COMPTROL

Computer Bender Controller

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INTRODUCTION AND FEATURES

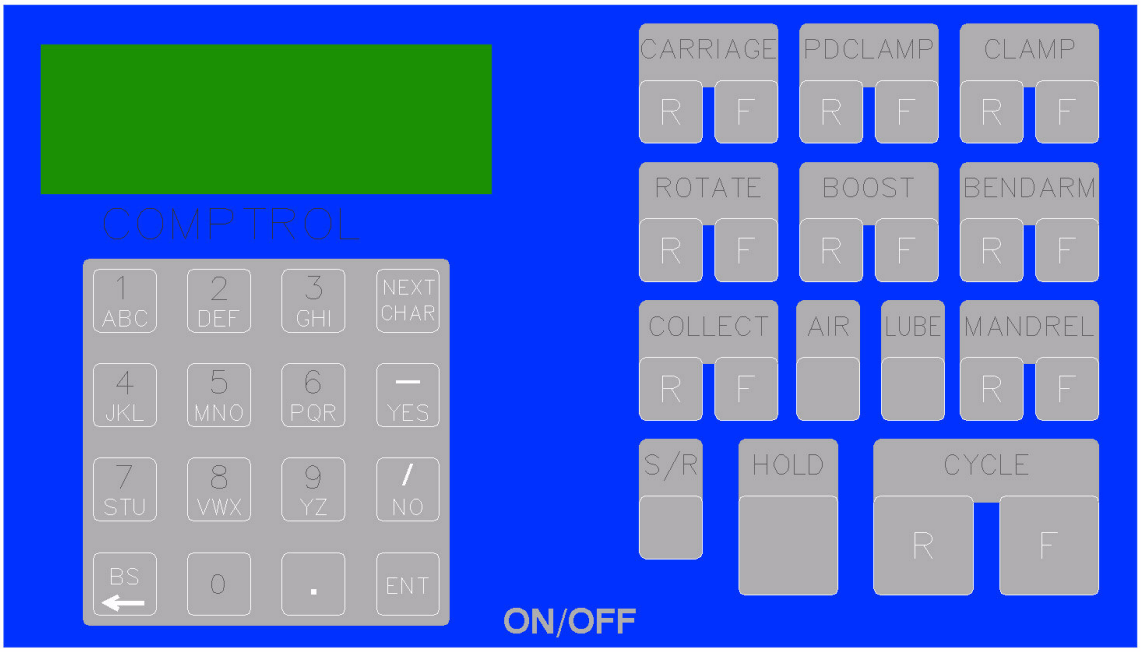

Figure 1

The COMPTROL computer bender controller was designed from the chip level up as a dedicated bender controller. The design was based entirely upon the needs of the tube bender. The controller board is based upon the Microchip PIC16F877 RISC microprocessor and is multiplexed to give a generous amount of dedicated analog and digital inputs and outputs. The board has integral relay ports for both input and output relays and is also capable of driving analog output relays for proportional valves. For bend accuracy, the board features an opto-isolated differential interrupt driven encoder input capable of getting inputs from two separate encoders. The controller also has a separate set of analog inputs with voltage reference levels, a built in hardware driver for stepper and servo drives, and a separate input and output relay bus for future expansion. For uploading and downloading of data, the COMPTROL also has a built-in UART for serial data transfer to a PC.

The second encoder, separate analog inputs and stepper/servo drive circuitry allow the COMPTROL to interface with an automatic advance and rotate system giving CNC functionality at a very low cost.

For the display, the COMPTROL features a bright 4 line by 20 character vacuum fluorescent display.

The software for the COMPTROL includes such features as:

- Intuitive menu driven part and setup screens
- Integrated manual and automatic controls
- Programmable mandrel oscillation
- Early mandrel extraction
- 3 return modes (manual, semi-automatic and automatic)
- Pressure die assist (boost) delay
- Bendarm deceleration
- Automatic parts counter
- Status line for the run mode
- Display of Bendarm angle and current part bend data
- Easy enabling and disabling of bender devices
- Easy toggling of bender inputs
- Two mandrel sequence modes
- Automatic mandrel lube intervals
- 3 axis control for CNC functionality

Each of the bend parameters can be programmed independently for each and every bend.

MODES OF OPERATION

The COMPTROL has two modes of operation, SETUP and RUN. The 2-position selector switch located at the bottom center of the controller chooses the mode. Setup mode is for the setup, loading and modifying of parts, the modifying, enabling and disabling of bender parameters and modification of bender timers and counters. The run mode is used for both the manual and automatic cycling of the bender.

SETUP MODE

The setup mode of the COMPTROL features intuitive menu driven displays to setup and modify all bender parameters. The main menu is shown in figure 2 and allows the user the choice of loading a pre-programmed part, adding or modifying a part, or modifying the bender setup. To choose an option, simply enter the number associated with the option. The backspace <BS> key at any sub-menu will move up one menu layer.

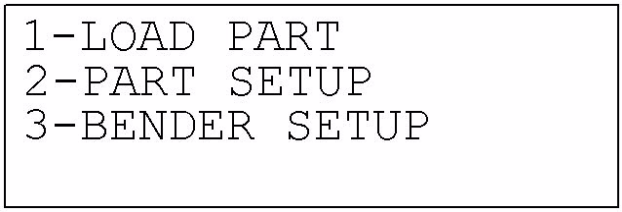

Figure 2

LOADING PROGRAMMED PARTS

When option one, “LOAD PART”, is selected from the main menu, the first part name and bend data in memory will be displayed. Use the CYCLE FWD and CYCLE REV button to move through the parts in memory. Holding the forward switch will continue to cycle forward through each bend as stored in memory. The reverse switch will cycle the parts in reverse order. When the part displayed is the part to be bent, pressing the enter <ENT> key will make that the active part. Pressing the enter key <ENT>for any of the bends of a multi-bend part will choose that part.

USING COMPTROL’s XYZtoYBC Program

Each COMPTROL is shipped with a XYZ to YBC converter that runs on a IBM compatible PC (see figure 3). Entering the XYZ coordinates and radius into the program will give YBCs for the part. In addition, any Ys, which are calculated to be less than the value in “Min Y” (usually defined as the clamp length), will be displayed in red.

