



# Setup and Operation for the Hardinge® Indexer Control

Software Version A  
Original U.S.A. Instructions

## Safety Recommendations

**READ COMPLETE INSTRUCTIONS CAREFULLY BEFORE OPERATING THIS UNIT.** Note: Equipment refers to the Hardinge Indexer Control, indexer and/or machine it is used with.

When this instruction book was printed, the information given was current. However, since we are constantly improving the design of our products, it is possible that the illustrations and descriptions may vary from the system.

### - WARNING -

Occupational Safety and Health Administration (OSHA) Hazard Communication Standard 1910.1200, effective May 25, 1986, and various state "employee right-to-know laws" require that information regarding chemicals used with this equipment be supplied to you.

### HARDINGE SAFETY RECOMMENDATIONS

Your Hardinge Indexer Control is designed and built for maximum ease and safety of operation. However, some previously accepted shop practices may not reflect current safety regulations and procedures, and should be re-examined to insure compliance with the current safety and health standards.

Hardinge Inc. recommends that all shop supervisors, maintenance personnel, and machine tool operators be advised of the importance of safe maintenance, setup and operation of Hardinge-built equipment. Our recommendations are described below.

**READ THESE SAFETY RECOMMENDATIONS BEFORE PROCEEDING ANY FURTHER.**

**ANYONE HAVING ACTIVE IMPLANTS** (pacemakers) or having any other ferromagnetic prosthesis is not qualified to work with these kinds of devices, or to approach them. Keep at a safe distance from the motor.

**READ THE APPROPRIATE MANUAL OR INSTRUCTIONS** before attempting operation or maintenance of the equipment. Make certain that you understand all instructions.

**DO NOT ALLOW** the operation or repair of equipment by untrained personnel.

**CONSULT YOUR SUPERVISOR** when in doubt as to the correct way to do a job.

**WEAR SAFETY GLASSES AND PROPER FOOT PROTECTION** at all times. When necessary, wear respirator, helmet, gloves and ear muffs or plugs.

**DON'T OPERATE EQUIPMENT** unless proper maintenance has been regularly performed and the equipment is known to be in good working order.

**WARNING or INSTRUCTION TAGS** are mounted on the unit for your safety and information. Do not remove them or damage them.

**DO NOT ALTER THE EQUIPMENT** to bypass any interlock, overload, disconnect or other safety device.

**DO NOT OPERATE EQUIPMENT** if unusual or excessive heat, noise, smoke or vibration occurs. Report any excessive or unusual vibration, sounds, smoke or heat as well as any damaged parts.

**LIFTING AND HANDLING OF THE UNIT** should be done with full knowledge of the unit weight and using proper procedures.

**MAKE CERTAIN** that the equipment is properly grounded. Consult National Electric Code and all local codes.

**REMOVE POWER** from the unit by unplugging the power cord before attempting repair or maintenance.  
(Where Applicable)

**DON'T OPEN THE CONTROL BOX** without consulting with Hardinge.

**DON'T TOUCH ELECTRICAL EQUIPMENT** when hands are wet or when standing on a wet surface.  
(Where Applicable)

**REPLACE BLOWN FUSES** with fuses of the same size and type as originally furnished. (Where Applicable)

## Safety Recommendations (continued)

ASCERTAIN AND CORRECT the cause of a shutdown caused by overload heaters before restarting the machine.  
(Where Applicable)

KEEP THE AREA AROUND THE EQUIPMENT well lit and dry.

KEEP CHEMICAL AND FLAMMABLE MATERIAL away from electrical or operating equipment.

HAVE THE CORRECT TYPE OF FIRE EXTINGUISHER handy when machining combustible material and keep chips clear of the work area.

DON'T USE a toxic or flammable substance as a solvent cleaner or coolant.

MAKE CERTAIN THAT PROPER GUARDING is in place and that all doors to the primary machine are closed and secured.

DON'T OPEN GUARD DOORS of the primary machine while any machine component is in motion.

MAKE SURE chucks, closers, fixture plates and all other spindle-mounted workholding devices are properly mounted and secured before starting the unit or the machine.

MAKE CERTAIN all tools are securely clamped in position before starting the unit or the machine.

REMOVE ANY LOOSE PARTS OR TOOLS left on the unit or the machine or in the work area before operating the equipment. Always check the machine and work area for loose tools and parts especially after work has been completed by maintenance personnel.

REMOVE CHUCK WRENCHES before starting the unit or the machine.

BEFORE PRESSING THE CYCLE START PUSH BUTTON, make certain that proper functions are programmed and that all controls are set in the desired modes.

KNOW WHERE ALL stop push buttons are located in case of an emergency.

MAKE CERTAIN that all guards are in good condition and are functioning properly before operating the equipment.

INSPECT ALL SAFETY DEVICES AND GUARDS to make certain that they are in good condition and are functioning properly before the cycle is started.

CHECK THE POSITION of any load/unload automation before pressing the Cycle Start push button.

CHECK SETUP, TOOLING AND SECURITY OF THE WORKPIECE if the machine has been OFF for any length of time.

DRY CYCLE a new setup to check for programming errors.

MAKE CERTAIN that you are clear of any "pinch point" created by moving slides before starting the machine.

DON'T OPERATE any equipment while any part of the body is in the proximity of a potentially hazardous area.

DON'T REMOVE CHIPS with hands. Use a hook or similar device and make certain that all machine movements have ceased.

BE CAREFUL of sharp edges when handling a newly machined workpiece.

DON'T REMOVE OR LOAD a workpiece while any part of the equipment is in motion.

DON'T OPERATE ANY EQUIPMENT while wearing rings, watches, jewelry, loose clothing, neckties or long hair not contained by a net or shop cap.

DON'T ADJUST tooling or coolant hoses while the equipment is running.

DON'T LEAVE tools, work pieces or other loose items where they can come in contact with a moving component of the equipment.

DON'T CHECK finishes or dimensions of workpiece near running spindle or moving slides.

DON'T JOG SPINDLE in either direction when checking threads with a thread gage.

DON'T ATTEMPT to brake or slow the equipment with hands or any makeshift device.

## Safety Recommendations (continued)

ANY ATTACHMENT, TOOL OR MACHINE MODIFICATION not obtained from Hardinge Inc. must be reviewed by a qualified safety engineer before installation.

USE CAUTION around exposed mechanisms and tooling especially when setting up. Be careful of sharp edges on tools.

DON'T USE worn or defective hand tools. Use the proper size and type for the job being performed.

USE ONLY a soft-faced hammer on tooling and fixtures.

DON'T USE worn or broken tooling on machine.

MAKE CERTAIN that all tool mounting surfaces are clean before mounting tools.

INSPECT ALL CHUCKING DEVICES daily to make certain that they are in good operating condition. Replace any defective chuck before operating the machine.

USE MAXIMUM ALLOWABLE gripping pressure on the chuck. Consider weight, shape and balance of the workpiece.

DON'T EXCEED the rated capacity of the equipment.

DON'T LEAVE the equipment unattended while it is operating.

DON'T CLEAN the equipment with an air hose.

KEEP TOTE PANS a safe distance from the machine. Don't overfill the tote pans.

DON'T LET STOCK project past the back end of the collet closer or equipment spindle without being adequately covered and properly supported.

UNLESS OTHERWISE NOTED, all operating and maintenance procedures are to be performed by one person. To avoid injury to yourself and others, be sure that all personnel are clear of the equipment when opening or closing the coolant guard door and any access covers.

**FOR YOUR PROTECTION - WORK SAFELY**

DON'T OPERATE THE EQUIPMENT with damaged or worn electrical cables.

VERIFY that the electrical cables are not restrained or pinched during full travel movement of the machine.

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## I. Introduction

The following information will be used to help you become familiar with the operation of the Hardinge® Indexer Control. This information is written for the Standard and Enhanced Indexer Controls. Hardinge rotary products can be utilized in various ways by the operator to perform simple to very complicated tasks.

### I.1 Five Ways to Configure a Hardinge Indexer Product to your Machine:

1. **As a stand-alone unit with a control.** Programming is done in the Indexer Control and executing the program is done through the cycle start button on the control.
2. **As an add-on to a host machine via the remote CNC cable.** Programming is done in the Indexer Control and the program is executed through a start signal via the remote CNC cable. This start signal can be provided by a mechanical switch (the remote quill switch) or by a relay contact from the host machine control using an M-code.
3. **As an add-on to a host machine utilizing RS-232 communication.** The Indexer Control has the ability to communicate with a host machine capable of RS-232 programming commands. Programming is done in the host machine control and commands are sent through the RS-232 cable. The Indexer Control interprets these commands and executes them. No programming is required in the Indexer Control.
4. **As an add-on to a host machine using the RS-232 communication and remote CNC cable in conjunction.** This is the most reliable use of the indexer with the Indexer Control. Programming is done in the host machine control and commands are communicated over the RS-232 cable. The machine then uses an M-code to send the start signal through the remote CNC cable and the Indexer Control will execute the commanded motion. The Indexer Control then sends a finish signal to the host machine control to cancel the M-code. No programming in the Indexer Control is required.
5. **As a true 4th-axis to the machine CNC control.** This configuration removes the Indexer Control from the application and the rotary product is wired directly to the machine. A rotary unit purchased with an Indexer Control may not be converted to a true 4th-axis configuration. A compatible motor to the host machine is required at time of purchase. When using the rotary product wired directly to the machine, consult the host machine manufacturer for information on 4th-axis operation.

This manual will outline in detail the operation and programming of the Indexer Control configured in methods 1-4.

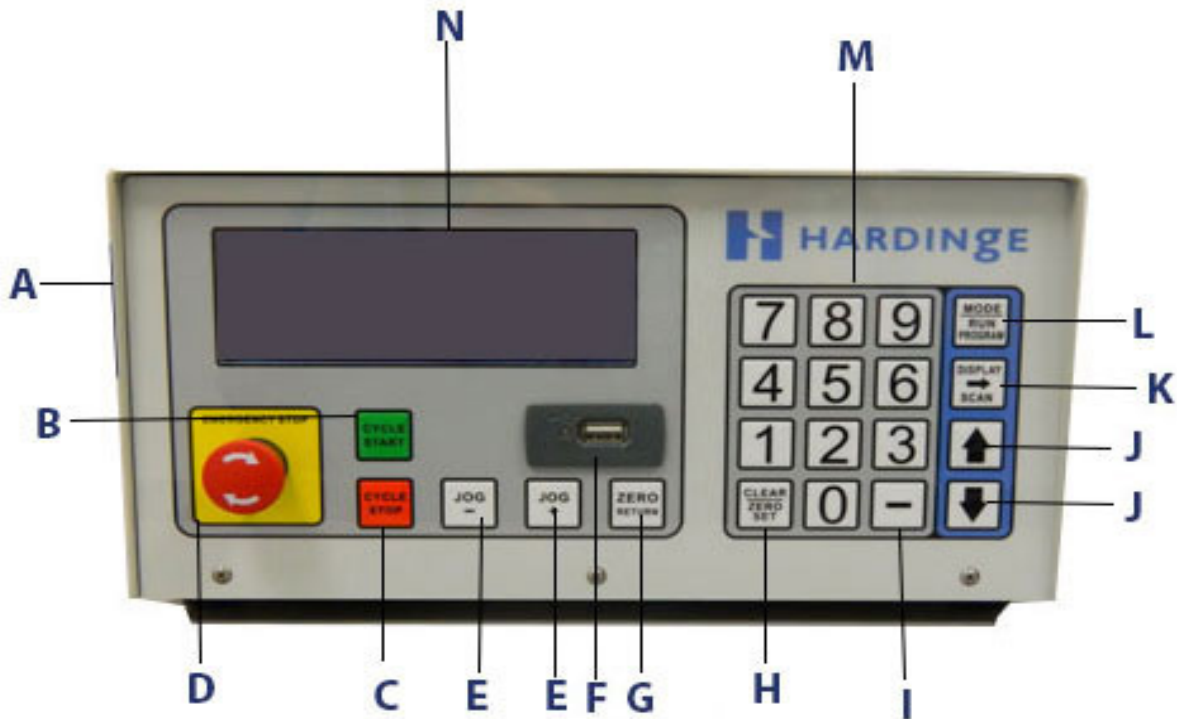


**IMPORTANT!** A Indexer Control is configured and tuned to the mechanical table indexer unit with which it ships. Substituting controls with mechanical units is not recommended unless you are advised to do so by a Hardinge technician for troubleshooting purposes. Prior to substituting any control with a different mechanical unit, contact the Hardinge technical department for approval. Failure to do so will void any and all warranties on all involved products.



## 2. Indexer Control Operation

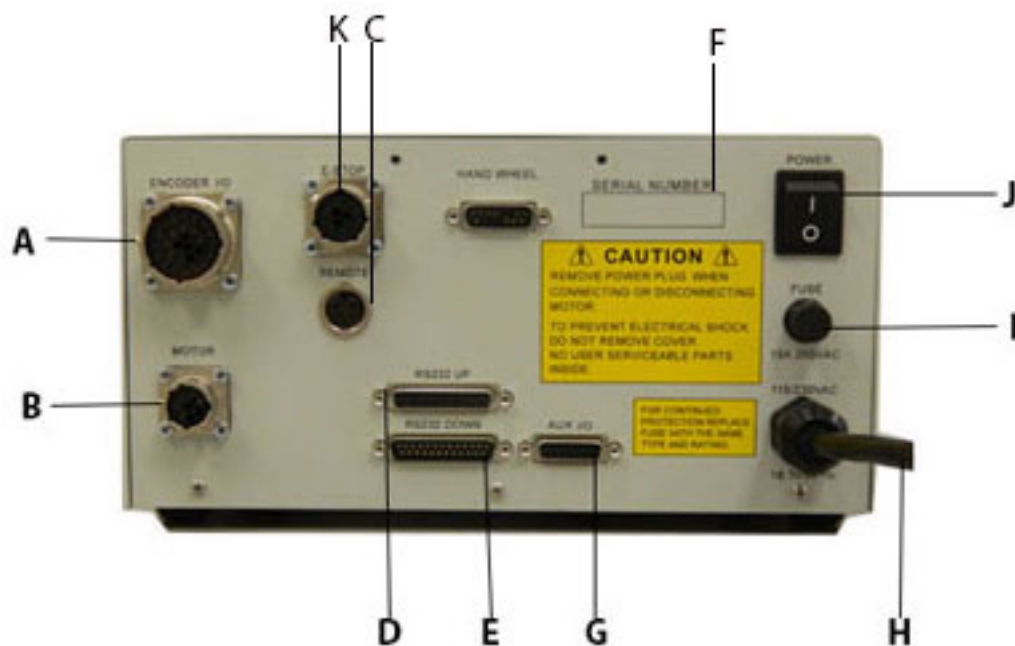
2.1



- A. Enclosure cover
- B. CYCLE START button begins or resumes a step, begins or resumes homing, resumes zero return, stops a continuous operation, selects a program, or inserts a step into a program.
- C. CYCLE STOP button pauses a step, pauses homing, and pauses zero return.
- D. STOP button turns off the motor when on and aborts a step in progress.
- E. JOG causes the motor to move in either the Forward or Backward direction in step increments or at a continuous rate defined by the last numeric key pressed-9 is the fastest and 0 is the slowest
- F. USB drive for receiving and transferring program data
- G. ZERO RETURN causes the indexer to return to HOME position, search for mechanical HOME, delete a step, move forward to the mechanical offset, or set parameters to their default values.  
WARNING: In Parameter Mode, ZERO RETURN resets the parameters to a set of default settings which may not be compatible with current unit.
- H. ZERO SET key clears the entered data or defines the present indexer position as HOME.  
WARNING: In program mode, holding down the ZERO RETURN button clears an entire program.
- I. MINUS KEY selects negative step values or Program/Upload/Download functions
- J. STEP SCAN scans program step numbers from 1 through 500 or parameter numbers 1 through 118. These buttons when held down are also used to select parameter mode, diagnostic mode, terminal mode, and File utilities mode.
- K. DISPLAY SCAN scans fields in PROGRAM mode and gear compensation mode, and switches to the gear compensation table from Parameter mode.
- L. MODE switches modes (MANUAL -> PROGRAM -> RUN -> MANUAL if table is not homed) and (RUN->EDIT->RUN if table is homed).
- M. Data entry keys and jog speed selection
- N. Four line display, each having twenty characters – a large amount of data can be viewed on one screen to reduce scrolling and simplify programming steps

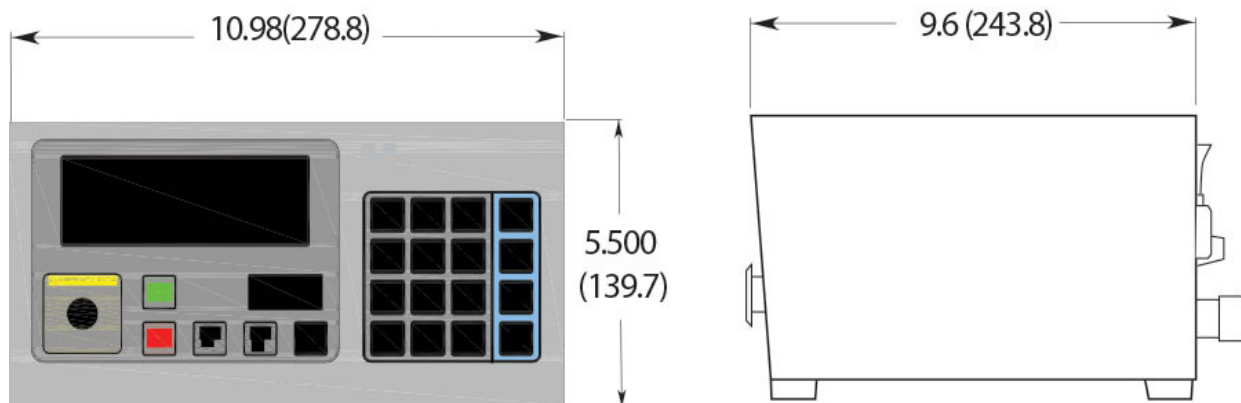


## 2.2 Rear Panel



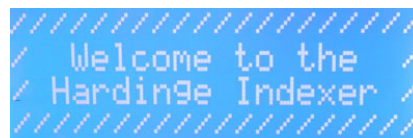
- A. Motor Encoder Cable Connector
- B. Motor Power Cable Connector
- C. Remote CNC Cable Port
- D. RS-232 Up Connector
- E. RS-232 Down Connector
- F. Serial Number
- G. I/O Connector
- H. Power Cord (120 or 230 volt)
- I. Main Power Fuse
- J. Main Power Switch to Turn the Unit OFF/ON
- K. E-Stop Connector

### 2.3 Dimensions



### 2.4 Turning ON the Indexer Control

1. Verify that the power switch to the Indexer Control is turned OFF and the power cord is unplugged.
2. Connect the encoder and power cables from the indexer to the Indexer Control for the geared indexer.
3. Check to verify that the red STOP button is pulled out.
4. Connect the power cord from the Indexer Control to a 120V/15A or 230V/15A outlet.
5. Turn the power switch to the Indexer Control ON. The display will read:



6. Pressing the cycle start button will allow you to continue. The panel now indicates that the axis is not homed. The motor is now powered but the zero position is not yet defined.
7. When the indexer homes after power up, the control is looking to see the home switch and a marker pulse on the encoder of the motor. This we will define as absolute home. A user defined home position can be set using the procedure in step 10. If a user defined home position has been put into the control, the indexer will show the absolute home after power up as a value other than 000.000. At this point the zero return button must be pushed again for the indexer to position to the user defined home position. If the previous user defined home position is no longer valid, press the clear zero set button until the control re-zeroes at the absolute home position. Now a new offset home position can be defined.
8. Jogging of the indexer can now be done with the front panel JOG button. Jog the indexer in both directions using the JOG button. The JOG button has a (+) for positive and a (-) for negative movement. Tap the JOG button and the table will move in step increments. Hold down the button for continuous smooth motion.

9. Press the ZERO RETURN button or the CYCLE START button to move the indexer back to the home (ZERO) position.

#### 10. Offsetting the Zero Position.

*Use the left/right JOG switch to position the indexer to the position that you want to use as zero (or home) and then press and hold the CLR key for three seconds.*

*The display should now indicate: P 000.000*

*This indicates that the zero position is established and the controller is ready to begin normal operations.*

*If a different position is to be used as zero, jog the indexer to the new position and press the CLR key for three seconds.*

*The display will again indicate: P 000.000*

*If you had previously cleared a new home position for the indexer, the display will show a nonzero position.*

*In this case, press the ZERO RETURN button once more and the indexer will move forward to the predefined zero position.*

11. Unless otherwise stated, always press and immediately release buttons on the control. Some buttons have more than one function depending upon which mode the Indexer Control is in.

### New Memory Card

When a new memory card is detected, the user inserts a USB stick that contains the required files for the software to operate correctly. The files must reside in a folder called MEMCARD on the USB device. The following files are required:

Files:

CC.IMG –

Hand wheel program binary image file. This program controls the table during hand wheel mode. The contents of the file are downloaded to a new drive and the hand wheel program starts executing inside the drive.

CC.TXT –

Checksum file. After the hand wheel program binary image file is downloaded into the drive, the drive performs a checksum calculation. The calculated checksum must match the value in this file otherwise the download fails.

555.TXT –

Cycle program. This program contains most of the move g-codes. It is used to test the software and to ensure that everything works correctly.

The following 5 files contain all of the drive parameter settings for each table type. The contents of these files are downloaded to a new drive automatically.

5C.TXT –

Drive parameter file for the 5C model table.

16C.TXT –

Drive parameter file for the 16C model table.

LP210.TXT –

Drive parameter file for the LP210 model table.

**PFILE.TXT –**

This file contains the control box parameter values. Refer to the parameter section for a detailed description of all of the control box parameters.

**DPARMS.TXT –**

Template file used to extract parameter values from the drive. Refer to the File Utilities section specifically uploading parameters.

Gear	Param	Pview	DMSGs
Gear	Offset	mTimer	

**New Drive:**

When a new drive is detected, the user is directed to the file utilities download drive page (refer to the File Utilities section). From there, the user selects the table type and then the drive parameter values are downloaded to the drive from one of the drive parameter files listed above. After the download has completed, the binary image of the hand wheel user program (CC.IMG) is downloaded to the drive. After the download completes, the drive computes a checksum and compares it with the checksum value in the CC.TXT file. If the two values match, the download completed successfully.

## 2.5 Basic Indexer Control Modes - RUN, PROGRAM, MANUAL, PARAMETER, DIAGNOSTIC, TERMINAL and FILE UTILITIES

**RUN** mode allows the operator to utilize the indexer during machining. The indexer will execute the programmed steps residing in the Indexer Control memory or will execute commands via RS-232 communication.

**PROGRAM** mode allows the operator to insert commands into the Indexer Control for execution once returned to RUN mode.

**MANUAL** mode allows the operator to perform set up type of operations like jogging, setting zero and zero return.

**PARAMETER** mode is used to define system specific settings for the Indexer Control. Using PARAMETER mode allows the system to be customized for specific customer requirements. The operator can identify which mode the Indexer Control is in by reading the display.

**DIAGNOSTIC** mode allows the service technician to check all of the system components.

**TERMINAL** mode allows the service technician to change drive parameters.

**FILE UTILITIES** mode allows the operator to copy programs to/from the memory card or USB device, delete programs from the memory card or USB device and download parameters to the Servo drive.

To change from RUN mode to PROGRAM mode, press the MODE button two times. To enter PARAMETER mode, the Indexer Control must first be in PROGRAM mode. Next, hold the UP STEP SCAN button for 3 seconds and the Indexer Control will enter PARAMETER mode.

**RUN mode display:**

Line 1 shows the (N) Step, (G) G-Code, (P) Commanded position,

Line 2 shows the (F) Commanded feed, (L) Loop count, (PR) Program number

Line 3 shows the current POSITION

Line 4 reports any alarm messages

N001 G90 P-263.000

F100.000 L02 PR001

P-263.000 V 000.000

MOTOR STUCK

**Cycle Timer:**

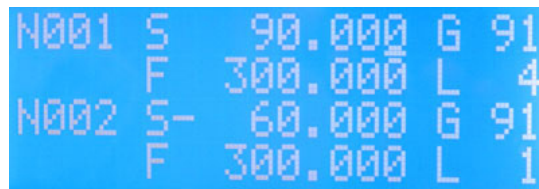
The cycle time is the time elapsed from when the cycle start button was pressed at the start of the program to when the end of the program is reached. The cycle time appears at the bottom right hand corner of the display. The cycle time is in "hh:mm:ss" format. The range is from 0 to 99 hours 59 minutes, and 59 seconds.

**PROGRAM mode display:**

Two steps of the program are visible on the display at one time. To move the cursor within a screen displaying two steps, use the DISPLAY SCAN button. To jump from screen to screen for more steps of the program, use the STEP SCAN button.

Lines 1 and 2 show a (N) step indicating its (P) position, (G) G-code, (F) feed rate and (L) loop count Lines 3 and 4 show the next step with its associated P, G, F and L

The Display Scan button is used to navigate between fields. The Up and Down Arrow buttons are used to navigate from screen-to-screen.



```

N001 S 90.000 G 91
      F 300.000 L 4
N002 S- 60.000 G 91
      F 300.000 L 1
  
```

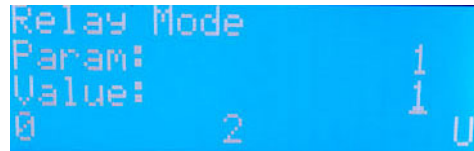
**PARAMETER mode display:**

Line 1 shows the description of the parameter in logical English

Line 2 shows the parameter number

Line 3 shows the parameter value

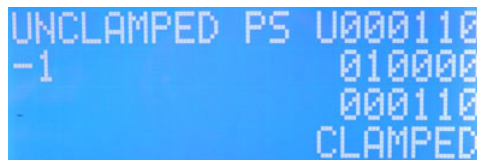
Line 4 shows the range of values and whether the parameter is unprotected "U" or protected "P".



```
Relay Mode
Param:      1
Value:      1
0           2      U
```

**DIAGNOSTIC mode display:**

Text        C010101  
0062471    001010  
            011001  
            001111



```
UNCLAMPED PS U000110
-1           010000
             000110
             CLAMPED
```

Line 1 – Columns 1-11 shows the current position in encoder counts, column 14 shows the last key pressed and columns 15-20 show the logical states of the first 6 inputs

Line 2 – Columns 15-20 show the logical states of the second 6 inputs

Line 3 – Columns 15-20 show the logical states of the third 6 inputs

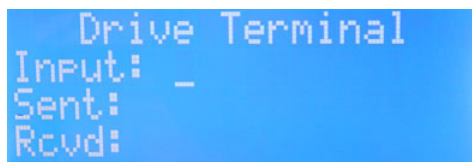
Line 4 – Columns 15-20 show the logical states of the fourth 6 inputs, and shows the results of the UART test, and also reports any alarm messages.

**TERMINAL mode display:****DRIVE TERMINAL MODE**

Input:

Sent:

Rcvd:



```
Drive Terminal
Input:  -
Sent:
Rcvd:
```

Line 1 shows the title

Line 2 is where drive commands are typed in

Line 3 shows the actual command line sent to the drive

Line 4 shows the response from the drive

FILE UTILITIES mode display: need new image

#### FILE UTILITIES

1. COPY FILES
2. DELETE FILES
3. DRIVE PARAMETERS

Line 1 shows the title

Line 2 allows the operator to copy files from the memory card to a USB device and vice versa.

