SYSTEMS
Engineering Associates, Inc.

EM2RDWCP
APM Electromagnet (EMM) Redraw And Servo Cupfeed User's Manual

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9/2006

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And Servo Cupfeed
User's Manual

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Revised: 20 September 2006

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.

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 it's performance or the contents of the User Manual without notice.

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SECTION 1
GENERAL DESCRIPTION

This section describes the features of the EM2RDWCP Servo Redraw/Cupfeed control system. This includes the functional description, alarms detected, interlocks between the control system and the existing controls.

1.1 FEATURES

- Used in conjunction with the APM Bodymaker Servo Redraw Electromagnetic Hold-down upgrade, the control system replaces the mechanically cammed redraw and cupfeed systems with a servo driven (electronically cammed) redraw and cupfeed.

- Provides three axis motion control including, motion control of the Redraw servo motor, motion control of the Cupfeed Cam servo motor and activation of the Hold-down coil.

- Interfaces directly with redraw servo motor, hold-down coil, cupfeed cam servo motor, machine mounted main crank resolver and existing control system to accurately cam redraw and cupfeed with main crank in all modes and all speeds.

- Performs additional high speed control functions of APM Bodymaker including:
  - Main Clutch Solenoid Control
  - Cupfeed Solenoid Control
  - Air Strip Control
  - Crank Resolver Timing Functions
  - Flywheel Speed Detection
  - Die Protection (short can detection)

- Accurate short can detection to a resolution of 1/4” can length. This incorporates immediate stop of the main clutch solenoids, cupfeed cam and cupfeed solenoid upon short can/tear-off detection to prevent the punch from entering tool pack again and prevent the feeding of an additional cup.

- Completely automatic synchronization of redraw and cupfeed cam with main crank when clutch is engaged to reduce down-time and reduce operator manual interaction.

- Highly repeatable air strip control to reduce can stripping and blow out problems.

- Alarm detection, including:
  - Short Can Detection
  - Die Sensor Fail Alarm
  - Timing Signal Fail Detection
  - Domer Jam (option)
  - Brake Response too Long Alarm

  - Redraw/Cupfeed servo alarms including:
    - Following Fault
    - Servo Motor O'temp
    - Motor Amplifier Fault

- Brake Wear compensation (Auto BDC algorithm) to stop press at BDC regardless of brake response. Brake response determination allows displaying of actual brake response (in degrees). Brake response alarm to indicate when brake stopping response (in degrees) has exceeded user preset limit.

- Data Acquisition (for both current shift and last shift):
  - Total Number of Good Cans Produced
  - Total Number of Short Can Faults

- Provided with set-up software, which allows all user selectable parameters to be set, as well as, download the respective application programs and set-up data.

- Built-in 2 Line X 40 character sealed display with 24 key membrane keypad allows local viewing of collected data (good can count, short can count, brake response) and set-up of user variables.

- Based on high performance M4510 PLC/PLS/Motion control module which, allows easy trouble-shooting and customization using SYSdev (DOS-based) programming package.

- Built-in PLS provides all machine timing, eliminating need for an additional PLS.

1.2 FUNCTIONAL DESCRIPTION

The EM2RDWCP Bodymaker servo redraw/cupfeed control system is an electronic upgrade used in conjunction with the APM servo redraw/cupfeed upgrade. The control system provides complete motion control of the servo redraw, electromagnetic hold-down and servo cupfeed cam plus performs the following high speed control functions of the bodymaker:

- Accurate Short Can Detection
- Reliable Cupfeed
- Precise Air Strip Control

In addition, the control system provides a brake wear compensation feature that automatically adjusts the BDC timing signal to stop the press at BDC regardless of brake stopping time.

The redraw and cupfeed cam servo motors and clutch solenoids are activated by the clutch solenoid control circuit of the existing control system. The “EM2RDWCP” is interlocked to the existing clutch circuit via redundant positively guided relays with self-check to maximize safety. The servo motors are enabled via contactors driven by these relays and thus incorporates the same level of safety typically provided with dual clutch solenoids with hardware interlocks. The clutch solenoids are enabled via the positively guided relays and M4510 software controlled outputs, thus maintaining a high level of safety for clutch control and a reliable and repeatable stopping position of the crank.

Alarm detection is provided including:

- Short Can Detection
- Die Sensor Failure Detection
- Timing Signal Failure
- Domer Jam (option)
- Brake Response too Long Alarm

Servo control related faults:

- Motor Over Temp
- Amplifier Fault
- Following Fault

SECTION 1
GENERAL DESCRIPTION

The control system interfaces directly to:

- Machine Mounted Redraw Servo Motor
- Hold-Down Coil
- Cupfeed Servo Motor
- Redraw and Cupfeed Timing Sensors
- Main Crank Resolver
- Short Can Sensor
- Domer Jam Sensor
- Flywheel Motion Sensor
- Main Clutch Solenoids
- Cupfeed Solenoids
- Air Strip Solenoids
- Host PLC via Discrete DC I/O

The controller incorporated is not a dedicated “black box”, but is instead implemented using the high performance Systems M4510 PLC/PLS Motion control module. This allows easy customization by either SEA or the end user. The M4510 module is programmed using the DOS-based SYSdev programming software. This 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 M4510 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 REDRAW SERVO MOTOR CONTROL

The redraw servo motor control is implemented with a high speed (0.5msec update) PID servo loop. The main crank position is used as the reference for the servo loop with the redraw position used as the feedback. Both main crank position and redraw positions are generated with resolvers to provide the highest degree of reliability and noise immunity. Both resolver format signals are converted to digital with a resolution of 12-bits (0-4095). The redraw motor turns 4 revolutions for every one cycle of the redraw mechanism, so that redraw resolution equals 14 bits (0-16383).

When the redraw is synchronized with the main crank, the PID servo loop nulls the error (difference) between the main crank and redraw positions to zero (or as minimal as is practical). Full access to the PID gains allows the servo loop to be tuned to provide the optimum balance between acceptable error and minimum running current.

The redraw servo control incorporates an automatic synchronization algorithm that accelerates the redraw to a preset speed when the clutch is first engaged in continuous mode and then synchronizes the redraw with the main crank when the redraw is in phase with the main crank. This reduces the harshness in which the redraw is initially accelerated (instead of just immediately synchronizing the redraw with the ram).

1.4 HOLD-DOWN COIL CONTROL

The Hold-Down coil is controlled as an open loop motion control axis where hold-down current is activated as a function of main crank position. Five consecutive timing signal channels provide a five step hold-down clamp force while the can is drawn. The five timing signals comprise a consecutive five phase clamp including the initial clamping phase, 2nd thru 4th clamping phases, and the final clamp phase. The clamping current (force) for each phase can be set independently, allowing variable clamping force as the can is drawn for optimum thin wall control. In addition, a manual static hold-down activation mode is provided for redraw/hold-down set-up.

1.5 CUPFEED CAM SERVO MOTOR CONTROL

The cupfeed cam motor control is implemented with a high speed (0.5msec update) PID servo loop. The main crank position is used as the reference for the servo loop with the cupfeed cam position used as the feedback. Both main crank position and cupfeed cam positions are generated with resolvers to provide the highest degree of reliability and noise immunity. Both resolver format signals are converted to digital with a resolution of 12-bits (0-4095).

The PID servo loop nulls the error (difference) between the main crank and cupfeed positions to zero (or as minimal as is practical). Full access to the PID gains allows the servo loop to be tuned to provide the optimum balance between acceptable error and minimum running current.

At the detection of a short can or tear-off, the cupfeed cam is immediately stopped to prevent the feeding of an additional cup which protects valuable tooling. The cupfeed cam automatically synchronizes with the main crank when the machine is re-started to minimize down-time and eliminate manual timing by the operator.

1.6 MAIN CLUTCH SOLENOID CONTROL

The EM2RDWCP control system provides direct control for the main clutch solenoids. The solenoids are controlled by positively guided safety relays and redundant outputs from the M4510 controller. The positively guided relays provide hardwired, redundant and self-checking control of the solenoids, thus maintaining a high level of safety in the clutch control circuits. The M4510 outputs provide high speed, accurate and repeatable control of the clutch solenoids, to ensure that the crank stops in the appropriate location. (refer to section 1.9 – "Brake Wear Compensation")

Two discrete inputs to the EM2RDWCP from the host PLC are used to control the clutch solenoids:

- "Clutch On Immediate"
- "Clutch On BDC"

Three discrete inputs to the EM2RDWCP from the existing control system provide clutch mode information:

- "Run Mode (not Bar)"
- "Continuous Mode"
- "Inch Mode"

"Clutch A" and "Clutch B" relays are driven by the original clutch solenoid outputs of the existing control system. The following description of operation defines the requirements of the existing control system and host PLC logic to activate the clutch solenoids through the EM2RDWCP.

Continuous Mode:

- Run Mode Input Is “ON”
- Continuous Mode Input Is “ON”
- Inch Mode Input Is “OFF”

1) To energize the clutch solenoids: All M4510 internal alarms have been cleared. “Clutch A” relay, “Clutch B” relay, “Clutch On Immediate” input and “Clutch On BDC” input must be turned on simultaneously (within 50 milliseconds of each other) and all signals must remain on while running.
2) To de-energize the clutch solenoids and stop the crank at Back Dead Center (BDC): “Clutch On BDC” input is first turned off. Several seconds later, the “Clutch A” relay, “Clutch B” relay and “Clutch On Immediate” input are turned off.
3) To de-energize the clutch solenoids and stop the crank immediately: Turn off “Clutch A” relay, “Clutch B” relay, “Clutch On Immediate” input and “Clutch On BDC” simultaneously.

   Note: If only one of the following signals is turned off (“Clutch A” relay, “Clutch B” relay or “Clutch On Immediate”) the solenoids will still de-energize immediately.

Inch Mode:

- Run Mode Input Is “ON”
- Continuous Mode Input Is “OFF”
- Inch Mode Input Is “ON”

1) To energize the clutch solenoids: All M4510 internal alarms have been cleared. “Clutch A” relay, “Clutch B” relay, “Clutch On Immediate” input and “Clutch On BDC” input must be turned on simultaneously (within 50 milliseconds of each other) and all signals must remain on while inch is running.
2) To de-energize the clutch solenoids and stop the crank immediately: Turn off “Clutch A” relay, “Clutch B” relay, “Clutch On Immediate” input and “Clutch On BDC” simultaneously.

   Note: If only one of the signals is turned off, the solenoids will still de-energize immediately.

Bar Mode:

- Run Mode input is "OFF"
- Continuous Mode is "OFF"
- Inch Mode input is "OFF"

1) To energize the clutch solenoids: All M4510 internal alarms have been cleared. "Clutch A" relay, "Clutch B" relay, "Clutch On Immediate" input and "Clutch On BDC" input must be turned on simultaneously (within 50 milliseconds of each other) and all signals must remain on while barring.
2) To de-energize the clutch solenoids and stop the crank immediately: Turn off "Clutch A" relay, "Clutch B" relay, "Clutch On Immediate" input and "Clutch On BDC" simultaneously.

   Note: If only one of the signals is turned off, the solenoids will still de-energize immediately.

3) **Warning: The "Clutch A" and "Clutch B" are positively guided safety relays, designed to be driven by the clutch solenoid outputs of the existing control system in order to simplify the installation of this retrofit control system. These clutch solenoid outputs from the existing control system must be hardwired, redundant and self-checking. The clutch circuit must meet appropriate national and/or international standards for power presses. DO NOT COMMISSION THIS RETROFIT CONTROL SYSTEM UNTIL THE EXISTING CLUTCH CIRCUITS ARE SAFE!**

1.7 CUPFEED SOLENOID CONTROL

The EM2RDWCP provides direct control for both the cupfeed "on" and "off" solenoids. For auto operation, the cupfeed is enabled by the host PLC via a discrete input to the EM2RDWCP. The cupfeed is timed "on" and "off" with the cupfeed timing signal to provide accurate cup loading. The manual cupfeed input is also provided to activate the cupfeed as long as the manual input is "on" when the machine is stopped (typically used to clear the rotary cupfeed while the machine is stopped) or to feed a single cup when the machine is running.

Two discrete DC inputs to the EM2RDWCP from the host PLC are used to control the cupfeed solenoids: "Cupfeed Auto Enable" and "Cupfeed Manual". The following description of operation defines the requirements of the host PLC logic to activate the cupfeed through the EM2RDWCP:

Auto Cupfeed Mode:

1) In continuous mode, the cupfeed is gated "on" with the leading edge of the cupfeed timing signal (CH04) and gated "off" with the trailing edge of the cupfeed timing signal (CH04). The cupfeed is opened after two strokes when the "Cupfeed Auto Enable" input is turned "on" and the leading edge of CH04 occurs. This allows three strokes of air strip to clear the punch of coolant before the first can is punched. The cupfeed is closed when the "Cupfeed On" input is turned "off" and the trailing edge of CH04 occurs.

   Note: It takes two strokes once the cupfeed is opened for the first can to be punched. Once the cupfeed is closed, it requires two strokes to punch the last two cups, which are in process of traveling through the positive cupfeed.

Manual Mode:

1) The cupfeed can be manually activated by the "Cupfeed ON Manual" input. With the machine stopped, activating the "Cupfeed ON Manual" input "ON" opens the cupfeed. When the "Cupfeed Manual" input is "off", the cupfeed is closed. With the machine running, activating the manual cupfeed feeds one cup with the corresponding three stokes of air strip prior to punching the cup.

1.8 AIR STRIP CONTROL

The EM2RDWCP provides a repeatability of 0.5 milliseconds for the air strip thus reducing can stripping and blow out problems. Both an “Air Strip (Low)” and “Air Strip (High)” timing signal is provided to activate the air strip when the press is running in low and high speed respectively. The air strip is enabled two stokes prior to the cupfeed open.

1.9 BRAKE WEAR COMPENSATION

The EM2RDWCP incorporates a brake wear compensation or automatic BDC timing feature to stop the press at BDC regardless of the actual braking response of the clutch/brake. The stopping compensation is accomplished by automatically adjusting the BDC timing signal based on the previous stop. Any overrun is detected and a new BDC timing signal is computed such that the machine will stop at the desired location on the next stop. Two BDC signals are provided: one for low speed and one for high speed. Both incorporate the break wear compensation feature. The appropriate BDC timing signal (low or high) is adjusted based on the speed of the machine when the BDC stop was initiated.

In addition to the brake wear compensation, the EM2RDWCP also calculates the actual brake response (in degrees). This is the number of degrees from where the clutch was de-activated (BDC 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.

1.10 ALARM DETECTION

The following alarms are detected:

Short Can Detection: The “Short Can Check” timing signal (CH02), along with the machine mounted short can sensor, is used to verify the entire length of the can. The short can sensor must see “Can” the entire time the “Short Can Check” timing signal (CH02) is “on”. If the can is short (tear off) or any void is detected, the short can alarm is generated. The main clutches are de-energized immediately, the cupfeed cam is immediately stopped and the cupfeed is immediately closed as well. The resolution of the short can check is 0.5 milliseconds. At a machine speed of 250CPM, this translates to approximately 1/4” resolution in can length.

Domer Jam (option): This alarm occurs when the domer is pushed too far by the punch. This is an indication that there is more than one thickness of can metal between the punch and domer.

Can Sensor Failure / Timing Signal Fail output: This alarm occurs when the short can sensor fails “ON” or when any of the timing signals fail to change state periodically (once per revolution). The “Sensor Check” timing signal (CH 03) is used to verify that the short can sensor does indeed turn “off” when a can is not present.

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.

Redraw Following Fault: This alarm occurs when the redraw following error (difference between main crank position and redraw position) exceeds a user defined preset. This indicates either binding in the redraw, miss-tuning of the PID gains, etc.

Redraw Out Of Time Fault: This alarm occurs when the redraw is unable to initially synchronize with the main crank at restart.

Redraw Amplifier Fault: This fault is generated by the B100A40 redraw amplifier directly. Sources of this fault include:

- Amplifier Output Short Circuit
- Amplifier Over-Voltage
- Amplifier Over Temperature
- Resolver Feedback Failure

Redraw Motor Over Temp: Activated by the thermostat in the redraw servo motor. This fault occurs when the temperature of the motor exceeds 155 degrees C.

Redraw S4520 Servo Controller Fault: This alarm occurs when the S4520 servo controller card in slot 01 has stopped program execution or has stopped communicating to the main M4510 processor.

Hold-Down Amplifier Fault: This fault is generated by the 100A25 Hold-down amplifier directly. Sources of this fault include:

- Amplifier Output Short Circuit
- Amplifier Over-Voltage
- Amplifier Over Temperature

Cupfeed Following Fault: This alarm occurs when the cupfeed cam following error (difference between main crank position and cupfeed cam position) exceeds a user defined preset. This indicates:

- Binding in the Cupfeed Cam
- Miss-Tuning of the PID Gains
- Broken Belt

Cupfeed Out Of Time Fault: This alarm occurs when the cupfeed is unable to initially synchronize with the main crank at restart.

Cupfeed Amplifier Fault: This fault is generated by the B25A20 Cupfeed amplifier directly. Sources of this fault include:

- Amplifier Output Short Circuit
- Amplifier Over-Voltage
- Amplifier Over Temperature

Cupfeed Motor Over Temp: Activated by the thermostat in the cupfeed servo motor. This fault occurs when the temperature of the motor exceeds 155 degrees C.

Cupfeed S4520 Servo Controller Fault: This alarm occurs when the S4520 servo controller card in slot 02 has stopped program execution or has stopped communicating to the main M4510 processor.

C3 Contactor Fault: This alarm occurs when the hold-down contactor has failed. This indicates that the contactor is not turning on and off at the appropriate time or may be taking too long to change state.

Note: The above alarms are displayed on the EM2RDWCP Keypad/Display. All Servo related alarms are summed into the "Servo Ready" output which is available to the host PLC via a discrete output. This should be used to stop the machine when any one of the alarms occurs. Additionally, Short can, Domer jam, Can Sensor / Timing Signal Fail, and Brake Response Too Long are separate discrete outputs to the host PLC and should be displayed on the operators console.

1.11 INTERLOCKS TO EXISTING CONTROL SYSTEM

In addition to the alarms listed in section 1.10 – "Alarm Detection", the following are +24VDC discrete signals passed to the Host PLC.

Servos Ready: This signal is the summation of all the Servo specific alarms in section 1.10 – "Alarm Detection". When "ON", all alarms are clear and the machine is enabled to stroke. When "off", one or more of the alarms is active and the machine must be stopped and disabled from running.

Redraw Auto Mode: This signal indicates that the redraw is in "Auto" mode. When "ON" indicates the redraw is in Auto mode. When "off" indicates the redraw is in Fixed Speed or Manual Hold-Down mode.

Short Can: This signal indicates that a short can or tear off has occurred or the can sensor failed to detect a can during the can check window, PLS CH02. "Off" is normal, "ON" indicates an alarm condition.

Domer Jam: This signal indicates that the domer die has exceeded a threshold which would indicate excessive can material has built up in the Domer. “Off” is normal, “ON” indicates an alarm condition.

Can Sensor / Timing Signal Fail: This signal indicates that the can sensor has failed “ON” or that one or more timing channels failed to change state. “Off” is normal, “ON” indicates an alarm condition.

Brake response too long: This signal indicates that the brake failed to bring the machine to a stop within a user defined limit and that the brake should be repaired immediately. “Off” is normal, “ON” indicates an alarm condition.

Bar Speed: This signal indicates that the flywheel is at zero speed. “ON” indicates zero speed, “off” indicates the flywheel is in motion.

Punch Speed: This signal indicates that the punch is at the speed required to go into production. “ON” indicates punch is at speed, “off” indicates that the punch not at the required speed.

Logic Sync: This is a timing channel output. When the clutch is engaged this signal changes state every 180 degrees of main crankshaft rotation. It is used to synchronize logic between the two PLC's.

Cupfeed Is Open: This signal indicates that the cupfeed is open and feeding cups. “ON” indicates that cups are feeding, “Off” indicates that the cupfeed gate is closed.

1.12 INTERLOCKS FROM EXISTING CONTROL SYSTEM

Clutch On Immediate: This signal indicates that all conditions have been satisfied to engage the clutch and that the operator has initiated clutch engagement. “ON” indicates that the clutch should be engaged, “Off” indicates that the clutch should be disengaged immediately by the M4510

Clutch on BDC: This signal is used by the M4510 to perform a precise BDC stop. When ON the machine remains in production. When turned OFF the cupfeed is sequenced off, the machine is cleared of cans and the clutch is disengaged at the required position to stop the ram at BDC.

Run Mode: This signal indicates that the machine is not in Bar mode. “ON” indicates the machine is in continuous or inch modes, “off” indicates the machine is in bar mode.

Continuous Mode: This signal indicates that the machine is in continuous run mode, (not inch mode). “ON” indicates continuous run mode, “Off” indicates inch mode.

Inch Mode: This signal indicates that the machine is in inch run mode, (not continuous run mode). “ON” indicates inch mode, “off” indicates continuous run mode.

Cupfeed Auto Enable: This signal indicates that all prerequisites have been met for the machine to go into production. “ON” indicates that the cupfeed is in automatic mode and that the cupfeed should be opened by the M4510, “Off” indicates that the cupfeed should be closed by the M4510.

Cupfeed On Manual: This signal allows the cupfeed solenoids to be operated depending on the state of the machine. At zero speed the solenoids will open or close normally. At punch speed this input allows the machine to produce one can.

Alarm Reset: This signal provides a means of resetting any alarm in the M4510. “ON” provides a reset signal, “off” allows any alarm to remain latched.

Data Counts Reset: This signal provides a means of resetting the data counts (Good Can and Short Can counts) in the M4510. “ON” provides a reset signal.

1.13 DATA COLLECTION

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

1) Total Number of Good Cans Produced
2) Total Number of Short Can Faults

This data can be viewed locally on the Keypad/Display. The information is updated (“Current” shift transferred to “Last” shift) based on the change of state of the “End of Shift” discrete input. This input can be activated on an 8 or 12 hour shift basis.

SECTION 1
GENERAL DESCRIPTION

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SECTION 2
INSTALLATION

2.1 WHAT'S INCLUDED

Verify that the following items are included when unpacking the EM2RDWCP:

1ea. EM2RDWCP User's Manual
1ea. M4500 User's Manual
1ea. EM2RDWCP Program Disk

The following items can be purchased separately as required or desired:

1ea. RSV34-MS1 Resolver
1ea. RSV-RSCBLE-XX Resolver Cable

The following electrical items are provided by Alcoa Packaging Machinery (APM):

1ea. MPM1423FRMM-A 6" Servo Motor (Redraw)
1ea. MPM892FRMM-B 3" Servo Motor (Cupfeed) (includes integrated cable)
1ea. Bi4-M12-AP6X-H1141 Timing Sensor
1ea. Bi2-G12K-AP6X Timing Sensor
2ea. WK 4T-6 Sensor Cable
1ea. 4-Conductor Servo Motor Power Cables
1ea. 8-Conductor Servo Motor Feedback Cables

2.2 POWER REQUIRED

1) 460VAC 50/60Hz or 380VAC 50/60Hz power feed rated at 20 amps (minimum).
2) 110/120VAC 50/60Hz rated at 1 amp (minimum).
3) Regulated +24VDC rated at 1 amp (minimum).
4) Regulated +24VDC rated at 4 amps (minimum).

The 380VAC/460VAC is used to power the servo amplifiers. The 115VAC is used to power the HSL controller rack. The +24VDC is used to power the 24VDC I/O (sensors, cupfeed solenoids, etc.).

Note: +24VDC solenoids must be used for the cupfeed and air strip solenoids. These provide a much more consistent and repeatable response than 115VAC solenoids.

The input power should be derived from (and must be interlocked with) the existing control system such that when the main disconnect is turned “off”, all power to the EM2RDWCP is also “off”.

2.3 LOCATING THE ENCLOSURE

Locate the enclosure in proximity to the existing control cabinet. Mount the 12KVA redraw servo transformer in proximity to the enclosure.

Mount the MPM1423FRMM-A motor on the redraw using the supplied hardware. Mount the Bi2-G12K-AP6X timing sensor in the mounting hole of the redraw (this will be adjusted in section 2.10.8 – “Time Redraw Motor”). Mount the MPM892FRMM-B cupfeed servo motor on the mounting bracket supplied with the mechanical portion of the APM servo cupfeed upgrade package. Mount the Bi4-M12-AP6X-H1141 timing sensor on the mounting bracket. (see the APM documentation for more details).

2.4 WIRING THE CONTROL SYSTEM

Referring to the wire run list drawing at the back of this manual, run conduit between the various components and run the listed wires in the conduit runs. Referring to the electrical control schematic at the back of this manual, wire the EM2RDWCP as follows:

1) Incoming Power:
   - 380/460VAC (wires phase A, B, C and ground)
   - 115VAC (wires 801, 900, GND)
   - Regulated +24VDC (wires 501 and 500)
   - Regulated +24VDC (wires 601 and 600)

2) Interlocks between existing control system and EM2RDWCP (wires 1005 through 1015, 1105 through 1116).

3) Clutch solenoid wiring (wires 1211, 1212, 600).

4) Cupfeed and Air Strip Solenoids (fuses FU10-FU12, wires 1213-1215).

5) Redraw and Cupfeed timing sensors (wires 512, 513, 501, and 500).

6) Short Can sensor (wires 510, 501, and 500).

7) Flywheel Motion and Domer Jam sensors (wires 1000, 1001, 501 and 500).

8) Redraw Motor - both stator and feedback using supplied 4-conductor and 8-conductor cable.

9) Cupfeed Motor - both stator and feedback using supplied 4-conductor and 8-conductor cable.

10) Hold-Down Coil (wires 3T1, 3T2 and 3G).

11) Main Crank Resolver: If machine is already equipped with a resolver and PLS, parallel the resolver wiring with existing PLS.

    Note: R2 of the M4510 is signal ground.

    If machine is not equipped with a resolver, see section 2.5 – "Mounting the RSV34-MS1 Resolver".

In General: When wiring the EM2RDWCP, keep all +24VDC and resolver wiring away from high voltage wiring.

2.5 MOUNTING THE RSV34-MS1 RESOLVER

The EM2RDWCP 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 EM2RDWCP. 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 M4510.

2.6 SOFTWARE INSTALLATION

Follow the steps below to install either the Windows or DOS based setup programs and PLC application program on a PC used to support the EM2RDWCP control system.

2.6.1 WINDOWS BASED SETUP PROGRAM INSTALLATION

The EM2RDWCP setup program is compatible with Windows 95/98/ME/2000/XP operating systems and is used to:

1) Setup (tune) the user adjustable variables
2) Adjust the timing channel set-points
3) Download the application programs to the M4510 and S4520's
4) Download (restore) or upload (save) the user setup variables
5) View "Shift" data.

To install the set-up software, perform the following steps:

1) Insert the EM2RDWCP CD into the drive

2) From the Windows desktop, "Click" Start and then select run.

3) From the "Run" dialog box, "Click" the Browse button.

4) Select the drive with EM2RDWCP CD. Select the "setup.exe" file and "Click" Open and then Ok.

5) This will initiate the installation process. Follow the instructions that appear on the screen to complete the installation process. The EM2RDWCP setup program can be executed from the "Systems" folder located in Programs.

2.6.2 DOS BASED SETUP PROGRAM INSTALLATION

The EM2RDWCP set-up software is used to:

1) Download the PLC program to the M4510 module.
2) Tune (set-up) the user adjustable variables of the EM2RDWCP.
3) Download (restore) and upload (save) the user set-up variables

To install the DOS based set-up software, perform the following:

1) Create one directory off the root for the EM2RDWCP called "EM2RDWCP". This will be used to store:
   - The "EM2RDWCP.EXE" setup program
   - The EM2RDWCP application programs
   - The EM2RDWCP set-up data for each bodymaker

   Create this directory by typing the following at the DOS prompt:

   MD \EM2RDWCP<ENTER>

2) Install the "EM2RDWCP" program disk into the drive, switch to that directory and install the "EM2RDWCP" programs by typing the following at the DOS prompt:

   CD \EM2RDWCP<ENTER>
   A:INSTALL<ENTER>

3) Add the EM2RDWCP set-up program to your computer's menu software by creating a selection called "B/M REDRAW SERVO CUPFEED". The DOS commands executed for these selections should be:

   For the "B/M REDRAW SERVO CUPFEED" selection:
   CD \EM2RDWCP
   EM2RDWCP
   CD \

4) To execute the servo cupfeed set-up program, simply select the corresponding "B/M REDRAW SERVO CUPFEED" selection from the menu software's menu.

2.6.3 SYSDEV PROGRAM DEVELOPMENT SOFTWARE INSTALLATION

The SYSdev Program Development software is used to perform on-line trouble-shooting and program modifications to the EM2RDWCP. If SYSdev was purchased with the EM2RDWCP and is not already installed on the your computer, install SYSdev onto the hard drive of your computer following the steps in outlined in the SYSdev Program Development manual.

2.6.4 APPLICATION PROGRAM INSTALLATION

The application program is a SYSdev based program, loaded into the M4510 module and the S4520 motion control boards. These programs perform the EM2RDWCP logic. The programs are 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 programs that constitute the EM2RDWCPP program, the application programs will have to be loaded onto the hard drive of the PC used to support the system. The SYSdev Program Development Software will also have to be loaded on the PC. To install this program perform the following:

1) Install the “EM2RDWCP” program disk into the drive.

2) For each of the “EM2RDWCP” directories (created in section 2.6.2 – “DOS Based Set-up Program Installation”), copy all the files from the disk to each of these subdirectories.

2.7 MODIFY EXISTING PLC PROGRAM

The EM2RDWCP now controls:

- The Main Clutch Solenoids
- Cupfeed Solenoids
- Air Strip Solenoid
- Main Crank Timing Functions
- Short Can Detection
- Flywheel Speed Detection

Modify the existing control system PLC program to interface with the EM2RDWCP by incorporating the following into the existing PLC ladder logic.

1) **Add "Clutch Is On" Feedback Input from the EM2RDWCP:** This is the clutch solenoid output of the M4500 controller to the actual clutch solenoid. The PLC uses this signal as clutch solenoid feedback. The PLC should monitor and compare the clutch solenoid feedback to the PLC's clutch solenoids output. If the PLC clutch solenoid output and the clutch solenoid feedback on or off states disagree for more than one second, then the PLC should generate a fault, which stops all clutch modes and turns off the main drive. The "Clutch Is On" feedback is also used in conjunction with the modified PLC clutch solenoid logic.

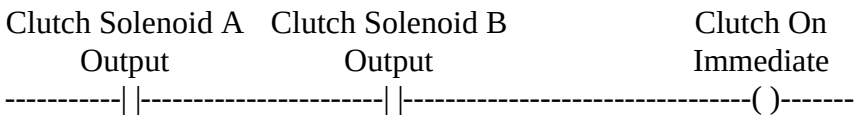
2) Modify the existing clutch solenoid logic so that when a back dead center (BDC) stop condition occurs in continuous mode, the clutch solenoid outputs turn off when the "Clutch Is On" feedback from the EM2RDWCP has turned off. If the "Clutch Is On" feedback has not turned off within three seconds, turn off the clutch solenoid outputs by default. The original PLC software for Continuous Immediate, Inch and Bar clutch logic should not need changing.

   Warning: **In addition to PLC software control, the original clutch solenoid outputs must be interlocked with hardwired, redundant and self-checking circuits. The clutch circuit must meet appropriate national and/or international standards for power presses. Do not commission this retrofit control system until the existing clutch circuits are safe!**

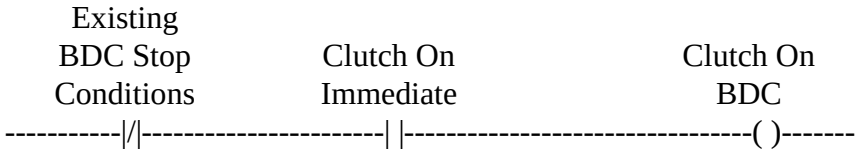
Note: The original clutch solenoid outputs of the existing control system are now used by the EM2RDWCP to drive the "Clutch A" and "Clutch B" relays. The EM2RDWCP enables the actual clutch solenoids and servo motors through the "Clutch A" and "Clutch B" relays.

3) **Add "Clutch On Immediate" Output:** Map the clutch solenoids output to this output signal.

Note: The purpose of this signal is to notify the EM2RDWCP to shutoff the clutch solenoids immediately, before the "Clutch A" and "Clutch B" relays de-energize. This saves wear and tear on the "Clutch A" and "Clutch B" relay contacts caused by electrical arcing.



4) **Add "Clutch On BDC" Output:** This is the summation of the existing back dead center (BDC) stop conditions and the "Clutch On Immediate" output. Examples of BDC type stops are:
   - "Line Control Standby"
   - "Cup Infeed Low"
   - Operator Depressing the BDC Stop Push-Button.



5) **Add "Cupfeed Auto Enable" Output:** This is the summation of the cupfeed auto mode selector switch and all line control standby conditions.

6) The following signals can be mapped through the PLC or may be hardwired to the EM2RDWCP from existing selector switches and push-buttons.
   - "Run Mode (Not Bar)" Selector Switch
   - "Continuous Mode" Selector Switch
   - "Inch Mode" Selector Switch
   - "Cupfeed On Manual" Push-Button
   - "Alarm Reset" Push-Button
   - "Data Counts Reset" Push-Button, Selector Switch or Signal from Line Control

7) **Add "Servos Ready" Input:** When "On" the servos are in a normal operating condition. When "Off" indicates a fault in the servos, this should inhibit the PLC from running in Continuous mode. Inch and Bar modes should not be affected by this fault. When this fault occurs, a status message should be displayed to inform the operator to look at the D4591 display in order to see the specific servo fault.

8) **Add "Redraw Auto Mode" Input:** When "On" indicates that the redraw mode is set for automatic following of the main crank. When "Off" the redraw is in fixed speed mode or manual hold-down mode. This should inhibit the PLC from feeding cups ("Cupfeed Auto Enable" should be turned off) and a status message should be displayed "Redraw Not In Auto Mode" to inform the operator of why cups are not feeding.

9) Defeat the existing short can detection in the PLC and add the "Short Can Alarm" input from the EM2RDWCP. This alarm should be summed with the immediate continuous alarm conditions. A status message should be displayed "Short Can Alarm" to inform the operator of why the bodymaker stopped. When "On" indicates the alarm is active, when "Off" indicates no alarm condition.

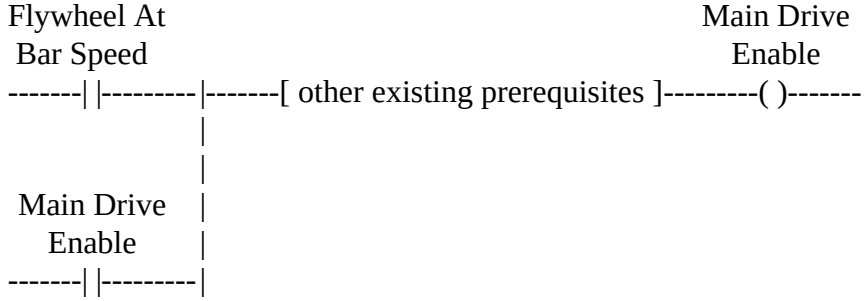
10) Defeat the existing domer jam detection in the PLC and add the "Domer Jam Alarm" input from the EM2RDWCP. This alarm should be summed with the immediate continuous alarm conditions and inch alarm conditions. A status message should be displayed "Domer Jam Alarm" to inform the operator of why the bodymaker stopped. When "On" indicates the alarm is active, when "Off" indicates no alarm condition.

11) Defeat the existing sensor failure detection and existing resolver/PLS timing failure detection and add the “Can Sensor / Timing Fail” input from the EM2RDWCP. This alarm should be summed with the immediate continuous alarm conditions. A status message should be displayed “Short Can Sensor Failed or Crank Resolver Timing Fault” to inform the operator of why the bodymaker stopped. When “On” indicates the alarm is active, when “Off” indicates no alarm condition.

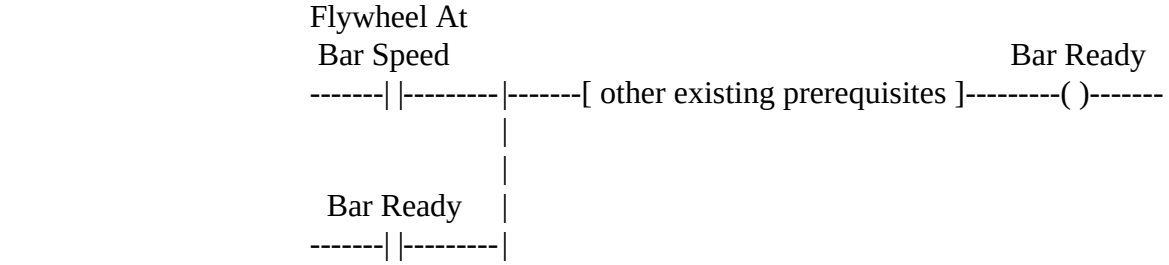
12) Add “Brake Response Too Long Alarm” input from the EM2RDWCP. This alarm should be summed with the immediate continuous alarm conditions. A status message should be displayed “Brake Stopping Distance Is Too Long” to inform the operator that the crank stopping distance was too great during the last stop and that the brake pads are probably worn. When “On” indicates the alarm is active, when “Off” indicates no alarm condition.

