MP39 BACKGAUGE CONTROLLER

The Model MP39 microprocessor controller is used to position a guide or a stop on a press brake. The unit controls a 2 speed DC electric drive system which turns a lead screw. The position of the gauge is sensed by an incremental shaft angle transducer that is geared to the lead screw. The controller then can turn on the drive unit and count the pulses from the transducer, and then turn the drive unit off when the gauge reaches the desired position.

The MP39 is programed using a display and keyboard similar to an electronic calculator. The display acts as a prompt for the operator and indicates what item of data is to be entered. This entry procedure is discussed in detail later in this manual in a section called ENTERING A NUMBER.

FRONT PANEL CONTROLS

On the front panel of the MP39 there are 6 lighted pushbutton switches and a 16 key keypad. The functions of these keys are as follows:

HALT

The HALT key is used to stop the gauge from moving. The red lamp indicates that the forward or reverse outputs are both off.

RUN

The RUN key is used to initiate a movement. It is normally not required since the CAL and ENT after PRG keys will automatically start a RUN function. If the HALT were used to stop a move then the RUN key would re-start the movement. The green lamp indicates that a movement is in progress.

METRIC WHEN LIT

The METRIC WHEN LIT key is used to toggle between inch units and centimeter units. When the lamp is lit, all lengths are displayed in centimeters and all lengths programed are interpreted by the computer as being centimeters. When the lamp is off, lengths are displayed in inches and all lengths programed are interpreted by the computer as inches. The actual measurements of the computer are in inches with resolution to the nearest .001 inches. When metrics are used the metric dimensions are converted to the nearest inch equivalent. If a roundoff occurs, the amount of roundoff can be seen by checking the number a second time. The computer takes the inch value and converts to the nearest .001cm. The value displayed may be different by one least significant digit but it will reflect the actual length that will be used. The difference will be less than the resolution of the system.

JOG OUT

The JOG OUT key is used to manually move the gauge when the machine is halted. The movement is in slow speed and away from the zero point of the machine. The yellow lamp indicates that the OUT output is turned on.

JOG IN

The JOG IN key is used to manually move the gauge when the machine is halted. The movement is in slow speed and toward the zero point of the machine. The yellow lamp indicates that the IN output is turned on.

SLOW

The SLOW key has no function. The yellow lamp is used to indicate that the SLOW output is turned on.

SET UP

The SET UP key is used to enter the mode for entering the constants of the machine which are the reference position of the table, the length of slowdown, and the transducer correction factor.

CAL

The CAL key is used to initiate the calibration or referencing sequence of the machine when the unit is turned on. Pushing this key will start the machine in its automatic referencing sequence.

POS

The POS key is used to set the gauge to a position. The operator presses this key, enters the desired position, then presses the ENT key. The machine will then automatically go to that position.

ENT

The ENT key is the ENTER key used in the SETUP or POS functions.

CLR

The CLR key is used to clear an entry make in the SETUP or POS functions.

The number keys and the decimal point are used in entering numbers.

SET UP MODE

The SET UP mode is used to enter data about the machine that the computer needs to know in order to perform its function. This data may vary from machine to machine and cannot by permanently set into the computer. However, the computer has re-chargable batteries that maintain power to the memory circuits so that this SET UP data can be retained when power is turned off. The batteries are automatically charged whenever the unit is turned on. If the batteries do discharge the display will show 'No SEtUP' when turned on and will not perform any other function until the SET UP procedure is completed. The data required in this mode is as follows:

REFERENCE POINT

The REFERENCE POINT is the number that the computer sets its length counter to when the reference procedure is done. It is approximately the distance from the zero point of the brake to the reference switch. The prompt for this parameter is:

rEF 00.000

with the number being the reference position.

SLOWDOWN DISTANCE

The SLOWDOWN DISTANCE is the distance from the objective position that the unit will shift from fast speed to slow speed. The display will show:

SLO LE 00.000

where the number shown is the current slowdown distance.

CORRECTION FACTOR

The CORRECTION FACTOR is a number that is used to compensate for slight gear size errors that may be in the machine. With no correction required, the value would be 1.00000 . A larger number would mean that a larger movement than programed and a smaller number would result in a smaller than programed movement. Refer to the section on LENGTH CALIBRATION for further datail. The prompt for this parameter is:

corr 1.00000

DIRECTION

The length transducer provides direction of flow information to the computer controller but it can be mounted on the machine so that for forward movement of the material, either clockwise or counter clockwise rotation of the transducer will occur. The DIRECTION parameter allows the operator to change the counting direction by pressing either the 0 or 1 key to change the direction setting. One of these settings will be correct for your installation. The prompt for this parameter is:

dirEction 0

COAST

Most systems will tend to move a small distance after the slow output is turned off. The MP38 turns the slow output off at the COAST distance before the actual desired postion to compensate for this. The prompt for this paramter is:

LEAd 0.00

MEMORY RESET OPTION

There are times when the operator may wish to clear all of the computers memory and program the computer from a reset condition. The FRESH start option allows the operator to reset the computer by entering the code 1984. Any other code will be ignored and data will be retained.