Line 3 allows the operator to delete files from the memory card and USB device.

Line 4 allows the operator to download parameters to the drive from a USB device and upload parameters from the drive to a USB device.

### 3. Manual Mode

Manual Mode is where setup type operations are performed. Manual Mode is entered when the cycle start button is pressed at power up, when a jog button is pressed from RUN Mode, or when the emergency stop button is pressed. When Manual Mode is entered, the following screen is displayed:

#### MANUAL MODE



The value beside the "P" is the actual position of the table in degree units. The "JOG SPD" value is how fast the table will turn while jogging. The higher the number the faster the table will rotate (see jog mode below). Line 4 is reserved for alarm and operator messages.

#### 3.1 Homing Function

When manual mode is first entered at power up, home the table by pressing the Zero Return button. The type of homing that is performed is based on the value of parameter number 27 "Home Type". When the homing function completes, press the "Cycle Start" button or the "Zero Return" button to return to the last saved zero position. Press the cycle Stop button or the emergency stop button to abort the homing sequence. If the cycle stop button was pressed, press the zero return button to resume the homing sequence. If the emergency stop was pressed, unpress the button, press the cycle start button to turn on the servo then press the zero return button to resume the homing sequence.

#### 3.2 Jog Function

Two types of jog functions are performed. Tapping a jog button moves the table in step increments. Holding down a jog button rotates the table in a desired direction at a desired speed. There are 10 selectable jogging speeds/ step increments available. Each speed/step is represented by a jog speed/step number. Below is a table showing the relationship between the jog speed/step number and how fast the table will turn in degrees per second for jog continuous mode and the step amount the table will move for step jog mode.



**JOG SPEED TABLE**

0 = 7.32 degrees/sec	0.001 degrees per step
1 = 8.14 degrees/sec	0.010 degrees per step
2 = 9.16 degrees/sec	0.100 degrees per step
3 = 10.46 degrees/sec	1.000 degrees per step
4 = 12.21 degrees/sec	5.000 degrees per step
5 = 14.65 degrees/sec	10.000 degrees per step
6 = 18.31 degrees/sec	15.000 degrees per step
7 = 24.41 degrees/sec	20.000 degrees per step
8 = 36.62 degrees/sec	25.000 degrees per step
9 = 73.24 degrees/sec	20.000 degrees per step

Press one of the numeric keys to change the value of the jogging speed number. The currently selected jog speed number is shown on the display at row 3 (see above).

Press and hold the Jog (+) button to rotate the table in the positive direction or press and hold the Jog (-) button to rotate the table in the negative direction. When the pressed button is released the table stops moving.

**3.3 Hand Wheel Function**

Press and hold the button on the hand held device to enter hand wheel mode. The selector switch on the hand held device is for selecting the MPG increment (1X, 5X, or 10X). 1X causes each click of the hand wheel to move the table 0.001 degrees (0.10 degrees/rev). 5X causes each click of the hand wheel to move the table 0.005 degrees (0.5 degrees/rev). 10X causes each click of the hand wheel to move the table 0.010 degrees (1 degree/rev). The active MPG increment is displayed on the 4th line of the screen. While holding down the button, turn the hand wheel to cause the table to move at the desired increment. Release the button to exit hand wheel mode.

**3.4 Zero Return Function**

Press the Zero Return button to cause the table to rotate back to the zero position. If bit 4 of the home type parameter is set to a 1, the table will take the shortest path to the zero position. If parameter 12 (UNITS) is set to a 5, the table will rotate back to the absolute zero position. For example, if bit 4 is set to a 1 and the table is at 270 degrees, pressing the zero return button will cause the table to rotate 90 degrees in the positive direction. If bit 4 is set to a 0 and the table is at 270 degrees, pressing the zero return button will cause the table to rotate 270 degrees in the negative direction. If parameter 12 (UNITS) is set to a 5, and the table is at 840 degrees, pressing the zero return button will cause the table

to rotate 840 degrees in the negative direction. Press the Cycle Stop button to suspend motion during zero return. Press the Cycle Start button to resume motion.

**3.5 Clear Zero Set Mode**

Press the Clear Zero Set button to zero out the position display. The new zero position is saved such that subsequent invocations of the zero return function will always cause the table to rotate back to this new position.

The table below lists all of the manual mode functions and the buttons required to operate them.

Function	Description	Button(s)
Homing	Establish the reference position	Zero Return Button (at power up only)
Zero Return	Move to the zero position	Zero Return Button (not at power up) Cycle Start Button (power up only)
Jogging	Jog the table in +/- directions	Jog +/- Buttons
Hand Wheel	Fine positioning	Button, Selector switch, & hand wheel on hand held device
Set Zero	Zero out the position display	Clear Zero Set Button

## 4. Programming the Indexer Control

The Indexer Control has the storage capacity for 9,999 programs that can contain 500 steps each. Program 0 should be saved for RS-232 communication. This will be covered later in the manual. The following paragraphs will guide the operator through the programming sequence. The indexer has two basic methods of positioning: incremental and absolute as defined below.

**Absolute Positioning:** Motion commands executed by the control to the indexer in absolute mode (G90) will cause the indexer to move to the commanded or absolute position in degrees. (If you are at a position of 90.000 and the next step in the program is 90.000 with a {G90}, the indexer will not move). The unit will rotate the shortest direction to get to the commanded position.

**Note:** If parameter 12 "Axis Control" is set to "Linear Axis" the unit will move the table to the commanded position without taking the shortest path.

**Incremental Positioning:** Motion commands executed by the control to the indexer in incremental mode (G91) will cause the indexer to move an additional number of degrees from its current position. (If you are at a position of 90.000 and the next step in the program is 90.000 with a {G91}, the indexer will move an additional 90 degrees).

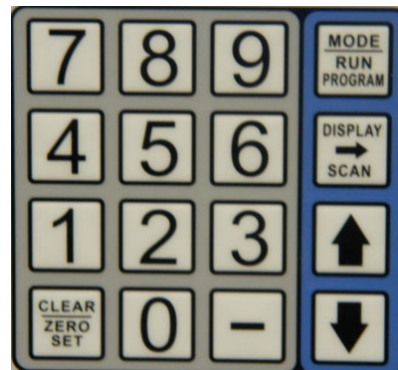
**NOTE:** Because positive 90.000 was entered, the indexer will move 90 degrees in the positive direction defined by parameter 11.

Programming is done through the square 15-key keypad on the right side of the front panel. The three buttons on the right column of the keypad are used for program control.

MODE/RUN PROG button

DISPLAY SCAN (RIGHT ARROW) button

STEP SCAN (UP/DOWN ARROWS) button



The MODE button is the most important. It selects between the RUN mode and PROGRAM mode.

To begin, verify that the Indexer Control is powered on and the indexer is in the homed position.

The MODE button is the most important. It selects all of the different modes (see above).

MANUAL MODE  
P 000.000 V 000.000  
JOG SPD=0



Enter PROGRAM mode. The cursor will be on the position area of step one.

F = Feed Rate programmed in degrees/second

N = Step Number

P = Position programmed in degrees with possible minus sign

G = G-code programmed using available G-code commands

L = Loop Count programmed as number of times to repeat current program step

#### 4.1 Feed Rate (F)

The default feed rate display is always the maximum feed rate (see table below) preceded by an F. This is the feed rate that will be used for the selected step. The feed rate corresponds to degrees rotated per second. A feed rate of 360.000 means the spindle will rotate 360 degrees in one second (60 RPM). The maximum feed rate programmable for a step is indexer unit dependent. Maximum Feed Rates for Hardinge Indexers:

Model	deg/sec (rev/minute)
GD5C2	360.000 (60 rpm)
GD16C2	300.000 (50 rpm)
GD160LP	240.000 (40 rpm)
GD210LP	240.000 (40 rpm)

#### 4.2 Step (N)

The step number identifies each consecutive step in the program. Each program can store up to 500 steps.

Two steps of the program are visible on the display at one time. To move the cursor within a screen displaying two steps, use the DISPLAY SCAN button. To jump from screen to screen for more steps of the program, use the STEP SCAN button. The Display Scan button is used to navigate between fields. The Up and Down Arrow buttons are used to navigate from screen-to-screen.

#### 4.3 Position (P)

The position identifies the angle in degrees to be used in the step. The value can be -9999.999 to 9999.999.

The position value is ignored with the use of certain G-codes.

#### 4.4 G-codes (G)

The G-code in a step of a program identifies the type of command to be executed in that step. G-codes can command incremental or absolute positioning, dwells, jumps, clamp commands, continuous motion, etc.

The following G-codes are possible:

- G28 return to home position (same as G88 and G90 with step 0)
- G80 controls the clamp function when parameter I10 is set to 1 in the enhanced control
- G81 controls the 3 general outputs of the enhanced control
- G82 controls the 3 general inputs of the enhanced control
- G83 continuous rotation in negative direction
- G84 continuous rotation in positive direction
- G85 fractional circle division (any value  $\leq$  360.000 degrees can be divided equally)
- G86 turn CNC relay ON
- G87 turn CNC relay OFF
- G88 return to HOME position (same as G28 and G90 with step 0)
- G89 wait for remote input
- G90 absolute position command
- G91 incremental position command
- G92 pulse CNC relay and wait for remote input
- G93 pulse CNC relay
- G94 pulse CNC relay and run next L steps automatically
- G95 end of subroutine/more steps follow
- G96 subroutine call/jump (destination is a step number)
- G97 delay by L count/10 seconds (down to 0.1 second)
- G98 circle division (always assumes 360.000 degrees to be divided equally)
- G99 end of program/return and end of steps

#### 4.5 Loop Count (L)

The loop count identifies how many times a step will be repeated before moving to the next step of the program. The loop count display is three digits between 1 and 999. If a G97 is used, the loop count is transformed to a timer to be used as a dwell. The loop count decrements when each step is executed and also decrements when the G97 timer counts down.

#### 4.6 Inserting a Step in a Program

In program mode, put the cursor on the position area of the step which you would like to insert a step. Hold the cycle START button for three seconds. It will cause the present step and all following steps to be moved down and cause the new step to be initialized with default values. You will need to check and update your jump-to locations after an insertion. The values can now be programmed for the inserted step.

#### 4.7 Deleting a Step in a Program

In program mode, put the cursor on the position area of the step to be deleted. Hold the Zero Return button for three seconds. It deletes the current step and will cause the next step and all following steps to be moved up by one. You will need to check and update your jump-to locations after a step is deleted.

#### 4.8 Selecting a Stored Program

There can be more than one stored program. Selection of that program is done by pressing the minus key while the cursor is on the G-code area of PROGRAM mode. The display will show up to 3 lines of existing program numbers on the memory card and prompt for the program number selection.

Press the number keys to select a new program and then press the MODE key to return to RUN mode or the START key to continue with the PROGRAM mode. There are 10,000 programs available, numbered 0 to 9999.

Press the up and down arrow keys to display additional program numbers.

#### 4.9 Clearing a Program

To initialize or clear a stored program (not including parameters), go to PROGRAM mode and press and hold the CLEAR-ZERO SET button for five seconds. The first step is set to G91, position value of zero, a maximum feed rate value, and a loop count of 1.

#### 4.10 Software Limit Switch Function

The Indexer Control has a feature called Software Limits. These are programmable software limits to limit the travel in jog and run mode. Whereas the hardware limit switches are physical limit switches, software limits are only defined in the parameters of the control. Software limits should generally be set 10 degrees less than the hardware limits. For example, if the hardware limits are set for +/- 160.000 degrees, the software limits should be set for +/- 150.000 degrees.

Set parameter 115 to a value of 1. This will enable the use of the software limit function.

NOTE: The software limit switch function is only used AFTER initial homing is done after power-up.

They provide NO protection during the power up homing sequence. The operator needs to use caution when operating the indexer during this time to prevent damage to the unit or to the host machine tool.

##### Setting the positive travel limit - Parameter 116

The positive travel limit has a value range of 0 to 180000. Units are 1000 = 1 degree. So 120.000 degrees = 120000. Jog the unit to the positive travel limit and record the value of the position. Go into parameter mode and set the value for the high (positive) software limit.

##### Setting the negative travel limit - Parameter 117

The negative travel limit has a value range of 0 to -180000. Units are -1000 = -1 degree. So -120.000 degrees = -120000. Jog the unit to the negative travel limit and record the value of the position. Go into parameter mode and set the value for the low (negative) software limit.

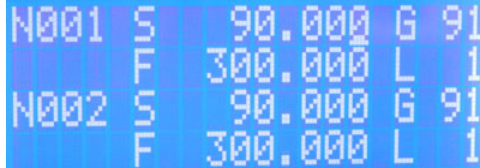
NOTE: It is possible to program a movement larger than the travel limit. The axis will rotate until it sees either the negative or positive software limit and will stop. An error will be posted that the software limit has been reached. This will require the operator to jog the axis in the opposite direction to reset the switch.

At this time, the operator should fix the limit value or change the programmed position. You can start your program on any step by using the UP/DOWN scan keys.

## 5. Programming Examples

To begin, verify that the Indexer Control is powered ON and the indexer is in the homed position.

MANUAL MODE  
P 000.000 V 000.000  
JOG SPD=0



```

N001 S 90.000 G 91
      F 300.000 L 1
N002 S 90.000 G 91
      F 300.000 L 1
  
```

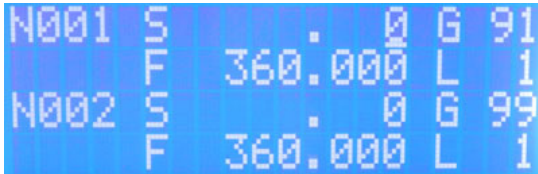
Enter PROGRAM mode. The cursor will be on the position area of step one.

Push the DISPLAY SCAN button to move the cursor to the G-code. Push the MINUS button. Up to 3 lines of existing programs will be displayed. On line 4, the current program number will be displayed. Use the up and down arrow keys to display more program numbers.

Use the number pad to select a new program number between 1 and 9999. As the buttons are pushed the desired program number will appear.

17 28 36 59 66 99 121  
131 142 148 156 172  
629 836 926 1024 8635  
Program Number: 48

Press the CYCLE START button to begin programming the new selected program. Pressing the MODE button will change the control to the new program but send you to RUN mode. If this happens, simply re-enter PROGRAM mode by pressing the MODE button twice.



```

N001 S . 0 G 91
      F 360.000 L 1
N002 S . 0 G 99
      F 360.000 L 1
  
```

Now you're ready to look at some examples.

### 5.1 Example 1: Utilizing G91, G28 and G99

We will program the indexer to perform four 90-degree moves in the positive direction, one 60-degree move in the negative direction and return to home. A feed rate of 300 degrees per second will be used to perform the moves. Enter the data using the numbers on the keypad, tabbing with the DISPLAY SCAN button for each screen and the STEP SCAN button to change screens. The cursor should be on the position area of step one of the program. Enter 90000 with the keypad and then use the DISPLAY SCAN button to forward to the feed rate. If the wrong value is entered, push and immediately release the CLEAR ZERO SET button to reset and enter the correct value. Enter 300000 for the feed rate and scroll to the position area of line two.

```

N001 S      .  0 G 91
      F 360.000 L 1
N002 S      .  0 G 99
      F 360.000 L 1

```

Repeat the values in step 1 for steps 2, 3 and 4 in the program. On step 5, enter -60000 for the position area and 300000 for the feed rate. On step 6, enter G28 for the G-code and 300.000 for the feed rate. For step 7, enter G99 for the G-code.

The program should read:

```

N001 S 90.000 G 91
      F 300.000 L 1
N002 S 90.000 G 91
      F 300.000 L 1

```

```

N003 S 90.000 G 91
      F 300.000 L 1
N004 S 90.000 G 91
      F 300.000 L 1

```

```

N005 S- 60.000 G 91
      F 300.000 L 1
N006 S  0.000 G 28
      F 300.000 L 1

```

```

N007 S  0.000 G 95
      F 300.000 L 1
N008 S  0.000 G 99
      F 360.000 L 1

```

To exit PROGRAM mode, press and release the MODE button. To run the program, press and release the CYCLE START BUTTON. The indexer will rotate to 90.000 degrees and move to step 2. Press the CYCLE START button on the control when the indexer stops motion to continue through the program. After the indexer executes the G28 command in step 6 to go home, the control will reset itself to step 1 because of the G99 command in step 7. This example was the long way to perform the motions required, taking 7 steps to program. With creative thinking and an understanding of the various G-code capabilities, programming complicated motion can be done with fewer steps in the program. For instance, the above program could have been written with just 4 steps a number of different ways. We will refer to example one in the following program examples to show the capability of the G-codes.



5.2 Example 2: This example will use G28, G91 and G99 to simplify example 1 by utilizing the loop count functionality.

Change the loop count value of step one from 1 to 4. Delete steps 2, 3 and 4. To delete a step, make sure the cursor is on position area of the step to be deleted. Press and hold the ZERO RETURN button for 3 seconds. Utilizing the various capabilities of the control will simplify programming.

```

N001 S 90.000 G 91
      F 300.000 L 4
N002 S- 60.000 G 91
      F 300.000 L 1

N003 S 0.000 G 99
      F 360.000 L 1
N004 S 0.000 G 99
      F 360.000 L 1

```

### 5.3 Example 3: Utilizing G90, G99 and G88

In example 1, we programmed four 90 degree moves using the incremental command of G91. Go to program mode and change the four 90 degree angles for the four positions to absolute positions and change the G codes to G90. Change the -60 degree move to 240.000 and make the G code G90. Finally, change the G28 to G88.

The program on the display should read:

```

N001 S 90.000 G 90
      F 300.000 L 1
N002 S 180.000 G 90
      F 300.000 L 1

N003 S 270.000 G 90
      F 300.000 L 1
N004 S 0.000 G 90
      F 300.000 L 1

N005 S 240.000 G 90
      F 300.000 L 1
N006 S 0.000 G 88
      F 360.000 L 1

N007 S 0.000 G 99
      F 360.000 L 1
N008 S 0.000 G 99
      F 360.000 L 1

```

#### 5.4 Example 4: Utilizing G98 and G99

The G-code G98 can be used to do circle division to simplify programming. The G98 command will divide 360 degrees by the value entered in the Loop Count. It is important to note that 360 degrees is always used as the angle with the G98 command. In this example we will program 6 moves of 60 degrees using the G98 command. In step one the Position value can be skipped. Regardless of what value is in the Position area, 360 degrees will be used. Enter G98 for the G-code. Set the feed rate to 75.000 degrees per second. When executing step one, the indexer will index incrementally from the current position the number of degrees it calculates for each move. For the Loop Count, since we want 60 degree moves,  $360/60 = 6$ , therefore enter 6 in the Loop Count. For step two, make sure G99 is in the

#### 5.5 Example 5: Utilizing G85 and G99

The G-code G85 is used to do angle division to simplify programming. Whereas G98 used an angle of 360 degrees exclusively, G85 uses an operator-entered angle for dividing the moves. The control will start the moves incrementally from the current position. To program positioning for a series of six holes which will lie in an included angle of 180 degrees, the program will read as follows:

```
N001 S 180.000 G 85
      F 75.000 L 6
N002 S 0.000 G 99
      F 360.000 L 1
```

#### 5.6 Example 6: Utilizing G83, G84, G94 and G99

The G-codes G83 and G84 allow the unit to enter a continuous rotation. For geared units, the feed rate for this motion must be limited to insure that damage to the gear system does not occur. The move should be tested and closely monitored so that the motion does not cause the indexer to heat up and bind the gears. On direct-drive units, the movement should be monitored so that the motor does not see a significant heat rise. In this case, liquid cooling may have to be implemented. Utilizing this feature is therefore greatly dependent on the duty cycle. If assistance is required to aid in the use of this function, please contact your Hardinge representative. In this example we will program the

G83 and G84 command using a feed rate of 10 degrees per second. When programming using incremental motion, the maximum programmable step is 9999.99 degrees. In some cases where spiral milling or grinding is to be done, a longer step may be required. The G83 and G84 commands allow this to be done. If a G83 command is given, the unit will start a motion in the negative direction at the programmed feed rate. G84 will cause the unit to rotate in the positive direction. This motion will continue until the control receives a command to stop. This will occur via pushing the CYCLE START button, sending a start signal through the CNC cable or via RS-232. In step one, enter G83 and a feed rate of 10.000. Step two should contain the G99.

The program should read as follows:

```
N001 S 0.000 G 83
      F 10.000 L 1
N002 S 0.000 G 99
      F 360.000 L 1
```

Press cycle START and the unit will rotate in the negative direction at 10-degrees per second until the cycle start button is pressed again to stop the motion. If motion is desired in the positive direction, enter a G84.

The program should now read:

```
N001 S 0.000 G 84
      F 10.000 L 1
N002 S 0.000 G 99
      F 360.000 L 1
```

In most applications the Indexer Control will be commanded to move through the host machine control via the CNC

cable. See section 10.1 for remote CNC cable use. An M-code will be executed in the machine control which will close a relay and send a start signal to the indexer Control. This will start the movement of the next step programmed into the indexer control. Usually the machine control will wait for a finish signal to come back to the machine from the indexer control to tell the machine the indexer is finished and go ahead with the part program. To use the G83 or G84 command in this fashion, a G94 will also have to be used to allow the machine to continue. The G94 command will cause the indexer Control to immediately send a finish signal to the machine host control and automatically execute the next number of steps determined by the value in the Loop Count. For step one, enter G94 and 1 for the Loop Count. Step two will contain the G83 or G84 and the feed rate to be programmed.

The program should read as follows:

```
N001 S 0.000 G 94
      F 10.000 L 1
N002 S 0.000 G 83
      F 10.000 L 1
```

The machine will send a start signal to the indexer Control. The Indexer Control will issue an immediate finish signal to the machine and perform the next step as determined by the 1 in the Loop Count. The indexer will begin a continuous rotation in the negative direction at 10 degrees per second. The machine can then bring the tool in to do the desired operation. When the machine is finished, it will issue another start command via the M-code which will cause the indexer Control to stop, send a finish signal and set the program to the next step. In this case, step 3 is the G99 so the program will go back to step 1. If step 3 was another type of move or command, step 3 would be loaded ready to go.

When G83 or G84 is programmed with a loop count greater than one, continuous rotation occurs for "loop count" seconds. After the time has elapsed, the table will stop and a finish signal is sent (if parameter is set to pulse at the end of motion).

### 5.7 Example 7: Utilizing spiral milling

The simultaneous rotation and milling feature of the Hardinge Indexer Control will permit machining of certain cam forms, spiral and angular cuts. Spiral milling is when the spindle rotates and an axis on your mill moves at the same time. To spiral mill, you will have to calculate the feed rate and angle of rotation for the Hardinge indexer spindle so that the machine and indexer will stop at the same instant to give the desired result.

To calculate the feed rate for the indexer you will need to know:

1. The angular rotation to be performed by the indexer in degrees (this should come from the blue print).
2. The feed rate for the axis of the mill (usually in inches per minute).
3. The distance you wish to travel on the axis on the CNC machine (this should come from the blue print).

For example, we wish to mill a spiral that is 6 revolutions on a part which is 12.5 inches in length. The part is oriented on the machine to utilize the movement of the x-axis. The desired feed rate for the x-axis on the machine is 2.000 inches per minute. To set up the indexer we have to calculate the angle of rotation in degrees, the cycle time in seconds and the feed rate in degrees/second of the indexer.

The angle of rotation is calculated as follows: 6 revolutions x 360 degrees/revolution = 2160 degrees.

NOTE: Parameter 12 will have to be changed to 5 to accommodate the 2160 degree move.

The cycle time is 12.5 inches/2.000 inches/minute = 6.25 minutes. Thus 6.25 minutes x 60 seconds/minute = 375 seconds.

The feed rate of the indexer is then calculated by dividing the angle by the cycle time. 2160 degrees/375 seconds = 5.760 degrees/second.

We can now program the indexer to perform the desired motion. A G94 and Loop Count of 1 will be used in step one to start the indexer and send a finish signal to the mill to start the x-axis. Thus both machine and indexer will be moving simultaneously. Step two will use the values calculated above to control the indexer to do the spiral.

The program will read as:

```

N001 S 0.000 G 94
      F 300.000 L 1
N002 S 2160.000 G 91
      F 5.760 L 1

N007 S 0.000 G 99
      F 360.000 L 1
N008 S 0.000 G 99
      F 360.000 L 1

```

This procedure will be the starting point for developing a sound program to carry out the desired task. Before machining of the actual part, put an offset into the tooling of the machine so that it does not contact the part and perform a dry run to determine if the program is working as desired. If possible, test the actual process on a setup part to insure the depth of cut and speeds are not an issue. Many times, the process will involve a "rough" pass followed up by a "finish" pass with a much smaller depth of cut. If additional spirals are to be added to the part, items such as re-orientation and dwells will have to be considered and worked into the program to work out the timing.

When the indexer executes a G94, a 250 millisecond delay is required before executing the following step. This may (it usually doesn't) cause your axis to move before the table rotates, leaving a flat spot in the cut. If this is a problem, a solution is to insert a G04 dwell (from 0 to 250 milliseconds) in the CNC after the M-function to prevent axis movement. By selecting the right dwell, the indexer and the mill should start moving at the same instant.

In the same manner, a problem may exist at the end of the spiral, but this can be eliminated by slightly altering the feed rate on the mill. Don't adjust the feed rate on the Hardinge Indexer Control because the mill has a much finer feed rate adjustment than the Hardinge Indexer Control. If the undercut appears to be in the X-axis direction, then slightly speed up (0.1 change in feed rate) the mill's feed rate. If the undercut appears in the radial direction of the spindle of the indexer, slow down the mill's feed rate.

If the timing is off by several seconds such that the mill completes movement before the indexer completes its movement and there are several spiral moves one right after another (such as in retracing a spiral cut), this may cause the CNC to stop for no reason. The reason for this is that your CNC will send a cycle start signal (for next cut) to the Hardinge Indexer Control before it has completed its first move, thereby causing a timing hang-up. The Hardinge Indexer Control will not accept another cycle start until it is finished with the first. If doing multiple moves, it is very important to check timing calculations. A way to verify if this is actually the problem is to single block the control allowing five seconds between steps. If you can single block the control but it will not successfully run in the continuous mode, then timing is off somewhere.

#### 5.8 Example 8: Utilizing G95, G96, G97, G88 and G99

Subroutines allow you to repeat a particular step sequence up to 999 times. A subroutine is invoked by entering 96 into the G-code. After entering 96, you must DISPLAY SCAN to the Feed Rate location to enter the step you wish to jump to. After executing a G96 step, the control will jump to the step called out in the Feed Rate location, execute that step and the ones following until it reaches G-code 95 or 99, the end of subroutine call. The program then jumps back to the step following the G96. A subroutine can be repeated a number of times by utilizing the loop count of the G96 step. To end the subroutine, insert a G-code of 95 or 99 after the last sequence step. A subroutine call is not considered a step by itself since it will always execute itself and the first step of the subroutine. Nesting of subroutine calls is not permitted.

G97 is used to program a dwell or delay time into a program. G97 does not pulse the CNC relay at step completion. As an example, programming a G97 and setting L = 10 will produce a 1 second dwell.

In this example, we will program the indexer to perform a subroutine which will index the unit 15 degrees with a feed rate of 300.000 then index -30 degrees with a feed rate of 25.000. Repeat the subroutine 3 times. Program a dwell of 5 seconds. Program a G88 to return home.