13) Add “Flywheel at Bar Speed” input and “Flywheel at Punch Speed” input from the EM2RDWCP.

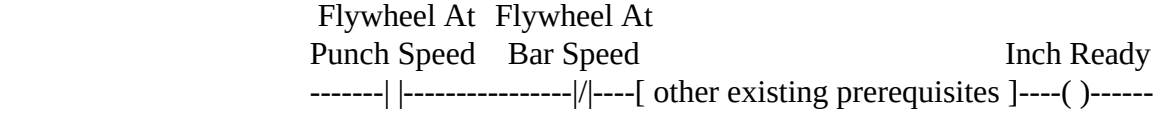
14) Include the “Flywheel at Bar Speed” input as a main drive enable prerequisite, so that the main drive can’t be restarted until the flywheel has come to a stop. When the flywheel has stopped and the main drive is enabled (ready), the main drive enable condition should latch around the “Flywheel at Bar Speed” input.



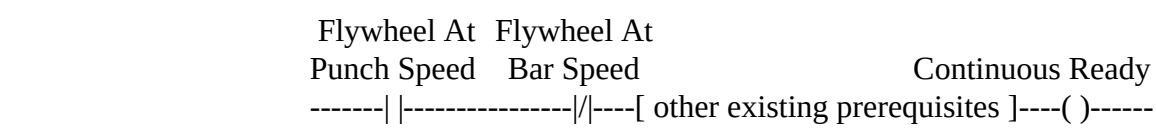
15) Include the “Flywheel at Bar Speed” input as a bar ready prerequisite, so that bar mode can’t be started until the flywheel has come to a stop. When the flywheel has stopped and bar mode is ready, the bar mode ready condition should latch around the “Flywheel at Bar Speed” input.



16) Include the “Flywheel at Punch Speed” input and the off state of “Flywheel at Bar Speed” as a inch ready prerequisite.



17) Include the “Flywheel at Punch Speed” input and the off state of “Flywheel at Bar Speed” as a continuous ready prerequisite.



18) If the flywheel is stopping and the “Flywheel at Bar Speed” is “Off”, a status message “Please Standby While Flywheel Stops” should be displayed to inform the operator why the main drive is not ready or why bar mode is not ready.

    If the main drive was just restarted and “Flywheel at Punch Speed” is “Off”, a status message “Please Standby While Flywheel Comes Up To Speed” should be displayed to inform the operator why Inch or Continuous modes are not ready.

    If “Flywheel At Bar Speed” stays on longer than 4 seconds after restarting the main drive, a fault should be generated to turn off the main drive. A status message “No Flywheel Motion Fault” should be displayed to inform the operator of a problem in the main drive.

    If “Flywheel At Punch Speed” stays off longer than 15 seconds after restarting the main drive, a fault should be generated to prevent inch or continuous ready conditions. A status message “Flywheel Not At Punch Speed Fault” should be displayed to inform the operator of a problem in the main drive.

19) Add “Logic Sync (Stroke Clock) input from the EM2RDWCP: This allows the PLC to count machine strokes. Use this signal in conjunction with the “Cupfeed Is Open” signal to count good cans.

20) Add “Cupfeed Is Open” input from the EM2RDWCP: Use this signal in conjunction with the “Logic Sync” signal to count good cans.

2.8 DISABLING SPECIFIC FEATURES

The primary purpose of the EM2RDWCP retrofit control system is to control the redraw and cupfeed servo systems. Control of various other high speed devices were incorporated into the EM2RDWCP due to the M4510 high speed capabilities. However, some customers may prefer to control these high speed devices with their original control system and not take advantage of some or all high speed functions. The following is a description of how to disable specific features in the EM2RDWCP:

1) **Disabling the "Air Strip Solenoid":** Disconnect air strip solenoid from fuse FU12, no other changes are required. The M4510 will think it's still controlling the air strip, even though it's not.

   Reminder for User's Controlling the Air Strip in the PLC: There are two cans fed into the bodymaker through the cupfeed cam after the cupfeed gate turns off. The air strip must be enabled those two additional strokes.

2) **Disabling "Cupfeed Solenoids", "Short Can Detection" And "Sensor Fail Detection":**
   a) Disconnect "Cupfeed On" solenoid from fuse FU10.
   b) Disconnect "Cupfeed Off" solenoid from fuse FU11.
   c) Disconnect "Short Can" sensor from wire terminal 510.
   d) Disconnect "Cupfeed Auto Enable" from the PLC to wire terminal 1007.
   e) Disconnect "Cupfeed On Manual" from the existing controls to wire terminal 1013.
   f) Disconnect "Cupfeed Is Open" wire terminal 1116 to PLC input.
   g) Set flag variable "Cupfeed Not Installed" (F15) equal to 1, in the initialization file for the M4510 processor.

Modify the Existing PLC Program: When the clutch is first engaged the crank accelerates to full speed in less than one stroke. The EMM redraw is unable to mechanically accelerate this fast and has been programmed to accelerate over several seconds. The PLC must not feed any cups into the bodymaker until the redraw has synchronized to the crank. The EM2RDWCP will notify the PLC when it's ok to feed cups with the "Redraw In Sync" signal (wire terminal #1107).

Note: Normally this signal is used for "Short Can Alarm", but this signal is remapped from "Redraw In Sync" when flag "Cupfeed Not Installed" (F15) is set to 1.

Reminder for User's Controlling the Cupfeed Solenoids and Short Can Detection in the PLC: When the cupfeed gate is first opened, it takes two strokes for the first can to be punched and likewise when the cupfeed gate is closed, two cups remain to be punched. During a BDC type stop, the "Clutch On BDC" output from the PLC must stay on until the last can has been punched. Short can detection must also take into account the two stroke shift between cupfeed gate and short can sensor.

3) **Disabling "Main Clutch Solenoids":**
   a) Disconnect "Main Clutch Solenoid A" from wire terminal 1211.
   b) Disconnect "Main Clutch Solenoid B" from wire terminal 1212.
   c) Disconnect "Clutch On BDC" from the PLC to wire terminal 1006 and jumper wire terminal 1005 to wire terminal 1006.
   d) Parallel "Main Clutch Solenoid A" with "Clutch A Relay" wire terminal 626 and parallel "Main Clutch Solenoid B" with "Clutch B Relay" wire terminal 627.

Even though the existing controls will be controlling the solenoids, the "Clutch A Relay" and "Clutch B Relay" must be energized to enable the servos. The M4500 will still think it's still controlling the clutch solenoids, even though it's not.

4) **Disabling "Flywheel Motion Speed Detection":**
   a) Disconnect "Flywheel Motion" sensor from wire terminal 1000,
   b) disconnect "Flywheel at Bar Speed" wire terminal 1113 to PLC input and
   c) disconnect "Flywheel at Punch Speed" wire terminal 1114 to PLC input.

   No other changes are required.

5) **Disabling "Domer Jam Detection":**
   a) Disconnect "Domer Jam" sensor from wire terminal 1001.
   b) Disconnect "Domer Jam Alarm" wire terminal 1110 to PLC input.

   No other changes are required.

6) **Disabling "Logic Sync (Stroke Clock)":**
   a) Disconnect "Logic Sync" wire terminal 1115 to PLC input.

   No other changes are required.

7) **Disabling Cupfeed Servo Functions:**
   a) Turn off circuit breaker CB2 (power for cupfeed amplifier).
   b) Set flag variable "Servo Cupfeed Not Installed" (F22) equal to 1, in the initialization file for the M4510 processor.

   The following components may also be removed:
   - Cupfeed Power Supply (PS2)
   - Cupfeed Amplifier (SA2)
   - Cupfeed Contactor (C2) (jumper wires 640 To 641)
   - S4520-RDC Cupfeed Servo Controller Card in Slot 02

2.9 APPLYING POWER TO THE EM2RDWCP

With the wiring to the EM2RDWCP complete, apply power and perform the following:

1) Verify green “PWR” and “RUN” LED's on M4510 main processor are “on” and red “FLT” LED is “off” (see figure 2.1 – “M4510 Configuration”).

2) Verify green “PWR” and “RUN” LED's on S4520s in M4510 slots 01 and 02 are both “on”. Green “AMP ENB” LED is “off” (see figure 2.1 – “M4510 Configuration”).

3) Verify LED on B25A20 cupfeed servo amplifier is “RED” (this is normal when the amplifier is disabled which it is until the cupfeed motor is actually running).

4) Verify LED on 100A25 hold-down amplifier is “RED” (this is normal when the amplifier is disabled which it is until the hold-down is actually enabled).

5) Verify LED on B100A40 redraw servo amplifier is “RED” (this is normal when the amplifier is disabled which it is until the redraw motor is actually running).

6) If the above is not as described, verify that power is applied to the M4510 module and all servo amplifiers. Also verify all cables are connected properly to the respective modules.

7) Using the “EM2RDWCP” set-up program, verify the following:
   - The M4510 main processor is loaded with the “EM2RDWCP” application program,
   - The S4520-RDC in slot 01 is loaded with the “SRVRDRW” application program.
   - The S4520-RDC in slot 02 is loaded with the “SRVCUPR” application program.

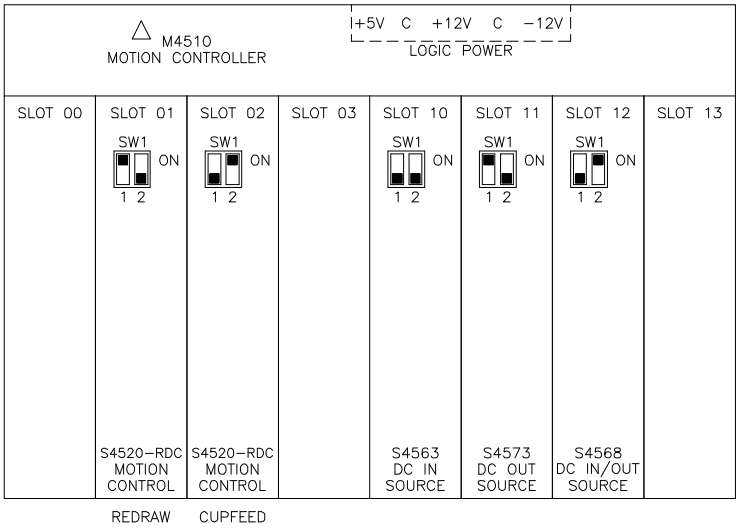


Figure 2.1 – M4510 Configuration

2.10 SET-UP

The control system is shipped from the factory loaded with the following PLC programs:

- "EM2RDWCP" – Main Processor of the M4510
- "TMGRDWCP" (PLS channel set-point file) – PLS section of the M4510
- "SRVRDRW" – S4520-RDC in slot 01 of the M4510
- "SRVCUPR" – S4520-RDC in slot 02 of the M4510

These are the standard programs used to implement the standard EM2RDWCP servo redraw/cupfeed control.

In some cases, the following user variables and timing channels may have to be altered to tune the control system to the actual bodymaker it is controlling.

Once installed and the control system is powered up, perform the following to set-up and tune the EM2RDWCP. The set-up is performed using a PC running the EM2RDWCP set-up program (see section 6, Windows based set-up program reference or section 7 for the DOS based set-up program reference). Some of the user variables can also be accessed using the Keypad/Display (see section 5 for a description of using the Keypad/Display).

2.10.1 DEFAULT SET-UP VARIABLES

Bodymaker Variables (M4510 PLC): As shipped, the set-up variables for the M4510 main processor are set to the following defaults:

Brake Wear Compensation:

Enabled:	Y
Desired BDC Stop Position (Low Speed):	000
Desired BDC Stop Position (High Speed):	000
Maximum Allowed Stopping Response (degrees):	300

Bodymaker Running Speeds:

Low Speed (SPM):	250
High Speed (SPM):	350

Trimmer Speed Reference:

Maximum Speed:	375
Idle Speed (W/I stopped):	250

Hold Down Current:

Initial Clamp (Amps):	30
2nd Hold (Amps):	22
3rd Hold (Amps):	22
4th Hold (Amps):	22
Final Hold (Amps):	22
Manual Mode (Amps):	35

Timing Channels (M4510 PLS)

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

CHAN	ON – OFF	DESCRIPTION
CH00:	110 – 130	BDC (High) timing
CH01:	095 – 115	BDC (Low) timing
CH02:	135 – 162	Short Can Check timing
CH03:	180 – 190	Sensor Check timing
CH04:	110 – 230	Cupfeed timing
CH05:	125 – 210	Air Strip (Low) timing
CH06:	105 – 200	Air Strip (High) timing
CH07:	180 – 000	PLC Clock
CH10:	032 – 057	Hold Down - Initial Clamp
CH11:	057 – 062	Hold Down - 2nd Hold
CH12:	062 – 067	Hold Down - 3rd Hold
CH13:	067 – 072	Hold Down - 4th Hold
CH14:	072 – 077	Hold Down - Final Hold
CH15:	___ - ___	Spare
CH16:	___ - ___	Spare
CH17:	___ - ___	Spare

Redraw Variables (S4520 Slot-01)

As shipped, the set-up variables for the redraw S4520-RDC motion control processor in slot 01 are set to the following defaults:

Redraw Jog Speeds:

Jog Forward Speed (SPM):	030
Jog Reverse Speed (SPM):	030
Homing Speed:	015

Continuous Run Redraw Start/Stop:

Ramp-up speed difference:	30
Acceleration Rate:	001
De-Clutch Stop Current Limit (%):	050
Redraw Homing Offset (counts):	2902
Redraw Start Position Offset (counts):	0

Synchronization Error Limits:

Max Error for “Out of Sync” Disable:	250
Max Error for Enable Cupfeed Synchronization:	200
Max Error for “Following Error” Alarm:	250

Redraw Home Position (Timing PRX “On”-to-”Off”): 15131

Redraw Servo PID Gains:

Normal Proportional (P) Gain:	1.30
Normal Integral (I) Gain:	450
Normal Derivative (D) Gain:	3
Low Gain Proportional (P):	0.5
Low Gain Integral (I):	5
Low Gain Derivative (D):	3

Cupfeed Variables (S4520 Slot-02)

As shipped, the set-up variables for the cupfeed S4520-RDC motion control processor in slot 02 are set to the following defaults:

Cupfeed Stop Position at Short Can: 1950

Synchronization Error Limits:

Max Error for “Out of Sync” Disable:	100
Max Error for Enable Cupfeed Synchronization:	500
Max Error for “Following Error” Alarm:	50

Cupfeed Cam Home Position:

(Timing PRX “Off”-to-”On”): 2412

Cupfeed Servo PID Gains:

Proportional Gain (P):	15.0
Integral Gain (I):	100
Derivative Gain (D):	25

Redraw, Hold-Down and Cupfeed Timing for Various Stroke Length Bodymakers:

	18.5"	26.5"	30" (Dia 30)
Redraw Home Pos:	15131	15450	15578
Hold-Down Initial:	32-57	39-64	39-62
Hold-Down 2nd:	57-62	64-69	62-67
Hold-Down 3rd :	62-67	69-74	67-72
Hold-Down 4th :	67-72	74-79	72-77
Hold-Down Final:	72-77	79-84	77-82
Cupfeed Home Pos:	2412	2417	2359

2.10.2 BODYMAKER SET-UP PARAMETERS

The Bodymaker 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
- Setting the Bodymaker Running Low and High Speeds

Brake Wear Compensation: If the brake wear compensation is to be used, enable it by:

1) Setting the "Brake Wear Compensation Enable" to "Y"
2) Set the "Desired BDC Stop Position (Low)" and "(High)" as well

If the compensation is enabled, the "Desired BDC Stop" positions are the desired location of the ram when it comes to rest after a BDC stop. Both the "Low" and "High" desired stopping positions are generally set to 000 degrees. Enabling the brake wear compensation allows the BDC timing channels to automatically adjust (CH00-High and CH01-Low) as necessary such that the press will stop at the desired stopping position regardless of the actual response.

If the brake wear compensation is not to be used, disable it by setting the "Brake Wear Compensation Enable" to "N"

Note: Disabling the brake wear compensation requires the BDC (High) timing (CH00) and the BDC (Low) timing (CH01) signals to be set manually such that the press stops at BDC. If the brake response changes, the press will not stop at the desired position if the brake wear compensation is disabled.

Maximum Allowed Stopping Response: This parameter defines the maximum allowed brake response 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 BDC stop is performed is longer than this number, the alarm is 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).

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

Note: This is not a speed reference that will make the bodymaker run at the speeds entered but is instead parameters used by the control system to know when to switch between the BDC (Low) and BDC (High) timing as well as the Air Strip (Low) and (High) timing etc.

See section 5 (Using the Keypad/Display) or section 6 (Windows Based Set-up Program Reference) or section 7 (DOS based Set-up Program Reference) for details on setting the above parameters.

2.10.3 TRIMMER SPEED REFERENCES

Set both the “Trimmer Maximum Speed” and “Trimmer Idle Speed” as desired. These two parameters are used to actually control the speed of the trimmer (via the 0-10VDC trimmer speed reference output of the M4510).

Trimmer Maximum Speed: The “Trimmer Maximum Speed” is used to scale the 0-10VDC analog output such that when the bodymaker is running at the speed entered in “Trimmer Maximum Speed”, the analog output will be at 10 volts.

Trimmer Idle (Minimum) Speed: This parameter determines the speed the trimmer will run at when the bodymaker is stopped (de-clutched).

Note: When the bodymaker is running, the trimmer speed reference is proportional (as set by the “Trimmer Maximum Speed” scaling) to the speed of the bodymaker. “Trimmer Idle (minimum) Speed is used to provide the speed reference when the bodymaker is at zero speed.

See section 5 (Using the Keypad/Display) or section 6 (Windows Based Set-up Program Reference) or section 7 (DOS based Set-up Program Reference) for details on setting the above parameters.

2.10.4 SERVO MOTOR SET-UP PARAMETERS

Using the set-up program, verify that the user variables of the S4520-RDC in slots 01 (redraw) and 02 (cupfeed) of the M4510 are set to the defaults as out-lined in section 2.10.1 – “Default Set-up Variables”. If not, download the default set-up parameters. These may be changed once the system is run, however should first be set to the defaults. Refer to section 6 – Windows Based Set-up Program Reference or section 7 – DOS based Set-up Program Reference for details on observing and downloading these variables.

2.10.5 VERIFY MAIN CRANK RESOLVER

From the “Cupfeed Cam Time/Position Diagnostics” menu of the set-up program, observe the actual main crank position. Verify that the main crank resolver direction is correct and is linear by barring or inching the machine forward. The position should increment linearly through the range of 0 to 4096. If the direction is backwards, reverse the S1 and S3 leads of the resolver at the connection to the M4510 module. If the position is not linear (increments up then down or does not increment through full range), verify that the resolver leads are connected correctly.

2.10.6 SET MACHINE ZERO

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

1) Press the “Set-Up” key on the Keypad/Display and Select “3: SET MACHINE TIMING”. 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 M4510 resolver connector. Then verify that the position then indeed does increase with forward movement.

2) Press “ESC” to exit back to the primary set-up menu.

3) Position the machine at back dead center (machine zero).

4) 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. The M4510 calculates the actual offset value required to make this the 000 position and displays this number in the offset field.

5) Press the <ESC> key to return to the primary set-up menu. Press the <ESC> key again, to return to the default screen.

2.10.7 VERIFY REDRAW MOTOR RESOLVER

From the “Redraw Cam Time/Position Diagnostics” menu of the set-up program, observe the actual redraw position. Verify that the redraw resolver direction is correct and is linear by rotating the redraw forward by hand. The position should increment linearly through the range from 0 to 16383. If the direction is backwards, Re-check the resolver connections to ensure they match the electrical drawings.

2.10.8 TIME REDRAW MOTOR TO MAIN CRANK

Prior to manually turning the redraw, make sure the redraw timing sensor is backed out of the mounting hole on the redraw sufficiently such that it will clear the redraw when dwelling at full back.

1) Manually rotate the redraw by hand until the redraw is dwelling at Back Dead Center.
2) Turn the redraw timing sensor all the way in until it bottoms out on the redraw, then back it out exactly 3/4 of a turn. This sets the distance between the sensor and the redraw and must be set accurately for consistent timing.
3) Lock the redraw sensor down with the supplied nut.
4) Power the EM2RDWCP system “off” and then back “on” again. This resets the system such that it can be timed with the newly adjusted redraw sensor.

Note: Prior to timing the redraw with respect to the main crank, rotate the redraw forward through at least one complete revolution with the target on the moving mass turning the timing sensor on and back off at least once since power-up.

Perform the following to time the redraw mechanism with respect to the main crank:

1) Inch or bar the ram to the back position and jog or bar the redraw to the back position (cup locator open).
2) Using the “Manual Cupfeed” push-button, feed one cup into the cupfeed cam and rotate the cam by hand until the cup is fully loaded into the cup locator.
3) Bar the ram in the forward direction until the punch just contacts the cup.
4) Bar the redraw in the forward direction until the face of the redraw sleeve is even with the top lip of the cup.
5) With the redraw and ram located as described above, “Home Redraw” using the Keypad/Display.

The previous steps will automatically set the “Redraw Home Position” by calculating the redraw offset relative to the main crank position.

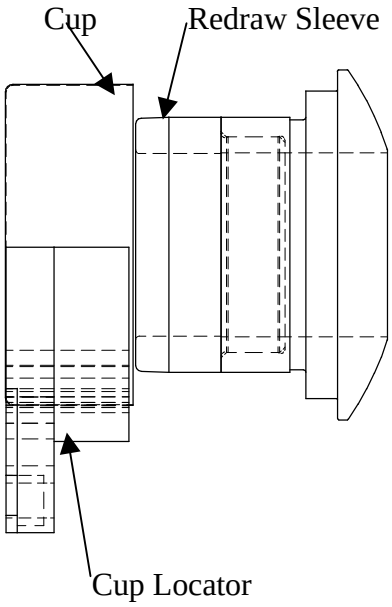


Figure 2.2 - Location of Redraw Sleeve at “Redraw Home” Position

Set Redraw Homing Offset (counts): The "Redraw Homing Offset" is empirically set and used to fine tune the relationship between the main crank and redraw. This is set such that the redraw sleeve is clamped for a certain number of degrees before the punch strikes the cup. The number of degrees the redraw must be clamped before punch strikes the cup depends on several variables:

- Redraw Stroke length (1-5/8" and 2")
- Cup Height
- Bodymaker Speed

Note: For the 2" redraw stroke length, this value should be set to 2902. It is yet to be determined the optimum value for the 1-5/8" stroke length.

Using the "EM2RDWCP" setup program, from the "Redraw Servo" menu, select "1: Set-up Parameters" and set the "Redraw Homing Offset (counts)" to this value.

2.10.9 VERIFY CUPFEED CAM RESOLVER

From the "Cupfeed Cam Time/Position Diagnostics" menu of the set-up program, observe the actual cupfeed cam position. Verify that the cupfeed resolver direction is correct and is linear by pulling the cupfeed cam forward by hand. The position should increment linearly through the range from 0 to 4095. If the direction is backwards, verify the resolver is wired per the schematic at the back of this manual. If the position is not linear (increments up then down or does not increment through full range), verify that the resolver leads are connected correctly.

2.10.10 TIME CUPFEED CAM TO MAIN CRANK

Prior to timing the cupfeed cam with respect to the main crank, pull the cam forward through at least one complete revolution with the target on the cam passing the timing sensor.

Perform the following to time the cupfeed cam with respect to the main crank:

1) Inch or bar the ram to the position where the punch has just opened to the point where the cup could first be loaded (this is when the ram is on the “Back Stroke”). See figure 2.3.

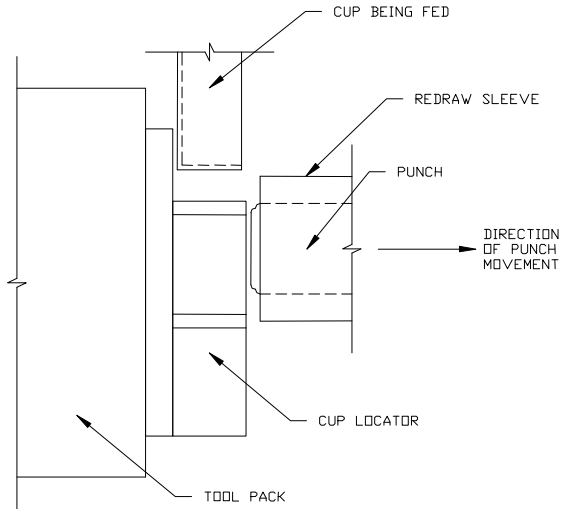


Figure 2.3 - Location of Ram at “Cupfeed Time” Position

2) Using the “Manual Cupfeed” push-button, feed one cup into the cupfeed cam and rotate the cam by hand until the cup is fully loaded into the cam. Rotate the cupfeed cam (with the cup loaded) into the position where the cup would first be loaded into the cup locator (see figure 2.4).

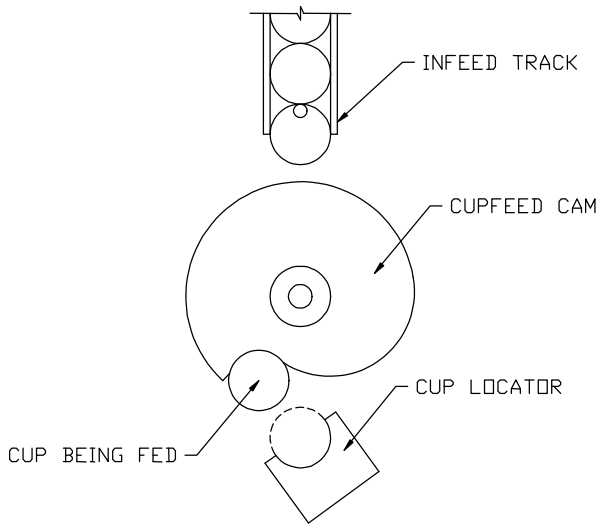


Figure 2.4 - Location of Cupfeed Cam at “Cupfeed Time” Position

3) With the cupfeed cam located as described above, “Home Cupfeed Cam” using the Keypad/Display. Make sure the cupfeed cam does not slip from the “Cupfeed Time” position when performing this step.

4) At this point, the cupfeed cam is timed with respect to the main crank such that when the machine is running the cupfeed cam will be in sync with the main crank and load the cup when the ram has just opened up.

The previous steps will automatically set the “Cupfeed Cam Home Position” by calculating the cupfeed cam offset relative to the main crank position.

2.10.11 VERIFY LOCATION OF SHORT CAN TIMING (CH02)

By barring the machine, verify that the “Short Can” timing (CH02) first turns “ON” when the short can sensor is over the nose of the punch on the forward portion of the stroke. This would be where the sensor would first see the “Can” as it emerges from the die set. Verify that the “Short Can” timing turns “off” right before the sensor would quit seeing the lip of the can as the ram continues it's forward motion. Adjust either or both of the turn “ON” or turn “off” locations of CH02 until the above is achieved. Depending on the location of the short can sensor, CH02 is typically set “ON” at 135 degrees and “off” at 162 degrees.

Note: The short can sensor must see “Can” the entire time the “Short Can” timing (CH02) is “ON” in order to pass the short can check. Otherwise, a “Short Can” alarm will be generated.

Verify that the “Sensor Check” timing (CH03) is set correctly. This timing signal should go “ON” for 10 degrees then back “off” just prior to the punch emerging from the die set (typically 180 to 190 degrees). This signal is used to verify that the short can sensor has not failed “ON” and therefore the short can sensor must be “off” the entire time CH03 is “ON” otherwise, the “Die Sensor Fail” alarm is generated.

Refer to section 5 (Using the Keypad/Display), section 6 (Windows Based Set-up Program Reference) or section 7 (DOS based Set-up Program Reference) for details on setting CH02 and CH03.

2.10.12 VERIFY CUPFEED TRACKING

By inching the machine, verify that the cupfeed tracks (follows) the main crank. Verify that the cupfeed is correctly in time with the crank in all crank positions.

If the cupfeed oscillates wildly or does not follow the crank, verify that the PID gains are set correctly (see section 3 – "Tuning the Servo Loop"). If the gains are set correctly, verify that the motor stator wiring and feedback wiring are correct (see electrical schematic at the back of this manual). If they are correct, verify that the analog command reference from the S4520-RDC to the B25A20 is not swapped (see electrical schematic at the back of this manual).

2.10.13 VERIFY REDRAW TRACKING

Run the machine in continuous mode without feeding cups and the redraw in auto mode. Verify that the redraw accelerates smoothly to punch speed when continuous mode is first started. Verify the redraw syncs in with the main crank within several seconds and that the redraw tracks the main crank and is fully stable.

Adjust the redraw "Start Position Offset". This is the position the redraw will begin its acceleration. When the clutch is engaged, the crank accelerates very quickly. Due to the inertia of the redraw, it must accelerate at its own separate slower acceleration rate to a speed slightly less than the crank speed (set in the "Initial Ramp-Up Speed Difference" parameter). This difference in speed allows the redraw to be overtaken by the crank, and synchronize into position. This parameter is experimentally adjusted such that the redraw position is always slightly ahead of the crank when the redraw reaches the synchronization speed. This significantly reduces the number of strokes required to synchronize the two mechanisms.

Note: The LED on SA3 (Redraw Hold Down Magnet amplifier) will turn green once the redraw synchronizes with the main crank.

If the redraw oscillates wildly while accelerating to punch speed, verify that the "Low PID" gains are set correctly (see section 3 – "Tuning the Servo Loop"). If the gains are set correctly, verify that the motor stator wiring and feedback wiring are correct (see electrical schematic at the back of this manual). If they are correct, verify that the analog command reference from the S4520-RDC to the B100A40 is not swapped (see electrical schematic at the back of this manual).

If the redraw oscillates wildly while attempting to synchronize with the main crank, verify that the "Normal PID" gains and the "Max Error to Enable Synchronization" are set correctly (see section 3 – "Tuning the Servo Loop"). If the gains and max error are set correctly, verify the main crank resolver function and wiring. (see electrical schematic at the back of this manual).

2.10.14 VERIFY SINGLE CUPFEED

With the machine running in continuous and the auto cupfeed "off", feed a single cup through the machine by depressing the "Cupfeed On Manual" push-button. The cupfeed solenoid should open for one cup with the air strip activated for three strokes prior to the can being punched (can punched on fourth stroke). Verify the cupfeed timing (CH04), air strip timing (CH05 and CH06), and short can timing (CH02). Adjust as necessary to achieve smooth cupfeed open with no false short can shut downs.

2.10.15 VERIFY MACHINE OPERATION

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 and the cupfeed open, verify that the cans are stripped without problems and no blow outs are occurring (verify at both low and high speed). If a problem is occurring, adjust the respective "Air Strip" timing (CH05-Low Speed, CH06-High Speed) until the problem is corrected. Refer to section 5 (Using the Keypad/Display), section 6 (Windows Based Set-up Program Reference) or section 7 (DOS based Set-up Program Reference) for details on adjusting CH05 and CH06.

Verify Short Can Timing: With the machine running with the cupfeed open, verify that false short can faults are not occurring (short can alarm occurs when full length can is made). If false short can alarms are occurring, narrow the short can timing one degree at a time until the false short can alarms quit occurring.

Verify that the short can detection is working correctly by generating a short can and verifying that the short can alarm is generated for this can. This can be done by stopping the press, removing one of the die rings then punching a cup in single stroke mode with the die ring removed. The short can alarm should be generated when the first cup is punched.

Note: False short can alarms can be a result of redraw following errors or hold-down current mis-adjustment. Verify both the redraw tracking and the hold-down adjustment.

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

Note: When the control system is first installed, it will take a few successive stops for the algorithm to program the BDC timing channels to the correct position. Also, the compensation is enabled after the press has been running at a fixed speed in continuous. The BDC 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 BDC stop to verify the stop position.

If the brake wear compensation is disabled, manually adjust both the BDC (High) timing (CH00) and the BDC (Low) timing (CH01) such that the press stops at back dead center at both respective speeds. Refer to section 5 (Using the Keypad/Display), section 6 (Windows Based Set-up Program Reference) or section 7 (DOS based Set-up Program Reference) for details on adjusting CH00 and CH01.

Verify BDC Stop Sequence: Perform a normal manual BDC stop while the cupfeed is open and verify that the cupfeed closes, the machine makes two extra strokes processing the two remaining cups in the cupfeed cam and stops at BDC with no cups in the cup locator or cupfeed cam. This sequence should be true for standby stops and BDC alarm stops as well. If the machine stops before making the two strokes and leaves a cup in the cam or cup locator, verify that the "BDC Stop Enable" input to the existing PLC is implemented correctly in the PLC ladder logic.

Verify Redraw and Cupfeed Cam servos are disabled in BAR mode: Activate the clutch in Bar mode and verify that the contactors for the servo amplifiers are not activated. This verifies that the redraw and cupfeed servo motors and hold-down magnet are disabled while activating the clutch in Bar mode.

The Machine Is Now Set-Up And Ready To Run!

2.11 COMPONENT INSTALLATION AND REPLACEMENT

The following is provided only as a reference. These steps are performed by the factory prior to shipping and need only be performed in the event the M4510 module, P4500 power supply, D4591 display, B100A40, 100A25, or B25A20 servo amplifier need to be replaced. Refer to the M4500 User's Manual for general details on installing the M4510, P4500, and D4591.

2.11.1 M4510 MODULE INSTALLATION

To install the M4510 module, perform the following:

1) Remove the cover from the M4510 chassis. Install the appropriate I/O boards in the appropriate slots. Refer to the electrical schematics at the back of this manual for locations and dip switch settings.

2) Install the cover, making sure all the board connectors protrude through the slots and tighten the captive screws.

3) Mount the M4510 chassis to the backpanel using four 8-32 screws.

4) With power to the P4500 “off”, install the P4500 power supply cable to the connector on the M4510 (the connector on the cable is polarized, and should mate with the connector on the M4510 only one way).

5) Install the respective field wiring arms on all the I/O boards of the M4510. Make sure all field wiring connectors are fully mated in the M4500.

2.11.2 P4500 POWER SUPPLY INSTALLATION

To install the P4500, perform the following steps:

1) Mount the P4500 to the back panel in the mounting holes next to the M4510 (left side) using two 8-32 screws.

2) Install the P4500 power supply cable to the (+5/C/+12/C/-12) connector on the M4510 (the connector on the cable is polarized, and should mate with the connector on the M4510 only one way).

3) With power to the P4500 L, N, G field wiring connector “off”, connect this connector to the P4500 input power connector.

2.11.3 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 in the enclosure. Secure the display to the enclosure using 7ea. 8-32 nuts and external lock washers.

2) With power to the M4510 module “off”, connect the display ribbon cable to the connector on the lower back of the display M4510 (the connector on the cable is polarized, and should mate with the connector on the M4510 only one way).

2.11.4 SERVO CUPFEED AMPLIFIER (B25A20) INSTALLATION

To install the B25A20 Servo Amplifier, perform the following steps:

1) Set the dip switches on the B25A20 as follows:

1:	Test/Offset:	OFF
2:	Loop Gain:	ON
3:	Current Scaling:	OFF
4:	Vel Loop Integrator:	ON
5:	Duty Cycle Feedback:	OFF
6:	Velocity Feedback:	OFF
7:	Velocity Direction:	OFF
8:	Cont Current Reduction:	OFF
9:	Integrate Cap:	OFF
10:	60/120 Phasing:	ON

Set the potentiometers as follows:

P1:	Loop Gain:	Fully Counter Clockwise
P2:	Current Limit:	Fully Clockwise
P3:	Ref Input Gain:	Fully Clockwise
P4:	Ref Offset:	See Section 9

2) Remove the cover of the B25A20 and verify that the J1 jumper on the PC board has been removed (cut out). This is a zero ohm surface mount resistor. If it has not been removed, carefully cut it out with a pair of side cutters. This inverts the Inhibit input turning it into an enable input. Install the cover back on the B25A20.

3) Mount the B25A20 to the side of the PS300W-96V power supply using the supplied 8-32 hardware.

4) Wire the MOTOR A, B, and C stator leads to the P2 connector along with the high power and ground leads. Be sure to connect the MOTOR A, B, and C stator leads per the schematic at the back of this manual, otherwise the motor will not run correctly (jerk or stall).

5) Connect the P1 Molex connector to the P1 connector of the B25A20.