The prompt for this parameter is:

FRESH 0

REFERENCING PROCEDURE

When the unit is turned on, the computer does not know the location of the gauge since it may have been moved since the last time the unit was turned on. The computer must find a known location on the machine via the REFERENCING PROCEDURE. The display will show:

CALibrAtE

which prompts the operator to press the CAL key. The computer will then drive the gauge in the OUT direction in fast speed until it hits the OUT limit switch. The computer will then sense that the gauge is in the full out position by noting the lack of signals from the transducer. Then the computer will then drive the gauge in the IN direction in SLOW speed and wait for the REFERENCE limit switch to close. This gives the computer a rough indication of the position of gauge. The unit continues in slow speed until the computer senses a ZERO signal from the transducer. This signal occurs in a precise location at one point on a revolution of the transducer shaft. At this point the computers length counter is set to the value of the reference point programed in the SETUP mode and then stops the line. As long as power is applied to the computer, it then can keep track of any further movement of the gauge by counting the pulses from the transducer. Determining the value can be done with the following procedure:

1. Measure the distance from the zero point of the machine to the center of the reference switch.

2. Enter this number as the REFERENCE NUMBER in the SETUP mode.

3. Execute the referencing sequence by pressing the CAL key.

4. Measure the position of the gauge when the machine stops and the HALT lamp is on. Compare this value with the position shown on the display. Subtract the actual position from the displayed position and add the result to the previously programed reference number to form a new reference number.

5. Enter this new reference number using the SETUP mode.

6. Execute the referencing sequence by pressing the CAL key.

OPERATING PROCEDURE

The operating procedure of the MP39 is as follows:

1. Press the POS key.

2. Key in the desired position.

3. If the value in the display is as wanted, press the ENT key.

4. The unit will automatically go to the position indicated.

The sequence of positioning that the computer uses is as follows:

1. Gauge is moved in high speed to a position equal to the desired position plus the length of slowdown.

2. The gauge is stopped briefly, then it moves in the IN direction in slow speed until the desired position is reached.

3. The gauge stops and the HALT lamp comes on.

ENTERING A NUMBER

Throughout this document references to entering a number are made. In this section, this procedure will be explained in detail one time so that the rest of the manual can be simplified.

Numerical data refers to such things as a length of a part, spacing between holes on a part, time duration of a press cycle, etc. In order to tell the computer what these values are, the operator must enter or key in these numbers through the keyboard in a manner that the computer can understand. This same procedure is used for all numerical data.

Before describing this procedure, a definition of some terms may be necessary. The following terms and their meaning will be seen throughout this manual:

PROMPT--There is two-way communication between the computer and the operator. The operator tells the computer what a certain value is but the computer must tell the operator what data item the operator is to key in next. This message from the computer is called a "prompt" and it appears on the left hand side of the display. Each prompt is unique so that the operator should know exactly what piece of data the computer is asking for by the prompt.

ENTER--When the operator keys in a piece of data, he must tell the computer when he is finished. This is done with the ENTER key and it is like the period at the end of a sentence. Pressing the ENTER key tells the computer "I am finished with this line of data. Store it away and go to the next line of data."

CLEAR--Before the ENTER key is pressed, the operator has the chance to check what he has entered to see if it is correct. If he finds that he has made a mistake, he can erase what he has entered so far by pressing the CLEAR key. THis will cause the display to revert back to showing the value that was present before any keys were present. Also, for any error that may occur, the display will show the error and the CLEAR key must be pressed before any other action can take place.

FORM--For each data item there is a form or shape associated with it. This consists of the number of digits above and below the decimal point. An example of this might be a length whose form is defined as XXX.XX. This means that there are allowed to be three digits above the decimal point and two digits below the decimal point. Thus the largest number that could be entered would be 999.99 and the smallest increment would be 0.01 units. When the maximum number of digits above the decimal have been entered, the decimal point is automatically inserted.

RANGE--For each data item there is a range of acceptable values that can be entered. Values entered outside of this range will cause an error message to be shown. A data item whose form may be XXX.XX may have a range of 100.00 to 10.00

because of some machine constraint. Values entered outside of this range will result in an error message.

With an understanding of these terms we can proceed to explaining the data entry procedure.