The program should read as:

```
N001 S 0.000 G 96
F 0.005 L 3
N002 S 0.000 G 97
F 300.000 L 50
```

```
N003 S 0.000 G 88
F 300.000 L 1
N004 S 0.000 G 99
F 360.000 L 1
```

```
N005 S 15.000 G 91
F 300.000 L 1
N006 S- 30.000 G 91
F 25.000 L 1
```

```
N007 S 0.000 G 95
F 300.000 L 1
N008 S 0.000 G 99
F 360.000 L 1
```

## 6. File Utilities Mode

In edit mode, press and hold the step scan down key (↓) for 3 seconds to display the file utilities screen. Press the mode key at any time to return to the EDIT mode. Pressing the 0 EXIT button always brings you up one level.

The sub menus for copy and delete display the existing program numbers on the media. Press the Step Scan Up Key (↑) to Page up file the selection list. Press the Step Scan Down Key (↓) – Page down the file selection list. To select a program, type the program number then press the cycle start button. If you make a mistake typing in the program number, press the clear zero set key to clear out the field.

### FILE UTILITIES

1. COPY FILES
2. DELETE FILES
3. DRIVE PARAMETERS

## 6.1 Copying Files

User presses the 1 key (from FILE UTILITIES)

### COPY FILES

- 0. EXIT
- 1. COPY USB TO MEM
- 2. COPY MEM TO USB

User presses the 1 key (from COPY FILES)

### COPY USB TO MEM

1 6 24 86 268 308 (EXISTING PROGRAMS ON USB MEDIUM)  
 489 621 1291  
 USB PGM (0=EXIT): (USER ENTERS EXISTING USB PROGRAM NUMBER)

User presses the 2 key (from COPY FILES)

### COPY MEM TO USB

8 61 84 186 222 358 (EXISTING PROGRAMS ON MEMORY CARD)  
 411 600 1093  
 MEM PGM (0=EXIT): (USER ENTERS EXISTING MEM PROGRAM NUMBER)

## 6.2 Deleting Files

User presses the 2 key (from FILE UTILITIES)

### DELETE FILES

- 0. EXIT
- 1. DELETE MEM FILE
- 2. DELETE USB FILE

User presses the 1 key (from DELETE FILES)

### DELETE MEM FILE

8 61 84 186 222 358 (EXISTING PROGRAMS ON MEMORY CARD)  
 411 600 1093  
 MEM PGM (0=EXIT): (USER ENTERS EXISTING MEM PROGRAM NUMBER)

User presses the 2 key (from DELETE FILES)

### DELETE USB FILE

1 6 24 86 268 308 (EXISTING PROGRAMS ON USB MEDIUM)  
 489 621 1291  
 USB PGM (0=EXIT): (USER ENTERS EXISTING USB PROGRAM NUMBER)

## 6.3 Downloading Drive Parameters

User presses the 3 key (from FILE UTILITIES).

Please note that before he can access these menus, the user must supply the correct password to parameter 30.

### DRIVE PARAMETERS

- 0. EXIT
- 1. DOWNLOAD PARAMS
- 2. UPLOAD PARAMS



User presses the 1 key (from DRIVE PARAMETERS)

DOWNLOAD PARAMS

- 0. EXIT
- 1. 5C TABLE
- 2. MORE

User presses the 2 key (from DOWNLOAD PARAMS)

DOWNLOAD PARAMS

- 0. EXIT
- 1. I6C TABLE
- 2. MORE

User presses the 2 key (from DOWNLOAD PARAMS)

DOWNLOAD PARAMS

- 0. EXIT
- 1. LP160 TABLE
- 2. LP210 TABLE

User presses the 1 key (from DOWNLOAD PARAMS)

Drive parameters for a LP160 table are downloaded to the drive.

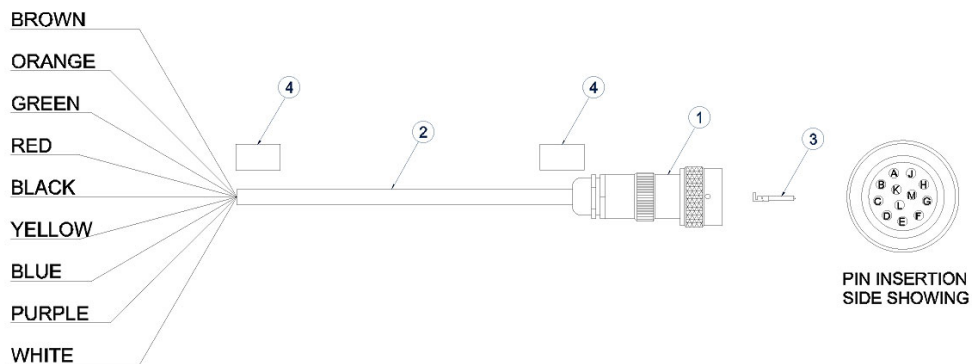
User presses the 2 key (from DRIVE PARAMETERS)

Drive parameters are extracted from the drive and uploaded through the USB port.

## 7. Emergency Stop Connectors

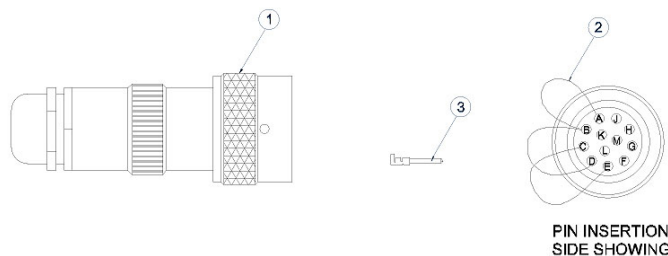
The indexer control has an emergency stop connector on the back for connection to various E-stop circuits. To issue an E-stop from the machine to the indexer control or from the indexer control to the machine see the circuits on drawing RT 000301 IECON. These circuits are a small sample of the circuits that are available for safely integrating an indexer control to a CNC machine tool. Manual machines are also covered, see drawing RT 000301 IEPLG for connection to a machine without a controller. The minimum requirement to operate the indexer control either manual or CNC is the manual plug shown on drawing RT 000301 IEPLG. The E-Stop cable needed for connection to CNC machines is shown in drawing RT 000301 IESCB.



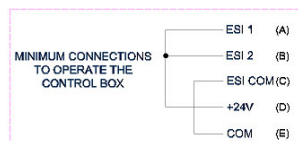


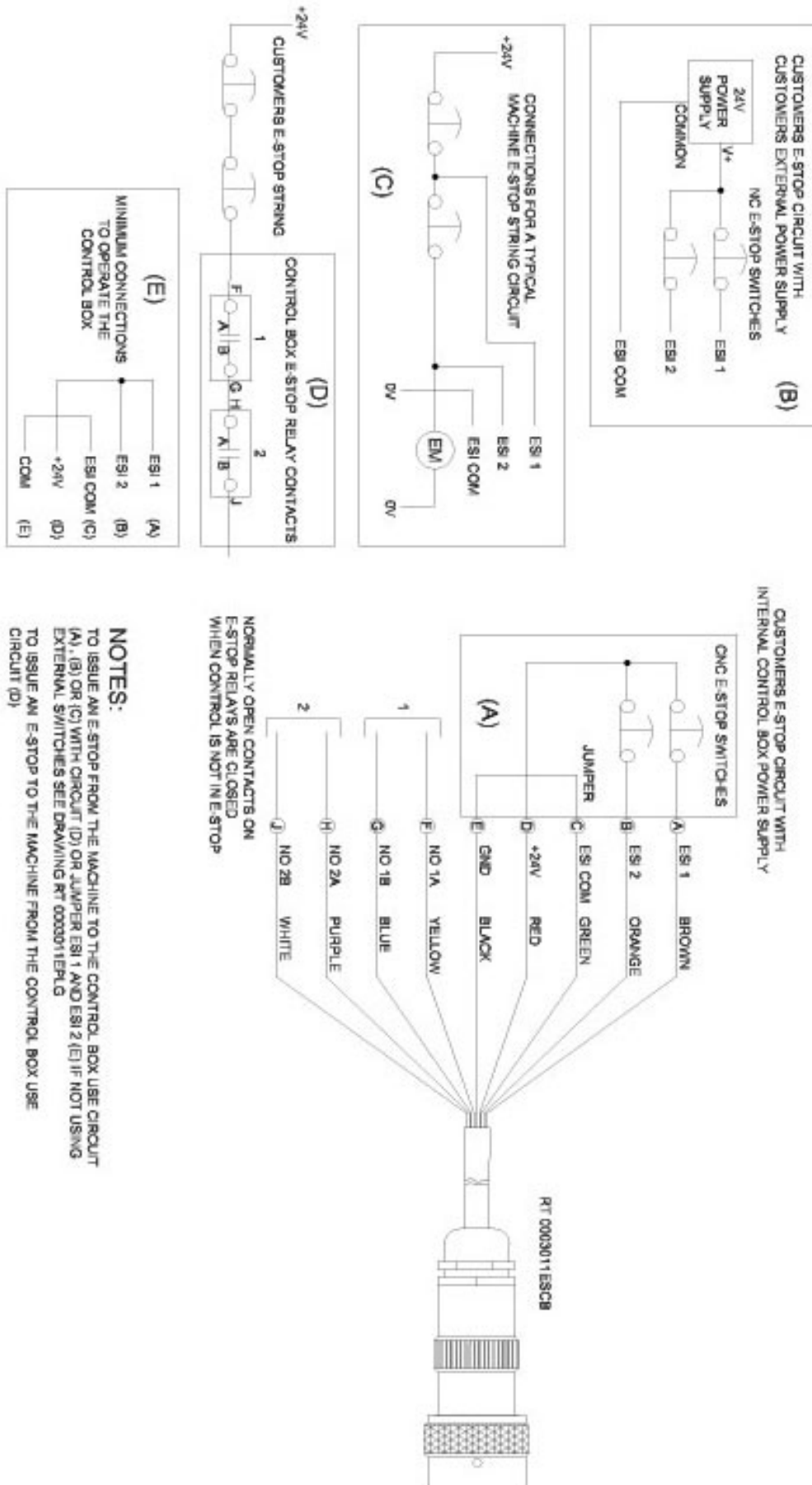
WIRE TABLE		
COLOR	CONNECTOR 1	SIGNAL
BROWN	A	ESI 1
ORANGE	B	ESI 2
GREEN	C	ESI COM
RED	D	+24V
BLACK	E	GND
YELLOW	F	NO 1A
BLUE	G	NO 1B
PURPLE	H	NO 2A
WHITE	J	NO 2B

ADD HEAT SHRINK TO CABLE JACKET ENDS



JUMPER PINS A TO B TO D ALSO  
PINS C TO E AS SHOWN





## 8. Diagnostic Mode

The Diagnostic Mode allows the service technician to check the states of all of the devices to ensure that the hardware components are functioning normally. Diagnostic mode is entered from the manual mode screen. If not currently in manual mode, you can get there by depressing the mode key until your are in run mode and then depressing either the jog+ or jog- keys. Press and hold the step scan up key (↑) for 3 seconds and the following screen will be displayed:

### Diagnostic Screen Display:

RCYC STR PB    U000100  
                         010000

983041            000100  
                         0011

Test UARTS 1, 3

The character on row 1, column 14 is the last keypad key pressed. The string of zeroes and ones in columns 16-20 are the states of all of the digital I/O with the exception of the home switch input. The left justified number on row 2 is the actual position in encoder counts.

All of the manual mode functions are also available to the Diagnostic mode as well. Refer to the Manual Mode section for the descriptions of the manual mode functions. The keys NOT located on the keypad will display as descriptive text messages on row 1 column 1 when depressed.

### 8.1 Keypad Key Display

The character on row 1 column 14 is the key code for the last keypad key pressed. Refer to the table below for a description of all of the key codes:

<u>Key Code</u>	<u>Key Description</u>
C	Clear Zero Set Key
0-9	Numeric Keys
-	Minus key
D	Step Scan Down Key (↓)
U	Step Scan Up Key (↑)
S	Display Scan Key
M	Mode Key

### 8.2 Digital I/O Display

The string of zeroes and ones in columns 16-20 are the states of all of the digital I/O with the exception of the home switch input. Refer to the table below for a description of all of the digital I/O:

<u>Row, Column</u>	<u>Function</u>
1, 20	Cycle Start PB
2, 15	Cycle Stop PB
1, 16	Jog Minus PB
1, 15	Jog Plus PB

1, 17	Zero Return PB
4, 16	MPG Enable PB
1, 18	Emergency Stop Input #1
1, 19	Emergency Stop Input #2
2, 20	Spare
3, 17	Over Temperature Switch
3, 15	Remote Cycle Start PB

<u>Row, Column</u>	<u>Function</u>
3, 19	Auxiliary Input #1
3, 20	MPG Increment #1
4, 15	MPG Increment #2
2, 17	Unclamped Pressure Switch
2, 16	Clamped Pressure Switch

When the states of the auxiliary inputs #1-3 go high/low, the states of the auxiliary outputs #1-3 go high/low as well. When the state of the clamped pressure switch input goes high/low, the clamp output goes high/low as well. When the state of the remote cycle start PB goes high/low, the finish relay output goes high/low as well. When the state of the Emergency Stop PB goes high/low, the state of the Emergency Stop relay goes high/low as well.

The CPU Running LED will be blinking at 2 second intervals if the control box software is operating correctly. Simply remove the top cover to view the LED. There are also two LED's on the front of the Printed Circuit Board that indicates the +5v and +24v supply's are operating.

### 8.3 Actual Position Display

Row 2 columns 1-8 is the actual position in encoder counts. For a 5C table for example, there are 1365.333 encoder counts in one degree. To determine where the table is in degrees you must divide the encoder count value by 1365.333. This diagnostic tests the operation of UART #4. UART #4 is the communication medium between the microcontroller chip and the drive. If it was not working we would not be able to get the encoder position from the drive.

### 8.4 UART Test

To test UARTs 1 and 3 connect the send line of UART 1 (RS232 UP) to the receive line of UART 3 (RS232 DOWN), If the UART test was successful, the words "Test UARTs 1, 3" will appear on row #4 (see Diagnostic Screen Display #2).

UART #1 (RS232 UP) is for RS232 file transfer and controlling the box over the RS-232 link. UART #3 (RS232 DOWN) is for communicating with another control box during daisy chaining. UART #2 is for communicating with the USB port. UART #4 is the communication medium between the microcontroller chip and the drive. If it was not working we would not be able to get the encoder position from the drive for example.

### 8.5 Memory Card

The memory card is the storage medium for part programs and parameter files. If it was not working correctly we would not be able to read the parameter file values or the current part program at power up. If the message rc= -1 MMC not detected press the cycle start to continue comes up, the memory card is missing or is corrupted.

#### 1. "PVIEW.TXT"

This file contains the "preview" text associated with each control box parameter. The preview mode is accessed dur

ing parameter edit. To receive more detailed information about a parameter press the cycle start button while editing the parameter and the preview text will appear. Press the up/ down arrow keys to move from page to page and pressing the cycle start button will return to parameter edit.

2. "555"

This is the cycle test program. It is used to check the control box functionality.

3. "DMSG.S.TXT"

This file contains the Elmo drive error messages text. When the control box software receives a fault status from the Elmo drive, this file is accessed and the corresponding message is displayed.

4. "CC.IMG"

This is the compiled hand wheel program. When a new Elmo drive is installed the control box software loads the contents of this file into the Elmo drive.

5. "CC.TXT"

This file contains the expected check sum code when the compiled hand wheel program is loaded into the Elmo drive. After the compiled hand wheel program is loaded, the control box software sends this code to the drive. The drive computes its own check sum from the data it received. If the two checksums match the load was successful.

6. "DPARMS.TXT"

This file contains all of the Elmo drive two letter commands that are used to extract all of the parameters from the drive during the drive upload function. This file is also used when creating a new table or motor drive parameter template file. When a new motor or table is required, the motor is tuned using the composer software. This software package loads in all of the drive parameters into the drive ROM memory. Another software program reads all of the parameters from the drive using the drive commands from this file and writes them to a drive template file. The new drive template file is then added to this list of files. When a new control box is required to have this configuration, the drive template file parameters are loaded and saved to the drive at the first power up.

7. "PFILE.TXT"

This file contains all of the control box parameter default values. When the control box is powered up for the first time the installer is prompted for the table type. Then the default values for the table are saved to this parameter file.

8. "GEAR.TXT"

This file contains the default gear compensation zero data. It gets overwritten when gear compensation is performed.

9. "5C.TXT"

"16C.TXT"

"LP160.TXT"

"LP210.TXT"

"LP250.TXT"

"DD100.TXT"

These are the drive parameter file values for all of the different table types. When a new control box is powered up for the first time, the installer is prompted for the table type. The software then guides the installer to the file utilities where the parameter values for the selected table are downloaded then saved to the drive.

## 8.6 USB Port

The USB port is for communicating with USB media. If it was not working correctly we would not be able to see any files on the USB storage media.

Press the mode key to exit the diagnostic mode and return to manual mode.

## 9. Features of the Indexer Control

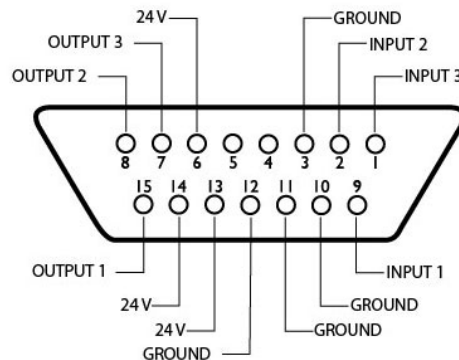
The control has many features which can be utilized by the customer. These features include three outputs and inputs to control extra devices, the ability to control the hardware limit switches, a handwheel option, and the addition of an E-stop circuit which can be tied to the host machine tool control. This section will discuss in detail these features.

### 9.1 General Purpose OUTPUT Functions of the Control

The Control is equipped with three 24V digital outputs available for custom use by the operator. These outputs function as a normally open set of contacts. These outputs can be useful in running valves automatically for items such as workholding for trunnions, tailstocks and collet chasers. The I/O connector has three ground sources available to run the external devices. Therefore, the devices need to be 2-wire, 24 volt devices. The 24V lead of the device should be connected to the output to be used. The other lead of the device should be connected to the ground.

Refer to the diagram below for the output signal locations on the I/O connector on the back panel of the Enhanced Indexer Control. The connector on the control is DB15 female. A DB15 male connector will be required to use this functionality (Part No. CI 001024201).

AUX I/O Connector on  
Back of the Control



Output 1 is pin 15

Output 2 is pin 8

Output 3 is pin 7

Pins 6, 13 and 14 are available 24V sources

To program the outputs, G81 is used in the step of the part program. The position value of the step will identify which output to be used. The feed rate value will determine whether the output is being turned on or off. In the position area, when selecting which output to use, the definitions are as follows:

Output 1 = 1.000

Output 2 = 2.000

Output 3 = 3.000

In the feed rate area, 1.111 will turn the output on and 0 will turn the output off.

Programming Example of Output Function:

To turn on output 1 and to turn off output 1 would appear as follows in program mode:

```

N001 S      1.000 G 81
      F      1.111 L 1
N002 S      1.000 G 81
      F      . 0 L 1
  
```

Step one is turning on the output and step two is turning off the output.

**NOTE:** When an output is turned ON or OFF, a finish signal will be sent to the machine host control.

The use of the outputs can be programmed and commanded using the RS-232 function. Follow the programming procedure outlined in the RS-232 section of the manual. The G-code will be G81, the feed rate will be 1.111 or 0 and the position value will be 1.000, 2.000 or 3.000.

## 9.2 General Purpose INPUT Functions of the Enhanced Indexer Control

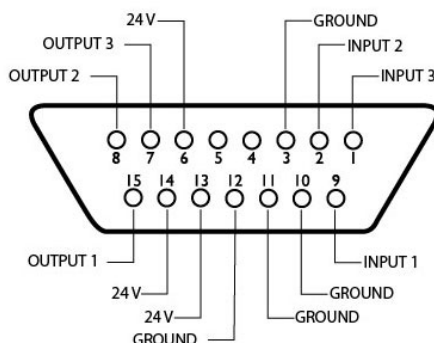
The enhanced Indexer Control box is equipped with three digital inputs available for custom use by the operator. The inputs can be configured to be normally open circuits or normally closed circuits. See parameter 112 for the definition of the status of the inputs. The inputs can be used to monitor safety switches used to check the status of devices using the control box outputs. They can also be configured to use hardware limit switches for applications when the travel of the indexer is restricted because of clearance issues. Parameter 113 defines the definition of the outputs when using them with hardware limit switches. The input device must be 24V.

When wiring an input device connect the signal lead to the input to be used. Connect the 24V lead to a 24V source on the I/O connector.

Refer to the diagram below for the input signal locations on the I/O connector on the back panel of the Enhanced Indexer Control.



### AUX I/O Connector on Back of the Control



Input 1 is pin 9

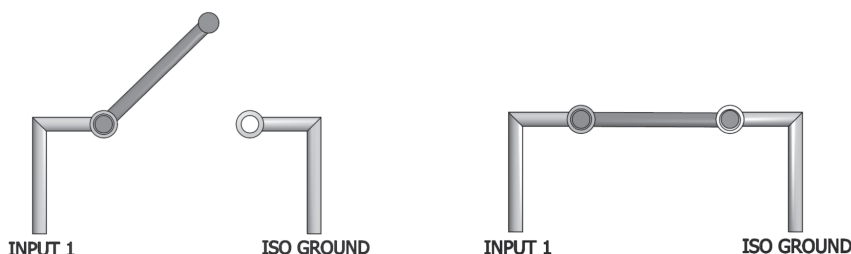
Input 2 is pin 2

Input 3 is pin 1

Pins 3, 10, 11 and 12 are available grounds

#### The logic of the Input software

In the control box, the input function can be used and programmed to monitor system devices. When using the input commands in a part program, the condition which the control is looking to be satisfied is a true condition to continue to the next program step. If the input condition is false, the program will hang on the input step until the condition is made to be true. The condition for which the input is looking for is set by Parameter 112 (see parameter section of manual for definitions). In the parameter section, a value of 0 identifies a normally open circuit and a value of 1 identifies a normally closed circuit.



Normally Open Circuit

Normally Closed Circuit

There are many different devices available that the operator may choose to use in the application. These devices can be chosen to be normally open or normally closed devices. Sometimes they are referred to as sourcing or sinking. Therefore, it is important to have the inputs correctly set by parameter 112 to work with the hardware device to be utilized

#### Programming the Inputs

To program the inputs, G82 is used as the G-code in the step of the part program. The position value of the step

will identify which input to be monitored. The feedrate values for this function are ignored. The program will not continue in the indexer control until the input is satisfied. In this example, make sure parameter 112 is set to 7. This means that all inputs are normally closed. Have a jumper ready to test the logic of the input circuit. To begin the test, no jumper is required.

In the position area, when selecting which input to use, the definitions are as follows:

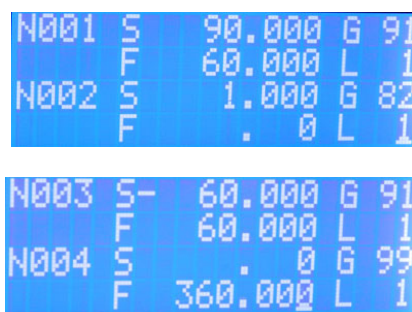
Input 1 = 1.000

Input 2 = 2.000

Input 3 = 3.000

#### Programming Example of Input Function

In the following photo, the monitoring of input 1 is demonstrated:



```

N001 S 90.000 G 91
      F 60.000 L 1
N002 S 1.000 G 82
      F . 0 L 1

N003 S- 60.000 G 91
      F 60.000 L 1
N004 S . 0 G 99
      F 360.000 L 1
  
```

Step two of the program will check for the status of input 1 when executed. The software will not allow the program to continue until the condition of input 1 is satisfied (true). Once input 1 is satisfied, the program will advance to step three. If the input is configured to be normally closed, it will wait for the circuit to be open. If the input is configured to be normally open, it will wait for the circuit to be closed.

Run the program with no jumper in place for input 1, the program should continue through step two. Repeat the program with the jumper installed between pin 9 (input 1) and pin 3 (ground) on the I/O connector. When the program is executed, it will hang on step two because the normally closed input 1 is now closed by the jumper. Remove the jumper and the program will move to step three.

The use of the input function can be programmed and commanded using the RS-232 function. Follow the programming procedure outlined in the RS-232 section of the manual. The G code will be G82 and the position value will be 1.000, 2.000 or 3.000.

### 9.3 Using the Inputs to Monitor Hardware Limit Switches

By changing parameter 113, the function of the general purpose inputs can be modified so that they can be used to monitor hardware limit switches. See the definitions of this option in the parameter section of the manual. Using these inputs for hardware limit switches can be valuable when there is a potential for damage to occur to the indexer or machine tool when the travel of the indexer should be limited. This is especially helpful in the homing procedure after power up in preventing travel into a restricted area. This is a backup to the software limits which are only valid after initial power up and homing. With the optional Hardinge limit switch kit, hardware limits are adjustable to meet most operator applications.

### 9.4 Procedure for Using the Optional Hardinge Hardware Limit Switch Kit

#### Parameter 112 Inverse Dig Input

This parameter inverts the input signal between normally open and normally closed.

To use the hardware limit switches this must be set to 3 or 7. This is because the limit switches utilized by the Hardinge Kit are normally closed and use inputs 1 and 2.

#### Parameter 113 Set Dig Input Mode

This parameter must be set to a value of 3 (Input 1 is positive hardware limit and input 2 is negative hardware limit).

When operating the system in jog or run mode, if a hardware limit is encountered there will be an error message posted on the control display which reads "HW LIMIT JOG OPP DIRECTION". This will require the operator to press the green cycle start key one time to clear the error message. Then the operator must jog the indexer in the opposite direction to the "safe area". The indexer will only be able to rotate in the "safe direction".

The hardware limit switches are located on the back of the indexer under a sheet metal cover. They have been adjusted to have a travel of +/- 160.000 degrees. Depending on the workholding and part size, these may have to be adjusted.

**NOTE:** It is very important that the indexer is homed prior to mounting any workholding on the system. Once homed, you can then jog the indexer in the positive and negative directions to determine the available travel. If needed, re-adjust the limit switches to safely operate the system. Once adjusted correctly to the workholding limitation, this will provide security when homing and running part programs.

### 9.5 Homing the Indexer Using the Hardware Limit Switch Kit

With the hardware limit switch function turned on and the switches properly adjusted, press ZERO return on the indexer Control. If the axis encounters a hardware limit switch, the control will stop the axis and require the operator to jog the axis in the opposite direction. Hold the jog button until the axis travels past the home position. Stop the indexer and press zero return. If needed, press the 5 key on the keypad to jog faster. During the homing operation, only the hardware limit switches are effective for protection against a crash. The indexer homes on power up in the positive direction. The home position is when the B-axis is vertical. If the A-axis is in a position in which the B-axis is on the positive side of home, the A-axis will trip the positive hardware limit switch when trying to home. This will require the operator to jog back in the negative direction to find home. If the B-axis is on the negative side of home, the A-axis will home directly to the home position. Once the home position is established on power-up, the indexer will take the shortest path to home until power is shut off to the control. After initial homing is done, the software limit switches will become active and be used. See the section of the manual defining the software limit switch function.