2.11.5 HOLD-DOWN AMPLIFIER (100A25) INSTALLATION

To install the 100A25 Servo Amplifier, perform the following steps:

1) Set the dip switches on the 100A25 as follows:

1:	Voltage Feedback:	OFF
2:	Current Feedback:	OFF
3:	Loop Gain:	OFF
4:	Loop Integrator:	OFF
5:	Current Scale:	ON
6:	Current Limit:	OFF
7:	Loop Integrate Disable:	ON
8:	Voltage Integrate Disable:	ON
9:	Integrate Cap:	OFF
10:	Test:	OFF

Set the potentiometers as follows:

P1:	Loop Gain:	Fully Counter Clockwise
P2:	Current Limit:	Fully Clockwise
P3:	Ref Input Gain:	See Paragraph 7 Below
P4:	Ref Offset:	See Paragraph 7 Below

3) Remove the cover of the 100A25 and verify that the J1 jumper on the PC board has been removed (cut out). This is a zero ohm surface mount resistor. If it has not been removed, carefully cut it out with a pair of side cutters. This inverts the Inhibit input turning it into an enable input. Install the cover back on the 100A25.

4) Mount the Hold-Down amplifier (100A25) to the back-panel using the supplied hardware.

5) Wire the hold-down coil leads to the MOTOR (+) and (-) connector along with the high power and ground leads. Be sure to connect the MOTOR (+) and (-) leads per the schematic at the back of this manual.

6) Connect the P1 Molex connector to the P1 connector of the 100A25 amplifier.

7) Calibrate the Hold-Down Coil Current

   a) Manually rotate the redraw to the full forward dwell position in front of the redraw die. Using a voltmeter connected to the "Current Monitor Test Point" (wire terminal 724) and common of the M232 module (terminal 5 - black wire of cable).

   b) Adjust the Hold-Down amps in manual hold down mode by setting the "Hold-Down Force - Manual" equal to 0 Amps (see section 4.2 – "Setting the Hold-Down Force"). Initiate manual hold-down mode (see section 4.3 – "Redraw Modes of Operation"). Adjust the "Offset" POT of the 100A25 until the voltmeter displays 0 VDC.

   c) Adjust the Hold-Down amps in manual hold down mode by setting the "Hold-Down Force - Manual" equal to 16 Amps (see section 4.2 – "Setting the Hold-Down Force"). Initiate manual hold-down mode (see section 4.3 – "Redraw Modes of Operation"). Adjust the "Reference in" POT of the 100A25 until the voltmeter displays 1.0 VDC.

      Note: The current monitor output is scaled 1volt / 16 amps.

2.11.6 REDRAW AMPLIFIER (B100A40) INSTALLATION

To install the B100A40 Servo Amplifier, perform the following steps:

1) Set the dip switches on the B100A40 as follows:

1:	Test / Offset:	Off
2:	Loop Gain:	On
3:	Current Scaling:	On
4:	Vel Loop Integrator:	On
5:	Open Loop Mode:	Off
6:	Velocity Feedback:	Off
7:	Velocity Direction:	Off
8:	Cont Current Reduction:	On
9:	Integrate Cap:	Off
10:	60 / 120 Phasing:	ON

Set the potentiometers as follows:

P1:	Loop Gain:	Fully Counter Clockwise
P2:	Current Limit:	Fully Clockwise
P3:	Ref Input Gain:	Fully Clockwise
P4:	Ref Offset:	See Section 9

2) Remove the cover of the Redraw amplifier (B100A40) and verify that the J1 jumper on the PC board has been removed (cut out). This is a zero ohm surface mount resistor. If it has not been removed, carefully cut it out with a pair of side cutters. This inverts the Inhibit input turning it into an enable input. Install the cover back on the B25A20.

3) Mount the Redraw amplifier (B100A40) to the back-panel using the supplied hardware.

4) Wire the +, -, A, B, and C motor stator leads to the B100A40 amplifier per the schematic at the back of this manual.

5) Connect the P1 and P2 connectors to the Redraw amplifier (B100A40).

2.11.7 RESTORING THE APPLICATION PROGRAM AND SET-UP DATA TO THE M4510

Once the M4510 is installed, perform the following to download the application program to the M4510 main processor as well as restore the previously saved set-up data and timing channel set-points:

1) Power up the M4510 and the PC used to interface with the control system.

2) Connect an RS-232 cable from the computer COM port to the "PROG" port on the M4510.

3) Using the set-up program download the application program to the M4510 (see section 6 – Windows based set-up program reference or section 7 – DOS based set-up program reference on downloading the application program to the M4510).

4) Using the set-up program, download the PLS timing set-points to the M4510 (see section 6 – Windows based set-up program reference or section 7 – DOS based set-up program reference on downloading the PLS timing set-points to the M4510).

5) Using the set-up program, download the previously saved set-up data to the M4510 (see section 6 – Windows based set-up program reference or section 7 – DOS based set-up program reference on downloading the set-up data to the M4510).

2.11.8 RESTORING THE SRVRDRW APPLICATION PROGRAM AND SET-UP DATA TO THE S4520-RDC (SLOT 01)

Perform the following to download the SRVRDRW application program to the S4520-RDC (slot 01) motion control processor as well as restore the previously saved set-up data:

1) Power up the M4510 and the PC used to interface with the control system.

2) Connect an RS-232 cable from the computer COM port to the "MOTION" port on the S4520-RDC in slot 01.

3) Using the set-up program, download the SRVRDRW application program to the S4520-RDC (see section 6 – Windows based set-up program reference or section 7 – DOS based set-up program reference on downloading the application program to the S4520 (slot 01)).

4) Using the set-up program, download the previously saved set-up data to the S4520-RDC (see section 6 – Windows based set-up program reference or section 7 – DOS based set-up program reference on downloading the previously saved set-up data to the S4520 (slot 01)).

2.11.9 RESTORING THE SRVCUPR APPLICATION PROGRAM AND SET-UP DATA TO THE S4520-RDC (SLOT 02)

Perform the following to download the SRVCUPR application program to the S4520-RDC (slot 02) motion control processor as well as download the previously saved set-up data:

1) Power up the M4510 and the PC used to interface with the control system.

2) Connect an RS-232 cable from the computer COM port to the "MOTION" port on the S4520-RDC in slot 02.

3) Using the set-up program, download the SRVCUPR application program to the S4520-RDC (see section 6 – Windows based set-up program reference or section 7 – DOS based set-up program reference on downloading the application program to the S4520 (slot 02)).

4) Using the set-up program, download the previously saved set-up data to the S4520-RDC (see section 6 – Windows based set-up program reference or section 7 – DOS based set-up program reference on downloading the previously saved set-up data to the S4520 (slot 02)).

The control system is now ready to run, loaded with the application programs, timing set-points, and set-up data that was previously saved for the respective bodymaker.

SECTION 3
TUNING THE SERVO LOOP

This section describes the PID servo loop in general (as used with both the redraw and cupfeed motors), provides definitions of the PID gains, tips on tuning the servo loop.

Note: The PID gains provided as the defaults, for both the redraw and the cupfeed, have been determined to be the optimum gains. The PID gains should only be changed by qualified personnel familiar with closed loop servo control. Instability (oscillation) of the servo motor can result if the PID gains are set incorrectly.

The following is a generalized description, which applies to both the redraw and cupfeed servo motors.

3.1 DESCRIPTION OF PID SERVO LOOP

In the servo redraw/cupfeed application, the intention is to have both the redraw and cupfeed track (follow) the main crank position as accurately as possible. This is accomplished using an individual S4520 motion controller per axis (redraw or cupfeed) implementing a PID servo loop.

Essentially the PID loop determines the difference between the main crank position and the actual servo motor position and generates a torque to null the difference to zero (or as minimal as is practical). This is done continuously throughout the main crank stroke. Full access to the PID gains allows the servo loop to be tuned to provide the optimum balance between acceptable error and minimum running current.

The servo motor control is implemented with a high speed (0.5msec update) PID servo loop. The main crank position is used as the reference for the servo loop with the servo motor position used as the feedback. Both main crank position and servo motor positions are generated with resolvers to provide the highest degree of reliability and noise immunity. Both resolver format signals are converted to digital with a resolution of 12-bits (0-4095).

The PID servo loop is implemented in the corresponding S4520 motion control processor of the M4510 (one S4520 per servo motor). This board interfaces to the respective servo amplifier, which drives the motor. The S4520 motion controller provides a +/-10 Volt analog signal to the amplifier, which is essentially a “torque” command.

SECTION 3
TUNING THE SERVO LOOP

The servo amplifier will supply a current to the servo motor, which is proportional to the +/-10 Volt analog command. The servo motor in turn generates a torque to the load which is again proportional to this current. Thus the +/-10 Volt analog signal from the S4520 can be considered a “torque” command (both positive and negative torque) to the motor.

The stability and responsiveness of the corresponding servo motor is defined by the combination of the PID gains. These gains determine whether the servo loop is stable (under damped, over damped, or critically damped) or unstable (oscillatory). Each individual (P), (I), and (D) gain is used to generate an individual error term. The summation of these three error terms is the “torque” command that is applied to the servo amplifier, which drives the motor.

In general, the gains are determined empirically by observing the response of the system (both step response and while running continuously) and adjusting the gains until the desired response (and required torque) are achieved. The gains are set using the set-up program (see section 6 – Windows Based Set-up Program Reference or section 7 – Dos Based Set-up Program Reference). The following describes the individual (P), (I), and (D) gains and corresponding error terms.

3.2 PROPORTIONAL (P) GAIN

The proportional gain is used to create an error term, which is "proportional" to the difference between the main crank position and servo motor position. The higher the proportional error term, the higher the torque generated to null the error. For a specific amount of error, the higher the (P) gain, the higher the torque generated.

Note: By itself, the (P) term cannot null the error to zero since a torque is only generated when there is a difference between the main crank position and servo motor.

This gain is used in conjunction with the other gains to define the system stability and responsiveness. The higher the (P) gain, the higher the responsiveness.

Note: Too high of a (P) gain will cause the system to be unstable (oscillate) because the system cannot respond quick enough. Excessive current will also be drawn which is undesirable. Too low a gain will cause excessive following error to the point of instability depending on where the (I) gain is set.

In general, the (P) gain can also be used to overcome high frictional loads (higher (P) for higher friction).

3.3 INTEGERAL (I) GAIN

The integral gain is used to create an error term, which is proportional to the cumulative difference (error) between the main crank position and servo motor position. Thus for a fixed amount of error, the torque generated due to the integral error term will continue to increase at a rate proportional to the (I) gain. The higher the integral error term, the faster the torque generated to null the error will increase. This term is used to null a fixed error to zero since a torque of whatever amplitude will be generated to null the error to zero.

Note: Without the other gains ((P) and (D)), the system would be unstable.

As with the (P) gain, the higher the integral gain, the higher the responsiveness. Too high of an (I) gain will cause the system to be unstable (oscillate) because the system cannot respond quick enough. Too low an (I) gain will cause excessive following error since at low (I) gains, the (P) gain would than be mostly responsible for nulling the error. The system will not be unstable if the (I) gain is set to zero.

3.4 DERIVATIVE (D) GAIN

The derivative gain is used to create an error term, which is proportional to the rate of change of error between the main crank position and servo motor position. Thus for a fixed amount of error, the torque generated due to the derivative error term will be zero (rate of change is zero). This error term is only generated when the amount of error is changing. The higher the rate at which the error changes, the higher the derivative error term. This term is primarily used to stabilize the servo loop. It is used to reduce ringing in under damped responses or to provide fundamental stability to loops that would otherwise be unstable.

There is a definite compromise between to much (D) gain and not enough (D). With too little, the system may go unstable or be marginally stable. Also excess ringing with a corresponding longer settling time to a step response will occur if the (D) gain is too low. If the derivative gain is too high, the system response will be reduced and high frequency oscillations may occur, not to the point of instability but to the point where higher current will be drawn and excessive high frequency torque will be applied to the load.

3.5 TUNING THE SERVO MOTOR WITH THE MACHINE RUNNING

Once the servo motor is approximately tuned (using the default PID gains), the servo loop can be further tuned by observing the response while the machine is running. This must be done using an oscilloscope to observe the actual position error, amplifier command reference, and the amplifier current monitor output.

Note: The "Actual Position Error" and "Amplifier Command Reference" are observed at the diagnostic analog output AOUT1 of the respective S4520 while the amplifier current is observed from the respective amplifiers current monitor pin (see electrical schematics at the back of this manual for amplifier pin-outs).

Run the machine and observe the "Actual Position Error" with the oscilloscope both during continuous operation and during stopping and starting. Minimum following error can be achieved by adjusting the PID gains but the starting and stopping responses should be observed to assure that these responses are acceptable as well.

SECTION 3
TUNING THE SERVO LOOP

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SECTION 4
OPERATOR'S REFERENCE

This section describes the operation of the hold-down coil with regards to the redraw system and the method of setting the hold-down force and the operation of the servo redraw/cupfeed system from the point of view of the operator. This includes adjusting the hold-down force of the electromagnetic hold-down, the different modes of operation for the redraw, timing sequence of the servos after power-up, alarm messages, and the differences in bodymaker operation when equipped with the servo redraw.

4.1 HOLD-DOWN THEORY OF OPERATION

The servo portion of the redraw system is used to position the redraw sleeve at the redraw die while the actual redraw force is provided by an electromagnet that clamps against the redraw die face. The actual hold-down force is determined by the amount of current running through the hold-down coil. The higher the current, the more force. The hold-down coil is activated at the forward portion of the redraw stroke where the redraw is dwelling at the redraw die. Current to the coil is supplied by a brush type servo amplifier capable of 100 Amps peak and 50 amps continuous.

Five consecutive timing signal channels provide a five step hold-down clamp force while the can is drawn (redraw dwelling at the redraw die). The five timing signals comprise a consecutive five phase clamp including the initial clamping phase, 2nd thru 4th clamping phases, and the final clamp phase (see figure 4.1 – "Variable Hold-Down Clamping Sequence"). The clamping current (force) for each phase can be set independently, allowing variable clamping force as the can is drawn for optimum thin wall control. In general, the initial clamping phase force is set higher than the other phases to eliminate bouncing in the hold-down when first activated.

4.2 SETTING THE HOLD-DOWN FORCE

The hold down force is set empirically and is proportional to the hold down current. At the extreme, too little current will result in too little hold down force resulting in a tear-off or punch through. Too much hold force likewise will result in a tear-off. The default settings of the five clamping phases incorporate a high initial clamping force with the following four phases being equal (see figure 4.2 – "Variable Hold-Down Clamping Sequence"). Since each phase can be adjusted independently, it is possible to vary the force as the can is being drawn.

Note: The force can be adjusted on the fly, while the machine is running.

In addition to the five phase hold down currents, the manual hold-down current can also be set independently. Adjusting the force for each phase, including the manual current, is accomplished via the Keypad/Display. To adjust the force, perform the following:

1) Place the "M4500 Set-up" switch in the "Enable" position.

2) Press the "HOLD DOWN FORCE" key on the keypad.

3) The "Hold Down Current - Initial Clamp:" (amps) will be displayed.

4) To advance to the "2nd" through "Final" hold down currents, press the "NEXT" key. To retard to the previous hold down, press the "PREV" key.

5) To increase the hold down current, press the "INCR" key or enter the desired number for the hold down current.

6) To decrease the hold down current, press the "DECR" key or enter the desired number for the hold down current.

7) To set the manual current, press "NEXT" until the "Hold Down Current - Manual Mode" is displayed. Press "INCR" or "DECR" to increase or decrease the current respectively.

8) Once the Hold-Down currents are set, press "ESC" to exit the hold down menu.

In addition to adjusting the hold down current for each phase, the timing of each phase may also be adjusted to lengthen or shorten the overall hold down time (in degrees) or adjust the individual phase windows. The timing for the five phases is generated in timing channels 10 thru 14.

Warning: Timing channel set-points must be set consecutively (i.e. CH10 (initial clamp) set "on" at 32 degrees, "off" at 57 degrees, CH11 (2nd Hold) set "on" at 57 degrees, "off" at 62 degrees, etc.) otherwise a "gap" will occur between the phases that will result in the hold down current dropping to zero.

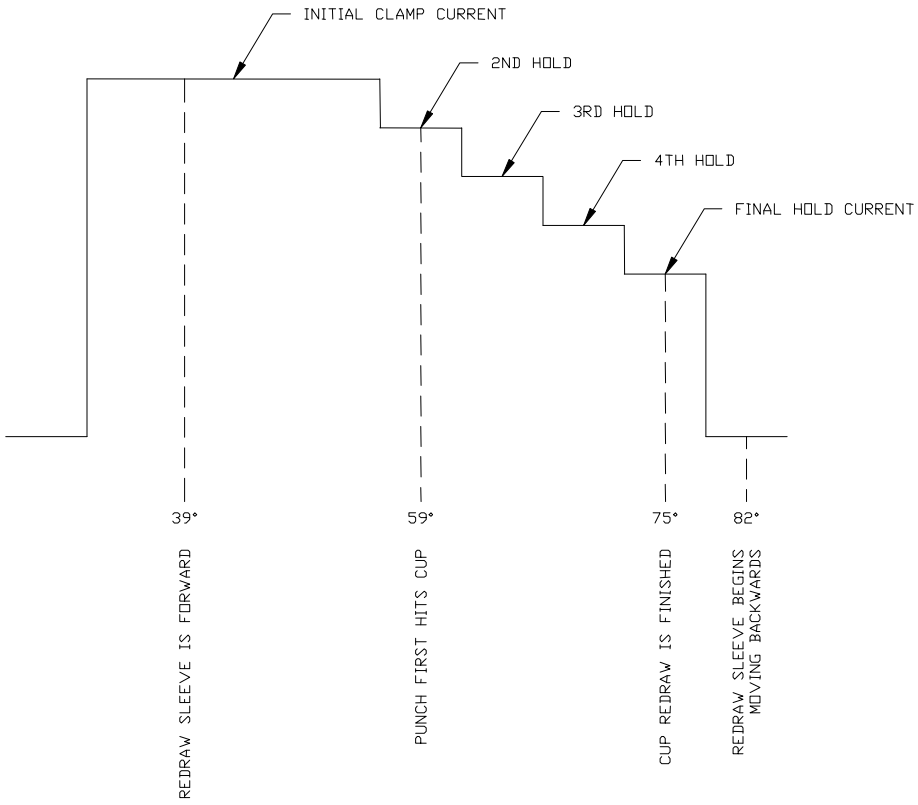

Figure 4.1 – Variable Hold-Down Clamping Sequence

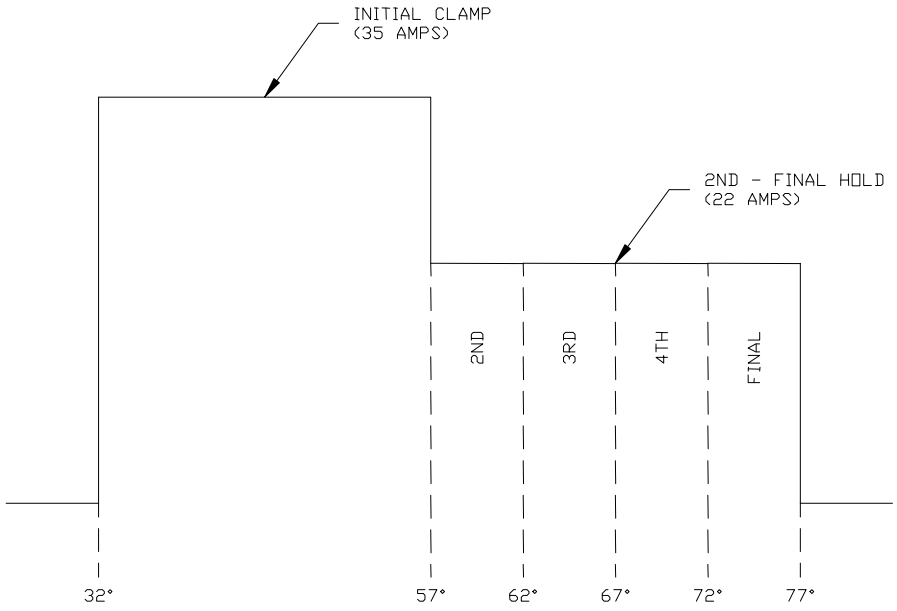

Figure 4.2 – Default Hold-Down Clamping Sequence

4.3 REDRAW MODES OF OPERATION

The redraw has four modes of operation:

- "Auto"
- "Fixed Speed Forward"
- "Fixed Speed Reverse"
- "Manual Hold-Down"

The three position selector switch mounted on the servo retrofit cabinet door, is used to select "Fixed Speed Reverse" / "Fixed Speed Forward" / Auto modes.

The two position selector switch mounted on the servo retrofit cabinet door, is used to select "Manual Hold-Down" / Auto modes. When the two position selector switch is in the "Manual Hold-Down" position, the fixed speed and auto modes are disabled.

1) **Auto Mode Operation (both switches in auto position):** In this mode, the redraw is synchronized with the main crank resolver (electronically geared to crank). This mode is only active when the bodymaker is running in continuous mode. For bar and inch modes the redraw does not move. The operator starts the bodymaker in continuous mode as they would normally do, no further action is required of the operator.

2) **Fixed Speed Forward Operation:** In this mode the redraw turns at a fixed speed in the forward direction which is independent of the main crank speed. The speed of this mode is set with the set-up program (see section 6 – Windows Based Set-up Program Reference or section 7 DOS – Based Set-up Program Reference). This mode is only active when the bodymaker is running in continuous mode. For bar and inch modes the redraw does not move. The operator starts the bodymaker in continuous mode, no further action is required of the operator. The cupfeed gate does not turn on in this mode.

3) **Fixed Speed Reverse operation:** Same operation as Fixed Speed Forward, except the redraw turns in reverse.

4) **Manual Hold-Down Operation:** In this mode the hold-down magnet can be actuated manually for set-up purposes. Typically, this mode is used for setting the redraw housing position in the bodymaker frame (see APM documentation for performing this procedure). This mode disables the main drive, inch clutch mode, continuous clutch mode, redraw servo motor and cupfeed servo motor. The bodymaker guard doors can be opened during manual hold-down operation. Bodymaker bar mode disables the manual hold-down mode and all other servo modes of operation. Manual hold-down mode is performed as follows:

   a) Manually rotate the redraw forward (by hand) until the redraw sleeve is dwelling at the redraw die (clamp position). The hold-down magnet should only be energized at this position. Energizing the electromagnet at another position won't harm any components, but nothing will be accomplished by energizing the magnet when the steel moving mass is not near the magnet.

   b) On the servo retrofit cabinet door, select "Hold-Down" mode.

   c) On the servo retrofit cabinet door, activate the hold-down by simultaneously pressing the "Manual Hold-Down" push-button and turning the spring return "Manual Hold-Down " selector switch to the right. Current to the hold-down coil will now be supplied.

      Note: The two-hand button and switch contains an anti-tie down feature, which requires the push-button and spring return switch to be simultaneously activated (within .5 seconds of each other). Otherwise, the hold-down will not be activated.

      The manual hold-down current can only be activated for a maximum of 20 seconds at which time the hold-down will automatically be released. At this point the manual hold-down cannot be re-activated for another 40 seconds. This maximum manual hold-down time and cool-down time is provided to prevent over heating of the hold-down coil and subsequent damage to the coil.

   d) Once hold-down activation is complete, turn the two-position selector switch from "Manual Hold Down" to the "Auto" position to enable the bodymaker.

4.4 CUPFEED CAM MODE OF OPERATION

The cupfeed cam operates in auto mode, only. In this mode the cupfeed is synchronized with the main crank resolver (electronically geared to crank). This mode is active when the bodymaker is running in continuous or inch modes. In bar mode the cupfeed does not move. The operator starts the bodymaker in continuous or inch modes, no further action is required of the operator.

4.5 BODYMAKER / SERVOS OPERATION

With the servo redraw installed, the operation of the bodymaker will be slightly different. When the clutch is first engaged the crank accelerates to full speed in less than one stroke. The EMM redraw is unable to mechanically accelerate this fast and has been programmed to accelerate over several seconds. After the redraw has accelerated to crank speed, the redraw then synchronizes to the crank position. This sequence takes between 10 to 30 strokes. In inch mode, the redraw is unable to synchronize with the crank and is disabled. In continuous mode, cups do not feed until the redraw has synchronized to the crank. Thus machines that previously fed cups immediately after restart, will now dry stroke for a short period before feeding cups.

Note: The redraw will automatically time itself, when the machine is first activated after power-up. If the redraw is in auto mode and when the machine is started in continuous the first time after power-up, the redraw will turn forward at slow speed until the redraw timing sensor stops seeing (on to off transition) the timing target on the aluminum moving mass. At this time the redraw will accelerate for several seconds to the crank speed. After the redraw has finished accelerating, the redraw will follow the crank automatically. With the redraw in auto mode, the redraw will continue to track the main crank automatically until power to the control system is turned "off".

The cupfeed cam automatically syncs in with the main crank and follows the main crank at all times (including inch) unless a short can or tear-off is detected. At detection of a short can, the cupfeed cam will stop immediately (out of sync with the main crank) to prevent feeding another cup.

Note: With the machine stopped, the cupfeed cam can be turned by hand to any position desired to help facilitate removal of a cup in the cam after a short can is detected. The cupfeed will automatically sync in with the main crank when the machine is restarted therefore it is not necessary to position the cupfeed cam at a specific position prior to restarting the machine.

The cupfeed will automatically time itself, when the machine is first activated after power-up. When the machine is started in continuous or inch the first time after power-up, the cupfeed cam will turn forward at slow speed until the cupfeed timing sensor sees the timing target on the cam. It will then follow the crank automatically and continue to track the main crank automatically until power to the control system is turned "off".

Note: At the detection of a short can or tear-off, any cups in the cupfeed cam (below the cupfeed stop finger) must be removed prior to starting the machine. In fact anytime the machine is stopped, the cupfeed cam must be clear of cups. When the machine is re-started, the redraw will not be in sync with the crank, therefore any cups that are attempted to be punched will cause a tear-off.

4.6 ALARM MESSAGES

The following lists the alarm messages, and their definitions, that may appear on the Keypad/Display:

Short Can/Tear Off: This alarm is displayed when a short can or tear-off is detected by the short can sensor when cups are being feed. This is determined with the "Short Can Timing" signal (CH02) (see section 8 – "General Timing Signal Locations").

Die Sensor Failed: This message is displayed when the die sensor (short can sensor) fails "ON". If the sensor fails "off", repeated short can alarms will occur. This alarm is detected with the "Sensor Check" timing (CH03) (see section 8 – "General Timing Signal Locations").

Domer Jam Alarm: This alarm is displayed when a domer jam (double can thickness in domer) has been detected.

Timing Signal Failure: This message is displayed if any one of the 13 timing channels (CH00-CH07 and CH10-CH14), fail to change state while the machine is running.

Redraw Following Fault (Out of Sync):

1) This fault will appear if the redraw servo motor falls out of sync with the main crank. This is set by "Max Error for Following Error Alarm" limit (see section 6 – Windows Based Set-up Program Reference or section 7 – DOS Based Set-up Program Reference).
2) This fault will also appear if the redraw timing sensor can't find the timing target within 5 seconds while the redraw timing procedure is being performed after power-up.

Redraw Motor Over Temperature: This message is displayed if the thermostat in the redraw servo motor opens. This occurs at 155 degrees C. This indicates that the redraw servo motor is overloaded.

Redraw Motor Amplifier Fault: This fault is generated by the Redraw Servo Amplifier (B100A40) and indicates any one of the following conditions:

1) Output Short Circuit: Indicates either a short in the redraw motor stators or stator wiring.
2) Over-Voltage: Indicates an excess voltage at the input to the amplifier.
3) Under Voltage: Indicates an under voltage at the input to the amplifier (blow fuse, etc.).
4) Amplifier Over Temperature: Indicates the power circuit of the amplifier is over loaded.

Redraw S4520 Controller (Slot0-1) Fault: This fault occurs when the S4520 motion controller in slot0-1 fails (watchdog timer time-out). Verify that the S4520-RDC in slot0-1 is loaded with the "SRVRDRW" application program and that the S4520-RDC processor is running (run LED "ON").

Hold-Down Coil Amplifier Fault: This fault is generated by the Hold-Down Coil Amplifier (100A25) and indicates any one of a the following conditions:

1) Output Short Circuit: Indicates either a short in the hold-down coil or hold-down coil wiring.
2) Over-Voltage: Indicates an excess voltage at the input to the amplifier.
3) Under Voltage: Indicates an under voltage at the input to the amplifier (blow fuse, etc.).
4) Amplifier Over-Temperature: Indicates the power circuit of the amplifier is over loaded.

Cupfeed Following Fault (Out of Sync):

1) This fault will appear if the cupfeed servo motor falls out of sync with the main crank. This is set by "Max Error for Following Error Alarm" limit (see section 6 – Windows Based Set-up Program Reference or section 7 – DOS Based Set-up Program Reference).
2) This fault will appear if the cupfeed timing sensor can't find the timing target within 5 seconds while the cupfeed timing procedure is being performed after power-up.

Cupfeed Motor Over Temperature: This message is displayed if the thermostat in the cupfeed servo motor opens. This occurs at 155 degrees C. This indicates that the cupfeed servo motor is overloaded.

Cupfeed Motor Amplifier Fault: This fault is generated by the Cupfeed Servo Amplifier (B25A20) and indicates any one of the following conditions:

1) Output Short Circuit: Indicates either a short in the cupfeed motor stators or stator wiring
2) Over-Voltage: Indicates an excess voltage at the input to the amplifier.
3) Under Voltage: Indicates an under voltage at the input to the amplifier (blow fuse, etc.).
4) Amplifier Over-Temperature: Indicates the power circuit of the amplifier is over loaded.

Cupfeed S4520 Controller (Slot0-2) Fault: This fault occurs when the S4520 motion controller in slot0-2 fails (watchdog timer time-out). Verify that the S4520-RDC in slot0-2 is loaded with the "SRVCUPR" application program and that the S4520-RDC processor is running (run LED "ON").

Safety Circuit Fault: This occurs when the system detects that either the C3 contactor has failed "ON" or "off" or that either the CR-CLTA or CR-CLTB clutch relays have failed "ON" or "off". The CR-CLTA/CR-CLTB safety circuit is a redundant self-checking circuit which, verifies the proper operation of itself as well as the clutch SOLA/SOLB inputs. This fault is determined by the "Clutch ON" and "C3 on" inputs to the M4510 and is set if the "Clutch ON" input is "ON" while the "C1 ON" input is "off" or vice versa. This indicates a fault in the clutch SOLA/SOLB inputs or the safety circuit itself.

Redraw Mode Changed While Running: Indicates that a redraw mode switch was changed while the bodymaker was running.

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OPERATOR'S REFERENCE

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SECTION 5
USING THE KEYPAD/DISPLAY

The D4591 Keypad/Display contains 24 keys consisting of data display commands, set-up commands, and a numeric keypad. The display is a 2 line by 40 character back-lit LCD display which displays the selected data and set-up menus. The Keypad/Display can be used to view data, adjust timing channel set-points and some of the set-up parameters.

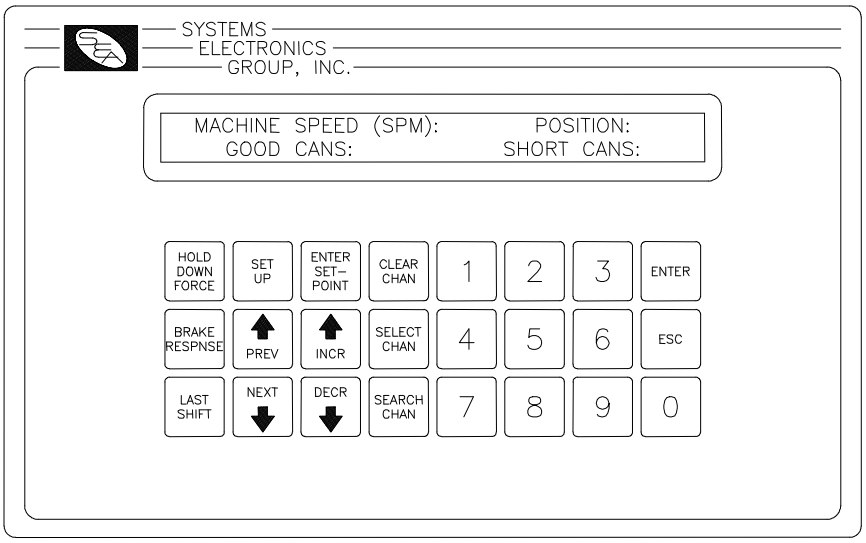


Figure 5.1 - EM2RDWCP Keypad/Display

The Keypad/Display allows the following to be viewed or adjusted:

1) Adjust the Hold-Down Force
2) View the Actual Brake Response (in degrees)
3) View the Current Shift Data
4) View the Last Shift Data
5) Set the Bodymaker Set-Up Parameters
6) Set the Trimmer Set-Up Parameters
7) Set Machine Timing
8) Set Machine Zero
9) Set Cupfeed Offset

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

SECTION 5
USING THE KEYPAD/DISPLAY

5.1 DEFAULT SCREEN

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

MACHINE SPEED (SPM): POSITION:
GOOD CANS: SHORT CANS:

Where:

- "Machine Speed" is the current speed of the bodymaker
- "Position" is the current angular position of the bodymaker crankshaft
- "Good Cans" is the total number of good cans produced so far into the current shift
- "Short Cans" is the total number of short can faults the machine has had so far into the current shift

This display effectively replaces a speed meter, a position display, and two can counters. This screen is always returned to when no commands are active.

5.2 HOLD DOWN FORCE KEY

This key is used to set the five hold down phase currents as well as the manual hold-down current.

The hold down force is set empirically and is proportional to the hold down current. At the extreme, too little current will result in too little hold down force resulting in a tear-off or punch through. Too much hold force likewise will result in a tear-off. The default settings of the five clamping phases incorporate a high initial clamping force with the following four phases being equal (see figure 4.2 – "Default Hold-Down Clamping Sequence"). Since each phase can be adjusted independently, it is possible to vary the force as the can is being drawn.

Note: The force can be adjusted on the fly, while the machine is running

To adjust the force, perform the following:

1) Place the “M4500 Set-up” switch in the “Enable” position.

2) Press the “HOLD DOWN FORCE” key on the keypad.

3) The “Hold Down Current - Initial Clamp:” (amps) will be displayed.

4) To advance to the “2nd” through “Final” hold down currents, press the “NEXT” key. To retard to the previous hold down, press the “PREV” key.

5) To increase the hold down current, press the “INCR” key or enter the desired number for the hold down current.

6) To decrease the hold down current, press the “DECR” key or enter the desired number for the hold down current.

7) To set the manual current, press “NEXT” until the “Hold Down Current - Manual Mode” is displayed. Press “INCR” or “DECR” to increase or decrease the current respectively.

8) Once the Hold-Down currents are set, press “ESC” to exit the hold down menu.

5.3 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 BDC 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. Press the “ESC” key to return to the default screen.

5.4 LAST SHIFT KEY

The Last shift data menu displays the following information:

Good Cans: This is the total number of good cans produced for the previous shift. This is essentially a can counter.

Short Cans: This is the total number of short can faults the machine had the previous shift.

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 "Data Counts Reset" input transfers from a "0" to a "1". This can be at the end of either an 8 or 12 hour shift. This data is only reset at the end of shift transition.

Note: The Current shift "Good Cans" and "Short Cans" is displayed as part of the default screen.

5.5 SET-UP KEY

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

1: SET BODYMAKER PARAMETERS
2: SET TRIMMER PARAMETERS
3: SET MACHINE TIMING (SET-POINTS, ETC.)
4: ZERO MACHINE (SET RESOLVER OFFSET)
5: HOME CUPFEED (SET CUPFEED OFFSET)
6: HOME REDRAW (SET REDRAW 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, press the corresponding numeric key (1 thru 6).

Note: For virtually all the menus, 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 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.

5.5.1 SET BODYMAKER PARAMETERS

This menu is activated when the "1" key (SET BODYMAKER 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 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", if the compensation is to be enabled, enter "1".

Desired BDC Stop Pos (Low Speed): This is the desired stopping location (in degrees) for a BDC stop in low speed when the brake wear compensation is enabled. This is typical set to 000 degrees (Back Dead Center). This prompt is only displayed when the brake wear compensation is enabled.

Desired BDC Stop Pos (High Speed): This is the desired stopping location (in degrees) for a BDC stop in high speed when the brake wear compensation is enabled. This is typical set to 000 degrees (Back Dead Center). This prompt is only displayed when the brake wear compensation is enabled.

Maximum Allowed Stopping Response: This defines the maximum allowed brake response is before a "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 stops at rest) when a BDC stop is performed is longer than this number, the alarm is 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 Bodymaker Low Speed (SPM): This is the speed (in strokes per minute), the bodymaker will run in low speed.

Running Bodymaker High Speed (SPM): This is the speed (in strokes per minute), that the bodymaker will run in high speed.

5.5.2 SET TRIMMER PARAMETERS

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

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

Trimmer Minimum Speed (CPM): This parameter determines the speed the trimmer will run at when the bodymaker is stopped (de-clutched).