The best way to explain this process is with an example. The example's data items are as follows:

DATA ITEM	Length from the center of the shear die to the center of a punch die.
PROMPT	LEN S-P
FORM	XX.XX
UNITS	INCHES
RANGE	12.00 TO 50.00
OLD VALUE	24.56
NEW VALUE	25.87

DISPLAY BEFORE KEY	KEY
LEN S-P 24.56	2
LEN S-P 2.	5
LEN S-P 25.	8
LEN S-P 25.8	7
LEN S-P 25.87	ENT

(next data item and old value)

A mistake and subsequent correction sequence would be as follows:

DISPLAY BEFORE KEY	KEY
LEN S-P 24.56	2
LEN S-P 2.	6
LEN S-P 26.	CLR
LEN S-P 24.56	2
LEN S-P 2.	5
LEN S-P 25.	8
LEN S-P 25.8	7
LEN S-P 25.87	ENT

(next data item and old value)

Leading and trailing zeroes do not have to be entered. An example would be the entry of a value of 10.00 inches.

DISPLAY BEFORE KEY	KEY
LEN S-P 24.56	1
LEN S-P 1.	0

LEN S-P	10.	ENT

(next data item and old value)

An out-of-range example would be:

DISPLAY BEFORE KEY	KEY
LEN S-P 24.56	1
LEN S-P 1.	ENT
Error	CLR
LEN S-P 24.56	1
LEN S-P 1.	0
LEN S-P 10.	ENT

(next data item and old value)

LENGTH CALIBRATION

The computer detects the movement of material through the machine by means of an optical shaft encoder which is also called a rotary pulse generator or rotopulser. It is a device that generates electrical pulses as the shaft is rotated. It can detect the direction of rotation and it generates a precise number of pulses for each revolution of its shaft. The computer detects these pulses and counts the net number of up and down pulses in order to know the shaft position.

The computer only knows the angular displacement of the shaft. In order to translate this angular movement into actual material movement, a precision measuring wheel is attached to the shaft of the encoder. The wheel rides on the material and is carefully aligned so that in one revolution of the shaft, an amount of material equal to the circumference of the wheel moves through the machine.

The resolution of the system (smallest measured increment) is equal to the circumference of wheel divided by the number of counts generated in one revolution of the encoder shaft. If the circumference of the wheel is 10 inches and there are 1000 pulses per revolution on the encoder, then the resolution would be 10 inches/1000 or 0.01 inches. If a 12 inch wheel were used then the resolution would be 0.012 inches.

In this system, the computer has a setup parameter called the correction factor. The correction factor is used to set the nominal resolution of the system and to compensate for small errors due to measuring wheel diameter errors. The initial value of the correction factor is computed by dividing 0.01 by the system resolution. Thus, a 10 inch wheel would have an initial correction factor of 0.01/0.01 or 1.00000 and the 12 inch wheel would have a correction factor of 0.01/0.012 or .83333.

Using this initial value of correction factor, the system can then be fine tuned in order to give optimum accuracy. Length inaccuracies consist of two distinct elements, the repeatability error and the linearity error. The repeatability error results from variations in the mechanics of the machine from one operation to the next. This variation would be the same for 1 inch long parts or 100 inch long parts. The linearity error is due to slight errors in the size of the measuring wheel. This error grows as the length of the part grows. It is not noticable on short parts and can get quite significant on long parts. These two error elements must be separated in order to properly calibrate the system.

The repeatability error can be determined by running a large number of short parts and measuring the total variation in length from the shortest part to the longest part. This total variation should be within the machine's specified tolerance. Further tests should not be attempted until this variation tolerance is met. Once the variation is determined, a part as long as possible should be run and its length carefully measured. A new value for correction factor can be calculated as follows:

NCF = OCF X PL/AL

where NCF is new correction factor

OCF is old correction factor

PL is the programed length

AL is the actual measured length

As an example, with the old correction factor at 1.00000, a 100 inch part was programed with the result being a 100.25 inch long part made. The new correction factor (NCF) would be:

NCF = 1.0000 X 100/100.25 = .99751

This new value for correction factor should be entered into the computer. If the resultant error was less than the allowable tolerance, the previous step should not be done.