### 9.6 Adjusting Hardware Limit Switches



The hardware limit switches are located on the back of the indexer. They must be removed to

observe and adjust the switches. Make sure the indexer is homed. Install the workholding and a part piece. Slowly jog the indexer until the workholding and part piece are within approximately 10 degrees of their travel limit in the positive direction. Adjust the positive travel switch by loosening the (2) M5 adjusting screws and sliding the bracket into position to sense the limit switch reference dog. Set the negative travel switch by jogging in the negative direction using the same technique.

### 9.7 Handwheel Option Info

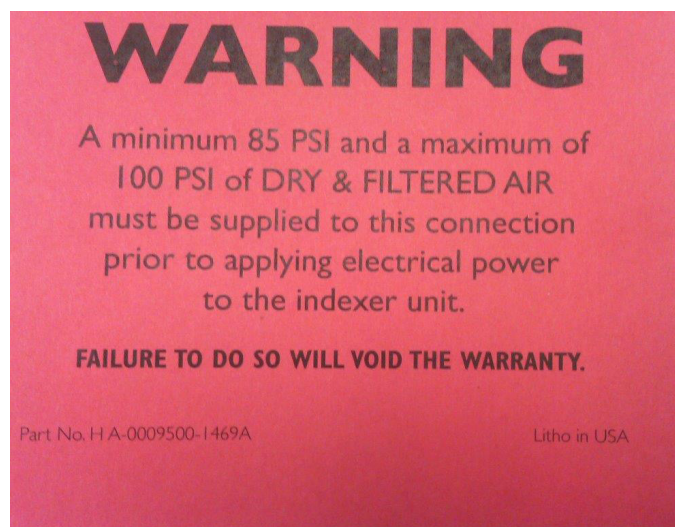
**NOTE:** Using this feature will prevent the user from operating the Enhanced Indexer Control until the machine is out of its E-stop condition.

## 10. Clamp Function in the Hardinge Indexer Control

The Hardinge 160, 210, 3J and 16C indexers are fitted with a spindle clamp. The following sections will detail the clamp functionality and requirements for proper operation.

### 10.1. Air Requirements for Clamp Operation

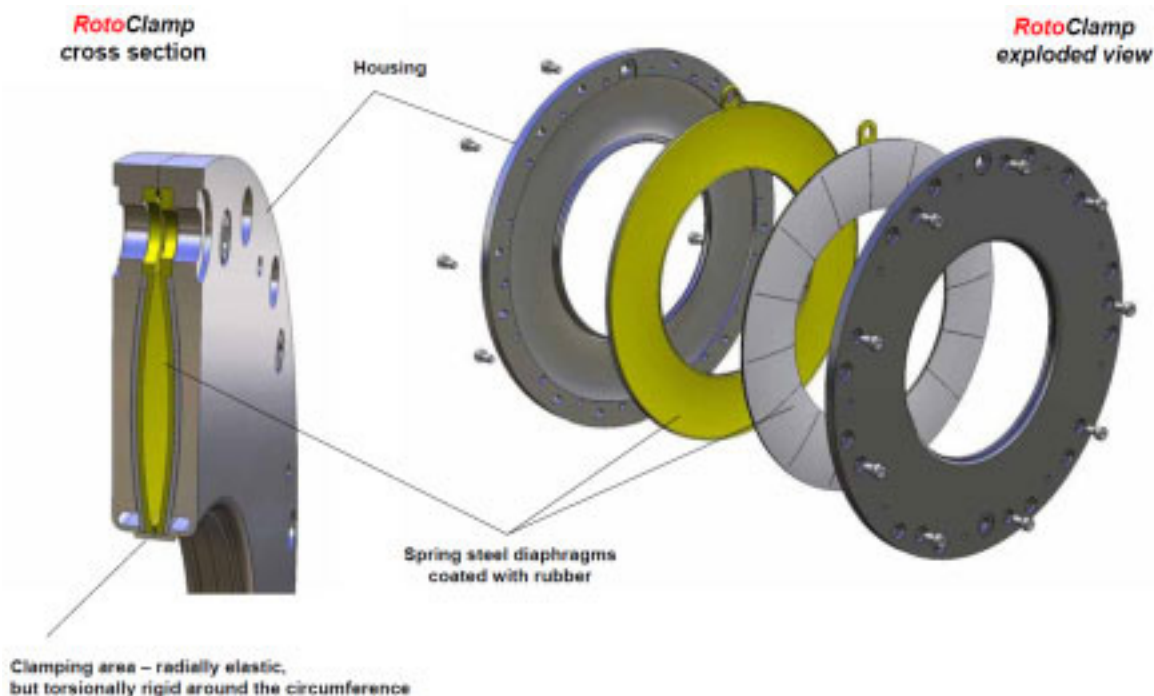
The clamp requires 85 psi minimum to 100 psi maximum air pressure to operate. The air must be DRY and FILTERED. Lubricated air CANNOT be used. Indexers which are fitted with a clamp will have an air connection on the motor cover to supply air for the clamp function. This connector is identified with a RED tag specifying the air requirements. A 9 ft. air hose is also supplied to aid in routing the air supply to the indexer inside of the machine tool.



**NOTE:** Use of improper air pressure or lubricated air for the indexer clamp will void the warranty of the indexer.

### 10.2 Clamp Specifications

The clamp is a purchased component manufactured by RotoClamp. This is a failsafe device which uses springs to grip on the outside diameter of the spindle to clamp the indexer in place. Air is supplied to the clamp open port to release the springs and unclamp the indexer. On some of the indexer products, air is supplied to the clamp close port to give the indexer extra gripping force.



#### Clamp Torque Values of Indexers:

160 Indexer = 150 ft-lbs

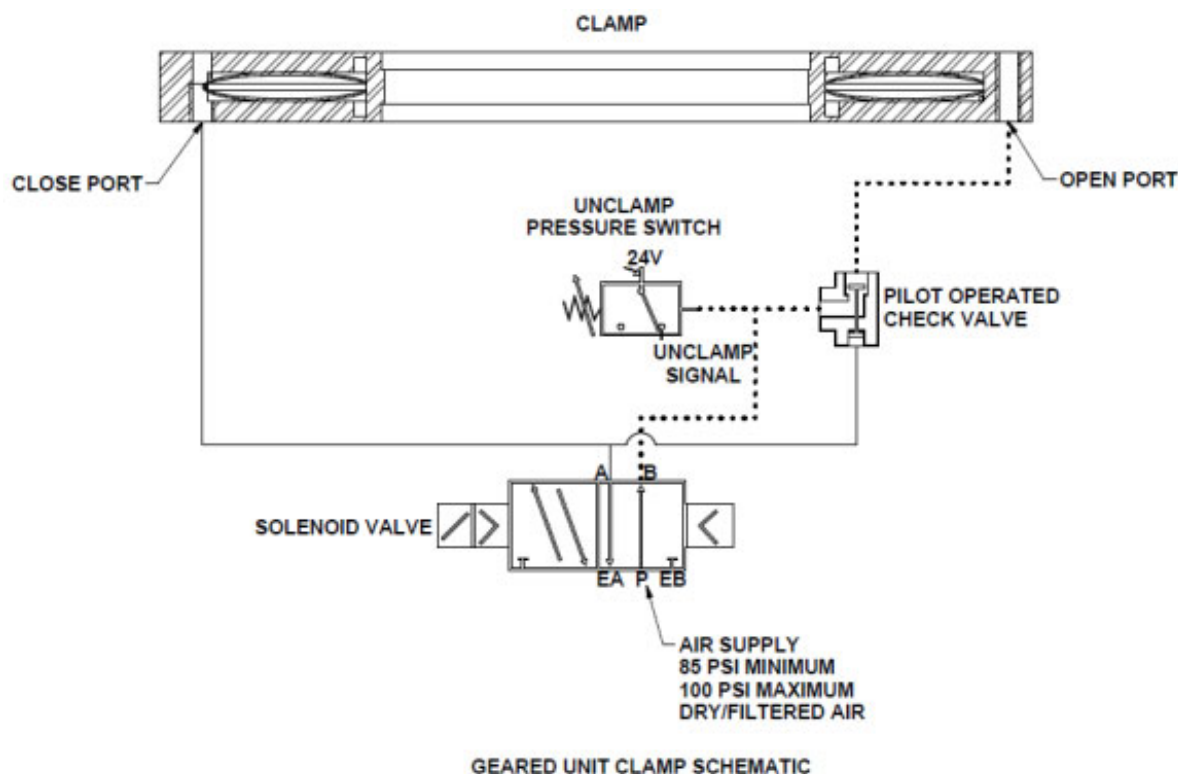
16C/3J Indexer = 175 ft-lbs

210 Indexer = 275 ft-lbs

#### 10.3 Clamp Circuit Definition

The clamp circuit consists of four major parts. These are identified in the diagram below.

Description	Hardinge Part Number	Manufacturer's Spec.
Solenoid Valve	CJ 0003048SCV	SMC: SY5120T-5MOZ-01T
Pressure Switch	RT 0003011PSAS	SMC: PSI000-R07L
P.O. Check Valve	CJ 0003048POCV	PNEUMADYNE: POC-61-F
Clamp	CJ 0003048RC90	ROTOCLAMP: RC 90 S



If the indexer is fitted with a clamp, there are two parameters which control the operation of the clamp function. These are parameters I10 and I11.

Parameter I10 defines the mode of the clamp circuit.

#### Settings:

- 0 Clamp not installed. This is the setting for 5C indexers only which do not have a clamp.
- 1 Manual clamp control. A G-code commands the clamp/ unclamp function.
- 2 Automatic clamp control. Clamp is automatically engaged\ disengaged through the software. This is the default setting for indexers shipped with a clamp installed.

Parameter I11 is a timer for the clamp dwell.

#### Settings:

0-2000

This parameter defines the length of dwell in milliseconds for the clamp function. If parameter I10 = 0, this timer should be set to 0. If parameter I10 = 1 or 2, this timer should be set to 1000-2000. The default setting for this parameter with indexers fitted with a clamp is 1000.

#### 10.4 Clamp Logic for Operation

##### Unclamp Logic:

- Solenoid Valve de-energized (low)
- Pressure Switch energized (high)
- Clamp Open



**Clamp Logic:**

Solenoid Valve energized (high)  
 Pressure Switch de-energized (low)  
 Clamp Closed

**10.5 Auto Clamp Operation with Parameter I10 = 2 and Parameter I11 = 1000**

- Air supplied to indexer, 85 psi min. – 100 psi max. Dry/filtered air.
- Power on indexer control.
- If air pressure is below 85 psi, “CLAMP FAULT PRES LOW” is displayed.
- If air pressure is good, the clamp will engage. Solenoid valve will energize, pressure switch will de-energize and the display will read “CLAMPED”
- When a move is commanded, solenoid will de-energize, pressure switch will energize, the dwell will count down and the indexer will rotate. Display will read “UNCLAMPED”.
- When motion stops, the dwell will count down and the solenoid valve will energize, the pressure switch will de-energize and the unit will clamp. Display will read “CLAMPED”.

With indexers supplied with a clamp, this is the recommended setting for clamp operation. This will provide the longest life for the gear set and overall indexer performance.

**NOTE: In this mode, if air pressure is lost when in the “UNCLAMPED” state, an alarm will be generated and the display will read “CLAMP FAULT PRES LOW”. The air pressure will have to be corrected before operation can resume. To clear the alarm cycle power to the control. If the problem has been corrected, there will be no alarm message on power up. If the alarm does not clear, contact a Hardinge Service Representative for help related to this issue.**

**10.6 Manual Clamp Operation with Parameter I10 = 1 and Parameter I11 = 1000**

Some machining processes may not require use of the indexer clamp. In this case the manual clamp operation may be used to save cycle time. Machining on the indexer with the clamp off should only be done for light cutting forces such as drilling and tapping on center of the part. For milling and off-center drilling the clamp must be utilized.

- Air supplied to indexer, 85 psi min. – 100 psi max. Dry/filtered air.
- Power on indexer control.
- If air pressure is below 85 psi, “CLAMP FAULT PRES LOW” is displayed.
- If air pressure is good, the control will power up with no alarms. The solenoid valve will remain de-energized, the pressure switch will be energized. The display will read “UNCLAMPED”
- The indexer will remain unclamped until a G-code in the program is given to turn the clamp on.
- When the G-code is commanded to clamp, the dwell will count down and the solenoid valve will energize, the pressure switch will de-energize and the unit will clamp. Display will read “CLAMPED”.
- When a G-code to Unclamp is commanded, solenoid will de-energize, pressure switch will energize, the dwell will count down. Display will read “UNCLAMPED”.

**Note: In this mode, if air pressure is lost when in the “UNCLAMPED” state, an alarm will be generated and the display will read “FLT CLAMP PRESSURE LOW”. The air pressure will have to be corrected before operation can resume. To clear the alarm, press “CYCLE START”.**



**If the problem has been corrected, this will clear the alarm message. If the alarm does not clear, contact a Hardinge Service Representative for help related to this issue.**

#### Programming Manual Clamp Operation:

The G-Code for Clamp/Unclamp is G80. The feedrate is used to define whether to clamp or unclamp. The position and loop counts are not used for this function.

Feedrate = 0 = Unclamped

Feedrate = 1.111 = Clamped

### 10.7 Parameter Changes Required

Change parameter #12 "Units" to a 5  
Absolute Position Display (Not Modulo 360)

Change parameter #13 "Linear Axis" to a 1  
Define a Linear Axis (Not a Rotary Axis)

Change parameter #14 "Encoder Counts Per Inch Numerator" to the numerator of the encoder resolution

Change parameter #17 "Encoder Counts Per Inch Denominator" to the denominator (divider) of the encoder resolution

Change parameter #24 "Inch Mode" to a 1 if inch mode is desired or to a 0 if metric mode is desired  
Inch mode: Input in inch (3.4 format displays)

Metric mode: Input in mm (4.3 format displays)

Change parameter #115 "SW Limit Mode" to a 1  
Use software limits

Change parameter #116 "SW Limit High" to the positive travel limit in inches x 1000  
Software Positive Travel Limit

Change parameter #117 "SW Limit Low" to the negative travel limit in inches x 1000  
Software Negative Travel Limit

If your application uses hardware limit switches then:

Change parameter #113 "Set Dig Inputs Mode" to a 3

Use Digital Input 1 as the positive limit switch and Digital Input 2 as the negative limit switch

### 10.8 Changing Back to a Rotary Axis

Change parameter #12 "Units" to a 6  
Modulo 360 display (Not abs Position Display)

Change parameter #13 "Linear Axis" to a 0  
Define a Rotary Axis (Not a Linear Axis)

Change parameter #24 "Inch Mode" to a 0  
Turn off inch mode

If your application requires software limit switches then:

Change parameter #115 "SW Limit Mode" to a 1  
Use software limits

Change parameter #116 "SW Limit High" to the positive travel limit in degrees x 1000  
Software Positive Travel Limit

Change parameter #117 "SW Limit Low" to the negative travel limit in degrees x 1000  
Software Negative Travel Limit

If your application does not require software limit switches then:

Change parameter #115 "SW Limit Mode" to a 0  
Do Not use software limits

If your application does not use hardware limit switches then:  
Change parameter #113 "Set Dig Inputs Mode" to a ???  
Digital Inputs 1 and 2 are general purpose inputs

## 11. Interfacing to your Host Machine

As mentioned earlier in this manual, there are five ways to configure a Hardinge rotary product to your machine:

1. **As a stand-alone indexer with a control.** Programming is done in the indexer control and executing the program is done through the cycle start button on the indexer control.
2. **As an add-on to a host machine via the remote CNC cable.** Programming is done in the indexer control and the program is executed through a start signal via the remote CNC cable. This start signal can be provided by a mechanical switch (the remote quill switch) or by a relay contact from the host machine control using an M-code.
3. **As an add-on to a host machine utilizing RS-232 communication.** The indexer control has the ability to communicate with a host machine capable of sending RS-232 programming commands. Programming is done in the host machine control and commands are sent through the RS-232 cable. The indexer control interprets these commands and executes them. No programming is required in the indexer control.
4. **As an add-on to a host machine using the RS-232 communication and remote CNC cable in conjunction.** This is the most reliable use of the indexer with the indexer control. Programming is done in the host machine control and commands are communicated over the RS-232 cable. The machine then uses an M-code to send the start signal through the remote CNC cable and the indexer control will execute the commanded motion. The indexer control then sends a finish signal to the host machine control to cancel the M-code. No programming in the indexer control is required.
5. **As a true 4th-axis to the machine CNC control.** This configuration removes the indexer control from the application and the is wired directly to the machine. An indexer purchased with an indexer control may not be convertible to a true 4th-axis configuration. A compatible motor to the host machine is required at time of purchase. When using the wired directly to the machine, consult the host machine manufacturer for information on 4th-axis operation.

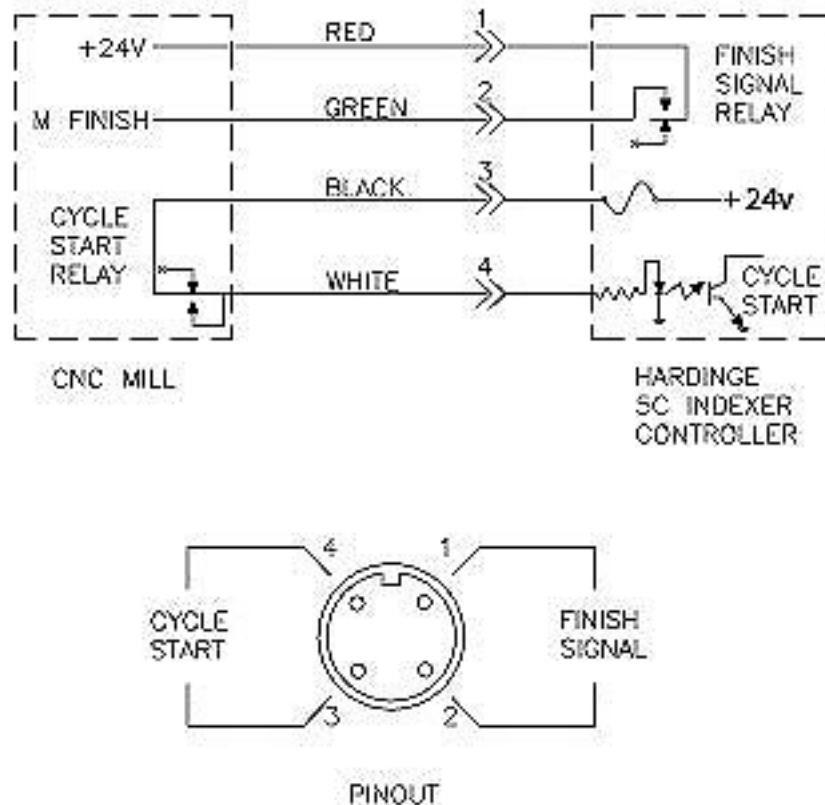
### 11.1 Remote CNC Cable Connection and Use

#### Cycle Start/Finish Circuit Definition

The function of the remote CNC interface cable is to provide a hardware "handshake" between the main machine and the indexer control. While the control will function without this handshake feature, as described elsewhere, it is much safer to use this simple 4-wire connection between the machine and indexer control to prevent the machine and indexer control from operating independently. To make this feature as universal as possible, the interface implementation is made with relay contacts. This allows the user to use an M-code relay or a quill switch to operate the indexer control and provides the capability of interfacing to many types of inputs with the indexer control's "FIN" (finished) response. It also helps prevent incompatibilities between equipment interface voltages. The operation of the "FIN" signal relay can also be inverted to act as a machine feed permissive circuit by changing parameter 2 to a 1 instead of a 0.

The indexer control expects to see a contact closure between pins 3 (black wire) and 4 (white wire) of the interface connector to "cycle START" the indexer control when in RUN mode. The control settings will determine if the cycle START executes a loop count, step or an entire program. When the indexer control has executed what was desired, the indexer control closes a relay contact back to the machine on pins 1 (red wire) and 2 (green wire). It should be noted that while every attempt has been made to work with a number of different voltages, the "FIN" contact circuitry is purposely designed to operate a 24 volt DC input. Operating at a lower or higher voltage or interfacing to an AC circuit should be discussed with a manufacturer's representative.

The typical 4 wire interface is shown below.



**NOTE:** On pin 1 the circuit voltage 24V DC originates in the machine. On pin 3 the 24vdc supply is provided by the indexer control. This 24volt supply is internally protected against overload and will crowbar to 0 vdc if the load is too great. The color codes given are typical. If your machine does not have relays for outputs, a relay kit may be available. It may also be possible to directly drive pin 4 with a sourcing DC output, but this should be discussed with a manufacturer's representative. The fin relay in the indexer control is a Coto 9007 series surface mounted SIP relay. The relay contacts are rated to carry 1 amp and can switch .5 amps. These circuits are designed for 24 VDC operation only. Other voltages may be possible but should be discussed with the manufacturer's representative to prevent the loss of warranty coverage on the indexer control.

**NOTE:** Make sure your CNC has the same number of M-functions programmed as you have steps in the Hardinge indexer control. Do not program two M-functions, one directly after another, in your CNC control to index the Hardinge indexer control. This may cause a timing hang up in your CNC. Use a dwell between them in the CNC control. See setting of parameter 31 and program the equivalent dwell.

## 11.2 RS-232 Capabilities

The Hardinge Indexer control has the capability of RS-232 communication for running commands and uploading/downloading programs. There are two connectors on the back panel of the control for connecting RS-232 cables. The top connector (RS-232 UP) is used for commanding and transferring programs. The bottom connector (RS-232 DOWN) is used for connecting indexer controls together. This is called daisy chaining. Up to nine controls can be daisy-chained together.

To use a PC to communicate with the indexer control, an RS-232 cable is required. This cable will require the DB-25 pin male connector on one end and either a USB or DB-9 connector for the PC. The cable used must be wired DTE (Data Terminal Equipment) on the PC end. Next the PC and indexer control must be configured to perform the communication. HyperTerminal is common on most PCs and will serve as the tool to accomplish the task.

The following parameters should be set in the indexer control to the appropriate value.

Parameter 21 = 4 (X-axis)

Parameter 26 = 3 (baud rate = 9600)

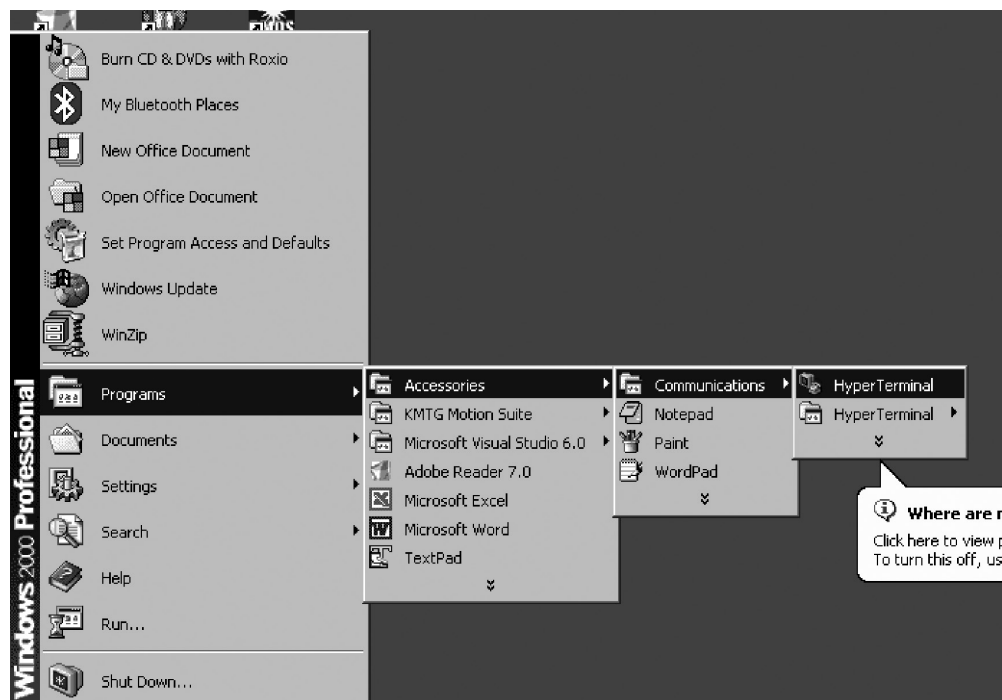
Parameter 105 = 1 (stop bits = 1)

Parameter 106 = 8 (data bits = 8)

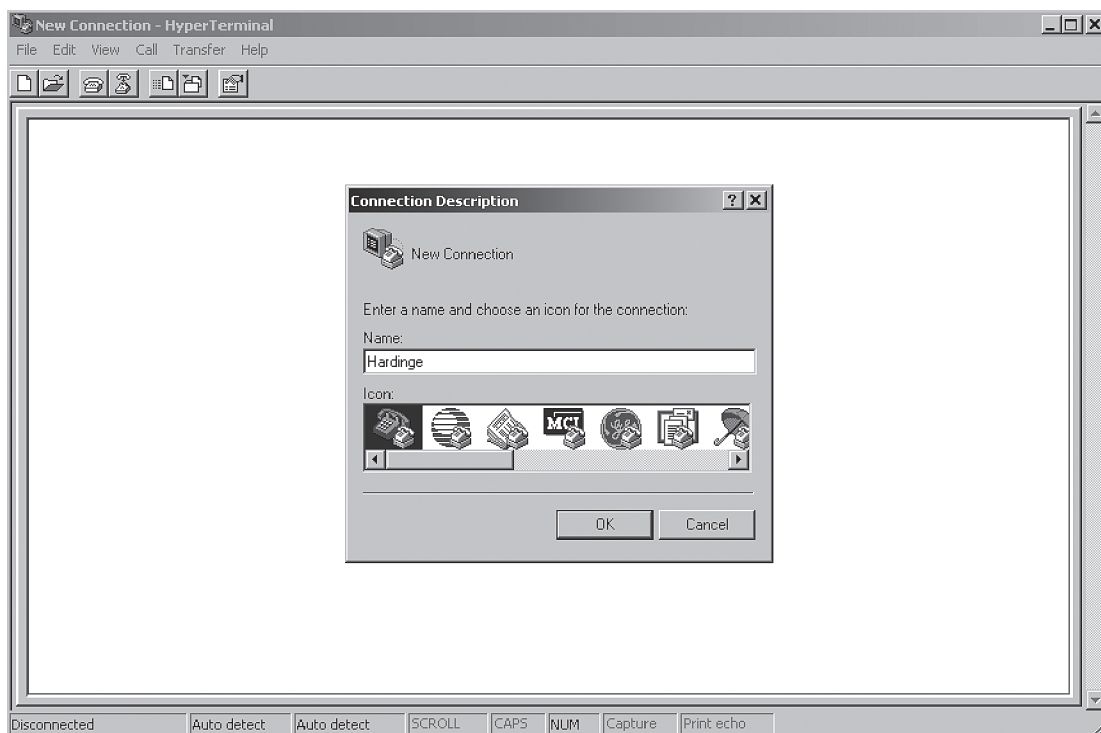
Parameter 107 = 0 (no parity checking)

### 11.2.1 Configuring the PC using HyperTerminal

1. Use the HyperTerminal application for uploading/downloading programs to the indexer control. The HyperTerminal application is available in every Windows operating system up to Windows XP. If you have Windows 7 or later copy hyperterm.exe and hypertrm.dll from the Hyperterminal folder located on the Hardinge CD ROM to a new folder. Then click on the EXE file to launch Hyperterminal. If you have Windows XP or earlier then launch HyperTerminal from the START menu Programs/Accessories/Communication/HyperTerminal.



