

**HSL-CUP3  
CUPPER  
HIGH SPEED FRONT END  
USER'S MANUAL**

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## WARNING

To ensure the equipment described by this User Manual, as well as the equipment connected to and used with it, operates satisfactorily and safely, all applicable local and national codes that apply to installing and operating the equipment must be followed. This includes the National Electric Code in the USA and other applicable legislation, regulations, and codes in practice elsewhere. Since codes can vary geographically and can change with time, it is the user's responsibility to determine which standards and codes apply, and to comply with them.

FAILURE TO COMPLY WITH APPLICABLE CODES AND STANDARDS CAN RESULT IN DAMAGE TO EQUIPMENT AND/OR SERIOUS INJURY TO PERSONNEL.

Persons supervising and performing installation or maintenance must be suitably qualified and competent in these duties, and should carefully study this User Manual and any other manuals referred to by it prior to installation and/or operation of the equipment.

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The contents of the User Manual are believed to be correct at the time of printing; however, no responsibility is assumed for inaccuracies. In the interests of a commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance or the contents of the User Manual without notice.

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## 1.1 FEATURES

- Performs high speed control functions of Cupper to speeds in excess of 300 CPM. This includes clutch control, air strip control, as well as brake wear compensation.
- Performs the following control functions:
  - 1) Rapid response control of clutch/brake system for emergency stops as well as precise TDC stops.
  - 2) Highly repeatable air strip control to reduce die jam problems.
  - 3) Brake Wear compensation (Auto TDC timing programming) algorithm to stop press at TDC regardless of brake response.
  - 4) Brake response determination allows displaying of actual brake response (in degrees).
  - 5) Brake response alarm to indicate when brake stopping response (in degrees) has exceeded user preset limit.
  - 6) Lubricator speed reference (0-10volt analog output) provides reference to lubricator proportional to speed of cupper (user scalable).
  - 7) Alarm detection: timing signal fail detection and brake response too long alarm.
  - 8) Data Acquisition: Total number of strokes (for both current shift and last shift).
- Built-in 2 Line X 40 character sealed display with 24 key membrane keypad allows local viewing of collected data (stroke count, brake response) by operator and set-up of all user variables.
- Interfaces directly with machine mounted resolver and all clutch and air strip solenoids.
- Based on high performance M4500 PLC/PLS module which allows easy trouble-shooting and user customization using SYSdev (DOS-based) programming package.
- Built-in PLS provides all machine timing, eliminating need for an additional PLS.

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## 1.2 GENERAL DESCRIPTION

The HSL-CUP3 Cupper high speed control package is an electronic upgrade package for coppers which performs the high speed control functions of the cupper including: rapid response clutch/brake control and precise air strip control. In addition, the package provides a brake wear compensation feature which automatically adjusts the TDC timing signal to stop the press at TDC regardless of brake stopping time. Alarm detection is provided including: timing signal failure and brake response too long alarm. Data collection includes: Total strokes (both for the current shift and previous (last) shift). The package interfaces directly to the machine mounted resolver, clutch/brake, and air strip solenoids as well as the host PLC via discrete DC I/O.

## **SECTION 1**

### **GENERAL DESCRIPTION**

The package is not a dedicated "black box", but is instead implemented using the high performance SYSTEMS M4500 PLC/PLS module which allows easy customization by either SEA or the end user. The M4500 module is programmed using the DOS-based SYSdev programming package which allows the module to be programmed in any combination of Ladder or High-level (subset of "C"), as well as perform on-line monitoring and trouble-shooting. The M4500 module incorporates a built-in PLS which interfaces directly with the machine mounted resolver and provides all machine timing, eliminating the need for an external PLS.

---

#### **1.3 CLUTCH/BRAKE CONTROL**

The clutch/brake solenoids are activated by the HSL-CUP3 through the electro mechanical two hand control circuitry provided externally by the user. The throughput of the HSL-CUP3 is 0.5 milliseconds. The fast throughput along with the fact that the PLS is fully integrated into the M4500, allows extremely fast and repeatable declutching and braking response to be achieved. Normally the clutch is controlled via inputs on the HSL-CUP3 that are controlled from outputs on the host PLC. However, detection of any of the alarms (timing signal failure, etc.) results in an immediate de-clutch of the solenoids.

---

##### **1.3.1 CONTROL OF CLUTCH VIA HOST PLC**

Four discrete DC inputs to the HSL-CUP3 from the host PLC are used to control the clutch: "Clutch On (TDC)", "Clutch On (IMED)", "Cont/Single Mode", and "Inch Mode". The following description of operation defines the requirements of the host PLC logic to activate the clutch through the HSL-CUP3:

###### **Continuous Mode:**

- 1) To activate the clutch in continuous mode, turn both the "Clutch On (TDC)" and "Clutch On (IMED)" inputs "on" simultaneously while the "Cont/Single Mode" input is "on".
- 2) To perform a TDC stop, turn "off" the "Clutch On (TDC)" input while leaving the "Clutch On (IMED)" input "on". Once the clutch is de-energized, then turn "off" the "Clutch On (IMED)" input.
- 3) To perform an immediate (emergency) stop, turn both the "Clutch On (TDC)" and "Clutch On (IMED)" inputs "off" simultaneously.



**Single Mode:**

- 1) To single stroke the press, with the "Cont/Single Mode" input "on", turn the "Clutch On (TDC)" input on for 5 to 50 milliseconds while simultaneously turning the "Clutch On (IMED)" input "on". Turn "off" the "Clutch On (IMED)" input once the press has de-clutched and stopped. The press will make one stroke.

**Inch Mode:**

- 1) To inch the press, with the "Inch Mode" input "on", simultaneously turn "on" and "off" both the "Clutch On (TDC)" and "Clutch On (IMED)" inputs. The clutch is activated as long as both inputs are "on" or until the TDC (low) timing signal occurs.

**Bar Mode:**

- 1) With both the "Cont/Single Mode" and "Inch Mode" inputs "off", the clutch can be activated by simultaneously turning both the "Clutch On (TDC)" and "Clutch On (IMED)" inputs "on". The clutch is activated as long as both inputs are "on".

**Note:** In all the above modes, the "Clutch On (TDC)" and "Clutch On (IMED)" inputs must be turned "on" simultaneously (within 0.5 seconds) in order for the clutch to activate.

---

**1.4 AIR STRIP CONTROL**

The HSL-CUP3 provides a repeatability of 0.5 milliseconds for the air strip thus die jam problems.

---

**1.5 BRAKE WEAR COMPENSATION**

The HSL-CUP3 incorporates a brake wear compensation or automatic TDC timing feature which stops the press at TDC regardless of the actual braking response of the clutch/brake. The stopping compensation is accomplished by automatically adjusting the TDC timing signal based on the previous stop. Any overrun is detected and a new TDC timing signal is computed such that the machine will stop at the desired location on the next stop. Two TDC signals are provided: one for low speed and one for high speed. Both incorporate the break wear compensation feature. The appropriate TDC timing signal (low or high) is adjusted based on the speed of the machine when the TDC stop was initiated.

## SECTION 1

### GENERAL DESCRIPTION

In addition to the brake wear compensation, the HSL-CUP3 also calculates the actual brake response (in degrees). This is the number of degrees from where the clutch was de-activated (TDC timing location) to where the crankshaft actually ended up stopping. This can then be displayed by the operator or maintenance personnel to determine the condition of the brake.

A "Brake Response Too Long" alarm is also generated when the actual brake response exceeds a user specified maximum allowed brake response. This can be used to indicate that service to the brake should be performed.

---

#### 1.6 ALARM DETECTION

The package detects the following alarms: timing signal failure and brake response too long.

**TIMING SIGNAL FAIL:** The timing signal fail occurs when any of the timing signals generated in the PLS section fail to change state periodically while the machine is running.

**BRAKE RESPONSE TOO LONG:** The "Brake Response Too Long" alarm is generated when the actual brake response exceeds a user specified maximum allowed brake response. This can be used to indicate that service to the brake should be performed.

The above alarms are available to the host PLC via discrete outputs. These should be used to stop the machine and indicate the problem when any one of the alarms occurs.

---

#### 1.7 DATA COLLECTION

The following data is collected for both the current shift and the previous (last) shift:

- 1) Total strokes made

This data can either be viewed locally on the display by the operator or can be sent to the host PLC via RS-232 communications (MODBUS or Allen-Bradley DF1 protocols) using the optional S4516 communications board. This information is updated ("current" shift transferred to "Last" shift) based on the change of state of a discrete bit (set via the MODBUS or DF1 communications). This bit can be activated on an 8 or 12 hour shift basis.