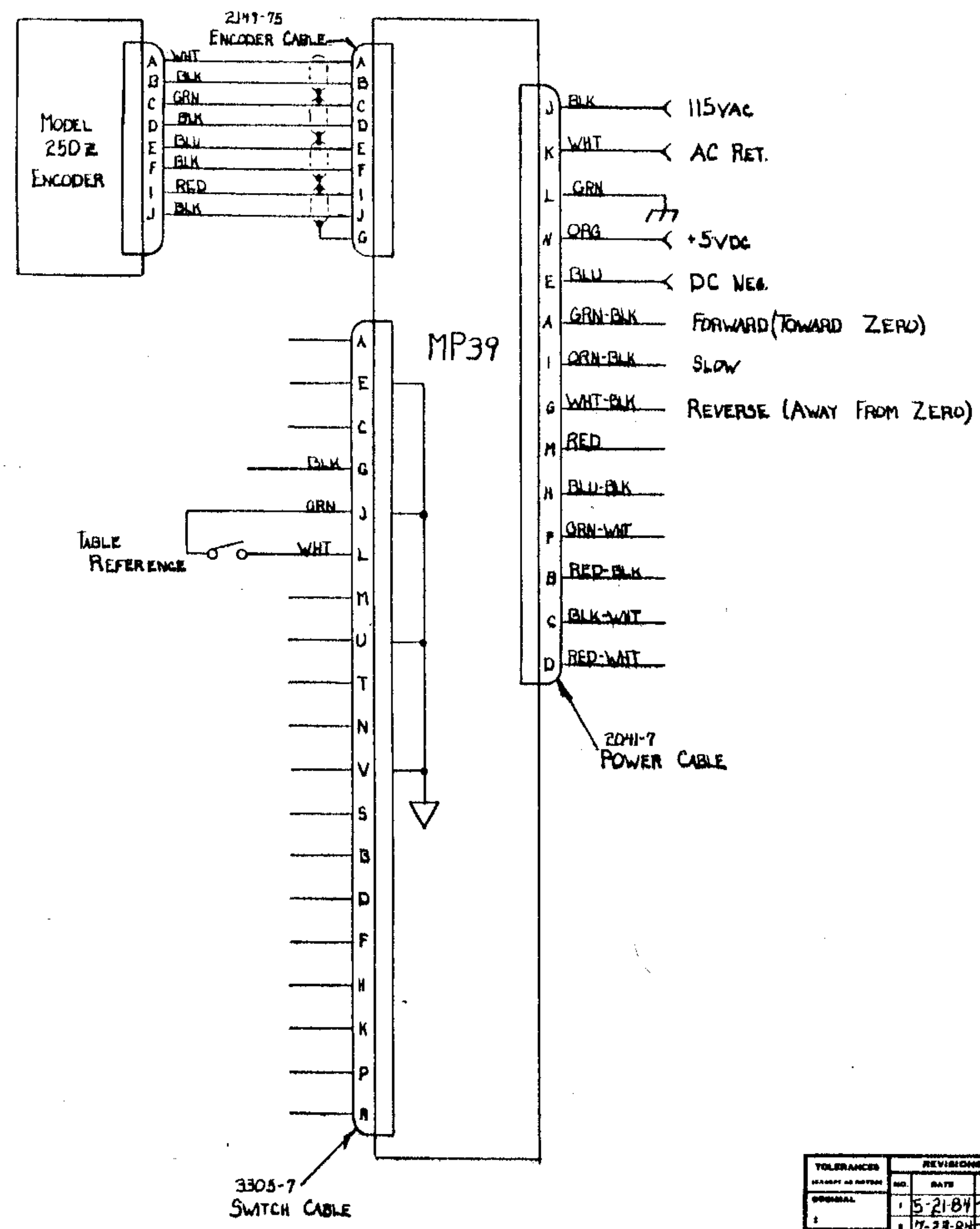
At this point, the machine should be reasonably well calibrated. However, a portion of the linear error detected could have been due to a repeatability error. Further calibration can be done be running a large sample of long parts and carefully measuring each part and finding the mean value. The previous calculation can be repeated using the mean value as the measured length to further refine the correction factor. If in the previous example, the correction factor of .99751 were entered and a new run of 100 inch parts resulted in a spread of 1000.00 to 100.06, the mean value would be 100.03 and the new calculation would be:

NCF = .99751 X 100/100.03 = .99721

This should then yield parts that are within the specified allowable length variation, centered around the length programed. Further adjustments can be made using this same procedure should the wheel begin to wear.

MP39 SET UP REFERENCE CHART

PARAMETER	PROMPT	VALUE	UNITS	FORM	RANGE
REFERENCE	rEF	____.______	IN/CM	XX.XXX	0 TO 99.999IN
SLOWDOWN	SLO LE	____.______	IN/CM	XX.XXX	.001 TO 99.999IN
CORRECTION	corr	__.__________	NONE	X.XXXXX	.5 TO 1.50000
DIRECTION	dirEction	__	NONE	X	0 or 1
LEAD	LEAd	____.______	IN/CM	XX.XXX	.001 TO 99.999IN
FRESH	FRESH		NONE	XXXX	NONE



BACKGAUGE

TOLERANCES	REVISIONS			APPLIED MICROSYSTEMS INC.
	NO.	DATE	BY	MACHINE INTERFACE
	1	5-21-84		
	2	7-23-84		
				DATE 4-4-84
				MP39