SINCE 1947

XL6000M

MATTRESS

PANEL

QUILTER

IM-3155

INSTRUCTION MANUAL APRIL 2002

ABM INTERNATIONAL

XL6000M Quilter

INSTRUCTION MANUAL

Revision - A
Approved By:

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1.0 DESCRIPTION

The XL6000M is a Servo controlled sewing machine that is used in the textile industry. This machine is capable of sewing various quilt patterns that are supplied to the machine in a G-code machine format. An IIS MSC-250 dual axis motion controller controls all Servomotors.

1.1 PURPOSE

The purpose of this document is to describe the operation of software packages SFO-3251 and 3252. These applications work together to direct the overall operation of the XL6000M.

SFO 3251 is an application written in the IIS Macroprogramming language.
This application contains the necessary routines to direct the operation of the MSC-250 during sewing and other various tasks.

SFO-3252 is a front-end application written in Visual BASIC 3 as an operator interface. This is an application that is loaded into a touch screen to provide the operator with various command buttons and menus to direct the operation of SFO 3251.

This manual will provide an overview of the Hardware that is used with the MSC-250 and SFO 3251 but will mainly focus on the front end Application (SFO 3252).

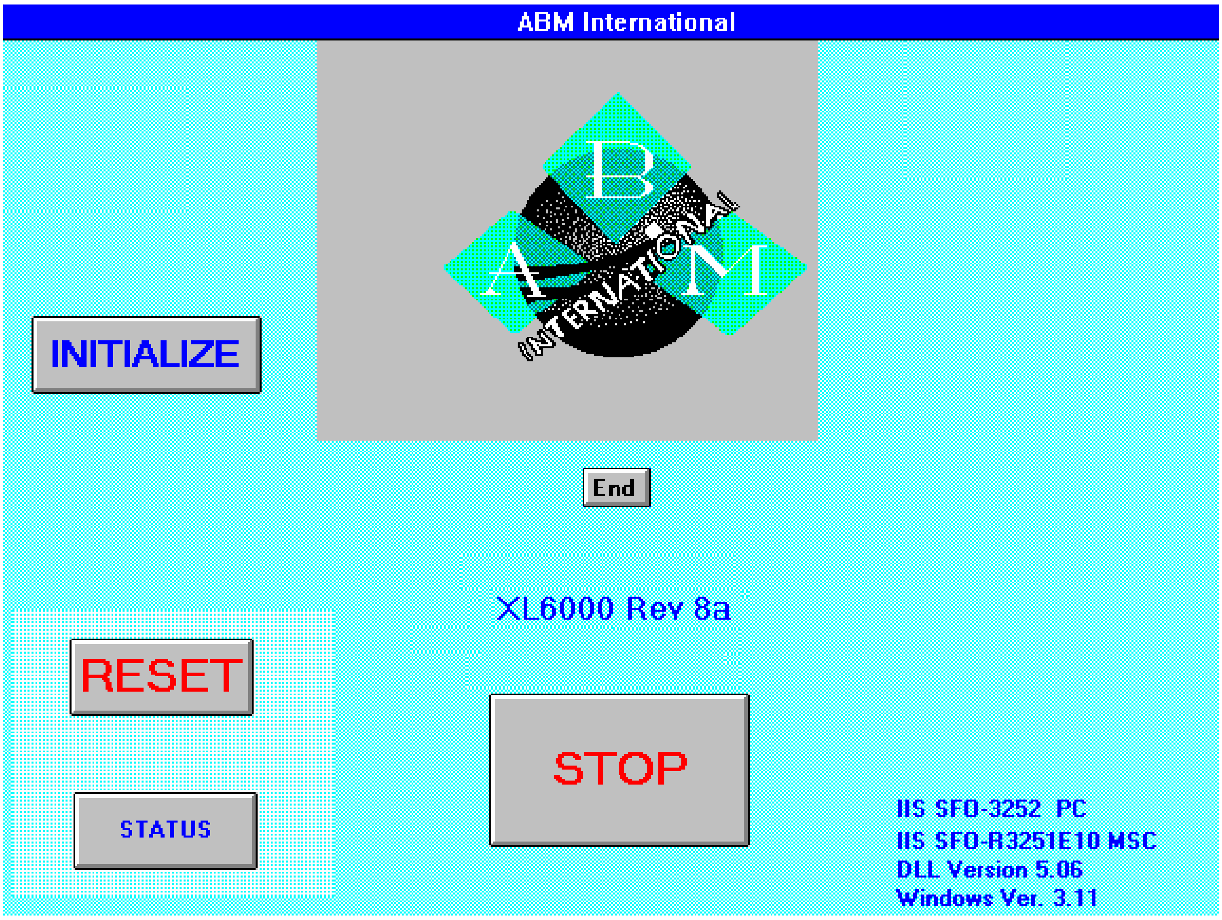
1.2 REQUIREMENTS

MEDIA:	3-1/2" disk
FORMAT:	IBM PC format
MSC DEVELOPMENT SOFTWARE:	Macropro
PROGRAM NAME:	SFO3251.PRG
	SFO3251.MCM
	SFO3251.SYM
	SFO3251.DBG
	SFO3251.ERR
Visual BASIC Application:	XL6000M#.exe
	Patdll.dll

2.0 XL6000M OPERATING SYSTEM OVERVIEW - The XL6000M operating system is the main operating interface between the touch screen and the MSC-250

2.1 MAIN SCREEN

When the XL6000M operating system is loaded, the un-initialized MAIN screen appears.



This screen has the INITIALIZE button highlighted. In order to access any other screen the XL6000M system must be initialized. This done by selecting the INITIALIZE button.

The Initialization process consists of two individual checks. First, the needle is energized and if no fault occurs a check appears in the Sewing Head Initialized box in the STATUS screen. (To view the status, select the STATUS button. The STATUS box and the different states are discussed later in section).

The Initialize routine is followed by the frame moving in a diagonal direction towards the opening of the frame until the X and Y limit sensors are tripped.

THE MAIN SCREEN - Continued

This position is remembered by XL6000M and used as machine zero.
If a "Rethread" position has been saved, the XL6000M will then move the frame to the preset Rethread position within the sewing area.

If this entire procedure is successful, a check will appear in the XY Initialize box of the STATUS screen. The Initialize procedure is only necessary on first power up after loading software or when a fault occurs and requires operator to re-initialize the machine.

When the XL6000M system is properly initialized the MAIN screen appears as **Figure 2.1b**.

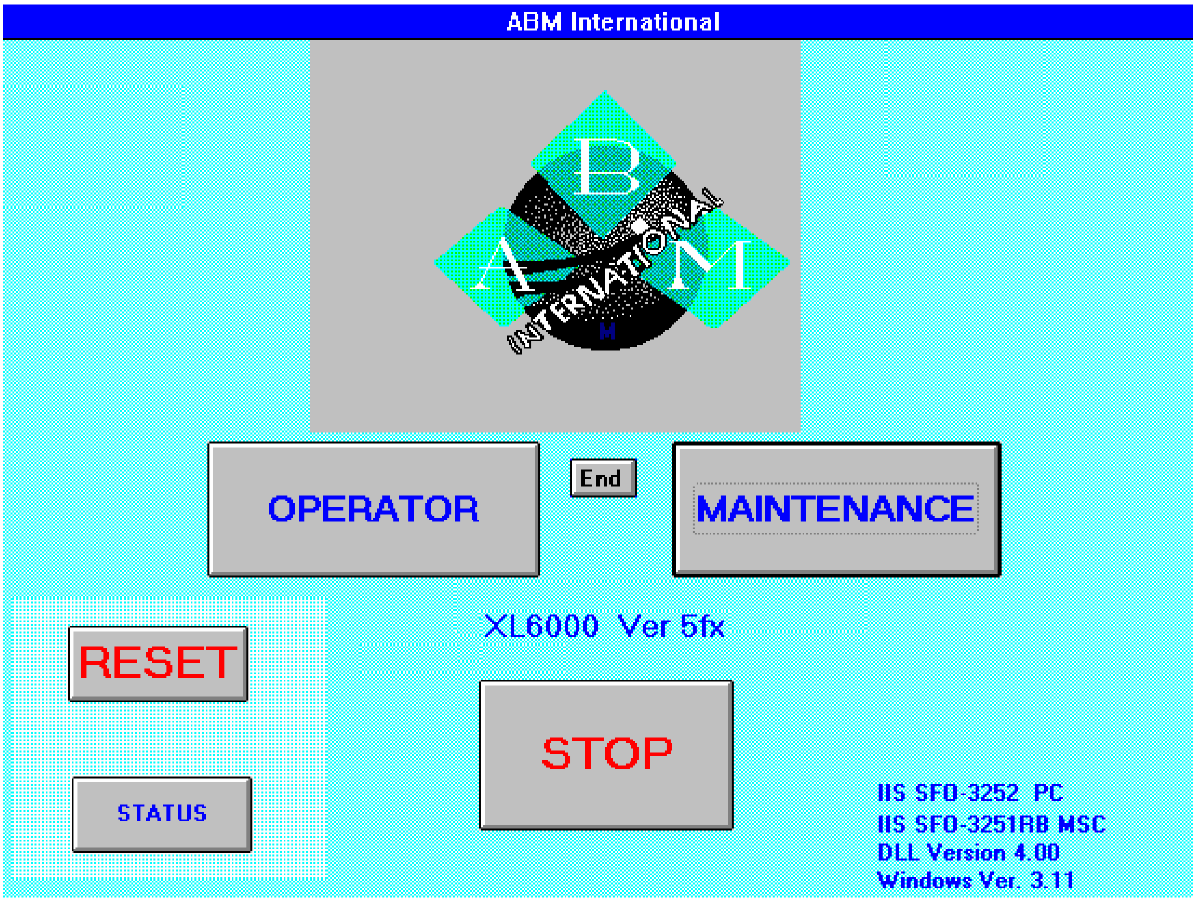


Figure 2.1b - The Initialized Main Screen

This screen shows the OPERATOR and MAINTENANCE buttons. Notice the INITIALIZE button is no longer visible. This screen also displays that the software revisions of the VB, MacroCode and the current DLL version.

The DLL is the program that allows the translation of Pattern G-Codes to a format that the MSC-250 understands.

The **RESET button** is used to clear any errors that may occur while in this screen.

The **STOP button** is used to interrupt the initialization process.

The **MAINTENANCE** button is used to enter the maintenance screen to change operating parameters.

This screen is password protected. Operating parameters for the patterns should be set up by the Technical personnel and should not have to be changed during normal operation. These screens are discussed in the Maintenance section.

Selecting the **Status button** will bring up the following screen, which is the normal running screen used for comforter sewing.

2.2 THE STATUS SCREEN

This screen shows the current state of the XL6000M system. The **Status button** is available on all screens.

The system Faults and the state of operation can be determined from this screen. The faults or current operating states are checked when that condition is in effect.

The Status and Mode settings are as follows:

Sewing Pattern:

This box will appear checked during normal sewing operation while a pattern is being sewed

Sewing Suspended:

Any time the machine is stopped during sewing, this box becomes checked. This can occur if there is a thread break, a sensor is tripped, or the stop button is pressed, etc.

Thread Break Enabled:

The *PARAMETER* screen has a parameter to set the Thread cut delay. The delay can be from 0 to 2000 milliseconds. If this parameter is not 0, this box becomes checked.

Thread Break:

When XL6000M senses that the thread has broken this box becomes checked.

Moving To Home:

This box becomes check while the XL6000M is moving to the unload rethread position.

Moving to Re-Sew:

This box becomes checked when the machine is moving to the restart position.

X Axis Fault:

If the X-axis servo motor faults, this box becomes checked.

Y Axis Fault:

If the Y-axis servo motor faults, this box becomes 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 has 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.

At Home:

When the operator selects the **HOME** button from the **OPERATORS** panel, XL6000M will move to the rethread position. When it gets there, this box becomes checked.

Measure Complete:

After a frame measure has been completed the **Measure Complete** box is checked.

Air Fault:

Compressed air is used to sequence the bobbin, activate the thread cutter, and open and close the Frame locks. These are I/O outputs that are displayed in the *I/O* screen.

XY Limit Exceeded:

If the frame attempts to move beyond the X or Y limit switches, an XY Limit Exceeded box becomes checked.

Measure in progress:

When the operator selects the frame measure button, this box becomes checked and will stay checked until the operation is complete.

Unused:

This status is currently not in use.

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 settings in the *Parameter* screen are changed, 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:
3. When the maintenance personnel enters the I/O screens for any reason
4. When the maintenance personnel changes the X or Y Scaling factors

NOTE: Changing settings 2 and 4 will force a frame measure.

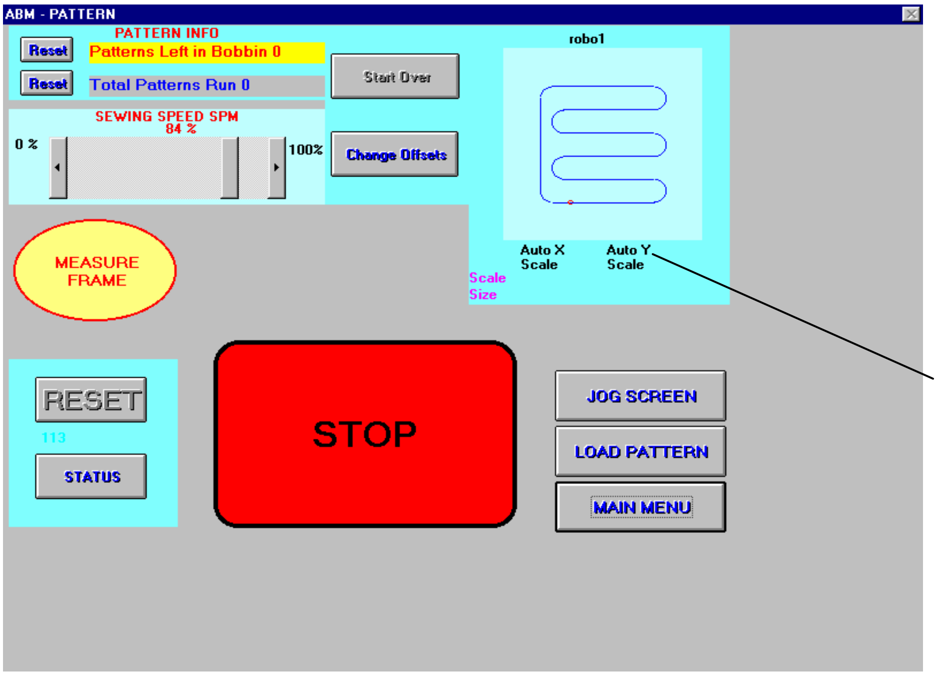
Needle Overtemp:

There is a temperature sensor on the needle motor. If the motor reaches a temperature that would damage the motor a fault occurs and this box becomes checked.

Frame Lock Failure:

If both cylinders don't close properly while the sewing frame is being secured, a fault will occur and this box will become checked.

2.3 THE OPERATOR SCREEN: Selecting the **OPERATOR button** will bring up the following screen, which is the normal running screen used for comforter sewing.



Pattern Viewing Area

Figure 2.3a - The Operator Screen

Operator Screen Options: (refer to figure 2.3a)

The Pattern info area displays how many patterns per bobbin are left. The starting value is set in the Maintenance Parameter screen.

The next value is the total patterns run. Each of these values can be reset by using the corresponding buttons.

The **Sewing speed** is displayed in stitches per minute. This value consists of a percentage of the maximum value set in the parameter screen.

Start Over Button – During normal operation, sewing can be started and stopped at any given time. If the machine stops by selecting the Stop Button or a thread break the machine will restart and continue sewing the pattern.

Selecting the **Measure Frame** button initiates the measure frame process, which is followed by a pattern download to the MSC-250 controller.
The frame is measured from the initialized point to the farthest sensor in both the X and Y directions.

The **Reset Button** performs the same function as in the Main screen. If there is status fault this button will appear red.

A description of the fault can be viewed by selecting the **Status Button**.

The **Stop Button** stops the machine to a point where sewing can be resumed.

Pressing the **Start Over Button** causes the machine to restart sewing from the pattern home position.

The **Change Offsets** button is used to change the sewing offsets. The sewing offsets can also be modified in the Maintenance Parameter screen.

In the **Pattern viewing area**, a picture of the pattern selected is displayed as well as scaling information. If manual scaling is used the operator has the option to adjust the scaling directly from this window.

The pattern scaling has a range from 4 to 12. 12 being a 120% of the actual size of the pattern.

After a successful frame measure has been completed, the **Run Screen button** will appear.

2.4 THE RUN SCREEN – To enter the Running screen; select the **Run screen button** from the operator menu.

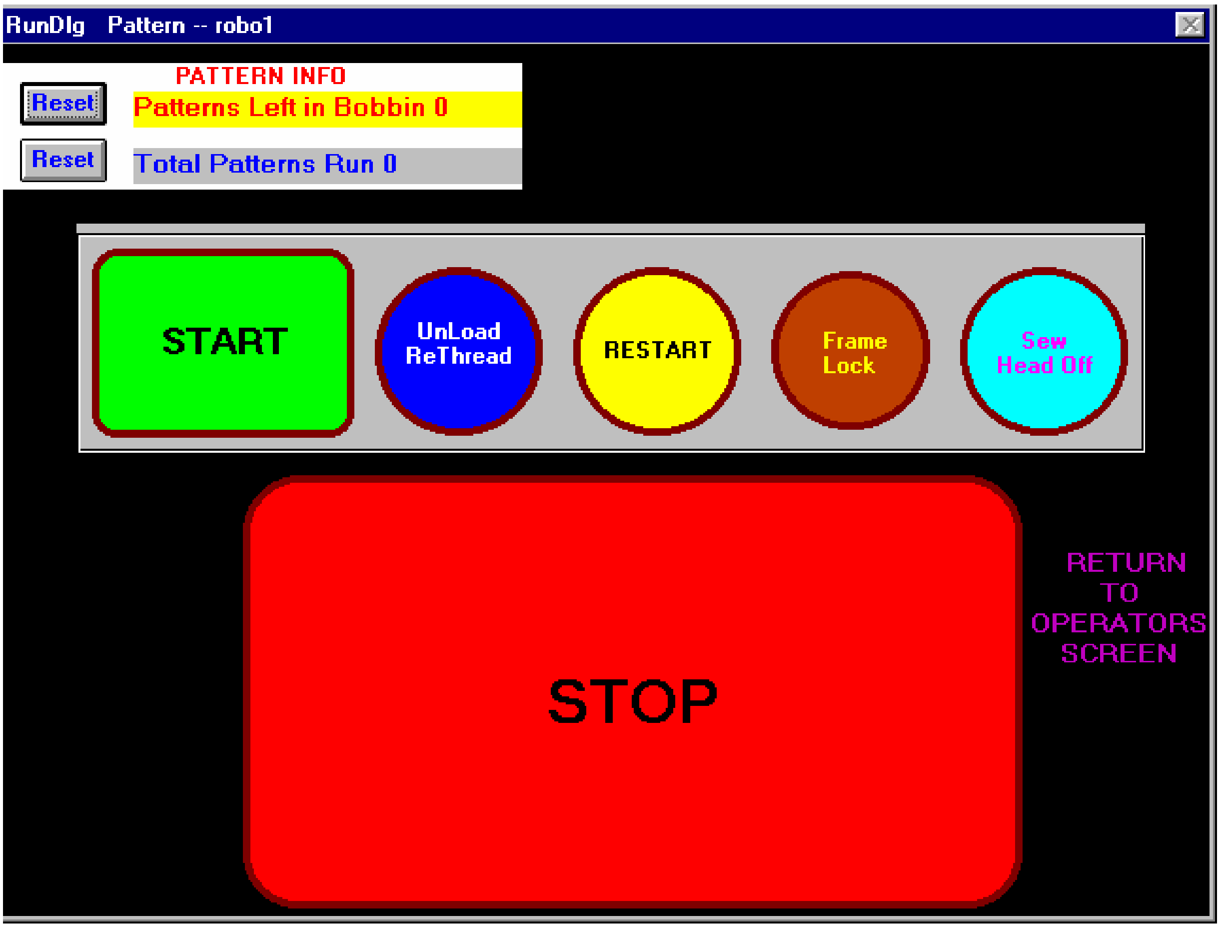


Figure 2.4a - Running Screen

In this screen there is no **Status button**. If a fault occurs, a message will be displayed indicating the nature of the fault

Run Screen Options (Refer to figure 2.4a)

The **Pattern Info** serves the same purpose as it dose when you are in the Operator screen.

The **Start Button** begins the sewing of the pattern.

The **Unload Rethread button** sends the frame to the position as it was set in the Jog screen.

The **Restart button** comes in handy after a thread break. After the thread has been reloaded, the operator can use the **Restart button** to back up in 12-inch increments through the pattern to the exact location where thread break took place. Following this procedure the operator can resume sewing by pressing the start button.

The **Frame Lock button** when pressed will engage or disengage the frame lock solenoids.

The **Sew Head Off button -**Engages or disengages the sew head
Using the feature the operator is able to simulate sewing with running the sew head. This prevents damage to the sew head during a machine setup.

To return to the operator screen touch area labeled Return **to Operators Screen.**

From the operator screen select the **Jog Screen button** to enter the **Jog Screen**.

2.5 **The Jog Screen**- Selecting the JOG SCREEN button allows the operator to enter the JOG screen.

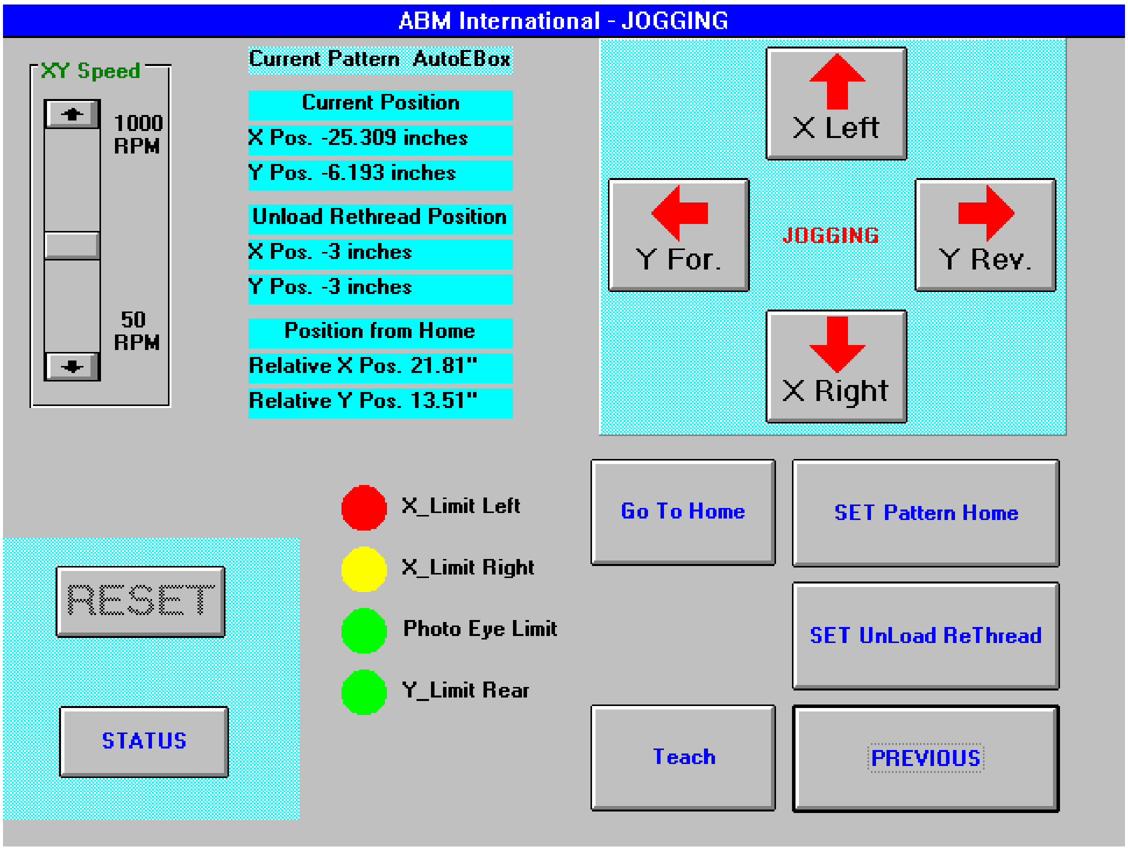


Figure 2. 5a - The Jog Screen

The box in the upper right has four Jogging buttons. These buttons allow the operator to jog the frame in the X and Y directions.

The XY Speed scroll bar can be used to adjust the jog speed. The range is from 50 to 1000 rpm.

The Current Pattern displays the name of the pattern that is being sewed.

The X and Y Current Position of the frame are shown by the X Pos and Y Pos indicators. When the frame is jogged, the new position is updated.

Unload Rethread displays the position that the frame returns to when the XL6000M is finished sewing. This position can set by jogging the frame to a desired position and selecting Set Unload Rethread button.

Position From Home displays the position of the frame in relation to the pattern home that was set by the operator. To set the pattern home, move the frame to a desired position and selecting the Set Pattern Home button. This position is stored and used as a starting to sew point for the pattern.

The Position from Home indicator and the Pattern home button only appear when the pattern selected is using Manual Mode scaling.

The Go To Home button will go to the rethread position that has been set by the unload rethread button.

2.6 THE TEACH AND LEARN SCREEN-To enter the teach and learn screen the Teach Button can be selected.

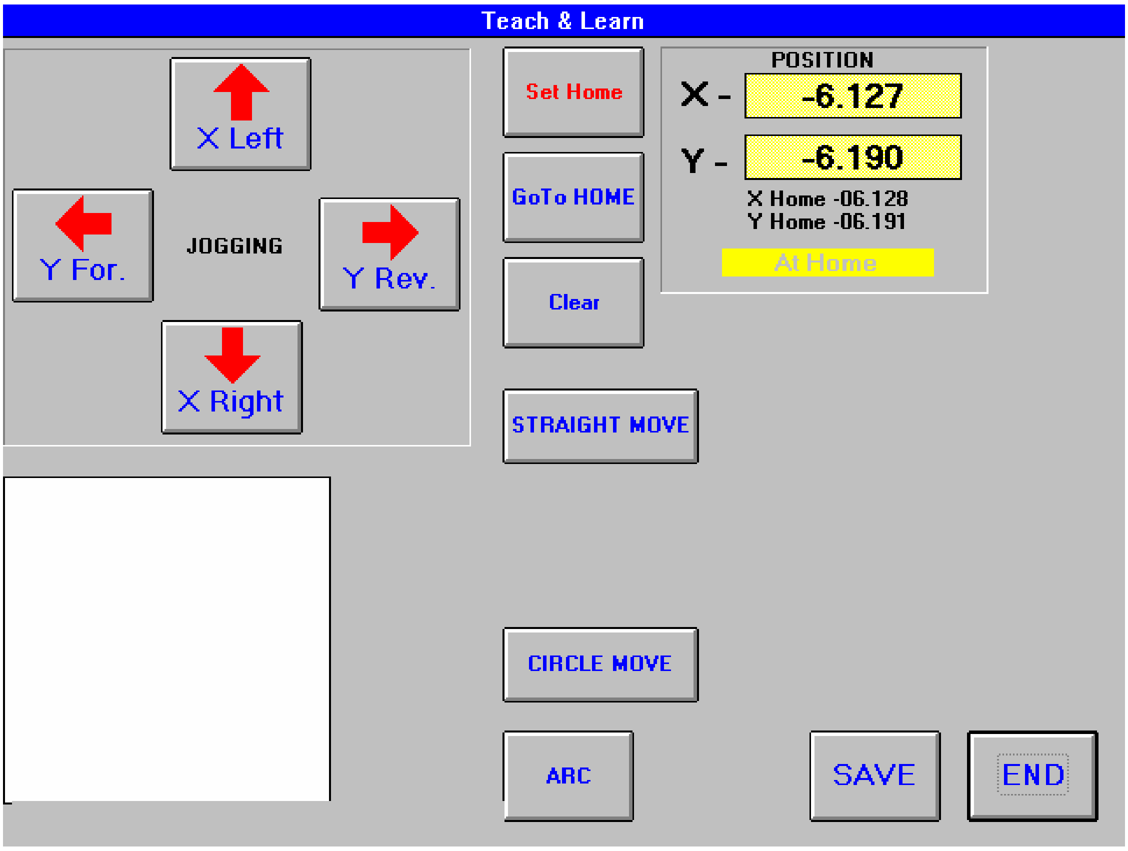


Figure 2.6a - The Teach and Learn Screen

While in the teach and learn screen, the operator attempts to simulate sewing a pattern by manually moving the frame through the pattern and recording positions.

The operator then saves the file as a new pattern that can be loaded into the XL6000M for sewing.

The preceding **(figure 2.6a)** page shows the Teach & Learn Screen.

The X and Y position is at Home and the screen is ready to accept a new Home position, or do a Straight Move, a Circle Move, or a Arc Command.

The Save button will ask for a file name, and will use the given name to create 2 files. One will be used for the pattern name and will be filed with the others in the patterns directory. The 2nd file is assigned as different file extension that will be used to save all Teach commands done up to this point in time, for this Teach session.

Developing a pattern can be a time consuming task. In order to overcome this, it is suggested that difficult parts of the pattern be saved to a separate file.

When the Arc command is first used, it will ask if you want to use a saved file.

If a pattern or Arc was created previously, it can be retrieved and used in the present pattern being developed. This can drastically reduce time when creating a pattern from scratch.

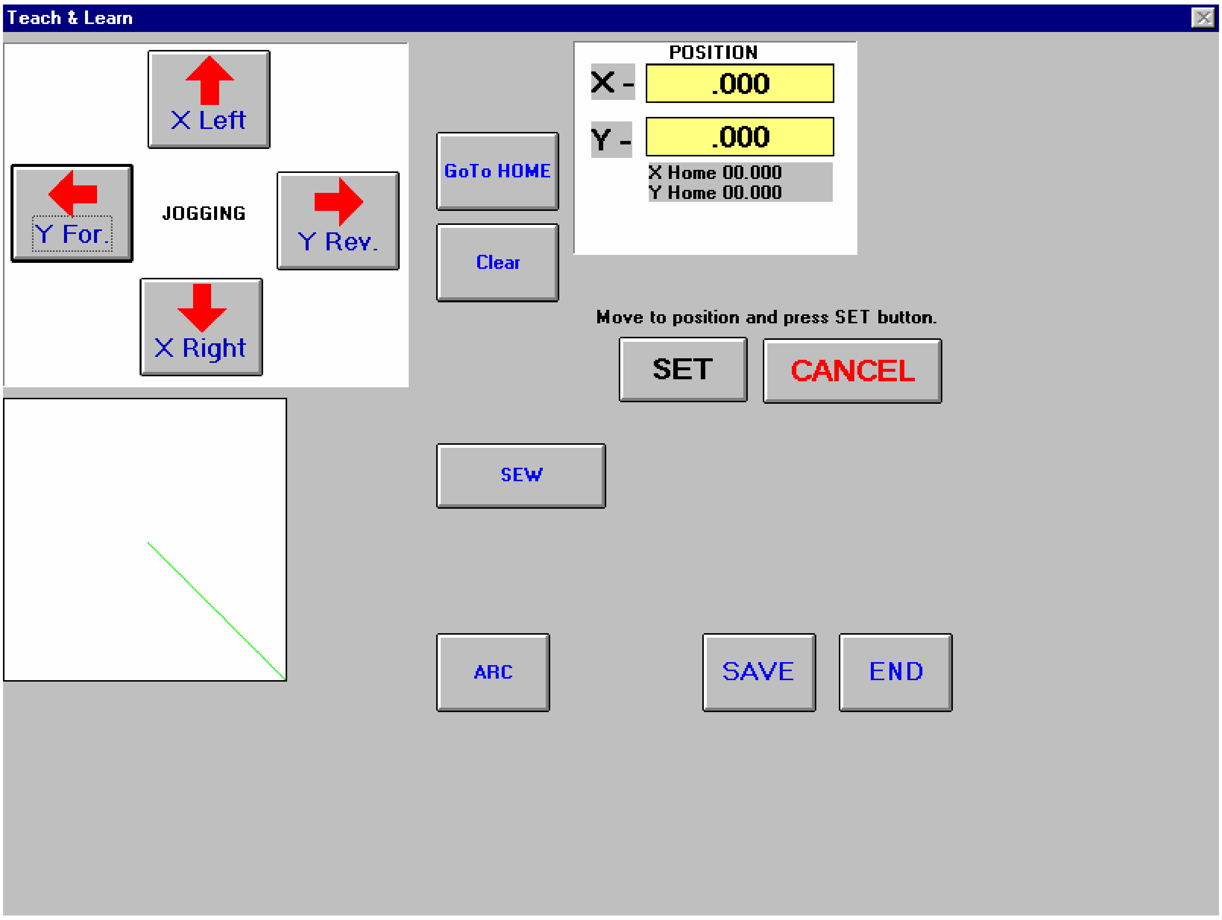
Developing a Pattern

The operator begins selecting a home or starting position for the sewing.

There are four separate jog buttons located at the top left hand corner of the screen. Start by jogging the machine to desired start of sewing position and select the **Set Home button.** This will set the start of sewing and cause the Home button to disappear from the screen.

After jogging away from this position, the operator can select the **Go to Home button.** This causes the machine to automatically position itself back to the preset home position. During the developing process it might become necessary to erase the pattern and start over. This can be accomplished by selecting the **Clear button**. Clearing the pattern will erase the pattern and cause the **Set home button** reappear.

After setting home the operator can decide whether to start the pattern with a straight line or create a circle. To create a straight line, jog the machine to the desired ending position of the line and select the **Straight Move button.**



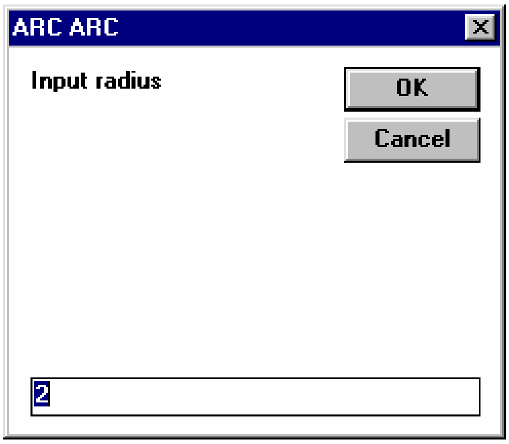
When these options appear, choose the **Set button** to record the move or the **Cancel button** remove the move.

If this line is not going to be a sewing line, click on the **Sew button** to change it to **No Sew.** This is required when jumping to different patterns with in the same area.

To use the Arc command click on the **Arc button.** A message box comes up displaying an option to retrieve an Arc from a file.

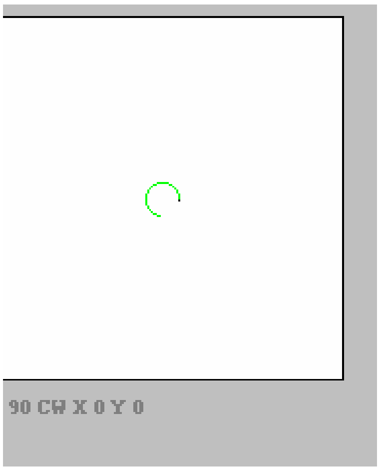
To create a more uniform pattern, an Arc can be copied into areas where the same type is needed.

If an input file is selected, another window will be displayed asking for the **Radius.**

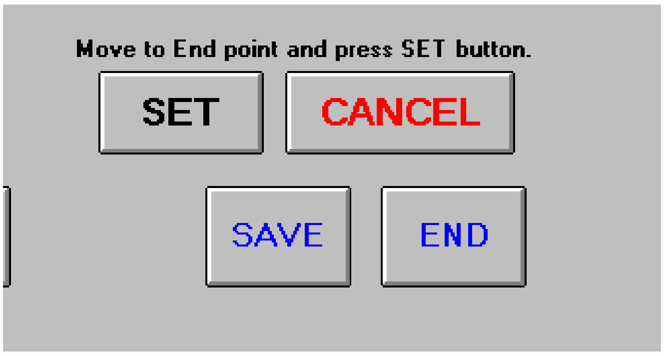


The radius is the distance perpendicular to current end point. This value can be a positive or negative number depending o the direction of the arc.

The next two windows are the degree value and direction of rotation. The degree value is in reference to the current point in a certain direction (Cw or CCw). A 90-degree rotation in a clockwise direction with a2 inch radius looks like this.



To use the **Circle button** starting from the last endpoint, move to the midpoint of the circle. Click the **Set button.** Next move to the point where the circle will end and click on set.



After the pattern is completed, click on the **Save button.** Give the file a name and when you enter the **Load Pattern Screen** the pattern will be available for sewing.

Click on the **End button** to return to the **Jog Screen**.

From the **Jog Screen** select the **Load Pattern button** to enter the pattern download screen.

2.7 THE LOAD PATTERN SCREEN

Patterns for sewing are selected from this screen. See **Figure 2.7a** below.

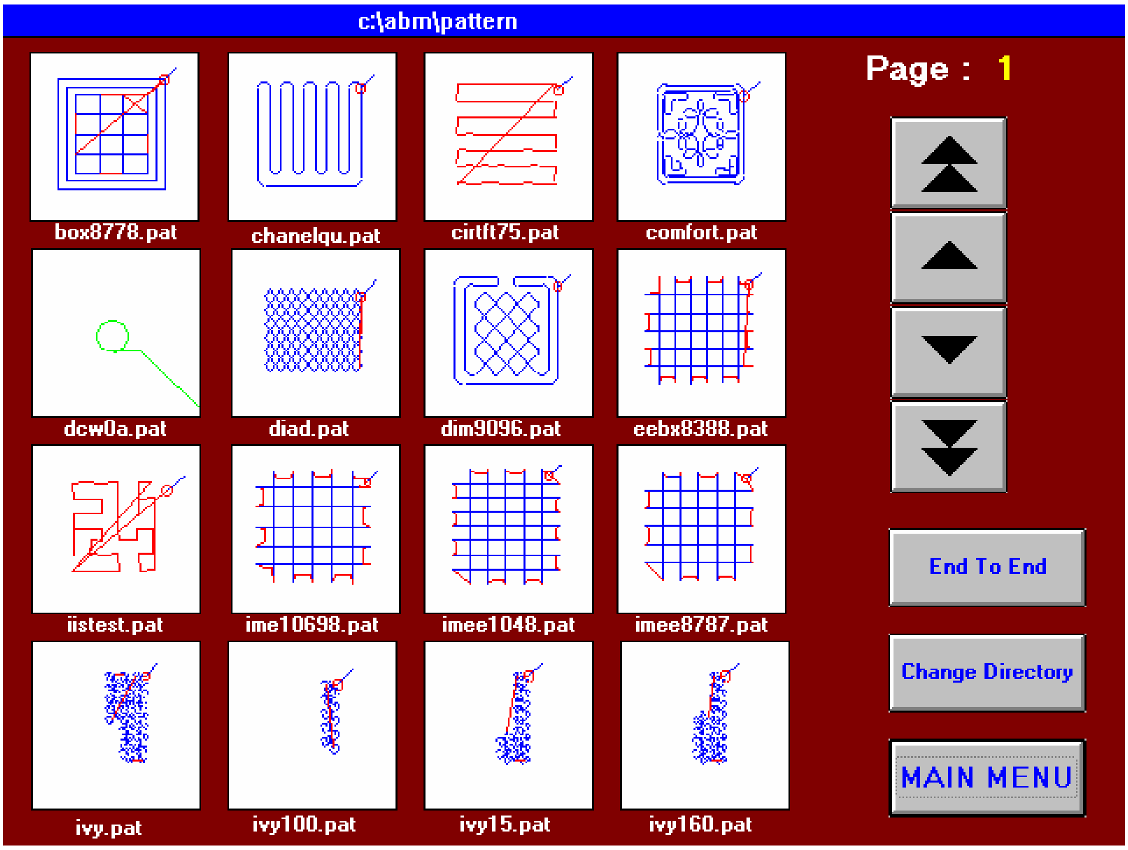


Figure 2.7a - The Load Pattern screen

From this screen up to sixteen patterns can be viewed. Other patterns if available can be selected by using the Arrow Keys.

The operator has the option of selecting a pattern by clicking on the picture displaying the pattern or choosing End To End by clicking on the End-To-End button.

When End-TO-End is selected, a pattern is automatically generated by inputting the number of X and Y lines required for that pattern.

The **Change Directory** button allows the operator to select patterns from another directory on the XL6000M System.

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

3.0 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 3.1a and 3.2a**).

3.1 ENTER PASSWORD

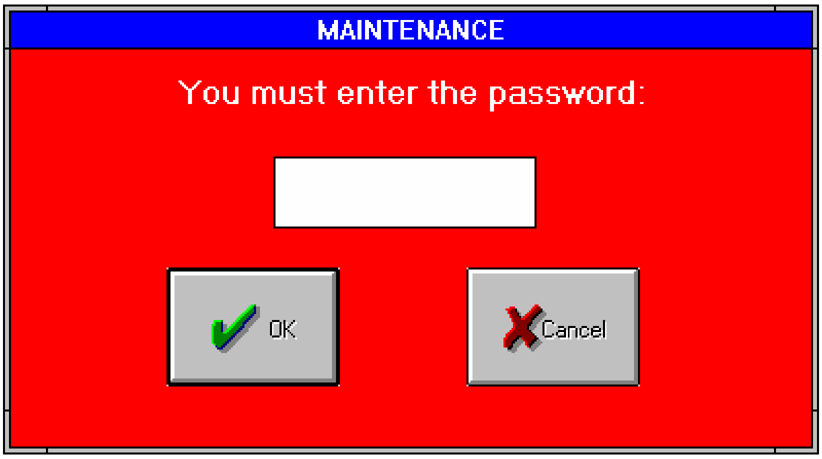


Figure 3.1a - The First Password Screen

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.

3.2 ALPHA-NUMERIC KEYPAD

The ALPHA-NUMERIC KEYPAD screen will appear that will allow you to enter alphanumeric keys for password entry (see **Figure 3.2a**).

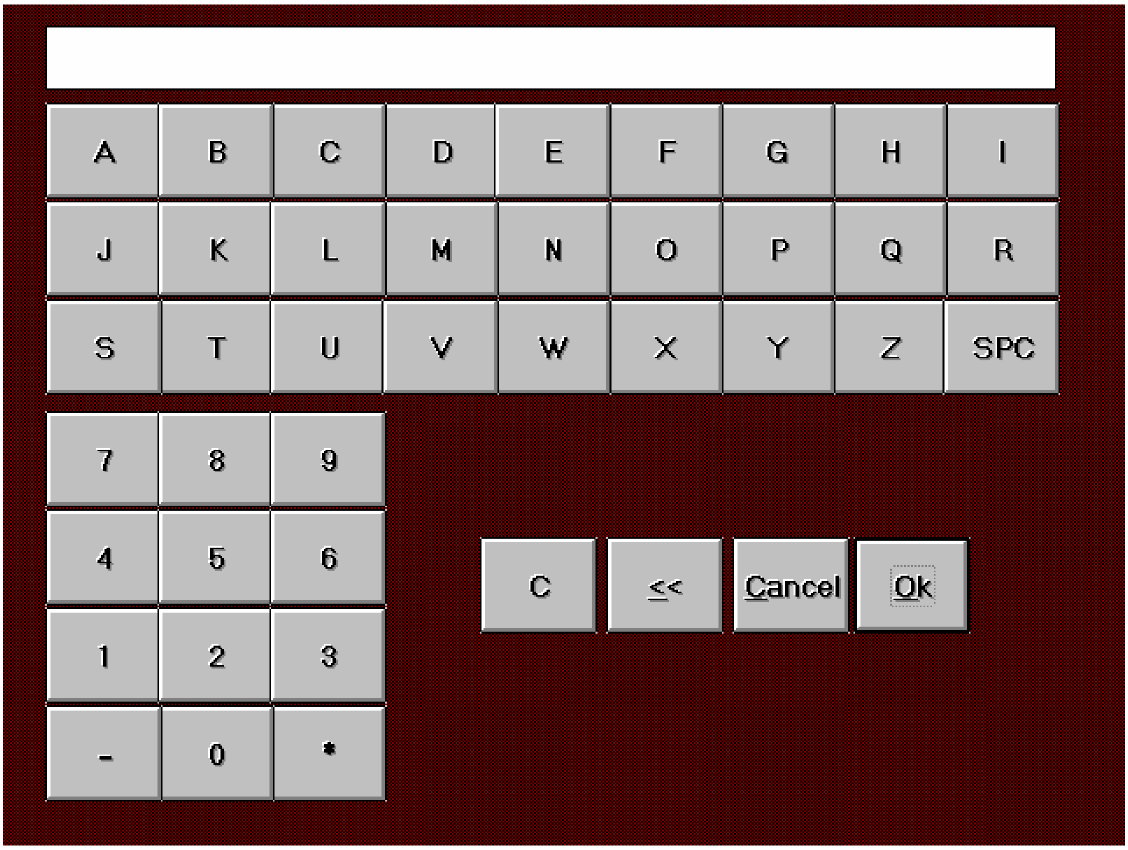


Figure 3.2a - Alpha-Numeric Keypad Screen

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 3.3a**) 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.

3.3 THE PARAMETER SCREEN

The PARAMETER screen allows entry of parameters and variables that both the IIS Macro-Program and the XL6000M 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 3.3a**).

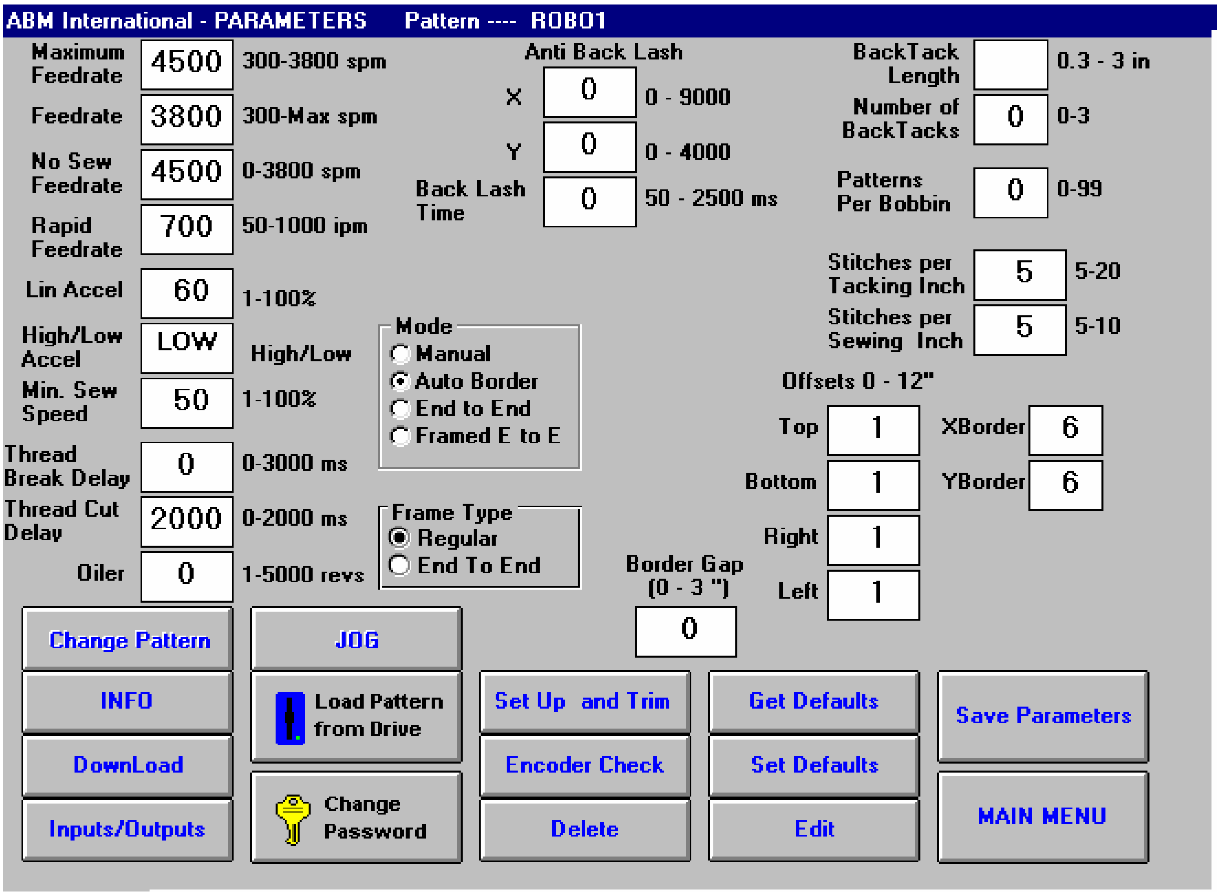


Figure 3.3a - The Parameter Screen

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.

The Parameter Screen - Continued

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.

Maximum Feedrate: Limits the fastest sewing speed. The XL6000M 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 XL6000M 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 XL6000M 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.

High / low Accel: If there is a pattern that has a lot of sharp turns it is recommended that this be set on low. This helps to smooth out the sewing process.

Minimum Sew Speed: The percentage of Feedrate used as the minimum sewing speed around sharp corners or reversals in sew direction.

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.

The Parameter Screen - Continued

Oiler: This determines how often the sew head will be oiled during operation.

Anti Back Lash: This helps to overcome gear backlash on the X and Y-axis.

Modes-: Manual This used when the machine is set up manually.

Auto Border: When selected, enables the Auto Border mode. This mode will produce the borders as selected by Xborder & Yborder parameters.

End-to-End: This is used when sewing patterns that only need to have the number of lines entered.

Framed End to End: This is used the same as above but it has an outside border.

Offsets: These are offset to the currently selected border. They will decrease the sewing area for the pattern by the amount selected.

Frame Type: This is used in conjunction with the mode selection determining which frame will be used.

Border Gap: This allows the border vary the outside border.

Back Tack Length: The length in inches of the Back Tack.

Number of Back Tacks: The number of back tacks to perform for the Back Tack.

Patterns per Bobbin: The number of patterns that can be run on a bobbin. This value is pattern dependent.

Back Tack Stitches per Inch: The number of stitches per inch used in back tacking.

Sewing Stitches per Inch: This determines how many sewing stitches there are in an inch.

Xborder: The Xborder element for Auto Border.

Yborder: The Yborder element for Auto Border.

3.4 THE SET UP AND TRIM SCREEN

From the PARAMETER screen the Set Up and Trim button can be selected (see **Figure 3.4a** below).

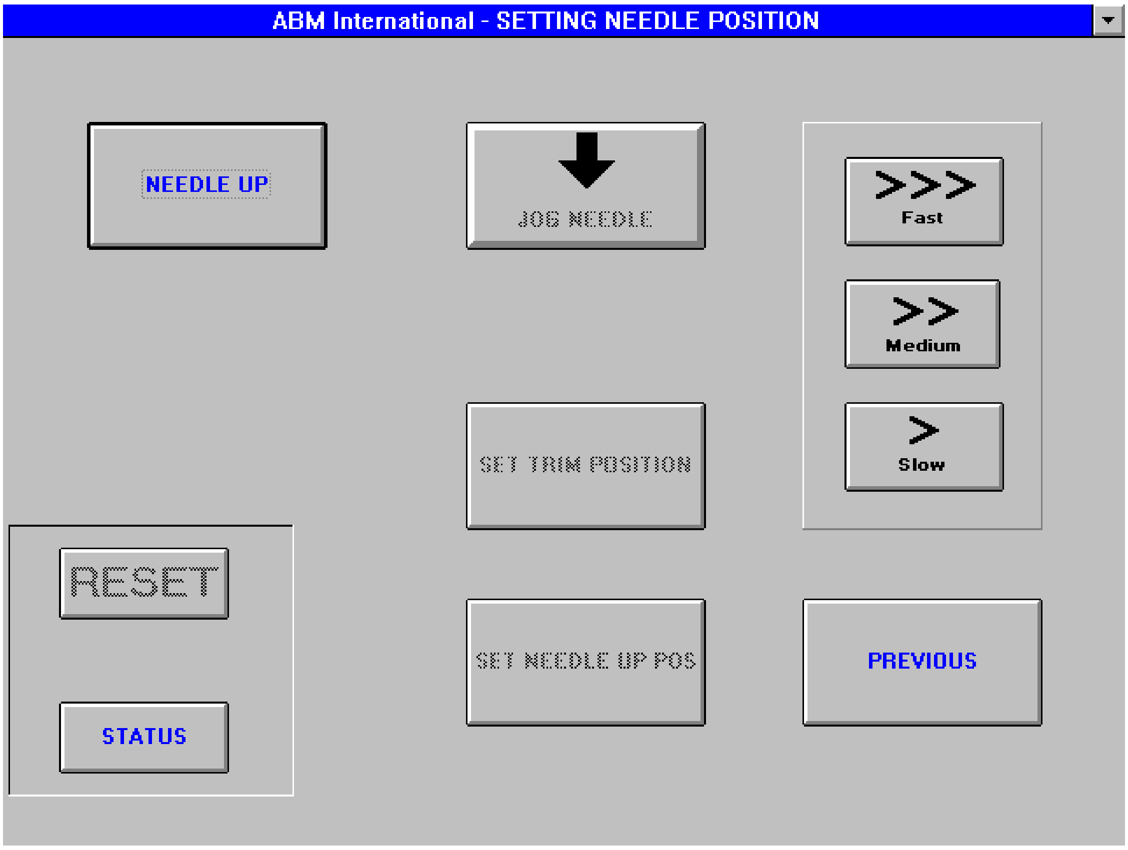


Figure 3.4a - The Set Up and Trim Screen

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 PARAMETER screen.

3.5 The Encoder Check Screen

Selecting the Encoder Check button from the PARAMETER screen will bring up the ENCODER screen (see **Figure 3.5a**).

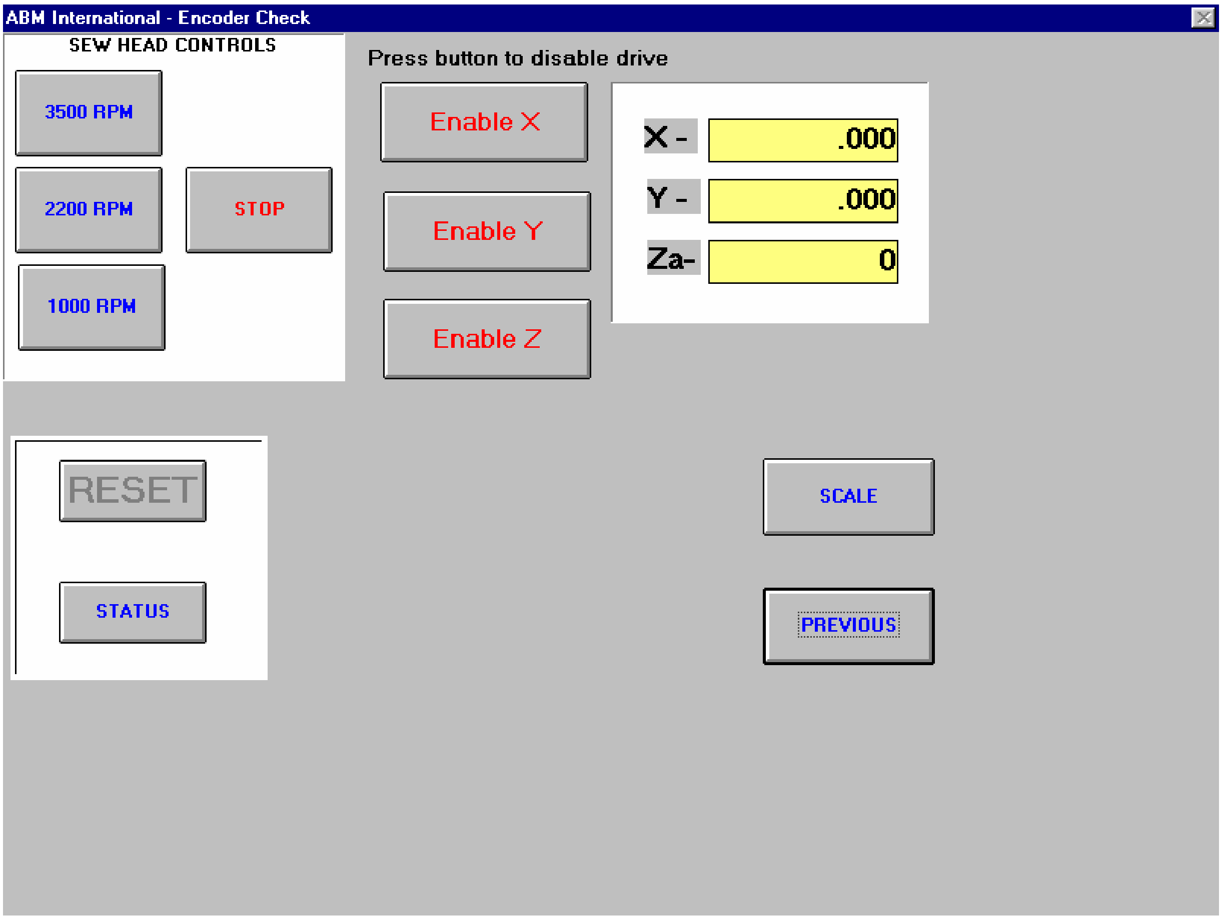


Figure 3.5a - The Encoder Screen

This example screen indicates 3 servo motor controls and 3 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 needle position. The Za- readout shows the sewing needle position. This button needs to be selected before any adjustments to the sewing area can be made or before removing/replacing a needle.

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 XL6000M system to the PARAMETER screen.

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

3.6 THE SCALE SCREEN

When the correct password has been entered, the SCALE screen will appear (see **Figure 3.6a**).

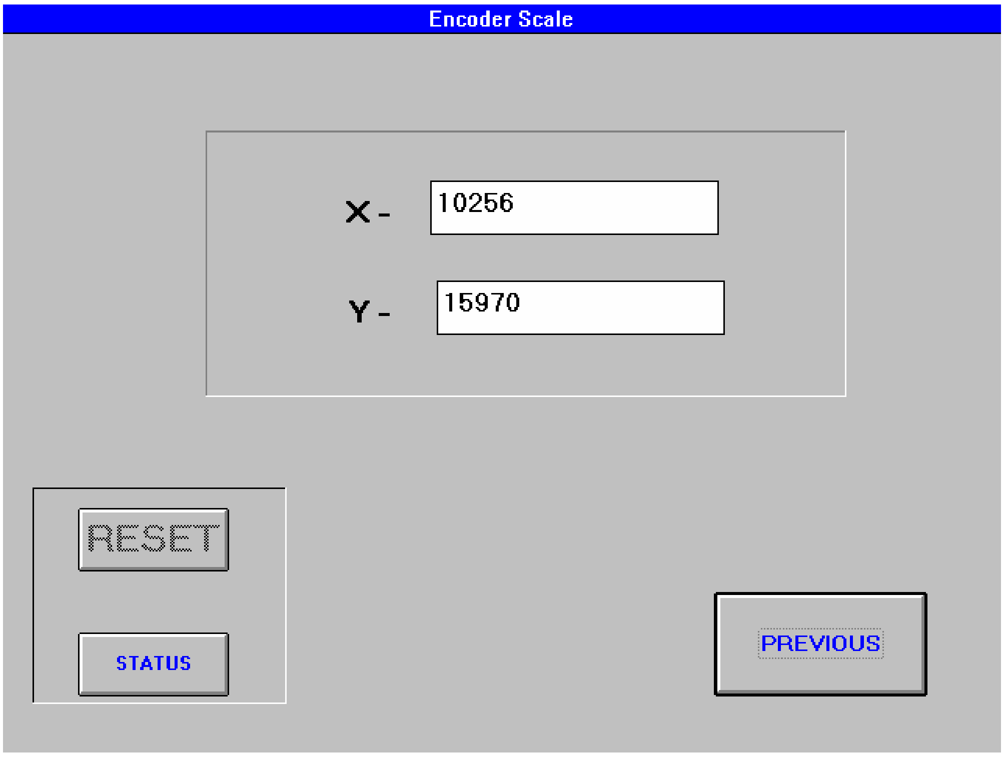


Figure 3.6a - The Scale Screen

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.

3.7 THE LOAD PATTERN FROM DRIVE SCREEN

When the Load Pattern from Drive button is selected from the PARAMETERS screen (see **Figure 3.7a**) the LOAD NEW PATTERN screen will appear.

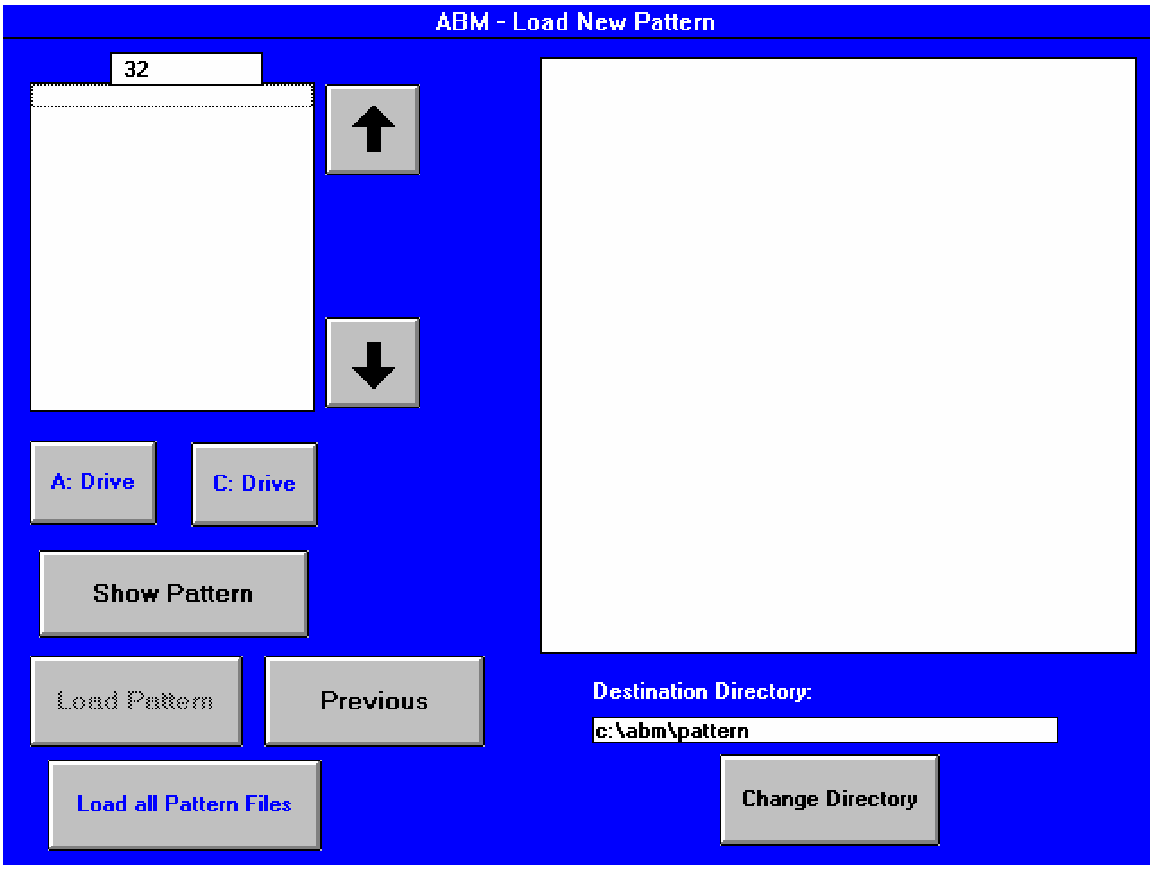


Figure 3.7a - The Load New Pattern Screen

The Load New Pattern Screen - Continued

New patterns can be entered into the XL6000M 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 3.8 & Figure 3.7b**).

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 3.7b**).

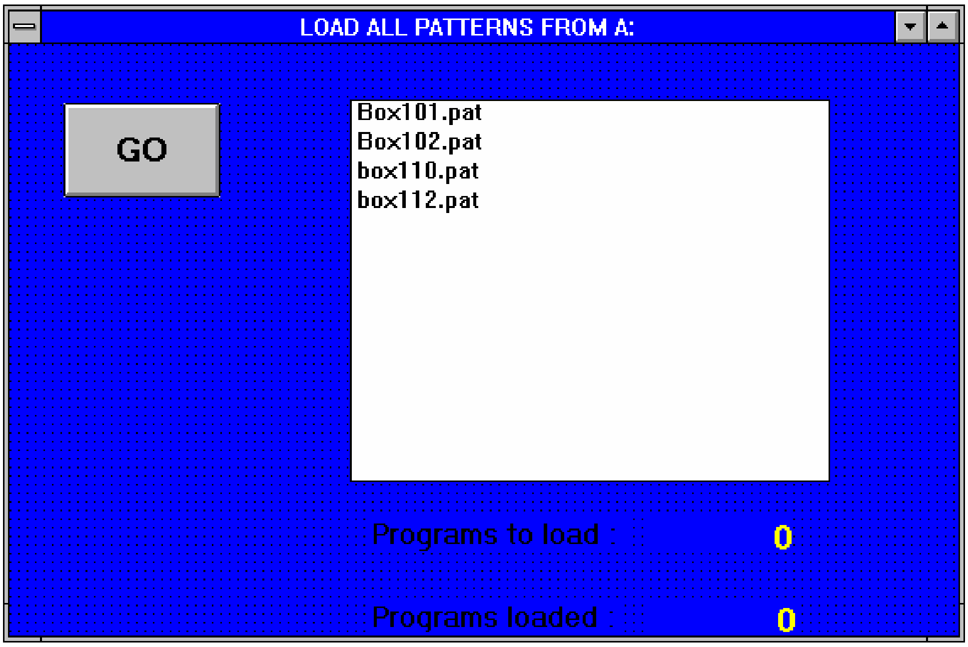


Figure 3.7b - The Load All Patterns Screen

When all of the patterns are loaded from the diskette, 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.

3.8 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 3.8a**).

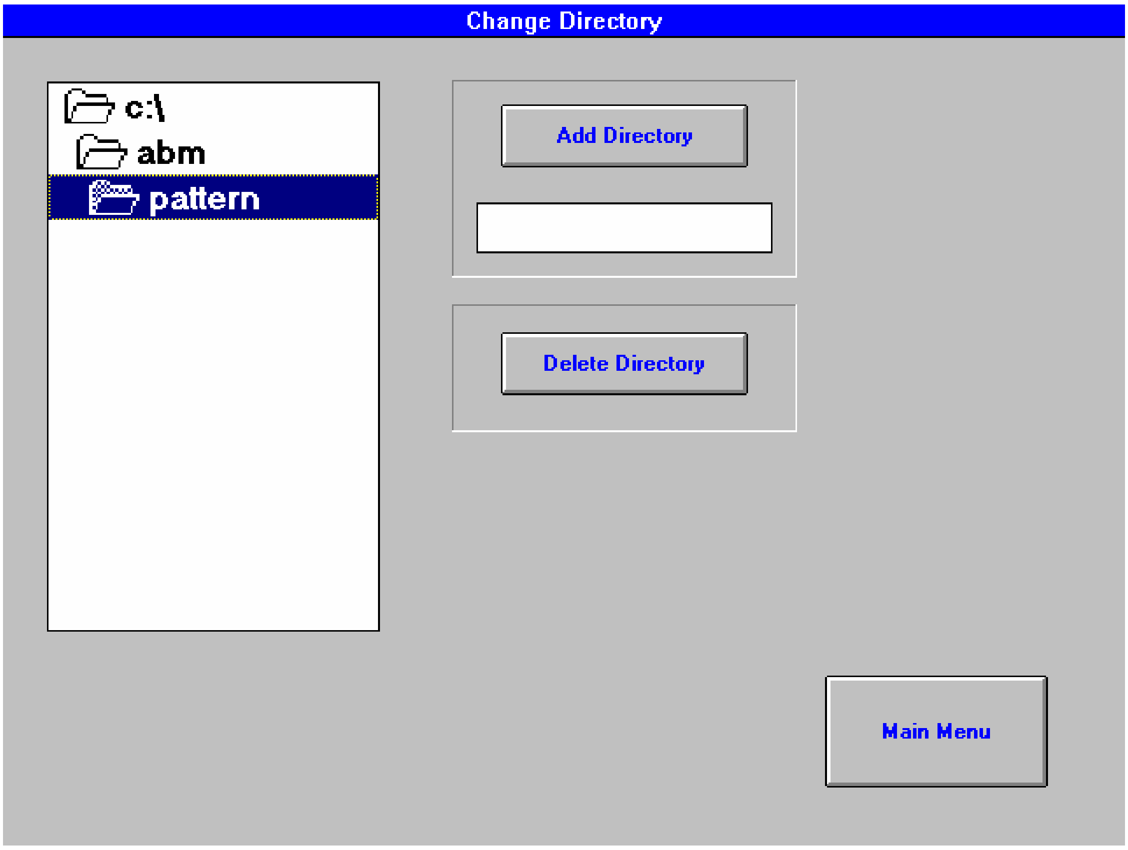


Figure 3.8a - The Change Directory Screen

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 keypad 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. **Important: Only sub directories can be deleted by using 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.