## SECTION 2 INSTALLATION

The standard HSL-CUP3 package is provided for back-panel mounting inside the existing user's control cabinet. In addition, the HSL-CUP3 can be purchased in a self contained NEMA 12 enclosure for mounting adjacent to the existing control cabinet by specifying part number HSL-CUP3-ENCL.

---

### 2.1 WHAT'S INCLUDED

Depending on which package is purchased, verify that the following items are included when unpacking the HSL-CUP3:

---

#### 2.1.1 HSL-CUP3 (for back-panel mounting)

- 1ea. HSL-CUP3 back-panel for mounting in the existing user's control cabinet including the following:
  - 1ea. M4500 PLC/PLS module
  - 1ea. P4500 Power Supply
  
- 1ea. D4591 Display with ribbon cable for mounting in the existing user's control cabinet door.
- 1ea. HSL-CUP3 User's Manual
- 1ea. M4500 User's Manual
- 1ea. HSL-CUP3 Program Disk

---

#### 2.1.2 HSL-CUP3-ENCL (with NEMA 12 ENCLOSURE)

- 1ea. HSL-CUP3 NEMA 12 enclosure including the following:
  - 1ea.M4500 PLC/PLS module
  - 1ea.P4500 Power Supply
  - 1ea.D4591 Display/Keypad
  
- 1ea.HSL-CUP3 User's Manual
- 1ea.M4500 User's Manual
- 1ea.HSL-CUP3 Program Disk

## SECTION 2 INSTALLATION

---

### 2.1.3 HSL-CUP3 OPTIONS (PURCHASED SEPARATELY)

The following items can be purchased separately as required or desired. All items are compatible with both the back-panel mountable package or the NEMA 12 enclosed package:

- 1ea. S4516 Data Communications Board (MODBUS and DF1 protocols)
- 1ea. RSV34-MS1 Resolver
- 1ea. RSV-RSCBLE-XX Resolver Cable

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## 2.2 HSL-CUP3 INSTALLATION

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### 2.2.1 POWER REQUIRED

The HSL-CUP3 is powered from 115VAC/230VAC 50/60HZ and +24VDC. The 115VAC/230VAC is used to power the M4500 module while the +24VDC is used to power the +24VDC I/O (clutch solenoids, etc.).

**Note:** +24VDC solenoids must be used for all clutch and air strip solenoids. These provide a much more consistent and repeatable response time than 115VAC solenoids. Assuming +24VDC solenoids were used in the existing system, the +24VDC current required by the HSL-CUP3 is no more than the existing systems +24VDC current requirement, therefore the existing +24VDC power supply should be adequate.

---

### 2.2.2 MOUNTING AND WIRING THE HSL-CUP3

If installing the HSL-CUP3-ENCL package mounted in the NEMA 12 enclosure, mount the HSL-CUP3 NEMA 12 enclosure in proximity to the existing control cabinet.

If installing the HSL-CUP3 package, mount the back-panel in the existing control cabinet. Referring to the M4500 User's manual, cut a cut-out in the existing control cabinet door and mount the D4591 display.

**Note:** The D4591 must be located within 6 feet of the M4500 module to avoid EMI pick-up on the Display ribbon cable. Connect the ribbon cable from the M4500 module to the D4591 module.

## SECTION 2 INSTALLATION

Wire the HSL-CUP3 to the existing control system, referring to the electrical control schematic at the back of this manual, keeping all +24VDC wiring away from high voltage wiring. Wire the machine mounted resolver directly to the 8-pin resolver input connector on the M4500 module using a three pair, two conductor shielded cable. The shield of the resolver cable should be tied to the "SHLD" terminal of the M4500 resolver input connector. Make sure the resolver cable shield is left floating at the resolver. Refer to the electrical control schematic at the back of this manual for details.

---

### 2.2.3 MOUNTING THE RSV34-MS1 RESOLVER (IF REQUIRED)

The HSL-CUP3 is designed to interface to a resolver (not encoder) for machine timing. If the machine is not already equipped with a resolver, then the existing encoder will have to be removed and an RSV34-MS1 resolver will have to be mounted in it's place. If this is the case, refer to the RSV34-MS1 data sheet for details on mounting the resolver. Use the RSV-RSCBLE cable to connect the resolver to the HSL-CUP3. Route the resolver cable in a separate conduit, away from all other high voltage and control wiring. Wire the cable directly to the 8-pin resolver connector on the M4500 (see section 2.2.2).

---

### 2.3 HSL-CUP3 SOFTWARE INSTALLATION

Follow the steps below to install the HSL-CUP3 Set-up software package and the HSL-CUP3 application programs onto the IBM PC or compatible which will be used to support the HSL-CUP3 package.

## SECTION 2 INSTALLATION

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### 2.3.1 HSL-CUP3 SET-UP SOFTWARE INSTALLATION

The HSL-CUP3 set-up software is used to download the program to the M4500 module, tune (set-up) the user adjustable variables of the HSL-CUP3, download and upload (save) the user set-up variables to disk, and view shift data on the IBM PC used to support the HSL-CUP3. To install the set-up software, perform the following steps:

- 1) Create one directory off the root directory of the PC for each cupper the HSL-CUP3 will be used on called "HSLCUP1" for cupper #1, "HSLCUP2" for cupper #2, etc. These will be used to store the "HSLCUP3.EXE" setup programs and HSLCUP3 set-up data for each cupper. Create these directories by typing the following at the DOS prompt:

```
MD \HSLCUP1<ENTER>
MD \HSLCUP2<ENTER>
MD \HSLCUP3<ENTER>
etc.
```

- 2) Install the disk labeled "HSL-CUP3 PROGRAMS" into the A: drive. For each "HSLCUP" directory you created in the previous step, switch to that directory and install the "HSL-CUP3" set-up programs by typing the following at the DOS prompt (cupper #1 is shown):

```
CD \HSLCUP1<ENTER>
A:INSTALL<ENTER>
```

- 3) Add each cupper's HSL-CUP3 set-up program to your computer's menu software by creating a selection for each cupper called "SET-UP CUPPER #1" for cupper #1, "SET-UP CUPPER #2" for cupper #2, etc.. The DOS commands executed for these selections should be:

For the "SET-UP CUPPER #1" selection:

```
CD \HSLCUP1
HSLCUP3 HSLCUP3
CD \
```

For the "SET-UP CUPPER #2" selection:

```
CD \HSLCUP2
HSLCUP3 HSLCUP3
CD \
```

etc.

- 4) To execute the respective cupper's set-up program, simply select the corresponding "SET-UP CUPPER" selection from the menu software's menu.

---

### 2.3.2 SYSdev PROGRAM DEVELOPMENT SOFTWARE INSTALLATION

The SYSdev Program Development software is used to perform on-line trouble-shooting and program modifications to the HSL-CUP3. If SYSdev was purchased with the HSL-CUP3 package and is not already installed on your computer, install SYSdev onto the hard drive of your computer following the steps in section 1.5 of the SYSdev Program Development manual.

---

### 2.3.3 HSL-CUP3 APPLICATION PROGRAM INSTALLATION

The HSLCUP3 application program is a SYSdev based program which is loaded into the M4500 module and performs the HSL-CUP3 logic. The HSLCUP3 program is written in a combination of Ladder logic and High-level. If the user desires to make program changes or perform on-line monitoring of the program execution, the files which constitute the HSLCUP3 program will have to be loaded onto the hard drive of the PC which is used to support the HSL-CUP3. The SYSdev Program Development Software will also have to be loaded on the PC (see section 2.3.2). To install this program perform the following:

- 1) If not already done, perform steps 1 through 3 of section 2.3.1. This creates the directories and menu selections which will be used to store and select the HSLCUP3 application programs.
- 2) Install the disk labeled "HSL-CUP3 PROGRAMS" into the A: drive. For each of the "HSLCUP" directories, switch to that directory and install the HSLCUP3 application program by typing the following at the DOS prompt (cupper #1 is shown):

```
CD \HSLCUP1<ENTER>  
COPY A:HSLCUP3.*<ENTER>  
CD \
```

- 3) Add the HSLCUP3 application programs to your computer's menu software by creating selections called "HSL-CUP3 PROGRAM CUPPER #1", etc. for each cupper. The DOS commands executed for these selections should be (cupper #1 shown):

```
CD \  
SYSDEV \HSLCUP1 HSLCUP3
```

- 4) To initiate SYSdev with the "HSLCUP3" program, simply select the respective "HSL-CUP3 PROGRAM" selection from the menu software's menu. The main development menu of SYSdev will be initiated with the HSLCUP3 program. See the SYSdev Program Development manual and the M4500 Program Development manual for complete details on on-line monitoring and program development with SYSdev.