2. Enter connection name (Hardinge for example) and click enter.



3. In the "Connect Using" option select the COM port to be used for communication.



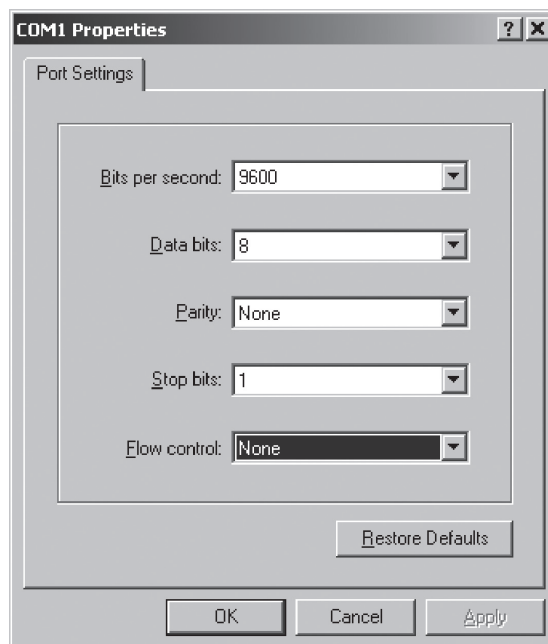
4. Define COM port properties:

"Bit per second" is an RS232 communication baud rate. This field should be set according to indexer control parameter 26. (E.g. if parameter 26 is 3, baud rate 9600 should be selected)

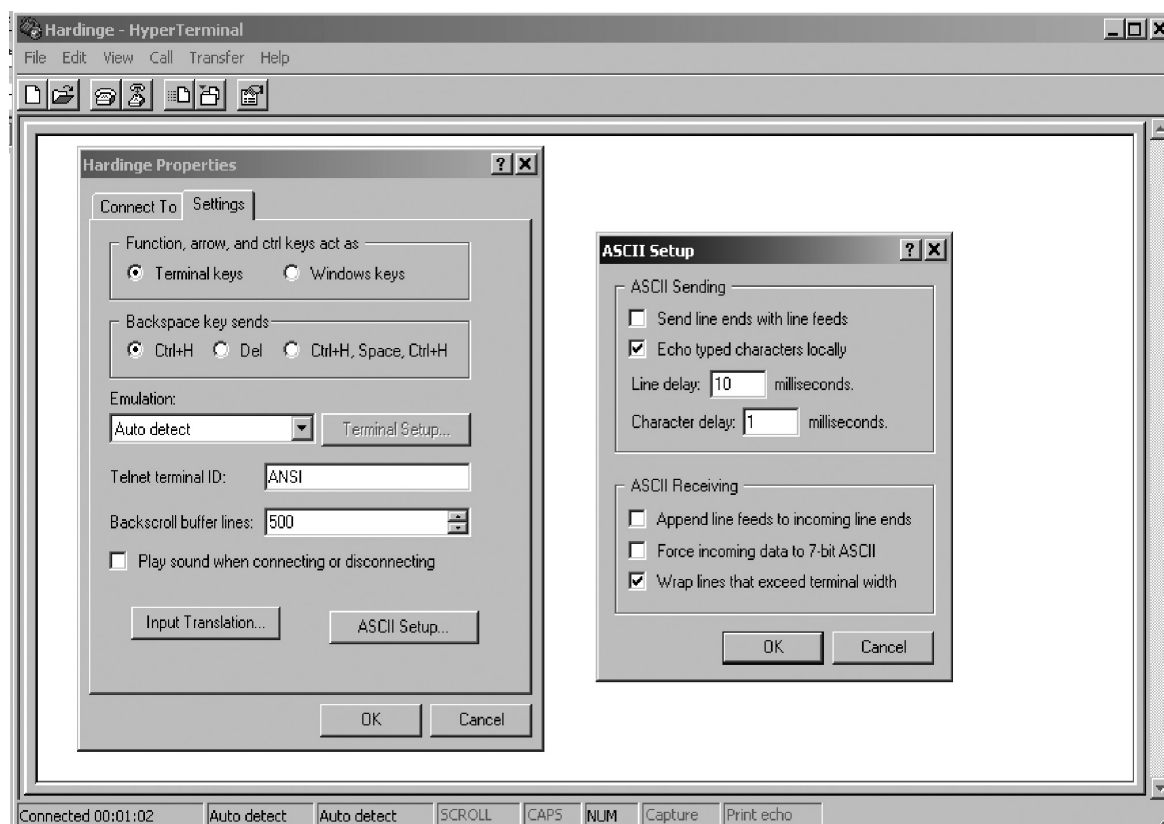
"Data bits" - select 8 "Parity" - select None "Stop bits" - select 1

"Flow control" - select None

Click OK



5. In the HyperTerminal menu, select File/Properties. "Hardinge properties" window will be open. Select "Settings" tab and click on "ASCII Setup". In "ASCII setup" window, set "Line delay" to 10, "Character delay" to 1. Select Echo type characters locally. Click OK. Click OK to exit properties.



### 11.2.2 Uploading and Downloading Programs using a PC

**UPLOADING** – Transfer programs from the Indexer Control to the computer.

1. Make sure HyperTerminal is open and communicating with the Indexer Control. This can be checked by sending an XP for an X axis box. It will respond with the axis position information when communicating properly.
2. Enter Program Mode on the indexer control.
3. Position the cursor on the G-code of step one.
4. Press the (–) button on the keypad. A display of the available programs to upload will be displayed. You can only upload the current program.
5. Press the (–) button again on the keypad. Display should now read: Send prog: #
6. In HyperTerminal, select Transfer/Capture text.
7. A dialogue box will appear asking for the file to be named and saved. Select location, name file and press start.
8. Press the Cycle Start button on the indexer control. Program will start uploading. A message "sending program" will appear followed by the program contents. Once the program contents stops scrolling, it is complete. In HyperTerminal, the program will be displayed on the computer screen.
9. In HyperTerminal, select transfer/capture text/stop.
10. The program has been uploaded and can be opened and edited with notepad.



11. Close HyperTerminal.
12. Exit Program Mode in the indexer control.

DOWNLOADING – Transfer programs from the computer to the indexer control.

1. Make sure HyperTerminal is open and communicating with the Indexer Control.
2. Enter Program Mode on the Indexer Control.
3. Activate the Program number where you wish to save the downloaded file. Right arrow over to the g code and press the (-) key. This will show a list of used programs. Enter a number either to overwrite a current program or download a new one and press the Cycle start key.
4. Position the cursor on the G-code of step one again.
5. Press the (-) button on the keypad.
6. Press the (-) button again on the keypad.
7. Press the (-) button a third time on the keypad. The display should now read: Receiving prog: #
8. In HyperTerminal, select transfer/send text file. A dialogue box will appear to select the file. Do not select yet. Leave dialogue box active and move to the indexer control.
9. On the indexer control, press Cycle Start. A message "Receiving program " will appear.
10. In HyperTerminal, select the program file using the dialogue box and press Open.
11. The program will be downloaded and a message will be displayed stating the number of lines and bytes received. Press cycle start and the program will be displayed on the indexer control when complete.
12. Check the steps of the program to insure that the transfer worked correctly.
13. Correct any errors manually that may have occurred in the program of the indexer control.
14. The program is now ready for use in the indexer control.
15. Close HyperTerminal.
16. Exit Program Mode in the indexer control.

#### Programming Format for Uploading/Downloading Programs

When downloading a program to the indexer control, the first and last lines of the program should be the % symbol. When programs are uploaded from the control to the PC, this is automatically completed.

For example:

```
%
N001 G91 S090.000 F080.000 L001
N002 G91 S-060.000 F100.000 L001
N003 G99
%
```

#### 11.2.3 Using a PC to Send Commands to the indexer control

A PC can be used to send commands to the indexer control via RS-232. The indexer control will translate these commands and execute the desired functions. This is particularly helpful for custom applications utilizing a PC-based control system. When using this function of the indexer control, Hyper Terminal can be used for controlling the indexer. Other programs may apply but this manual will outline using HyperTerminal. It is important that the HyperTerminal function be configured as described above. Be sure caps-lock is on when typing the commands in HyperTerminal.

The following are the RS-232 commands, where "x" is the selected Axis and "n" is the Value:

<b>Command</b>	<b>Meaning</b>
xSn.nnn	Specifies a step size or absolute position. Step size can be negative or positive.
xFn.nnn	Specifies the Feed Rate in units/second.
xGnn	Specifies the G-code to be used.
xLnnn	Specifies the Loop Count to be used.
xP	Will show the indexer controller's current position.
xB	Begin the programmed step on the "x" axis only.
B	Begin the programmed step on ALL axes at once.
xH	Return to the Home position.
xC	Clear the current indexer position vale and set to zero.
xO	Turn on the position loop control.
xE	Turn off the position loop control.
xSTOP	Stop the indexer control.
x J	Jog the indexer. Units are degrees/second. Can be negative or positive. There must be a space between the capital "J" and the number.

NOTE: Above where an "n" decimal value is possible, at least one digit to the right of the decimal point has to be entered. For example, "xS90." will not work, it must be "xS90.0".

#### Programming Example:

Program the indexer control to make a 90 degree move at 30 degrees/second incrementally using the PC and RS-232 communication. The axis identifier will be A (parameter 21 = 7).

#### In HyperTerminal type:

AS90.000	[Enter]	Programs an angle of 90 degrees
AF30.000	[Enter]	Programs a feed rate of 30 degrees/second
AG9I	[Enter]	Programs a G9I for incremental motion
AB	[Enter]	Sends a start command to the A axis

Once a command is sent to the indexer control, it will remember the command until it is changed. Therefore, to repeat a move, simply send nB to the control again.

All of the G codes are allowed except for G94 "Pulse CNC relay and run next L steps automatically", G95 "End Subroutine", G96 "Start Subroutine", G97 "Dwell", and G99 "End of Program". Datat sent over the RS232 interface can be interger or decimal values. If an interger value is sent, a decimal point is inserted automatically. For example, if 86723 is sent, the control interprets it as 86.723.

#### 11.2.4 Multiple controls utilizing RS-232 (Daisy Chaining)

If a situation exists where more than one indexer with indexer control is placed on a machine tool, it is possible to communicate with the indexer controls and the machine tool control using RS-232.

This is accomplished by connecting RS-232 cables from one control to the next. To accomplish this, a DB25 male to DB25 female null modem cable is required. One indexer control, which will serve as the master, will connect to the machine tool host control as normal. A second RS-232 cable will run from the master indexer control DOWN port to the next indexer control UP port. This is called daisy chaining. Up to nine controls may be daisy-chained together. When programming the machine tool control, it is important that the axis identifier preceding a command is properly addressed. Each indexer control should be set up as a different axis using parameter 21. See parameter 21 definition for the available labels. It is also important to note that the axis identifier be used before a B command, i.e. XB, AB, etc. If only B is programmed, all axes will move at the same time.

If you are only using one of the boxes in the chain, it is necessary to power up all of the boxes between the data source and the box you are using. Data is not passed through an unpowered box.

#### 11.3 Remote Operation with a FANUC CNC Control

There are several requirements that must be met before a Hardinge indexer control can be interfaced with a FANUC-controlled mill.

1. FANUC control with custom macro enabled and parameter 6001, bits 1 and 4 set to "1". Setting bit 1 to a 1 means that the DPRNT command does not output leading zeroes. Setting bit 4 to a 1 means that the DPRNT command outputs both a "CR" and "LF" character after outputting the data.
2. A serial port on the FANUC control must be available for exclusive use by the Hardinge indexer control while DPRNT program is running.
3. Hardinge Indexer Control and indexer table indexer UNIT.
4. RS-232 shielded cable 25' DB25M/DB25M (null modem not required)
5. A shielded remote CNC interface cable Hardinge Part Number: CI-301 I-IC

DB25 pinout:

1-1	2-2
3-3	4-4
5-5	6-6
7-7	8-8
	20-20

### HARDINGE INDEXER CONTROL Parameters for RS-232 Interface

Once the previous requirements have been met, you can revise the parameters of the Hardinge control. Listed below are the parameters that will need to be changed.

Parameter 1	"Relay Mode" = 1 (Relay pulsed for 0.25 sec at the end of motion)
Parameter 2	"Relay Polarity" = 0 (Normally open. Closes when cycle completes)
Parameter 5	"Double Remote Trigger" = 0 (Single trigger)
Parameter 8	"Disable Remote Start" = 0 (Remote cycle start circuit enabled)
Parameter 10	"Auto Continue Control" = 0 (Run one loop and stop)
Parameter 12	"Axis Type" = 5 or 6 (Linear or rotary)
Parameter 21	= 4* (see table 1)
Parameter 26	"RS-232 Baud Rate" = 2* (see table 2)
Parameter 31	"Relay Hold Time" = 0 (0.25 seconds)
Parameter 105	"RS-232 Stop Bits" = 1 (1 stop bit)
Parameter 106	"RS-232 Data Bits" = 8 (8 data bits)
Parameter 107	"RS-232 Parity" = 0 (no parity)

Table 1: (Parameter 21 "RS-232 Axis Address)

0 = upload/download programs	1 = U
2 = V	3 = W
4 = X	5 = Y
6 = Z	7 = A
8 = B	9 = C

Table 2: (Parameter 26 "RS-232 Baud Rate)

1 = 2400	2 = 4800
3 = 9600	4 = 19200
Default = 9600	

### FANUC CNC CONTROL Parameters for RS-232 Interface

The FANUC control parameters are usually set as follows to successfully communicate with the Hardinge Indexer Control.

Baud Rate	4800*
No Parity	(Required setting, do not experiment)
Data Bits	(Required setting, do not experiment)
Stop bits	1 (Required setting, do not experiment)
Character Coding (EIA/ISO)	ISO (Required setting, EIA will not work)
DPRNT EOB	LF CR CR (CR is required, LF is always ignored by the indexer control)
DPRNT leading zeroes as blanks	OFF

\*Initial settings. Experiment with these settings only AFTER interface is functional.

Be certain to set FANUC parameter related to actual serial port connected to Hardinge Indexer Control. The parameters have been set for remote operation. You can now program or run an existing program

There are several key items you need to consider to insure your program will run successfully. First and foremost DPRNT must proceed every command sent to the Hardinge Control. The commands are sent to the control in ASCII code and terminated by a carriage return (CR) and line feed (LF). All commands must be preceded by an axis select code (U,V,W,X,Y,Z), parameter 21 = 4. For this explanation, X will represent the axis code.

#### RS 232 Command Blocks

DPRNT[ ]	Clear/Reset receive buffer
DPRNT[XGnn]	Loads G-code nn into Step
DPRNT[XSnn.nnn]	Loads Step Size nnn.nnn into Step
DPRNT[XFnn.nnn]	Loads Feed Rate nnn.nnn into Step
DPRNT[XLnnn]	Loads Loop Count into Step*
DPRNT[XH]	Return home immediately without M-FIN
DPRNT[XB]	Activates Remote Cycle Start without M-FIN for X-axis only*
DPRNT[B]	Activates Remote Cycle Start without M-FIN for all axes*

\*Initial settings. Experiment with these settings only AFTER interface is functional.

Only one step can be programmed at a time over the RS-232 interface to the indexer control. If multiple commands are sent, only the last sent codes are retained and executed when a start signal is received.

#### NOTES:

1. Use of "X" above assumes Hardinge Indexer Control Parameter 21 = 4.
2. You must use a decimal point. At least one numeric digit after the decimal point is required.  
(Correct: S045.000, Wrong: S45)
3. When writing your program in the FANUC format, it is important not to have blank spaces or carriage returns (CR) in your DPRNT statement.

The following is an Example of one way to program the FANUC.

```

POPEN (OPEN FANUC SERIAL PORT)
DPRNT [ ] (CLEAR/RESET HARDINGE)
G04 P64 (DWELL)
DPRNT [XG91] (LOAD AN INCREMENTAL MOVE COMMAND)
G04 P64 (DWELL)
DPRNT [XS90.0] (LOADS STEP SIZE 90.0 INTO STEP)
G04 P64 (DWELL)
DPRNT [XF50.0] (LOAD FEED RATE 50 DEGREES/SEC INTO STEP)
G04 P64 (DWELL)
Mnn (REMOTE CYCLE START, MOVES TO S90.0, SENDS M-FIN)
G04 P250 (DWELLS TO AVOID DPRNT WHILE M-FIN IS STILL HIGH)
PCLOS (CLOSE FANUC SERIAL PORT)

```

## 12. Control Parameters

There are a number of stored Parameters associated with the Indexer Control. There is nonvolatile memory in the control that will keep the parameters (and the stored programs) saved forever. These parameters are used to change the way the control operates.

To enter PARAMETER mode, go to the PROGRAM mode by pressing the MODE button if not already in PROGRAM mode. Then press the UP arrow and hold it for about five seconds. After which the display will change to the PARAMETER mode. The UP arrow key (↑) is used to select the next higher numbered parameter and the DOWN arrow key (↓) is used to select the next lower numbered parameter. If a parameter value is changed, pressing the UP arrow, DOWN arrow, or MODE keys will cause an entered parameter to be stored. Parameters are one to ten digits in length and are decimal integers. The effective range of the parameter is displayed on line 4. The lower bound appears on the left hand side and the upper bound appears on the right hand side. Attempting to enter a value into a parameter that does not lie in its effective range is not allowed. To exit from PARAMETER mode, simply press the MODE button..

When in PARAMETER mode, the display will read:

Parameter Description

Param: NNN Value: NNN

L: Lower Limit          H: Upper Limit P or U

Where:

Lower limit is the minimum value the parameter can have

Upper limit is the maximum value the parameter can have

For U - P means that it is a protected parameter and U means that it is an unprotected parameter

### PROTECTED and UNPROTECTED Parameters

PROTECTED parameters are set at the factory and are system specific. These parameters deal with accelerations/ decelerations, home type, velocity limits, control serial number, firmware revision, and RS-232 protocols. These parameters require a password to change and can only be changed by a Hardinge authorized service technician. If an attempt to change a PROTECTED parameter is made without entering the correct password the change is disallowed. These PROTECTED parameters are factory set and designed to work with the limitations of the particular unit. If a protected parameter is in question, contact Hardinge with the indexer control serial number to determine if the value is correct.

UNPROTECTED Parameters consist of settings which adapt the control to customer specific functions. These include positive direction, dwells, automatic modes, etc. These can be changed by the customer at any time to gain a desired result.

NOTE: Before any attempt is made to alter factory settings, the value of all parameters should be recorded for future reference. There is a section in the rear of the manual to record these values. Standard default values for various systems can also be found in the back of the manual.

### Help Parameter Mode

Press the cycle start button from the parameter setting page to display additional information about the parameter. Press the cycle start button again to return the parameter setting page. "Additional information" is typically a description of each value the parameter can have.

#### 12.1 Parameter Definitions and Settings

The parameters visible in parameter mode of the Indexer Control are listed below.

*(Default settings are shown in Italics, or with an \* in the Help Parameter Mode)*

**Parameter 1: UNPROTECTED**

Relay Mode

Param: 1

Value: 0, 1 or 2

This parameter defines how the finish signal relay associated with the remote cable operates.

```

FIN RELAY MODE
0: ACTIVE IN MOTION
1: *PULSE .25 S END
2: NO RELAY ACTION

```

```

Relay Mode
Param:      1
Value:      1
0           2           1   U

```

**Parameter 2: UNPROTECTED**

Relay Polarity

Param: 2

Value: 0 or 1

This parameter describes the relay associated with the remote cable finish signal operates.

0: normally open, the relay will close when the indexer control finishes the cycle.

1: normally closed, the relay will open when the indexer control finishes the cycle.

```

PARAMETER HELP
FIN RELAY POLARITY
0: *NORMALLY OPEN
1: NORMALLY CLOSED

```

**Parameter 3: UNPROTECTED!**

Scrolling

Param: 3

Value: 1 or 2

This parameter defines the number of steps that are incremented or decremented whenever the step scan up (↑) or step scan down (↓) keys are pressed in the edit (program mode). If this parameter is set to a 1 the top step number is incremented or decremented by one. If it is set to a 2, the top step number is incremented or decremented by two.

```

PARAMETER HELP
SCROLLING
1: UP/DOWN 1 STEP
2: *UP/DOWN 2 STEPS

```

**Parameter 4: PROTECTED**

TOTAL RUN TIME HR

Param: 4

Value: 0 - 999999999

**Parameter 5: UNPROTECTED**

Double remote trig

Param: 5

Value: 0 or 1

This parameter defines how the remote start trigger will operate. The remote trigger is either the green cycle START button or the remote cable cycle start signal.

0: One trigger to the remote input or one press of the cycle start button will activate the control to trigger a step.

1: The remote start must be triggered twice or the cycle start button must be pushed twice to



activate the control to trigger a step.

PARAMETER HELP  
DBL REMOTE TRIGGER  
0:\*1 CYCLE START PR  
1: 2 CYCLE START PR

(Default settings are shown in *Italics*)

#### Parameter 6: UNPROTECTED

Disable panel start

Param: 06

Value: 0 or 1

This parameter defines how the Cycle Start and Home Buttons function on the control panel.

0: *Front panel Cycle Start and Home buttons are enabled.*

1: Front panel Cycle Start and Home buttons are disabled. Control will only function through the remote input.

PARAMETER HELP  
DISABLE FRONT PANEL  
0:\*ENABLE BUTTONS  
1; DISABLE BUTTONS

#### Parameter 7: UNPROTECTED

Program Protection

Param: 7

Value: 0 or 1

This parameter defines the protection level of stored programs in the indexer control.

0: *Programs are unprotected and can be modified by the operator.*

1: Programs are protected and cannot be altered until this parameter is changed to 0.

PARAMETER HELP  
PROGRAM PROTECTION  
0:\*CAN MODIFY PGMS  
1: CAN'T MODIFY PGMS

#### Parameter 8: UNPROTECTED

Disable Remote Start

Param: 8

Value: 0 or 1

This parameter defines the operation of the start circuit of the remote cycle start function.

0: *Remote Cycle Start circuit is enabled.*

1: Remote Cycle Start circuit is disabled. In this mode, only pushing the cycle start button on the indexer control will start a step.

PARAMETER HELP  
REMOTE CYCLE START  
0:\*ENABLED  
1: DISABLED

**Parameter 9: UNPROTECTED**

Gear Input

Param: 9

Value: 1-32767

This Parameter defines the number of encoder steps (counts) required to complete one full unit (degree, inch, millimeter, etc).

Example 1 For a Hardinge GD5C2 Indexer

The brushless motor encoder has 2048 lines per revolution. With quadrature (2048 x 4), this encoder has 8192 counts per revolution. The mechanical unit has a 60:1 gear ratio. Therefore, one revolution of the motor results in 6 degrees of movement on the output shaft ( $360/60 = 6$ ). To calculate encoder counts per degree, the equation would be  $(8192 \text{ counts/rev}) \times (1 \text{ rev}/6 \text{ degrees}) = 1365.333$  encoder counts per degree. Since 1365.333 is not a whole integer, it must be multiplied by some number to clear the decimal point.

Parameter 20 is used to accomplish this. Set parameter 20 to 3, therefore  $1365.333 \times 3 = 4096$  (entered in parameter 9). At 1365.333 counts/degree the system will have a total of 491520 counts/revolution on the output shaft ( $1365.333 \times 360$ ).

Example 2 for a Hardinge GD210LP Indexer

The brushless motor encoder has 2048 lines per revolution. With quadrature (2048 x 4), this encoder has 8192 counts per revolution. The mechanical unit has a 90:1 gear ratio. Therefore one revolution of the motor results in 4 degrees of movement on the output shaft ( $360/90 = 4$ ). To calculate counts per degree, the equation would be  $(8192 \text{ counts/rev}) \times (1 \text{ rev}/4 \text{ degrees}) = 2048$  encoder counts per degree. 2048 is a whole integer and parameter 20 must be set to at least a value of 2. Therefore to calculate parameter 9,  $2048 \times 2 = 4096$  (entered in parameter 9). At 2048 counts/degree, the system will have a total of 737280 counts/revolution on the output shaft ( $2048 \times 360$ ).

(Default settings are shown in *Italics*)

**Parameter 10: UNPROTECTED**

Auto Continue Ctrl

Param: 10

Value: 0-3

This parameter defines how the indexer control executes the program in memory. For normal operation, this should be set to zero.

- 0: *Run one loop or if the loop count is one, run one step.*
- 1: Continue all loops in a step and stop before the next step.
- 2: Continue all steps in a program until end code 99 or 95 and stop.
- 3: Repeat all steps until stopped manually.

PARAMETER HELP  
 AUTO CONT. CTL PI  
 0:\*RUN ONE LOOP  
 1: RUN ALL LOOPS  
 2: RUN ALL STEPS

**Parameter 11: UNPROTECTED**

Feedback Direction

Param: 11

Value: 0 or 1

This parameter defines the positive direction of the indexer when viewed looking at the spindle nose. This is defined with the motor located in the standard position of the left side as viewed from the spindle nose. When motor is located on the right, the values below are reversed. The drive must be disabled (Position loop control OFF) to change this parameter.

- 0: Counterclockwise is positive direction  
 1: Clockwise is positive direction

PARAMETER HELP  
 FEEDBACK DIRECTION  
 0:\*CCW IS + DIR  
 1: CW IS + DIRECTION

#### Parameter 12: UNPROTECTED

Units

Param: 12

Value: 5 or 6

This parameter defines how the position value is to be displayed. Set this parameter to a value to a 5 for an absolute position display. Set this parameter to a value to a 6 for a modulo 360 position display where the range of the position value is from 0 to 359.999 degrees.

If a linear axis is being controlled, set parameter #12 to 5 so that the read out becomes an absolute position display. This means that if a G90 absolute move is commanded to 600 user units the motor will rotate until the absolute encoder position has reached 600 user units and the position display will read 600 user units as well.

If a an indexing axis is being controlled, set parameter #12 to a 6 so that the position display will only show a value from 0 to 359.999 degrees. If the display reads 359.999 and a positive move is commanded the display will roll back to zero then increment. If the display reads 0 and a negative move is commanded the display will roll back to 359.999 then decrement.

If an absolute position move (G90) is commanded, the control will take the shortest path to the end point position. For example, if the table is at 320 degrees and a G90 move to zero degrees is commanded, the table will rotate 40 degrees in the positive direction instead of 320 degrees in the negative direction. Example 2: The table is at 20 degrees and a G90 move to 330 degrees is commanded, the table will rotate 50 degrees in the negative direction instead of 310 degrees in the positive direction. Example 3: The table is at 20 degrees and a G90 move to 400 degrees is commanded, the table will only rotate 20 degrees in the positive direction.

If, however, an incremental move is commanded, the table will move the number of degrees specified but the position display will only read from 0 – 359.999 degrees. For example, if the table is at 60 degrees and a G91 move of 400 degrees is commanded, the table will rotate 400 degrees in the positive direction. The display end point position will read 100 degrees because  $60 + 400 = 460$  and  $460 \bmod 360 = 100$  degrees.

*(Default settings are shown in Italics)*

#### Parameter 13: UNPROTECTED

Linear Axis

Param: 13

Value: 0 or 1

0= Rotary Axis is being controlled

1= Linear Axis is being controlled

PARAMETER HELP  
 LINEAR AXIS CONTROL  
 0:\*ROTARY AXIS  
 1: LINEAR AXIS

**Parameter 14: UNPROTECTED**

Encoder Cts/Inch Numer

Param: 14

Value: 0 - 999999999

The numerator of the number of encoder counts for one inch of movement. This parameter is only active when parameter 13 "Linear Axis" is set to 1. The value of this parameter does not change when parameter 24 "INCH" is set to 1.