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

5.5.3 SET MACHINE TIMING

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

CHuu SETPOINT:xxx [] “channel name”
RPM:yyyy POS:zzz OFFSET:wwww SCALE:360

Each field is defined as follows:

Field	Definition
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) BDC (HIGH) TIMING, (CH01) BDC (LOW) TIMING, etc.
RPM:yyyy	Current machine speed where “yyyy” is in CPM.
POS:zzz	Current resolver position where “zzz” is in degrees.
OFFSET:wwww	Resolver offset where “wwww” is the offset in degrees.
SCALE:360	Resolver SCALE FACTOR (360 degrees per revolution).

- **“ENTER SET-POINT” Key:** Used to enter a new set-point (both “on” and “off” set-points) in the selected channel.
- **“CLEAR CHANNEL” Key:** Used to clear all set-points from the selected channel.
- **“SELECT CHANNEL” Key:** Used to select a new channel for programming.
- **“SEARCH CHANNEL” Key:** Used to view both the “on” and “off” set-points in the selected channel.

Searching A Channel: Press the "SEARCH CHANNEL" key to view the set-points in a channel. 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.

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

1) Press the "SELECT CHANNEL" key to Select a channel to be adjusted and enter the channel number (00 to 17). In addition, the "NEXT" and "PREV" keys can be used to advance to the next channel or retard to the previous channel.

2) Press the "CLEAR CHANNEL" key to clear out the existing set-point(s).

   Note: Entering a new set-point does not automatically clear out the old set-point. If the two set-points are not in the same place, the channel will simply have two set-points if the old one is not cleared out first.

   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 the "ENTER SET-POINT" key to enter a new set-point. The display will then prompt for the "ON" set-point. Enter the position (in degrees) where the set-point should go "ON". The display will now prompt for the "OFF" set-point. Enter the position (in degrees) where the set-point should go "off". 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) Press <ESC> to return to the primary set-up menu. Press <ESC> again to return to the default screen.

5.5.4 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 M4510 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 (back 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 M4510 will calculate the actual offset value required to make this the 000 position and will display this number in the offset field.

5) Return to the primary set-up menu by pressing <ESC>. Return to the default screen by pressing <ESC> again.

5.5.5 HOME CUPFEED (SET CUPFEED OFFSET)

This selection is used to set the cupfeed cam's relative position to the crank. To set the cupfeed home position (cupfeed offset) perform the following:

1) Set the punch and cupfeed cam at the their correct relative positions. Typically, these positions are determined as follows:
   a) With the punch on the backward stroke, bar the crank until the nose of the punch has just past the cup position (cup is free to enter cup locator without interference with punch).
   b) With a cup in the cupfeed cam, rotate the cup cam until the bottom edge of the cup is just above the punch.

   This relative position gives the cup the maximum amount of time to settle into the cup locator, while insuring the cup and punch do not interfere with each other.

2) Home the cupfeed cam by selecting "5: HOME CUPFEED (SET CUPFEED OFFSET)" from the primary set-up menu. Enter "0" to set the relative positions of the cupfeed cam and punch. The main set-up menu will now be displayed.

3) The M4510 calculates the actual cupfeed cam offset value that is required to set this relative position of the cupfeed cam to the punch.

4) Return to the default screen by pressing <ESC>.

5.5.6 HOME REDRAW (SET REDRAW OFFSET)

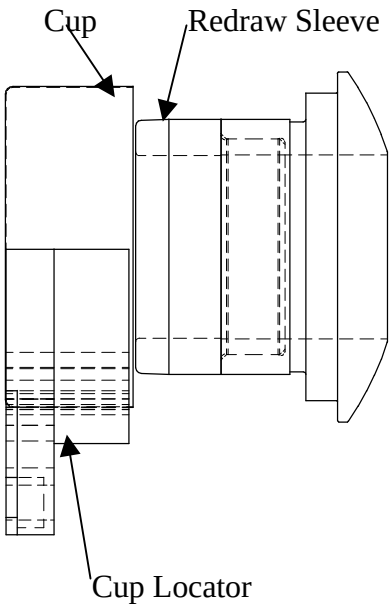
Prior to performing this timing procedure, adjust the redraw timing sensor to moving mass gap per APM set-up procedures.

Prior to timing the redraw with respect to the main crank, rotate the redraw forward through at least one complete revolution with the target on the moving mass turning the timing sensor on and back off at least once since power-up.

Perform the following to time the redraw mechanism with respect to the main crank:

1) Inch or bar the ram to the back position and jog or bar the redraw to the back position (cup locator open).
2) Using the “Manual Cupfeed” push-button, feed one cup into the cupfeed cam and rotate the cam by hand until the cup is fully loaded into the cup locator.
3) Bar the ram in the forward direction until the punch just contacts the cup.
4) Bar the redraw in the forward direction until the face of the redraw sleeve is even with the top lip of the cup.
5) With the redraw and ram located as described above, “Home Redraw” using the Keypad/Display.

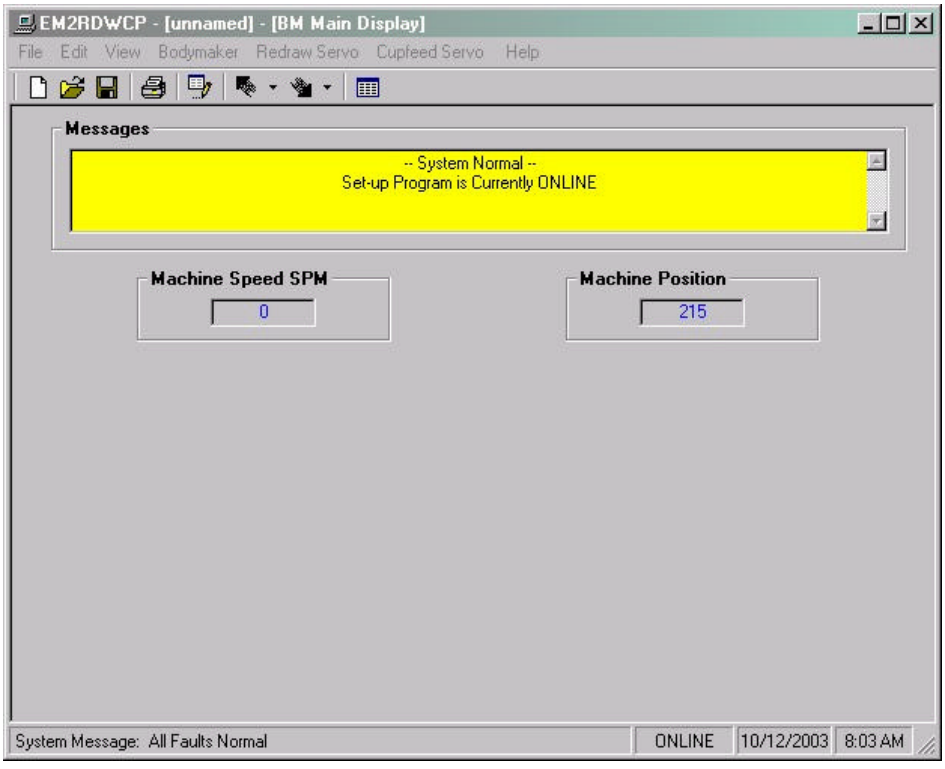
The previous steps will automatically set the “Redraw Home Position” by calculating the redraw offset relative to the main crank position.



SECTION 6
WINDOWS BASED
SET-UP PROGRAM REFERENCE

The Windows based set-up program is menu driven, allowing the user to easily view data, alter set-up variables or set machine timing (machine offset, timing signal locations, etc.), using a PC running the Windows (95/98/ME/2000/XP/NT) operating system. The set-up variables are used to configure and tune the M4510 to match the configuration and performance of the specific bodymaker (see section 2.10 – "Set-Up").

Note: The set-up program is an on-line communications program used to interface with the M4510 module. The data displayed and set in the windows is communicated directly to the module, while in the "Online" edit mode. Therefore, prior to going online with the processor, make sure an RS-232 cable is connected from the COM port on the computer to the "PROG" or "MOTION" port on the M4510. The variables displayed while in the "Online" edit mode are read directly from the processor. Data can be saved to a "Set-up Data" file (*.sdt) whenever changes are made to a parameter or if the data is uploaded from the processor.



SECTION 6
WINDOWS BASED
SET-UP PROGRAM REFERENCE

6.1 GENERAL DESCRIPTION

Title Bar: At the top of the window is the "Title Bar". The title bar is used to display the name of the working "Set-up Data" file, as well as, the name of the active "Window". The title bar is dark if the window is active and grayed if another window is active. The color depends on the settings of the Display Properties of the Control Panel.

Tool Bar: At the top of the window is a "Tool Bar". The tool bar allows the user to quickly execute those functions most often used. These functions can also be executed from the drop down menus at the top of the window. The following functions can be executed from the tool bar:

New… This creates a completely new "Setup" file, loaded with the default variables and the word "[unnamed]" displayed in the title bar. If any changes were made to the existing file, the user is prompted to save changes to the existing file before exiting the program.

Open… This displays a dialog box allowing the user to select an existing setup data file to open. The name of the file will be displayed in the title bar.

Save This displays a dialog box allowing the user to select a folder and enter a name for the file. The user will be notified if the file already exists and the extension ".sdt" will automatically be added to the file name. If a file has been opened, the data is saved directly to the selected file.

Print This allows the user to generate a "Report" printout of all set-up parameters, timing set-points and shift data contained in the current setup data file.

Offline Edit This function allows the user to perform "Offline" editing on the current set-up data file. This allows the user the ability to make any necessary changes to the set-up parameters while not online with the processor.

Upload (save) Settings This allows the user to upload (save) set-up parameters, timing set-points and shift data from the M4510, S4520 (slot0-1) and S4520 (slot0-2) to a "Set-up Data" file.

Note: The default selection is to upload from the M4510. The user can select a specific board from the associated drop down list.

Download (restore) Settings This allows the user to download (restore) set-up parameters, timing set-points and shift data to the M4510, S4520 (slot01-) and S4520 (slot0-2). This can be the default setting or from a "Set-up Data" file.

Note: The default selection is to download to the M4510. The user can select a specific board from the associated drop down list.

Target Board Interface This allows the user to view fault codes, S3000 network communication error codes and review the current "Ident" and "Revision" of the application program loaded into the M4510, S4520 (slot0-1) or S4520 (slot0-2).

Status Bar: At the bottom of the window is the "Status Bar". The status bar is used to display system messages, online or offline mode, as well as, the current time and date as set by the operating system. The system messages panel displays general information about the operation of the system. The Online/Offline mode panel displays the status of the current set-up program mode of operation. The mode of operation can be changed by "Double-Clicking" the online/offline mode panel.

Hot Keys: Hot keys are activated by holding down the "ALT" key and simultaneously pressing the underlined letter of the desired function. Almost every function can be activated by either pressing a series of hot keys or using the "TAB" key to move between fields.

SECTION 6
WINDOWS BASED
SET-UP PROGRAM REFERENCE

Online/Offline Modes: The set-up program allows the user to make changes while "Online" with the processor. The "Offline" mode is used to preset parameters prior to download or view data and settings while not "Online" with the processor. All functions are available to the user while "Online", however, specific "Online" functions are disabled in the "Offline" edit mode.

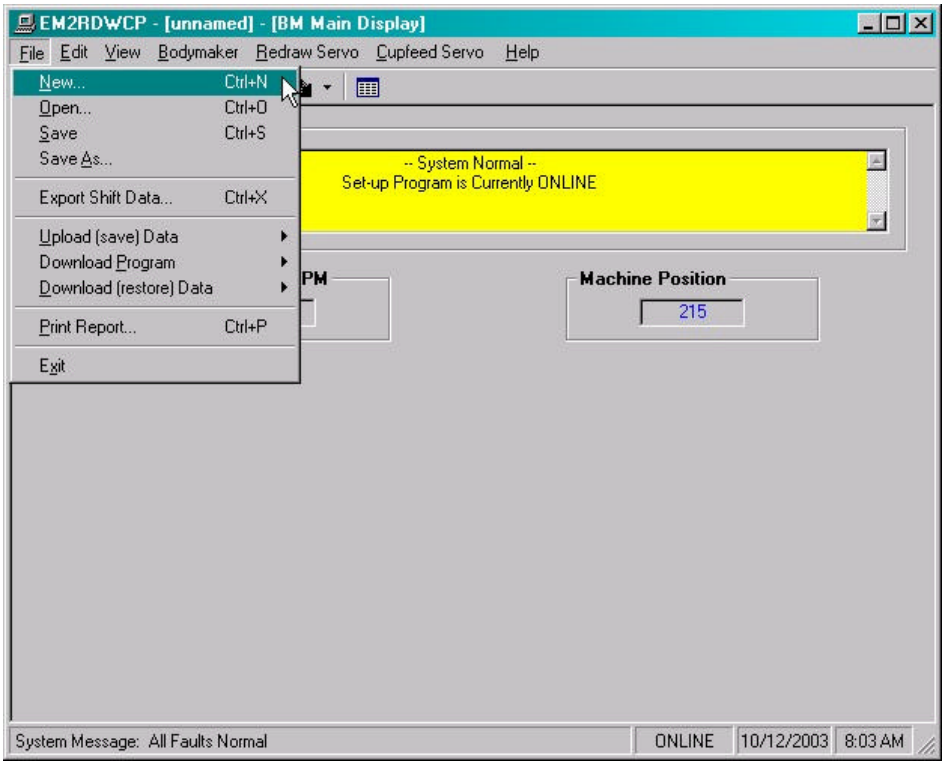
Note: Offline changes can only be made by enabling "Offline Editing", accessed under the "Edit" menu, pressing function key F2 or selecting the "Offline Edit" icon from the tool bar.

Getting Help: The entire contents of this manual, is contained within the help file. Pressing Ctrl+H will display the help file window. Pressing the F1 key will display the contents file. Hot spots allow jumps to other topics to display additional information as desired. Selecting "About EM2RDWCP" from the help menu will display a dialog box listing information about the current revision of the setup program and how to obtain technical support.

6.2 THE FILE MENU

The "File" menu allows the user to perform the following functions:

- Create a "New" set-up "Data File".
- Open an existing "Data File".
- Save any changes made to the current "Data File" to disk.
- Upload (save) Data from the Processor.
- Download a SYSdev (.sdv) program to the processor
- Download (restore) Data from the current set-up "Data File" to the processor.
- Print a Report of the current set-up parameters.
- Exit the set-up program.



6.2.1 THE SET-UP DATA FILE

The set-up "Data File" (.sdt) is a binary access file, designed for fast file I/O operation. When the set-up program is first invoked, a default set of parameters, are loaded into memory. If changes are made to any of the set-up parameters (either online or offline), the user will be flagged to "Save Changes" upon exit of the program.

Note: Any windows based "Set-up" program can open a set-up "Data File", however, the data tables will not be properly aligned. The user will be alerted to the problem if a set-up data file has been created by either a different set-up program or a different revision of the software.

The set-up "Data File" is similar to that of a word processing file. When the program first starts, a default file is loaded and the user is able to make any changes as desired. To "normalize" the set-up program with the processor, the user should define or open an existing file, then "Upload" from each of the processors. This allows the user to either create a backup of the data or maintain an existing file. The user can even open a data file for another bodymaker, save the file to a new name, make the necessary changes and simply download the new parameters to another processor.

The following functions can be accessed from any set-up or display window.

New…: To create a "New" data file, select "New" from the "File" menu or press "Ctrl + N". This creates a completely new file, loaded with the default variables and the word "[unnamed]" is displayed in the title bar. If any changes were made to the existing file, the user is prompted to save changes to the existing file.

Open…: To "Open" and existing data file, select "Open" from the "File" menu or press "Ctrl + O". This displays a dialog box allowing the user to select an existing data file to open. The name of the file will be displayed in the title bar. If any changes were made to the existing file, the user will be prompted to save any changes before terminating the program.

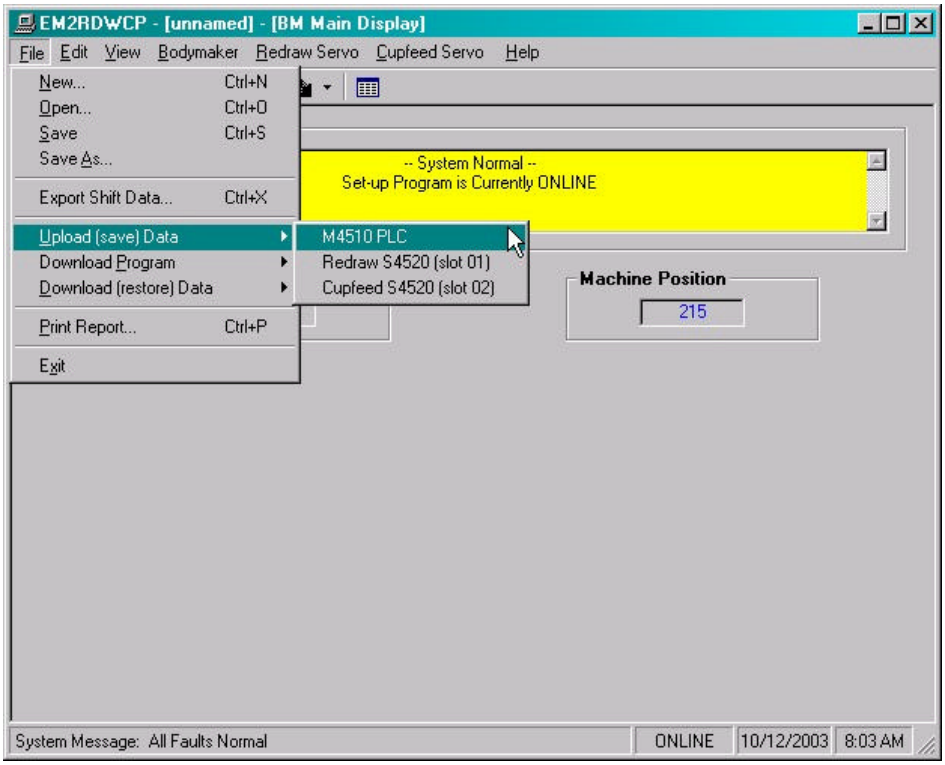
Save: To "Save" the data to disk, select "Save" from the "File" menu or press "Ctrl + S". If this is a "New" file, a dialog box will be displayed, allowing the user to select a folder and enter a name for the file. The user will be notified if the file already exists and the extension ".sdt" will automatically be added to the file name.

Save As: To save the data to a new name, select "Save As" from the "File" menu. This displays a dialog box allowing the user to select a folder and enter in a new name for the file. The user will be notified if the file exists and the extension ".sdt" will automatically be added to the file name.

Export Shift Data…: This function allows the user to export the shift data to a "Tab Delimited" text file. This allows the user to easily use the shift data to produce production reports.

6.2.2 UPLOAD (SAVE) DATA

The "Set-up" program allows the user to upload set-up parameters, timing channel set-points and shift data from the M4510, Redraw S4520 (slot0-1) and Cupfeed S4520 (slot0-2) into a set-up "Data File". This function is accessed from the "File" menu and the user is given the choice of the following options:



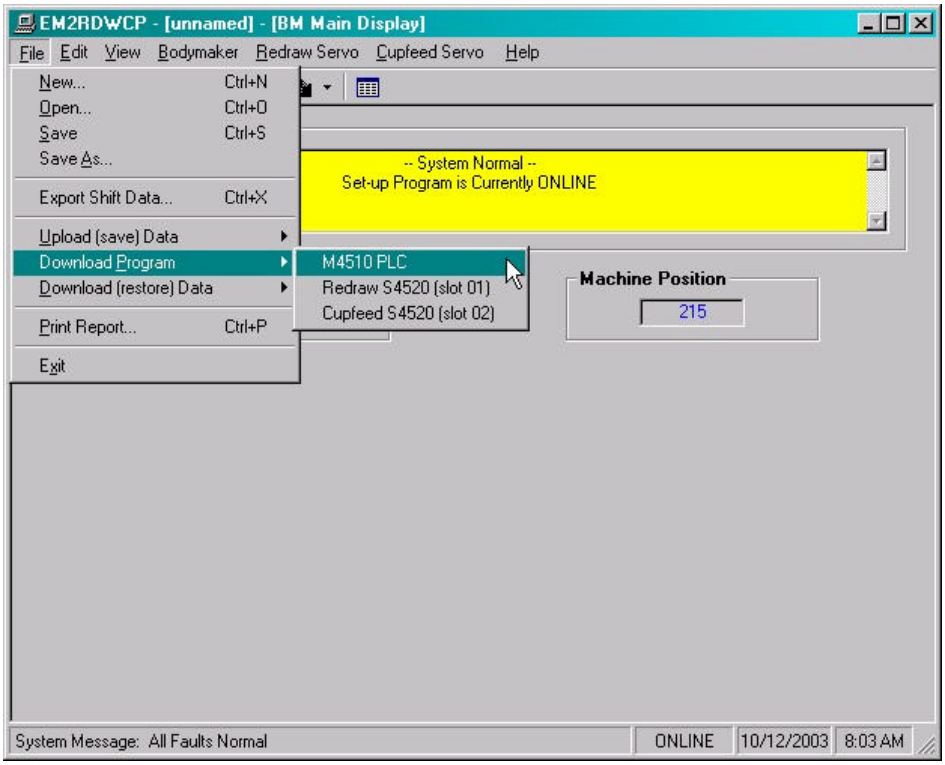
M4510 PLC: This option uploads (reads) set-up parameters, machine timing set-points and shift data from the M4510, only.

Redraw S4520 (slot 01): This option uploads (reads) set-up and tuning parameters from the "Redraw" S4520 Motion Control Board (slot 01), only.

Cupfeed S4520 (slot 02): This option uploads (reads) set-up and tuning parameters from the "Cupfeed" S4520 Motion Control Board (slot 01), only.

6.2.3 DOWNLOAD PROGRAM

The “Set-up” program allows the user to “Download” any SYSdev program file to the M4510, Redraw S4520 (slot 01) or Cupfeed S4520 (slot 02).



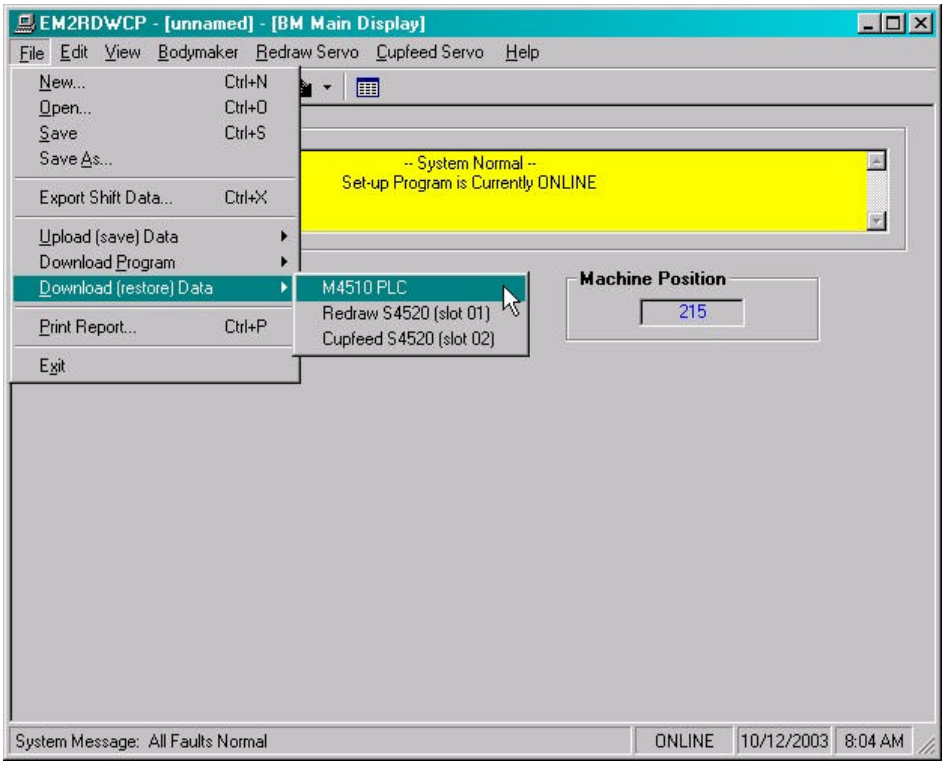
To “Download” a SYSdev program to the processor, the program must be “Online”. If “Online” mode cannot be achieved, program download will not be executed. If the program is currently “Offline”, the user will be prompted to first go “Online”. A dialog box will be then be displayed, allowing the user to select the SYSdev file to download.

Note: Only the files with the “.sdv” file extension will be displayed. It is important to keep in mind that only a valid M4500 PLC SYSdev file can be downloaded through the set-up program. Care should be taken when selecting a program to download.

Once selected, a message box is displayed informing the user of the current program, revision and checksum of the program loaded in the processor, as well as, that of the selected program. The user must confirm their selection by clicking the "Yes" command button. After the user confirms their choice, program download is initiated and the current program download address is displayed. When program download is complete, the user is prompted to acknowledge. Control is passed back to the main program and the set-up program remains in an "Online" edit mode.

6.2.4 DOWNLOAD (RESTORE) DATA

The set-up program allows the user to download "Set-up" parameters, timing channel set-points and shift data to the M4510, Redraw S4520 (slot 01) or Cupfeed S4520 (slot 02) from the set-up "Data File". This function is accessed from the "File" menu and the user is given the choice of the following options:



M4510 PLC: This option downloads set-up parameters, machine timing set-points and shift data to the M4510, only.

Redraw S4520 (slot 01): This option downloads (restores) set-up and tuning parameters to the "Redraw" S4520 Motion Control Board (slot 01), only.

Cupfeed S4520 (slot 02): This option downloads (restores) set-up and tuning parameters to the "Cupfeed" S4520 Motion Control Board (slot 01), only.

Note: Only the values contained within the current data file are used. If the validity of the current data file is questionable, review the data in an "Offline" mode prior to download.

6.2.5 PRINT REPORT

The "Set-up" program allows the user to generate a "Report" printout of all the set-up parameters, timing channel set-points and shift data. This function is accessed from the "File" menu.

At the top of each page, the report displays the name of the set-up file being printed. At the bottom of each page is the date and time the document was printed, as well as, the page number.

To printout a report of the settings contained in the set-up "Data File", perform the following:

1) From the "File" menu, select "Print Report" or press "Ctrl + P".

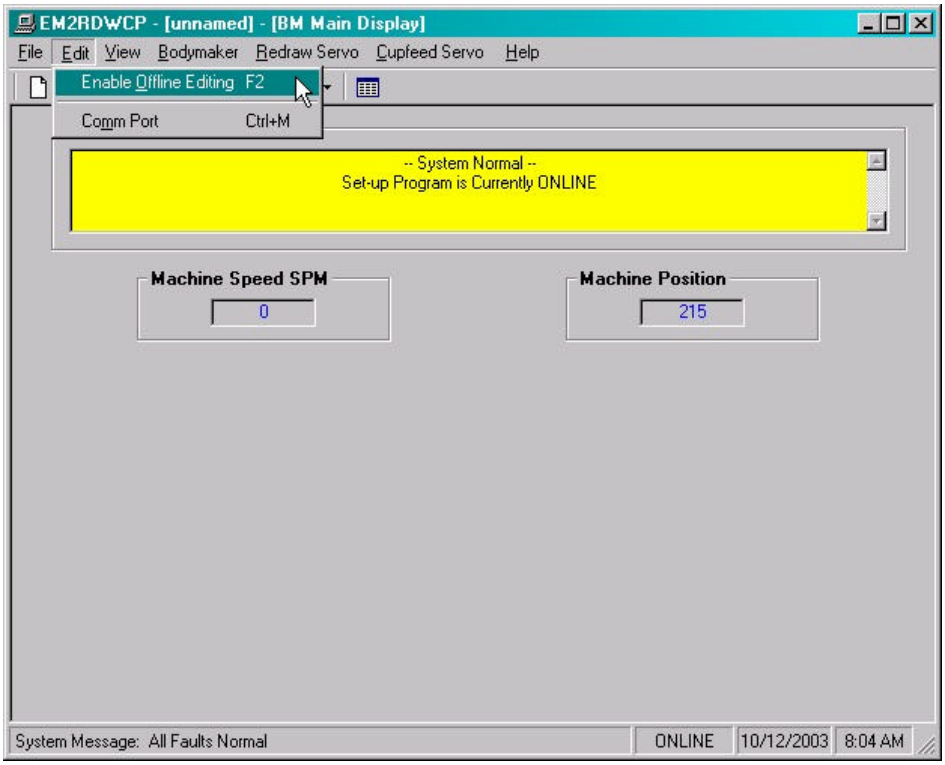
2) This displays the "Print Setup" dialog box, allowing the user to select a printer, as well as, the paper size and orientation. Once the user selects "OK", the report is generated and sent to the specified printer device.

Note: This function makes use of the windows print manager, which allows the user to continue with their work while the document is being printed.

6.3 THE EDIT MENU

The "Edit" menu allows the user to perform the following functions:

- Enable/Disable Offline Editing.
- Set-up the Comm Port.



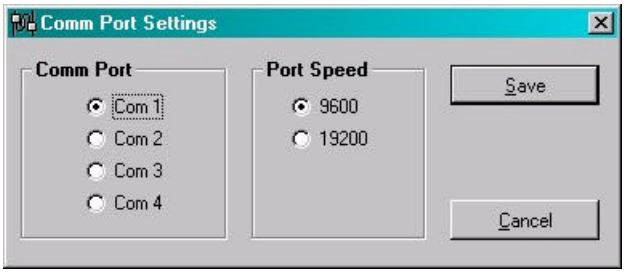
6.3.1 ENABLE OFFLINE EDITING

This function allows the user to perform "Offline" editing on the currently loaded set-up data file. This allows the user the ability to make any necessary changes to the set-up parameters while "Offline" with the processor.

If offline editing is not enabled, the user is only able to view the set-up parameters and shift data. When the program is first invoked, the default setting is offline editing disabled. The user will need to specifically select "Enable Offline Editing" (either from the edit menu, pressing function key F2 or from the tool bar) to enable/disable this feature.

6.3.2 SET-UP COMM PORT

This function allows the user to specify the serial communications port and rate to communicate with the M4510. The PROG port (of the M4510) and MOTION port (of the S4520) communicate at 9600 baud.



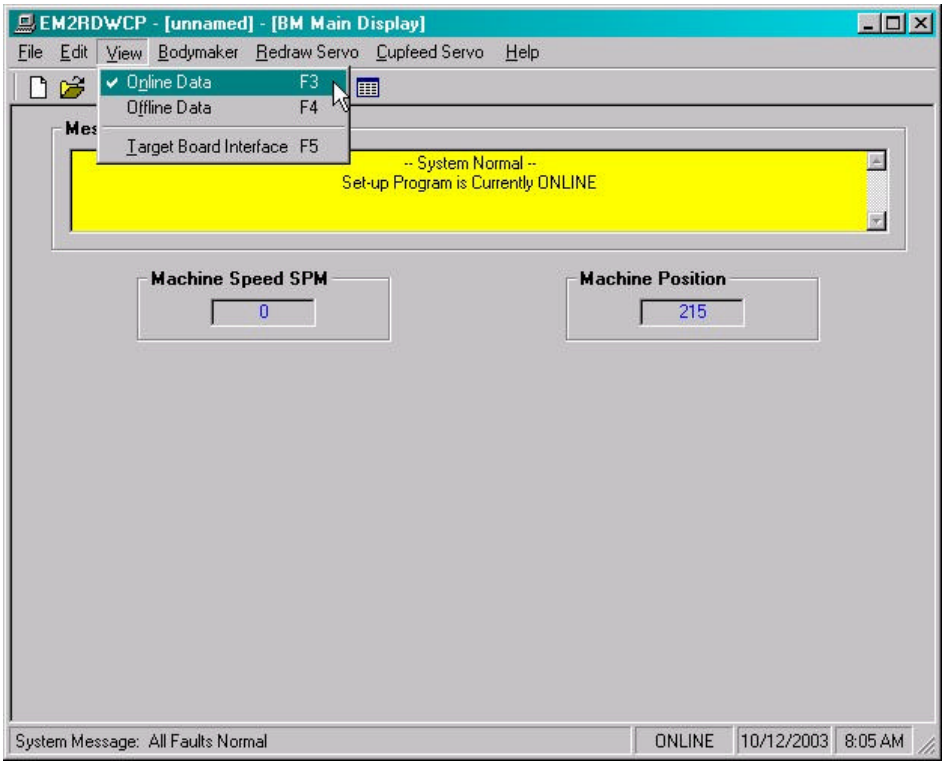
The option to select the 19200 baud rate is to allow the user to communicate via the S4516 serial communications board. In most cases, the user will only need to specify the communications port and leave the baud rate at 9600.

If communication problems occur, make sure there is a secure connection from the PC to the PLC. Then check the Comm port. In most cases, the user will only need to select a new Comm port. If communication problems persist, there may be another program causing a conflict with the port. Check the port configuration from the “Settings” folder.

6.4 THE VIEW MENU

The "View" menu allows the user to perform the following functions:

- View "Online" Data
- View "Offline" Data
- View the "Target Board Interface"



6.4.1 VIEW ONLINE DATA

This function allows the user to go "Online" with the M4510, Redraw S4520 (slot 01) or Cupfeed S4520 (slot 02). This is accessed from the "View" menu, by selecting "Online Data" or by simply pressing the "F3" function key.

Note: The user can be toggled between "Offline" and "Online" by simply double clicking on the "Online" or "Offline" panel displayed in the status bar at the bottom of the window.

Once invoked, the set-up program will open the Comm port and attempt to communicate with the processor. If unsuccessful, a warning message will be displayed prompting the user to either "Retry" or "Cancel" the operation. If the operation is canceled and communication with the processor cannot be established the system will be placed in an "Offline" mode.

Note: Anytime while the set-up program is "Online" with the processor and communication is interrupted, a warning message will be displayed.

6.4.2 VIEW OFFLINE DATA

This function allows the user to place the set-up program in an "Offline" mode. This is accessed by the "View" menu, by selecting "Offline Data" or by simply pressing the "F4" function key. All values displayed in "Offline" edit mode reflect the actual values contained in the currently loaded set-up data file.

Note: The program can be toggled between "Online" and "Offline" by simply double clicking on the "Online" or "Offline" panel displayed in the status bar at the bottom of the window.

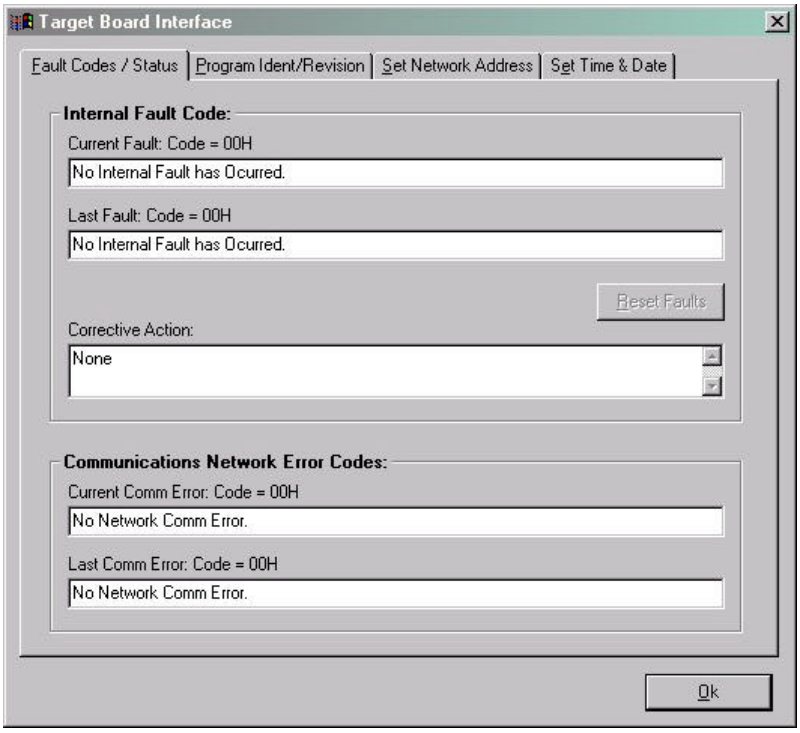
Once invoked, the set-up program will cease communication with the processor and close the Comm port.