## SECTION 2 INSTALLATION

---

### 2.4 TUNING THE HSL-CUP3

The HSL-CUP3 is shipped from the factory with the PLC program "HSLCUP3" loaded in the M4500 module (PLC section) and the PLS channel set-point file "CUP3TMG" loaded in the PLS section of the M4500 module. These are the standard programs used to implement the standard HSL-CUP3 copper algorithm. In addition, as shipped, the user variables for the M4500 are set the following defaults:

Brake Wear Compensation:

Enabled \_\_\_\_\_ : N  
Desired TDC Stop Position (Low Speed) \_\_\_\_\_ : 000  
Desired TDC Stop Position (High Speed) \_\_\_\_\_ : 000

Maximum Allowed Stopping Response (degrees) \_\_\_\_\_ : 300

Copper Running Speeds:

Low Speed (SPM) \_\_\_\_\_ : 120  
High Speed (SPM) \_\_\_\_\_ : 220

Lubricator Speed Reference:

Maximum Speed \_\_\_\_\_ : 250  
Idle Speed (Copper stopped) \_\_\_\_\_ : 100

The "CUP3TMG" timing channel file, as shipped, contains the following default timing set-points:

CHAN	ON	OFF	DESCRIPTION
CH00:	140	- 160	TDC (High) timing
CH01:	180	- 200	TDC (Low) timing
CH02:	120	- 270	Die Jam Check timing
CH03:	300	- 320	Cup Jam Check timing
CH04:	000	- 020	Die Check Reset timing
CH05:	120	- 200	Air Strip timing
CH06:	020	- 040	Scrap Jam timing
CH07:	180	- 000	Stroke Count timing
CH10:	000	- 030	Motion ("on" for 30, "off" for 30 thru-out)
CH11:	___	- ___	
CH12:	___	- ___	
CH13:	___	- ___	
CH14:	___	- ___	
CH15:	___	- ___	
CH16:	___	- ___	
CH17:	___	- ___	



## SECTION 2 INSTALLATION

In most cases, the previous user variables and timing channels will have to be altered to tune the HSL-CUP3 to the actual cupper it is controlling.

Once the HSL-CUP3 is installed and the control system is powered back up, perform the following to set-up and tune the HSL-CUP3. The set-up is performed using either an IBM PC or compatible running the "HSLCUP3" set-up program or the Display/Keypad of the HSL-CUP3. See section 3 for a description of the "HSLCUP3" menus and variables and how to use the "HSLCUP3" program. See section 4 for a description of the Keypad commands and menu displays of the HSL-CUP3 Display/Keypad.

---

### 2.4.1 SET CUPPER SET-UP PARAMETERS

The Cupper set-up parameters include: enabling or disabling the brake wear compensation, setting the desired low and high speed stopping points (if the brake wear compensation is enabled), setting the maximum allowed stopping response, and setting the cupper running low and high speeds.

**Brake Wear Compensation:** If the brake wear compensation is to be used, enable it by setting the "Brake Wear Compensation Enable" to "Y". Set the "Desired TDC Stop Position (Low)" and "(High)" as well if the compensation is enabled. The "Desired TDC Stop positions" are the location you want the ram to be at when it comes to rest after a TDC stop. Both the "Low" and "High" desired stopping positions are generally set to 000 degrees. Enabling the brake wear compensation allows the HSL-CUP3 to automatically adjust the TDC timing channels (CH00-High) and (CH01-Low) as necessary such that the press will stop at the desired stopping position regardless of the actual brake response.

If the brake wear compensation is not to be used, disable it by setting the "Brake Wear Compensation Enable" to "N". Disabling the brake wear compensation requires the TDC (High) timing (CH00) and the TDC (Low) timing (CH01) signals to be set manually such that the press stops at TDC.

**Note:** If the brake response then changes, the press will not stop at the desired position if the brake wear compensation is disabled.

## SECTION 2 INSTALLATION

**Maximum Allowed Stopping Response:** This parameter defines what the maximum allowed brake response is before the "Brake Response Too Long" alarm is generated. If the actual brake response (number of degrees from when the brake is activated to the position where the press ends up at rest) when a TDC stop is performed is longer than this number, the alarm is generated. If the actual brake response is less, the alarm is not generated. Set this parameter to the value where the brake response is considered too long and service to the brake should be performed (typically 270 to 300 degrees).

**Copper Running Speeds:** Set the Copper running "Low Speed" and "High Speed" to the speeds that the copper will actually run at when the respective speed is selected.

**Note:** This is not a speed reference that will make the copper run at the speeds entered but is instead simply parameters used by the HSL-CUP3 to know when to switch between the TDC (Low) and TDC (High) timing etc.

See section 3.1 (HSLCUP3 set-up program) or section 4.4.1 (HSL-CUP3 keypad) for details on setting the above set-up parameters.

---

### 2.4.2 SET LUBRICATOR SPEED REFERENCES

Set both the "Lubricator Maximum Speed" and "Lubricator Idle Speed" as desired. These two parameters are used to actually control the speed of the lubricator (via the 0-10VDC lubricator speed reference output of the M4500).

**Lubricator Maximum Speed:** The "Lubricator Maximum Speed" parameter is used to scale the 0-10VDC analog output such that when the copper is running at the speed entered in "Lubricator Maximum Speed", the analog output will be at 10 volts.

**Lubricator Idle (Minimum) Speed:** This parameter determines the speed the lubricator will run at when the copper is stopped (de-clutched).

**Note:** When the copper is running, the lubricator speed reference is proportional (as set by the "Lubricator Maximum Speed" scaling) to the speed of the copper. This parameter is used to provide the speed reference when the copper speed is zero.

See section 3.1 (HSLCUP3 set-up program) or section 4.4.2 (HSL-CUP3 keypad) for details on setting the above set-up parameters.

---

### 2.4.3 SET MACHINE ZERO

Inch the cupper to top dead center (TDC) and set the M4500 offset per section 3.2.1 ("HSLCUP3" set-up program) or section 4.4.4 (HSL-CUP3 keypad).

---

### 2.4.4 VERIFY MACHINE OPERATION

Once steps 2.4.1 thru 2.4.4 are complete, run the machine in normal production (both at low and high speeds where practical) and verify the following:

**Verify Air Strip Timing:** With the machine running with the coil stock, verify that the cups are stripped with-out any problems. If a problem is occurring, adjust the "Air Strip" timing (CH05) until the problem is corrected. See section 3.2.2 (HSLCUP3 set-up program) or section 4.4.3 (HSL-CUP3 keypad) for details on adjusting CH05.

**Verify Die Protection:** Adjust the "Die Jam Check" (CH02), "Cup Jam Check" (CH03), and "Die Check Reset" (CH04) timing signals as required by the host PLC to perform die jam and cup jam checks successfully.

**Verify TDC Stops:** If the brake wear compensation is enabled, verify that the press does stop at the desired location in both the high and the low speeds.

**Note:** When the HSL-CUP3 is first installed, it will take a few successive stops for the algorithm to program the TDC timing channels to the correct position. Also note that the compensation is enabled after the press has been running at a fixed speed in continuous. The TDC timing channels will not be modified when single strokes are made or if press is started in continuous and then immediately stopped again. Wait about 5 seconds after the press is started before performing the TDC stop to verify the stop position.

If the brake wear compensation is disabled, manually adjust both the TDC (High) timing (CH00) and the TDC (Low) timing (CH01) such that the press stops at top dead center at both respective speeds. See section 3.2.2 (HSLCUP3 set-up program) or section 4.4.3 (HSL-CUP3 keypad) for details on adjusting CH00 and CH01.

**Verify Lubricator Speed References:** Verify that the coil stock is feed adequately from the lubricator when the machine is running in continuous. The lubricator will feed stock proportionally to the speed of the cupper (based on the scaling set in "Lubricator Maximum Speed (Calibration)". Also verify that the stock is feed satisfactorily in inch and single modes. The "Lubricator Minimum Speed" reference is used to feed stock by hand, etc. when the cupper is de-clutched.

**The machine is now set-up and ready to run.**

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### 2.5 M4500/P4500/D4591 INSTALLATION

The following is provided only as a reference. These steps are performed by the factory prior to shipping the HSL-CUP3. These steps need only be performed in the event either the M4500 module, P4500 power supply, or D4591 display need to be replaced. Refer to the M4500 User's Manual for general details on installing the M4500, P4500, and D4591.