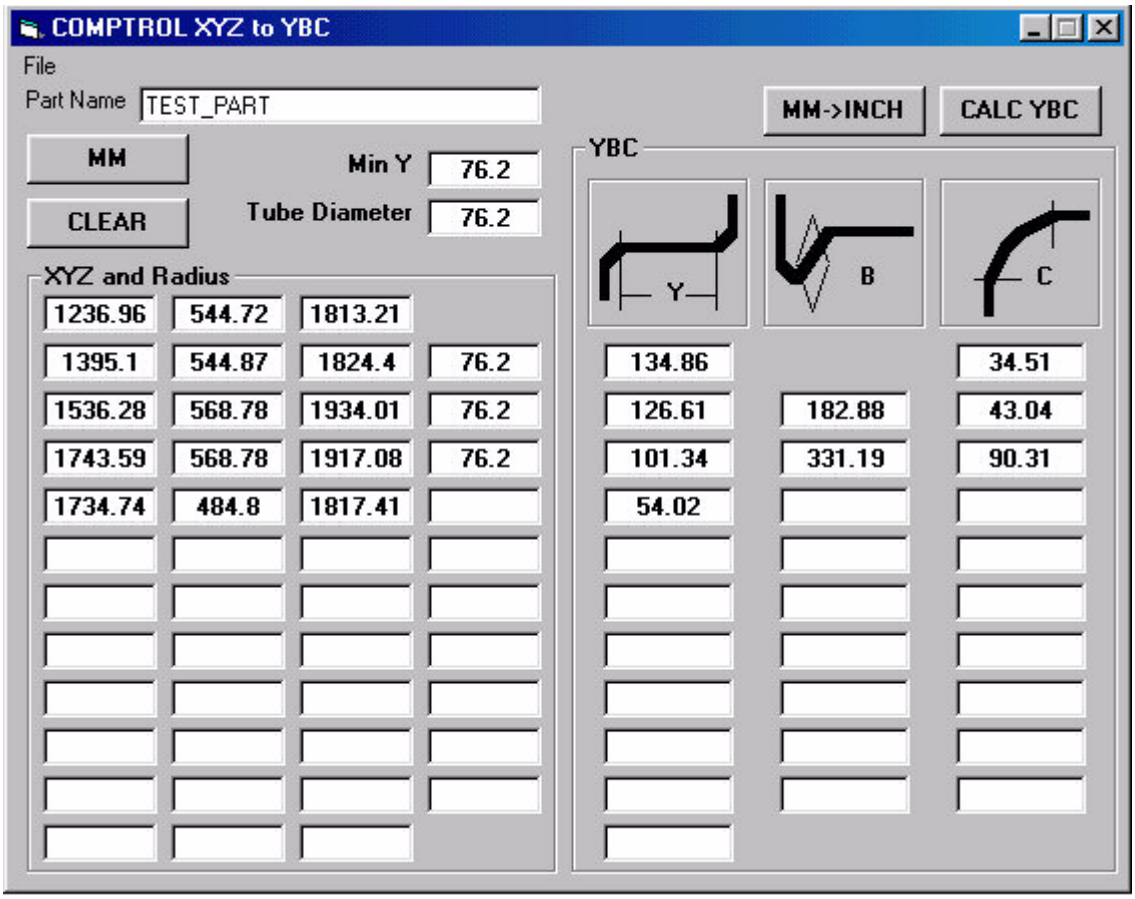

Figure 3.

Once the data has been converted, the rest of the bend data can be defined by choosing the “BEND DATA” option in the “File” menu. The “BEND DATA” screen as shown in figure 4 will be displayed. To enter bend data without XYZ coordinates, choose “BEND DATA” from an empty XYZ screen and enter all bend data. Once the bend data has been entered, it can be saved off under the part name, printed out for manual programming into the COMPTROL or downloaded serially to the COMPTROL.