3.9 THE CHANGE PASSWORD SCREEN

When the Change Password button is selected from the PARAMETERS screen, the CHANGE PASSWORD screen appears (see **Figure 3.9a**).

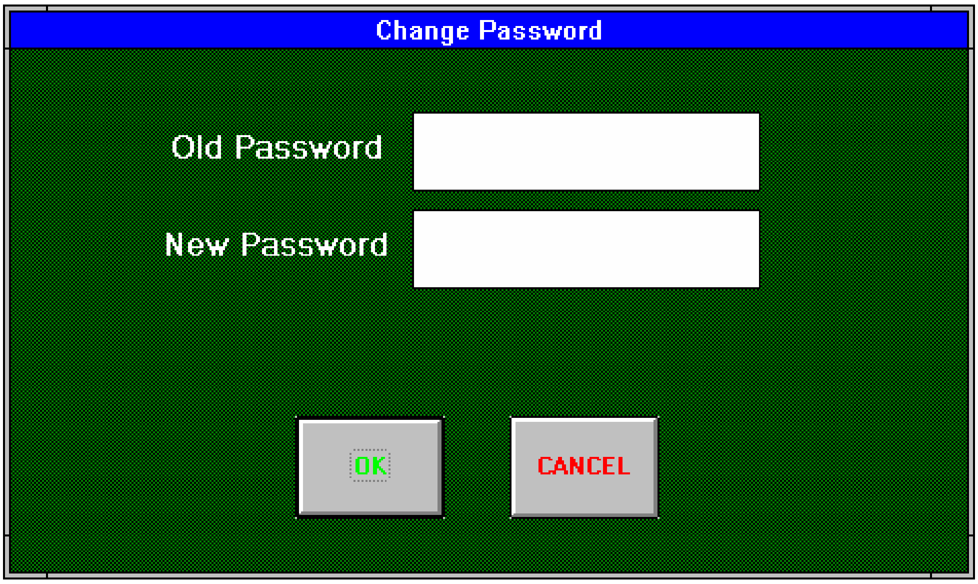


Figure 3.9a - The Change Password Screen

This screen will change the password that the XL6000M 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.

3.10 DELETING FILES

Selecting the Delete button from the PARAMETERS screen will bring up the DELETE FILES screen (see **Figure 3.10a**).

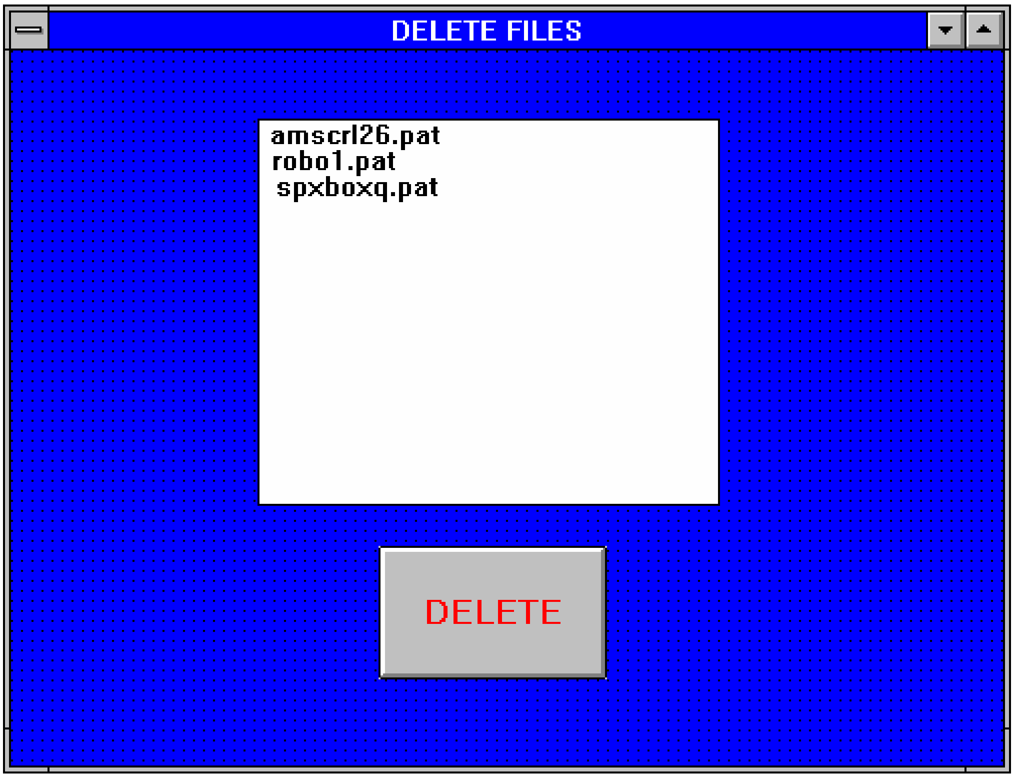


Figure 3.10a - The Delete Files Screen

From this screen you can individually select patterns for deletion. The pattern is selected, and 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.

3.11 THE INPUT OUTPUT SCREEN

Selecting the Inputs/Outputs button from the PARAMETERS screen will bring up the INPUTS screen (see **Figure 3.11a**).

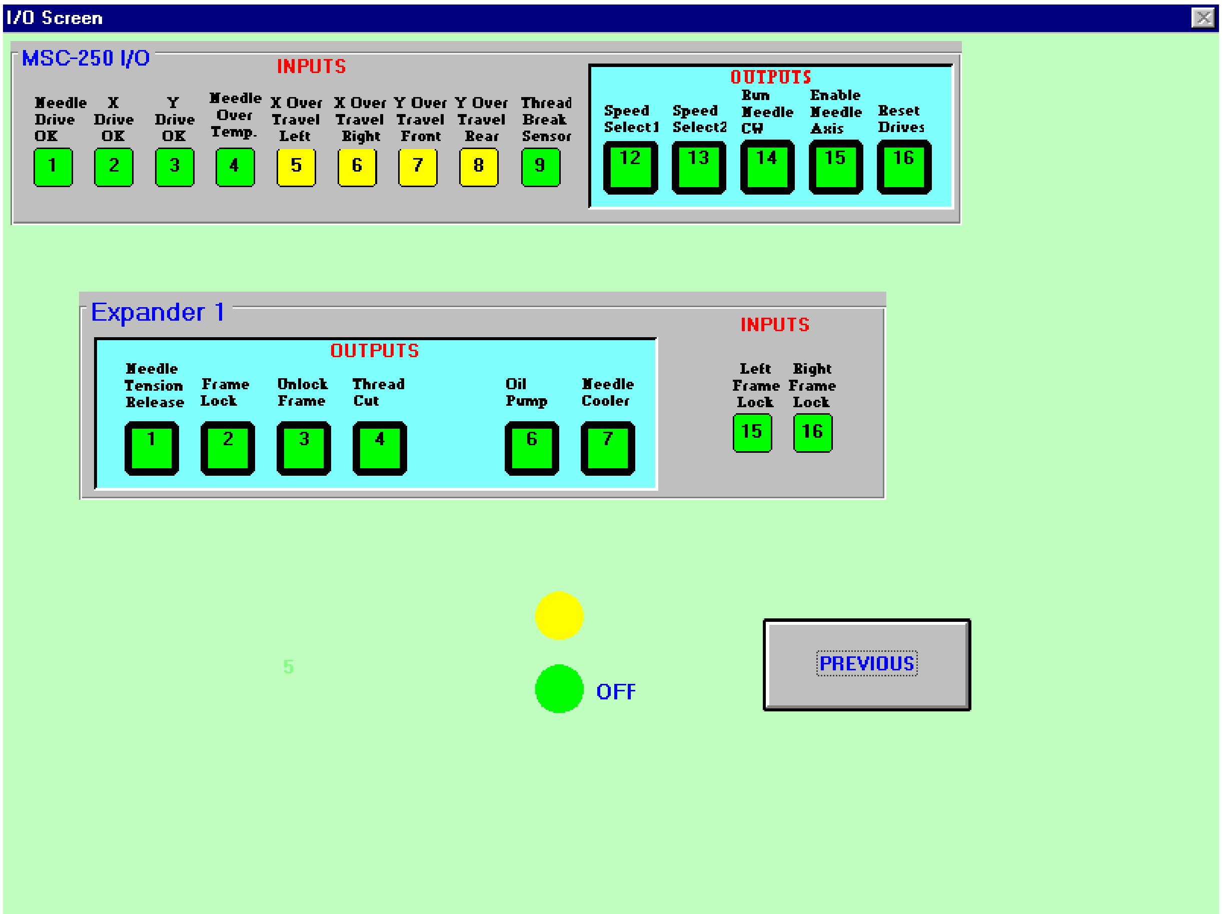


Figure 3.11a - The Input I/O Screen

This screen shows the Inputs for the XL6000M 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.

Only outputs can be toggled on and off from this screen.

I/O Definitions:

Needle Drive Ok	This input signals the MSC-250 in the case of fault in the Needle Drive.
X drive Ok	This input signals the MSC-250 in the case of a fault in the X-Axis Drive.
Y Drive Ok	This input signals the MSC-250 in the case of a fault in the Y-Axis Drive.
Needle over Temp	This input is for monitoring the temperature of the needle motor.
X Over travel Left **X Over travel Right**	These inputs serve as overtravel limits that prevent the frame from crashing into the sew head in the X-Direction.
Y Over Travel Front **Y over Travel Rear**	These inputs serve as overtravel limits to prevent the frame from crashing into the sew head in the Y-Direction
Thread Break Sensor	This is a constant pulsing input. Interruption of this signal will cause a fault condition.
Speed Sel1 **Speed Sel2**	These two outputs are connected to the needle drive for different speed modes
Run needle CW	This output is used to allow the MSC-250 place the needle drive in Run mode
Enable Needle Axis	This output is used to allow the MSC-250 enable and disable the needle drive.
Reset Drives	This output is used to reset all drives in the case of a drive fault condition.

Expander 1 Definitions – These are I/O that are located on the IOE-850 board.

Needle Tension	The MSC-250 controls the tension release on the sew head with this output.
Frame Lock	The MSC-250 controls the frame-lock air solenoid with this output.
Frame Unlock	The MSC-250 controls the frame –unlock solenoid with this output.
Thread Cut	This output is used to control the operation of the thread cutter solenoid.
Oil Pump	The oil pump valve solenoid is controlled by this output.
Needle Cooler	This is connected to the air solenoid that controls the cooling system for the needle.
Left Frame Lock	These inputs monitor the frame lock sensor switches. The absence of either input causes a fault.
Right Frame Lock	

3.12 THE INFO SCREEN

Selecting the INFO button will bring up the MSC INFORMATION screen (see **Figure 3.12a**).

Figure 3.12a - MSC Information

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.

3.13 THE DOWNLOAD SCREEN

Selecting the Download button will bring up the MACROPRO DOWNLOAD screen (see **Figure 3.13a**).

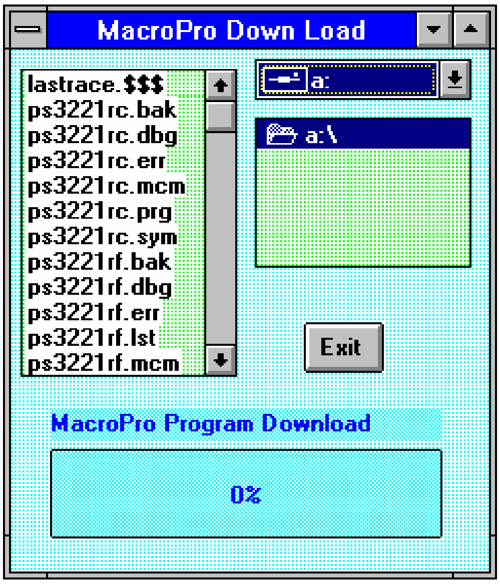


Figure 3.13a - MACROPRO Download Screen

A floppy is needed with the Macro-Program that is to be downloaded. Maintenance personnel select 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.

3.14 THE PROGRAM EDIT SCREEN

Selecting the Edit button from the PARAMETERS screen will bring up the PROGRAM EDIT screen (see **Figure 3.14a**).

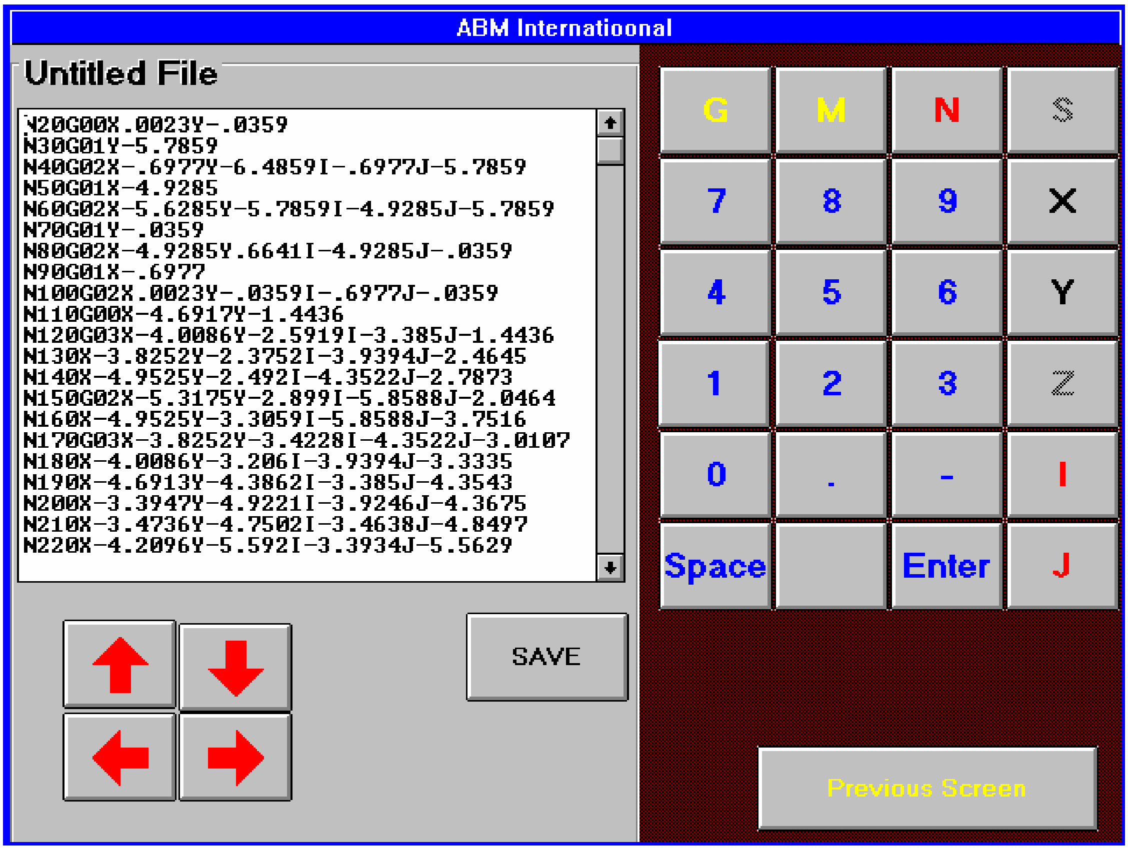
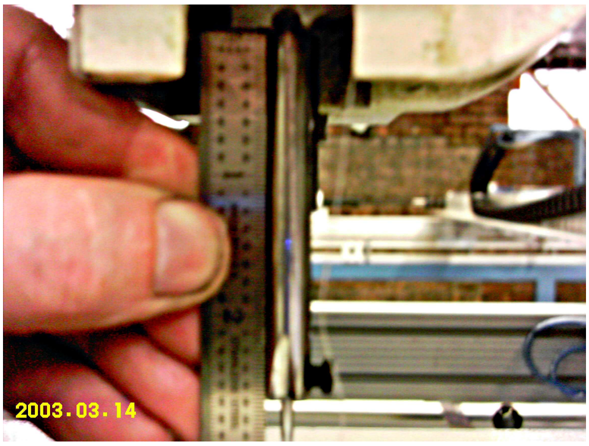


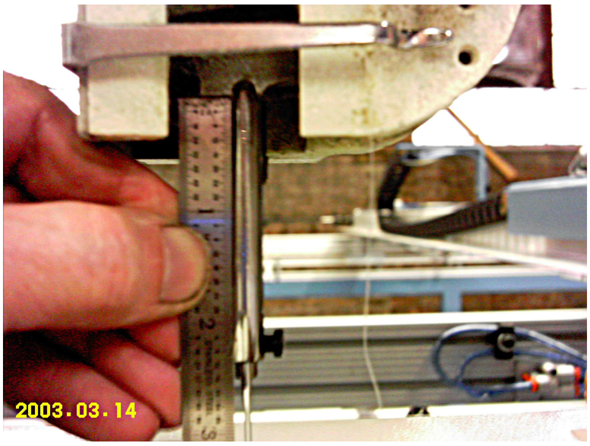
Figure 3.14a - The PROGRAM EDIT Screen

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.

Timing the Mattress sewing head





Setting the Low position

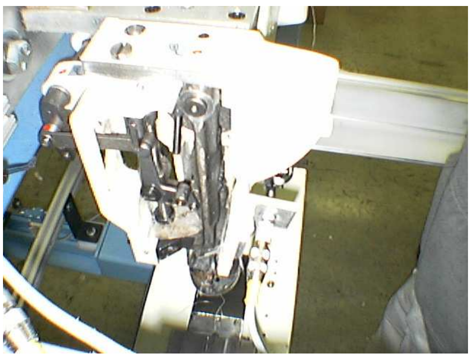
Rotate the sewing head Handwheel (encoder check) Z axis off until the needle bar Is at it's lowest position. Loosen Needle bar clamp screw and adjust The needle bar to 2 19/32"

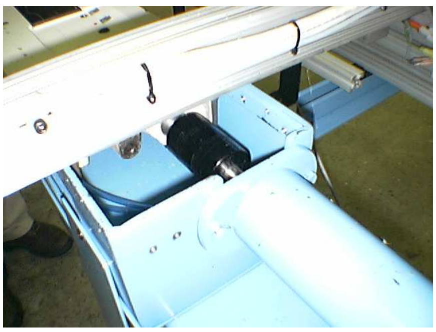
Setting the hook point

Raise needle bar to 2 11/32" Loosen the back coupling for the lower shaft and Position the hook point in center line of the needle. Lock all screws.

Depending on Mattress Thickness additional settings may work better.

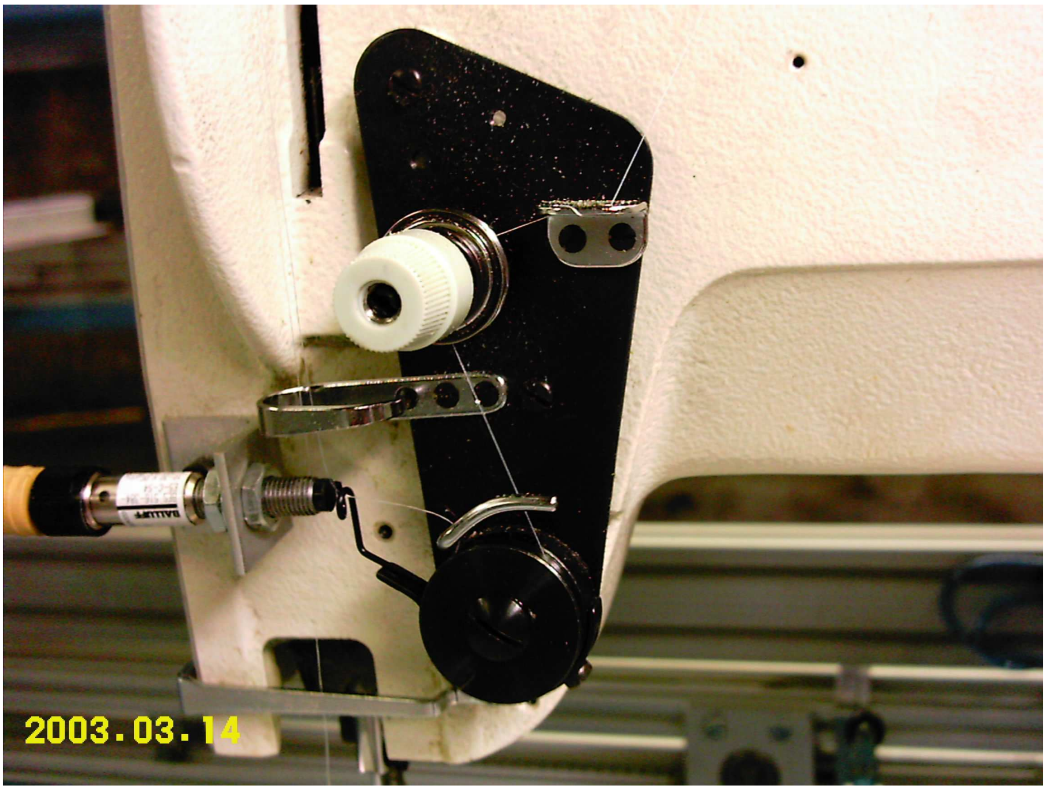
Factory Settings:	2 18/32	2 14/32
Bobs Settings:	2 15/32	2 12/32





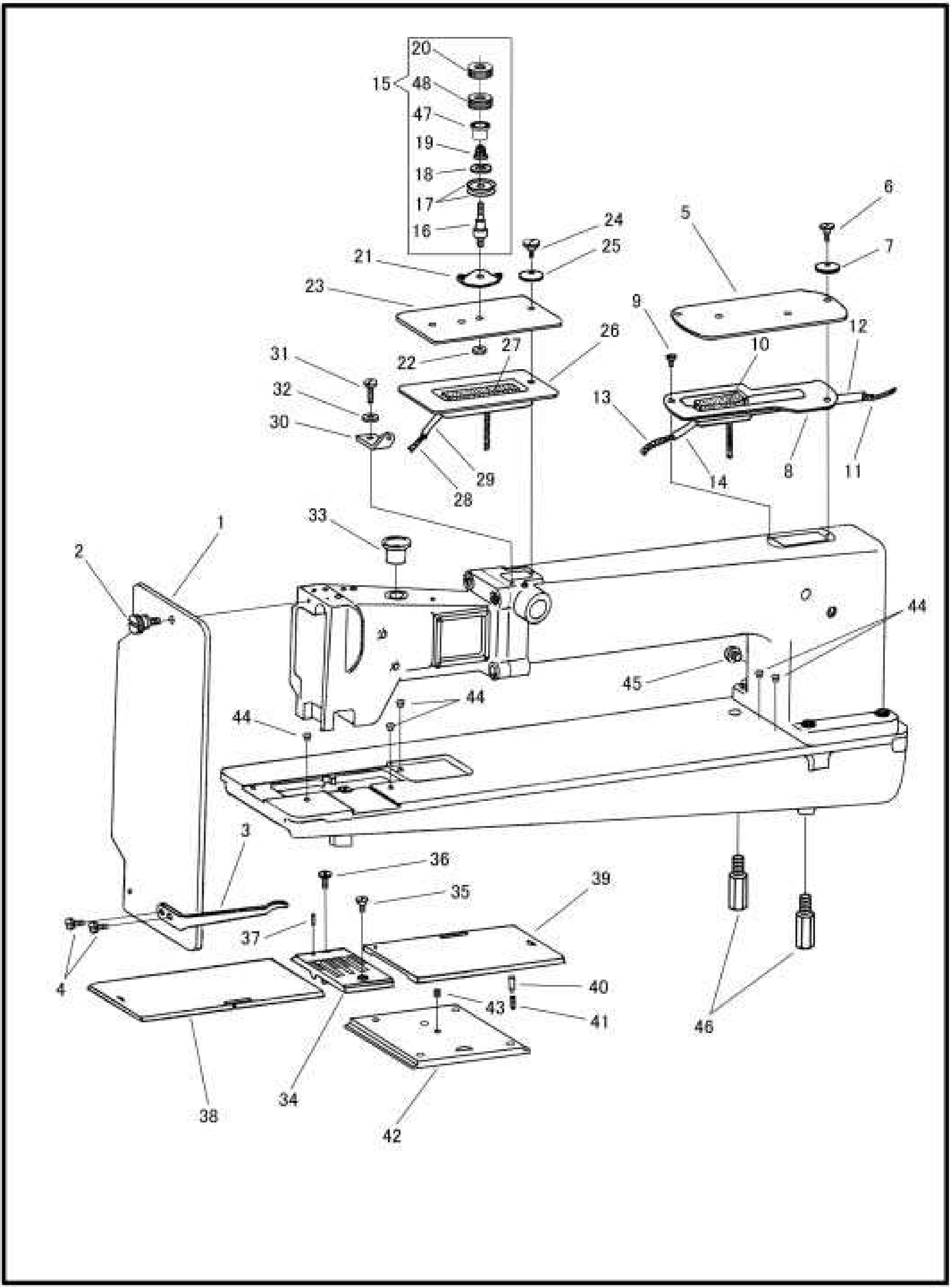
<u>Threading the Mattress Quilting Machine</u>

Use only ABM recommended quilting thread.



wrap black flywheel 1 ½ turns before going thru check spring.

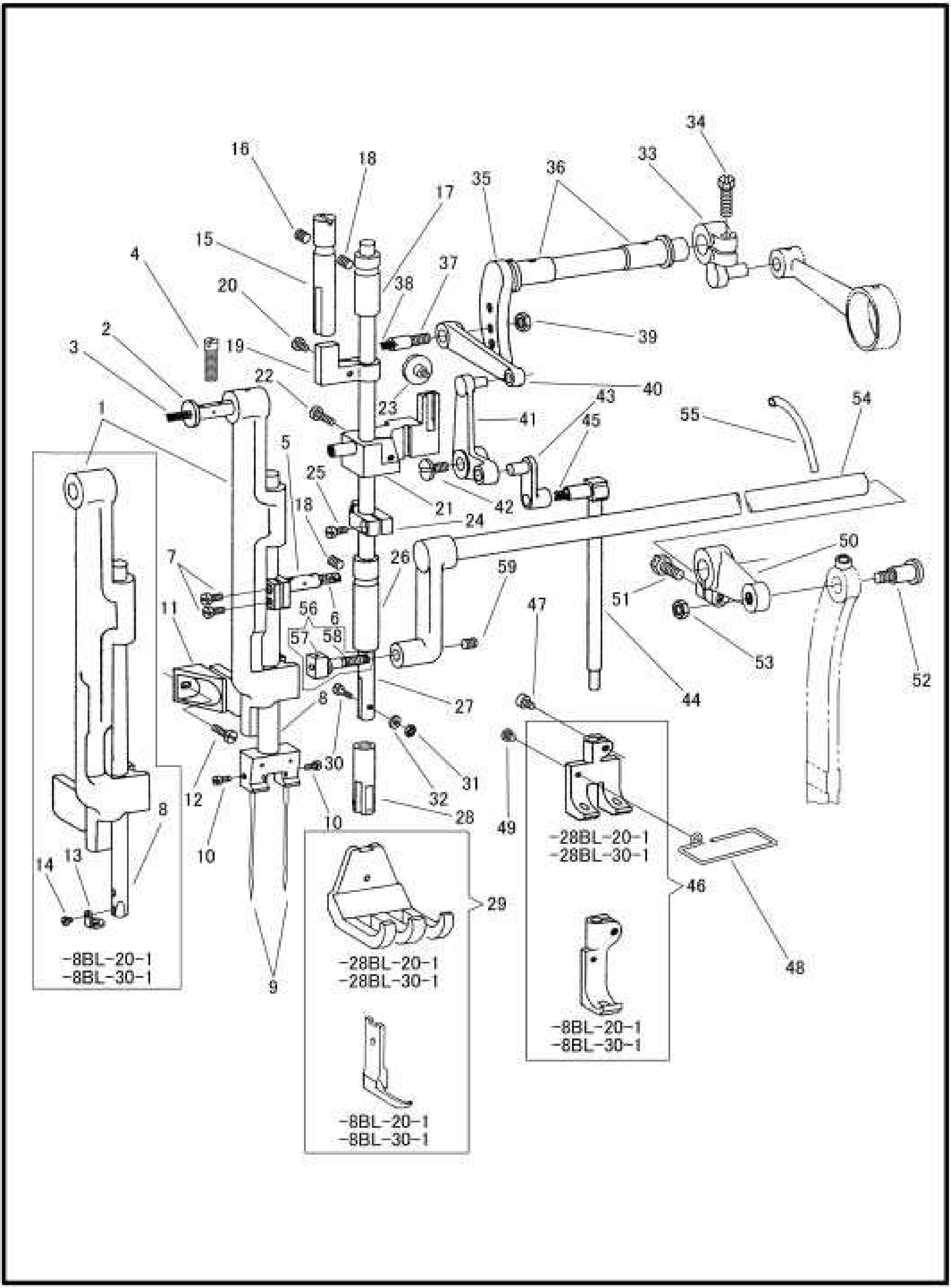
面板、上板
FACE PLATE, ARM TOP COVER



面板、上板
FACE PLATE, ARM TOP COVER

No.	部品番号 PARTS NO.	-8BL-20-1	-28BL-20-1	-8BL-30-1	-28BL-30-1	数量 QTY	品名	DESCRIPTION
1	70079	*	*	*	*	1	面板	FACE PLATE
2	11570	*	*	*	*	1	面板止めねじ	THUMB SCREW 13/64X32 L=7.0
3	70080	*	*	*	*	1	面板糸掛	FACE PLATE THREAD GUIDE
4	10597	*	*	*	*	2	面板糸掛止めねじ	SCREW 1/8X40 L=3.3
5	18004	*	*	*	*	1	上板（後）	ARM CAP (REAR)
6	10704	*	*	*	*	1	上板段ねじ	SCREW 3/16X28 L=6.5
7	10703	*	*	*	*	1	上板ワッシャー	WASHER
8	18103	*	*	*	*	1	オイルタンク(後)	LUBRICATING OIL CUP (REAR)
9	7041	*	*	*	*	1	オイルタンク（後）止めねじ	SCREW 1/8X44 L=7.0
10	18104	*	*	*	*	1	オイルタンク（後）フエルト	OIL PAD
11	70181	*	*	*	*	1	油芯	OIL WICK
12	70186	*	*	*	*	1	ビニールパイプ	VINYL TUBE
13	70182	*	*	*	*	1	油芯	OIL WICK
14	70187	*	*	*	*	1	ビニールパイプ	VINYL TUBE
15	20018C	*	*	*	*	1	糸巻き糸調子（組）	BOBBIN WINDER TENSION BRACKET COMPLETE
16	150326	*	*	*	*	1	糸巻き糸調子心棒	TENSION STUD
17	20019	*	*	*	*	2	調子皿	TENSION DISC
18	20020	*	*	*	*	1	丸一皿	TENSION RELEASE DISC
19	70095	*	*	*	*	1	渦巻スプリング	TENSION SPRING
20	20021	*	*	*	*	1	糸巻き調子ローレットナット（A）	TENSION THUMB NUT (A)
21	20025	*	*	*	*	1	糸巻き糸調子棒糸掛け	TENSION STUD THREAD GUIDE
22	10652	-	-	*	*	1	糸調子心棒ナット	NUT
23	70081	-	-	*	*	1	上板（前）	ARM CAP (FRONT)
24	10704	-	-	*	*	1	上板段ねじ	SCREW 3/16X28 L=6.5
25	10703	-	-	*	*	1	上板ワッシャー	WASHER
26	70082	-	-	*	*	1	オイルタンク（前）	LUBRICATING OIL CUP (FRONT)
27	70115	-	-	*	*	1	オイルタンク（前）フェルト	OIL PAD
28	70180	-	-	*	*	1	油芯	OIL WICK
29	70185	-	-	*	*	1	ビニールパイプ	VINYL TUBE
30	70111	*	*	*	*	1	糸巻糸掛け	BOBBIN WINDER THREAD GUIDE
31	8040	*	*	*	*	1	糸巻糸掛け止めねじ	SCREW 9/64X40 L=8.0
32	30025	*	*	*	*	1	ワッシャー	WASHER
33	70092	*	*	*	*	1	アーム油栓	ARM OIL PLUG
34	70116	*	-	*	-	1	針板	THROAT PLATE
34	70290	-	*	-	*	1	針板 1/4"	THROAT PLATE 1/4"
35	6031-01	-	*	-	*	1	針板止めねじ	SCREW 11/64X40 L=8.3
35	6031-01	*	-	*	-	2	針板止めねじ	SCREW 11/64X40 L=8.3
36	11162	-	*	-	*	1	針板決めねじ	SET SCREW 3.4X36 L=5.4
37	11163	-	*	-	*	1	ピン	THROAT PLATE STOP
38	70119	*	-	*	-	1	角板（左）	BED SLIDE (LEFT)
38	70218	-	*	-	*	1	角板（左）1/4"	BED SLIDE (LEFT) 1/4"
39	70120	*	-	*	-	1	角板（右）	BED SLIDE (RIGHT)
39	70224	-	*	-	*	1	角板（右）1/4"	BED SLIDE (RIGHT) 1/4"
40	10667	*	*	*	*	1	角板ピン	BED SLIDE STOP
41	10668	*	*	*	*	1	角板スプリング	BED SLIDE STOP SPRING
42	70214	-	*	-	*	1	差し板	BED SLIDE (FRONT)
43	13085	-	*	-	*	1	差し板止めねじ	SCREW 13/64X32 L=4.3
44	10794	*	*	*	*	5	玉入カップ（3／8）	BALL OILER
45	30046	*	*	*	*	1	アース線止めねじ	SCREW M4X0.7 L=4.0
46	30137	*	*	*	*	2	本体支え棒(A)	MACHINE SUPPORTING BOLT
47	143657	*	*	*	*	1	糸巻き調子ラチェット	RATCHET
48	153672	*	*	*	*	1	糸巻き調子ローレットナット（B）	TENSION THUMB NUT (B)

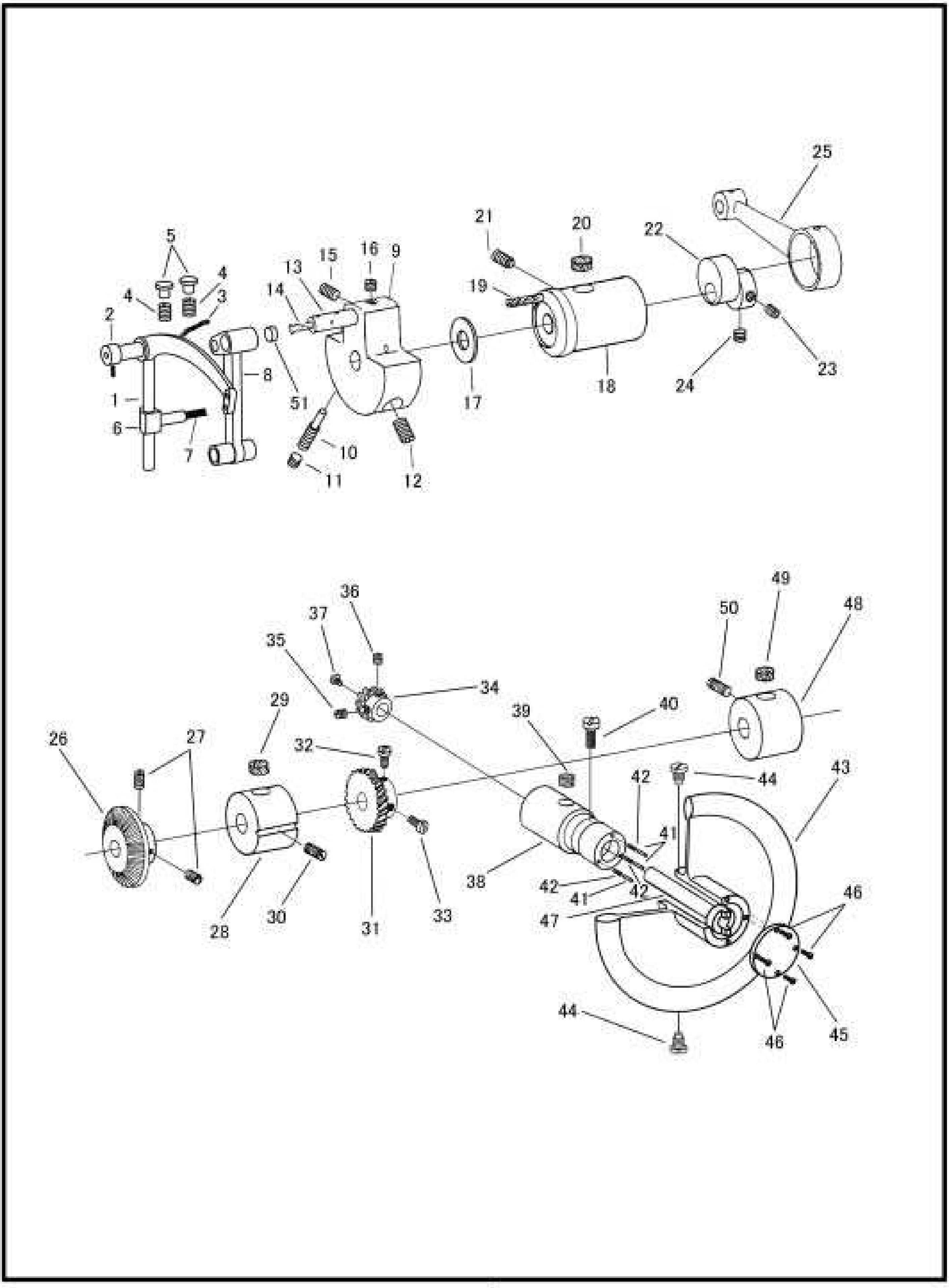
押え棒、中押え棒
PRESSER BAR, VIBRATING PRESSER BAR



押え棒、中押え棒
PRESSER BAR, VIBRATING PRESSER BAR

No.	部品番号 PARTS NO.	-8BL-20-1	-28BL-20-1	-8BL-30-1	-28BL-30-1	数量 QTY	品名	DESCRIPTION
1	70027	*	-	*	-	1	針棒土台	NEEDLE BAR ROCK FRAME
1	70201	-	*	-	*	1	針棒土台	NEEDLE BAR ROCK FRAME
2	70028	*	*	*	*	1	針棒土台ピン	NEEDLE BAR ROCK FRAME HINGE STUD
3	10728	*	*	*	*	1	油芯	OIL WICK
4	70029	*	*	*	*	1	針棒土台ピン止めねじ	SCREW 6.75X24 L=19.5
5	70022	*	*	*	*	1	針棒抱き	NEEDLE BAR CONNECTION STUD
6	10726	*	*	*	*	1	油芯	OIL WICK
7	10532	*	*	*	*	2	針棒抱き締ねじ	PINCH SCREW 5/32X40 L=9.0
8	70023	*	-	*	-	1	針棒	NEEDLE BAR
8	70230	-	*	-	*	1	針棒 1/4	NEEDLE BAR 1/4
9	N3324	*	-	*	-	1	針 DYX3 ＃24	NEEDLE DY X 3 #24
9	N3324	-	*	-	*	2	針 DYX3 ＃24	NEEDLE DY X 3 #24
10	70025	*	-	*	-	1	針止めねじ	SCREW 3/16X32 L=5.5
10	70025	-	*	-	*	2	針止めねじ	SCREW 3/16X32 L=5.5
11	70030	*	*	*	*	1	イケール	NEEDLE BAR LOCK FRAME POSITION BRACKET
12	15055	*	*	*	*	1	イケール止めねじ	SCREW 1/64X32 L=9.0
13	70024	*	-	*	-	1	針棒糸掛	NEEDLE BAR THREAD GUIDE
14	10534	*	-	*	-	1	針棒糸掛止	SCREW 2.25X48 L=2.6
15	70006	*	*	*	*	1	案内棒	PRESSER BAR POSITION GUIDE
16	10761	*	*	*	*	1	案内棒止めねじ	SCREW 6.75X24 L=11.0
17	10538	*	*	*	*	1	押え棒メタル（上）	PRESSER BAR BUSHING (UPPER)
18	10761	*	*	*	*	2	押え棒メタル止めねじ	SCREW 6.75X24 L=11.0
19	70032	*	*	*	*	1	押え棒案内	PRESSER BAR POSITION GUIDE LEVER
20	10662	*	*	*	*	1	締めねじ	PINCH SCREW 5/32X40 L=6.5
21	70033	*	*	*	*	1	押え棒抱き	PRESSER BAR LIFTING BRACKET
22	10545	*	*	*	*	1	押え棒抱き締ねじ	PINCH SCREW 11/64X32 L=14.0
23	10548	*	*	*	*	1	押え棒抱き振れ止めねじ	SCREW 6.75X24 L=8.1
24	70034	*	*	*	*	1	押え棒抱きリング	PRESSER BAR SPRING BRACKET
25	70035	*	*	*	*	1	押え棒抱リング締ねじ	PINCH SCREW 3/16X32 L=13.7
26	10538	*	*	*	*	1	押え棒メタル（下）	PRESSER BAR BUSHING (LOWER)
27	70031	*	*	*	*	1	押え棒	PRESSER BAR
28	70378	*	*	*	*	1	押え金ホルダー	HOLDER
29	70114	*	-	*	-	1	外押え	LIFTING PRESSER FOOT
29	70270	-	*	-	*	1	外押え 1/4	LIFTING PRESSER FOOT 1/4
30	70379	*	*	*	*	1	押え金ホルダー止めねじ	PINCH SCREW 3.4X36 L=10.0
31	20272	*	*	*	*	1	押え金ホルダー止めねじナット	NUT
32	10677	*	*	*	*	1	ワッシャー	WASHER
33	70014	*	*	*	*	1	横軸だるま	LIFTING ECCENTRIC
34	10754	*	*	*	*	1	横軸だるま締ねじ	PINCH SCREW 6.75X24 L=16.0
35	70015	*	*	*	*	1	横軸	LIFTING ROCK SHAFT
36	10514	*	*	*	*	2	横軸メタル	LIFTING ROCK SHAFT BUSHING
37	15053	*	*	*	*	1	横軸ピンねじ	SCREW STUD
38	10728	*	*	*	*	1	油芯	OIL WICK
39	10517	*	*	*	*	1	横軸ピンねじナット	NUT
40	70038	*	*	*	*	1	くの字連結（大）	LIFTING BELL CRANK LINK
41	70036	*	*	*	*	1	くの字	LIFTING BELL CRANK
42	10559	*	*	*	*	1	くの字止めねじ	SCREW 4.5X32 L=8.0
43	70037	*	*	*	*	1	くの字連結（小）	VIBRATING PRESSER BAR CONNECTING LINK
44	70039	*	-	*	-	1	中押え棒	VIBRATING PRESSER BAR
44	70202	-	*	-	*	1	中押え棒	VIBRATING PRESSER BAR
45	10728	*	-	*	-	1	油芯	OIL WICK
46	70113	*	-	*	-	1	中押え	VIBRATING PRESSER FOOT
46	70250	-	*	-	*	1	中押え 1/4"	VIBRATING PRESSER FOOT 1/4"
47	141158	*	*	*	*	1	中押え止めねじ	SCREW 11/64X40 L=7.3
48	70219-02	*	*	*	*	1	フィンガーガード 1/4"	FINGER GUARD 1/4"
49	8111	*	*	*	*	1	フィンガーガード止めねじ	SCREW 1/8X44 L=3.6
50	70056	*	*	*	*	1	連結だるま	NEEDLE BAR ROCK FRAME CRANK
51	10754	*	*	*	*	1	連結だるま締ねじ	PINCH SCREW 6.75X24 L=16.0
52	13134	*	*	*	*	1	連結ロッド段ねじ	HINGE SCREW 6.75X24 L=12.0
53	10586	*	*	*	*	1	連結ロッド段ねじナット	NUT
54	70373	*	*	-	-	1	上送り竿	NEEDLE BAR ROCK FRAME ROCK SHAFT
54	70055	-	-	*	*	1	上送り竿	NEEDLE BAR ROCK FRAME ROCK SHAFT
55	70188	*	*	*	*	1	油パイプ	VINYL TUBE
56	11876C	*	*	*	*	1	上送り竿角玉（組）	SLIDE BLOCK COMPLETE
57	11877	*	*	*	*	1	上送り竿角玉	SLIDE BLOCK
58	11876	*	*	*	*	1	上送り竿角玉ピンねじ	SLIDE BLOCK STUD
59	10581	*	*	*	*	1	上送り竿角玉ピンねじ止めねじ	SCREW 7/32X32 L=7.0

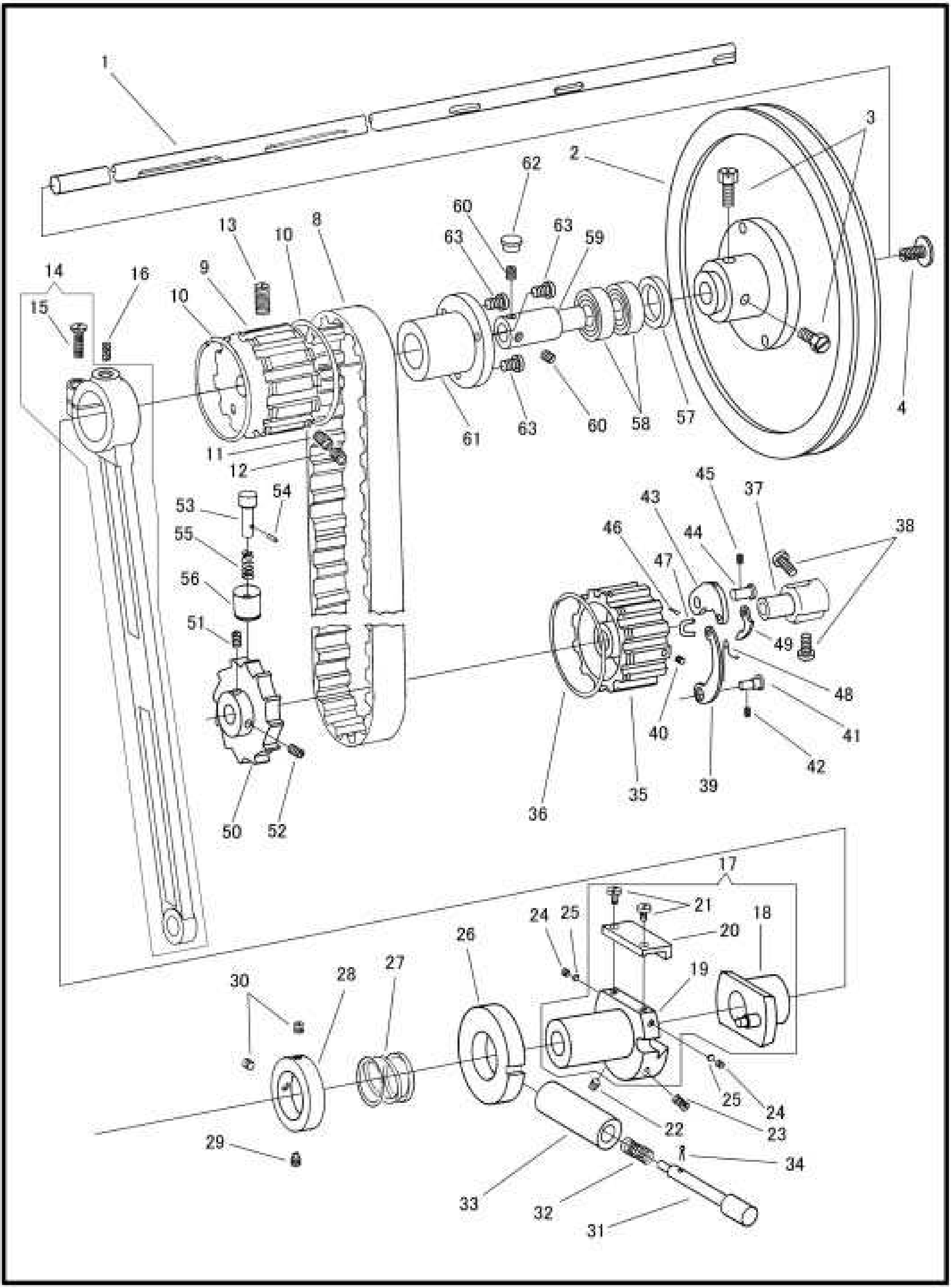
天秤、ハンドプーリー
THREAD TAKE-UP LEVER, HAND WHEEL



天秤、ハンドプーリー
THREAD TAKE-UP LEVER, HAND WHEEL

No.	部品番号 PARTS NO.	-8BL-20-1	-28BL-20-1	-8BL-30-1	-28BL-30-1	数量 QTY	品名	DESCRIPTION
1	70018	*	*	*	*	1	天秤	THREAD TAKE-UP LEVER
2	70019	*	*	*	*	1	天秤ピン	THREAD TAKE-UP LEVER HINGE STUD
3	11042	*	*	*	*	1	油芯	OIL WICK
4	10571	*	*	*	*	2	天秤ピン止めねじ	SCREW 6.75X24 L=20.0
5	20172	*	*	*	*	2	アームゴム栓	CAP
6	70020	*	*	*	*	1	天秤抱き	THREAD TAKE-UP LEVER DRIVING STUD
7	10728	*	*	*	*	1	油芯	OIL WICK
8	70021	*	*	*	*	1	針棒連結	NEEDLE BAR CONNECTING LINK
9	70017	*	*	*	*	1	クランクモーションカム	NEEDLE BAR CRANK
10	10570	*	*	*	*	1	位置決めねじ	SET SCREW 6.75X24 L=14.5
11	10524-G	*	*	*	*	1	位置決めねじ止めねじ	SCREW 6.75X24 L=6.5
12	10571-G	*	*	*	*	1	止めねじ	SCREW 6.75X24 L=20.0
13	10523	*	*	*	*	1	針棒連結ピン	NEEDLE BAR CONNECTING LINK STUD
14	10726	*	*	*	*	1	油芯	OIL WICK
15	10524	*	*	*	*	1	針棒連結ピン止めねじ 長)	SCREW 6.75X24 L=6.5
16	70016	*	*	*	*	1	針棒連結ピン止めねじ 短)	SCREW 6.75X24 L=3.5
17	10563	*	*	*	*	1	上軸メタル 前)ワッシャー	WASHER
18	70007	*	*	*	*	1	上軸メタル 前)	ARM SHAFT BUSHING (FRONT)
19	10729	*	*	*	*	1	油芯	OIL WICK
20	10725	*	*	*	*	1	上軸メタル 前)フエルト	OIL PAD
21	10571	*	*	*	*	1	上軸メタル 前)止めねじ	SCREW 6.75X24 L=20.0
22	70013	*	*	*	*	1	中押え上下カム	FEED DRIVING ECCENTRIC
23	10639-G	*	*	*	*	1	中押え上下カム位置決めねじ	SET SCREW 1/4X32 L=8.0
24	10766-G	*	*	*	*	1	止めねじ	SCREW 1/4X32 L=7.0
25	70012	*	*	*	*	1	上連結ロッド	LIFTING ECCENTRIC CONNECTION
26	70112	*	*	*	*	1	糸巻ギヤー	BOBBIN WINDER DRIVING GEAR
27	10766	*	*	*	*	2	止めねじ	SCREW 1/4X32 L=7.0
28	70009	*	*	*	*	1	上軸中間メタル 前)	ARM SHAFT CENTER BUSHING (FRONT)
29	10725	*	*	*	*	1	上軸中間メタルフエルト	OIL PAD
30	10522	*	*	*	*	1	上軸中間メタル止めねじ	SCREW 6.75X24 L=14.0
31	70046	-	-	*	*	1	大ギヤー	HAND WHEEL DRIVING GEAR
32	70040	-	-	*	*	1	大ギヤー止位置決めねじ	SET SCREW 1/4X32 L=13.0
33	12388	-	-	*	*	1	大ギヤー止めねじ	SCREW 1/4X32 L=13.0
34	35405	-	-	*	*	1	小ギヤー	ARM CROSS SHAFT GEAR
35	10658	-	-	*	*	1	小ギヤー止めねじ	SCREW 1/4X32 L=5.5
36	10566	-	-	*	*	1	位置決めねじ	SET SCREW 1/4X32 L=5.5
37	10577	-	-	*	*	1	ハンドプーリー軸止めねじ	SCREW 6.75X24 L=11.0
38	70043	-	-	*	*	1	ハンドプーリー偏心メタル	ARM CROSS SHAFT BUSHING
39	10725	-	-	*	*	1	フエルト	OIL FELT
40	10519	-	-	*	*	1	ハンドプーリー偏心メタル止めねじ	SCREW 6.75X24 L=17.5
41	35412	-	-	*	*	3	クラッチスプリングピン	HAND WHEEL DISENGAGING SPRING PLUNGER
42	35413	-	-	*	*	3	クラッチスプリング	HAND WHEEL DISENGAGING SPRING
43	70041	-	-	*	*	1	ハンドプーリー	HAND WHEEL
44	35407	-	-	*	*	2	ﾊﾝﾄﾞﾌﾟｰﾘｰｽｯﾄﾊﾟｰねじ	SCREW 1/4X32
45	70044	-	-	*	*	1	ハンドプーリークラッチ板	HAND WHEEL ENGAGING PLATE
46	12122	-	-	*	*	4	ハンドプーリークラッチ板止めねじ	SCREW 11/64X32 L=8.5
47	70042	-	-	*	*	1	ハンドプーリー軸	ARM CROSS SHAFT
48	70010	*	*	*	*	1	上軸中間メタル 後)	ARM SHAFT CENTER BUSHING (REAR)
49	10725	*	*	*	*	1	上軸中間メタルフエルト	OIL PAD
50	10571	*	*	*	*	1	上軸中間メタル止めねじ	SCREW 6.75X24 L=14.0
51	15038	*	*	*	*	1	針棒連結ピン油栓	CAP

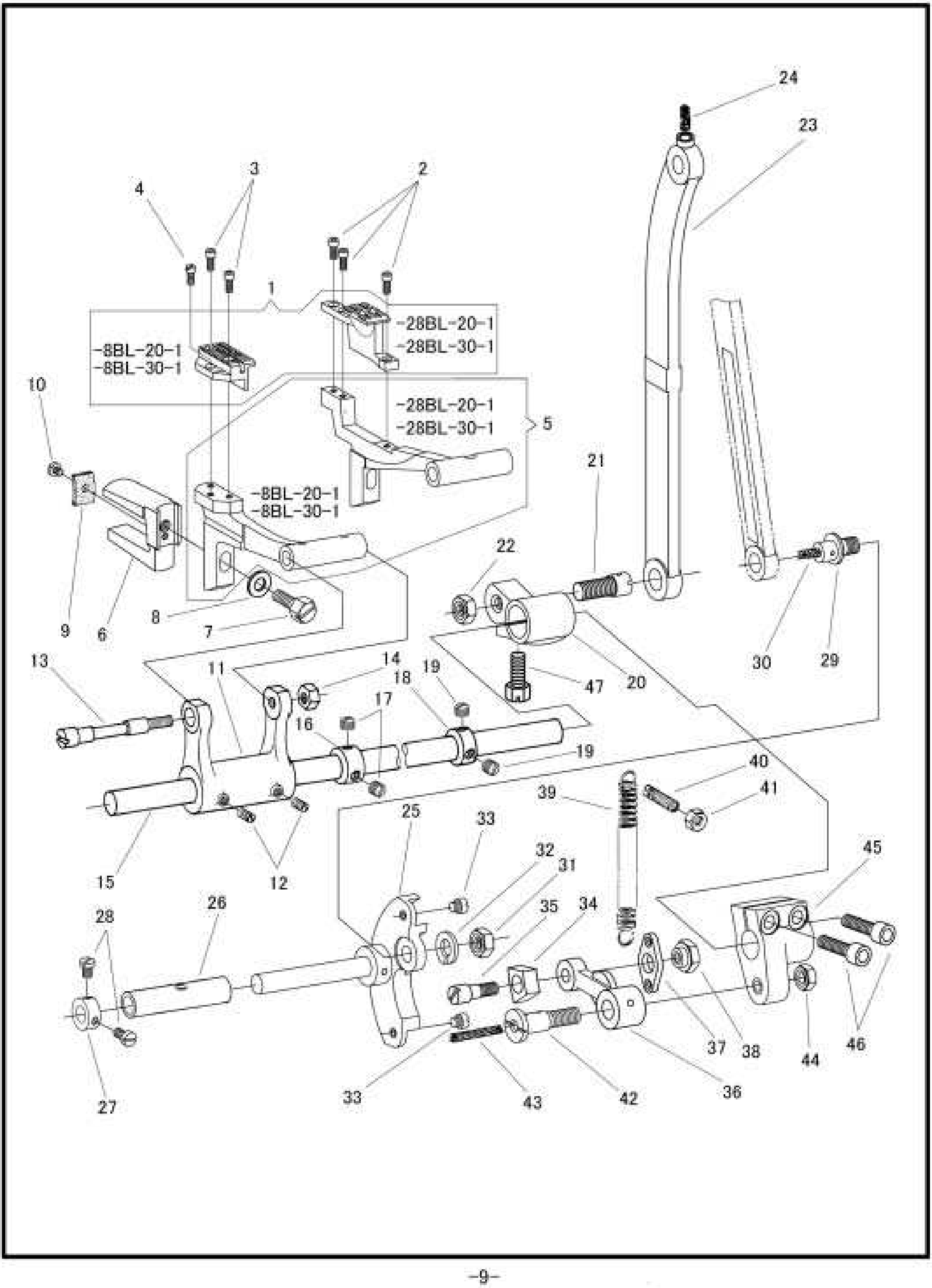
上軸、プーリー
ARM SHAFT, MACHINE PULLEY



上軸、プーリー
ARM SHAFT, MACHINE PULLEY

No.	部品番号 PARTS NO.	-8BL-20-1	-28BL-20-1	-8BL-30-1	-28BL-30-1	数量 QTY	品名	DESCRIPTION
1	70008	-	-	*	*	1	上軸	ARM SHAFT
1	70372	*	*	-	-	1	上軸	ARM SHAFT
2	70093	*	*	*	*	1	プーリー	MACHINE PULLEY
3	10754	*	*	*	*	2	プーリー止めねじ	SCREW 6.75X24 L=16.0
4	10577	*	*	*	*	1	プーリー押しねじ	SCREW 6.75X24 L=11.0
8	10464-WH	*	*	*	*	1	タイミングベルト	CONNECTION BELT
9	10569	*	*	*	*	1	上ベルトプーリー	ARM SHAFT CONNECTION BELT PULLEY
10	10574	*	*	*	*	2	プーリーリング	ARM SHAFT CONNECTION BELT PULLEY SPRING FLANGE
11	10761	*	*	*	*	1	上ベルトプーリー位置決めねじ	SET SCREW 6.75X24 L=11.0
12	10524-G	*	*	*	*	1	位置決めねじ止めねじ	SCREW 6.75X24 L=6.5
13	10571-G	*	*	*	*	1	止めねじ	SCREW 6.75X24 L=20.0
14	70047	*	*	*	*	1	立ロッド	FEED DRIVING CONNECTION
16	10728	*	*	*	*	1	油芯	OIL WICK
17	70049C	*	*	*	*	1	送り土台 ·送りカム 組)	FEED DRIVING ECCENTRIC FLANGE COMPLETE
18	70050	*	*	*	*	1	送りカム	FEED DRIVING ECCENTRIC
19	70049	*	*	*	*	1	送りカム土台	FLANGE
20	11095	*	*	*	*	1	送りカム調節板	FRICTION PLATE
21	11096	*	*	*	*	2	送りカム調節板止めねじ	SCREW 3/16X40 L=11.0
22	11093	*	*	*	*	1	位置決めねじ	SET SCREW 3/16X32 L=10.5
23	11094	*	*	*	*	1	止めねじ	SCREW 3/16X32 L=10.5
24	2067	*	*	*	*	2	ライナー止めねじ	SCREW 11/64X40 L=6.0
25	11097	*	*	*	*	2	送りカム土台ライナー	LINING METAL
26	70051	*	*	*	*	1	渦巻カム	FEED DRIVING ECCENTRIC ADJUSTING DISC
27	11099	*	*	*	*	1	押しリングスプリング	SPRING
28	70052	*	*	*	*	1	押しリング	COLLAR
29	10639	*	*	*	*	1	位置決めねじ	SET SCREW 1/4X32 L=8.0
30	10566	*	*	*	*	2	止めねじ	SCREW 1/4X32 L=5.5
31	70054	*	*	*	*	1	押しボタン	FEED REGULATING STUD
32	12383	*	*	*	*	1	段ピンスプリング	SPRING
33	70053	*	*	*	*	1	押しボタン土台	BUSHING
34	15076	*	*	*	*	1	吊り棒止割りピン	RETAINING SPRING
35	70155	*	*	*	*	1	下ベルトプーリー	SAFETY CLUTCH PULLEY
36	10574	*	*	*	*	1	プーリーリング	SAFETY CLUTCH PULLEY SPRING FLANGE
37	10611	*	*	*	*	1	下ベルトプーリー心棒	SAFETY CLUTCH PULLEY COLLAR
38	10612	*	*	*	*	2	止めねじ	SCREW 1/4X32 L=10.5
39	70153	*	*	*	*	1	下ベルトプーリー板ばね	SAFETY CLUTCH LOCKING LEVER SPRING
40	70154	*	*	*	*	1	下ベルトプーリー調節ねじ	ADJUSTING SCREW 5/32X40 L=3.6
41	70169	*	*	*	*	1	下ベルトプーリー板ばねピン	STUD
42	10581	*	*	*	*	1	止めねじ	SCREW 7/32X32 L=7.0
43	10616	*	*	*	*	1	下ベルトプーリー掛金	SAFETY CLUTCH LOCKING LEVER
44	10613	*	*	*	*	1	下ベルトプーリー掛金ピン	STUD
45	10581	*	*	*	*	1	止めねじ	SCREW 7/32X32 L=7.0
46	10620	*	*	*	*	1	下ベルトプーリー割りピン	SAFETY CLUTCH THROW-IN LATCH PIN
47	10618	*	*	*	*	1	下ベルトプーリー小連結	CONNECTING LINK
48	10619	*	*	*	*	1	下ベルトプーリースプリング	SAFETY CLUTCH THROW-IN LATCH SPRING
49	10617	*	*	*	*	1	下ベルトプーリー小爪	SAFETY CLUTCH THROW-IN LATCH
50	70139	*	*	*	*	1	爪車	HOOK DRIVING SHAFT LOCK RATCHET
51	10639	*	*	*	*	1	位置決めねじ	SET SCREW 1/4X32 L=8.0
52	10766	*	*	*	*	1	止めねじ	SCREW 1/4X32 L=7.0
53	13046	*	*	*	*	1	押しボタン	HOOK DRIVING SHAFT LOCK STUD
54	15076	*	*	*	*	1	押しボタン割りピン	STOP
55	13047	*	*	*	*	1	押しボタンスプリング	SPRING
56	13045	*	*	*	*	1	押しボタン土台	SOCKET
57	10568	*	*	*	*	1	溝なしリング	RETAINING RING
58	10567	*	*	*	*	2	上軸ベアリング	ARM SHAFT BALL BEARING
59	70652	*	*	*	*	1	上軸ベアリングカラー	ARM SHAFT BALL BEARING ADAPTER
60	23637	*	*	*	*	2	上軸ベアリングカラー止めねじ	SCREW 1/4X28 L=7.5
61	70651	*	*	*	*	1	上軸ベアリングケース	ARM SHAFT BALL BEARING ADAPTER SLEEVE
62	20171	*	*	*	*	1	ゴム栓(Φ11)	RUBBER CAP
63	50109	*	*	*	*	3	上軸ベアリングケース止めねじ	SCREW 3/16X32 L=17.0

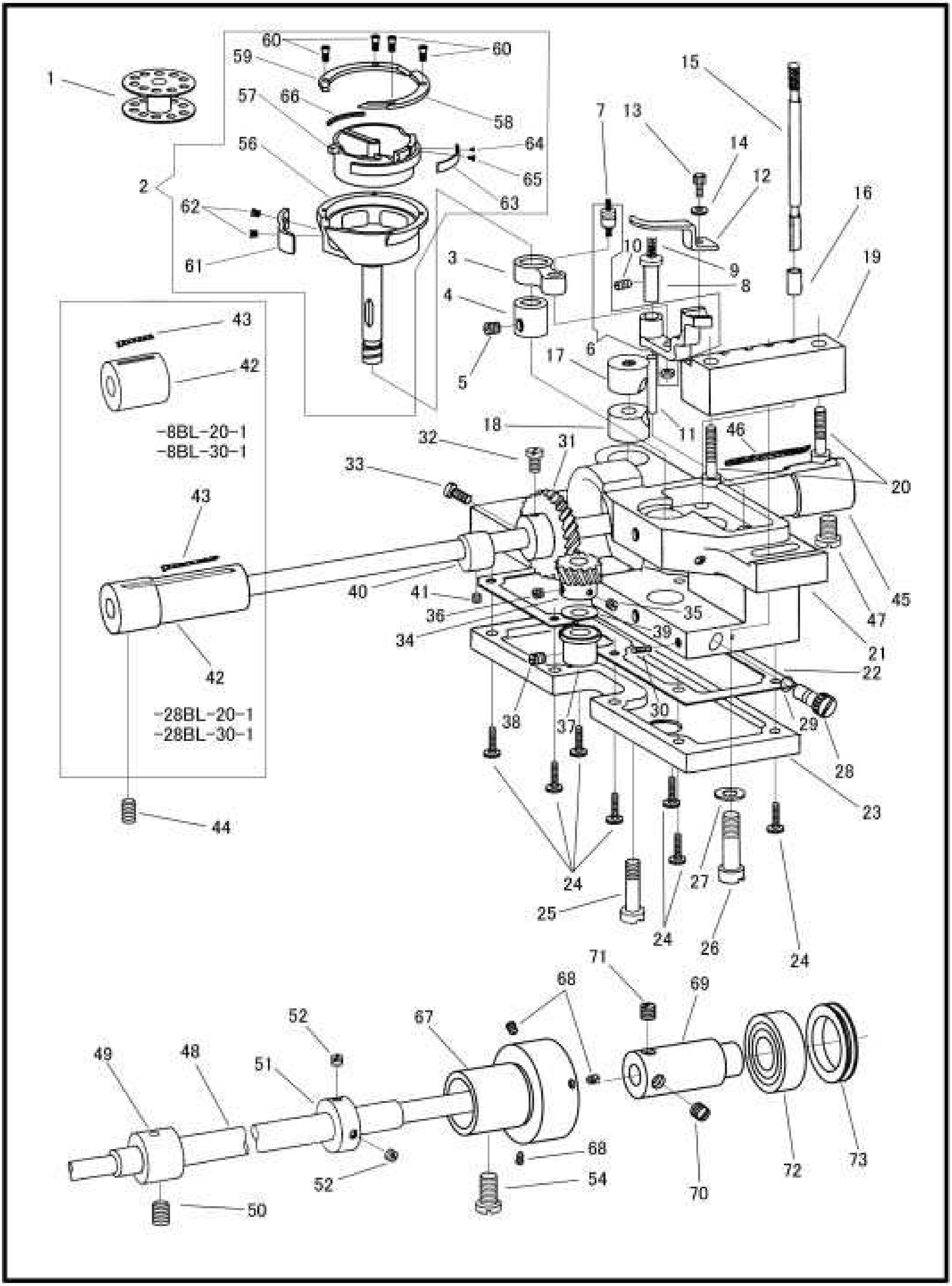
送り歯、送り軸
FEED DOG, FEED DRIVING ROCK SHAFT



