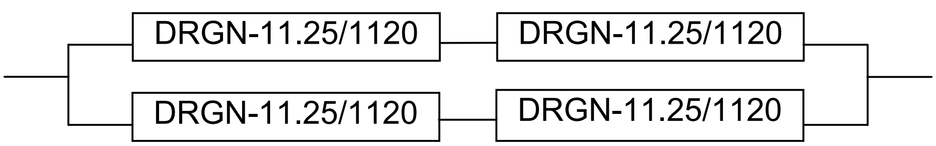
In general, wound metal ribbon resistors are recommended for this type of application. IIS offers a complete line of enclosed panel mounted regen resistor units to complement the Delta driver. Various combinations of series and parallel connections are allowed to provide adequate regen resistor capacity.

IIS P/N	Description	UP-30	UP-31
MFS30A300J*	30 Ohm 30 Watts	N/A	N/A
RGH200-30*	30 Ohm 200 Watts	30	0.20
DRGN-20/400*	20 Ohm 400 Watts	20	0.40
DRGN-45/420	45 Ohm 420 Watts	45	0.42
DRGN-22.5/655	22.5 Ohm 655 Watts	22.5	0.65
DRGN-15/880	15 Ohm 880 Watts	15	0.88
DRGN-11.25/1120	11.25 Ohm 1120 Watts	11.25	1.12

*Not UL/CE approved

EXAMPLE CALCULATION:

If 4 KW of regen were needed on a DSD-115 driver, four (4) DRGN-11.25/1120 units could be connected as follows to yield 11.25 Ohms at 4480 Watts.



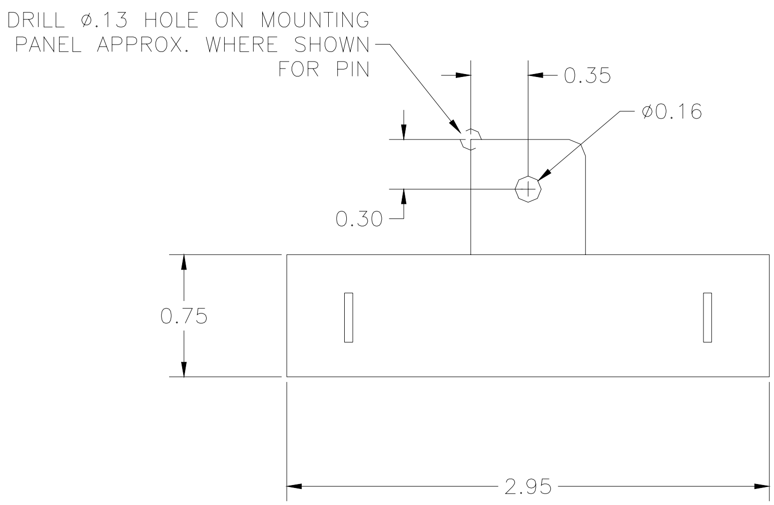
DRAWING NUMBER	DESCRIPTION
MFS30A300J	Resistor
RGH200-30	Regen Resistor
DRGN-20/400	Regen Resistor
DRGN-45/420	Regen Resistor
DRGN-45/420-2	Regen Resistor
DRGN-22.5/655	Regen Resistor
DRGN-15/880	Regen Resistor
DRGN-11.25/1120	Regen Resistor

NOTES:

1.) THIS RESISTOR IS NOT UL OR CE APPROVED.

2.) RESISTOR MUST BE SECURELY MOUNTED ON LARGE HEATSINK SUCH AS ENCLOSURE WALL OR BACKPANEL.

SPECIFICATIONS	
RESISTANCE:	30 Ohms
CONTINUOUS POWER:	30 Watts
MAXIMUM VOLTAGE:	VDC
MAXIMUM PULSE CURRENT:	15 A
MAXIMUM RMS CURRENT:	1 A
DUTY CYCLE	6 %



INDUSTRIAL INDEXING SYSTEMS, Inc.

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TITLE RESISTOR, 30 OHM, 30W

DRAWING NUMBER MFS30A300J

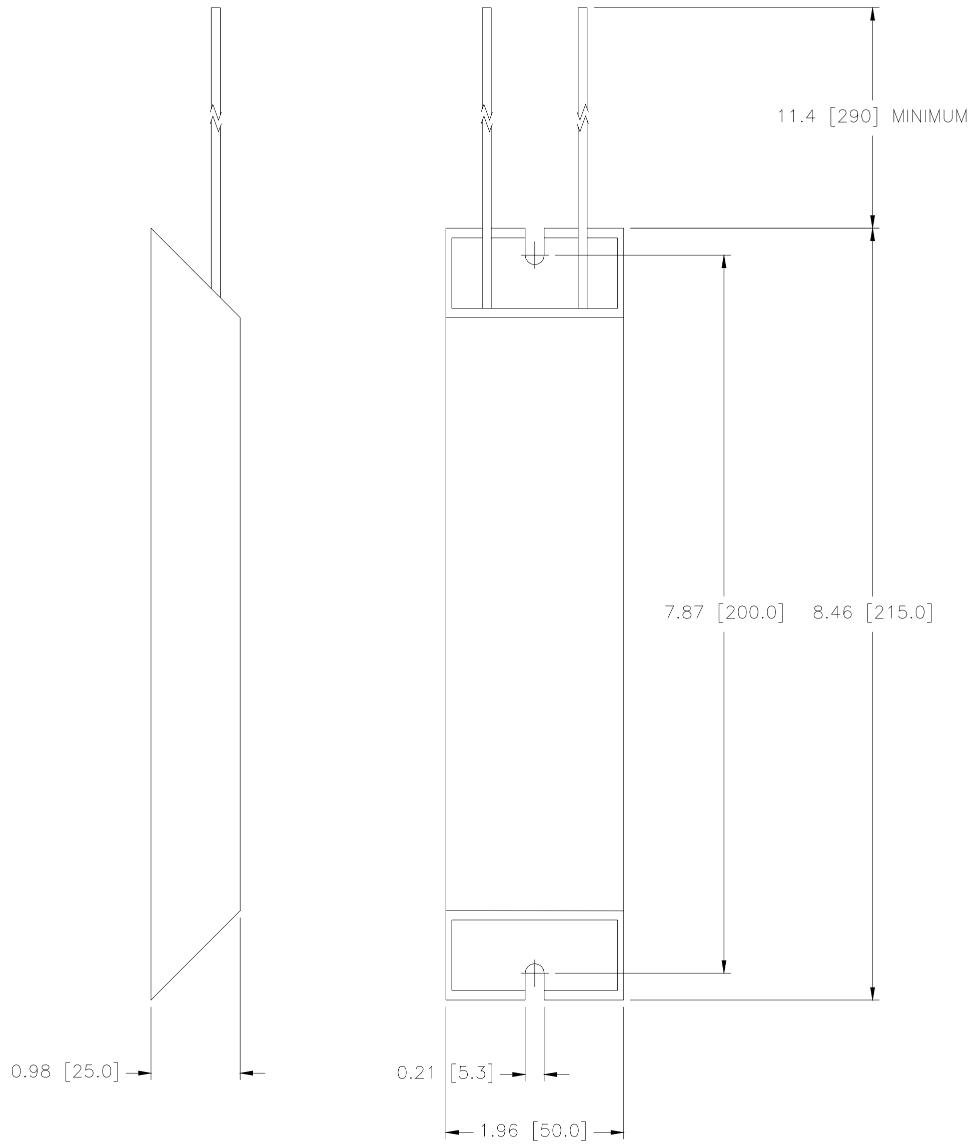
DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± --- X.XXX± --- ∠ ± ---	REV 0		ECN 03-322	DATE 16JUL03	SH. 1 OF 1

NOTES:

1.) RESISTOR MUST BE MOUNTED ON A FLAT SURFACE AT LEAST 12" X 12" IN FREE AIR TO MEET THE 200 WATT POWER DISSIPATION.

2.) THIS RESISTOR IS NOT UL OR CE APPROVED.

SPECIFICATIONS	
RESISTANCE:	30 Ohms
CONTINUOUS POWER:	200 Watts
MAXIMUM VOLTAGE:	425 VDC
MAXIMUM PULSE CURRENT:	14.0 A
MAXIMUM RMS CURRENT:	5.0 A
DUTY CYCLE	50%



INDUSTRIAL INDEXING SYSTEMS, Inc.

www.iis-servo.com

TITLE REGEN RESISTOR					
DRAWING NUMBER RGH200-30					
DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± 0.01 X.XXX± 0.005 ∠ ± ---	REV 0	ECN 01-067	DATE 27FEB01	SH. 1 OF 1

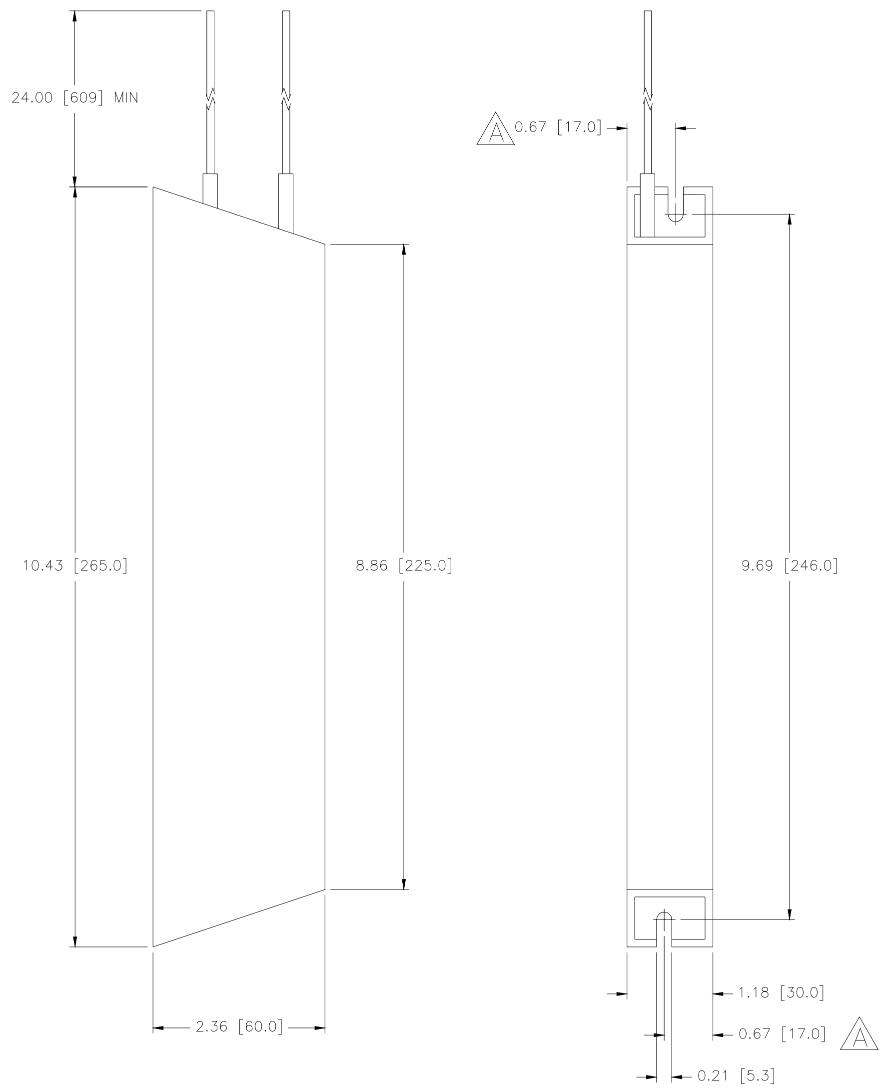
NOTES:

1.) RESISTOR MUST BE MOUNTED ON A FLAT SURFACE AT LEAST 12" X 12" IN FREE AIR TO MEET THE 200 WATT POWER DISSIPATION.

2.) THIS RESISTOR IS NOT UL OR CE APPROVED.

3.) RESISTOR MUST BE SECURELY MOUNTED ON LARGE HEATSINK SUCH AS ENCLOSURE WALL OR BACKPANEL.

SPECIFICATIONS	
RESISTANCE:	20 Ohms
CONTINUOUS POWER:	400 Watts
MAXIMUM VOLTAGE:	425 VDC
MAXIMUM PULSE CURRENT:	22 A
MAXIMUM RMS CURRENT:	4.5 A
DUTY CYCLE	15 %



INDUSTRIAL INDEXING SYSTEMS, Inc.

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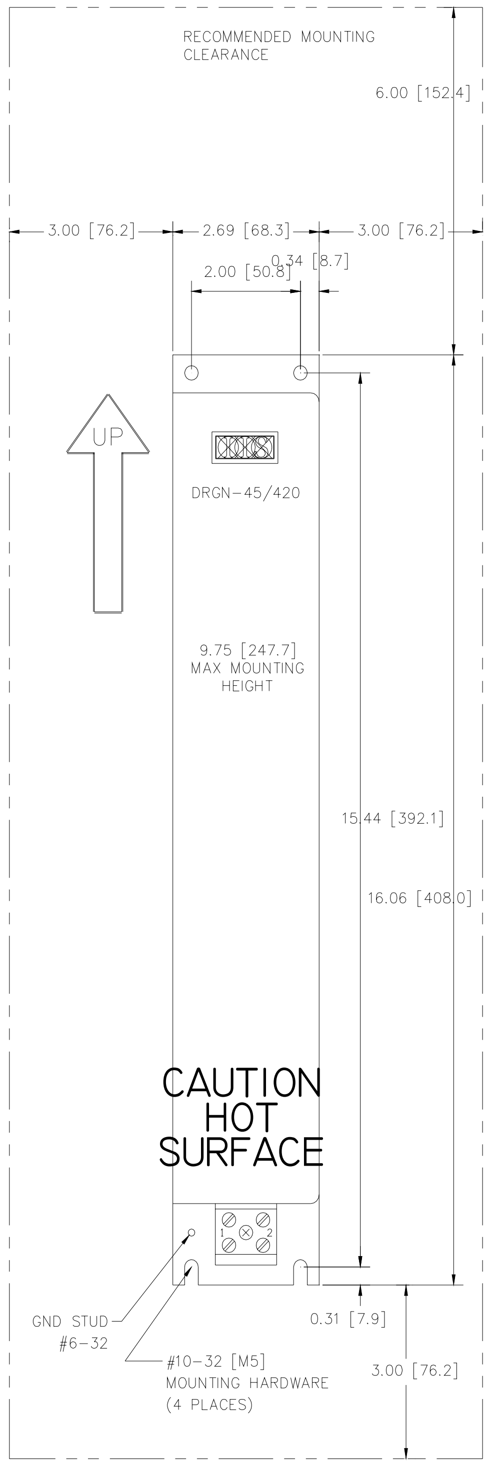
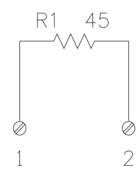
TITLE REGEN RESISTOR						
DRAWING NUMBER DRGN-20/400						
DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± 0.01 X.XXX± 0.005 ∠ ± 5°	REV A	ECN 01-259	DATE 28JUN01	SH. 1 OF 1	

SPECIFICATIONS	
RESISTANCE:	45 Ohms
CONTINUOUS POWER:	420 Watts
MAXIMUM VOLTAGE:	425 VDC
MAXIMUM PULSE CURRENT:	9.5 A
MAXIMUM RMS CURRENT:	3.1 A
DUTY CYCLE	15%





INDUSTRIAL INDEXING SYSTEMS, Inc.

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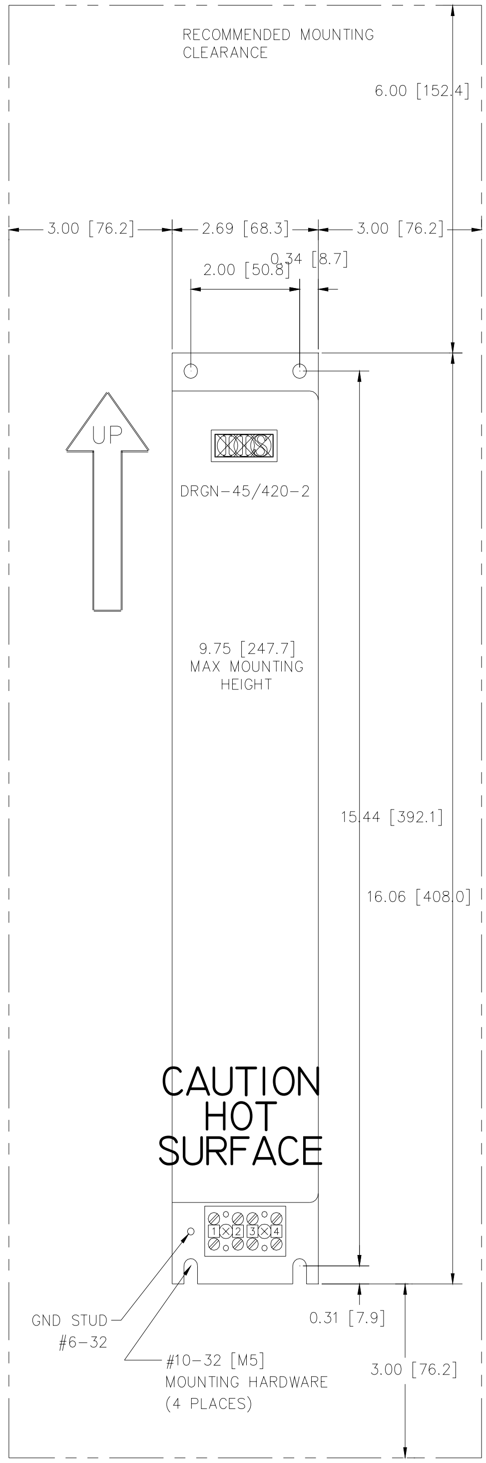
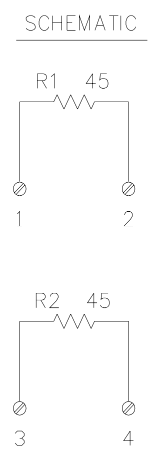
TITLE: REGEN RESISTIOR

DRAWING NUMBER: DRGN-45/420

DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± .02 [0.5] X.XXX± -- ∠ ± 5°	REV B		ECN 96-269	DATE 6/25/96	SH. 1 OF 1

SPECIFICATIONS	
RESISTANCE:	45 Ohms
CONTINUOUS POWER:	420 Watts
MAXIMUM VOLTAGE:	425 VDC
MAXIMUM PULSE CURRENT:	9.5 A
MAXIMUM RMS CURRENT:	3.1 A
DUTY CYCLE	15%



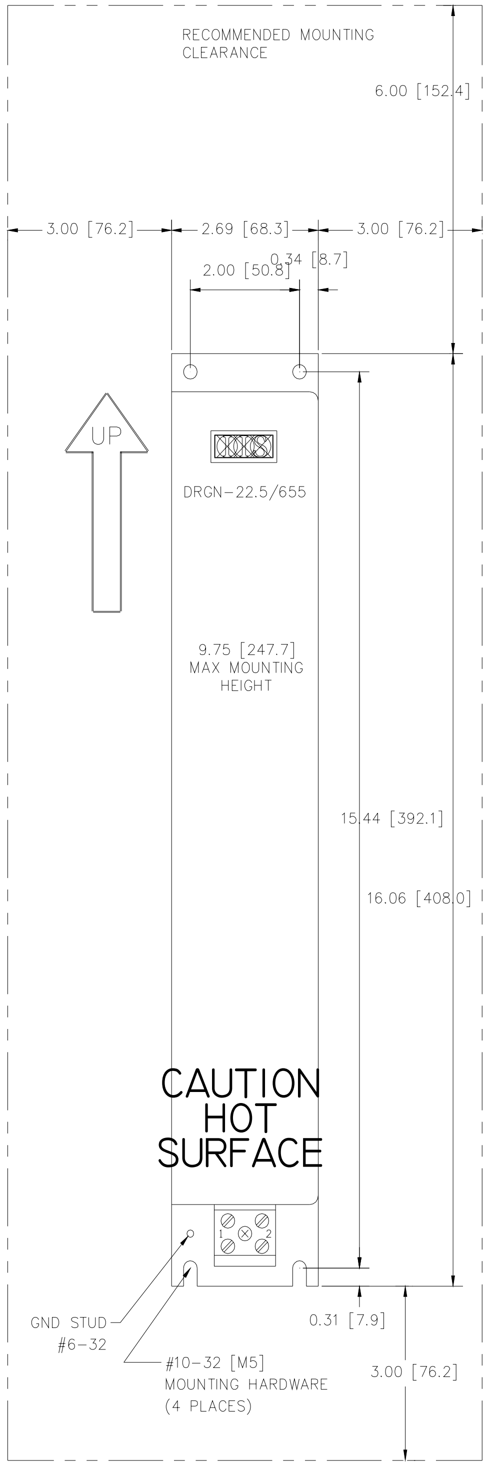


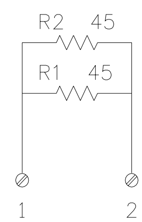
INDUSTRIAL INDEXING SYSTEMS, Inc.

www.iis-servo.com

TITLE: REGEN RESISTIOR					
DRAWING NUMBER: DRGN-45/420-2					
DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± .02 [0.5] X.XXX± -- ∠ ± 5°	REV A	ECN 98-269	DATE 06AUG98	SH. 1 OF 1

SPECIFICATIONS	
RESISTANCE:	22.5 Ohms
CONTINUOUS POWER:	655 Watts
MAXIMUM VOLTAGE:	425 VDC
MAXIMUM PULSE CURRENT:	18.9 A
MAXIMUM RMS CURRENT:	5.4 A
DUTY CYCLE:	15%





INDUSTRIAL INDEXING SYSTEMS, Inc.

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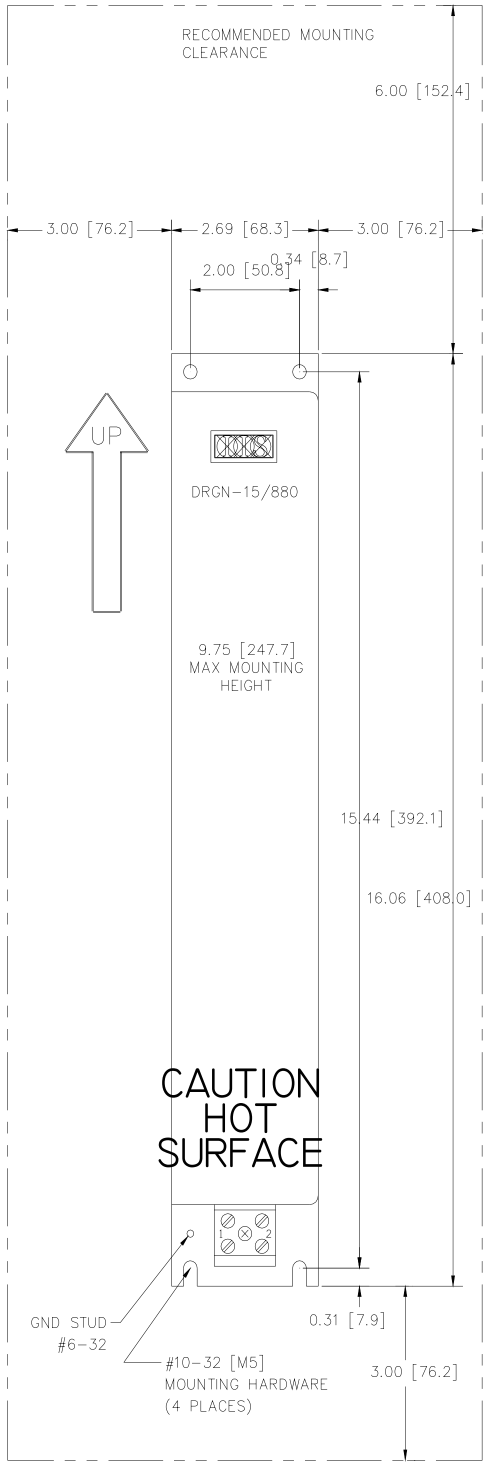
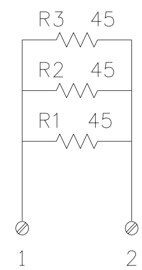
TITLE
REGEN RESISTIOR

DRAWING NUMBER
DRGN-22.5/655

DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± .02 [0.5] X.XXX± -- ∠ ± 5°	REV B		ECN 96-269	DATE 6/25/96	SH. 1 OF 1

SPECIFICATIONS	
RESISTANCE:	15 Ohms
CONTINUOUS POWER:	880 Watts
MAXIMUM VOLTAGE:	425 VDC
MAXIMUM PULSE CURRENT:	28.4 A
MAXIMUM RMS CURRENT:	7.6 A
DUTY CYCLE	15%





INDUSTRIAL INDEXING SYSTEMS, Inc.

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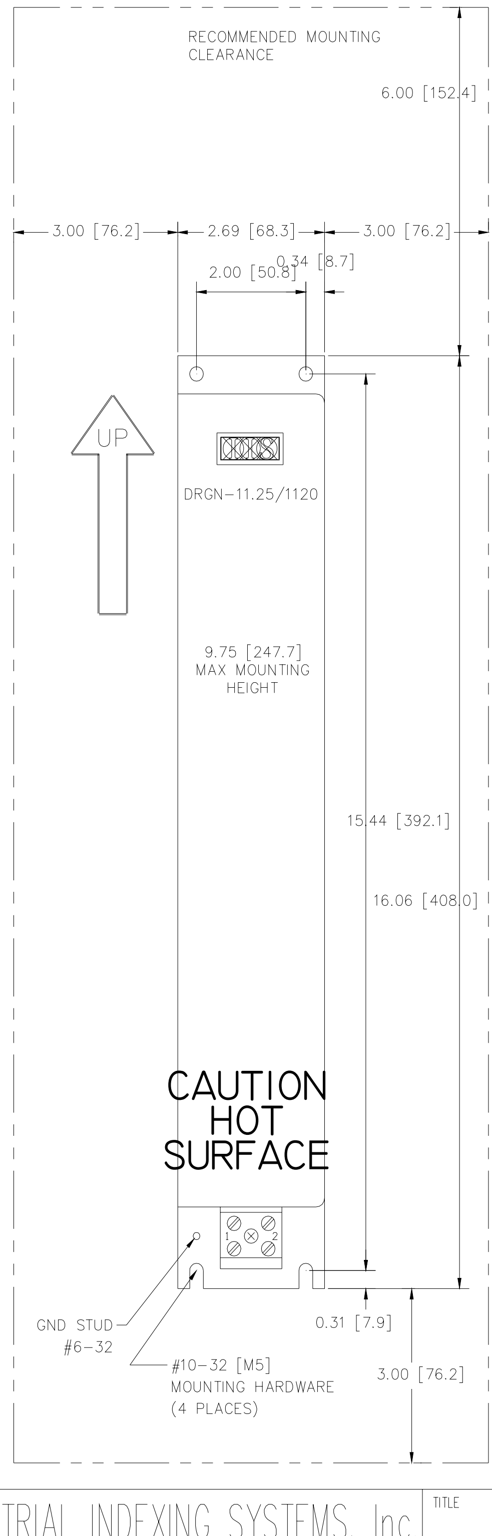
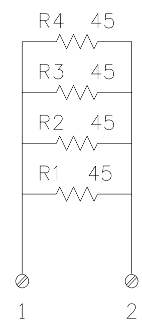
TITLE: REGEN RESISTIOR

DRAWING NUMBER: DRGN-15/880

DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± .02 [0.5] X.XXX± --	∠ ± 5°	REV B		ECN 96-269	DATE 6/25/96	SH. 1 OF 1

SPECIFICATIONS	
RESISTANCE:	11.25 Ohms
CONTINUOUS POWER:	1120 Watts
MAXIMUM VOLTAGE:	425 VDC
MAXIMUM PULSE CURRENT:	38.7 A
MAXIMUM RMS CURRENT:	10 A
DUTY CYCLE	15%





INDUSTRIAL INDEXING SYSTEMS, Inc.
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TITLE	REGEN RESISTIOR
DRAWING NUMBER	DRGN-11.25/1120

DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± .02 [0.5] X.XXX± --	∠ ± 5°	REV B	ECN 96-269	DATE 6/25/96	SH. 1 OF 1

SECTION 8 - DYNAMIC BRAKES

The Delta driver is equipped with special circuitry and software to sequence a dynamic braking relay connected across the motor windings. It is very important for proper operation that the dynamic breaking relay contacts be open before the driver circuitry is turned on and that the driver is off before the dynamic braking relay contacts close. The driver in conjunction with external braking relays provide the proper sequencing to prevent driver damage.

If dynamic braking is not used, tie the BRAKE CONFIRM input ON for the DSD-1.5 through DSD-17.5 driver sizes. For DSD-35 and larger drivers, a jumper must be provided between B11 and B12. A B11 to B12 jumper is installed by the factory and must be removed if dynamic braking is to be used.

Parameter UP-16 should be set to the default value of 0 for dynamic braking or no brake connections.

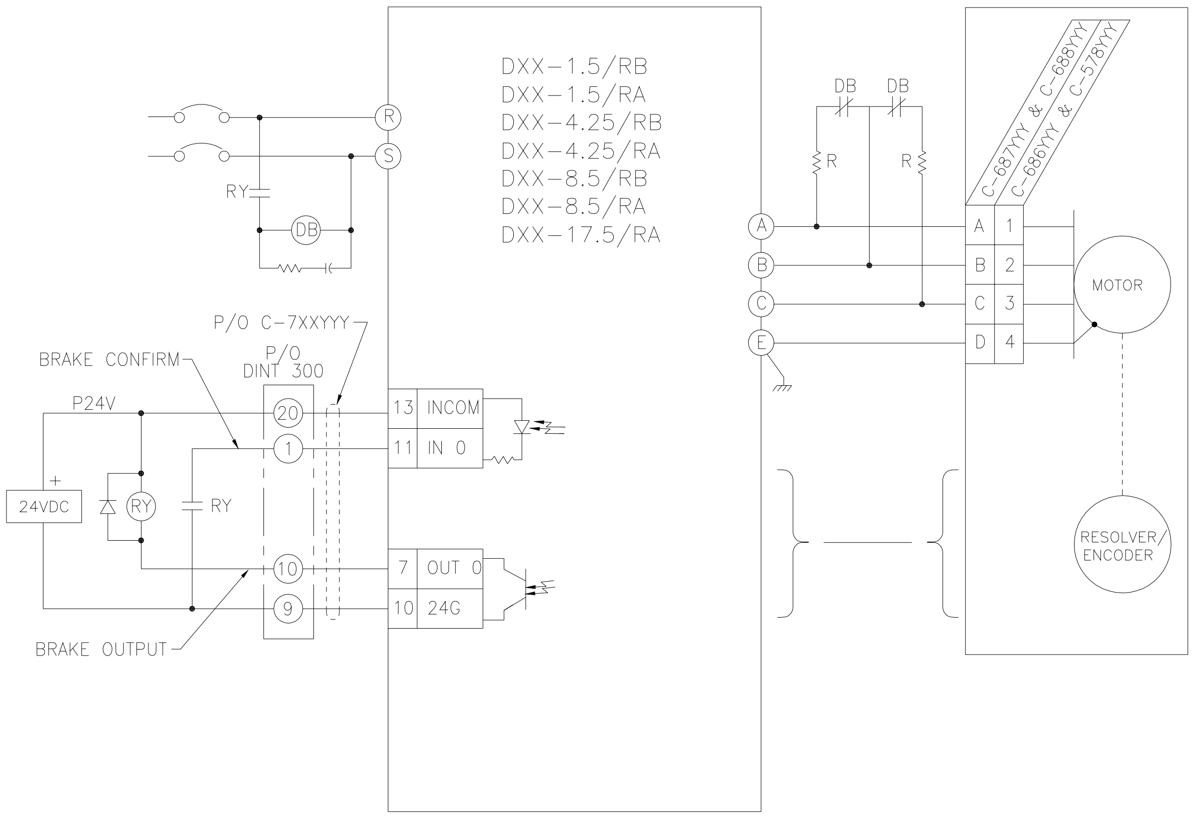
Be sure to select a dynamic braking resistor with a sufficient peak power rating.

$$\text{Resistor Peak Power} = \frac{150 * V^2}{R}$$

Where V = maximum motor voltage when dynamic braking is applied.

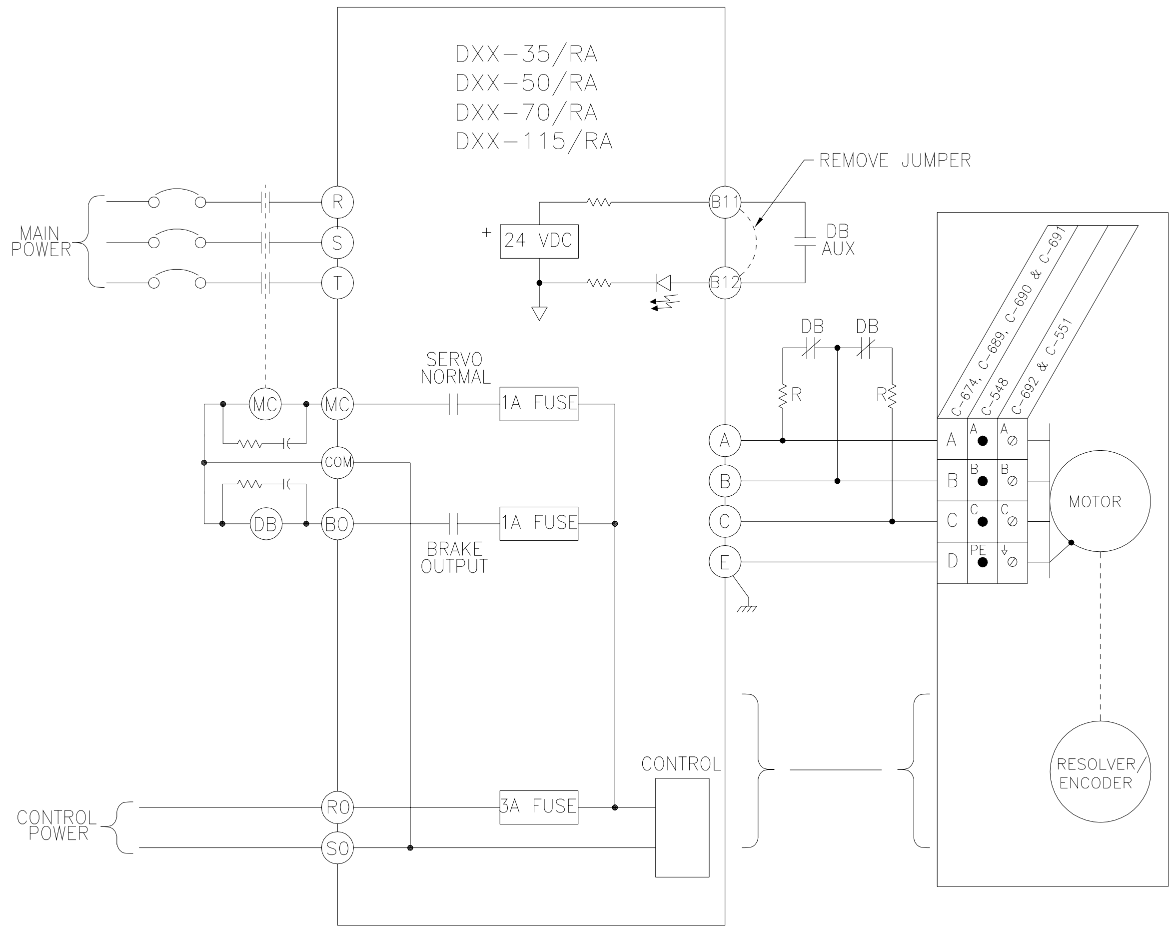
General rule: V = 300 * (motor speed @ braking) / (motor maximum speed rating)

Figures 8.1 and 8.2 show the connections for dynamic braking.



DRIVER	DB COIL	DB N.C. CONTACT	DB AUX N.O. CONTACT	RY COIL	RY CONTACT	MINIMUM RESISTOR VALUE R
DXX−1.5/RB	115 VAC	1.5 A RMS	24 VDC @ 8 MA	24 VDC 40 MA	115 VAC 1 A RMS	60 OHMS
DXX−1.5/RA	220 VAC	1.5 A RMS	24 VDC @ 8 MA	24 VDC 40 MA	220 VAC 0.5 A RMS	60 OHMS
DXX−4.25/RB	115 VAC	4.25 A RMS	24 VDC @ 8 MA	24 VDC 40 MA	115 VAC 1 A RMS	30 OHMS
DXX−4.25/RA	220 VAC	4.25 A RMS	24 VDC @ 8 MA	24 VDC 40 MA	115 VAC 1 A RMS	30 OHMS
DXX−8.5/RB	115 VAC	8.5 A RMS	24 VDC @ 8 MA	24 VDC 40 MA	220 VAC 0.5 A RMS	15 OHMS
DXX−8.5/RA	220 VAC	8.5 A RMS	24 VDC @ 8 MA	24 VDC 40 MA	220 VAC 0.5 A RMS	15 OHMS
DXX−17.5/RA	220 VAC	17.5 A RMS	24 VDC @ 8 MA	24 VDC 40 MA	220 VAC 0.5 A RMS	8 OHMS

Figure 8.1 - Dynamic Brake Connection for the DSD-1.5 Through DSD-17.5 Drivers



DRIVER	DB COIL	DB N.C. CONTACT	DB AUX N.O. CONTACT	MINIMUM RESISTOR VALUE R
DXX−35/RA	220 VAC	35 A RMS	24 VDC @ 25 MA	4 OHMS
DXX−50/RA	220 VAC	50 A RMS	24 VDC @ 25 MA	3 OHMS
DXX−70/RA	220 VAC	70 A RMS	24 VDC @ 25 MA	2 OHMS
DXX−115/RA	220 VAC	115 A RMS	24 VDC @ 25 MA	1 OHMS

Figure 8.2 - Dynamic Brake Connection for the DSD-35 Through DSD-115 Drivers

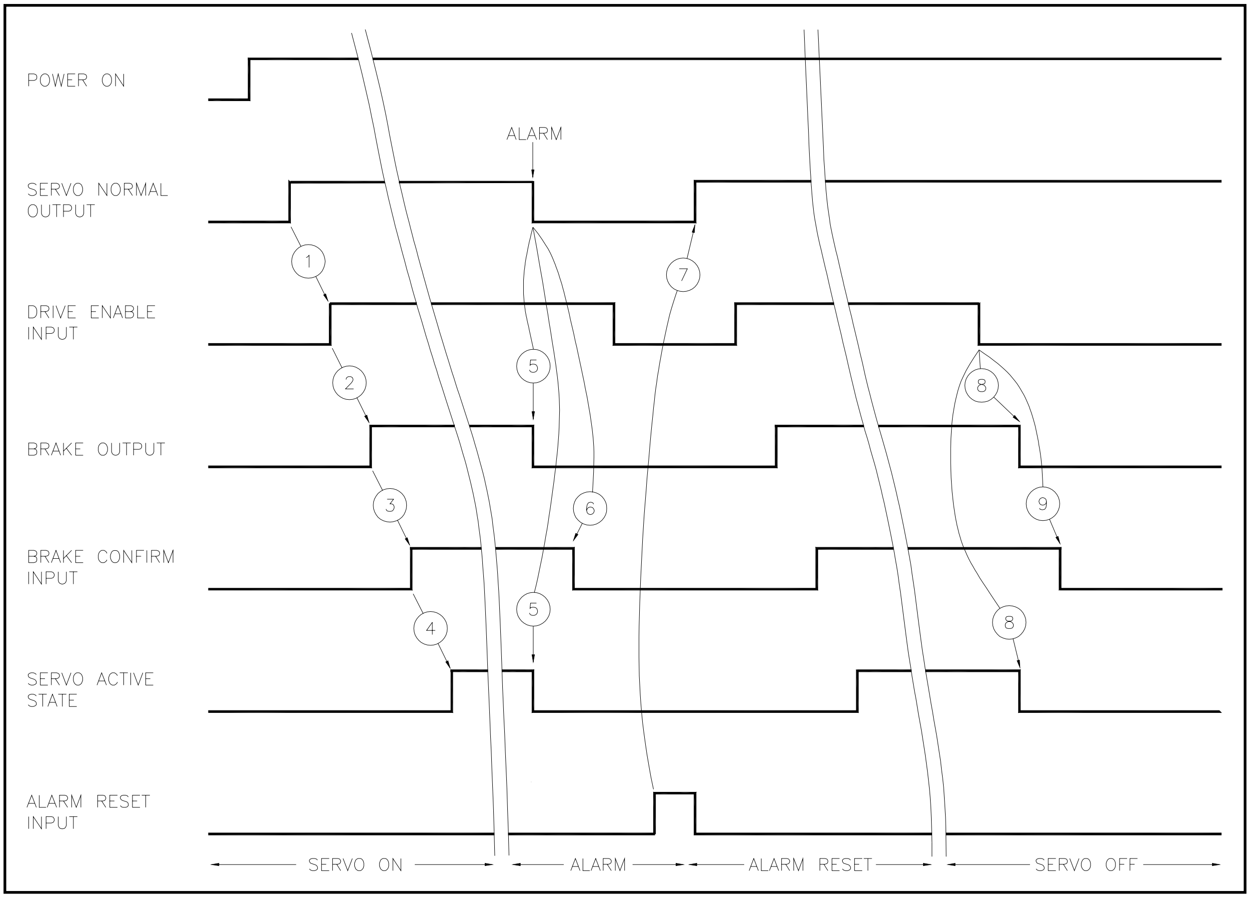


Figure 8.3 - Dynamic Braking Control Signals

1. DRIVE ENABLE may be turned ON within 0.6 seconds of SERVO NORMAL.
2. BRAKE turns on within 800µsec. of DRIVE ENABLE.
3. BRAKE CONFIRM must be returned within 100ms. or AL-14 will be generated.
4. The servo will become active within 800µsec of sensing BRAKE CONFIRM.
5. When an alarm is sensed, the SERVO NORMAL and BRAKE outputs are turned OFF. The DRIVE ENABLE must be turned OFF before alarm clearing can be accomplished.
6. The BRAKE CONFIRM turns OFF indicating the braking relay has toggled and dynamic braking is engaged.
7. ALARM RESET causes driver to check for clearing of the alarm condition and if all alarm states are clear the SERVO NORMAL will turn ON within 30 ms. ALARM RESET should be turned OFF before DRIVE ENABLE is turned ON.
8. The servo becomes inactive and the BRAKE output turns OFF within 800µsec of DRIVE ENABLE being turned OFF.
9. The BRAKE CONFIRM turns OFF indicating the braking relay has toggled and dynamic braking is engaged.

SECTION 9 - MECHANICAL BRAKES

The Delta driver is equipped with special circuitry and software to sequence an electrically released mechanical brake. The full line of Delta motors are available with mechanical brakes to provide mechanical fail safe braking in the case of power loss and driver disable.

It is very important for proper operation to sequence the driver servo lock and mechanical brake to avoid loss of holding torque during the transition. The driver in conjunction with an external relay and brake power supply provide for the optimum sequencing to prevent loss of holding torque or driver damage.

9.1 NO MECHANICAL BRAKING

If a mechanical brake is not used, tie BRAKE CONFIRM input ON for the DSD-1.5 through DSD-17.5 driver sizes. For the DSD-35 and larger drivers, a jumper must be provided between B11 and B12. The factory installs a B11 to B12 jumper.

Set UP-16 to the default value of 0.

9.2 MECHANICAL BRAKING WITH HARD DECEL

The driver sequencing can be set to apply the mechanical brake immediately upon driver disable. Since the mechanical brake is applied immediately upon driver disable the deceleration of the motor will be abrupt and limited only by the brake torque and mechanical system.

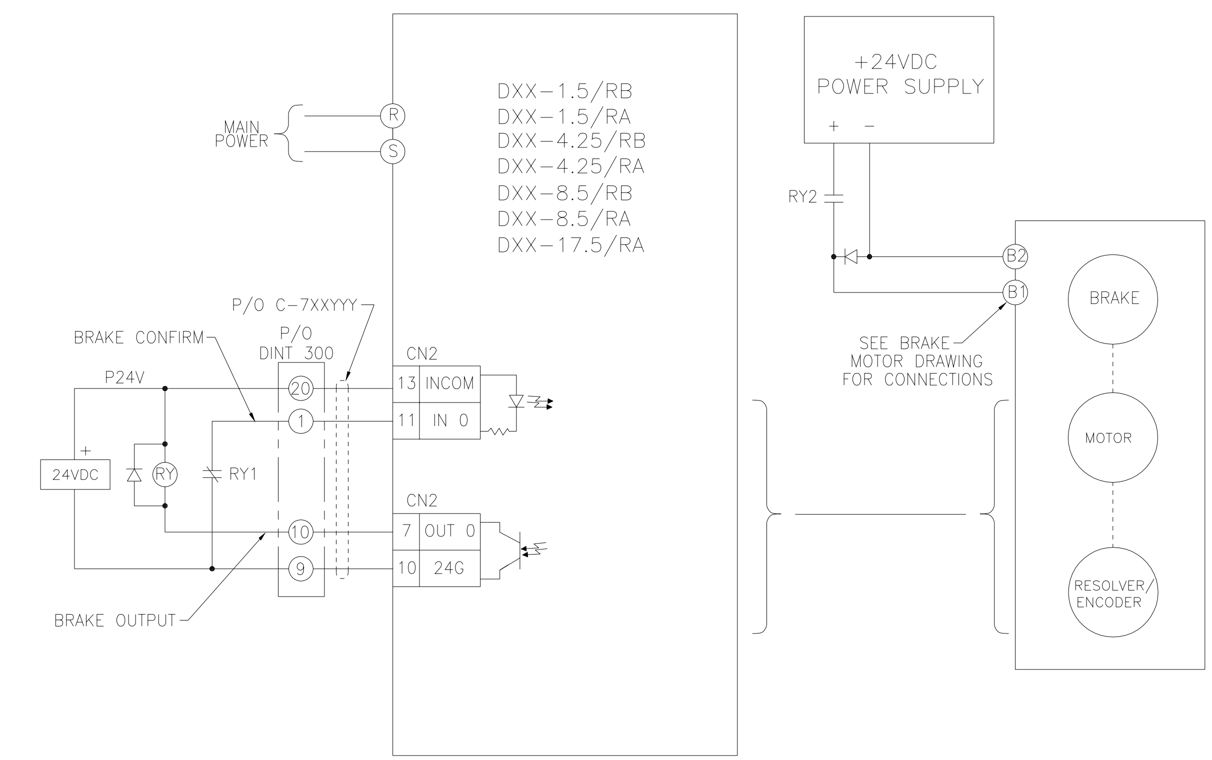
Connect the braking relay and power supply as shown in **Figures 9.1 or 9.2** and set UP-16 to a value of 02. The sequencing will be as shown in **Figure 9.3**.

9.3 MECHANICAL BRAKING WITH SOFT DECEL

The driver sequencing can be set to apply the mechanical brake after the driver has reduced the motor speed to a programmable set point. The decel rate is set by UP-13 and the speed set point at which the brake is applied is set by UP-28.

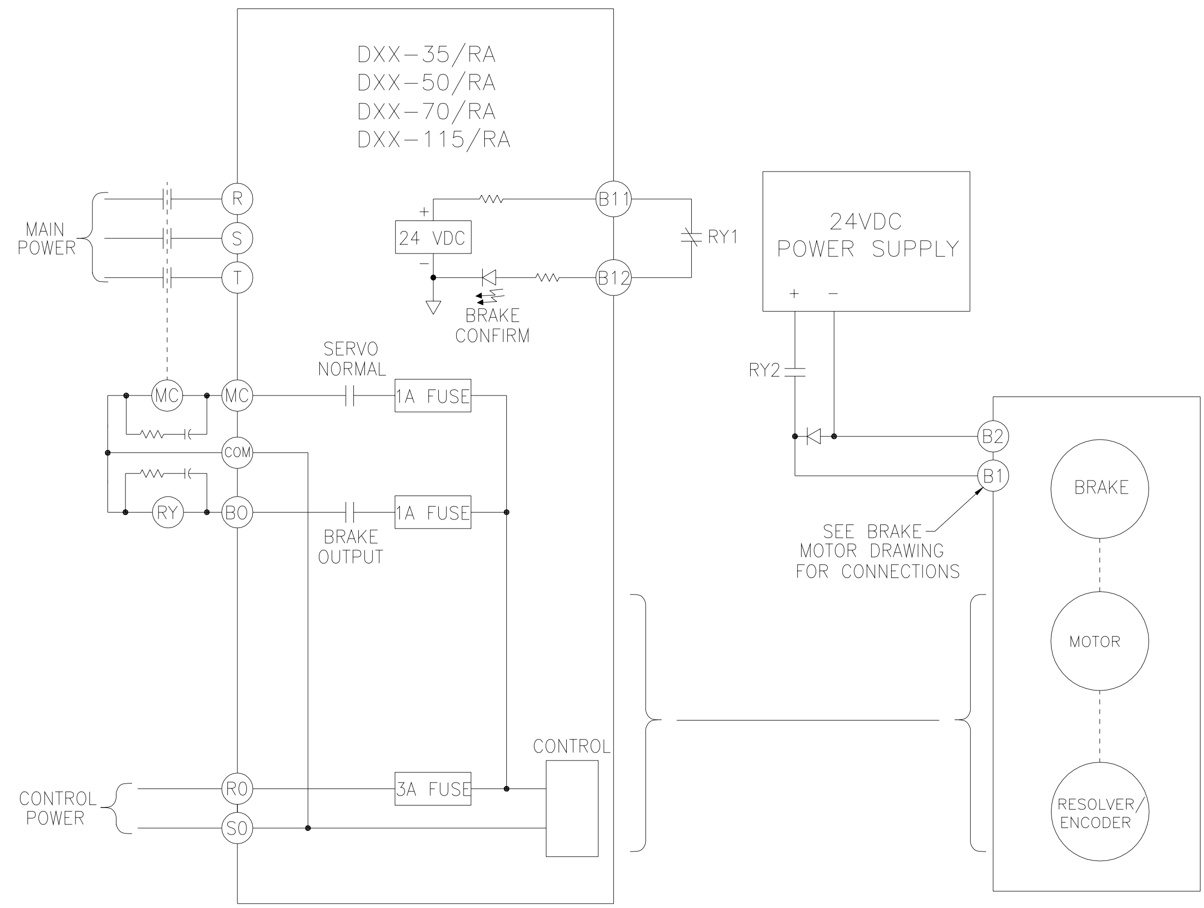
The mechanical brake is applied immediately upon driver alarm or loss of power.