For example, say that an application uses a 0.2 inch pitch ball screw to drive a table. There is a pulley connected to the motor shaft and ball screw and the ratio is 2:1 such that two rotations of the motor cause 1 rotation of the ball screw. There is a 250 line encoder on the motor. The formula to compute the "Encoder Counts Per Inch" value is:

Encoder Counts Per Inch = (encoder counts per motor revolution x pulley ratio) / screw pitch (inches)

In this case,

Encoder counts per motor revolution = 250 lines x 4 (in quadrature) = 1000 encoder counts per motor revolution

Encoder Counts Per Inch =  $(1000 \times 2) / 0.2 = 10,000$  encoder counts per inch

Set parameter #14 to 10,000

Set parameter #17 to a 1

Encoder Counts Per Inch = Encoder Counts Per Inch Numerator (#14) / Encoder Counts Per Inch Denominator (#14)

If the Encoder Counts Per Inch result contained a remainder. Say the result came out to 1000.333. In that case Set parameter #14 to 3001

Set parameter #17 to a 3

Encoder Counts Per Inch =  $3001 / 3 = 1000.333$

**Parameter 15: UNPROTECTED**

Backlash Amount

Param: 15

Value: 0-99

This parameter defines the electronic compensation for mechanical gear backlash. It is measured in units of encoder counts. This parameter **CANNOT** correct mechanical backlash.

**Parameter 16: UNPROTECTED**

DWELL

Param: 16

Value: 0-99

This parameter defines the length of a user defined pause at the end of a step before performing the next step when the automatic continuation option (parameter 10) is used. The delay is in multiples of 1/10 second. Thus, a value of 13 will give 1.3 seconds of delay.

*During normal operation with parameter 10 = 0, this should be set to 0.*

*(Default settings are shown in Italics)*

**Parameter 17: UNPROTECTED Encoder Counts Per Inch Denominator**

Param: 17

Value: 1 -999999999

This denominator of the number of encoder counts for one inch of movement. This parameter is only active when parameter 13 "Linear axis" is set to a 1. The value of this parameter does not change when parameter 24 "INCH" is set to a 1.

**Parameter 18: PROTECTED!**

Acceleration

Param: 18

Value: 1298-54612570

This parameter defines how fast the motor is accelerated up to the desired speed. The value used is measured in motor counts/second/second. For geared indexers this value should not be set higher than 750000.

**Parameter 19: UNPROTECTED**

Table Maximum Speed

Param: 19

Value: 1- (1 Unit)

This parameter defines the maximum recommended speed of the indexer in units of degrees per second. It is also the default speed used for cleared program blocks. The protects the indexer from being run at too high a rate for the gearing. This is only a reference and the velocity limit of the tuned and mechanical constraints system is used to calculate the individual table max speed. This parameters also fills in the default speed for cleared program steps.

**Parameter 20: UNPROTECTED**

Gear Ratio Divider

Param: 20

Value: 2-100

This parameter defines the non-integer multiplier to be used with Parameter 9. Parameter 20 must be set to a value of 2 to 100. Parameter 9 is divided by Parameter 20 before it is used. As an example, if Parameter 9 = 4096 and Parameter 20 = 3, the number of steps per unit will be  $4096/3 = 1365.333$  thus compensating for fractional gear ratios. Parameter 20 must be set to the lowest possible multiplier to work with Parameter 9. See Parameter 9 for examples. Do NOT use Value 1.

**Parameter 21: UNPROTECTED**

RS232 axis address

Param: 21

Value: 0-10

This parameter defines the axis identifier in the indexer control using the RS-232 function. When this parameter is zero, no remote RS-232 functions are available. When using the RS-232 function to control the indexer, this identifier should match between the part program and the set value of the parameter in the indexer control.

<b>Value</b>	<b>Axis Identifier</b>
0	<i>DISABLED</i>
1	U
2	V
3	W
4	X
5	Y
6	Z
7	A
8	B
9	C
10	Internal Hardinge Use Only

(Default settings are shown in *Italics*)

**Parameter 22: PROTECTED!**

Maximum Position Error

Param: 22

Value: 0-2,147,483,64

This parameter defines the maximum allowed value of following error. It is measured in motor counts. When this parameter is set to 0, the function is disabled. If set to non-zero and the error exceeds the value, the drive will become disabled and the message "FOLLOWING ERROR" will appear on the display.

**Parameter 23: PROTECTED!**

NOT USED

Param: 23

Value: 0

**Parameter 24: UNPROTECTED**

Inch Mode

Param: 24

Value: 0 or 1

0= Input is in millimeters for the linear axis being controlled

1= Input is in inches for the linear axis being controlled

This parameter defines the input and display modes for a linear device. Set this parameter to a zero if metric mode is desired or a one if inch mode is desired.

Inch Mode:

The linear axis position and feed rate use a 3.4 format for edit and display. This means that there is a maximum of 3 digits to the left of the decimal point and always 4 digits to the right of the decimal point.

The range of the position value is from -999.9999 to +999.9999 inches. The range of the feed rate value is from 0 to +999.9999 inches per minute.

Metric Mode:

The linear axis position and feed rate use a 4.3 format for edit and display. This means that there is a maximum of 4 digits to the left of the decimal point and always 3 digits to the right of the decimal point.

The range of the position value is from -9999.999 to +9999.999 millimeters. The range of the feed rate value is from 0 to +9999.999 millimeters per minute.

PARAMETER HELP

INCH MODE

0:\*INCH MODE OFF

1: INCH MODE ON

**Parameter 25: UNPROTECTED**

Use OverTemp Switch

Param: 25

Value: 0 or 1

Change this value to a one to allow the Indexer Control to monitor a motor overtemp switch. When 0 the motor current over time is monitored.

**Parameter 26: UNPROTECTED**

RS232 Com rate

Param: 26

Value: 0-4

This parameter defines the communications rate on the RS-232 interface. This parameter should be set to match the transmission rate of the computer or machine control that it is being interfaced with.

The parameter values and rates are:

- 1: 2400 bps (bits per second)
- 2: 4800 bps
- 3: 9600 bps
- 4: 19200 bps

PARAMETER HELP  
 RS232 COMM RATE P1  
 1: 2400 BPS  
 2:\*4800 BPS  
 3: 9600 BPS

RS232 COMM RATE P2  
 4: 19200 BPS

*(Default settings are shown in Italics)*

#### Parameter 27: PROTECTED!

Home Type

Param: 27

Value: 1-999999

This parameter defines the homing routine for the indexer and can be modified to customize the homing routine of the unit. When the control is shut down and restarted, it will give an "axis not homed" display, requiring the user to press the "zero return" button. When the zero return button is pressed, the unit will follow a homing sequence defined by the value in parameter 27. Depending on the system, one of the values from 1-3 must be used. Any additional functions desired will be added to the initial required value.

#### Example GD5C2 Indexer

3 must be chosen to use both the Z channel and table zero switch. After initial power up and the unit is homed, it is desired that, for subsequent homing moves, that the indexer moves in the shortest direction to the zero position. Therefore:  $8 + 3 = 11$ . 11 would be inserted for the value of this parameter.

Values available for customization:

- 1: only table zero position switch available
- 2: only Z channel home available
- +3: home on both Z channel and table zero switch
- +4: auto start mode
- +8: shortest path

#### Auto Start Mode

If 4 is added to the value set in parameter 27 "Homeing Type", the following sequence of events occurs at power up:

1. Position loop control On Automatically
2. Home the Table Automatically
3. Switch to Run Mode Automatically

The control box is now ready to run the loaded program or accept commands from the RS232 interface.

#### Parameter 28: PROTECTED!

NOT USED

Param: 28

Value: 0



# Parameter 29: UNPROTECTED

## Clamp Functionality

Value: 0-1

0= Unclamp switch is wired normally opened. This means that the switch closes when the table is unclamped

1= Unclamp switch is wired normally closed. This means that the switch opens when the table is unclamped

## PARAMETER HELP

### CLAMP FUNCTIONALITY

0:\*SWITCH NORM OPEN

1: SWITCH NORM CLOSE

# Parameter 30: UNPROTECTED

## Password Protection

Param: 30

Value: (random)

This parameter is a random number which is used to unlock the control and alter parameters as required.

# Parameter 31: UNPROTECTED

## Relay Hold Time

Param: 31

Value: 0-9

This parameter defines the amount of time the CNC interface finish relay is held active at the end of a step.

If the value is set to zero, the relay time defaults to 1/4 second. All other values extend the hold time by 0.1 seconds. *Value is set to 0 from factory.*

value	setting
0	.25 s
1	.35 s
2	.45 s
3	.55 s
4	.65 s
5	.75 s
6	.85 s
7	.95 s
8	1.05 s
9	1.15 s

# Parameter 32: UNPROTECTED

## Table Type

Value: 0-6

0= 5C Table

1= 16C Table

2= LP160 Table

3= LP210 Table

4= DD100 Table

5= DD200 Table

If it is a 5C table, no clamping pressure check is performed. This parameter also determines the maximum feed rates to use. See table below. Parameter 36 "Velocity Limit" is set to the table value as well.

Table Type	Maximum Feed Rate (DEG/SEC)
5C	360
I6C	300
LPI60	240
LP210	4200 @ 220, 2700 @ 110
DD100	2700
DD200	21000 @ 220, 1050 @ 110

An attempt to program a feed rate greater than the maximum feed rate is not allowed. When a new program or a new block is created, the maximum feed rate value shall appear in the block feed rate value.

PARAMETER HELP  
TABLE TYPE P1  
0: \*5C TABLE  
1: I6C TABLE  
2: LPI60 TABLE  
  
TABLE TYPE P2  
3: LP210 TABLE  
4: DD100 TABLE  
5: DD200 TABLE

Parameter 33: PROTECTED  
V\_DISPLAY  
Value: 0 or 1

0 = No Velocity Display appears in the Run and Manual Mode Screens  
1 = Velocity Display appears in the Run and Manual Mode Screens

Parameter 34: UNPROTECTED

GEAR TABLE INCREMENT  
Value 0-180

This parameter describes the intervals in degrees the compensation table is using for the gear error compensation.  
Default is typically 1 degree.

Parameter 35: UNPROTECTED

Homing Speed  
Value 1 - 360

Establishes the rate in degrees per second at which the indexer searches for the home switch (when used). For a linear axis this would be in inches per minute or millimeters per minute.

Parameter 36: PROTECTED!

Velocity limit (VLIM)  
Param: 36

Value: 10-360 (geared rotary)

Value: 10-999 (linear)

This parameter defines the velocity limit of the system. It is measured in degrees per second for a rotary axis and inches per minute or millimeters for a linear axis. This value must be less than or equal to parameter 18. For direct drive systems see speed maximums in parameter 32.

**Parameter 39: PROTECTED!**

Not Used

Value 0

**Parameter 40: PROTECTED**

Value: 0

**Parameter 41: PROTECTED**

Not Used

Value: 0

**Parameter 42: Protected**

Not Used

Value: 0

**Parameter 43: PROTECTED**

Not Used

Value: 0

**Parameter 100: PROTECTED!**

Motor Type

Param: 100

Value: 0 or 1

This parameter defines the type of motor used in the system.

0: brushless

1: brush

**Parameter 101: PROTECTED!**

Serial Number

Param: 101

Value: (value)

This parameter displays the serial number of the indexer control. This parameter, along with parameter 30, is used for removing the parameter PROTECT so that PROTECTED parameters can be changed by the customer under engineering supervision.

**Parameter 102: PROTECTED!**

Firmware Revision

Param: 102

Value: ????

This parameter displays the software revision of the Indexer Control.

**Parameter 103: UNPROTECTED**

Not Used

Value: 0

**Parameter 104: PROTECTED**

Not Used  
Value: 0

**Parameter 105: PROTECTED**

RS232 Stop Bits

Param: 105

Value: 1 or 2

This parameter defines the RS-232 communication stop bits settings. This parameter should be set to the value in the machine control or the computer settings to allow RS-232 communication.

1: 1 stop bits

2: 2 stop bits

**Parameter 106: UNPROTECTED**

RS232 Data Bits

Param: 106

Value: 7 or 8

This parameter defines the RS-232 communication data bits settings. This parameter should be set to the value in the machine control or the computer settings to allow RS-232 communication.

7: 7 data bits

8: 8 data bits

**PARAMETER HELP**

RS232 DATA BITS

1: 7 DATA BIT

2:\*8 DATA BITS

**Parameter 107: UNPROTECTED**

RS232 Parity

Param: 107

Value: 0-2

This parameter defines the RS-232 parity checking value for RS-232 communication. This parameter should be set to the value in the machine control or the computer settings to allow RS-232 communication.

0: no parity checking

1: odd parity

2: even parity

**PARAMETER HELP**

RS232 PARITY

0:\*NO PARITY CHK

1: ODD PARITY

2: EVEN PARITY

**Parameter 108: UNPROTECTED**

Speed Units

Value: 2 or 3

**Parameter 109: PROTECTED**

Not used

Value: 0

### Parameter 110: UNPROTECTED

Clamp Control

Param: 110

Value: 0-2

This parameter defines the clamp functionality of the Indexer Control. The clamp is a spring-to-close, air-to-open actuator. The clamp functionality will take place after power up and initial homing is performed. No clamp functionality is applied before this. If the indexer is not equipped with a clamp, the value of this parameter must be set to 0. Indexers fitted with clamps can utilize values of 1 or 2.

**WARNING!** A minimum of 85 psi of filtered dry air is required for the clamp to open. If the clamp is not going to be used, the air **MUST** still be connected to allow the indexer to rotate.

0: Clamp Ignored

1: G code commands the clamp to open/close

2: Auto-clamp when motion stops. Auto-unclamp when motion starts. A minimum value of 350 must be in parameter 111.

### Parameter 111: UNPROTECTED

Clamp Time Delay

Param: 111

Value: 0-2000

This parameter sets the time delay in milliseconds before opening/closing the clamp when a indexer move is to be performed. When Parameter 110 is equal to 1 or 2, parameter 111 must be set to a minimum of 350 and to a maximum of 2000. When the clamp function is turned on and a command to move is executed to the control, the clamp will open and wait the time delay before the motion is started. When the indexer comes to a stop at the commanded position, the time delay will be counted down before the clamp is engaged.

*(Default settings are shown in Italics)*

### Parameter 112: UNPROTECTED

Inverse Digital Inputs

Param: 112

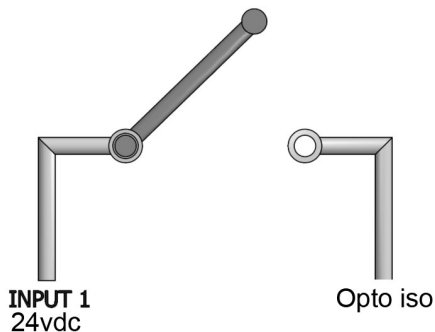
Value: 0-7

This parameter inverts the input condition to be satisfied between normally open and normally closed. The 3 general inputs can be configured in the following manner. 0 means NORMALLY OPEN operation, 1 identifies NORMALLY CLOSED operation.

<b>Value</b>	<b>Input 1</b>	<b>Input 2</b>	<b>Input 3</b>	<b>General Input Condition</b>
0	0	0	0	Inputs 1, 2 and 3 operate as normally open
1	1	0	0	Input 1 is normally closed, 2 and 3 normally open
2	0	1	0	Input 2 is normally closed, 1 and 3 normally open
3	1	1	0	Input 1 and 2 normally closed, 3 normally open
4	0	0	1	Input 3 normally closed, 1 and 2 normally open
5	1	0	1	Input 1 and 3 normally closed, 2 normally open
6	0	1	1	Input 2 and 3 normally closed, 1 normally open
7	1	1	1	Inputs 1, 2 and 3 normally closed

## Visual Definition of Settings for Normally-Open and Normally-Closed circuits

### Input Value of 0



Normally Open Circuit

### Input Value of 1



Normally Closed Circuit

### Parameter 113: UNPROTECTED

Set Digitl Inp Mode (INXMODE)

Param: 113

Value: 0-3

This parameter defines the functionality of the 3 general purpose inputs of the Indexer Control.

The definitions for the various values are shown below.

- 0: Digital inputs 1, 2 and 3 are general purpose inputs
- 1: Digital input 1 is the positive hardware limit switch and input 2 and 3 are general purpose inputs.
- 2: Digital input 2 is the negative hardware limit switch and input 1 and 3 are general purpose inputs.
- 3: Digital input 1 is the positive hardware limit switch and digital input 2 is the negative hardware limit switch. Digital input 3 is a general purpose input.

PARAMETER HELP  
DIGITAL INP MODE P1  
GP=GENERAL PURPOSE  
0:\*1,2,3 GP  
1: 1=+LMT, 2,3 GP

DIGITAL INP MODE P2  
2: 2=-LMT, 1,3 GP  
3: 1=+LMT, 2=-LMT, 3=GP

### Parameter 114: UNPROTECTED

Enab/Disab By Clamp

Param: 114

Value: 0 or 1

This parameter defines the motor behavior in conjunction with the clamp function. By enabling this parameter, the power of the motor is removed when the clamp is on. This function utilizes the dwell time in parameter 111 before energizing or de-energizing the motor.

Below are the permitted values of this parameter and their definition.

0: Turns this function OFF

1: Turns this function ON

Example: If parameter I10 = 2, I11 = 350 and I14 = 1.

When the indexer stops after a commanded move, a 350 millisecond dwell counts down and the clamp turns on. Another 350 millisecond dwell counts down and the motor is de-energized. When a command to move is executed, the motor is energized and a 350 millisecond dwell counts down before the clamp is turned off. Then another 350 millisecond dwell counts down before the indexer moves.

#### Parameter I15: UNPROTECTED

Software Limit Mode

Param: I15

Value: 0 or 1

This parameter defines the status of the software limit switch function. The Indexer Control has the ability to set software limits for added crash protection when the work envelope becomes restricted. It is important to understand that these limits do not take effect on control power up and initial homing of the indexer. These limits only take effect after initial power up and the homing operation is performed.

0: Software limit switch function OFF

1: Software limit switch function ON

#### Parameter I16: UNPROTECTED

Software Limit High

Param: I16

Value: 0 to 180000

This parameter defines the POSITIVE software travel limit. The units are degrees  $\times$  1,000.

Example: If the positive travel limit is 105 degrees, the value in parameter I16 =  $105.000 \times 1,000 = 105000$ .

#### Parameter I17: UNPROTECTED

Software Limit Low

Param: I17

Value: 0 to -180000

This parameter defines the NEGATIVE software travel limit. The units are degrees  $\times$  1,000.

Example: If the negative travel limit is -73 degrees, the value in parameter I17 =  $-73.000 \times 1,000 = -73000$ .

NOTE: It is possible to program a movement larger than the travel limit. The axis will rotate until it sees either the negative or positive software limit and will stop. An error will be posted that the software limit has been reached. This will require the operator to jog the axis in the opposite direction to reset the switch. At this time the operator should fix the limit value or change the programmed position.

## 12.2 Gear Compensation

### 12.2.1 Rotary Axis

The Hardinge Indexer Control can store a compensation table to correct for small errors in the gear. The gear compensation tables are part of the parameters. While in parameter mode, press the DISPLAY SCAN button to select the gear compensation tables.

The gear compensation data is displayed as:

POS      Indexer position in degrees.

- CW Compensation value in encoder steps in the negative (clockwise) direction.  
 CCW Compensation value in the encoder steps in the positive direction (counterclockwise).

There is a table entry every degree starting at 001 and going to 359. It is recommended that you do not change the values in the gear compensation tables. When there are values in the gear compensation table, the Indexer Control is 'married' to a particular indexer. Indexers and Indexer controls must be kept together as much as possible. When a control is replaced its compensation is also replaced with the same Hardinge stored values.

When the gear compensation tables are displayed, the up and down arrow button will select the next three degree entry and the minus (-) and numeric buttons will enter a new value. In addition to this, the JOG button may be used to adjust the compensation value. If the position loop control is on when changes are made, the indexer motor will move by the adjustment amount if the table is at the position corresponding to the entry changed. This is valuable in that the JOG button can be used to move the motor to a desired position.

To exit the gear compensation display, press the MODE button to return the control to RUN mode.

### 12.2.2 Linear Axis

The Hardinge Indexer Control can store a compensation table to correct for small errors in the driver (i.e. pitch errors in the ball screw or lead screw driver). The compensation tables are part of the parameters. While in parameter mode, press the DISPLAY SCAN button to select the compensation tables.

- POS Linear axis position in inches. Please note that the compensation table is always in units of inches regardless of whether the control box is in inch or metric mode.  
 MINUS Compensation value in encoder steps in the minus axis direction.  
 PLUS Compensation value in the encoder steps in the plus axis direction.

There is a table entry every inch starting at 001 and going to a maximum of 359 inches. It is recommended that you do not change the values in the compensation tables. Obviously if the stroke is 30 inches you would have zeros in positions 31-359.

When the compensation tables are displayed, the up and down arrow button will select the next three inch entry and the minus (-) and numeric buttons will enter a new value. In addition to this, the JOG button may be used to adjust the compensation value. If the position loop control is on when changes are made, the indexer motor will move by the adjustment amount if the table is at the position corresponding to the entry changed. This is valuable in that the JOG button can be used to move the motor to a desired position.

To exit the gear compensation display, press the MODE button to return the control to RUN mode.

### 12.3 Default Parameter Settings for Hardinge Standard Indexer Control

The following table identifies the parameter value for standard indexers shipped from Elmira, New York. The column on the right is provided to record any changes made to the original parameters. Circle the unit for the indexer purchased and fill in the control and mechanical unit serial number for reference. In the event of a service call, have this information available for the technician to reference.



## Indexer Control PARAMETERS

Parameter	Description	5C STAN- DARD	16C SINGLE	LP160	LP210	LP250	DD100	DD200	Protection
1	RELAY MODE	1	1	1	1	1	1	1	U
2	POLARITY	0	0	0	0	0	0	0	U
3	SCROLLING	2	2	2	2	2	2	2	U
4	TOTAL MOTION TIME HR	Time	Time	Time	Time	Time	Time	Time	P
5	DOUBLE REMOTE TRIGGER	0	0	0	0	0	0	0	U
6	DISABLE PANEL START	0	0	0	0	0	0	0	U
7	PROGRAM PROTECTION	0	0	0	0	0	0	0	U
8	DISABLE REMOTE START	0	0	0	0	0	0	0	U
9	GEAR INPUT	4096	4096	4096	4096	4096	16384	16384	U
10	AUTO CONTINUE CTRL	0	0	0	0	0	0	0	U
11	FEEDBACK DIRECTION	0	0	0	0	0	0	0	U
12	UNITS	6	6	6	6	6	6	6	U
13	LINEAR AXIS	0	0	0	0	0	0	0	U
14	ENC CTS / INCH NUMER	0	0	0	0	0	655360	655360	U
15	BACKLASH AMOUNT	0	0	0	0	0	0	0	U
16	DWELL	0	0	0	0	0	0	0	U
17	ENC CTS / INCH DENOM	0	0	0	0	0	360	360	U
18	ACCELERATION	750000	750000	750000	750000	750000	40000000	40000000	P
19	TABLE MAXIMUM SPEED	360 <sup>1</sup>	300 <sup>1</sup>	240	240	240	2700	750	U
20	GEAR RATIO DIVIDER	3	3	2	2	2	9	9	P
21	RS232 AXIS ADDRESS	4	4	4	4	4	4	4	U
22	MAX POSITION ERROR	6800	6800	6800	6800	6800	9100	9100	P
23	NOT USED	0	0	0	0	0	0	0	P
24	INCH MODE	0	0	0	0	0	0	0	U
25	USE OVERTEMP SWITCH	0	0	0	0	0	0	0	U
26	RS232 BAUD RATE	2	2	2	2	2	2	2	U
27	HOME TYPE	11	11	11	11	11	10	10	P
28	NOT USED	0	0	0	0	0	0	0	P
29	CLAMP FUNCTIONALITY	0	0	0	0	0	0	0	P
30	PASSWORD PROTECTION	0	0	0	0	0	0	0	U
31	RELAY HOLD TIME	0	0	0	0	0	0	0	U
32	TABLE TYPE	0	1	2	3	4	5	6	P
33	V_DISPLAY	0	0	0	0	0	0	0	P
34	GEAR TABLE INCREMENT	0	0	0	0	0	0	0	P
35	HOMING SPEED	0	0	0	0	0	0	0	P

36	VELOCITY LIMIT	360	300	240	240	240	2700	750	P
37	MARKER SPEED SEARCH	0	0	0	0	0	0	0	P
38	NOT USED	0	0	0	0	0	0	0	P
39	NOT USED	0	0	0	0	0	0	0	P
40	NOT USED	0	0	0	0	0	0	0	U
41	NOT USED	0	0	0	0	0	0	0	P
42	NOT USED	0	0	0	0	0	0	0	P
43	NOT USED	0	0	0	0	0	0	0	P
101	SERIAL NUMBER	0	0	0	0	0	0	0	P
102	FIRMWARE REVISION	37	37	37	37	37	37	37	P
103	NOT USED	0	0	0	0	0	0	0	P
104	NOT USED	0	0	0	0	0	0	0	P
105	RS232 STOP BITS	1	1	1	1	1	1	1	U
106	RS232 DATA BITS	8	8	8	8	8	8	8	U
107	RS232 PARITY	0	0	0	0	0	0	0	U
108	SPEED UNITS	2	2	2	2	2	2	2	U
109	NOT USED	0	0	0	0	0	0	0	U
110	CLAMP CONTROL	0	2	2	2	2	0	0	U
111	CLAMP TIME DELAY	0	1000	1000	1000	1000	0	1000	U
112	INVERT DIGITAL INPUTS	0	0	0	0	0	0	0	U
113	SET DIGITAL INPUT MODE	0	0	0	0	0	0	0	U
114	ENAB/DISABLE BY CLAMP	0	0	0	0	0	0	0	U
115	SOFTWARE LIMIT MODE	0	0	0	0	0	0	0	U
116	SOFTWARE LIMIT HIGH	90000	90000	90000	90000	90000	90000	90000	U
117	SOFTWARE LIMIT LOW	-90000	-90000	-90000	-90000	-90000	-90000	-90000	U

Note <sup>1</sup> 5C and 16C multiple tables have reduced max speed parameters as follows.

5C With two to four tables parameter 19 = 180

16C With two or three tables parameter 19 = 60

Indexer Control S/N Mechanical Unit S/N

### 12.3 Motors approved for use with the Hardinge Indexer Control

The following listed motors have been tested and approved with the Hardinge indexer control. Attempting to replace the original motor of the indexer with a different motor will void the warranty. If an issue occurs that may be motor related, contact the Hardinge technical department immediately for assistance.

The mechanical unit and indexer control serial number will be required.

Description	Approved Motor	Hardinge P/N
GD5C2, GD16C2, GD160LP	Kollmorgen AKM41H-CSSN2-02	CI 0002412
GD16C2 Multi-spindle, GD210LP	Kollmorgen AKM42S-CSSN2-02	CI 0002412M42

## 13. Control Message Information

I:BAD DR RESP: <drive-command>

This message appears when uploading parameters from the drive if the drive rejected the command.

I:BAD DR RESP: <drive-response>

This message appears while downloading parameters to the drive if the drive did not accept the downloaded parameter value.