---

#### 2.5.1 M4500 MODULE INSTALLATION

To install the M4500 module, perform the following:

- 1) Remove the cover from the M4500 chassis (retained with three captive screws on the lower front of the cover and two captive screws on each side of the M4500 chassis).
- 2) Install S4573 (SLOT0-0): Set the slot address dip switches (SW1) on the S4573 to the following positions (slot0):

S4573: SW1 switch1 = "OFF"  
SW1 switch2 = "OFF"

Install the S4573 in Slot0-0 (furthest left slot) of the M4500 chassis.

- 3) Install S4568 (SLOT0-1): Set the slot address dip switches (SW1) on the S4568 to the following positions (slot1):

S4568: SW1 switch1 = "ON"  
SW1 switch2 = "OFF"

Install the S4568 in Slot0-1 (slot next to S4573) of the M4500 chassis.

## SECTION 2 INSTALLATION

- 4) Install S4516 (SLOT0-3) (OPTIONAL): Set the slot address dip switches (SW2) on the S4516 to the following positions (slot3):

S4516: SW2 switch1 = "ON"  
SW2 switch2 = "ON"

Set the RS-232/RS-422 select dip switches (SW1) on the S4516 to the following positions (RS-232 selected):

S4516: SW1 switch1 = "ON"  
SW1 switch2 = "OFF"

Install the S4516 in Slot0-3 of the M4500 chassis.

- 5) Install the cover back over the M4500, making sure all the board connectors protrude through the slots in the cover. Tighten the three captive screws on the lower front of the cover and the two captive screws on each side of the M4500 chassis.
- 6) Connect the display ribbon cable to the connector on the back of the M4500 (the connector on the cable is polarized and should mate with the connector on the M4500 only one way).
- 7) Mount the M4500 chassis to the HSL-CUP3 back panel using four 8-32 screws.
- 8) With power to the P4500 "off", install the P4500 power supply cable to the +5/C/+12/C/-12 connector on the M4500 (the connector on the cable is polarized and should mate with the connector on the M4500 only one way).
- 9) Install the respective field wiring arms on all the I/O boards of the M4500 (I/O slots0 and 1, MODBUS connector on USER PORT, resolver connector, and IN0/IN1 connector). Make sure all the field wiring connectors are fully mated in the M4500.

## **SECTION 2 INSTALLATION**

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### **2.5.2 P4500 POWER SUPPLY INSTALLATION**

To install the P4500, perform the following steps:

- 1) Mount the P4500 to the HSL-CUP3 in the mounting holes next to the M4500 (left side) using two 8-32 screws.
- 2) With power to the P4500 "off", install the P4500 power supply cable to the +5/C/+12/C/-12 connector on the M4500 (the connector on the cable is polarized and should mate with the connector on the M4500 only one way).

---

### **2.5.3 D4591 KEYPAD/DISPLAY INSTALLATION**

To install the D4591, perform the following steps:

- 1) With the gasket installed on the mounting studs of the D4591, install the D4591 in the cut-out either in the HSL-CUP3 enclosure or the cut-out in the user's existing control cabinet. Secure the display to the enclosure using 7ea. 8-32 nuts and external lock washers.
- 2) Connect the display ribbon cable to the connector on the lower back of the display (the connector on the cable is polarized and should mate with connector on the M4500 only one way).

---

### 2.5.4 DOWNLOAD HSLCUP3 PROGRAM AND SET-UP DATA TO M4500

Once the M4500/P4500/D4591 are installed, perform the following to download the HSLCUP3 application program to the M4500 as well as download the previously saved set-up data and timing channel set-points:

- 1) Power up the M4500 and the IBM PC or compatible used to interface with the HSL-CUP3.
- 2) Connect an RS-232 cable from the computer COM port to the "PROG" port on the M4500.
- 3) From the computer's menu program, select the respective cupper's "SET-UP CUPPER" selection (this was set in section 2.3.1). The "HSLCUP3" set-up program will be invoked with the corresponding HSLCUP3 application program for that cupper.
- 4) Download the HSLCUP3 application program to the M4500 by selecting "4: Download Program to M4500" from the HSL-CUP3 main menu. A prompt will be displayed verifying the download, press the <ENTER> key to start the download. Once the download is complete, press any key to return to the HSL-CUP3 main menu. See section 3.4 for complete details.
- 5) Download the PLS timing set-points to the M4500 by selecting "2: Machine Timing" from the HSL-CUP3 main menu. From the PLS main development menu, select "4: Download Channels to PLS". Press the <ENTER> key to start the download. Press any key to return back to the PLS main development menu. Press 12<ENTER> to return back the HSL-CUP3 main menu.
- 6) Download the previously saved to disk set-up data to the M4500 by selecting "5: Download Set-up data to M4500" from the HSL-CUP3 main menu. Press the <ENTER> key to start the download. Once the download is complete, press any key to return to the HSL-CUP3 main menu. See section 3.5 for complete details.
- 7) The M4500 is now ready to run, loaded with the HSLCUP3 application program, timing set-points, and set-up data that was previously saved for the respective cupper. Press <ESC> to return back to the computer's menu software program.

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## SECTION 3 USING THE "HSLCUP3" SET-UP PROGRAM

The "HSLCUP3" set-up program is a DOS based menu driven program which allows the user to easily view the HSL-CUP3 data or alter the HSL-CUP3 set-up variables using an IBM PC or compatible. In addition to setting the set-up variables, "HSLCUP3" can be used to set the machine timing (machine offset, timing signal locations, etc.). The set-up variables are used to configure and tune the HSL-CUP3 to match the configuration and performance of the specific cupper (see section 2.4).

The main menu of the "HSLCUP3" set-up program incorporates the following menu selections:

- 1: Set Cupper/Lubricator Set-up Parameters
- 2: Set Machine Timing
- 3: Shift Data/Brake Response
- 4: Download Program to M4500
- 5: Download Set-up data to M4500
- 6: Upload (Save) Set-up data from M4500

**Note:** The "HSLCUP3" program is an on-line communications program used to interface with the M4500 module. The data displayed in the menus and set in the menus is communicated directly to the M4500. Therefore, prior to selecting any of the above selections, make sure an RS-232 cable is connected from the COM port on the computer running "HSLCUP3" to the "PROG" port on the M4500.

The following sections are a complete description of the "HSLCUP3" selections and menus.

---

### 3.1 SET CUPPER/LUBRICATOR SET-UP PARAMETERS

The Cupper/Lubricator set-up menu is used to set the various set-up parameters in the M4500. This menu is invoked by selecting "1: Set Cupper/Lubricator Set-Up Parameters" from the Main Menu.

**Note:** Prior to selecting this selection, make sure the RS-232 cable is connected from the COM port on the computer to the PROG PORT on the M4500.

## SECTION 3

### USING THE "HSLCUP3" SET-UP PROGRAM

---

#### 3.1.1 CUPPER/LUBRICATOR PARAMETER DEFINITIONS

**Brake Wear Compensation Enable? (0=No, 1=Yes):** This prompt is used to enable or disable the brake wear compensation. If the compensation is to be disabled, enter "0" and press <ENTER>. If the compensation is to be enabled, enter "1" and press <ENTER>.

**Desired TDC Stop Position (Low Speed):** This is the desired stopping location (in degrees) for a TDC stop in low speed when the brake wear compensation is enabled. This is typical set to 000 degrees (Top Dead Center)..

**Desired TDC Stop Position (High Speed):** This is the desired stopping location (in degrees) for a TDC stop in high speed when the brake wear compensation is enabled. This is typical set to 000 degrees (Top Dead Center).

**Maximum Allowed Stopping Response (degrees):** This defines what the maximum allowed brake response is before the "Brake Response Too Long" alarm is generated. If the actual brake response (number of degrees from when the brake is activated to the position where the press ends up at rest) when a TDC stop is performed is longer than this number, the alarm is generated. If the actual brake response is less, the alarm is not generated. Set this parameter to the value where the brake response is considered too long and service to the brake should be performed (typically 270 to 300 degrees).

**Running Cupper Low Speed (SPM):** This is the speed (in strokes per minute) that the cupper will run when in low speed.

**Running Cupper High Speed (SPM):** This is the speed (in strokes per minute) that the cupper will run when in high speed.

**Lubricator Maximum Speed (CPM):** The "Lubricator Maximum Speed" parameter is used to scale the 0-10VDC analog output such that when the cupper is running at the speed entered in "Lubricator Maximum Speed", the analog output will be at 10 volts. This is typically set to the running high speed of the Cupper or slightly higher.

**Lubricator Idle Speed (CPM):** This parameter determines the speed the lubricator will run at when the cupper is stopped (de-clutched).