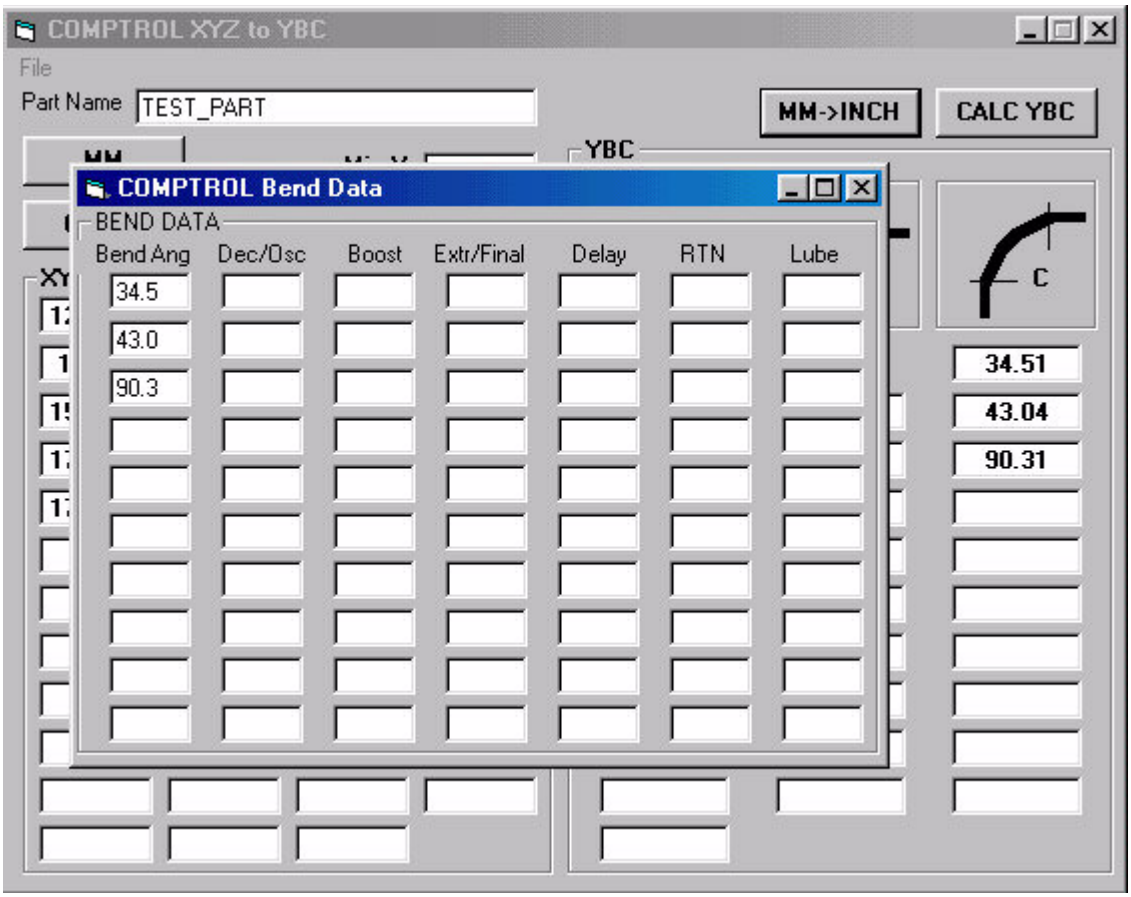

Figure 4.

SERIAL TRANSFER OF DATA TO AND FROM THE COMPTROL

Once data has been generated from the "XYZ to YBC" program, it can be downloaded to the COMPTROL via a serial cable connected to the base of the controller. Use a 9 pin straight serial cable for all uploads and downloads. To receive data serially to the COMPTROL, choose menu item 4 from the "PART SETUP" menu (see figure 6). The "SERIAL DATA TRANSFER" menu will be displayed as shown in figure 5. To send the data to the COMPTROL, choose "SEND DATA" from the "XYZ to YBC" file menu after choosing menu item 2 from the COMPTROL display. To copy data from the COMPTROL to the PC, choose "RECEIVE DATA" from the "XYZ to YBC" file menu after choosing menu item 1 from the COMPTROL display.

```
1-SEND DATA
2-RECEIVE DATA
```

Figure 5.

PART SETUP

Choosing the second option, “PART SETUP”, from the main menu will display the part setup screen shown in figure 6. Options for the part setup screen include adding parts, modifying parts and deleting parts. Pressing the number associated with the option will choose that option, pressing the <BS> key will move one level up to the main menu screen.

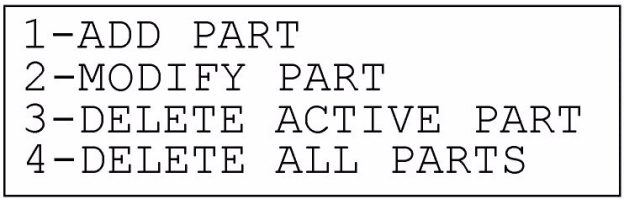

Figure 6.

PROGRAMMING PARTS

Depending on the number of bends and the length of the part names, up to 800 parts can be stored in the COMPTROL’s non-volatile flash memory. Parts can easily be added, modified or deleted using the intuitive menu driven displays. In addition, the bend parameters (bend arm decel, early mandrel extraction, mandrel oscillation angle, final mandrel oscillation, mandrel oscillation delay, return mode, pressure die assist delay and mandrel lube angle) can all be set uniquely for each and every bend.

ENTERING PART NAME

Part names can be stored using any combination of alphanumeric characters and symbols present on the keypad. To specify a number or symbol, simply press the associated key. To specify an alphabetic character, press the key containing the character. See keypad in figure 7. The number on that key will be displayed at the prompt. Pressing the <NEXT CHAR> key will cycle through the alphanumeric characters on that key. Pressing another key will repeat the process and pressing the <ENT> key will store the name. As an example, to enter the part name “PART1” enter the following keys:

6	- displays the character ‘6’ on the screen
<NEXT CHAR>	- changes character to a ‘P’
1	- displays the character ‘1’ on the screen
<NEXT CHAR>	- changes character to a ‘A’
6	- displays the character ‘6’ on the screen
<NEXT CHAR>	- changes character to a ‘P’
<NEXT CHAR>	- changes character to a ‘Q’
<NEXT CHAR>	- changes character to a ‘R’
7	- displays the character ‘7’ on the screen
<NEXT CHAR>	- changes character to a ‘S’

<NEXT CHAR> - changes character to a ‘T’
1 - displays the character ‘1’ on the screen
<ENT> - stores the part name

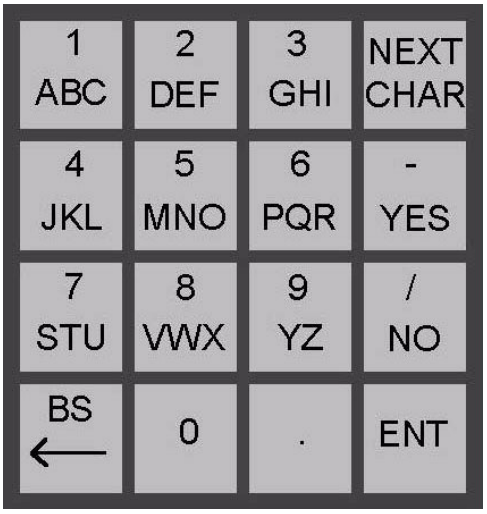

Figure 7

ENTERING BEND ANGLE

After the part name is entered, the operator will be prompted for the bend angle. Valid bend angles are from 0.1 to 200.0 degrees with 0.1-degree resolution. The angle can be entered as either a whole number or decimal.

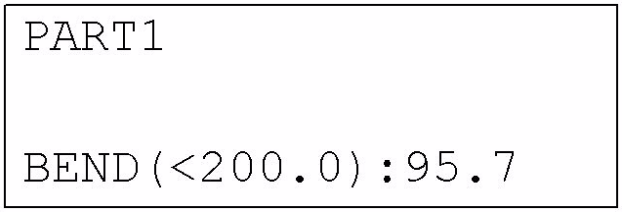

Figure 8

ENTERING DECEL ANGLE

The decel angle represents the number of degrees before the end of the bend that the primary bend valve will be de-energized in order for the bend arm velocity to be reduced. If no decel is desired this value should be zero. Angle resolution is 1 degree and the valid range is 0..25 degrees.