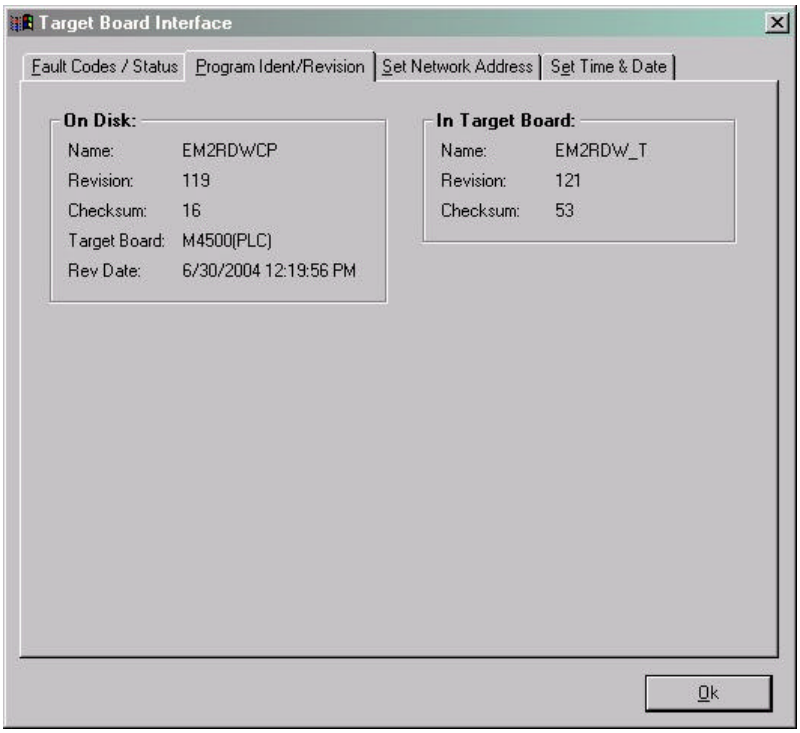
6.4.3 TARGET BOARD INTERFACE

This function allows the user to view fault codes, S3000 network communication error codes and review the current "Ident" and "Revision" of the application program. This is accessed from the "View" menu, by selecting "Target Board Interface" or by simply pressing the "F5" function key.

Once invoked, the set-up program will prompt the user to select a program. The setup program will then attempt to communicate with the processor. If unsuccessful, a warning message will be displayed, prompting the user to either "Retry" or "Cancel" the operation. The "Target Board Interface" window will then be displayed.

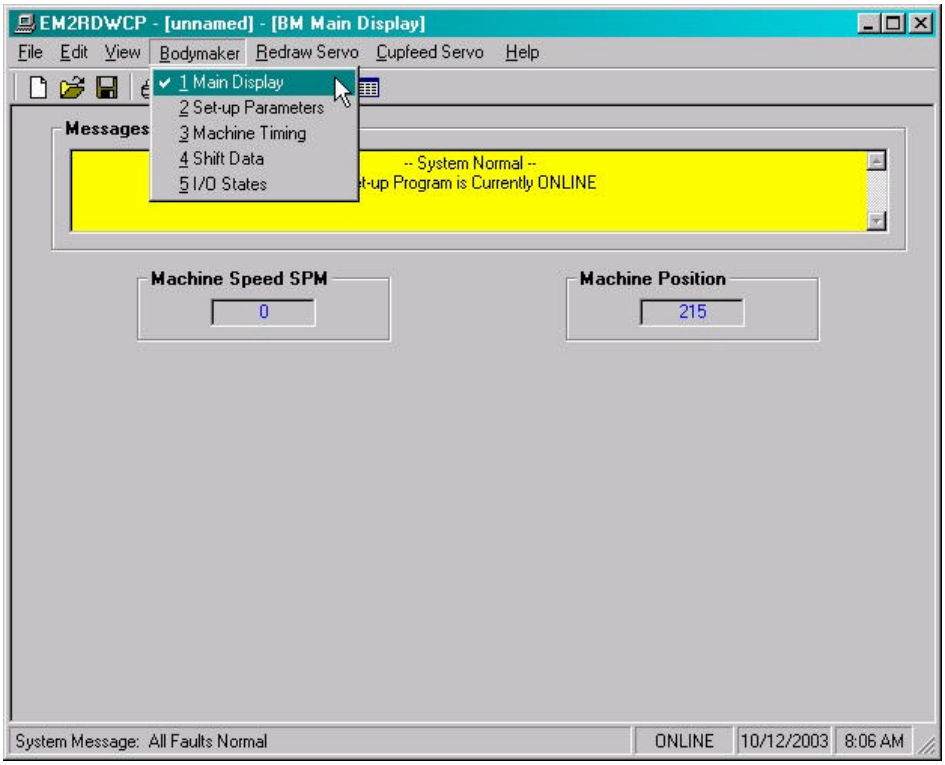
SECTION 6
WINDOWS BASED
SET-UP PROGRAM REFERENCE





6.5 THE BODYMAKER MENU

The “Bodymaker” menu allows the user to select one of five different Display/Set-up windows, used to modify set-up parameters, view shift data, adjust timing channel set-points or receive feedback about the current status of the control system.

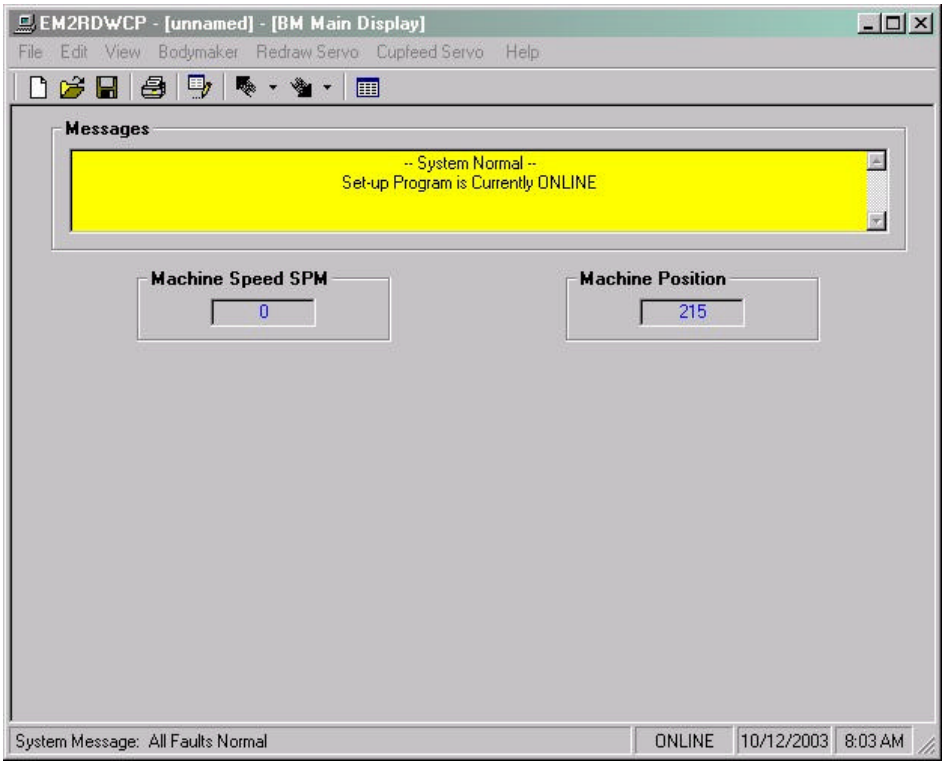


Once a menu item is selected, a check mark is placed next to the selection and the window is displayed with the name displayed in the title bar.

Note: “Read” only variables are displayed in blue with a gray background. Any variables that can be altered by the user are displayed in black with a white background. In most cases, a parameter that can be changed by the user will have an associated increment/decrement control. The user can either click on the desired parameter and enter in a new value, or use the increment/decrement controls to change the value by 1 unit.

6.5.1 THE BODYMAKER MAIN DISPLAY WINDOW

The bodymaker "Main Display" window is used to display the general state of the control system, as well as alarm messages. This window is selected from the "Bodymaker" menu.



The following is a list of the functions of the Bodymaker "Main Display" window.

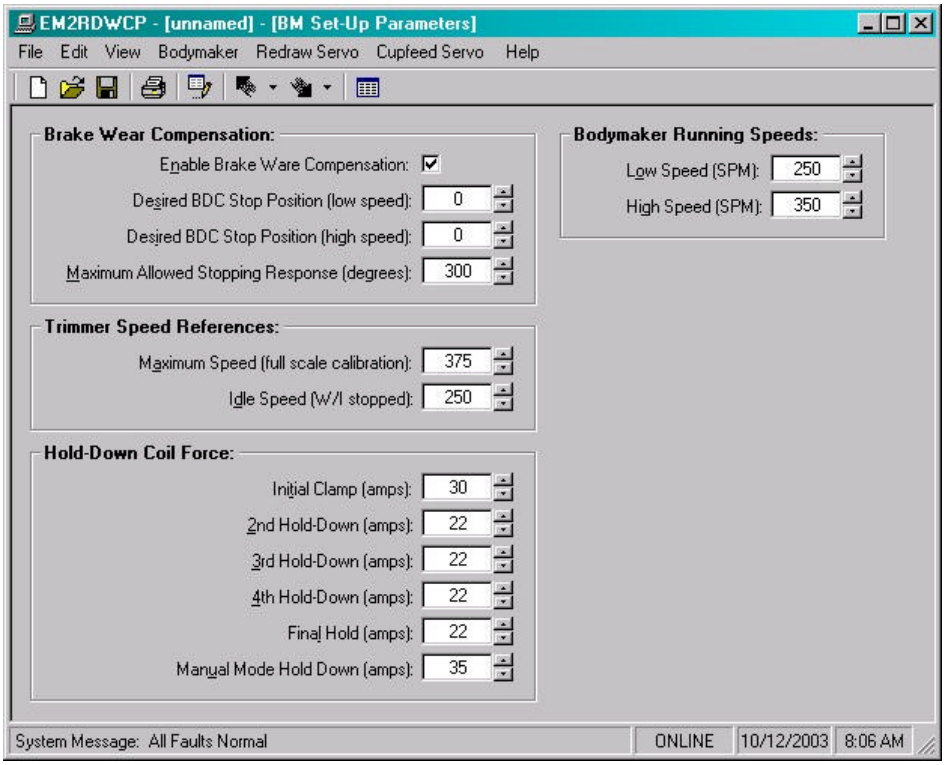
Messages: The "Messages" display is continuously updated and displays alarm and status messages specific to the M4510. If no alarm or status messages are active, a default message is displayed.

Machine Speed SPM: This display is only active while "Online" and displays the current speed of the machine in "Strokes Per Minute".

Machine Position: This display is only active while "Online" and displays the current position to the main crank resolver in degrees.

6.5.2 THE BODYMAKER SET-UP PARAMETERS WINDOW

The bodymaker "Set-up Parameters" window is used to view and adjust the set-up parameters. This window is selected from the "Bodymaker" menu.



Brake Wear Compensation:

1) **Brake Wear Compensation Enable:** This is used to enable or disable the brake wear compensation. To disabled, click the checkbox and remove the checked state. If the compensation is to be enabled, click the checkbox to set the checked state.

2) **Desired BDC Stop Position (Low Speed):** This is the desired stopping location (in degrees) for a BDC stop at low speed when the brake wear compensation is enabled. This is typically set to 000 degrees (back dead center).

   Note: This parameter is automatically disabled whenever "Brake Wear Compensation" is disabled.

3) **Desired BDC Stop Position (High Speed):** This is the desired stopping location (in degrees) for a BDC stop at high speed when the brake wear compensation is enabled. This is typically set to 000 degrees (back dead center).

   Note: This parameter is automatically disabled whenever "Brake Wear Compensation" is disabled.

4) **Maximum Allowed Stopping Response:** This defines the maximum allowed brake response 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 BDC stop is performed) is longer than this number, the alarm is generated. Set this parameter to a value where the brake response is considered too long and service to the brake should be performed (typically 270 to 300 degrees).

Bodymaker Running Speeds:

1) **Running Bodymaker Low Speed (SPM):** This is the speed (in strokes per minute) the bodymaker will run when in low (inch) speed.

2) **Running Bodymaker High Speed (SPM):** This is the speed (in strokes per minute) the bodymaker will run when in high (cont./single) speed.

Trimmer Speed References:

1) **Trimmer Maximum Speed (CPM):** This is used to scale the 0-10VDC analog output such that when the bodymaker is running at the speed entered the analog output is 10 volts. This is typically set to the running high speed of the Bodymaker or slightly higher.

2) **Trimmer Idle Speed (CPM):** This parameter determines the speed the trimmer will run at when the bodymaker is stopped (de-clutched).

   Note: This parameter is used to provide the speed reference when the bodymaker speed is zero. When the bodymaker is running, the trimmer speed reference is proportional to the speed of the bodymaker.

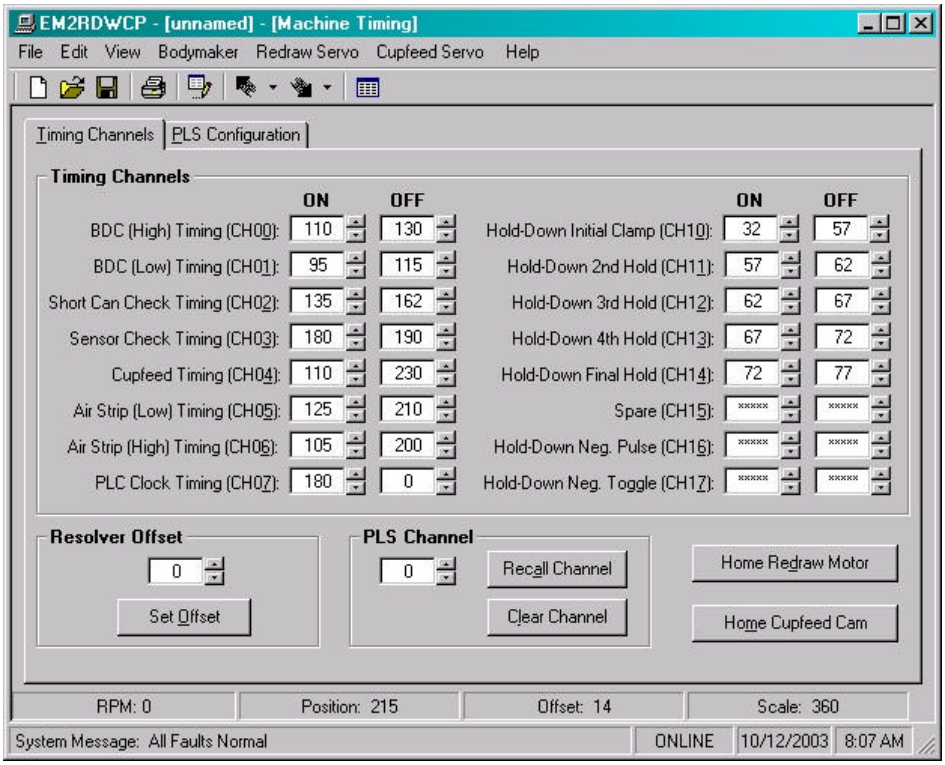
Hold-Down Coil Force:

The hold down force is set empirically and is proportional to the hold down current. At the extreme, too little current will result in too little hold down force resulting in a tear-off or punch through. Too much hold force likewise will result in a tear-off. The default settings of the five clamping phases incorporate a high initial clamping force with the following four phases being equal (see figure 4.2 – "Default Hold-Down Clamping Sequence"). Since each phase can be adjusted independently, it is possible to vary the force as the can is being drawn.

Note: The force can be adjusted on the fly, while the machine is running.

6.5.3 THE MACHINE TIMING WINDOW

The Machine Timing window is used to invoke the PLS programming command menus.



The following parameters are displayed at the bottom of this window:

RPM: This is the current speed in "Revolutions per Minute" of the main crank resolver.

Position: This is the current "Position" in degrees of the main crank resolver.

Offset: This is the current resolver offset (set in degrees).

Scale: This is the scale factor of the resolver or the number of divisions in one revolution.

Zeroing the Machine (setting the resolver offset): To set machine zero, perform the following:

1) Connect an RS-232 SYSdev cable from the COM port on the computer to the "PROG" port on the M4510.

2) Observe the "Position" field at the bottom of the window. Verify that as the machine is rotated forward, that the position increases linearly from 0 through 359 degrees. If not, swap the S1 and S3 leads at the resolver connector on the M4510. Then, verify that the position does indeed increase with forward movement.

3) Position the machine at back dead center.

4) Auto zero the resolver by entering "0" in the "Resolver Offset" field and clicking the "Set Offset" command button. A message box will appear, prompting the user to confirm their choice. Select "Yes" to set the resolver offset.

5) The M4510 will calculate the actual offset value required to make this the "0" position. The new offset value will be displayed in the "Offset" field and the position will then read zero.

Adjusting the Timing Channel Set-points: To set any of the timing signal set-points, perform the following:

Note: Any changes made to the timing channel set-points will be saved as part of the setup data file.

1) Connect an RS-232 SYSdev cable from the COM port on the computer to the "PROG" port on the M4510.

2) Set-points for a particular channel are either entered in the field or adjusted by using the increment/decrement controls.

   Note: Only a single set-point per channel is used.

3) If a channel needs to be "Recalled" or "Cleared", enter the desired channel number into the "PLS Channel" field. Click the "Recall Channel" command button to recall the set-point. Click the "Clear Channel" command button the completely clear the selected channel.

   Note: If a channel has been cleared or the "On" and "Off" set-points have the same setting, the set-point will be displayed as "*****".

Home Redraw Motor: This selection is used to set the redraw motor's relative position to the crank. To set the redraw home position (redraw offset) perform the following:

1) Set the punch and redraw at the their correct relative positions. Typically, these positions are determined as follows:

   Prior to performing this timing procedure, adjust the redraw timing sensor to moving mass gap per APM set-up procedures.

   Prior to timing the redraw with respect to the main crank, rotate the redraw forward through at least one complete revolution with the target on the moving mass turning the timing sensor on and back off at least once since power-up.

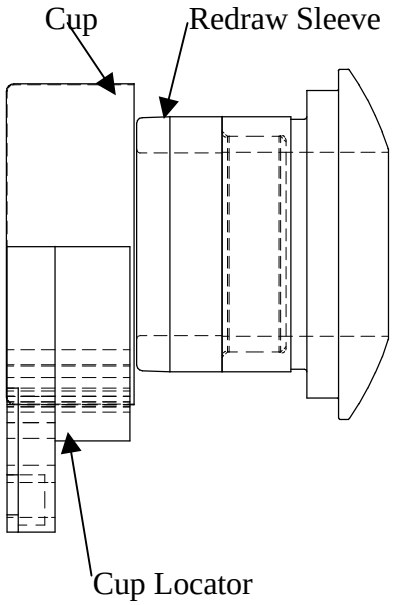
Perform the following to time the redraw mechanism with respect to the main crank:

a) Inch or bar the ram to the back position and jog or bar the redraw to the back position (cup locator open).

b) Using the “Manual Cupfeed” push-button, feed one cup into the cupfeed cam and rotate the cam by hand until the cup is fully loaded into the cup locator.

c) Bar the ram in the forward direction until the punch just contacts the cup.

d) Bar the redraw in the forward direction until the face of the redraw sleeve is even with the top lip of the cup.



2) Home the redraw motor by clicking the “Home Redraw Motor” command button. A message box will be displayed prompting the user to confirm their choice.

3) The M4510 calculates the actual redraw motor offset value that is required to set this relative position of the redraw motor to the punch.

Home Cupfeed Cam: This selection is used to set the cupfeed cam's relative position to the crank. To set the cupfeed home position (cupfeed offset) perform the following:

1) Set the punch and cupfeed cam at the their correct relative positions. Typically, these positions are determined as follows:
   a) With the punch on the backward stroke, bar the crank until the nose of the punch has just past the cup position (cup is free to enter cup locator without interference with punch).
   b) With a cup in the cupfeed cam, rotate the cup cam until the bottom edge of the cup is just above the punch.

   This relative position gives the cup the maximum amount of time to settle into the cup locator, while insuring the cup and punch do not interfere with each other.

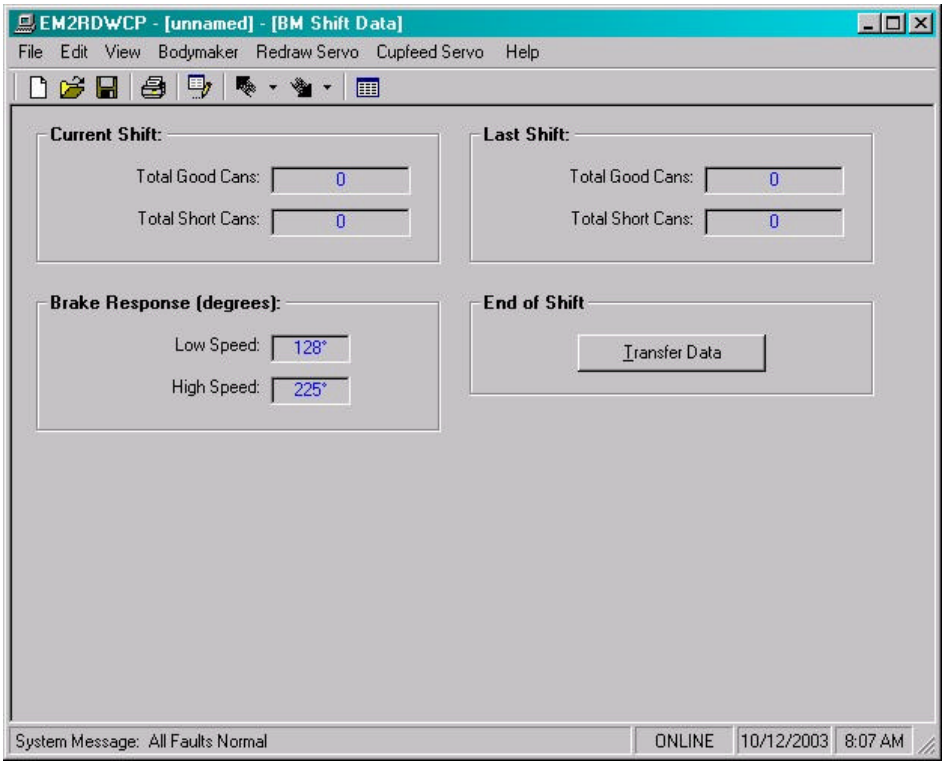
2) Home the cupfeed cam by clicking the "Home Cupfeed Cam" command button. A message box will be displayed prompting the user to confirm their choice.

3) The M4510 calculates the actual cupfeed cam offset value that is required to set this relative position of the cupfeed cam to the punch.

Resetting the PLS Configuration: As an aid to the user, the current PLS configuration is displayed on a separate tab as part of this window. The PLS configuration should only need to be reset if a new module has been installed. To reset the PLS configuration, click the "Reset PLS Config" command button. This function only resets the PLS configuration to the default settings for the bodymaker.

6.5.4 THE SHIFT DATA WINDOW

This window is used to view the Current Shift data, Last Shift data, Low and High speed brake responses and to invoke the “End of Shift” data transfer.



Current Shift - Total Good Cans: This is the total number of good cans produced so far into the current shift. This is essentially a can counter.

Current Shift - Total Short Can Faults: This is the total number of short can faults that have occurred so far into the current shift.

Last Shift - Total Good Cans: This is the total number of good cans produced in the last (previous) shift. This is essentially a can counter.

Last Shift - Total Short Can Faults: This is the total number of short can faults that occurred in the last (previous) shift.

Note: The current shift data is transferred to the “Last shift” data when the end of shift input transfers from a “0” to a “1”. This can be at the end of either an 8 or 12-hour shift. This data can also be reset from this menu by clicking the “Transfer Data” command button.

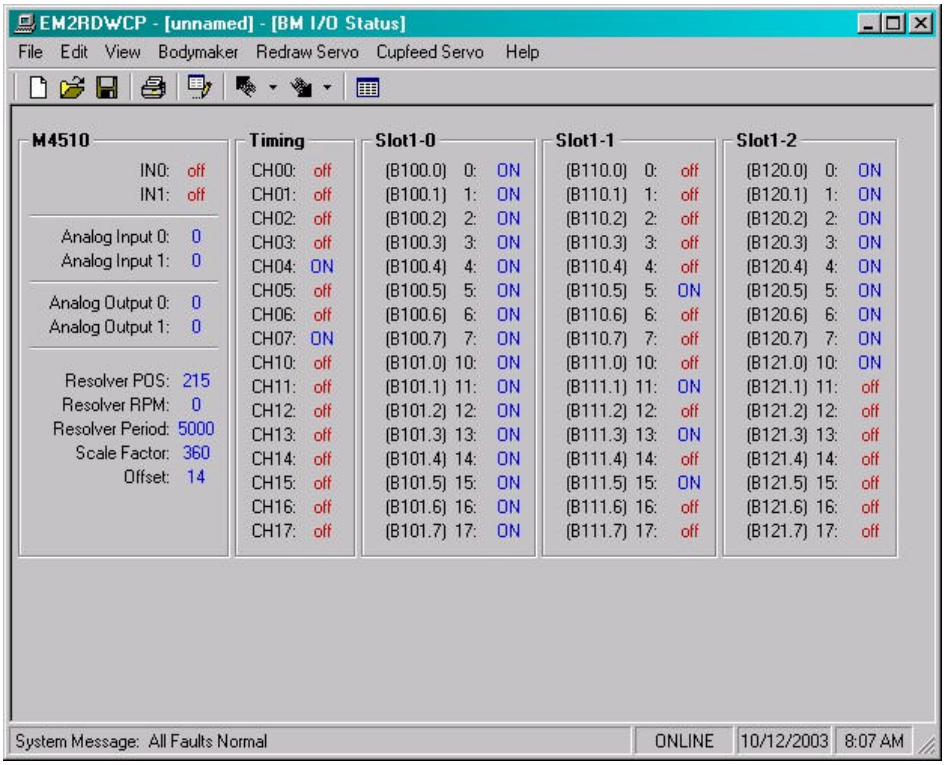
Lo Speed Brake Response (degrees): This is the number of degrees from the when the clutch was de-activated (at the BDC (Lo) timing) to where the bodymaker crankshaft came to rest when a BDC stop was performed at Low speed. This can be used to determine the general condition of the brake and whether servicing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

Hi Speed Brake Response (degrees): This is the number of degrees from the when the clutch was de-activated (at the BDC (hi) timing) to where the bodymaker crankshaft came to rest when a BDC 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.

Note: The brake response for both high and low speeds is updated after each BDC stop.

6.5.5 THE I/O STATES WINDOW

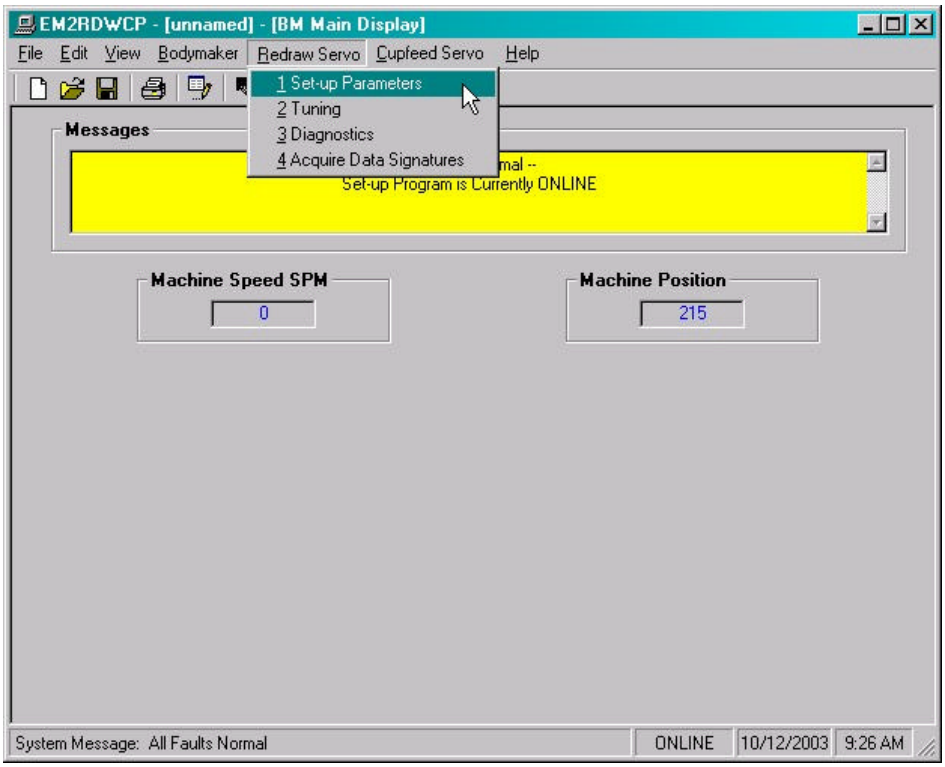
The "I/O States" window is provided to display states of the inputs and outputs. The control boards, the states of the timing channels, as well as states of the M4510 are shown. This includes the interrupt inputs (IN0 and IN1), the analog I/O and the resolver. These values are displayed as read by the M4510 processor.



6.6 THE REDRAW SERVO MENU

The “Redraw Servo” menu allows the user to select one of four different Display/Set-up windows, used to modify set-up parameters and tune the redraw servo motor.

Prior to making this selection, make sure an RS-232 SYSdev cable is connected from the COM port on the computer to the MOTION port on the Redraw S4520 motion control board (slot 0-1).

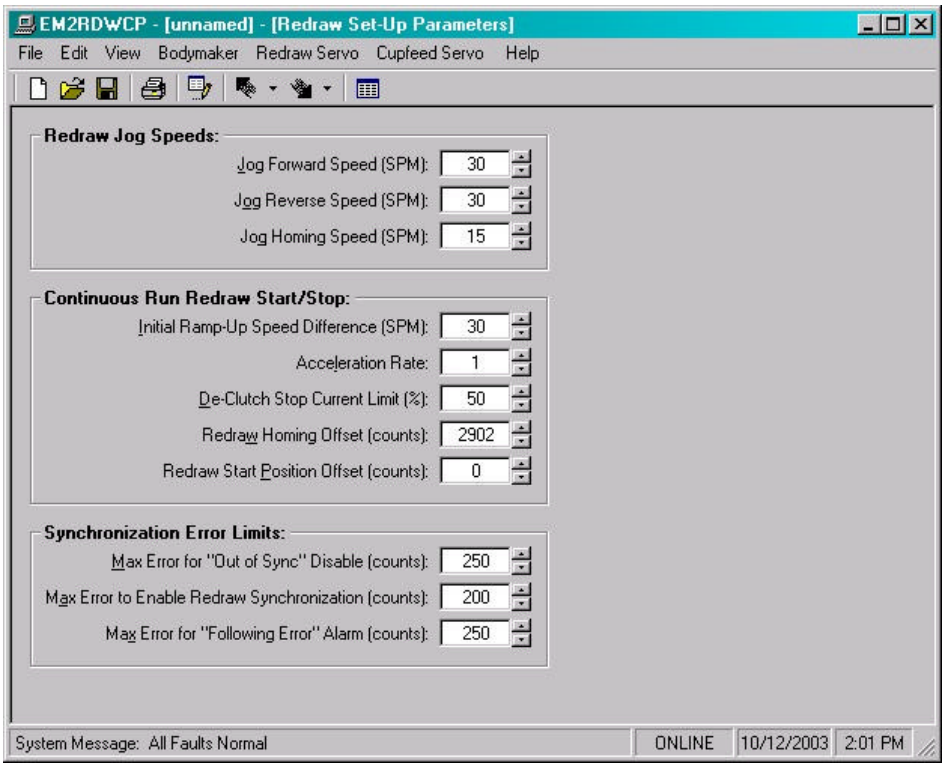


Once a menu item is selected, the window is displayed and the name changed in the title bar.

Note: In general, “Read” only variables are displayed in blue with a gray background. Any variables that can be altered by the user are displayed in black with a white background. In most cases, a parameter that can be changed will have an associated increment/decrement control. The user can either click on the desired parameter and enter in a new value, or use the increment/decrement control to change the value by one unit.

6.6.1 THE REDRAW SET-UP PARAMETERS WINDOW

This selection is used to set the redraw set-up parameters. When selected, the servo redraw "Set-up Parameters" window is invoked.



The servo redraw "Set-up Parameters" window contains the following selections:

Redraw Jog Speeds:

Jog Forward Speed (SPM): This is the speed (in strokes per minute), the redraw will stroke when the redraw is jogged forward fast.

Note: The number entered will round off to the nearest 15 strokes per minute.

Jog Reverse Speed (SPM): This is the speed (in strokes per minute), the redraw will stroke when the redraw is jogged in reverse.

Note: The number entered will round off to the nearest 15 strokes per minute.

Jog Homing Speed (SPM): This is the speed (in strokes per minute), the redraw will stroke when the redraw is performing the initial timing sequence after power-up.

Continuous Run Redraw Start/Stop:

Initial Ramp-Up Speed Difference (SPM): When the bodymaker is first started, the redraw will accelerate to a speed equal to "Main Crank Speed" minus the "Initial Ramp-Up Speed Difference". This allows the redraw to run at a speed slightly slower than the crank speed, so that the crank position can lap the redraw position every few seconds. As the crank position catches up to the redraw and begins to pass the redraw, the redraw will then lock onto the crank and go into sync. This allows the redraw to come into sync with the ram at a controlled pace rather than attempting to sync immediately.

Note: The number entered will be rounded off to the nearest 15 strokes per minute.

Acceleration Rate: This is the rate at which the redraw will accelerate when the clutch is first engaged in continuous mode and the redraw is accelerated up to the "Crank Speed" minus "Initial Ramp-Up Speed Difference". This is provided to reduce the harshness in which the redraw is initially accelerated (instead of just trying to immediately synchronize with the ram). This is also used to accelerate and decelerate the redraw when the jog speeds are activated. The acceleration rate should be set in the range of 1 to 4.

De-Clutch Current Limit (%): This is the negative current limit applied when the clutch is disengaged in continuous and the redraw is stopped.

Note: Only negative current is applied (no positive current) to the redraw when the clutch is disengaged.

Thus the redraw is no longer in sync with the ram via the full PID loop and is stopped with the negative current only limited to a percentage of full peak current as set by this number. With a 100AMP peak amplifier, setting this parameter to 50% will limit the max negative current to 50AMPS. This allows the redraw to be stopped in a more gentle manner than would be done if it stayed in sync with the ram using the full PID loop.

Redraw Homing Offset (counts): The "Redraw Homing Offset" is empirically set and used to fine tune the relationship between the main crank and redraw. This is set such that the redraw sleeve is clamped for a certain number of degrees before the punch strikes the cup. The number of degrees the redraw must be clamped before punch strikes the cup depends on several variables:

- Redraw Stroke length (1-5/8" and 2")
- Cup Height
- Bodymaker Speed

Note: For the 2" redraw stroke length, this value should be set to 2902. It is yet to be determined the optimum value for the 1-5/8" stroke length.

Redraw Start Position Offset (counts): The redraw "Start Position Offset" is the position the redraw will begin its acceleration. When the clutch is engaged, the crank accelerates very quickly. Due to the inertia of the redraw, it must accelerate at its own separate slower acceleration rate to a speed slightly less than the crank speed (set in the "Initial Ramp-Up Speed Difference" parameter). This difference in speed allows the redraw to be overtaken by the crank, and synchronize into position. This parameter is experimentally adjusted such that the redraw position is always slightly ahead of the crank when the redraw reaches the synchronization speed. This significantly reduces the number of strokes required to synchronize the two mechanisms.

Note: The LED on SA3 (Redraw Hold Down Magnet amplifier) will turn green once the redraw synchronizes with the main crank.

Synchronization Error Limits:

Max Error for "Out of Sync" Disable (counts): This is the maximum amount of error allowed between the ram and the redraw to enable the cups to be fed. If the running error is less than this threshold, the redraw will be in sync with the ram and the cupfeed can be opened. If the running error is greater than this threshold, the cupfeed solenoid will be disabled. This threshold is also used to enable the Hold Down coil activation such that the hold down is activated only when the redraw is in sync with the ram.

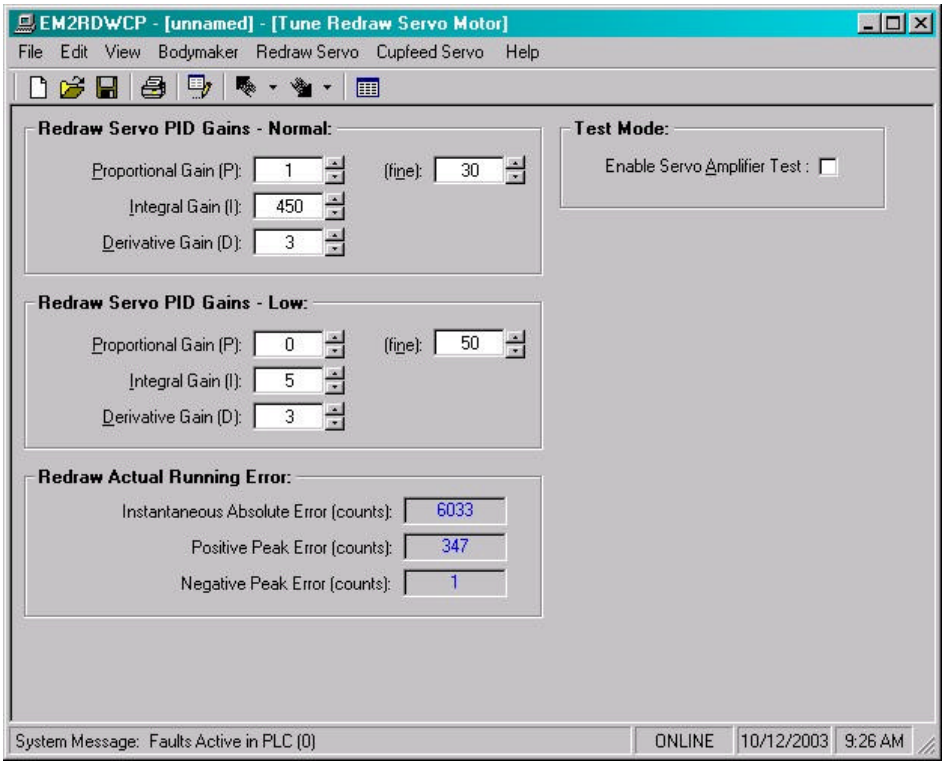
Max Error to Enable Redraw Synchronization (counts): This threshold is used to synchronize the redraw with the main crank when the machine is first activated in continuous mode. When the clutch is initially activated in continuous, the redraw will accelerate up to the "Crank Speed" minus the "Initial Ramp Up Speed Difference". The ram will then be running faster than the redraw and thus will come into sync with the redraw after some number of strokes.