送り歯、送り軸
FEED DOG, FEED DRIVING ROCK SHAFT

No.	部品番号 PARTS NO.	-8BL-20-1	-28BL-20-1	-8BL-30-1	-28BL-30-1	数量 QTY	品名	DESCRIPTION
1	70172	*	-	*	-	1	送り歯	FEED DOG
1	70310	-	*	-	*	1	送り歯 1/4	FEED DOG 1/4
2	70118	-	*	-	*	3	送り歯止めねじ	SCREW M3X0.5 L=8.0
3	70118	*	-	*	-	2	送り歯止めねじ	SCREW M3X0.5 L=8.0
4	23350	*	-	*	-	1	送り歯止めねじ	SCREW M3X0.5 L=7.5
5	70170	*	-	*	-	1	送り土台	FEED BAR
5	70217	-	*	-	*	1	送り土台	FEED BAR
6	70128	*	*	*	*	1	コの字	FEED LIFTING CAM FORK
7	70129	*	*	*	*	1	コの字止めねじ	SCREW 7/32X32 L=15.0
8	10599	*	*	*	*	1	コの字ワッシャー	WASHER
9	10596	*	*	*	*	1	コの字フエルト	OIL FELT
10	10597	*	*	*	*	1	コの字フエルト止めねじ	SCREW 1/8X40 L=3.3
11	70126	*	*	*	*	1	送り土台腕	FEED BAR CRANK
12	12408	*	*	*	*	2	送り土台腕止めねじ	SCREW 6.75X24 L=7.5
13	10602	*	*	*	*	1	送り土台ピンねじ	FEED BAR HINGE SCREW
14	10636	*	*	*	*	1	送り土台ピンねじナット	NUT
15	70380	*	*	-	-	1	送り軸	FEED DRIVING ROCK SHAFT
15	70608	-	-	*	*	1	送り軸	FEED DRIVING ROCK SHAFT
16	10593	*	*	*	*	1	送り軸カラー 前)	COLLAR (FRONT)
17	10764	*	*	*	*	2	送り軸カラー 前)止めねじ	SCREW 6.75X24 L=4.5
18	10593	*	*	*	*	1	送り軸カラー(後)	COLLAR (REAR)
19	10764	*	*	*	*	2	送り軸カラー 後)止めねじ	SCREW 6.75X24 L=4.5
20	70124	*	*	*	*	1	送り軸だるま 前)	FEED REVERSING CRANK (FRONT)
21	70613	*	*	*	*	1	連結ロッドピンねじ	FEED REVERSING CRANK SCREW STUD
22	11185	*	*	*	*	1	連結ロッドピンねじナット	NUT
23	70057	*	*	*	*	1	連結ロッド	NEEDLE BAR ROCK FRAME CRANK CONNECTION
24	10728	*	*	*	*	1	油芯	OIL WICK
25	70162-A	*	*	*	*	1	切り換え案内台	FEED REVERSING LEVER
26	70160	*	*	*	*	1	切り換え案内台メタル	FEED REVERSING LEVER BUSHING
27	70161	*	*	*	*	1	切り換え案内台カラー	COLLAR
28	10561	*	*	*	*	2	切り換え案内台カラー止めねじ	SCREW 11/64X32 L=6.5
29	70048-A	*	*	*	*	1	立ロッドピンねじ	HINGE SCREW 7.85X20 L=12.0
30	10728	*	*	*	*	1	油芯	OIL WICK
31	11185	*	*	*	*	1	立ロッドピンねじナット	NUT
32	20191	*	*	*	*	1	スプリングワッシャー	SPRING WASHER
33	70163	*	*	*	*	2	案内駒ストッパーねじ	SCREW 3/16X32 L=3.6
34	70612	*	*	*	*	1	切換え案内駒	FEED REVERSING LEVER SLIDE BLOCK
35	70611	*	*	*	*	1	案内駒ピンねじ	HINGE SCREW 15/64X28 L=10.0
36	70610	*	*	*	*	1	切換えクランク	FEED REVERSING LINK
37	70159	*	*	*	*	1	切換えクランクスプリング掛け	SPRING AND TREADLE CONNECTING LINK
38	70167	*	*	*	*	1	案内駒ピンねじナット	NUT
39	70158	*	*	*	*	1	切換えクランクスプリング	SPRING
40	70156	*	*	*	*	1	切換えスプリング掛ねじ	SPRING HOOK
41	70157	*	*	*	*	1	切換えスプリング掛ねじナット	NUT
42	70168	*	*	*	*	1	切換えクランク段ねじ	HINGE SCREW 7.85X20 L=21.6
43	10728	*	*	*	*	1	油芯	OIL WICK
44	11185	*	*	*	*	1	切換えクランク段ねじナット	NUT
45	70609	*	*	*	*	1	送り軸だるま 後)	FEED REVERSING CRANK (REAR)
46	35034	*	*	*	*	2	送り軸だるま 後)締めねじ	PINCH SCREW M6X1 L=20.0
47	10754	*	*	*	*	2	送り軸だるま 前)締めねじ	PINCH SCREW 6.75X24 L=16.0

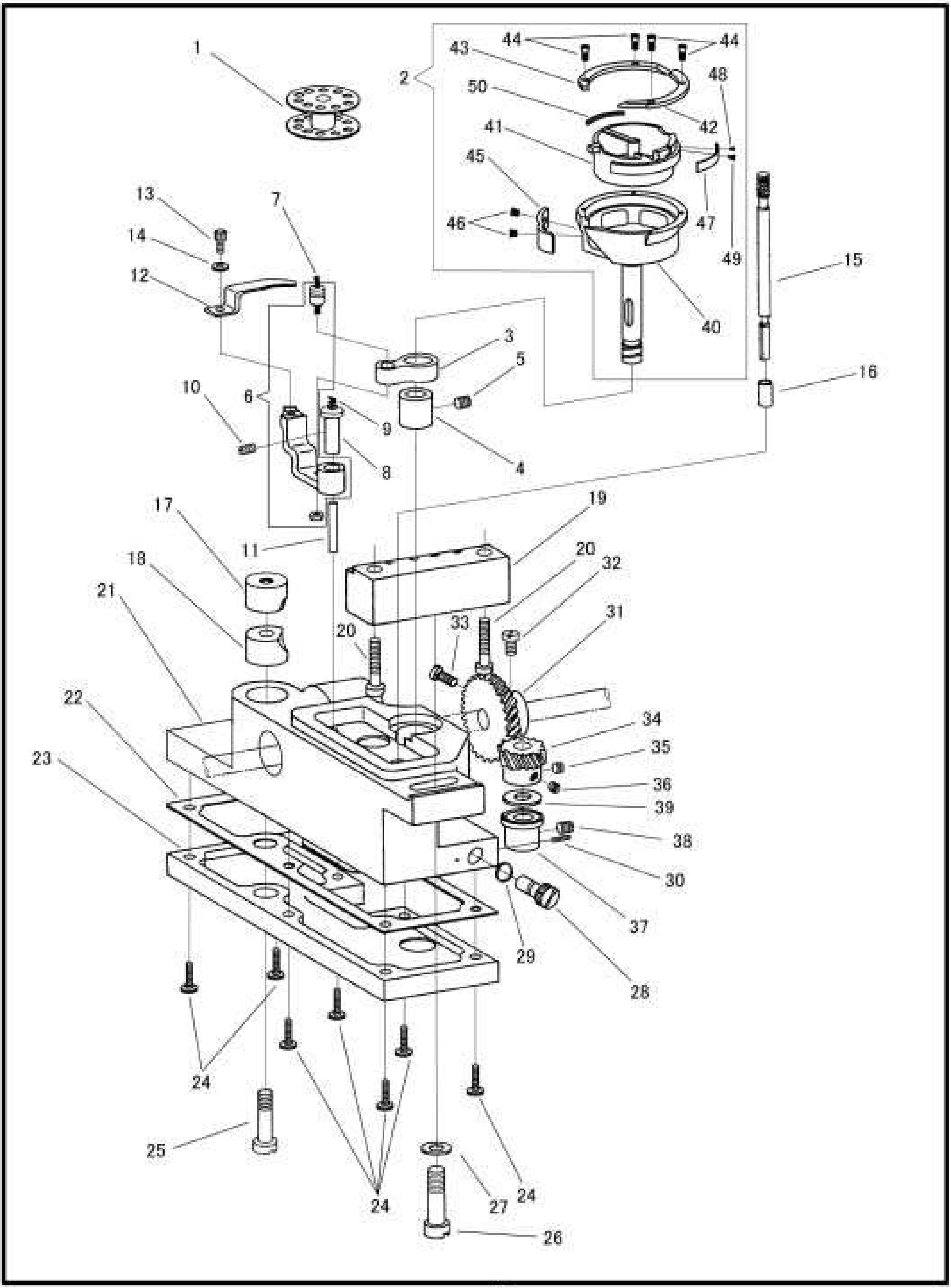
カマ土台（右）、下軸
HOOK SADDLE (RIGHT), HOOK DRIVING SHAFT



カマ土台 右)、下軸
HOOK SADDLE (RIGHT), HOOK DRIVING SHAFT

No.	部品番号 PARTS NO.	-8BL-20-1	-28BL-20-1	-8BL-30-1	-28BL-30-1	数量 QTY	品名	DESCRIPTION
1	70141	*	*	*	*	1	ボビン	BOBBIN
2	70140	*	*	*	*	1	カマ 組)	HOOK COMPLETE
3	70151	*	*	*	*	1	カマ連結メガネ	BOBBIN CASE OPENER LEVER LINK
4	70145	*	*	*	*	1	カマメタル 上)	HOOK BUSHING (UPPER)
5	11176	*	*	*	*	1	カマメタル 上)止めねじ	SCREW 7/32X32 L=5.5
6	70149C	*	*	*	*	1	オープナー土台 組)	BOBBIN CASE OPENER LEVER
7	10727	*	*	*	*	1	フエルト	OIL FELT
8	70150	*	*	*	*	1	オープナー土台ピン	BOBBIN CASE OPENER LEVER HINGE STUD
9	10727	*	*	*	*	1	フエルト	OIL FELT
10	10573	*	*	*	*	1	オープナー土台ピン止めねじ	SCREW 7/32X32 L=11.0
11	11137	*	*	*	*	1	オープナー土台ピンパイプ	OIL WICK VINYL TUBE
12	70146	*	*	*	*	1	ボビンケースオープナー	BOBBIN CASE OPENER
13	70147	*	*	*	*	1	止めねじ	SCREW M3X0.5 L=6.0
14	70148	*	*	*	*	1	ワッシャー	WASHER
15	70152	*	*	*	*	1	オイルゲージ	OIL GAUGE
16	11131	*	*	*	*	1	案内パイプ	OIL GAUGE GUIDE
17	11145	*	*	*	*	1	カマ土台締付カラー 上)	HOOK SADDLE COLLAR (UPPER)
18	11146	*	*	*	*	1	カマ土台締付カラー 下)	HOOK SADDLE COLLAR (LOWER)
19	70143	*	*	*	*	1	カマ土台取付台	OIL RESERVOIR SPACER
20	70144	*	*	*	*	2	カマ土台取付台止めねじ	SCREW 7/32X32 L=21.0
21	70142	*	*	*	*	1	カマ土台 右)	HOOK SADDLE (RIGHT)
22	15092	*	*	*	*	1	カマ土台シートパッキン	HOOK SADDLE GASKET
23	15091	*	*	*	*	1	カマ土台油タンク 右)	OIL RESERVOIR (RIGHT)
24	15007	*	*	*	*	7	カマ土台油タンク止めねじ	SCREW 9/64X40 L=10.0
25	11144	*	*	*	*	1	カマ土台締ねじ	PINCH SCREW 7/32X32 L=32.0
26	10646	*	*	*	*	1	カマ土台止めねじ	SCREW 6.75X24 L=28.0
27	10647	*	*	*	*	1	カマ土台止めねじワッシャー	WASHER
28	15093	*	*	*	*	1	油調節ダイヤル	OIL REGULATING DIAL
29	15094	*	*	*	*	1	Oリング	O-RING
30	10629	*	*	*	*	1	油調節ダイヤル止めねじ	SCREW 1/8X40 L=8.0
31	10638	*	*	*	*	1	大ギヤー	HOOK DRIVING GEAR
32	70137	*	*	*	*	1	位置決めねじ	SET SCREW 1/4X32 L=9.0
33	70138	*	*	*	*	1	止めねじ	SCREW 1/4X32 L=8.0
34	10657	*	*	*	*	1	小ギヤー	HOOK DRIVING PINION
35	10658	*	*	*	*	1	小ギヤー止めねじ A)	SCREW 1/4X32 L=5.5
36	10767	*	*	*	*	1	小ギヤー止めねじ B)	SCREW 1/4X32 L=4.5
37	15096	*	*	*	*	1	カマメタル 下)	HOOK BUSHING (LOWER)
38	11176	*	*	*	*	1	カマメタル 下)止めねじ	SCREW 7/32X32 L=5.5
39	10644	*	*	*	*	1	カマメタル 下)ワッシャー	WASHER
40	10637	*	*	*	*	1	上下送りカム ねじ付)	FEED LIFTING CAM COMPLETE
41	10658	*	*	*	*	1	上下送りカム止めねじ	SCREW 1/4X32 L=5.5
42	12135	*	-	*	-	1	下軸メタル 前)	HOOK DRIVING SHAFT BUSHING (FRONT)
42	70132	-	*	-	*	1	下軸メタル 前) 1/16～1/4	HOOK DRIVING SHAFT BUSHING (FRONT) 1/16～1/4
42	70132-A	-	*	-	*	1	下軸メタル 前) 5/16～1-1/8	HOOK DRIVING SHAFT BUSHING (FRONT) 5/16～1-1/8
42	70132-B	-	*	-	*	1	下軸メタル 前) 1-3/16～	HOOK DRIVING SHAFT BUSHING (FRONT) 1-3/16～
43	10729	*	*	*	*	1	油芯	OIL WICK
44	10571	*	*	*	*	1	下軸メタル止めねじ	SCREW 6.75X24 L=11.0
45	70132	*	*	*	*	1	下軸中間メタル 前) 1/16～9/16	HOOK DRIVING SHAFT BUSHING (MIDDLE, FRONT) 1/16～9/16
45	70132-A	-	*	-	*	1	下軸中間メタル 前) 5/8～1-1/2	HOOK DRIVING SHAFT BUSHING (MIDDLE, FRONT) 5/8～1-1/2
45	70132-B	-	*	-	*	1	下軸中間メタル 前) 1-9/16～	HOOK DRIVING SHAFT BUSHING (MIDDLE, FRONT) 1-9/16～
46	10729	*	*	*	*	1	油芯	OIL WICK
47	10519	*	*	*	*	1	下軸中間メタル 前)止めねじ	PINCH SCREW 6.75X24 L=17.5
48	70660	*	*	-	-	1	下軸	HOOK DRIVING SHAFT
48	70655	-	-	*	*	1	下軸	HOOK DRIVING SHAFT
49	70134	*	*	*	*	1	下軸中間メタル 後)	HOOK DRIVING SHAFT BUSHING (MIDDLE, REAR)
50	10766	*	*	*	*	1	下軸中間メタル 後)止めねじ	SCREW1/4X32 L=7.0
51	10593	*	*	*	*	1	下軸カラー	HOOK DRIVING SHAFT COLLAR
52	10764	*	*	*	*	2	下軸カラー止めねじ	SCREW 6.75X24 L=4.5
54	70136	*	*	*	*	1	下軸メタル 後)止めねじ	SCREW 6.75X24 L=13.0
56	70140-01	*	*	*	*	1	外かま	HOOK
57	70140-02	*	*	*	*	1	内かま	BOBBIN CASE
58	70140-3A	*	*	*	*	1	内かま押え A	HOOK GIB (A)
59	70140-3B	*	*	*	*	1	内かま押え B	HOOK GIB (B)
60	16407-04	*	*	*	*	4	内かま押え止めねじ	SCREW
61	70104-05	*	*	*	*	1	針受板	NEEDLE GUARD
62	70140-06	*	*	*	*	2	針受板止めねじ	SCREW
63	70140-10	*	*	*	*	1	糸調子バネ	BOBBIN CASE TENSION SPRING
64	70140-11	*	*	*	*	1	糸調子バネ止めねじ	SCREW
65	70140-12	*	*	*	*	1	糸調子バネ調節ねじ	BOBBIN CASE TENSION REGULATING SCREW
66	70140-19	*	*	*	*	1	フエルト	FELT
67	30157	*	*	*	*	1	下軸ベアリングケース	HOOK DRIVING SHAFT BALL BEARING ADAPTER SLEEVE
68	10609	*	*	*	*	3	溝付きリング止めねじ	SCREW 3.4X36 L=5.0
69	10607	*	*	*	*	1	下軸ベアリングカラー	HOOK DRIVING SHAFT BALL BEARING ADAPTER
70	10658	*	*	*	*	1	位置決めねじ	SCREW 1/4X32 L=5.5
71	10566	*	*	*	*	1	止めねじ	SCREW 1/4X32 L=5.5
72	10567	*	*	*	*	1	下軸ベアリング	HOOK DRIVING SHAFT BALL BEARING
73	10608	*	*	*	*	1	溝付きリング	GROOVED RETAINING RING

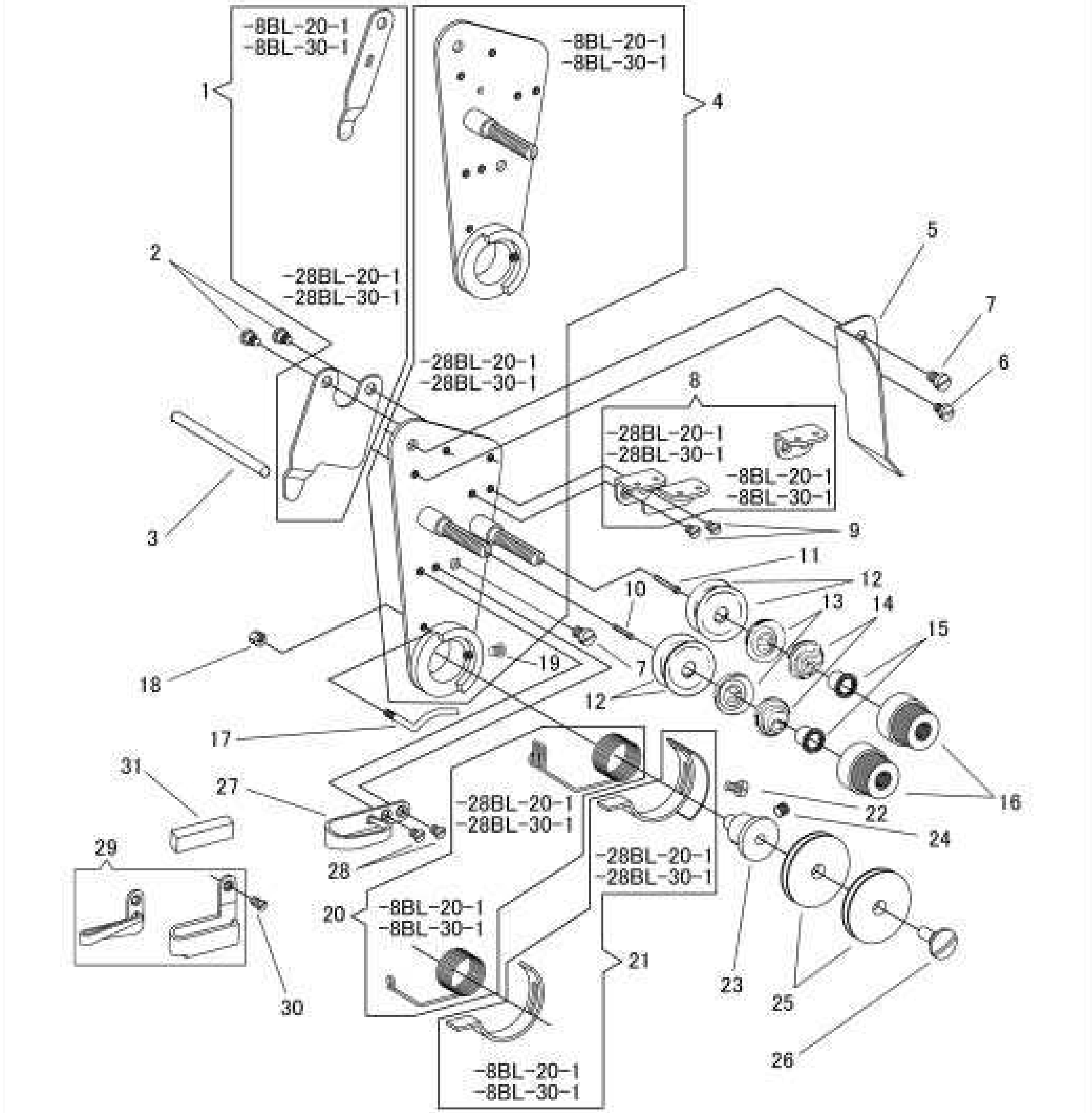
カマ土台（左）
HOOK SADDLE (LEFT)



カマ土台 (左)
HOOK SADDLE (LEFT)

No.	部品番号 PARTS NO.	-8BL-20-1	-28BL-20-1	-8BL-30-1	-28BL-30-1	数量 QTY	品名	DESCRIPTION
1	70141	-	*	-	*	1	ボビン	BOBBIN
2	70140	-	*	-	*	1	カマ (組)	HOOK COMPLETE
3	70151	-	*	-	*	1	カマ連結メガネ	BOBBIN CASE OPENER LEVER LINK
4	70145	-	*	-	*	1	カマメタル (上)	HOOK BUSHING (UPPER)
5	11176	-	*	-	*	1	カマメタル (上) 止めねじ	SCREW 7/32X32 L=5.5
6	70149C	-	*	-	*	1	オープナー土台 (組)	BOBBIN CASE OPENER LEVER
7	10727	-	*	-	*	1	フエルト	OIL FELT
8	70150	-	*	-	*	1	オープナー土台ピン	BOBBIN CASE OPENER LEVER HINGE STUD
9	10727	-	*	-	*	1	フエルト	OIL FELT
10	10573	-	*	-	*	1	オープナー土台ピン止めねじ	SCREW 7/32X32 L=11.0
11	11137	-	*	-	*	1	オープナー土台ピンパイプ	OIL WICK VINYL TUBE
12	70146	-	*	-	*	1	ボビンケースオープナー	BOBBIN CASE OPENER
13	70147	-	*	-	*	1	止めねじ	SCREW M3X0.5 L=6.0
14	70148	-	*	-	*	1	ワッシャー	WASHER
15	70152	-	*	-	*	1	オイルゲージ	OIL GAUGE
16	11131	-	*	-	*	1	案内パイプ	OIL GAUGE GUIDE
17	11145	-	*	-	*	1	カマ土台締付カラー (上)	HOOK SADDLE COLLAR (UPPER)
18	11146	-	*	-	*	1	カマ土台締付カラー (下)	HOOK SADDLE COLLAR (LOWER)
19	70143	-	*	-	*	1	カマ土台取付台	OIL RESERVOIR SPACER
20	70144	-	*	-	*	2	カマ土台取付台止めねじ	SCREW 7/32X32 L=21.0
21	70203	-	*	-	*	1	カマ土台 (左)	HOOK SADDLE (LEFT)
22	15092	-	*	-	*	1	カマ土台シートパッキン	HOOK SADDLE GASKET
23	15521	-	*	-	*	1	カマ土台油タンク (左)	OIL RESERVOIR (LEFT)
24	15007	-	*	-	*	7	カマ土台油タンク止めねじ	SCREW 9/64X40 L=10.0
25	11144	-	*	-	*	1	カマ土台締ねじ	PINCH SCREW 7/32X32 L=32.0
26	10646	-	*	-	*	1	カマ土台止めねじ	SCREW 6.75X24 L=28.0
27	10647	-	*	-	*	1	カマ土台止めねじワッシャー	WASHER
28	15093	-	*	-	*	1	油調節ダイヤル	OIL REGULATING DIAL
29	15094	-	*	-	*	1	Oリング	O-RING
30	10629	-	*	-	*	1	油調節ダイヤル止めねじ	SCREW 1/8X40 L=8.0
31	10638	-	*	-	*	1	大ギヤー	HOOK DRIVING GEAR
32	70137	-	*	-	*	1	位置決めねじ	SET SCREW 1/4X32 L=9.0
33	70138	-	*	-	*	1	止めねじ	SCREW 1/4X32 L=8.0
34	10657	-	*	-	*	1	小ギヤー	HOOK DRIVING PINION
35	10658	-	*	-	*	1	小ギヤー止めねじ (A)	SCREW 1/4X32 L=5.5
36	10767	-	*	-	*	1	小ギヤー止めねじ (B)	SCREW 1/4X32 L=4.5
37	15096	-	*	-	*	1	カマメタル (下)	HOOK BUSHING (LOWER)
38	11176	-	*	-	*	1	カマメタル (下) 止めねじ	SCREW 7/32X32 L=5.5
39	10644	-	*	-	*	1	カマメタル (下) ワッシャー	WASHER
40	70140-01	*	*	*	*	1	外かま	HOOK
41	70140-02	*	*	*	*	1	内かま	BOBBIN CASE
42	70140-3A	*	*	*	*	1	内かま押えA	HOOK GIB (A)
43	70140-3B	*	*	*	*	1	内かま押えB	HOOK GIB (B)
44	16407-04	*	*	*	*	4	内かま押え止めねじ	SCREW
45	70104-05	*	*	*	*	1	針受板	NEEDLE GUARD
46	70140-06	*	*	*	*	2	針受板止めねじ	SCREW
47	70140-10	*	*	*	*	1	糸調子バネ	BOBBIN CASE TENSION SPRING
48	70140-11	*	*	*	*	1	糸調子バネ止めねじ	SCREW
49	70140-12	*	*	*	*	1	糸調子バネ調節ねじ	BOBBIN CASE TENSION REGULATING SCREW
50	70140-19	*	*	*	*	1	フエルト	FELT

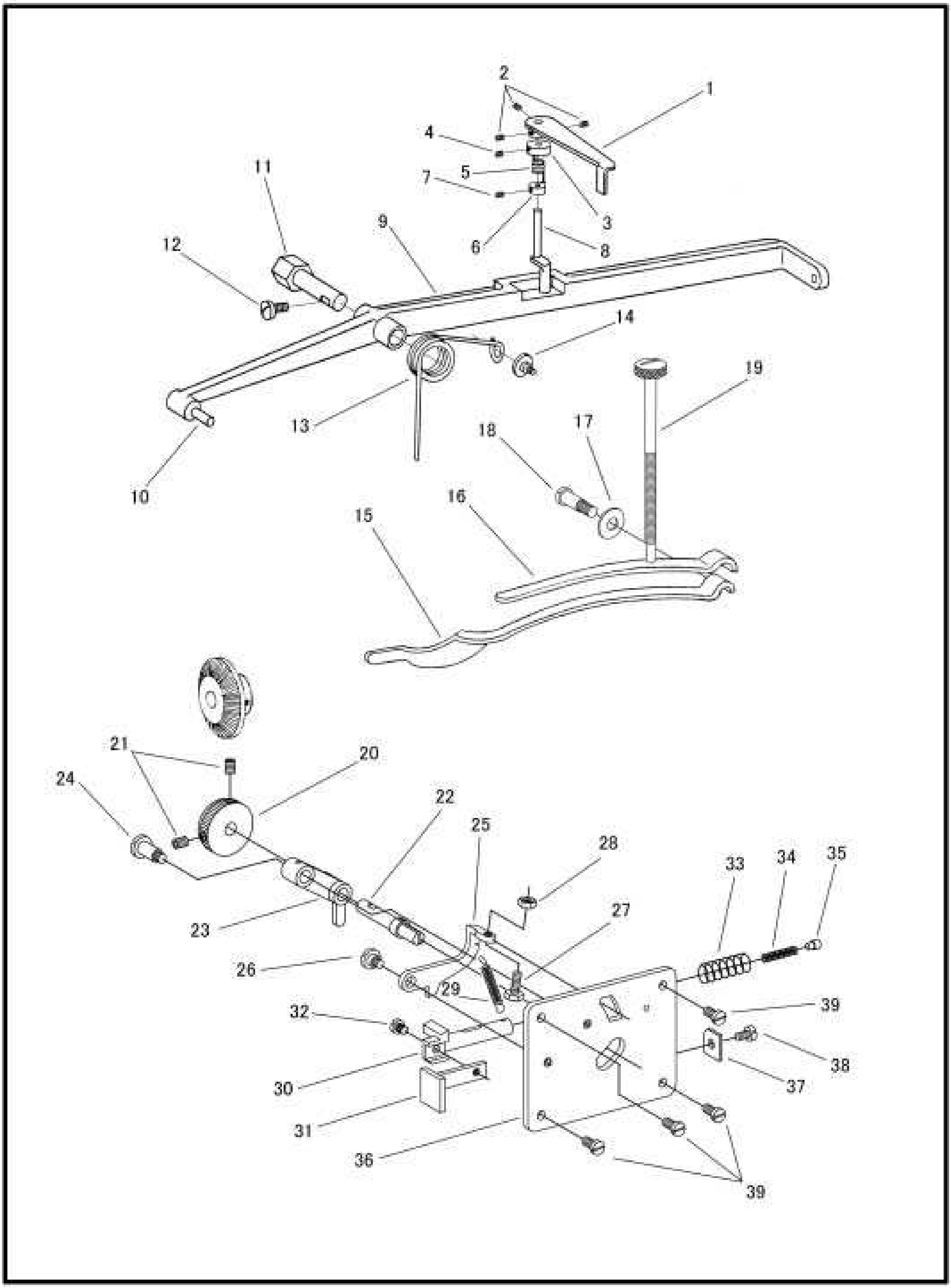
調子板
TENSION BRACKET



調子板
TENSION BRACKET

No.	部品番号 PARTS NO.	-8BL-20-1	-28BL-20-1	-8BL-30-1	-28BL-30-1	数量 QTY	品名	DESCRIPTION
1	70067	*	-	*	-	1	糸ゆるめ板	TENSION RELEASE PLATE
1	70206	-	*	-	*	1	糸ゆるめ板	TENSION RELEASE PLATE
2	10679	*	-	*	-	1	糸ゆるめ板段ねじ	SCREW 3.4X36 L=2.5
2	10679	-	*	-	*	2	糸ゆるめ板段ねじ	SCREW 3.4X36 L=2.5
3	70074	*	*	*	*	1	糸ゆるめピン	TENSION RELEASE PLUNGER
4	70063C	*	-	*	-	1	調子板 組	TENSION BRACKET COMPLETE
4	70204C	-	*	-	*	1	調子板 組	TENSION BRACKET COMPLETE
5	70075	*	*	*	*	1	糸調子カバー板	THREAD CONTROLLER COVERING PLATE
6	10650	*	*	*	*	1	糸調子カバー板止めねじ	SCREW 3.4X36 L=6.0
7	10561	*	*	*	*	2	止めねじ	SCREW 11/64X32 L=6.5
8	70076	*	-	*	-	1	調子板糸掛 (上)	THREAD CONTROLLER THREAD GUIDE (UPPER)
8	70209	-	*	-	*	1	調子板糸掛 (上)	THREAD CONTROLLER THREAD GUIDE (UPPER)
9	12113	*	*	*	*	2	調子板糸掛 (上) 止めねじ	SCREW 3.4X36 L=4.0
10	70066	*	*	*	*	1	糸ゆるめ段ピン (短)	TENSION RELEASE PIN (SHORT)
11	70207	-	*	-	*	1	糸ゆるめ段ピン (長)	TENSION RELEASE PIN (LONG)
12	8077	*	-	*	-	2	糸調子皿	TENSION DISC
12	8077	-	*	-	*	4	糸調子皿	TENSION DISC
13	3071	*	-	*	-	1	丸一皿	TENSION RELEASE WASHER
13	3071	-	*	-	*	2	丸一皿	TENSION RELEASE WASHER
14	8078	*	-	*	-	1	渦巻ばね	TENSION SPRING
14	8078	-	*	-	*	2	渦巻ばね	TENSION SPRING
15	143657	*	-	*	-	1	ラチェット	RATCHET
15	143657	-	*	-	*	2	ラチェット	RATCHET
16	27061	*	-	*	-	1	ローレットナット	REGULATING THUMB NUT
16	27061	-	*	-	*	2	ローレットナット	REGULATING THUMB NUT
17	70078	*	-	*	-	1	調子板糸掛 (下)	THREAD CONTROLLER THREAD GUIDE (LOWER)
17	70210	-	*	-	*	1	調子板糸掛 (下)	THREAD CONTROLLER THREAD GUIDE (LOWER)
18	11067	*	*	*	*	1	調子板糸掛 (下) 止めナット	NUT
19	15055	*	*	*	*	1	糸調子カラー受ピン止めねじ	SCREW 11/64X32 L=9.0
20	70072	*	-	*	-	1	糸引スプリング	THREAD CONTROLLER SPRING
20	70221	-	*	-	*	1	糸引スプリング	THREAD CONTROLLER SPRING
21	70073	*	-	*	-	1	糸引スプリング受	THREAD CONTROLLER SPRING STOP
21	70222	-	*	-	*	1	糸引スプリング受	THREAD CONTROLLER SPRING STOP
22	10650	*	*	*	*	1	糸引スプリング受止めねじ	SCREW 3.4X36 L=6.0
23	70070	*	*	*	*	1	糸調子カラー受ピン	THREAD CONTROLLER SPRING STUD
24	12421	*	*	*	*	1	糸調子棒カラー止めねじ	SCREW 11/64X32 L=4.0
25	70069	*	-	*	-	1	糸調子棒カラー	THREAD CONTROLLER DISC
25	70069	-	*	-	*	2	糸調子棒カラー	THREAD CONTROLLER DISC
26	70071	*	-	*	-	1	糸調子棒カラー押えピン	THREAD CONTROLLER STUD
26	70208	-	*	-	*	1	糸調子棒カラー押えピン	THREAD CONTROLLER STUD
27	70077	*	-	*	-	1	調子板糸掛 (中)	THREAD CONTROLLER THREAD GUIDE (MIDDLE)
27	70400	-	*	-	*	1	調子板糸掛 (中)	THREAD CONTROLLER THREAD GUIDE (MIDDLE)
28	12113	*	*	*	*	2	調子板糸掛 (中) 止めねじ	SCREW 3.4X36 L=4.0
29	10759-A	-	*	-	*	1	面糸掛 ～1	THREAD GUIDE ～1
29	10684	-	*	-	*	1	面糸掛 1-3/16～	THREAD GUIDE 1-3/16～
30	10685	-	*	-	*	1	面糸掛止めねじ	SCREW 3.4X36 L=6.5
31	10760	-	*	-	*	1	面糸掛フエルト	FELT

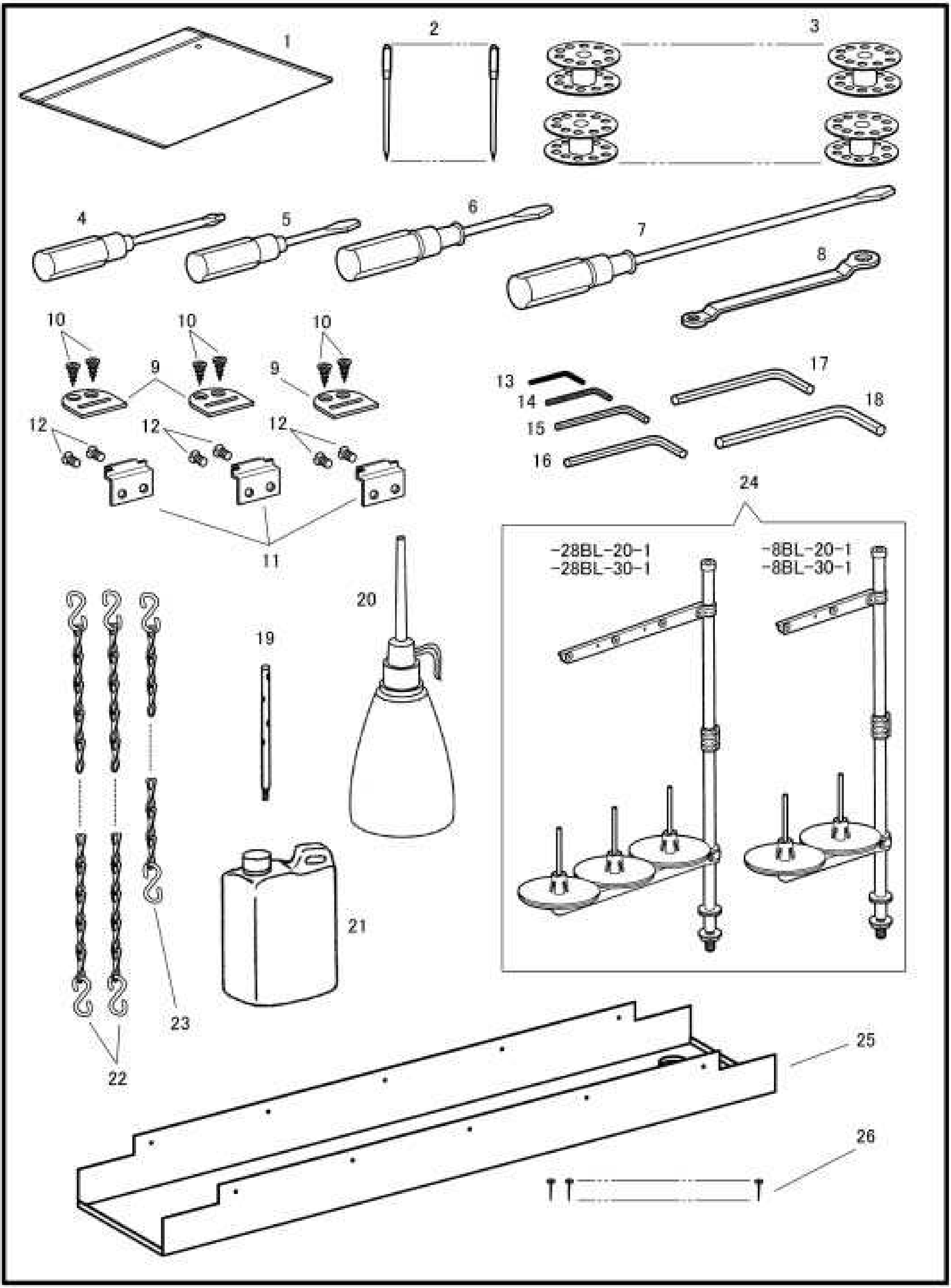
押え棒大板バネ、糸巻き
PRESSER BAR SPRING, BOBBIN WINDER



押え棒大板バネ、糸巻き
PRESSER BAR SPRING, BOBBIN WINDER

No.	部品番号 PARTS NO.	-8BL-20-1	-28BL-20-1	-8BL-30-1	-28BL-30-1	数量 QTY	品名	DESCRIPTION
1	70091	*	*	*	*	1	ストッパーレバー	FOOT LIFTER LIFTING LEVER LATCH HANDLE
2	2067	*	*	*	*	3	ストッパーレバー止めねじ	SCREW 11/64x40 L=6.0
3	70089	*	*	*	*	1	ストッパーカラー（上）	COLLAR (UPPER)
4	8042	*	*	*	*	1	ストッパーカラー止めねじ	SCREW 11/64X40 L=5.0
5	70088	*	*	*	*	1	ストッパースプリング	FOOT LIFTER LIFTING LEVER LATCH SPRING
6	70090	*	*	*	*	1	ストッパーカラー（下）	COLLAR (LOWER)
7	50287	*	*	*	*	1	ストッパーカラー止めねじ	SCREW 1/8X44 L=5.0
8	70087	*	*	*	*	1	ストッパークランク	FOOT LIFTER LIFTING LEVER LATCH
9	70376	*	*	-	-	1	大弓	FOOT LIFTER LIFTING LEVER
9	70083	-	-	*	*	1	大弓	FOOT LIFTER LIFTING LEVER
10	70084	*	*	*	*	1	大弓ピン	PIN
11	70085	*	*	*	*	1	弓受ピン	FOOT LIFTER LIFTING LEVER HINGE STUD
12	70136	*	*	*	*	1	弓受ピン止めねじ	SCREW 1/4X32 L=9.0
13	70086	*	*	*	*	1	大弓ばね	FOOT LIFTER LIFTING LEVER SPRING
14	10548	*	*	*	*	1	大弓ばね止めねじ	SCREW 6.75X24 L=8.1
15	70060	*	*	*	*	1	押え棒大板ばね	PRESSER BAR SPRING
16	70061	*	*	*	*	1	押え棒大板補助ばね	PRESSER BAR SPRING (AUXILIARY)
17	70094	*	*	*	*	1	大板ばね受ワッシャー	WASHER
18	70121	*	*	*	*	1	大板ばね受ねじ	SCREW 6.75X24 L=13.0
19	70062	*	*	*	*	1	大板ばね調節ねじ	SCREW 6.75X24 L=127.0
20	70101	*	*	*	*	1	糸巻ローラー	BOBBIN WINDER SHAFT DRIVING ROLLER
21	70175	*	*	*	*	2	糸巻ローラー止めねじ	SCREW 11/64X40 L=5.8
22	70100	*	*	*	*	1	糸巻芯棒	BOBBIN WINDER SHAFT
23	70099	*	*	*	*	1	糸巻連結	BOBBIN WINDER LINK
24	70103	*	*	*	*	1	糸巻連結段ねじ	HINGE SCREW 11/64X40
25	70102	*	*	*	*	1	糸巻調節板	BOBBIN WINDER CONNECTING PLATE
26	4094	*	*	*	*	1	糸巻レバー止めねじ	SCREW M4X0.7 L=5.0
26	70104	*	*	*	*	1	糸巻調節板段ねじ	HINGE SCREW 11/64X40 L=4.0
27	70106	*	*	*	*	1	糸巻調節ねじ	SCREW M4X0.7 L=12.0
28	4137	*	*	*	*	1	糸巻調節ねじナット	NUT
29	70107	*	*	*	*	1	糸巻調節板戻しスプリング	BOBBIN WINDER CONNECTING PLATE SPRING
30	70110	*	*	*	*	1	糸巻切り換え軸	BOBBIN WINDER RELEASING LEVER
31	70109	*	*	*	*	1	糸巻レバー	BOBBIN WINDER SET LEVER
32	4094	*	*	*	*	1	糸巻レバー止めねじ	SCREW M4X0.7 L=5.0
33	70108	*	*	*	*	1	糸巻レバースプリング	BOBBIN WINDER SET LEVER RELEASING SPRING
34	70105	*	*	*	*	1	糸巻連結戻スプリング	BOBBIN WINDER LINK RELEASING SPRING
35	70096	*	*	*	*	1	糸巻連結押しピン	STOP STUD
36	70097C	*	*	*	*	1	糸巻取付板（組）	BOBBIN WINDER BRACKET COMPLETE
37	12738	*	*	*	*	1	糸巻きローラーストッパー板	STOPPER PLATE
38	10650	*	*	*	*	1	糸巻きローラーストッパー板止めねじ	SCREW 3.4X36 L=6.0
39	15055	*	*	*	*	4	糸巻取付板止めねじ	SCREW 11/64X32 L=9.0

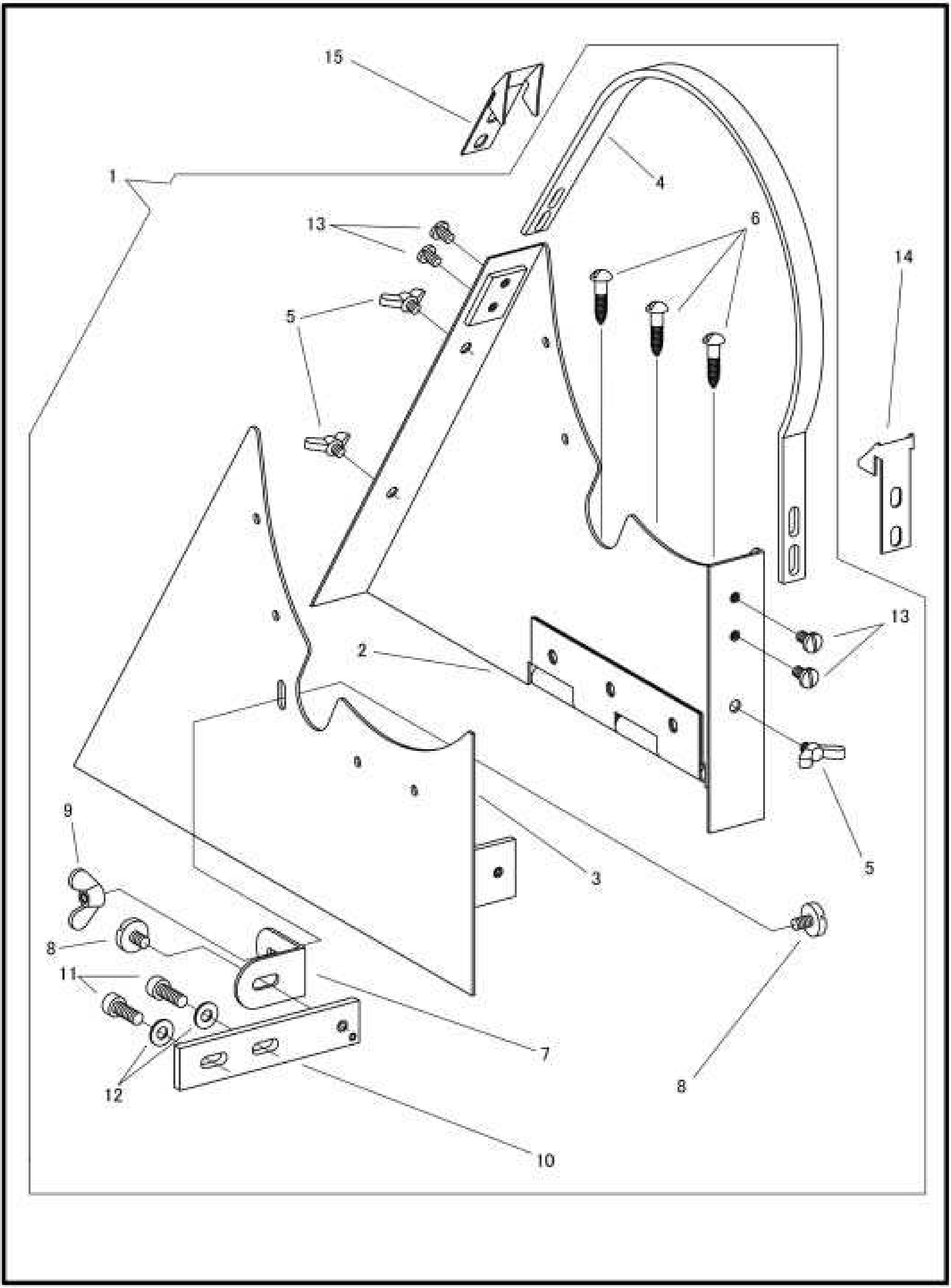
付属品1
ACCESSORIES 1



付属品 1
ACCESSORIES 1

No.	部品番号 PARTS NO.	-8BL-20-1	-28BL-20-1	-8BL-30-1	-28BL-30-1	数量 QTY	品名	DESCRIPTION
1	8132-A	*	*	*	*	1	部品袋チャック付	ACCESSORIES PACK
2	N3324	*	-	*	-	3	針 DYX3 (#24)	NEEDLE DYX3 (#24)
2	N3324	-	*	-	*	6	針 DYX3 (#24)	NEEDLE DYX3 (#24)
3	70141	*	-	*	-	5	ボビン	BOBBIN
3	70141	-	*	-	*	10	ボビン	BOBBIN
4	19473	*	*	*	*	1	十字ドライバー	SCREW DRIVER (CROSS TYPE)
5	8121	*	*	*	*	1	ドライバー (小)	SCREW DRIVER (SMALL)
6	8120	*	*	*	*	1	ドライバー (中)	SCREW DRIVER (MIDDLE)
7	8118	*	*	*	*	1	ドライバー (大)	SCREW DRIVER (LARGE)
8	19462	*	*	*	*	1	メガネレンチ	DOUBLE HEAD WRENCH
9	11171	*	*	*	*	3	ヒンジ受け	MACHINE HINGE CONNECTION PLATE
10	6052	*	*	*	*	6	ヒンジ受け止め木ねじ	MACHINE HINGE CONNECTION PLATE WOOD SCREW
11	11169	*	*	*	*	3	ヒンジ	BED HINGE
12	11170	*	*	*	*	6	ヒンジ止めねじ	BED HINGE SCREW
13	10747	*	*	*	*	1	六角レンチ (1/16 インチ)	WRENCH (1/16 ")
14	19456	*	*	*	*	1	六角レンチ (2 ミリ)	WRENCH (2 mm)
15	19457	*	*	*	*	1	六角レンチ (2.5 ミリ)	WRENCH (2.5 mm)
16	19458	*	*	*	*	1	六角レンチ (3 ミリ)	WRENCH (3 mm)
17	19459	*	*	*	*	1	六角レンチ (4 ミリ)	WRENCH (4 mm)
18	19460	*	*	*	*	1	六角レンチ (5 ミリ)	WRENCH (5 mm)
19	10942	*	*	*	*	1	糸立棒	THREAD GUIDE
20	8125	*	*	*	*	1	油差し	OILER
21	11193	*	*	*	*	1	油	OIL
22	13079	*	*	*	*	2	くさり(1000 mm)	CHAIN (1000 mm)
23	70197	*	*	*	*	1	くさり(90 mm)	CHAIN (90 mm)
24	10947	-	*	-	*	1	糸立てセット	THREAD STAND
24	35254	*	-	*	-	1	糸立てセット	THREAD STAND
25	70377	*	*	-	-	1	油受け	DRIP PAN
25	70171	-	-	*	*	1	油受け	DRIP PAN
26	6055	*	*	-	-	8	釘	NAIL
26	6055	-	-	*	*	10	釘	NAIL

付属品2
ACCESSORIES 2

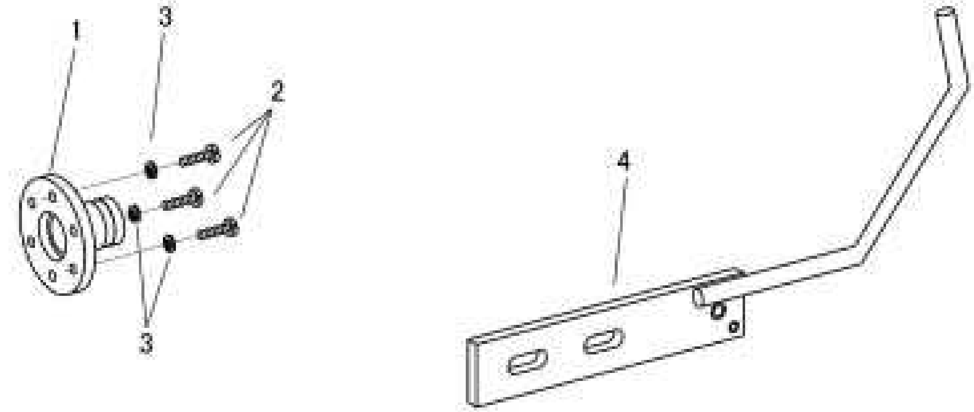


付属品 2
ACCESSORIES 2

No.	部品番号 PARTS NO.	-8BL-20-1	-28BL-20-1	-8BL-30-1	-28BL-30-1	数量 QTY	品名	DESCRIPTION
1	70199DC	*	*	*	*	1	ベルトガード（組）	BELT GUARD COMPLETE
2	70199-A	*	*	*	*	1	ベルトガード（右）	BELT GUARD (RIGHT)
3	70199-B	*	*	*	*	1	ベルトガード（左）	BELT GUARD (LEFT)
4	70199-C	*	*	*	*	1	ベルトカバー	BELT GUARD COVER
5	28080	*	*	*	*	3	ベルトガード（右）（左）止め蝶ねじ	SCREW M5X0.8 L=6.0
6	70215	*	*	*	*	3	ベルトガード止め木ねじ	WOOD SCREW
7	70199-E	*	*	*	*	1	ベルトガード振れ止め板	BELT GUARD STAY
8	12386	*	*	*	*	2	ベルトガード振れ止め板止めねじ	SCREW 7/32X32 L=9.0
9	10776	*	*	*	*	1	ベルトガード振れ止め板止め蝶ナット	WING NUT
10	70199-D	*	*	*	*	1	ベルトガード振れ止め受板	BELT GUARD SUPPORT
11	28076	*	*	*	*	2	ベルトガード振れ止め受板止めねじ	SCREW M6X1 L=18
12	10599	*	*	*	*	2	ベルトガード振れ止め受板止めねじワッシャー	WASHER
13	12418	*	*	*	*	4	ベルトカバー止めねじ	SCREW 13/64X32 L=9.0
14	70199-F	*	*	*	*	1	補助ガード（前）（CE用）	AUXILIARY GUARD (FRONT) : for CE
15	70199-G	*	*	*	*	1	補助ガード（後）（CE用）	AUXILIARY GUARD (REAR) : for CE

別売品

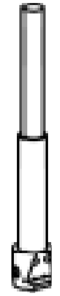
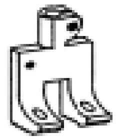
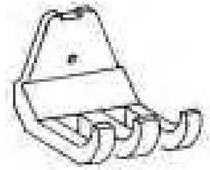
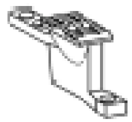
PARTS AVAILABLE AT EXTRA CHARGE



別売品
PARTS AVAILABLE AT EXTRA CHARGE

No.	部品番号 PARTS NO.	-8BL-20-1	-28BL-20-1	-8BL-30-1	-28BL-30-1	数量 QTY	品名	DESCRIPTION
1	30169	*	*	*	*	1	検出器アダプター	ADAPTOR FOR SYNCHRONIZER
2	30170	*	*	*	*	3	検出器アダプター止めねじ	SCREW M4×0.7 L=16.0
3	31208	*	*	*	*	3	検出器アダプター止めばね座金	SPRING LOCK WASHER
4	70189	*	*	*	*	1	検出器支え棒(組)	SYNCHRONIZER SUPPORT

ゲージ表
TABLE OF GAUGE PARTS JW-28BL-20-1/JW-28BL-30-1

									
針巾		針棒（針株付）	中押え	外押え	針板	送り歯	角板（左）	角板（右）	ﾌｨﾝｶﾞｰｶﾞｰﾄﾞ
GAUGE SIZE		NEEDLE BAR WITH CLAMP	VIBRATING PRESSER FOOT	LIFTING PRESSER FOOT	THROAT PLATE	FEED DOG	BED SLIDE (LEFT)	BED SLIDE (RIGHT)	FINGER GUARD
inch	mm								
-	5	70225-03	70226-03	70227-03	70228-03	70229-03	70218	70224	70219-02
1/4	6.4	70230	70250	70270	70290	70310	70218	70224	70219-02
5/16	7.9	70232	70252	70272	70292	70312	70348	70368	70219-02
-	8.3	70248	70268	70288	70308	70328	70348	70368	70219-02
3/8	9.5	70233	70253	70273	70293	70313	70333	70353	70219-03
-	10	70249	70269	70289	70309	70329	70333	70353	70219-03
7/16	11.1	70234	70254	70274	70294	70314	70335	70355	70219-04
1/2	12.7	70235	70255	70275	70295	70315	70335	70355	70219-04
-	14	70236-B	70256-B	70276	70296	70316-B	70335	70355	70219-04
9/16	14.3	70236-A	70256-A	70276	70296	70316-A	70335	70355	70219-04
-	15	70225-01	70226-01	70227-01	70228-01	70229-01	70337	70357	70219-04
5/8	15.9	70237	70257	70277	70297	70317	70337	70357	70219-04
3/4	19.1	70238	70258	70278	70298	70318	70338	70358	70219-05
7/8	22.2	70239	70259	70279	70299	70319	70339	70359	70219-06
1	25.4	70240	70260	70280	70300	70320	70340	70360	70219-07
1-3/16	30.2	70241	70261	70281	70301	70321	70342	70362	70219-09
1-1/4	31.8	70242	70262	70282	70302	70322	70342	70362	70219-09
1-3/8	34.9	70243	70263	70283	70303	70323-S	70343	70363	70219-09
1-1/2	38.1	70244	70264	70284	70304	70324	70344	70364	70219-09
1-5/8	41.3	70225-05	70226-05	70227-05	70228-05	70229-05	70341	70361	70219-08
1-3/4	44.5	70245	70265	70285	70305	70325	70345	70365	-
2	50.8	70246	70266	70286	70306	70326-S	70346	70366	-
2-1/4	57.2	70460	70465	70470	70475	70480	70490	70485	-
2-3/8	60.3	70247	70267	70287	70307	70327	70347	70367	-
2-1/2	63.5	70225-02	70226-02	70227-02	70228-02	70229-02	70349	70369	-

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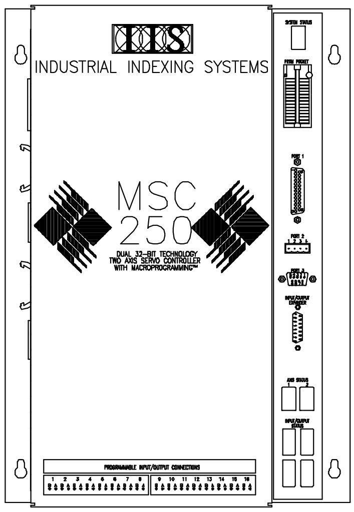
MOTION CONTROL SYSTEMS, MSC-250 **AUGUST 1998**



MSC-250
2½-AXIS
SERVO
CONTROLLER

USER'S GUIDE

ABM International, Inc.

Revision - C
Approved By:

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SECTION 4 - MAINTENANCE AND TROUBLESHOOTING

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INTRODUCTION

The Industrial Indexing Systems Motion Control System MSC-250 is a microprocessor-based, position-loop controller. It is a dual 32-bit technology, 2½-axis, closed-loop controller that works with separate servo drives, motors, and encoder feedback devices to accurately fix the position of the motor shafts.

The MSC-250 controller is part of the MSC family of controllers and peripheral equipment produced by Industrial Indexing Systems. It uses the same Macroprogram control language already familiar to users of the MSC-850 family of controllers and is fully compatible with this family of controllers.

This manual describes proper installation, operation, and troubleshooting procedures for the MSC-250 controller. The manual assumes no prior knowledge of Industrial Indexing System equipment. It does assume knowledge of proper mechanical, electrical, and electronic maintenance and safety procedures. If the equipment is used in a manner not specified in this manual, the protection provided by the equipment may be impaired. Information in this manual is subject to change without prior notification.

The manual uses a variety of highlighted blocks to emphasize important information. Always pay careful attention to this information. The types of highlighted blocks used are:

WARNING

USED TO ALERT THE READER TO ACTIONS OR CONDITIONS WHICH MIGHT PRESENT HAZARDS OR CAUSE INJURY TO PERSONNEL.

CAUTION

USED TO ALERT THE READER TO ACTIONS WHICH MIGHT CAUSE LOSS OF MATERIALS OR DAMAGE TO EQUIPMENT.

NOTE

Used to identify unusual or unexpected conditions or to point out the need for alternate procedures. It is also used for emphasis when a CAUTION or WARNING is not required.

This manual describes the controller and some related devices. For completeness, this manual also describes various aspects of related feedback devices and drives. However, as sold, the MSC-250 controller only includes the controller, a line cord, and manual. All other items are optional — and must be specified separately — to allow total design flexibility. Connecting cables can be specified with any desired length (although there are some limits on communication and feedback cable lengths) or with just connectors and no cable for user assembly.

Industrial Indexing Systems fully supports all equipment it manufactures and supplies. If there are any problems with this equipment or if assistance is required for installation or operation, contact our Integrated Technical Services Department.

Assistance and training is available in our factory, for a fee. In addition, Industrial Indexing Systems can custom configure controllers for O.E.M. applications.

SECTION 1 – DESCRIPTION

The Industrial Indexing Systems MSC-250 is a microprocessor-based, position-loop servo controller. It is a dual 32-bit technology, 2½-axis, closed-loop servo controller that works with separate servo drives, motors, and encoder feedback devices to accurately fix the position of the motor shaft.

1.1 INDEXING DRIVE SYSTEM OVERVIEW

An indexing drive system (or indexing system) may be used in a variety of applications where accurate movement or positioning is required. A basic single-axis system consists of eight main components as illustrated in **Figure 1.1**.

1. Input Device: The input device provides data to the controller. It is the interface between the operator (or system computer or programmable logic controller) and the indexing system. In a given system, there may actually be several input devices.

2. Controller: The controller receives data from the input device and issues commands to the drive. It also accepts information from the feedback device. The programming and settings of the controller determine what types of commands are issued to the drive in response to the data inputs and feedback.

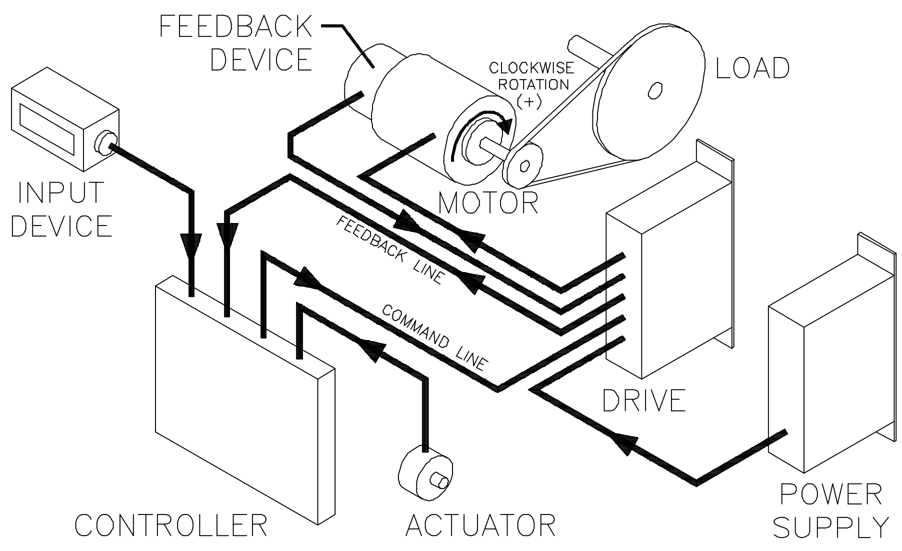


Figure 1.1 - Basic Indexing System

3. Actuator: The actuator supplies the signal which causes the controller to initiate the specified sequences. It may be a separate device or part of a computer program from the Input Device.

4. Power Supply: The power supply converts AC input power into DC power and conditions this secondary power so it can be used by the drive.

5. Drive: The drive (also called a servo-amplifier) amplifies a low voltage velocity command signal from the controller into the necessary voltage and current to cause the motor shaft to rotate. The amount of power and polarity (positive or negative) of the voltage supplied to the motor is determined by the command signals from the controller.

6. Motor: The motor is the device being controlled by the indexing system. The system controls the amount and speed of motor shaft rotation.

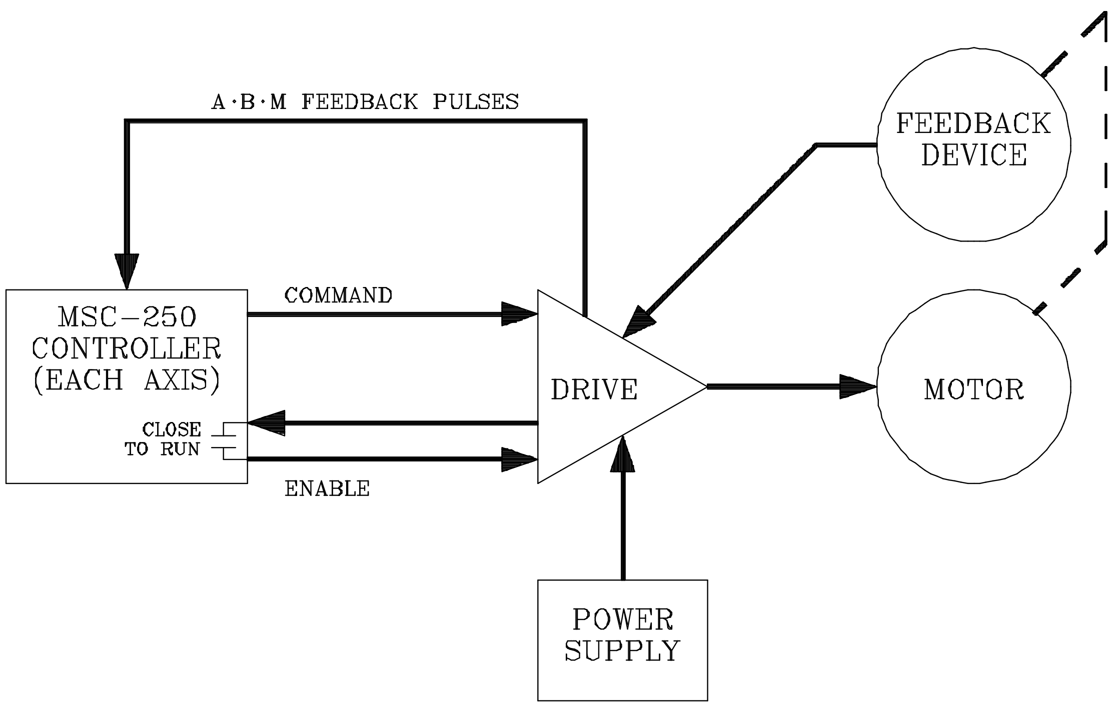


Figure 1.2 - Position Loop

7. Load: The load is the object of the motion. It absorbs the work energy of the motor.

8. Feedback Device: The feedback device (always a shaft encoder or equivalent A×B×M signal device with the MSC-250 servo controller) monitors the position of the motor shaft and sends this information to the controller. (Refer to Section 1.2.1.1 for additional details on the feedback device.)

The objective of the indexing system is to accurately control the position and speed of rotation of a motor shaft at any given time. This control may be used to move the load a specific distance (index) or to a specific location (position). It also may be used to move the load in a pattern duplicating the motion that would be produced by the action of mechanical cam, remembering that motion can occur in both clockwise and counterclockwise directions.

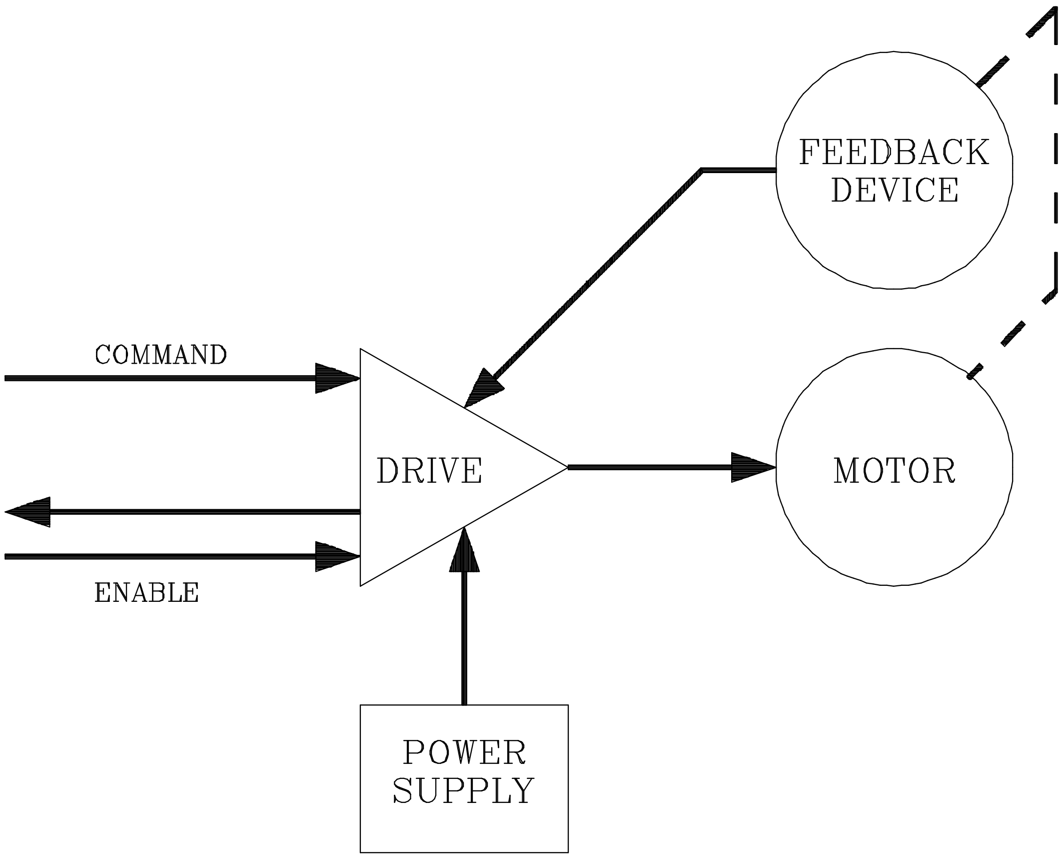


Figure 1.3 - Velocity Loop

The components of the basic indexing drive system form two information loops. The position loop is a closed-loop which consists of the controller, drive, motor, and feedback device. The controller, continually compares motor position, derived from the feedback pulses received from the drive, with the desired position calculated within the controller. Any difference between calculated position and actual position results in a corrective command signal being sent to the drive. The drive then corrects motor position by adjusting its velocity loop. The objective of the position loop is to keep the actual position equal to the commanded position.

The velocity loop is also a closed-loop system. The drive continually compares motor velocity, derived from the feedback device, with the magnitude of the command signal generated by the controller. Any difference causes the drive to alter the current to the motor, which in turn changes the motor velocity. The objective of the velocity loop is to keep actual velocity equal to commanded velocity.

The position loop and velocity loop are independent loops, but the controller uses the velocity loop to achieve movement to the desired position. When data is received by the controller specifying a movement, the controller calculates the time required to accelerate to maximum speed and to decelerate from maximum speed. It then calculates the time at maximum speed necessary to complete the movement. This information is then transmitted to the drive by the controller.

1.2 SYSTEM FUNCTIONS

The MSC-250 servo controller can simultaneously and independently regulate two motion axes. Programming of the motion control is supplied by a separate computer program or by a pre-programmed PROM (Programmable Read-Only Memory). Once loaded, the program is stored in non-volatile memory in the controller.

The controller uses two processors. One processor is labeled "Main Microprocessor" and the other is labeled "Axis Microprocessor" (refer to "Section 1.3 - Components"). These two processors communicate through two kilobytes of dual-port RAM (Random Access Memory) for maximum processing and communication speed. (Dual-port RAM is memory which is mapped in the same location on each processor and is simultaneously accessible by both processors.) The main microprocessor processes information from the operating program, communication ports, and I/O (Input/Output) modules. The axis microprocessor processes information from the feedback devices and sends commands to the drives.