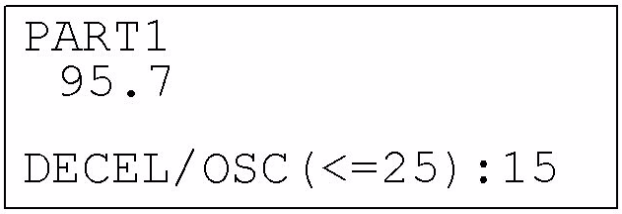

Figure 9

ENTERING PRESSURE DIE ASSIST (BOOST) DELAY ANGLE

The COMPTROL Computer Controller allows the pressure die assist (boost) to be delayed for up to 7 degrees from the start of the bend. The boost delay angle represents the number of degrees after the bend arm starts traveling that the pressure die assist (boost) valve will be energized. If no delay is desired this value should be zero. Angle resolution is 1 degree and the valid range for is 0..7 degrees.

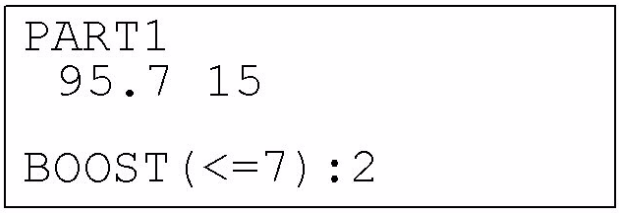

Figure 10

ENTERING EARLY MANDREL EXTRACTION ANGLE

The early mandrel extraction angle represents the number of degrees before the end of the bend that the mandrel retract valve will be energized in order to extract the mandrel before the end of the bend. If no early mandrel extraction is desired this value should be zero. Angle resolution is 1 degree and the valid range for early mandrel extraction is 0..60 degrees.

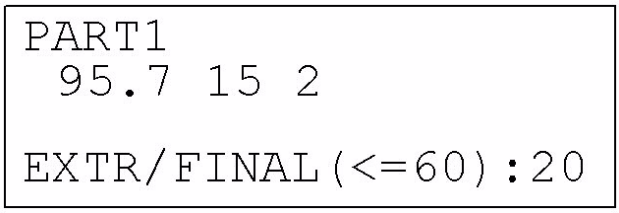

Figure 11

MANDREL OSCILLATION

Entering an oscillation delay in the appropriate field enables mandrel oscillation. Whenever mandrel oscillation is enabled, the decel angle and early mandrel extraction angle are used for oscillation angle and final oscillation angle. Oscillation angle is the number of degrees of bend arm travel between oscillations. The oscillation sequence is as follows:

Bendarm travel stops
Mandrel extracts for specified amount of time
Mandrel moves forward for specified amount of time
Bendarm travel resumes

The final oscillation is the number of degrees for the final oscillation. Sometimes it is beneficial to increase the final oscillation by as much as 50% for bend repeatability. When the final oscillation angle is specified, the second to last oscillation will be shortened by an amount necessary to guaranty the specified amount for the final oscillation. If the bender is equipped with decel and the decel is enable in the setup screen, the final oscillation will be done at decel velocity.

The amount of time that the mandrel extracts is specified in milliseconds and will be rounded down to the 1/16th second.

ENTERING MANDREL OSCILLATION ANGLE

The mandrel oscillation angle represents the number of degrees the bend arm will travel between oscillations. Angle resolution is 1 degree and the valid range is 0..25 degrees. See Figure 9.

ENTERING FINAL MANDREL OSCILLATION ANGLE

The final mandrel oscillation angle represents the number of degrees before the end of the bend that the final mandrel oscillation will occur. Angle resolution is 1 degree and the valid range for the final mandrel oscillation is 0..60 degrees. See Figure 11.

ENTERING MANDREL OSCILLATION DELAY

The oscillation delay field determines whether the mandrel oscillation or the decel/extraction angles are used. If a value is specified enabling the oscillation, it determines the amount of time the mandrel is retracted during the oscillation. The oscillation is specified in milliseconds and is rounded down to the 1/16th of a second. The maximum value for mandrel oscillation is 1000 milliseconds (see figure 12).

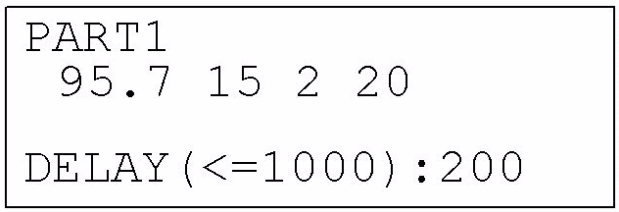

Figure 12

ENTERING BENDARM RETURN MODE

The COMPTROL computer controller has three methods of returning the bend arm, manual, semi-automatic and automatic. In manual mode, the bend arm only moves while the “CYCLE REV” button is pressed. Releasing the button will stop the bend arm. In semi-automatic mode, the bend arm will stop when the bend is completed but will return automatically once the “CYCLE REV” button is activated. Releasing the switch in semi-automatic mode WILL NOT stop the bend arm. Care must be taken whenusing semi-automatic mode to insure the bend arm and part are clear before energizing. Automatic mode returns the bend arm immediately upon the end of the bend. This mode should only be used for small bends where the part will not interfere with the return of the bend arm. Automatic mode is not intended to allow the operator to remove the part, there is NO DELAY between cycles to tempt an operator to reach for a part.

The return mode is specified according to the prompt shown in figure 13.

```
PART1
 95.7 15 2 20 192

RTN(1-M,2-S,3-A):2
```

Figure 13

ENTERING MANDREL LUBE ANGLE

Mandrel lube is specified in degrees of bend between pulses of the lube solenoid. When a mandrel lube angle is specified, lube will be dispensed at the clamp closing and at the specified interval. If lube is only desired at the clamp closing, simply specify an angle greater than the degree of bend. Specifying zero for this field will disable the lube completely for the bend. Angle resolution is 1 degree and the valid range for is 0..255 degrees. See figure 14.

```
PART1
 95.7 15 2 20 192 S

LUBE(<=250):35
```

Figure 14

MANDREL SEQUENCE

The mandrel has two modes, “NORMAL” and “INHIBITED”. In normal mode, the mandrel is moved forward at the end of the reverse cycle. In the inhibited mode, the mandrel remains in the reverse position and moves forward after the clampshave

closed. The inhibited mode can be very useful in loading some parts that may have difficulty sliding completely over the mandrel. In either mode, the mandrel can be positioned manually prior to loading and will travel full forward after the clamps close. Selecting the menu item as shown in figure 15 chooses the mode.