I:NO DATA: <drive- command >

This message appears while uploading parameters from the drive when the software requested a parameter value from the drive and the drive returned nothing.

I:NO NUM DATA <drive- command >

This message appears while uploading parameters from the drive when numeric data was expected but the software received no numeric data.

2:BAD DR RESP: <drive-response>

This message appears while downloading parameters to the drive if the drive rejected the command. After a value is set in the drive, it is read back and verified to be the same as the expected value. This message is displayed while attempting to read the value back from the drive.

2 MANY TOKS @<byte-location>

The format of the DPARMS.TXT is incorrect. The number of tokens in a line exceeds seven. Replace the file or run CHKDSK to correct the file.

**3:BAD DR RESP:SV;**

This message appears immediately after downloading parameters to the drive has completed. The attempt to save the parameter values to flash ROM failed.

**ALLOC FAILED**

The software failed to allocate sufficient heap memory to store the program numbers from the file allocation table located on the memory card or USB device. Contact Hardinge service.

**BAD COMMAND**

The USB command to the VINICULUM is not recognized.

**BAD F-CODE**

This error pertains to the feed word in a part program block. The feed word consists of the letter "F" followed by an unsigned decimal value. This error is displayed when one of the following conditions occur:

1. Duplicate F word found
2. No data follows the "F" letter
3. More than one decimal point was found
4. "F" was specified without data
5. The value to the left of the decimal point exceeds 4 digits

**BAD G-CODE**

This error pertains to the "G" word in a part program block. The "G" word consists of the letter "G" followed by an up to 3 digit g-code value. This message is displayed when one of the following conditions occur:

1. Duplicate "G" word was found
2. No g-code value follows the "G" letter
3. "G" code value exceeds 3 digits

**BAD L-CODE**

This error pertains to the "L" word in a part program block. The "L" word consists of the letter "L" followed by an up to 3 digit loop value. This message is displayed when one of the following conditions occur:

1. Duplicate "L" word was found
2. No loop value follows the "L" letter
3. Loop value exceeds 3 digits

**BAD P-CODE**

This error pertains to a "P" word or an "S" word in a part program block. The "P" or "S" word consists of the letter "P" or "S" followed by a signed decimal position value. This message is displayed when one of the following conditions occur:

1. Duplicate "P" or "S" word was found
2. No position value follows the "P" or "S" letter
3. No position value follows a minus sign
4. More than one decimal point was found
5. The value to the left of the decimal point exceeds 4 digits
6. "P." or "P-." or "S." or "S-." was specified without data

**BAD RESPONSE FORMAT**

The file size was returned by the Vinculum in an unrecognized format.

#### BAD RS232 CONFIG

1. The number of data bits is not 8 or 9.
2. The number of stop bits is not 1 or 2.
3. Attempting to use even or odd parity when the number of data bits is 9.

#### BAD SEQUENCE #

This error pertains to the "N" word in a part program block. The "N" word consists of the letter "N" followed by a 3 digit sequence number. This message is displayed when one of the following conditions occur:

1. No sequence number follows the "N" letter
2. The "N" letter is not the first character in the block
3. Duplicate N word was found
4. The sequence number exceeds 3 digits

#### BAD SYNTAX

1. The F word of a G81 command is not zero or "1.111".
2. The P word of a G81 or G82 command is not 1, 2, or 3.
3. A word in the block does not start with "N", "S", "G", "F", or "L".

#### BYTES RECEIVED <byte-count>

#### PRESS CYCLE START

#### TO CONTINUE

This message appears after a RS232 file transfer. It shows the number bytes of data received.

#### CANNOT START MOTOR

An obstruction is preventing the motor from moving.

#### CAN'T TALK TO DRIVE

#### TURN POWER OFF

The software cannot RS232 communicate with the drive over UART #4. Ensure that communication lines are well connected with adequate grounding.

#### CHANGE DIR/FILE FAIL

The directory name specified for the USB device is used as a file name, volume label, or other FAT structure.

#### CLAMPED

This message appears on line 4 of the display whenever the indexing table is clamped. No movement is allowed when the table is clamped.

#### CLAMP FAULT PRES LOW

This error means that there is insufficient air pressure to unclamp the table. Check that the air hose is connected properly.

#### CLAMPING

This message indicates that the table is in the process of clamping. No movement is allowed while the table is clamping.

#### CLAMPING DONE

This message indicates that a clamping operation has completed successfully.

#### COPYING FILE ...

This message appears on the 4th line while a copy operation is in progress.

#### COPY SUCCESSFUL

This message indicates that a copy operation completed successfully.

#### CPU EXCEPTION

A divide by zero or another fatal firmware error has occurred.

#### DB INCONSISTENCY

The motor cannot be started because of an inconsistent data base.

#### DEFAULT SETTINGS

This message appears on line 1 when all parameter values have been reset to their default settings. This will happen whenever the user holds down the "clear zero set" button for 3 or more seconds while in the parameter mode.

#### DELETE SUCCESSFUL

This message indicates that a delete operation completed successfully.

#### DELETING FILE ...

This message appears on the 4th line while a delete operation is in progress.

#### DEVICE DETECTED

The software detected that a USB device has been inserted into the USB port.

#### DEVICE REMOVED

The software detected that a USB device has been removed from the USB port.

**DL ALLOC OUT FAILED****PRESS CYCLE START****TO CONTINUE**

This message is displayed while downloading the user program to the drive if the allocation of the memory required to hold the downloaded segments failed.

**DIR NOT EMPTY**

There are files or subdirectories in the USB subdirectory to be deleted. The subdirectory must be empty before the operation can be completed.

**DIR REQUEST FAILED****PRESS CYCLE START****TO CONTINUE**

This message appears when the user is selecting a program residing on the USB device. The reasons that this message will appear are:

1. Unable to allocate enough memory space to hold all of the file names
2. No USB device was detected by the firmware
3. A USB file is currently open for reading or writing.

**DISK FULL**

The USB media is full.

**<drive-command> FAILED****R:!**<drive-response>**!**

This message appears when a command was sent to the drive but the drive did not accept the command.

The following 6 messages pertain to the format of the file DPARMS.TXT. There are 3 possible formats:

1. FORMAT I -                   <alpha> <alpha>
2. FORMAT II -                 <alpha> <alpha>[<number>]
3. FORMAT III -                <alpha> <alpha>[<number>..**<number>**]

**DRIVE INHIBITED**

An obstruction is preventing the motor from moving.

**ECAM DIFF TOO LARGE**

There is too large a difference in the ECAM table. This application does not use the ECAM table so EM[1] must be set to zero.

**ELEC 0 SEARCH FAILED**

The drive failed to find the electrical zero of the motor in an attempt to start it with an incremental encoder and no digital hall sensors. The reason may be that the applied motor current did not suffice for moving the motor from its position.

**EMGCY STOP**

This message appears on line 4 of the display whenever the controller is in the emergency stop state. Press the red button on the operator panel to enter the emergency stop state. Pull out the button to exit the emergency stop state.

**EXISTS.OVERWRITE I/O**

The USB target file number to copy to already exists. Type a "I" to overwrite the existing file or a "0" to abort the copy operation.

**FEEDBACK LOSS**

No match between the encoder and hall location.

**FILE <file-name>****EXISTS.OVERWRITE I/O**

This message appears while attempting to copy a file from the memory card to the USB device or vice versa while using the file utilities function. The message states that the file already exists on the target device. Press the "I" key to overwrite or "0" to abort the copy command.

**FILE CORRUPTED**

The command failed while attempting to access information about a file residing on the memory card. Perform a "CHKDSK" operation on the memory card.

**FILE CREATE FAILED**

This message appears on line 4 of the display when attempting to save a program, the active program number, a comp table file, or a parameter file to the memory card or USB device. The software could not write to the media. Possible causes are that the disk is full, corrupted, or protected.

**FILE IS EMPTY**

A file was expected to contain the part program but the file was found to be empty. Delete the file from the memory card using the file utilities software.

**FILE IS READ ONLY**

The read only USB file attribute is set.

**FILE NOT FOUND**

The requested USB file is not found.



**FILE OPEN FAILED**

This message appears on line 4 of the display when attempting to read from a program, comp file, or parameter file. The software detected that the desired file exists in the file allocation table (FAT) but either could not open the file because there was no file at the location specified by the file allocation table (FAT) or the software could not open it because the file is corrupted. Possible causes are that the file, disk, or FAT is corrupted or protected.

**FILE STILL OPEN**

A USB file is already opened for reading or writing.

**HDWL mode**

This message appears whenever hand wheel mode is active. You must first be in the manual mode to enter hand wheel mode. Press the mode key until the display reads "MANUAL MODE" on line 1. Press and hold down the button on the hand held device to activate hand wheel mode. You can now use the hand wheel to move the table. To exit hand wheel mode just release the button on the hand held device.

**HEART BEAT FAILURE**

This error occurs only if the drive is set to abort during a heart beat failure in a CAN open network. We do not have a CAN open network so this error will never occur.

**HOMING****JOG OFF SW TO CENTER****PRESS CYCLE START****TO CONTINUE**

This message appears while attempting to home a linear axis. It means that the switch is depressed and the axis cannot be homed. Jog the axis towards the center of travel then home.

**INPUT:**

This prompt indicates where drive commands are typed in during drive terminal mode.

**INS DSK THN PRS STRT**

The software is prompting for the user to insert a USB stick into the USB drive slot.

**INSERT USB MEDIA**

The USB media is incorrectly formatted or the file system is not recognized.

**INVALID FILE NAME**

USB file name contains disallowed characters. File names must be letters and numbers and can also contain the following characters: \$, %, ', -, \_ , @, ~, ` , !, ( , ) , { , } , ^ , # , & . File names are made up of up to 8 characters main part and an optional 3 character extension.

**JUMP LABEL NOT EXIST**

The step number called out in the G96 "Jump to Subroutine" block does not exist in the program.

**LINE 2 LARGE @<line-number>**

The format of the DPARMS.TXT is incorrect. The length of the line exceeds 25 characters. Replace the file or run CHKDSK to correct the file.

**LINE 2 LONG @:<line-number>**

This message appears while downloading parameters to the drive if a line in the table parameter file exceeds 25 bytes.

**LINES RECEIVED <line-count>****PRESS CYCLE START****TO CONTINUE**

This message appears after a RS232 file transfer. It shows the number of program lines recieved.

**MEM PGM(0=EXIT):**

This message appears in the file utilities mode whenever a program number residing on the MEM card is to be selected. It prompts for the desired program number to copy or delete. Typing zero moves up one level in the file utilities menu hierarchy.

**MISS 2ND ALPHA @<line-number>**

The format of the DPARMS.TXT is incorrect. Replace the file or run CHKDSK to correct the file.

**MISSING =:<drive-parameter-assignment>**

This message appears while downloading parameters to the drive. The table parameter file (5C.TXT, I6C.TXT, LP160.TXT, LP210.TXT, LP250.TXT, or LP300 .TXT) is corrupted. This message is displayed if the drive parameter assignment is missing the equal sign.

**MISSING ;:<drive-parameter-assignment>**

This message appears while downloading parameters to the drive. The table parameter file (5C.TXT, I6C.TXT, LP160.TXT, LP210.TXT, LP250.TXT, or LP300 .TXT) is corrupted. This message is displayed if the drive parameter assignment is missing the semi colon termination character.

**MMC NOT DETECTED****PRESS CYCLE START****TO CONTINUE**

This message appears at power up when the memory card detection fails or the file format is not FAT32. Replace the memory card. You should still be able to operate the table without the memory card but you will not be able to save your programs and parameter settings. When the memory card is not detected, a set of default control box parameters will be used.

**MOTOR STUCK**

The motor is powered but not moving.

**NEW DRIVE****PRESS & HOLD DOWN****ARROW KEY TO ENTER****UTILS THEN SELECT 3**

This message is displayed when a new drive is detected. The user is directed to the file utilities download drive page (refer to the File Utilities section).

**NO DISK DETECTED**

This software prompted for a USB device but no such device was inserted into the USB drive.

**NO HELP****AVAILABLE**

Pressed the cycle start button to obtain more information on the parameter but no additional information was available.

**NOT HOMED**

This message appears at power up after cycle start is pressed to remove the splash screen indicating that the table must be referenced. Press the zero return button to home the table.

**OFFS FILE OPEN FAIL**

The offset file contains the offset amount in encoder counts from the index pulse (home position). This is the distance from the home position to the user specified zero position.

This message appears on line 4 of the display when attempting to read from the offset file. The software detected that the desired file exists in the file allocation table (FAT) but either could not open the file because there was no file at the location specified by the file allocation table (FAT) or the software could not open it because the file is corrupted. Possible causes are that the file, disk, or FAT is corrupted or protected.

**OFFS FILE WR FAIL**

The offset file contains the offset amount in encoder counts from the index pulse (home position). This is the distance from the home position to the user specified zero position.

This message appears on line 4 of the display when attempting to save the offsets file to the memory card. The software could not write to the media. Possible causes are that the disk is full, corrupted, or protected.

**<percentage> % COMPLETE**

This message displays the status of the drive download/upload process.

**Param:**

This prompt is where the parameter number appears during parameter mode.

**PASSWORD:**

**PRESS CS WHEN DONE**

The software is prompting for a password. After the password has been entered, press the cycle start button.

**PARAM FILE NO EXIST****MEMCARD ASSUM EMPTY****INS DSK THN PRS STRT****TO LOAD PARAM FILES**

If the software does not detect the existence of the control box parameter file on the memory card, the memory card is assumed to be empty. The user is prompted to insert a USB device containing all of the required system files. To load these files, press the cycle start button. For a detailed description of these files and the file load procedure refer to the parameter download section of this document.

**PARAMS SAVED**

This message indicates that the drive parameter download completed successfully.

**PARSER ERROR**

An unknown error occurred while scanning the part program.

**PEAK CURRENT EXCEEDED**

The peak drive current has been exceeded. Possible reasons are drive malfunction or bad tuning of the current controller.

**P FLIE NOT EXIST**

The file containing the name of the last active program does not exist. Load a program and this message should disappear.

**POSITION LIMIT EXCEEDED**

$PX < LL[3]$  or  $PX > HL[3]$  or  $PY < LL[3]$  or  $PY > HL[3]$

Where:

PX is the actual position of the main encoder

PY is the actual position of the auxiliary encoder

LL[3] is the motor encoder position lower limit

HL[3] is the motor encoder position upper limit

**POSN TRACKING ERROR**

Position following error limit exceeded.

$DV[3] - PX > ER[3]$

Where:

DV[3] is the position command

PX is the actual position

ER[3] is the position following error limit

This may occur due to:

1. Bad tuning of the position or speed controller
2. Too tight a position error tolerance
3. Abnormal motor load or reaching a mechanical limit

Program Number:

This prompts for a program number during edit mode.

Receiving prog:#:

This message displays the name of the incoming program that will be received from the RS232 remote device.

Receiving program

This message is displayed during RS232 data reception. When data reception completes, this message will disappear and the edit screen will appear containing the received program.

Rcvd:

This is where the drive response appears during drive terminal mode.

PROGRAM TOO LARGE

MAX SIZE= 18000

PRESS CYCLE START

TO CONTINUE

The size of a program has exceeded 18,000 bytes.

RESOLVER OR HALL BAD

1. The resolver or analog halls feedback was not ready. The resolver or analog halls angle was not found.
2. The amplitude of the analog sensor is lost or too low.

Sending prog:#:

This message displays the name of the program that will be sent to the RS232 remote computer.

Sending program

This message appears briefly at the start of RS232 data transmission. During data transmission, the transmitted program should scroll across the screen.

Sent:

This is where the command sent to the drive appears during drive terminal mode.

**RS232**

This message appears on the run mode screen indicating that the box is in RS232 mode. When in this mode the box receives commands from a remote device using the RS232 interface. To enter RS232 mode, send an xG, xS, xF, or xL command

**SCANNING USB...****PLEASE WAIT**

This message notifies the user that the software is scanning the USB device.

**SERVO DRIVE FAULT**

This error is described according to the indexer drive fault detail bits B1-B3. Refer to the table below:

B3	B2	B1	
0	0	0	
0	0	1	Under voltage error occurred. The power supply is shut down or has too high an output impedance.
0	1	0	Over voltage error occurred. The voltage of the power supply is too high or the indexer drive did not succeed in absorbing the kinetic energy while braking the load. A shunt resistor may be required.
0	1	1	
1	0	0	
1	0	1	A short circuit occurred. The motor or its wiring may be defective or the drive is faulty.
1	1	0	The drive is overheating. The environment is too hot or lacks heat removal. There may be a large thermal resistance between the drive and its mounting.
1	1	1	

**SERVO DRIVE FAULT B1**

1 drive fault detail bit 1. Please refer to the table above.

**SERVO DRIVE FAULT B2**

Indexer drive fault detail bit 2. Please refer to the table above.

**SERVO DRIVE FAULT B3**

Indexer drive fault detail bit 3. Please refer to the table above.

**SERVO OFF**

This message appears at power up or when coming out of an emergency state. It means that the table is not under position loop control.

**SPEED LIMIT EXCEEDED**

$VX < LL[2]$  or  $VX > HL[2]$

Where:

VX is the actual velocity

LL[2] is the lower limit of the allowed motor speed

HL[2] is the upper limit of the allowed motor speed

#### SPEED TRACKING ERROR

Velocity following error exceeded.

$DV[2] - VX > ER[2]$

Where:

DV[2] is the speed command

VX is the actual velocity

ER[2] is the velocity following error limit

This may occur due to:

1. Bad tuning of the speed controller
2. Too tight a speed error tolerance
3. Inability of the motor to accelerate to the required speed due to too low a line voltage or not a powerful enough motor.

#### STACK OVERFLOW

This may occur if the CPU was subject to a load it could not handle.

#### TEMPL FILE CORRUPTED

The software could not determine the existence of the file DPARMS.TXT on the memory card. Run the CHKDSK utility on the memory card.

#### TEMPL FILE NOT FOUND

The file DPARMS.XT was not found on the memory card.

#### Test UARTs 1,3

This message will appear if the UART test was successful at the start of diagnostic mode. To test UARTs 1 and 3 connect the send line of UART 1 to the receive line of UART 3.

#### TOO MANY INT DIGITS

The interger part of a value sent over the RS232 interface was too large.

#### TOO MANY FRAC DIGITS

The fractional paart of a value sent over the RS232 interface was too large.

**UNCLAMPED**

This message appears at the bottom right hand corner of the display when the tale is unclamped.

**UNCLAMPING**

This message indicates that the table is in the process of unclamping. No movement is allowed while the table is unclamping.

**UNKNOWN CHAR @<line-number>**

The format of the DPARMS.TXT is incorrect. Replace the file or run CHKDSK to correct the file.

**UNCLAMPING DONE**

This message indicates that an unclamping operation has completed successfully.

**UNKNOWN USB RESPONSE**

The Vinculum returned an unrecognized message.

**UPGRADE FL NOT FOUND**

This message is displayed when a USB media without a firmware upgrade file is inserted into the USB port.

**USB PGM(0=EXIT):**

This message appears in the file utilities mode whenever a program number residing on the USB media is to be selected. It prompts for the desired program number to copy or delete. Typing zero moves up one level in the file utilities menu hierarchy.

**Value:**

This is where the parameter value appears during parameter mode.

**VNC:BAD INIT STR LEN**

Unexpected Vinculum firmware version string length

**VALUE 2 LARGE @<line-number>**

The format of the DPARMS.TXT is incorrect. A number exceeds 6 digits. Replace the file or run CHKDSK to correct the file.

**VALUE MISMATCH: <line-number>**

This message appears while downloading parameters to the drive if the value in the drive does not match the expected value.

**VNC:BAD INIT STRING**

Unrecognized Vinculum firmware version string format.

**WAIT ...**



**DOWNLOADING PARAMS**

This message is displayed during the entire drive download process.

WAIT ...

**DOWNLOADING USER PGM**

This message is displayed during the entire user program download process.

WAIT ...

**UPLOADING PARAMS**

This message is displayed during the entire drive upload process.

**When the drive does not accept a command one of the following errors will be displayed:**

**2 BAD COMMAND**

The interpreter has not understood the command.

**3 BAD INDEX**

Attempt to access a vectored variable outside of its boundaries. Observe the index range for the used command.

**5 BAD CHARACTER**

An unrecognized character has been found where a command was expected.

**6 PROGRAM NOT RUNNING**

This command requires a running program.

**7 BAD INIT DATA**

Mode cannot be started - bad initialization data. This error is returned when preset values of a function are wrong.

**11 CANT WRITE TO FLASH**

Cannot write to flash memory. An error interfacing the serial flash has occurred. Most probably a hardware problem.

**12 COMMAND DISALLOWED**

Command not available in this unit mode.

**13 CANT RESET RS-232**

Cannot reset communication – UART is busy. Modification of the parameters of the serial communication has been attempted while the communication line is busy.

**18 BAD RIGHT ASSIGN**

Empty assign. The right side of an equation is missing.

**19 BAD COMMAND FORMAT**

An unresolved syntax error in the command has occurred.

**21 OPERAND OUT OF RANGE**

Assignment of an illegal value to a parameter has been attempted.

**22 DIVIDE BY ZERO ERROR**

**23 CANT ASSIGN TO CMD**

Cannot assign a value to the variable on the left hand side of the equal sign.

**24 BAD OPERATOR**

An unrecognized character has been found in an expression where an operator has been expected.

**25 INVALID WHILE MOVING**

The Command is not valid while moving.

**26 MOTION MODE INVALID**

A Begin Motion was attempted but the parameters of the motion were not properly set.

**28 OUT OF LIMIT RANGE**

A command was specified out of its permitted limits.

**30 NO PGM TO CONTINUE**

An XC (resume program) command has been issued but there is no halted program to continue.

**32 RS-232 COMM ERROR**

Communication overrun, parity, noise or framing error. Ensure that communication lines are well connected with adequate grounding.

**37 2+ HALLS SAME LOC**

Two or more Hall sensors are defined for the same location.

**39 MOTION START 2 LATE**

Motion start specified for the past. The time requested for synchronized motion has elapsed.

**41 UNKNOWN COMMAND**

Command not supported by this product. An attempt has been made to assign an illegal value to the command.

**42 NO SUCH LABEL**

The program does not contain a label with the specified name.

**43 CAN STATE MACH FAULT**

CAN state machine fault (object 0x6040 on DS402).

**45 BAD SUB RETURN ADDR**

Returned error from subroutine. Occurs when a return op-code has no valid address to return to.

**46 BAD STOP EVENT**

May not use multi-capture homing mode with stop event. Occurs when trying to set multiple capture events with a STOP between events.

**47 USER PGM NO EXIST**

User program does not exist. XQ or XC returns this error if a program has not been loaded to and successfully verified by the drive.

**50 STACK OVERFLOW**

A CPU exception was detected. This error reflects either a hardware problem or a faulty power supply.

**53 ONLY FOR CURRENT**

Command is applicable only in torque control modes UM=1 or 3.

**54 SETUP INCONSISTENT**

Cannot start the motor, because the setup data is not consistent.

**55 BAD CONTEXT**

A command that is not applicable in the present context has been attempted.

**56 UNKNOWN COMMAND**

The product grade does not support this command.

**57 MOTOR MUST BE OFF**

This command cannot be used when the motor is on.

**58 MOTOR MUST BE ON**

This command cannot be used when the motor is off.

**60 BAD UNIT MODE**

Something not supported in this unit mode has been attempted.

**61 PARAMETERS RESET**

The database has been restored to factory defaults after the parameters loaded from the flash memory failed a consistency check.

**64 BAD INDEX**

Cannot set the index of an active table.

**65 MOTION DISABLED**

Motion could not begin because a switch programmed to abort motion was active when MO=1 was tried.

**66 DRIVE NOT READY**

The motor could not be powered due to:

- a. Over- or under-voltage
- b. Over-temperature

- c. Short circuit (a shorted motor or a hardware problem)
- d. Hall sensor problem

**67 RECORDER IS BUSY**

A recording process is in progress and the recorder settings cannot be changed. Recorded data cannot be fetched.

**69 RECORDER USAGE ERROR**

Something illegal was attempted with the recorder.

**70 RECORDER DATA INVALID**

Cannot upload recorded data because the recorder contains no valid data.

**71 HOMING IS BUSY**

Cannot change the modulo count (XM or YM) while homing is in progress.

**72 RESULT MUST BE EVEN**

The result of a calculation must be even.

**73 SET POSITION FAILED**

An attempt to set the position counts modulo to a smaller number than the present position was made.

**77 BUFFER TOO LARGE**

A string command that is too long (more than 255 characters in a single command) has been sent.

**78 OUT OF PROGRAM RANGE**

An attempt to load a program larger than the drive storage capabilities has been made.

**80 BAD ECAM DATA**

The jumps between consecutive ECAM table points are greater than 32,767 counts and therefore cannot be interpolated.

**81 IN "QUICK STOP" MODE**

Occurs only if a CAN master used the DS402 standard control word to block motor movements.

**82 PROGRAM IS RUNNING**

Cannot load a new program, compile a program or start program execution because a program is already running.

**83 CMD NOT FOR PROGRAM**

An attempt has been made to use a command (such as XQ, DL, LS or DF) that has a NotProgram flag set.

**84 NOT IN PT TO PT MODE**

The system is not in point to point mode. A position relative cannot be set in non-point to point mode, because it has no reference position from which to start.

**90 CAN STATE NOT READY**

CAN state machine is not ready (object 0x6041 on DS402).

**93 BAD INIT VALUE**

There is a wrong initiation value for this command.

**95 TOO LARGE FOR MODULO**

Too large for modulo setting.

**96 USER PROGRAM TIMEOUT**

Execution of a single user program line was more than expected (more than 3 seconds). The SimpliQ drives stops program execution.

**97 RS232 RCV BUF OVRFLW**

Characters arrived through RS-232 at too high a rate, causing internal storage to exceed its capacity. No more space is left to store new characters.

**99 BAD AUX FEEDBACK**

The auxiliary feedback entry does not configure as output during the activation of Output Compare

**100 PWM VAL UNSUPPORTED**

The requested PWM value is not supported

**101 ABS POS ENC RD FAIL**

Abortive attempt to read a position value from the absolute position sensor. CD command also indicates failure details.

**105 SPD LP GAIN RANGE ER**

Speed loop gain KP out of range.

**106 POS LP GAIN RANGE ER**

Position loop gain KP out of range.

**111 FILTER VECT INVALID**

Controller filter vector is invalid.

**112 INVALID FILTER PARM**

Controller filter defines scheduled block but scheduling is off. Invalid values in Controller filter parameters.

**113 EXP TASK QUEUE FULL**

Exp task queue is full. Internal error during auto-tuning process.

**114 EXP TASK QUEUE EMPTY**

Exp task queue is empty. Internal error during auto-tuning process.

**115 EXP OUTP QUEUE FULL**

Exp output queue is full. Internal error during auto-tuning process.

**116 EXP OUTP QUEUE EMPTY**

Exp output queue is empty. Internal error during auto-tuning process.

**I 17 BAD FILTER SETTING**

Bad Controller filter setting for sensor filter.

**I 18 BAD FILTER VECTOR**

Bad Controller filter vector

**I 19 BAD ANALOG FILTER**

Bad Analog sensor Filter

**I 20 BAD # BLOCKS FILTER**

Bad number of blocks for Analog sensor Filter

**I 21 ANALOG SENSR NOT RDY**

Analog sensor is not ready

**I 27 MOD RANGE MUST BE +**

Modulo range must be positive.