NOTE

All operating commands used by the MSC-250 servo controller are part of the Industrial Indexing Systems' Macroprogram command language. Refer to the separate *Macroprogram Development System Instruction Book* for detailed information on the actual commands and use of Macroprogram control.

1.2.1 AXIS CONTROL

The MSC-250 can control one or two motion axes, providing precision position-loop control to each axis. The controller can provide indexing, positioning, cam following, and profiling control. It can also be used as a passive position sensing device. A third axis (referred to as a half axis) can only monitor information received from a master axis or controller or from the pseudo axis. It does not provide any control functions.

Each full axis can be controlled directly from the Macroprogram or can act as a slave, referencing its motion from angles supplied over the two Master Angle Buses provided in the controller. The information on the angle bus can come from one of five sources:

a. A pseudo-axis (internal) provided by the controller
b. A real axes
c. Another controller with angle information supplied through the fiber optics receiver
d. A master resolver with angle information supplied through the fiber optics receiver
e. A master encoder with angle information supplied through the fiber optics receiver

1.2.1.1 Position Feedback

Instructions from the Macroprogram provide the parameters for indexing and positioning. This motion information is processed and converted into voltage information which is sent to the drive to cause the motor to rotate to a desired position. At the same time, the encoder, which is mechanically connected to the motor shaft, sends information to the processor which indicates the actual position of the motor shaft. The difference between the actual position of the motor shaft, as indicated by the encoder, and the commanded position is called the "following error".

The feedback device is an A·B·M shaft encoder or electronic equivalent. The MSC-250 will accept inputs from a variety of encoders, but each drive system and its corresponding Macroprogram must be designed around a specific encoder line count.

WARNING

WHEN A SHAFT ENCODER IS REPLACED, ALWAYS USE AN IDENTICAL ENCODER. IF A DIFFERENT ENCODER LINE COUNT IS USED, THE MACROPROGRAM MUST BE REVIEWED AND POSSIBLY REVISED BEFORE THE SYSTEM IS OPERATED. FAILURE TO CORRECTLY MATCH THE MACROPROGRAM TO THE ENCODER BEING USED MAY RESULT IN IMPROPER SYSTEM MOVEMENT WHICH COULD CAUSE EQUIPMENT DAMAGE AND POSSIBLE PERSONAL INJURY.

The encoder produces current loop pulses of approximately 10 mA per channel. There are three channels. Channels A and B are quadrature encoded with channel A leading channel B by 90° for clockwise shaft rotation. Channel M provides a marker once per encoder revolution. The pulses are square-wave signals (refer to **Figure 1.4**).

NOTE

On some encoders, channels A and B are designated channels 1 and 2. Always connect encoders so the leading channel for clockwise rotation is connected to channel A while the second quadrature channel is connected to channel B. The marker channel is always channel M (or "3" or "Z").

Each edge (change in state) of the quadrature-encoded square waves is counted by an interface circuit. Thus, the change from low to high is one edge and the change from high to low of the same pulse is a second edge. The counting of edges plus the 90° offset of the two pulse streams provide position and direction sensing with a resolution equal to four times the encoder line count. Other line counts can be used with software scaling of parameters.

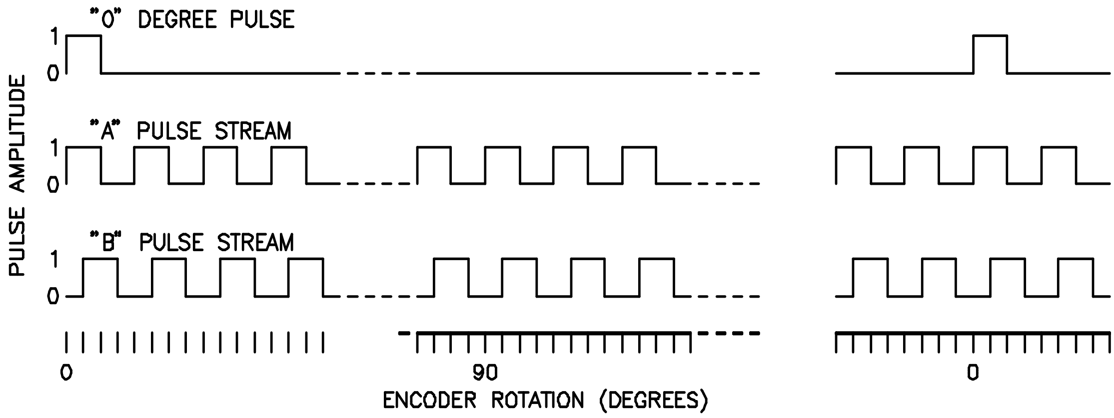


Figure 1.4 - Typical Encoder Pulse Patterns

Encoders may have different line counts per one revolution of the encoder. This line count is an important factor in determining 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 reduced. The standard line count assumed by the MSC-250 controller and the Macroprogram software is 1024 pulses per revolution.

NOTE

To use encoders with line counts other than 1024, the values for RPM and acceleration must be properly scaled to provide accurate motor shaft movement (refer to the *Macroprogram Development System Instruction Book*).

The marker provided by channel M is also a square-wave signal. However, different encoders use markers of varying duration. The marker bit may go high (positive amperage) for a single pulse width, for 90° of encoder shaft revolution, or for 180° of encoder shaft revolution. When this pulse goes high in a clockwise rotation (or low in a counterclockwise rotation), the controller uses the state change to mark the "0.00" absolute reference point.

The encoder is not an absolute position sensing device. When first powered up, the encoder shaft position in its rotation cannot be determined until the marker bit is recorded. Rather, the position at power up is referred to as "local mode home" or "0.0" as opposed to absolute 0.00. The controller can determine actual movement from this local home position by counting pulses.

When the absolute position of the system must be known, the system must be initialized after it is powered up. For encoders with marker bits less than 180° of encoder shaft rotation, use the **find_mark_cw** and **find_mark_ccw** commands to initialize the system and determine the absolute system position. For encoders with marker bits of 180° of encoder shaft rotation, use the **find_tm_cw** and **find_tm_ccw** commands. (Refer to the *Macroprogram Development System Instruction Book* for complete command instructions.)

NOTE

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.

1.2.1.2 POS OUT Signal

The position of the encoder, as understood by the controller, is translated into a "POS OUT" voltage signal based on a digital compensation gain algorithm. This algorithm has four variable components of Proportional Gain, Integral Gain, Derivative Gain, and Feed Forward Gain values which respectively represent the Proportional, Integral, Derivative, and Feed Forward terms of the algorithm.

With standard values of Proportional Gain = 16, Integral Gain = 0, Derivative Gain = 0, and Feed Forward Gain = 0, the POS OUT voltage signal is +5 VDC at the 90° encoder shaft position and +10 VDC at the 180° encoder shaft position for clockwise shaft rotation. The signal is -5 VDC at the 90° encoder shaft position and -10 VDC at the 180° encoder shaft position for counterclockwise shaft rotation. However, the Proportional Gain value can be set to produce a voltage signal of from 10 VDC per 1/32 revolution of the encoder shaft to 10 VDC per 8 turns of the encoder shaft. (Refer to the *Macroprogram Development System Instruction Book* for information on setting the digital compensation values.)

1.2.1.3 Pseudo Axis

The pseudo axis is an imaginary, perfect motor which can be controlled by the software of the MSC-250. The desired position of the pseudo-axis motor is determined by the Macroprogram and the resulting position signal perfectly reflects the desired position at any given time. This perfect-position information can then be used by the real axes as reference information for their own movements or it can be used to actuate programmable limit switches or other I/O functions. The pseudo axis information can be broadcast (transmitted) on either or both of the controller master angle buses.

1.2.1.4 Master Angle Buses

The MSC-250 controller has two master angle buses which can be used for reference by the real axes. The information on the two buses may be the same, although it is usually different, or the buses may not be used at all by the controller. These options are all programmable by the system designer. (Refer to the *Macroprogram Development System Instruction Book* for information on using the axis controller or fiber optic receiver as a slave and sending and receiving information on the master angle buses.)

When the master angle buses are used, the angle information on the bus comes from one of three sources:

1. As discussed above, the angle information on the bus may come from the pseudo axis generated by the Macroprogram. At any specific time, the information on the bus represents the angular position of the perfect motor controlled by the pseudo axis.

2. The angle information on the bus may come from the position of one of the MSC-250 axes, real or passive. This information is determined from the encoder information processed by the controller. Real axis information represents the actual position of the motor ¾ not the theoretical position ¾ and will reflect any differences in this position from the theoretical.

3. The angle information on the bus may come from another controller. This information is received at the fiber optics receiver and broadcast on the desired bus or buses based on the Macroprogram. This information may reflect a real axis or a pseudo axis. (Refer to the specific manuals for the MSC-850 Motion Control System family of products for information on using a controller as a master and sending the information over the fiber optic path.)

The real axes can receive reference position information from either master angle bus. The Macroprogram can also direct the axis to receive reference information from first one bus and then the other.

1.2.2 ANALOG INPUT/OUTPUT CHANNELS

The MSC-250 provides a 12-bit analog input/output subsystem which has one ±10 VDC input channel and one ±10 VDC output channel. This subsystem also provides one +10 VDC reference signal and one -10 VDC reference signal. These reference signals can be used as a voltage source for potentiometer inputs. (Refer to **"Section 2 - Installation"** for appropriate connection diagrams.)

The analog input channel may be used as either a single-ended (ground referenced unbalanced) channel or as a differential (isolated ground balanced) channel. Under Macroprogram control, the user may select an analog offset value and a maximum slew rate value (refer to **Figure 1.5**). For each analog input cycle, the A/D (Analog-to-Digital) converter reading is added to the offset value. The rate of change of the resulting sum is limited by the slew rate value. This limited result is sign extended to a 32-bit value and made available to the Macroprogram.

The analog output channel provides a ±10 VDC output channel with its common referenced to controller ground. Under Macroprogram control, the user may select an analog offset value and a maximum slew rate for the analog output channel (refer to **Figure 1.5**). For each analog output cycle, the analog output value specified in the Macroprogram is added to the analog offset value and the slew rate limit applied. The resulting value is output to the D/A (Digital-to-Analog) converter.

A pair of voltage reference signals are available for connection to a potentiometer. Each reference provides nominally +10 VDC and -10 VDC and each can deliver up to 10 mA of current.

1.2.3 INPUT/OUTPUT MODULES

The MSC-250 controller has 16 on-board locations for I/O (Input/Output) modules (refer to **Figure 1.6**). In addition, two IOE-850 I/O Expanders of 16 positions each can be daisy-chained from the INPUT/OUTPUT EXPANDER PORT to provide an additional 32 I/O locations. Any of the 48 positions can be used for either an AC or DC input or output module.

When equipped with an input module, the controller will monitor the location for a specific change in state of the module, as directed by the Macroprogram, and will perform specific actions when the state change occurs. When equipped with an output module, the controller will change the state of the module at the location, as directed by the Macroprogram. Monitoring of each of the module locations is supplied by a status indicator
on the front of the controller (refer to "Section 1.3 - Components).

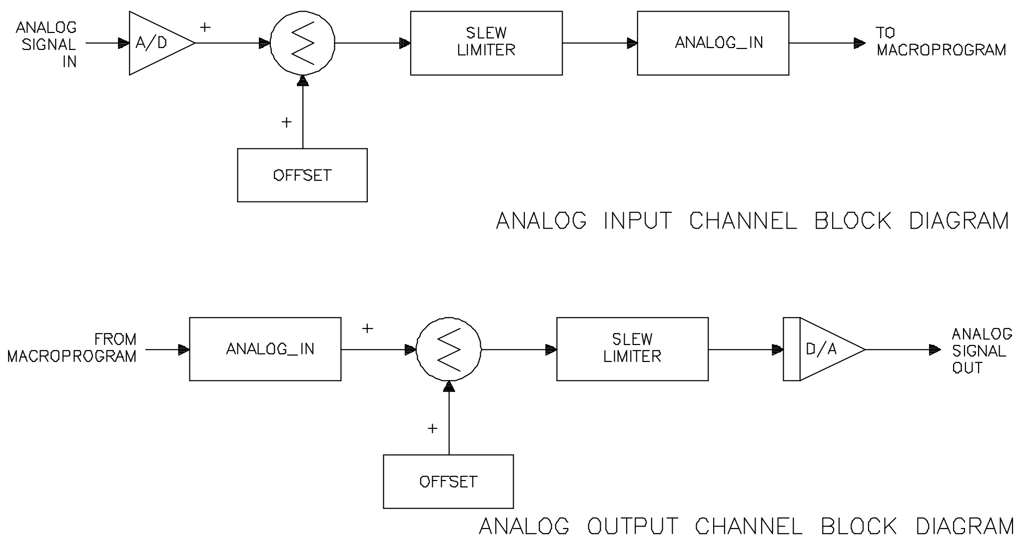


Figure 1.5 - Analog Input and Output Channel Block Diagrams

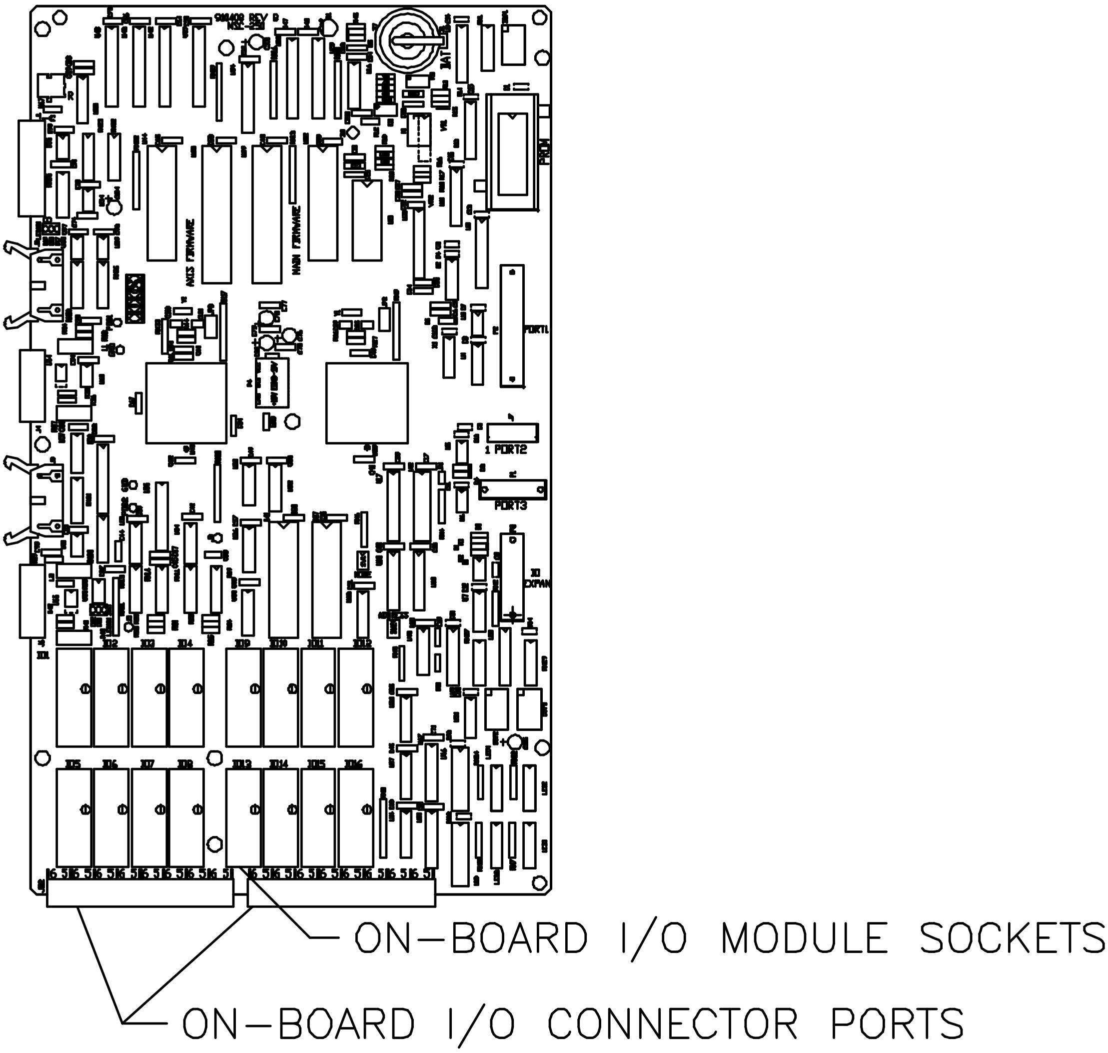


Figure 1.6 - Input/Output Module Locations

In addition to I/O functions, one of the sixteen position groups — either the controller board or one of the I/O expanders — can be used for programmable limit switches (PLS). These limit switches can be actuated at master angle bus positions specified by the Macroprogram. (Refer to the *IOE-850 I/O Expander Instruction Manual* for additional information on use of these modules for I/O module and PLS functions.)

NOTE

Only one of the three groups of sixteen module locations can be used for programmable limit switches at a time. Of the sixteen locations in the single group, there are no use restrictions. Any of the sixteen can be used as PLS locations with the balance used for I/O modules or left empty.

1.2.4 PROGRAMMING

The MSC-250 servo controller uses the Macroprogram command language developed for Industrial Indexing Systems' MSC family of motion control products. This command language can be used on any IBM™-compatible personal computer running under the MS-DOS™ environment to create the necessary program to operate the controller. Industrial Indexing Systems, Inc. provides a software system to assist the designer in creation of these programs.

The system is the Macroprogram Development System. This software tool provides an effective environment for creating Macroprograms for the MSC family of motion controllers. Program development consists of creating and editing text files containing the appropriate program instructions, compiling these files to generate executable programs, and on-line program debugging. In addition, the Macroprogram Development System provides aids for disk file maintenance and configuration.

The Macroprogram Development System includes a software package called the MSC Tool Kit which simplifies the use of the system. The MSC Tool Kit allows simple entry and editing of programs while providing on-line documentation describing the purpose and format of each Macroprogram Language instruction. For additional information, refer to the *Macroprogram Development System Instruction Book*.

Once a program has been created, it can be loaded to the controller memory directly from the computer or from a PROM loaded into the controller PROM POCKET (refer to "Section 1.3 - Components" and "Section 3 - Operation"). Once loaded, the program is stored in non-volatile memory so it will not be lost if the power is turned off. This memory is protected by a lithium battery. The program will remain in memory until a new program is entered or the battery backup is removed.

NOTE

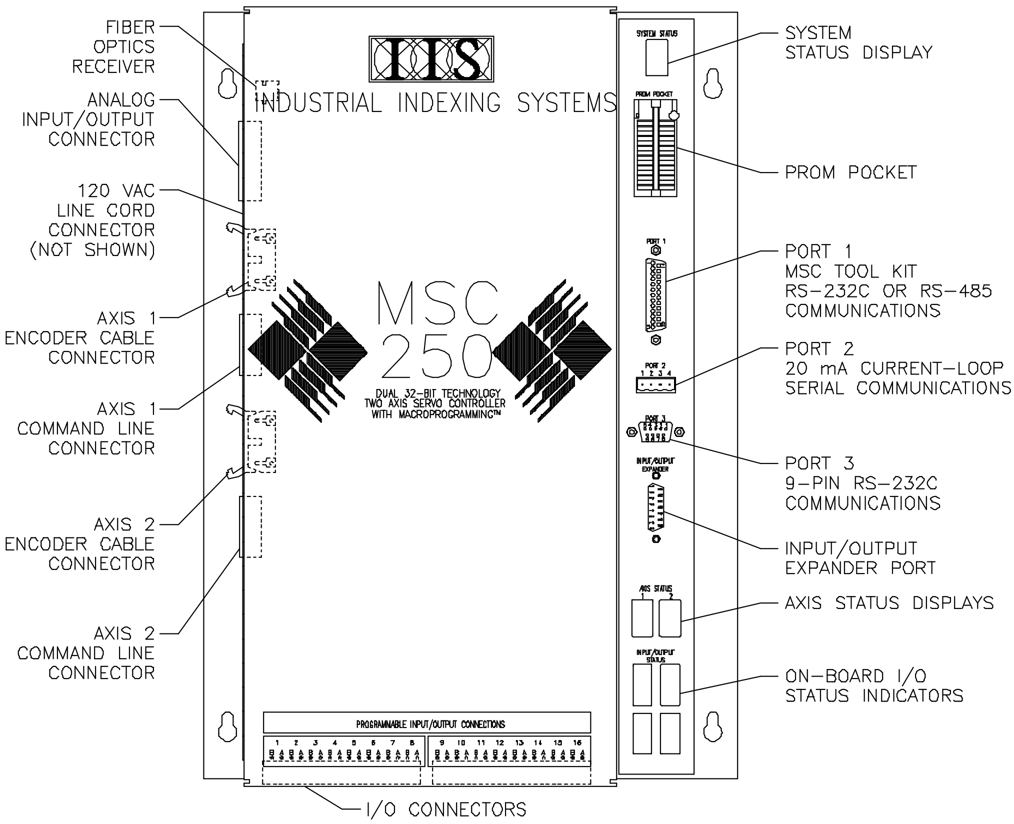
The PROM can also be used by the controller as a data access or storage (read or write) location (refer to "Section 3 - Operation").

1.3 COMPONENTS

Figure 1.7 shows the various connectors and status indicators of the MSC-250 controller. Several of the connectors are attached to the printed circuit board of the controller and protrude through the side or bottom of the controller cabinet. These connectors are shown as dotted lines to indicate their relative position, even though they are not really visible from this view.

1.3.1 STATUS INDICATORS

1. SYSTEM STATUS Display: This 7-segment LED (Light Emitting Diode) with decimal place indicates the status of the main processor. Each number displayed represents a specific status code. (Refer to "Section 3.2 - Controller Use and Status" for the meaning of these codes.) An illuminated decimal point indicates that the program is running.



1.2

Figure 1.7 - Connectors and Status Indicators

2. AXIS STATUS Displays: One 7-segment LED with decimal place indicates the status for each of the axes. Each number displayed represents a specific status code. (Refer to "Section 3.2 - Controller Use and Status" for the meaning of these codes.) An illuminated decimal point indicates that the drive for that axis is enabled.

3. On-board I/O Status Indicators: There is one LED position for each of the 16 on-board I/O locations. When the I/O module is accessed, an LED will illuminate beneath the number of the I/O location. If no module is present, the illumination will be dim. If the module is present, the illumination will be bright.

1.3.2 CONNECTORS

1. PROM POCKET: This 28-pin ZIF (Zero Insertion Force) socket accepts PROMs for program input and data storage.

2. 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 ADDRESS switch on the printed circuit board must be set to allow proper communications. (Refer to "Section 2 - Installation" for proper cable pin-outs for this port.)

3. 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 2 - Installation" 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.

4. PORT 3: This is a 9-pin D-connector RS-232C serial communications port. It is accessible through the Macroprogram language for

sending and receiving data and commands. (Refer to "Section 2 - Installation" for proper cable pin-outs for this port.)

5. INPUT/OUTPUT EXPANDER PORT: This 15-pin D-connector is a serial communications port used to daisy-chain the IOE-850 I/O Expanders to the controller. It utilizes a proprietary communications protocol.

6. Command Cable Connector: There is one six-pin command cable connector for each real axis controlled by the MSC-250. It is used to communicate indexing commands to the drive amplifier. (Refer to "Section 2 - Installation" for proper cable pin-outs for this connector.)

7. Encoder Cable Connector: There is one ten-pin connector for each real axis controlled by the MSC-250. It is used to communicate the encoder feedback signals to the controller axis processor. (Refer to "Section 2 - Installation" for proper cable pin-outs for this connector.)

8. Line Cord Connector: This 3-pin connector (supplied with system unit) provides the attachment point for the C-800006 connector cable used to supply 120 VAC input power and earth ground connection to the MSC-250 servo controller. (Refer to "Section 2 - Installation" for proper connections to this port.)

9. Analog Input/Output Connector: This connector (supplied with system unit) provides contacts for one analog input channel, one analog output channel, and a reference voltage. Use of these input and output channels is controlled by the Macroprogram.

10. Fiber Optics Receiver: This receiver is used to receive the protocol for master angle passing from the Industrial Indexing Systems' EFC-100 encoder-to-fiber-optics converter, RFC-100 resolver-to-fiber-optics converter, and MCF-850 function card.

11. I/O Connectors: These connectors (supplied with system unit) are used for the physical connection of the devices actuating and being actuated by the on-board input and output modules. (Refer to "Section 2 - Installation" for appropriate input and output connections.)

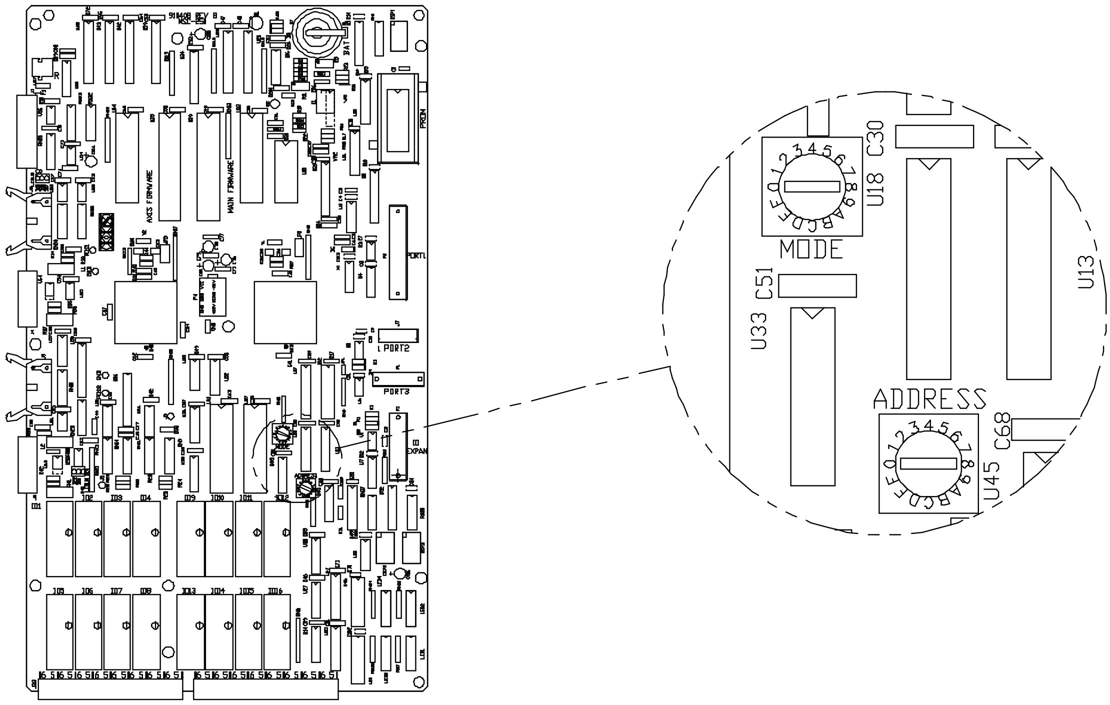


Figure 1.8 - ADDRESS and MODE Selector Switches

1.3.3 SELECTOR SWITCHES

There are two 16-position rotary selector switches on the MSC-250 circuit board as indicated in **Figure 1.8.**

1. ADDRESS: 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 ¾ 1 through F ¾ are used to designate the node number of the controller when it is used for RS-485 serial communications.

2. MODE: This selector switch is used to determine the operating mode of the controller.

   Normal Operation = Port 1, 2, & 3 default to 9600 Baud - Packet Protocol.

Position 0	=	Normal Operation
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
Position B	=	Port 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.

1.3.4 TEST POINTS AND LED INDICATORS

There are a variety of test points and LED indicators on the MSC-250 circuit board which are used for diagnostic and trouble-shooting purposes (refer to **Figure 1.9**). Procedures for use of these items are discussed in "Section 4 - Maintenance".

1. POS and GND Test Points: There is one set of test points for each axis (refer to **Figure 1.10** and **Figure 1.11**). Place a meter between these test points to measure the POS OUT signal of the axis. (Refer to "Section 4 - Maintenance" for applications involving the use of these test points.)

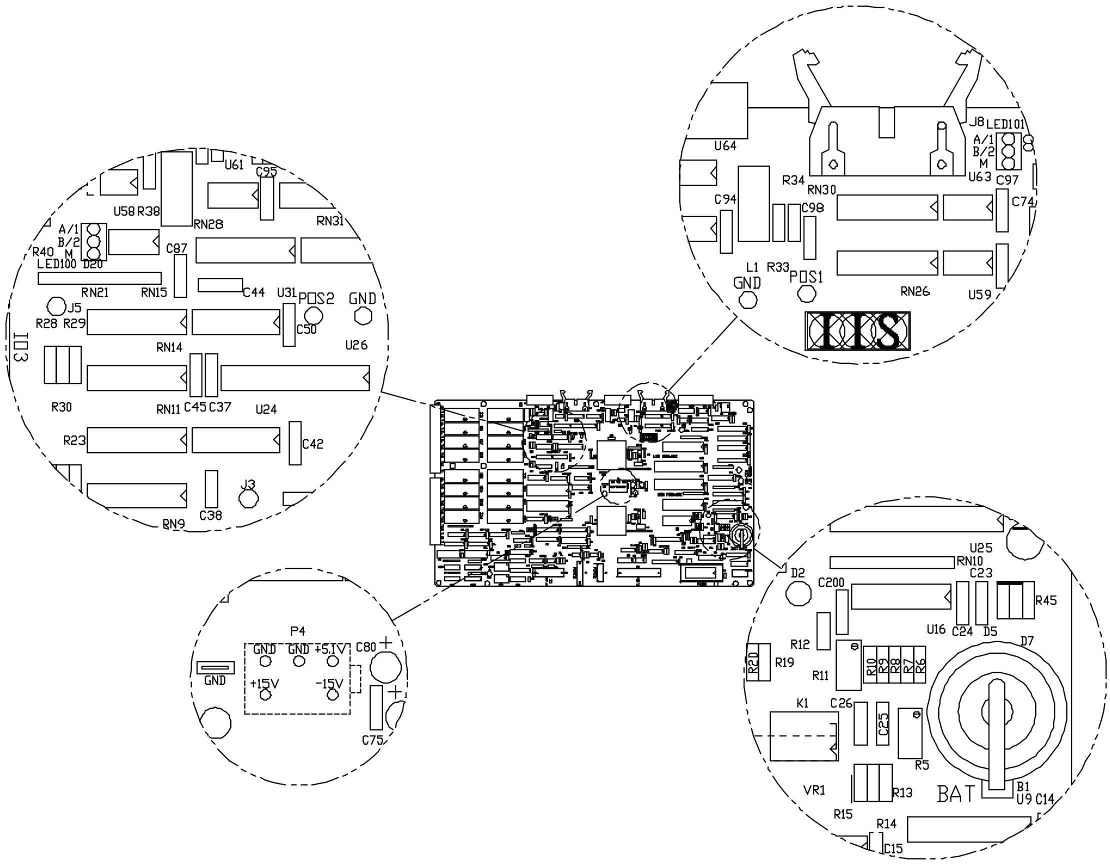


Figure 1.9 - Circuit Board Test Points

2. Encoder Signal Monitor: There is one set of three LED encoder signal indicators for each axis (refer to **Figure 1.10** and **Figure 1.11**). One LED is assigned to each channel of the encoder and illuminates each time the channel generates a pulse. The quadrature channels (1 and 2) will flash very rapidly while the encoder shaft is turning. The indicator for the marker channel will flash once per encoder-shaft revolution.

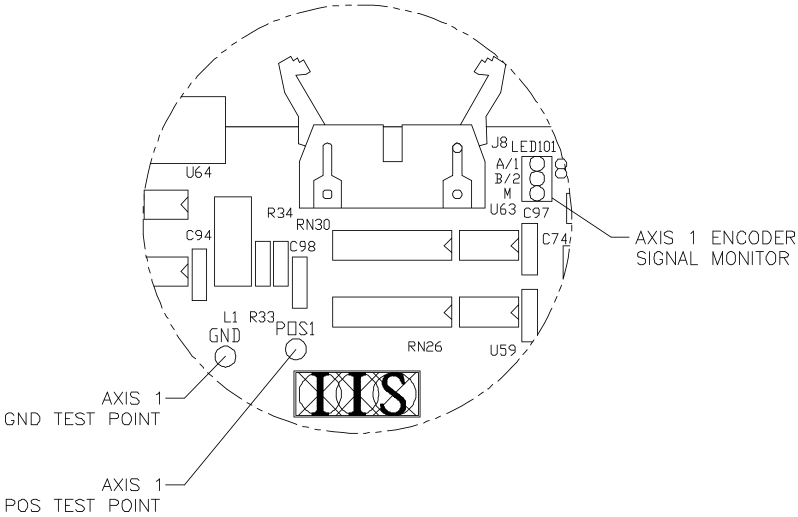


Figure 1.10 - Axis 1 Test Points and Indicators

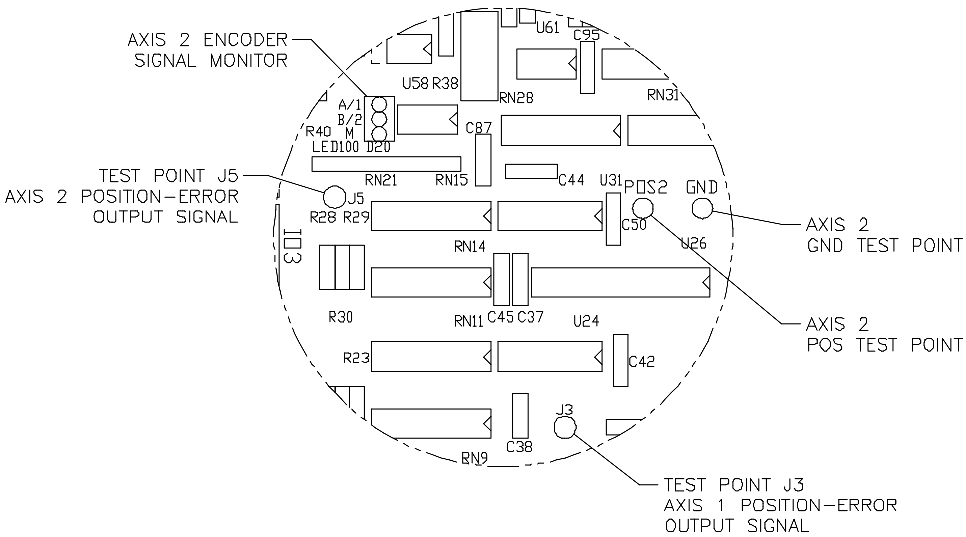


Figure 1.11 - Axis 1 and Axis 2 Test Points and Indicators

3. Position-error Output Signal: One test point for measuring the following error is provided for each axis (refer to **Figure 1.11**). J3 is the test point for axis 1 and J5 is the test point for axis 2. (Refer to "Section 4 - Maintenance" for applications involving the use of these test points.)

4. Voltage Test Points: The voltage test point block and additional ground loop are available for checking the system voltages used by the controller (refer to **Figure 1.12**).

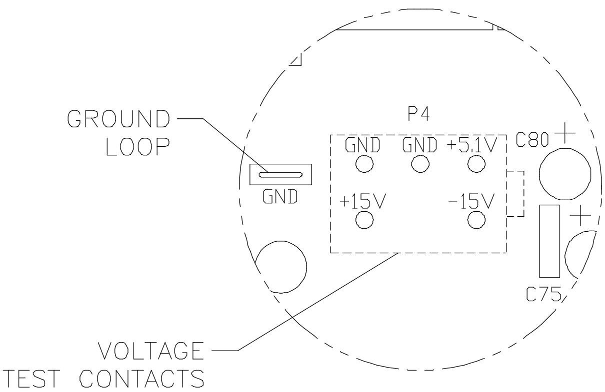


Figure 1.12 - Voltage Test Contacts

5. Low Input Line Power Indicator: LED indicator D2 will illuminate whenever input line power is reduced to a point that could result in improper controller operation. The status indicator on the cover of the controller will also display an error code.

CAUTION

THE TWO POTENTIOMETERS INDICATED IN FIGURE 1.13 CONTROL USE OF BATTERY POWER TO PROTECT THE NON-VOLATILE MEMORY REQUIRED TO MAINTAIN THE OPERATING PROGRAM IN THE CONTROLLER. THESE POTENTIOMETERS ARE FACTORY SET AND MUST NOT BE ADJUSTED. IMPROPER ADJUSTMENT OF THESE POTENTIOMETERS COULD RESULT IN LOSS OF PROGRAM MEMORY.

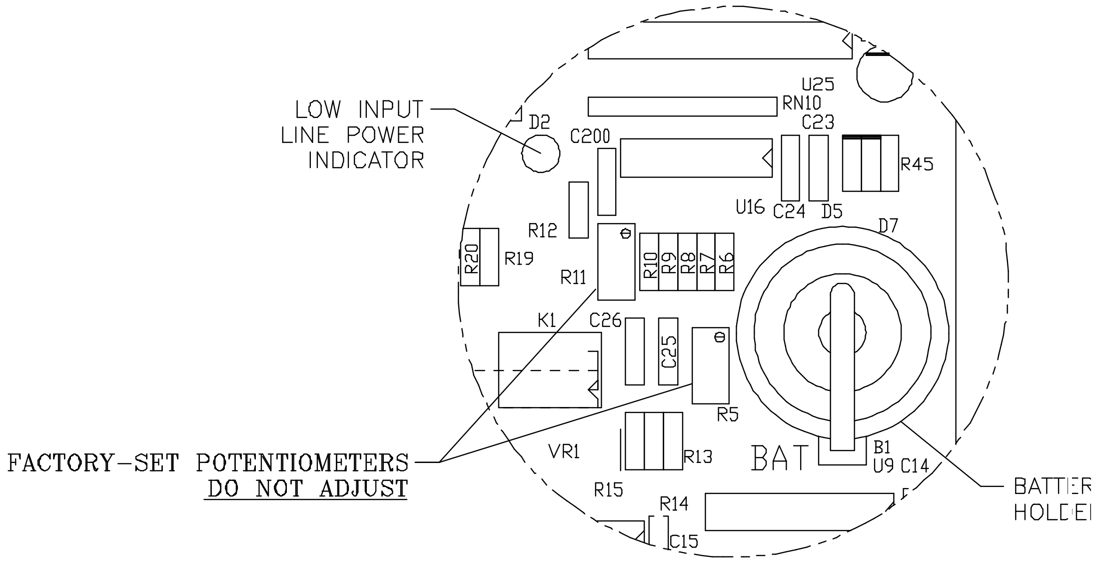


Figure 1.13 - Low Input Line Power Indicator

1.4 SPECIFICATIONS

1.4.1 PHYSICAL CHARACTERISTICS

SIZE:	15.24" high x 9.34" wide x 5.00 deep
WEIGHT:	11.25 lbs. [5.1 kg.]
OPERATING TEMPERATURE:	32°F to 140°F [0°C to 60°C]
OPERATING HUMIDITY:	30% to 90% non-condensing
INPUT POWER:	115 VAC ±15VAC, 48 to 62 Hz, 2 Amps This device is intended to be connected to a category II type power source.
BATTERY:	CR2477 or DL2430

1.4.2 PERFORMANCE CHARACTERISTICS

DRIVE ENABLE CONTROL:	Optically isolated Off Voltage = 30 VDC On Voltage = 1.5 VDC. 20 mA
DRIVE COMMAND OUTPUT:	PID loop with 2.048 KHz digital signal processing sample rate
FEEDBACK DEVICE: Marker Types:	Digital quadrature encoder with marker 1/2 Revolution = MSB 1/4 Cycle = A & B
LINE RECEIVER:	Isolated Differential Receiver - required drive of 10ma or 4V drop accross inputs.
POSITIONAL RANGE:	+2,147,483,648/-2,147,483,649 counts
POSITIONAL ABSOLUTE ACCURACY:	±1 count
ACCELERATION/DECELERATION RATE:	16 to 3,276,800 counts/second/second
SPEED	0.266 to 245,760 counts/second
DECODING:	Fixed quadrature (x4) at 400 KHz max.

SERIAL COMMUNICATION:	PORT 1:	RS-232C or RS-485 multi-drop (Packet Protocol) 9600 Baud, 1 Stop Bit, 8 Data Bits, No Parity
	PORT 2:	20 mA Current Loop, ASCII Programmable
	PORT 3:	RS-232C, ASCII Programmable

1.4.3 PROMS

ACCESS TIME: 150 nanoseconds maximum

PACKAGE TYPE:
SGS Thompson TS27C256_
Toshiba TC57256_
National Semiconductor NMC27C256_
Signetics 27C256_

NOTE

The PROM package types shown are those which have been tested by Industrial Indexing Systems, Inc. and found satisfactory for this application. Equivalent PROMs from other manufacturers may also be acceptable.

1.4.4 ANALOG INPUT CHANNELS

ANALOG INPUT CHANNEL:

Type	Unbalanced or Balanced
Voltage Range	-10 Volts to +10 Volts
Resolution	12 bit (1 part in 4096)
Accuracy	10 bit
Update Rate	1 millisecond loop
Input Impedance	10K Ohm Single-ended

ANALOG OUTPUT CHANNEL:

Type	Unbalanced
Voltage Range	-10 Volts to +10 Volts
Resolution	12 bit (1 part in 4096)
Accuracy	10 bit
Update Rate	1 millisecond loop
Output Drive	10 mA Maximum

VOLTAGE REFERENCE SOURCE:

Type	(1) +10V Ground Referenced (1) -10V Ground Referenced
Voltage Reference	±10 V ±0.5 V at 10 mA Maximum

DIGITAL FILTERING (Slew Control):

Unit	Bits per 10 Milliseconds
Range (programmable)	1 to 2048 bits
Resolution	1 part in 2048 bits

1.4.5 INPUT/OUTPUT MODULES

I/O INTERFACE:	16 positions, on-board, discrete 32 positions, on expansion modules (16 Programmable Limit Switches max.)

DC INPUT MODULE (**HSI-250**)
(High Speed Input)

JUMPER INSTALLED	
Input Voltage Range	4.5 to 8 VDC
Input Current at Max. Line	28 ma
Input allowed for No Output	

JUMPER CUT	
Input Voltage Range	9 to 24 VDC
Input Current at Max. Line	38 ma
Input allowed for No Output	
Isolation Input-to-output	2500 V_{rms}
Turn-on Time	6 ms
Turn-off Time	6 ms

DC INPUT MODULE (**IDC15**)	
Input Voltage Range	10 to 32 VDC
Input Current at Max. Line	25 ma
Input allowed for No Output	1 ma (3 V)
Isolation Input-to-output	4000 V_{rms}
Turn-on Time	5 ms max.
Turn-off Time	5 ms max.

DC Input Module - High Speed (**HSI-250**)	
Input Voltage	5vdc or 15vdc Jumper Selectable
Input Current at Max. Line	25 ma
Input Allowed For No Output	2 V
Isolation Input-to-output	2500 VAC
Turn-on Time	100u Sec max.
Turn-off Time	100u Sec max.

AC INPUT MODULE (**IAC15**)	
Input Voltage Range	12 to 140 VAC

Input Current at Max. Line	11 ma
Input allowed for No Output	3 ma (45 V)
Isolation Voltage (Input-to-output)	4000 V_{rms}
Turn-on Time	20 ms max.
Turn-off Time	20 ms max.

NOTE

Do not use the IAC15 module for applications intended to be used in the European Community.

DC OUTPUT MODULE (**ODC15**)

Operating Voltage Range	5 to 60 VDC
Current Rating (at 70°F)	2 amps
One Second Surge	5 amps
Output Voltage Drop	1.6 max.
Off-state Leakage at Max. Voltage	1 ma
Isolation Voltage (Input-to-output)	4000 V_{rms}
Turn-on Time	100 microseconds
Turn-off Time	750 microseconds

AC OUTPUT MODULE (**OAC15**)

Operating Voltage Range	12 to 140 VAC
Current Rating (at 70°F)	2 amps
One Cycle Surge	80 amps peak
Minimum Load Current	20 ma
Output Voltage Drop	1.6 max. peak
Off-state Leakage at Nominal Voltage (60 Hz)	5 ma_{rms}
Isolation Voltage (Input-to-output)	4000 V_{rms}
Operating Frequency	25 to 65 Hz
Turn-on Time	100 microseconds
Turn-off Time	750 microseconds

NOTE

Do not use the OAC15 module for applications intended to be used in the European Community.

NOTES

SECTION 2 – INSTALLATION

The MSC-250 servo controller is designed for use in custom indexing systems. Therefore, each installation may vary, depending on the application. The instructions in this section are general guidelines to assist in the design and installation of the controller. Specific cables and optional equipment indicated on the illustrations are for reference only and may not required.

2.1 MOUNTING

The controller is designed for surface mounting on a wall or in an electrical cabinet. It must be protected from adverse environmental conditions such as dust, moisture, and vibration. It must also be protected from excessive heat or cold. If mounted in an electrical cabinet, provide adequate ventilation to maintain temperature and humidity within allowable limits (refer to "Section 1.4 - Specifications").

For applications that are to be delivered to Europe and must meet the European standards, the controller must be installed inside an electrical cabinet.

The controller mounts flat against a wall or panel using four mounting key-hole slots in the back of the unit (refer to **Figure 2.1**).

NOTE

Allow a minimum of 3" clearance on all sides of the controller. Extra clearance may be desired on the left, right, and bottom to allow easier insertion of cable connectors.

1. Select the desired position for the controller and lay out the locations for the (4) mounting bolts as shown in **Figure 2.1**.

2. If panel mounted, provide clearance holes or tapped holes for (4) #10 machine screws for mounting the controller. If wall mounted, provide the necessary anchors for (4) #10 mounting screws.

3. Locate the controller in position and attach to the wall or panel using (4) #10 screws.

NOTE

The larger holes in the mounting plate slots allow the plate to be placed over the heads of #10 socket-head cap screws. If these are used, the screws may be started in the holes before the controller is placed in its final location.

4. Mount any auxiliary equipment following the directions in the instruction manuals provided with the equipment.

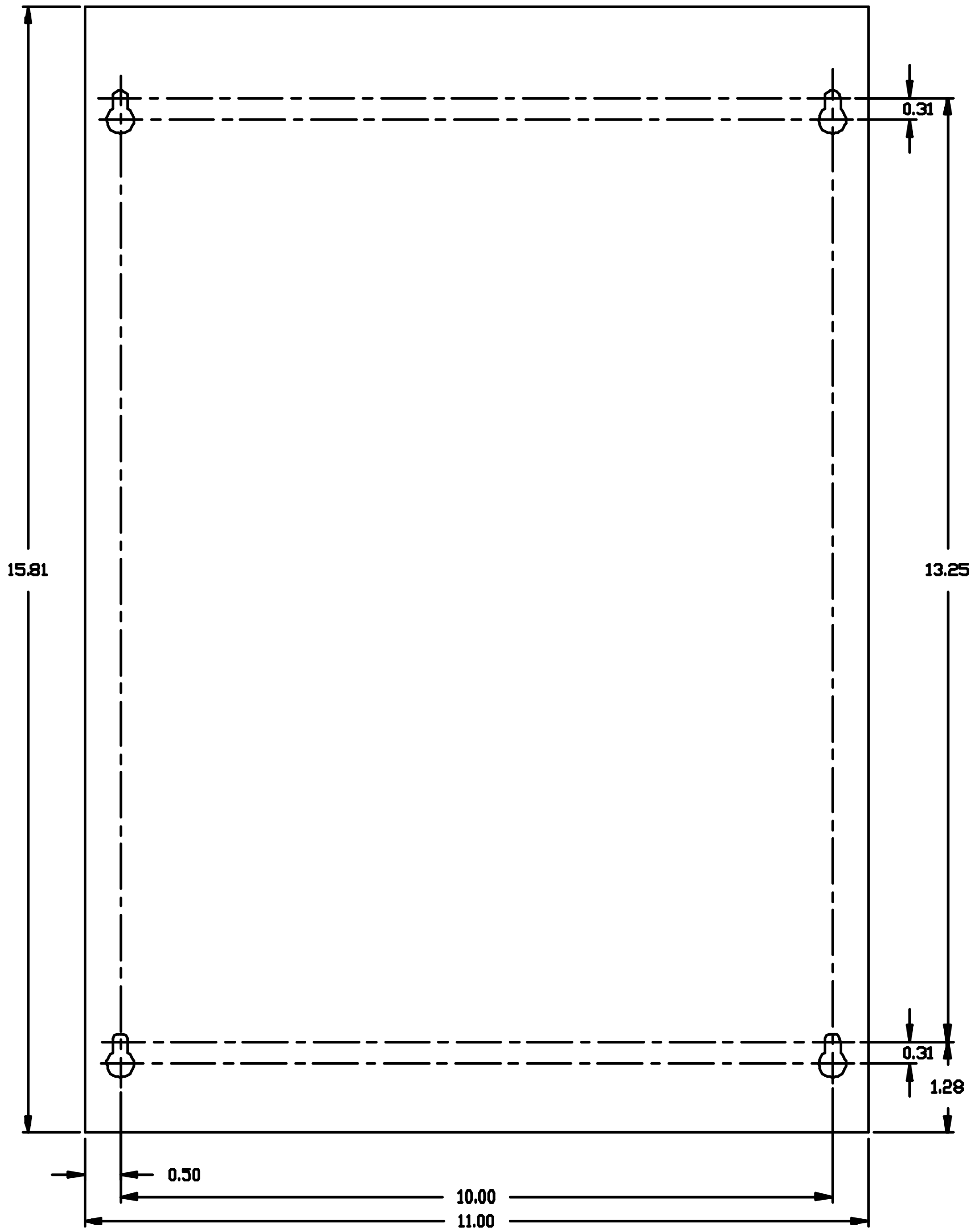


Figure 2.1 - Mounting Dimensions

2.2 ELECTRICAL CONNECTIONS

WARNING

IT IS THE RESPONSIBILITY OF THE CUSTOMER TO MAKE SURE THE INSTALLATION COMPLIES WITH ALL NATIONAL, STATE, AND LOCAL CODES INCLUDING THE NATIONAL ELECTRIC CODE (NEC).

CAUTION

THE MSC-250 CONTROLLER AND ALL RELATED ELECTRONIC EQUIPMENT MUST BE CONNECTED TO A SEPARATE EARTH GROUND — NOT PLANT ELECTRICAL GROUND. MAKE ALL CONNECTIONS WITH SHIELDED CABLES AND CONNECT THE SHIELDS TO THE EARTH GROUND. FAILURE TO PROVIDE THIS EARTH GROUND COULD RESULT IN ELECTRICAL DAMAGE TO THE EQUIPMENT.

Since there are several connections required to the single earth ground, it is recommended that an MSC ground strip be installed. This terminal strip is connected to earth ground and has capacity for several wire connections. It should be located as close as possible to the MSC-250 controller.

1. Locate an MSC ground strip in a convenient location near the controller and related system equipment.

WARNING

THE EARTH GROUND WIRE MUST BE NO SMALLER THAN THE MINIMUM ALLOWABLE ELECTRICAL GROUND CABLE FOR THE SUM OF THE LOADS BEING CONNECTED.

1. Connect the MSC ground strip to earth ground using copper wire appropriately sized for the equipment being grounded.

2. Supply a separate terminal location for connecting incoming 120 VAC electrical power. **DO NOT APPLY INCOMING POWER AT THIS TIME!**

3. Connect the 110V power cable that is provided for the MSC-250.

   a. Plug the connector end of the power cable into the receptacle on the side of the MSC-250 controller.

   b. Attach the ground wire from the power cable to the MSC ground strip.

c. Attach the brown and light blue power and the green with yellow stripe neutral wires from the cable to the appropriate terminals on the 120 VAC terminal strip.

2.2.1 INPUT/OUTPUT MODULES

Use of input and output modules will depend on the design of the system. 16 I/O module locations are provided on the controller and 32 more can be added using IOE-850 I/O Expanders. Each location can be equipped with any of five input or output modules. The IDC15 and HSI-250 are DC input modules and the IAC15 is an AC input module. Similarly, the ODC15 is a DC output module and the OAC15 is an AC output module. For applications that are intended for use in the European Community, use only the I/O modules that require 60 vdc or less. (IAC15 and OAC15 must not be used for European applications.)

Figure 2.2 shows the proper connections for each type of input and output module. Note

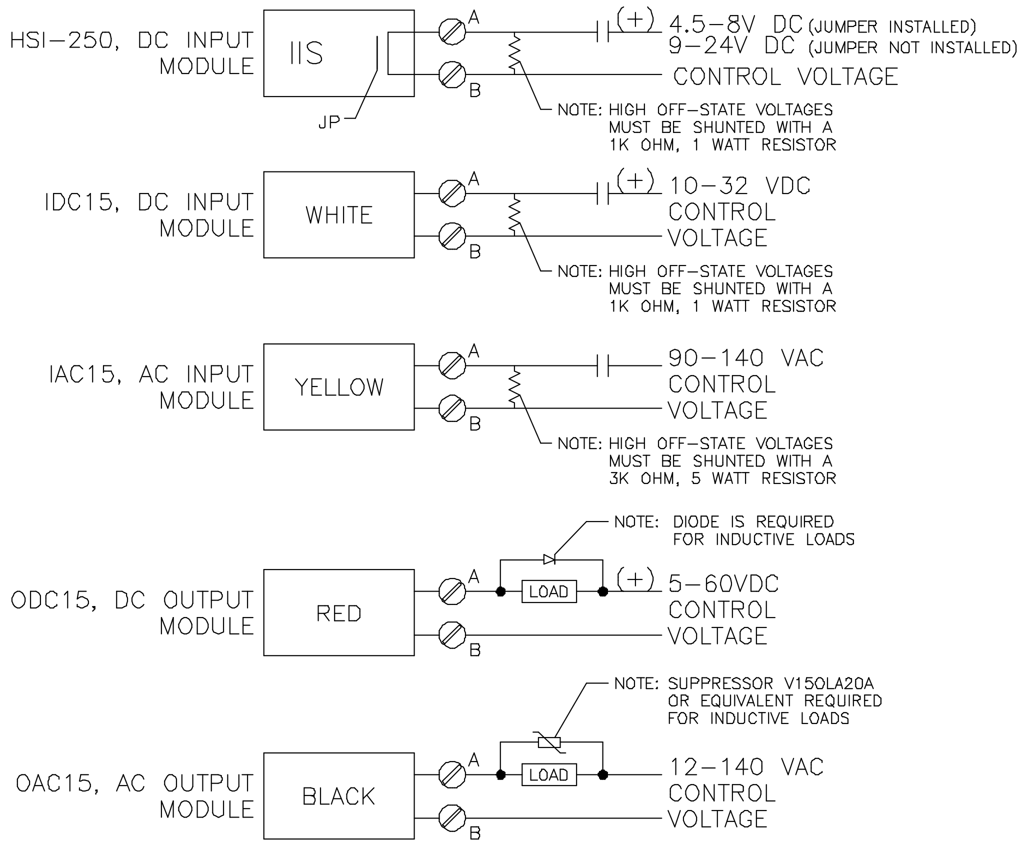


Figure 2.2 - Input and Output Module Connections

the use of resistors, diodes, and suppressors. These must be supplied by the customer. An illustration on the bottom of the MSC-250 front panel shows the appropriate connection points for the "A" and "B" terminals of each I/O module location (refer to **Figure 2.3**).

> **NOTE**
>
> **The sixteen module locations on the controller or either IOE-850 I/O Expander may also be used as programmable limit switches. Refer to the *IOE-850 I/O Expander Instruction Manual* and *Macroprogram Development System Instruction Book* for additional information.**

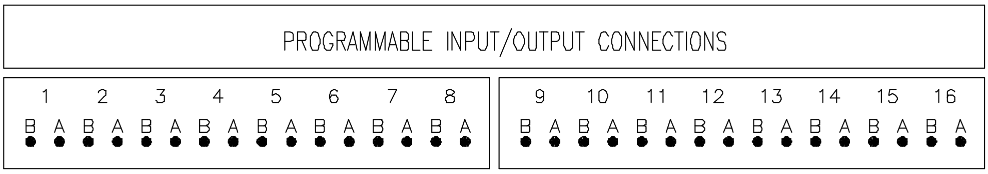


Figure 2.3 - Programmable Input/Output Connections Label

1. Insert the appropriate input or output module in each assigned I/O module location.

2. If using one or two IOE-850 I/O Expanders, attach the appropriate cables to daisy-chain the modules to the MSC-250 controller and to each other.

3. Make the proper system connections between the input and output devices and the "A" and "B" connector locations for each I/O module location.

2.2.2 SYSTEM INTERCONNECTIONS

The system connections for the MSC-250 servo controller will also depend on system design. **Figure 2.4** shows typical system interconnections for the controller, drives, and encoders. Axis 1 connections are shown with the optional INT-810 interface module. This module has ribbon cable inputs to match the connectors on the MSC-250 and terminal outputs to facilitate customer wiring. Axis 2 connections are shown without the interface module. Such a connection would run direct cables as illustrated.

The pinouts for the encoder cable connector and drive cable connector are shown in **Figure 2.4**. These are repeated in the sequence of pinout illustrations which follow along with the pinouts for the communication ports. The balance of these instructions assume all ports and connectors are used although this may not be the actual case.

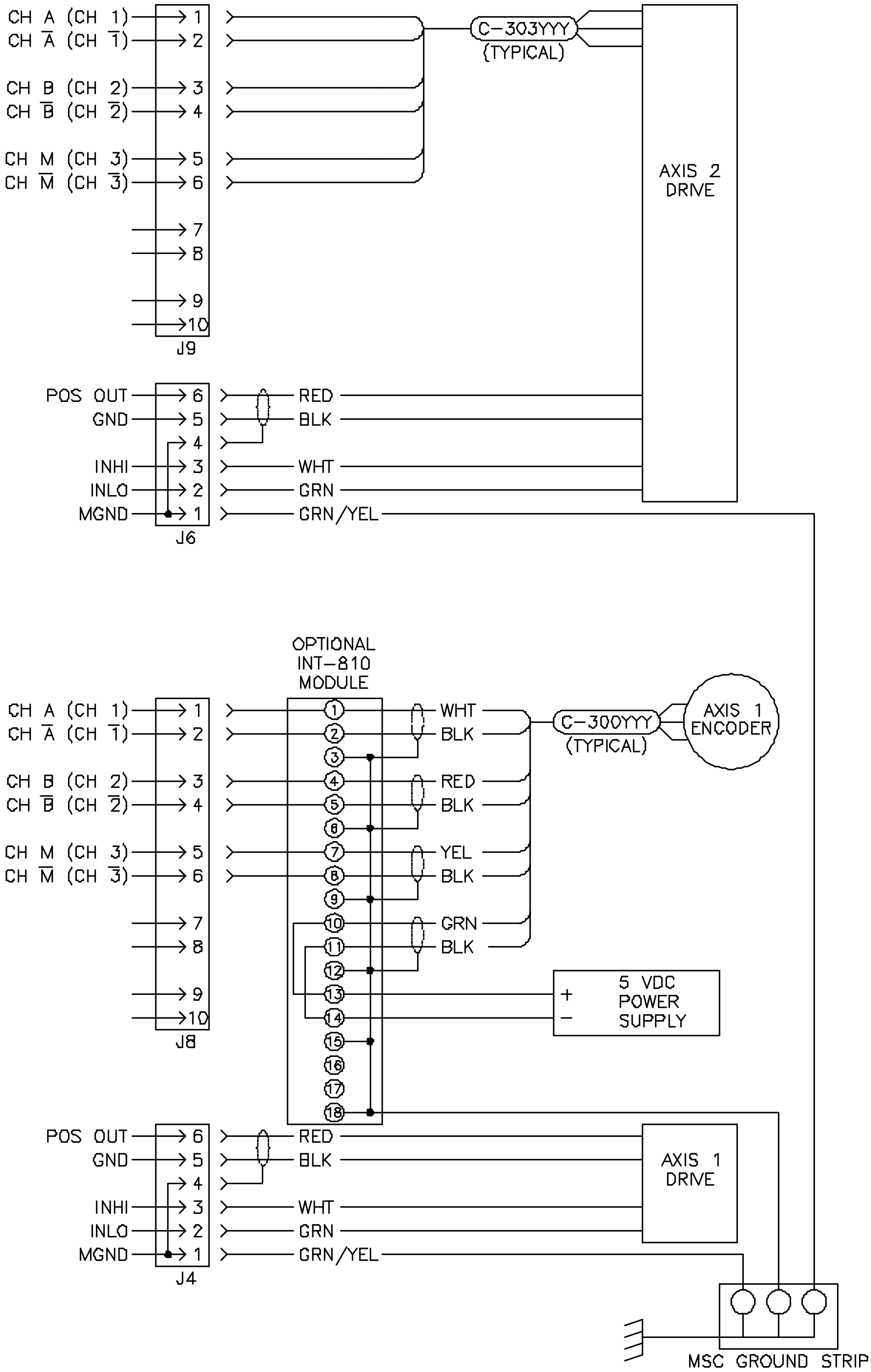


Figure 2.4 - Typical System Interconnections

1. For each axis, connect the encoder to the controller.

   a. Connect the encoder end of cable C-303yyy to the encoder. Make sure the connector is securely seated.

   b. Connect the other end of cable C-303yyy to the encoder cable connector on the MSC-250 controller. Make sure the connector is securely seated.

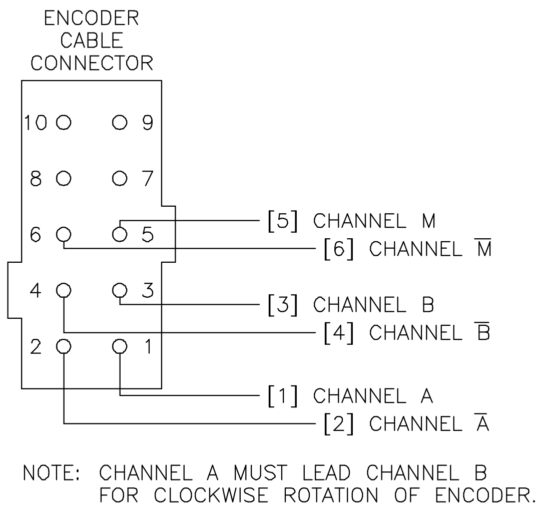


Figure 2.5
Encoder Cable Connector Pinouts

<u>OR</u>

   a. If the INT-810 interface is used, connect the encoder end of cable C-300yyy to the encoder. Make sure the connector is securely seated.

   b. Connect each wire of cable C-300yyy to the correct terminal of the INT-810 interface module (refer to **Figure 2.4**) and plug the encoder connector from the INT-810 into the encoder cable connector on the MSC-250 controller. Make sure all wires terminals are tight and that the connector is securely seated.

2. For each axis, connect the drive to the controller.

   a. Connect the drive end of the command cable to the drive. Make sure the connector is securely seated.

   b. Connect the other end of the command cable to the command line connector on the MSC-250 controller. Make sure the connector is securely seated.

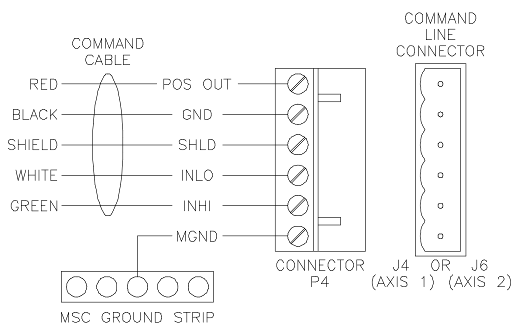


Figure 2.6
Command Line Connector Pinouts

3. If using the INT-810 interface module, connect the 5 VDC power supply to the proper terminals on the interface module (refer to **Figure 2.4**).

4. Connect the communications cables from PORT 1, PORT 2, and PORT 3 to their respective communication devices. Refer to the pinouts shown in **Figure 2.7**, **Figure 2.8**, and **Figure 2.9**, respectively.

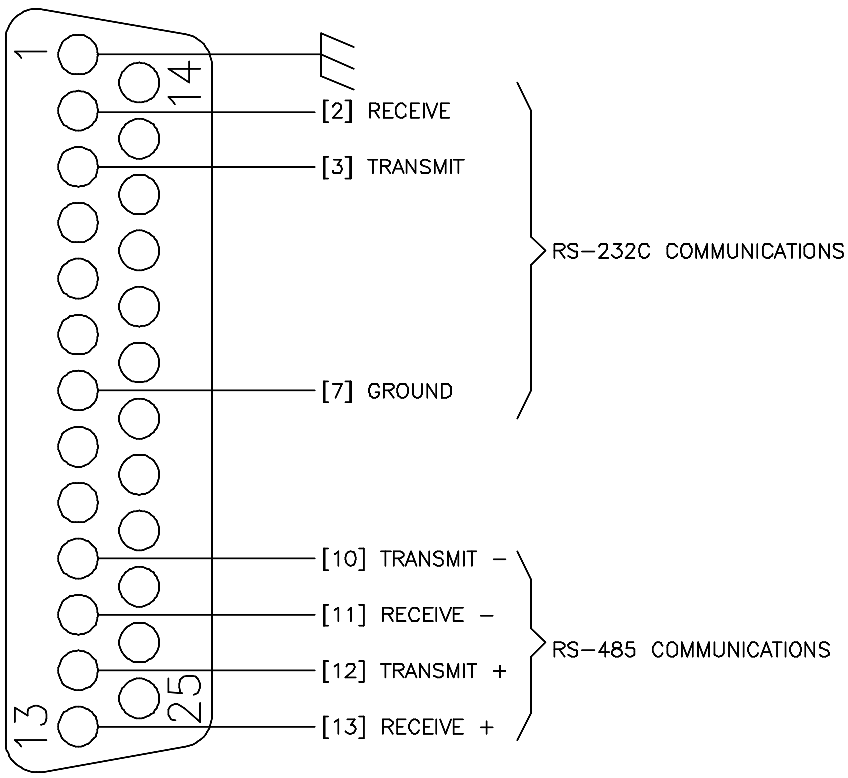


Figure 2.7 - PORT 1 Pinouts

> **NOTE**
>
> **The last device in an RS-485 multidrop communications chain must have a 120 ohm, 1/4 watt terminating resistor connected between "Receieve -" and "Receive +".**

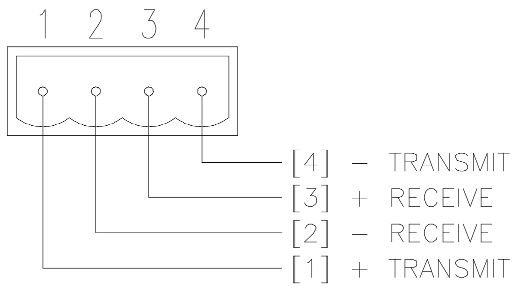


Figure 2.8
PORT 2 Pinouts

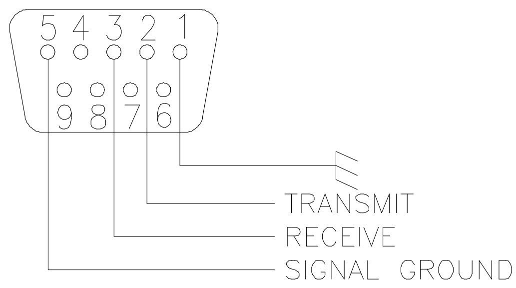


Figure 2.9
PORT 3 Pinouts

5. Connect the analog input/output channels and reference voltages.

   a. Connect the controller end of the cable for the analog input and output channels to the analog input/output connector (refer to **Figure 2.10**).

   b. Connect any analog input, or analog output to the other end of the connector cable (refer to **Figure 2.11**).

   c. If a potentiometer input is to be used, connect the potentiometer to the cable as shown in **Figure 2.11**.