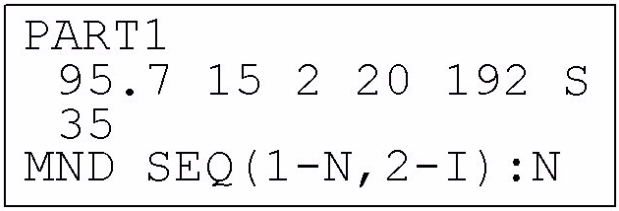

Figure 15

ADDING ADDITIONAL BENDS

After all fields have been entered, the operator will be prompted for more bends according to the prompt shown in figure 16. If there are no more bends to be entered, the "ADD PART" mode is exited and the entered part becomes the active part. If more parts are to be entered, the fields will be prompted for as before. Each field can be independently specified for each bend. If the parameters are not changing since the previous bend, pressing the <ENT> key with no value specified will default to the previous value.

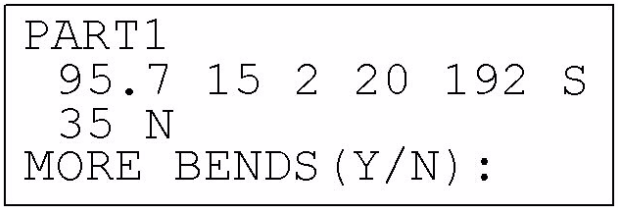

Figure 16

MODIFYING PARTS

Selecting "MODIFY PART" from the part setup menu allows the operator to modify the active part. The part becomes active when it is added or chosen from the "LOAD" screen. Using the "RAM FWD" and "RAM REV" switch will cycle through the bends for the part. When the appropriate bend is displayed on the screen, pressing the <ENT> key will start the modification process. The operator will be prompted for input for each field in the bend. If the field is to be modified, entering a value at the prompt and pressing the <ENT> key will modify it. Pressing the <ENT> key with no value will leave the field unchanged and move to the next one. To exit the modification mode without selecting a bend, press the <BS> key.

DELETING INDIVIDUAL PARTS

Choosing the "DELETE ACTIVE PART" function will delete the active part The part becomes active when it is added or chosen from the "LOAD" screen. When the

appropriate part is active, choosing option 3 will select that part for deletion. Before the part is actually deleted, the operator will be prompted to confirm the deletion. Once the active part is deleted, there will be no active part loaded. Before automatic cycling can continue, a part must be made active by adding or loading from memory.

DELETING ALL PARTS

Choosing the "DELETE ALL PARTS" function will delete all parts in memory. Before all parts are actually deleted, the operator will be prompted to confirm the deletion by the screen shown in figure 8.

Figure 8.

MODIFYING BENDER PARAMTERS

Choosing the bender setup screen allows many parameters of the bender to be modified. These parameters include input mask, devices enabling, timers and counters. The specific functions are chosen from the menu as shown in Figure 17.

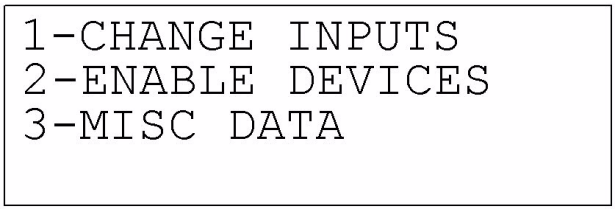

Figure 17.

CHANGING BENDER INPUTS

The COMPTROL interfaces with many types of input signals. These signals can be either AC or DC voltages and can either go high or low when the switch is made. The input mask specified under "CHANGE INPUTS" screen specifies the state of the inputs when the switch is made. If the voltage of the switch goes high when the switch is made, the field should be set to '1'. If the voltage of the signal goes low when the switch is made, the field should be set to '0'. To toggle the field for the input, simply press the menu number associated with. For instance, to toggle the field for "CLAMP REVERSE" as shown in figure 18, press the '3' key. The inputs are as follows:

CLMPF	Clamp forward
CLMPR	Clamp reverse
PDCLF	Pressure die clamp forward

PDCLR	Pressure die clamp reverse
BOOST	Pressure die assist (Boost) home
BENDH	Bend arm home
MNDLF	Mandrel forward
MNDLR	Mandrel reverse

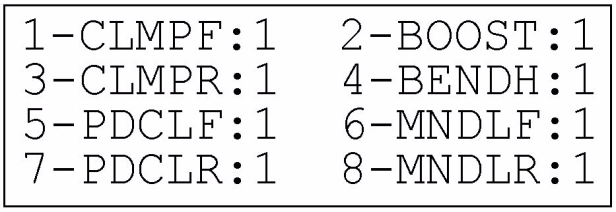

Figure 18.

ENABLING BENDER DEVICES

Like the inputs, outputs for the various devices can be enabled and disabled by toggling them on and off (1-on, 0-off) in the “ENABLE DEVICES” screen. To toggle the field for the input, simply press the menu number associated with. For instance, to toggle the field for “BOOST” as shown in figure 19, press the ‘3’ key. The outputs are as follows:

MNDRL	Mandrel
PRSDC	Pressure die clamp
BOOST	Pressure die assist (Boost)
SAFSW	Safety switch
DECEL	Bend arm decel valve

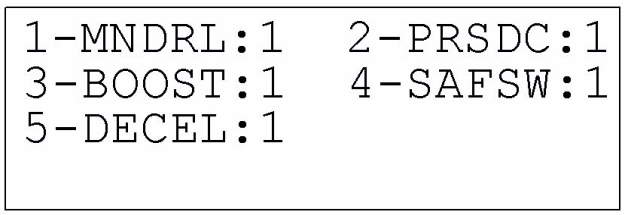

Figure 19.

CHANGING BENDER VALUES AND TIMERS

Certain bender values and timers can be modified using the “BEND PARM” screen. These values include the encoder counts, bend delay timer and part count as shown in Figure 20.