**Note:** When the cupper is running, the lubricator speed reference is proportional (as set by the "Lubricator Maximum Speed" scaling) to the speed of the cupper. This parameter is used to provide the speed reference when the cupper speed is zero.

## SECTION 3 USING THE "HSLCUP3" SET-UP PROGRAM

---

### 3.1.2 CUPPER/LUBRICATOR SET-UP PARAMETER SELECTIONS

The menu selections on the "Cupper/Lubricator Set-Up Parameters" menu allow you to set the set-up variables listed under the following menu selections:

**1: Enable/Disable Brake Wear Compensation**

- Enable/Disable Brake wear compensation
- Desired TDC Stop Position (Low speed)
- Desired TDC Stop Position (High speed)

**2: Maximum Allowed Cupper Stopping Response**

- Maximum Allowed Cupper Stopping Response

**3: Set Cupper Running Speeds**

- Low Speed (SPM)
- High Speed (SPM)

**4: Set Lubricator Speed References**

- Maximum Speed (CPM)
- Idle Speed (CPM)

To set a particular variable, select the corresponding menu selection and follow the prompts as they occur.

---

### 3.2 SET MACHINE TIMING

The Set Machine Timing selection is used to invoke the PLS programming command menus (these are the same menus used in SYSdev to program the PLS section of the M4500). When selected, the PLS programming main development menu will be invoked using the default CUP3TMG channel set-point file. From this menu, the user can zero the machine (set the resolver offset) and adjust the timing signal set-points. The following sections describe how to perform these functions, section 5 provides a complete description of each timing signal.

**Note:** Prior to selecting the Machine Timing selection, make sure the RS-232 cable is connected from the COM port on the computer to the PROG PORT on the M4500.

## **SECTION 3 USING THE "HSLCUP3" SET-UP PROGRAM**

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### **3.2.1 ZEROING THE MACHINE**

To set the machine zero (resolver offset) perform the following:

- 1) Connect the RS-232 cable from the COM port on the computer to the "PROG" port on the M4500.
- 2) Select the "2: Set Machine Timing" selection from the HSL-CUP3 set-up program main menu.
- 3) Select "1: Online Channel Setpoint Programming" from the Main Development menu.
- 4) Select "F9: POS/RPM" and observe the "POS:" field. Verify that as the machine is rotated forward (either inching or barred) that the position increases linearly from 0 through 359. If not, swap the S1 and S3 leads of the resolver at the M4500 resolver connector. Then verify that the position then indeed does increase with forward movement. Press "ESC" to exit the "POS/RPM" update.
- 5) Position the machine at top dead center.
- 6) Auto zero the resolver by selecting "F10: Set Offset". Enter "0" in the offset field and press <ENTER>.
- 7) The M4500 will calculate the actual offset value required to make this the 000 position and will display this number in the offset field. The position will now read 0.
- 8) Exit back to the PLS Main Development menu by pressing <ESC>. Exit back to the "HSLCUP3" set-up main menu by pressing <ESC> again.

## SECTION 3 USING THE "HSLCUP3" SET-UP PROGRAM

---

### 3.2.2 ADJUSTING THE TIMING CHANNEL SET-POINTS

To set or alter any of the timing signal set-points, perform the following:

- 1) Connect the RS-232 cable from the COM port on the computer to the "PROG" port on the M4500.
- 2) Select the "2: Set Machine Timing" selection from the HSL-CUP3 set-up program main menu.
- 3) Select "1: Online Channel Setpoint Programming" from the Main Development menu.
- 4) Set all channels per section 5. Set-points are entered for a particular channel simply by typing in the set-point in the form XXX-YYY<ENTER> in the first set-point of the given channel.

**Note:** Up to 50 set-points may be entered for any channel. However for the copper only one set-point is used per channel and this should be entered in the number 1 set-point.

The XXX is the location the set-point will turn "on" while YYY is the location where the set-point will turn "off". Use the PgUp, PgDn, F1:Next Chan, or F2: Prev Chan keys to select the desired channel for programming.

- 5) Once all channels are programmed, press <ESC> to exit back to the PLS Main Development Menu. Press <ESC> again to exit back to the "HSLCUP3" set-up main menu. The new channels will be saved both in the M4500 and in the "CUP3TMG" file on the hard drive.

## SECTION 3 USING THE “HSLCUP3” SET-UP PROGRAM

---

### 3.3 SHIFT DATA

The shift data menu displays the following information:

Current Shift:  
Total Strokes

Last Shift:  
Total Strokes

Brake Response:  
Low Speed  
High Speed

This data is the totals so far into the current shift and the totals for the last (previous) shift. The current shift data is transferred to the "Last shift" data when the end of shift bit (set via the RS-232 data communications) transfers from a "0" to a "1". This can be at the end of either an 8 or 12 hour shift. This data cannot be reset either from this menu or by the operator, only at the end of shift transition.

In addition to the shift data, this screen also shows the brake response of the brake for both high and low speeds. This data is updated after each TDC stop.

To exit back to the main menu, press <ESC>.

---

#### 3.3.1 SHIFT DATA DEFINITIONS

**Total Strokes:** This is the total number of strokes the press has made for the shift. This is essentially a can counter.

**Low Speed Brake Response (degrees):** This is the number of degrees from the when the clutch was de-activated (at the TDC (Lo) timing) to where the copper crankshaft came to rest when a TDC stop was performed at Low speed. This can be used to determine the general condition of the brake and whether servicing of the brake is required.

**High Speed Brake Response (degrees):** This is the number of degrees from the when the clutch was de-activated (at the TDC (hi) timing) to where the copper crankshaft came to rest when a TDC stop was performed at high speed. This can be used to determine the general condition of the brake and whether servicing of the brake is required.

## SECTION 3 USING THE "HSLCUP3" SET-UP PROGRAM

---

### 3.4 DOWNLOAD PROGRAM TO M4500

This selection is used to download the HSLCUP3 application program to the M4500 module. This should only be performed when either replacing the M4500 module (see section 2.5) or when the program has been changed. To download the program, perform the following:

**Note:** Program download cannot be performed while the cupper is running. All outputs on the M4500 are turned "off" and no program execution is performed. The clutch would therefore be disengaged. The cupper should be stopped before the download takes place (approximately 15 to 45 seconds depending on the computer used).

- 1) Connect the RS-232 cable from the COM port on the computer to the "PROG" port on the M4500.
- 2) Select "4: Download Program to M4500". A prompt will be displayed asking to continue or abort. To continue, press any key except the <ESC> key. To abort, press the <ESC> key. If a prompt stating that the "HSLCUP3.REV" file could not be opened is displayed, then the "HSLCUP3" application program is not installed in the current directory. To install the program, perform the steps in section 2.3.3 to install the program.
- 3) Once program download is initiated, M4500 program execution will cease, the current address being downloaded will be displayed, and the "RUN" LED on the M4500 will flash continuously.
- 4) Once the download is complete, the "RUN" LED on the M4500 will illuminate solid and program execution in the M4500 will resume. Press any key to return back to the "HSLCUP3" main menu.

## SECTION 3

### USING THE "HSLCUP3" SET-UP PROGRAM

---

#### 3.5 DOWNLOAD SET-UP DATA TO M4500

This selection is used to download the previously uploaded (saved) set-up variables to the M4500. This should only be performed when replacing the M4500 module (see section 2.5).

**Note:** The set-up data consists of the cupper and lubricator set-up parameters (see section 3.1). Timing channel set-points are not stored as part of the set-up data. To download the set-up data, perform the following:

- 1) Connect the RS-232 cable from the COM port on the computer to the "PROG" port on the M4500.
- 2) Select "5: Download Set-up data to M4500". A prompt will be displayed asking to continue or abort. To continue, press any key except the <ESC> key. To abort, press the <ESC> key.
- 3) Once data download is initiated, the current address being downloaded will be displayed.

**Note:** M4500 program execution is not ceased, therefore data download can be performed while the machine is running.

- 4) Once set-up data download is complete, press any key to return to the "HSLCUP3" main menu.



## SECTION 3 USING THE "HSLCUP3" SET-UP PROGRAM

---

### 3.6 UPLOAD (SAVE) SET-UP DATA FROM M4500

This selection is used to save the set-up variables from the M4500 to the hard drive (current directory selected). This should be performed anytime any of the set-up variables have been changed.

**Note:** When the set-up variables are changed, they are changed directly in the M4500, not on the file in the computer. By uploading (saving) the set-up variables to disk, they can be downloaded to the M4500 in the event the module must be replaced. The set-up data consists of the copper and lubricator set-up parameters (see section 3.1). Timing channel set-points are not stored as part of the set-up data. To upload the set-up data, perform the following:

- 1) Connect the RS-232 cable from the COM port on the computer to the "PROG" port on the M4500.
- 2) Select "6: Upload (Save) Set-up data from M4500". A prompt will be displayed asking to continue or abort. To continue, press any key except the <ESC> key. To abort, press the <ESC> key.
- 3) Once data upload is initiated, the current address being uploaded will be displayed.