Once the main crank is within this error threshold of the redraw, the redraw will then sync in with the main crank and track the ram using the PID servo loop. This reduces the torque required (and harshness to the redraw) at synchronization then if the redraw simply synchronized immediately with the main crank when the clutch is first engaged.

Max Error for "Following Error" Alarm (counts): This is the maximum amount of error allowed between the ram and the redraw before a "Following Error" fault is generated. This is enabled once the redraw is in sync with the main crank. The "Following Error" alarm is filtered to allow short errors in excess of this threshold to occur without generating the alarm. This threshold is primarily used to detect instability in the redraw servo motor or peak current limit conditions (excessive frictional loads in the redraw).

6.6.2 THE REDRAW TUNING WINDOW

This selection is used to tune the servo redraw motor. When selected, the servo redraw "Tuning" window is invoked.



Redraw Servo PID Gains:

Proportional (P) Gain: The proportional gain is used to create an error term, which is "proportional" to the difference between the main crank position and servo motor position. For a specific amount of error, the higher the (P) gain, the higher the torque generated to null the error.

Note: By itself, the (P) term cannot null the error to zero since a torque is only generated when there is a difference between the main crank position and servomotor.

This (P) gain is used in conjunction with the other gains to define the system stability and responsiveness. A higher the (P) gain will cause the servo motor to be more responsive. Too high of a (P) gain will cause the motor to become unstable (oscillate) because the system cannot respond quickly enough. Excessive current will also be drawn which is undesirable. Too low of a gain will cause excessive following error to the point of instability depending on where the (I) gain is set. The (P) gain can also be used to overcome high frictional loads (higher (P) for higher friction).

Integral (I) Gain: The integral gain is used to create an error term, which is proportional to the cumulative difference (error) between the main crank position and servo motor position. Thus for a fixed amount of error, the torque generated due to the integral error term will continue to increase at a rate proportional to the (I) gain. The higher the integral error term, the faster the torque generated to null the error will increase. This term is used to null a fixed error to zero since a torque of whatever amplitude will be generated to null the error to zero.

Note: Without the other gains ((P) and (D)), the system would be unstable.

As with the (P) gain, a higher (I) gain will cause the servo motor to be more responsive.

Note: Too high of an (I) gain will cause the motor to be unstable (oscillate) because the system cannot respond quickly enough. Too low of an (I) gain will cause excessive following error since at low (I) gains, the (P) gain would than be mostly responsible to null the error. The system will not be unstable if the (I) gain is set to zero.

Derivative (D) Gain: The derivative (D) gain is used to create an error term, which is proportional to the rate of change of error between the main crank position and servo motor position. Thus for a fixed amount of error, the torque generated due to the derivative error term will be zero (rate of change is zero). This error term is only generated when the amount of error is changing. The higher the rate at which the error changes, the higher the derivative error term. This term is primarily used to stabilize the servo loop. It is used to reduce ringing in under-damped responses or to provide fundamental stability to loops that would otherwise be unstable.

There is a definite compromise between to much and not enough (D) gain. With too low, the system may be marginally to completely unstable. Excess ringing with a corresponding longer settling time to a step response will occur if the (D) gain is too low. If the (D) gain is too high, system response will be reduced and high frequency oscillations may occur. This will not cause instability but higher current will be drawn and excessive high frequency torque will be applied to the load.

Redraw Actual Running Error:

Instantaneous Absolute Error (Counts): This is the current instantaneous absolute (magnitude) difference between the main crank position and the redraw servo position.

Positive Peak Error (Counts): This is the maximum positive peak error detected as the redraw strokes. This is updated once every 1.5 seconds while the machine is running.

Negative Peak Error (Counts): This is the maximum negative peak error detected as the redraw strokes. This is updated once every 1.5 seconds while the machine is running.

Servo Amplifier Test Mode:

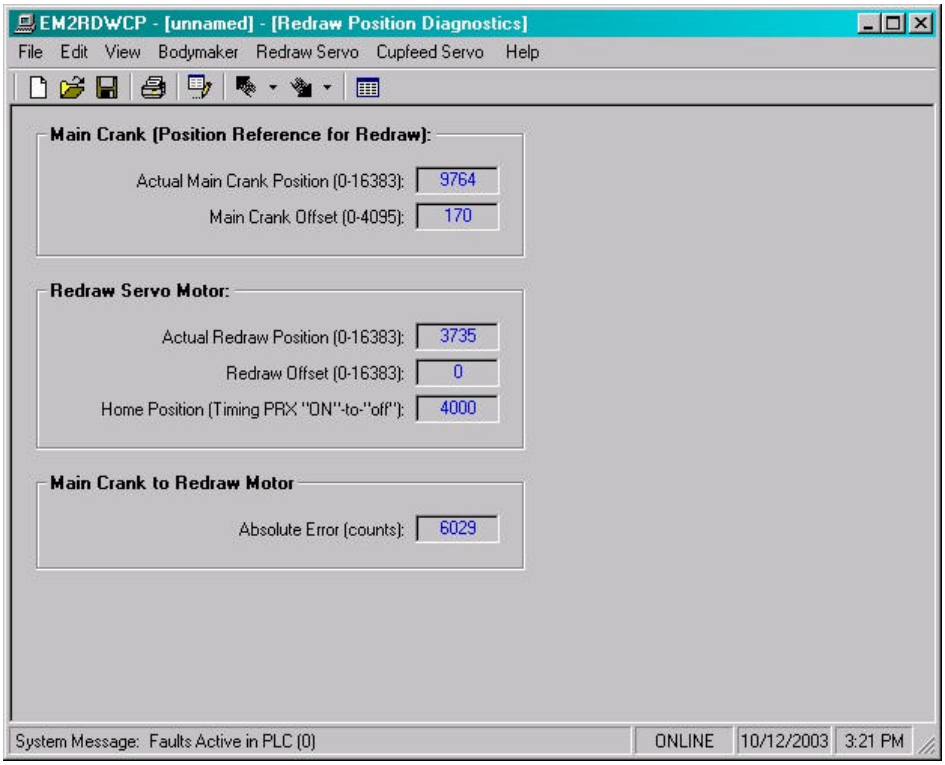
When selected, the user is prompted to confirm their choice to enable servo amplifier test mode. If enabled, the servo amplifier test outlined in the trouble-shooting section 9.2.4 – "Motor and Amplifier Test" can be performed.

Note: This is only used to verify the servo amplifier and motor. The machine cannot be run with the test mode enabled. For this reason due caution must be used when performing this test.

WARNING!! IN THE TEST MODE, THE SERVO MOTOR IS EXCLUSIVELY CONTROLLED WITH THE "TEST/OFFSET" (POT 4) ON THE B25A20. STAY CLEAR OF THE CUPFEED CAM AT ALL TIMES WHEN IN THE SERVO AMPLIFIER TEST MODE!!

6.6.3 THE REDRAW DIAGNOSTICS WINDOW

This, displays the main crank position (counts) and redraw servo motor position (counts). This is useful for trouble-shooting purposes to observe the resolver feedback is correct for the main crank and redraw (correct direction and linear).



This window contains the following selections:

Actual Main Crank Position (0-16383): This is the current main crank position with reference to a scale factor of 16384 for one complete revolution of the main crank. This is used as the primary reference for the redraw PID servo loop.

Main Crank Offset: This is set automatically when the main crank position is zeroed.

Actual Redraw Position (0-16383): This is the current redraw position with a scale factor of 16384 for one complete revolution of the redraw. This is used as the feedback to the redraw PID servo loop.

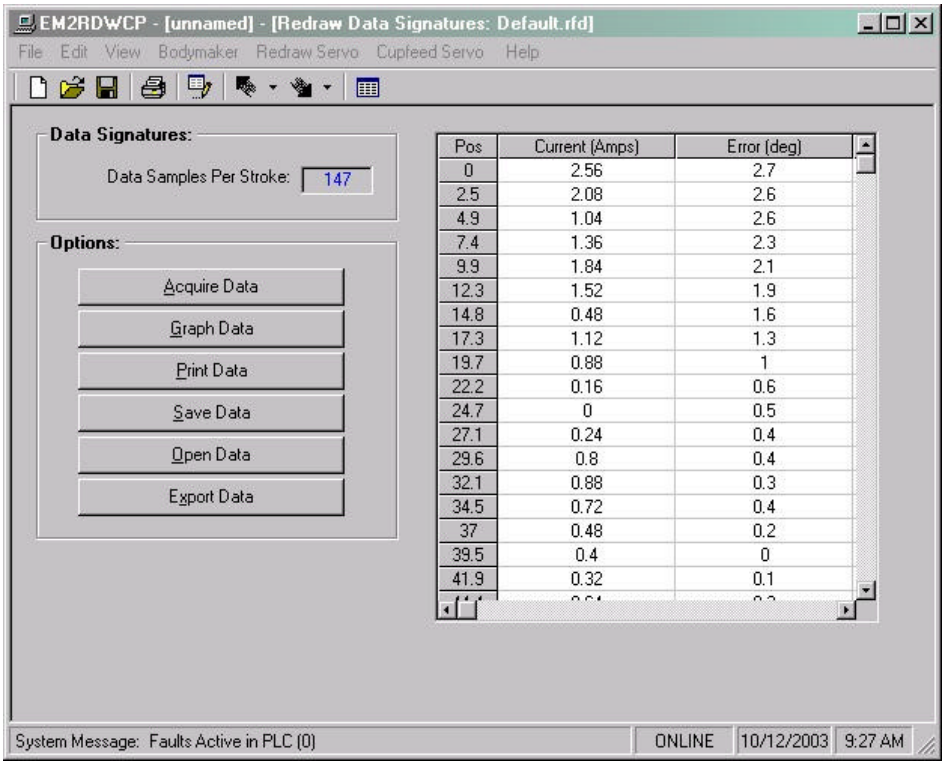
Redraw Offset (0-16383): This is set automatically when the redraw is initially timed after power up and is calculated based on the "Redraw Home Position".

Redraw Home Position: This is the relative position of the redraw to the main crank. The redraw is timed such that it will be "In Sync" with the main crank when the punch of the ram is at "Front Dead Center" and the redraw is just beginning to back away from the face of the toolpack.

Main Crank to Redraw Motor Absolute Error: This is the absolute (magnitude) difference between the main crank position and the redraw motor. When the PID servo loop is active, the torque applied to the cupfeed cam motor will be a function of this error.

6.6.4 THE ACQUIRE DATA SIGNATURES WINDOW

This selection is used to acquire the current and error data for one stroke. This data is sampled once every millisecond for one complete stroke and uploaded from the processor. This is used for tuning while the machine is running as well as trouble-shooting.



The total number of samples taken in one stroke is equal to the period in milliseconds, up to a maximum of 255 samples. This value is displayed in the "Data Samples per Stroke" field.

The following functions can be executed from this window:

Acquire Data: By clicking this command button, the S4520 initiates collecting the data signatures for one stroke. Once completed, the data collected is displayed in the chart to the right.

Note: The "Acquire Data" function is only enabled when the set-up program is "Online" with the processor.

Print Data: By clicking this command button, the user can obtain a printout of the data displayed. Once executed, the "Print Setup" dialog box is displayed, allowing the user to choose a printer device, as well as, define the size and orientation of the paper. This printout also displays the current settings of the PID gains.

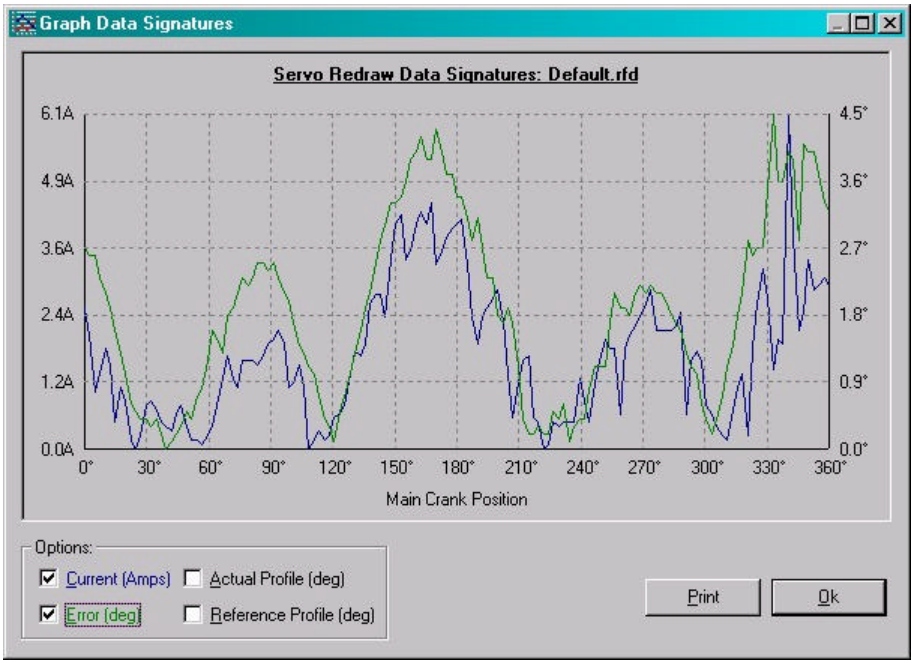
Save Data: By clicking this command button, the user can save the data to a "Redraw Data" file. This allows the user to easily save different sets of acquired data signatures.

Open Data: By clicking this command button, the user can open an existing "Redraw Data" file. This allows the user to examine previously saved acquired data signatures, while not "Online" with the processor.

Export Data: By clicking this command button, the user can export the displayed data to a "Text" file format. This allows the data to be easily used by other windows programs such as Microsoft Excel or Microsoft Word. Any program that can open a "Text" file format, can have access to this data.

Note: Data displayed can also be copied to the windows clipboard. Simply select the desired data, press "Ctrl+C" and the data will be copied to the windows clipboard. The user can then open another windows program, such as Microsoft Excel, and paste the contents of the clipboard into the new worksheet.

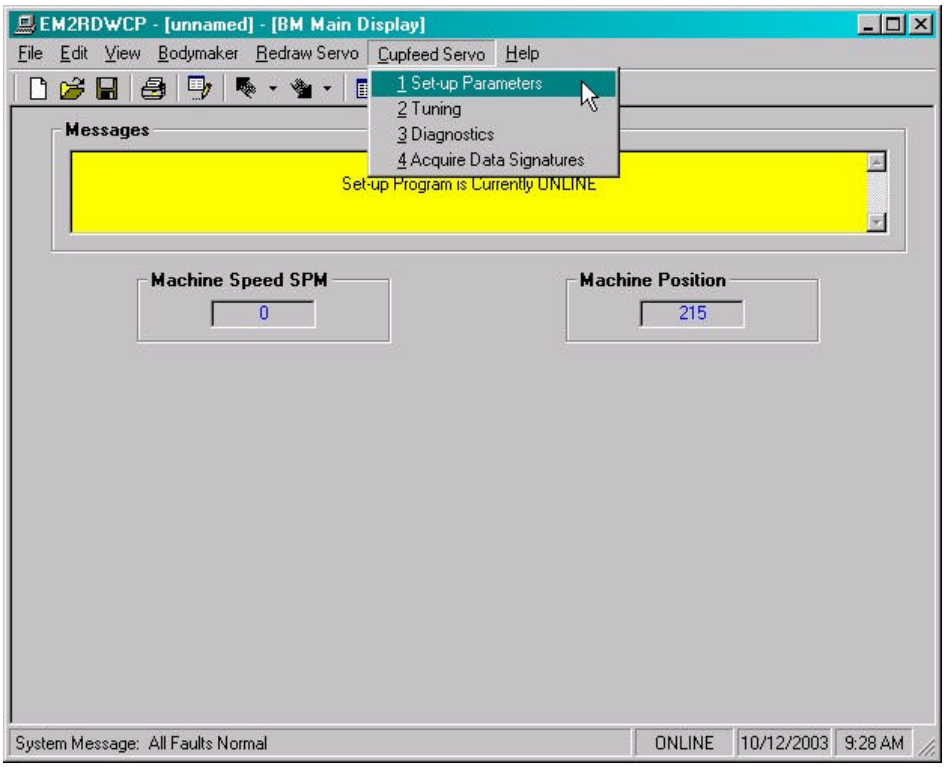
Graph Data: By clicking this command button, the user is able to graph the acquired data. This function displays another window, allowing the user to graph the different data signatures against one another and obtain a printout of the graph. This printout also displays the current settings of the PID gains.



6.7 THE CUPFEED SERVO MENU

The “Cupfeed Servo” menu allows the user to select one of four different Display/Set-up windows, used to modify set-up parameters and tune the cupfeed servo motor.

Prior to making this selection, make sure an RS-232 SYSdev cable is connected from the COM port on the computer to the MOTION port on the S4520 motion control board (slot 0-2).

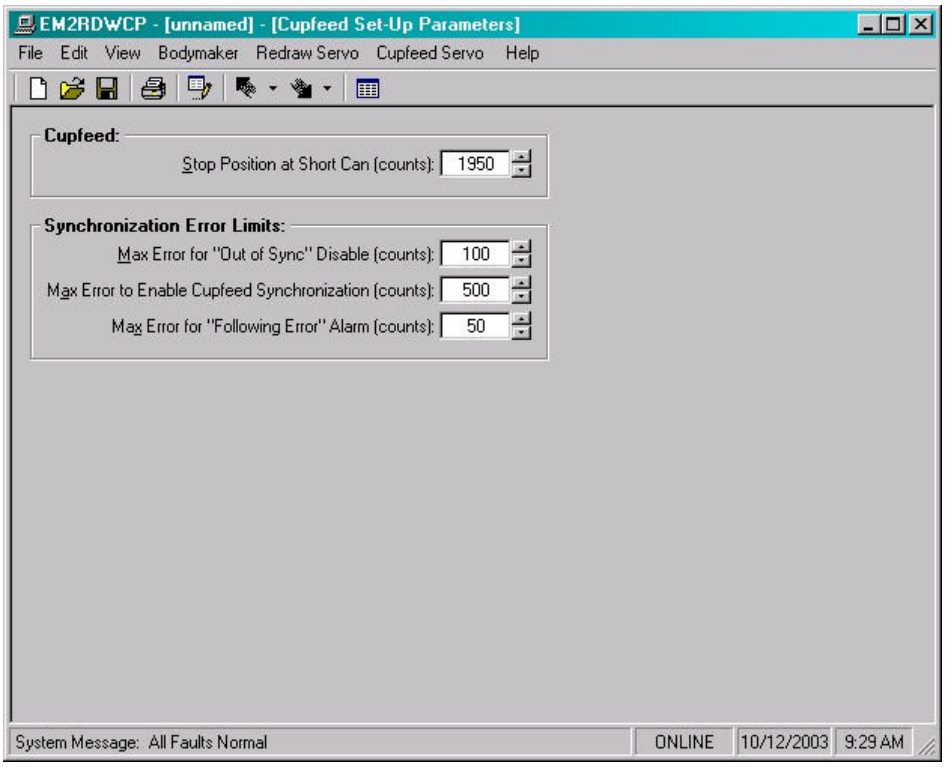


Once a window menu item is selected, the window is displayed and the name changed in the title bar.

Note: In general, “Read” only variables are displayed in blue with a gray background. Any variables that can be altered by the user are displayed in black with a white background. In most cases, a parameter that can be changed will have an associated increment/decrement control. The user can either click on the desired parameter and enter in a new value, or use the increment/decrement control to change the value by one unit.

6.7.1 THE CUPFEED SET-UP PARAMETERS WINDOW

This selection is used to set the cupfeed set-up parameters. When selected, the servo cupfeed "Set-up Parameters" window is invoked.



The servo cupfeed "Set-up Parameters" window contains the following selections:

Cupfeed Stop Position at Short Can (Counts): This is the position the cupfeed cam will stop at when a short can alarm occurs. This should be set to the trailing edge of the short can check timing signal such that when a short can is detected, the cupfeed cam will immediately stop (and not continue following the ram).

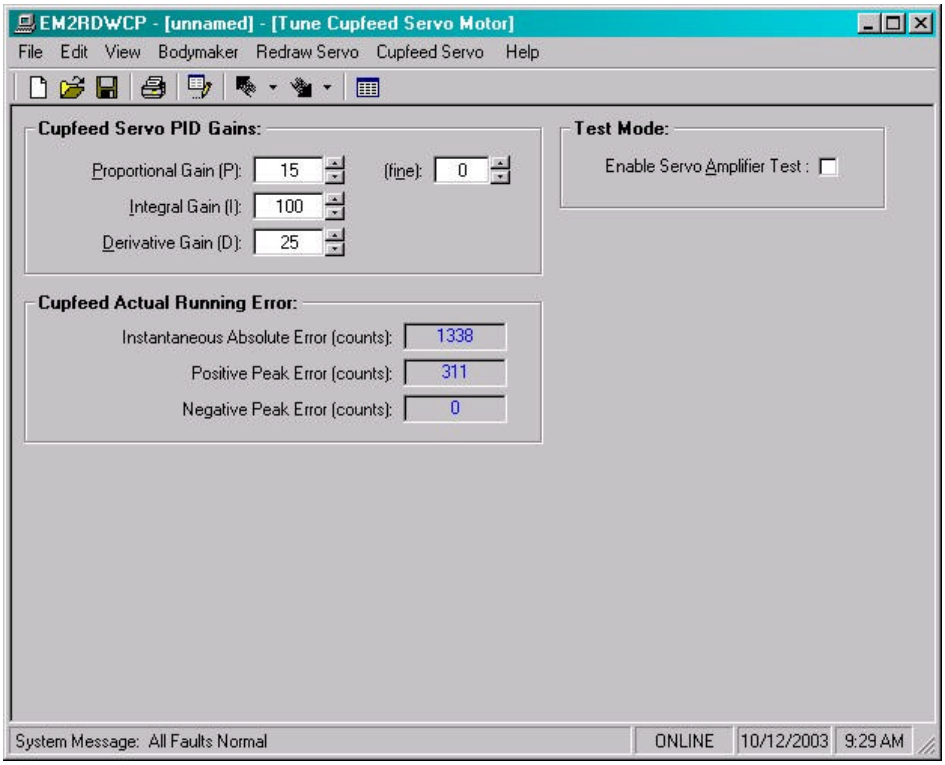
Max Error for "Out of Sync" Disable: This is the maximum amount of error allowed between the ram and the cupfeed to enable the cupfeed to open. If the running error is less than this threshold, the cupfeed is "In Sync" with the ram and the cupfeed can be opened. If the running error is greater than this threshold, the cupfeed will be disabled.

Max Error to Enable Cupfeed Synchronization: This threshold is used to synchronize the cupfeed with the main crank when the clutch is activated. Once the main crank is within this error threshold of the cupfeed, the cupfeed will then sync in with the main crank and track the ram using the PID servo loop.

Max Error for "Following Error" Alarm: This is the maximum amount of error allowed between the ram and the cupfeed before a "Following Error" fault is generated. This is enabled once the cupfeed is "In Sync" with the main crank. The "Following Error" alarm is filtered to allow short errors in excess of this threshold to occur without generating the alarm. This threshold is primarily used to detect instability in the cupfeed servomotor or peak current limit conditions (excessive frictional loads in the cupfeed).

6.7.2 THE CUPFEED TUNING WINDOW

This selection is used to tune the servo cupfeed motor. When selected, the servo cupfeed "Tuning" window is invoked.



Cupfeed Servo PID Gains:

Proportional (P) Gain: The proportional gain is used to create an error term, which is "proportional" to the difference between the main crank position and servo motor position. For a specific amount of error, the higher the (P) gain, the higher the torque generated to null the error.

Note: By itself, the (P) term cannot null the error to zero since a torque is only generated when there is a difference between the main crank position and servomotor.

This (P) gain is used in conjunction with the other gains to define the system stability and responsiveness. A higher the (P) gain will cause the servo motor to be more responsive. Too high of a (P) gain will cause the motor to become unstable (oscillate) because the system cannot respond quickly enough. Excessive current will also be drawn which is undesirable. Too low of a gain will cause excessive following error to the point of instability depending on where the (I) gain is set. The (P) gain can also be used to overcome high frictional loads (higher (P) for higher friction).

Integral (I) Gain: The integral gain is used to create an error term, which is proportional to the cumulative difference (error) between the main crank position and servo motor position. Thus for a fixed amount of error, the torque generated due to the integral error term will continue to increase at a rate proportional to the (I) gain. The higher the integral error term, the faster the torque generated to null the error will increase. This term is used to null a fixed error to zero since a torque of whatever amplitude will be generated to null the error to zero.

Note: Without the other gains ((P) and (D)), the system would be unstable.

As with the (P) gain, a higher (I) gain will cause the servo motor to be more responsive.

Note: Too high of an (I) gain will cause the motor to be unstable (oscillate) because the system cannot respond quickly enough. Too low of an (I) gain will cause excessive following error since at low (I) gains, the (P) gain would than be mostly responsible to null the error. The system will not be unstable if the (I) gain is set to zero.

Derivative (D) Gain: The derivative (D) gain is used to create an error term, which is proportional to the rate of change of error between the main crank position and servo motor position. Thus for a fixed amount of error, the torque generated due to the derivative error term will be zero (rate of change is zero). This error term is only generated when the amount of error is changing. The higher the rate at which the error changes, the higher the derivative error term. This term is primarily used to stabilize the servo loop. It is used to reduce ringing in under-damped responses or to provide fundamental stability to loops that would otherwise be unstable.

There is a definite compromise between to much and not enough (D) gain. With too low, the system may be marginally to completely unstable. Excess ringing with a corresponding longer settling time to a step response will occur if the (D) gain is too low. If the (D) gain is too high, system response will be reduced and high frequency oscillations may occur. This will not cause instability but higher current will be drawn and excessive high frequency torque will be applied to the load.

Cupfeed Actual Running Error:

Instantaneous Absolute Error (Counts): This is the instantaneous absolute (magnitude) difference between the main crank position and the cupfeed cam position.

Positive Peak Error (Counts): This is the maximum positive peak error detected as the cupfeed cam rotates. This is updated once every 1.5 seconds while the machine is running.

Negative Peak Error (Counts): This is the maximum negative peak error detected as the cupfeed cam rotates. This is update once every 1.5 seconds while the machine is running.

The above diagnostic error data can be used to judge how well the cupfeed cam motor is tuned and how well the cupfeed cam is tracking the main crank.

Servo Amplifier Test Mode:

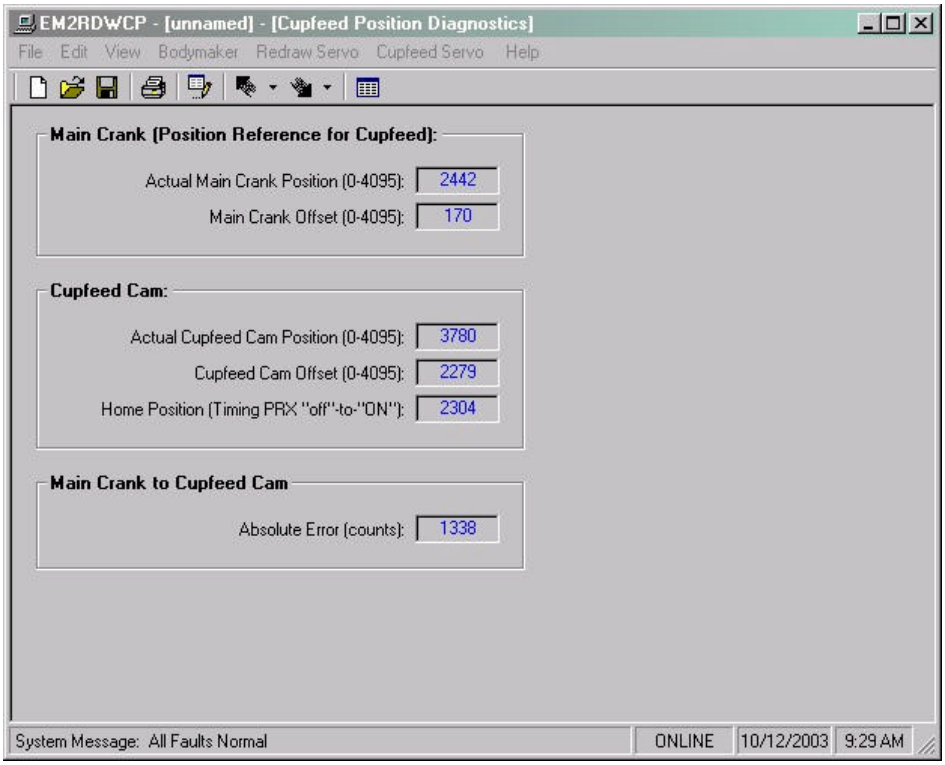
When selected, the user is prompted to confirm their choice to enable servo amplifier test mode. If enabled, the servo amplifier test outlined in the trouble-shooting section 9.1.3 – "Motor and Amplifier Test" can be performed.

Note: This is only used to verify the servo amplifier and motor. The machine cannot be run with the test mode enabled. For this reason due caution must be used when performing this test.

WARNING!! IN THE TEST MODE, THE SERVOMOTOR IS EXCLUSIVELY CONTROLLED WITH THE "TEST/OFFSET" (POT 4) ON THE B25A20. STAY CLEAR OF THE CUPFEED CAM AT ALL TIMES WHEN IN THE SERVO AMPLIFIER TEST MODE!!

4.6.3 THE CUPFEED DIAGNOSTICS WINDOW

This window displays both the main crank position (counts) and cupfeed servo motor position (counts). This is useful for trouble-shooting purposes to observe the resolver feedback is correct for both the main crank and cupfeed cam (correct direction and linear).



This window contains the following selections:

Actual Main Crank Position (0-4095): This is the current main crank position with reference to a scale factor of 4096 for one complete revolution of the main crank. This is used as the primary reference for the cupfeed PID servo loop.

Main Crank Offset: This is set automatically when the main crank position is zeroed.

Actual Cupfeed Cam Position (0-4095): This is the current cupfeed cam position with a scale factor of 4096 for one complete revolution of the cupfeed cam. This is used as the feedback to the cupfeed PID servo loop.

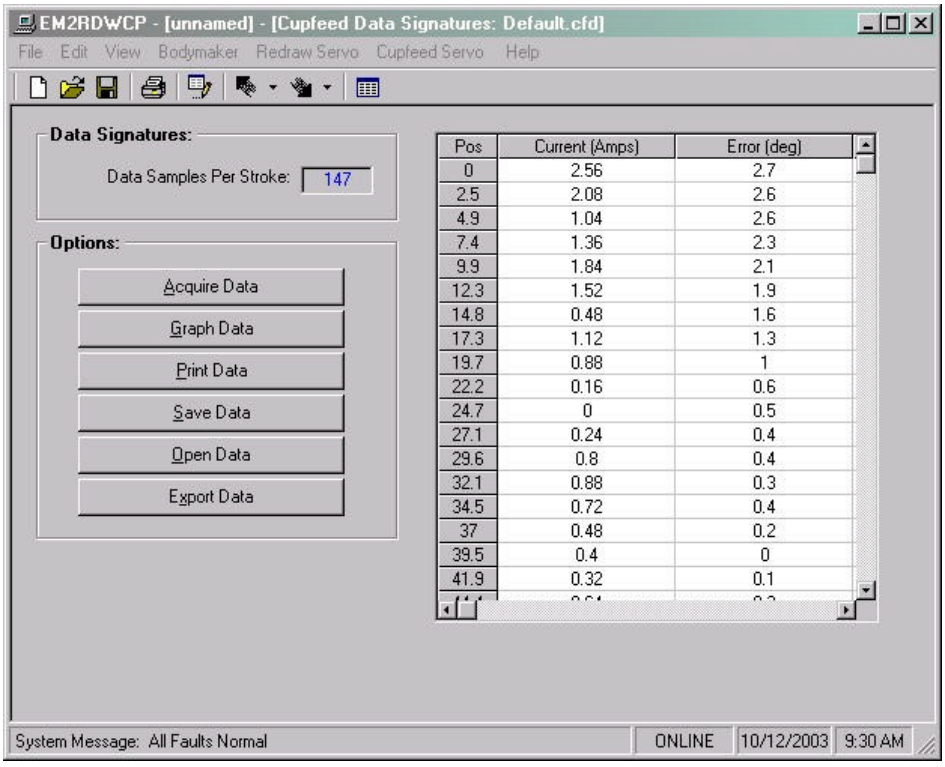
Cupfeed Cam Offset (0-4095): This is set automatically when the cupfeed is initially timed after power up and is calculated based on the "Cupfeed Home Position".

Cupfeed Cam Home Position: This is the position of the cupfeed cam when a cup is loaded into the cup locator. The cupfeed cam is timed such that it will be "In Sync" with the main crank and load the cup when the ram has just opened up.

Main Crank-to-Cupfeed Absolute Error: This is the absolute (magnitude) difference between the main crank position and the cupfeed cam. When the PID servo loop is active, the torque applied to the cupfeed cam motor will be a function of this error.

6.7.4 THE ACQUIRE DATA SIGNATURES WINDOW

This selection is used to acquire the current, error, actual cam profile, and reference profile data for one stroke. This data is sampled once every millisecond for one complete stroke and uploaded from the processor. This is used for tuning while the machine is running as well as trouble-shooting.



The total number of samples taken in one stroke is equal to the period in milliseconds, up to a maximum of 255 samples. This value is displayed in the "Data Samples per Stroke" field.

The following functions can be executed from this window:

Acquire Data: By clicking this command button, the S4520 initiates collecting the data signatures for one stroke. Once completed, the data collected is displayed in the chart to the right.

Note: The "Acquire Data" function is only enabled when the set-up program is "Online" with the processor.

Print Data: By clicking this command button, the user can obtain a printout of the data displayed. Once executed, the "Print Setup" dialog box is displayed, allowing the user to choose a printer device, as well as, define the size and orientation of the paper. This printout also displays the current settings of the PID gains.

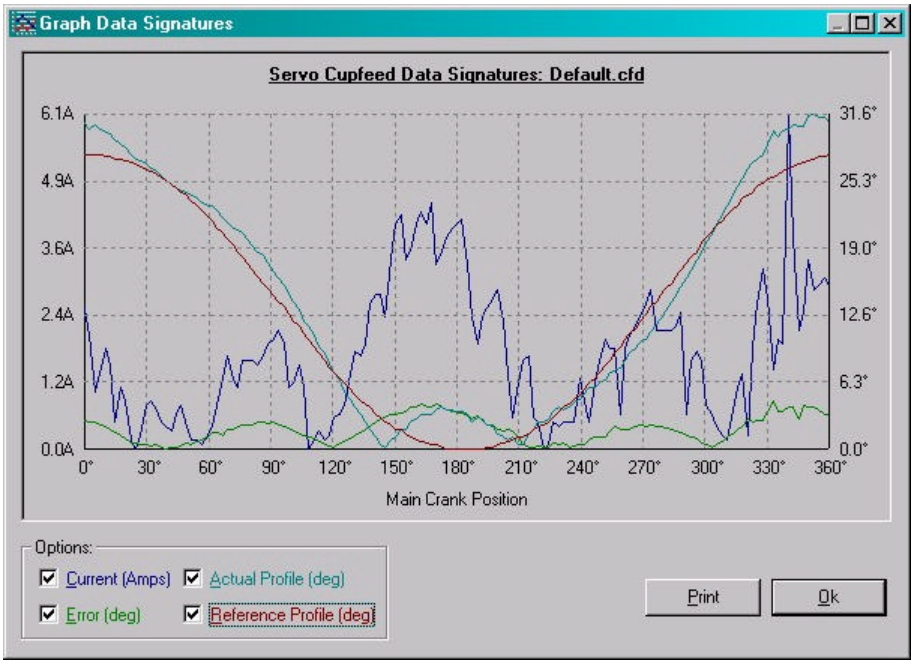
Save Data: By clicking this command button, the user can save the data to a "Cupfeed Data" file. This allows the user to easily save different sets of acquired data signatures.