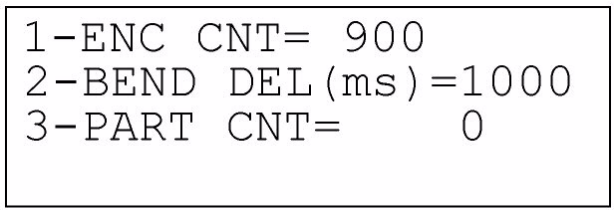

Figure 20

ENCODER COUNT

Each COMPTROL ships with a 900 PPR encoder. Properly used, a 900 PPR encoder will give the most accurate results when 0.1-degree resolution is desired. Each pulse of an encoder is made up of 4 equally spaced phases giving a total of 3600 phase changes per revolution. Or, 1 phase change for each 0.1-degree. Encoders which are not multiples of 900 counts will not fall on even 0.1 degree boundaries and therefore will not be as accurate. Even though the COMPTROL will interface with any quadrature encoder, the supplied one will give the best results. To change the encoder counts, select menu item 1 and enter in the new counts.

BENDER DELAY

The bender delay is the amount of time in milliseconds before the bendarm will start traveling after the clamps have fully closed. This delay is to allow the operator to release the cycle forward switch in the event the tube has not clamped up properly or has moved during clamping. If either the cycle forward button or the safety button (if enabled) is released prior to the bend start, the operator can unclamp and repeat the process.

CLEARING OR PRELOADING PARTS COUNTER

The controller has a part counter, which will keep track of up to 65535 parts bents. The counter is incremented at the completion of the final bend for the active part. The part counter can either be cleared (set to zero) or pre-loaded with a specified number. Choosing option '3' from the parameter menu can reset the part counter. When this option is chosen, a prompt will appear on the bottom of the screen. This prompt will allow the user to enter a number to pre-load the part counter, or to simply hit the enter key to clear the counter.

SPRINGBACK COMPENSATION

Springback compensation is the amount a tube must be "overbent" to compensate for the springback that occurs when the clamps open. The amount of springback depends on many factors including:

- Degree of bend
- Bend radius
- Orientation of weld seam (if present)
- Speed of bend arm
- Material bent
- Neutral axis of the bent tube

Even the reaction time of the valves plays into this equation since the reaction time dictates when the valves must fire to stop the bend arm at a given angle. With all these

variables, it is easy to understand why there is no such thing as a valid springback formula. Most equations are nothing more than a simple linear interpolation of two bend points, a 45 degree bend and a 90 degree bend. From these two bends, a slope and intercept are calculated. These values are commonly referred to as a “CONSTANT” and “PROPORTIONAL” value. While these values may be accurate at 45 and 90 degrees, they very well may require “adjusting” of the bend angle elsewhere.

The simplest and most effective way to compensate for springback is to program in the desired bend angle, bend the part and measure the final angle. If the part is slightly underbent, add that amount to the bend angle. This method requires one bend and adjusts the angle to the specific bend being produced. The linear interpolation method requires three bends, the 45 and 90 degree test bends and the final bend to check the angle. Even the advocates of the linear interpolation method suggest that this test must be re-run any time a bender parameter or material lot changes. The interpolation method actually creates more waste and takes more time than the simple test bend.

RUN MODE

Selecting “RUN” mode from the selector switch will place the bender in the run mode. The screen will change from the menu driven display to the run screen similar to that shown in figure 21. The display shows the part name, part count, bend number and angle if an active part is loaded and the current bendarm angle and status line.

The run mode integrates the manual and automatic modes to allow the operator complete control over the bender. This melding of these two modes would allow the operator to manually position the bender components if he chooses, and to complete the cycle from that point. For instance, if a part that was to receive a 90-degree bend had mistakenly gotten only a 45-degree bend, the operator could swing the bend arm out to 45 degrees, clamp up the part and cycle forward to complete the bend.

Under normal circumstances, all that is required of the operator bend a part is to load the part, cycle the bender forward, remove the part and cycle the bender reverse.

The “RUN SCREEN” shows all the necessary data for the bend cycle, It shows the part name, bend arm angle, part count, part bend number, part bend angle and bender status.

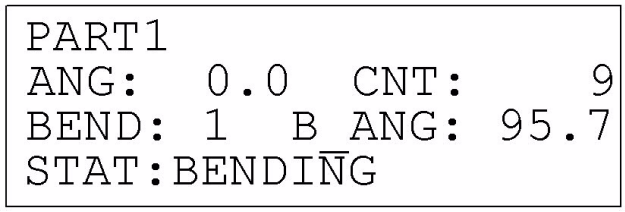

Figure 21

STARTING THE HYDRAULIC MOTOR

The red E-stop switch located on the lower center of the controller controls the hydraulic motor. The switch has two states, a maintained up position, which allows the motor to run and down, which is the motor off position. To the left of the E-stop switch, is the green start switch. To start the motor, the E-stop must be in the up position and the start button pressed.

CYCLE HOLD

The "CYCLE HOLD" button will pause the current bend cycle while still maintaining clamp pressure. To resume the bend cycle, press the "CYCLE FWD" button.

SAFETY SWITCH

There is a safety switch located on the left side of the controller. The position of this switch prevents the operator from energizing this switch and either the clamp closed or cycle switches with only one hand. Requiring two-handed operation during these operations prevents the operator from clamping up on his hand. There is an air ram feature on the controller, which enables the operator to hold the part in place while both hands are moved to the controller. For more information on the use of the air ram, refer to the appropriate section. The safety switch can be disabled in the bender setup screen. If this feature is disabled, it is the operators responsibility to insure that adequate precautions are taken to prevent injuries from the bender.

AIR RAM SWITCH

The air ram switch can be used to engage a pneumatic ram, which can be used to hold a part in position while the operator's hands are removed from it. Pressing the air ram switch will extend the ram and hold it in place. Pressing the switch again will retract the air ram. The air ram is automatically retracted at the beginning of the bend cycle after the clamps have fully closed. Typical air ram installation is shown in figure 22. The air ram presses against the mandrel and pushes the part against the radius block preventing it from moving.