Connect the braking relay and power supply as shown in **Figures 9.1 or 9.2** and set UP-16 to a value of 01. The sequencing will be as shown in **Figure 9.4**.



DRIVER	RY COIL	CONTACT RY1	CONTACT RY2	POWER SUPPLY
DXX-1.5/RB	24 VDC @ 40 ma MAX	24 VDC @ 8 ma	24 VDC @ 1 A	DMBPS-115/24
DXX-1.5/RA	24 VDC @ 40 ma MAX	24 VDC @ 8 ma	24 VDC @ 1 A	DMBPS-220/24
DXX-4.25/RB	24 VDC @ 40 ma MAX	24 VDC @ 8 ma	24 VDC @ 1 A	DMBPS-115/24
DXX-4.25/RA	24 VDC @ 40 ma MAX	24 VDC @ 8 ma	24 VDC @ 1 A	DMBPS-220/24
DXX-8.5/RB	24 VDC @ 40 ma MAX	24 VDC @ 8 ma	24 VDC @ 1 A	DMBPS-115/24
DXX-8.5/RA	24 VDC @ 40 ma MAX	24 VDC @ 8 ma	24 VDC @ 1 A	DMBPS-220/24
DXX-17.5/RA	24 VDC @ 40 ma MAX	24 VDC @ 8 ma	24 VDC @ 1 A	DMBPS-220/24

Figure 9.1 - Mechanical Brake Connection for the DSD-1.5 Through DSD-17.5 Drivers



DRIVER	RY COIL	CONTACT RY1	CONTACT RY2	POWER SUPPLY
DXX–35/RA	220 VAC @ 0.2 ARMS MAX	24 VDC @ 25 ma	24 VDC @ 1 A	DMBPS–220/220
DXX–50/RA	220 VAC @ 0.2 ARMS MAX	24 VDC @ 25 ma	24 VDC @ 1 A	DMBPS–220/220
DXX–70/RA	220 VAC @ 0.2 ARMS MAX	24 VDC @ 25 ma	24 VDC @ 1 A	DMBPS–220/220
DXX–115/RA	220 VAC @ 0.2 ARMS MAX	24 VDC @ 25 ma	24 VDC @ 1.5 A	DMBPS–220/220

Figure 9.2 - Mechanical Brake Connection for the DSD-35 Through DSD-115 Drivers

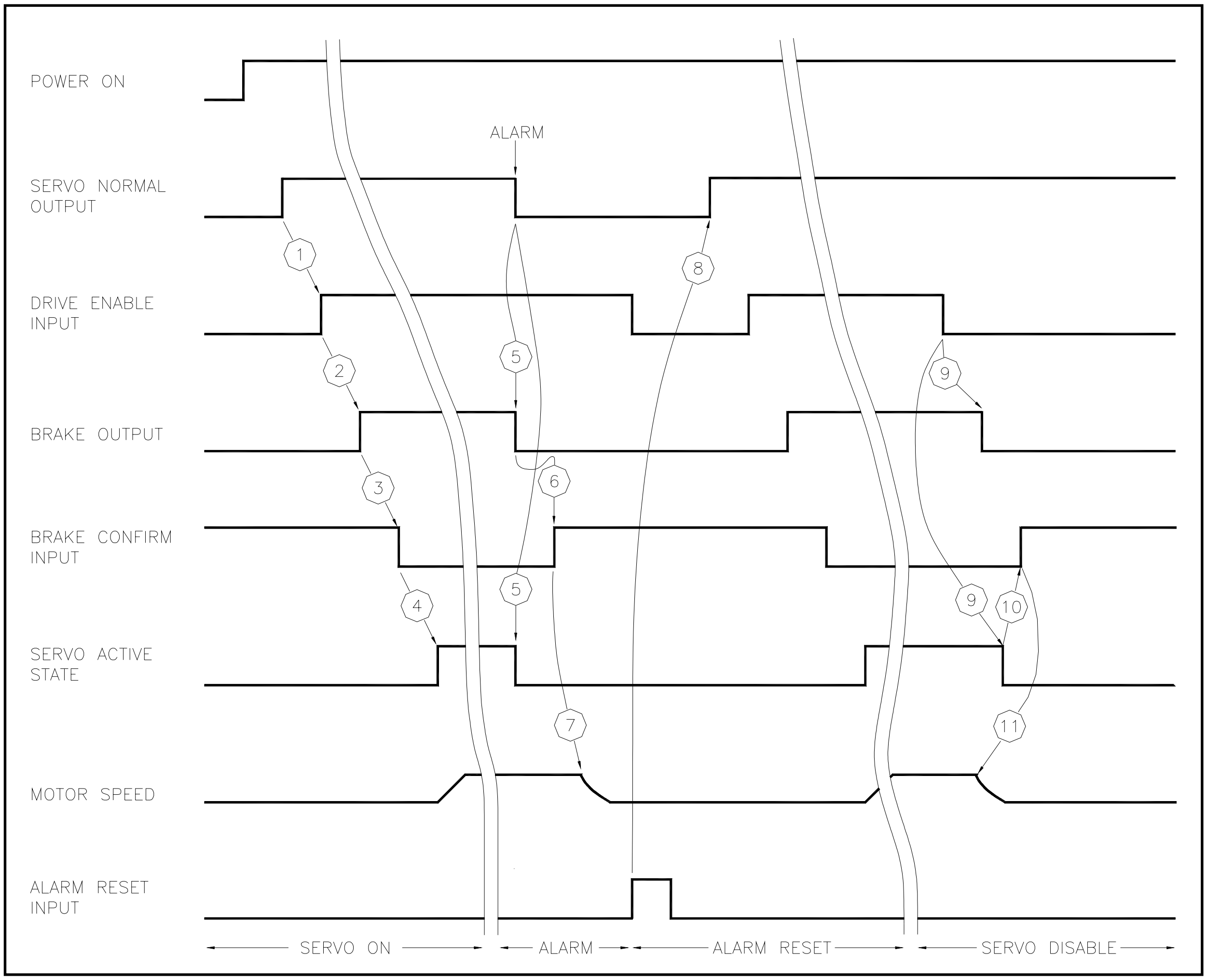


Figure 9.3 - Mechanical Brake Sequencing for Hard Decel

1. DRIVE ENABLE may be turned ON within 0.6 seconds of SERVO NORMAL.
2. BRAKE turns on within 800µsec. of DRIVE ENABLE.
3. BRAKE CONFIRM must be returned within 100ms or AL-14 will be generated.
4. The servo will become active within 800µsec of sensing BRAKE CONFIRM.
5. When an alarm is sensed, the SERVO NORMAL and BRAKE outputs are turned OFF and the servo becomes inactive.
6. The BRAKE CONFIRM turns ON indicating the braking relay has toggled.
7. The mechanical brake engages after a delay in the braking mechanism.
8. The DRIVE ENABLE must be turned OFF before alarm clearing can be accomplished. ALARM RESET causes driver to check for clearing of the alarm condition and if all alarm states are clear the SERVO NORMAL will turn ON within 30 ms. ALARM RESET should be turned OFF before DRIVE ENABLE is turned ON.
9. The servo applies maximum braking torque until the motor speed falls below UP-28. Then the brake output turns off. The servo goes inactive 200 ms later.
10. The BRAKE CONFIRM turns ON indicating the braking relay has toggled.
11. The mechanical brake engages after a delay in the braking mechanism.

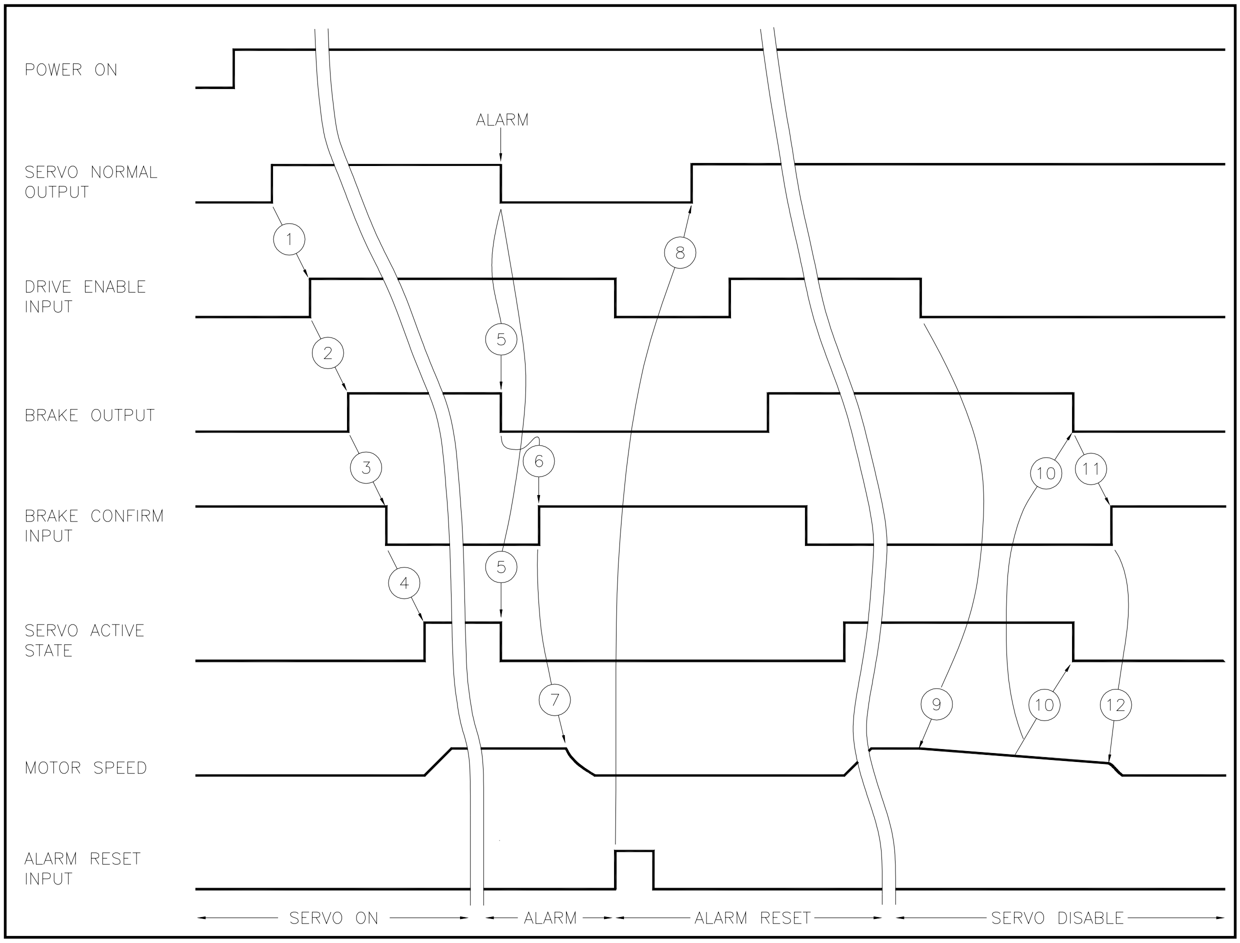


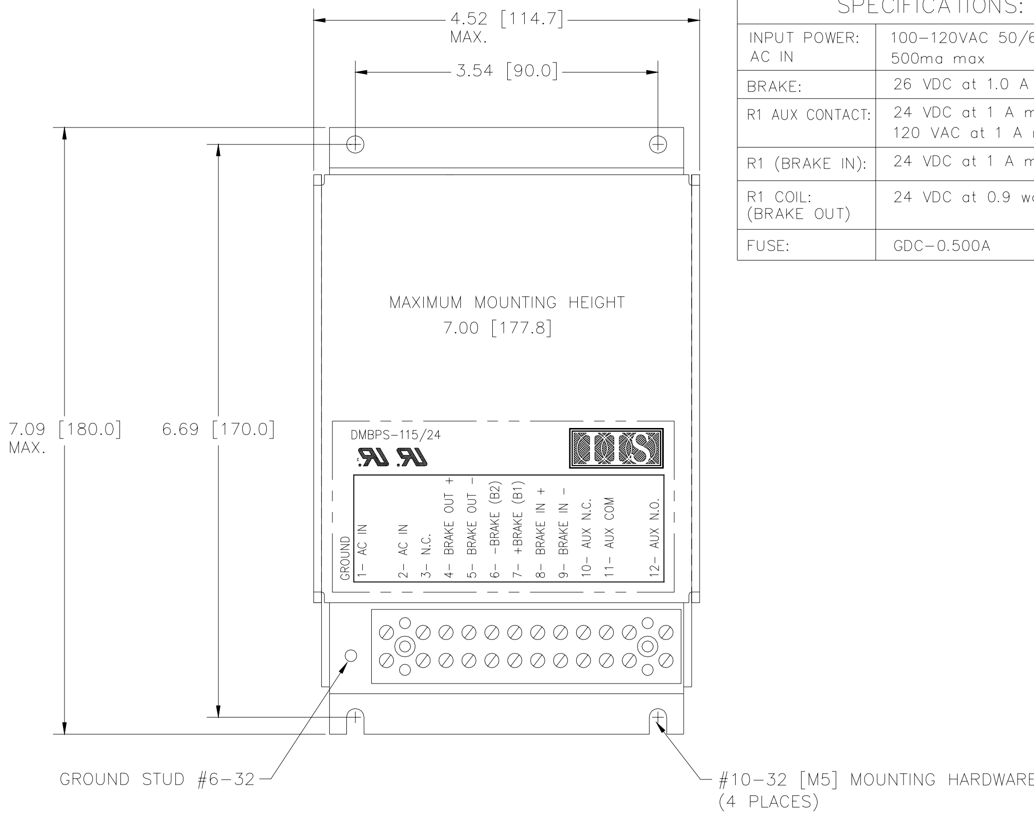
Figure 9.4 - Mechanical Brake Sequencing for Soft Decel

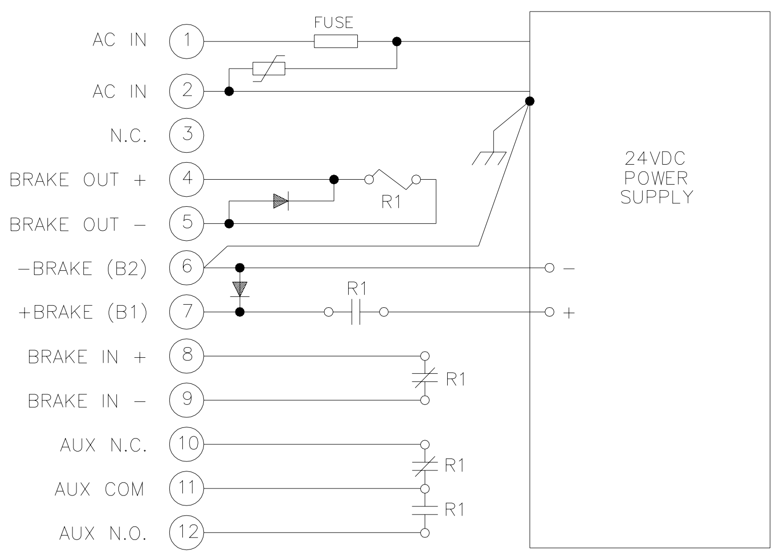
1. DRIVE ENABLE may be turned ON within 0.6 seconds of SERVO NORMAL.
2. BRAKE turns on within 800µsec. of DRIVE ENABLE.
3. BRAKE CONFIRM must be returned within 100ms or AL-14 will be generated.
4. The servo will become active within 800µsec of sensing BRAKE CONFIRM.
5. When an alarm is sensed, the SERVO NORMAL and BRAKE outputs are turned OFF and the servo becomes inactive.
6. The BRAKE CONFIRM turns ON indicating the braking relay has toggled.
7. The mechanical brake engages after a delay in the braking mechanism.
8. The DRIVE ENABLE must be turned OFF before alarm clearing can be accomplished. ALARM RESET causes driver to check for clearing of the alarm condition and if all alarm states are clear the SERVO NORMAL will turn ON within 30 ms. ALARM RESET should be turned OFF before DRIVE ENABLE is turned ON.
9. The servo starts to decelerate within 800µsec of DRIVE ENABLE being turned OFF. Decel rate is specified in UP-13 and UP-14.
10. The servo becomes inactive and the BRAKE output turns OFF within 800µsec of the motor speed dropping below the set point in UP-28.
11. The BRAKE CONFIRM turns ON indicating the braking relay has toggled.
12. The mechanical brake engages after a delay in the braking mechanism.

9.4 MECHANICAL BRAKE POWER SUPPLY

DRAWING NUMBER	DESCRIPTION
DMBPS-115/24	Mechanical Brake Power Supply
DMBPS-220/24	Mechanical Brake Power Supply
DMBPS-220/220	Mechanical Brake Power Supply

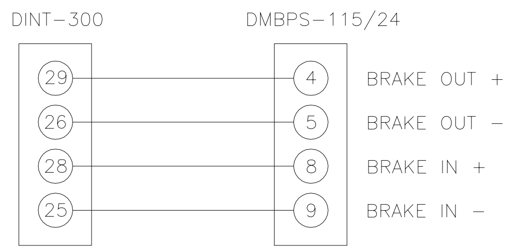
SPECIFICATIONS:	
INPUT POWER: AC IN	100–120VAC 50/60Hz 500ma max
BRAKE:	26 VDC at 1.0 A max.
R1 AUX CONTACT:	24 VDC at 1 A max./ 120 VAC at 1 A max.
R1 (BRAKE IN):	24 VDC at 1 A max.
R1 COIL: (BRAKE OUT)	24 VDC at 0.9 watts
FUSE:	GDC–0.500A



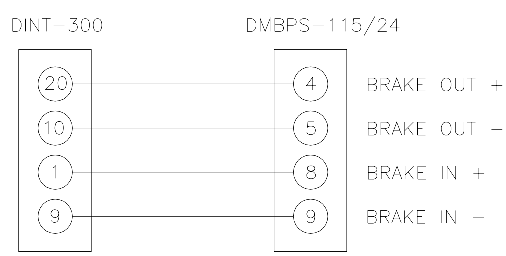


INDUSTRIAL INDEXING SYSTEMS, Inc. www.iis–servo.com		TITLE MECHANICAL BRAKE POWER SUPPLY			
		DRAWING NUMBER DMBPS–115/24			
DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± 0.02 X.XXX± ––– ∠ ± ––	REV F	ECN 00–399	DATE 00–339	SH. 1 OF 2

FOR DELTAMAX AND DELTAPRO SOURCING I/O CONTROLLERS WITH
DSD-8.5 AND DSD-17.5 DRIVES:



FOR DELTA DSD-8.5 AND DSD-17.5 DRIVES:



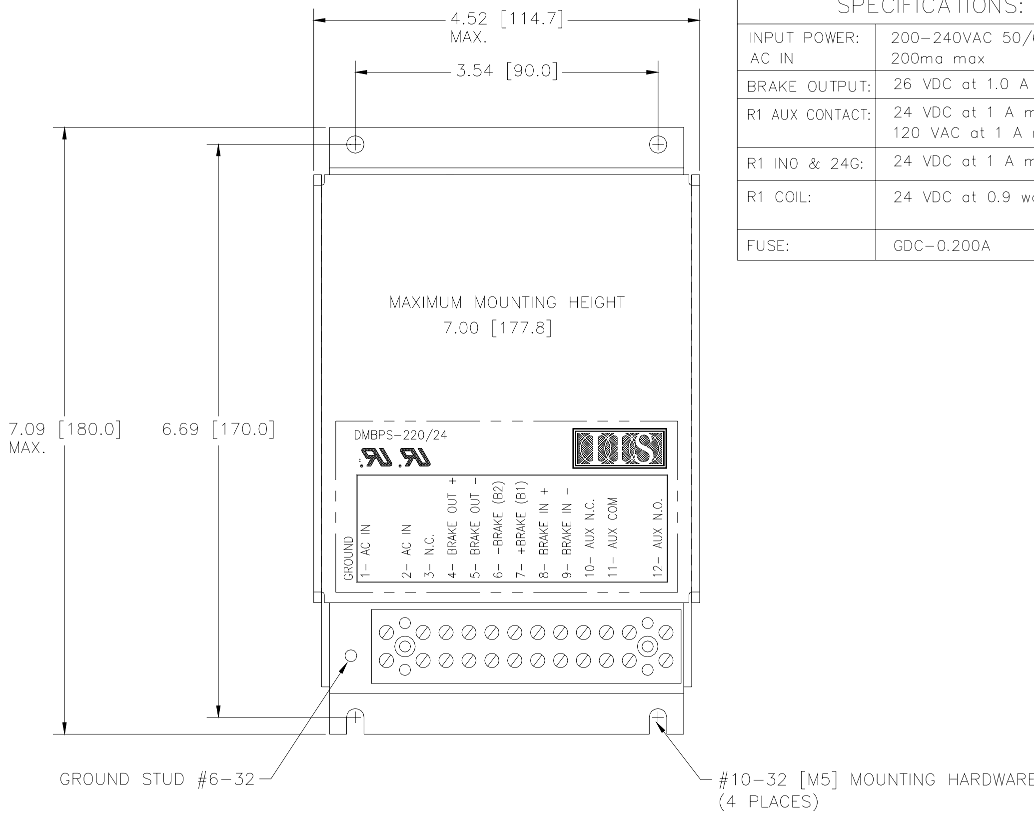
INDUSTRIAL INDEXING SYSTEMS, Inc.
www.iis-servo.com

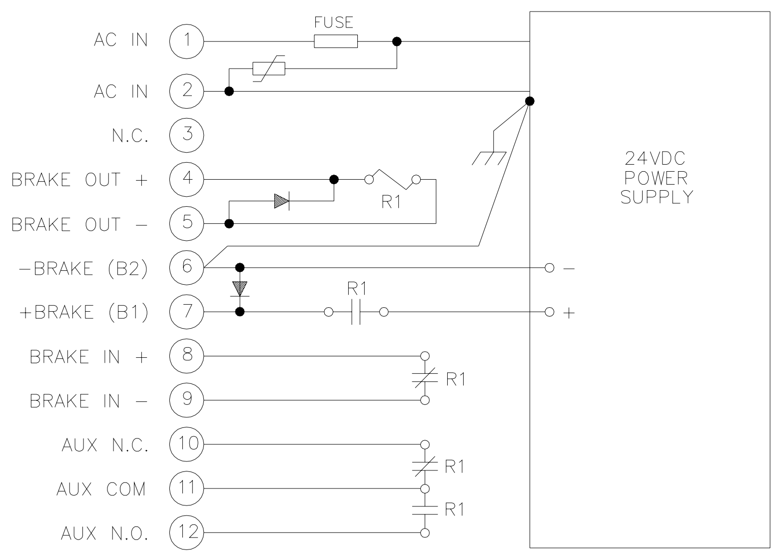
TITLE
MECHANICAL BRAKE POWER SUPPLY

DRAWING NUMBER
DMBPS-115/24

DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± 0.02	X.XXX± --	∠ ± --	REV F		ECN 00-399	DATE 00-399	SH. 2 OF 2

SPECIFICATIONS:	
INPUT POWER: AC IN	200–240VAC 50/60Hz 200ma max
BRAKE OUTPUT:	26 VDC at 1.0 A max.
R1 AUX CONTACT:	24 VDC at 1 A max./ 120 VAC at 1 A max.
R1 INO & 24G:	24 VDC at 1 A max.
R1 COIL:	24 VDC at 0.9 watts
FUSE:	GDC–0.200A





INDUSTRIAL INDEXING SYSTEMS, Inc.

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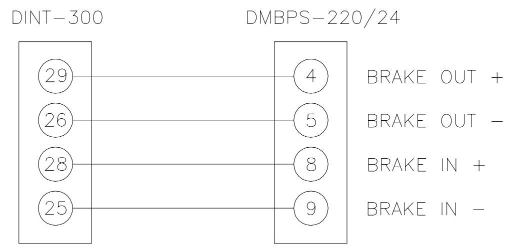
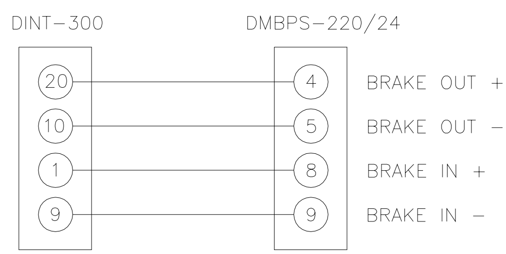
TITLE	MECHANICAL BRAKE POWER SUPPLY					
DRAWING NUMBER	DMBPS–220/24					
DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± 0.02 X.XXX± –– ∠ ± ––	REV J		ECN 02–186	DATE 19JUN96	SH. 1 OF 2

FOR DELTAMAX AND DELTAPRO SOURCING I/O CONTROLLERS WITH DSD–8.5 AND DSD–17.5 DRIVES:



FOR DELTA DSD–8.5 AND DSD–17.5 DRIVES:



INDUSTRIAL INDEXING SYSTEMS, Inc.

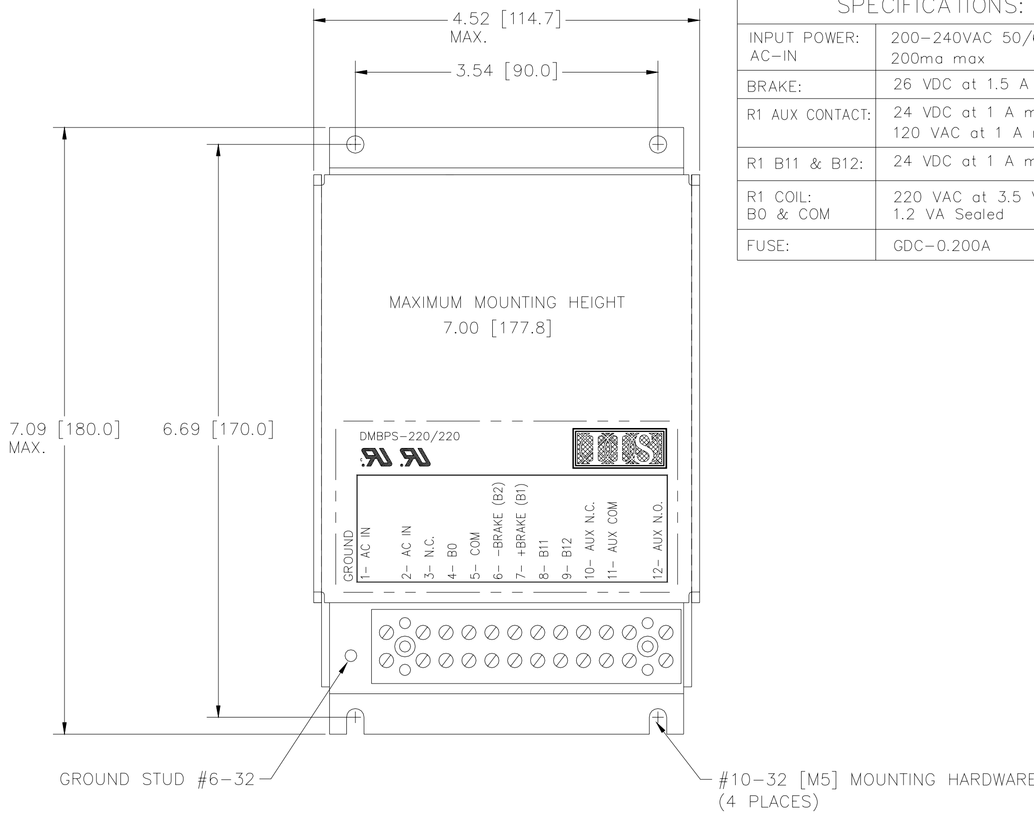
www.iis–servo.com

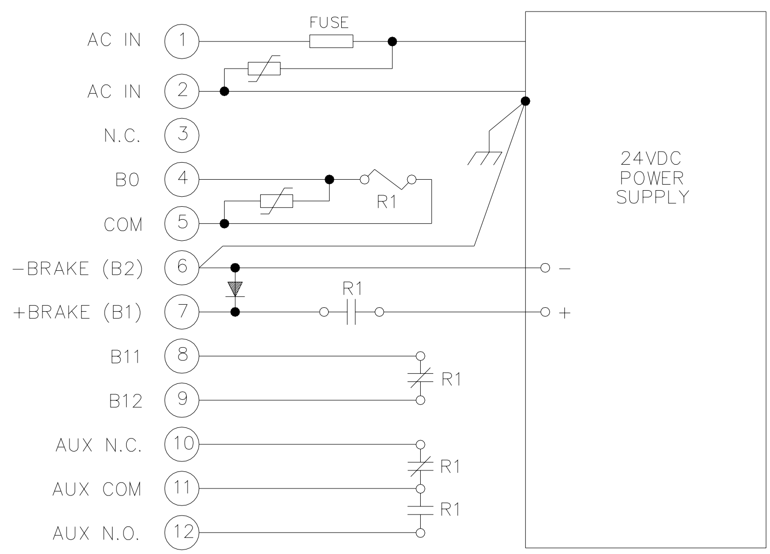
TITLE
MECHANICAL BRAKE POWER SUPPLY

DRAWING NUMBER
DMBPS–220/24

DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± 0.02	X.XXX± – –	∠ ± – –	REV J		ECN 02–186	DATE 19JUN96	SH. 2 OF 2

SPECIFICATIONS:	
INPUT POWER: AC-IN	200–240VAC 50/60Hz 200ma max
BRAKE:	26 VDC at 1.5 A max.
R1 AUX CONTACT:	24 VDC at 1 A max./ 120 VAC at 1 A max.
R1 B11 & B12:	24 VDC at 1 A max.
R1 COIL: B0 & COM	220 VAC at 3.5 VA Inrush 1.2 VA Sealed
FUSE:	GDC–0.200A





INDUSTRIAL INDEXING SYSTEMS, Inc.

www.iis-servo.com

TITLE	MECHANICAL BRAKE POWER SUPPLY				
DRAWING NUMBER	DMBPS-220/220				
DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± 0.02	X.XXX± ---	∠ ± --		
REV H		ECN 00-399	DATE 19JUN96	SH. 1 OF 1	

SECTION 10 - ALARM CODES

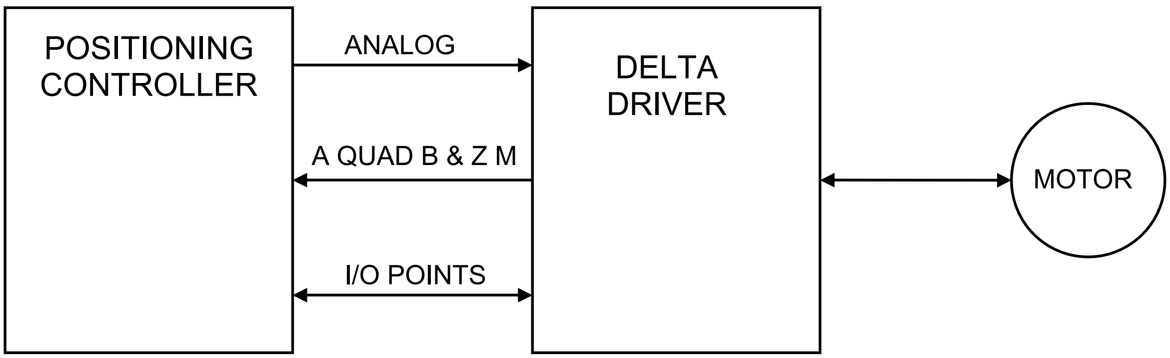
ALARM CODE	DESCRIPTION	REMEDY
HALt	Driver fatal fault	Replace driver.
AL -01 Internal Power Module Error	Driver has detected the following: • Overcurrent • Overheat • Gate voltage drop	Check if the motor wire (A/B/C) is shorted or grounded. Ambient temperature over 55° C. Indicates a fatal fault in the driver power stage. If motor wires are not shorted and temperature is below 55° C contact IIS factory.
AL -02 Overvoltage	DC power bus exceeds 420 VDC.	Power line voltage fluctuation above 264 VAC for "A" model drivers or 126 VAC for "B" model drivers. Excessive regeneration energy. Check line voltage fluctuations. Add additional external regeneration resistor.
AL -03 Under Voltage	DC power bus below 200 VDC.	Power line voltage fluctuation below 170 VAC for "A" model drivers or 85 VAC for "B" model drivers. Check line voltage fluctuations. Check for missing phase of AC line power for 3 phase models DSD-35 and above.
AL -06 Resolver Open	Resolver feedback signal (R1, R2) drops below 0.34 VAC.	Check for broken resolver wire or loose connection. Voltage between R1-R2 must be above 0.34VAC.
AL -07 Power Stage Error	Main control unit identifies a fault in the power stage of the driver.	Indicates a fatal fault in the driver power stage. Contact IIS factory.
AL -09 Regen Resistor Over Temperature	Excessive regen energy being dissipated by the internal or external regeneration resistor.	The frequency or rate of acceleration/deceleration may be too high. Excessive power line voltage. Add additional regen resistor capacity.
AL -10 Regen Resistor Open (DSD-35 and above only)	Regen transistor is ON for more than 50ms.	**WITH POWER OFF:** If an internal regen resistor is used, check that the resistance from P to JP2 is less than 20-30 ohms and that a jumper is installed from JP1 to JP2. If an external regen resistor is used, verify the regen resistor is the proper value and that all wiring to the resistor is secure.
AL -12 Watchdog timer	Internal CPU clock has stopped.	Unit is damaged. Contact IIS factory.
AL -14 Brake Alarm	Sequencing of the static or dynamic brake is faulty.	Check wiring connections of the static or dynamic brake. Verify that the external braking relay is functional.
AL -15 Excessive Current	Motor current exceeds the rating by 120%.	Check if the motor wire (A/B/C) is shorted or grounded. Verify that motor shaft or machine system is not jammed. Check motor code UP-02 is set for the proper motor.

ALARM CODE	DESCRIPTION	REMEDY
AL -16 Speed amp Saturated	Internal speed loop is saturated and max. torque is applied for more than 3 sec.	Verify that motor shaft or machine system is not jammed. Check motor code UP-02 is set for the proper motor. Acel/decel rate is too large for the inertia load on the motor causing maximum torque during acel/decel.
AL -17 Motor overload	Calculated motor temperature exceeds rating 110%.	Verify that the average torque required to drive the load does not exceed the motor/driver continuous rating. Check if the duty cycle of the machine is too high. Check motor code UP-02 is set for the proper motor. $t = -Tm \left(1 - \frac{1.05^2}{\left(\frac{I}{IR}\right)^2}\right)$ Where: t = time in minutes I = motor current I_R = motor rated current T_M = thermal time constant of motor Status display oL is $\frac{I}{IR}$ x 100 See **Section 2**.
AL -18 Driver Overload	Motor current exceeds intermittent rating of driver or motor whichever is less.	Verify that motor shaft or machine system is not jammed. Check motor code UP-02 is set for the proper motor. Acel/decel rate is too large for the inertia load on the motor causing maximum torque during acel/decel. $t = \frac{K}{\left(\frac{I}{IR*1.2}\right) - 1}$ Where: t = time in seconds I = motor current I_R = motor rated current K = 1.5 for Delta-D30HRA 2.0 for Delta-120HRA & Delta-D50HRA 2.5 for Delta-200HRA & Delta-D100HRA 3.0 for Delta-D200HRA 3.5 for Delta-400HRA 4.0 for Delta-D400HRA 6.0 for all others See Overload Protection Characteristic Curve in **Section 2**.
AL -19 Resolver Error	Resolver feedback error.	Check resolver cable and connectors. Check if resolver is loose on motor shaft. Verify that resolver cable is separated from power wiring to prevent noise coupling to resolver signals.

ALARM CODE	DESCRIPTION	REMEDY
AL -20 Overspeed	Motor speed exceeds maximum rating by 120%.	Check resolver cable and connectors. Check if resolver is loose on motor shaft. Verify that resolver cable is separated from power wiring to prevent noise coupling to resolver signals. Overshoot is generated due to improper setting of AJ2, AJ3 & AJ4 parameters.
AL -21 Deviation counter overflow	Motor is unable to follow the commanded profile. Deviation counter exceed $\pm 2^{21}$.	Excessive load. Load inertia is too large for acceleration/deceleration rate. Position gain (AJ4) is too high. Torque limit is too low.
AL-22 Absolute encoder phase error	Absolute encoder CHA and CHB have been detected out of phase.	Replace motor.
AL-23 Absolute encoder disconnected	Absolute encoder connection is broken.	Check absolute encoder/resolver cable, C-253YYY. If cable is OK, replace motor.
AL-25 Option	Self-diagnostic checks of options failed.	14-bit A/D converter not functioning to specification. Return to factory.
AL-26 Parameter setting error	UP-01 (Control mode) or UP-02 (motor code) are not set or are set improperly.	Control Mode and motor code must be set to operate. Set UP-01 & UP-02 then cycle power to have the parameters take effect.
AL-27 Absolute encoder fault	CHA or CHB of absolute encoder is non-functional.	Check absolute encoder/resolver cable, C-253YYY. If cable is OK, replace motor.
AL-32 Absolute Home Position not set	Absolute Home Position has not been established. Also set with AL-6, 19, 22 and 23.	Check for cause of fault in the case of AL-6, 19, 22 and 23.
AL-33 Absolute Home Position setting error	Absolute Home setting procedure is not correctly completed. Also set with AL-6, 19, 22, 23 and 27.	Check for cause of fault in the case of AL-6, 19, 22, 23 and 27. Correct fault and set Absolute Home Position.
AL-36 Battery Missing	Battery has been disconnected when the power was OFF.	Check for detached battery or cable short.
AL-40 Encoder Signal Short	A, B, Z, U, W or V phases of encoder not functional.	Check encoder cable and connections.
AL-41 Encoder Communication error	Communication problem with absolute encoder	Check encoder cable, replace driver, motor.
AL-42 Encoder Power	Absolute encoder backup power low	Replace battery.
AL-43 Encoder Checksum	Encoder communication checksum error at power up	Replace motor/encoder.
AL-44 Battery Low	Absolute battery voltage has fallen below 2.8V.	Replace absolute battery.
AL-45 Absolute encoder error	Signal sequencing problem in the absolute encoder.	Replace motor.

SECTION 11 - CONNECTING A DELTA DRIVER TO AN EXTERNAL POSITIONING CONTROLLER

The Delta motors and drivers are commonly connected to external positioning controllers. An external positioning controller would typically use the encoder equivalent output of the Delta Driver for feedback and the analog speed or torque input for command. Several I/O points should be used for DRIVE ENABLE, SERVO NORMAL and RESET. Typical connections would be as follows:



The IIS MSC line of multi-axis positioning controllers can be easily connected to the Delta motor and driver using standard cables provided by IIS. Detailed connection diagrams (IC-065002) and the drawing for cable C-477YYY can be found in **Appendix B**.

The Delta Driver would typically be loaded with the following parameters to run with the IIS MSC line of positioning controllers.

Parameter	Description	Value
AJ0	REF1 Speed Command Zero	0.00
AJ1	Speed Command Scale	7.00
UP-01	Control Mode set to SPEED MODE	1
UP-04	Electronic Gear Ratio Numerator	24000
UP-05	Electronic Gear Ratio Denominator	4096
UP-12	Accel Time	0.00
UP-13	Decel Time	0.00
UP-14	S-Shaped Time	0.00
UP-17	REF1 & REF2 Polarity	00
UP-19	Output Pulse Coding	01

Many other parameters in the Delta Driver would be set per the motor type, resolver cable length, braking method, regen resistor, etc.

SECTION 12 - EMC INSTALLATION GUIDELINES FOR DELTA SERIES MOTORS AND DRIVERS

12.1 INTRODUCTION TO EMC GUIDELINES

This chapter provides guidance and requirements when installing IIS Delta Series motors and drivers into industrial control machinery required being CE marked. These guidelines are intended to provide the machine builder with the necessary EMC information, including parts and wiring techniques to comply with the European Community Standards for industrial control equipment. The final conformance to the standards for the overall machine remains the sole responsibility of the machine builder.

12.2 EMC REQUIREMENTS

In 1996, the European Community enacted standards concerning conducted and radiated emissions and immunity to various types of interference for industrial control equipment. The EMC Directive 89/336/EEC and harmonized standards define specific EMC levels and test procedures to gain conformance.

Emission Standards provide maximum levels of noise permitted to be generated by the equipment. Immunity Standards subject the equipment to various types of disturbances and verifies that the equipment continues to perform in a safe manner.

The IIS Delta Series motors and drivers have been tested and have been shown to comply with the following standards when installed per the guidelines in this section.

EMISSIONS STANDARDS:

EN55011 Class A	Power line conducted noise
EN55011 Class A	Radiated noise

IMMUNITY STANDARDS:

EN61000-4-2	Static discharge
ENV50140 & ENV50204	Electromagnetic irradiation
EN61000-4-4	Burst noise injected into power and signal wiring
EN61000-4-5	Lightning surge into power line
ENV50141	RF frequency injection into power and signal wiring
EN61000-4-8	Power frequency magnetic field
EN61000-4-11	Power line fluctuation and drop out

12.3 CONTROL ENCLOSURE

The Delta Series drivers must be installed in a suitable control enclosure that provides a good quality ground system and tight construction. The cabinets can be of welded construction, metal to metal conductive joints or have overlapping EMC gasketed joints. All joints and removable panels must have metal-to-metal ground contact. All hinged panels or doors must have a bonded ground wire from the hinged panel to the main body of the enclosure.

12.4 ENCLOSURE MOUNTING PANEL

It is highly recommended that a galvanized panel be used. Galvanized panels provide a continuous conductive surface that provides a low impedance ground plane for mounting the servo components.

The mounting panel must be grounded to the control enclosure with metal to metal joints, bolted together with external tooth lock washers or have multiple short ground jumper wires between the panel and the enclosure.

Painted panels can be used if the mounting area for the servo components and all grounding points have been masked off or have the paint removed.

All servo components that require grounding must use fasteners with external tooth lock washers.

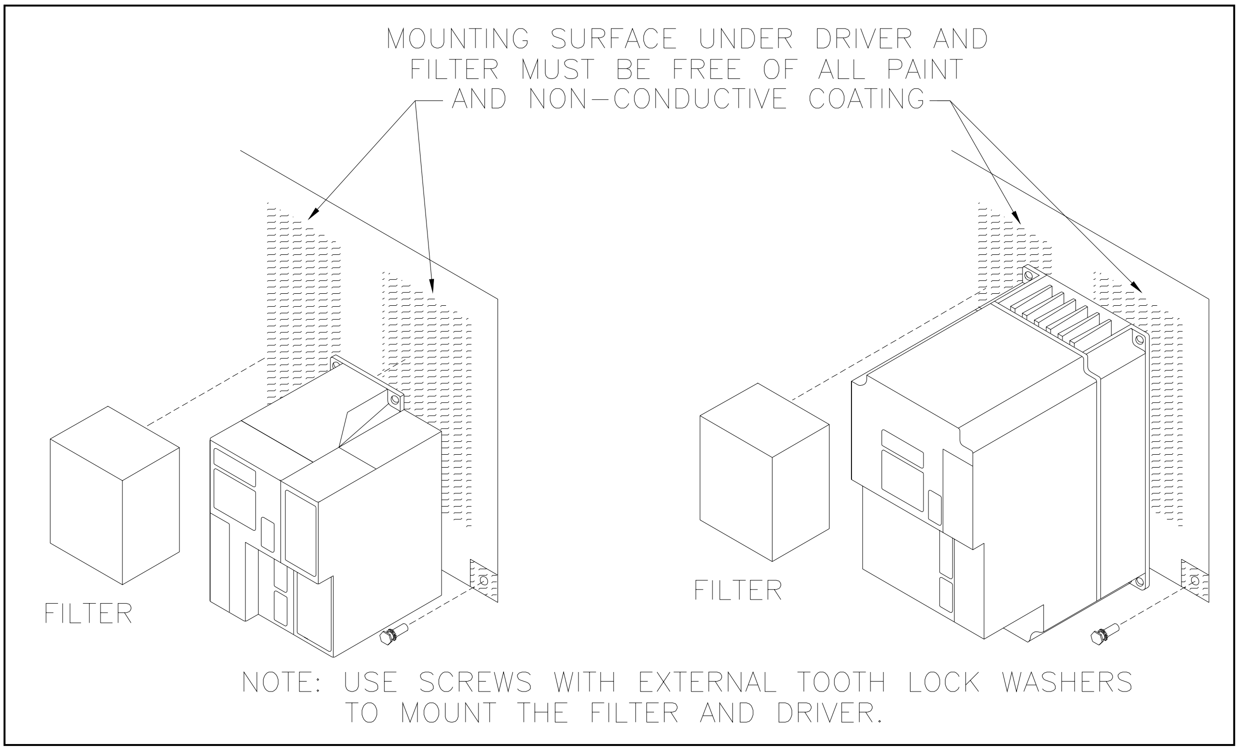


Figure 12.1 - Enclosure Mounting Panel

12.5 POWER LINE FILTER

A filter must be installed between the Delta Series Driver and the incoming power line to prevent conducted noise for getting onto the power line. It is recommended that a separate filter be used for each driver but it is possible to use a single larger filter to supply multiple drivers if the wiring between the filter and drivers is kept as short as possible.

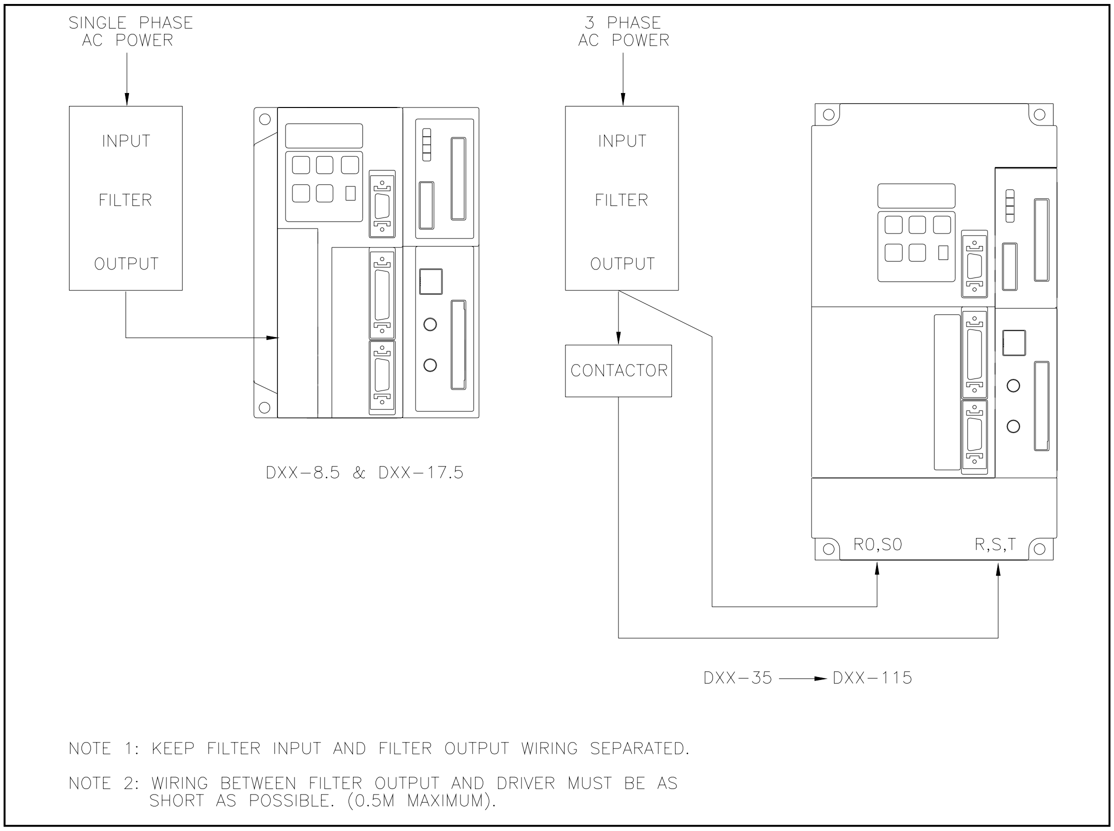


Figure 12.2 - Power Line Filter

The following power line filters are recommended for use with the Delta Series motors and drivers:

Total Motor Capacity	Phase	SOSHIN ELECTRONICS
500W max.	1	HF2010A-PI
500W -> 1000W	1	HF2015A-PI
1000W ->1800W	3	HF3010A-PI
1800W -> 2600W	3	HF3020A-PI
2600W -> 3700W	3	HF3030A-PI
3700W -> 6500W	3	HF3040A-PI
6500W -> 11000W	3	HF3060A-TMA

Total Motor Capacity	Phase	SCHAFFNER ELECTRONIC AG
500W max.	1	FN 2070-3
500W -> 1000W	1	FN 2070-6
1000W ->2200W	3	FN 258-16
2200W -> 3700W	3	FN 258-30
3700W -> 6500W	3	FN 258-42
6500W -> 11000W	3	FN 258-55

12.6 DRIVER OUTPUT (MOTOR ARMATURE) FILTER

The Delta Series Driver uses pulse width modulation (PWM) control of the motor windings. The PWM switching of the motor output generates transient voltages that must be suppressed before exiting the control enclosure. A simple ferrite core can be used as shown below.