**Note:** M4500 program execution is not ceased, therefore data upload can be performed while the machine is running.

- 4) Once set-up data upload is complete, press any key to return to the "HSLCUP3" main menu.

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USING THE “HSLCUP3”  
SET-UP PROGRAM**

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## SECTION 4 USING THE HSL-CUP3 KEYPAD/DISPLAY

The keypad of the HSL-CUP3 contains 24 keys consisting of data display commands, set-up commands, and a numeric keypad. The display of the HSL-CUP3 is 2 line by 40 character back-lit LCD display which displays the selected data and set-up menus. The keypad/display can be used by the operator to view data or can be used to adjust the timing and all set-up parameters.

The display/keypad allows the following to be viewed or adjusted:

- 1) Set the Cupper Set-Up Parameters
- 2) Set the Lubricator Speed References
- 3) Set Machine Timing
- 4) Set Machine Zero
- 5) View the Actual Brake Response (in degrees)
- 6) View the Current Shift Data
- 7) View the Last Shift Data

The definitions of the keypad commands and menus are described in the following sections.

**Note:** For virtually all the menus, the "NEXT" and "PREV" keys can be used to advance to the next item of the menu or retard to the previous item on the menu.

---

### 4.1 DEFAULT SCREEN

The default screen (displayed when no other commands are active) contains the following data:

```
MACHINE SPEED (SPM):xxxx  POSITION:xxx  
TOTAL STROKES:xxxxxxx
```

Where the "Machine Speed" is the current speed of the cupper, the "Position" is the current angular position of the cupper crankshaft, and the "Total Strokes" field is the total number of strokes the press has made so far into the current shift. This display effectively replaces a speed meter, a position display, and a counter. This screen is always returned to when no commands are active.

---

### 4.2 "BRAKE RESPONSE" KEY

This key displays the brake response of both low speed and high speed stops. The response is the number of degrees it takes the press to stop from when the clutch is de-activated for a TDC stop to the position that the machine comes to rest. This can be used to determine the general condition of the brake and whether servicing of the brake is required. To exit back to the default screen, simply press the "ESC" key.

## SECTION 4 USING THE HSL-CUP3 KEYPAD/DISPLAY

---

### 4.3 "LAST SHIFT" KEY

The Last shift data menu displays the following information:

TOTAL STROKES:

This data is the totals for the last (previous) shift. This data is transferred from the current shift to the "Last shift" data when the end of shift bit (set via the RS-232 communications) transfers from a "0" to a "1". This can be at the end of either an 8 or 12 hour shift. This data cannot be reset by the operator, only at the end of shift transition.

**Note:** The Current shift "Total Strokes" is displayed as part of the default screen (see section 4.1).

---

#### 4.3.1 LAST SHIFT DATA DEFINITIONS

Total Strokes: This is the total number of strokes the press made for the previous shift. This is essentially a counter.

---

### 4.4 "SET-UP" KEY

This selection is used to invoke the primary set-up menu. This consists of the following four selections:

- 1: SET CUPPER PARAMETERS
- 2: SET LUBRICATOR SPEED REFERENCE
- 3: SET MACHINE TIMING (SET-POINTS, ETC.)
- 4: ZERO MACHINE (SET RESOLVER OFFSET)

When selected, each of the above selections bring up a sub-menu with the corresponding set-up parameters. The following sections describe these sub-menus and the definitions of the corresponding variables. To select the respective set-up sub-menu, simply press the corresponding numeric key (1 thru 4).

---

#### **4.4.1 SET CUPPER PARAMETER**

This menu is activated when the "1" key (SET CUPPER PARAMETERS) is pressed while the primary set-up menu is active. The following four set-up parameters may then be adjusted or viewed:

**BRAKE WEAR COMP ENBLE? (0=NO, 1=YES):** This prompt is used to enable or disable the brake wear compensation. If the compensation is to be disabled, enter "0" and press <ENTER>. If the compensation is to be enabled, enter "1" and press <ENTER>.

**DESIRED TDC STOP POS (LOW SPEED):** This is the desired stopping location (in degrees) for a TDC stop in low speed when the brake wear compensation is enabled. This is typical set to 000 degrees (Top Dead Center). This prompt is only displayed when the brake wear compensation is enabled.

**DESIRED TDC STOP POS (HIGH SPEED):** This is the desired stopping location (in degrees) for a TDC stop in high speed when the brake wear compensation is enabled. This is typical set to 000 degrees (Top Dead Center). This prompt is only displayed when the brake wear compensation is enabled.

**MAXIMUM ALLOWED STOPPING RESPONSE:** This defines what the maximum allowed brake response is before the "Brake Response Too Long" alarm is generated. If the actual brake response (number of degrees from when the brake is activated to the position where the press ends up at rest) when a TDC stop is performed is longer than this number, the alarm is generated. If the actual brake response is less, the alarm is not generated. Set this parameter to the value where the brake response is considered too long and service to the brake should be performed (typically 270 to 300 degrees).

**RUNNING CUPPER LOW SPEED (SPM):** This is the speed (in strokes per minute) that the cupper will run when in low speed.

**RUNNING CUPPER HIGH SPEED (SPM):** This is the speed (in strokes per minute) that the cupper will run when in high speed.

The "NEXT" and "PREV" keys can be used to advance to the next parameter or the previous parameter respectively. To change the currently displayed parameter, simply enter the new value on the numeric keypad and press <ENTER>. The value will be entered and the next parameter will automatically be displayed. When the last parameter (Running Cupper High Speed) is entered, the primary set-up menu is again displayed. Pressing <ESC> at anytime will also exit you back to the primary set-up menu.

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### USING THE HSL-CUP3 KEYPAD/DISPLAY

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#### 4.4.2 SET LUBRICATOR SPEED REFERENCE

This menu is activated when the "2" key (SET LUBRICATOR SPEED REFERENCE) is pressed while the primary set-up menu is active. The following lubricator set-up parameters may then be adjusted or viewed:

**LUBRICATOR MAXIMUM SPEED (CPM):** The "Lubricator Maximum Speed" parameter is used to scale the 0-10VDC analog output such that when the cupper is running at the speed entered in "Lubricator Maximum Speed", the analog output will be at 10 volts. This is typically set to the running high speed of the Cupper or slightly higher.

**LUBRICATOR MINIMUM SPEED (CPM):** This parameter determines the speed the lubricator will run at when the cupper is stopped (de-clutched).

**Note:** When the cupper is running, the lubricator speed reference is proportional (as set by the "Lubricator Maximum Speed" scaling) to the speed of the cupper. This parameter is used to provide the speed reference when the cupper speed is zero.

The "NEXT" and "PREV" keys can be used to advance to the next parameter or the previous parameter respectively. To change the currently displayed parameter, simply enter the new value on the numeric keypad and press <ENTER>. The value will be entered and the next parameter will automatically be displayed. When the last parameter (Lubricator Minimum Speed) is entered, the primary set-up menu is again displayed. Pressing <ESC> at anytime will also exit you back to the primary set-up menu.

### 4.4.3 SET MACHINE TIMING (SET-POINTS, ETC.)

This selection brings up the timing set-point menu which displays the following fields:

```
CHuu SETPOINT:xxx [] "channel name"
RPM:yyyy POS:zzz OFFSET:www SCALE:360
```

Each field is defined as follows:

<u>Field</u>	<u>Definition</u>
Chuu	Currently selected channel (CH00 thru CH17) where "uu" is the octal channel number.
SETPOINT:xxx	Channel "on" or "off" set-point where "xxx" is the set-point position
[]	State of channel set-point (blank = "off", solid block character = "on")
"channel name"	selected channel name: (CH00) TDC (HIGH) TIMING, (CH01) TDC (LOW) TIMING, etc.
RPM:yyyy	Current machine speed where "yyyy" is in CPM.
POS:zzz	Current resolver position where "zzz" is in degrees.
OFFSET:www	Resolver offset where "www" is the offset in degrees.
SCALE:360	Resolver SCALE FACTOR (360 degrees per revolution).

In addition to displaying the timing set-point menu, the following keys are also enabled: "ENTER SET-POINT", "CLEAR CHANNEL", "SELECT CHANNEL", and "SEARCH CHANNEL".