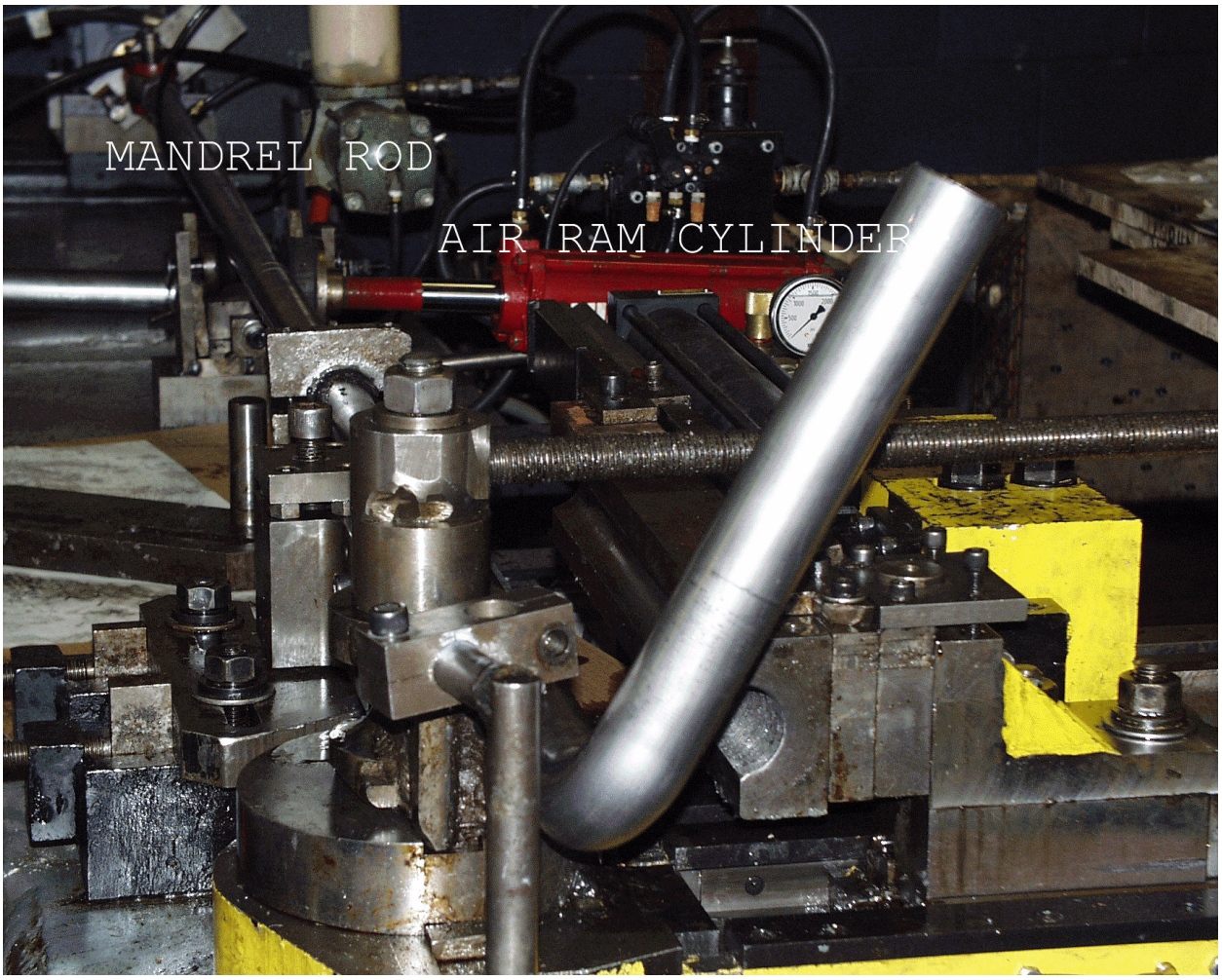

Figure 22

MANUAL MODE

Energizing any of the manual switches on the controller will energize the relay for that valve and the relay for the hydraulic dump valve (if equipped). In addition, for benders that have a sequence valve, the controller will also energize the appropriate clamp valve if the clamp position switch shows it is fully engaged.

For benders with sequence valves, the clamp must be moved to the fully open or closed position before any of the other valves will get sufficient pressure.

AUTOMATIC MODE

Automatic mode consists of a “CYCLE FWD” and “CYCLE REV’ button for automatic cycling of the bender. The automatic mode and manual mode are fully integrated allowing the operator to position the components of the bender manually and then initiating a cycle from that point on. This integration of modes allows such things as careful manual clamping and positioning of parts before cycling, moving the bend arm

and clamping up on pre-bent parts in order to bend them further and positioning of the mandrel in a position other than full forward or full back for easier loading of parts. The benefits of such integration are numerous. The cycling can be used by itself for simple forward and reverse cycling with no manual intervention. At the completion of each full cycle (all bends) the part counter is incremented. The parts counter can be manually incremented and decremented during the run by pressing the '-' (decr) key and the '/' (incr) key. This function is useful for changing the part count as a result of things such as scrap parts.

CYCLING FORWARD

Pressing the "CYCLE FWD" button will cause the bender to initiate the following sequence of events:

MANDREL FWD (if not inhibited)
CLAMP FWD
PDCLAMP FWD
MANDREL FWD (if inhibited)
BENDER DELAY
BEND CYCLE FWD
BOOST FWD
BEND CYCLE COMPLETE
MANDREL REV
PDCLAMP REV
CLAMP REV
WAIT FOR BUTTON RELEASE

Once the bend delay time has elapsed, the bender will "lock in" the cycle mode and continue without intervention from the operator until the completion of the bend or interruption to the motor power. Prior to the timer elapsing, the operator can pause the cycle by releasing the "CYCLE FWD" button or the "SAFETY SWITCH" (if enabled).

CYCLING REVERSE

Pressing the "CYCLE REV" button will cause the bender to initiate the following sequence of events:

PDCLAMP REV
CLAMP REV
BOOST REV
BEND REV
MANDREL FWD
WAIT FOR BUTTON RELEASE

If the return mode from the previous part is “automatic”, this chain of events will happen immediately and automatically at he end of the bend. In the semi-automatic mode, the cycle can be initiated by pressing the “CYCLE REV” button. Once the button is pressed in “semi-automatic” mode, the bender will continue on automatically. In either of these return modes, pressing the “CYCLE HOLD” button can stop the cycle. If the cycle is stopped, it can be resumed by pressing the cycle. In the manual mode, the cycle will only continue as long as the operator is pressing the cycle button. If it is released, the cycle will stop. Re-pressing the button will restart the cycle.

