

MODEL MP38

BACKGAUGE CONTROLLER

REFERENCE MANUAL

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**AMS** APPLIED  
MICROSYSTEMS  
ST. LOUIS, MISSOURI

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# MP38 BACKGAUGE CONTROLLER MANUAL

## INTRODUCTION

The Model MP38 microprocessor controller is used to position a guide or a stop on a press brake. The unit controls a 2 speed DC electric drive or hydraulic system which turns a lead screw. The position of the gauge is sensed by an incremental shaft angle transducer that is geared to a lead screw. The controller 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 MP38 is programmed 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.

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### FRONT PANEL CONTROLS

On the front panel of the unit 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 during a move. The red lamp indicates that the forward and reverse outputs are off.

#### RUN

The RUN key is used to initiate a movement. It is normally not required to use the run key since the unit will automatically initiate a run sequence after the desired position is programed. If the HALT were used to stop a move then the RUN key would restart 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 .001 cm. The value displayed may be different by one

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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.

### LOCAL

The LOCAL key is used to select the local or remote mode of operation. In the local mode the lamp is illuminated and the operator has full control of the programming, running, and manual operation of the unit. In the remote mode the lamp is not illuminated and a main computer controls the programming and running of the unit. Also, in the remote mode, all manual functions are disabled. If the unit is in the remote mode for more than 15 seconds with the communications link disabled, the local lamp will flash on and off indicating a fault in the serial link. For more information concerning the remote mode of operation, see the remote communication specification.

### SETUP

The SETUP key is used to enter the setup mode for entering the

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constanta about the machine.

### CAL

The CAL key is used to manual initiate the calibration sequence of the machine.

### POS

The POS key is used to enter the programing mode. The operator presses the POS key, enters the desired position, then presses the ENT key. The unit will automatically start a run sequence to move to the desired distance.

### ENT

The ENT key is the ENTER key and is used in the SETUP and POS functions to terminate the entry of a data item.

### CLR

The CLR key is used to clear an entry made in the SETUP or POS modes of operation. The key is used to erase the contents of an entry before the ENT key is pressed.

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

## SETUP MODE

The SETUP mode is used to enter data about the machine that the computer needs to know in order to perform it's function. This data may vary from machine to machine and cannot be permanenetly set into the computer. However, the computer has recharagable batteries that maintain power to the memory circuits so that this data can be retained when the power to the unit is turned off. The batteries are automatically charged when the unit is turned on. If the batteries do discharge the unit will automatically enter the setup mode when turned on and will not perform any other function until the setup procedure is completed. A list of the setup data parameters and a description of each are as follows:

## COUNTS PER REVOLUTION

The COUNTS PER REVOLUTION parameter is the number of counts per revolution that are contained in the incremental shaft angle transducer being used with the unit. The prompt for this parameter is:

Counts 256

Note that the number displayed is the current counts per revolution.

## DISTANCE PER REVOLUTION

The DISTANCE PER REVOLUTION parameter is the distance that the wheel that is attached to the incremental shaft angle transducer travels in one full revolution. The prompt for this parameter is:

diSt. 12.000

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Note that the number displayed is the current distance per revolution.

### CORRECTION FACTOR

The CORRECTION FACTOR parameter is used to make minute corrections in the system after the cycles per revolution and distance per revolution parameters have been correctly entered. This number is actually a multiplication factor to scale the actual system counts-per-inch factor by. The prompt for this parameter is:

Corr. 1.00000

Note that the number displayed is the current correction factor.

### DIRECTION OF TRAVEL

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

dirEction 0

Note that the number is the current direction setting.

### DISTANCE

Most machines tend to move a small distance after the direction output is turned off. The unit will turn the direction output off at the LEAD distance before the actual desired position to compensate for this. The prompt for this parameter is:

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LEAD 0.000

Note that the number displayed is the current lead distance.

### REFERENCE POINT

The REFERENCE POINT parameter is the distance that the computer sets it's length counter to when a calibrate sequence 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. 0.000

Note that the number displayed is the current reference point.

### SLOWDOWN DISTANCE

The SLOWDOWN DISTANCE parameter is the distance from the objective position that the unit will shift from fast speed into slow speed. The prompt for this parameter is:

SLO. LE. 0.000

Note that the number displayed is the current slowdown distance.

### LEAD DISTANCE

The LEAD DISTANCE parameter is used to compensate for machines that coast a small distance after the slow output is turned off. The controller subtracts this distance from the objective position before movement begins. The prompt for this parameter is:

LEAD 0.000

Note that the number displayed is the current lead distance.

### INSIDE TOLERANCE

The INSIDE TOLERANCE parameter is used by the unit to determine if the final position reached is within an acceptable tolerance. After a run sequence is completed, the unit subtracts the inside



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tolerance length from the objective position and compares this number to the present position. If the present position is less than the objective position minus the inside tolerance, the unit will automatically adjust the LEAD DISTANCE and initiate another run sequence. The prompt for this parameter is:

In. LE. 0.000

Note that the number displayed is the current inside tolerance.