Open Data: By clicking this command button, the user can open an existing "Cupfeed Data" file. This allows the user to examine previously saved acquired data signatures, while not "Online" with the processor.

Export Data: By clicking this command button, the user can export the displayed data to a "Text" file format. This allows the data to be easily used by other windows programs such as Microsoft Excel or Microsoft Word. Any program that can open a "Text" file format, can have access to this data.

Note: Data displayed can also be copied to the windows clipboard. Simply select the desired data, press "Ctrl+C" and the data will be copied to the windows clipboard. The user can then open another windows program, such as Microsoft Excel, and paste the contents of the clipboard into the new worksheet.

Graph Data: By clicking this command button, the user is able to graph the acquired data. This function displays another window, allowing the user to graph the different data signatures against one another and obtain a printout of the graph. This printout also displays the current settings of the PID gains.



SECTION 7
DOS BASED
SET-UP PROGRAM REFERENCE

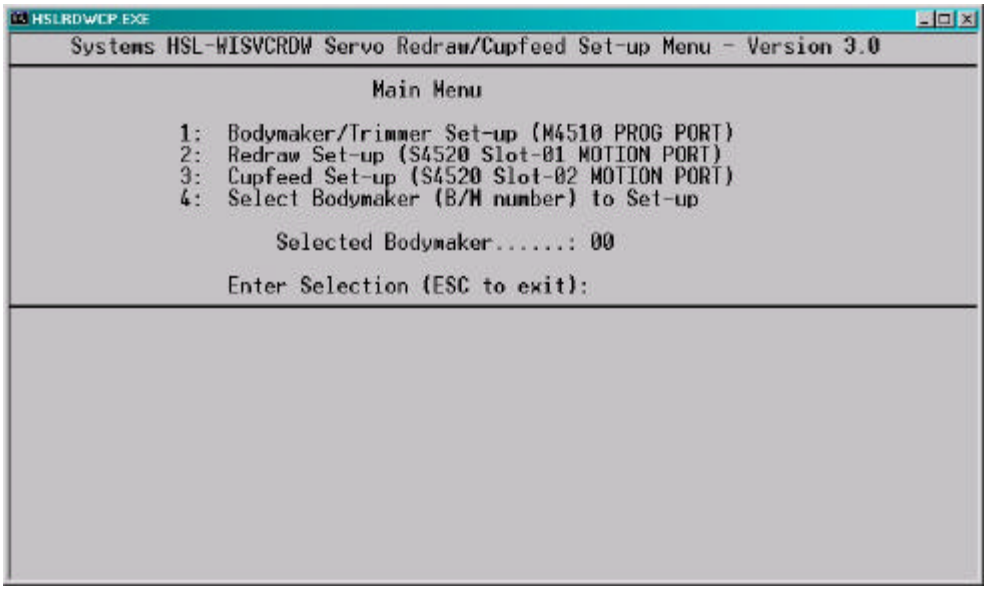
The “EM2RDWCP” set-up program is a DOS based menu driven program, which allows the user to easily view the EM2RDWCP data or alter set-up variables using a PC or laptop computer. In addition to setting the set-up variables and setting the machine timing, the set-up program can be used to tune and test the redraw and cupfeed servo motors. The set-up variables are used to configure and tune the control system to match the configuration and performance of the specific bodymaker.

Note: The “EM2RDWCP” set-up program is an on-line communications program used to interface with the M4510 module and S4520 Motion Control boards. The data displayed and set in the menus is communicated directly to the M4510 and S4520's. Therefore, prior to selecting any of the above selections, make sure an RS-232 cable is connected from the COM port on the computer to the respective port (“PROG” or “MOTION”) port on the M4510.

The following sections are a complete description of the “EM2RDWCP” selections and menus.

7.1 MAIN MENU

The main menu of the “EM2RDWCP” set-up program incorporates the following menu selections:



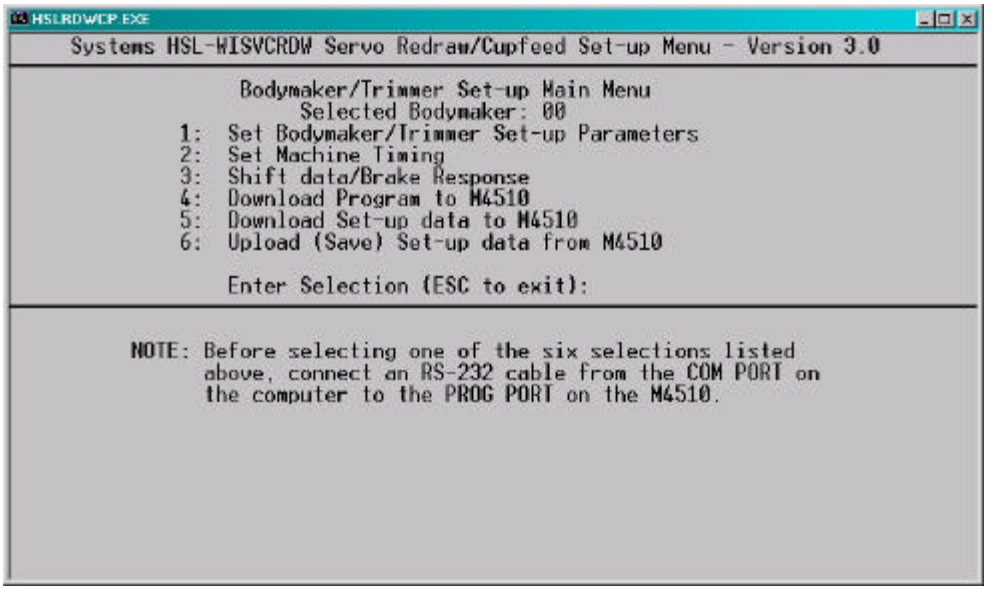
SECTION 7
DOS BASED
SET-UP PROGRAM REFERENCE

7.2 BODYMAKER/TRIMMER SET-UP

This selection is used to interface with the main processor of the M4510. This includes:

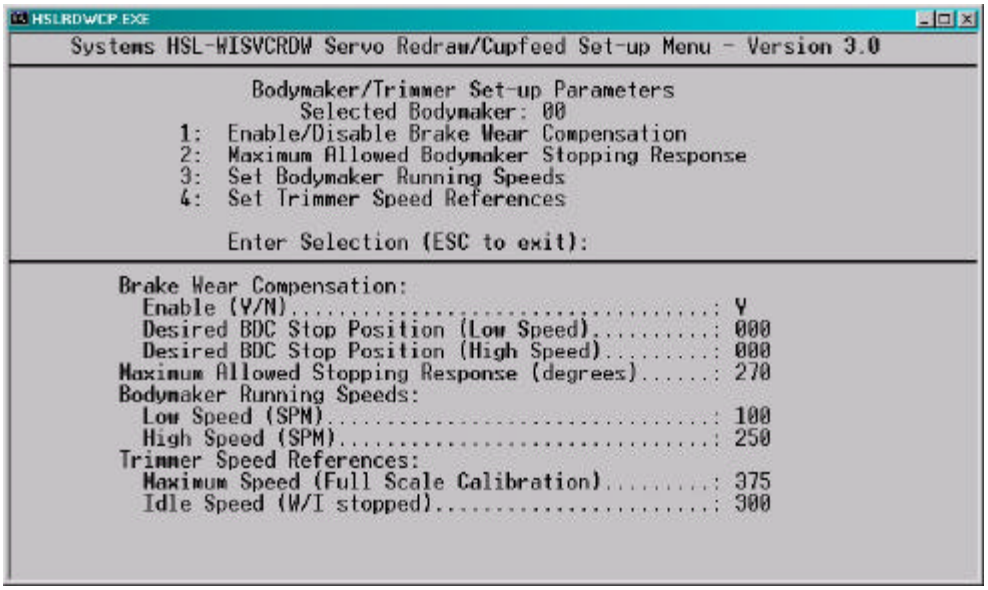
- Set-Up of the Basic Bodymaker and Trimmer Parameters
- Viewing of the Shift Data (total good cans and short cans)
- Downloading the “EM2RDWCP” Application Program to the M4510
- Downloading and Uploading the Bodymaker/Trimmer Set-Up Data
- Saving These Parameters to Disk

When selected, the “Bodymaker/Trimmer Set-Up Main Menu” is invoked.



7.2.1 SET BODYMAKER/TRIMMER SET-UP PARAMETERS

This selection is used to set the Bodymaker and Trimmer set-up parameters. When selected, the “Bodymaker/Trimmer Set-up Parameters” menu is invoked.



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 M4510.

In addition to the selections listed above, the corresponding parameters set by these selections are displayed as well. The following selections set the corresponding parameters:

1: Enable / Disable Brake Wear Compensation

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", if the compensation is to be enabled, enter "1".

Desired BDC Stop Position (low speed): This is the desired stopping location (in degrees) for a BDC stop in low speed when the brake wear compensation is enabled. This is typical set to 000 degrees (back dead center).

Desired BDC Stop Position (high speed): This is the desired stopping location (in degrees) for a BDC stop in high speed when the brake wear compensation is enabled. This is typical set to 000 degrees (back dead center).

2: Maximum Allowed Stopping Response: This defines the maximum allowed brake response before a "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 BDC stop is performed is longer than this number, the alarm is 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).

3: Set Bodymaker Running Speeds

Running Bodymaker Low Speed (SPM): This is the speed (in strokes per minute), that the bodymaker will run when in low speed.

Running Bodymaker High Speed (SPM): This is the speed (in strokes per minute), that the bodymaker will run when in high speed.

4: Set Trimmer Speed References

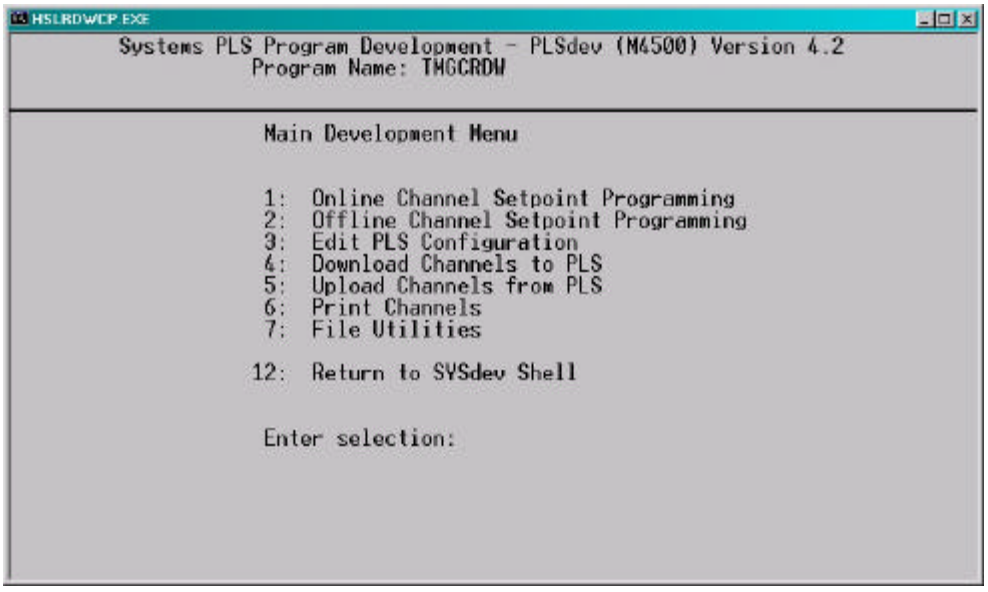
Trimmer Maximum Speed (CPM): The "Trimmer Maximum Speed" parameter is used to scale the 0-10VDC Analog output such that when the bodymaker is running at the speed entered, the analog output will be at 10 volts. This is typically set to the running high speed of the Bodymaker or slightly higher.

Trimmer Idle Speed (CPM): This parameter determines the speed the trimmer will run at when the bodymaker is stopped (de-clutched).

Note: When the bodymaker is running, the trimmer speed reference is proportional (as set by the "Trimmer Maximum Speed") to the speed of the bodymaker. This parameter is used to provide the speed reference when the bodymaker speed is zero.

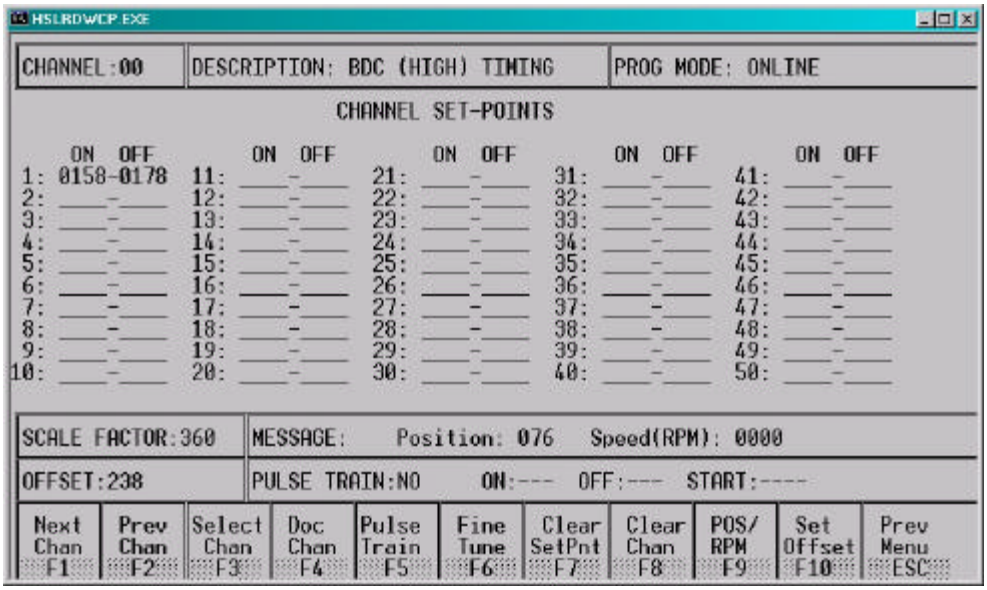
7.2.2 SET MACHINE TIMING

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 M4510). When selected, the PLS programming main development menu will be displayed, using the default "TMGCRDW" channel set-point file.



From this menu, the user can adjust the timing signal set-points or zero the main crank (set the resolver offset). Section 8 – "General Timing Signal Locations" 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 M4510.



Adjusting Timing Channel Set-points:

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

1) Select "1: Online Channel Set-point Programming" from the PLS Program Development main development menu.

2) Set all channels per section 8 – "General Timing Signal Locations". 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 bodymaker only one set-point is used per channel 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.

3) Once all channels are programmed, press <ESC> to return to the PLS Main Development Menu. Press <ESC> again, to return to the main menu. The new channels will be saved both in the M4510 and in the timing channel file.

Zeroing the Machine:

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

1) Select “1: Online Channel Set-point Programming” from the PLS Program Development main development menu.

2) 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 S1and S3 leads of the resolver at the M4510 resolver connector and then verify that the position indeed increases with forward movement. Press “ESC” to exit the “POS/RPM” update.

3) Position the machine at back dead center.

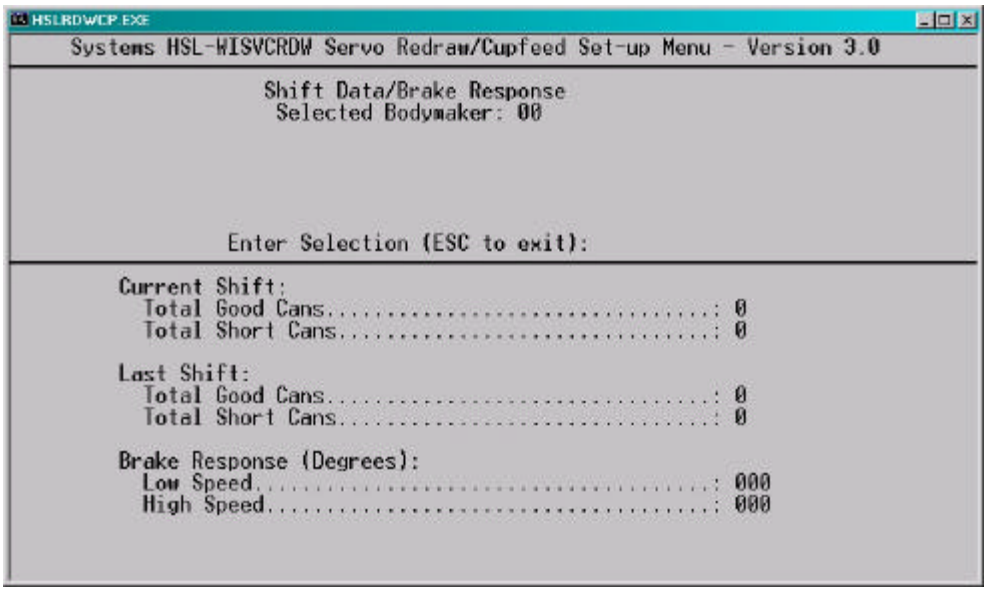
4) Auto zero the resolver by selecting “F10: Set Offset” and enter “0” in the offset field.

5) The M4510 will calculate the actual offset value required to make this the “0” position and will display this number in the offset field. The position will now read 000.

6) Return to the PLS Main Development menu by pressing <ESC>. Press <ESC> again, to return to the main menu.

7.2.3 SHIFT DATA/BRAKE RESPONSE

The shift data menu displays the Current and Last shift total good can counts as well as the low and high speed brake responses. 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" input 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 BDC stop.

The data displayed is defined as follows:

Total Good Cans: This is the total number of good cans produced for the shift. This is essentially a can counter.

Total Short Can Faults: This is the total number of short can faults for the shift.

Low Speed Brake Response (degrees): This is the number of degrees from when the clutch was de-activated (at the BDC Lo timing) to where the bodymaker crankshaft came to rest when a BDC 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.

Hi Speed Brake Response (degrees): This is the number of degrees from when the clutch was de-activated (at the BDC Hi timing) to where the bodymaker crankshaft came to rest when a BDC 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.

7.2.4 DOWNLOAD PROGRAM TO M4510

This selection is used to download the application program to the M4510 module. This should only be performed when replacing the module or whenever the program has been modified.

Note: Program download cannot be performed while the bodymaker is running. All outputs on the M4510 are turned "off" and no program execution is performed. The bodymaker should therefore be stopped before the download takes place.

To download the program, perform the following:

1) Select "4: Download Program to M4510". The current program ident, revision, and checksum for both the program on disk and already loaded in the module will be displayed. A prompt will be displayed asking to continue or abort. Press any key to continue. To abort, press the <ESC> key.

   Note: If a prompt stating that the "EM2RDWCP" file could not be opened is displayed, then the "EM2RDWCP" application program is not installed in the current directory.

2) Once program download is initiated, M4510 program execution will cease, the current address being downloaded will be displayed, and the "RUN" LED on the M4510 will flash continuously.

3) Once the download is complete, the "RUN" LED on the M4510 will illuminate solid and program execution will resume. Press any key to return to the main menu.

4) This selection can also be used to verify the program ident, revision, and checksum without downloading the program. Perform step 1 above but instead of initiating the download, simply press the <ESC> key to abort the download once the ident, revision, and checksum have been displayed.

7.2.5 DOWNLOAD SET-UP DATA TO M4510

This selection is used to download (previously uploaded or saved) bodymaker/trimmer set-up variables for the currently selected Bodymaker to the M4510. This should only be performed when replacing the module.

Note: This set-up data consists of the bodymaker and trimmer set-up parameters (not redraw or cupfeed set-up data). Timing channel set-points are not stored as part of the set-up data as well.

To download the bodymaker set-up data, perform the following:

1) Select "5: Download Set-up data to M4510". A prompt will be displayed asking to continue or abort. Press any key to continue. To abort, press the <ESC> key.

2) Once data download is initiated, the current address being downloaded will be displayed.

   Note: M4510 program execution is not ceased therefore data download can be performed while the machine is running.

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

7.2.6 UPLOAD (SAVE) SET-UP DATA FROM M4510

This selection is used to save the bodymaker/trimmer set-up variables from the M4510 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 M4510, not on the file in the computer. By uploading (saving) the set-up variables to disk, they can be downloaded to the M4510 in the event the module must be replaced.

The set-up data consists of the bodymaker and trimmer set-up parameters for the currently selected Bodymaker. Timing channel set-points are not stored as part of the set-up data.

To upload the set-up data, perform the following:

1) Select “6: Upload (Save) Set-up data from M4510”. A prompt will be displayed asking to continue or abort. Press any to continue. To abort, press the <ESC> key.

2) Once data upload is initiated, the current address being uploaded will be displayed.

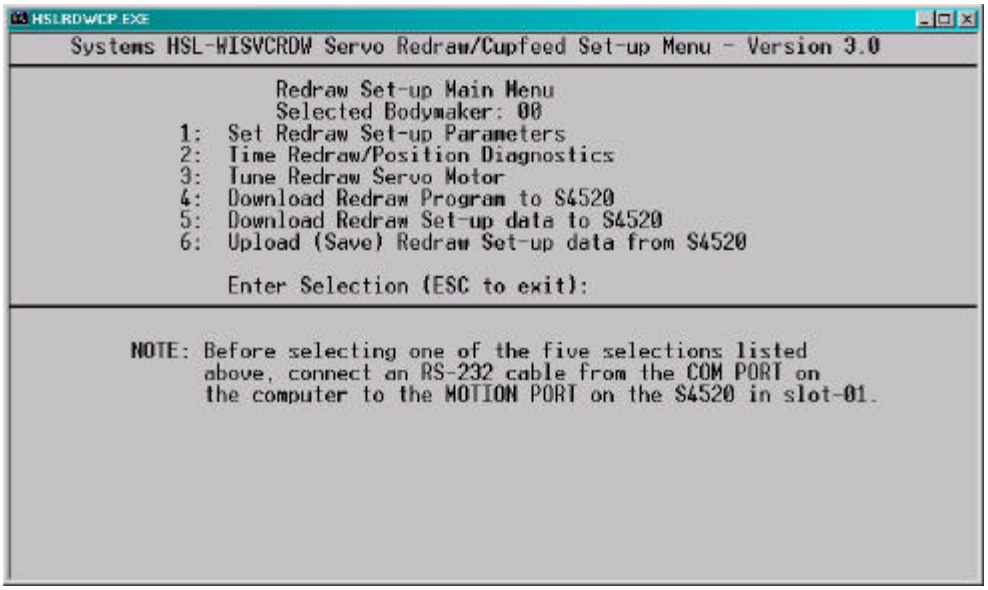
   Note: M4510 program execution is not ceased, therefore data upload can be performed while the machine is running.

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

SECTION 7
DOS BASED
SET-UP PROGRAM REFERENCE

7.3 REDRAW SET-UP

The Redraw Set-up main menu of the “EM2RDWCP” program incorporates the following menu selections:

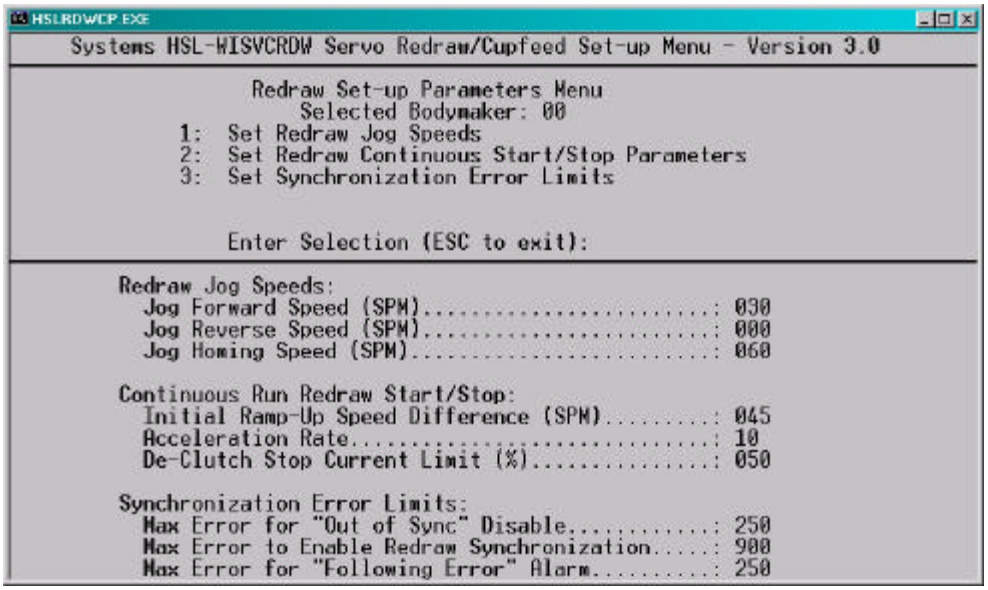


7.3.1 REDRAW SET-UP PARAMETERS

This selection is used to set the redraw set-up parameters. When selected, the “Redraw Set-up Parameters” menu is invoked.

Note: Prior to making this selection, make sure the RS-232 cable is connected from the COM port on the computer to the MOTION PORT on the S4520 in slot-01.

The “Redraw Set-up Parameters” menu contains the following selections:



In addition to the selections listed above, the corresponding parameters set by these selections are displayed as well. The following selections set the corresponding parameters:

1: Set Redraw Jog Speeds:

Jog Forward Speed (SPM): This is the speed (in strokes per minute), the redraw will stroke when the redraw is jogged forward fast.

Note: The number entered will round off to the nearest 15 strokes per minute.

Jog Reverse Speed (SPM): This is the speed (in strokes per minute), the redraw will stroke when the redraw is jogged in reverse.

Note: The number entered will round off to the nearest 15 strokes per minute.

Jog Homing Speed (SPM): This is the speed (in strokes per minute), the redraw will stroke when the redraw is performing the initial timing sequence after power-up.

2: Set Redraw Continuous Start/Stop Parameters:

Initial Ramp-Up Speed Difference (SPM): When the bodymaker is first started, the redraw will accelerate to a speed equal to "Main Crank Speed" minus the "Initial Ramp-Up Speed Difference". This allows the redraw to run at a speed slightly slower than the crank speed, so that the crank position can lap the redraw position every few seconds. As the crank position catches up to the redraw and begins to pass the redraw, the redraw will then lock onto the crank and go into sync. This allows the redraw to come into sync with the ram at a controlled pace rather than attempting to sync immediately.

Note: The number entered will be rounded off to the nearest 15 strokes per minute.

Acceleration Rate: This is the rate at which the redraw will accelerate when the clutch is first engaged in continuous mode and the redraw is accelerated up to the "Crank Speed" minus "Initial Ramp-Up Speed Difference". This is provided to reduce the harshness in which the redraw is initially accelerated (instead of just trying to immediately synchronize with the ram). This is also used to accelerate and decelerate the redraw when the jog speeds are activated. The acceleration rate should be set in the range of 1 to 4.

De-Clutch Stop Current Limit (%): This is the negative current limit applied when the clutch is disengaged in continuous and the redraw is stopped.

Note: Only negative current is applied (no positive current) to the redraw when the clutch is disengaged.

Thus the redraw is no longer in sync with the ram via the full PID loop and is stopped with the negative current only limited to a percentage of full peak current as set by this number. With a 100AMP peak amplifier, setting this parameter to 50% will limit the max negative current to 50AMPS. This allows the redraw to be stopped in a more gentle manner than would be done if it stayed in sync with the ram using the full PID loop.

3: Set Synchronization Error Limits

Max Error for "Out of Sync" Disable: This is the maximum amount of error allowed between the ram and the redraw to enable the cups to be fed. If the running error is less than this threshold, the redraw will be in sync with the ram and the cupfeed can be opened. If the running error is greater than this threshold, the cupfeed solenoid will be disabled. This threshold is also used to enable the Hold Down coil activation such that the hold down is activated only when the redraw is in sync with the ram.

Max Error to Enable Redraw Synchronization: This threshold is used to synchronize the redraw with the main crank when the machine is first activated in continuous mode. When the clutch is initially activated in continuous, the redraw will accelerate up to the "Crank Speed" minus the "Initial Ramp Up Speed Difference". The ram will then be running faster than the redraw and thus will come into sync with the redraw after some number of strokes.

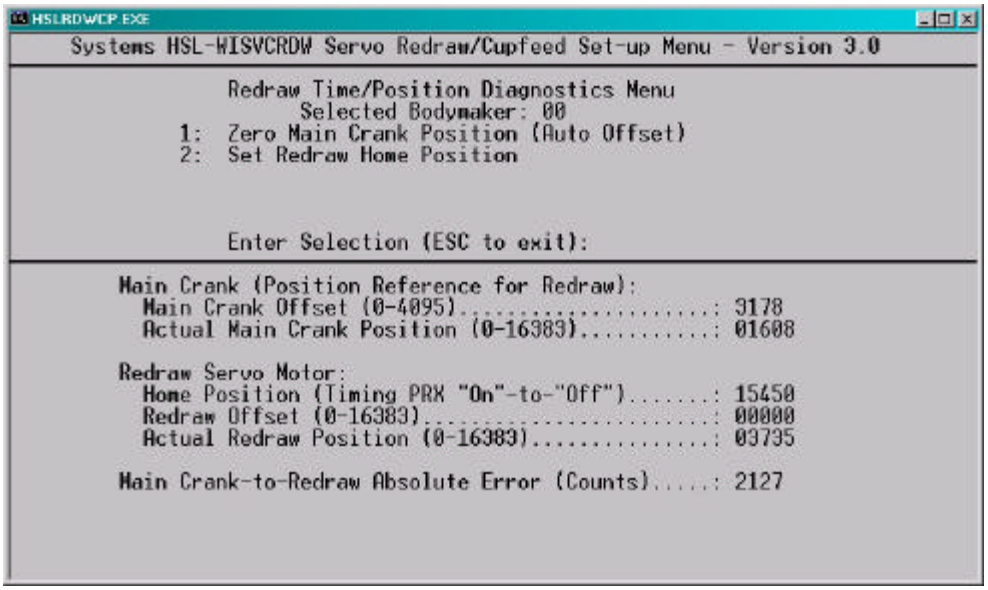
Once the main crank is within this error threshold of the redraw, the redraw will then sync in with the main crank and track the ram using the PID servo loop. This reduces the torque required (and harshness to the redraw) at synchronization then if the redraw simply synchronized immediately with the main crank when the clutch is first engaged.

Max Error for "Following Error" Alarm: This is the maximum amount of error allowed between the ram and the redraw before a "Following Error" fault is generated. This is enabled once the redraw is in sync with the main crank. The "Following Error" alarm is filtered to allow short errors in excess of this threshold to occur without generating the alarm. This threshold is primarily used to detect instability in the redraw servo motor or peak current limit conditions (excessive frictional loads in the redraw).

7.3.2 TIME REDRAW/POSITION DIAGNOSTICS

This selection is used to time the redraw and zero the main crank position in the Redraw S4520 of slot-01. In addition this menu displays the main crank position (0-to-16383) and redraw servo motor position (0-to-16383), which is useful for trouble-shooting purposes to observe that the resolver feedback for both is correct (in the correct direction and linear).

When selected, the “Redraw Time/Position Diagnostics” menu is displayed.



Note: Prior to selecting this selection, make sure the RS-232 cable is connected from the COM port on the computer to the MOTION PORT on the S4520 in slot-01.

In addition to the selections listed above, the following data is displayed in the menu:

Main Crank Offset: This is set automatically when the main crank position is zeroed.

Actual Main Crank Position (0-16383): This is the current main crank position with reference to a scale factor of 16384 for one complete revolution of the main crank. This is used as the primary reference for the redraw PID servo loop.

Redraw Servo Motor Home Position: This location is set by the user and corresponds to the desired location of the redraw when the redraw timing sensor transitions from "ON"-to-"off". This is used to time the redraw with respect to the main crank (ram).

Redraw Offset (0-16383): This is set automatically when the redraw is initially timed after power up and is calculated based on the "Redraw Home Position".

Actual Redraw Position (0-16383): This is the current redraw servo motor position with a scale factor of 16384 for one complete stroke of the redraw. This is used as the feedback to the redraw PID servo loop.

Main Crank-to-Redraw Absolute Error: This is the absolute (magnitude) difference between the main crank position and the redraw servo motor. When the PID servo loop is active, the torque applied to the redraw motor will be a function of this error.

1: Zero Main Crank Position (Auto Offset):
This selection zeros the main crank position by calculating the required offset to make the current position zero. This would be done when a new S4520 board has been installed.

To Zero the Main Crank Position:
a) Set the Ram at Back Dead Center
b) Select this Selection
c) A prompt asking "Are You Sure?" is displayed. Press "Y" to zero the position, or "N" to abort

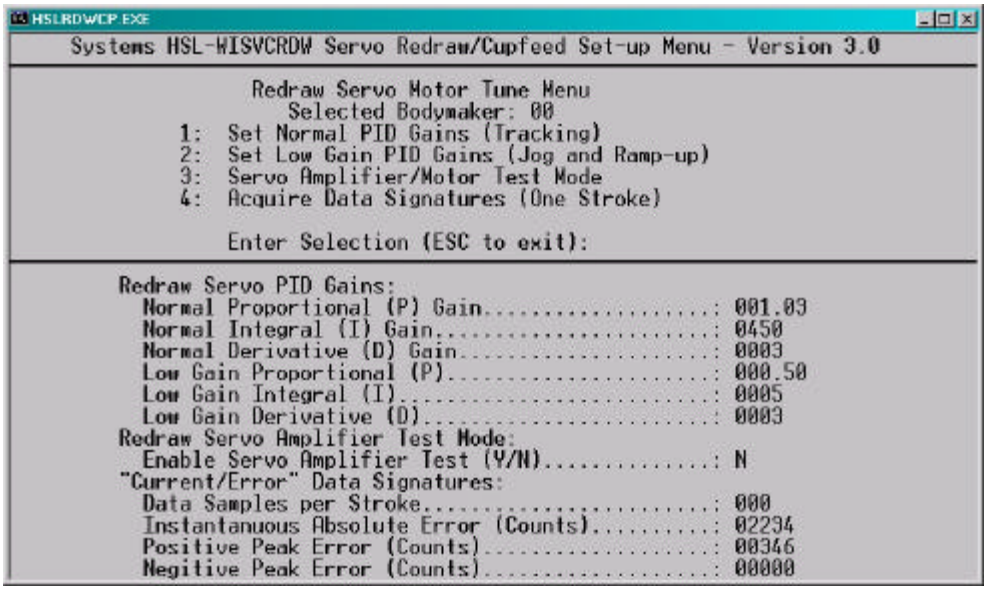
The "Main Crank Offset" will be calculated and the "Actual Main Crank Position" will now read "0".

Note: This selection will only zero the main crank position in the redraw S4520 (slot-01). The M4510 and Cupfeed S4520 in slot-02 main crank positions are not set from this selection. To set all three simultaneously, zero the main crank position using the Keypad/Display.

2: Set Redraw Home Position: This selection is used to set the "Redraw Servo Motor Home Position".

7.3.3 TUNE REDRAW SERVO MOTOR

This selection is used to tune the redraw motor (PID gains). When selected, the “Redraw Servo Motor Tune” menu is displayed.



Note: Prior to selecting this selection, make sure the RS-232 cable is connected from the COM port on the computer to the MOTION PORT on the S4520 in slot-01.

In addition to the selections listed above and the corresponding parameters set by these selections, the following diagnostic data is displayed in the “Redraw Servo Motor Tune” menu:

Instantaneous Absolute Error (Counts): This is the current instantaneous absolute (magnitude) difference between the main crank position and the redraw servo position.

Positive Peak Error (Counts): This is the maximum positive peak error detected as the redraw strokes. This is updated once every 1.5 seconds while the machine is running.

Negative Peak Error (Counts): This is the maximum negative peak error detected as the redraw strokes. This is updated once every 1.5 seconds while the machine is running.

The above diagnostic error data can be used to judge how well the redraw motor is tuned and how well the redraw is tracking the main crank. See section 3 – "Tuning the Servo Loop" for details on tuning the PID servo loop.

1: Set Normal PID Gains

Normal Proportional (P) Gain: This is the proportional gain (torque proportional to error) used when the redraw is following the crank.

Normal Integral (I) Gain: This is the integral gain (torque proportional to cumulative error) used when the redraw is following the crank.

Normal Derivative (D) Gain: This is the derivative gain (torque proportional to rate of change of error) used when the redraw is following the crank.

2: Set Low Gain PID Gains: The definition and specific function (P, I, and D) are identical to the Normal gains, the purpose of the Low Gain settings are for Jog and Ramp-up modes of the redraw and should be set accordingly.

3: Enable Servo Amplifier / Motor Test Mode: This selection is used to test the redraw amplifier and motor (see section 9 – "Servo Test & Troubleshooting Guide").