Figure 2.10
Analog Channel Connections

> **WARNING**
>
> **DOUBLE CHECK ALL WIRING CONNECTIONS. MAKE SURE ALL ARE PROPER AND SECURE. IMPROPER CONNECTIONS COULD RESULT IN SYSTEM MALFUNCTIONS.**

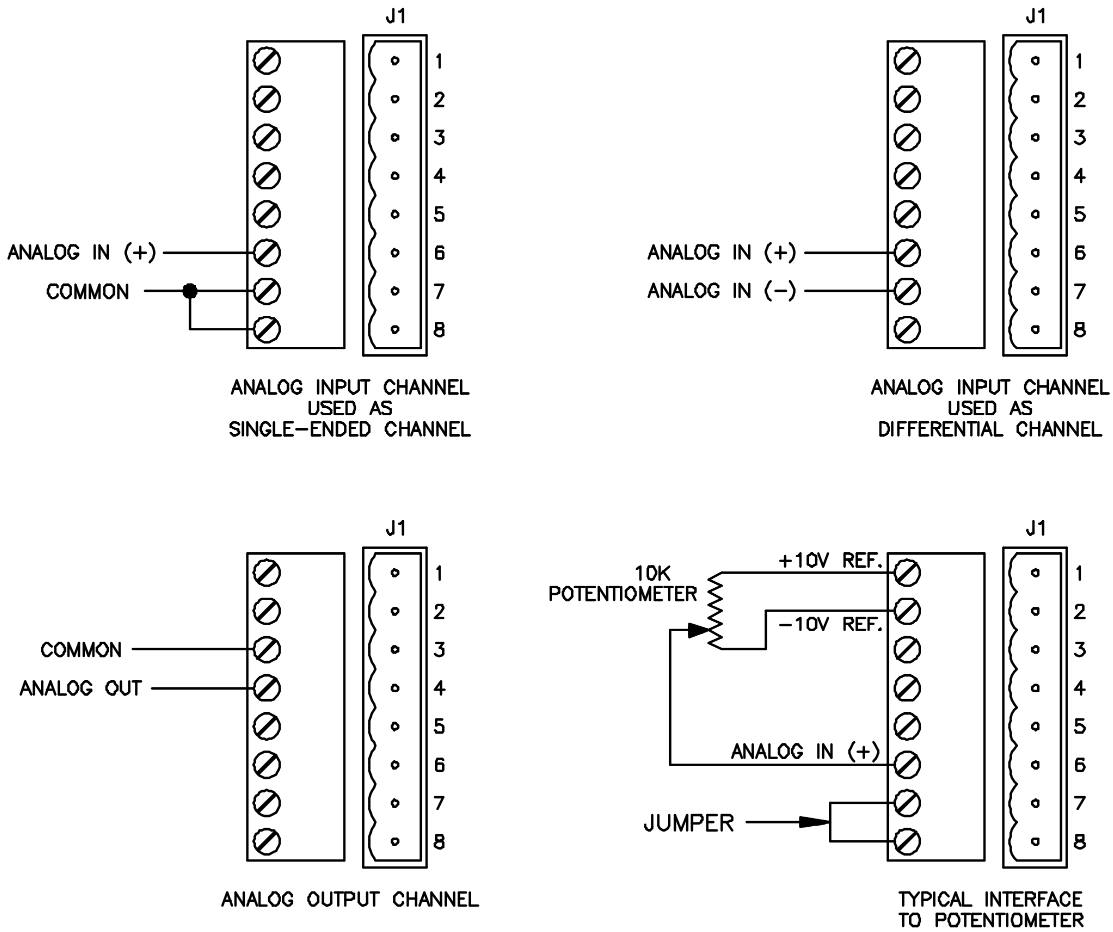


Figure 2.11 - Typical Analog Input/Output Channel Connections

SECTION 3 – OPERATION

The operation sequence of the MSC-250 servo controller is provided by the Macroprogram stored in its memory. Other than the specific procedures for loading the program into memory and certain setup and test procedures, there is no operator control over the MSC-250 functions.

3.1 CONTROL PROGRAM

The control program consists of Macroprogram commands as assembled by the MSC Tool Kit. Refer to the *Macroprogram Development System Instruction Book* for details on constructing the Macroprogram.

3.1.1 PROGRAMMING CONSIDERATIONS

When creating a Macroprogram for the MSC-250 controller, the programmer must know the specific type of encoder which will be used with each axis. If this information is not correct, the motor being controlled will travel the wrong distance when an indexing or positioning command is given. It will also travel at the wrong speed and have the wrong acceleration and deceleration.

WARNING

INCORRECT PROGRAMMING AND INCORRECT ENCODER SPECIFICATIONS COULD CAUSE IMPROPER MOVEMENT WHICH MAY RESULT IN EQUIPMENT DAMAGE OR PERSONAL INJURY.

The Macroprogram will support any quadrature encoder. The standard encoder, around which the command language is fashioned, has 1024 pulses per revolution, a 1/4-cycle marker pulse, channel A leading channel B for clockwise rotation, a Proportional Gain value of 16, an Integral Gain value of 0, a Derivative Gain value of 0, and a Feed Forward Gain Value of 0 (refer to "Section 1.2.1 - Axis Control"). However, even these standard values must be properly used in the Macroprogram to achieve proper motor-shaft movement.

When establishing the Macroprogram, the two real axes are designated Axis 1 and Axis 2 to correspond to the designation of the controller. The pseudo axis and Programmable Limit Switch functions (refer to "Section 1.2 - System Functions") are designated as Axis 3 in the Macroprogram. The analog input and output functions are referenced as Axis 4. The two real axes have encoder feedback signals. The pseudo axis, because it represents a perfect motor, does not have a feedback signal.

Each I/O module location has a specific address. Each location can be used as either an input or an output location. In addition, the locations in any one group of 16 I/O module locations can be used for programmable limit switches.

PORT 1 is used for communication with the MSC Tool Kit. However, PORT 2 and PORT 3 are addressable by the program for communication with other devices during control operations.

The PROM POCKET location can hold a PROM with the program which is to be used by the controller. The program can also be written so data is stored to a PROM in the PROM POCKET, or so data is retrieved from the PROM, or both. Although data can only be written to the PROM once, it can be retrieved from the PROM as often as necessary.

NOTE

For additional information on creating the system control Macroprogram, refer to the *Macroprogram Development System Instruction Book*, the *IOE-850 I/O Expander Instruction Manual* and the instruction manuals for any other accessories being used in the system.

3.1.2 LOAD MACROPROGRAM TO MEMORY

The MSC-250 has 32,000 bytes of non-volatile memory for storage of the control program. This memory location is protected by a lithium battery to maintain the information when the power is turned off to the controller. Once a control program is loaded into memory, the MSC-250 will continue to use the program until a new program is loaded.

The program can be loaded into memory directly from a personal computer communicating through PORT 1. It can also be loaded from a PROM placed in the PROM POCKET.

NOTE

The PROM can be "burned in" using the PROM POCKET in the MSC-250 controller and direct communication from the MSC tool kit. This prom can then be used to load the program to other controllers. Refer to the *Macroprogram Development System Instruction Book* for instructions on preparing and using the PROMs.

3.1.2.1 Load Program From MSC Tool Kit

1. Turn off all power to the controller.

2. Open the controller cover and set the ADDRESS selector switch to "0" for RS-232C communications (refer to **Figure 3.1**). For RS-485 communications, set the switch to location "1" through "F" depending on the address of the controller on the communications network.

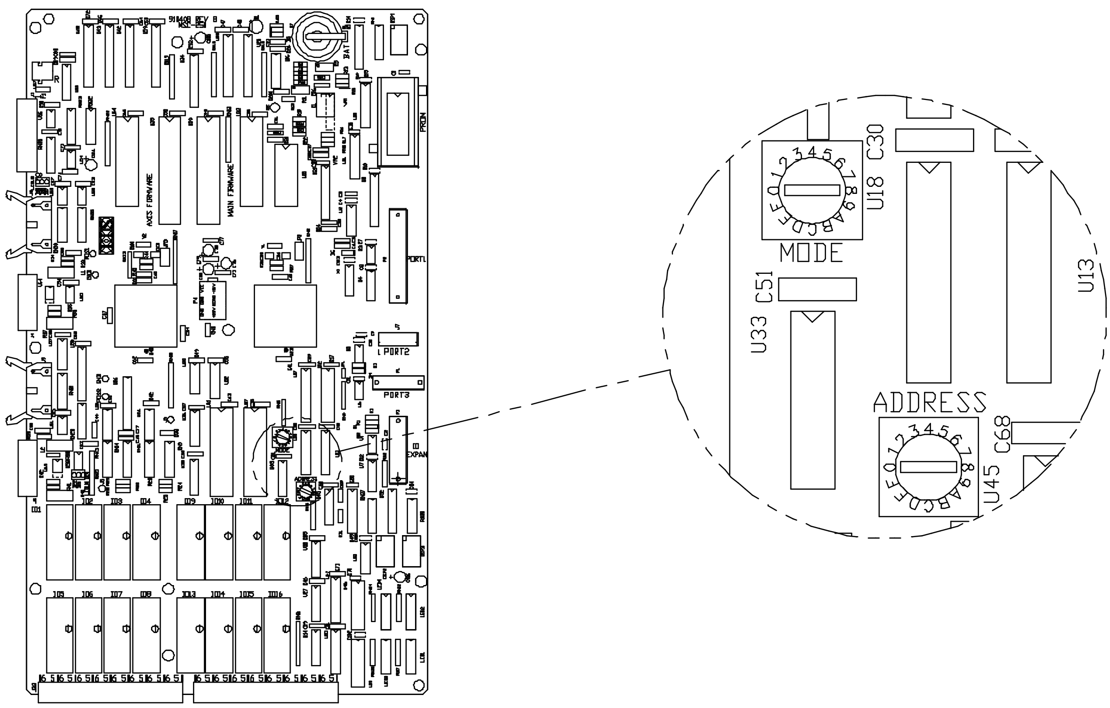


Figure 3.1 - ADDRESS and MODE Selector Switches

3. Make sure the MODE selector switch is set to the desired power-up configuration (refer to **Figure 3.1**).
   Normal operation = Port 1, 2, & 3, default to 9600 Baud - Packet Protocol.

   Position 0 = Normal Operation.

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

   Position A = Normal Operation
   Position B = Port 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.

4. Close and latch the controller cover.

5. If necessary for data collection or if the program is to be burned in to a PROM, open the PROM POCKET by moving the handle to a position perpendicular to the pocket. Load a PROM into the PROM POCKET and close the latch on the pocket by moving the pocket handle to a position parallel to the pocket.

6. Turn on power to the controller.

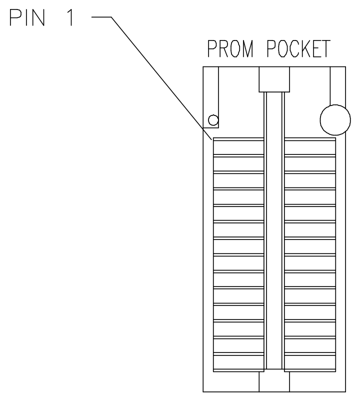
7. Follow the instructions in the *Macroprogram Development System Instruction Book* to load the program to non-volatile memory.

3.1.2.2 Load Program From PROM

1. Turn off all power to the controller.

> **NOTE**
>
> **Make sure the ADDRESS selector switch is set to "0" for RS-232C communications. For RS-485 communications, the switch must be set to location "1" through "F" depending on the address of the controller on the communications network. Make sure the MODE selector switch is set to "0" (refer to Figure 3.1).**

2. Open the PROM POCKET by moving the handle to a position perpendicular to the pocket. Load a PROM into the PROM POCKET (note pin 1 location in diagram below) and close the latch on the pocket by moving the pocket handle to a position parallel to the pocket.



3. Turn on power to the controller. If the first file on the PROM contains a Macroprogram, that Macroprogram will be loaded into memory, execution of the program will begin, and the MSC-250 AUTOSTART bit will be set. In future applications, with the PROM removed, the MSC-250 will start execution of this Macroprogram as soon as power is applied to the controller.

> **NOTE**
>
> **If a PROM containing a Macroprogram as the first file is in the PROM POCKET when power is applied to the controller, this file will always be loaded to memory, even if there is a valid Macroprogram already in memory with the AUTOSTART bit set.**

3.2 CONTROLLER USE AND STATUS

As discussed in Section 1, the MSC-250 servo controller is extremely flexible in its uses for indexing system control. Depending on how the Macroprogram is written and how the system is designed, it can be used in a variety of applications.

1. The controller can directly control one or two real axes with encoder feedback.

2. The controller has a pseudo-axis whose position can be broadcast on one or two master angle buses. Either or both real axes can then use this pseudo axis as a reference.

3. The feedback signal from either real axis can be broadcast over either or both master angle buses, or the feedback signal from one real axis can be broadcast over one master angle bus and the feedback signal from the second real axis can be broadcast over the second master angle bus. As required by the Macroprogram, each axis can periodically reference the other.

4. A position signal from another controller can be received at the fiber optics receiver and transmitted over one or both master angle buses. Either or both real axes can then reference this signal.

NOTE

While an axis is using a master angle bus for reference, the axis is acting as a "slave" and the axis or controller supplying the reference signal is acting as the "master".

During controller operations, the status of the controller processors and axes are displayed on the SYSTEM STATUS and AXIS STATUS displays. If there is an error or fault, the code for this will also be displayed on the appropriate STATUS display (refer to **Figure 3.2** and **Figure 3.3**).

NOTE

If the decimal point is illuminated in the SYSTEM STATUS display, it indicates that the macroprogram is running. If the decimal point is illuminated in the AXIS STATUS display, it indicates that the axis is enabled.

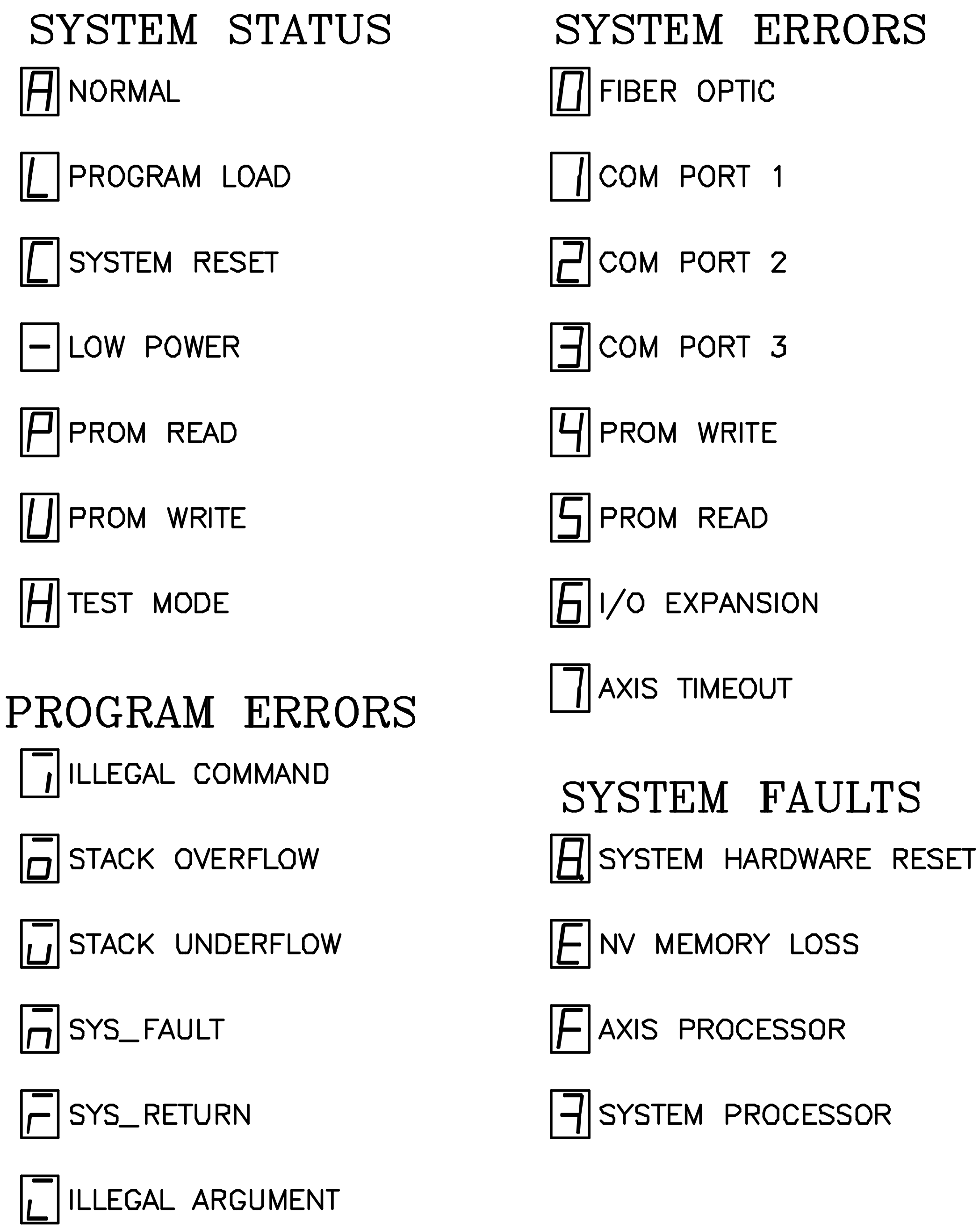


Figure 3.2 - Main System Status and Fault Codes

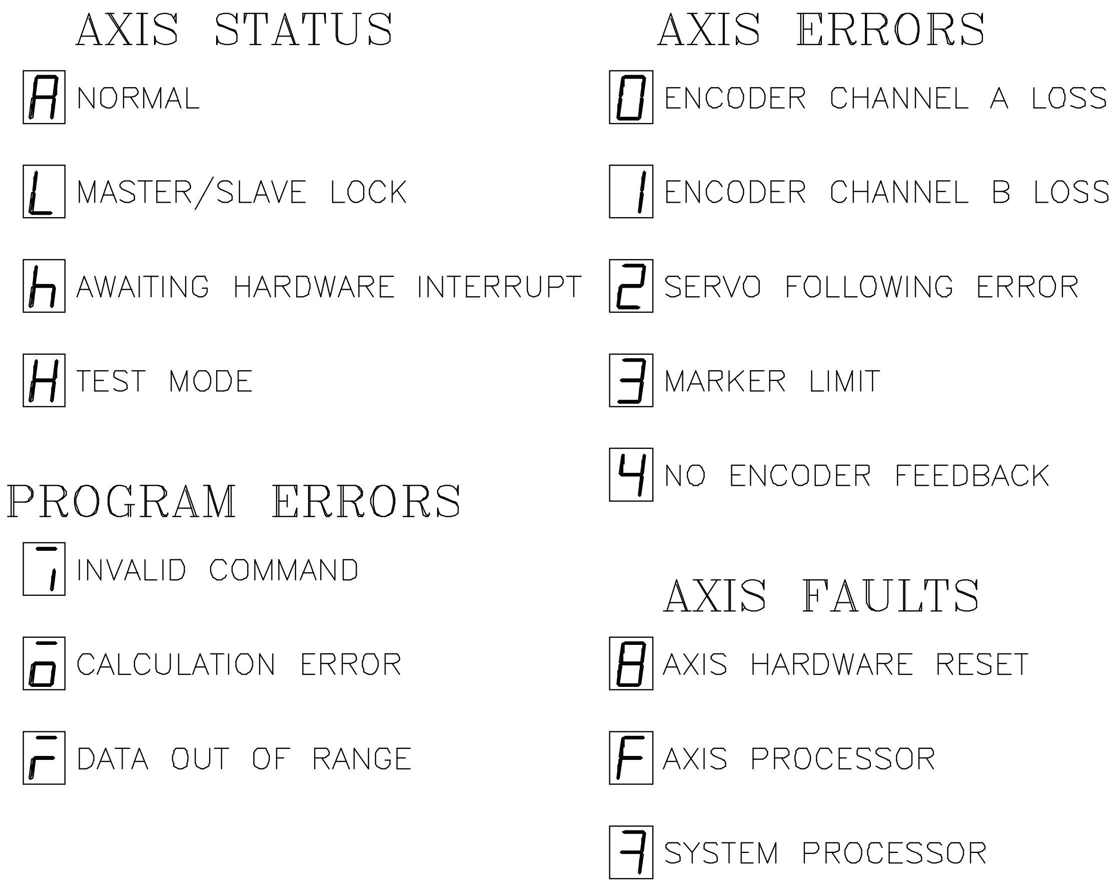


Figure 3.3 - Axis Status and Fault Codes

SECTION 4 – 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.

4.1 COMPONENT REPLACEMENT

Components which may require replacement on the MSC-250 include the battery and the firmware. The battery which protects the non-volatile memory must be replaced whenever the battery voltage drops below 2.6 V. This battery is located at the upper right of the MSC-250 circuit board (refer to **Figure 4.1**).

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.

4.1.1 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 battery 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.

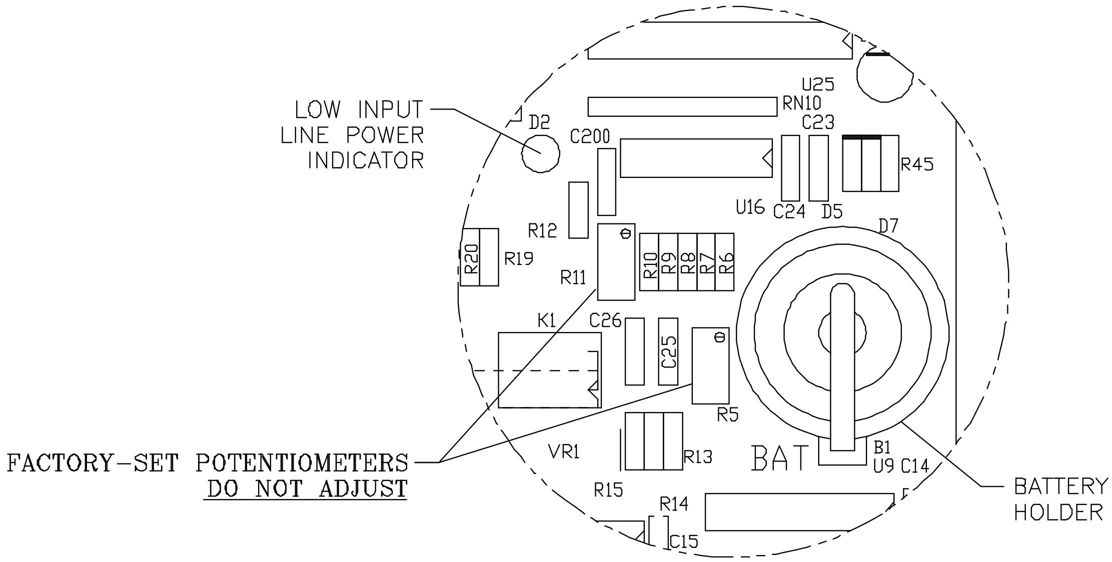


Figure 4.1 - Battery Holder

4.1.2 FIRMWARE REPLACEMENT

1. Each firmware EPROM is located in a 40-pin LIF (Low Insertion-Force) socket on the controller circuit board (refer to **Figure 4.2**).

> **NOTE**
>
> **When shipped, the EPROM chips will be labeled as SFO5102R_ for the main firmware or SFO5103R_ for axis software where the "_" position represents a revision number. Each chip must be replaced in its proper socket. The main firmware is located in socket U33 and the axis firmware is located in socket U19 (refer to 1). If the wrong firmware is in the socket, a fault code will be displayed on the status LED.**

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!**

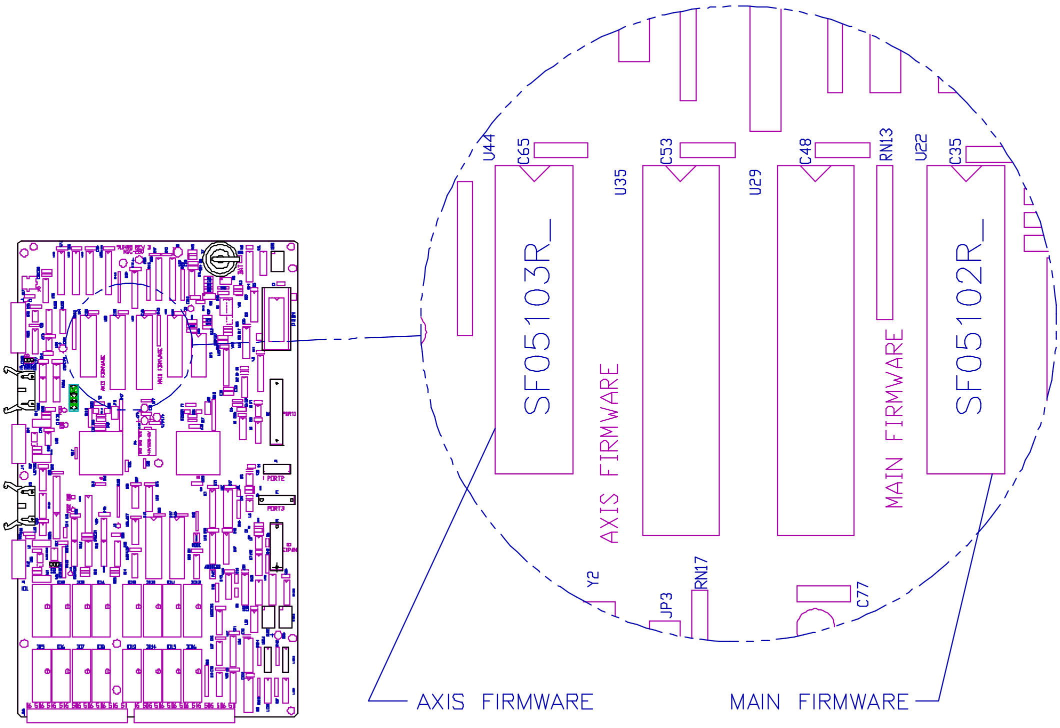


Figure 4.2 - Firmware Locations

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!**

> **NOTE**
>
> **As of January 1994, SFO5102R_ supersedes SFO5100R_ for the main firmware, and SFO5103R_ supersedes SFO5101R_ for the axis firmware.**

4.2 TROUBLESHOOTING

The balance of this section is designed to assist trained personnel in identifying and correcting controller malfunctions. A prerequisite to the use of this troubleshooting guide is a thorough knowledge of the MSC-250 controller. When a problem occurs, first read the appropriate sections of this manual to make sure that the controller is installed properly and that it is being operated correctly.

CAUTION

WHEN ALL TROUBLESHOOTING FUNCTIONS ARE COMPLETED, MAKE SURE THE MODE SWITCH IS RETURNED TO THE 0 POSITION FOR NORMAL CONTROLLER OPERATION.

4.2.1 BASIC SYSTEM CHECKS

Most problems with the controller can be found by following a systematic sequence of observations and tests. Many start-up problems can be associated with improperly installed devices, loose or improper wiring connections, or improper settings.

All troubleshooting should include an initial check of various basic areas. For the MSC-250 controller, some of the areas to be checked include the following:

1. If this is an initial installation, check all installation procedures to make sure they have been followed properly.

2. Check to make sure 120 VAC power is being supplied to the controller and all system power supplies. Check to make sure plugs are securely inserted in their respective sockets and supply disconnects are turned on. Check all fuses.

3. Check the status displays to see if an error message is being displayed. Take appropriate corrective actions if an error message is displayed.

4. Check for loose or broken wires.

5. Check all serial and peripheral cable connectors to make sure they are securely seated in their respective sockets.

6. Check all input devices for proper settings.

7. Check for a loose mechanical coupling between the motor and the encoder.

8. Check each of the test points on the controller circuit board for the correct voltages (refer to **Figure 4.3**).

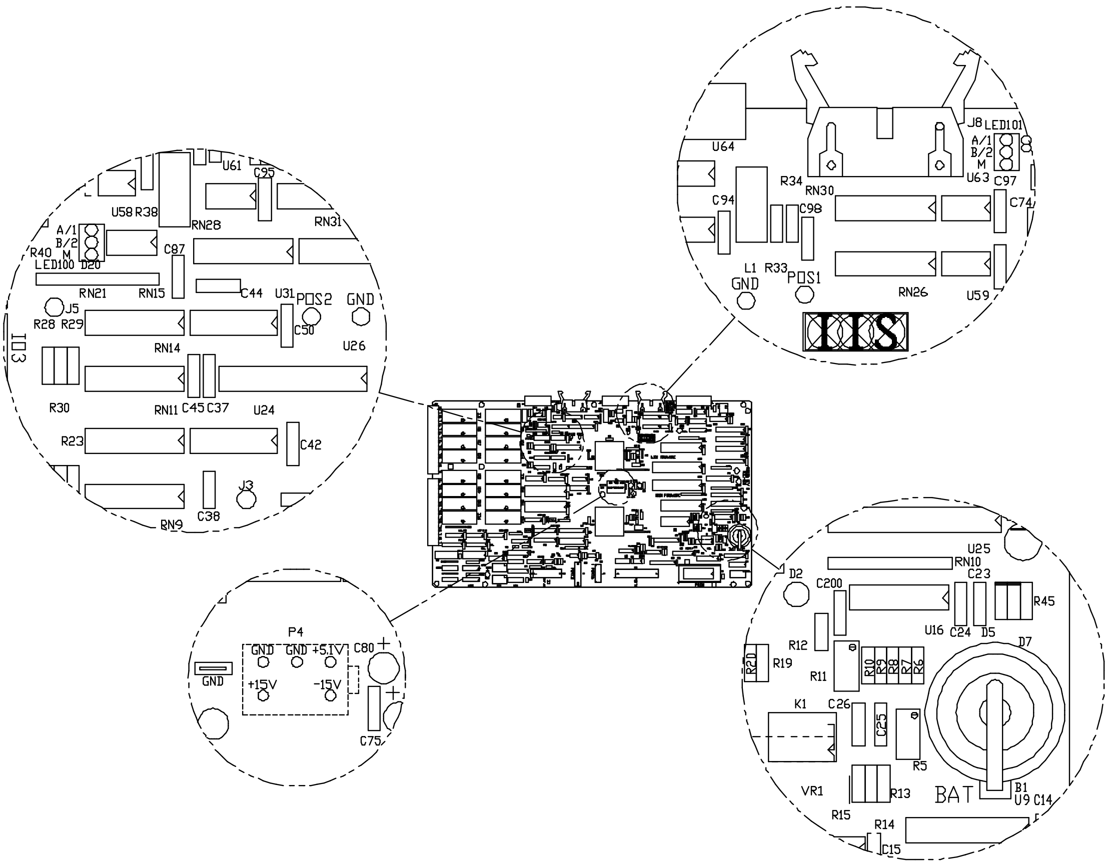


Figure 4.3 - Controller Circuit Board Test Points

a. System voltage between the +15 VDC and GND test points should read +15 ±0.15 VDC.

b. System voltage between the -15 VDC and GND test points should read -15 ±0.15 VDC.

c. System voltage between the +5.1 VDC and GND test points should read +5.1 +0.051/-0.00 VDC.

If the system problems are not resolved after checking these areas, proceed to the system test procedures detailed in "Section 4.2.2 - System Tests".

4.2.2 SYSTEM TESTS

The tests in this section are designed to be followed sequentially until the problem is found.

4.2.2.1 Velocity Loop Test

The velocity loop test removes the controller from the loop for the purpose of testing the motor, drive, and power supply. In this test, the drive is manually enabled and a velocity command voltage is applied to the amplifiers by means of a Volt Ohm Meter (V.O.M.) command input.

WARNING

THIS TEST CAUSES THE MOTOR TO TURN. MAKE SURE THAT THE MECHANICAL LOAD WILL ACCEPT MOVEMENT IN BOTH DIRECTIONS WITHOUT DAMAGE TO THE EQUIPMENT AND THAT ALL PERSONNEL ARE CLEAR BEFORE STARTING THIS TEST.

1. Remove controller and system power.

2. Open the controller cover and set the MODE selector switch to position 1. Close the cover.

3. Remove the 6-Pin command line connector, for the axis to be tested, from the controller (refer to "Section 1.3 - Components").

4. Restore power to the controller and system.

5. Using a short jumper wire, temporarily short together the INLO (white wire) and INHI (green wire) terminals on the command line connector (refer to **Figure 4.4**). This step causes the drive (amplifier) to turn "On" manually.

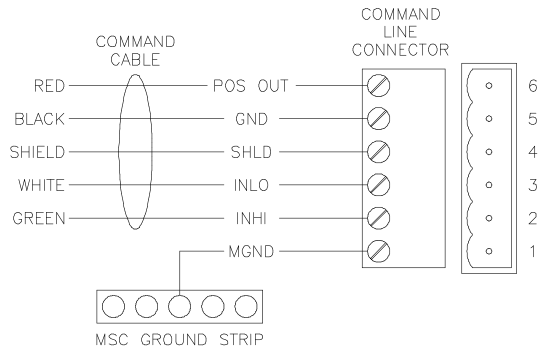


Figure 4.4
Controller Connectors

6. Apply system power. The motor should be stationary and should resist any attempt to turn the motor shaft.

NOTE

Since this is a feedback system, there will always be some slight drift to the motor shaft when it is tested in this manner. However, the motor will not be free to be turned by hand.

7. Set an analog V.O.M. for use as an ohmmeter using the R´1 resistance scale or use a DC voltage source of approximately 0.5 VDC.

8. Connect the positive meter lead to the POS OUT (red wire) command line connector terminal and the negative meter lead to the GND (black wire) command line connector terminal. This applies voltage (approximately 0.5 volts) into the drive input acting as a velocity command.

RESULT: **The motor should accelerate sharply to a controlled speed in a counter-clockwise direction and decelerate sharply when either meter lead is removed.**

9. Reverse the meter leads to the POS OUT and GND command line connector terminals. This changes polarity of the velocity command.

RESULT: **The motor should accelerate sharply to a controlled speed in a clockwise direction and decelerate sharply when either meter lead is removed.**

10. If all tests pass, the velocity loop is functioning correctly.

11. Remove all system power, remove all temporary jumpers, replace all disconnected wires, and connect the command line connector to the controller.

Items to check if test fails:

a. Troubleshoot velocity loop according to manufacturer's recommendations.
b. Power supply voltages.
c. Motor armature wiring and polarity.
d. Feedback device wiring and polarity.

4.2.2.2 Position Loop Test

NOTE

The Position Loop Test assumes a 1024 line encoder.

The position loop test is used to verify that the MSC-250 controller and encoder are functioning properly. The controller and encoder are placed in a condition where the encoder signals are fed back to the controller. As the encoder is rotated, a corresponding voltage can be measured at the test points on the controller.

1. Remove controller and system power.

2. Open the controller cover and set the MODE selector switch to position 2.

3. Remove the 6-Pin command line connector, for the axis to be tested, from the controller.

4. Restore power to the controller and system.

WARNING

THE COMMAND LINE CONNECTOR MUST BE DISCONNECTED FROM THE CONTROLLER TO MAKE SURE THE DRIVE DOES NOT BECOME ENABLED.

5. Connect a DC volt meter to the appropriate test points on the MSC-250 controller. Connect the positive meter lead to the POS OUT test point and the negative meter lead to the GND test point.

NOTE

Full scale voltage for this test should not exceed ±10 VDC.

6. Apply system power.

7. Manually turn the motor shaft until the meter reading is 0.0 VDC ±0.1 VDC.

8. Turn the motor shaft 1/4 turn clockwise. The volt meter should indicate a voltage of +5 VDC ±1 VDC.

9. Turn the motor shaft back to the starting point. The volt meter should indicate 0.0 VDC ±0.1 VDC.

10. Turn the motor shaft 1/4 turn counterclockwise. The volt meter should indicate a voltage of -5 VDC ±1 VDC.

11. Continue to turn the motor shaft in a counterclockwise direction. The voltage should increase negatively to -10.0 VDC ±1 VDC. When the motor has been turned 180 degrees from the starting point, the voltage will suddenly change polarity to +10 VDC. As the motor continues turning in a counterclockwise direction, the voltage will decrease toward 0.0 VDC. When the motor has been turned 360 degrees (back to the starting point), the voltage should again be 0.0 VDC ±1 VDC. The cycle should repeat if the motor shaft continues to be turned in a counterclockwise direction.

12. Turn off all power, remove all temporary jumpers, replace all disconnected wires, and connect the command line connector to the controller.

13. Failure of the above test (as shown by incorrect voltages or no voltages) indicates a problem in the position sensing circuitry (encoder, cable, or controller).

Items to check if test fails:

a. Secure encoder connections.
b. Encoder reference and feedback signals.
c. Failed controller board.
d. Failed encoder.
e. Open or shorts in encoder cables.
f. 5 VDC Power Supply

4.2.2.3 Encoder Test

1. Remove controller and system power.

2. Open the controller cover and set the MODE selector switch to position 3.

3. Apply power to the controller.

4. Rotate the encoder (motor) slowly.

RESULT: **The channel 1 and channel 2 encoder pulse LEDs should flash at the same rate, but not at the same time. The channel 3 encoder pulse LED should flash once per revolution.**

Items to check if test fails:

a. Check that drive power is on for a shared encoder.
b. Make sure the feedback device connector is secure.
c. Check the cable for shorts.
d. Check the cable for breaks.

e. Troubleshoot the drive of a shared encoder according to the manufacturer's instructions.

4.2.2.4 Encoder and Power Supply Test

This test is used when the INT-810 Interface module is used with the MSC-250 controller.

1. Remove controller and system power.

2. Open the controller cover and set the MODE selector switch to position 3. Close the cover.

3. Apply power to the controller.

4. Check the power supply connected to the INT-810 interface module.

   a. Connect a DC volt meter set to the 10 VDC scale to terminals 13 and 14 on the INT-810 interface module. Connect the positive meter lead to terminal 13 and the negative meter lead to terminal 14.

   b. The meter should read 5 VDC ±0.25 VDC.

   c. If the reading is improper, replace the 5 VDC power supply.

5. Check the encoder pulse channels.

   a. Connect a DC volt meter set to the 10 VDC scale to terminals 1 and 2 on the INT-810 interface module. Connect the positive meter lead to terminal 1 and the negative meter lead to terminal 2.

   b. Move the encoder shaft to find two different voltages. The greater voltage should be no less than +2.5 VDC. The lesser voltage should be no more than -2.5 VDC. If the readings are out of specification, replace the encoder.

   c. Connect a DC volt meter set to the 10 VDC scale to terminals 4 and 5 on the INT-810 interface module. Connect the positive meter lead to terminal 4 and the negative meter lead to terminal 5.

   d. Move the encoder shaft to find two different voltages. The greater voltage should be no less than +2.5 VDC. The lesser voltage should be no more than -2.5 VDC. If the readings are out of specification, replace the encoder.

   e. Connect a DC volt meter set to the 10 VDC scale to terminals 7 and 8 on the INT-810 interface module. Connect the positive meter lead to terminal 7 and the negative meter lead to terminal 8.

f. Move the encoder shaft to find two different voltages. The greater voltage should be no less than +2.5 VDC. The lesser voltage should be no more than -2.5 VDC. If the readings are out of specification, replace the encoder.

6. Check the encoder connection cable for shorts or breaks in the cable.

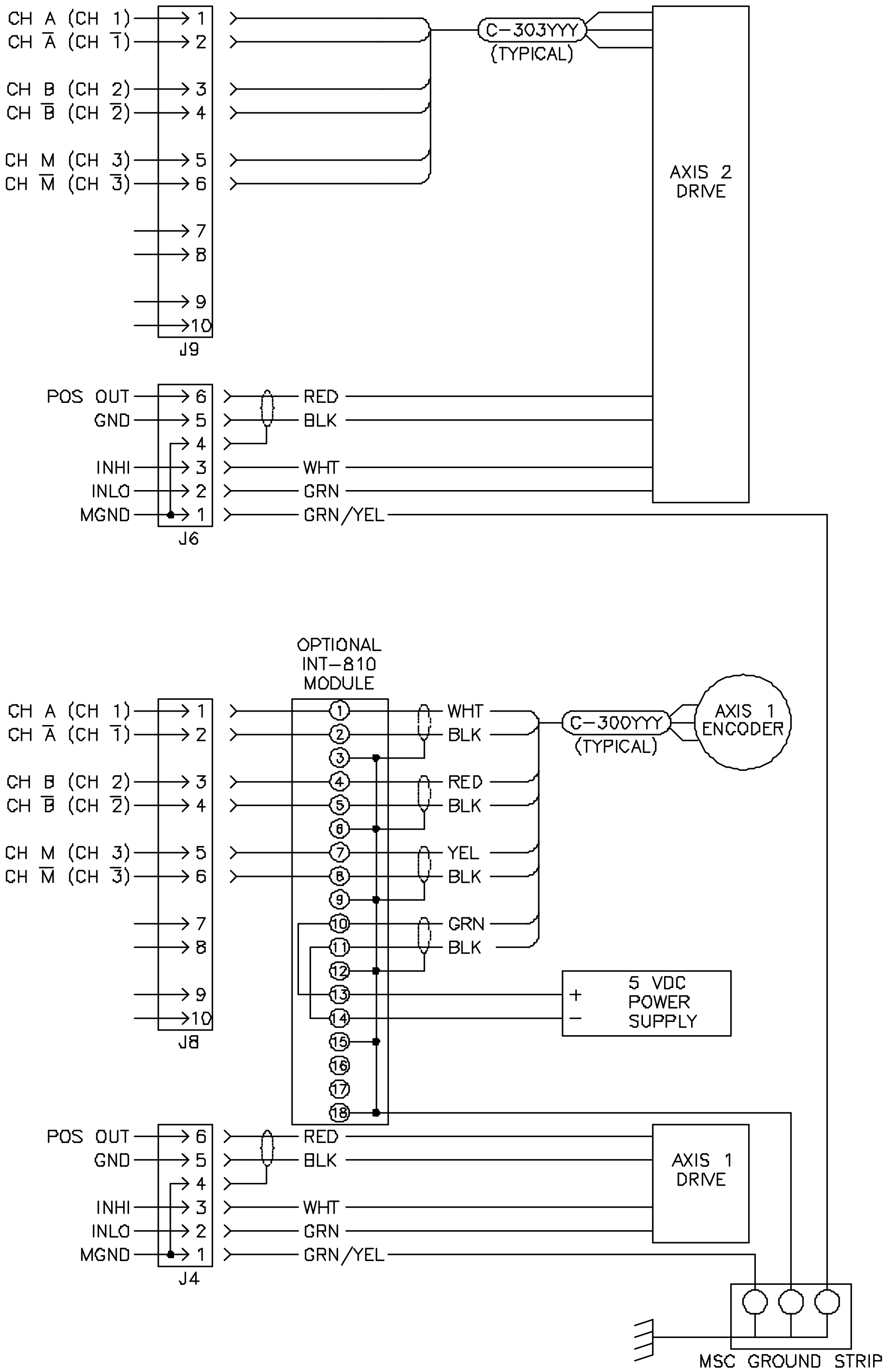


Figure 4.5 - Typical System Interconnections

4.2.2.5 Fiber Optic Light Transmission Test

1. Remove the fiber optic transmission line from the fiber optic receiver.

2. Visually check for the presence of light at the end of the fiber optic cable.

3. If no light is present at the receiver end of the cable, check the transmitter to see if light is present.

4. If light is present at the transmitter, but not the end of the fiber optics cable, replace the fiber optics cable. If light is not present at the transmitter, troubleshoot the source controller following manufacturer's instructions.

NOTES

APPENDIX A - GLOSSARY

Actuator: 1. A device used to supply a signal causing the controller to initiate the specified sequences.
2. A device (such as a motor) which creates mechanical motion by converting various forms of energy to mechanical energy.

ASCII: American Standard Code for Information Interchange

BAUD: The number of bits per second that can be transmitted in computer communications.

BCD: Binary Coded Decimal System. A system of number representation in which each digit of a decimal number is represented by a binary number.

Check Sum: A sum of digits or numbers used in a summation check. (A summation check is an error-detecting procedure involving adding together all the digits of some number and comparing this sum to a previously computed value of the same sum.)

Closed Loop: A regulating device in which the actuator position is sensed, and a signal proportional to this position (feedback position) is compared with a signal proportional to the desired actuator position (command position). The difference between these signals is the error signal. The error signal causes a change in the actuator so as to force this difference to be zero.

Communications: The transmission of information from one device to another. The information can take many forms such as command signals, device status, and fault conditions.

Comparator: A device where the feedback signal is subtracted from the command signal. The difference output of the comparator is called the error signal.

Controller: The device which receives data from various input devices and issues commands to the drive.

Daisy Chain: A means of connecting devices to a central processor by input/output buses which transmit in both directions simultaneously.

Edge triggered: An electronic circuit which must sense the initial change in a voltage before it is actuated.

Encoder: A type of feedback device which converts mechanical motion into electrical signals to indicate actuator position. The encoder typically produces an electrical pattern based on the interruption of a light source as a printed pattern is rotated between the source and a sensor. The interruptions are sensed and converted to electrical pulses. Actuator shaft position is determined by counting these pulses.

Feedback Device: Device which monitors shaft position by sending signals to the controller as the shaft rotates.

Flag: A bit in memory used by the programmer to evaluate action to be taken. A program branch may be executed depending on the true or false result of a bit test.

Gain: A multiplication factor. When used with the MSC-250 controller, it is the factor used to increase or decrease the apparent number of counts per revolution.

High True: A binary coded decimal condition where the binary digit "1" is the high logic voltage.

Home: Absolute 0.00 or the point from which all absolute points are measured.

Host Computer: A computer system whose function is to monitor and coordinate the processes of other devices. A host computer will typically coordinate motion control functions as well as their interaction with other machine processes.

Index: To move the motor shaft an incremental distance from the current position.

Initialize: To execute a series of Macroprogram instructions to teach a MSC axis controller an absolute zero reference.

I/O: Input/Output. (Pertaining to all equipment and activity that transfers information into or out of a computer or similar device — such as the MSC-250 controller.)

Least Significant Bit: The bit that carries the lowest value or weight in the binary notation for a numeral. The right-most bit in the binary word (notation).

LED: Light-Emitting Diode. Also known as solid-state lamp. A semiconductor diode that converts electric energy to light.

MSC Toolkit: The personal computer-based software package used to edit, compile, and debug Macroprograms developed for MSC controllers.

MSC-850: A multi-axis, programmable, servo motion controller capable of synchronously controlling from 1 to 8 axes.

Mode: The way in which the MSC-250 executes instructions. It is determined by the position of a 16-position selector switch.

Most Significant Bit: The bit that carries the greatest value or weight in the binary notation for a numeral. The left-most bit in the binary word (notation).

Nonvolatile Memory: A computer storage medium that retains information in the absence of power.

Optically Isolated: Indicates an I/O which uses a coupling device in which a light-emitting diode, energized by an input signal, is optically coupled to a photodetector.

Parameters: Predefined data which is used in the execution of instructions.

Peripheral: Various kinds of devices that operate in combination or conjunction with the MSC-250 controller but are not physically part of the controller.

PLC: Programmable Logic Controller.

Position: To move the motor to an absolute position in reference to a previously established 0.00 point (Home).

Position Error: The difference between the present actuator position (feedback) and the desired position (command).

Position Feedback: Present actuator position as measured by a position transducer.

POS OUT: Position Output (motor error output).

Programmable Logic

Controller: An electronic device that scans on/off type inputs and controls on/off type outputs. The relationship between the inputs and outputs are programmable by the user.

Quadrature: When relating to a shaft encoder, indicates that there are two oscillating outputs whose frequencies are 90° out of phase.

Resolver: A type of feedback device which converts mechanical position into an electrical signal. A resolver is a variable transformer that divides the impressed AC signal into a sine and cosine output signal. The phase of these two signals represent the absolute position of the resolver shaft.

APPENDIX B - MACROPROGRAM COMMANDS

COMMAND	PARAMETERS
analog_in	controller#,channel#,variable
analog_out	controller#,channel#,value
analog_rt	controller#,channel#,value
analog_zo	controller#,channel#,value
begin_cam	
begin_data	
blk_io_in	input_flag#,variable
blk_io_out	output_flag#,variable
calc_cam_sum	controller#,starting element,ending element
calc_unit_cam	controller#,starting element,ending element
cam	value,value,etc.
cam_data	controller#,data_label,master_scale,data_scale
case	num
close	unit,status
clr_all_swi	
clr_bit	bit#,variable
clr_flag	user_flag#
clr_local	controller#
clr_swi	interrupt#
create	unit,file_name,status
data	value,value,etc.
declare	mode
default	
digi_comp	controller#,gain,integral,damp
dim	size
disable_hwi	controller#
disable_swi	
drive_off	controller#
drive_on	controller#
enable_hwi	
enable_swi	
end_cam	
end_data	
end_select	
equ	constant_expression
exec_profile	controller#
exit_select	
f_decel	controller#
find_mrk_ccw	controller#,counts
find_mrk_cw	controller#,counts
COMMAND	**PARAMETERS**

find_tm_ccw	controller#,counts
find_tm_cw	controller#,counts
get_act_spd	controller#,variable
get_cam_cnt	controller#,variable
get_cam_end	controller#,variable
get_cam_ptr	controller#,variable
get_cam_strt	controller#,variable
get_cam_sum	controller#,variable
get_com	controller#,variable
get_fol_err	controller#,variable
get_for_angle	controller#,channel#,variable
get_map	variable
get_map_stat	variable
get_mcf	controller#,variable
get_pls_mask	controller#,variable
get_pls_out	controller#,variable
get_pos	controller#,variable
get_pstat	controller#,status
get_space	unit,space,status
get_status	controller#
get_t_mark	controller#,state
get_time	variable
get_trap_pos	controller#,variable
get_volume	unit,data_area,status
gosub	subroutine_label
goto	address_label
if	compare1 operator compare2,address_label
if_bit_clr	bit#,variable,address_label
if_bit_set	bit#,variable,address_label
if_char	port#,address_label
if_flag_off	user_flag#,address_label
if_flag_on	user_flag#,address_label
if_io_off	I/O flag#,address_label
if_io_on	I/O flag#,address_label
if_no_char	port#,address_label
if_stat_off	status_flag#,address_label
if_stat_on	status_flag#,address_label
if_tmr_off	timer_flag#,address_label
if_tmr_on	timer_flag#,address_label
incr_offset	controller#,bits,ticks
index	controller#,distance
initialize	unit,data_area,status
input	text_label,length,decimals,value,user_flag
COMMAND	**PARAMETERS**

integer

jog_ccw	controller#
jog_cw	controller#
let	variable=operand1 opcode operand2
let_byte	destination=source
load	unit,file_name,status
lock	controller#,lock#
l_track_spd	controller#,speed
master	controller#
msc_type	system_type
no_op	
open	unit,file_name,status
over_draw	controller#,speed,limit,distance
port_set	port#,baud,protocol
position	controller#,abs_position
prep_profile	controller#,data_label
preset	controller#,variable
print	text_label
print_num	length,decimals,value
p_vector	master_controller#,slave_controller#
rand_int	max_number,variable
ratio	controller#,ratio
read	unit,data_area,length,status
read_offset	controller#,variable
restart_at	address_label
return_sub	
save	unit,file_name,status
select	variable
set_ac_dc	controller#,rate
set_bit	bit#,variable
set_cam_ptr	controller#,value
set_flag	user_flag#
set_gl_ccw	controller#
set_gl_cw	controller#
set_home	controller#, offset
set_local	controller#
set_map	variable
set_mcf	controller#,variable
set_offset	controller#,value
set_pls_ang	controller#,on_angle,off_angle,module#
set_pls_cnt	controller#,count
set_pls_mask	controller#,variable
set_pls_time	controller#,time,module#
COMMAND	**PARAMETERS**
set_speed	controller#,speed
set_swi_mask	variable

set_tmr	timer_flag#,time
set_trig_cam	controller#,master_angle
set_trig_pw	controller#,master_angle
set_vgain	controller#,variable
stop_input	
swi_if_off	interrupt#,flag,subroutine_label
swi_if_on	interrupt#,flag,subroutine_label
switch_cam	controller#,start element,# of elements
sys_fault	
sys_return	
test_mode	controller#
text	"ASCII string"
track_spd	controller#,speed
trap_pos	controller#
turn_off	I/O flag#
turn_on	I/O flag#
unlock	controller#,mode#
vel_ccw	controller#
vel_cw	controller#
write	unit,data_area,length,status

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DELTA SERIES JUNE 2003

DELTA MOTOR

&

DELTA DRIVER

INSTRUCTION BOOK

INDUSTRIAL INDEXING SYSTEMS, Inc.

Revision - J
Approved By:

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ERRATA SHEET, IB-19B001 Rev. J **AUGUST 2006**

Date	Rev.	ECN No.	DR	CHK	CHK
9/3/03	0	ECN-03-392 (See Note 1)	KY	CD	
10/28/03	A	ECN-03-446 (See Note 2)	KY	CM	
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06/04/04	C	ECN-04-216 (See Note 4)	KY	ELS/MH	
11/24/04	D	ECN-03-267, 03-358, 03-462 ECN-04-137, 04-198, 04-220, 04-290, 04-404 (See Note 5)	KY	KY	
9/23/05	E	ECN-05-260 (See Note 6)	KY	KY	
3/9/06	F	ECN-06-007 (See Note 7)	KY	KY	
8/9/06	G	ECN-06-181 (See Note 8)	KY	KY	

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%

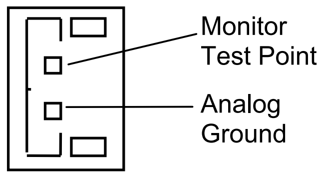
2.1.4 ENVIRONMENT

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**

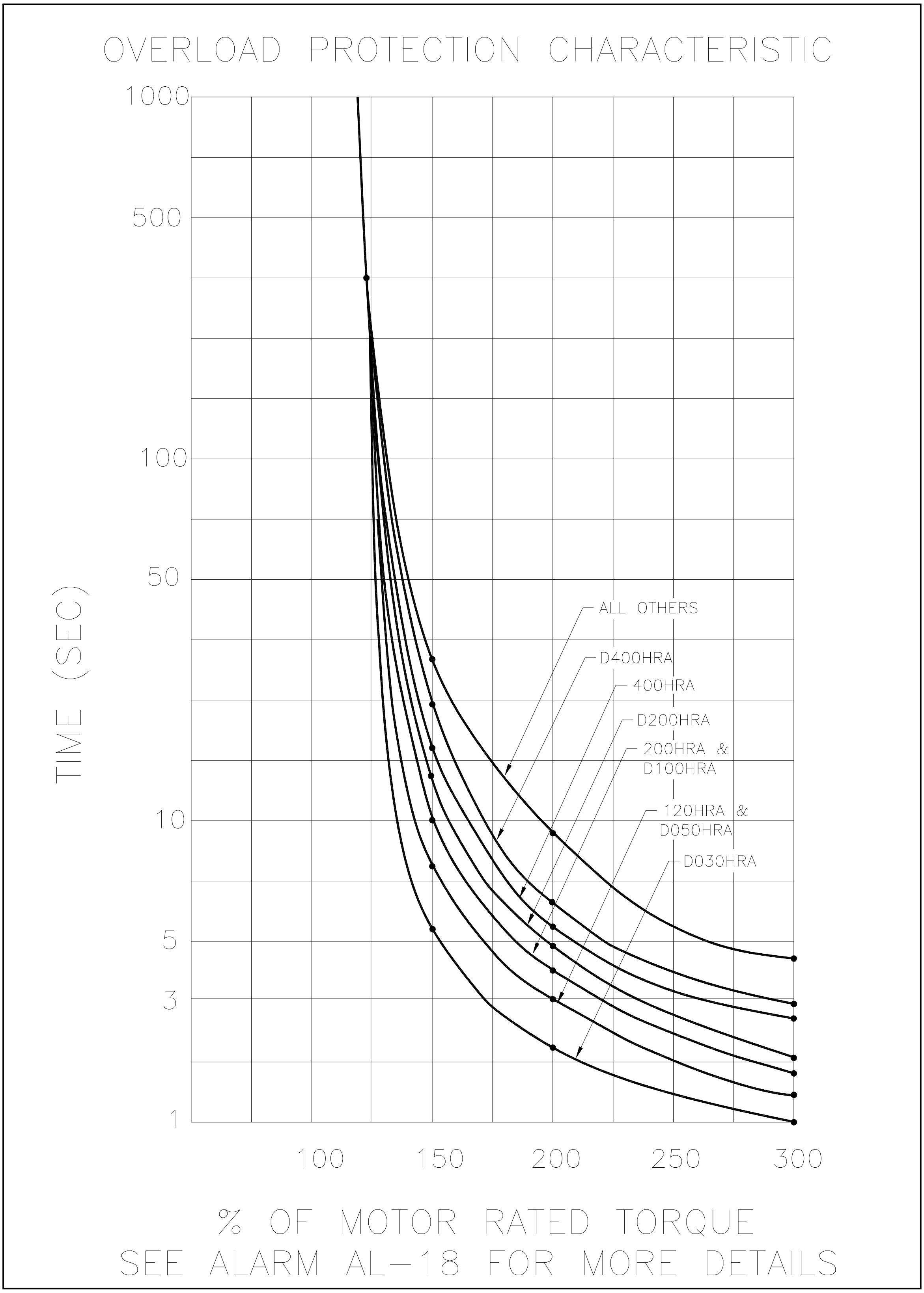


Figure 2.1 - Delta Overload Protection Characteristic

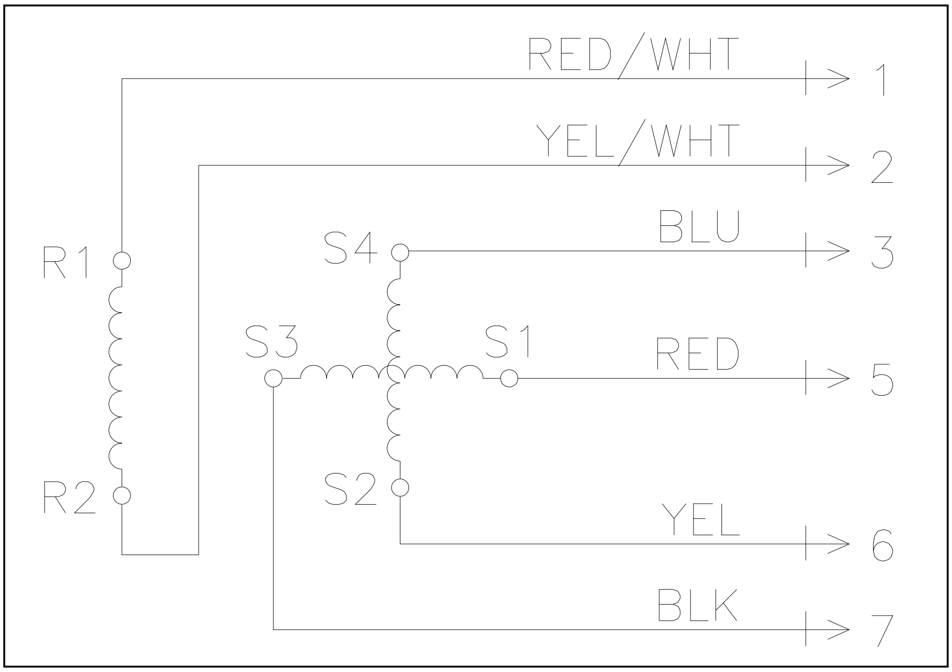


Figure 2.2 - Standard Resolver Wiring Connections for DBM-XXX/15R, DBM-500/30R and Larger

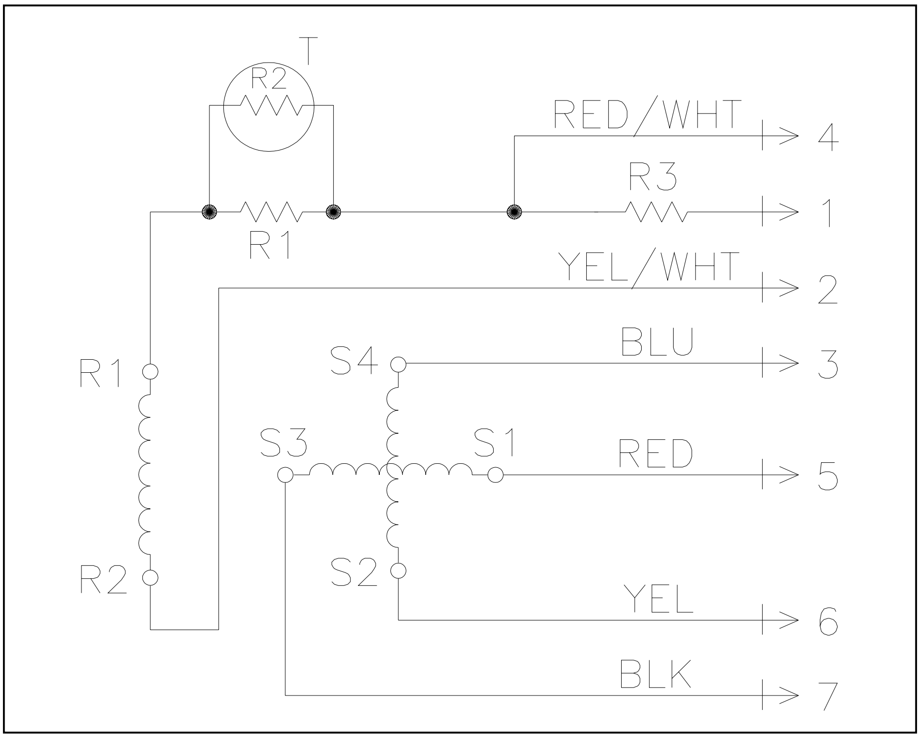


Figure 2.3 - Alternate Resolver Wiring Connections for DBM-XXX/15R, DBM-500/30R and Larger

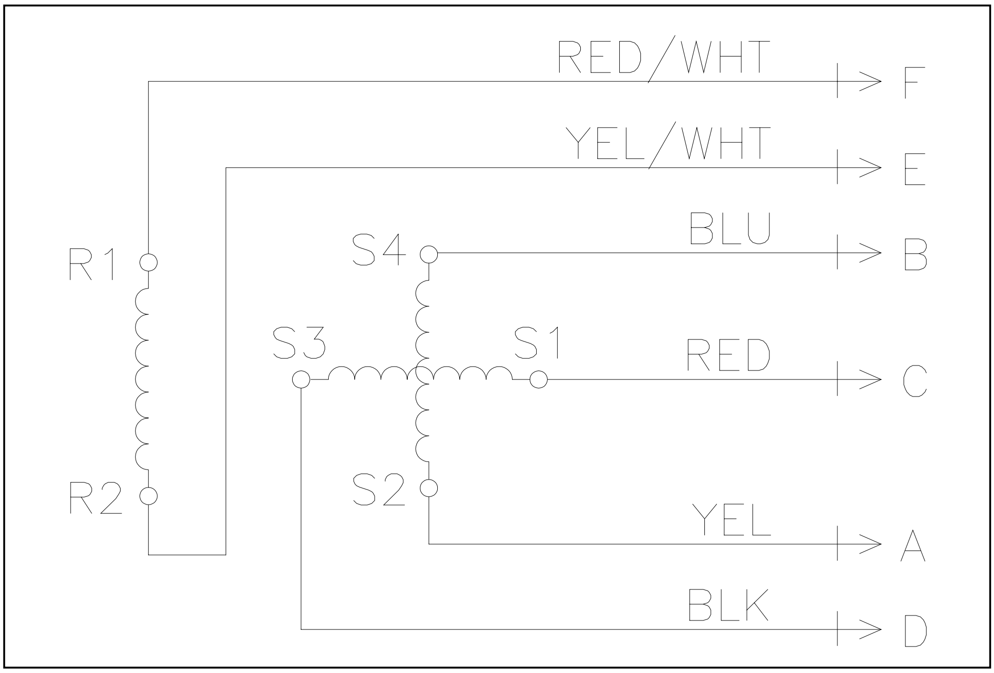


Figure 2.4 - Standard Resolver Wiring Connections for DBM-120/30R, DBM-200/30R, DBM-400/30R, DBM-BXXX/30R, DBM-D30/30R and DBM-D50/30R

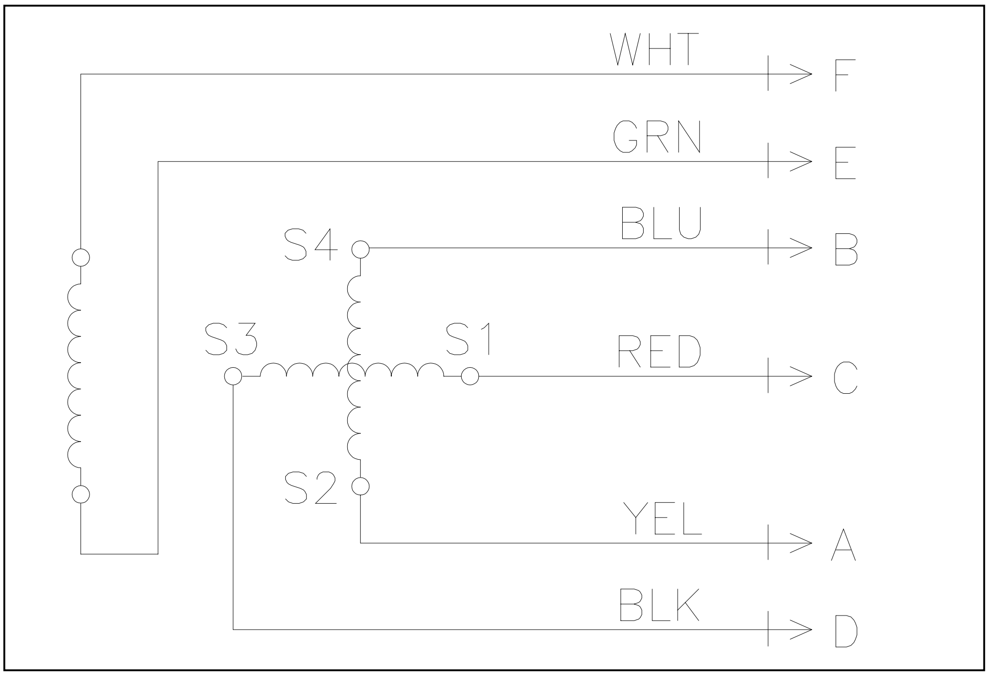


Figure 2.5 - Alternate Resolver Wiring Connections for DBM-120/30R, DBM-200/30R and DBM-400/30R

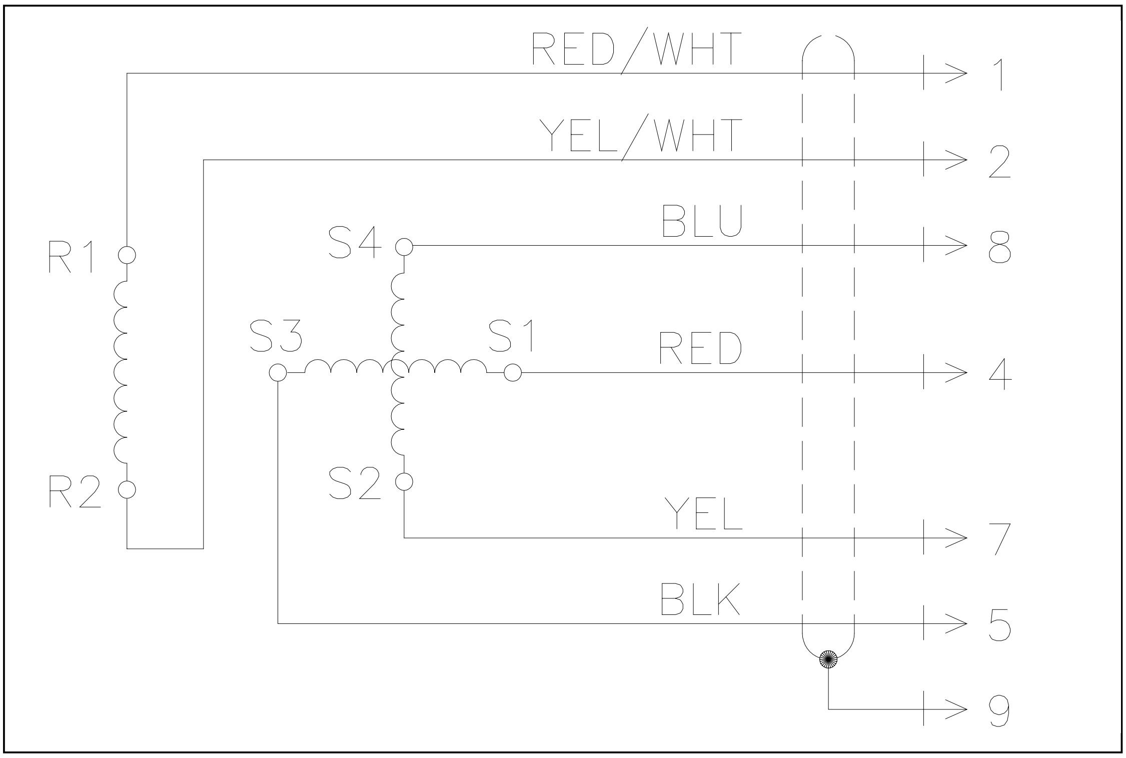


Figure 2.6 - Standard Resolver Wiring Connections for DBM-D100/30R Through DBM-D800/30R

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** 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** 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** key to prepare a parameter for modification.
- **FLASHING DECIMAL POINT** indicates that an alarm is active.