The following ferrite core filters are recommended for use with the Delta Series motors and drivers:

Drive Size	Manufacturer	Part Number
DSD-1.5 -> DSD-70	TDK Corp.	ZCAT3035-1330
DSD-115	TOKIN Corp.	ESD-R-47DB

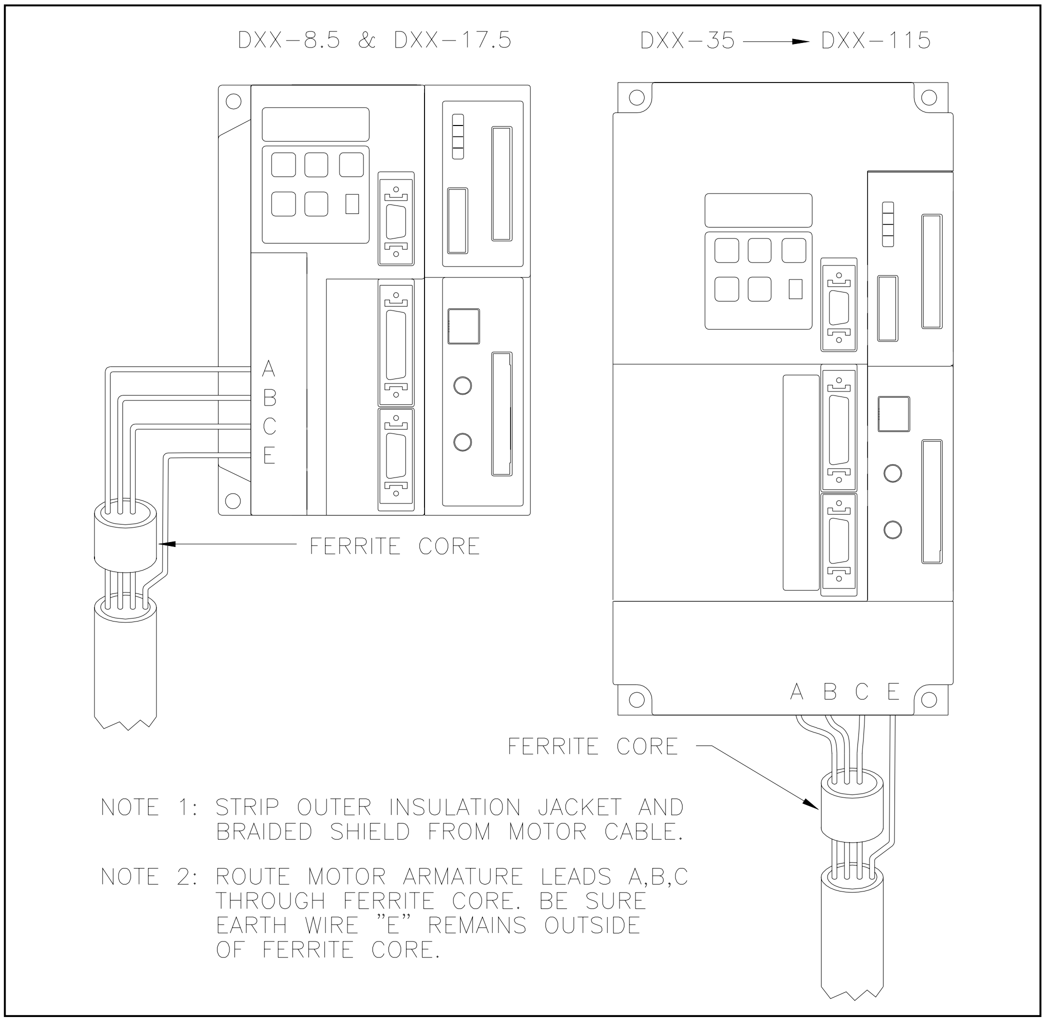


Figure 12.3 - Driver Output (Motor Armature) Filter

12.7 SHIELDED MOTOR CABLE

The motor armature cable between the driver and motor must be shielded and grounded at both the driver and motor end. The motor armature cable length between the control enclosure and motor must be less than 50 meters or additional shield is necessary. The following shielded motor armature wire is recommended.

Motor Capacity	TAIYO Electric	OFLEX	BELDEN
500W max.	VCT-SB0.75SQ4C	891804CY	7411AS
500W -> 1000W	VCT-SB1.25SQ4C	891604CY	7423AS
1000W ->1800W	VCT-SB2.0SQ4C	891404CY	7436AS
1800W -> 2600W	VCT-SB3.5SQ4C	891204CY	7445AS
2600W -> 3700W	VCT-SB5.5SQ4C	891004CY	7447AS
3700W -> 11000W	VCT-SB14SQ4C	N/A	7450AS

Figures 12.4 and 12.5 show the recommended technique for grounding the motor armature cable.

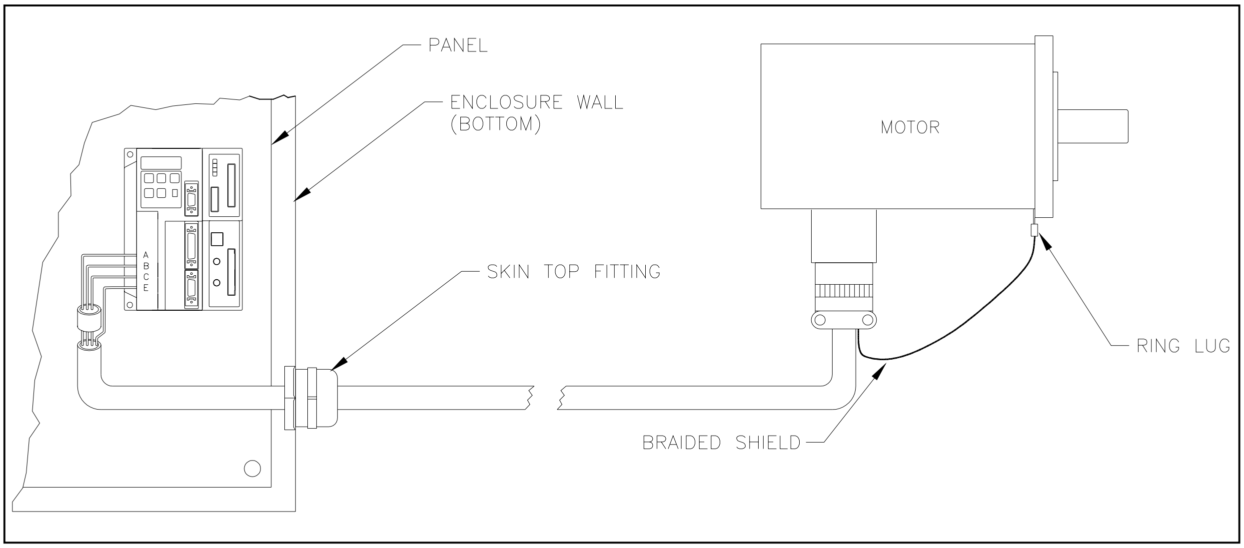


Figure 12.4 - Grounding Motor Armature Cable

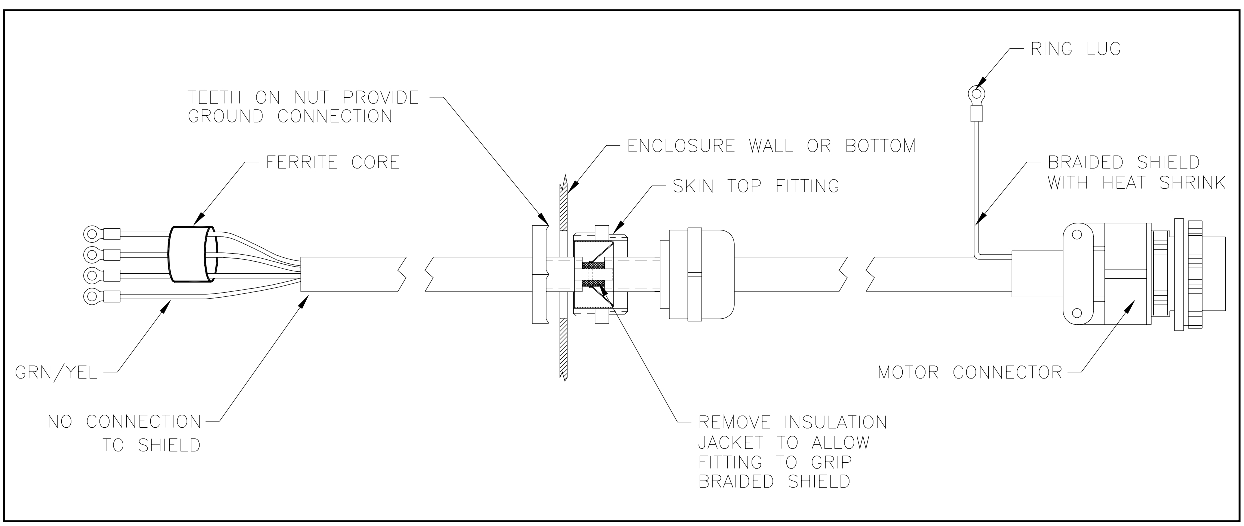


Figure 12.5 - Grounding Motor Armature Cable

12.7 SHIELDED MOTOR CABLE (cont'd)

The ground fittings shown in the figures above are made by OFLEX. The fittings are OFLEX SKINTOP MS-SC series P/N 5311-22x0; where x is a code for the wire diameter.

Figures 12.6 and 12.7 show an alternate method to ground the motor armature cable shield using saddle clamps.

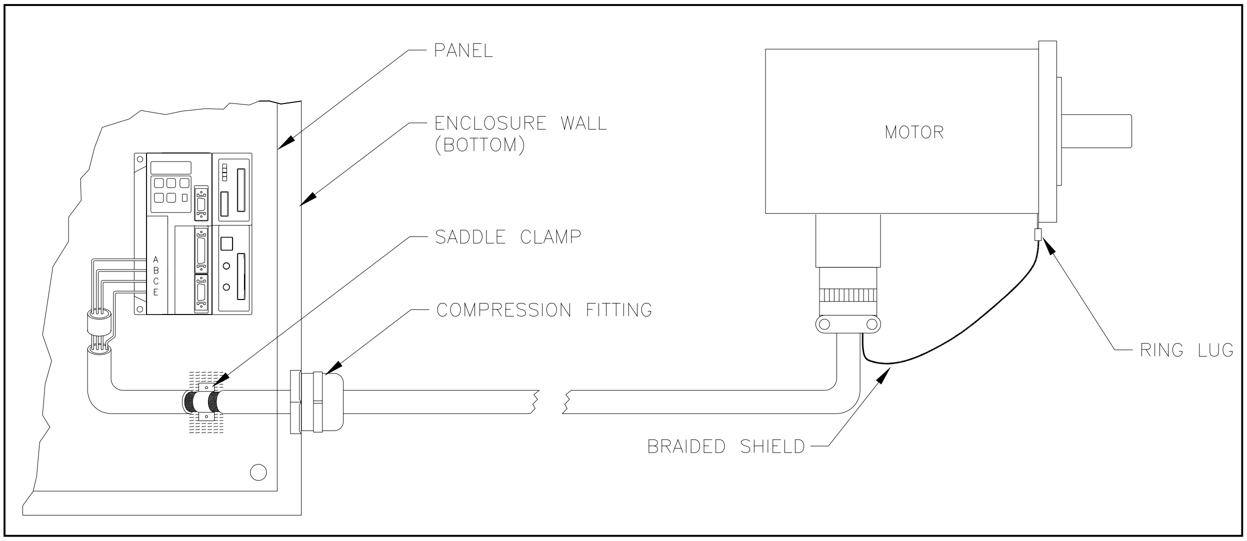


Figure 12.6 - Alternate Method to Ground the Motor Armature Cable

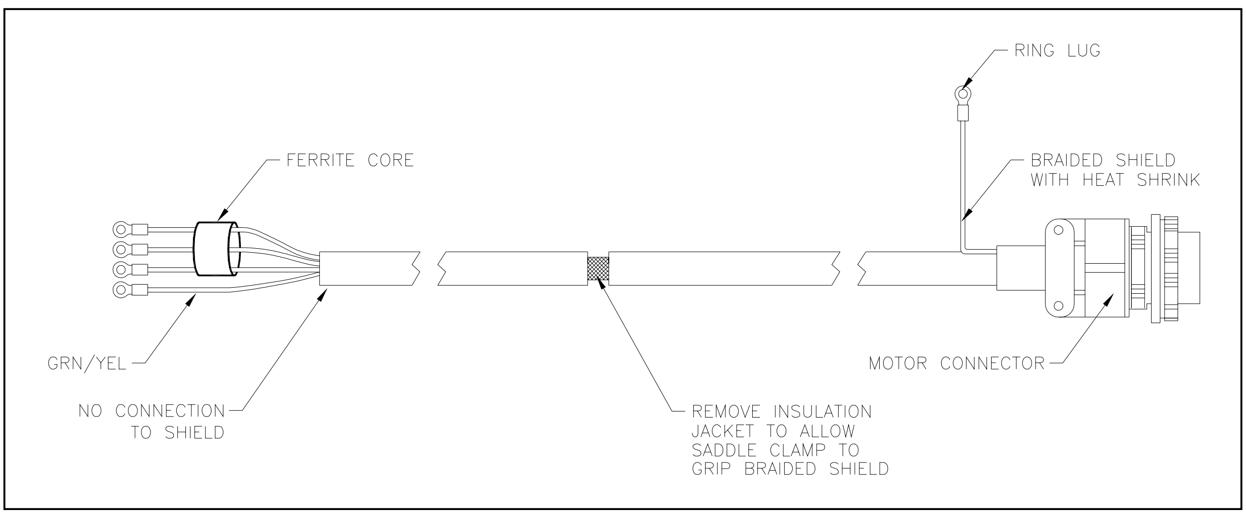


Figure 12.7 - Alternate Method to Ground the Motor Armature Cable

12.8 REGENERATION RESISTOR WIRING (OPTION)

If the regeneration resistor is located in the same enclosure as the driver, shielded wire is not necessary if the wiring is kept as short as possible. If the regeneration resistor is located in another enclosure, the regeneration resistor wire must be shielded and grounded in both enclosures. The SKINTOP ground fittings are shown in **Figure 12.8** but the saddle clamp method of grounding can also be used as shown in **Figure 12.9**.

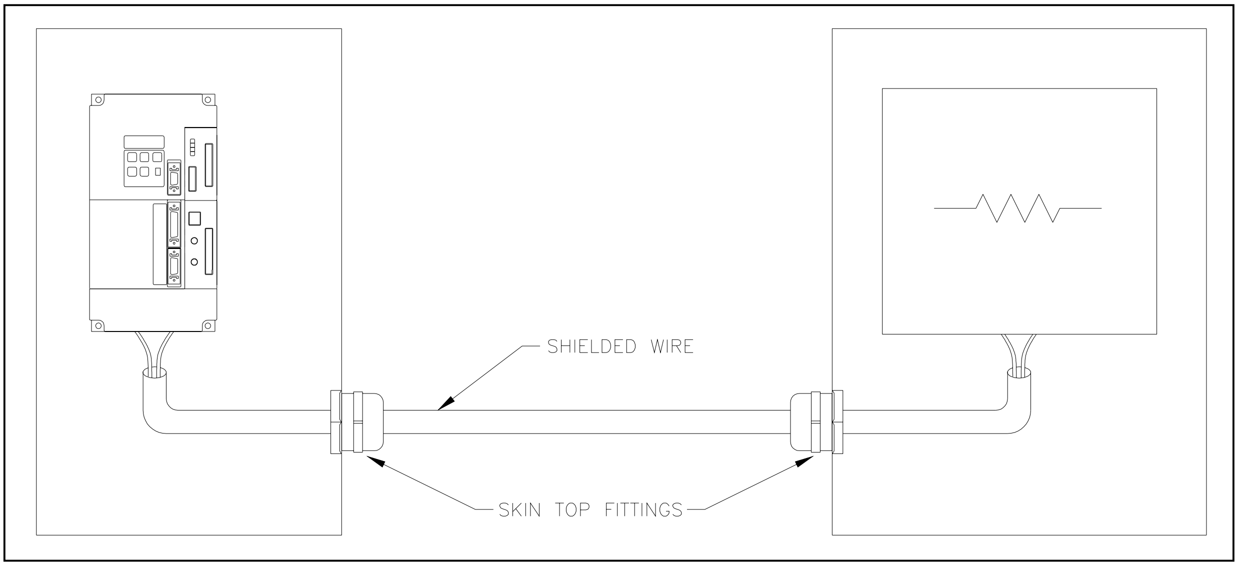


Figure 12.8 - SKINTOP Ground Fittings

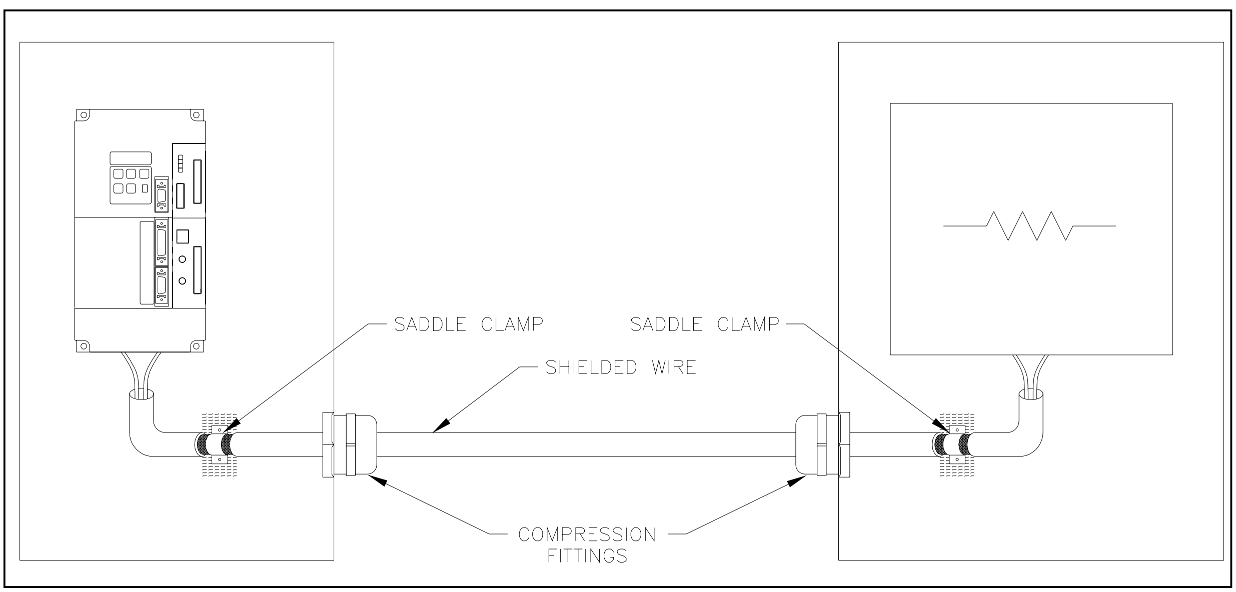


Figure 12.9 - Saddle Clamp Method of Grounding

12.9 DIGITAL CONTROL SIGNALS

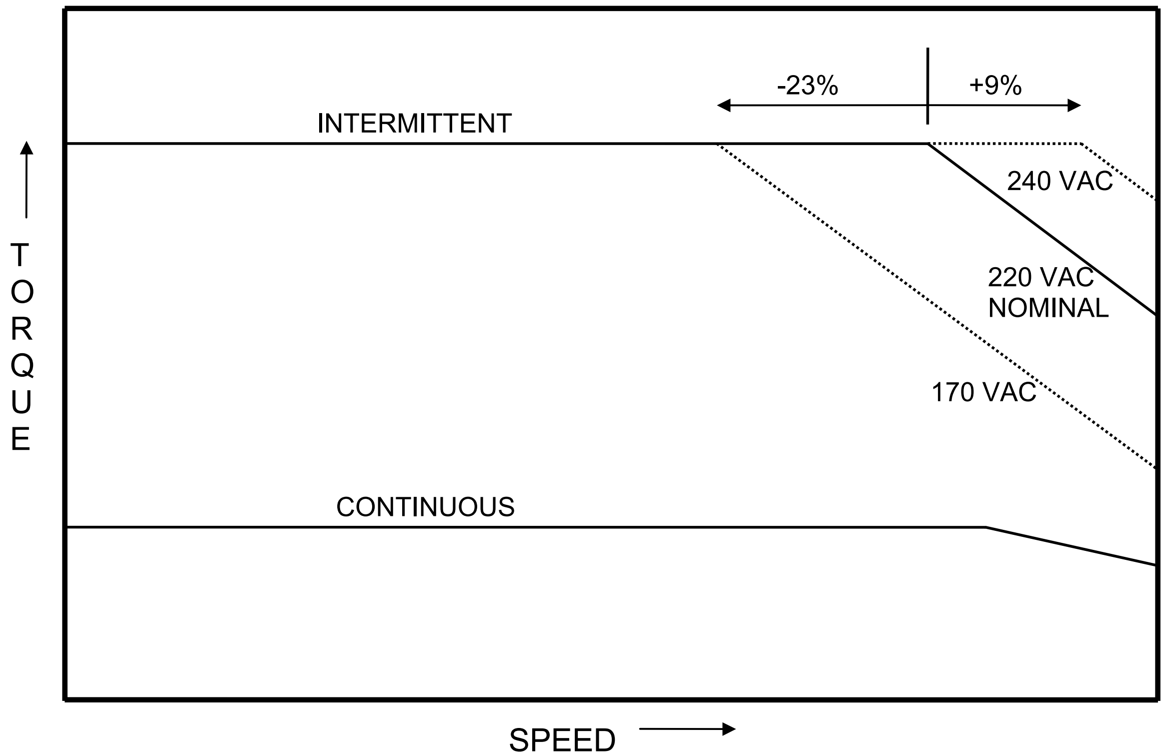
High speed, fast rise time signals used with the Delta driver, such as command pulse inputs or pulse outputs, radiate high frequency noise. This noise must be suppressed to prevent excessive EMC radiation.

If the positioning controller and Delta driver are in the same control enclosure, the cable between the two must be shielded and grounded at both ends. If the positioning controller is located in a separate control enclosure, the cable between enclosures must be a braided shielded cable with both enclosure entries grounded with SKINTOP fittings or saddle clamps.

SECTION 13 - APPLICATION NOTES

13.1 SPEED TORQUE CURVES

The Delta Driver speed/torque curves are shown with a nominal 115 VAC and 220 VAC, 50/60Hz incoming line voltage. The Delta Drivers however are rated at 85-126 VAC for the "B" models and 170-264 VAC for the "A" models. The intermittent torque rating at the high speed is nearly linearly related to the line voltage. Motor winding resistance, winding inductance and motor losses also play a role in rolling off the peak torque and higher speeds.



As the servo motor speed goes up, the counter EMF or generator action of the motor increases the voltage across the motor windings. The driver must provide a voltage greater than the motor voltage to produce current in the winding and therefore torque at the motor shaft. The intermittent torque curve rolls off when the motor voltage reaches the driver's internal DC bus voltage. The internal DC bus voltage is directly related to the incoming line voltage.

The roll off in the continuous torque curve is caused by motor heating due to internal losses in the motor, not line voltage.

Note that the speed/torque curves shown in the specifications represent the speed and torque being applied in the same direction, as is the case when the motor is driving the load.

When the speed and torque are in opposite directions, as is the case when the motor is braking the load, the motor is putting the load's mechanical energy back into the driver in the form of electrical energy. The result is that the driver internal voltage DC bus is pumped up rather than drained down, as is the case when the motor is driving the load. The driver has a higher bus voltage in this braking mode; therefore the intermittent zone of speed/torque curve is higher. This means that there is more high-speed torque available for braking/deceleration than there is for accelerating a load.

13.1 SPEED TORQUE CURVES (cont'd)

When the driver is braking the load it is absorbing the mechanical energy of the load and pumping up the internal voltage bus. If the energy absorption is great enough the driver switches in a regeneration resistor to dump some of the energy as heat. Repetitive or excessive absorption can overheat the regeneration resistor resulting in a fault condition. Absorption energy and the use of an internal or external regeneration resistor are discussed in detail in the Delta Driver Technical manual **Section 7**.

When reviewing a particular application, consideration of the line voltage fluctuation can be an important issue. Generally speaking, applications in the more developed countries in the world can be more aggressively sized because a stable 220 VAC line is readily available. In emerging countries the line voltage is not likely to be stable, so more conservative sizing is necessary. It may even be necessary to move up a size rating to be sure the application will run properly when the line voltage dips. This could be of particular concern for Original Equipment Manufacturers that ship machines around the globe.

**** CAUTION ****

It might appear tempting to simply use a transformer to raise the nominal line voltage to 240-250 VAC to avoid the low line problem. Raising the nominal line voltage poses the risk of overheating the driver's regeneration resistor in the case of heavy motor braking or in the case of a rise in the line voltage.

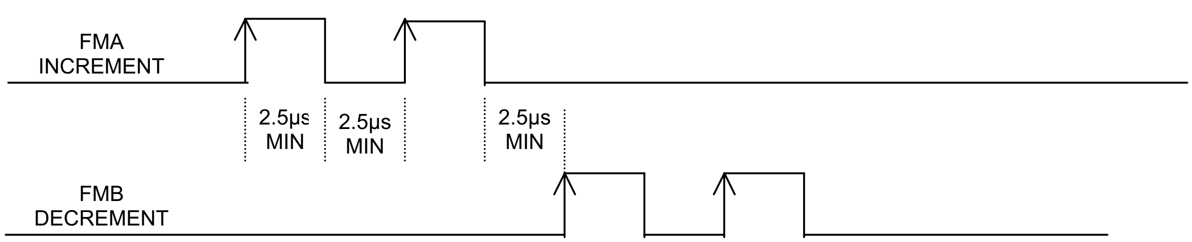
13.2 PULSE INPUT & OUTPUT

13.2.1 PULSE INPUTS FMA & FMB

The Delta driver can be use as a position controller in modes 3, 4 and 6. The position command to the Delta driver is provided by pulse inputs from an external source. The Delta driver, depending on the settings in UP-18, can configure the pulse inputs, FMA and FMB, in one of six ways. In the following descriptions an up arrow ? and down arrow ? indicates a pulse.

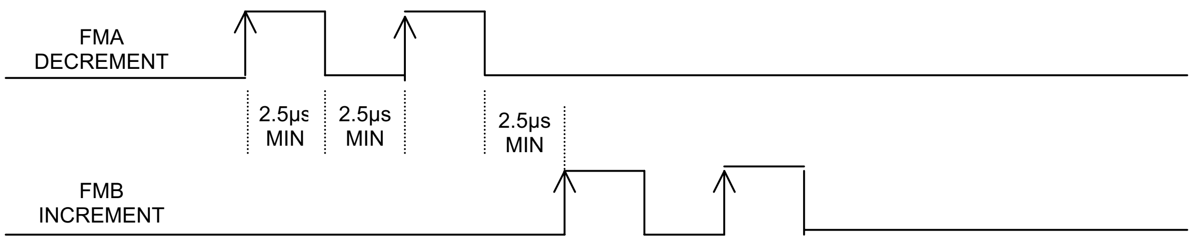
The direction of rotation of the motor is controlled by UP-26. With UP-26 = 0 the motor rotates CCW when the command position is incremented. With UP-26 = 1 the motor rotates CW when the command position is incremented.

PULSE-PULSE DECODING (UP-18 = 00) where FMA increments the command position and FMB decrements the command position. Maximum frequency of FMA and FMB is 200 KHZ.

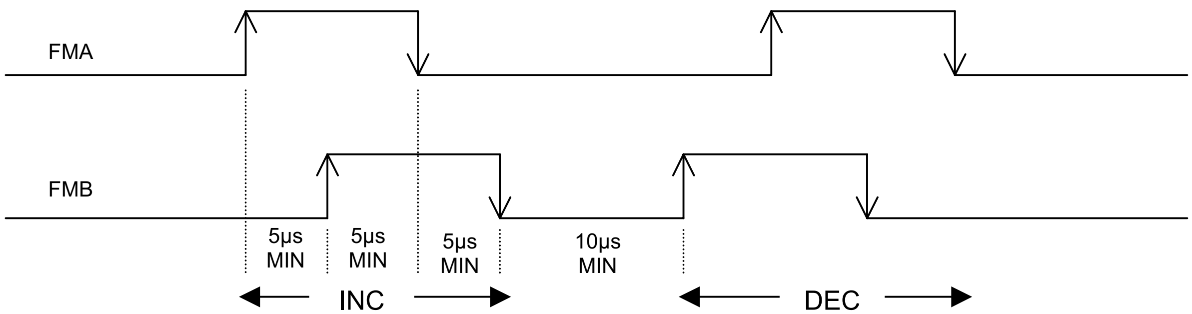


13.2.1 PULSE INPUTS FMA & FMB (cont'd)

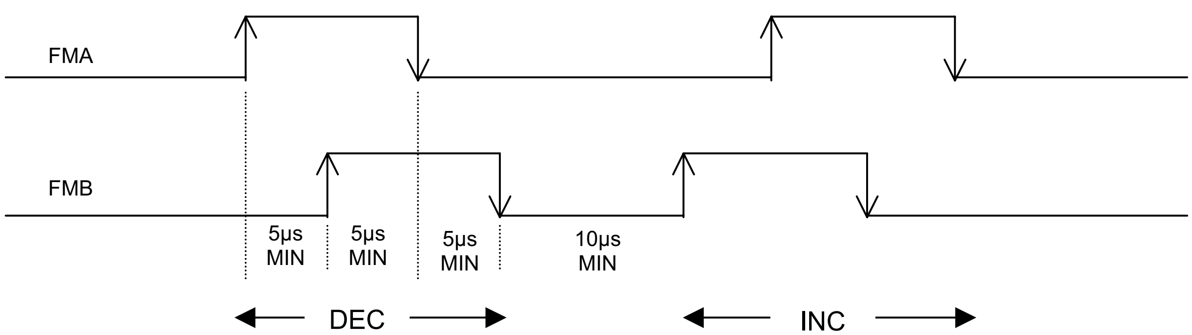
PULSE-PULSE DECODING (UP-18 = 10) where FMA decrements the command position and FMB increments the command position. Maximum frequency of FMA and FMB is 200 KHZ.



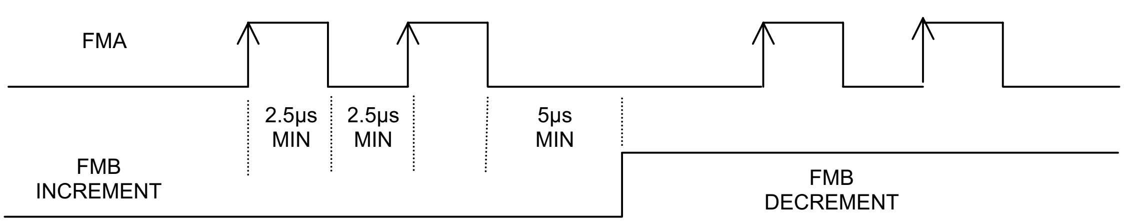
AB QUADRATURE DECODING (UP-18 = 01) where FMA leading FMB increments the command position, FMB leading FMA decrements the command position. Maximum frequency of FMA and FMB is 50 KHZ.



AB QUADRATURE DECODING (UP-18 = 11) where FMB leading FMA increments the command position, FMA leading FMB decrements the command position. Maximum frequency of FMA and FMB is 50 KHZ.

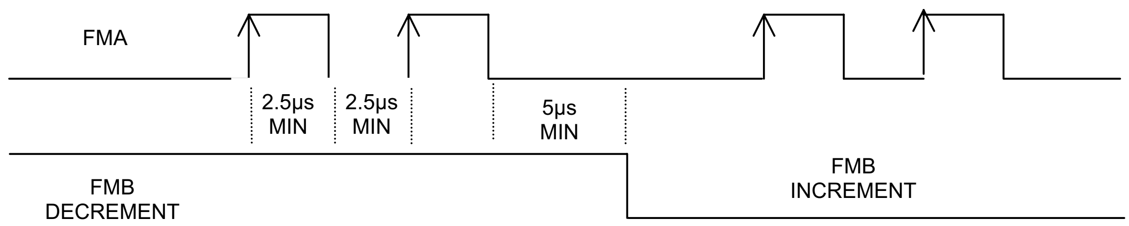


PULSE AND DIRECTION DECODING (UP-18 = 02) where FMA is pulse count and FMB is direction. Maximum frequency of FMA is 200 KHZ.



13.2.1 PULSE INPUTS FMA & FMB (cont'd)

PULSE AND DIRECTION DECODING (UP-18 = 12) where FMA is pulse count and FMB is direction. Maximum frequency of FMA is 200 KHZ.

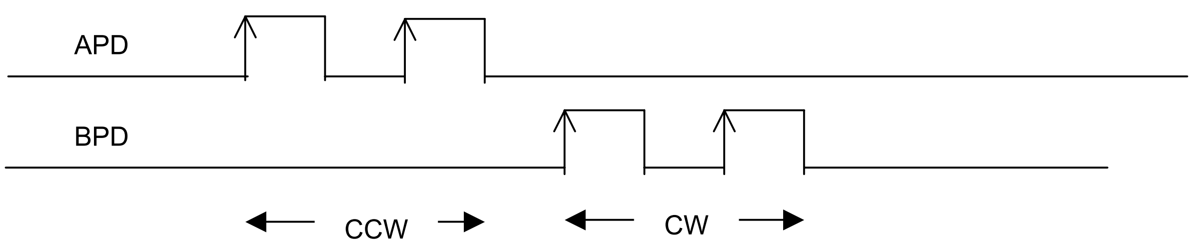


13.2.2 PULSE OUTPUTS APD, BPD & ZPD

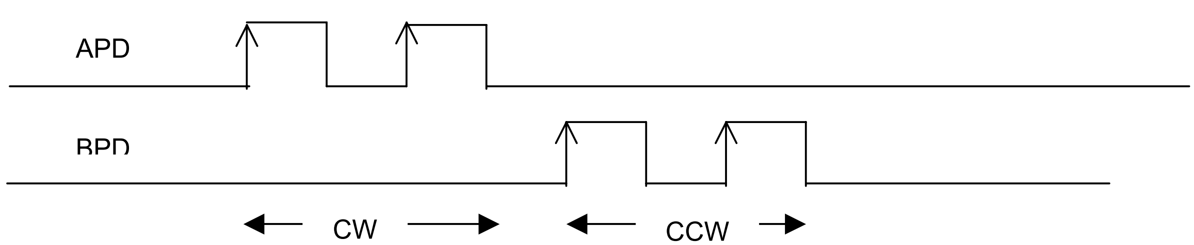
The pulse outputs of the Delta driver, APD, BPD & ZPD, are used primarily to provide motor position to an external controller. These outputs can provide other types of data depending on the setting of UP-20. For the purpose of this application note, UP-20 is assumed to be equal to 0000. The APD, BPD & ZPD outputs are RS422 compatible and are driven by a 26LS31 driver or equivalent. The width of the pulses is dependant on motor speed, resolver resolution and the setting of UP-04 and UP-05.

The ZPD pulse occurs when the motor's resolver is at 0 degrees. The Delta motors have various configurations of resolvers that provide 1, 2 or 3 electrical cycles per rotation of the motor shaft. Each resolver electrical cycle causes a 0 degree position and therefore a ZPD pulse. See individual motor data sheets for details. The ZPD pulse spacing will be (360º of motor rotation / # of resolver cycles) and the ZPD pulse width will be a multiple of 400μsec.

PULSE-PULSE DECODING (UP-19 = 00) where APD pulses when the motor actual position moves CCW and BDP pulses when the motor actual position moves CW. Maximum frequency of FMA and FMB is 400 KHZ.

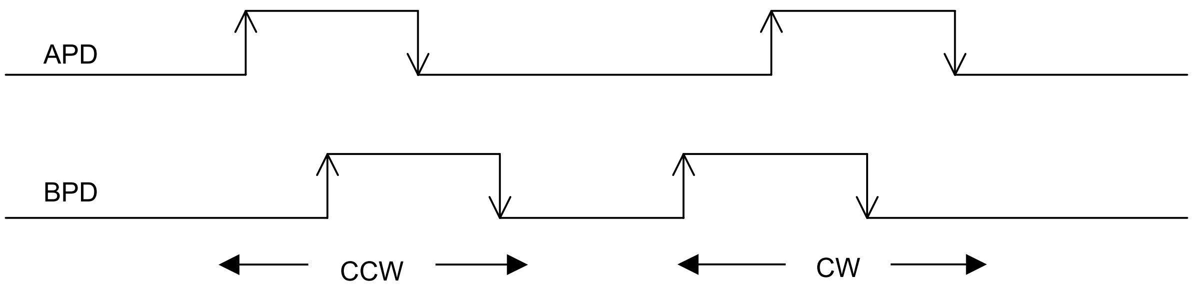


PULSE-PULSE DECODING (UP-19 = 10) where APD pulses when the motor actual position moves CW and BDP pulses when the motor actual position moves CCW. Maximum frequency of FMA and FMB is 400 KHZ.

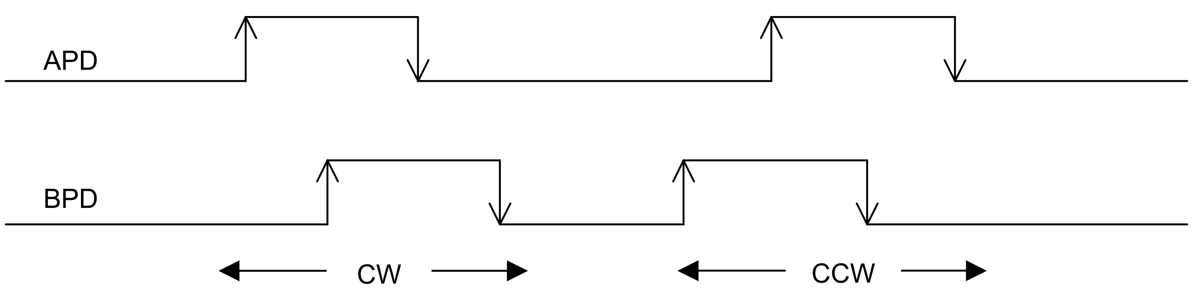


13.2.2 PULSE OUTPUTS APD, BPD & ZPD (cont'd)

AB QUADRATURE DECODING (UP-19 = 01) where APD leads BPD for CCW motor rotation. Maximum frequency of APD and BPD is 100 KHZ. This mode simulates an encoder output being read as 4X.



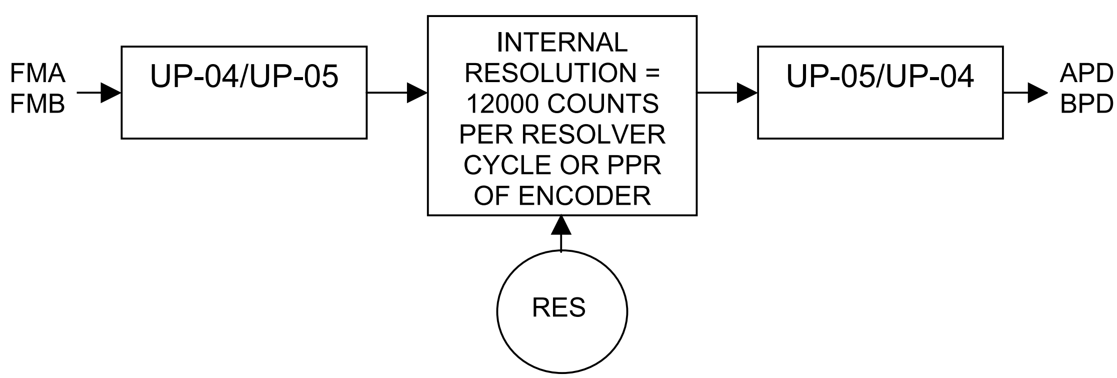
AB QUADRATURE DECODING (UP-19 = 11) where BPD leads APD for CCW motor rotation. Maximum frequency of APD and BPD is 100 KHZ. This mode simulates an encoder output being read as 4X.



13.2.3 SETTING THE RESOLUTION OF THE PULSE INPUTS AND OUTPUTS

The feedback resolver in the motor determines the internal resolution of the Delta driver. The driver resolution is 12000 counts per resolver electrical cycle. The Delta motors have one cycle (1X), two cycle (2X) or three cycle (3X) resolvers. (i.e. a 2X resolver has 2 electrical cycles per 1 rotation of the motor shaft). Delta driver can also have various encoder options with a different number of pulses per motor revolution (PPR).

The resolution of the pulse inputs and outputs are set by parameters UP-04 and UP-05.



13.2.3 SETTING THE RESOLUTION OF THE PULSE INPUTS AND OUTPUTS (cont'd)

Example #1: It is required to run a DBM-800/15R motor in a position loop with a command scaling of 1000 pulses per motor revolution.

The DBM-800/15R has a 2X resolver so the driver internal resolution is 2*12000 = 24000 counts/rev of the motor. The pulse inputs must be multiplied by a factor of 24 to yield one motor rotation for 1000 pulses input. Set UP-04 = 24000 and UP-05 = 1000 or any ratio equal to 24 such as UP-04 = 24 and UP-05 = 1. The pulse outputs will also be 1000 pulses per revolution of the motor because of the complementary effect of UP-05/UP-04.

Example #2: It is required to run a DBM-8600/22R motor in a position loop such that a command frequency of 20 KHz is equal to 1500 RPM. The pulse inputs will be configured as pulse and direction (UP-18 = 02).

The DBM-8600/22R has a 3X resolver so the driver internal resolution is 3*12000 = 36000 counts/rev of the motor. The internal frequency of the driver at a motor speed of 1500 RPM will be 1500 * 36000 / 60 = 900 KHZ. The pulse inputs must be multiplied by a factor of 45 to get 900 KHz or 1500 RPM. This yields UP-04 = 45000 and UP-05 = 1000 but the upper limit of UP-04 is 32767 so use any other ratio equal to 45 such as UP-04 = 45 and UP-05 = 1 or UP-04 = 90 and UP-05 = 2.

If the pulse outputs are configured as pulse-pulse (UP-19 = 00) one of the pulse outputs, depending on direction, will be 20 KHz for a motor speed of 1500 RPM because of the complementary effect of UP-05/UP-04.

If the pulse outputs are configured as AB quadrature (UP-19 = 01), each pulse output will be 5 KHz for a motor speed of 1500 RPM. Since each edge is counted there will be 20 K edges per second.

This setting of UP-04 and UP-05 yields a pulse input resolution of 36000/45 = 800 pulses per revolution of the motor shaft.

Example #3: It is required to run a DBM-B630/30R1X motor in a torque mode with an encoder equivalent feedback to an external positioning controller. The required resolution is 4096 counts quadrature per revolution of the motor. In this case the pulse inputs are not used.

The DBM-B630/22R has a 1X resolver so the driver internal resolution is 1*12000 = 12000 counts/rev of the motor. The internal driver resolution must be multiplied by 4096/12000 to yield a pulse output of 4096 per motor revolution. Set UP-04 = 12000 and UP-05 = 4096 or any other equivalent ratio such as UP-04 = 375 and UP-05 = 128.

IB-19B001

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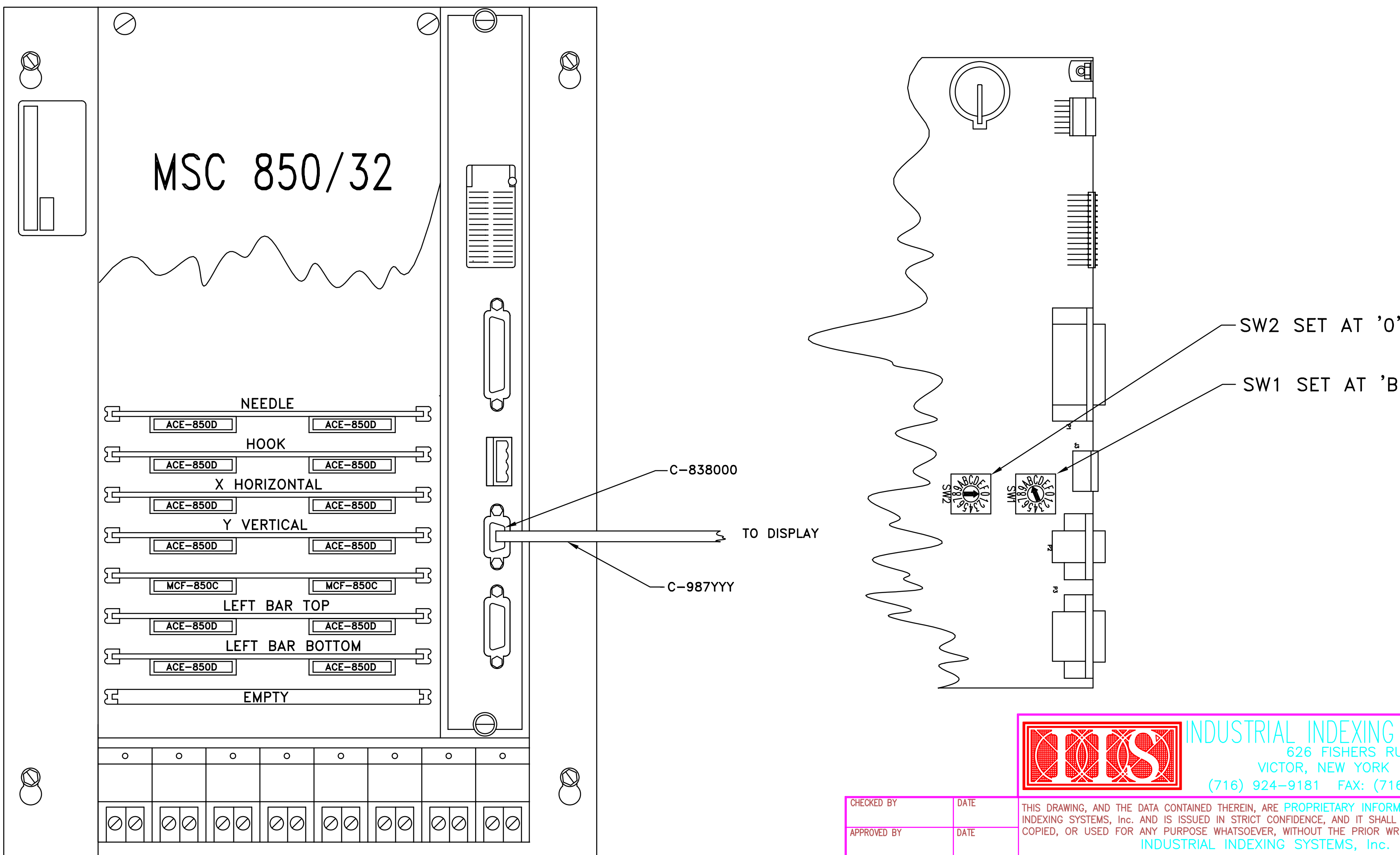
DATE	SYM	REVISION RECORD	DR	CK	CK
09APR99	0	PER ECN 99-117	EB	RB	



NOTES:

1. SEE ID-1097

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CHECKED BY	DATE
APPROVED BY	DATE
APPROVED BY	DATE
MATERIAL	-------------
FINISH	-----------

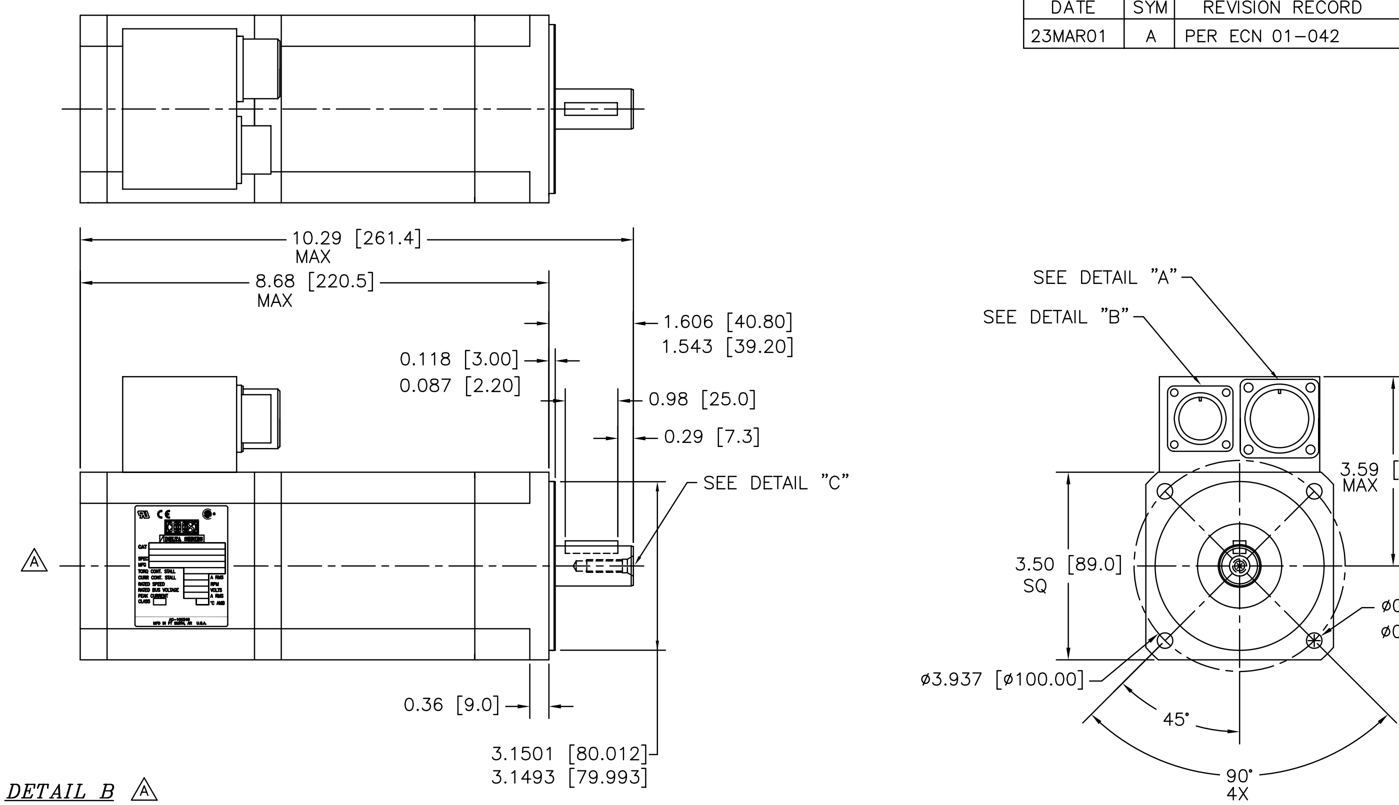
TITLE: SETUP, ABM/MSC-850

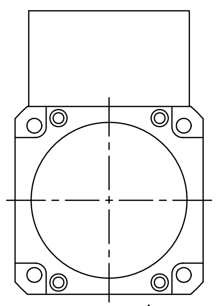
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	
TOLERANCES	
X.X± --	ANGULAR
X.XX± --	± --
X.XXX± --	
DRAWN BY	BAIER
AutoCAD FILE LOCATION	Q\CAD\SU
SIZE	B
DATE	09APR99
SCALE	---
DRAWING NUMBER	SU-000010
SHEET NO.	1 OF 1
REVISION	0

DATE	SYM	REVISION RECORD	DR	CK	CK
23MAR01	A	PER ECN 01-042	CWB		

NOTES: A

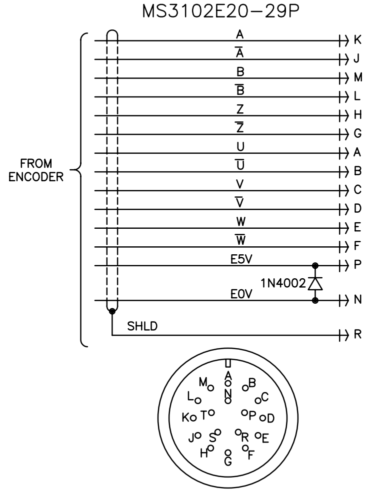
1.) MOTOR CAN BE MOUNTED IN ANY POSITION.
2.) ALL DIMENSIONS ARE IN INCHES [MM].
3.) MOTOR WEIGHT 6.4 KG 14 LBS.
4.) MOTOR SHAFT SEAL STANDARD.
5.) THRUST LOAD 289 N 64 LBS.
6.) RADIAL LOAD 267 N 60 LBS.
7.) ENCODER 1024 LINE COUNT 4096 PPR QTY 1 ZERO MARKER.
8.) IP-65 SEALING.