4: Acquire Data Signatures: This selection is used to acquire redraw error and current data for one bodymaker stroke. The data is saved in a delimited ASCII text file "SERVORDW.TXT". The data from the text file can then be imported into many popular spread sheet software packages, and from there the data can be graphed.

7.3.4 DOWNLOAD REDRAW PROGRAM TO S4520

This selection is used to download the SRVRDRW application program to the S4520 (slot-01). This should only be performed when either replacing the S4520 or when the program has been modified.

Note: The bodymaker should be stopped before program download takes place. Program download cannot be performed while the bodymaker is running because control of the Redraw servo motor will cease while the program is downloaded.

To download the program, perform the following:

1) Select "4: Download Redraw Program to S4520". The current program ident, revision, and checksum for both the program on disk and already loaded in the board will be displayed. A prompt will be displayed asking to continue or abort. Press any key to continue. To abort, press the <ESC> key.

   Note: If a prompt stating that the "SRVRDRW" file could not be opened is displayed, then the application program is not installed in the current directory.

2) Once program download is initiated, S4520 program execution will cease, the current address being downloaded will be displayed, and the "RUN" LED on the S4520 will flash continuously.

3) Once the download is complete, the "RUN" LED on the S4520 will illuminate solid and program execution in the S4520 will resume. Press any key to return to the main menu.

4) This selection can also be used to verify the program ident, revision, and checksum without downloading the program. Perform step 1 above but instead of initiating the download, simply press the <ESC> key to abort the download once the ident, revision, and checksum have been displayed.

7.3.5 DOWNLOAD REDRAW SET-UP DATA TO S4520

This selection is used to download the previously uploaded (saved) redraw set-up variables for the currently selected Bodymaker to the S4520. This should only be performed when replacing the S4520 board in slot-01.

Note: This set-up data consists of the redraw set-up parameters only and not the bodymaker or cupfeed set-up data.

To download the redraw set-up data, perform the following:

1) Select “5: Download Redraw Set-up data to S4520”. A prompt will be displayed asking to continue or abort. Press any key to continue. To abort, press the <ESC> key.

2) Once data download is initiated, the current address being downloaded will be displayed.

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

7.3.6 UPLOAD (SAVE) REDRAW SET-UP DATA FROM S4520

This selection is used to save the redraw set-up variables from the S4520 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 S4520, not on the file in the computer.

By uploading (saving) the set-up variables to disk, they can be downloaded to the S4520 in the event the board must be replaced. The set-up data consists of the redraw set-up parameters for the currently selected Bodymaker.

To upload the set-up data, perform the following:

1) Select “6: Upload (Save) Redraw Set-up data from S4520”. A prompt will be displayed asking to continue or abort. Press any key to continue. To abort, press the <ESC> key.

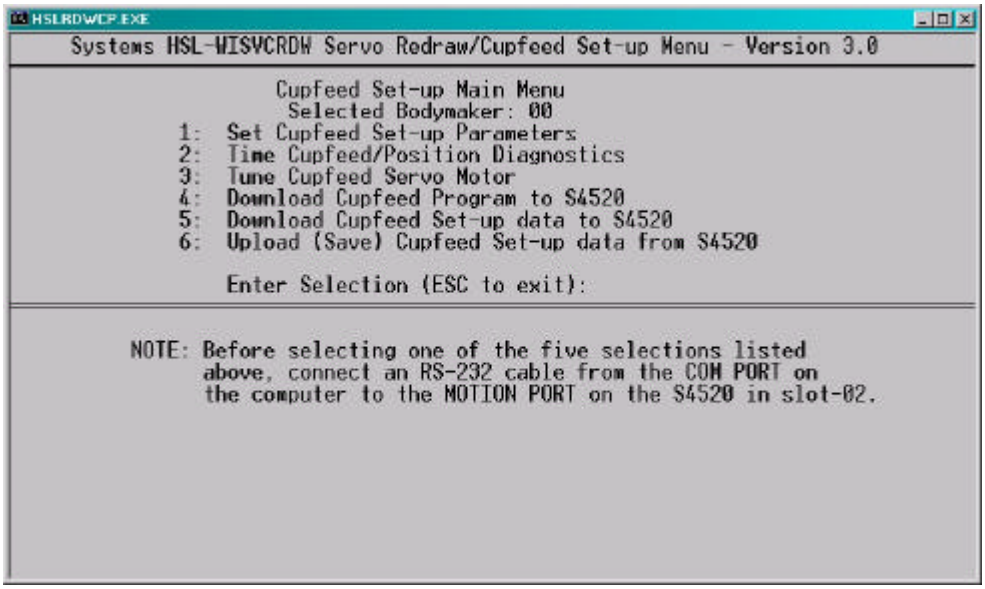
2) Once data upload is initiated, the current address being uploaded will be displayed.

   Note: S4520 program execution is not ceased, therefore data upload can be performed while the machine is running.

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

7.4 CUPFEED SET-UP

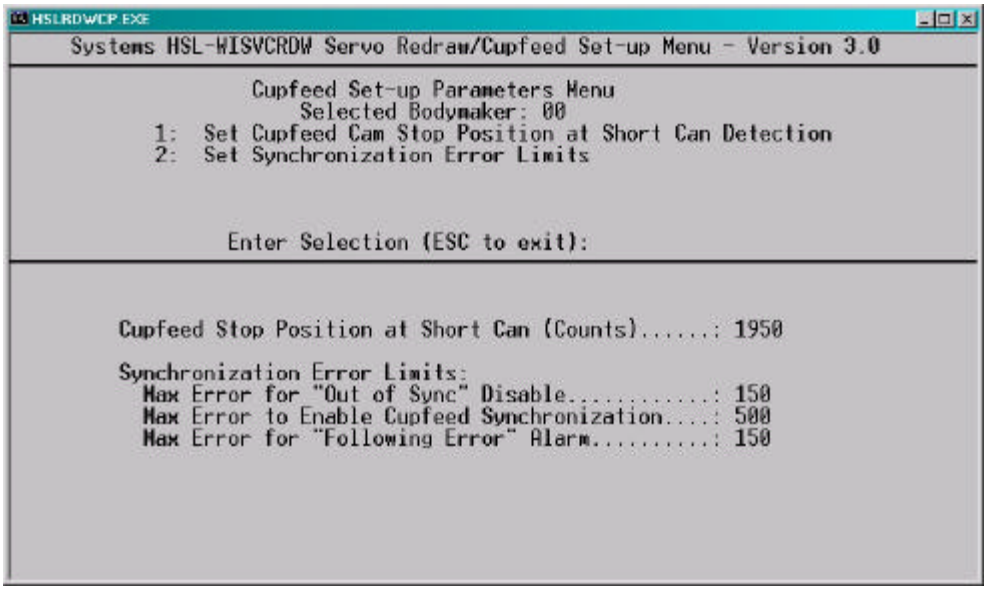
The Cupfeed Set-up main menu of the set-up program incorporates the following menu selections:



7.4.1 SET CUPFEED SET-UP PARAMETERS

This selection is used to set the cupfeed set-up parameters. When selected, the “Cupfeed Set-up Parameters” menu is displayed.

The “Cupfeed Set-up Parameters” menu contains the following selections:



Note: Prior to selecting this selection, make sure the RS-232 cable is connected from the COM port on the computer to the MOTION PORT on the S4520 in slot-02.

1: **Set Cupfeed Cam Stop Position at Short Can Detection: Cupfeed Stop Position at Short Can (Counts):** This is the position the cupfeed cam will be stopped at when a short can alarm occurs. This should be set between the trailing edge of the short can check timing signal and where the cupfeed cam picks up the next cup.

2: Set Synchronization Error Limits:

Max Error for "Out of Sync" Disable: This is the maximum amount of error allowed between the ram and the cupfeed to enable the cupfeed to open. If the running error is less than this threshold, the cupfeed is in sync with the ram and the cupfeed can be opened. If the running error is greater than this threshold, the cupfeed will be disabled.

Max Error to Enable Cupfeed Synchronization: This threshold is used to synchronize the cupfeed with the main crank when the clutch is activated. Once the main crank is within this error threshold of the cupfeed, the cupfeed will then sync in with the main crank and then track the ram using the PID servo loop.

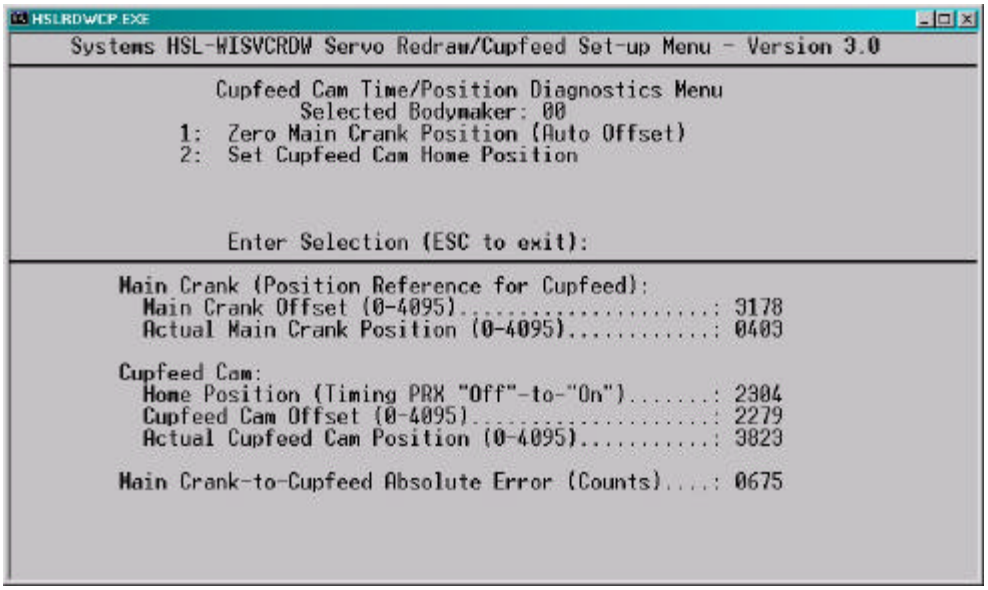
Max Error for "Following Error" Alarm: This is the maximum amount of error allowed between the ram and the cupfeed before a "Following Error" fault is generated. This is enabled once the cupfeed is in sync with the main crank. The "Following Error" alarm is filtered to allow short errors in excess of this threshold to occur without generating the alarm. This threshold is primarily used to detect instability in the cupfeed servo motor or peak current limit conditions (excessive frictional loads in the cupfeed).

7.4.2 TIME CUPFEED/POSITION DIAGNOSTICS

This selection is used to time the cupfeed and zero the main crank position in the Cupfeed S4520 (slot-02). In addition, this menu displays the main crank position (0-to-4095) and cupfeed servo motor position (0-to-4095), which is useful for trouble-shooting purposes to observe that the resolver feedback for both is correct (in the correct direction and linear).

When selected, the "Cupfeed Time/Position Diagnostics" menu is displayed.

The “Cupfeed Time/Position Diagnostics” menu contains the following selections:



Note: Prior to making this selection, make sure the RS-232 cable is connected from the COM port on the computer to the MOTION PORT on the S4520 in slot-02.

In addition to the selections listed above, the following data is displayed in the menu:

Main Crank Offset: This is set automatically when the main crank position is zeroed.

Actual Main Crank Position (0-4095): This is the current main crank position with reference to a scale factor of 4095 for one complete revolution of the main crank. This is used as the primary reference for the cupfeed PID servo loop.

Cupfeed Cam Home Position: This location is set by the user and corresponds to the desired location that the cupfeed should be at when the cupfeed timing sensor transitions from “off”-to-”ON”. This is used to time the cupfeed with respect to the main crank (ram).

Cupfeed Cam Offset (0-4095): This is set automatically when the cupfeed is initially timed after power up and is calculated based on the "Cupfeed Home Position".

Actual Cupfeed Cam Position (0-4095): This is the current cupfeed cam position with a scale factor of 4096 for one complete revolution of the cupfeed cam. This is used as the feedback to the cupfeed PID servo loop.

Main Crank-to-Cupfeed Absolute Error: This is the absolute (magnitude) difference between the main crank position and the cupfeed cam. When the PID servo loop is active, the torque applied to the cupfeed cam motor will be a function of this error.

1: **Zero Main Crank Position (Auto Offset):** This selection zeros the main crank position by calculating the required offset to make the current position zero. This would be done when a new S4520 board has been installed, etc. To zero the main crank position, set the ram at Back Dead Center and select this selection. A prompt asking "are you sure?" is displayed. Press "Y" to zero the position, or "N" to abort. The "main crank offset" will be calculated and the "Actual Main Crank Position" will now read "0".

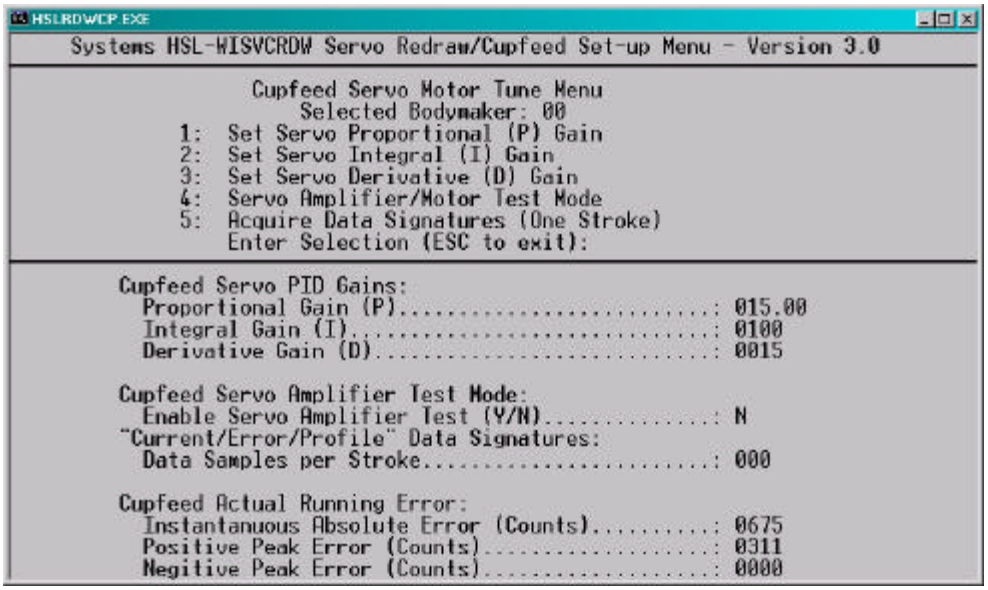
   Note: This selection only zeros the main crank position in the cupfeed S4520 in slot-02. The M4510 and Redraw S4520 in slot-01 main crank positions are not set from this selection. To set all three simultaneously, zero the main crank position using the Keypad/Display.

2: **Set Cupfeed Cam Home Position:** This selection is used to set the "Cupfeed Cam Home Position".

7.4.3 TUNE CUPFEED SERVO MOTOR

This selection is used to tune the cupfeed motor. When selected, the "Cupfeed Servo Motor Tune" menu is invoked.

The "Cupfeed Servo Motor Tune" menu contains the following selections:



Note: Prior to selecting this selection, make sure the RS-232 cable is connected from the COM port on the computer to the MOTION PORT on the S4520 in slot-02.

In addition to the selections listed above and the corresponding parameters set by these selections, the following diagnostic data is displayed in the "Cupfeed Servo Motor Tune" menu:

Instantaneous Absolute Error (Counts): This is the current instantaneous absolute (magnitude) difference between the main crank position and the cupfeed cam position.

Positive Peak Error (Counts): This is the maximum positive peak error detected as the cupfeed cam rotates. This is updated once every 1.5 seconds while the machine is running.

Negative Peak Error (Counts): This is the maximum negative peak error detected as the cupfeed cam rotates. This is update once every 1.5 seconds while the machine is running.

The above diagnostic error data can be used to judge how well the cupfeed cam motor is tuned and how well the cupfeed cam is tracking the main crank. See section 3 – "Tuning the Servo Loop" for details on tuning the PID servo loop.

1: Set Proportional (P) Gain: This is the proportional gain (torque proportional to error) of the PID servo loop.

2: Set Integral (I) Gain: This is the integral gain (torque proportional to cumulative error) of the PID servo loop.

3: Set Derivative Gain (D): This is the derivative gain (torque proportional to rate of change of error) of the PID servo loop.

4: Enable Servo Amplifier/Motor Test Mode: This selection is used to test the cupfeed amplifier and motor (see section 9 – "Servo Test & Troubleshooting Guide").

5: Acquire Data Signatures: This selection is used to acquire cupfeed error and current data for one bodymaker stroke. The data is saved in a delimited ASCII text file "SERVOCUP.TXT". The data from the text file can then be imported into many popular spread sheet software packages, and from there the data can be graphed.

7.4.4 DOWNLOAD CUPFEED PROGRAM TO S4520

This selection is used to download the SRVCUPR application program to the S4520 (slot-02). This should only be performed when replacing the S4520 or when the program has been modified.

Note: The bodymaker should be stopped before the download takes place. Program download cannot be performed while the bodymaker is running. Control of the Cupfeed servo motor will cease while the program is downloaded.

To download the program, perform the following:

1) Select "4: Download Cupfeed Program to S4520". The current program ident, revision, and checksum for both the program on disk and already loaded in the board will be displayed. A prompt will be displayed asking to continue or abort. Press any key to continue. To abort, press the <ESC> key.

   Note: If a prompt stating that the "SRVCUPR" file could not be opened is displayed, then the application program is not installed in the current directory.

2) Once program download is initiated, program execution will cease, the current address being downloaded will be displayed, and the "RUN" LED on the S4520 will flash continuously.

3) Once the download is complete, the "RUN" LED on the S4520 will illuminate solid and program execution in the S4520 will resume. Press any key to return to the main menu.

4) This selection can also be used to verify the program ident, revision, and checksum without downloading the program. Perform step 1 above but instead of initiating the download, simply press the <ESC> key to abort the download once the ident, revision, and checksum have been displayed.

7.4.5 DOWNLOAD CUPFEED SET-UP DATA TO S4520

This selection is used to download the previously uploaded (saved) cupfeed set-up variables for the currently selected Bodymaker to the S4520. This should only be performed when replacing the S4520 board in slot-02.

Note: Set-up data consists of the cupfeed set-up parameters only and not the bodymaker or redraw set-up data.

To download the cupfeed set-up data, perform the following:

1) Select “5: Download Cupfeed Set-up data to S4520”. A prompt will be displayed asking to continue or abort. Press any key to continue. To abort, press the <ESC> key.

2) Once data download is initiated, the current address being downloaded will be displayed.

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

7.4.6 UPLOAD (SAVE) CUPFEED SET-UP DATA FROM S450

This selection is used to save the cupfeed set-up variables from the S4520 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 S4520, not on the file in the computer.

By uploading (saving) the set-up variables to disk, they can be downloaded to the S4520 in the event the board must be replaced. The set-up data consists of the cupfeed set-up parameters for the currently selected Bodymaker.

To upload the set-up data, perform the following:

1) Select “6: Upload (Save) Cupfeed Set-up data from S4520”. A prompt will be displayed asking to continue or abort. Press any key to continue. To abort, press the <ESC> key.

2) Once data upload is initiated, the current address being uploaded will be displayed.

   Note: S4520 program execution is not ceased, therefore data upload can be performed while the machine is running.

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

SECTION 8
GENERAL TIMING SIGNAL LOCATIONS

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

CH00: BDC (High) Timing: This signal is used to de-activate the clutch for a BDC 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. 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 back dead center for a BDC stop at high speed.

CH01: BDC (Low) Timing: Same as the BDC (High) timing (CH00) except used when the machine is running in low speed.

CH02: Short Can Timing: This signal is used to verify the length of the can and verify that the can is good. The short can sensor must see "Can" the entire time this signal is "on" to prevent a short can alarm. This signal is generally set in the range of "on" at 150 to 160 and "off" at 170 to 175.

CH03: Sensor Check Timing: This signal is used to verify that the short can sensor does not fail "on". The short can sensor must be "off" the entire time this signal is "on" in order to prevent a "die sensor fail" alarm. This signal is generally programmed to be "on" just prior to the punch reaching front dead center (typically 180 degrees) and to turn off when the punch is just past front dead center (typically 190 degrees).

CH04: Cupfeed Timing: This signal is used to activate the cupfeed "on" when enabled and back "off" when disabled. The leading edge of this signal is used to activate the solenoid "on" while the trailing edge is used to activate it "off". The "on" set-point is generally set such that when the cupfeed is opened, the cup will drop onto the high part of the rotary cam. The "off" set-point is generally set such that the cupfeed will close such that the cup is caught with-out causing damage to the cup that is retained. This signal is generally set "on" at 110and "off" at 230.

CH05: Air Strip (Low) Timing: This signal is used to activate the air strip solenoid when the machine is running in low speed. The air strip is “ON” for the entire window that CH05 is “ON” while the machine is running with the cupfeed open. This signal is generally set “on” about 125 degrees and then set “off” at about 210.

CH06: Air Strip (High) Timing: Same as the Air Strip (Low) timing (CH05) except used when the machine is running in high speed. This is generally set “on” about 105 degrees and then “off” at about 200.

CH07: PLC Clock: Used to synchronize logic between the host PLC and the M4500. This is generally set “on” at 180 degrees and then “off” at 0 degrees.

CH10: Hold Down - Initial Clamp: This timing signal activates the hold down coil with the “Initial Hold-Down” current. The default setting of this channel is “on” at 32 degrees, “off” at 57 degrees.

CH11: Hold Down - 2nd Hold: This timing signal activates the hold down coil with the “2nd Hold-Down” current. The default setting of this channel is “on” at 57 degrees, “off” at 62 degrees.

CH12: Hold Down - 3rd Hold: This timing signal activates the hold down coil with the “3rd Hold-Down” current. The default setting of this channel is “on” at 62 degrees, “off” at 67 degrees.

CH13: Hold Down - 4th Hold: This timing signal activates the hold down coil with the “4th Hold-Down” current. The default setting of this channel is “on” at 67 degrees, “off” at 72 degrees.

CH14: Hold Down - Final Hold: This timing signal activates the hold down coil with the “Final Hold-Down” current. The default setting of this channel is “on” at 72 degrees, “off” at 77 degrees.

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9.1 CUPFEED SERVO

9.1.1 INITIAL SYSTEM TEST

Before performing any of the following tests, verify the cupfeed servo system as follows:

1) Disconnect the cupfeed timing sensor cable from the cupfeed timing sensor.

2) Cycle logic power to the M4500 controller.

3) Bring the system up as you would normally, so that there is a continuous ready condition.

4) Start the bodymaker in continuous mode while watching the cupfeed cam. The cupfeed cam should rotate forward slowly and smoothly about 2 revolutions in an attempt to time itself. After two revolutions, it will stop on a “Cupfeed Following Fault”. This process is normal and indicates that the servo system (servo motor, amplifier, cables, etc.) is functioning correctly. The “Following Fault” at the end of the two revolutions simply indicates that the timing sensor was never located. It is not necessary to perform the following steps if this is the case.

5) If on the other hand, a “Following Fault” is detected immediately without making the two revolutions (the motor may jerk forward or backwards or may not move at all), then a problem does exist in the servo system. Perform the following steps to isolate the problem.

9.1.2 RESOLVER AND COMMUTATION TEST

The following tests will verify the cupfeed resolver, commutation, servo amp and servo motor.

1) With the C2 contactor off (machine is stopped, guards open and control power is on), jumper 718 to 719 on the N.O. auxiliary contact of C2.

   WARNING: Make sure the C2 contactor is off throughout the resolver and commutation test.

2) Using the set-up program, go on-line with the cupfeed S4520-RDC in slot 02.

3) Monitor the “Actual Cupfeed Cam Position”.

4) Rotate the cupfeed cam by hand in the forward direction at a slow constant rate, while monitoring the “Actual Cupfeed Cam Position”. The “Actual Cupfeed Cam Position” should increase in value from 0 to 4095 then back to 0 in one revolution of the cupfeed cam. If the cam is turned at a steady rate, the “Actual Cupfeed Cam Position” should also increase at the same steady rate. If the “Actual Cupfeed Cam Position” jumps or stops there is problem with the cupfeed resolver or wiring.

5) Using the set-up program enable the servo amplifier/motor test mode. (see section 6 – Windows Based Set-up Program Reference or section 7 – DOS Based Set-up Program Reference).

6) Verify the “Servo Enable” LED on the S4520-RDC turns on and the LED on the cupfeed amplifier should turn green.

7) Rotate the cupfeed cam one revolution by hand in either direction and verify the amplifier LED stays green the entire revolution. If it is always red, there is a problem with the enable circuit (INH) between the S4520-RDC and the amplifier or the commutation is not correct. If it is red during part of the revolution and green the remainder of the revolution, the commutation is not correct. If it stays green through the entire revolution, the commutation (HALL signals from S4520-RDC) is OK.

8) Disable the servo amplifier/motor test mode in the set-up program, the LED on the amplifier should turn red.

9) Enable the servo amplifier/motor test mode in the set-up program, the LED on the amplifier should turn green.

10) Remove the jumper from 718 and 719 on the N.O. contact of C2. The LED on the amplifier should turn red.

11) Disable the servo amplifier/motor test mode in the set-up program.

9.1.3 MOTOR AND AMPLIFIER TEST

Note: A second person should watch the cupfeed servo throughout this test. The bodymaker should be stopped immediately if the cupfeed begins to run in an unstable manner (jerking, oscillating or running away).

1) Close the bodymaker guards and restart the bodymaker in continuous mode.

2) Enable the servo amplifier/motor test mode using the set-up program, the LED on the amplifier should change from red to green.

3) The cupfeed servo motor should run proportional to the "Test/Offset" potentiometer (P4) on the B25A20 amplifier.

4) The motor is running in open loop and may stall at lower speeds, otherwise the motor should run smoothly (no harsh jerking or jumping) either forward or backwards depending on which way the "Test/Offset" potentiometer is turned. You should also be able to stop the motor by nulling the potentiometer.

5) If the motor does not run smoothly (not moving, jerking or running out of control), something is wrong with the motor stator wiring or the motor itself.

6) When done with the test, null the "Test/Offset" potentiometer out such that the motor is stopped. Stop the bodymaker and disable the servo amplifier/motor test mode using the set-up program.

9.1.4 MOTOR STATOR AND WINDINGS TEST

If the “Cupfeed Servo Motor/Amplifier” test is not passed, verify the motor stator windings as follows:

1) Turn “off “ the C2 contactor (e-stop depressed) and turn off the circuit breaker (CB2) which feeds power to the cupfeed servo amplifier. Wait until the amplifier LED turns off. Measure at the contactor the impedance of the R, S and T stator windings against each other. The impedance from any stator to any other stator should be approximately 6-7 ohms.

2) If any stator to any other stator is shorted, remove the motor leads at the motor and recheck the motor leads for a short between leads, also check for a short in the motor between stator to stator connections.

3) If any stator to any other stator is open, then measure the impedance of the stators to each other at the R, S and T terminals inside the motor. If these measure OK, then one of the leads of the cable from C2 contactor to the motor is bad. If the measurements at the motor terminals are not OK, the motor itself is bad.

4) If the stator-to-stator readings check out OK, then measure the impedance from each stator to ground, these should read open. If this is not the case, disconnect the motor leads at the motor and read the impedance from each stator to ground at the motor terminals. If these read OK, the cable from the C2 contactor to the motor is bad. If the readings are not OK, the motor itself is bad. Stator to ground shorts may be checked with a “Megger” instead of an ohm meter if one is available.

   Warning: Do not megger connections on the feed side of the C2 contactor or damage may occur to the amplifier.

9.1.5 MOTOR AMPLIFIER FUNCTIONAL TEST

If the cupfeed motor stator windings check out OK, verify the B25A20 amplifier is functional as follows:

1) If the stator impedance readings check OK, re-activate the motor as was done in the "Servo Motor/Amplifier" test. With the motor stalled at a specific location, measure the DC voltage on all three stators (the VDC range on this check is as high as 100VDC). Two of the three stators should have some DC voltage (these may vary significantly), while one stator should have essentially no voltage. Disable the motor (C2 contactor off) and move the cam 180 degrees or so. Re-activate the motor again and measure the stator voltages. The stator that had no voltage on the previous reading should now read some DC voltage while one of the other stators no longer reads a voltage.

   This test verifies that all three stators are driven by the amplifier. Thus if voltage can be read at each stator at some position of the cam, the amplifier is OK.

   Note: Only two stators are driven at a time, and therefore the cam will have to be moved to different positions to verify that each stator is active at some position.

2) If all the above tests check out OK, then most likely the motor is bad. Replace the motor and retry the "Servo Motor/Amplifier" test.

3) Disable the servo amplifier/motor test mode using the set-up program.

9.2 REDRAW SERVO

9.2.1 INITIAL SYSTEM TEST

Before performing any of the following tests, verify the redraw servo system as follows:

1) Disconnect the redraw timing sensor cable from the redraw timing sensor.

2) Cycle logic power to the M4500 controller.

3) Bring the system up as you would normally, so that there is a continuous ready condition and the redraw is in auto mode.

4) Start the bodymaker in continuous mode while watching the redraw mechanism. The redraw should rotate forward slowly and smoothly about 2 cycles in an attempt to time itself. After two cycles, it will stop on a “Redraw Following Fault”. This process is normal and indicates that the servo system (servo motor, amplifier, cables, etc.) is functioning correctly. The “Following Fault” at the end of the two cycles simply indicates that the timing sensor was never located. It is not necessary to perform the following steps if this is the case.

5) If on the other hand, a “Following Fault” is detected immediately without making the two cycles (the motor may jerk forward or backwards or may not move at all), then a problem does exist in the servo system. Perform the following steps to isolate the problem.

9.2.2 REDRAW MECHANICAL CHECKS

Depress an e-stop on the machine (safe mode), then, manually rotate the redraw mechanism one cycle. The redraw should turn freely and smoothly with no binding at any position of its cycle. If it does not, then refer to APM mechanical troubleshooting procedures.

The following tests will verify the redraw resolver, commutation, servo amp and servo motor.

9.2.3 RESOLVER AND COMMUTATION TEST

1) With the C1 contactor off (machine is stopped, guards open and control power is on), jumper 714 to 715 on the N.O. auxiliary contact of C1.

   WARNING: Make sure the C1 contactor is off throughout the resolver and commutation test.

2) Using the set-up program, go on-line with the redraw S4520-RDC in slot 01.

3) Monitor the “Actual Redraw Position” (see section 6 – Windows Based Set-up Program Reference or section 7 – DOS Based Set-up Program Reference).

4) Rotate the redraw by hand (using the manual barring bolt) in the forward direction at a slow constant rate, while monitoring the “Actual Redraw Position”. The “Actual Redraw Position” should increase in value from 0 to 16383 then back to 0 in one cycle of the redraw. If the redraw is turned at a steady rate, the “actual redraw position” should also increase at the same steady rate. If the “Actual Redraw Position” jumps or stops there is problem with the redraw resolver or wiring.

5) Using the set-up program enable the servo amplifier/motor test mode. (see section 6 – Windows Based Set-up Program Reference or section 7 – DOS Based Set-up Program Reference).

6) Verify the “Servo Enable” LED on the S4520-RDC turns on and the LED on the redraw amplifier should turn green.

7) Rotate the redraw motor one revolution by hand (one revolution of the manual barring bolt) in either direction and verify the amplifier LED stays green the entire revolution. If it is always red, there is a problem with the enable circuit (INH) between the S4520-RDC and the amplifier or the commutation is not correct. If it is red during part of the revolution and green the remainder of the revolution, the commutation is not correct. If it stays green through the entire revolution, the commutation (HALL signals from S4520-RDC) is OK.

8) Disable the servo amplifier/motor test mode using the set-up program, the LED on the amplifier should turn red.

9) Enable the servo amplifier/motor test mode using the set-up program, the LED on the amplifier should turn green.

10) Remove the jumper from 714 and 715 on the N.O. contact of C1. The LED on the amplifier should turn red.

11) Disable the servo amplifier/motor test mode using the set-up program.

9.2.4 MOTOR AND AMPLIFIER TEST

Note: A second person should watch the redraw servo throughout this test. The bodymaker should be stopped immediately if the redraw begins to run in an unstable manner (jerking, oscillating or running away).

1) Close the bodymaker guards and restart the bodymaker in continuous mode.

2) Enable the servo amplifier/motor test mode using the set-up program, the LED on the amplifier should change from red to green.

3) The redraw servo motor should run proportional to the “Test/Offset” potentiometer (P4) on the B100A40 amplifier.

4) The motor is running in open loop and may stall at lower speeds, otherwise the motor should run smoothly (no harsh jerking or jumping) either forward or backwards depending on which way the “Test/Offset” potentiometer is turned. You should also be able to stop the motor by nulling the potentiometer.

5) If the motor does not run smoothly (not moving, jerking or running out of control), something is wrong with the motor stator wiring or the motor itself.

6) When done with the test, null the “Test/Offset” potentiometer such that the motor is stopped. Stop the bodymaker and disable the servo amplifier/motor test mode using the set-up program.

9.2.5 MOTOR STATOR WINDINGS TEST

If the “Redraw Servo Motor/Amplifier” test is not passed, verify the motor stator windings as follows:

1) With the C1 contactor off (e-stop depressed) and turn off the circuit breaker (CB1) which feeds power to the redraw servo amplifier (wait until the amplifier LED turns off). Measure at the contactor the impedance of the R, S and T stator windings against each other. The impedance from any stator to any other stator should be approximately 0.1-0.2 ohms.

2) If any stator to any other stator is shorted, remove the motor leads at the motor and recheck the motor leads for a short between leads, also check for a short in the motor between stator to stator connections.

3) If any stator to any other stator is open, then measure the impedance of the stators to each other at the R, S and T terminals inside the motor. If these measure OK, then one of the leads of the cable from C1 contactor to the motor is bad. If the measurements at the motor terminals are not OK, the motor itself is bad.

4) If the stator-to-stator readings check out OK, then measure the impedance from each stator to ground. These should read as an open. If this is not the case, disconnect the motor leads at the motor and read the impedance from each stator to ground at the motor terminals. If these read OK, the cable from the C1 contactor to the motor is bad. If the readings are not OK, the motor itself is bad. Stator to ground shorts may be checked with a megger instead of an ohm meter if one is available.

   Warning: Do not megger connections on the feed side of the C1 contactor or damage may occur to the amplifier.

9.2.6 MOTOR AMPLIFIER FUNCTIONAL TEST

If the redraw motor stator windings check out OK, verify the B100A40 amplifier is functional as follows:

1) If the stator impedance readings check OK, re-activate the motor as was done in the “Servo Motor/Amplifier” test. With the motor stalled at a specific location, measure the DC voltage on all three stators (the VDC range on this check is as high as 400VDC). Two of the three stators should have some DC voltage (these may vary significantly), while one stator should have essentially no voltage.

   Disable the motor (C1 contactor off) and move the redraw motor 180 degrees or so (180 degrees of the manual barring bolt). Re-activate the motor again and measure the stator voltages. The stator that had no voltage on the previous reading should now read some DC voltage while one of the other stators no longer reads a voltage. This test verifies all three stators are driven by the amplifier. Thus if voltage can be read at each stator at some position of the cam, the amplifier is OK.

   Note: Only two stators are driven at a time, and therefore the cam will have to be moved to different positions to verify that each stator is active at some position.

2) If all the above tests check out OK, then most likely the motor is bad. Replace the motor and retry the “Servo Motor/Amplifier” test.

3) Disable the servo amplifier/motor test mode using the set-up program.

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SECTION 10
RECOMMENDED SPARE PARTS

The following are recommended spares for the EM2RDWCP.

Quantity	Part Number	Manuf	Description
1ea.	M4510	SEG	PLC/PLS Processor/Chassis
1ea.	P4500	SEG	Power Supply
1ea.	S4520-RDC	SEG	Motion Control CO-CPU (Resolver)
1ea.	S4563	SEG	16PT DC Input Board
1ea.	S4573	SEG	16PT DC Output Board
1ea.	S4568	SEG	8 input/8 output 10-30VDC I/O Board
1ea.	D4591	SEG	Display/Keypad
1ea.	MPM1423FRMM-A	CSM	6” Servo Motor (redraw)
1ea.	MPM892FRMM-B	CSM	3” Servo Motor (cupfeed)
1ea.	B100A40	AMC	Brushless Servo Amplifier (100 Amp)
1ea.	B25A20	AMC	Brushless Servo Amplifier (25 Amp)
1ea.	100A25	AMC	Brush Type Servo Amplifier (100 Amp)
1ea.	PS300W-96V	SEG	300 Watt Power Supply
1ea.	PS1600W-170	SEG	1600 Watt Power Supply
1ea.	PS18KW-370	SEG	18KW Power Supply
2ea.	SH04.31-NSW	AEG	Positively Guided Relay

Manufacturers Index:

SEG Systems Electronics Group, Inc.
CSM Custom Servo Motor, Inc.
AMC Advanced Motion Controls, Inc.