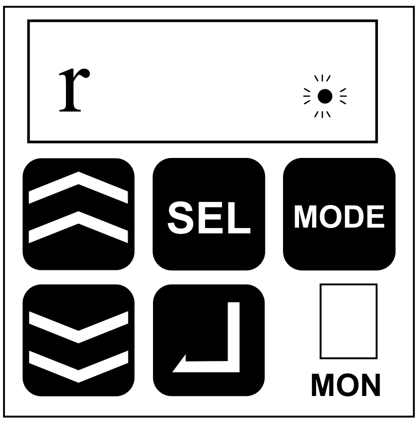


Figure 3.1 - Delta Driver Keypad and Display

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  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 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  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  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)

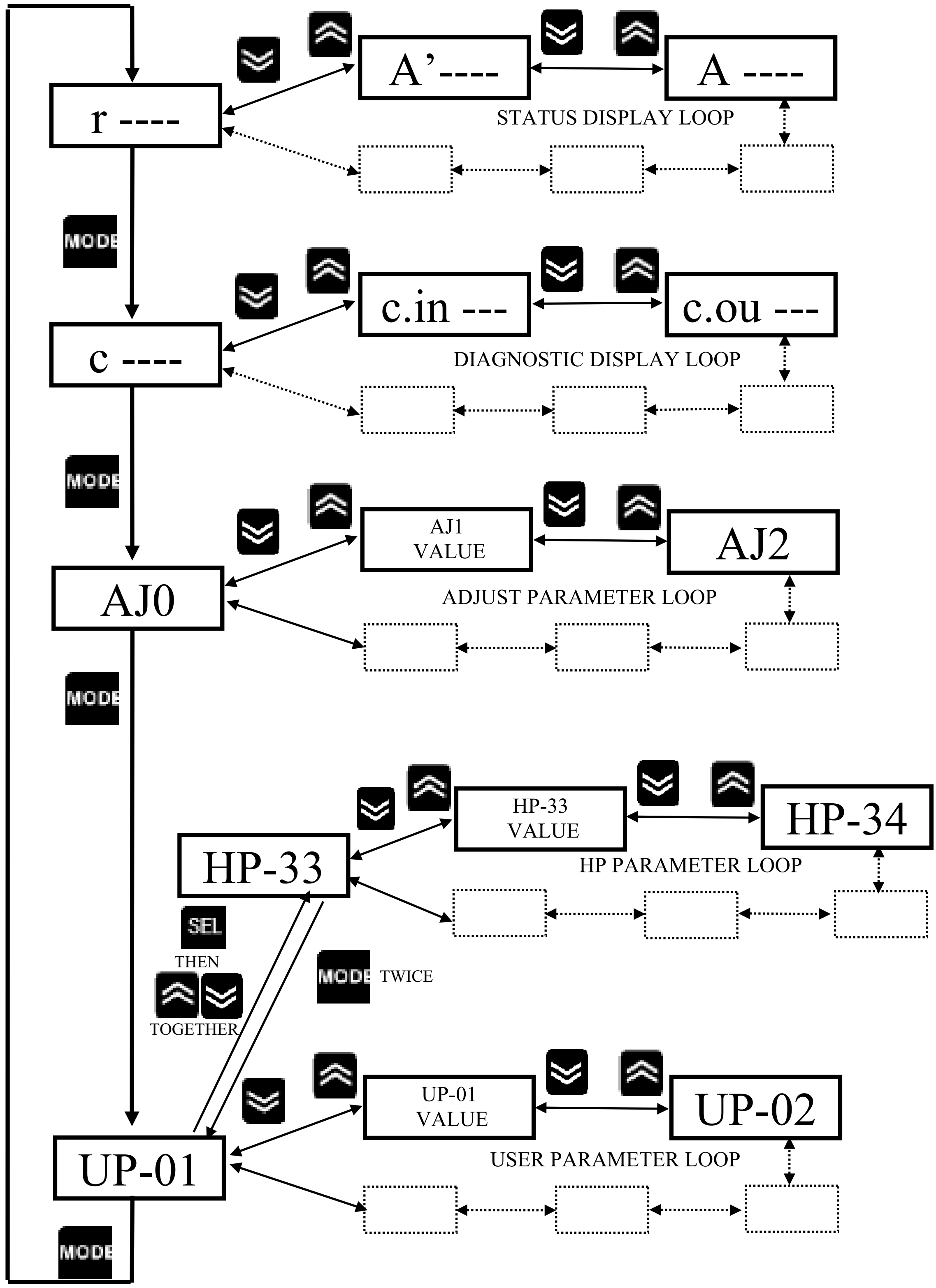


Figure 3.2 - Main Menu Loop and Minor Loops

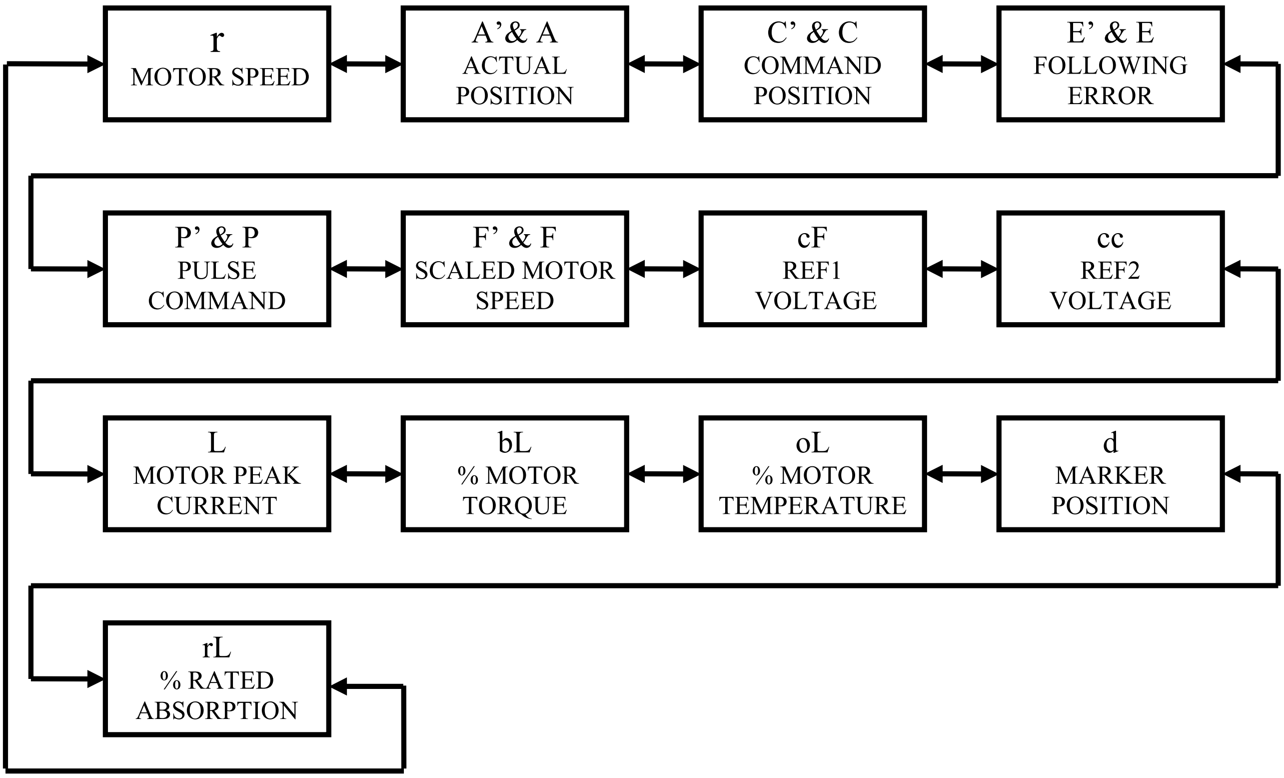
3.1.1 STATUS DISPLAY MENU LOOP

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).

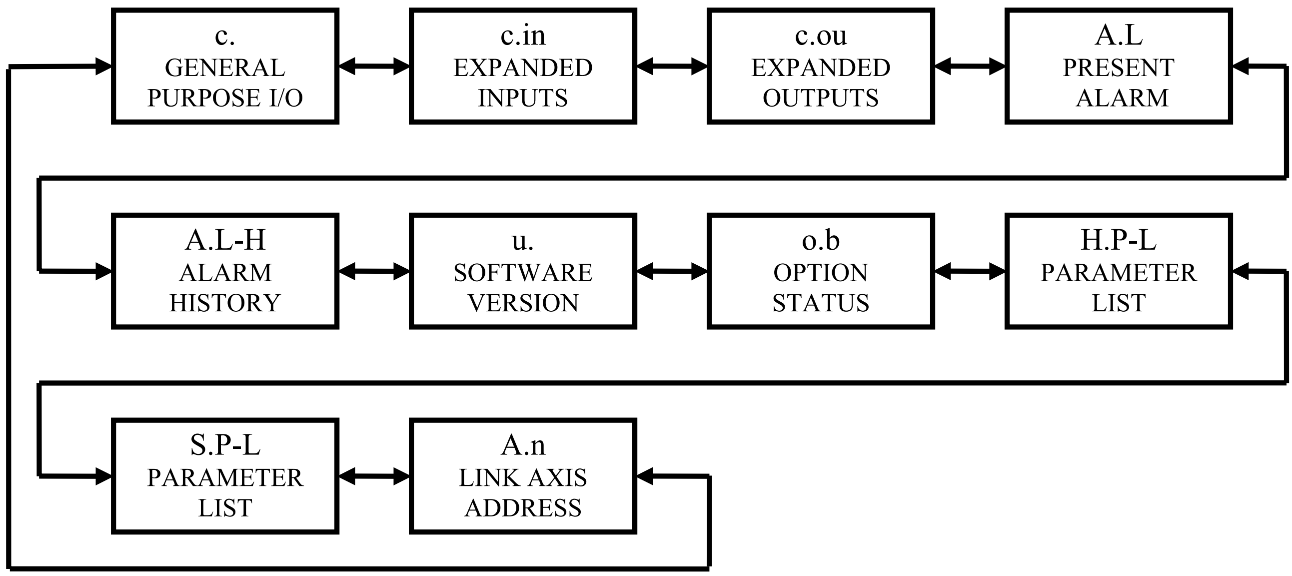
3.1.2 DIAGNOSTIC DISPLAY MENU LOOP

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):

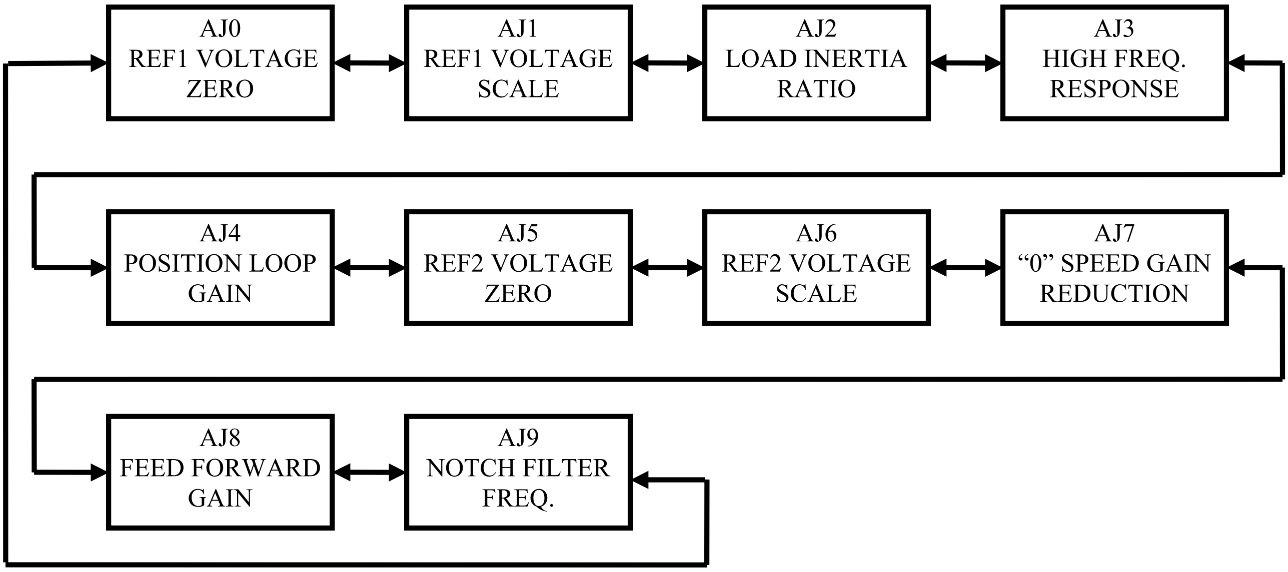
DISPLAY ITEM	SYMBOL	CONTENTS
Option Status	**o.b**	Displays the status of any option modules installed. 00: No options 02: 14 bit A/D converter
HP Parameter Change History	**H.P-L**	Displays a history of the HP parameters that have been changed. When SEL key and key are concurrently pressed the display 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 SEL 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.

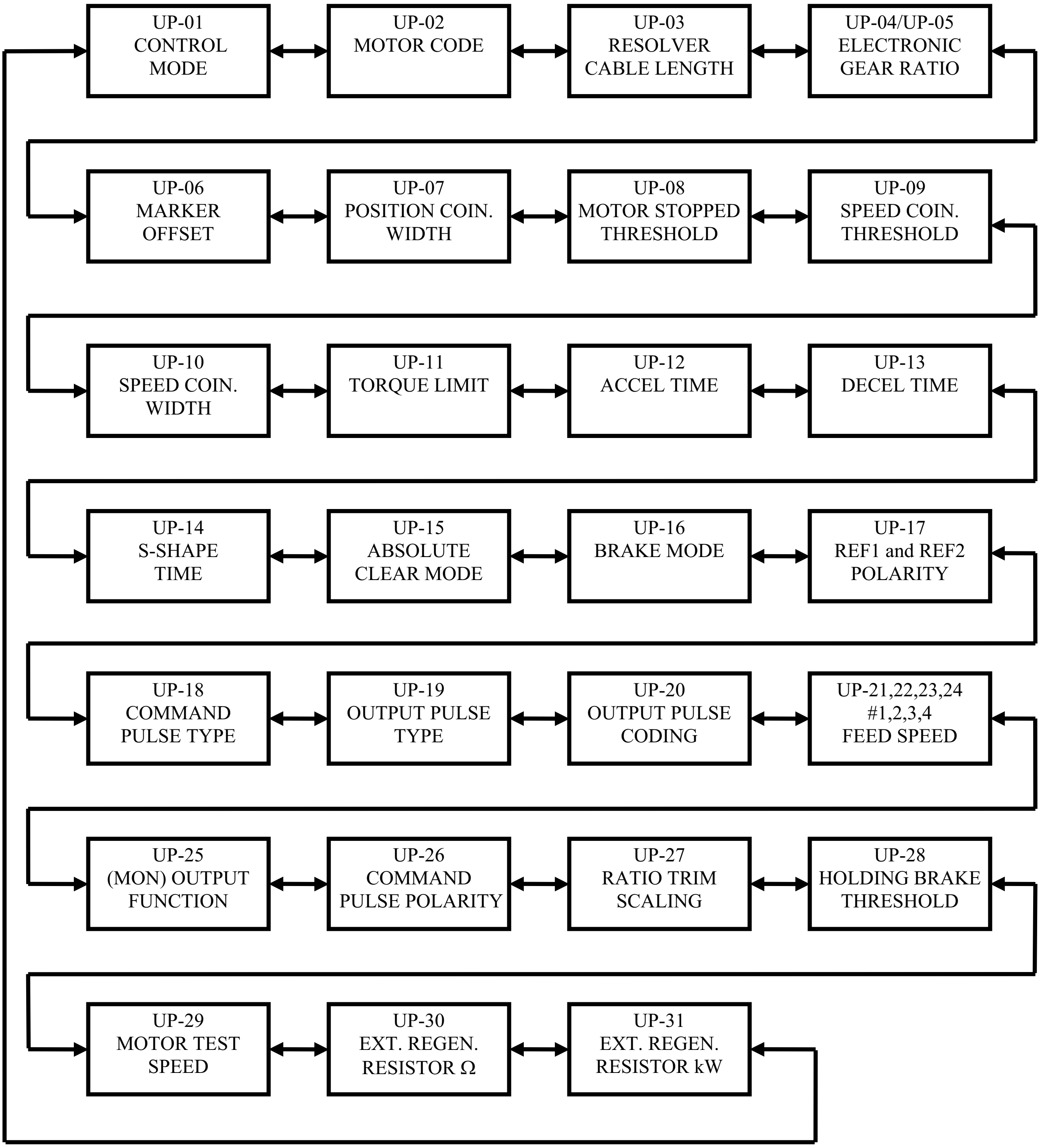
3.1.4 USER PARAMETER MENU LOOP

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:

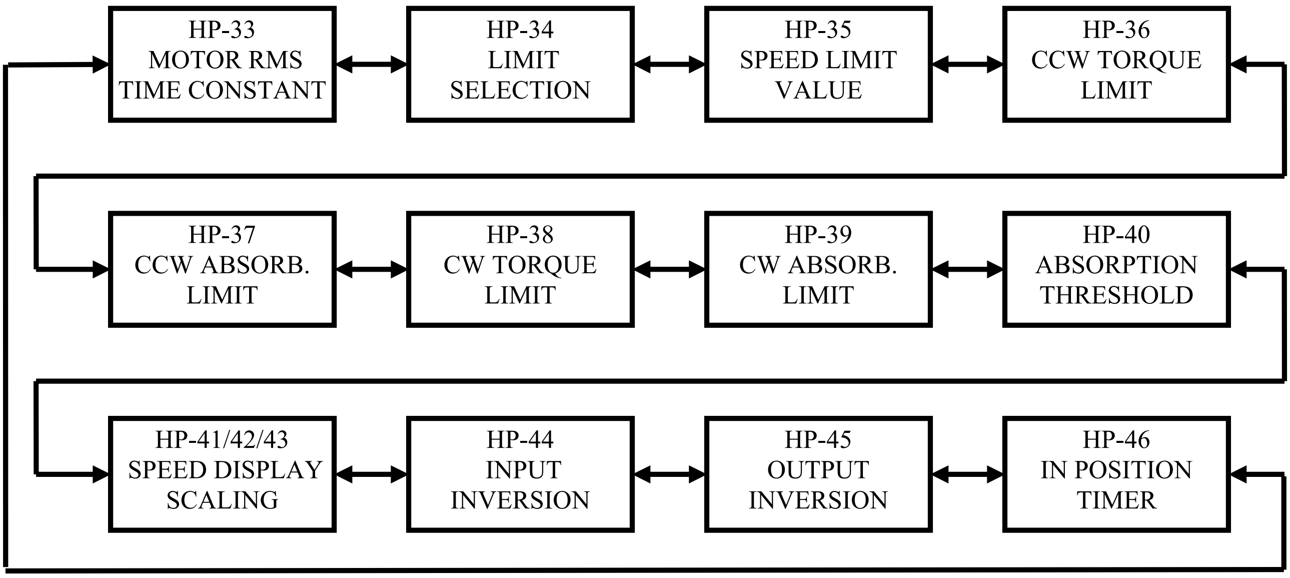


3.1.5 HP PARAMETER MENU LOOP

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 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 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 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 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 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.

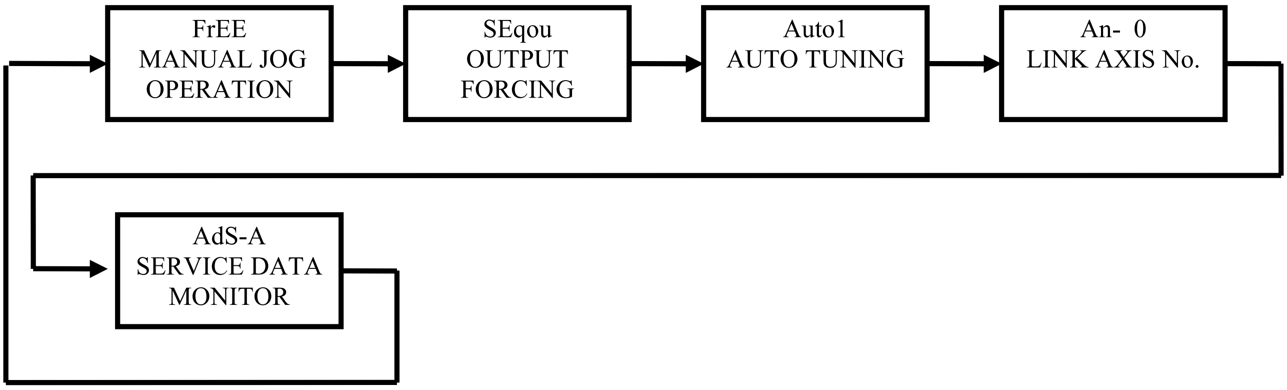
The following parameters require a power OFF, power ON cycle to have the parameter take effect:
AJ-9, UP-01, UP-02, UP-03, UP-04, UP-05 & UP-16.

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 key.

Once in the Special Menu the 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 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 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 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

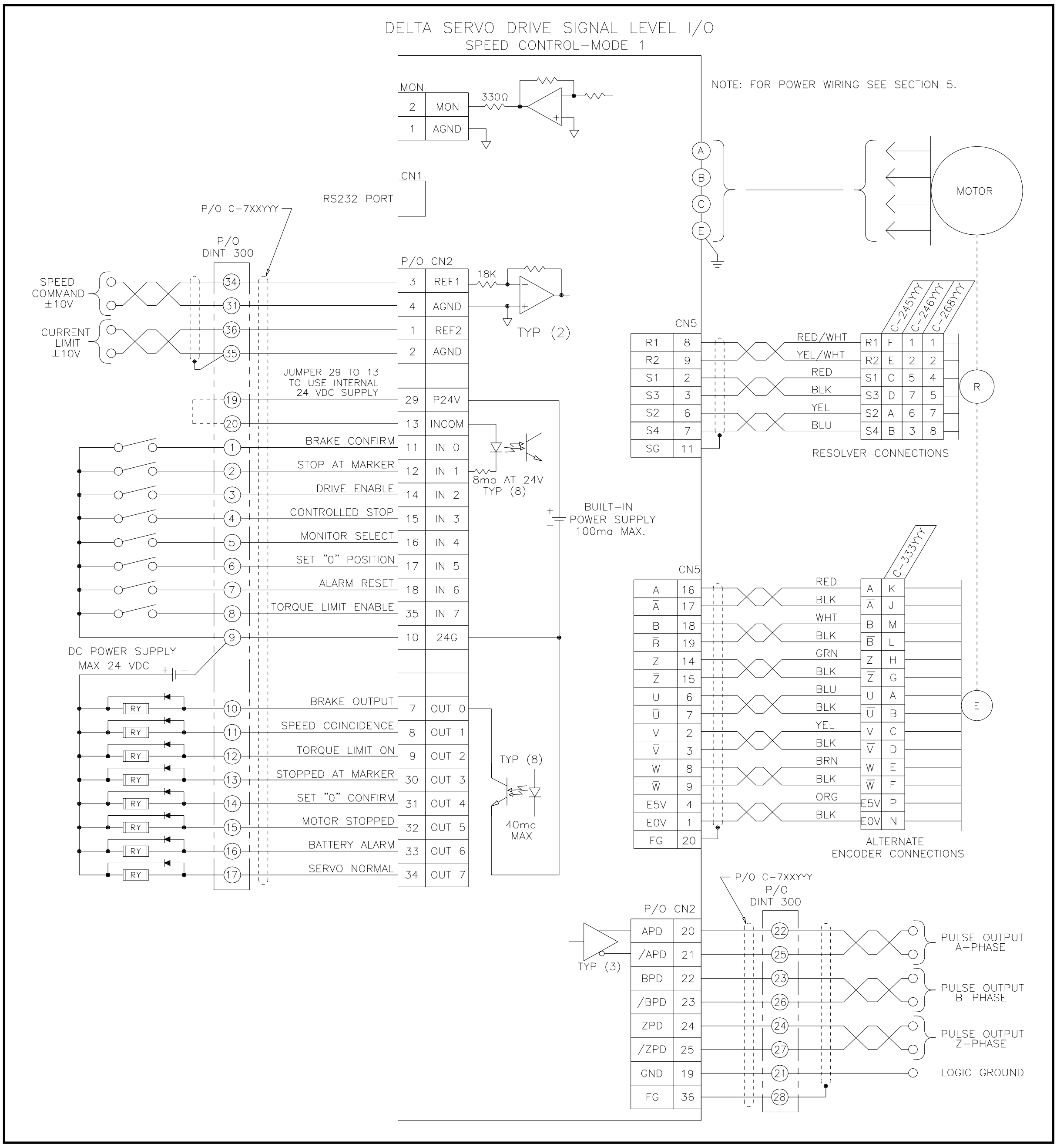
PRIMARY MOTION CONTROL FEATURES

- 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

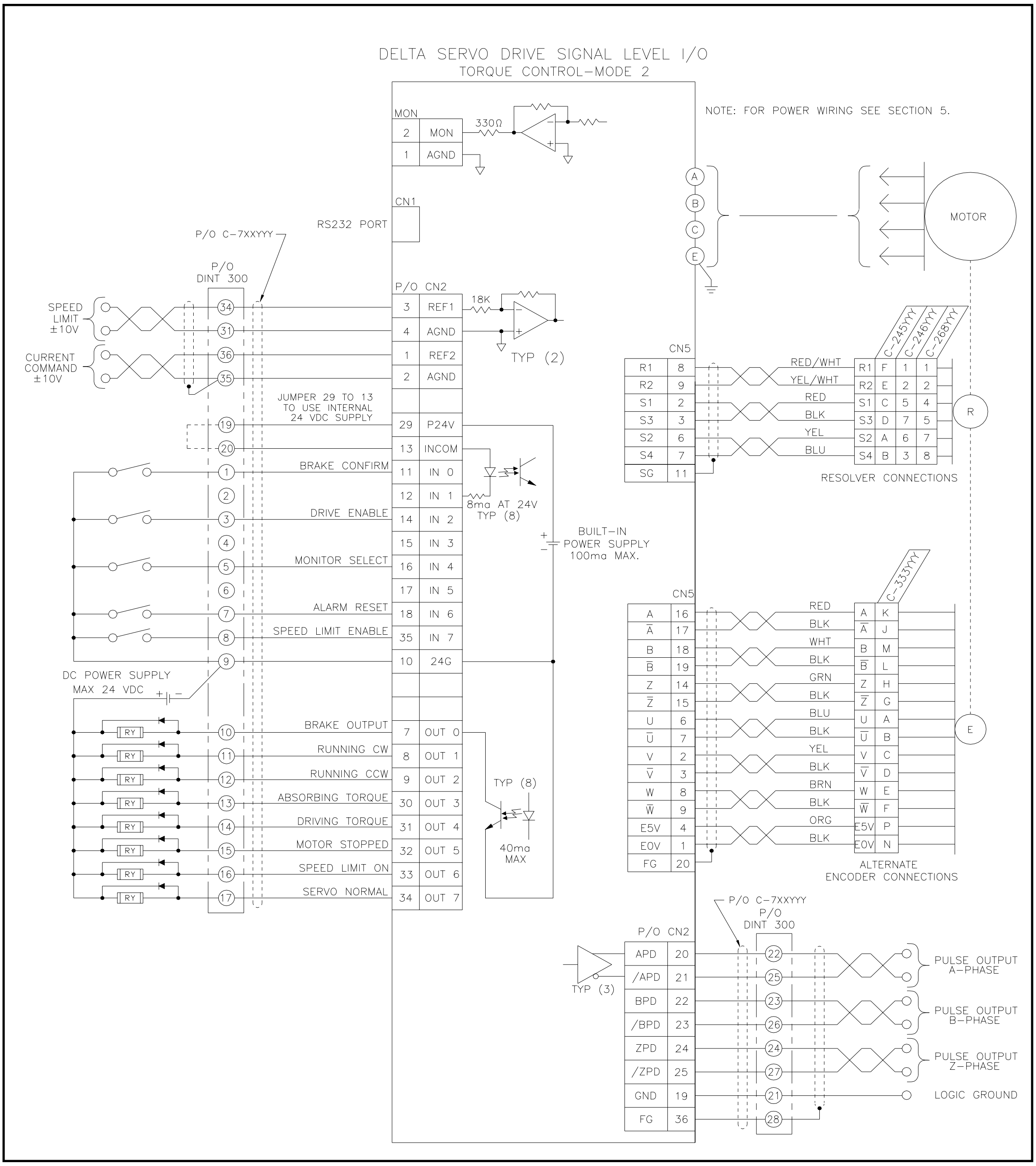
PRIMARY MOTION CONTROL FEATURES

- 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 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 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 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 ▲ ▼.

4.2.3.1 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

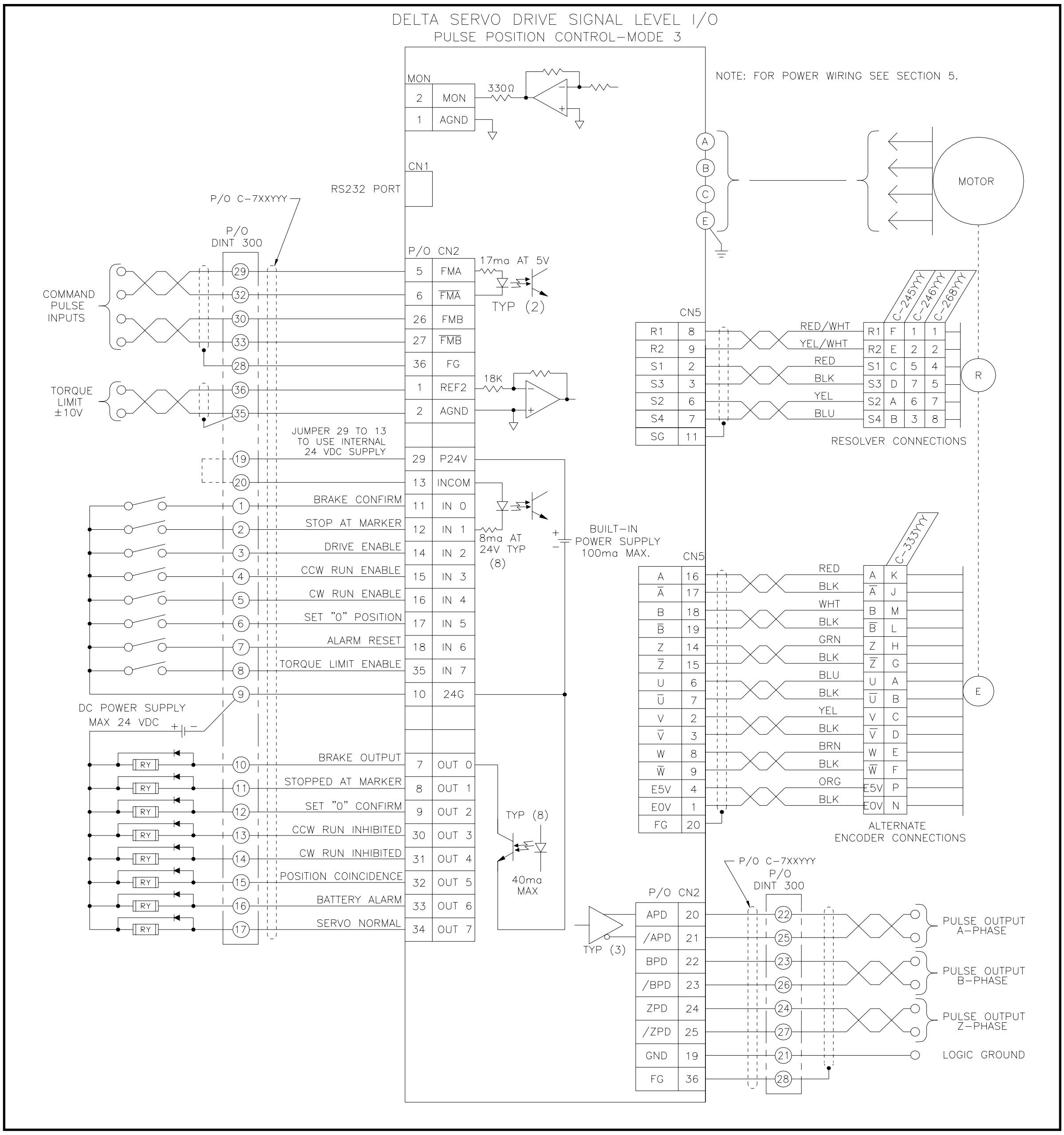
PRIMARY MOTION CONTROL FEATURES

- 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

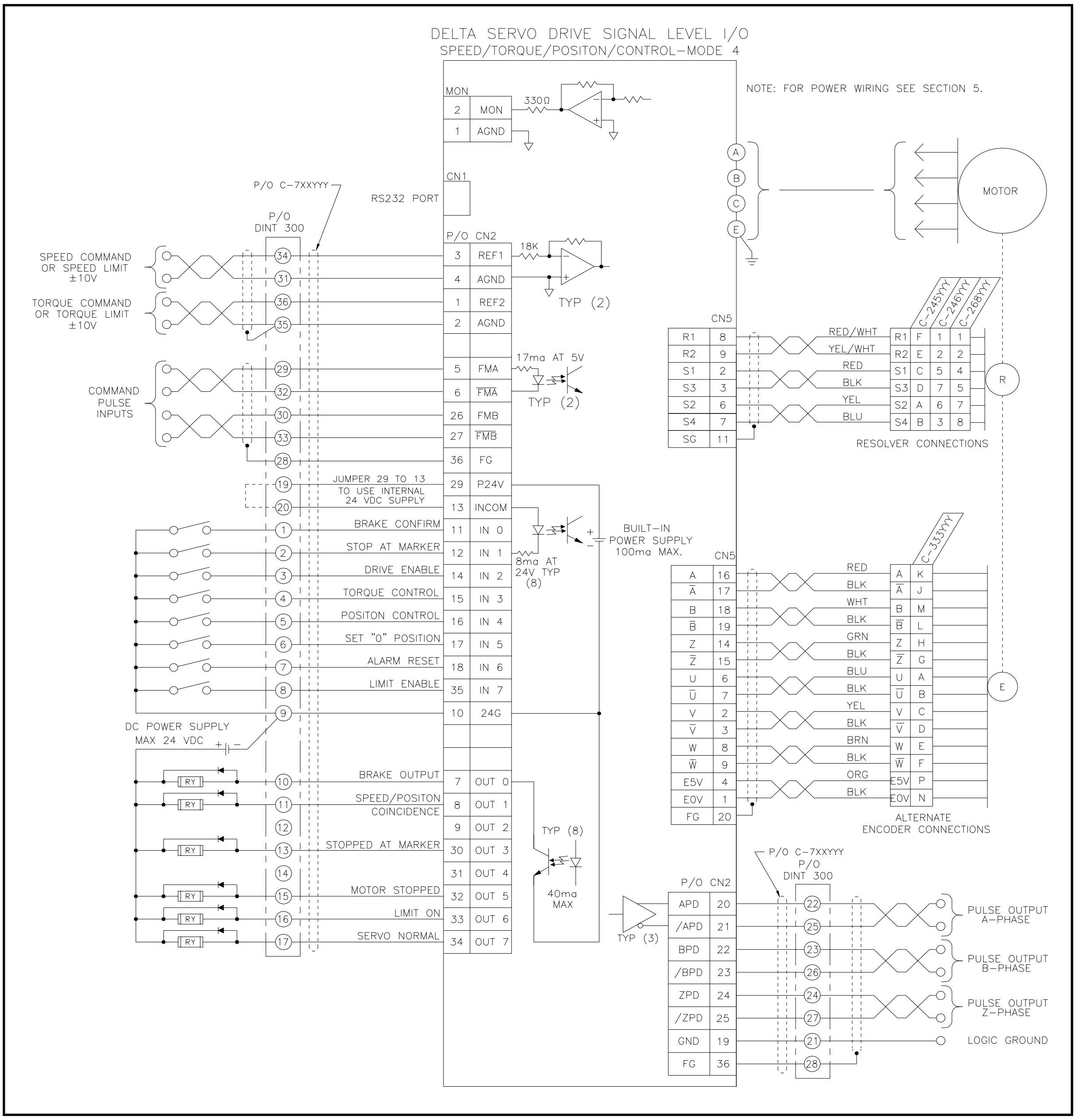
PRIMARY MOTION CONTROL FEATURES

- 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

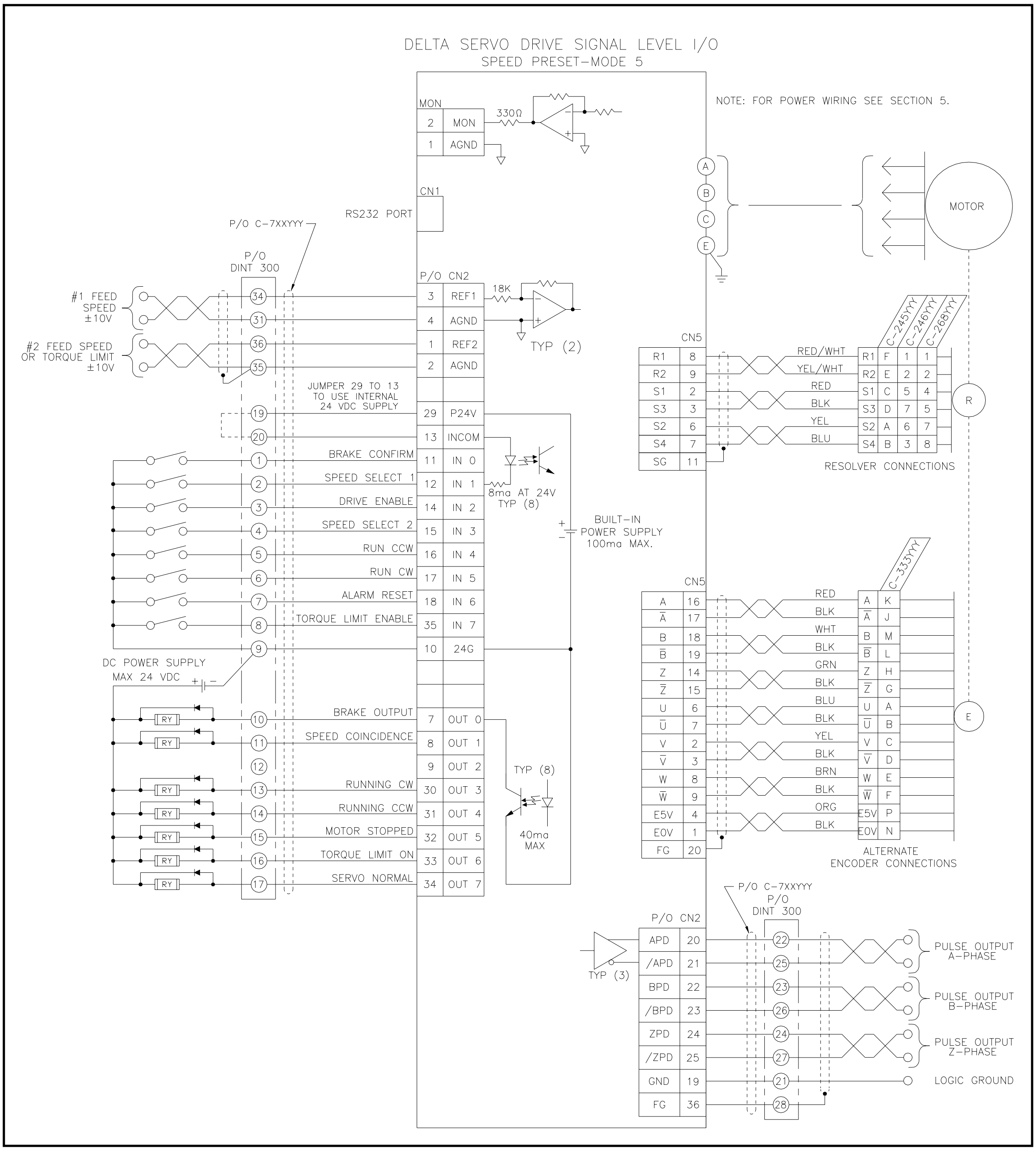
PRIMARY MOTION CONTROL FEATURES

- 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

<table>
<tr><th>TYPE</th><th>NAME</th><th>FUNCTION</th></tr>
<tr><td>Analog Input</td><td>#1 FEED SPEED (REF1)</td><td>#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---".</td></tr>
<tr><td></td><td>#2 FEED SPEED (REF2)

or (Selected by IN7)</td><td>#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---".</td></tr>
<tr><td></td><td>TORQUE LIMIT (REF2)</td><td>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---".</td></tr>
<tr><td>24V Input</td><td>BRAKE CONFIRM (IN0)</td><td>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</td></tr>
<tr><td></td><td>SPEED SELECT 1 (IN1)</td><td><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></td></tr>
<tr><td></td><td>DRIVE ENABLE (IN2)</td><td>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.</td></tr>
<tr><td></td><td>SPEED SELECT 2 (IN3)</td><td>Feed speed selection, see (IN1) above.</td></tr>
</table>

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

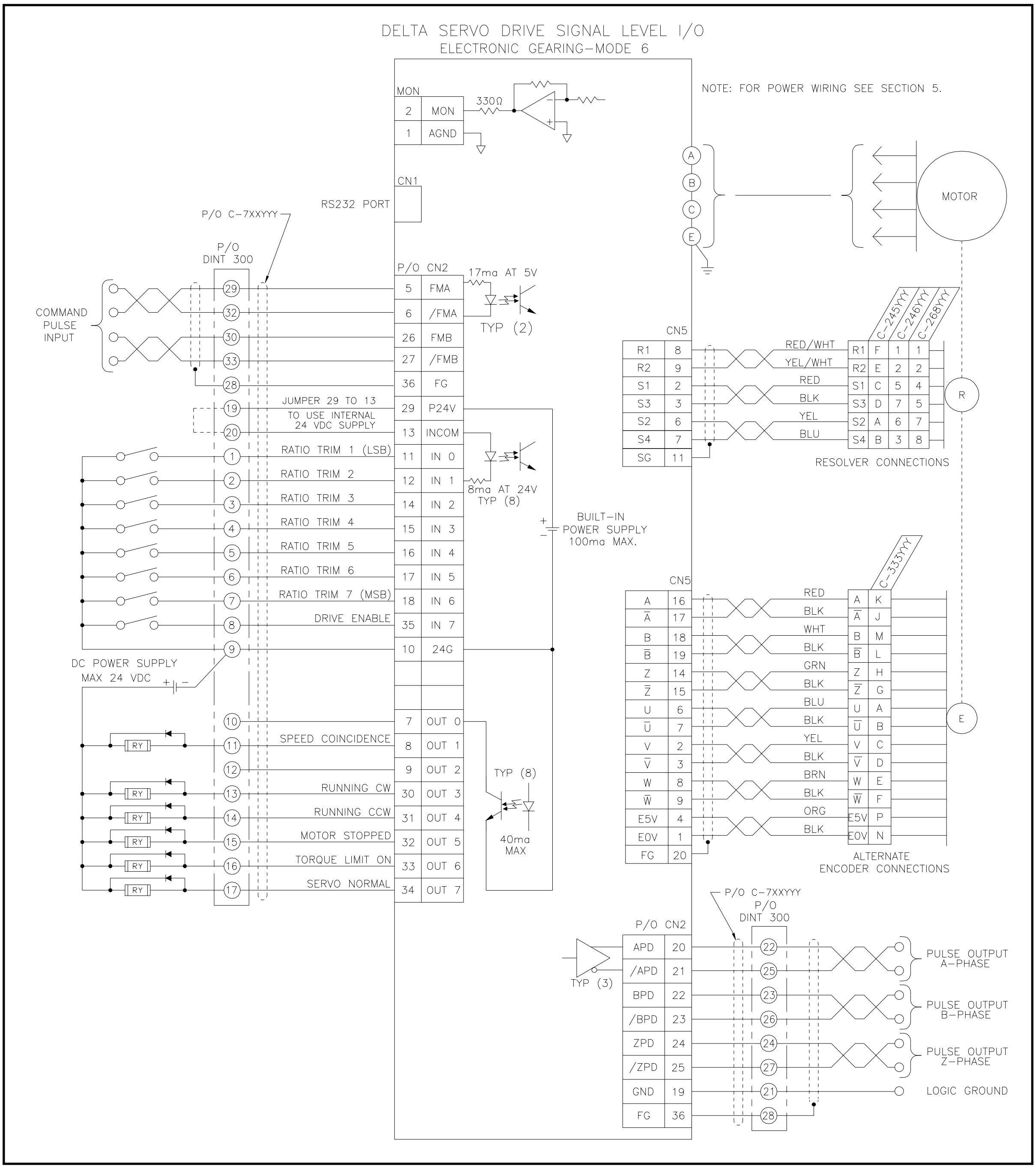
PRIMARY MOTION CONTROL FEATURES

- 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:
$$UP\text{-}04/UP\text{-}05 * [1 + \frac{\underline{RATIO\ TRIM}}{100} * UP\text{-}27]$$</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 rowspan="4">24V Output</td><td>SPEED COINCIDENCE
(OUT1)</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</td></tr>
<tr><td>RUNNING CW
(OUT3)</td><td>This output turns ON when the motor is rotating CW above the stop detection speed set in UP-8.</td></tr>
<tr><td>RUNNING CCW
(OUT4)</td><td>This output turns ON when the motor is rotating CCW above the stop detection speed set in UP-8.</td></tr>
<tr><td>MOTOR STOPPED
(OUT5)</td><td>This output turns ON when the motor speed drops below the internal preset speed set in UP-8.</td></tr>
<tr><td rowspan="2">24V Output (cont'd)</td><td>TORQUE LIMIT ON
(OUT6)</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</td></tr>
<tr><td>SERVO NORMAL
(OUT7)</td><td>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-04/UP-05*[1+$\frac{\text{RATIO TRIM}}{100}$*UP-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.

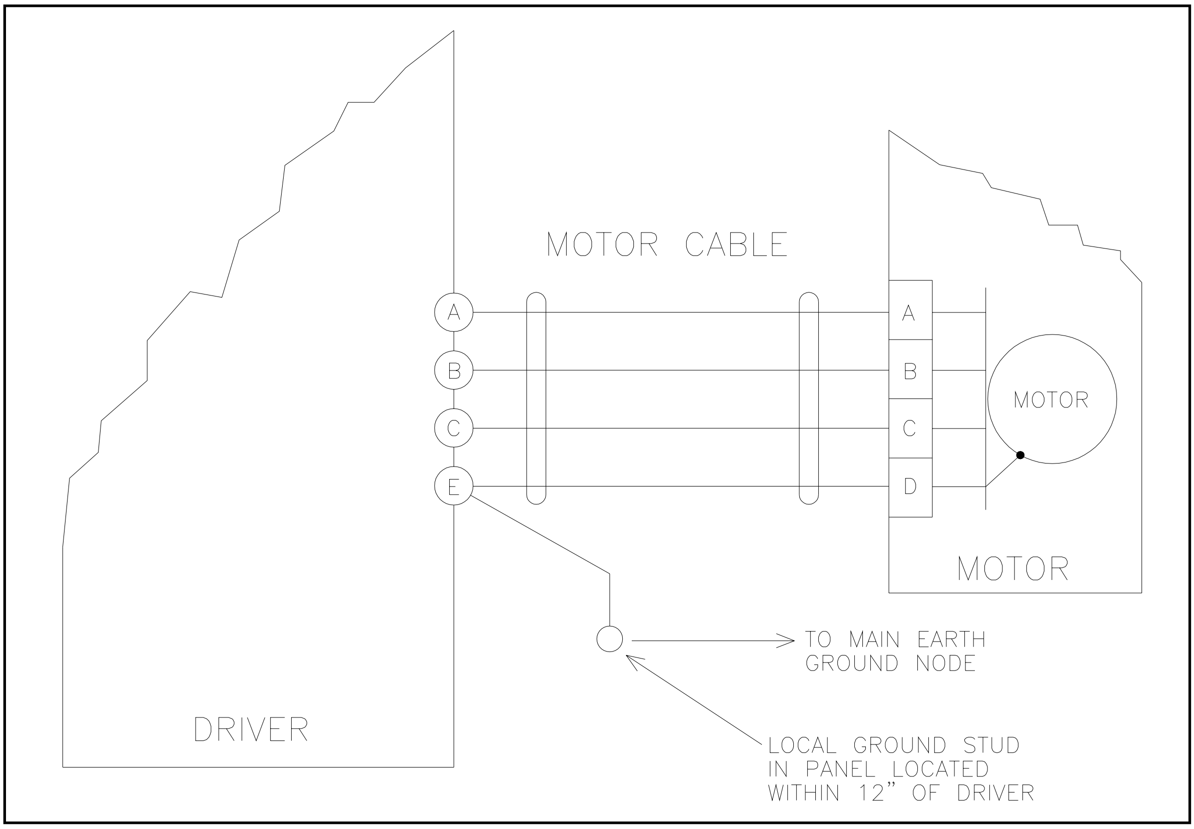


Figure 5.1 - Grounding Technique

****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)

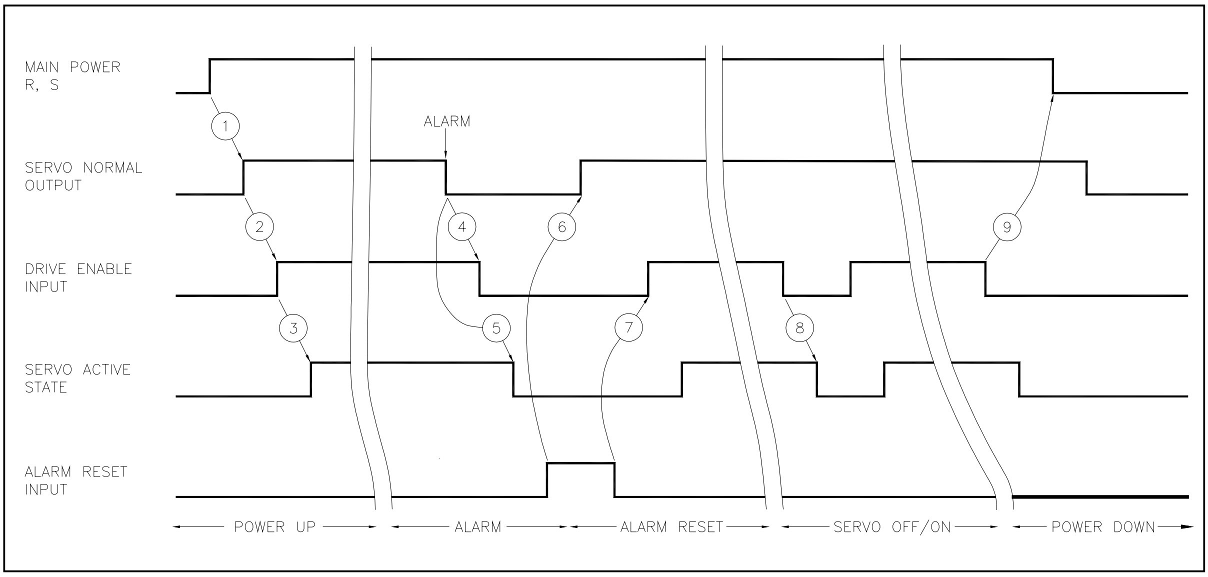


Figure 5.2 - Power and Control Signals for DSD-1.5 Through DSD-17.5 Drivers

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 800usec.
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 800usec 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 800usec 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)

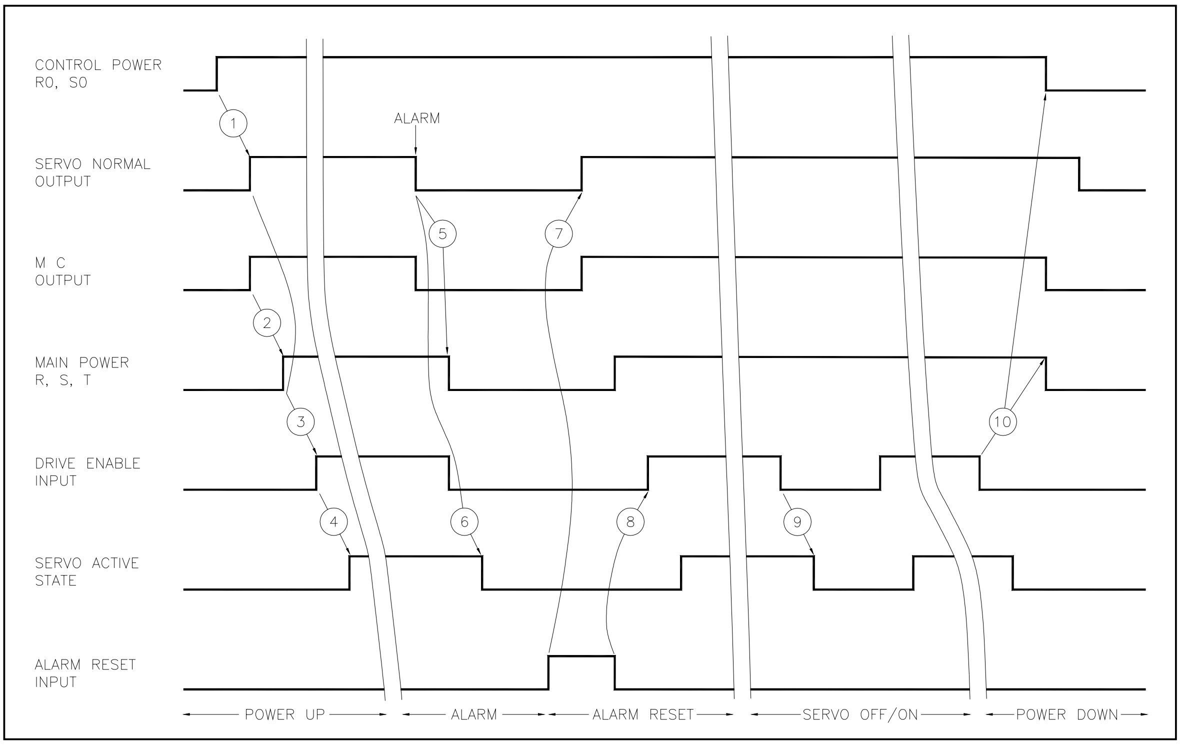
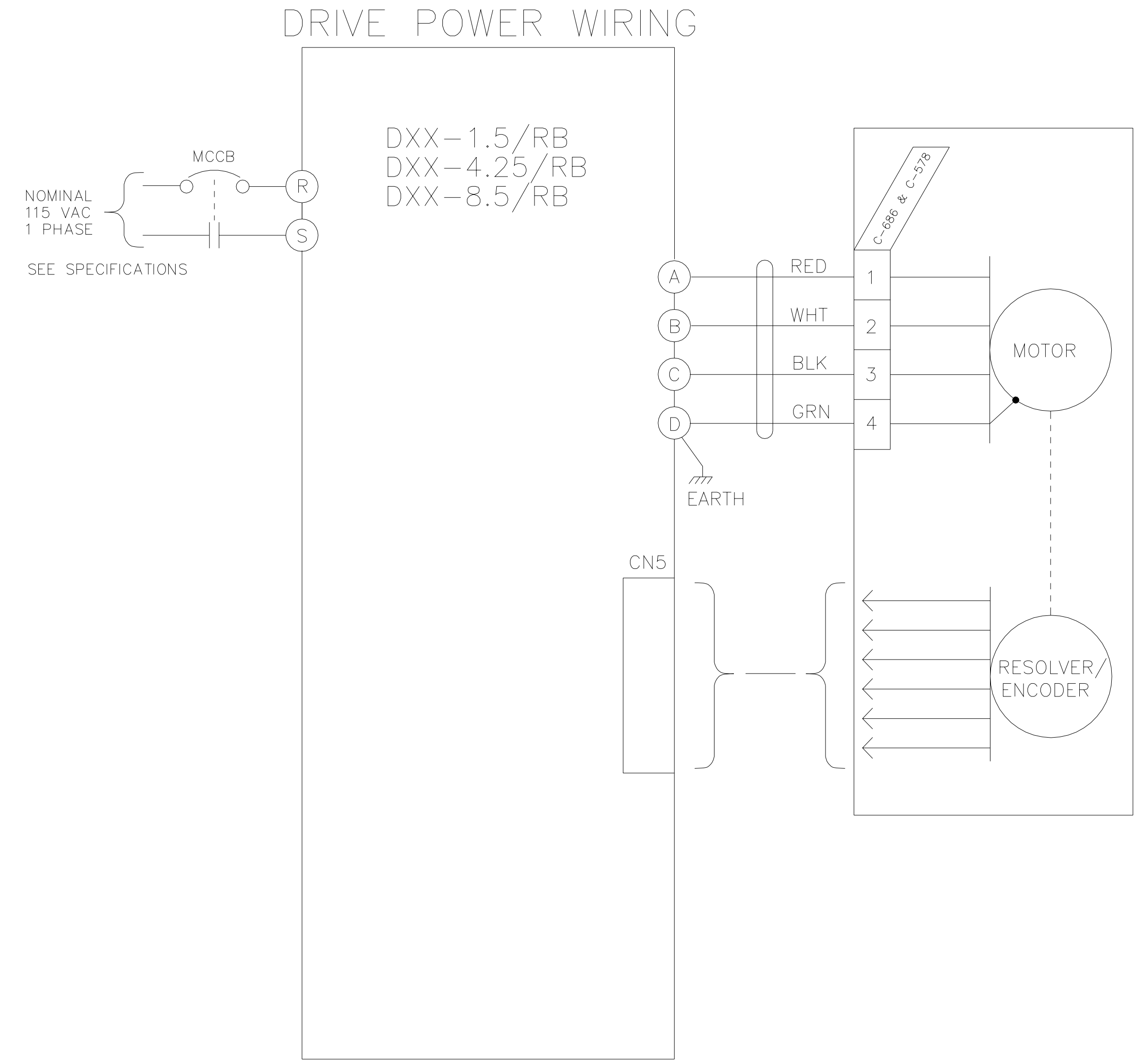


Figure 5.3 - Power and Control Signals for DSD-35 Through 115 Drivers

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 800usec.
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 800usec 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 800usec 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)

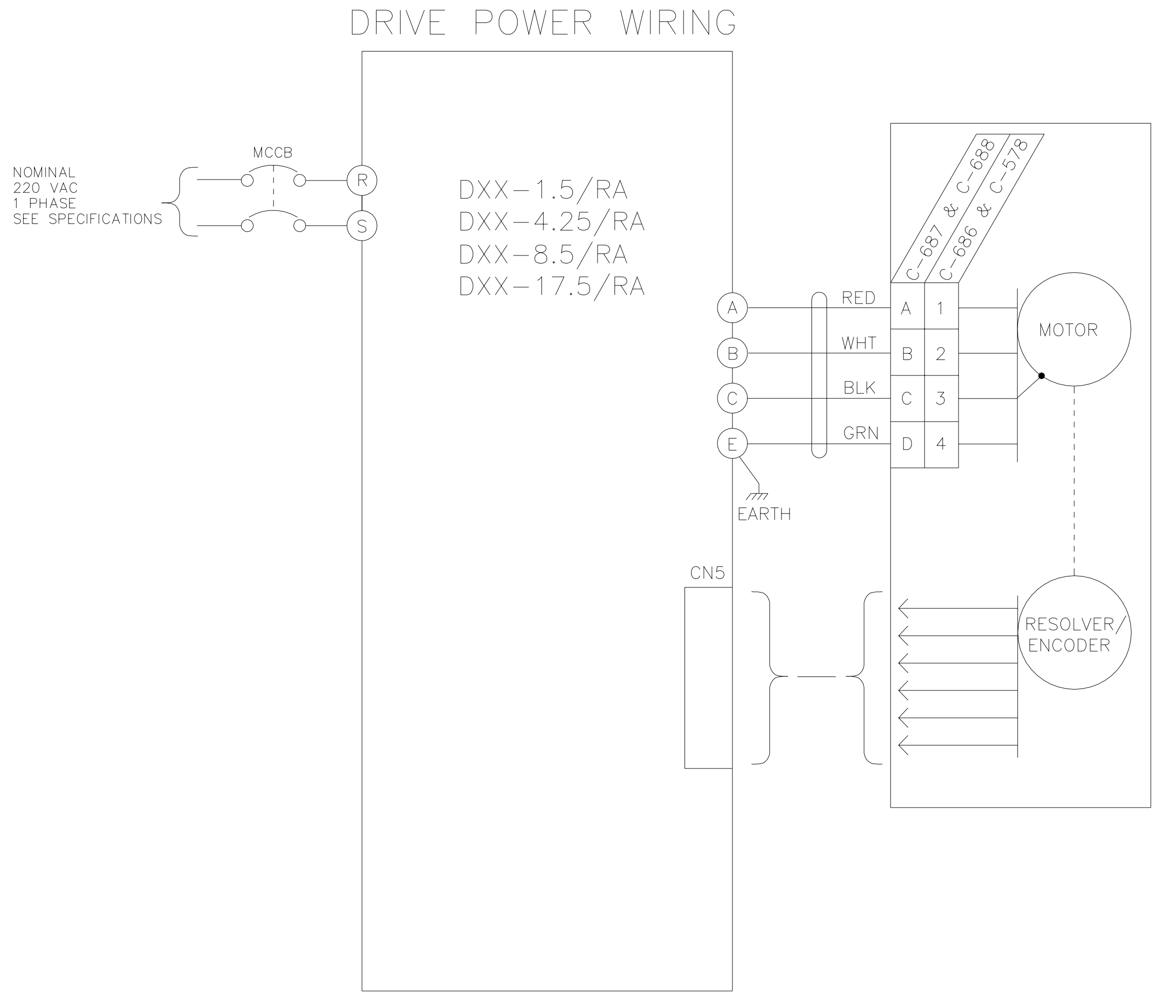


DRIVER	MCCB	R,S & EARTH CIRCUIT WIRE SIZE	REQUIRED TORQUE (LB-IN) ON POWER WIRING TERMINALS
DXX-1.5/RB DXX-4.25/RB	ABB-S271-K4NA 4 AMPS	14 AWG, 1.25 MM^2	12.00**
DXX-8.5/RB	ABB-S271-K8NA 8 AMPS	14 AWG, 1.25 MM^2	12.00**

** 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)

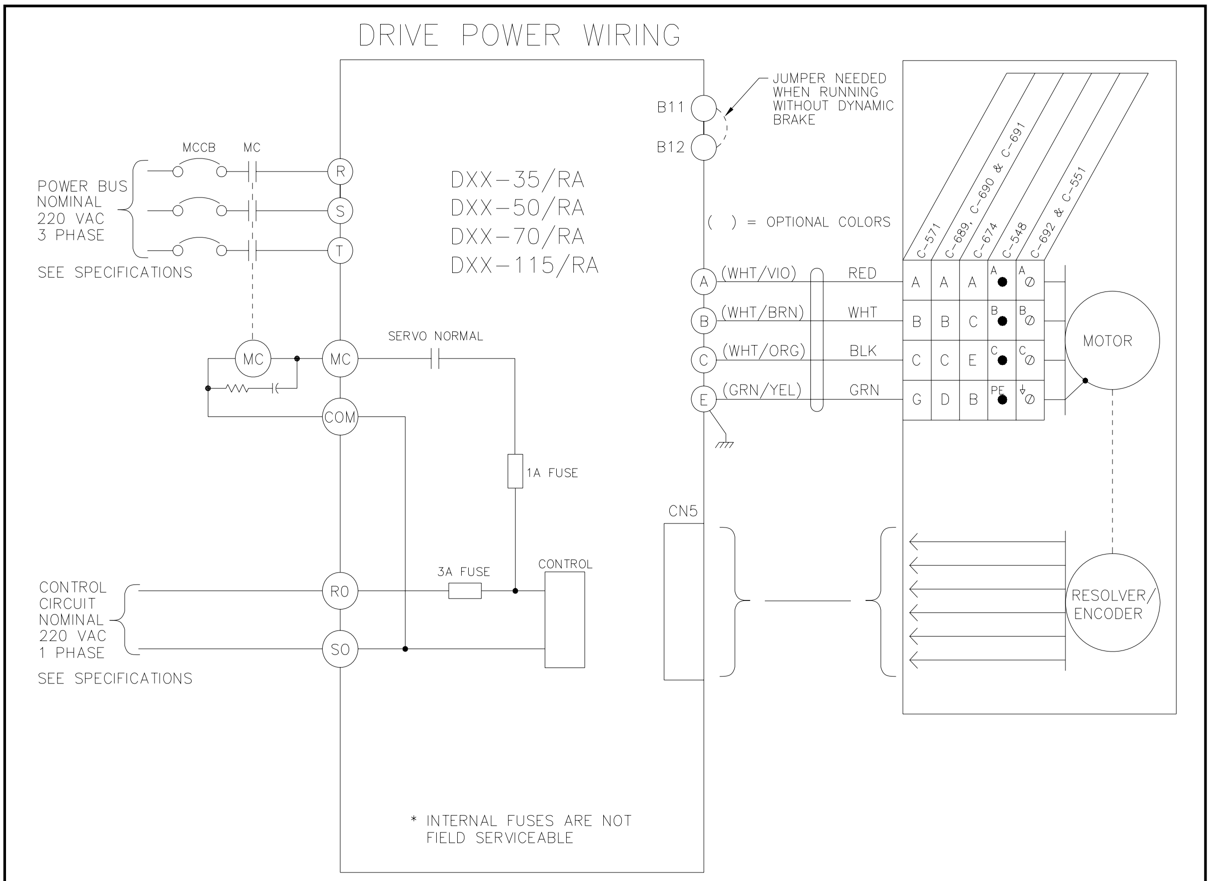


DRIVER	MCCB	R,S & EARTH CIRCUIT WIRE SIZE	REQUIRED TORQUE (LB−IN) ON POWER WIRING TERMINALS
DXX−1.5/RA & DXX−4.25/RA	(ABB) S272−K4	14 AWG, 1.25 MM^2	12.00**
DXX−8.5/RA	(ABB) S272−K8 (SQD) MG24448 8 AMPS	14 AWG, 1.25 MM^2	12.00**
DXX−17.5/RA	(ABB) S272−K16 (SQD) MG24451 16 AMPS	14 AWG, 1.25 MM^2	12.00**

** 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.

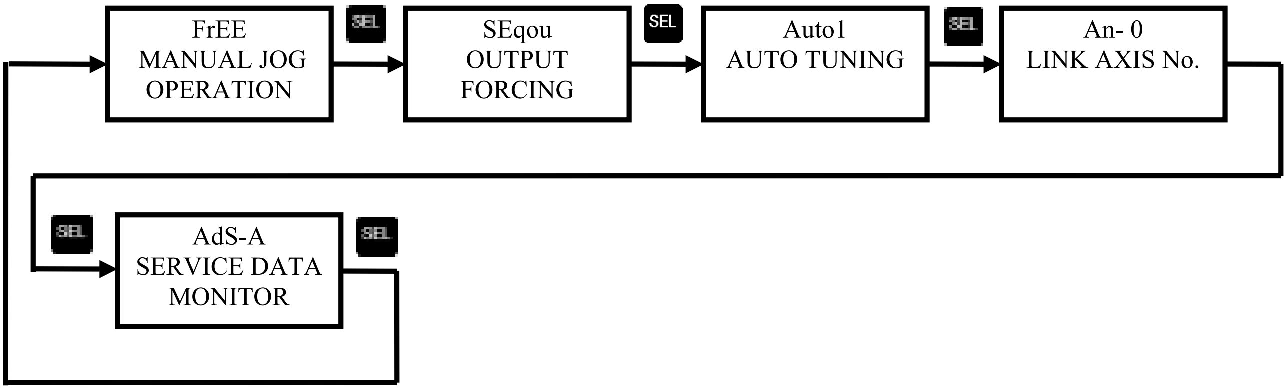
**** CAUTION ****

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

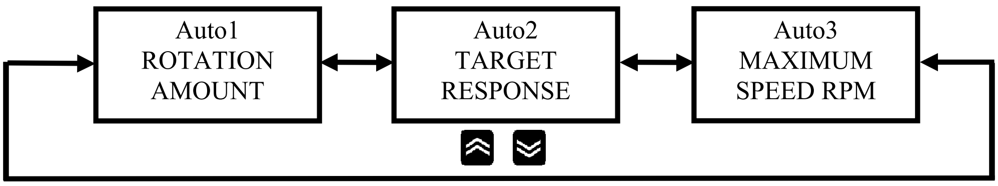
Enter the Special Function Menu Loop by concurrently pressing the keys for 5 seconds while the Main Menu status display shows motor speed [r 0]. The special menu will appear with the display showing [FrEE]. To exit the Special Function Menu double click the key.

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** (for t_a, t_b, t_c)

* The above equations are reasonable approximations.