DETAIL A A

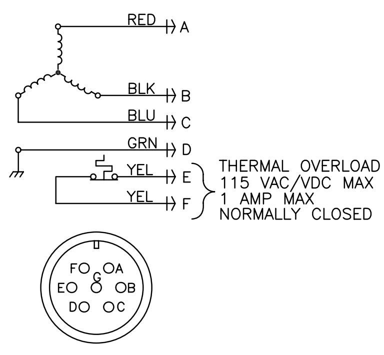
ENCODER CONNECTION
MS3102E20-29P



VIEW OF CONNECTOR
MATING SOCKET:
ENCODER: MS3106A20-29S

DETAIL B A

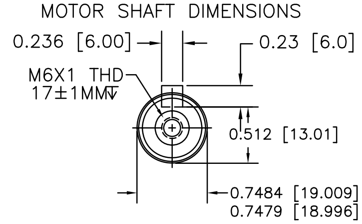
ARMATURE CONNECTION
MS3100A16S-1P



VIEW OF CONNECTOR
MATING SOCKET:
MOTOR: MS3106A16S-1S

DETAIL C

MOTOR SHAFT DIMENSIONS



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www.iis-servo.com

TITLE: MOTOR, DELTA SERIES				
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TOLERANCES	AutoCAD FILE LOCATION: Q:\CURRENT DWGS			
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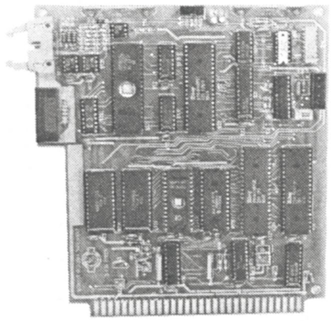
			SHEET NO.: 1 OF 1	REVISION: A

IB-11B003

MOTION CONTROL SYSTEM, MSC-850

AUGUST 1989



ACE-850 ENCODER AXIS CONTROLLER

INSTRUCTION BOOK

INDUSTRIAL INDEXING SYSTEMS, INC.

ER-6012

ERRATA SHEET, IB-11B003 JULY 1993

Date	Rev.	ECN No.	DR	CHK	CHK
8/31/92	A	ECN-92-191 (See Note 1)	MFE		
12/3/92	B	ECN-92-318 (See Note 2)	MFE	EB	JC
7/12/93	C	ECN-93-112 (See Note 3)	EB		

Notes:

1) Section 5, Page 4, dated September 1992, supercedes Section 5, Page 4, dated August 1989.

2) Section 2, page 2-2; Section 5, page 5-8; Section 6, pages 6-3 thru 6-4, dated December 1992, supersedes Section 2, page 2-2; Section 5, page 5-8; Section 6, pages 6-3 thru 6-4, dated August 1989.

3) Section 2, page 2-4 dated July 1993 supercedes page 2-4 dated August 1992.

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

1.0 INTRODUCTION

1.1 About This Instruction Book

This document is part of a series of books that support Industrial Indexing Systems' MSC-850 based Motion Control System. It provides product information about the ACE-850 Encoder Axis Controller including; a product overview, product description, product specifications, description of controls and indicators, and connection diagrams.

1.2 Product Overview

The ACE-850 Encoder Axis Controller is an edge connector printed circuit board (Figure 1-1) that can be plugged into one of the controller slots of the MSC-850 System Unit. It provides precision position loop control utilizing feedback data from the encoder on the motion control device (Figure 1-2).

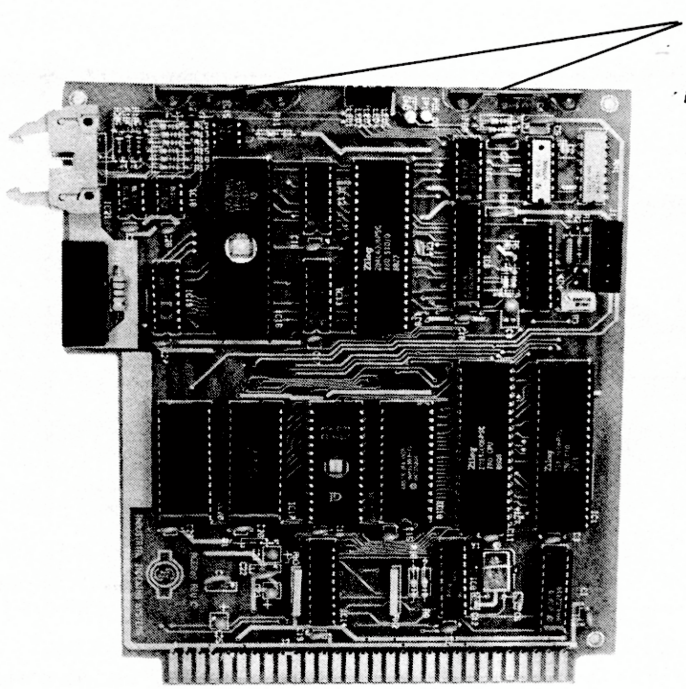

Figure 1-1 ACE-850 Encoder Axis Controller

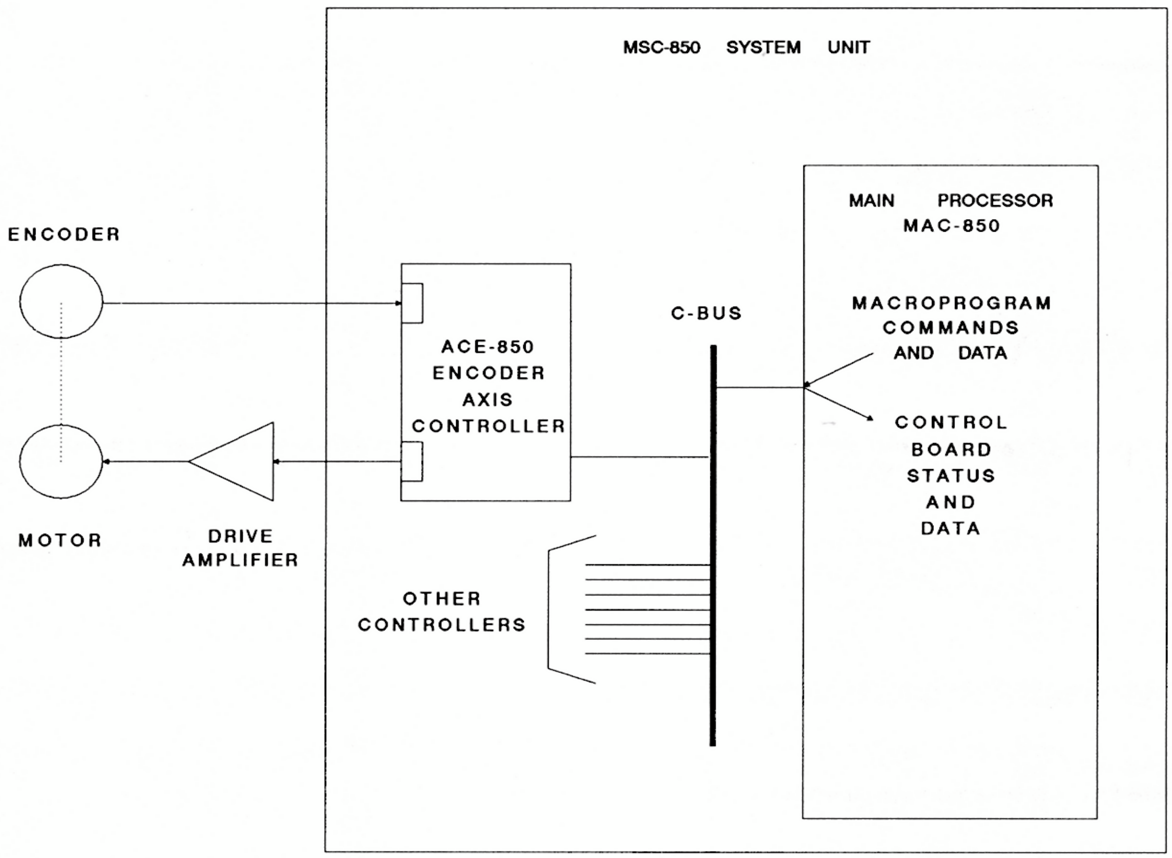

Figure 1-2 ACE-850 Position Loop Overview Diagram

2.0 DESCRIPTION

2.1 General

The ACE-850 Encoder Axis Controller is an intelligent circuit board that works in conjunction with an encoder connected to the motion device. In combination, the two devices produce an offset output signal that causes the motion device to move in relation to the commands as instructed by the Macroprogram running in the System Unit. The controller is capable of performing indexing, positioning, cam following, piecewise profiling, and can also be used as a passive position sensing device.

2.2 Encoder Functional Description

The encoder produces current loop pulses of approximately 10 mA per channel. There are three channels. Two of the channels are quadrature encoded and the third channel produces a marker. Each of the quadrature channels (Figure 2-1) produce a squarewave signal that is offset by 90 degrees from each other. Each edge of the squarewave is counted by an interface circuit. This technique provides direction sensing capability as well as an increase in resolution that is 4 times the encoder line count. The marker produced by the third channel is used to mark the 0.0 degree absolute reference point. It also is used for loss of count detection.

2.2.1 Encoder Count Channels

The feedback, with a resolution of 1024 counts from the encoder, is multiplied by a factor of 4 to produce 4096 counts per revolution. All further descriptions in this instruction book are based on this line count. Encoders having line counts of other than 1024 lines per revolution can be used but must be compensated for by scaling the rpm and acceleration values accordingly (ie, a 512 line encoder commanded to 200 rpm will actually provide 400 at the encoder shaft).

The line count of the encoder determines the performance of the system. High line count encoders offer high resolution and accuracy but affect speed and acceleration rates. Low line count encoders provide higher speed and acceleration but resolution is sacrificed.

2.2.2 Home Reference Channel

Unlike a resolver, an encoder is not an absolute position sensing device. At power up, the true encoder position is not known. For this reason, the power up location is defined to be 0.00 and is known as the local mode home. The encoder contains a once per revolution pulse channel called the marker (Figure 2-1) to provide an absolute 0.00 degree reference.

The Encoder Axis Controller provides 'find_mark_cw' and 'find_mark_ccw' commands which are used to initialize the system. This is referred as the absolute mode. These instructions cause the motor to move in the desired direction until the marker is crossed and the motor stops (not necessarily at 0.00 degrees). At this time, automatic bit loss detection begins.

Some drive manufactures provide an electronic encoder interface with a marker whose pulse width is 180 degrees (Figure 2-2) of shaft movement instead of the normal 1/4 cycle pulse width. The 'find_tm_cw' and 'find_tm_ccw' instructions should be used for these drives.

The ability to find a marker or initialize the system is only valid when the controller is being used as an active (versus passive) position sensing device and does not affect the master angle data.

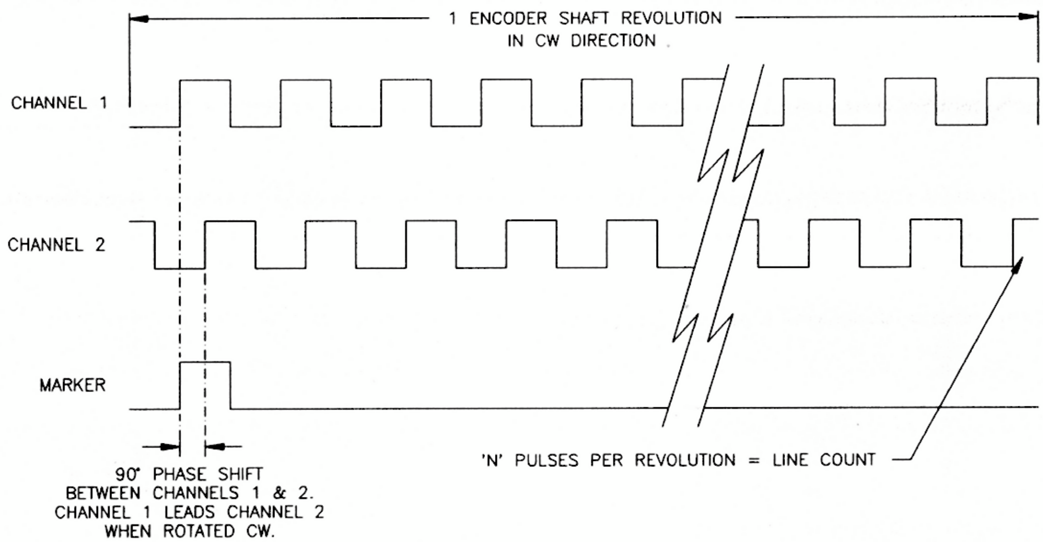

Figure 2-1 - Standard Encoder Output Channels Relationship

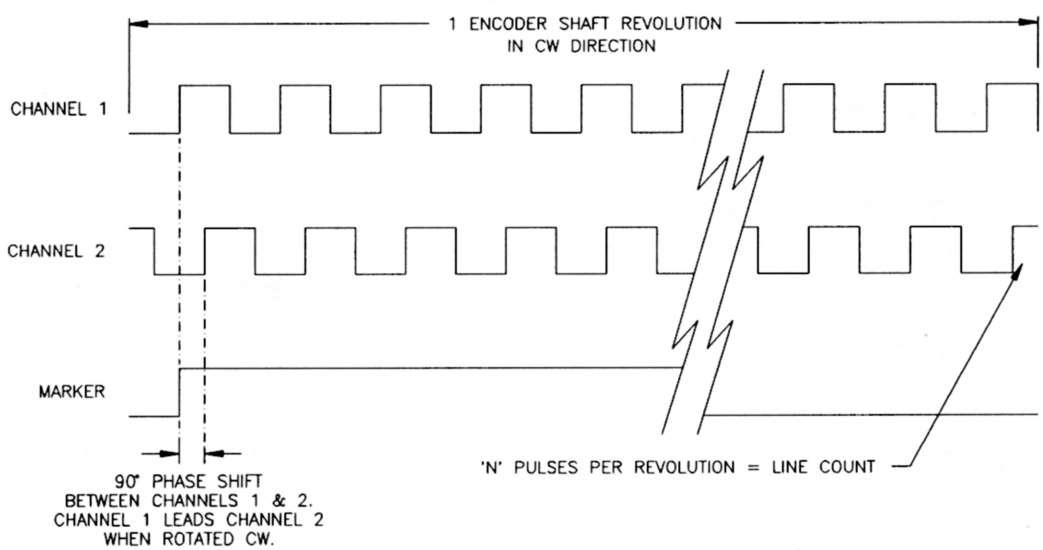

Figure 2-2 - 180° Marker Output Channels Relationship

2.3 Position Loop Control Functions

2.3.1 Overall Position Loop Description

The ACE-850 Encoder Axis Controller is the heart of the position loop (Figure 2-3). Instructions from the Macroprogram tell the controller what the parameters of the motions are for indexing or positioning. The information is processed by the command generator and the resulting position commands are sent to the comparator along with feedback from the encoder. The command generator produces a command position which represents speed, acceleration rate, direction, and distance that the motion device must move. This difference between the commanded position and the actual position is the POS OUT signal which is sent to the drive amplifier to power the motion device. The shaft of the motion device and the shaft of the encoder are mechanically connected. As the encoder turns to this new position, the actual position command feedback signal once again matches the position command signal thus satisfying the comparator and thereby causing the POS OUT signal to go to 0.00 Volts. The difference between the actual position of the encoder shaft and the commanded position is known as the following error.

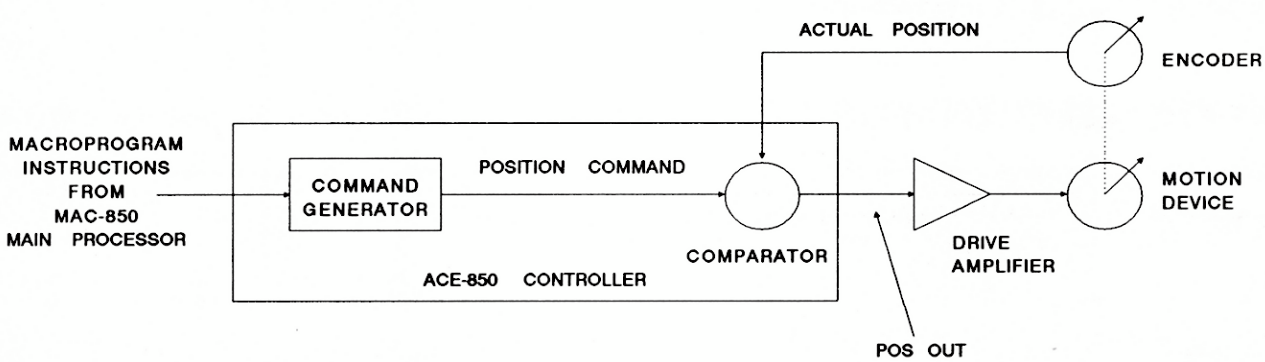

Figure 2-3 Position Loop Block Diagram

2.3.2 ACE-850 Encoder Axis Controller Description

The controller (Figure 2-4) is a microprocessor based board running under the control of a unique IIS Operating System. The digital signals from the encoder are detected by the controller. The output of the feedback device connected to channel 1 of the controller must lead the output connected to channel 2 when the feedback device is rotating in a clockwise direction (Table 2-1).

Table 2-1 Encoder Output to Controller Interface

ENCODER OUTPUT	ACE-850 CONNECTIONS CH1	CH2	CH3
Channel A leads B when CW	A	B	I,M, or Z
Channel B leads A when CCW	B	A	I,M, or Z

Commands from the Macroprogram running in the MAC-850 Main Processor (Figure 1-2) are sent over a Command Bus (C-Bus) to the controller's microprocessor. The 24-bit wide digitized signals from the encoder and command generator are parallel processed. The microprocessor and its associated circuits perform the multiple functions of position command generation, comparator, and PID digital compensation to produce the POS OUT signal. With the standard default in the digital compensation gain algorithm (P), the POS OUT voltage is +/-5 Volts (ccw versus cw respectively) at the 90 degree position of the encoder shaft and +/-10 Volts at the 180 degree position.

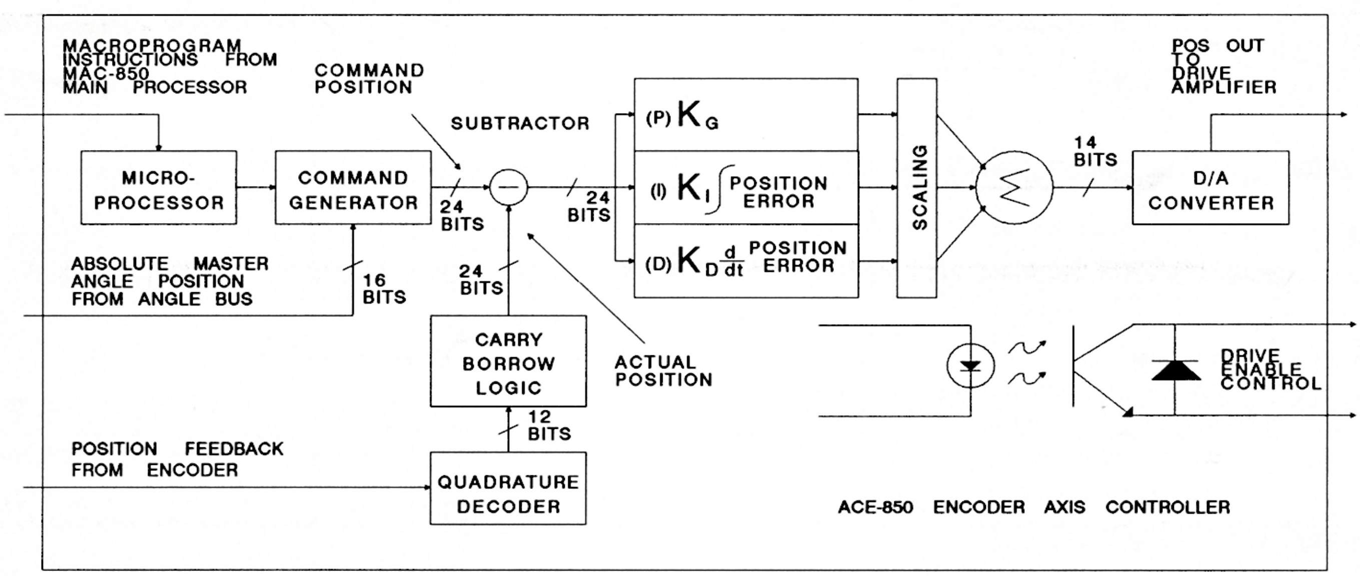

Figure 2-4 ACE-850 Controller, Functional Block Diagram

The Macroprogram can override the standard gain value of 16, integral value of 0, and damp value of 0 which represents the Proportional, Integral, and Derivative terms of the algorithm. The gain value can be set to produce a per revolution POS OUT signal of 20 Volts per 1/16th turn of the encoder shaft to 20 Volts per 16 turns of the encoder shaft. Refer to the Macroprogram Development System Instruction Book for further information about the setting of the digital compensation values.

The controller can communicate over the 2 Angle Buses which are located on the motherboard of the System Unit for a master/slave applications. The controller can be designated as the master controller (talker) by the Macroprogram or the controller can be designated a slave controller (listener). This master/slave relationship is communicated over either of the 2 Angle Buses.

Depending upon the specific mechanical motion being simulated, the command generator of the slave controller (Figures 2-5 and 2-6) computes a command position based on the absolute master angle information from the Angle Bus.

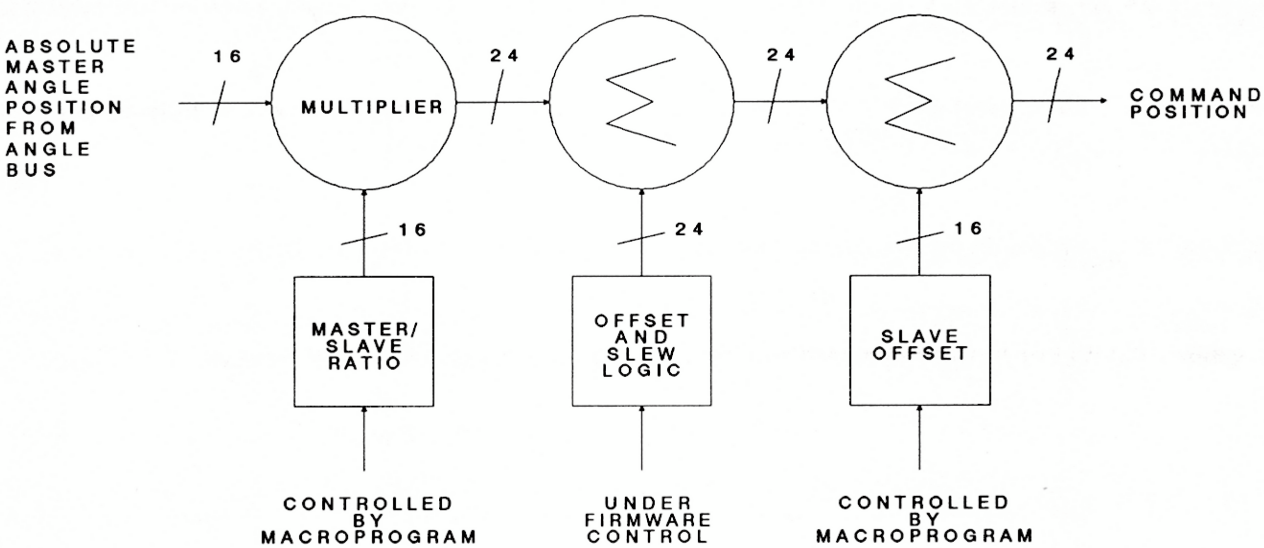

Figure 2-5 Electronic Gearbox Command Generator

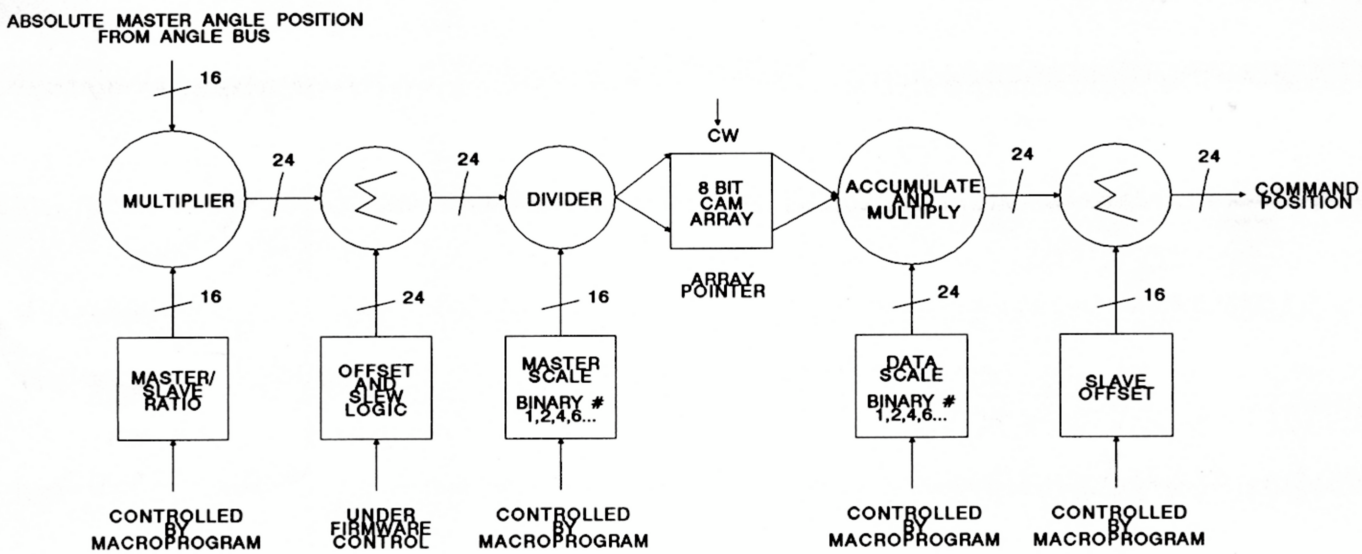

Figure 2-6 Electronic CAM and Gearbox Command Generator

As a passive position sensing device, the controller can be used to monitor the motion of other machine components. This information can be communicated over the angle buses or reported to the Main Processor for integration into functions of the Macroprogram

When the Macroprogram commands the controller with the 'drive_off' instruction, the drive enable control is turned off and the controller is now in a passive mode. The POS OUT signal represents the count of the encoder referenced to X.0 degrees home (ie; zero volts is zero degrees). This home reference is the encoder position at power up unless the 'find_mark_xx' or 'find_tm_xx' instructions were executed which changes the zero degrees of the encoder marker position. The transition from +10 Volts to -10 Volts represents 180 degrees angle of the encoder. Any time the System Unit is powered up, the Macroprogram can command the controller to look for the marker produced by the encoder to determine the 0 degree position of the encoder's shaft.

When 'drive_off' is executed in the Macroprogram, the POS OUT signal is first driven to 0V dc by making the command position equal to the actual position then the Drive Enable Control is turned on.

2.4 Hardware Interrupts

Hardware interrupts are selected and enabled by the Macroprogram using the 'enable_hwi' instruction. These hardware interrupt routines are initiated by MEC type input modules. The high level input being monitored is connected to the input module which isolates the low level logic circuitry of the controller from the high level input. Both AC and DC inputs can be handled. In addition, a special input module manufactured by IIS, Inc. can handle DC inputs at a much faster rate than the conventional module (MEC type). The input module servicing the controller is position dependent relative to the slot in which the controller is located (Figure 2-7). The controller located in slot 1 of the System Unit is serviced by the input module located in position 1 of the on-board I/O module connectors.

2.5 Status and Fault Indicators

2.5.1 Power-up Fault Detection

On power-up, the controller's microprocessor, memory, and multiply/divider circuits are put through a series of tests. If the controller passes these tests, then the board is considered to be operational and a green indicator, labeled SELF TEST OK, is lighted. On Start-up, the SELF TEST OK indicator may also be lighted along with the yellow INTERRUPT, red BUS FAULT, and red ERROR indicators. If this combination of indicators are lighted on start-up, a controller start-up fault has occurred. This may or may not be a fault of the controller. A start-up retry should be attempted and if the same combination of indicators are lighted, the controller can be suspected as being faulty.

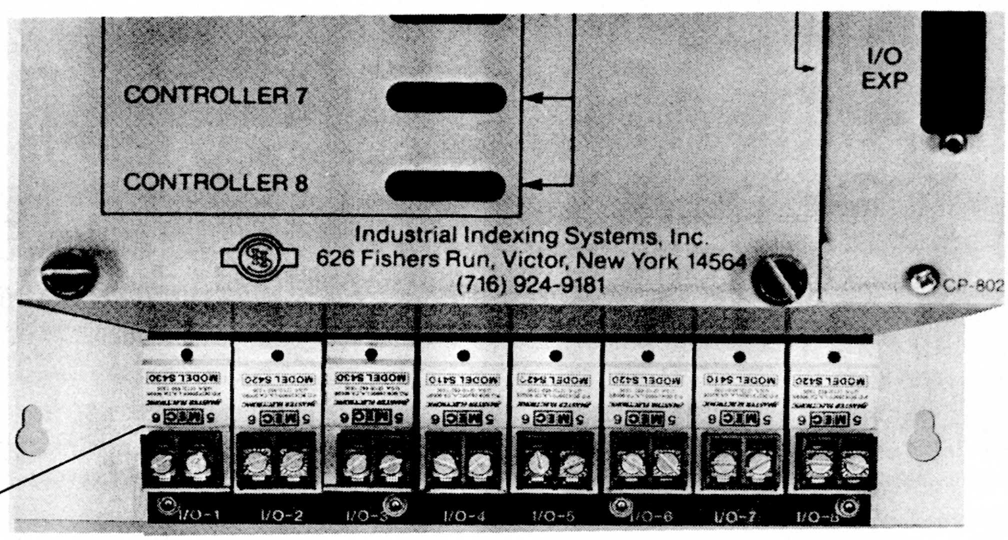

Figure 2-7 On-board I/O Module to Controller Slot Relationship

2.5.2 Operational Fault Detection

The ACE-850 Encoder Axis Controller has built-in fault detection. While the DRIVE ENABLE indicator is lighted, the controller monitors the following error and immediately sets the POS OUT signal to 0.00 Volts and then turns off the drive enable control under the following conditions;

- If no motor motion is commanded, the controller will not allow the encoder to be more than 17 degrees off of its commanded position.
- If motor motion is commanded, the controller will not allow the encoder to be more than 180 degrees from its commanded position.

The following error trip angles are modified when the digital compensation 'digi_comp' instruction is executed in the Macroprogram (Refer to the Macroprogram Development System Instruction Book).

2.5.3 Status Indicator Description

During normal operation, the SELF TEST OK indicator is lighted. As the Macroprogram executes the 'drive_on' instruction, the ENABLE OUTPUT indicator comes on to enable the position loop and to start monitoring the "following error". As the MAC-850 Main Processor communicates with the controller, the INTERRUPT indicator flickers (or appears to be on steady due to rapid flickering.

If, during normal operation, a problem with controller or main processor is detected, the BUS FAULT indicator will come on.

For a more detailed description of the physical and functional characteristics of these indicators, refer to Section 4.

3.0 SPECIFICATIONS

3.1 Functional Characteristics

Drive Enable Control	Optically Isolated
Off Voltage	30V dc
On Voltage	1.5V dc, 20mA
Drive Command Output	+/-10V dc @ 10mA
Digital Compensation	PID Loop with 1KHz Digital Signal Processing Sample Rate
Feedback Device	Digital Quadrature Encoder with marker.
Line Count	1024 Pulses per revolution
Quadrature Alignment	90 +/-22.5
Pulse Sysmmetry	180 +/-22.5
Marker Types	
1/2 revolution	MSB
1/4 cycle	A & B
Line Receiver	Dual Differential driving 10mA into Isolated Receivers.

3.2 Performance Characteristics

Positional Range	+/- 8,388,608 counts
Positional Absolute Accuracy	+/- 1 count
Acceleration/Deceleration Range	16 to 3,276,800 counts/sec/sec
Speed Range	0.266 to 245,760 counts/sec
Decoding	Fixed quadrature (X4) @400 KHz maximum
Environmental	
Operating Temperature	32° to 140° F (0° to 60° C)
Operating Humidity	30 to 90% (Non-condensing)

3.3 Physical Characteristics

Dimensions	
Width	5 5/16 in. (135 mm)
Depth	6 5/16 in. (160 mm)
Weight	1 lb. (0.45 Kg)
Mounting	Occupies any slot in the MSC-850 System Unit

4.0 CONTROLS AND INDICATORS

4.1 General

The ACE-850 Encoder Axis Controller is equipped with five status indicators. These indicators are visible through a cut-out in the faceplate of the System Unit. The indicators are illustrated in Figure 4-1 and listed in Table 4-1.

There are no setable devices on the ACE-850 Encoder Axis Controller. All parameters and functional control are established by the Macroprogram

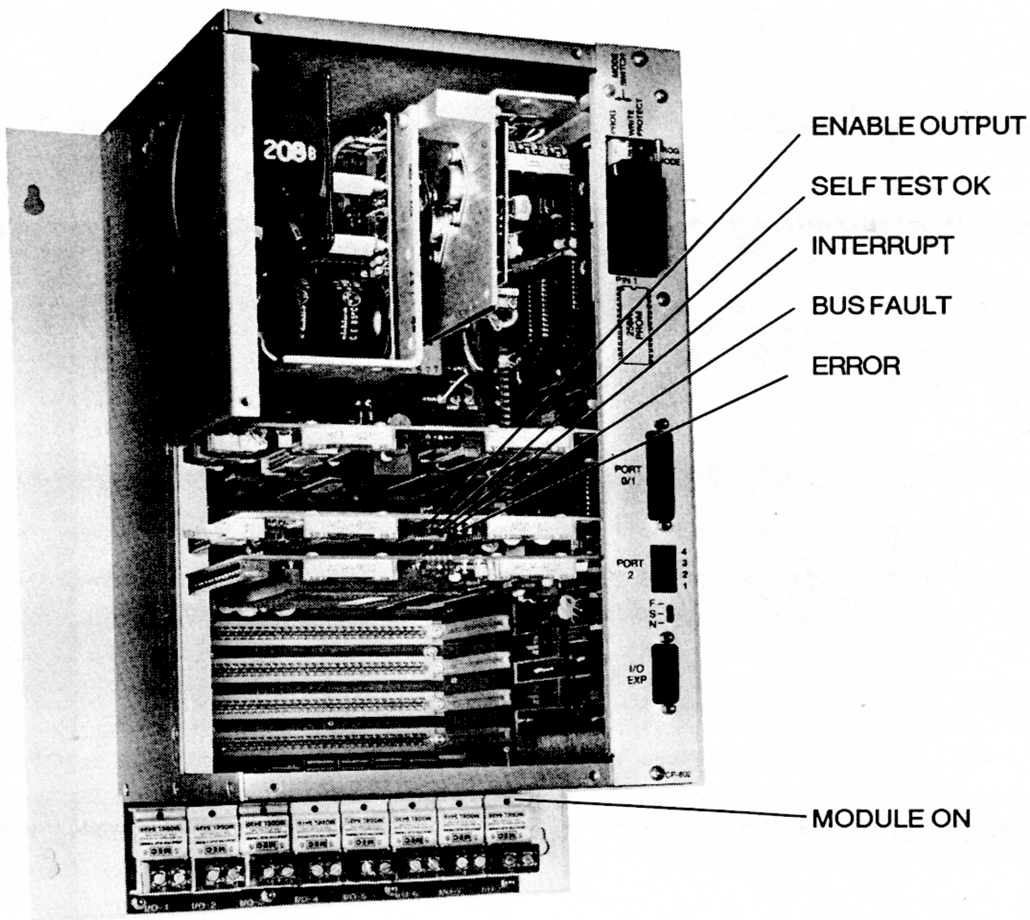

Figure 4-1 Identification of Status Indicators

Table 4-1 Description of Indicators

PANEL MARKING	DESCRIPTION	OBSERVED INDICATION	INDICATOR FUNCTION
ENABLE OUTPUT	Green LED	Steady On	The position loop is active and drive enable is closed
SELF TEST OK	Green LED	Steady On	The controller passed the self test during start up.
INTERRUPT	Yellow LED	Flashing	The controller is communicating with the Main Processor.
BUS FAULT	Red LED	Steady On	Communication, on the C-Bus between the controller and the Main Processor was faulty. A subsequent good communication sequence resets the BUS FAULT indicator
ERROR	Red LED	Steady On	A following error fault has been detected.
		Flashing	A controller fault has been detected.

NOTE

If, during start up, the SELF TEST OK, INTERRUPT, BUS FAULT, and ERROR indicators all come on, a controller start-up fault has occurred. A start-up retry should be attempted and if the same combination of indicators are lighted, then the controller can be suspected of being faulty.

5.0 FUNCTIONALITY TESTS

5.1 General

The ACE-850 Encoder Axis Controller provides motion control by controlling the position of a encoder type feedback device. The encoder is physically connected to the motion device and is aligned such that the encoder's shaft position is relative to the motion device's position.

The position loop, consisting of the ACE-850 Encoder Axis Controller and the encoder, controls a velocity loop consisting of the drive amplifier, motor, and power supply. The velocity loop has a voltage input which is proportional to motor speed. The velocity loop polarity must be configured such that a positive voltage drives the encoder counterclockwise.

The Overall Trouble Shooting Chart (Figure 5-1) provides a quick reference guide to fault isolation. the specific tests provided in paragraphs 5.2 and 5.3 are designed to quickly isolate the faulty component.

To determine if the ACE-850 Encoder Axis Controller is functioning properly, it is first necessary to check whether the problem is in the velocity loop or in the position loop. This is accomplished by using the test described in paragraph 5.2. If the problem is found to be in the position loop, then the tests provided in paragraph 5.3 can be used to isolate the faulty component within the position loop. This includes the ACE-850 Encoder Axis Controller. If the problem is in the velocity loop. refer to the specific instruction book for the motor/drive components used in your system.

WARNING

High torque motors and high voltages can be dangerous. Use extreme caution when working around the motors and drive circuits.

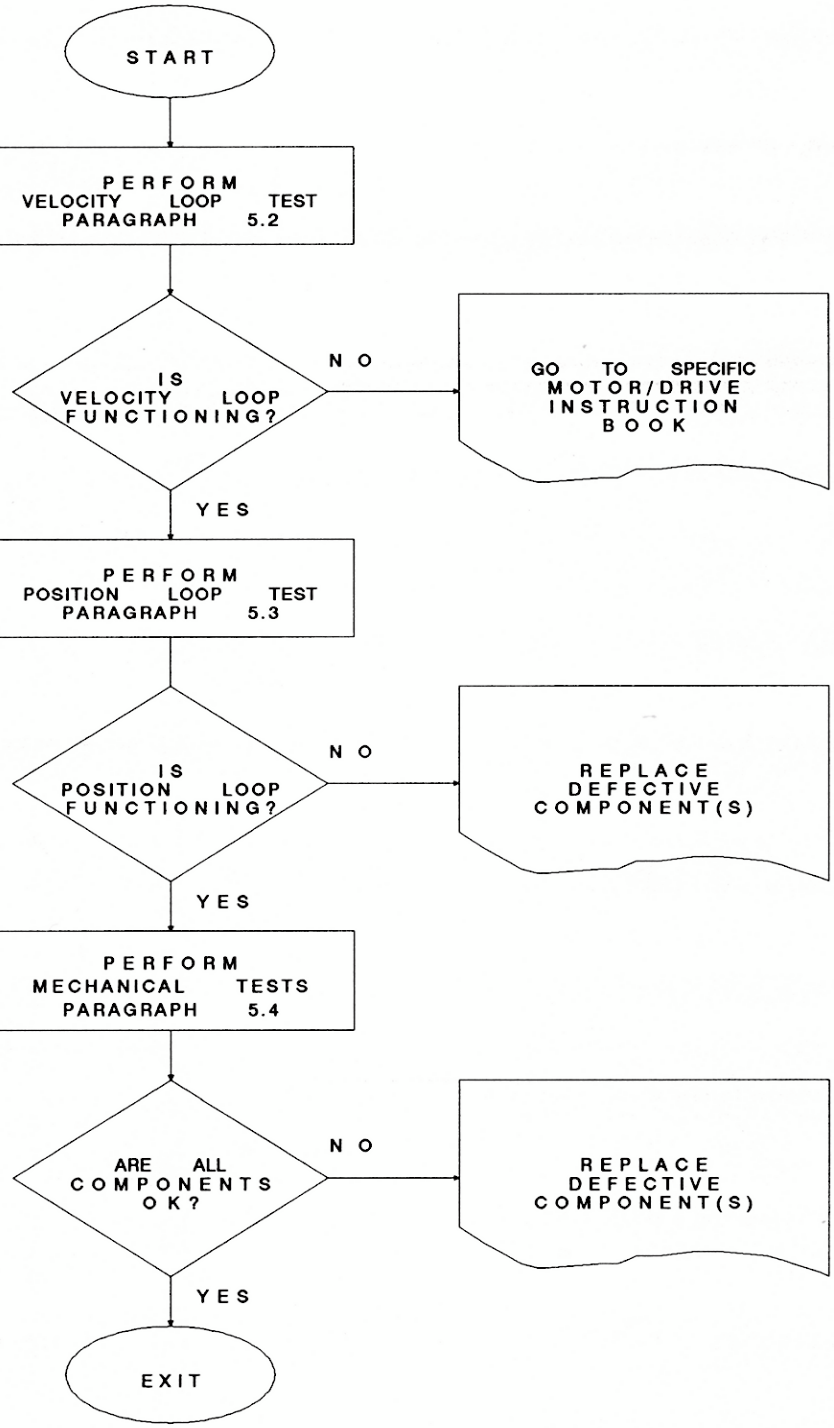

Figure 5-1 Overall Trouble Shooting Chart

5.2 Velocity Loop Functional Test

This test puts the drive amplifier and motion device in a velocity mode of operation. It is used to determine if the problem is in the velocity loop or the position loop. If all of the following tests pass, then the problem is in the position loop. The position loop can be tested by proceeding with the test described in paragraph 5.3. If any of the following tests fail, refer to the instruction book on the specific motor/drive package used in your system.

CAUTION

This test causes the motion device to move. Be sure that the mechanical load can accept movement in both directions without damaging the equipment.

1. Turn off the power to the system.
2. Remove the 6-pin connector P4 from the ACE-850 Encoder Axis Controller in the System Unit.
3. Connect a jumper (Figure 5-2) between P4-2 (green wire) and P4-3 (white wire)
4. Apply power to the system.
5. The motion device should be at rest. A small amount drift is acceptable for the remainder of the test.
6. Using a Multimeter as a power source, set the Multimeter on the X1 Ohms scale.
7. While observing the shaft of the motion device, connect the red and black meter leads to P4-6 and P4-5 respectively (Figure 5-2). The shaft should rapidly accelerate in a counterclockwise direction.
8. Now remove either meter lead and observe the shaft of the motion device. The shaft of the motion device should quickly decelerate to a stopped position.
9. Reverse the meter leads at P4-6 and P4-5. The shaft of the motion device should rapidly accelerate in the clockwise direction.
10. Now remove either meter lead and observe the shaft to the motion device. The shaft should quickly decelerate to a stopped position.
11. If any of the previous tests fail, refer to the Instruction Book on the specific motor/drive package used in your system. If all tests pass, refer to paragraph 5.3.
12. Remove jumper and Multimeter leads.

5.3 Position Loop Functional Tests

The position loop (Figure 5-3) functional tests consist of two parts. The first test checks out the overall position loop. The second test determines whether the problem is in the 5V-dc Power Supply, the interconnecting cable, the encoder, or in the ACE-850 Encoder Axis Controller.