**I 28 BAD INTERNAL INDEX**

Bad variable index in database - internal compiler error. Index of the variable in the database is not correct.

**I 29 VARIABLE NOT ARRAY**

Cannot access a scalar variable defined according to its index in square brackets as an array in the user program.

**I 30 VAR NAME NO EXIST**

Variable name does not exist.

**I 31 CANT RECORD LOC VARS**

Cannot record local variables.

**I 32 VARAIBLE NOT ARRAY**

**I 33 MISMATCHED ARGS**

Mismatched number of user/system function input arguments. An attempt was made to call user/system function with the number of input arguments not as defined.

**I 34 CANT RUN LOCAL LABEL**

Cannot run local label with the user program execute command.

**I 37 PGM ALREADY COMPILED**

An attempt was made to download a user program before previous one was erased.

**I 39 TOO MANY BREAK PNTS**

The number of breakpoints exceeds the maximum number.

**I 40 WRONG BP LINE**

An attempt to set/clear breakpoint at the non-relevant line.

**I41 BOOT PRM SECT NO CLR**

Boot identity parameters section is not clear. Internal error during download of boot identity parameters.

**I42 CHECKSUM NOT CORRECT**

Checksum of data is not correct. Internal error during download of boot identity parameters.

**I43 MISSING BOOT ID PRMS**

Missing boot identity parameters. Internal error during download of boot identity parameters.

**I44 NUM STACK UNDERFLOW**

Numeric stack underflow. An attempt has been made to retrieve an entry from an empty stack.

**I45 NUM STACK OVERFLOW**

Numeric stack overflow. An attempt has been made to push a value to the numeric stack when it is full.

**I46 EXPR STACK OVERFLOW**

Expression stack overflow. An attempt has been made to push a value to the expression stack when it is full.

**I47 EXEC CMD ASSIGNMENT**

Executable command within math expression. An attempt has been made to assign an executable command.

**I48 EMPTY EXPRESSION**

Nothing in the expression. An attempt has been made to evaluate an empty expression.

**I49 UNEXP EXP TERMINATOR**

Unexpected sentence termination. An expression terminator appears in the middle of the expression.

**I50 EXP TERM NOT FOUND**

Sentence terminator not found. The expression is too long to be evaluated (exceeding the maximum length).

**I51 PARENTHESES MISMATCH**

There is a mismatch between opening and closing parentheses. Pertains to both parentheses and brackets.

**I52 BAD OPERAND TYPE**

There is a mismatch between the actual value type and the expected value type.

**I54 MEM SEG ADDR 2 LARGE**

Address is out of data memory segment. Variable address in the data segment exceeds the data segment size.

**I55 BEYOND STACK RANGE**

Compiled code contains a pointer to the stack entry, exceeding the actual stack range (STACK\_IMMEDIATELY addressing method).

**I56 BAD OP CODE**

Compiled code contains mismatched addressing mode.

**I57 TOO MANY USER PGMS**

No available program stack. An attempt was made to run too many user programs simultaneously.

**I58 UPL/DWNL DATA 2 LARGE**

Out of flash memory range. Failure in download and upload process: an attempt to access flash memory because its size.

**I59 FLASH VERIFY ERROR**

Failure in download and upload process: checksum does not match.

**I60 USER PGM ABORTED**

Program aborted by another threat. Failure while running one virtual machine aborts all other virtual machines.

**I61 PROGRAM NOT HALTED**

Execution of a command that requires user program to be halted.

**I62 FLOAT # OUT OF RANGE**

Floating point number exceeds the valid range supported by the SimplIQ.

**I64 EC COMMAND**

EC command (not an error).

**I65 FLASH MEM READ FAIL**

An attempt to access serial flash while busy. Failure on reading serial flash memory, possible due to hardware problem.

**I66 OUT OF MODULO RANGE**

**I67 INFINITE LOOP**

Infinite loop in for loop - zero step

**I68 SPEED TOO LARGE**

Speed too large to start motor. MO=1 or motor started with Enable switch while motor was rotating too quickly.



## 2 HALL CHG SAMETIME

Two digital hall sensors changed at the same time. An error occurs because the digital hall sensors must change one at a time.

# 14. Hardware Supported by the Indexer Control

This portion of the manual will outline information of the various components powered by the indexer control. These will include items which may have to be replaced over time. The information is a guide for the customer. If the function of any of the components described below is in question, consult the Hardinge technical department prior to the ordering of parts. The technician will help troubleshoot the issue and make sure the correct parts are ordered .

## 14.1 Main Control Cable Indexer

The cable which connects the indexer control to the indexer mechanical unit is responsible for controlling the communication of the motor, encoder, home switch and clamp circuit of the indexer system. This cable in most applications is subject to the harsh machining environment. The condition of this cable should be routinely checked for any signs of damage occurring from operation that may cause this communication to fail. Check for any abrasions, cuts or loose connectors. If any damage to the cable is suspected, contact the Hardinge technical department for assistance. This cable should immediately be replaced on the discovery of an issue. Damage to the indexer system resulting from the use of a defective cable will void the warranty. It is the operator's responsibility to make sure that the cable is properly installed and routed in the machine to insure that the cable will not be damaged during motion of the machine's axes.

Main Control Cable – Part No. RT 000301 IRTEC



## 14.2 Remote CNC Cable

One remote CNC Cable is supplied with all Hardinge indexing systems. This cable is used to remotely start the indexer using a spare M-code on a machine tool. It can also be connected to a mechanical switch which can then be driven by a moving portion of a manually-controlled machine. This is called the remote quill switch. This is a four-wire cable with a connector on one end that will directly connect with the remote CNC cable port located on the back of the indexer control. The black and white wires control the start signal. The red wire should be connected to a 24 volt supply and the green wire serves as the finish input signal if used. Additional cables can be purchased and wired to machines making the movement of a indexer from one machine to another more convenient.

In Hardinge machines built after 1/1/2011 there is a prewired connector for an Indexer control connection already prewired into the machine power case. This connector on the machine is a 6 socket

Amphenol military style connector. The mating connector is a MS3106A-16S-1P that can be purchased from an electrical distributor. The 4 wire Remote CNC cable hooks up to this connector

and then plugs directly into the prewired machine. The wiring of the connector is as follows in the table below.

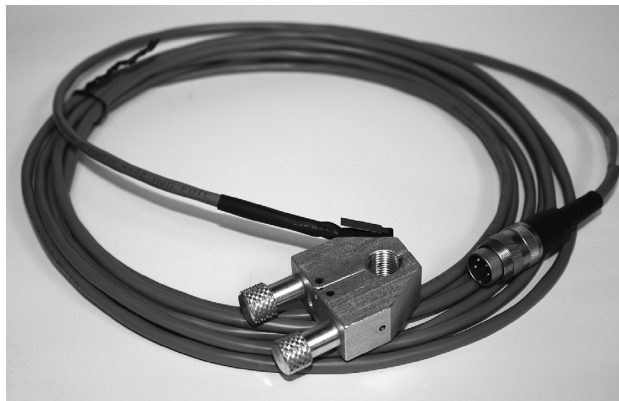
Pin	Color	Socket Connector
1	Red	A
2	Green	B
3	Black	C
4	White	D

This quick connect Remote CNC cable is available from Hardinge Rotary under part number CI 000301 IICQC. This cable is not supplied with the standard indexer control and must be purchased separately.



Remote CNC Cable – Part No. CI 000301 IIC

Remote CNC Cable with Remote Quill Switch installed – Part No. CI 0010224RSA (shown)



### 14.3 Home Switch

The home switch used with geared indexer units is a two-wire proximity switch. This switch is a normally closed switch. The switch is located inside of the motor cover and installed in the housing of the indexer. Located on the gear of the mechanical unit is a magnet reference dog for the switch. When this dog passes the sensor of the switch, the switch goes low sending a signal to the control to verify that the home position has been reached. This switch is only active during the initial homing sequence after power up. If the indexer fails to home after power up, contact a Hardinge service technician for assistance.

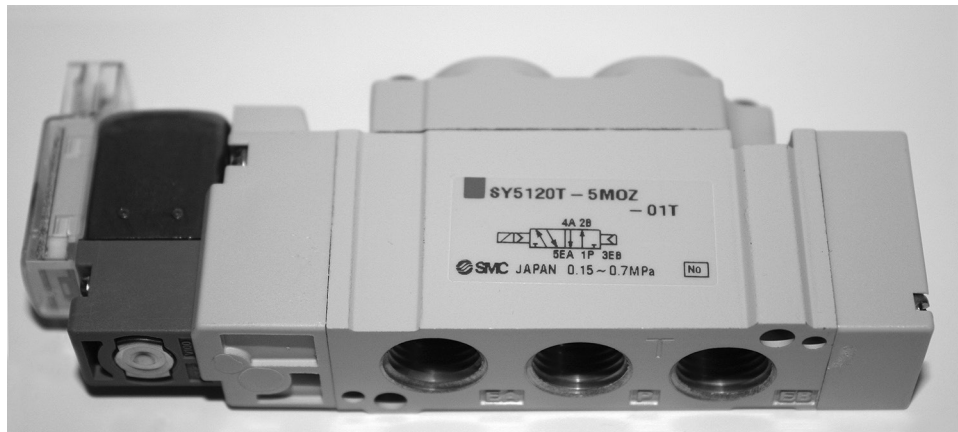
Home Switch Assembly – Part No. CIA0010224SEM



### 14.4 Pneumatic Clamp Valve

The valve used to operate the clamp on the indexer is a two-wire 24-volt device. This valve is located inside the motor cover. The valve is configured so that an air supply is delivered to the clamp when the solenoid of the valve is de-energized. When the clamp is supplied air, the clamp on the unit is in the "un-clamped" state. To "clamp" the spindle of the indexing table, the solenoid of the valve is energized, removing the air supplied to the clamp. For issues with the clamp valve, contact a Hardinge service technician for assistance.

Clamp Valve with 1/8 NPT Ports – Part No. CJ 0003048SCV (SMC: SY5120T-5M0Z-01T)



#### 14.5 Clamp Pressure Switch

The clamp circuit in the Hardinge indexer units includes a pressure switch to monitor the status of the clamp device. The pressure switch is on "high" when the clamp is released. A red LED on the sensor is illuminated when the clamp is released. This switch is set to go high with an air pressure of 85 psi. When the pressure drops below 85 psi, the LED turns off and the sensor is considered off "low". This will indicate a clamped state.

Set incoming air pressure for the clamp circuit to 85 psi minimum to insure a satisfactory working pressure.

For issues with the pressure switch, contact a Hardinge service technician for assistance. This switch has a maximum air pressure of 100 psi. Incoming air should be set to 85-100 psi.

Pressure Switch – RT 000301 IPSAS



#### 14.6 Control Support Options

Hardinge offers two styles of support options (bracket shelves) when trying to mount the Indexer Control box to a host machine. One type of support swivels and tilts. This support is recommended for machines for which placing the control on the roof is not practical as the machine is too tall. The other type of support is the stationary, which tilts only.

Swivel Control Support – Part No. CI 0001990BCB



Stationary Control Support – Part No. CI 0001990CBSA



## 15. Troubleshooting

### 15.1 Testing the Remote CNC Cable and Cycle Start/Finish Circuit of the Indexer Control

1. Make sure control is powered off.
2. Connect the CNC cable to the Indexer Control box.
3. Attach a multi-meter with the continuity function to the red and green wires of the cable.
4. Power on the indexer Control and home the indexer.
5. Program a simple 90 degree move on the first line of the indexer program.
6. Touch the black wire on the CNC Cable to the white wire and release.
7. The indexer will move 90 degrees and when finished, the multi-meter should beep, verifying the function of the cable and also the cycle start/finish circuit of the control box.

### 15.2 Inspecting Main Control Cable

Check the rear panel of the indexer control for loose or broken connectors for the power and encoder cable.



Check to make sure there are no bent, loose or broken pins in cable connectors.

MAIN CABLE POWER SIDE



MAIN CABLE ENCODER SIDE



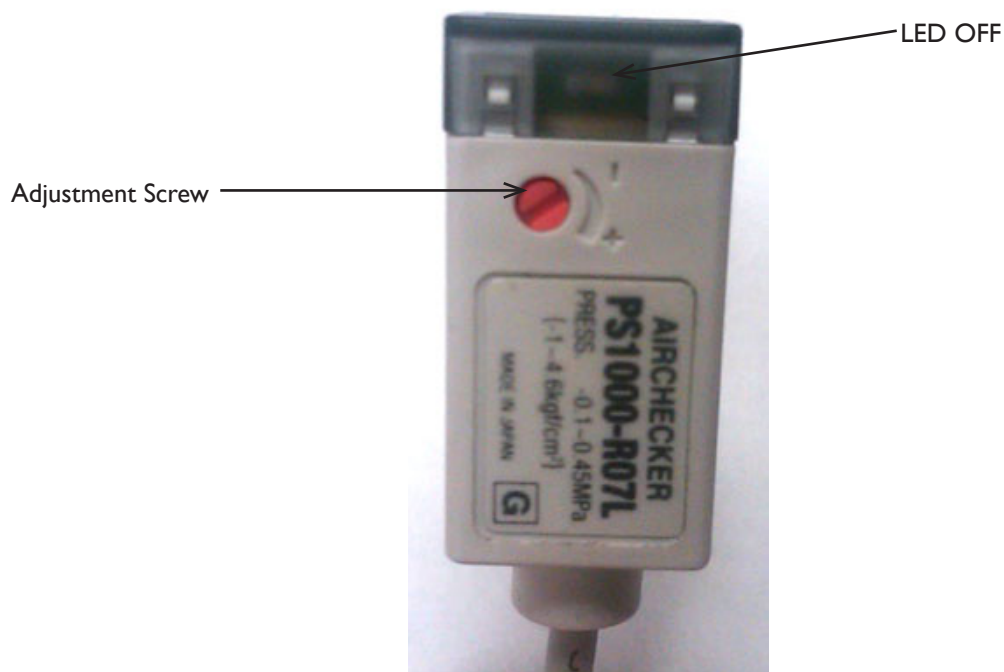


### 15.3 Checking the Pressure Switch

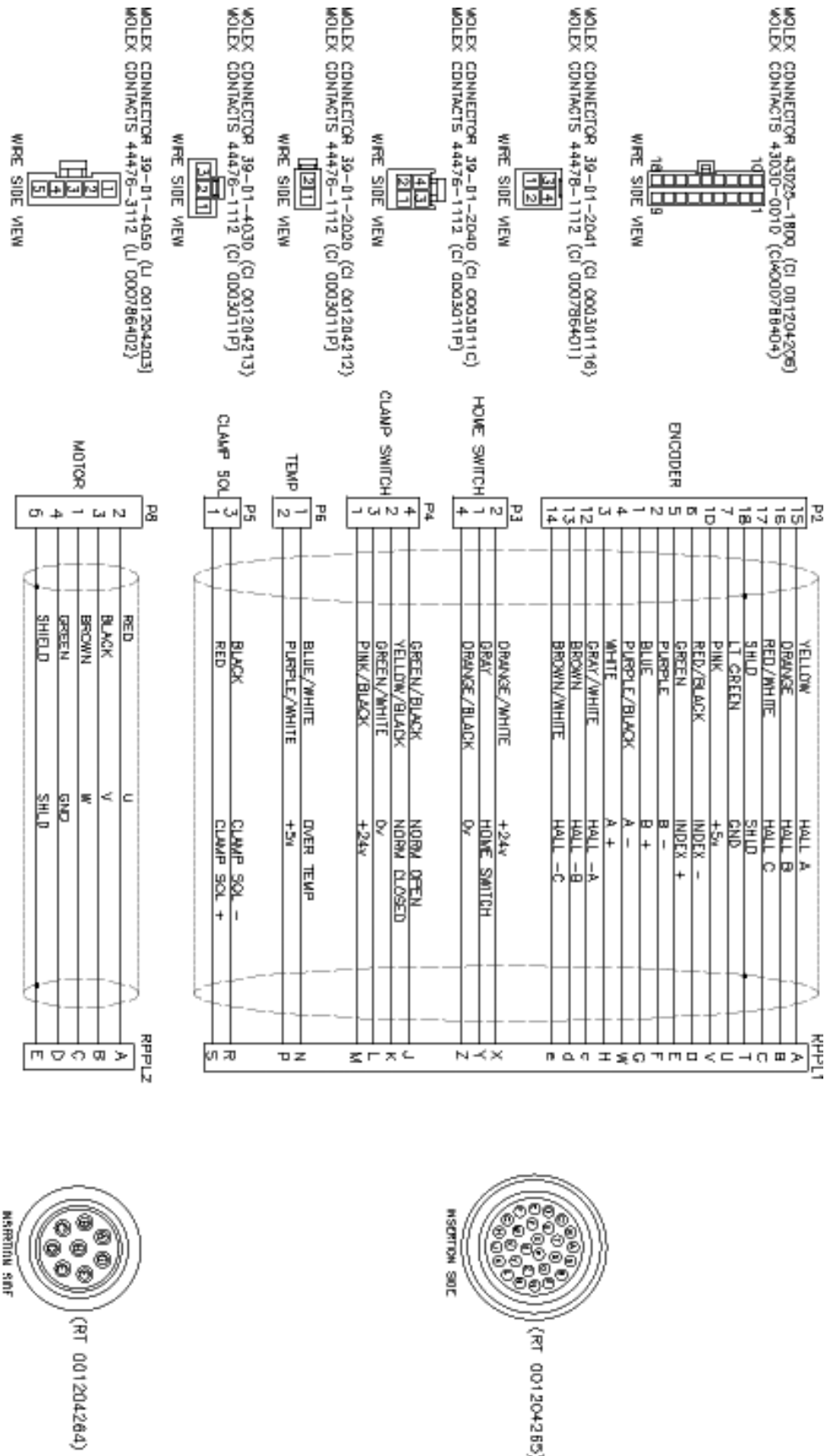
Insure that the air is connected and supplying 85 psi to the clamp valve. When the clamp is in the "unclamped" state, the pressure switch will be "high" (the LED will be on).



By actuating valve or by decreasing the air pressure below 75psi, the pressure switch should go "low" (LED will go off). If the switch needs to be adjusted, the adjustment screw is located below the LED.

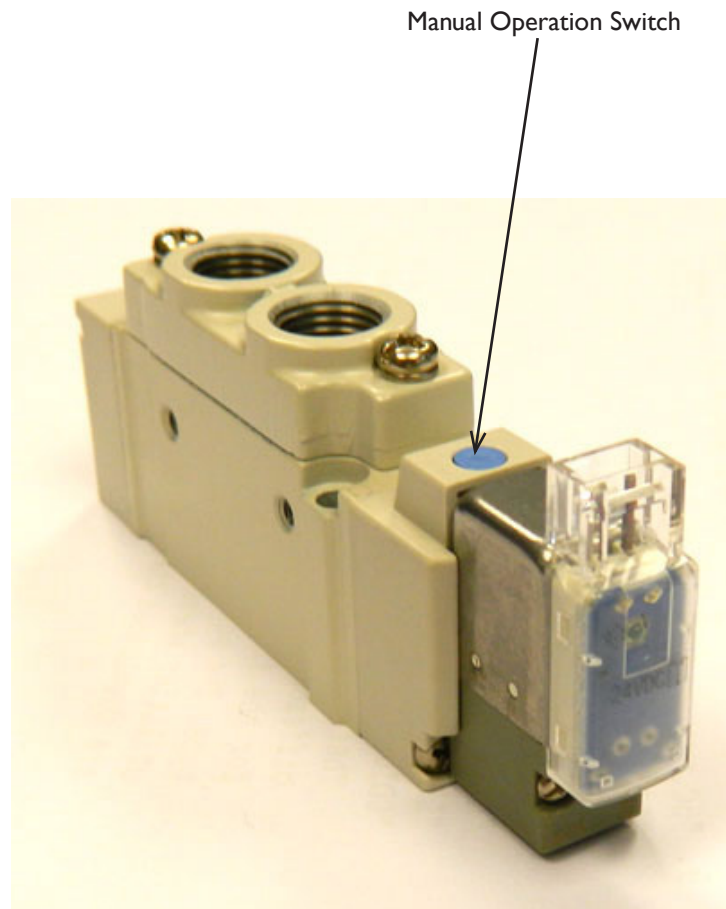
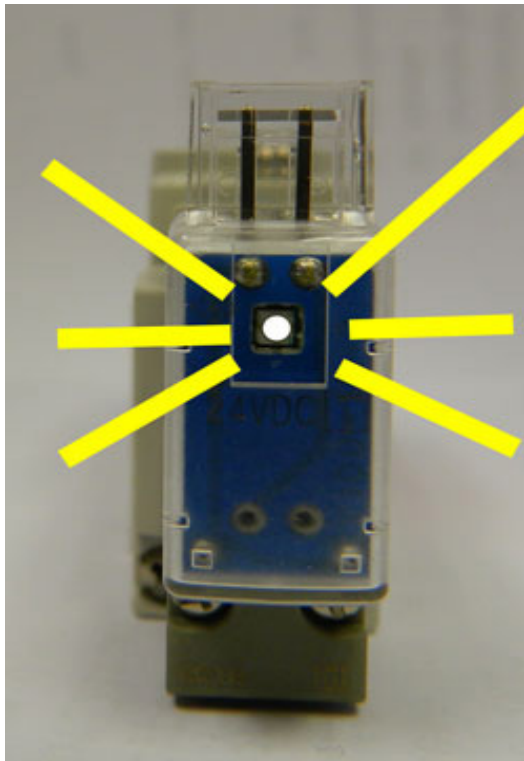


### 15.4 Pin Schematic for the Encoder/Power Cable



### 15.5 Checking the Clamp Valve

Insure that 85 psi is supplied to the clamp valve in port. This is the port located between the two exhaust ports on any of the three available valves for the clamp. The air line to supply air to the open port of the clamp should be exiting the valve on port "B". There is a mechanical switch located on the valve to manually shift the spool to check operation. When the valve is de-energized, the clamp should be "unclamped". At this time, the LED on the valve should be off. If the valve does not appear to be functioning correctly, turn off the indexer control and unplug the air supply at the quick disconnect either on the control box or the top of the indexer unit. Next, unplug the air line from port "B" of the valve. Reconnect the air supply at the quick disconnect. Air should exit port "B" in this state. Activate the mechanical switch to shift the valve and the air should stop. If it does not, the valve is faulty and needs to be replaced.





## 16. One-Year Limited Warranty

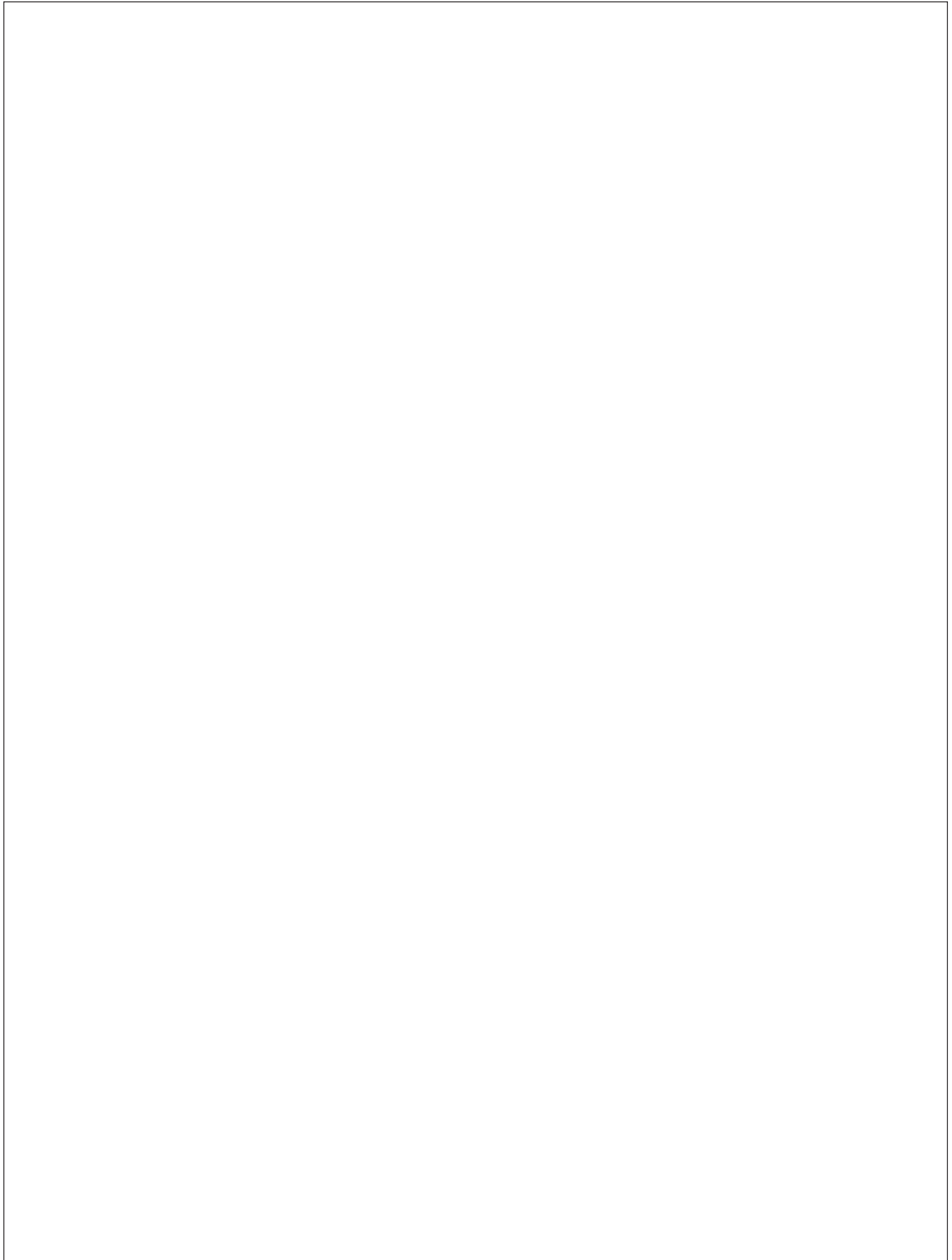
The Hardinge Indexer Control is provided with a one-year warranty against any defects in material and workmanship. Specific details of the warranty can be found in the Hardinge Terms and Conditions document associated with the purchase agreement.

## Addendum A G-Code Reference Chart

The G-code in a line of a program identifies the type of command to be executed in that line. G-codes can command incremental or absolute positioning, dwells, jumps, clamp commands, continuous motion, etc.

**G-CODE REFERENCE CHART:**

G28	return to home position (same as G88 and G90 with step 0)
G80	controls the clamp function when parameter I10 is set to 1 in the control
G81	controls the 3 general outputs of the control
G82	controls the 3 general inputs of the control
G83	continuous rotation in negative direction
G84	continuous rotation in positive direction
G85	fractional circle division (any value < or = 360.000 degrees can be divided equally)
G86	turn CNC relay ON
G87	turn CNC relay OFF
G88	return to HOME position (same as G28 and G90 with step 0)
G89	wait for remote input
G90	absolute position command
G91	incremental position command
G92	pulse CNC relay and wait for remote input
G93	pulse CNC relay
G94	pulse CNC relay and run next L steps automatically
G95	end of subroutine/more steps follow
G96	subroutine call/jump (destination is a step number)
G97	delay by L count/10 seconds (down to 0.1 second)
G98	circle division (always assumes 360.000 degrees to be divided equally)
G99	end of program/return and end of steps



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