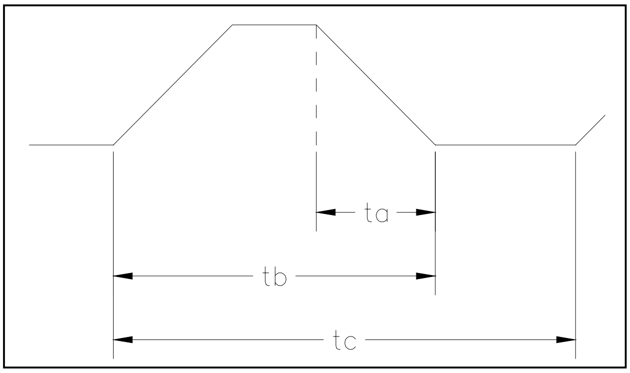


Figure 7.1

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)

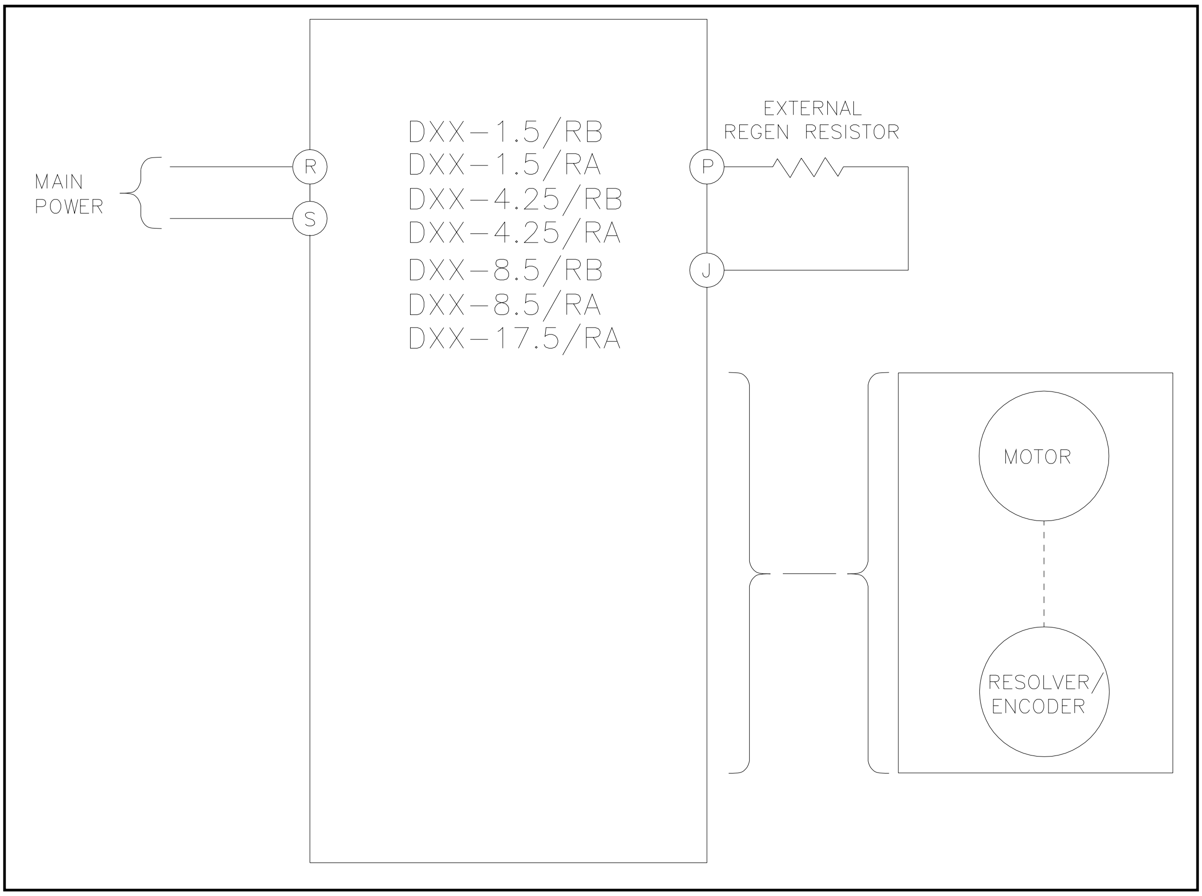


Figure 7.2 - Connection of an External Regen Resistor for Driver Sizes DSD-1.5 Through DSD-17.5

7.2 SELECTION OF REGENERATION RESISTOR (cont'd)

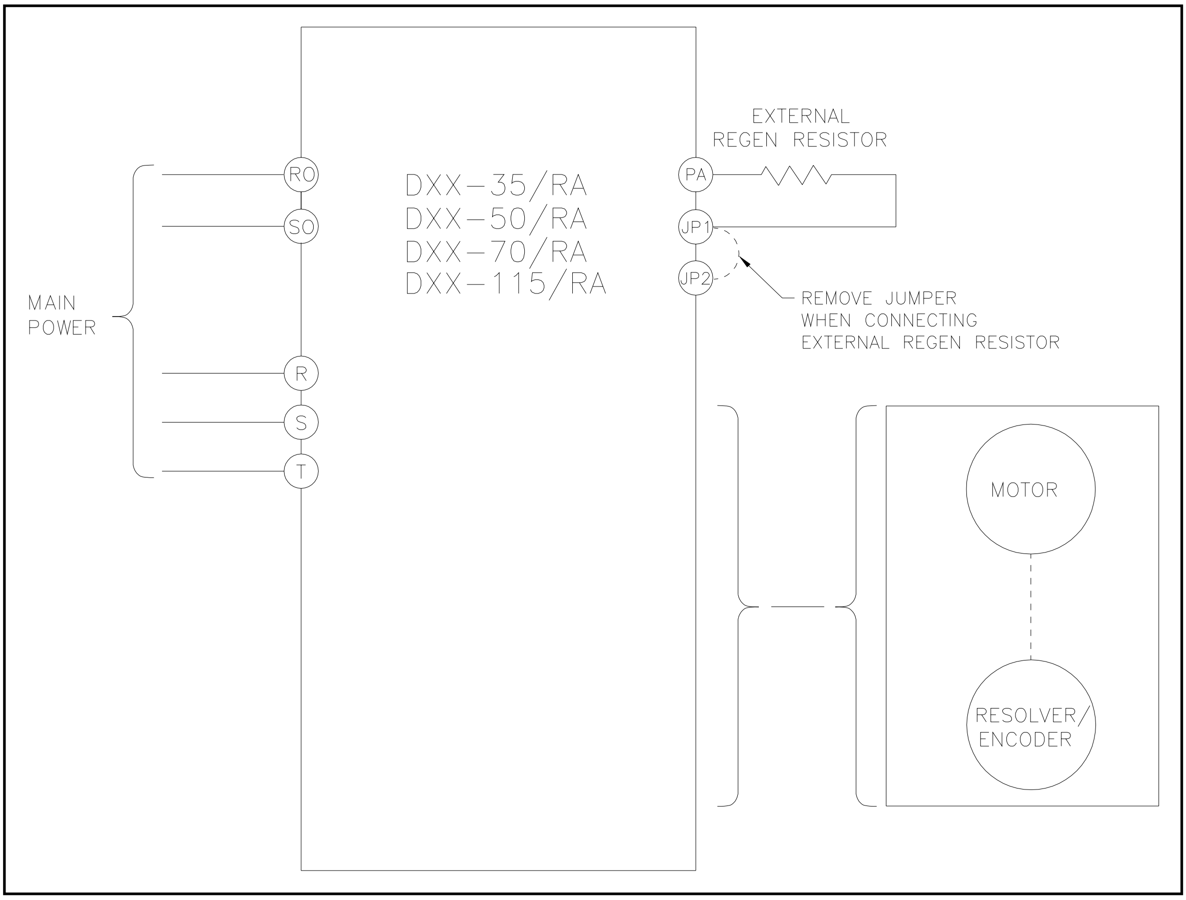


Figure 7.3 - Connection of an External Regen Resistor for Driver Sizes DSD-35 and Larger

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

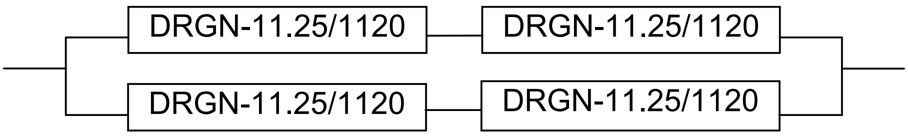
In general, wound metal ribbon resistors are recommended for this type of application. IIS offers a complete line of enclosed panel mounted regen resistor units to complement the Delta driver. Various combinations of series and parallel connections are allowed to provide adequate regen resistor capacity.

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.



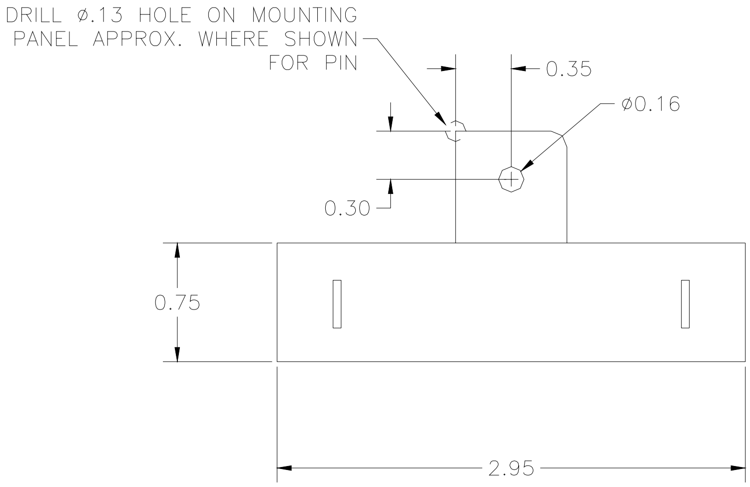
DRAWING NUMBER	DESCRIPTION
MFS30A300J	Resistor
RGH200-30	Regen Resistor
DRGN-20/400	Regen Resistor
DRGN-45/420	Regen Resistor
DRGN-45/420-2	Regen Resistor
DRGN-22.5/655	Regen Resistor
DRGN-15/880	Regen Resistor
DRGN-11.25/1120	Regen Resistor

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 %



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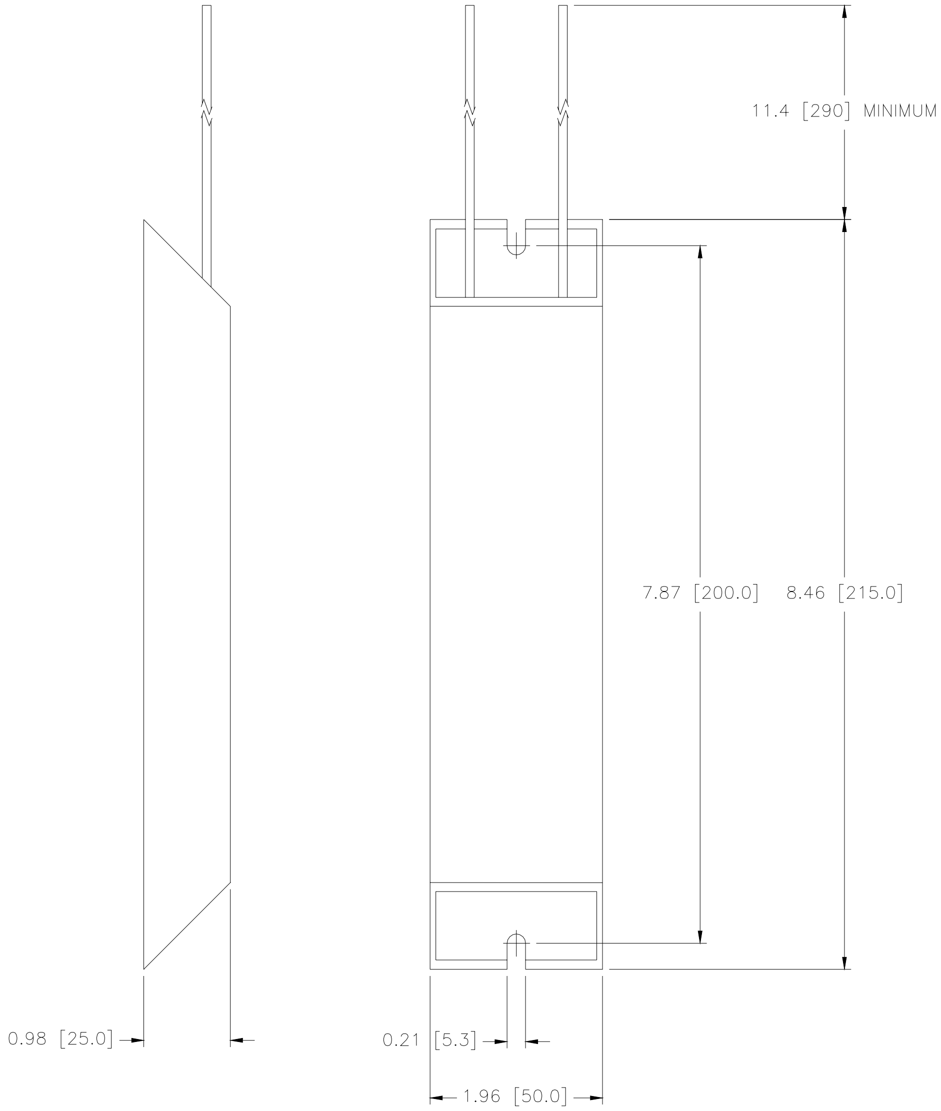
TITLE RESISTOR, 30 OHM, 30W					
DRAWING NUMBER MFS30A300J					
DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± --- X.XXX± --- ∡ ± ---	REV 0	ECN 03-322	DATE 16JUL03	SH. 1 OF 1

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

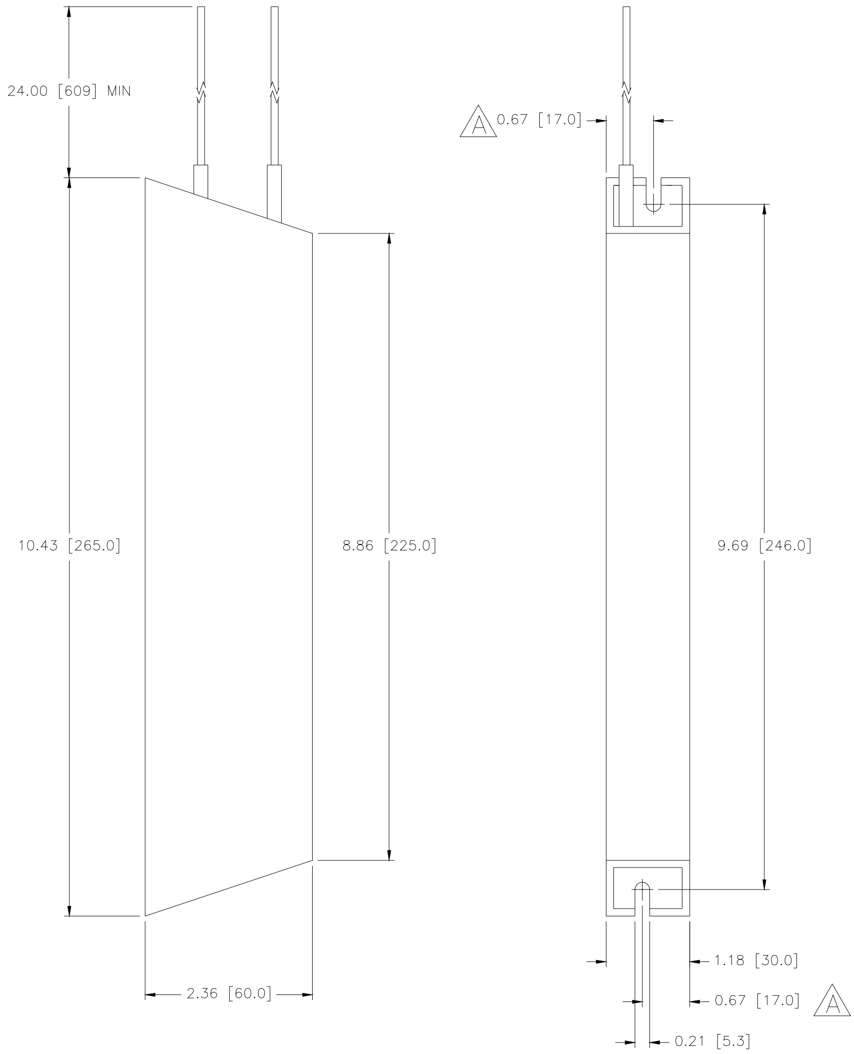
NOTES:

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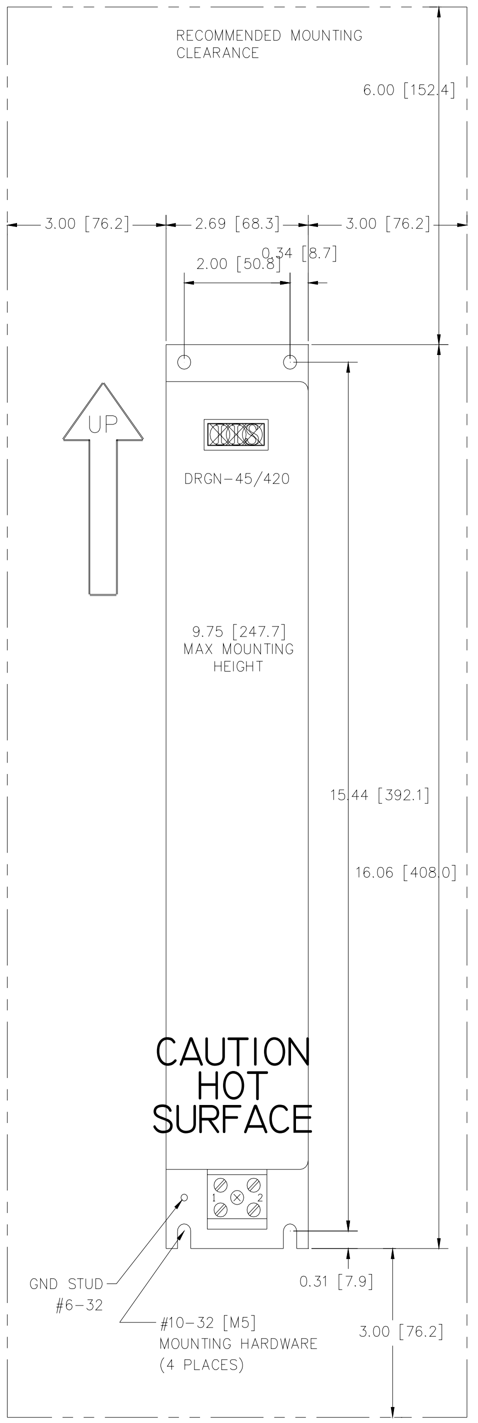
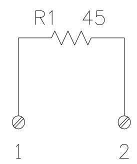
TITLE REGEN RESISTOR						
DRAWING NUMBER DRGN-20/400						
DIMENSIONS ARE INCHES [mm]	TOLERANCES X.XX± 0.01 X.XXX± 0.005 ∠ ± 5°	REV A	ECN 01-259	DATE 28JUN01	SH. 1 OF 1	

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%





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TITLE

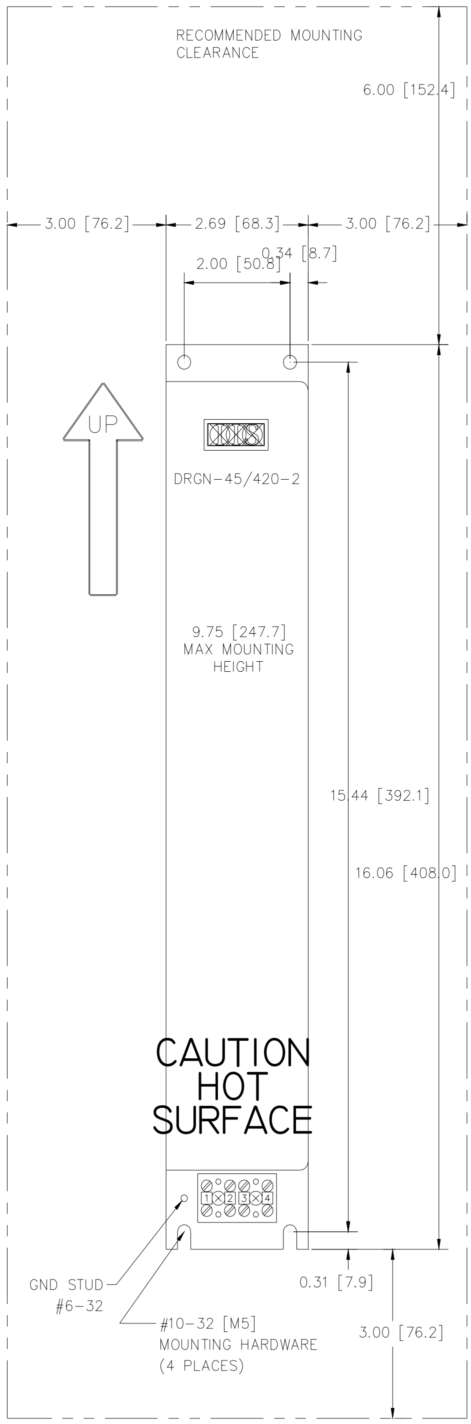
REGEN RESISTIOR

DRAWING NUMBER

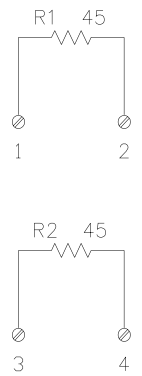
DRGN-45/420

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%



SCHEMATIC



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TITLE

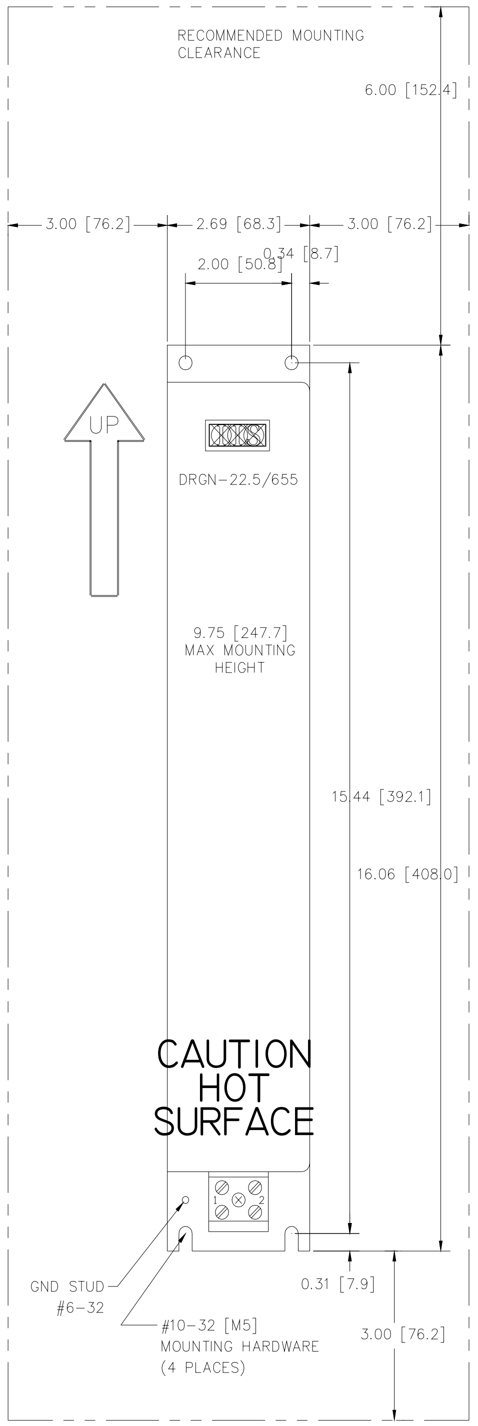
REGEN RESISTIOR

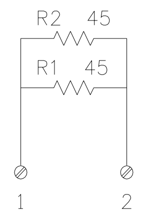
DRAWING NUMBER

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%

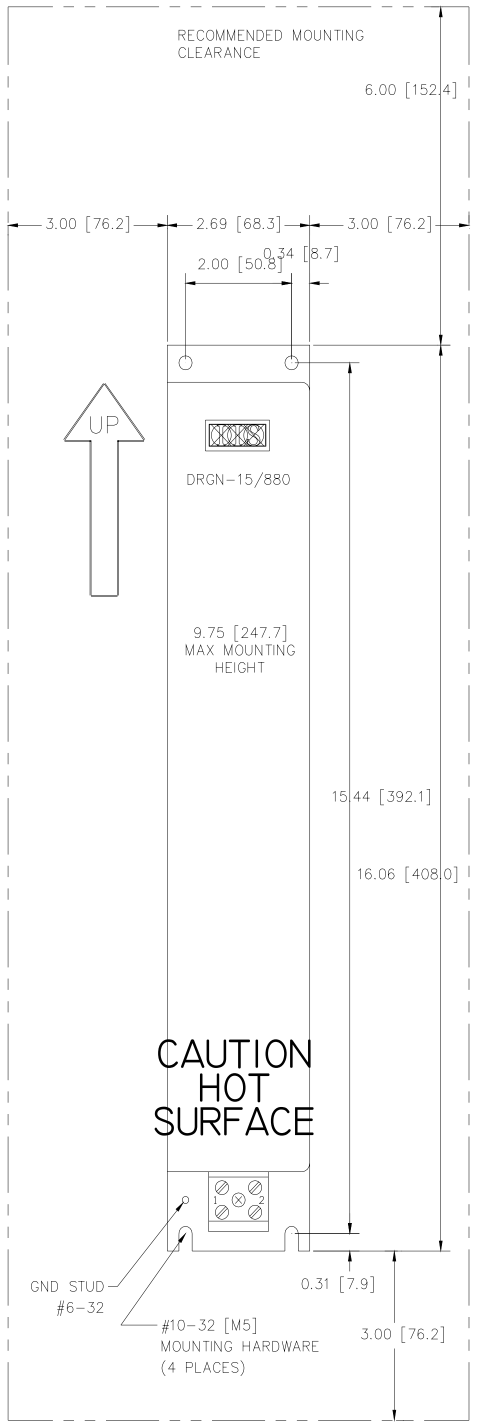


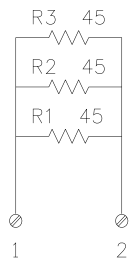


INDUSTRIAL INDEXING SYSTEMS, Inc. www.iis-servo.com	TITLE REGEN RESISTIOR
	DRAWING NUMBER DRGN-22.5/655

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%





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TITLE

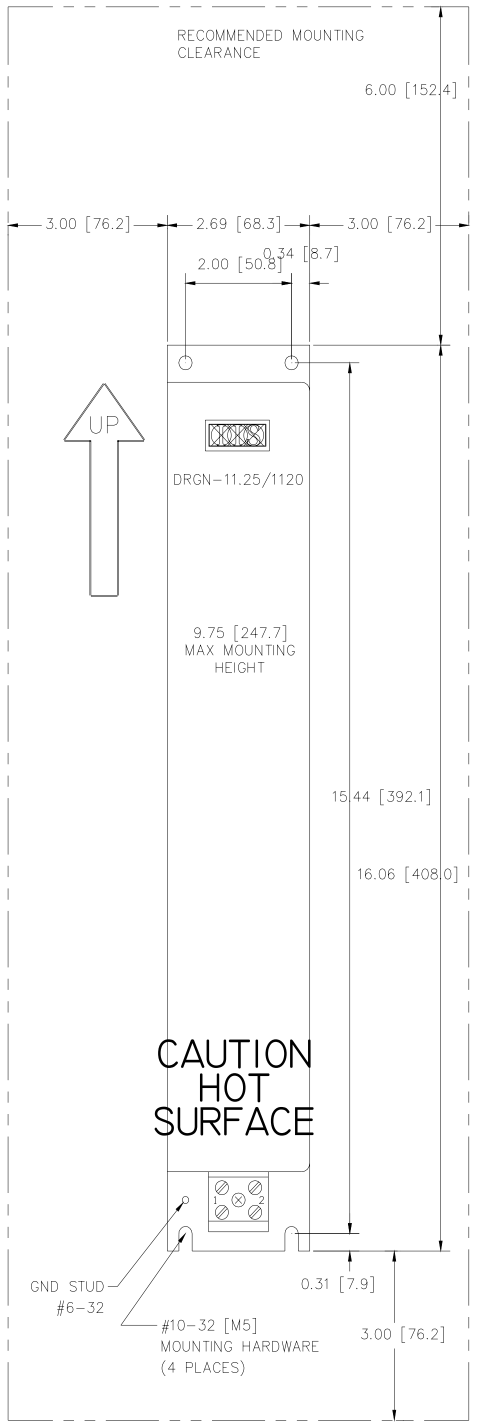
REGEN RESISTIOR

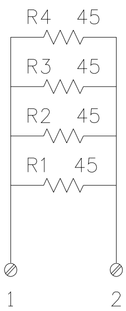
DRAWING NUMBER

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.

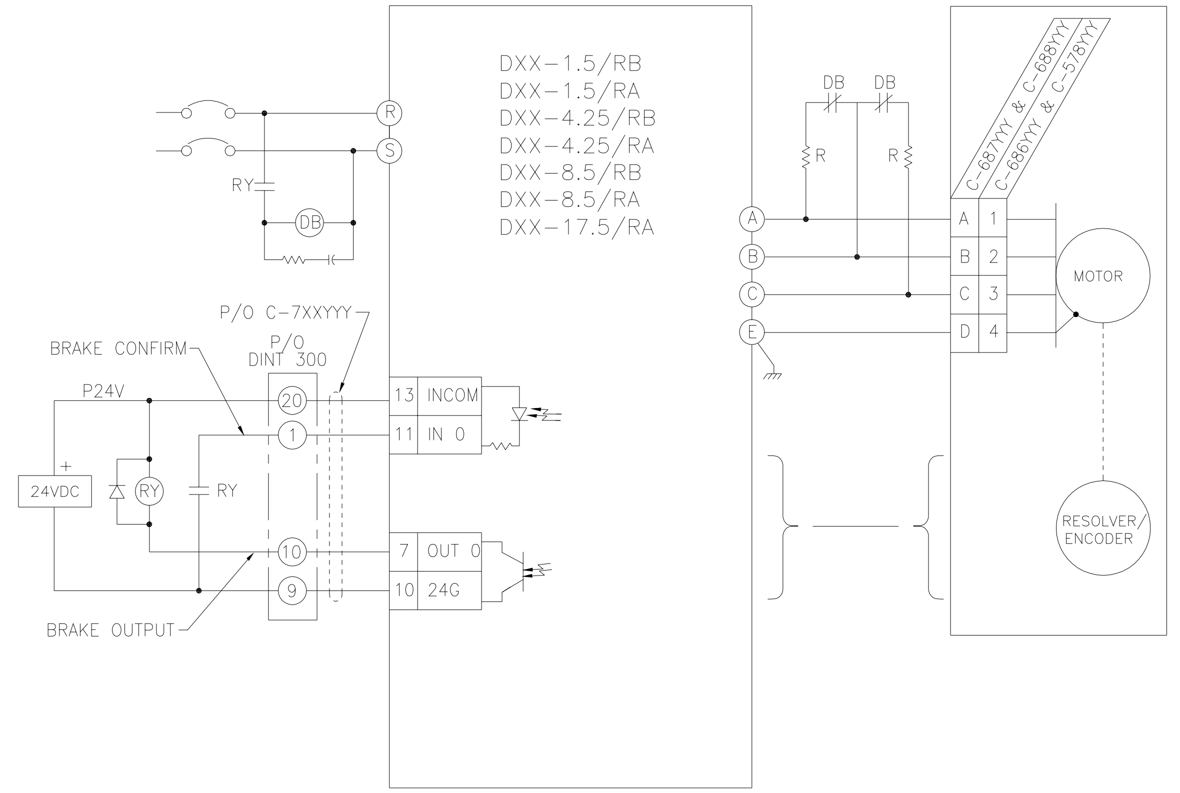
Be sure to select a dynamic braking resistor with a sufficient peak power rating.

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

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

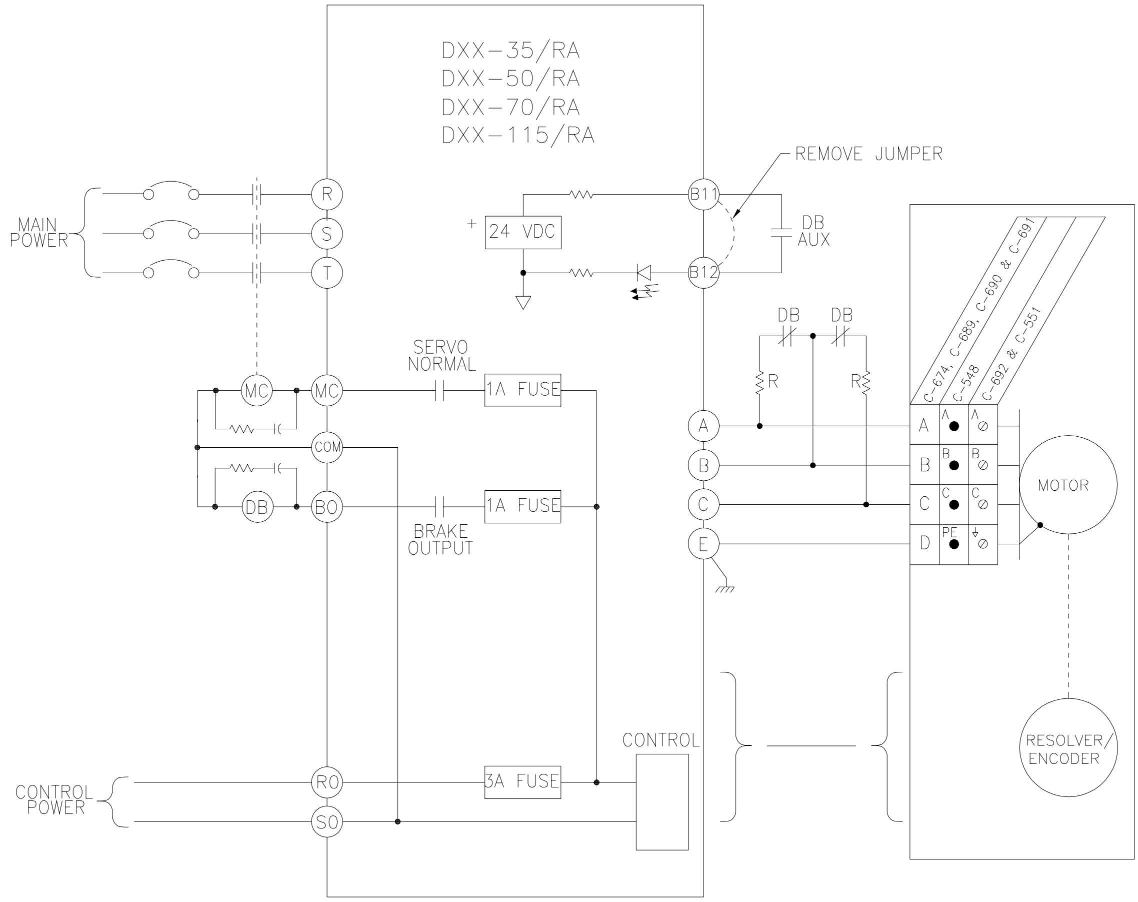
General rule: V = 300 * (motor speed @ braking) / (motor maximum speed rating)

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

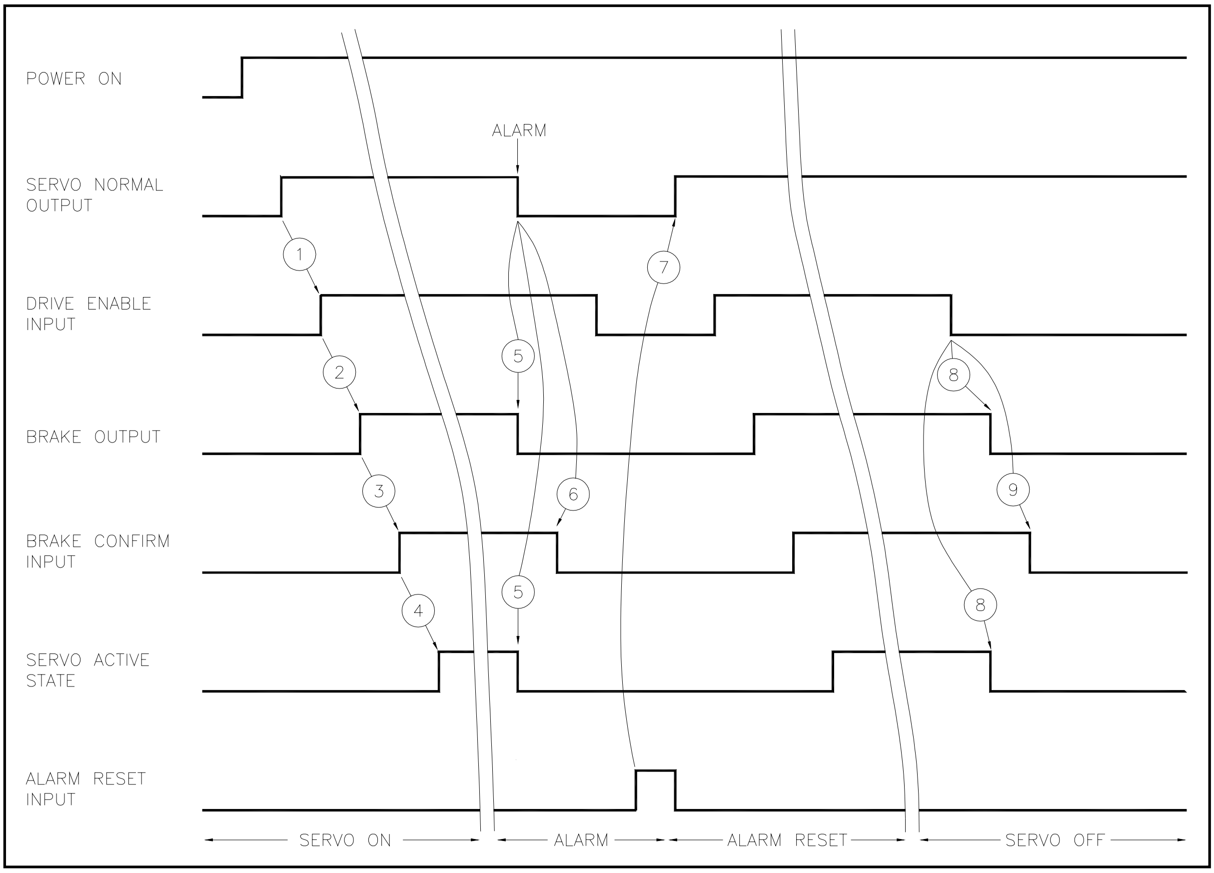


Figure 8.3 - Dynamic Braking Control Signals

1. DRIVE ENABLE may be turned ON within 0.6 seconds of SERVO NORMAL.
2. BRAKE turns on within 800usec. of DRIVE ENABLE.
3. BRAKE CONFIRM must be returned within 100ms. or AL-14 will be generated.
4. The servo will become active within 800usec 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 800usec 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.

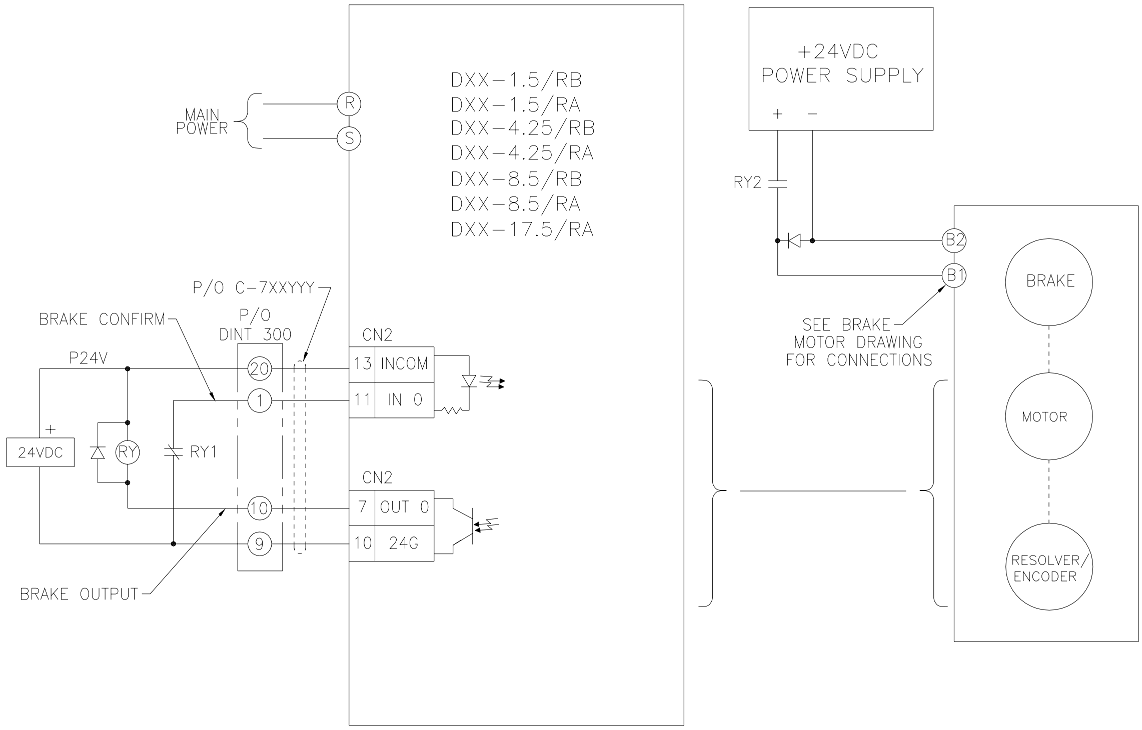
Connect the braking relay and power supply as shown in **Figures 9.1 or 9.2** and set UP-16 to a value of 02. The sequencing will be as shown in **Figure 9.3**.

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.

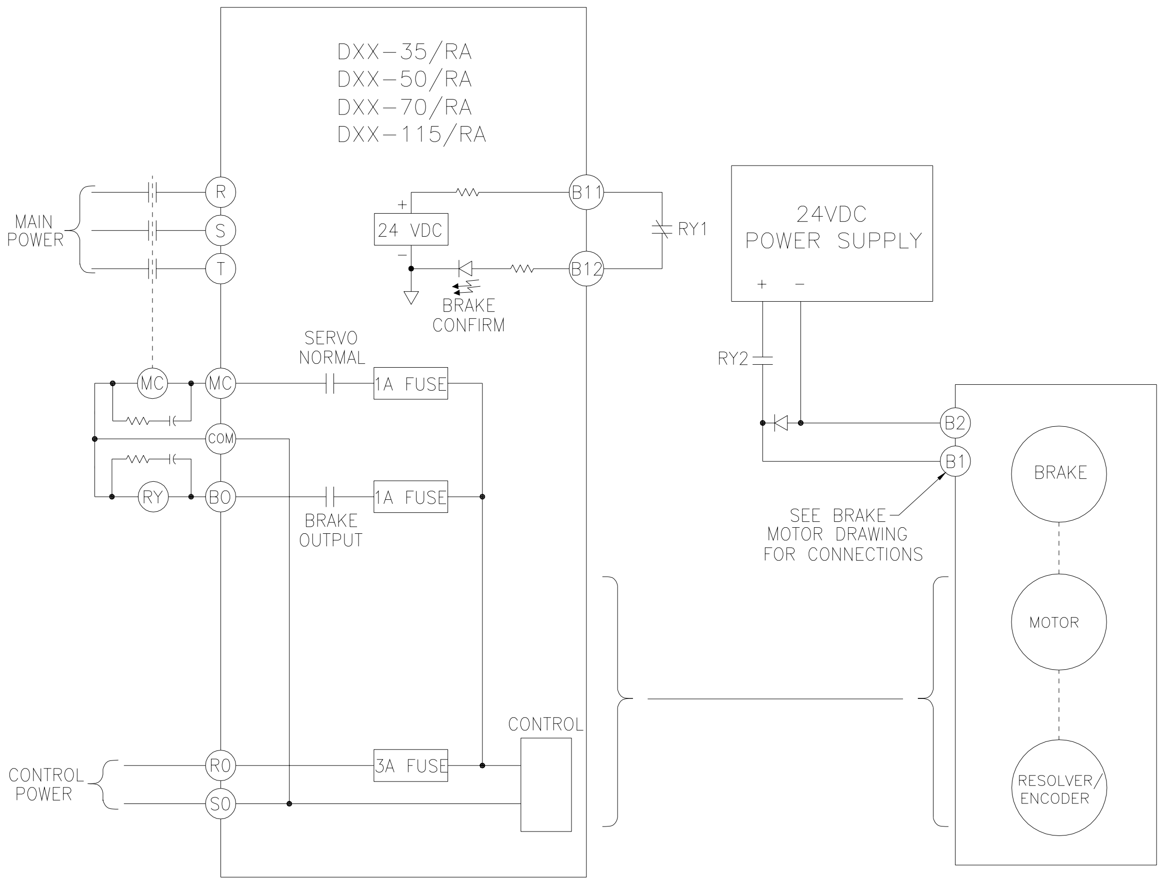
The mechanical brake is applied immediately upon driver alarm or loss of power.

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 A_{RMS} MAX	24 VDC @ 25 ma	24 VDC @ 1 A	DMBPS-220/220
DXX-50/RA	220 VAC @ 0.2 A_{RMS} MAX	24 VDC @ 25 ma	24 VDC @ 1 A	DMBPS-220/220
DXX-70/RA	220 VAC @ 0.2 A_{RMS} MAX	24 VDC @ 25 ma	24 VDC @ 1 A	DMBPS-220/220
DXX-115/RA	220 VAC @ 0.2 A_{RMS} 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

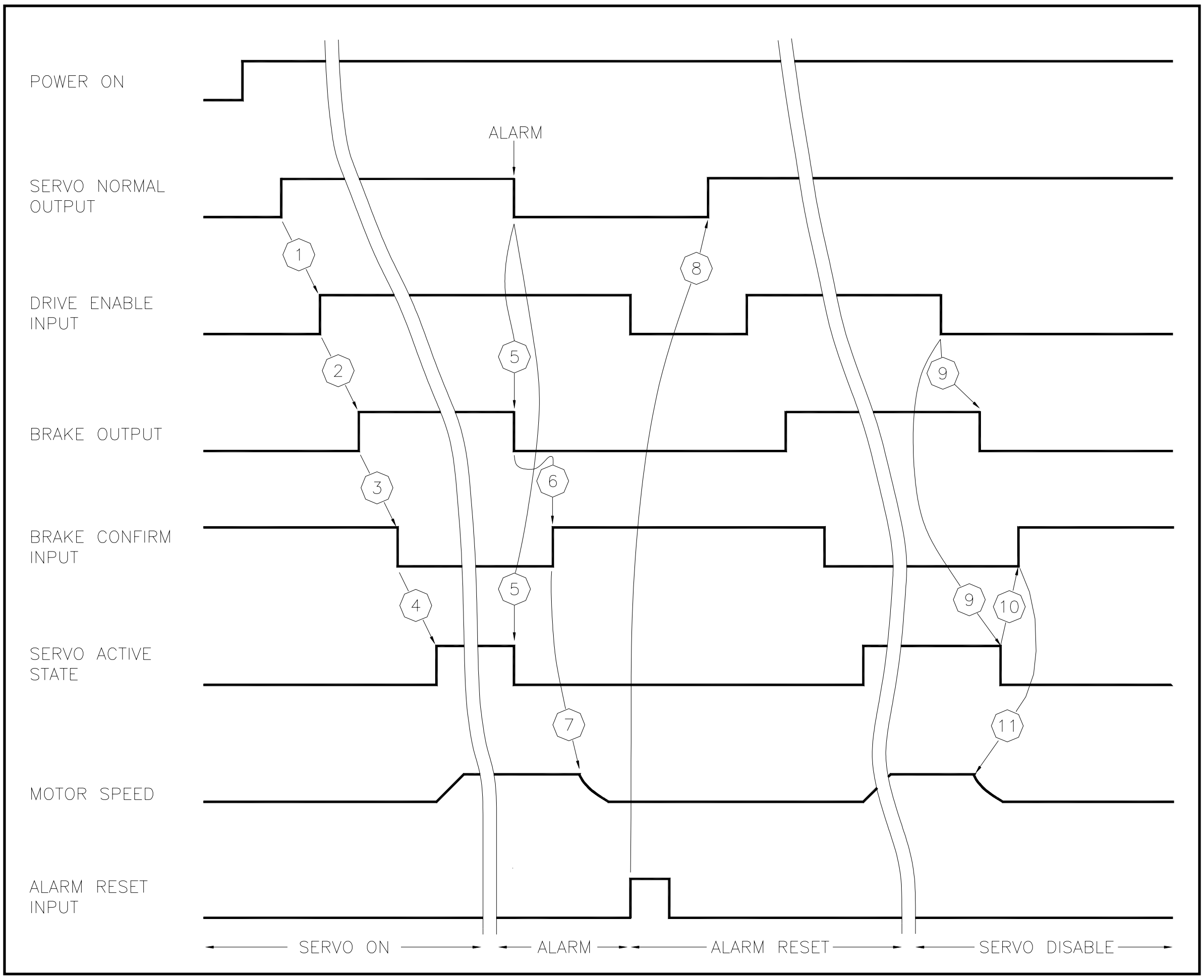


Figure 9.3 - Mechanical Brake Sequencing for Hard Decel

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.

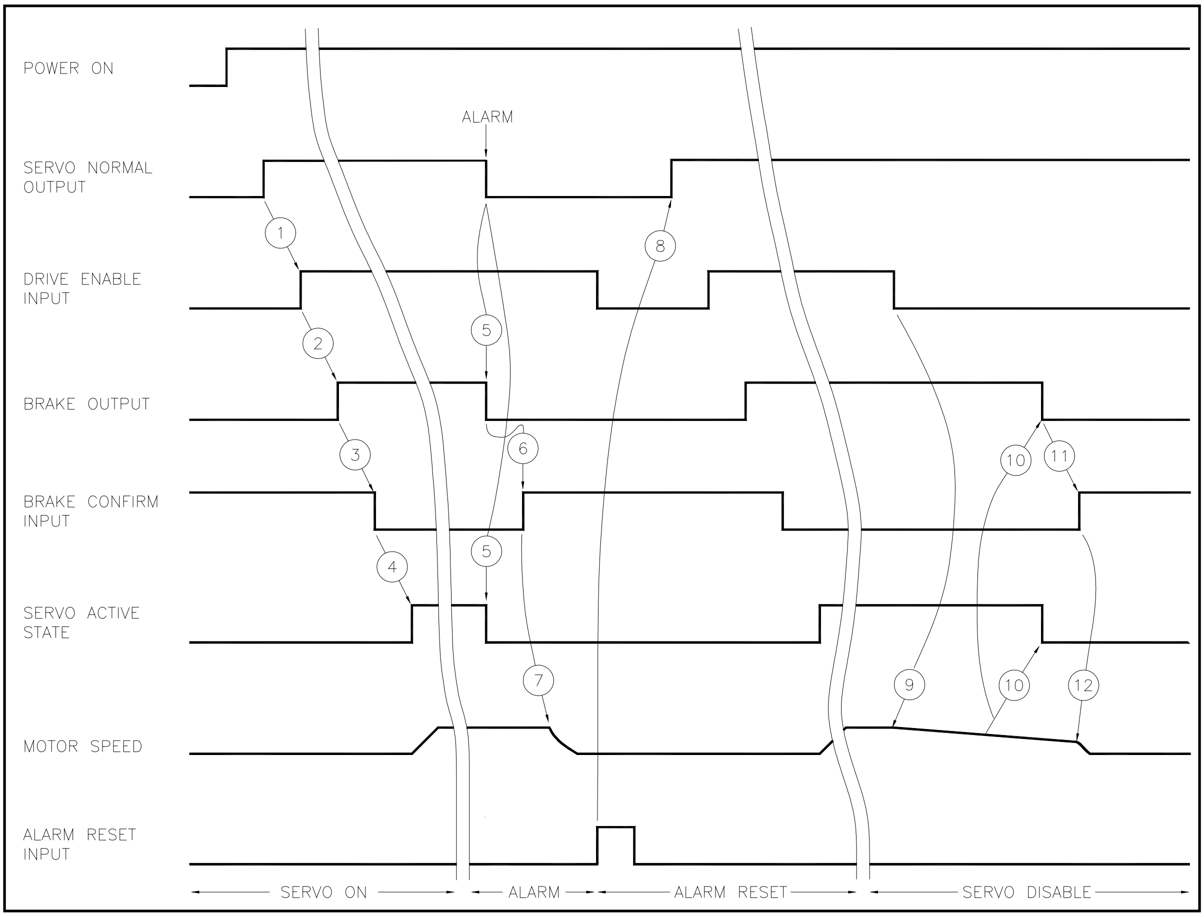


Figure 9.4 - Mechanical Brake Sequencing for Soft Decel

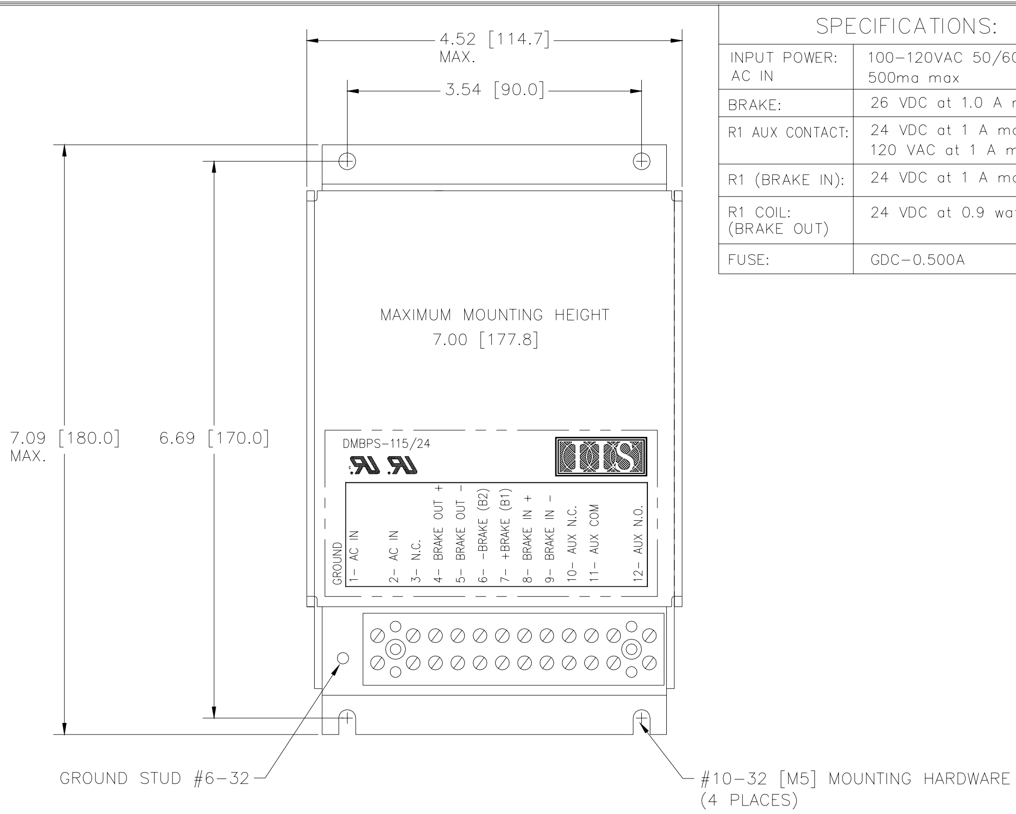
1. DRIVE ENABLE may be turned ON within 0.6 seconds of SERVO NORMAL.
2. BRAKE turns on within 800μsec. of DRIVE ENABLE.
3. BRAKE CONFIRM must be returned within 100ms or AL-14 will be generated.
4. The servo will become active within 800μsec of sensing BRAKE CONFIRM.
5. When an alarm is sensed, the SERVO 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.

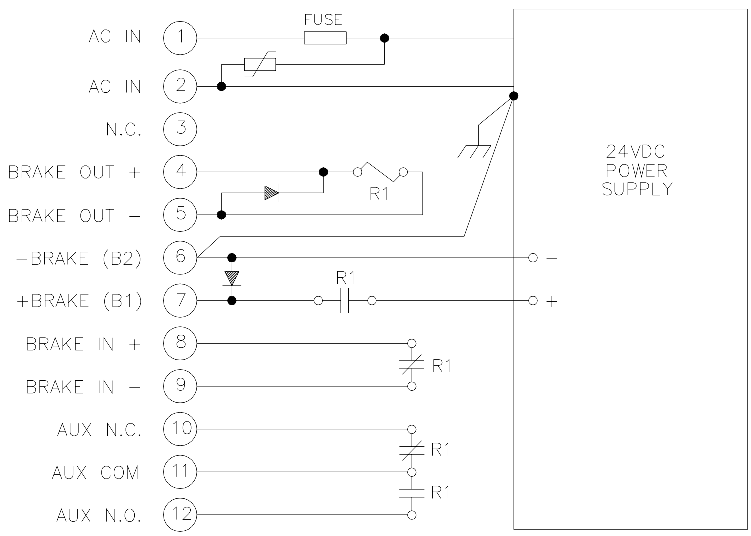
9.4 MECHANICAL BRAKE POWER SUPPLY

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

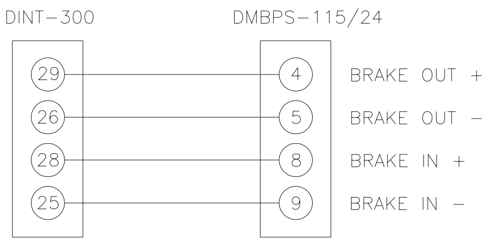




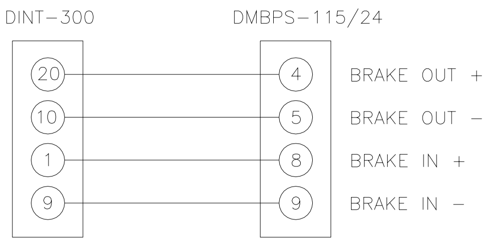
INDUSTRIAL INDEXING SYSTEMS, Inc. www.iis–servo.com	TITLE MECHANICAL BRAKE POWER SUPPLY	
	DRAWING NUMBER DMBPS–115/24	

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:



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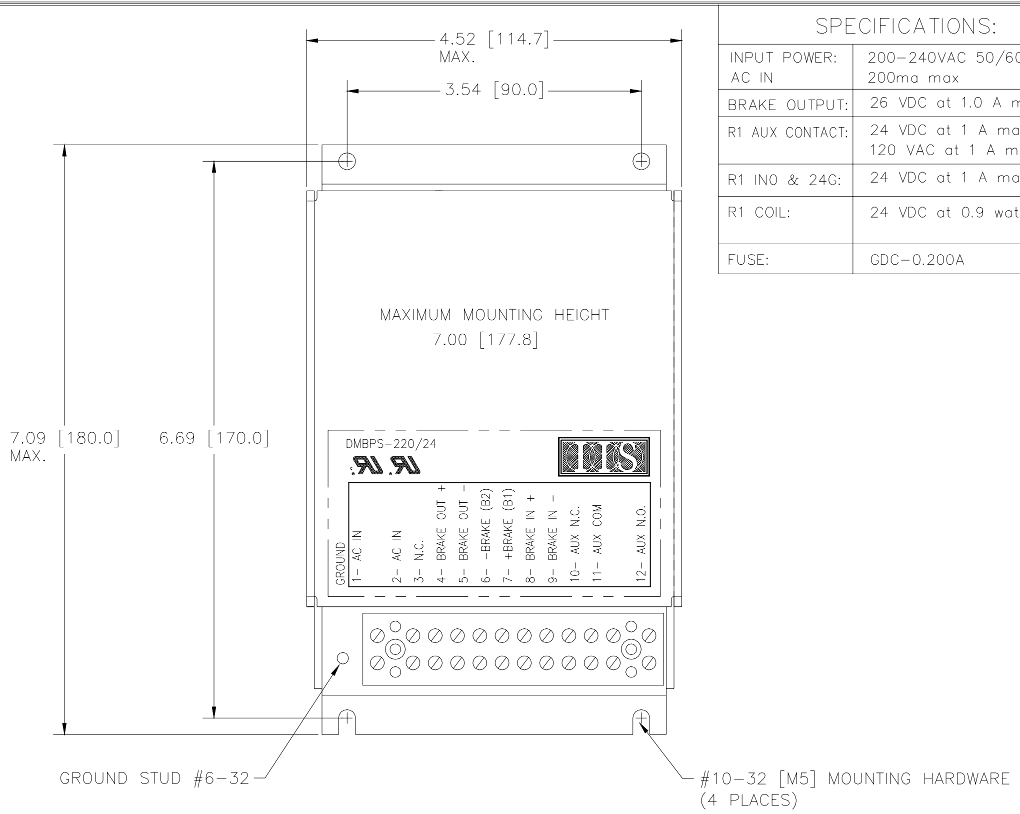
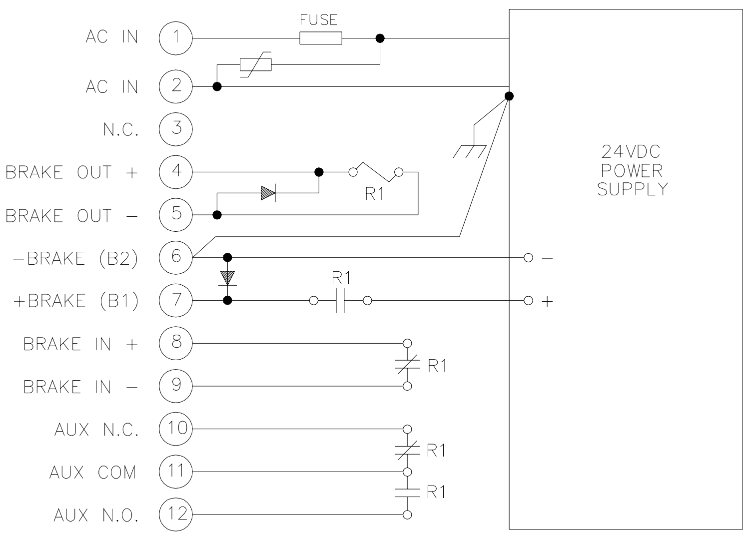
TITLE
MECHANICAL BRAKE POWER SUPPLY

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





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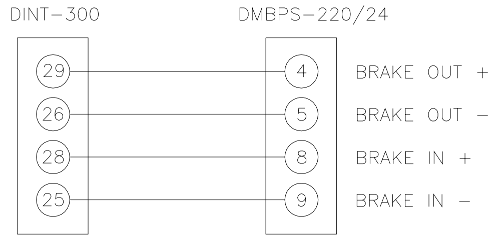
TITLE: MECHANICAL BRAKE POWER SUPPLY

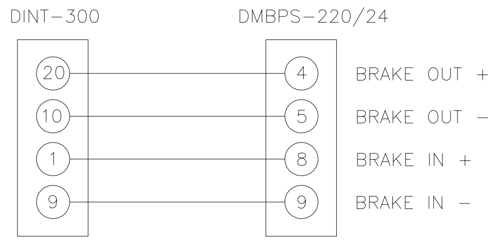
DRAWING NUMBER: DMBPS–220/24

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:



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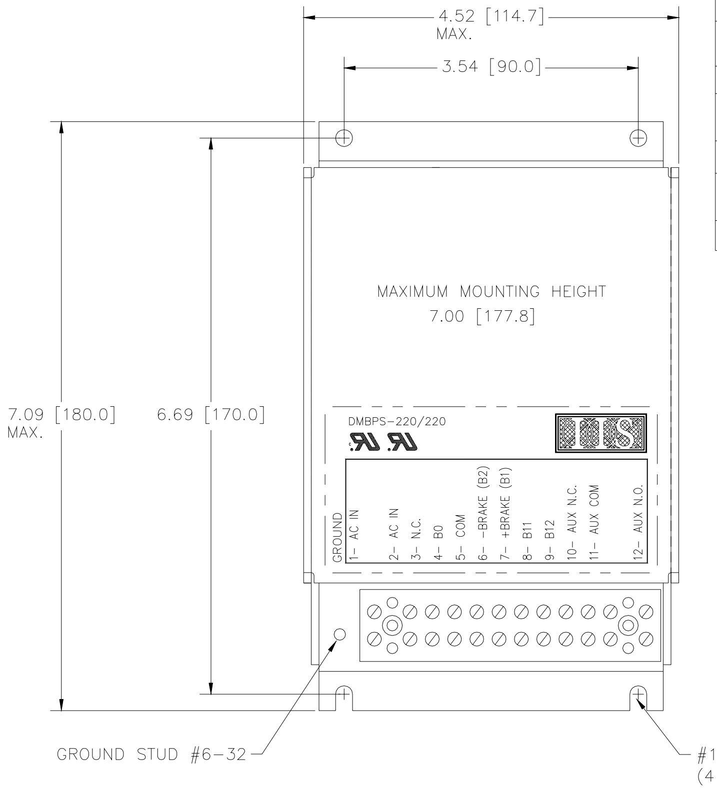
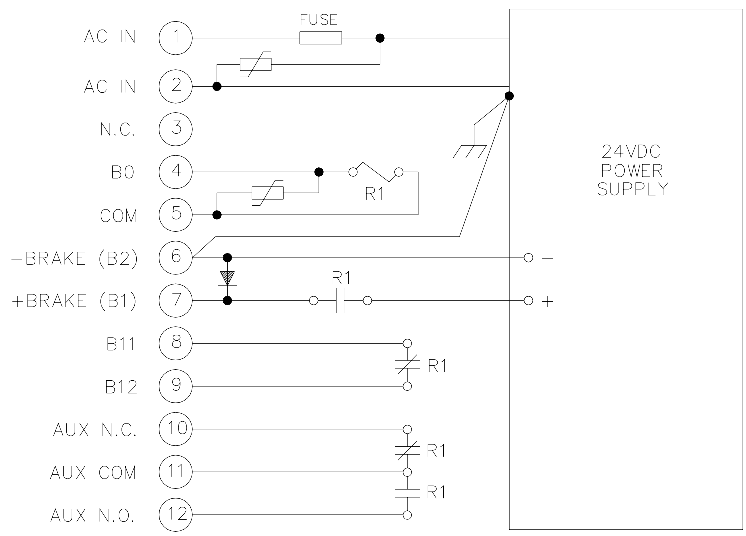
TITLE
MECHANICAL BRAKE POWER SUPPLY

DRAWING NUMBER
DMBPS-220/24

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

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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

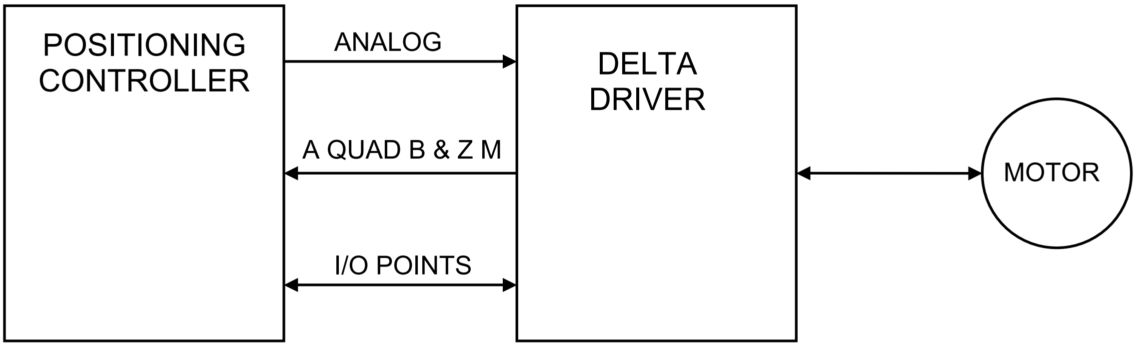
ALARM CODE	DESCRIPTION	REMEDY
HALt	Driver fatal fault	Replace driver.
AL -01 Internal Power Module Error	Driver has detected the following: • Overcurrent • Overheat • Gate voltage drop	Check if the motor wire (A/B/C) is shorted or grounded. Ambient temperature over 55° C. Indicates a fatal fault in the 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.

<u>EMISSIONS STANDARDS:</u>

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

<u>IMMUNITY STANDARDS:</u>

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.

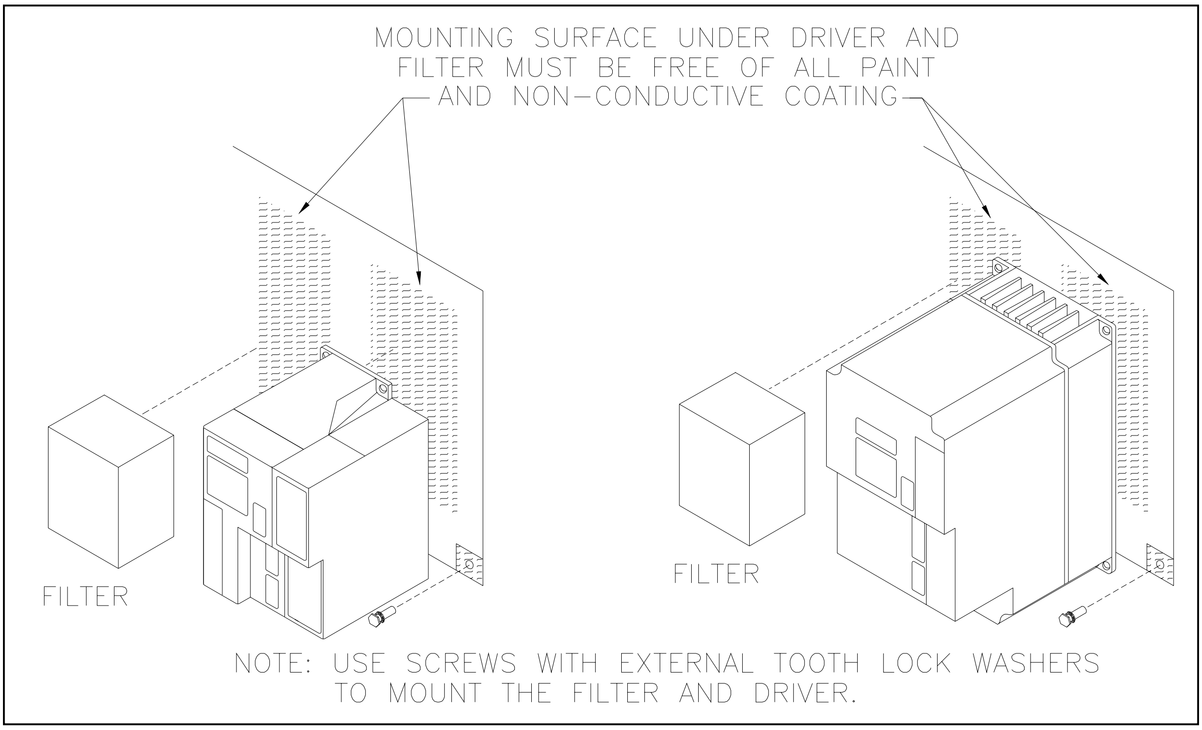


Figure 12.1 - Enclosure Mounting Panel

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.