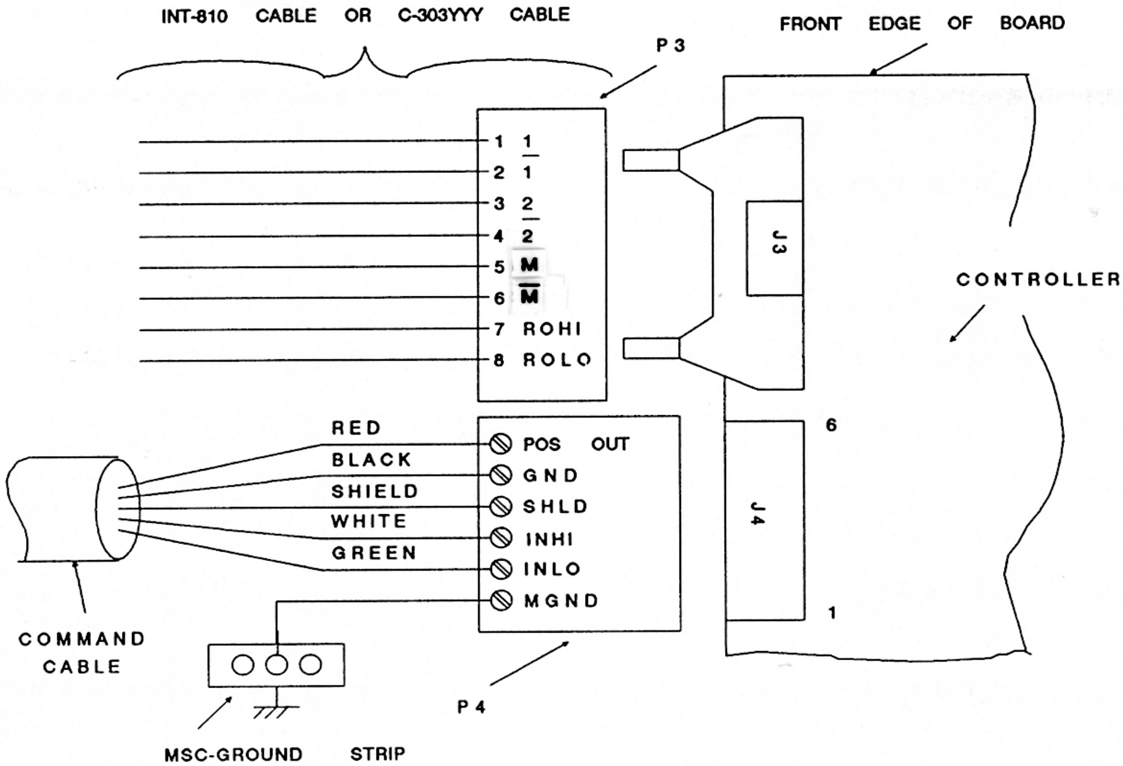

Figure 5-2 Connector Plug P4 Pin Identification

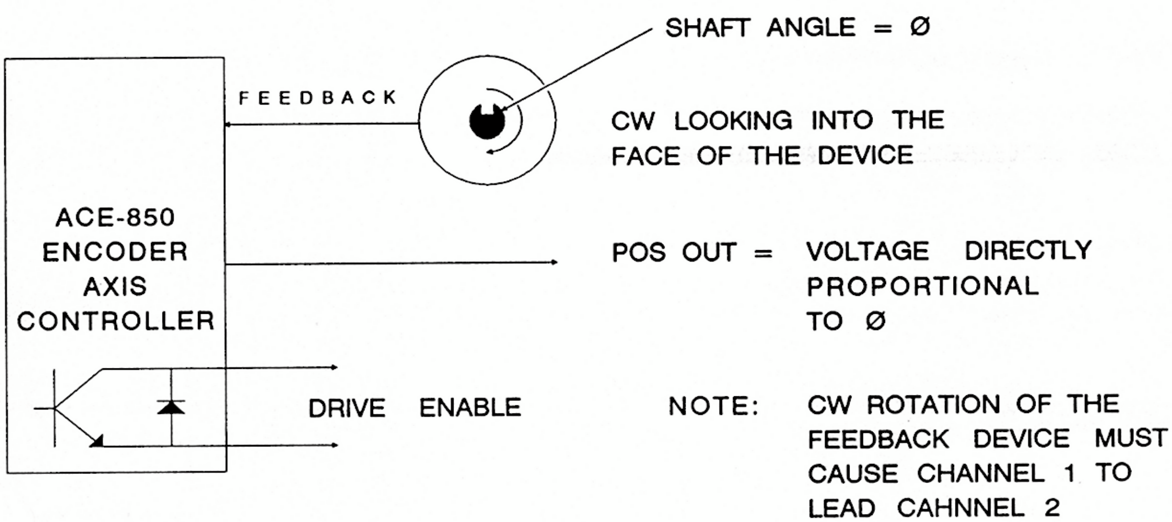

Figure 5-3 Position Loop Components

5.3.1 Position Loop Functionality Verification Tests

This test verifies that the position loop is malfunctioning. If at any time during the test abnormal results are obtained, go directly to paragraph 5.3.2 to determine the faulty component within the position loop.

1. Turn off power to the System.
2. Remove Connector P4 from the ACE-850 Encoder Axis Controller in the System Unit.
3. Apply power to the System.
4. Place the MSC-850 System Unit in the test mode (refer to the Macroprogram Development System Instruction Book.
5. Set a Multimeter on the 10V-dc scale.
6. Connect the red and black meter leads to test points TP1 (POS) and TP2 (GND) respectively (Figure 5-4).

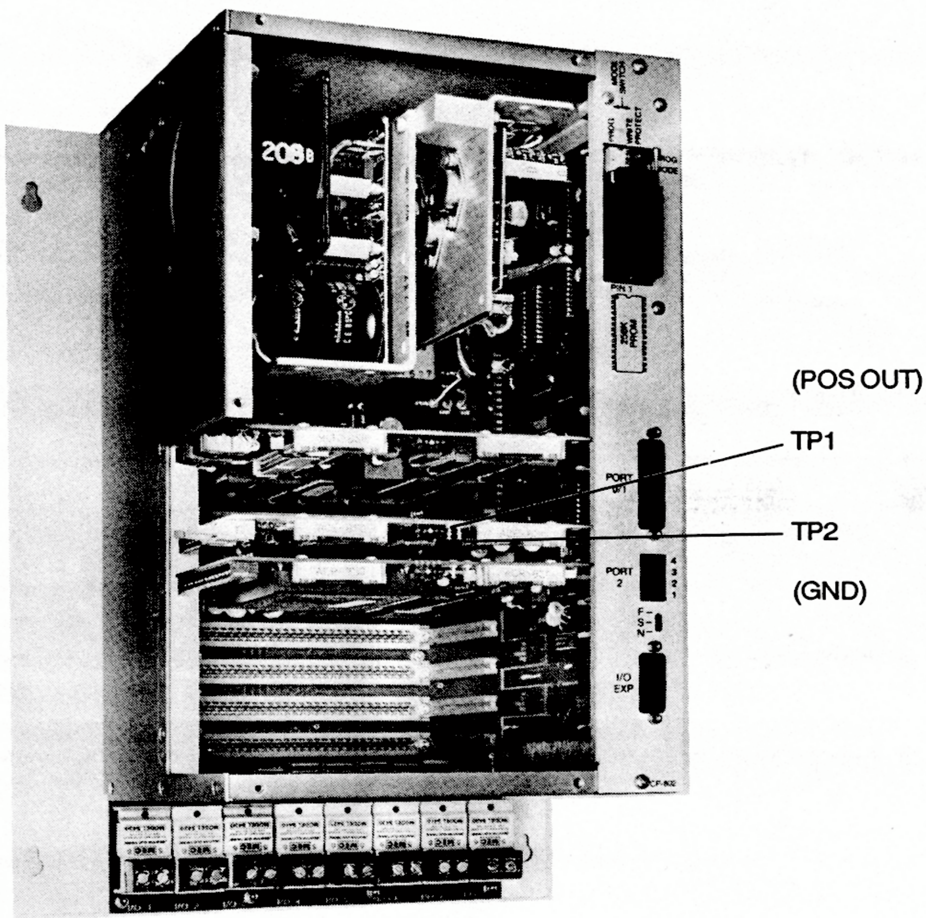

Figure 5-4 Location Of Test Points TP1 and TP2

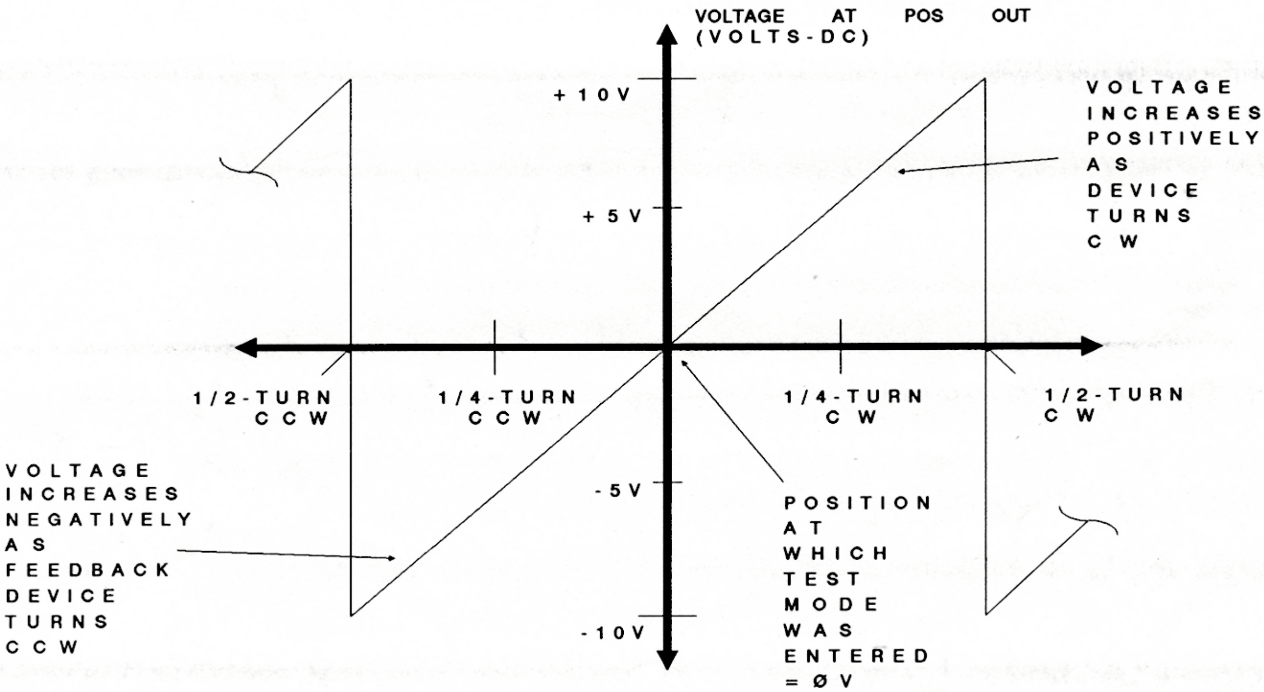

Figure 5-5 Voltage Versus Encoder Displacement in Test Mode

7. With the motor at rest, the voltage reading on the meter should be 0.00V dc +/-0.1V dc.

8. Rotate the motor shaft clockwise 1/4 turn while observing the meter which should smoothly increase (Figure 5-5) to approximately 5V dc.

9. Rotate the motor shaft back to its original at-rest position and observe that the voltage smoothly returns to 0.00V dc.

10. Reverse the meter leads at Test Points TP1 and TP2.

11. Rotate the motor shaft 1/4 turn counterclockwise and observe that the meter again increases smoothly to approximately 5V dc.

12. Continue to turn the motor shaft in the counterclockwise direction. The voltage should increase to +10.00V dc, and as the shaft is rotated beyond the 1/2 turn point, the voltage should abruptly switch to -10V dc. As the shaft is continued to be moved, the voltage should decrease to 0.00V dc upon reaching the 1 full turn position.

NOTE

If the voltage polarities are opposite to those shown in Figure 5-5, the encoder channels may be reversed.

5.3.2 Encoder Versus Power Supply Versus Cable Test

1. Set a Multimeter on the 10V-dc scale.
2. Connect the red and black meter leads to pins 13 and 14 respectively of the INT-810 Interconnection Module (Figure 5-2).
3. The meter should indicate 5V dc +/-0.25V dc. If an out of specification reading is obtained, replace the 5V-dc Power Supply.
4. Reconnect the red and black meter leads to pins 1 and 2 respectively.
5. Move the encoder shaft to find two different voltages; one being 0.8V dc or less and the other being 2.5V dc or more. If an out of specification reading is obtained, replace the encoder.
6. Reconnect the red and black meter leads to pins 4 and 5 of the INT-810 Interconnection Module.
7. Move the encoder shaft to find two different voltages; one being 0.8V dc or less and the other being 2.5V dc or more. If an out of specification reading is obtained, replace the encoder.
8. Set the Multimeter on the low Ohms scale.
9. Refer to Figure 5-6 and check for shorts between conductors or opens within conductors. If either opens or shorts are suspected, replace the interconnecting cable.
10. Visually inspect the INT-810 Interconnection Module and its ribbon cable for properly seated connections and for physical damage .
11. If all of the tests pass, replace the controller in the system unit.

NOTE

Before reapplying operational power, remove meters leads and connect all cable connectors removed during testing.

5.4 Mechanical Components Test

This Test Checks the mechanical componente of the Motion Control System.

1. Check for intermittent wirings faults.
2. Check for a loose mechanical coupling between the motor and the positional feedback encoder.
3. Check the motor brushes, if applicable.
4. Make sure that the systems frictional load on the motor has not changed.
5. Do the set-up proceudre in the instruction book on the specific motor/drive package for the system.

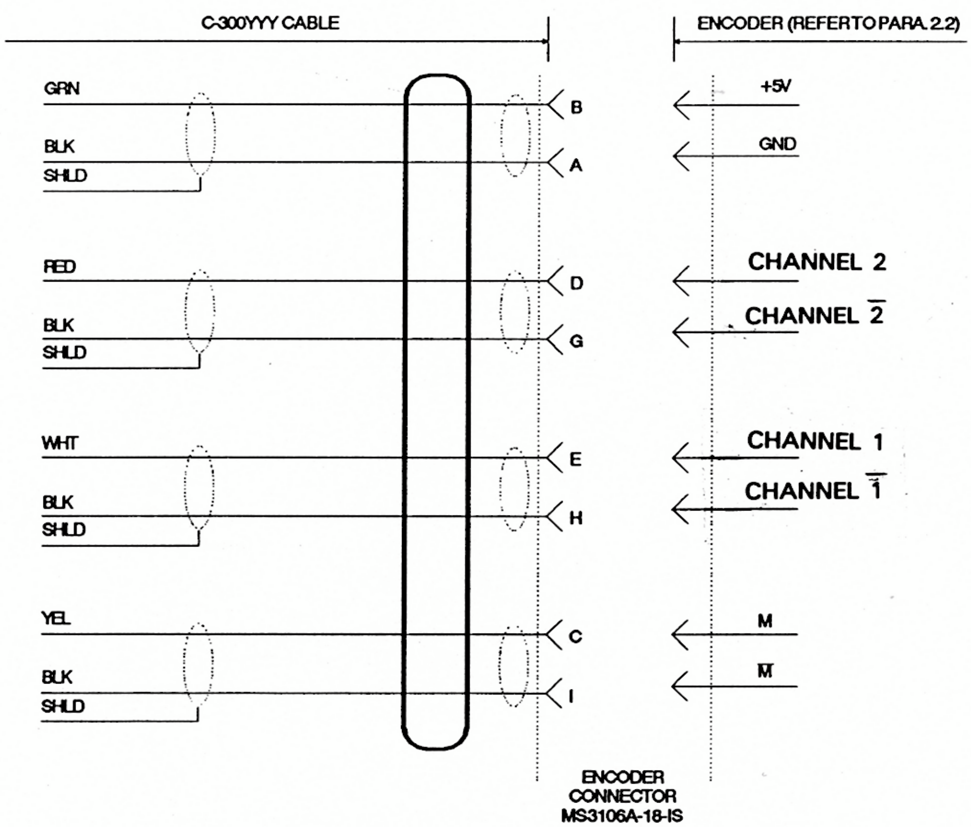

Figure 5-6 C-300YYY Interconnecting Cable, Wiring Diagram

6.0 CONNECTION DIAGRAMS

6.1 General

Good grounding of the controller is essential for proper operation. Figure 6-1 illustrates the MSC Ground Strip typical location to which P4-1 must be connected.

This section also contains the connection details of the INT-810 Connection Module (Figures 6-2 and 6-3). The electrical connections for the controller to encoder and controller to drive amplifier for both brush and brushless type motors are given in Figure 6-4.

MSC GROUND STRIP

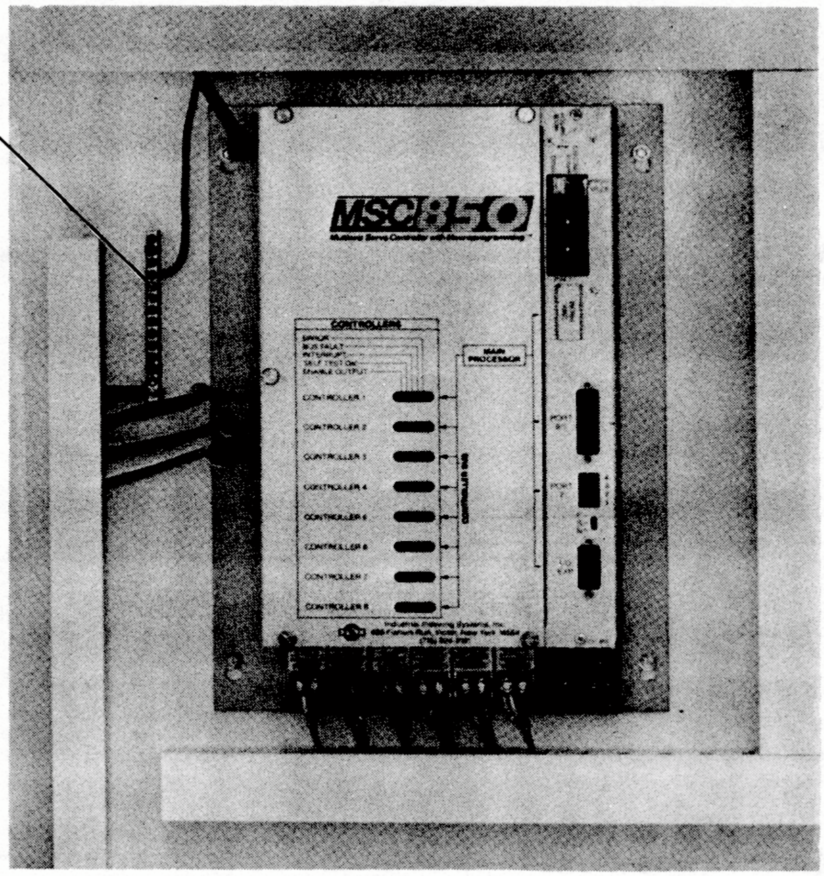

Figure 6-1 MSC Ground Strip

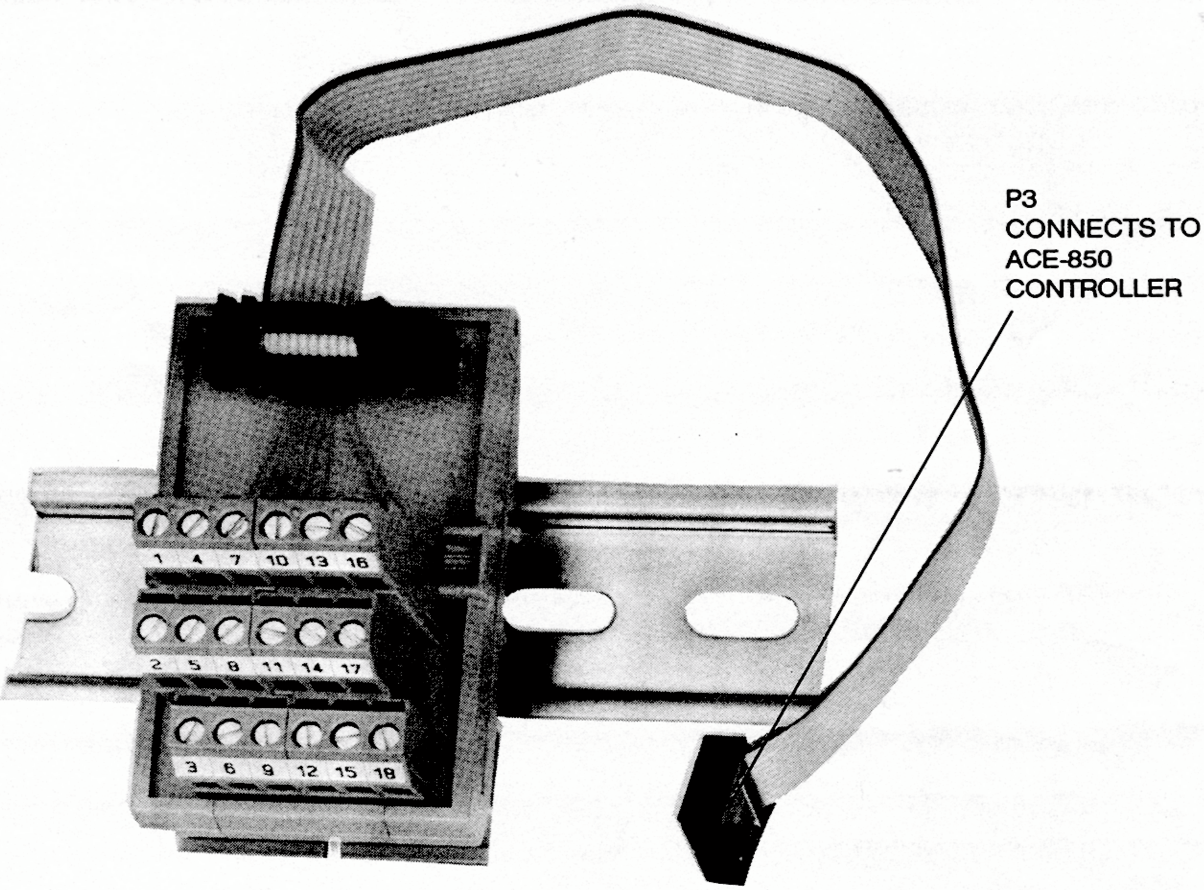

Figure 6-2 INT-810 Interconnection Module, Overview

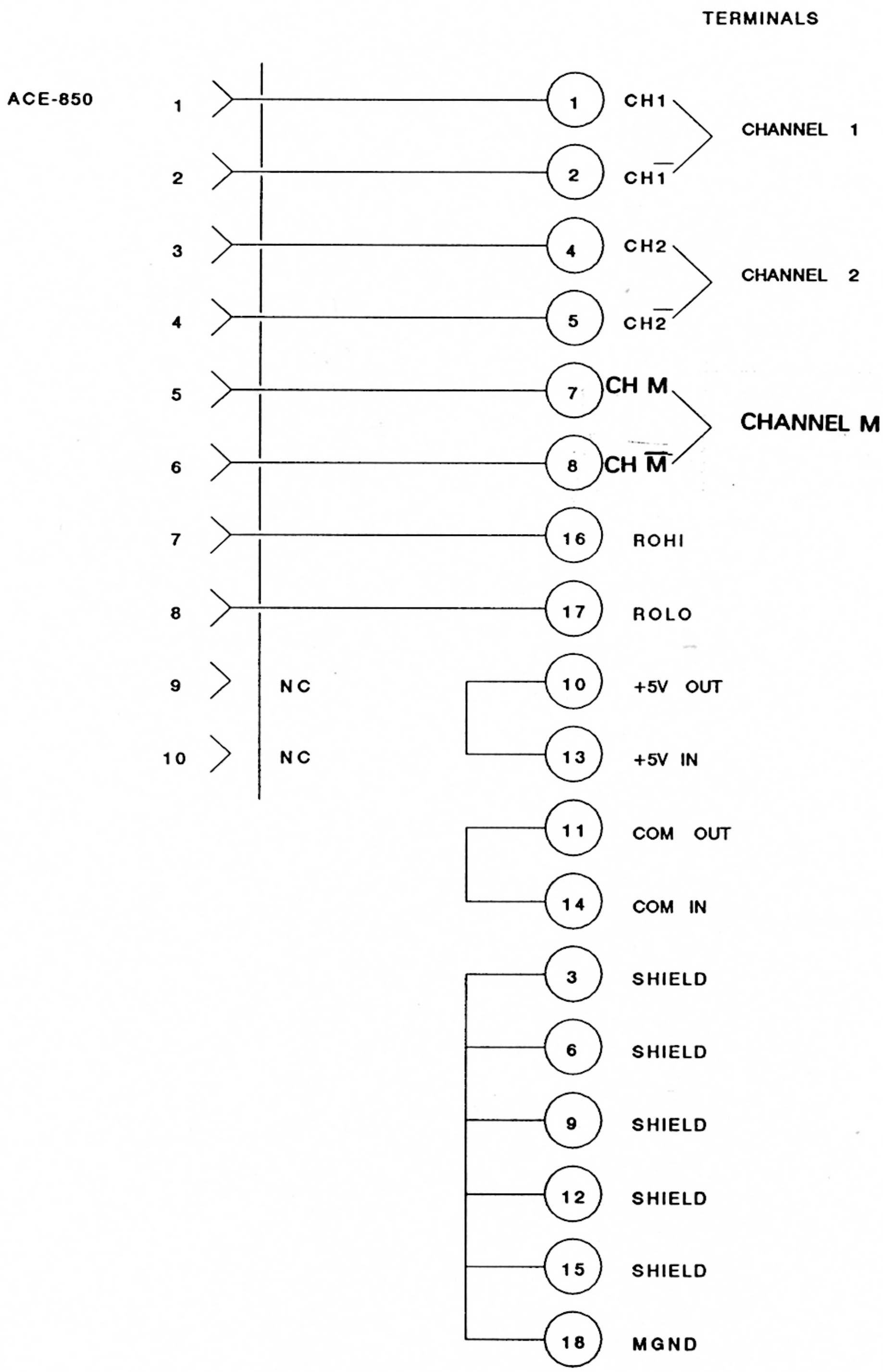

Figure 6-3 INT-810 Interconnection Module, Connection Details

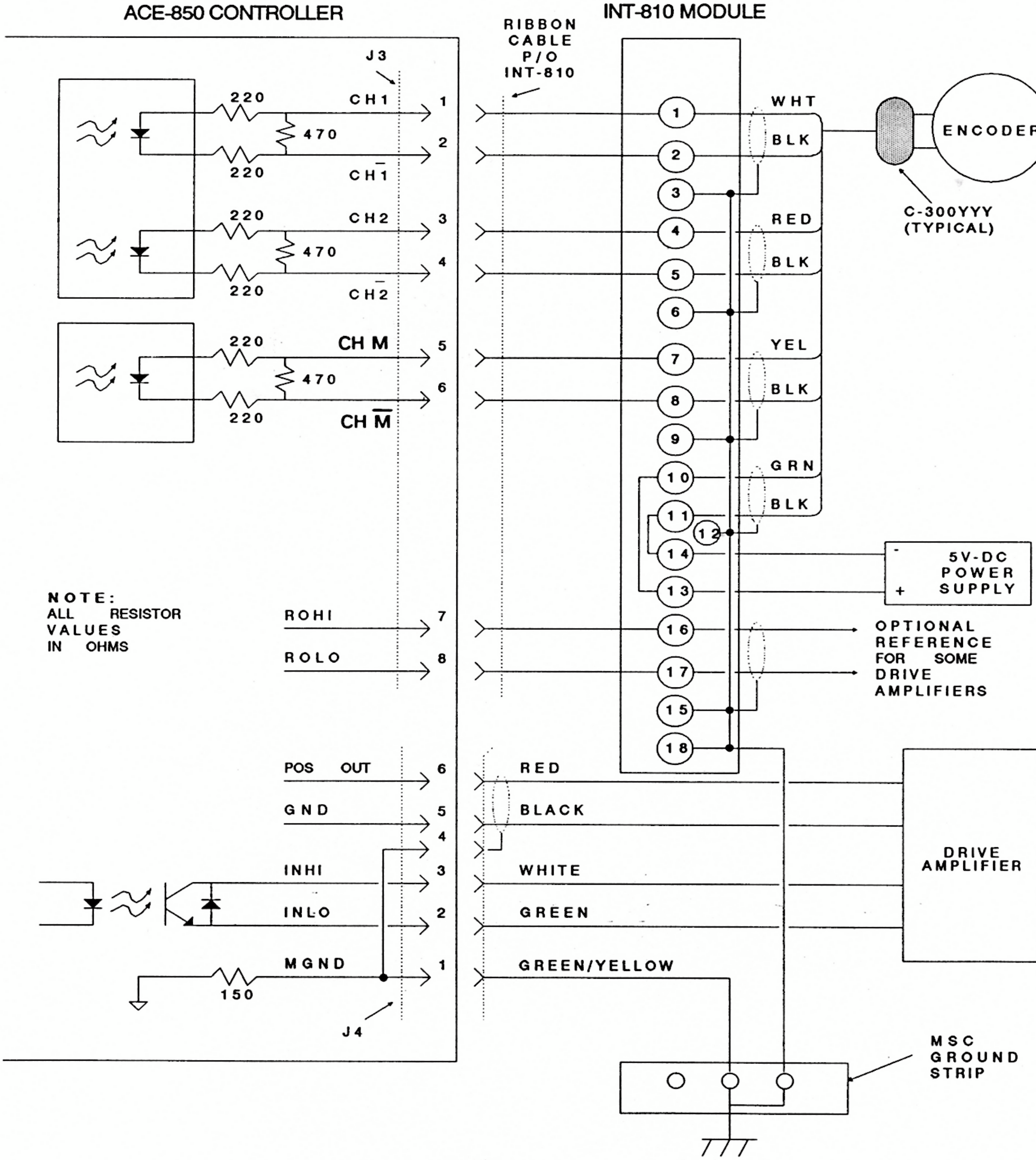

Figure 6-4 ACE-850 Controller, Electrical Connections

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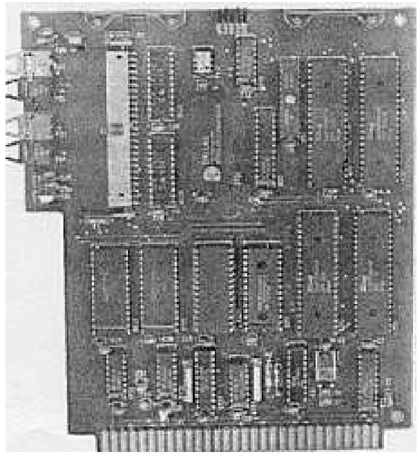
MOTION CONTROL SYSTEM, MSC-850

OCTOBER 1989



MCF-850 MULTI-FUNCTION CONTROLLER

INSTRUCTION BOOK

INDUSTRIAL INDEXING SYSTEMS, INC.

ER-6015

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LIST OF TABLES

1.0 INTRODUCTION

1.1 About This Instruction Book

This document is part of a series of books that support Industrial Indexing Systems' MSC-850 based Motion Control System. It provides information about the MCF-850 Multifunction Controller (Figure 1-1) including a product overview, product description, product specifications, description of controls and indicators, and connection diagrams.

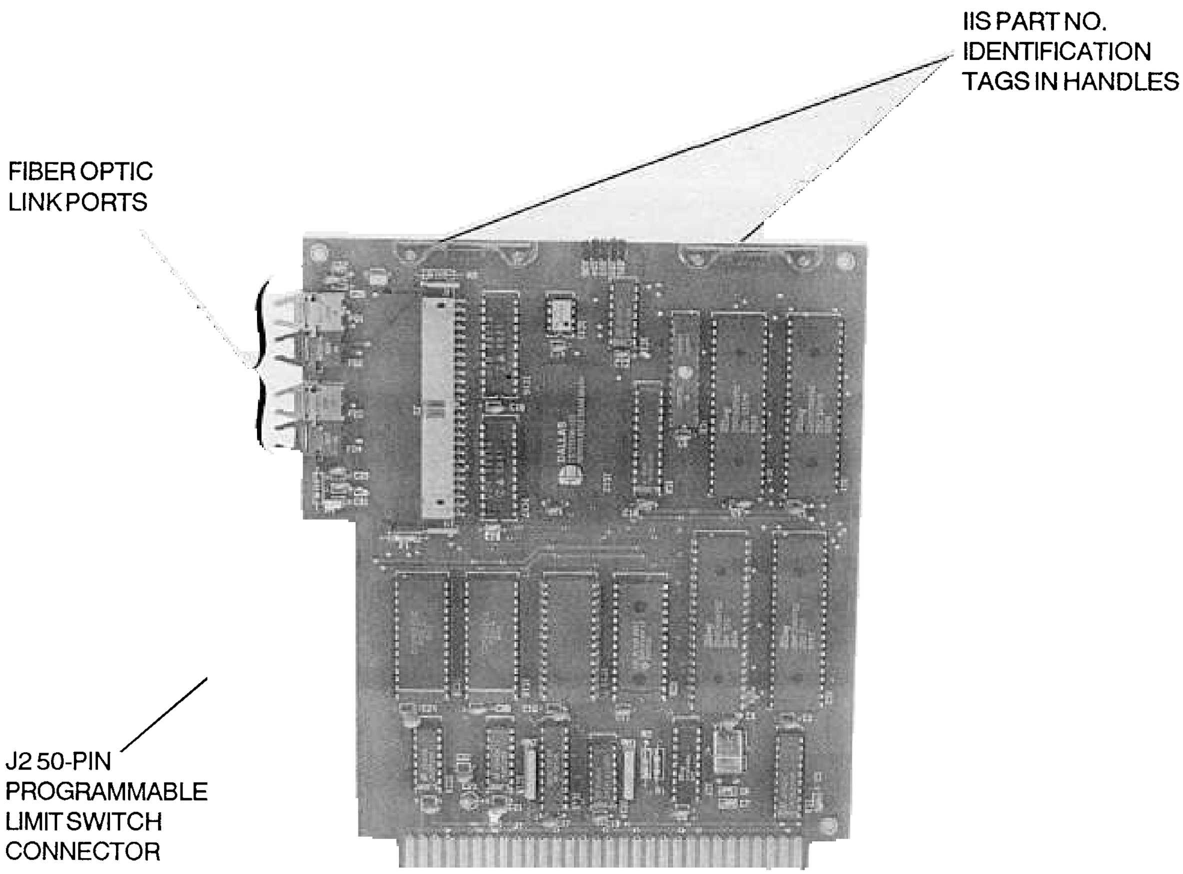


Figure 1-1 MCF-850 Multifunction Controller

1.2 Product Overview

The MCF-850 Multifunction Controller is an edge connector printed circuit board that can be plugged into any one of the controller slots of the MSC-850 System Unit. As the name implies, this controller can be used to perform a number of different functions as follows;

- o Pseudo Axis - A command generator used to generate angle data in terms of acceleration, speed, and distance.
- o Programmable Limit Switching - Provides programmable position dependent outputs to simulate cam or drum switching.
- o Nonvolatile Data Storage - Provides an additional 32K bytes of nonvolatile RAM that can be accessed as data arrays by the Macroprogram for storing and saving data.
- o Fiber Optic Link - Provides High Speed inter-controller data buses for transmission of master angle data from one MSC-850 System Unit to another.

To provide these functions, the MCF-850 Multifunction Controller has several data paths as illustrated in Figure 1-2. These data paths are defined by Macroprogram instructions.

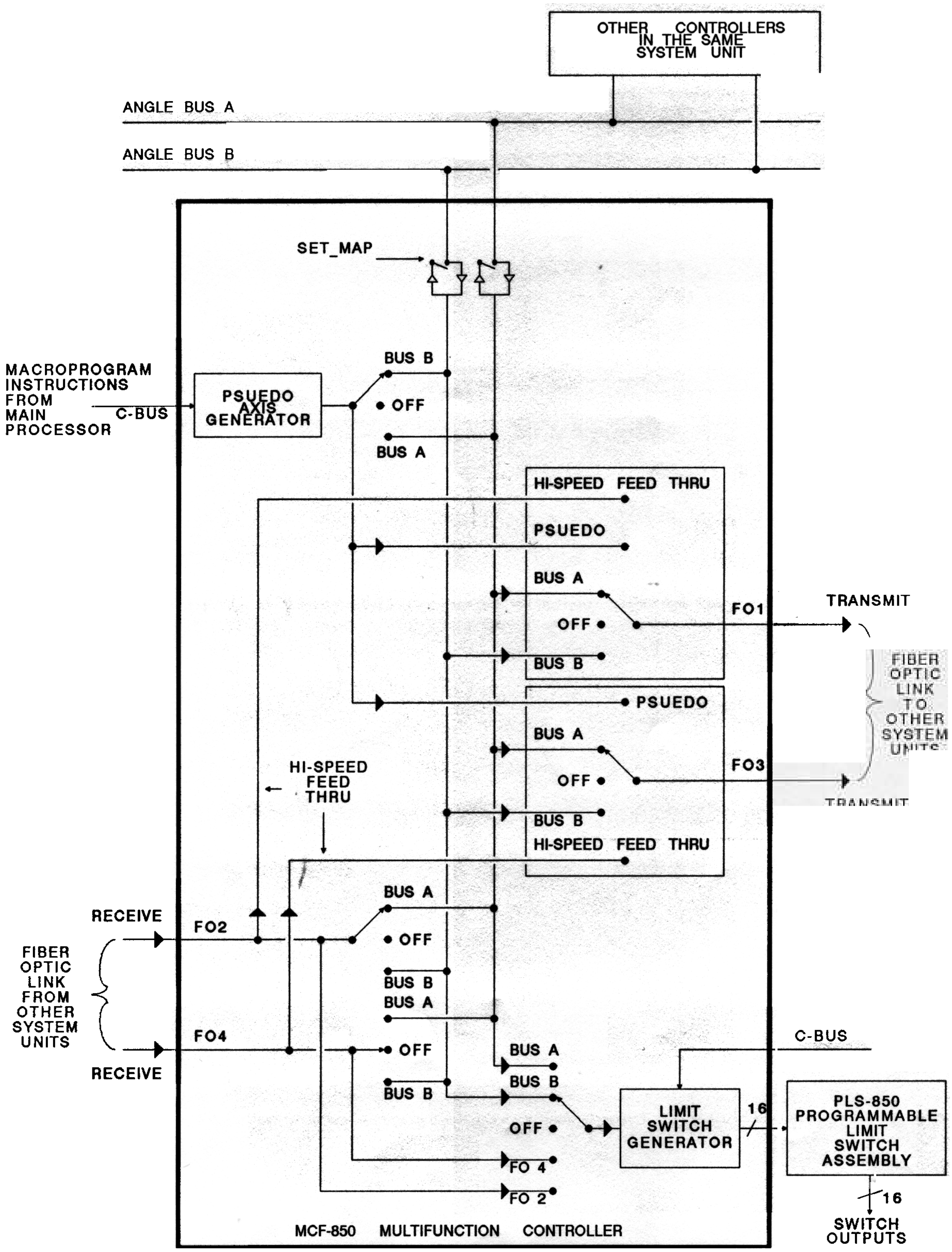


Figure 1-2 MCF-850 Multifunction Controller, Data Paths

2.0 DESCRIPTION

2.1 General

The MCF-850 Multifunction Controller is an intelligent circuit board that provides complementary functions to the MSC-850 Motion Control System.

2.2 Pseudo Axis Functional Description

The Multifunction Controller can be used to accept motion commands which act on an imaginary motor called the pseudo axis. The pseudo is capable of:

- o velocity control
- o positioning
- o indexing
- o master/slave

The pseudo axis (Figure 1-2) is typically used as a master and its command data can be broadcast through software configured switches ('set_map' and 'set_mcf') to one of the Angle Buses in the same MSC-850 System Unit. The pseudo axis output can also be sent over Fiber Optic Links to either of the Angle Buses in other MSC-850 System Units. Other axis controllers can lock onto this angle data.

The pseudo axis may also be used to provide angle data in programmable limit switch applications when an active or passive master is not available.

The motion control commands generated by any of the controllers assigned and locked to the same Angle Bus, are now synchronized to the pseudo axis of the Multifunction Controller.

The pseudo axis can perform any motion that a motion control axis can perform, including certain master/slave locks (refer to IB-11C001 for specific lock types available). The pseudo axis cannot perform any cam profiles.

2.3 Programmable Limit Switch Functional Description

The MCF-850 Multifunction Controller in conjunction with the PLS-850 Programmable Limit Switch Assembly is used to produce position related outputs. These outputs can simulate the functions of mechanical cam switching and drum switching techniques.

The Macroprogram can command the Multifunction Controller to produce an output that closes or opens a solid state relay switch (OPTO 22 type Output Module mounted on the PLS-850 Assembly) at a specific angle for each revolution of the feedback device's shaft. Since the Multifunction Controller does not have a direct position sensor input, the position information is provided through an Angle Bus or Fiber Optic Link (Figure 1-2).

The angles are entered as bits of a revolution with a resolution of 1 part in 4096, where 0 bits is equal to 0 degrees and 4095 bits is equal to 359.9 degrees. Each output can be programmed for one on-angle and one off-angle. For example: on at 1000 and off at 2000 means that an output is on when the feedback device's shaft is between 1000 bits (87.9 degrees) and 2000 bits (175.8 degrees) regardless of the direction of rotation.

The PLS-850 Assembly (Figure 2-1) on which the output modules are mounted requires a separate 115V ac power source. The assembly can support 16 modules of either the DC or AC output type. The assembly is connected through a 50-pin 2-ft. (610 mm) flat ribbon cable (supplied as part of the PLS-850 Programmable Limit Switch Assembly) to the MCF-850 Multifunction Controller.

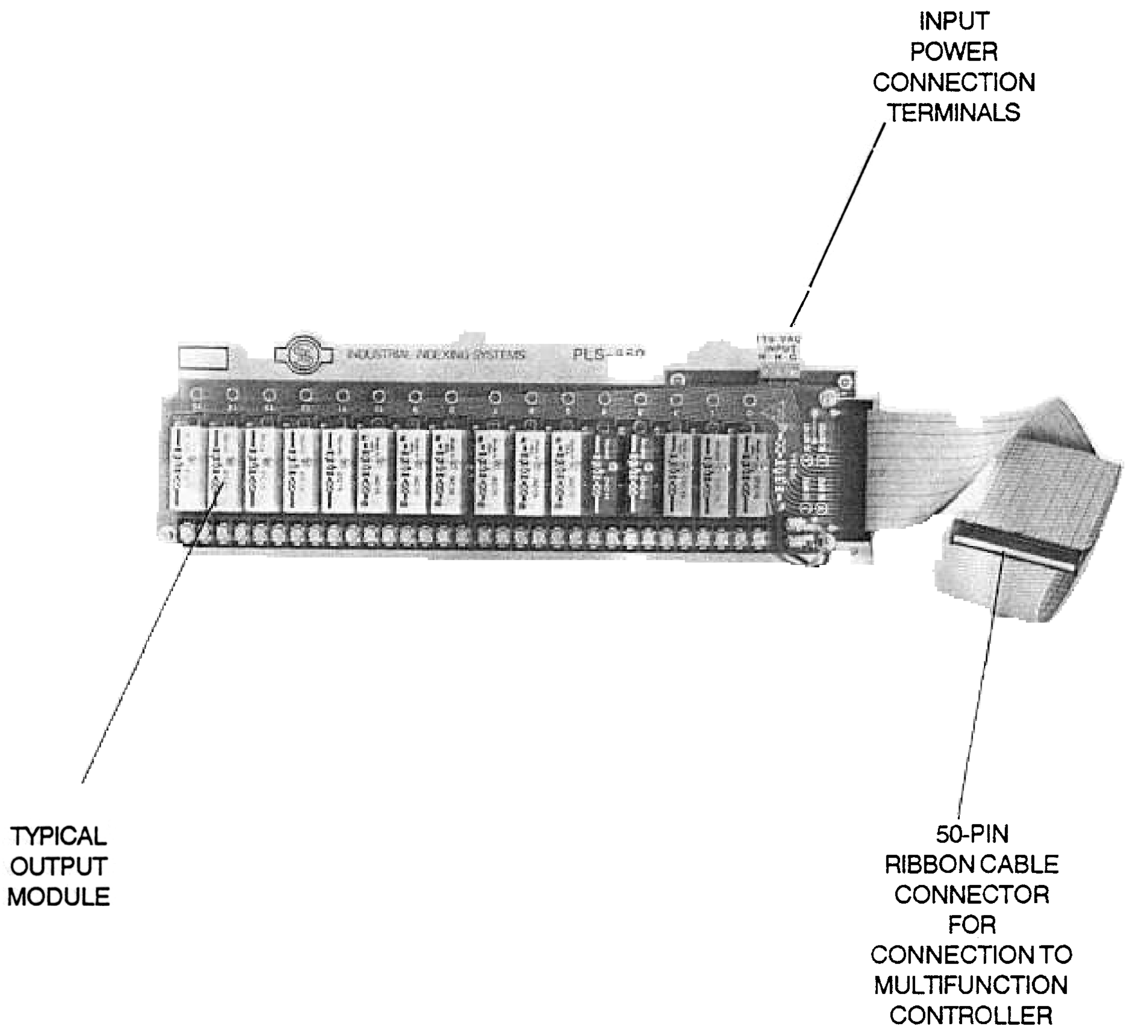


Figure 2-1 PLS-850 Programmable Limit Switch Assembly

2.4 Fiber Optic Link Functional Description

The Multifunction Controller can be used to connect the Angle Buses of multiple System Units together through a Fiber Optic Communication Network. Fiber Optic transmission of data is done at high speeds and can provide excellent noise immunity. Each System Unit in the network must have a Multifunction Controller and the distance between System Units cannot exceed 100 feet (30 Meters).

The controller has 4 Fiber Optic Link ports. Two of the ports are transmit ports and 2 of the ports are receive ports. Any transmit port on one Multifunction Controller can physically be connected to any receive port on another Multifunction Controller. This is done through software switches (Figure 1-2) over the Fiber Optic Communication Network (Figure 6-3). The Macroprograms, unique to each System Unit, instruct their respective controllers to create the link for transmission of master angle data from either Angle Bus of one System Unit to either angle bus of the other System Unit.

The Angle Bus in each System Unit is internally synchronized to its own unit's system clock. The Multifunction Controller takes the master angle data once every millisecond and transmits it over the Fiber Optic Link in a synchronous format. The master angle data being transferred between the two System Units is handled by the sync-encode / sync-decode functions on the Multifunction Controller.

A high-speed feed through path is provided to allow the angle data to pass from one System Unit to another without the 1 millisecond delay caused by the angle bus in the interconnecting System Unit (Figures 1-2 and 6-3).

2.5 Nonvolatile Data Storage Functional Description

The MCF-850 Multifunction Controller contains 32K bytes of nonvolatile RAM that can be used to store program data. The method of accessing this RAM is identical to the method used to access data arrays in the System Unit. Refer to the Macroprogram Development System Instruction Book for a detailed explanation of this method.

2.6 Status and Fault Indicators

2.6.1 Power-up Fault Detection

On power-up, the controller's microprocessor, memory, and multiply divide circuit are put through a series of tests. If the controller passes the tests, then the board is considered to be operational and a green indicator, labeled SELF TEST OK, is lighted and remains lighted even if a subsequent fault occurs. On start-up, the SELF TEST OK indicator may also be lighted along with the yellow INTERRUPT and red BUS FAULT indicators. If this combination of indicators are lighted on start-up, a controller start-up fault has occurred. This may or may not be the fault of the controller. A start-up retry should be attempted and if the same combination of indicators are lighted, then the controller can be suspected as being faulty.

2.6.2 Status Indicators Description

During normal operation, the SELF TEST OK indicator is lighted. As the Macroprogram executes the required instruction and the MAC-850 Main Processor communicates with the controller, the INTERRUPT indicator flickers or appears to be on steady due to rapid flickering.

If during normal operation, a problem with the controller or main processor is detected, the BUS FAULT indicator will come on.

For a more detailed description of the physical and functional characteristics of these indicators, refer to Section 4.

3.0 SPECIFICATIONS

3.1 Functional Characteristics

3.1.1 Pseudo Axis Functions

Commands	Velocity Positioning Indexing

3.1.2 Programmable Limit Switch Functions

Hardware Outputs	16 industry standard ODC15 and OAC15 output type solid state relay modules

Optically Isolated Output Modules

AC Output Module (OAC15)	
Operating Voltage Range	12 to 140V ac
Current Rating @ 70 C	2 Amps Max
Output Voltage Drop (Peak)	1.6V ac Max
Off-state Leakage @ 120V ac	5 mA rms
DC Output Module (ODC15)	
Operating Voltage Range	5 to 60V dc
Current Rating @ 70 C	2 Amps Max
Output Voltage Drop	1.6V dc Max
Off-state Leakage @ 60V dc	1 mA

Software Outputs	8 polling flags of which 4 can cause software interrupts
Source of Angle Data	Programmable from either Angle Bus or either Fiber Optic Link.

3.1.3 Fiber Optic Link Functions

Data Ports	2 Transmitters 2 Receivers
Data Type	Master Angle Data with synchronization

3.1.4 Data Storage Functions

Data Retention Method	Nonvolatile RAM
Storage Space	32 K Bits
Data Type	Macroprogram variables

3.2 Performance Characteristics

3.2.1 Pseudo Axis Functions

Positional Range	+/- 2047 Revolutions
Positional Resolution	1/4096 Revolution increments
Acceleration/Deceleration Range	0.004 to 800 revolutions/sec/sec
Speed Range	0.004 to 3600 rpm in 1 rpm increments +/- 1% accuracy of set speed

3.2.2 Programmable Limit Switch Functions

Reaction Time Delay	
Hardware Outputs	
Type ODC15	1.2 milliseconds max
Type OAC15	1.2 milliseconds + line cycle
Software Flags	Program dependent
Input Power	
Voltage	100 to 130V ac
Frequency	48 to 62 Hz
Current	0.5 A max

3.2.3 Data Storage Functions

Nonvolatile RAM Battery Life	7 years min @ 25 C

3.2.4 Environmental

Operating Temperature	32° to 140° F (0° to 60° C)
Operating Humidity	30 to 90 % Non-condensing

3.3 Physical Characteristics

3.3.1 MCF-850 Multifunction Controller

Dimensions	
Width	5 5/16 in. (135 mm)
Depth	6 5/16 in. (160 mm)
Weight	1 lb. (0.45 Kg)
Mounting	Occupies any slot in MSC-850 System Unit

3.3.2 PLS-850 Programmable Limit Switch Assembly

Dimensions	
Height	5 in. (127 mm)
Width	15 3/4 in. (400 mm)
Depth	2 1/2 in. (63.5 mm)
Weight	3 lbs (1.36 Kg)
Mounting	Panel

3.3.3 Fiber Optic Link Cable

Length	100 ft. (30 M) Max

4.0 CONTROLS AND INDICATORS

4.1 General

The MCF-850 Multifunction Controller is equipped with five status indicators. These indicators are visible through a cut-out in the faceplate of the System Unit. The indicators are illustrated in Figure 4-1 and listed in Table 4-1.

There are no setable devices on the MCF-850 Controller. All parameters and functional controls are established by the Macroprogram.