The "ENTER SET-POINT" key is used to enter a new set-point (both "on" and "off" set-points) in the selected channel. The "CLEAR CHANNEL" key is used to clear all set-points from the selected channel. The "SELECT CHANNEL" key is used to select a new channel for programming. The "SEARCH CHANNEL" is used to view both the "on" and "off" set-points in the selected channel.

**Searching Channel:** To view the set-points in a channel simply press the "SEARCH CHANNEL" key. The next "off" to "on" or "on" to "off" position is shown in the "SETPOINT" field. If the transition was "off" to "on", the state character [] will be a solid block. If the transition was "on" to "off", the state character [] will be blank.

## SECTION 4

### USING THE HSL-CUP3 KEYPAD/DISPLAY

**Entering or Adjusting Set-point:** To set or adjust a timing channel, perform the following:

- 1) Select the channel to be adjusted by pressing the "SELECT CHANNEL" key, entering the channel number (00 to 17) and pressing enter. In addition, the "NEXT" and "PREV" keys can be used to advance to the next channel or retard to the previous channel.
- 2) Press "CLEAR CHANNEL" to clear the existing set-point out.

**Note:** Entering a new set-point does not automatically clear the old set-point out. If the two set-points are not in the same place, the channel will simply have two set-points in it if the old one is not cleared out first. Therefore always clear the channel before entering a new set-point. A set-point may, however, be "extended" by programming another set-point onto an existing set-point using either the existing "on" or "off" set-point as the starting position for the new set-point. This will result in one larger set-point.

- 3) Press "ENTER SET-POINT" to enter the new set-point. The display will then prompt "'ON" SETPOINT:". Enter the position (in degrees) where the set-point should go "on" and press <ENTER>. The display will now prompt "'OFF" SETPOINT:". Enter the position (in degrees) where the set-point should go "off" and press <ENTER>. The channel will now be programmed with a set-point that goes "on" at the "on" position entered and "off" at the "off" position entered.
- 4) Exit back to the primary set-up menu by pressing <ESC>. Exit back to the default screen by pressing <ESC> again.



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#### **4.4.4 ZERO MACHINE (SET RESOLVER OFFSET)**

This selection is used to auto zero the resolver. To set the machine zero (resolver offset) perform the following:

- 1) Select "3: SET MACHINE TIMING" and observe the "POS:" field. Verify that as the machine is rotated forward (either inched or barred) that the position increases linearly from 0 through 359. If not, swap the S1 and S3 leads of the resolver at the M4500 resolver connector. Then verify that the position then indeed does increase with forward movement. Press "ESC" to exit back to the primary set-up menu.
- 2) Position the machine at machine zero (top dead center).
- 3) Auto zero the resolver by selecting "4: ZERO MACHINE" from the primary set-up menu. Enter "0" to zero the resolver. The timing set-up menu will be displayed, now showing the "POS:" at zero.
- 4) The M4500 will calculate the actual offset value required to make this the 000 position and will display this number in the offset field.
- 5) Exit back to the primary set-up menu by pressing <ESC>. Exit back to the default screen by pressing <ESC> again.

**SECTION 4  
USING THE HSL-CUP3  
KEYPAD/DISPLAY**

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## SECTION 5

# GENERAL TIMING SIGNAL LOCATIONS

The following is a general description of the timing signals and the locations they should be set at:

**CH00: TDC (HIGH) TIMING:** This signal is used to de-activate the clutch for a TDC stop at high speed.

**Note:** The leading edge is used to de-activate the clutch, thus the width of the signal is not critical (generally set 20 degrees wide). When the brake wear compensation is enabled, this signal is adjusted automatically by the M4500. If the brake wear compensation is disabled, this signal must be set manually. In this case it should be set such that the press stops at top dead center for a TDC stop at high speed.

**CH01: TDC (LOW) TIMING:** Same as the TDC (High) timing (CH00) except used when the machine is running in low speed.

**CH02: DIE JAM CHECK TIMING:** This signal is used by the host PLC to perform the Die Jam Check. This should be set per the algorithm the host PLC uses to perform the check.

**CH03: CUP JAM CHECK TIMING:** This signal is used by the host PLC to perform the Cup Jam Check. This should be set per the algorithm the host PLC uses to perform the check.

**CH04: DIE CHECK RESET TIMING:** This signal is used by the host PLC as part of the Die Jam/Cup Jam die protection. This should be set per the algorithm the host PLC uses to perform the check.

**CH05: AIR STRIP TIMING:** This signal is used to activate the air strip solenoid. The air strip is "on" for the entire window that CH05 is "on" while the machine is running. This signal is generally set "on" about 120 degrees and then set "off" at about 200.

**CH06: SCRAP JAM TIMING:** This signal is used by the host PLC to perform the Scrap Jam Check. This should be set per the algorithm the host PLC uses to perform the check.

**CH07: STROKE COUNT TIMING:** This signal is used by the host PLC to count strokes.

**CH10: MOTION TIMING:** This signal is provided to the PLC via a discrete DC output. This is used by the host PLC to detect when the crankshaft is moving as a back-up to verify that the clutch was activated when commanded to. This is a pulse train set "on" for 30 degrees and then set "off" for 30 degrees through-out the entire channel.

## **SECTION 5 GENERAL TIMING SIGNAL LOCATIONS**

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## SECTION 6 RECOMMENDED SPARE PARTS

The following are recommended spares for the HSL-CUP3. These parts are available through Systems Engineering Assoc. Inc.

<u>Quantity</u>	<u>Part Number</u>	<u>Description</u>
1ea.	M4500	PLC/PLS Processor/Chassis – 4 Slot
1ea.	P4500	Power Supply
1ea.	S4568	8 input/8 output 10-30VDC I/O Board
1ea.	S4573	16 point 10-30VDC Output Board
1ea.	D4591	Display/Keypad

## **SECTION 6 RECOMMENDED SPARE PARTS**

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## APPENDIX A MODBUS COMMUNICATIONS

The MODBUS communications driver uses the S4516 communications board to both read and write data to a MODICON PLC.

The following data is written to the MODICON PLC:

MODICON Dest		M4500 Source
<u>4x Address</u>	<u>Data Definition</u>	<u>Address</u>
401700	Speed (CPM)	W182
401701	Resolver Position	W180
401702	Number of Strokes (Lo-0 to 9,999)	W1100
401703	Number of Strokes (Hi-10,000's)	W1102
401704	Spare Count	W1104
401705	Status (to MODICON)	W790
401706	Hi Speed Brake Response (degrees)	W1042
401707	Lo Speed Brake Response (degrees)	W1040
401708	TDC Timing "On" (Hi) - BW Comp	W2120
401709	TDC Timing "Off" (Hi) - BW Comp	W2122
401710	TDC Timing "On" (Lo) - BW Comp	W2124
401711	TDC Timing "Off" (Lo) - BW Comp	W2126

The definitions of the data sent from the M4500 to the MODICON are as follows:

- 401700: Speed - Current strokes per minute of the copper
- 401701: Resolver Position - Current angular position of the copper crankshaft (in degrees)
- 401702: Number of Strokes - This is the total number of strokes the press has made so far in the current shift. This is essentially a counter.
- 401704: Spare Count - Not Used.
- 401706: Hi Speed Brake Response (degrees) - This is the number of degrees from the when the clutch was de-activated (at the TDC (hi) timing) to where the copper crankshaft came to rest when a TDC stop was performed at high speed. This can be used to determine the general condition of the brake and whether servicing of the brake is required.
- 401707: Lo Speed Brake Response (degrees) - This is the number of degrees from the when the clutch was de-activated (at the TDC (Lo) timing) to where the copper crankshaft came to rest when a TDC stop was performed at Low speed. This can be used to determine the general condition of the brake and whether servicing of the brake is required.

## APPENDIX A

### MODBUS COMMUNICATIONS

- 401708: TDC Timing "On" (Hi) [BW Comp] - This is the "on" set-point of the TDC (Hi) timing (CH00) when modified by the brake wear compensation algorithm. This is modified by the M4500 when the brake wear compensation is enabled and CH00 was reprogrammed when the brake response was too long or too short on a high speed TDC stop. This is only updated if the brake wear compensation is enabled, otherwise it is not used.
- 401709: TDC Timing "Off" (Hi) [BW Comp] - This is the "off" set-point of the TDC (Hi) timing (CH00) when modified by the brake wear compensation algorithm. This is modified by the M4500 when the brake wear compensation is enabled and CH00 was reprogrammed when the brake response was too long or too short on a high speed TDC stop. This is only updated if the brake wear compensation is enabled, otherwise it is not used.
- 401710: TDC Timing "On" (Lo) [BW Comp] - This is the "on" set-point of the TDC (Lo) timing (CH01) when modified by the brake wear compensation algorithm. This is modified by the M4500 when the brake wear compensation is enabled and CH01 was reprogrammed when the brake response was too long or too short on a low speed TDC stop. This is only updated if the brake wear compensation is enabled, otherwise it is not used.
- 401711: TDC Timing "Off" (Lo) [BW Comp] - This is the "off" set-point of the TDC (Lo) timing (CH01) when modified by the brake wear compensation algorithm. This is modified by the M4500 when the brake wear compensation is enabled and CH01 was reprogrammed when the brake response was too long or too short on a low speed TDC stop. This is only updated if the brake wear compensation is enabled, otherwise it is not used.