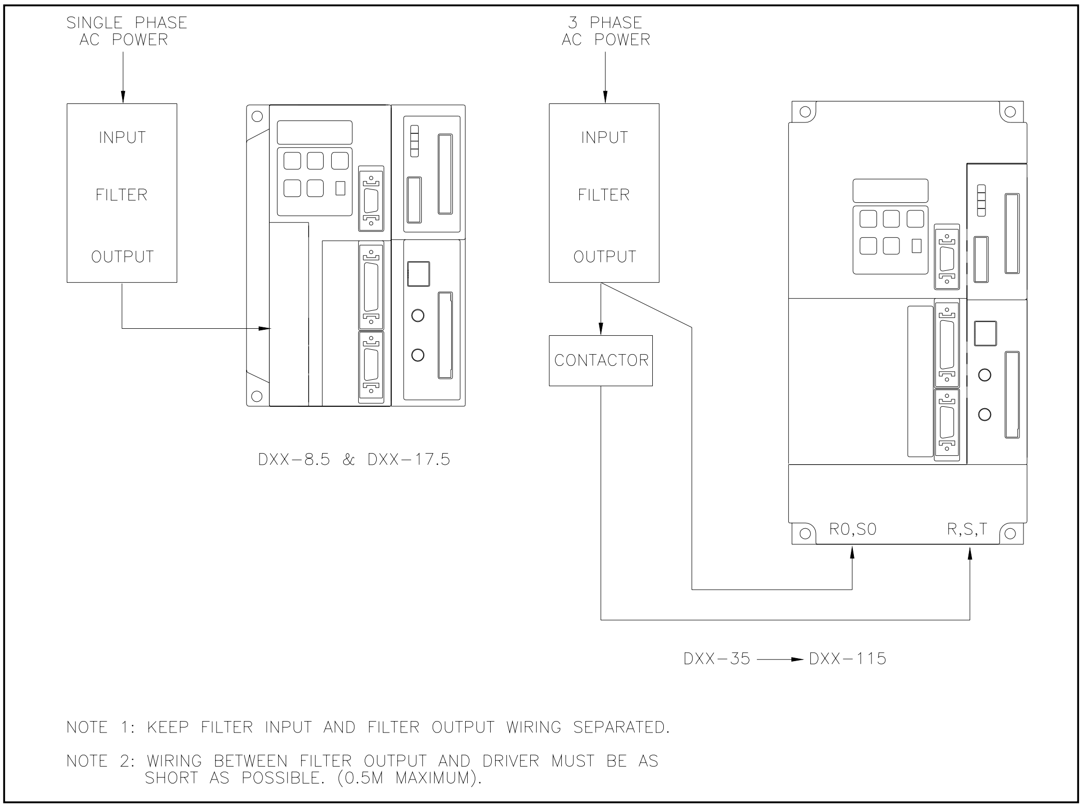


Figure 12.2 - Power Line Filter

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

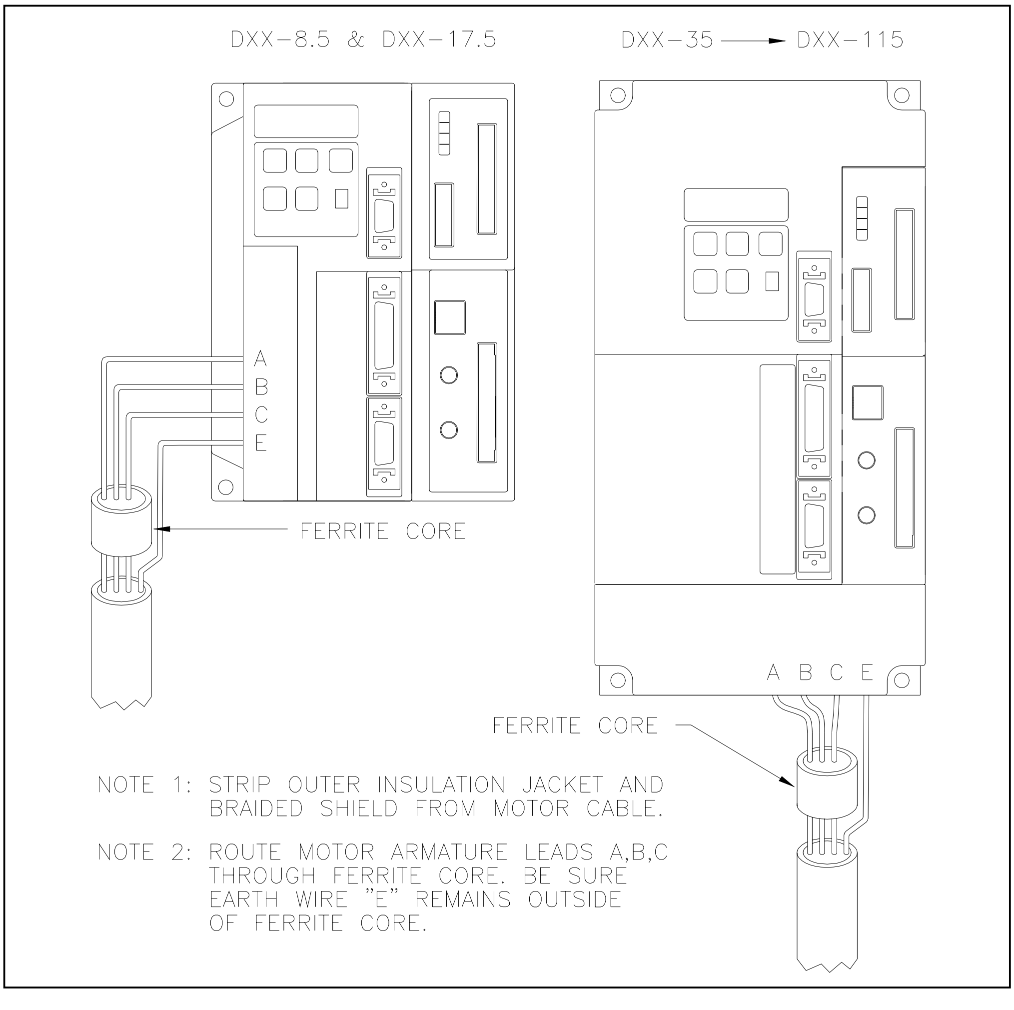


Figure 12.3 - Driver Output (Motor Armature) Filter

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.

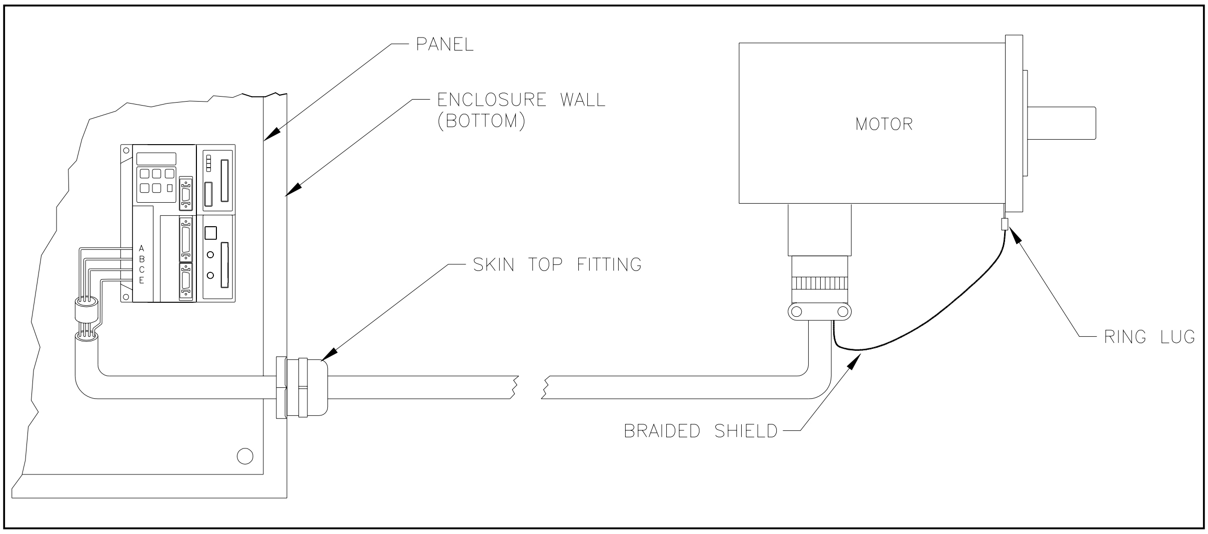


Figure 12.4 - Grounding Motor Armature Cable

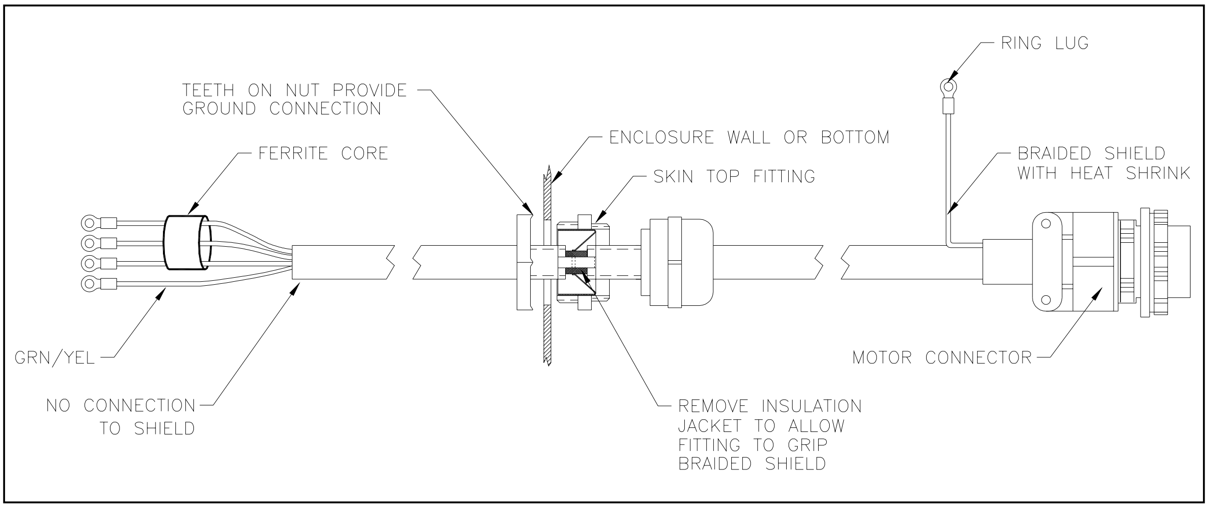


Figure 12.5 - Grounding Motor Armature Cable

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.

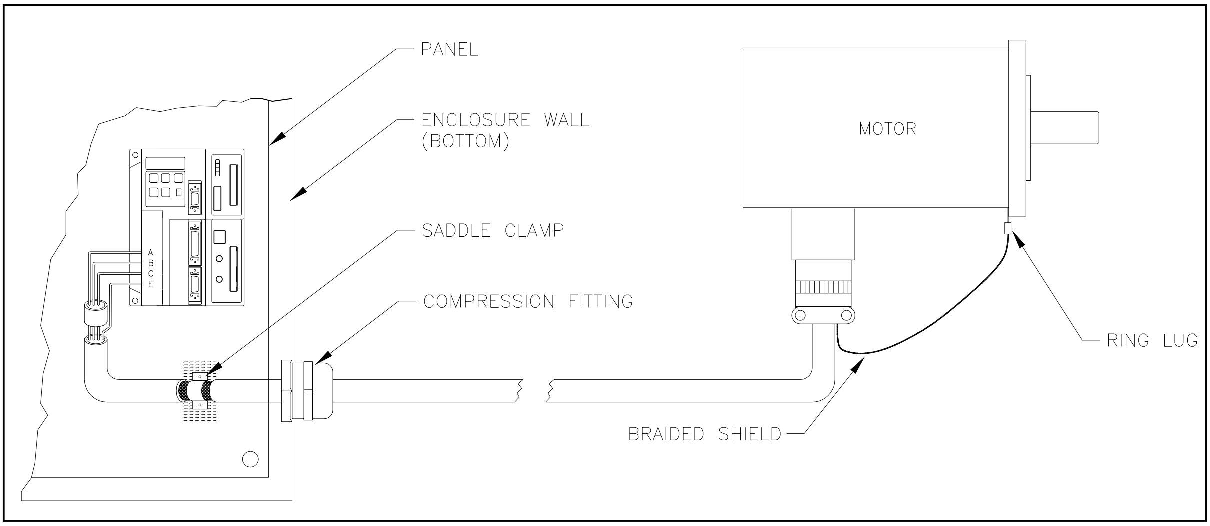


Figure 12.6 - Alternate Method to Ground the Motor Armature Cable

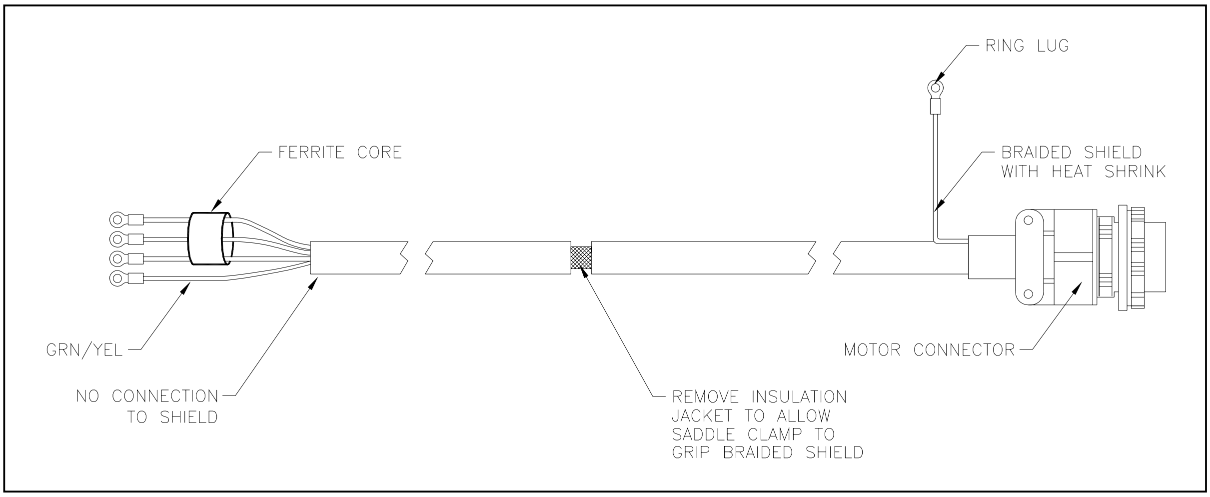


Figure 12.7 - Alternate Method to Ground the Motor Armature Cable

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.

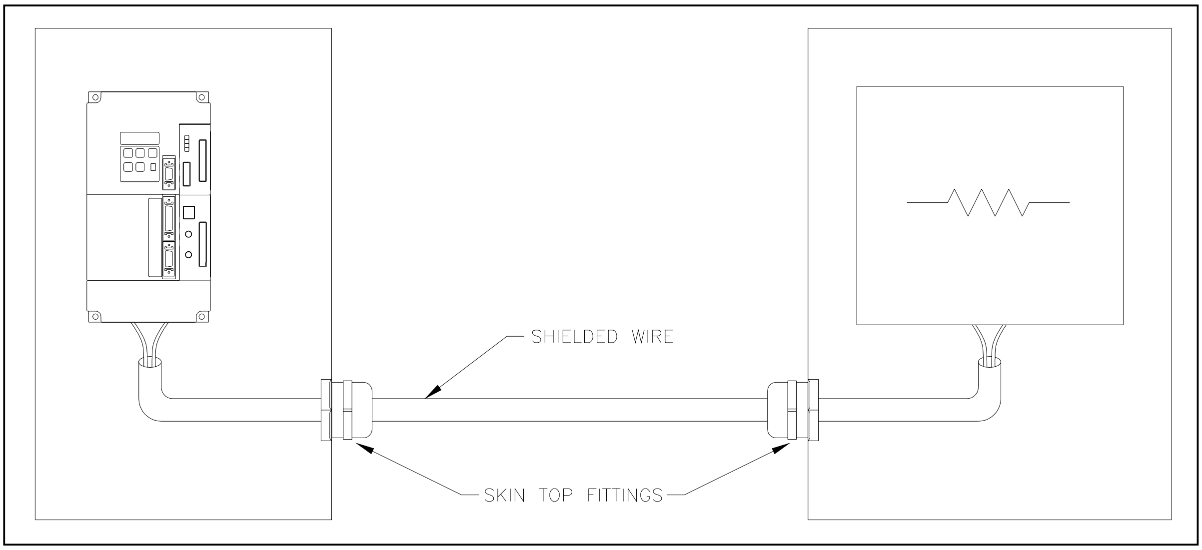


Figure 12.8 - SKINTOP Ground Fittings

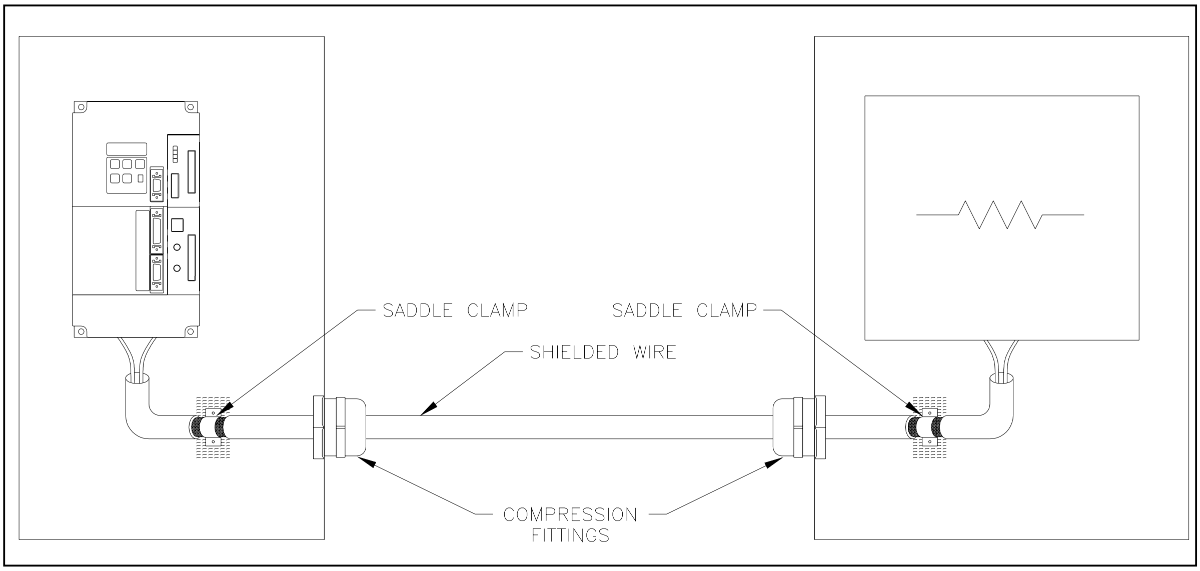


Figure 12.9 - Saddle Clamp Method of Grounding

12.9 DIGITAL CONTROL SIGNALS

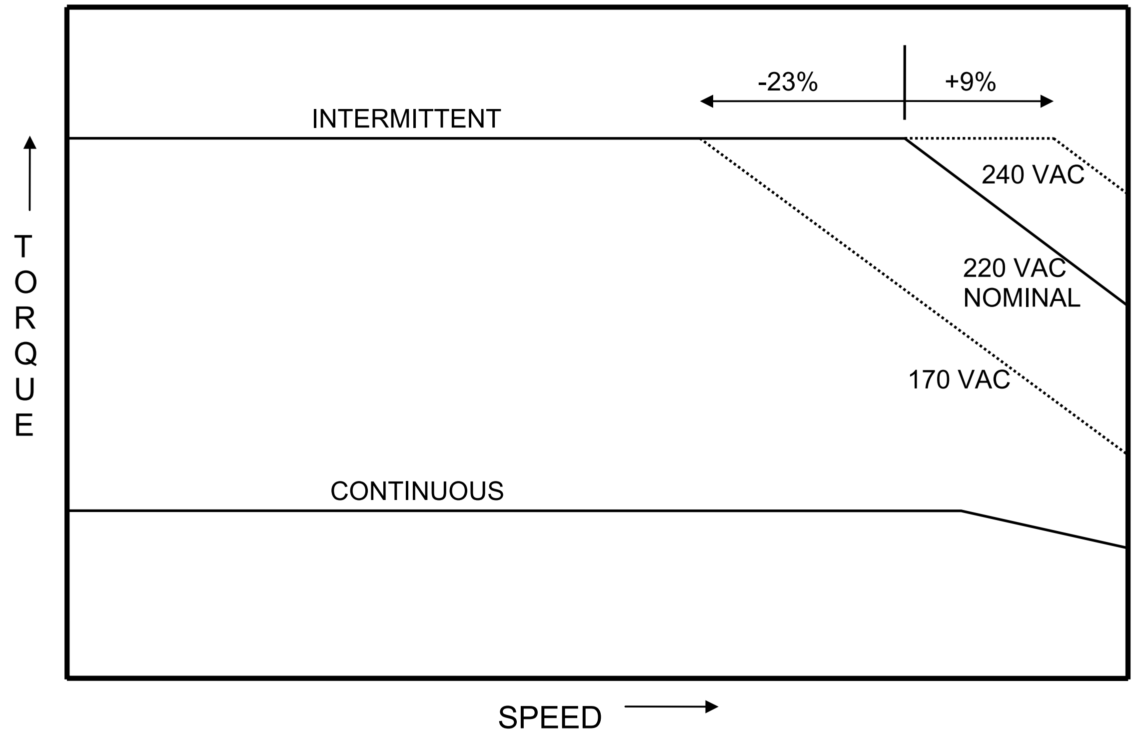
High speed, fast rise time signals used with the Delta driver, such as command pulse inputs or pulse outputs, radiate high frequency noise. This noise must be suppressed to prevent excessive EMC radiation.

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.

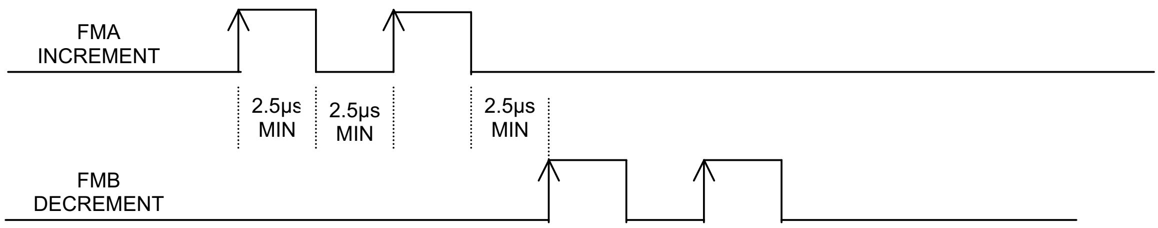
13.2 PULSE INPUT & OUTPUT

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.

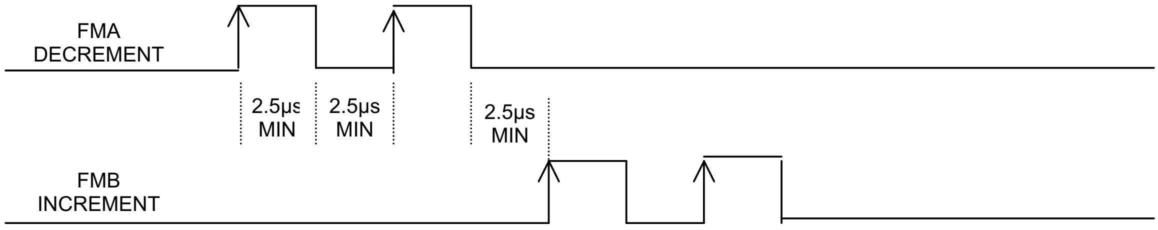
The direction of rotation of the motor is controlled by UP-26. With UP-26 = 0 the motor rotates CCW when the command position is incremented. With UP-26 = 1 the motor rotates CW when the command position is incremented.

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.

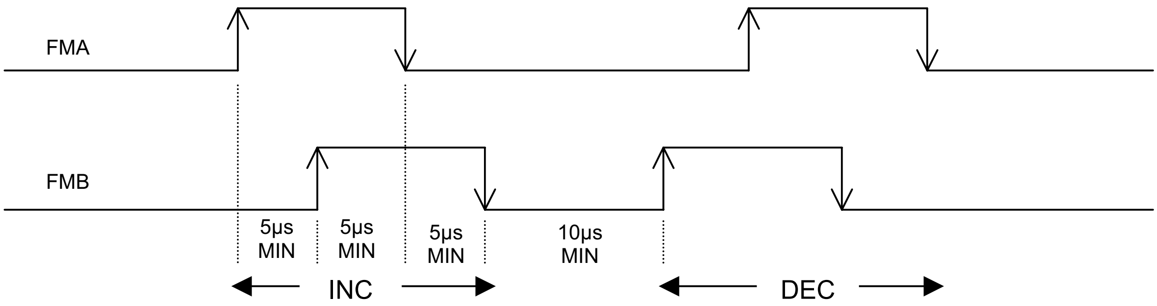


13.2.1 PULSE INPUTS FMA & FMB (cont'd)

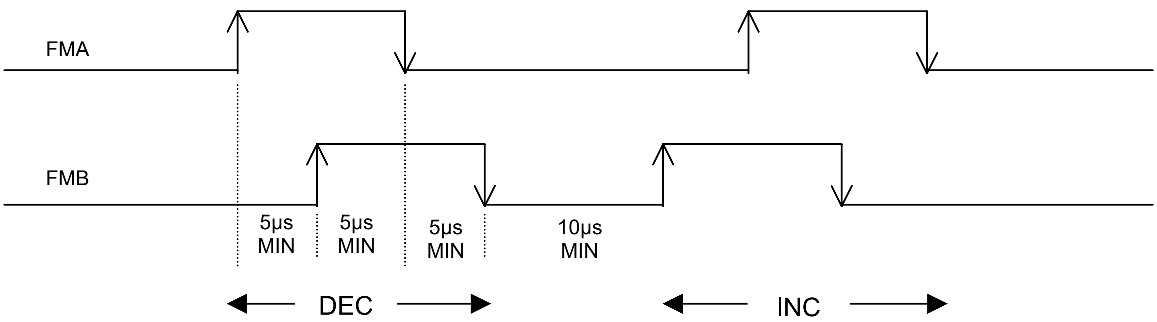
PULSE-PULSE DECODING (UP-18 = 10) where FMA decrements the command position and FMB increments the command position. Maximum frequency of FMA and FMB is 200 KHZ.



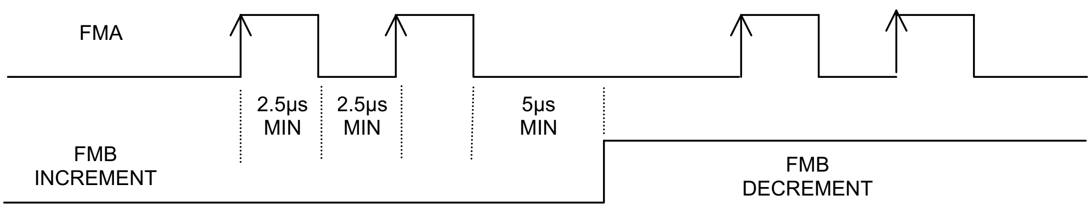
AB QUADRATURE DECODING (UP-18 = 01) where FMA leading FMB increments the command position, FMB leading FMA decrements the command position. Maximum frequency of FMA and FMB is 50 KHZ.



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.

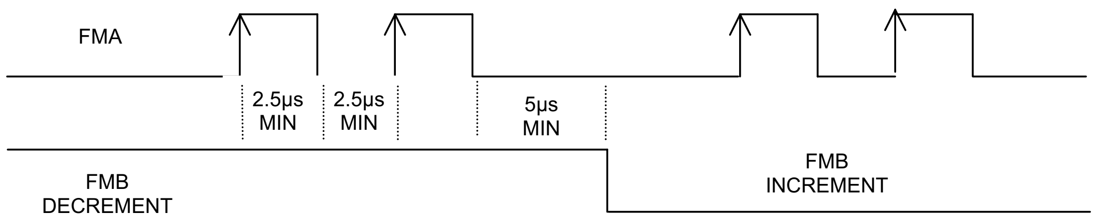


PULSE AND DIRECTION DECODING (UP-18 = 02) where FMA is pulse count and FMB is direction. Maximum frequency of FMA is 200 KHZ.



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.

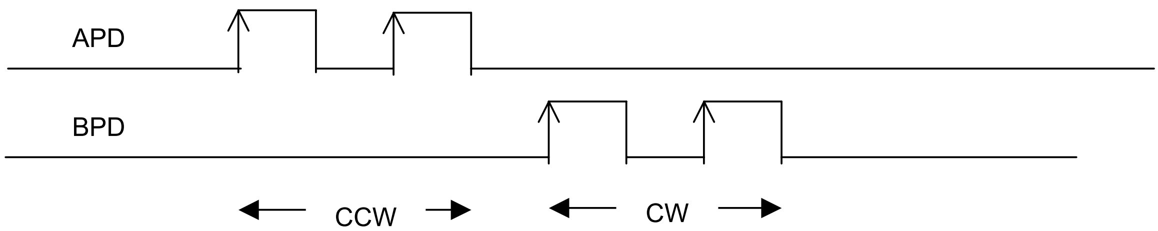


13.2.2 PULSE OUTPUTS APD, BPD & ZPD

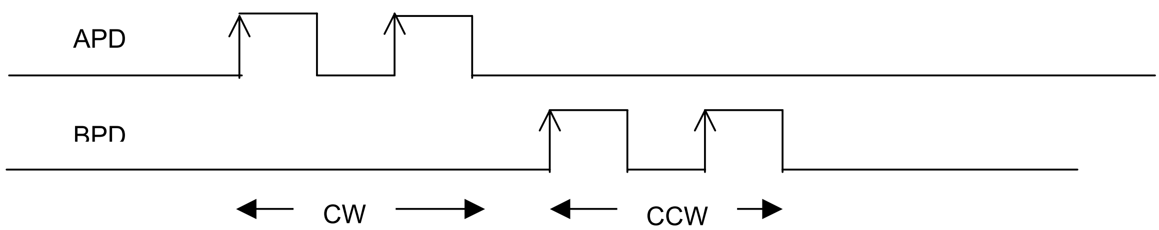
The pulse outputs of the Delta driver, APD, BPD & ZPD, are used primarily to provide motor position to an external controller. These outputs can provide other types of data depending on the setting of UP-20. For the purpose of this application note, UP-20 is assumed to be equal to 0000. The APD, BPD & 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.

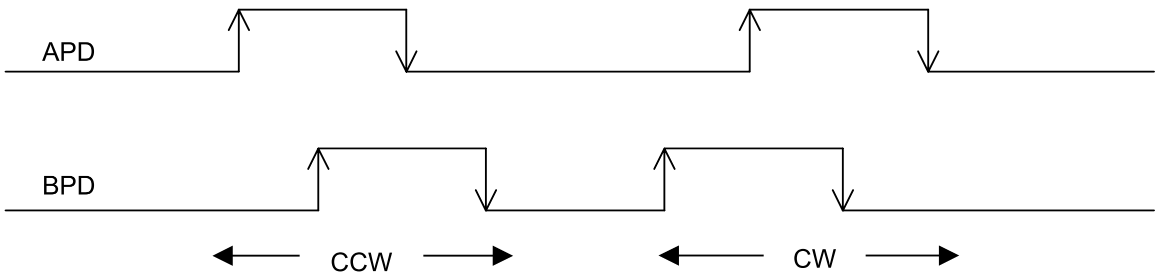


PULSE-PULSE DECODING (UP-19 = 10) where APD pulses when the motor actual position moves CW and BDP pulses when the motor actual position moves CCW. Maximum frequency of FMA and FMB is 400 KHZ.

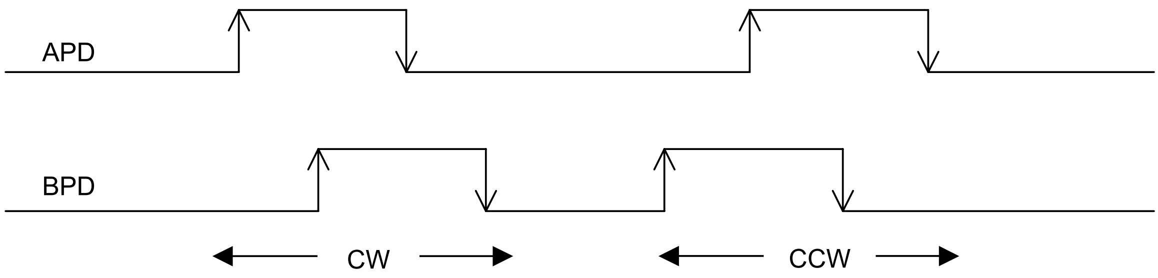


13.2.2 PULSE OUTPUTS APD, BPD & ZPD (cont'd)

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.



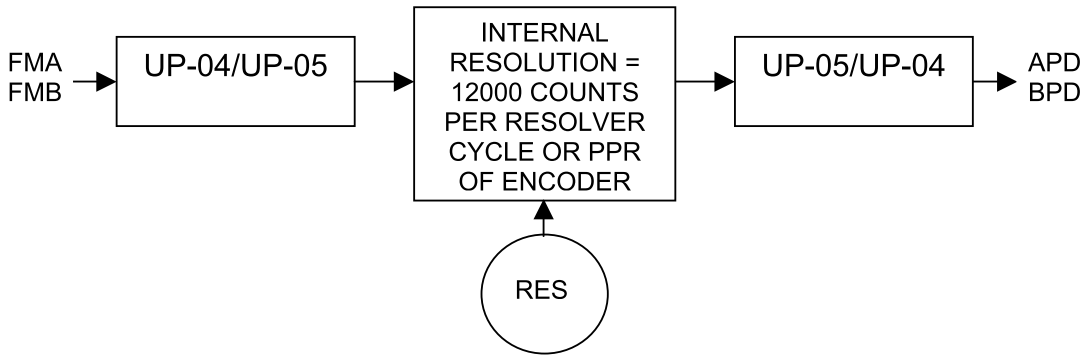
AB QUADRATURE DECODING (UP-19 = 11) where BPD leads APD for CCW motor rotation. Maximum frequency of APD and BPD is 100 KHZ. This mode simulates an encoder output being read as 4X.



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

INDUSTRIAL INDEXING SYSTEMS INC.

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VICTOR, NEW YORK 14564

(585) 924-9181
FAX: (585) 924-2169

SU-065110

AMPLIFIER SET-UP APRIL 2002

DSD-8.5/RAI
(500W)

AMPLIFIER
SET-UP

XL6000M
(X-AXIS)

ABM INTERNATIONAL

Revision - C
Approved By:

USER PARAMETER	FUNCTION	RANGE	APPLICATION
UP-01	Control Mode	00~FF	1
UP-02	Applicable Motor	000~FFFF	1308
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
UP-12	Soft Start Acceleration Time	0~32.76 sec	0
UP-13	Soft Start Deceleration Time	0~32.76 sec	0
UP-14	S-curve Accel/Decel Time	0~32.76 sec	0
UP-15	ABS Clear	0~2	0
UP-16	Brake Mode	0~2	0
UP-17	Analog Command Polarity	00~11	0
UP-19	Pulse Output Type	00~11	01
UP-20	Differential Output Type	0000-5533	0
UP-25	Monitor Output Type	000~111	010
UP-28	Brake ON RPM	0~100.0%	100
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
AJ1	Speed Command Span Adj.	3~10.00v	7.00
*AJ2	Load Inertial Magnification	0~100.0 times	4.0
*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
AJ6	Current Command Span Adj.	3~10.00v	10
AJ7	Gain Reduction While Stopped	0~10000	0
AJ9	Current Command Filter	100~20000 rad/s	6000

*Auto tuning affects these parameters

SU-065111

AMPLIFIER SET-UP APRIL 2002

DSD-8.5/RAI
(500W)

AMPLIFIER
SET-UP

XL6000M
(Y-AXIS)

ABM INTERNATIONAL

Revision - C
Approved By:

USER PARAMETER	FUNCTION	RANGE	APPLICATION
UP-01	Control Mode	00~FF	1
UP-02	Applicable Motor	000~FFFF	1308
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
UP-12	Soft Start Acceleration Time	0~32.76 sec	0
UP-13	Soft Start Deceleration Time	0~32.76 sec	0
UP-14	S-curve Accel/Decel Time	0~32.76 sec	0
UP-15	ABS Clear	0~2	0
UP-16	Brake Mode	0~2	0
UP-17	Analog Command Polarity	00~11	0
UP-19	Pulse Output Type	00~11	01
UP-20	Differential Output Type	0000-5533	0
UP-25	Monitor Output Type	000~111	010
UP-28	Brake ON RPM	0~100.0%	100
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
AJ1	Speed Command Span Adj.	3~10.00v	7.00
*AJ2	Load Inertial Magnification	0~100.0 times	3.0
*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
AJ6	Current Command Span Adj.	3~10.00v	10
AJ7	Gain Reduction While Stopped	0~10000	0
AJ9	Current Command Filter	100~20000 rad/s	6000

*Auto tuning affects these parameters

DSD-8.5/EAI
(630W)

AMPLIFIER
SET-UP

XL6000M
(NEEDLE)

ABM INTERNATIONAL

Revision - E
Approved By:

USER PARAMETER	FUNCTION	RANGE	APPLICATION
UP-01	Control Mode	00~FF	5
UP-02	Applicable Motor	000~FFFF	805
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
UP-12	Soft Start Acceleration Time	0~32.76 sec	0.44
UP-13	Soft Start Deceleration Time	0~32.76 sec	0.44
UP-14	S-curve Accel/Decel Time	0~32.76 sec	0
UP-15	ABS Clear	0~2	0
UP-16	Brake Mode	0~2	0
UP-17	Analog Command Polarity	00~11	0
UP-19	Pulse Output Type	00~11	11
UP-20	Differential Output Type	0000-5533	0
UP-21	No. 1 Feed Speed	0~100.00%	0
UP-22	No. 2 Feed Speed	0~100.00%	2.5
UP-23	No. 3 Feed Speed	0~100.00%	0.5
UP-24	No. 4 Feed Speed	0~100.00%	1.5
UP-25	Monitor Output Type	000~111	010
UP-28	Brake ON RPM	0~100.0%	100
UP-29	Motor Test RPM	1~4000 rpm	10
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

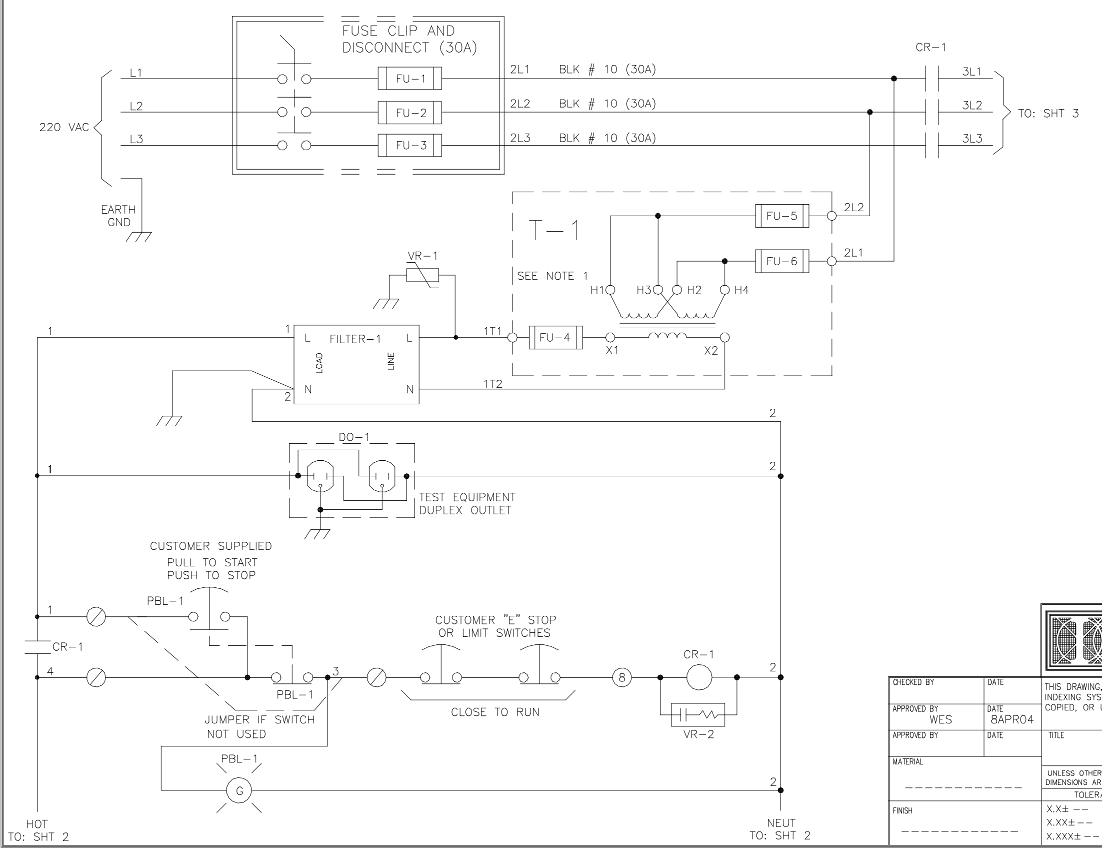
ADJUSTMENT	FUNCTION	RANGE	APPLICATION SETTING
AJ0	Speed Command Zero Adj.	±10.00v	0
AJ1	Speed Command Span Adj.	3~10.00v	7
*AJ2	Load Inertial Magnification	0~100.0 times	5
*AJ3	High Speed Response	0.1~20.0	0.1
*AJ4	Position Gain	1~200 rad/s	30
AJ5	Current Command Zero Adj.	±10.00v	0
AJ6	Current Command 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

NOTES:

1) CONNECT H1 TO H3 AND H2 TO H4 FOR 230 VAC LINE.

DATE	SYM	REVISION RECORD	DR	CK	CK
07APR04	0	PER ECN 04-113	CWB	WES	
14DEC04	A	PER ECN 04-515	EB	WES	
24JUN05	B	PER ECN 05-243	CWB		



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CHECKED BY	DATE
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TITLE	INTERCONNECTION
MATERIAL	------------
FINISH	------------
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY: BOWMAN
TOLERANCES: X.X± -- X.XX± -- X.XXX± --	ANGULAR: ± --
AutoCAD FILE LOCATION	Q\CURRENT DWGS
DRAWING NUMBER	IC-565009
SIZE	B
DATE	07APR04
SCALE	NTS
SHEET NO.	1 OF 8
REVISION	B

DATE	SYM	REVISION RECORD	DR	CK	CK
07APR04	0	PER ECN 04-113	CWB	WES	
14DEC04	A	PER ECN 04-515	EB	WES	
24JUN05	B	PER ECN 05-243	CWB		

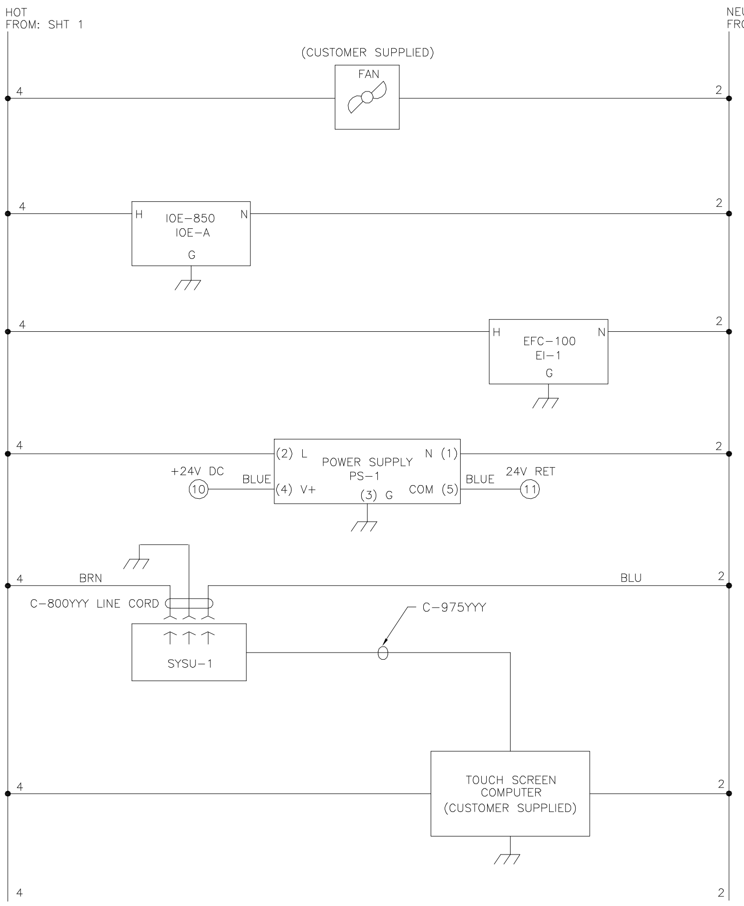


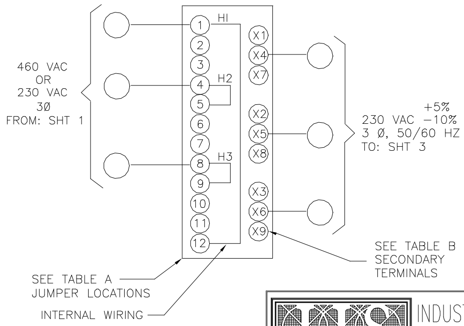
TABLE A

LOW VAC OPERATION JUMPER	HIGH VAC OPERATION 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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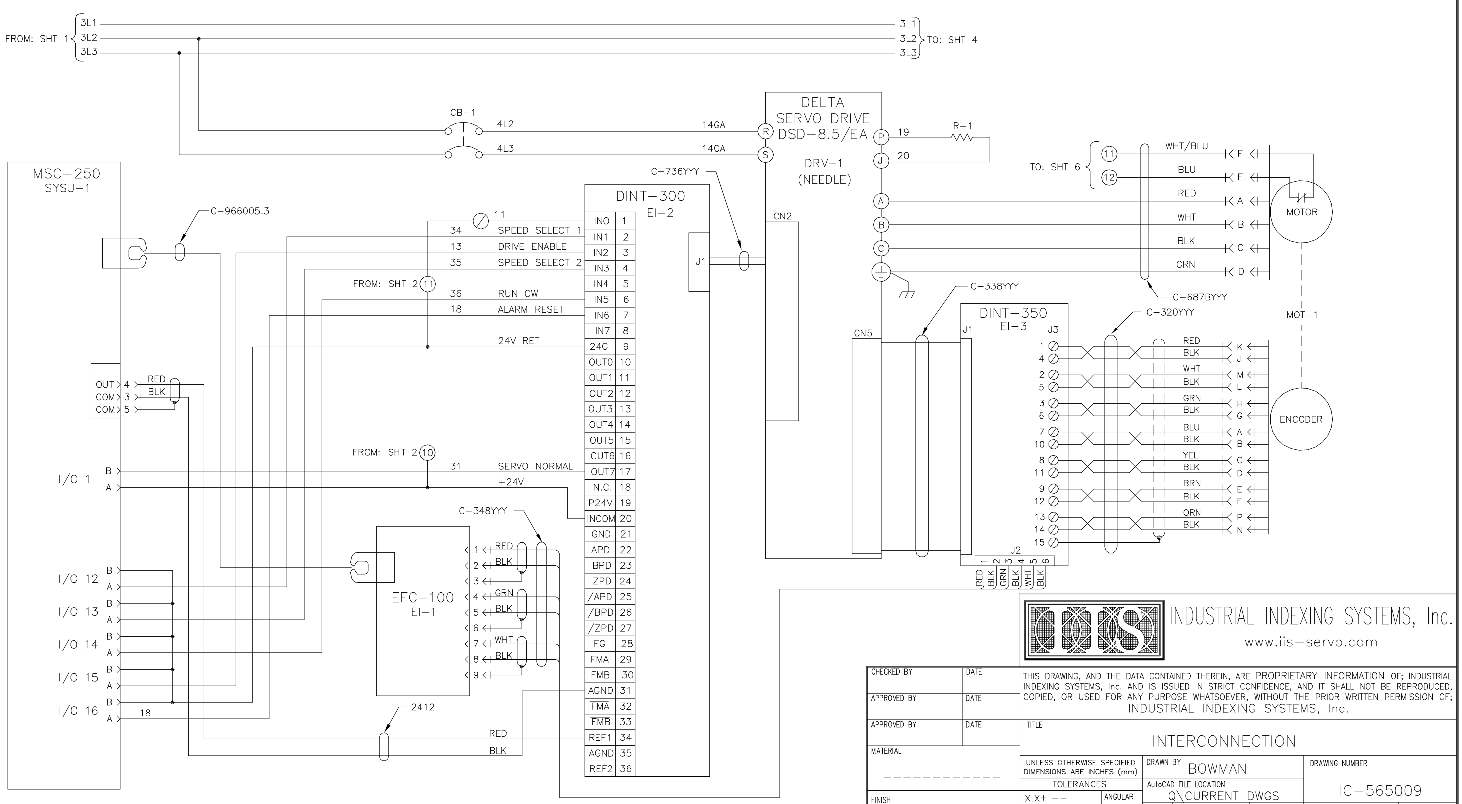
DATE	SYM	REVISION RECORD	DR	CK	CK
07APR04	0	PER ECN 04-113	CWB	WES	
14DEC04	A	PER ECN 04-515	EB	WES	
24JUN05	B	PER ECN 05-243	CWB		



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MATERIAL ------------	
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TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)

TOLERANCES: X.X± -- X.XX± -- X.XXX± -- ANGULAR ± --

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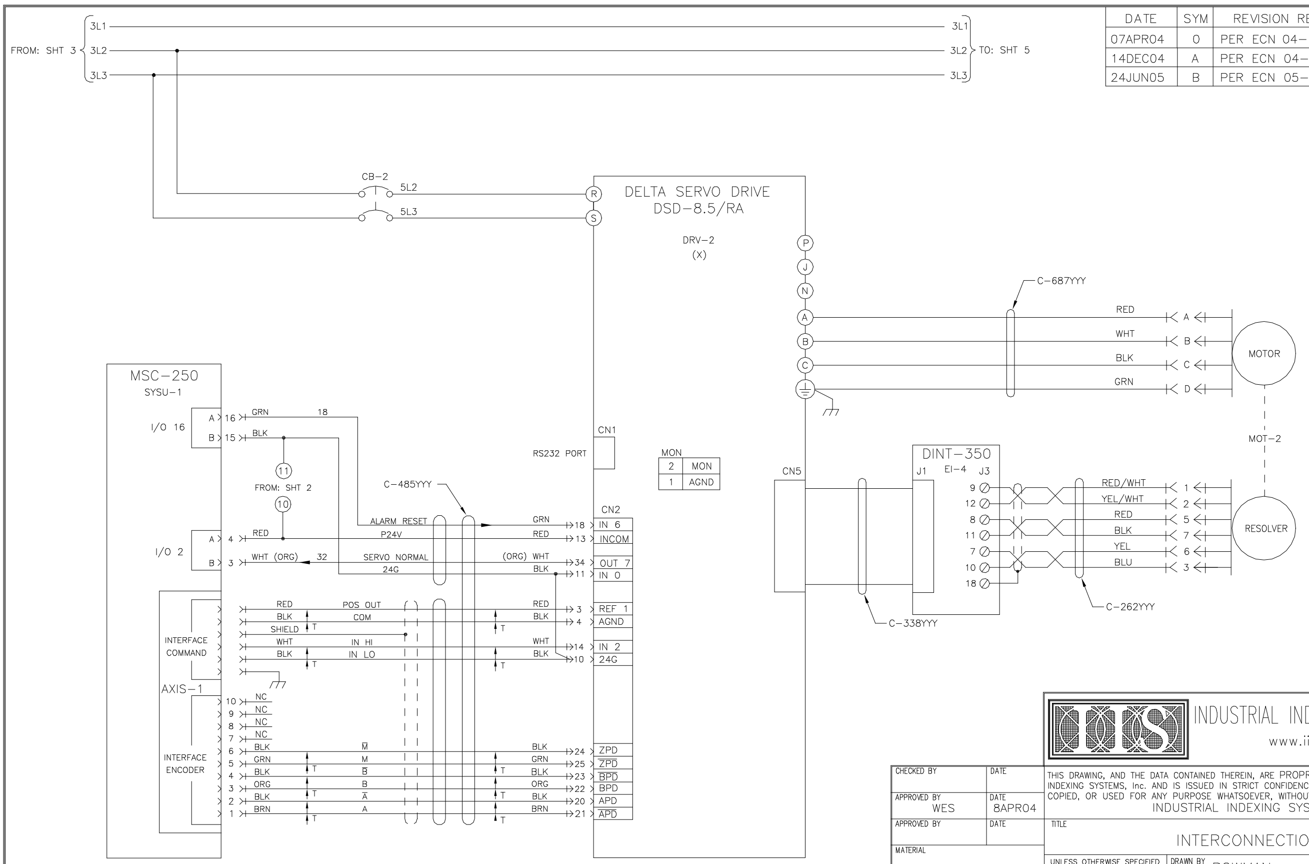
AutoCAD FILE LOCATION: Q\CURRENT DWGS

DRAWING NUMBER: IC-565009

B | DATE: 07APR04 | SCALE: NTS | SHEET NO. 3 OF 8 | REVISION: B

DATE	SYM	REVISION RECORD	DR	CK	CK
07APR04	0	PER ECN 04-113	CWB	WES	
14DEC04	A	PER ECN 04-515	EB	WES	
24JUN05	B	PER ECN 05-243	CWB		



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APPROVED BY	DATE	TITLE INTERCONNECTION

MATERIAL ------------

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TOLERANCES: X.X± -- ; X.XX± -- ; X.XXX± -- ; ANGULAR ± --

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SHEET NO. 4 OF 8

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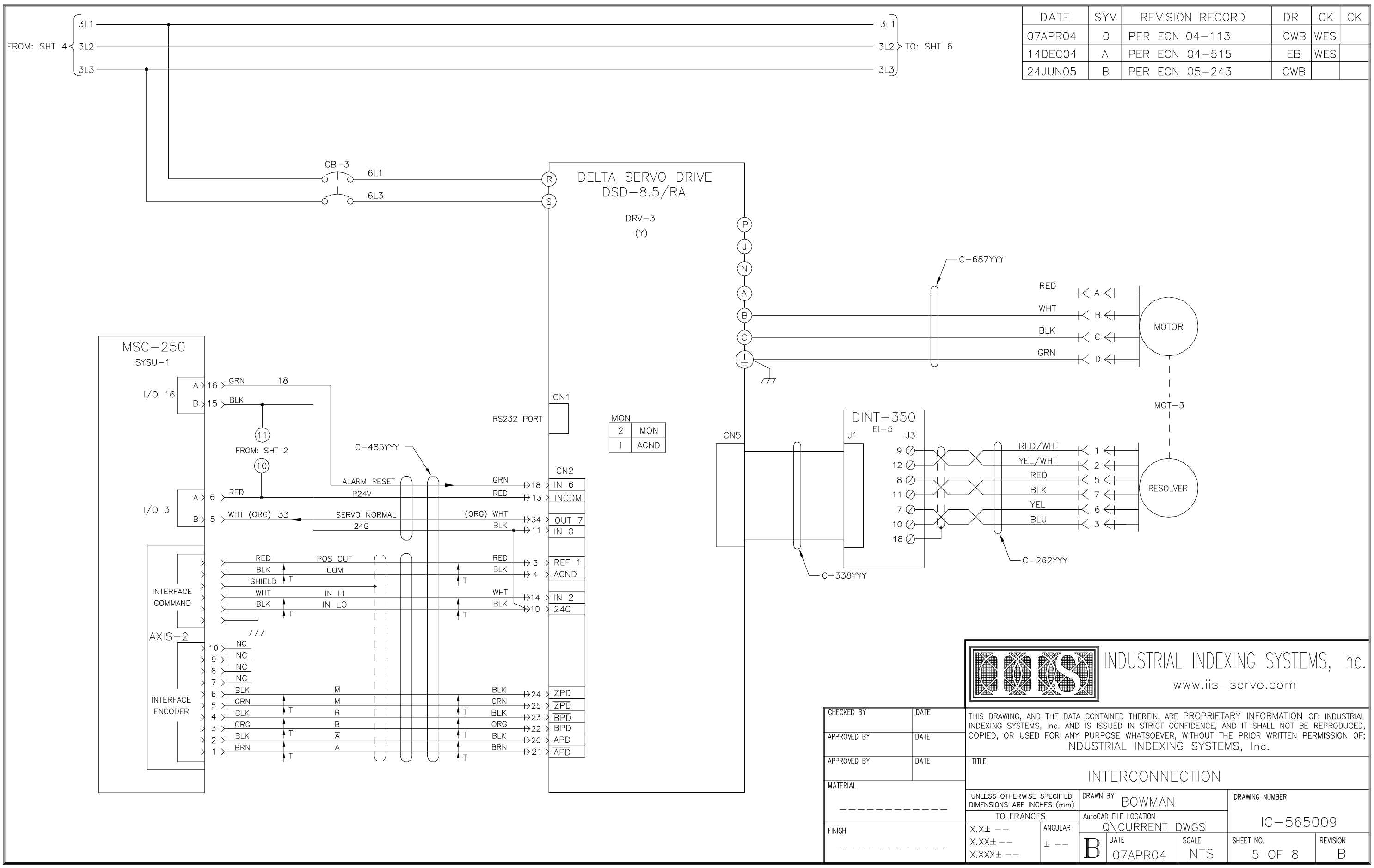

DATE	SYM	REVISION RECORD	DR	CK	CK
07APR04	0	PER ECN 04-113	CWB	WES	
14DEC04	A	PER ECN 04-515	EB	WES	
24JUN05	B	PER ECN 05-243	CWB		

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APPROVED BY	DATE
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TITLE: INTERCONNECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)

TOLERANCES: X.X± -- ; X.XX± -- ; X.XXX± -- ; ANGULAR ± --

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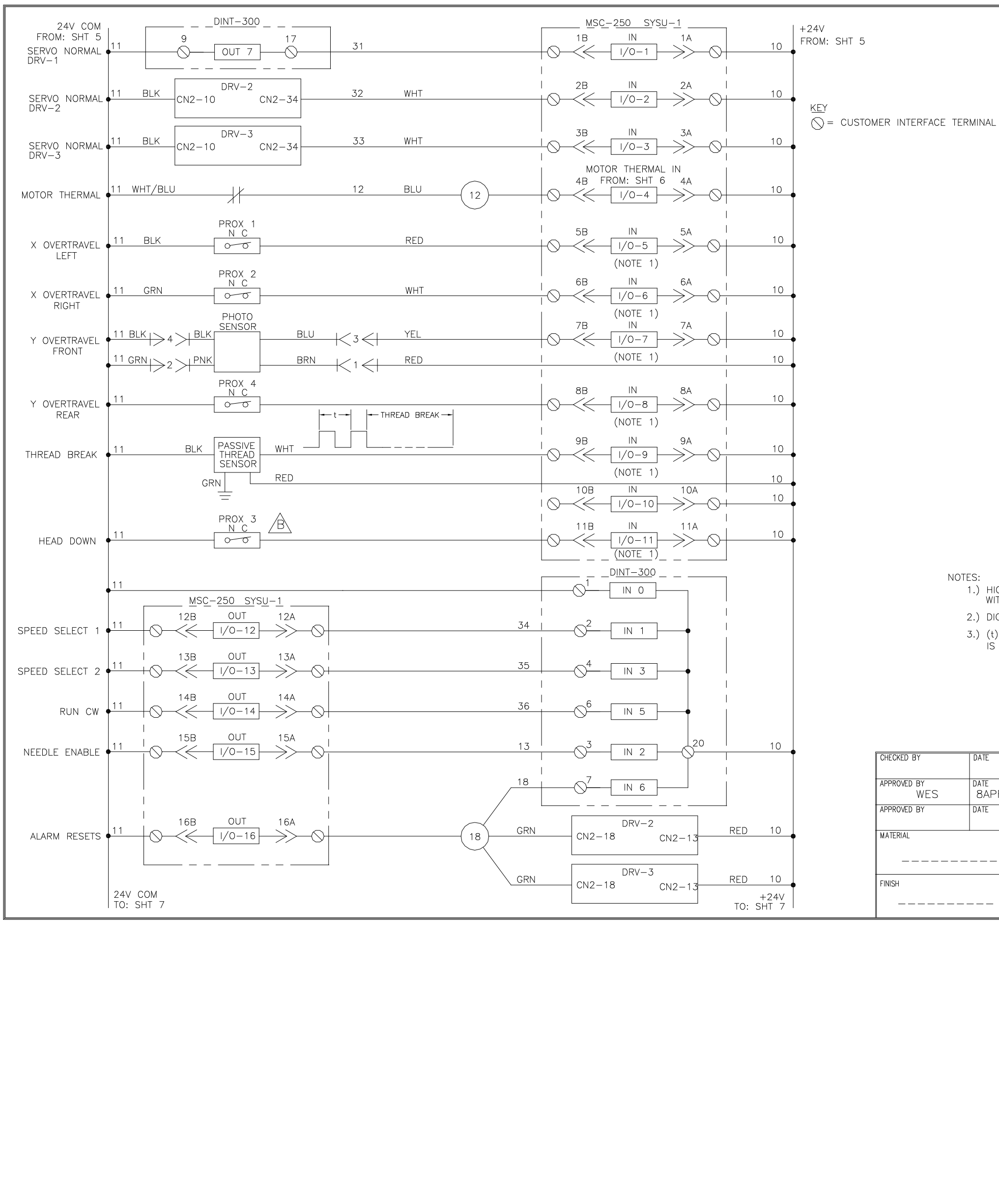
DATE	SYM	REVISION RECORD	DR	CK	CK
07APR04	0	PER ECN 04-113	CWB	WES	
14DEC04	A	PER ECN 04-515	EB	WES	
24JUN05	B	PER ECN 05-243	CWB		



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.
3.) (t) REPRESENTS THREAD BREAK DELAY WHICH IS SET FROM THE PARAMETER SCREEN.

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TOLERANCES: X.X± --- / X.XX± --- / X.XXX± ---	ANGULAR: ± ---
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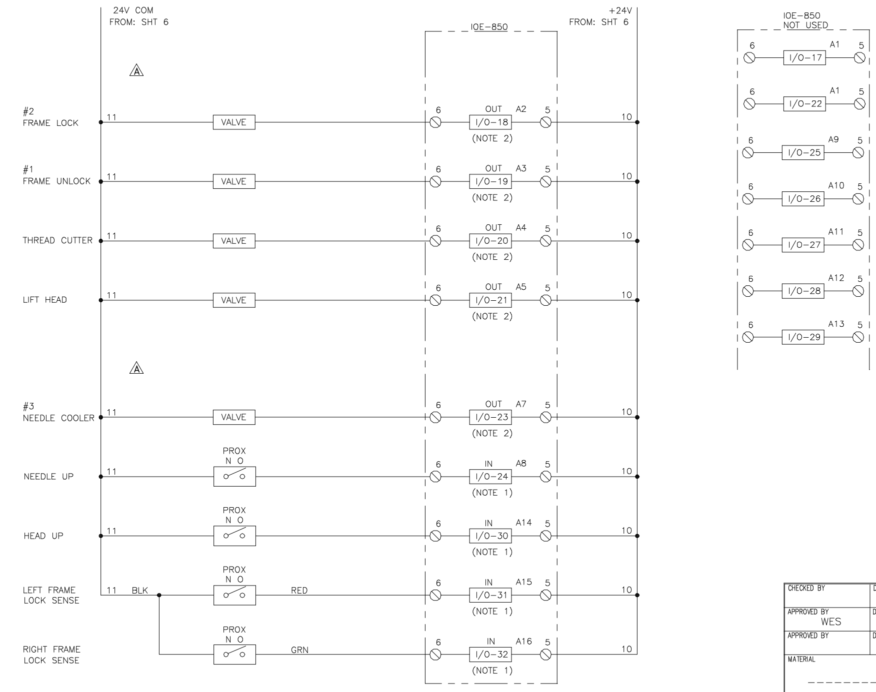
DRAWING NUMBER	IC-565009
SIZE	B
DATE	07APR04
SCALE	---
SHEET NO.	6 OF 8
REVISION	B

NOTES:
1.) HIGH OFF-STATE VOLTAGES MUST BE SHUNTED WITH A 1K OHM 1 WATT RESISTOR.
2.) DIODE IS REQUIRED FOR INDUCTIVE LOADS.

KEY
⦸ = CUSTOMER INTERFACE TERMINAL

DATE	SYM	REVISION RECORD	DR	CK	CK
07APR04	0	PER ECN 04-113	CWB	WES	
14DEC04	A	PER ECN 04-515	EB	WES	
24JUN05	B	PER ECN 05-243	CWB		



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TITLE	INTERCONNECTION
MATERIAL	----------
FINISH	----------
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	
TOLERANCES	X.X± --- / X.XX± --- / X.XXX± ---
ANGULAR	± ---
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SCALE	---
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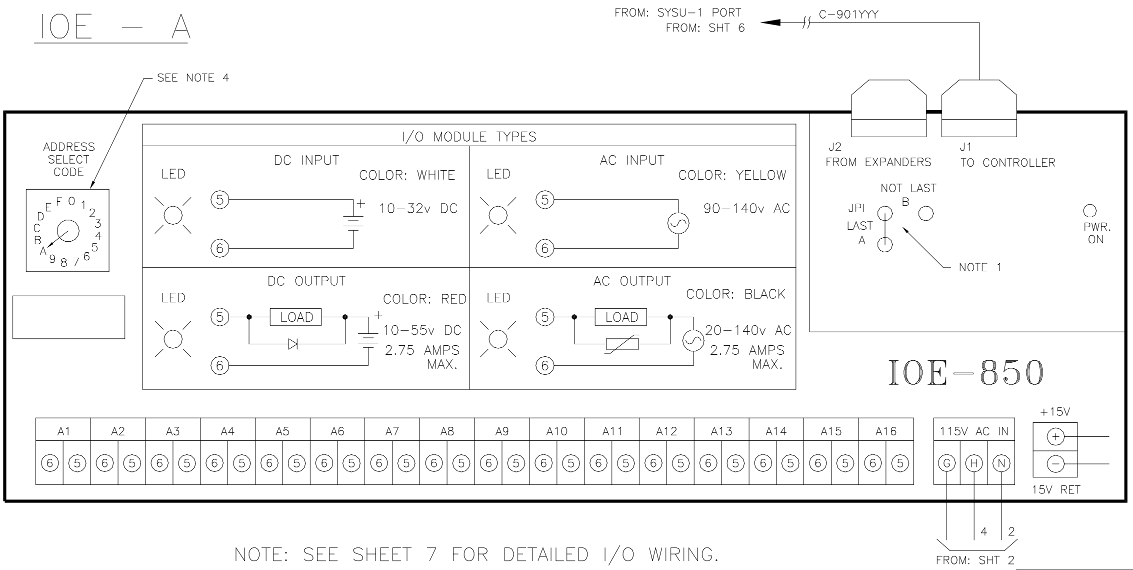
REVISION	B

DATE	SYM	REVISION RECORD	DR	CK	CK
07APR04	0	PER ECN 04-113	CWB	WES	
14DEC04	A	PER ECN 04-515	EB	WES	
24JUN05	B	PER ECN 05-243	CWB		

IOE — A



NOTE: SEE SHEET 7 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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DRAWN BY BOWMAN
AutoCAD FILE LOCATION Q:\CURRENT DWGS
B | DATE 07APR04 | SCALE NTS
DRAWING NUMBER IC-565009
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