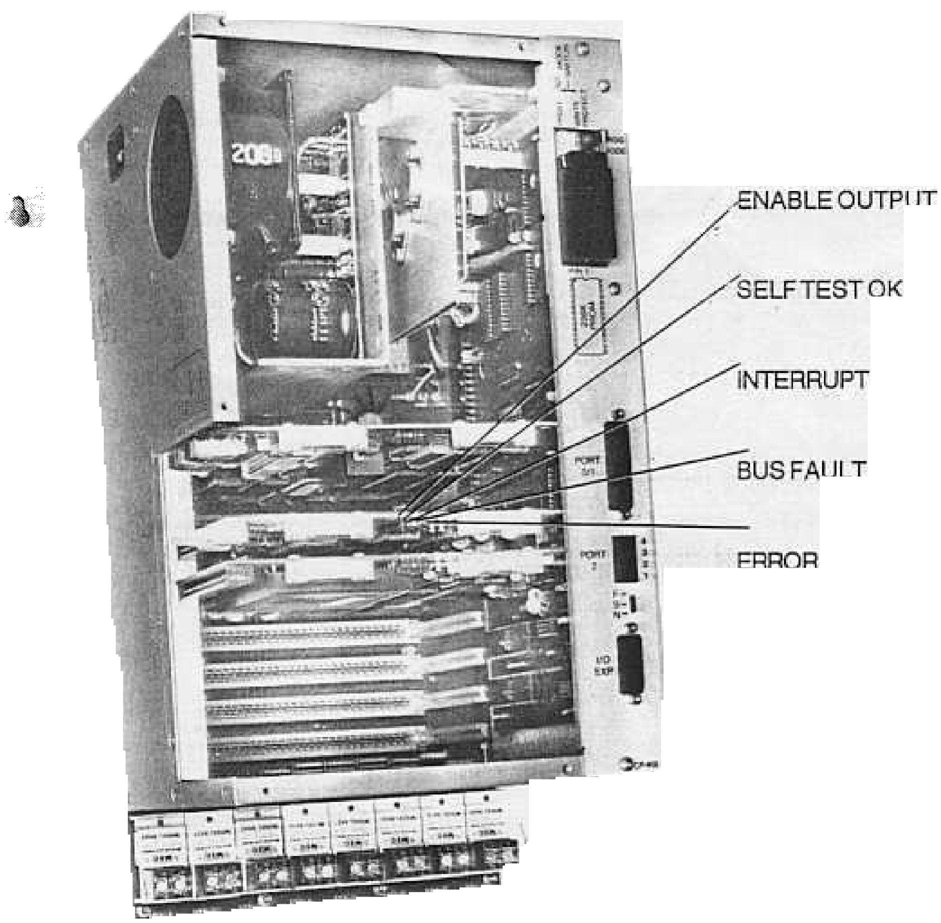


Figure 4-1 Identification of Status Indicators

Table 4-1 Identification of Status Indicators

PANEL MARKING	DESCRIPTION	OBSERVED INDICATION	INDICATION FUNCTION
ENABLE OUTPUT	Green LED	Steady On	When angle data to PLS-850 function is zero.
SELF TEST OK	Green LED	Steady On	The controller passed the self test during start up.
INTERRUPT	Yellow LED	Flashing	The controller is communicating with the Main Processor.
BUS FAULT	Red LED	Steady On	Communication on the C-Bus between the controller and Main Processor was faulty. A subsequent good communication sequence resets the BUS FAULT indicator.
ERROR	Red LED	Flashing	A controller fault has been detected.

NOTE

If, during start up, the SELF TEST OK, INTERRUPT, BUS FAULT and ERROR indicators come on, a controller start-up fault has occurred. A start-up retry should be attempted and if the same combination of indicators are lighted, then the controller can be suspected of being faulty.

5.0 FUNCTIONALITY TESTS

5.1 General

The MCF-850 Multifunction Controller has 4 different functions. These functions can be used independently or in any combination.

For an MCF-850 Multifunction Controller that is performing multiple functions, a simple observation can indicate the controller's functionality. That is:

- o If just one function is not operating properly then the problem may not be on the controller and the tests described in this section can help isolate the fault. The tests provided in this section treat each function independently.
- o If all functions are not operating properly, then the controller is probably faulty. In this case the controller should be replaced and if the functions are still not operational, then the problem is probably in the MSC-850 System Unit.

5.2 Pseudo Axis Functions

If the Multifunction Controller is performing the pseudo axis function and the Motion Control System seems to be lacking this information, proceed as follows:

1. Turn off the system power.
2. Check to make sure the controller is in the correct slot based on your Macroprogram and is properly seated in the connector.
3. Verify that the 'set_map' instruction in the Macroprogram is directing the angle data generation command to the correct slot in the System Unit. Refer to 'set_map' instruction in the Macroprogram Development System Instruction Book.
4. Turn on the system power and observe the status indicators on the front edge of the MCF-850 Multifunction Controller.
    - o The green SELF TEST OK indicator should come on and stay on. If the green SELF TEST OK indicator does not stay on, replace the MCF-850 Multifunction Controller.
    - o If the green SELF TEST OK indicator comes on along with the yellow INTERRUPT indicator and the red BUS FAULT indicator, replace the MCF-850 Multifunction Controller.

5.3 Programmable Limit Switch Functions

When the MCF-850 Multifunction Controller is operating as a programmable limit switch, it works in conjunction with a ribbon cable and a PLS-850 Programmable Limit Switch Assembly. The output module logic circuits on this assembly are powered by an on-board 15V-dc Power Supply. This power supply is connected to a 115V-ac source. The following tests can help isolate the faulty element in this group of components.

5.3.1 Mechanical and Software Tests

1. Turn off system power.
2. Check to make sure the controller is in the right slot and is properly seated in the connector.
3. Verify that the Macroprogram is directing the programmable limit switching commands to the right slot in the Svstem Unit.
4. Restart the system and observe the status indicators on the front edge of the MCF-850 Multifunction Controller.
   - o The green SELF TEST OK indicator should come on and stay on. If the green SELF TEST OK indicator does not stay on, replace the MCF-850 Multifunction Controller.
   - o If the green SELF TEST OK indicator comes on along with the yellow INTERRUPT indicator and the red BUS FAULT indicator, replace the MCF-850 Multifunction Controller.

5.3.2 PLS-850 Programmable Limit Switch Assembly Tests

1. Turn on the system power
2. Observe the indicators on the PLS-850 Programmable Limit Switch Assembly in which output modules are located. If none of the indicators are lighted, proceed as follows:
   - o Set a Multimeter to the 15V-dc scale.
   - o Connect the red and black meter leads to the + and - terminals located next to the ribbon connector.
   - o The meter should indicate 15V dc +/-1V dc. If the 15V-dc indication is within specifications, go to step 3. If not, proceed as follows.
   - o Set the Multimeter to the 115V-ac scale.

WARNING

Lethal voltages. Proceed with caution.

   - o Connect the meter leads to the "N" and "H" terminals.
   - o The meter should indicate between 100 and 130 V ac.
   - o If the meter indication is within specification, replace the PLS-850 Programmable Limit Switch Assembly. If out of specification, check the incoming power cord and the ac power source.

3. Turn off the system power and check the 50-conductor ribbon cable between the PLS-850 Programmable Switch Assembly and the controller for open conductors or shorts between conductors.

   - o Replace the PLS-850 Programmable Limit Switch Assembly if any problems are suspected.
   - o Turn on the system power and if problems still exists, replace the MCF-850 Multifunction Controller.

NOTE

Output Module must be installed for LED to function.

5.4 Fiber Optic Link Functions

When the MCF-850 Multifunction Controller is operating as part of a Fiber Optic Network, multiple controllers linked together with fiber optic cables are involved. Any of these elements can be at fault. The following tests help isolate the faulty component.

5.4.1 Mechanical and Software Test

1 Turn off the system power.

2. Check to make sure the cards are properly seated in the controller slots.

3. Verify that the Macroprogram is directing the transmit and receive commands to the correct ports of both controllers and to the right slots in each of the System Units .

4. Turn on the system power and observe the status indicators on the front edge of the MCF-850 Multifunction Controllers.

   - o The green SELF TEST OK indicator should come on and stay on. If the green SELF TEST OK indicator does not stay on, replace the MCF-850 Multifunction Controller.
   - o If the green SELF TEST OK indicator comes on along with the yellow INTERRUPT indicator and the red BUS FAULT indicator, replace the MCF-850 Multifunction Controller.

5.4.2 Light Transmission Tests

The light transmission tests are conducted by visually checking for the presence of light at the source and destination at each Multifunction Controller in each System Unit in the Fiber Optic Network. This is accomplished by following the instructions in the Fiber Optic Network Troubleshooting Chart, Figure 5-1.

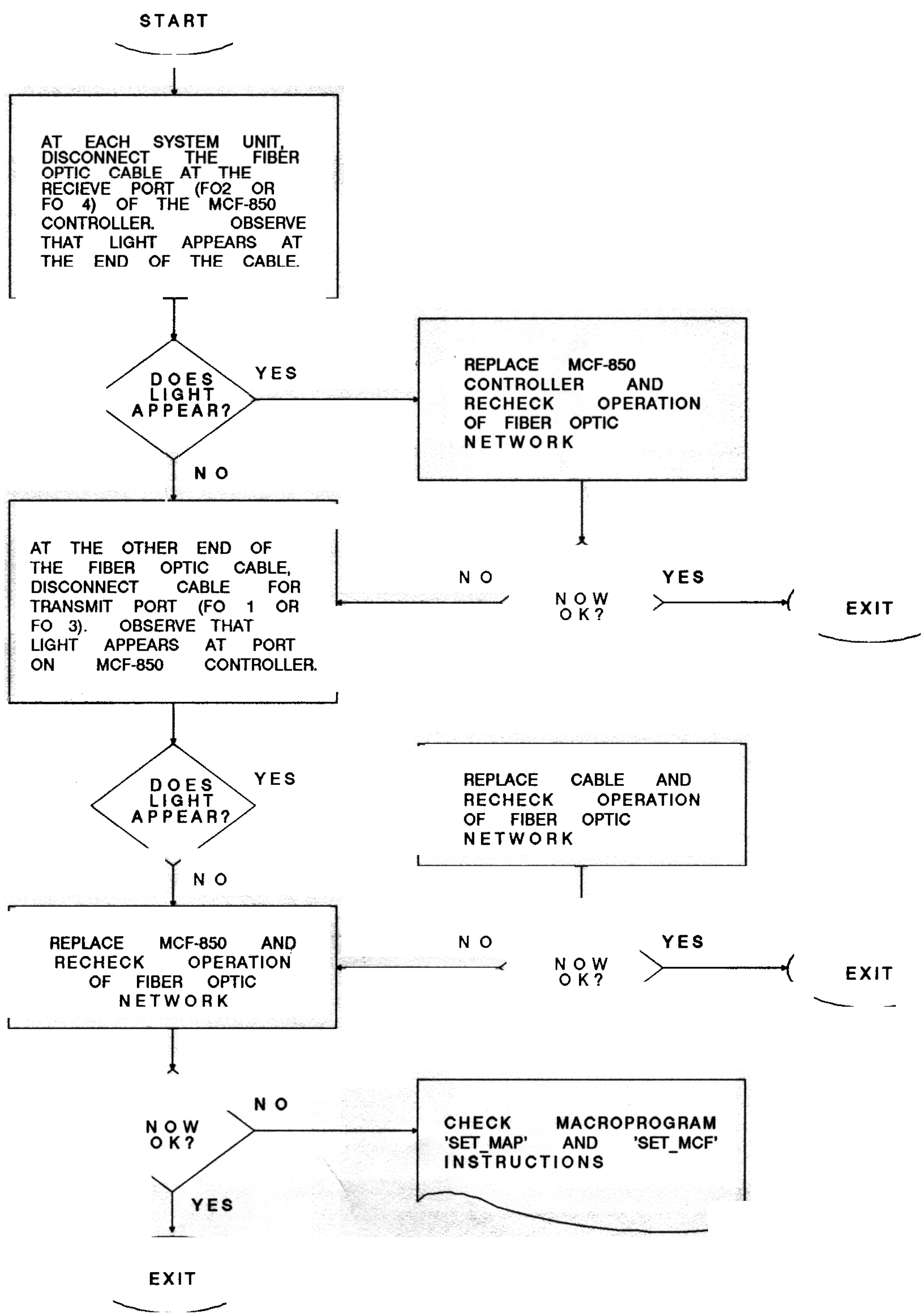


Figure 5-1 Fiber Optic Network, Troubleshooting Chart

5.5 Nonvolatile Memory Functions

1 Turn off the svstem power.

2. Check to make sure the controller is in the right slot and is properly seated.

3. Verify that the Macroprogram is directing the data to the right slot in the System Unit.

4. Turn on the system power and observe the status indicators on the front edge of the MCF-850 Multifunction Controller.

   o The green SELF TEST OK indicator should come on and stay on. If the green SELF TEST OK indicator does not stay on, replace the MCF-850 Multifunction Controller.

   o If the green SELF TEST OK indicator comes on along with the yellow INTERRUPT indicator and the red BUS FAULT indicator, and if the red ERROR indicator is flashing, replace the MCF-850 Multifunction Controller.

6.0 DIAGRAMS

6.1 General

This section contains the electrical connections for the programmable limit switch functions and fiber optic link functions of the MCF-850 Multifunction Controller. Detailed information on the proper connection of the OPTO type output relay modules is included in Figures 6-1 and 6-2. The multiple combinations of Fiber Optic Link configurations is given in Figures 6-3 and 6-4. The 50-pin connector which connects the PLS-850 Programmable Switch Assembly to the Multifunction Controller is given in Figure 6-5. The physical make up of the Fiber Optic Link Cable is given in Figure 6-6.

Figure 6-7 illustrates the mounting dimension requirements for the PLS-850 Programmable Limit Switch Assembly.

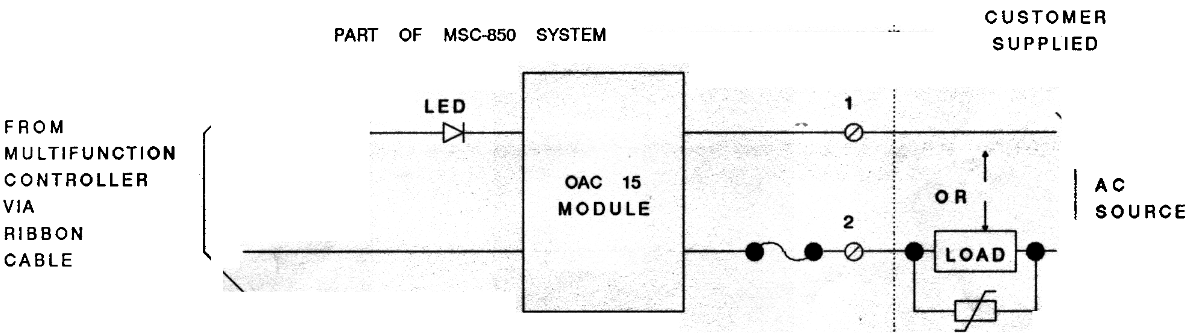


Figure 6-1 AC Output Module, Connection Diagram

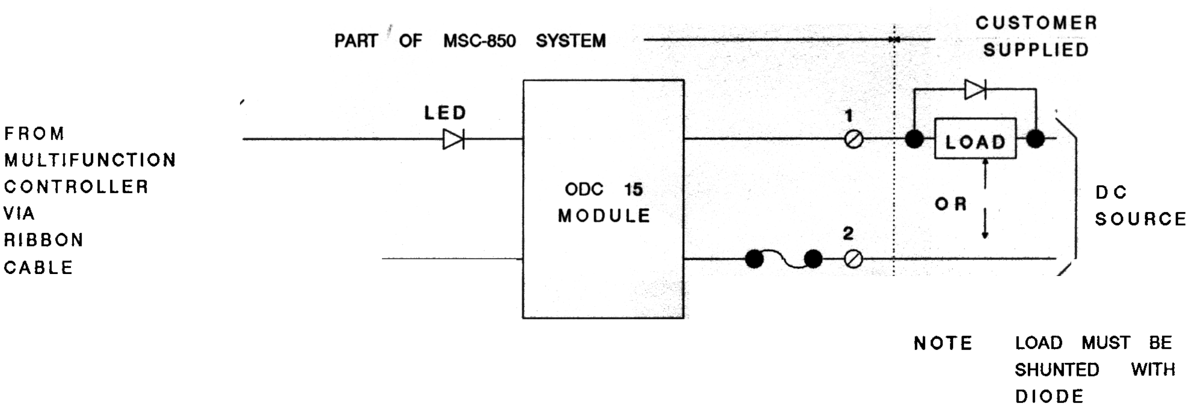
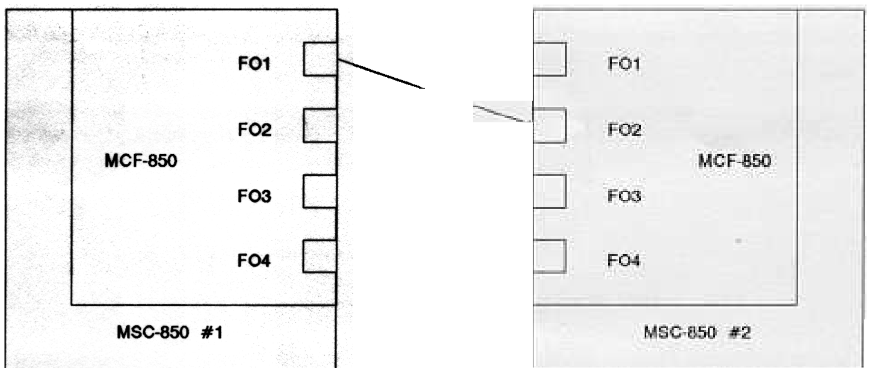
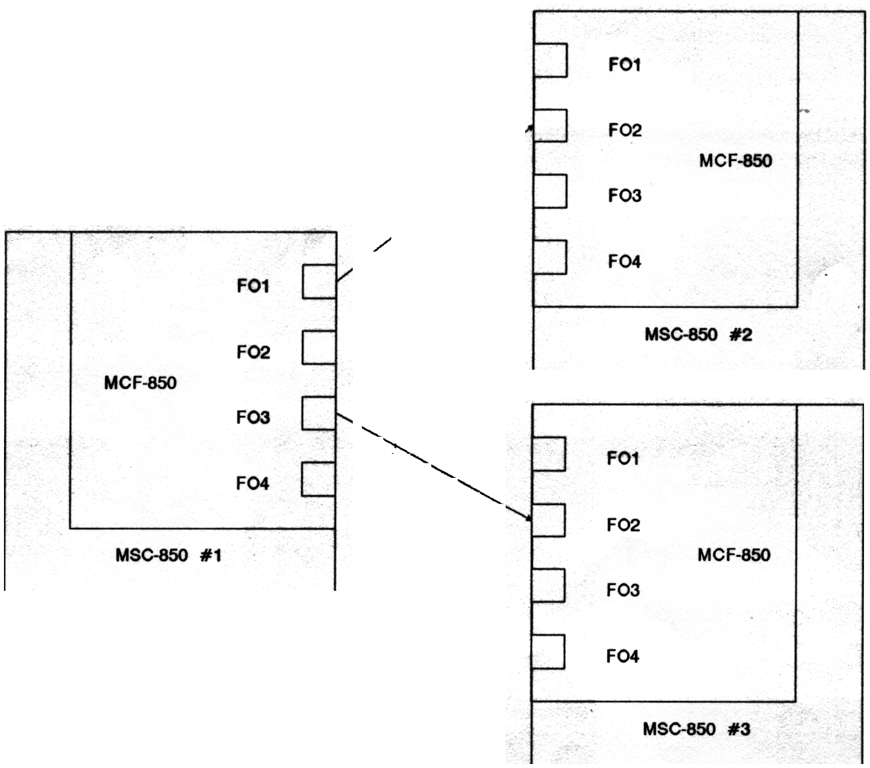


Figure 6-2 DC Output Module, Connection Diagram



CONFIGURATION NO. 1

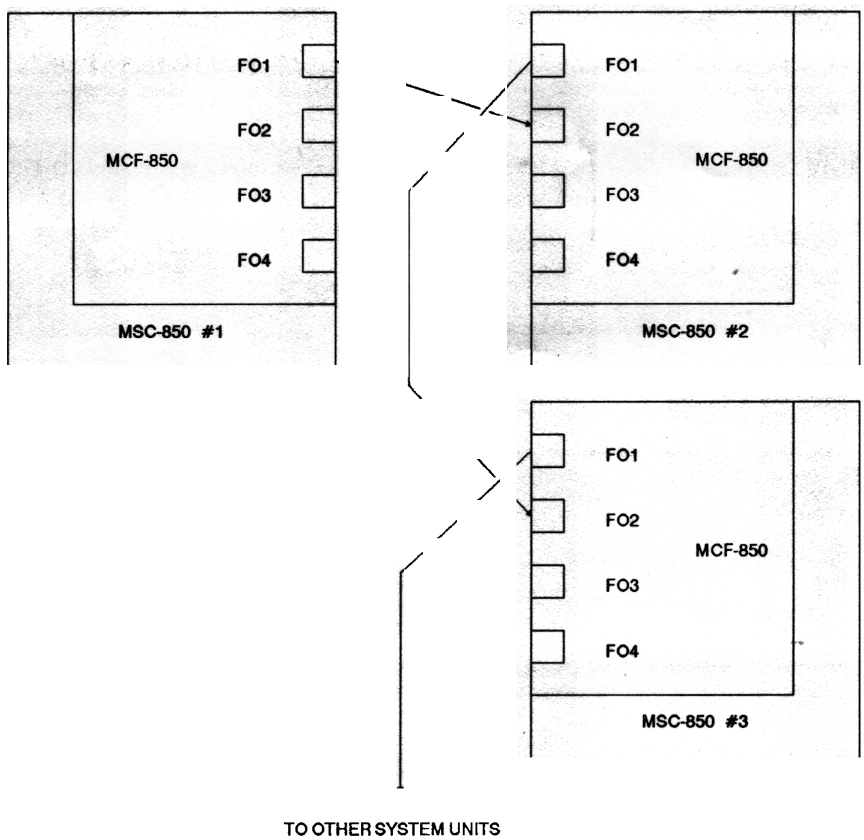
1 ANGLE BUS IN A SYSTEM UNIT TO 1 ANGLE BUS IN ANOTHER SYSTEM UNIT



CONFIGURATION NO. 2

2 ANGLE BUSES IN A SYSTEM UNIT TO 1 ANGLE BUS IN 2 OTHER SYSTEM UNITS

Figure 6-3 Fiber Optic Link Configurations 1 and 2



CONFIGURATION NO. 3

1 ANGLE BUS IN A SYSTEM UNIT THROUGH HIGH-SPEED FEED-THRU TO 1 ANGLE BUS ON MULTIPLE SYSTEM UNITS

Figure 6-4 High-speed Feed-thru Fiber Optic Link Configuration

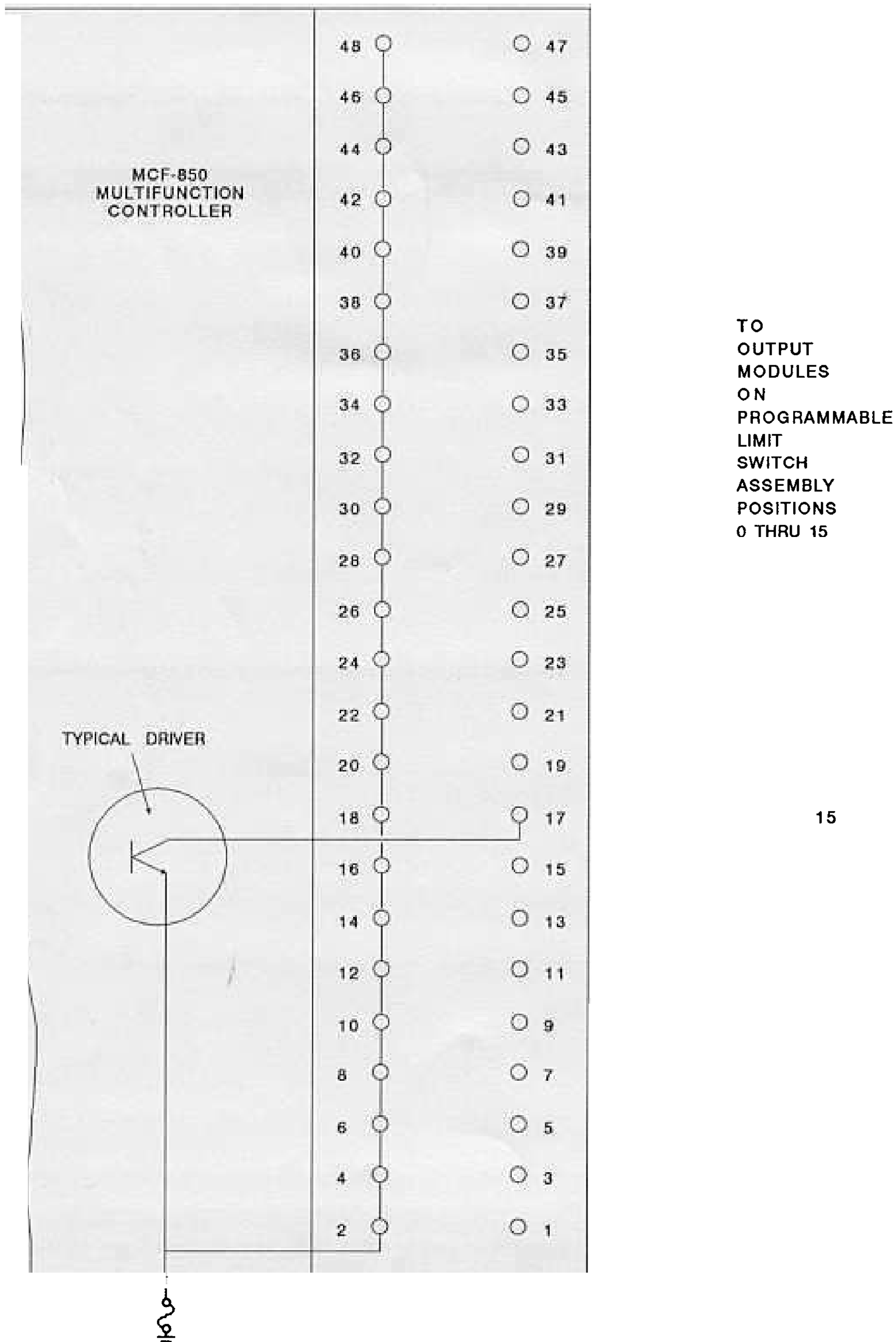
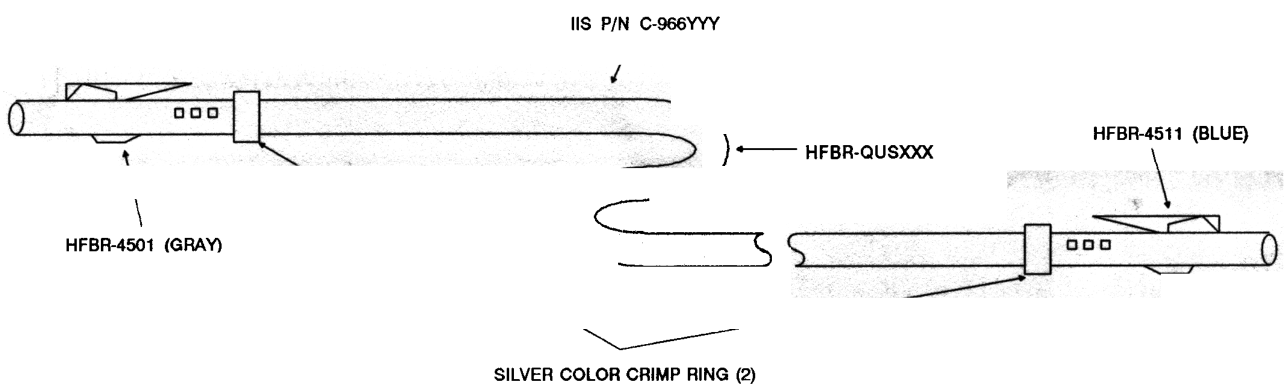


Figure 6-5 PLS-850 Programmable Limit Switch 50-Pin Connector



PREMADE CABLES

HEWLETT-PACKARD P/N	LENGTH (METERS)
HFBR-QNS001	1
HFBR-QNS005	5
HFBR-QNS010	10

NOTE: LENGTH NOT TO EXCEED 100 FT (30 M)

Figure 6-6 Fiber Optic Link Cable, C-966YYY

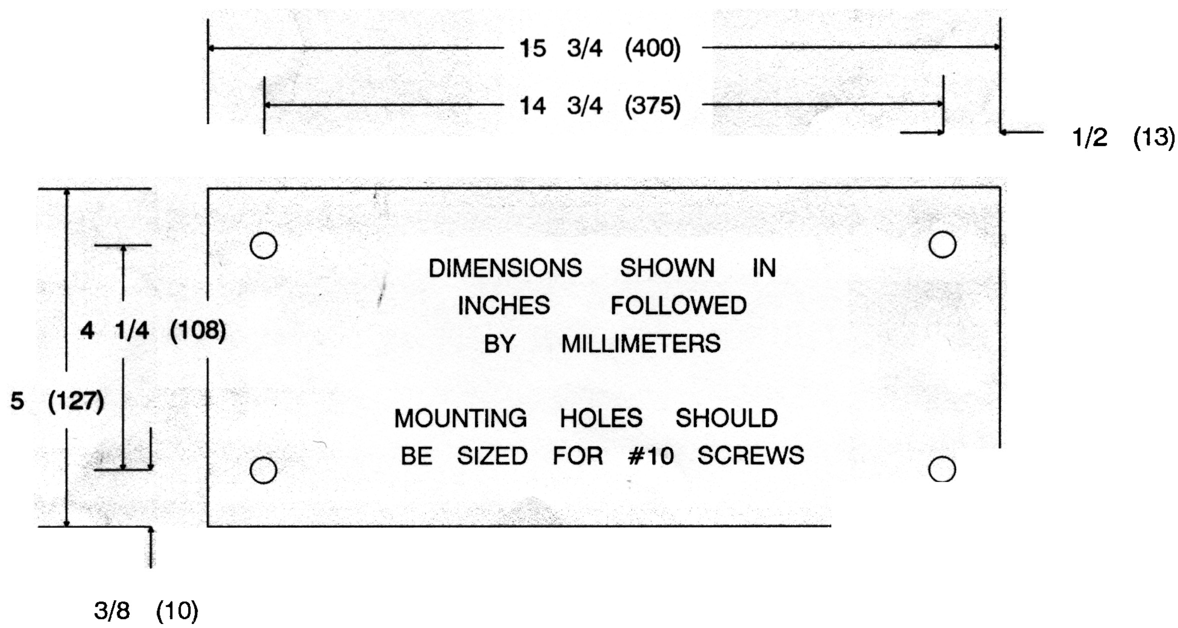


Figure 6-7 PLS-850 Assembly, Mounting Requirements

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- o Macroprogram Development System
- o MSC-850 System Unit

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IB-11B004

INDUSTRIAL INDEXING SYSTEMS INC.

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X-AXIS

DSD-35/RAI (800W)

AMPLIFIER SET-UP

ROBO

ABM INTERNATIONAL

INDUSTRIAL INDEXING SYSTEMS, Inc.

Revision - 0
Approved By:

USER PARAMETER	FUNCTION	RANGE	APPLICATION
UP-01	Control Mode	00~FF	1
UP-02	Applicable Motor	000~FFFF	1309
UP-03	Resolver Cable Length	0-120m	5
UP-04	Electronic Gear Numerator	1-32767	24000
UP-05	Electronic Gear Denominator	1~32767	4096
UP-06	Home Position Shift Amount	0~11999	0
UP-08	Stop Detection RPM	1-4000 rpm	50
UP-09	Speed Reach RPM	0-4000 rpm	0
UP-10	Speed Reach Detection Width	1-4000 rpm	20
UP-11	Current Limit Value	0~100.0%	100.0
UP-12	Soft Start Acceleration Time	0~32.76 sec	0.00
UP-13	Soft Start Deceleration Time	0~32.76 sec	0.00
UP-14	S-curve Accel/Decel Time	0~32.76 sec	0.00
UP-15	ABS Clear	0~2	0
UP-16	Brake Mode	0~2	0
UP-17	Analog Command Polarity	00~11	00
UP-19	Pulse Output Type	00~11	01
UP-20	Differential Output Type	0000-5533	0000
UP-25	Monitor Output Type	000~111	010
UP-28	Brake ON RPM	0~100.0%	100.0
UP-29	Motor Test RPM	1~4000 rpm	50
UP-30	External Regen Resistor Ω (Software version 10 and above)	0~100.0	0
UP-31	External Regen Resistor W (Software version 10 and above)	0~ 327.67 Kw	0

ADJUSTMENT	FUNCTION	RANGE	APPLICATION SETTING
AJ0	Speed Command Zero Adj.	±10.00v	0.00
AJ1	Speed Command Span Adj.	3~10.00v	7.00
*AJ2	Load Inertial Magnification	0~100.0 times	14.0
*AJ3	High Speed Response	0.1~20.0	0.1
*AJ4	Position Gain	1~200 rad/s	30
AJ5	Current Command Zero Adj.	±10.00v	-0.00
AJ6	Current Command Span Adj.	3~10.00v	10.00
AJ7	Gain Reduction While Stopped	0~10000	0
AJ9	Current Command Filter	100~20000 rad/s	6000

*Auto tuning affects these parameters

SU-065114

AMPLIFIER SET-UP - AXIS 4 **JULY 1999**

Y-AXIS

DSD-35/RAI
(1400W)

AMPLIFIER
SET-UP

ROBO

ABM INTERNATIONAL

INDUSTRIAL INDEXING SYSTEMS, Inc.

Revision - 0
Approved By:

USER PARAMETER	FUNCTION	RANGE	APPLICATION
UP-01	Control Mode	00~FF	1
UP-02	Applicable Motor	000~FFFF	1311
UP-03	Resolver Cable Length	0-120m	5
UP-04	Electronic Gear Numerator	1-32767	24000
UP-05	Electronic Gear Denominator	1~32767	4096
UP-06	Home Position Shift Amount	0~11999	0
UP-08	Stop Detection RPM	1-4000 rpm	50
UP-09	Speed Reach RPM	0-4000 rpm	0
UP-10	Speed Reach Detection Width	1-4000 rpm	20
UP-11	Current Limit Value	0~100.0%	100.0
UP-12	Soft Start Acceleration Time	0~32.76 sec	0.00
UP-13	Soft Start Deceleration Time	0~32.76 sec	0.00
UP-14	S-curve Accel/Decel Time	0~32.76 sec	0.00
UP-15	ABS Clear	0~2	0
UP-16	Brake Mode	0~2	0
UP-17	Analog Command Polarity	00~11	00
UP-19	Pulse Output Type	00~11	01
UP-20	Differential Output Type	0000-5533	0000
UP-25	Monitor Output Type	000~111	010
UP-28	Brake ON RPM	0~100.0%	100.0
UP-29	Motor Test RPM	1~4000 rpm	50
UP-30	External Regen Resistor Ω (Software version 10 and above)	0~100.0	0
UP-31	External Regen Resistor W (Software version 10 and above)	0~ 327.67 Kw	0

ADJUSTMENT	FUNCTION	RANGE	APPLICATION SETTING
AJ0	Speed Command Zero Adj.	±10.00v	0.00
AJ1	Speed Command Span Adj.	3~10.00v	7.00
*AJ2	Load Inertial Magnification	0~100.0 times	6.0
*AJ3	High Speed Response	0.1~20.0	0.1
*AJ4	Position Gain	1~200 rad/s	30
AJ5	Current Command Zero Adj.	±10.00v	-0.00
AJ6	Current Command Span Adj.	3~10.00v	10.00
AJ7	Gain Reduction While Stopped	0~10000	0
AJ9	Current Command Filter	100~20000 rad/s	6000

*Auto tuning affects these parameters

UPPER

DSD-8.5/RAI (400W)

AMPLIFIER SET-UP

ROBO

ABM INTERNATIONAL

INDUSTRIAL INDEXING SYSTEMS, Inc.

Revision - A
Approved By:

USER PARAMETER	FUNCTION	RANGE	APPLICATION
UP-01	Control Mode	00~FF	1
UP-02	Applicable Motor	000~FFFF	1307
UP-03	Resolver Cable Length	0-120m	5
UP-04	Electronic Gear Numerator	1-32767	24000
UP-05	Electronic Gear Denominator	1~32767	4096
UP-06	Home Position Shift Amount	0~11999	0
UP-08	Stop Detection RPM	1-4000 rpm	50
UP-09	Speed Reach RPM	0-4000 rpm	0
UP-10	Speed Reach Detection Width	1-4000 rpm	20
UP-11	Current Limit Value	0~100.0%	100.0
UP-12	Soft Start Acceleration Time	0~32.76 sec	0.00
UP-13	Soft Start Deceleration Time	0~32.76 sec	0.00
UP-14	S-curve Accel/Decel Time	0~32.76 sec	0.00
UP-15	ABS Clear	0~2	0
UP-16	Brake Mode	0~2	0
UP-17	Analog Command Polarity	00~11	00
UP-19	Pulse Output Type	00~11	01
UP-20	Differential Output Type	0000-5533	0000
UP-25	Monitor Output Type	000~111	010
UP-28	Brake ON RPM	0~100.0%	100.0
UP-29	Motor Test RPM	1~4000 rpm	50
UP-30	External Regen Resistor Ω (Software version 10 and above)	0~100.0	0
UP-31	External Regen Resistor W (Software version 10 and above)	0~ 327.67 Kw	0

ADJUSTMENT	FUNCTION	RANGE	APPLICATION SETTING
AJ0	Speed Command Zero Adj.	±10.00v	0.00
AJ1	Speed Command Span Adj.	3~10.00v	7.00
*AJ2	Load Inertial Magnification	0~100.0 times	1.0
*AJ3	High Speed Response	0.1~20.0	0.1
*AJ4	Position Gain	1~200 rad/s	30
AJ5	Current Command Zero Adj.	±10.00v	0.00
AJ6	Current Command Span Adj.	3~10.00v	10.00
AJ7	Gain Reduction While Stopped	0~10000	0
AJ9	Current Command Filter	100~20000 rad/s	1000

*Auto tuning affects these parameters

SU-065116

AMPLIFIER SET-UP - AXIS 6 OCTOBER 1999

LOWER

DSD-8.5/RAI (400W)

AMPLIFIER SET-UP

ROBO

ABM INTERNATIONAL

INDUSTRIAL INDEXING SYSTEMS, Inc.

Revision - A
Approved By:

USER PARAMETER	FUNCTION	RANGE	APPLICATION
UP-01	Control Mode	00~FF	1
UP-02	Applicable Motor	000~FFFF	1307
UP-03	Resolver Cable Length	0-120m	5
UP-04	Electronic Gear Numerator	1-32767	24000
UP-05	Electronic Gear Denominator	1~32767	4096
UP-06	Home Position Shift Amount	0~11999	0
UP-08	Stop Detection RPM	1-4000 rpm	50
UP-09	Speed Reach RPM	0-4000 rpm	0
UP-10	Speed Reach Detection Width	1-4000 rpm	20
UP-11	Current Limit Value	0~100.0%	100.0
UP-12	Soft Start Acceleration Time	0~32.76 sec	0.00
UP-13	Soft Start Deceleration Time	0~32.76 sec	0.00
UP-14	S-curve Accel/Decel Time	0~32.76 sec	0.00
UP-15	ABS Clear	0~2	0
UP-16	Brake Mode	0~2	0
UP-17	Analog Command Polarity	00~11	00
UP-19	Pulse Output Type	00~11	01
UP-20	Differential Output Type	0000-5533	0000
UP-25	Monitor Output Type	000~111	010
UP-28	Brake ON RPM	0~100.0%	100.0
UP-29	Motor Test RPM	1~4000 rpm	50
UP-30	External Regen Resistor Ω (Software version 10 and above)	0~100.0	0
UP-31	External Regen Resistor W (Software version 10 and above)	0~ 327.67 Kw	0

ADJUSTMENT	FUNCTION	RANGE	APPLICATION SETTING
AJ0	Speed Command Zero Adj.	±10.00v	0.00
AJ1	Speed Command Span Adj.	3~10.00v	7.00
*AJ2	Load Inertial Magnification	0~100.0 times	1.0
*AJ3	High Speed Response	0.1~20.0	0.1
*AJ4	Position Gain	1~200 rad/s	30
AJ5	Current Command Zero Adj.	±10.00v	0.00
AJ6	Current Command Span Adj.	3~10.00v	10.00
AJ7	Gain Reduction While Stopped	0~10000	0
AJ9	Current Command Filter	100~20000 rad/s	1000

*Auto tuning affects these parameters

SU-065127

AMPLIFIER SET-UP - AXIS 1 MARCH 2002

NEEDLE

(ENCODER)

DSD-8.5/EAI
(950W)

AMPLIFIER
SET-UP

ROBO
ABM INTERNATIONAL

INDUSTRIAL INDEXING SYSTEMS, Inc.

Revision - A
Approved By:

USER PARAMETER	FUNCTION	RANGE	APPLICATION
UP-01	Control Mode	00~FF	1
UP-02	Applicable Motor	000~FFFF	6
UP-03	Resolver Cable Length	0-120m	5
UP-04	Electronic Gear Numerator	1-32767	4096
UP-05	Electronic Gear Denominator	1~32767	4096
UP-06	Home Position Shift Amount	0~11999	0
UP-08	Stop Detection RPM	1-4000 rpm	50
UP-09	Speed Reach RPM	0-4000 rpm	0
UP-10	Speed Reach Detection Width	1-4000 rpm	20
UP-11	Current Limit Value	0~100.0%	100.0
UP-12	Soft Start Acceleration Time	0~32.76 sec	0.00
UP-13	Soft Start Deceleration Time	0~32.76 sec	0.00
UP-14	S-curve Accel/Decel Time	0~32.76 sec	0.00
UP-15	ABS Clear	0~2	0
UP-16	Brake Mode	0~2	0
UP-17	Analog Command Polarity	00~11	00
UP-19	Pulse Output Type	00~11	01
UP-20	Differential Output Type	0000-5533	0000
UP-25	Monitor Output Type	000~111	010
UP-28	Brake ON RPM	0~100.0%	100.0
UP-29	Motor Test RPM	1~4000 rpm	50
UP-30	External Regen Resistor Ω (Software version 10 and above)	0~100.0	30
UP-31	External Regen Resistor W (Software version 10 and above)	0~ 327.67 Kw	.03

ADJUSTMENT	FUNCTION	RANGE	APPLICATION SETTING
AJ0	Speed Command Zero Adj.	±10.00v	0.00
AJ1	Speed Command Span Adj.	3~10.00v	7.00
*AJ2	Load Inertial Magnification	0~100.0 times	5.0
*AJ3	High Speed Response	0.1~20.0	0.1
*AJ4	Position Gain	1~200 rad/s	30
AJ5	Current Command Zero Adj.	±10.00v	-0.00
AJ6	Current Command Span Adj.	3~10.00v	10.00
AJ7	Gain Reduction While Stopped	0~10000	300
AJ9	Current Command Filter	100~20000 rad/s	3000

*Auto tuning affects these parameters

SU-065128

AMPLIFIER SET-UP - AXIS 2 MARCH 2002

HOOK
(ENCODER)

DSD-8.5/EAI
(950W)

AMPLIFIER
SET-UP

ROBO
ABM INTERNATIONAL

INDUSTRIAL INDEXING SYSTEMS, Inc.

Revision - A
Approved By:

USER PARAMETER	FUNCTION	RANGE	APPLICATION
UP-01	Control Mode	00~FF	1
UP-02	Applicable Motor	000~FFFF	6
UP-03	Resolver Cable Length	0-120m	5
UP-04	Electronic Gear Numerator	1-32767	4096
UP-05	Electronic Gear Denominator	1~32767	4096
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UP-08	Stop Detection RPM	1-4000 rpm	50
UP-09	Speed Reach RPM	0-4000 rpm	0
UP-10	Speed Reach Detection Width	1-4000 rpm	20
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UP-12	Soft Start Acceleration Time	0~32.76 sec	0.00
UP-13	Soft Start Deceleration Time	0~32.76 sec	0.00
UP-14	S-curve Accel/Decel Time	0~32.76 sec	0.00
UP-15	ABS Clear	0~2	0
UP-16	Brake Mode	0~2	0
UP-17	Analog Command Polarity	00~11	00
UP-19	Pulse Output Type	00~11	01
UP-20	Differential Output Type	0000-5533	0000
UP-25	Monitor Output Type	000~111	010
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UP-29	Motor Test RPM	1~4000 rpm	50
UP-30	External Regen Resistor Ω (Software version 10 and above)	0~100.0	30
UP-31	External Regen Resistor W (Software version 10 and above)	0~ 327.67 Kw	.03

ADJUSTMENT	FUNCTION	RANGE	APPLICATION SETTING
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AJ1	Speed Command Span Adj.	3~10.00v	7.00
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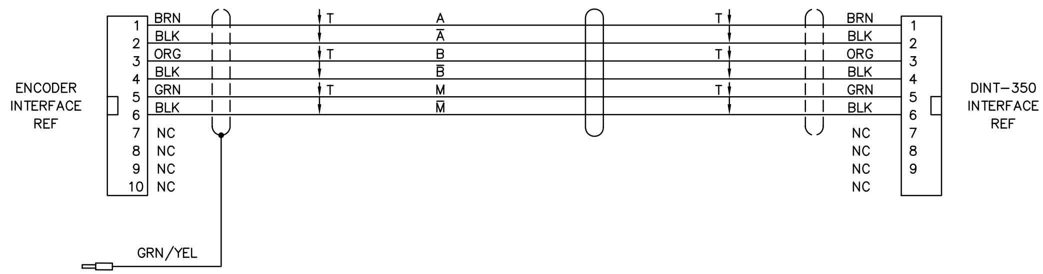
*AJ3	High Speed Response	0.1~20.0	0.1
*AJ4	Position Gain	1~200 rad/s	30
AJ5	Current Command Zero Adj.	±10.00v	-0.00
AJ6	Current Command Span Adj.	3~10.00v	10.00
AJ7	Gain Reduction While Stopped	0~10000	300
AJ9	Current Command Filter	100~20000 rad/s	3000

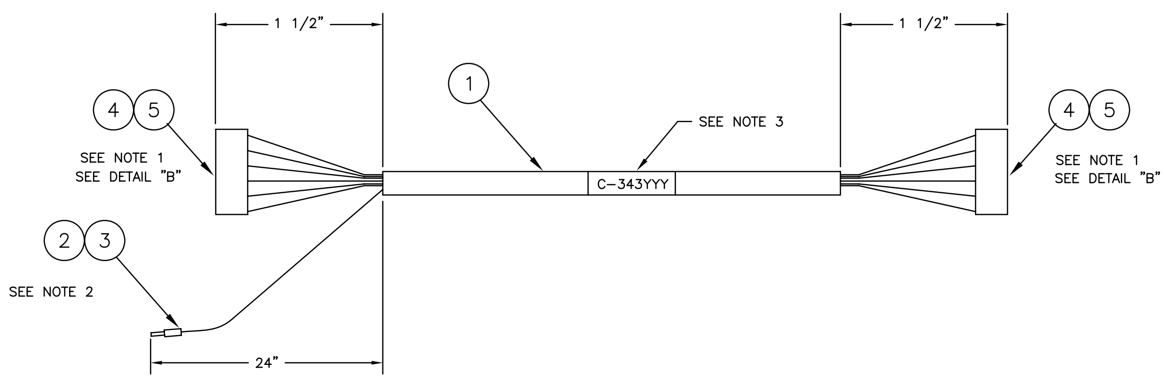
*Auto tuning affects these parameters

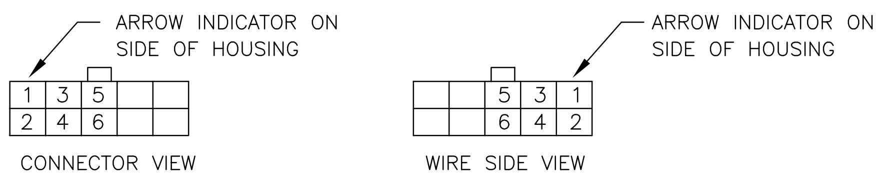
DATE	SYM	REVISION RECORD	DR	CK	CK
31JUL00	0	PER ECN 00-254	JBC		

NOTES:

1) USE AMP CRIMP TOOL 90277-1 OR EQUIV FOR INSTALLATION OF ITEM 5.
2) CRIMP FERRULES USING WEIDMULLER CRIMP TOOL PZ-4 OR EQUIVALENT.
3) MARK PER QP-08-0001.