The bits of the Status register (to the MODICON from the M4500) are mapped as follows:

W790: Status to MODICON (4x address 401705 in MODICON)

B790.0: Not Used

B790.1: Not Used

B790.2: Timing Signal Fail Alarm

B790.3: Brake Wear Alarm

B790.4: Not Used

thru

B791.7: Not Used



## APPENDIX A MODBUS COMMUNICATIONS

The Status bits sent to the MODICON PLC are defined as follows:

- B790.2: Timing Signal Fail Alarm - The timing signal fail occurs when any of the timing signals generated in the PLS section fail to change state periodically while the machine is running.
- B790.3: Brake Response Too Long - The "Brake Response Too Long" alarm is generated when the actual brake response exceeds a user specified maximum allowed brake response. This can be used to indicate that service to the brake should be performed.

The following data is read from the MODICON PLC:

MODICON Dest		M4500 Source
<u>4x Address</u>	<u>Data Definition</u>	<u>Address</u>
401760	Status/Control (from MODICON)	W900
401761	CH00 "On" - TDC Timing (Hi)	W902
401762	CH00 "Off" - TDC Timing (Hi)	W904
401763	CH01 "On" - TDC Timing (Lo)	W906
401764	CH01 "Off" - TDC Timing (Lo)	W908
401765	CH02 "On" - Die Jam Check Timing	W910
401766	CH02 "Off" - Die Jam Check Timing	W912
401767	CH03 "On" - Cup Jam Check Timing	W914
401768	CH03 "Off" - Cup Jam Check Timing	W916
401769	CH04 "On" - Die Check Reset Timing	W918
401770	CH04 "Off" - Die Check Reset Timing	W920
401771	CH05 "On" - Air Strip Timing	W922
401772	CH05 "Off" - Air Strip Timing	W924
401773	CH06 "On" - Scrap Jam Timing	W926
401774	CH06 "Off" - Scrap Jam Timing	W928
401775	CH07 "On" - Stroke Count Timing	W930
401776	CH07 "Off" - Stroke Count Timing	W932
401777	BW Comp Desired Stop (Lo)	W934
401778	BW Comp Desired Stop (Hi)	W936
401779	Max Allowed Stop Response (BW Alarm)	W938
401780	Copper Running Low Speed	W940
401781	Copper Running High Speed	W942
401782	Lubricator Maximum Speed (Calibrate)	W944
401783	Lubricator Idle Speed	W946

## APPENDIX A

### MODBUS COMMUNICATIONS

The definitions of the data read from the MODICON to the M4500 are as follows:

- 401761: CH00 "On" - TDC Timing (Hi)  
thru  
401776: CH07 "Off" - Spare Timing  
Variables 401761 thru 401776 are the "On" and "Off" timing set-points for CH00 thru CH07 respectively. This allows the MODICON to program these timing channels when the "Timing Channel Program Enable" bit (401760.3 from the MODICON) is set to a "1". These are the same "On" and "Off" set-points that would normally be set through the HSL-CUP3 keypad (see section 4.4.3 of the HSL\_WI3 User's manuals) or set through the HSLCUP3 set-up program (See section 3.2.2 of the HSL-CUP3 User's manual). See section 5 of the HSL-CUP3 user's manual for the definitions of the CH00 through CH07 timing channels.
- 401777: BW Comp Desired Stop (Lo) - This is the desired stopping location (in degrees) for a TDC stop in low speed when the brake wear compensation is enabled. This is typical set to 000 degrees (Top Dead Center)..
- 401778: BW Comp Desired Stop (Hi) - This is the desired stopping location (in degrees) for a TDC stop in high speed when the brake wear compensation is enabled. This is typical set to 000 degrees (Top Dead Center).
- 401779: Max Allowed Stop Response (BW Alarm) - This defines what the maximum allowed brake response is before the "Brake Response Too Long" alarm is generated. If the actual brake response (number of degrees from when the brake is activated to the position where the press ends up at rest) when a TDC stop is performed is longer than this number, the alarm is generated. If the actual brake response is less, the alarm is not generated. Set this parameter to the value where the brake response is considered too long and service to the brake should be performed (typically 270 to 300 degrees).
- 401780: Cupper Running Low Speed - This is the speed (in strokes per minute) that the cupper will run when in low speed.
- 401781: Cupper Running High Speed - This is the speed (in strokes per minute) that the cupper will run when in high speed.

## APPENDIX A MODBUS COMMUNICATIONS

- 401782: Lubricator Maximum Speed (Calibrate) - The "Lubricator Maximum Speed" parameter is used to scale the 0-10VDC analog output such that when the cupper is running at the speed entered in "Lubricator Maximum Speed", the analog output will be at 10 volts. This is typically set to the running high speed of the Cupper or slightly higher.
- 401783: Lubricator Idle Speed - This parameter determines the speed the lubricator will run at when the cupper is stopped (de-clutched).

**Note:** When the cupper is running, the lubricator speed reference is proportional (as set by the "Lubricator Maximum Speed" scaling) to the speed of the cupper. This parameter is used to provide the speed reference when the cupper speed is zero.

**Note:** The above parameters (401777 thru 401773) are effective only when the "Set-Up Parameters Enable" bit (401760.2 from the MODICON) is set to a "1". Otherwise these variables are not updated in the M4500.

The bits of the Status/Control register (from the MODICON to M4500) are mapped as follows:

W900: Status/Control from MODICON (4x address 401760 in MODICON)

- B900.0: End of Shift
- B900.1: Brake Wear Compensation Enable
- B900.2: Set-Up Parameters Enable
- B900.3: Timing Channel Program Enable
- B900.4: Set Resolver Zero (Auto-Zero)
- B900.5: Alarm Reset
- B900.6: Not Used
- thru
- B901.7: Not Used

## APPENDIX A

### MODBUS COMMUNICATIONS

The Status/Control bits sent from the MODICON PLC are defined as follows:

- B900.0: End of Shift - Setting this bit to a "1" transfers the current shift data in the M4500 to the last shift data and clears the current shift data (to start data collection for the next shift). The current shift data in the MODICON should be saved to the last shift data stack prior to setting this bit.
- B900.1: Brake Wear Compensation Enable - This bit is used to enable or disable the brake wear compensation. If the compensation is to be disabled, set B900.1 to a "0". If the compensation is to be enabled, set B900.1 to a "1".
- B900.2: Set-Up Parameters Enable - Setting this bit to a "1" enables the set-up parameters (401777 thru 401783 in the MODICON) to be used in the M4500. If this bit is set to a "0", the values in 401777 thru 401783 in the MODICON are not used as the set-up parameters, the M4500 instead uses the values set-up thru the HSL-CUP3 keypad or the "HSLCUP3" set-up program.
- B900.3: Timing Channel Program Enable - Setting this bit to a "1" enables the CH00 thru CH07 "On" and "Off" set-points (401761 thru 401776) from the MODICON to be used as the set-points for CH00 thru CH07 in the PLS section of the M4500. If this bit is set to a "0", the values in 401761 thru 401776 in the MODICON are not used as the set-points, the M4500 instead uses the values set-up thru the HSL-CUP3 keypad or the "HSLCUP3" set-up program.
- B900.4: Set Resolver Zero (Auto Zero) - Setting this bit sets the PLS offset such that the current position is "0". To set the resolver zero, position the machine at Top Dead Center and then set this bit to a "1". The resolver position will now read 000. Reset this bit back to "0" when done.
- B900.5: Alarm Reset - Setting this bit to a "1" resets the timing signal fail alarm and the brake response too long alarm.

## APPENDIX A MODBUS COMMUNICATIONS

The MODBUS driver uses the following data format and parameters (the MODBUS port on the MODICON PLC must be set to match these):

MODBUS Port (PLC address):	5
MODBUS Baud:	19.2K
MODBUS framing mode:	RTU
Number of start bits:	1
Number of data bits:	8
Number of stop bits:	1
Parity:	NONE