BEND ARM DELAY

The bendarm delay is the amount of time that elapses once the clamps are fully closed before the bendarm begins its travel. This delay is intended to allow the operator a moment to verify the tube has not moved during clamping and that it is in the correct position to bend. If the tube is not in the correct position, releasing the cycle button before the time has elapsed will halt the cycle allowing the operator to unclamp and re-position the part.

ANTI-TIEDOWN, ANTI-REPEAT FEATURE

At the end of each cycle, the operator must release the cycle switch and safety switch (if enabled) in order to start the next cycle. This feature prevents an operator from bypassing the safety feature by jamming the switch into an “engaged” position. This feature also prevents the cycle from inadvertently repeating if the operator forgets to release the switches at the end of the cycle.

SKIPPING BENDS

Skipping through he bends of a multi-bend part is accomplished by pressing the <ENT> key on the keypad. Each time the key is pressed, the controller will advance to the next bend and loop around to the first bend at the end of the sequence.

STEPPER AND SERVO DRIVES

The COMPTROL controller contains two sets of hardware circuits for driving both unipolar and bipolar stepper motors. ”. In addition, it will drive servomotors capable of using step input. Support for these drives is implemented in the software version for the “Automatic Advance and Rotate System”. Contact technical support for more information on this feature.

PROPORTIONAL VALVE SUPPORT

Proportional valves are supported for the bendarm forward and reverse valves. Contact technical support for more information on this feature.

TROUBLESHOOTING

Problem: No display
Action: Verify that there is AC power to the controller. This can be measured across the two terminals of the power supply (see wiring diagram for location). If power is supplied to the power supply, check for power to the controller board. This should be measured across the terminal block located in the upper right of the board. This voltage should measure 5 VDC. If the controller board is getting power and the display still does not illuminate, check for proper seat of all components and cables between the controller and display.

Problem: Bendarm angle does not update when bendarm is moved. This problem can cause many other problems since automatic cycling uses the feedback from the encoder to determine bendarm position and as a result, many of the bender functions. Typical problems will be the bendarm does not stop during a forward cycle.
Action: The controller is not properly getting updates from the encoder. This could be either a mechanical connection problem between the encoder and the bendarm, an electrical connection problem between the encoder and the controller or a faulty encoder. To check the mechanical connection, verify the integrity of the coupling between the bendarm and the encoder. Next verify the encoder shaft rotates with the bendarm. If it does not, check all mechanical connections. If the encoder is rotating properly, the next item to check is the electrical connection between the encoder and the controller. Verify the encoder is getting a 12 VDC supply at the connection according to the wiring diagram. If the encoder is getting the proper supply voltage, check the A and B signals in the controller. Refer to wiring diagram for the location of the signals on the controller board. With a voltmeter across the A- and A+ terminals jog the bendarm several time forward and backward looking for a high and low voltage state across the terminals. A high state will be a voltage differential of more than 5 VDC and the low state should be less than 2VDC. Make the same check for the B signal. If the both signals change state and the controller still does not update the angle contact the technical support line. If both signals do not change, repeat the steps at the encoder. If the signals at the encoder change, there is most likely faulty wiring between the encoder and the controller. If the signals do not change at the encoder, it is either faulty or the wiring is shorted and forcing the signal either high or low. Repeating the steps with the signal lines disconnected can check this,

Problem: Bender stops during cycle for no apparent reason.
Action: If the bender stops during a cycle for no apparent reason, it is probably either waiting for an input which has not occurred or is enabling an output which is not working. The bender status is the best indication of the problem. For instance, if the status is “CLAMP CLOSE”, the controller is waiting for thisevent to occur. In this case the first thing to check would be the position of the clamp. If the clamp is open or “REVERSE”, the problem most likely exists with the output. If the clamp is closed or “FORWARD” the problem most likely exists with the input.

To troubleshoot the output, first verify the appropriate output relay has been energized (indicated by the small LED on the relay). If the LED is not on, consult the Technical Support number for further assistance. If the LED is on, a voltmeter capable of measuring the voltage for the valve will be necessary. The first place to check the voltage is across the two terminals for the relay. If the relay is properly closed, no voltage differential should exist. If there is a voltage differential, the problem is either with the fuse located on the relay or the relay itself. If no differential exists, the problem would most likely be in the external wiring or the valve.

To troubleshoot the input, first verify the appropriate input relay has changed (indicated by the small LED on the relay). Since the COMPTROL can handle inputs that can go either high or low when made, it is important only to verify the relay changes state when the state of the switch is changed. If the relay does change state, verify the input mask is set accordingly (see the section on input masks). If the relay does not change state, check external wiring and/or the proximity switch.

Problem: Bender devices do not move in manual mode.
Action: Refer to output section for bender stopping during cycle.

WARANTY

The COMPTROL Controller board is covered by a two-year warranty from date of purchase. The interface cable and the balance of the components are covered for is covered for six months.

INSTALLATION

1. Mount controller on optional stand or pedestal. The controllers come with either a side flange mount or ¼" studs on the back of the controller.
2. Remove all existing wiring and components **specific to any previous controller** used on the machine. Leave only the motor start circuit and the wiring from the valves and switches to the main terminal block.
3. The interface cable has a 46-pin quick disconnect connector on one end, which mounts to the controller. The other end contains a pigtail, which is mounted to the main panel box on the bender. To mount interface cable to main panel box, drill or cut a 1.375" diameter hole for the cable strain relief. Feed the wires through the hole and secure the cable strain relief with the supplied nut. Mount the interface cable into hole on side of panel and run the cable to the terminal strip for the bender devices. See the wiring diagram for specific wiring instructions.
4. Mount the encoder assembly per the assembly drawing included with the encoder and run the enclosed cable to the terminals specified in the wiring schematic.

CONFIGURING INPUT AND OUTPUT RELAYS

The standard controller is shipped with 120 VAC output relays and 3– 32 VDC input relays. The common sides of the relays are tied to 120 VAC and 0 VDC respectively. The controller can be shipped with alternative relays to accommodate other input and output voltages. If the relays need to be switched after delivery, this can be accomplished by changing the relay and the common. Consult the technical support line for specifics on the application.