DETAIL B

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CHECKED BY	DATE
APPROVED BY	DATE
APPROVED BY	DATE
MATERIAL ----------	
FINISH ----------	

TITLE: CABLE, ENCODER, SHIELDED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)

TOLERANCES: X.X± --- X.XX± --- X.XXX± --- ANGULAR ± ---

DRAWN BY: CASSANO

AutoCAD FILE LOCATION: Q:\CURRENT DWGS

SIZE: B

DATE: 31JUL00

SCALE: ---

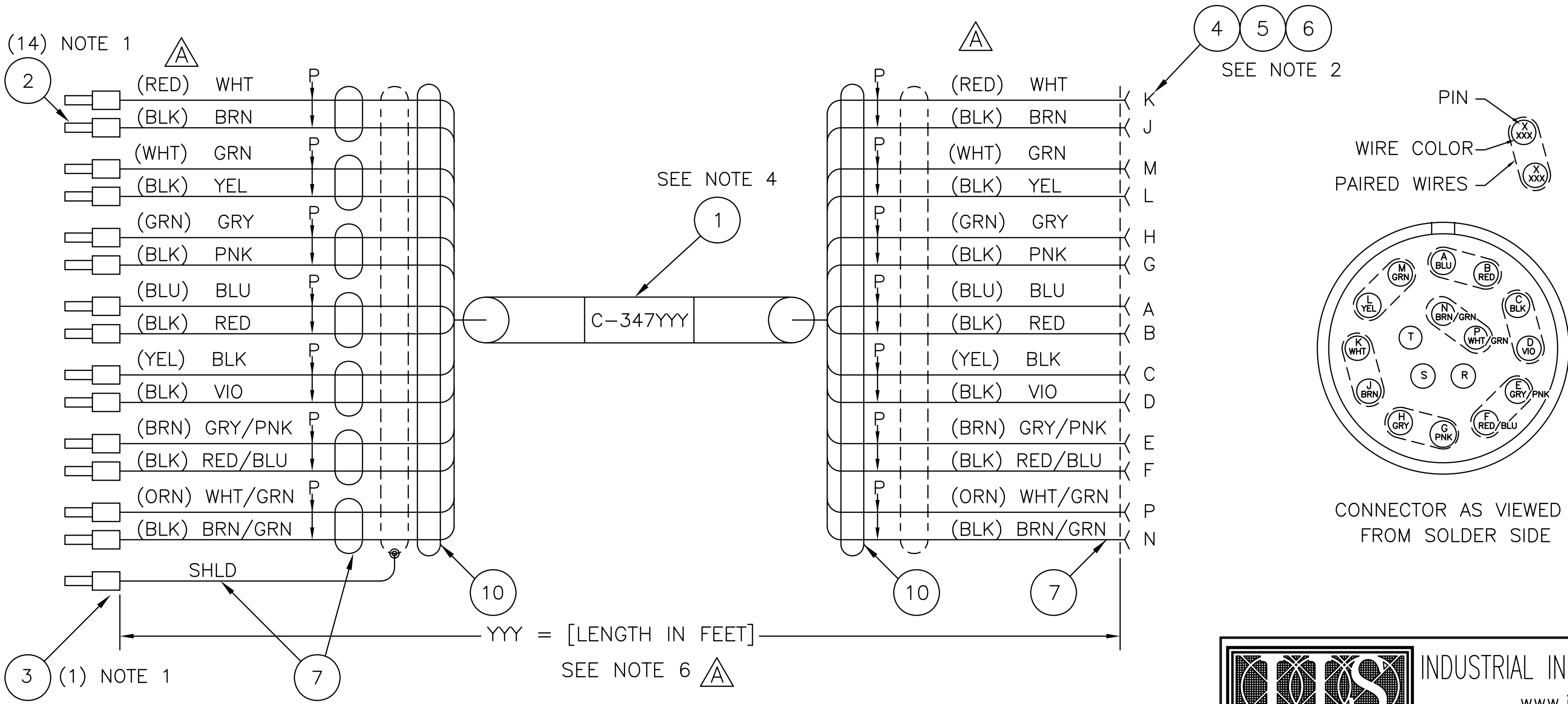
DRAWING NUMBER: C-343YYY

SHEET NO.: 1 OF 1

REVISION: 0

DATE	SYM	REVISION RECORD	DR	CK	CK
10JUL02	A	PER ECN 02-218	EB		

NOTES:
1. INSTALL ITEM 2 & 3 USING WEIDMULLER CRIMP TOOL PZ4 OR EQUIV.
2. ITEM 6 SUPPLIED AS PART OF STRAIN RELIEF, ITEM 5.
3. IF CRIMP TYPE CONNECTOR IS USED:
   INSTALL ITEM 4 USING AMP TOOL #90277-1.
4. MARK PER QP-08-0001.
5. A COLORS IN ( ) INDICATE ALTERNATE CABLE COLORS.
6. A THERE IS A POTENTIAL FOR SIGNAL DEGRADATION WHEN CABLE LENGTH EXCEEDS 20 FEET, CONSULT FACTORY WHERE APPLICABLE.



INDUSTRIAL INDEXING SYSTEMS, Inc.
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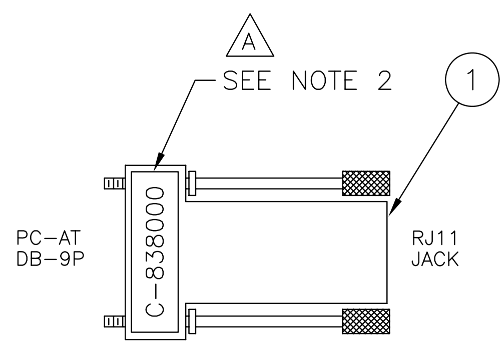
CHECKED BY W.E.S.	DATE 12/21/01
APPROVED BY	DATE
APPROVED BY	DATE
MATERIAL ----------	
FINISH ----------	

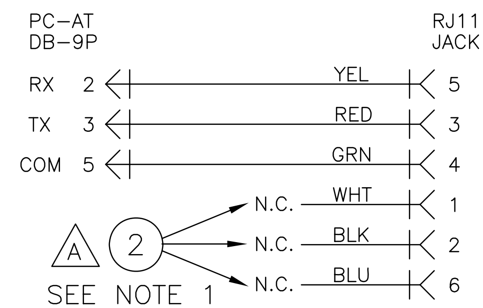
TITLE: CABLE, FLEXIBLE, ENCODER

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY BAIER	DRAWING NUMBER
TOLERANCES	AutoCAD FILE LOCATION Q:\CURRENT DWGS	C-347YYY
X.X± --- / X.XX± --- / X.XXX± --- ; ANGULAR ± ---	B; DATE 21DEC01; SCALE ---	SHEET NO. 1 OF 1; REVISION A

DATE	SYM	REVISION RECORD	DR	CK	CK
13MAR01	A	PER ECN 01-070	CWB		

NOTES: A
1.) INSULATE UNUSED WIRES.
2.) MARK PER QP-08-0001.





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CHECKED BY: E.BAIER	DATE: 1/9/96
APPROVED BY: JC	DATE: 1/9/96
APPROVED BY:	DATE:
MATERIAL: -----------	
FINISH: -----------	

TITLE: CABLE, ADAPTOR

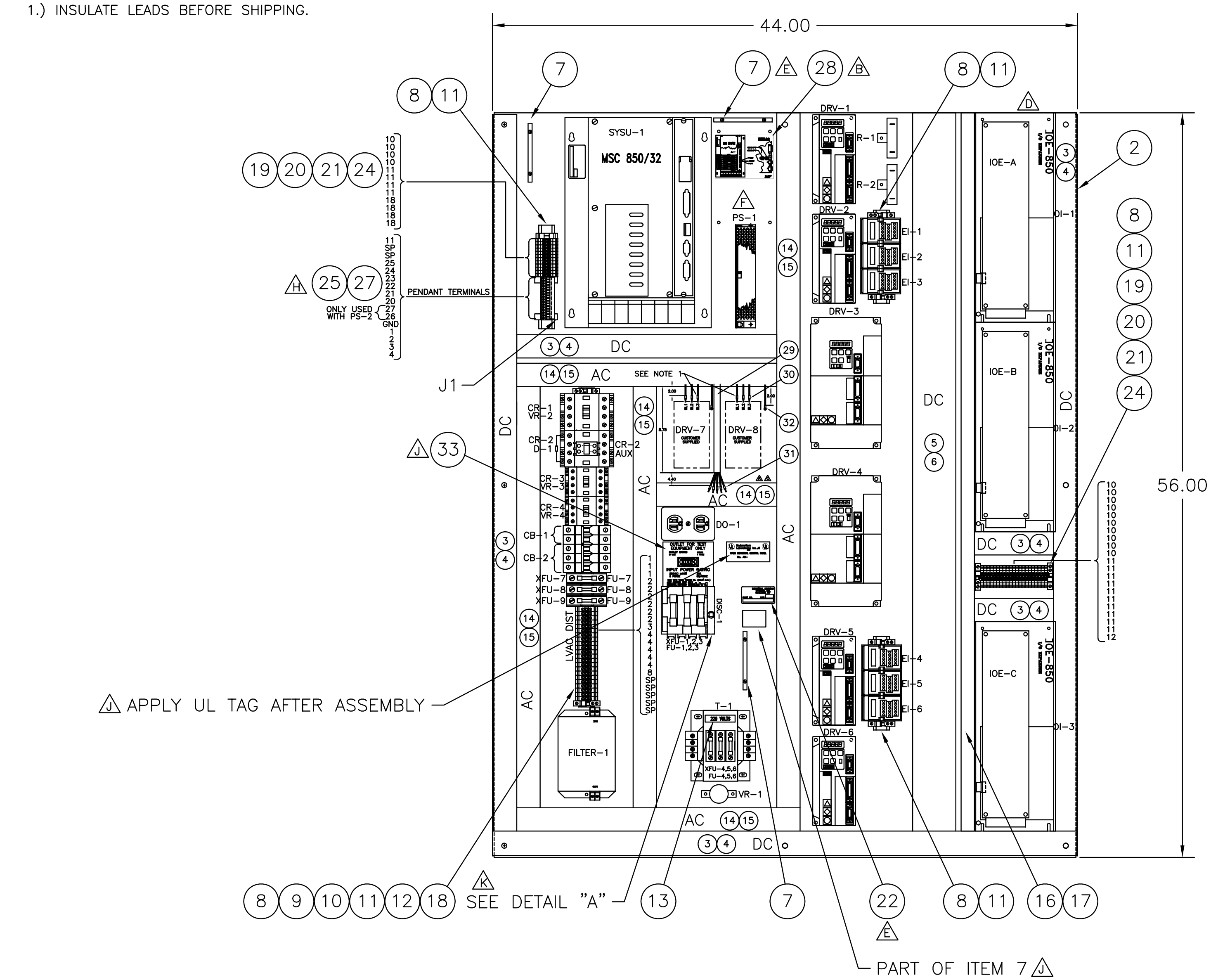
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	
TOLERANCES	ANGULAR
X.X± ---	± ---
X.XX± ---	
X.XXX± ---	

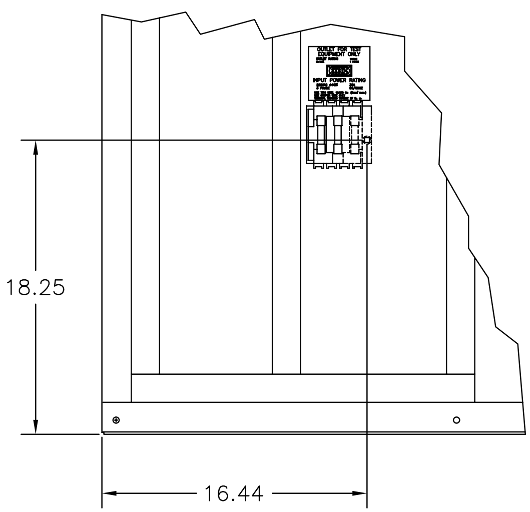
DRAWN BY	BOWMAN
AutoCAD FILE LOCATION	Q:\CURRENT DWGS
SIZE	B
DATE	09JAN97
SCALE	---
DRAWING NUMBER	C-838000
SHEET NO.	1 OF 1
REVISION	A

NOTES:

1.) INSULATE LEADS BEFORE SHIPPING.

DATE	SYM	REVISION RECORD	DR	CK	CK
23OCT98	O	PER ECN 98-324	CWB		
18DEC98	A	PER ECN 98-424	CWB	CAB	
27APR99	B	PER ECN 99-117	EB	WES	
06MAY99	C	PER ECN 99-143	CWB	WES	
08JUL99	D	PER ECN 99-231	CWB	WES	
14AUG00	E	PER ECN 00-257	EB	CD	
23MAR01	F	PER ECN 01-097	CWB	CD	
28NOV01	H	PER ECN 01-405	EB	CD	
18JUN02	J	PER ECN 02-201	CWB	CD	
12NOV02	K	PER ECN 02-369	CWB		





DETAIL A
DISCONNECT MOUNTING DETAIL

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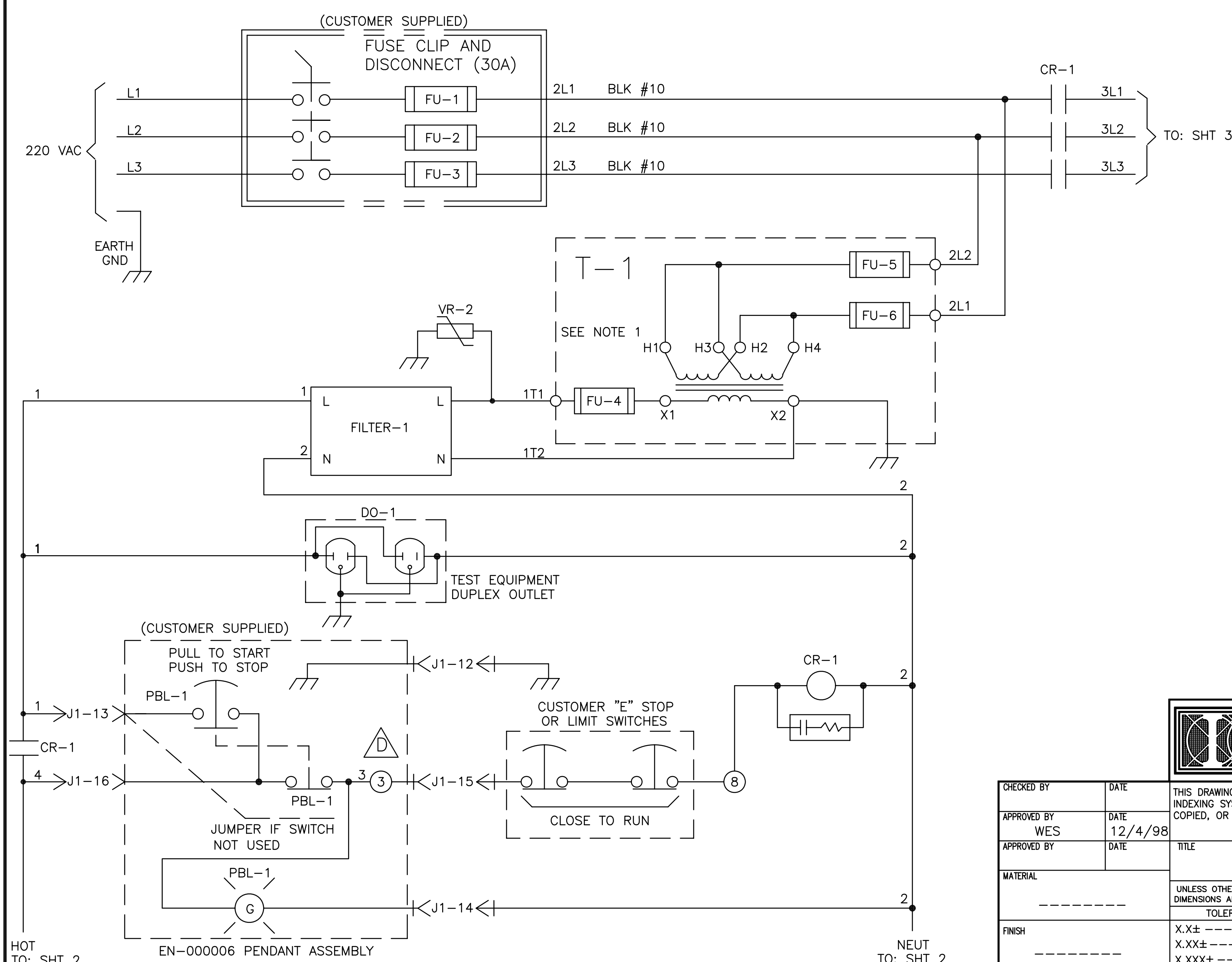
CHECKED BY	DATE	
APPROVED BY	DATE WES	12/4/98
APPROVED BY	DATE	TITLE: ENCLOSURE ASSEMBLY
MATERIAL: ---------	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY: BOWMAN
FINISH: ---------	TOLERANCES: X.X± --- X.XX± --- X.XXX± --- ANGULAR ± ---	AutoCAD FILE LOCATION: Q:\CURRENT DWGS
	D	DATE: 23OCT98 · SCALE: ---
	DRAWING NUMBER: EN-865004	SHEET NO. 1 OF 1 · REVISION K

NOTES:

1) CONNECT H1 TO H3 AND H2 TO H4 FOR 230 VAC LINE.



DATE	SYM	REVISION RECORD	DR	CK	CK
20OCT98	0	PER ECN 98-324	CWB		
18DEC98	A	PER ECN 98-424	CWB	CAB	
19APR99	B	PER ECN 99-125	EB	WES	
06MAY99	C	PER ECN 99-143	CWB	WES	
08JUL99	D	PER ECN 99-231	CWB	WES	
05AUG99	E	PER ECN 99-271	CWB	DH	
11OCT99	F	PER ECN 99-356	CWB	KS	
21OCT99	H	PER ECN 99-366	CWB	KS	
17JUL00	J	PER ECN 00-217	CWB	WS	
09AUG00	K	PER ECN 00-264	CWB	JC	
29SEP00	L	PER ECN 00-322	CWB	WES	
09MAR01	M	PER ECN 01-082	CWB	WES	
17MAY01	N	PER ECN 01-184	CWB	WES	
14JUN01	P	PER ECN 01-207	EB	WES	
18JAN01	R	PER ECN 02-030	CWB		

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CHECKED BY	DATE
APPROVED BY WES	DATE 12/4/98
APPROVED BY	DATE
MATERIAL --------	
FINISH --------	

TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY BOWMAN
TOLERANCES	AutoCAD FILE LOCATION Q:\CURRENT DWGS
X.X± --- / X.XX± --- / X.XXX± ---	ANGULAR ± ---
B	DATE 20OCT98
SCALE ---	DRAWING NUMBER IC-865004
SHEET NO. 1 OF 19	REVISION R

DATE	SYM	REVISION RECORD	DR	CK	CK
18JAN02	R	PER ECN 02-030	CWB		

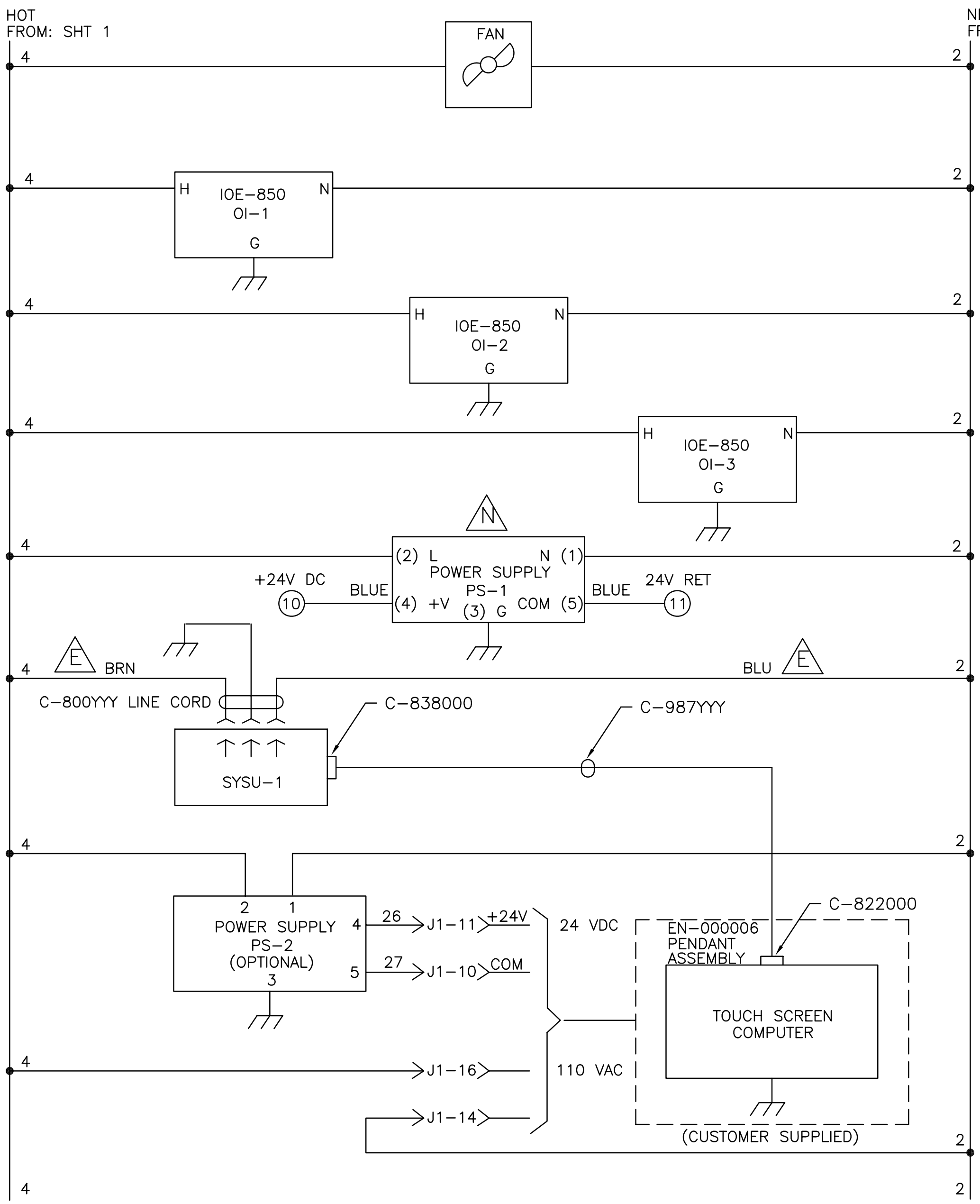


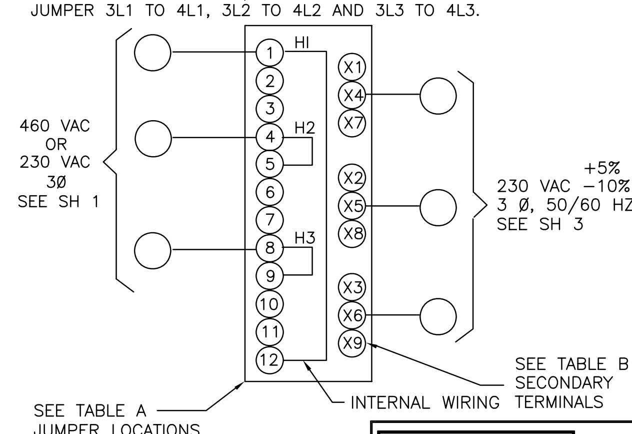
TABLE A

LOW VAC OPERATION	HIGH VAC OPERATION
JUMPER	JUMPER
1-3	2-3
2-4	6-7
5-7	10-11
6-8	
9-11	
10-12	

TABLE B

SECONDARY TERMINALS	SECONDARY VOLTAGE
X1, X2, X3	207 VAC
X4, X5, X6	230 VAC
X7, X8, X9	253 VAC

DRIVE ISOLATION TRANSFORMER IS RECOMMENDED FOR ALL LINE VOLTAGES BUT IS NOT REQUIRED IF THE INCOMING LINE IS 230 VAC $^{+5\%}_{-10\%}$, 3 Ø, 50/60 HZ. IF TRANSFORMER IS NOT REQUIRED JUMPER 3L1 TO 4L1, 3L2 TO 4L2 AND 3L3 TO 4L3.



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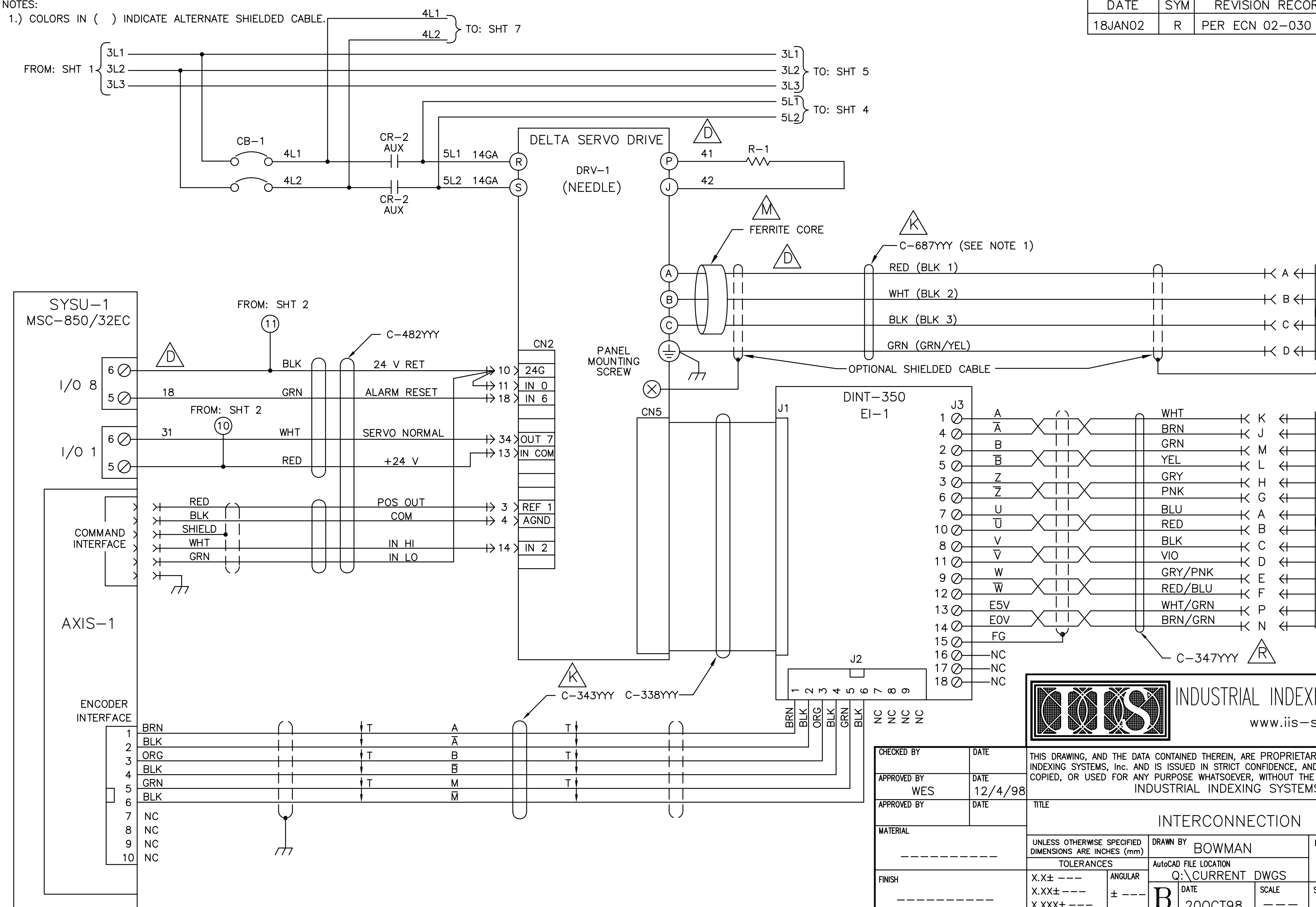
APPROVED BY WES | DATE 12/4/98
APPROVED BY | DATE
MATERIAL ------------
FINISH ------------

TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)
TOLERANCES: X.X± --- X.XX± --- X.XXX± --- ANGULAR ± ---
DRAWN BY: BOWMAN
AutoCAD FILE LOCATION: Q:\CURRENT DWGS
B | DATE: 20OCT98 | SCALE: ---
DRAWING NUMBER: IC-865004
SHEET NO. 2 OF 19 | REVISION R

NOTES:
1.) COLORS IN ( ) INDICATE ALTERNATE SHIELDED CABLE.

DATE	SYM	REVISION RECORD	DR	CK	CK
18JAN02	R	PER ECN 02-030	CWB		



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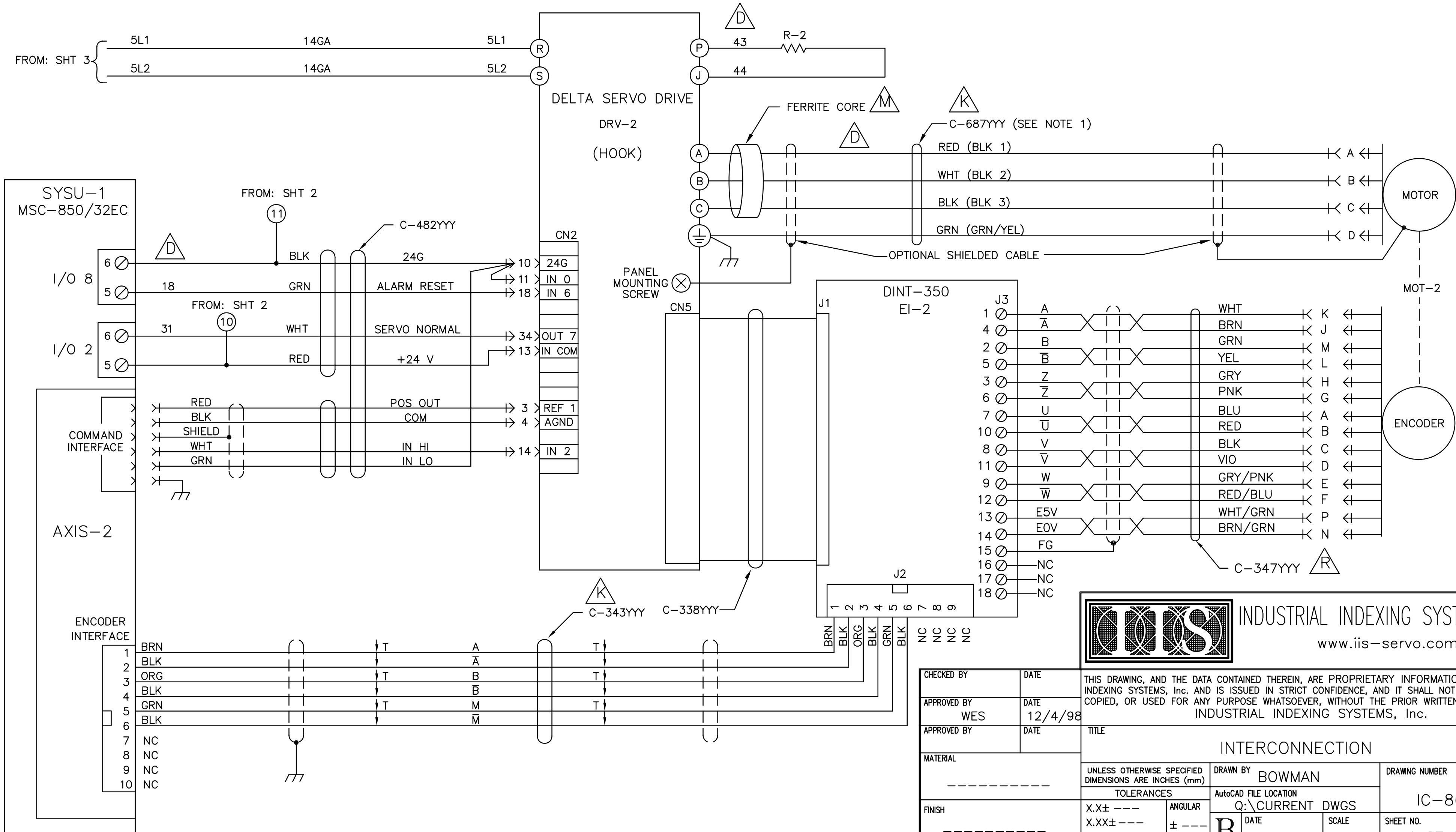
APPROVED BY WES	DATE 12/4/98
APPROVED BY	DATE
MATERIAL ----------	
FINISH ----------	

TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY BOWMAN		DRAWING NUMBER IC-865004
TOLERANCES X.X± --- X.XX± --- X.XXX± ---	ANGULAR ± ---	AutoCAD FILE LOCATION Q:\CURRENT DWGS	
B	DATE 20OCT98	SCALE ---	SHEET NO. 3 OF 19	REVISION R

NOTES:
1.) COLORS IN ( ) INDICATE ALTERNATE SHIELDED CABLE.

DATE	SYM	REVISION RECORD	DR	CK	CK
18JAN02	R	PER ECN 02-030	CWB		



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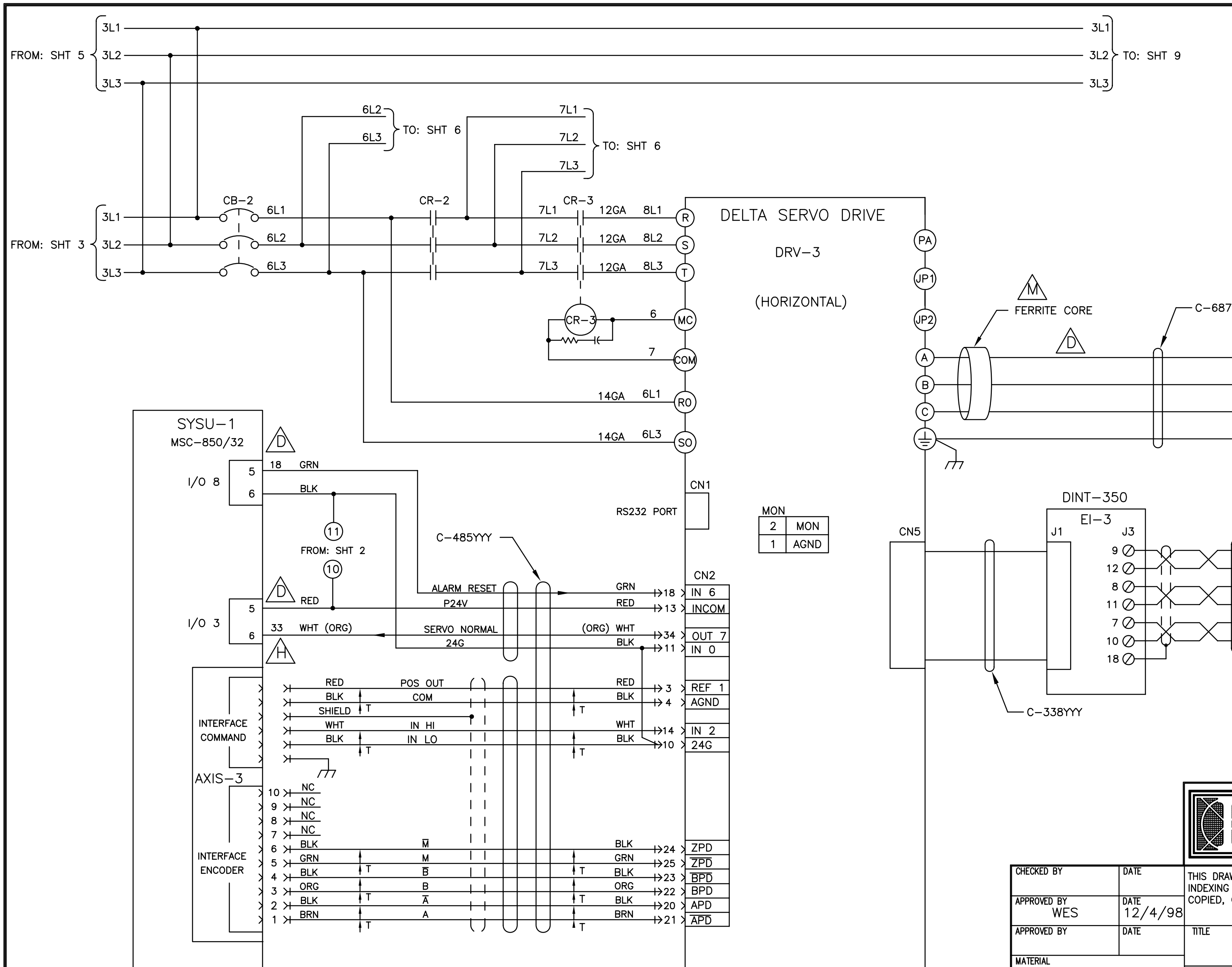
APPROVED BY: WES	DATE: 12/4/98
APPROVED BY	DATE
MATERIAL: ----------	
FINISH: ----------	

TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY: BOWMAN	DRAWING NUMBER: IC-865004
TOLERANCES: X.X± --- X.XX± --- X.XXX± --- ANGULAR: ± ---	AutoCAD FILE LOCATION: Q:\CURRENT DWGS	
B	DATE: 20OCT98 SCALE: ---	SHEET NO.: 4 OF 9 REVISION: R

DATE	SYM	REVISION RECORD	DR	CK	CK
18JAN02	R	PER ECN 02-030	CWB		



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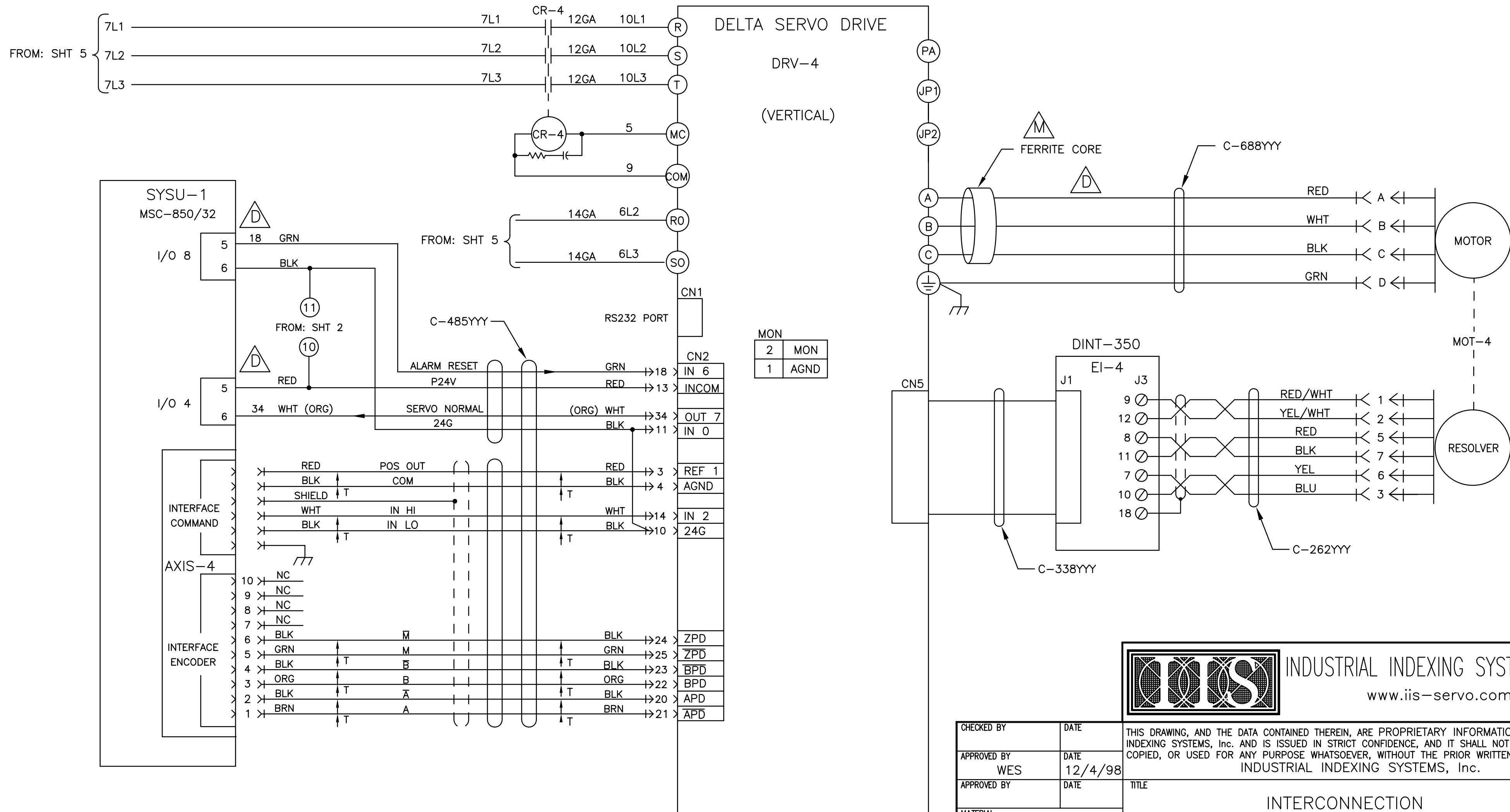
CHECKED BY	DATE
APPROVED BY WES	DATE 12/4/98
APPROVED BY	DATE
MATERIAL -----------	
FINISH -----------	

TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)		DRAWN BY BOWMAN		DRAWING NUMBER	
TOLERANCES		AutoCAD FILE LOCATION Q:\CURRENT DWGS		IC-865004	
X.X± --- / X.XX± --- / X.XXX± ---	ANGULAR ± ---	B	DATE 20OCT98	SCALE ---	SHEET NO. 5 OF 19	REVISION R

DATE	SYM	REVISION RECORD	DR	CK	CK
18JAN02	R	PER ECN 02-030	CWB		



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CHECKED BY	DATE
APPROVED BY WES	DATE 12/4/98
APPROVED BY	DATE
MATERIAL ----------	
FINISH ----------	

TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)

TOLERANCES: X.X± --- X.XX± --- X.XXX± --- ANGULAR ± ---

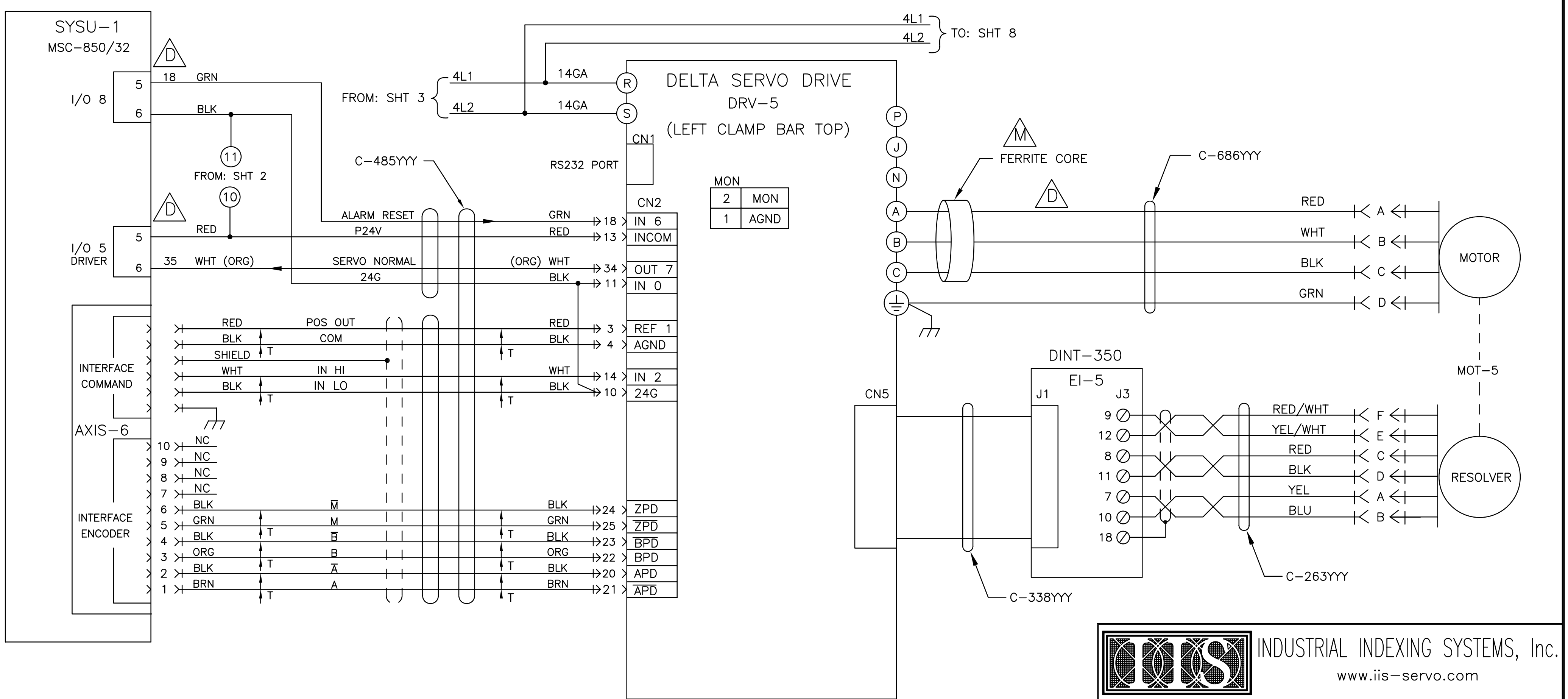
DRAWN BY: BOWMAN

AutoCAD FILE LOCATION: Q:\CURRENT DWGS

B | DATE: 20OCT98 | SCALE: --- | SHEET NO. 6 OF 19 | REVISION R

DRAWING NUMBER: IC-865004

DATE	SYM	REVISION RECORD	DR	CK	CK
18JAN02	R	PER ECN 02-030	CWB		



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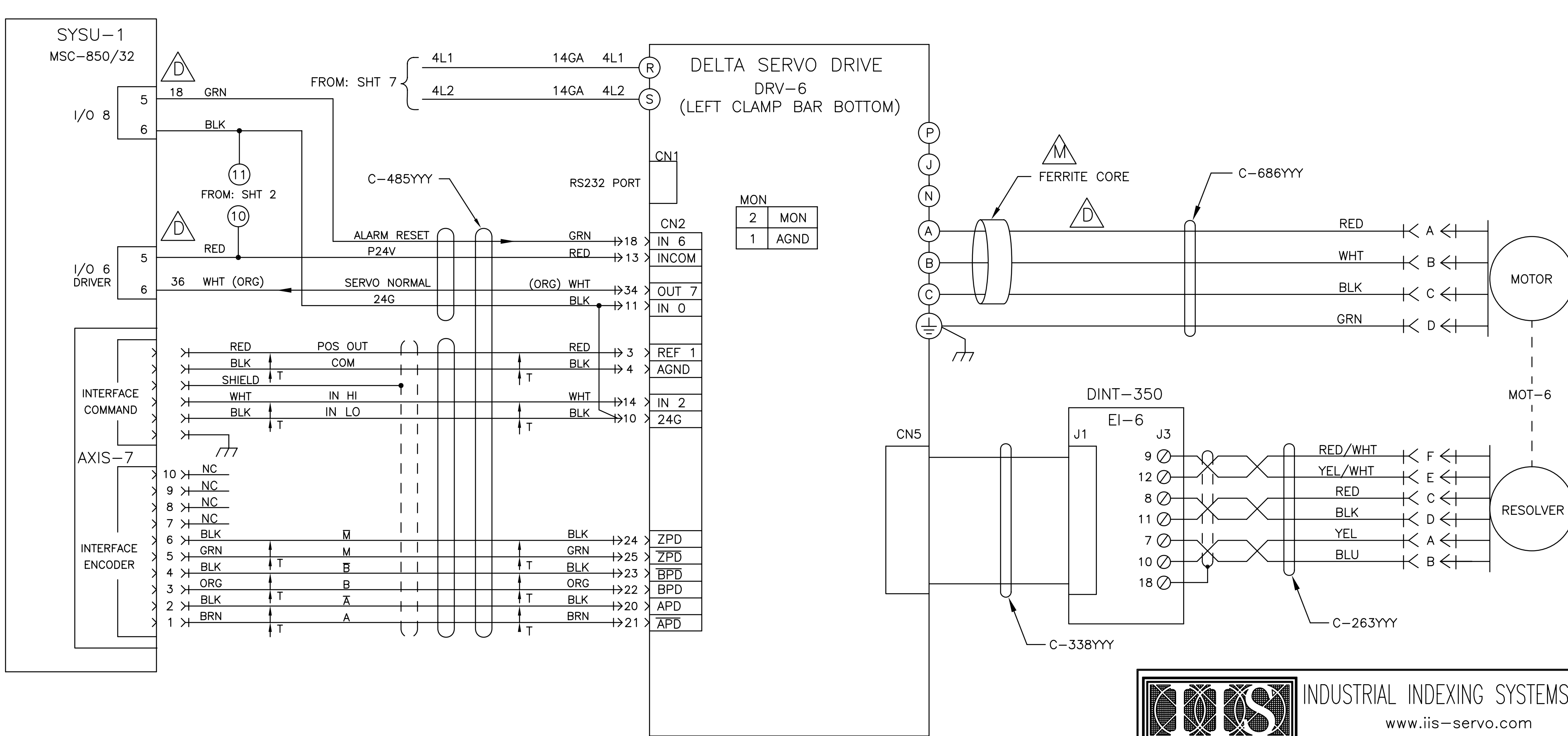
CHECKED BY	DATE
APPROVED BY WES	DATE 12/4/98
APPROVED BY	DATE
MATERIAL ----------	
FINISH ----------	

TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY: BOWMAN
TOLERANCES: X.X± --- X.XX± --- X.XXX± --- ; ANGULAR ± ---	AutoCAD FILE LOCATION: Q:\CURRENT DWGS
SIZE: B	DATE: 20OCT98 ; SCALE: ---
DRAWING NUMBER: IC-865004	SHEET NO.: 7 OF 19 ; REVISION: R

DATE	SYM	REVISION RECORD	DR	CK	CK
18JAN02	R	PER ECN 02-030	CWB		



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CHECKED BY	DATE
APPROVED BY WES	DATE 12/4/98
APPROVED BY	DATE
MATERIAL ----------	
FINISH ----------	

TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)

TOLERANCES: X.X± --- X.XX± --- X.XXX± --- ANGULAR ± ---

DRAWN BY: BOWMAN

AutoCAD FILE LOCATION: Q:\CURRENT DWGS

B

DATE: 20OCT98

SCALE: ---

DRAWING NUMBER: IC-865004

SHEET NO.: 8 OF 19

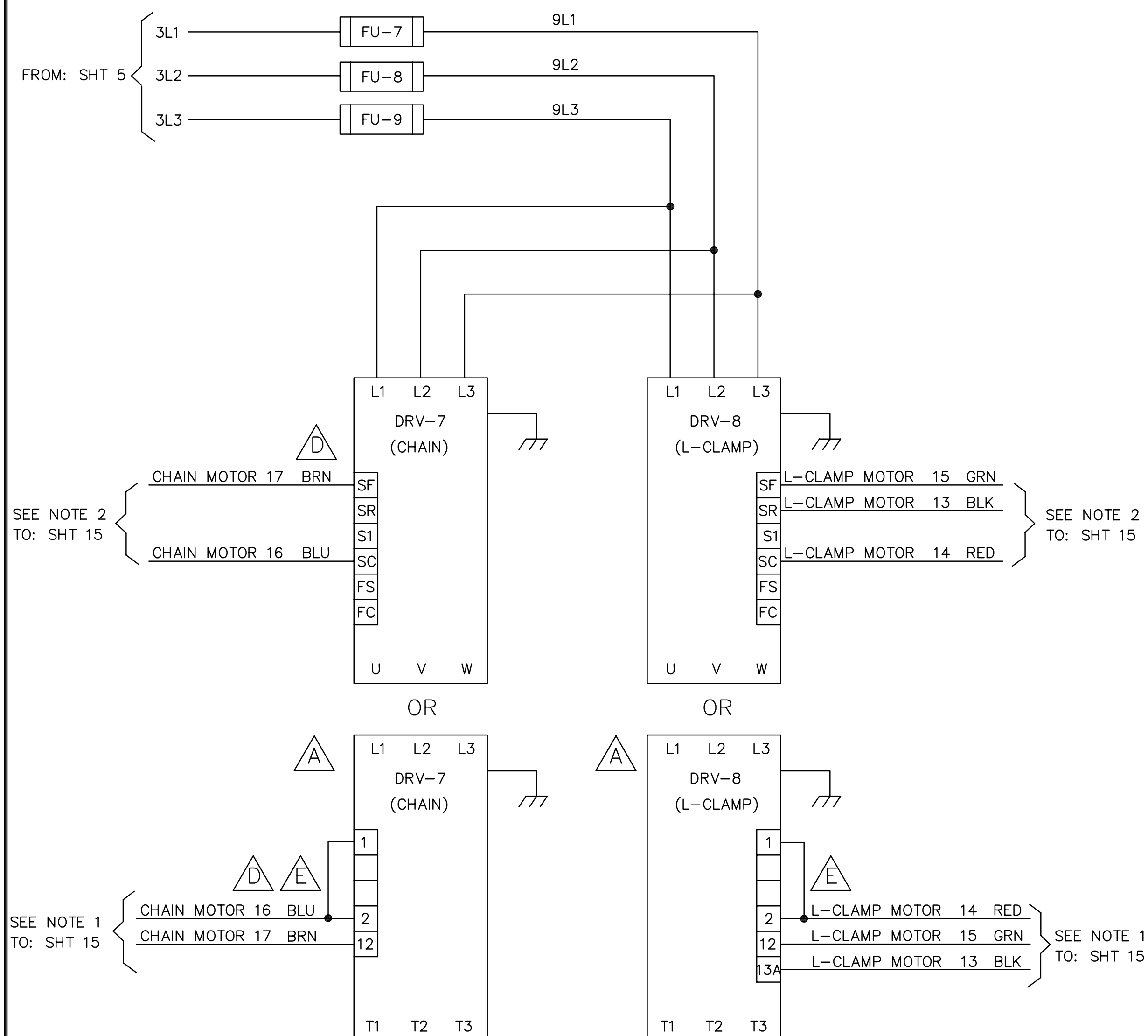
REVISION: R

DATE	SYM	REVISION RECORD	DR	CK	CK
18JAN02	R	PER ECN 02-030	CWB		

NOTES:

1.) CONNECTIONS APPLY TO AC TECH INVERTER DRIVES.

2.) CONNECTIONS APPLY TO MITSUBISHI INVERTER DRIVES. A



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CHECKED BY	DATE
APPROVED BY WES	DATE 12/4/98
APPROVED BY	DATE
MATERIAL -----------	
FINISH -----------	

TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)

TOLERANCES: X.X± --- X.XX± --- X.XXX± --- ANGULAR ± ---

DRAWN BY: BOWMAN

AutoCAD FILE LOCATION: Q:\CURRENT DWGS

B

DATE: 17JUL00

SCALE: ---

DRAWING NUMBER: IC-865004

SHEET NO.: 9 OF 19

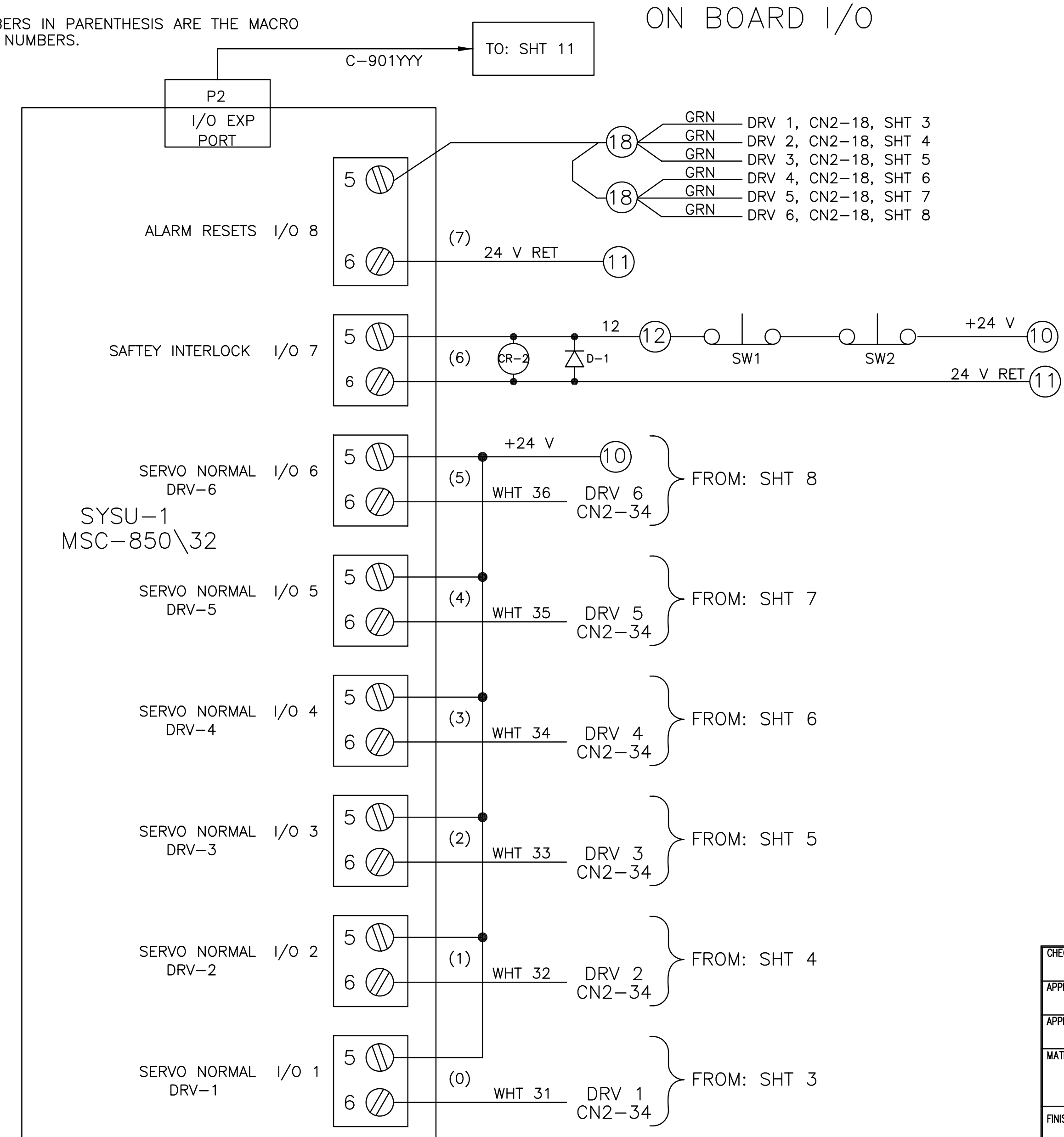
REVISION: R

DATE	SYM	REVISION RECORD	DR	CK	CK
18JAN02	R	PER ECN 02-030	CWB		

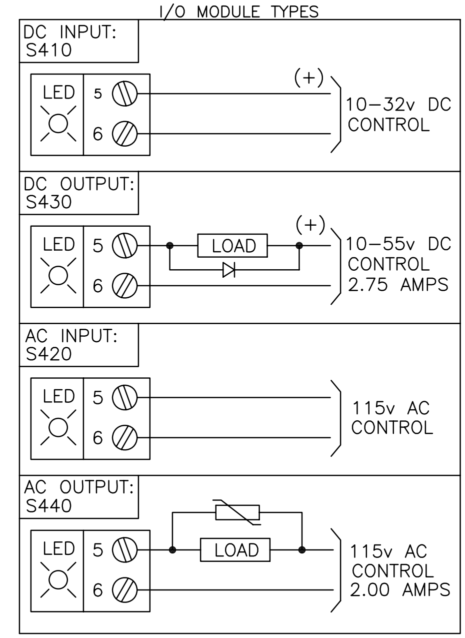
NOTES:

1) NUMBERS IN PARENTHESIS ARE THE MACRO FLAG NUMBERS.

ON BOARD I/O



I/O MODULE TYPES



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CHECKED BY	DATE
APPROVED BY WES	DATE 12/4/98
APPROVED BY	DATE
MATERIAL ---------	
FINISH ---------	

TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)

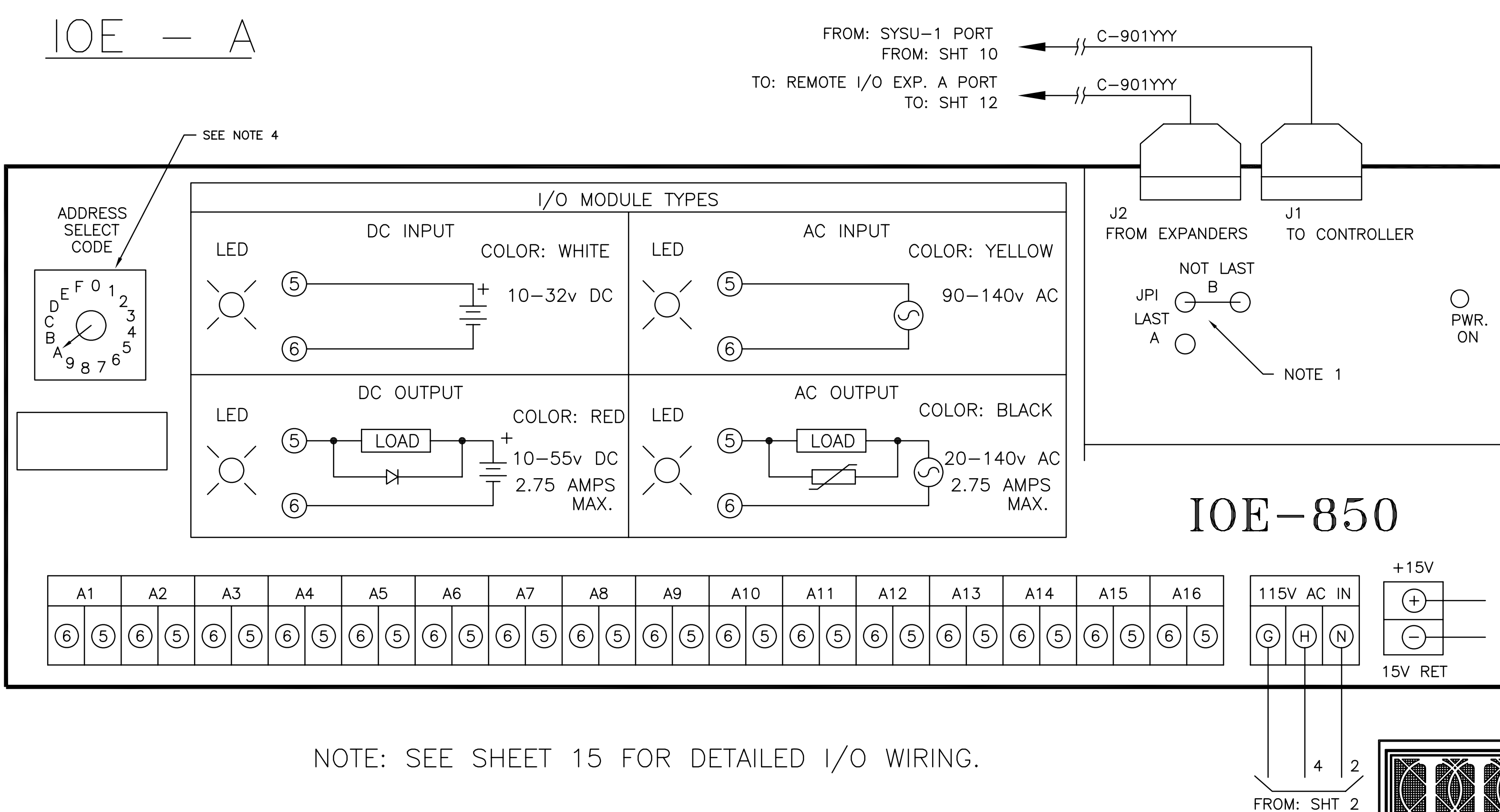
TOLERANCES: X.X± --- X.XX± --- X.XXX± --- ANGULAR ± ---

B

DRAWN BY	AutoCAD FILE LOCATION	DATE	SCALE	DRAWING NUMBER	SHEET NO.	REVISION
BOWMAN	Q:\CURRENT DWGS	20OCT98	---	IC-865004	10 OF 19	R

DATE	SYM	REVISION RECORD	DR	CK	CK
18JAN02	R	PER ECN 02-030	CWB		

IOE — A



NOTE: SEE SHEET 15 FOR DETAILED I/O WIRING.

NOTES:

1) JUMPER POSITION "A" FOR LAST I/O EXPANDER IN CHAIN; IF NOT LAST EXPANDER PLACE IN POSITION "B".
2) LED's ON WHEN INPUT OR OUTPUT IS IN TRUE STATE.
3) ADDRESS SELECT CODE MUST BE SET PROPERLY (A,B,C,or D).
4) ANY INPUT OR OUTPUT MODULES (AC or DC) MAY RESIDE IN ANY I/O POSITION
5) THIS UNIT TO BE POWERED BY 115 VAC OR 15 VDC, BUT NOT BOTH.

CAUTION: CUSTOMER IS RESPONSIBLE FOR PROPER USE OF MODULES.

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CHECKED BY	DATE
APPROVED BY WES	DATE 12/4/98
APPROVED BY	DATE
MATERIAL ----------	
FINISH ----------	

TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)

TOLERANCES: X.X± --- X.XX± --- X.XXX± --- ANGULAR ± ---

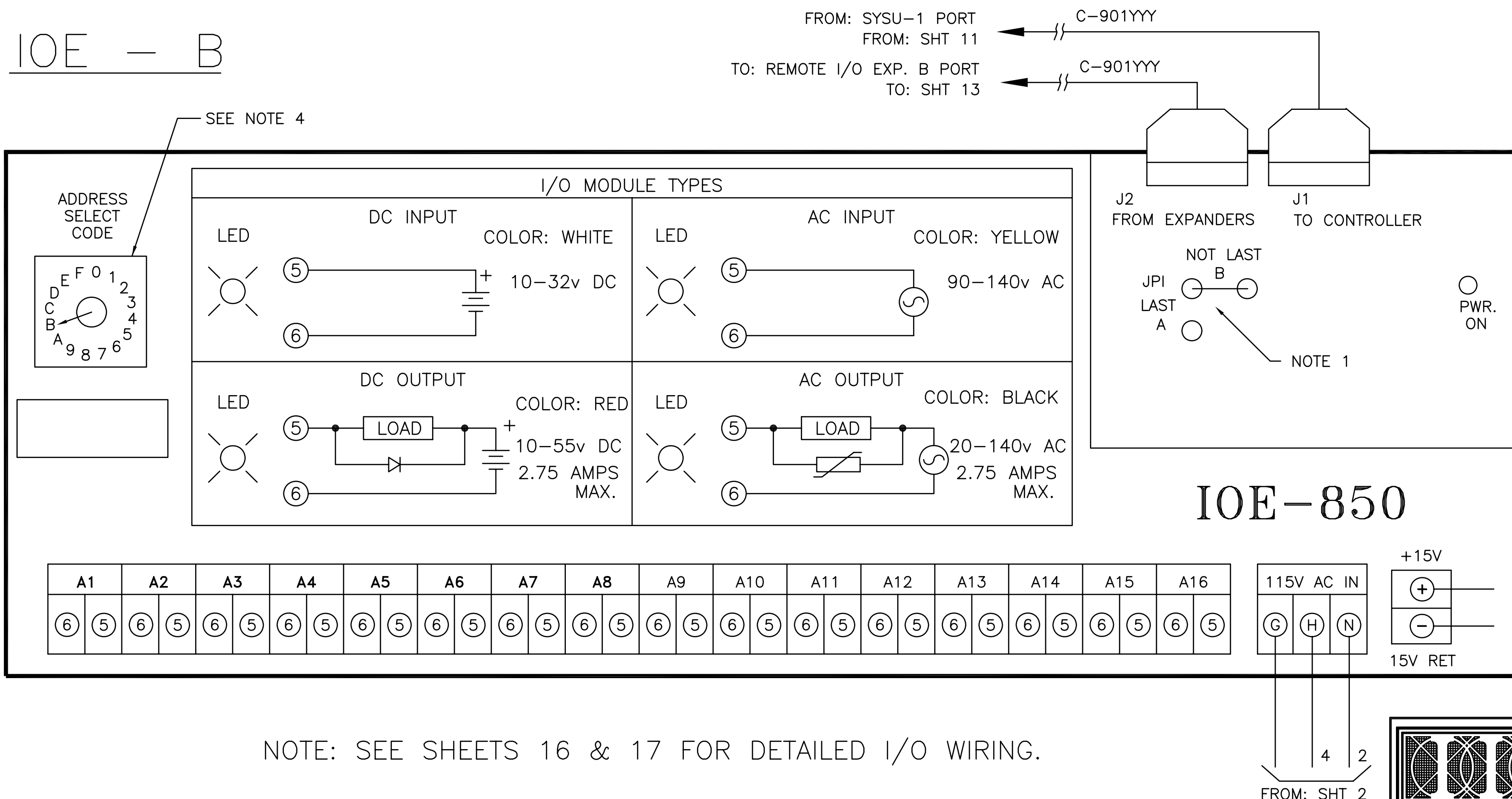
DRAWN BY: BOWMAN

AutoCAD FILE LOCATION: Q:\CURRENT DWGS

B | DATE: 20OCT98 | SCALE: --- | DRAWING NUMBER: IC-865004 | SHEET NO. 11 OF 19 | REVISION R

DATE	SYM	REVISION RECORD	DR	CK	CK
18JAN02	R	PER ECN 02-030	CWB		

IOE — B



NOTE: SEE SHEETS 16 & 17 FOR DETAILED I/O WIRING.

NOTES:

1) JUMPER POSITION "A" FOR LAST I/O EXPANDER IN CHAIN; IF NOT LAST EXPANDER PLACE IN POSITION "B".
2) LED's ON WHEN INPUT OR OUTPUT IS IN TRUE STATE.
3) ADDRESS SELECT CODE MUST BE SET PROPERLY (A,B,C,or D).
4) ANY INPUT OR OUTPUT MODULES (AC or DC) MAY RESIDE IN ANY I/O POSITION
5) THIS UNIT TO BE POWERED BY 115 VAC OR 15 VDC, BUT NOT BOTH.

CAUTION: CUSTOMER IS RESPONSIBLE FOR PROPER USE OF MODULES.

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CHECKED BY	DATE
APPROVED BY WES	DATE 12/4/98
APPROVED BY	DATE
MATERIAL ----------	
FINISH ----------	

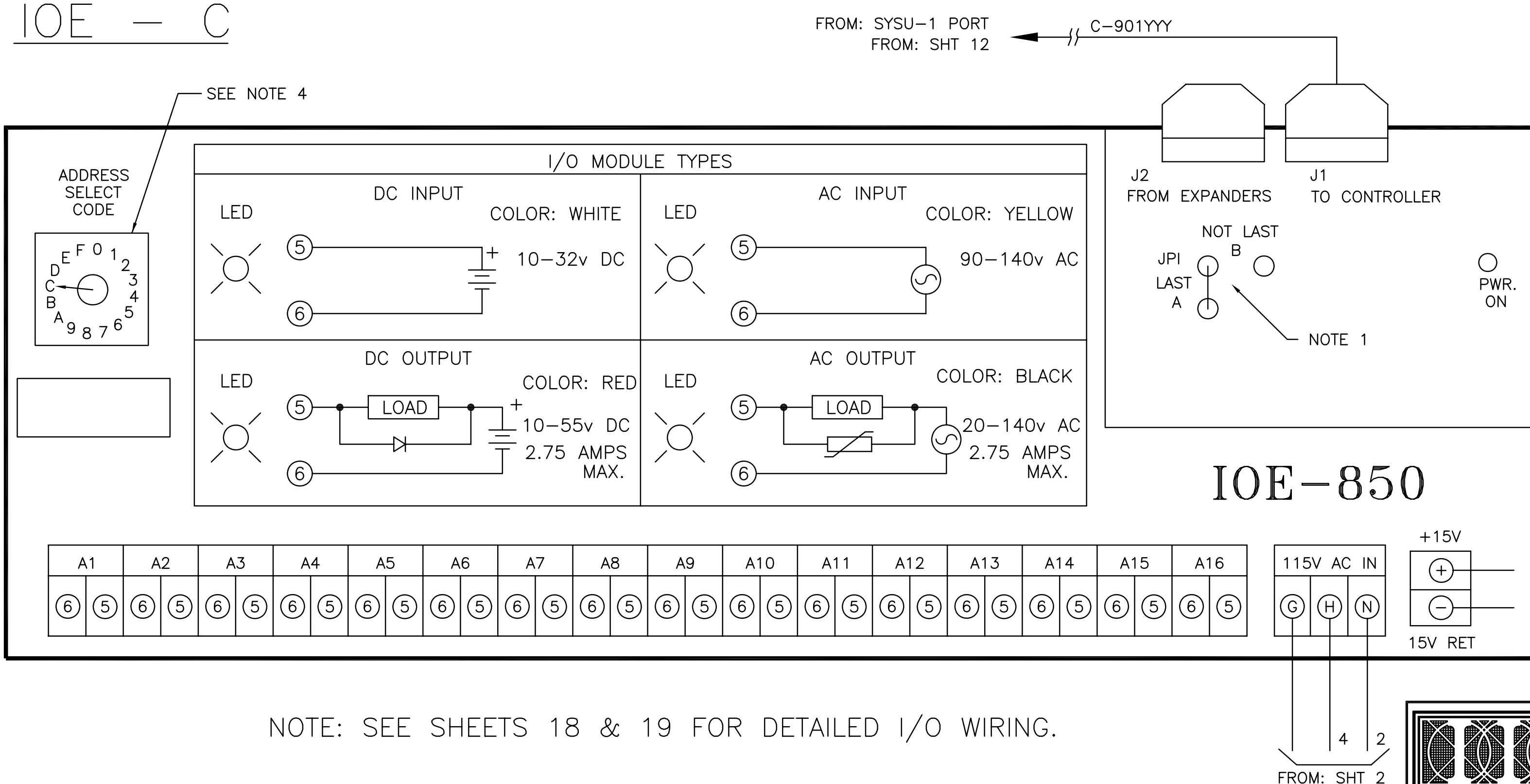
TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)
TOLERANCES: X.X± --- X.XX± --- X.XXX± --- ANGULAR ± ---

DRAWN BY: BOWMAN
AutoCAD FILE LOCATION: Q:\CURRENT DWGS
B
DATE: 20OCT98
SCALE: ---
DRAWING NUMBER: IC-865004
SHEET NO.: 12 OF 19
REVISION: R

DATE	SYM	REVISION RECORD	DR	CK	CK
18JAN02	R	PER ECN 02-030	CWB		

IOE – C



NOTE: SEE SHEETS 18 & 19 FOR DETAILED I/O WIRING.

NOTES:

1) JUMPER POSITION "A" FOR LAST I/O EXPANDER IN CHAIN; IF NOT LAST EXPANDER PLACE IN POSITION "B".
2) LED's ON WHEN INPUT OR OUTPUT IS IN TRUE STATE.
3) ADDRESS SELECT CODE MUST BE SET PROPERLY (A,B,C,or D).
4) ANY INPUT OR OUTPUT MODULES (AC or DC) MAY RESIDE IN ANY I/O POSITION
5) THIS UNIT TO BE POWERED BY 115 VAC OR 15 VDC, BUT NOT BOTH.

CAUTION: CUSTOMER IS RESPONSIBLE FOR PROPER USE OF MODULES.

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MATERIAL ----------	
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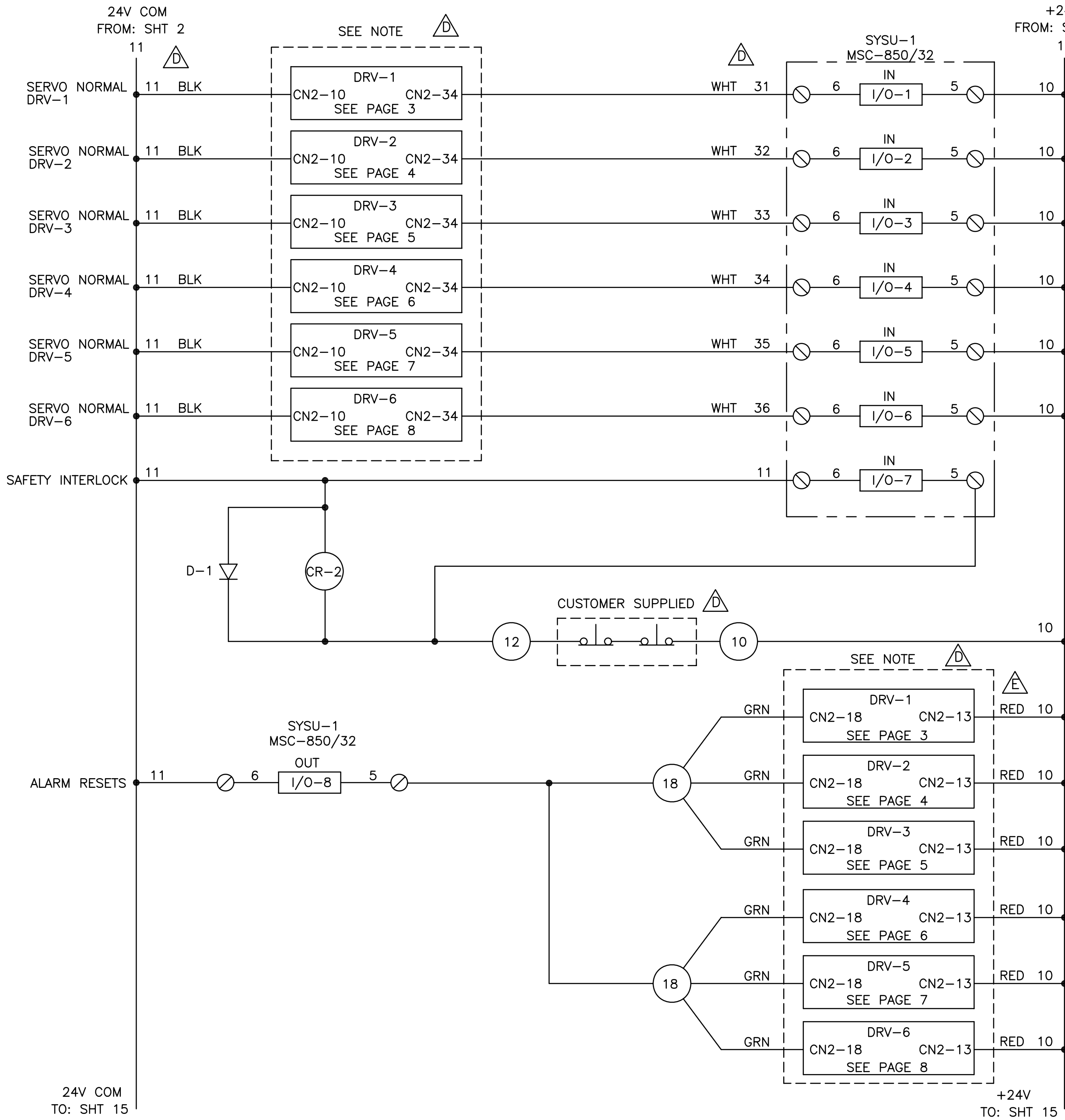
TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY BOWMAN
TOLERANCES	AutoCAD FILE LOCATION Q:\CURRENT DWGS
X.X± --- X.XX± --- X.XXX± ---	ANGULAR ± ---
B	DATE 20OCT98
SCALE ---	
DRAWING NUMBER	IC-865004
SHEET NO.	13 OF 19
REVISION	R

DATE	SYM	REVISION RECORD	DR	CK	CK
18JAN02	R	PER ECN 02-030	CWB		



KEY
⊘ = CUSTOMER INTERFACE TERMINAL

NOTE:
REFER TO PAGE NUMBERS FOR DETAILED WIRING OF DRIVES.

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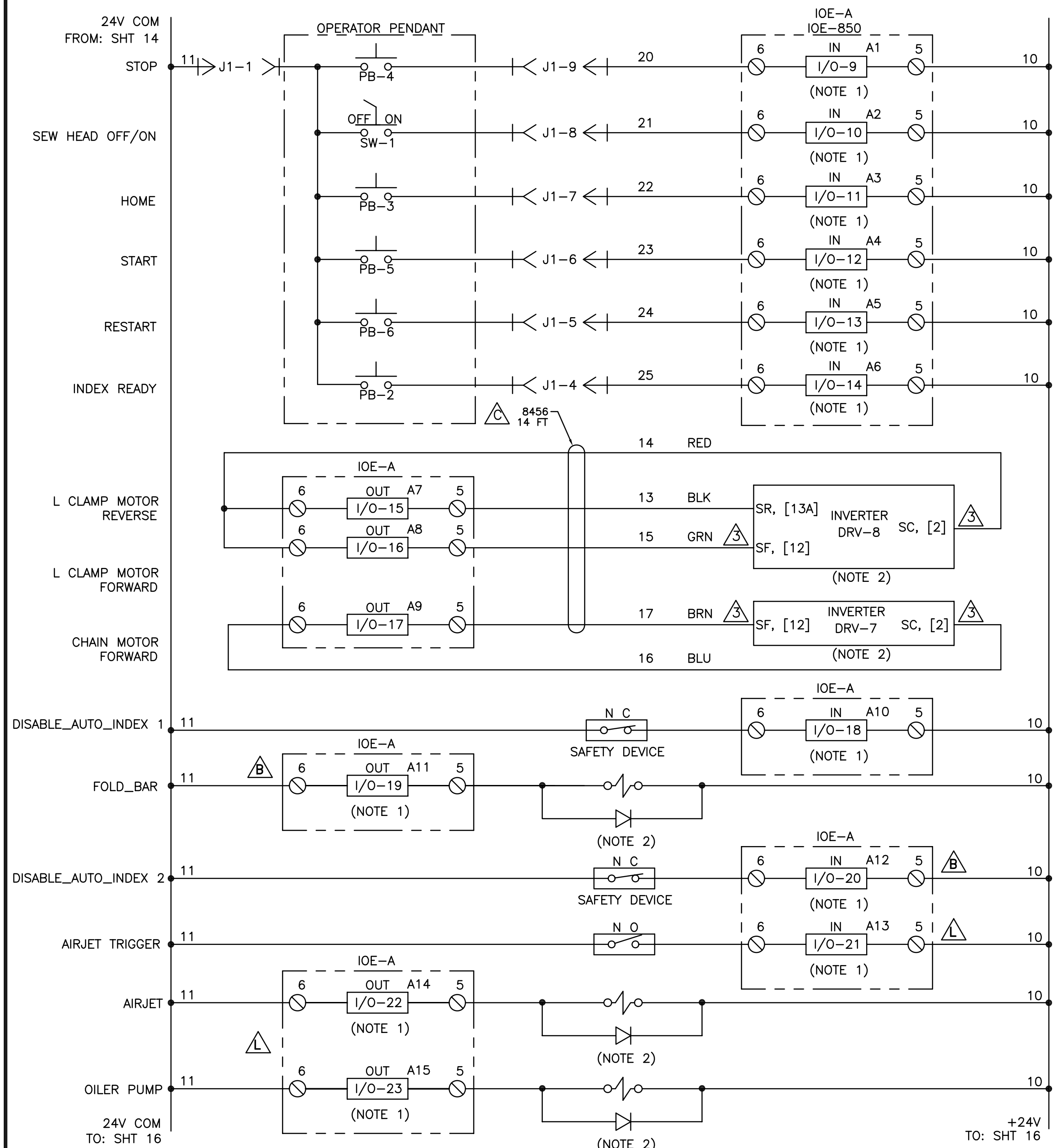
AutoCAD FILE LOCATION: Q:\CURRENT DWGS
SIZE: B
DATE: 20OCT98
SCALE: ---
DRAWING NUMBER: IC-865004
SHEET NO.: 14 OF 19
REVISION: R

DATE	SYM	REVISION RECORD	DR	CK	CK
18JAN02	R	PER ECN 02-030	CWB		



KEY

⊘ = CUSTOMER INTERFACE TERMINAL

NOTES:

1.) HIGH OFF-STATE VOLTAGES MUST BE SHUNTED WITH A 1K OHM 1 WATT RESISTOR.

2.) DIODE IS REQUIRED FOR INDUCTIVE LOADS.

A 3.) [ ] APPLIES TO AC TECH INVERTER DRIVES.

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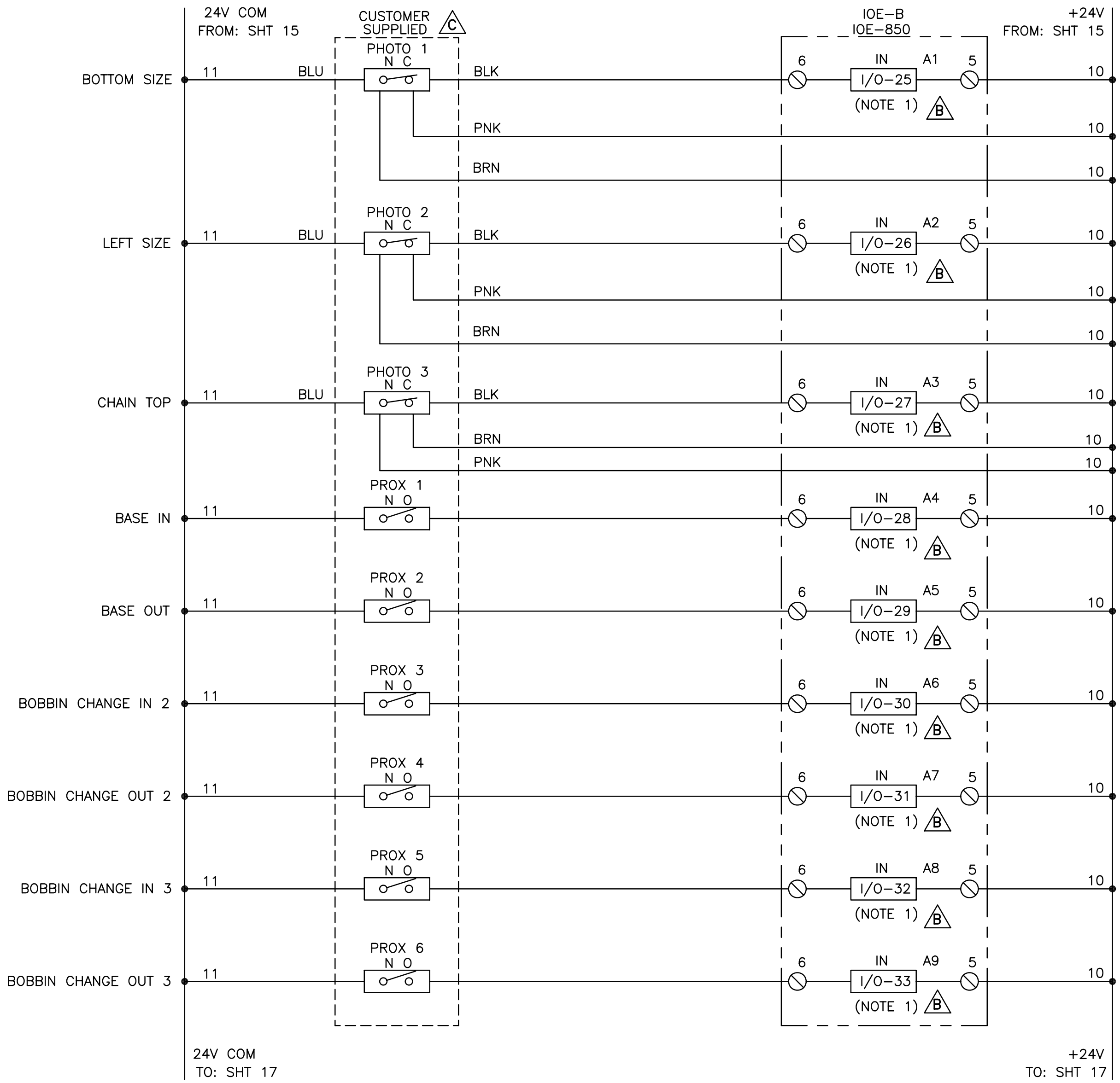

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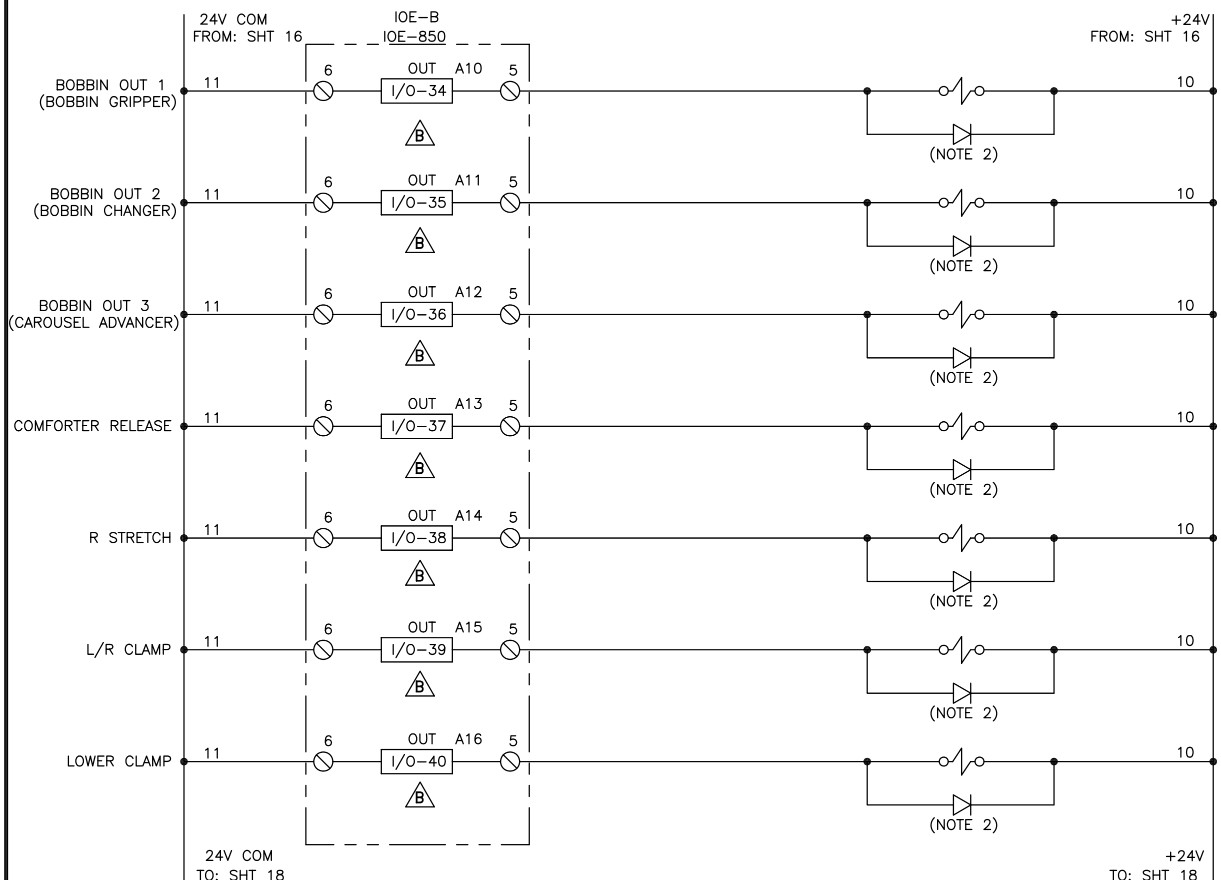

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DATE	SYM	REVISION RECORD	DR	CK	CK
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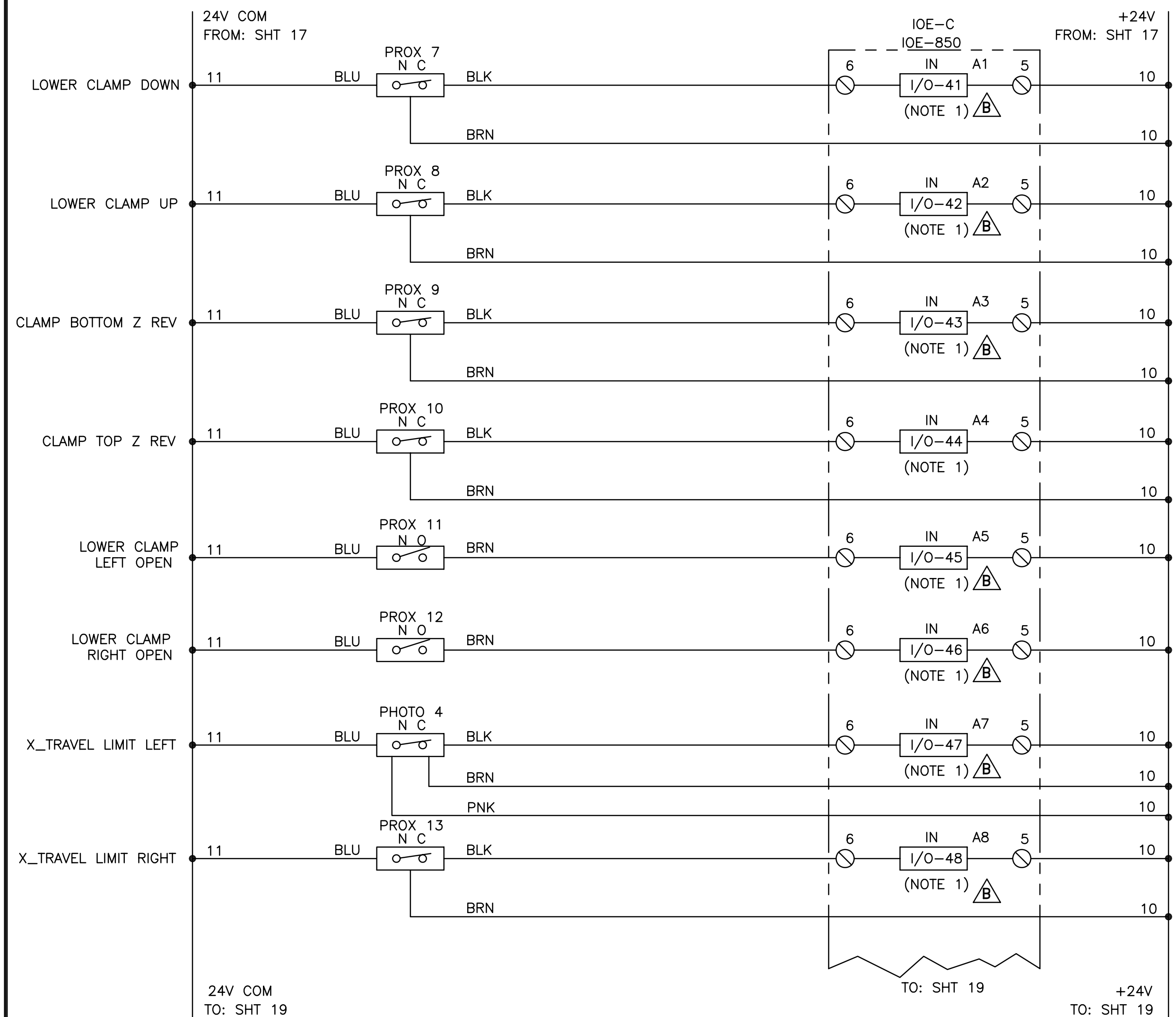

KEY
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NOTES:
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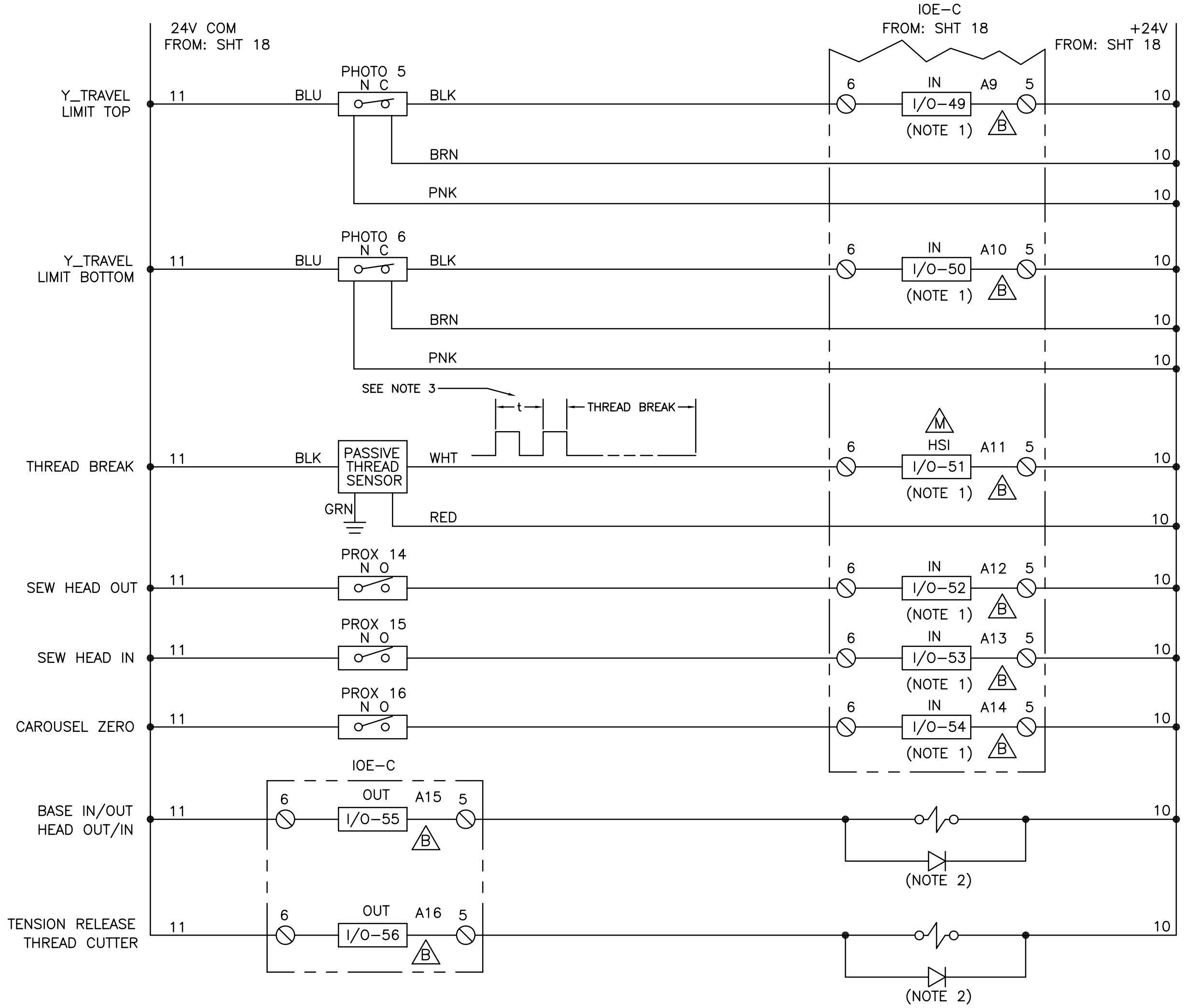

KEY
⊘ = CUSTOMER INTERFACE TERMINAL

NOTES:
1.) HIGH OFF-STATE VOLTAGES MUST BE SHUNTED WITH A 1K OHM 1 WATT RESISTOR.
2.) DIODE IS REQUIRED FOR INDUCTIVE LOADS.
3.) (t) REPRESENTS THREAD BREAK DELAY WHICH IS SET FROM THE PARAMETER SCREEN.

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