### OUTSIDE TOLERANCE

The OUTSIDE TOLERANCE parameter is used by the unit to determine if the final position reached is within an acceptable tolerance. After a run sequence is completed, the unit adds the outside tolerance length to the objective position and compares this number to the present position. If the present position is greater than the objective position plus the outside tolerance, the unit will automatically adjust the LEAD DISTANCE and initiate another run sequence. The prompt for this parameter is:

Out. LE. 0.000

### MEMORY RESET OPTION

There are times when the operator may wish to clear all of the unit's 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 number will be ignored. The prompt for this parameter is:

FrESh 0

## CALIBRATION 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 calibration procedure. Assuming that the machine setup data has been entered, the display will show:

CALibrAtE

This is the prompt for the operator to press the CAL key. The computer will then drive the gauge in the <sup>(REV)</sup> 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. Next the computer will 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 the gauge. The computer continues in slow speed until it senses a zero signal from the incremental shaft angle transducer. This signal occurs in a precise location at one point per revolution of the transducer shaft. At this point the computer sets it's length counter to the value of the reference point programed in the setup mode and stops all movement. To determine the value of the reference point the following procedure should be done:

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 point in the setup mode.
3. Execute the calibration procedure by pressing the CAL key.
4. Measure the position of the gauge when the gauge stops and the

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HALT lamp illuminates. Compare this value with the position on the display. Subtract the actual position from the displayed position and add the result to the previously programmed reference length to form a new reference length.

5. Enter this new reference number using the setup mode.
6. Execute the calibration sequence by pressing the CAL key.

This sequence should be repeated until the position of the gauges matches that on the unit's display.

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## OPERATING PROCEDURE

To move the gauge to a desired position the following procedure should be done:

1. Press the POS key to enter the program mode.
2. Key in the desired position for the gauge to move to.
3. Press the ENT key to terminate data entry. The unit will then automatically initiate a run sequence to move to the desired position.

The run sequence that the computer uses to move to a desired location is as follows:

1. If the objective position is greater than the present position plus the slowdown length, the gauge is moved in high speed to a position equal to the desired position plus the slowdown length.
2. The gauge is stopped briefly and allowed to coast out.
3. The gauge is moved in the IN direction in slow speed until it reaches the objective position minus the lead distance.
4. The gauge stops and is allowed to coast in. A check is done to see if the current length is within tolerance. If not, the lead distance is automatically adjusted and a new run sequence is initiated. If the current length is within tolerance, the HALT lamp is illuminated.

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### ENTERING A NUMBER

Throughout this document, references have been made to entering a number. This procedure will be explained in detail now so that the rest of the manual can be simplified.

Numerical data refers to such things as length of a part or duration of a press cycle. 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 meanings will be seen throughout this manual:

PROMPT -- There is a 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 ENT key and it is used like the period at the end of a sentence. Pressing the ENT 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 ENT key is pressed, the operator has the

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option 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 by pressing the CLR key. This will cause the display to revert back to showing the value that was present before any keys were pressed. Also, for any errors that may occur, the display will show the error code 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 point have been entered, the decimal point is automatically inserted or the decimal point may be entered at any time before by pressing the decimal point key.

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 10.00 to 100.00 because of some machine constraint. Values entered outside of this range will result in an error message being displayed.

With an understanding of these terms we can proceed to explain the data entry procedure. The best way to do this is with an example.

The example's data items consist of:

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Data Item	Distance per shaft transducer revolution
Prompt	diSt.
Form	XX.XXX
Units	Inches
Range	2.500 to 20.000 inches
Old Value	12.000
New Value	11.987

Display	Key
diSt. 12.000	1
diSt. 1	1
diSt. 11.	9
diSt. 11.9	8
diSt. 11.98	7
diSt. 11.987	ENT

The value is now entered and the next data item will appear.

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A mistake and subsequent correction sequence might go like:

Display	Key
diSt. 12.000	1
diSt. 1	2
diSt. 12.	CLR
diSt. 12.000	1
diSt. 1	1
diSt. 11.	9
diSt. 11.9	8
diSt. 11.98	7
diSt. 11.987	ENT

The value is now stored and the next data item appears.

Leading and trailing zeroes do not have to be entered. An example would be the entry of the value of 10.000 inches.

Display	Key
diSt. 12.000	1
diSt. 1	0
diSt. 10.	ENT

The value is now stored and the next data item appears.



## LENGTH CALIBRATION

The computer detects the movement of material through the machine by means of an optical incremental shaft angle transducer which is also referred to as a rotary pulse generator or rotopulser. It is a device which 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 rotopulser shaft. In order to translate this angular movement into actual material movement, a precision measuring wheel is attached to the shaft of the rotopulser. 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 is equal to the circumference of the wheel divided by the number of counts generated in one revolution of the rotopulser shaft. If the circumference of the wheel is 10 inches and there are 1000 pulses per revolution on the rotopulser, then the resolution would be  $10 \text{ inches} / 1000 \text{ pulses}$  or 0.01 inches.

In this system the computer uses the parameters of CYCLES PER REVOLUTION, DISTANCE PER REVOLUTION, and CORRECTION FACTOR to determine the resolution of the system and to calculate a system rate multiplier which is used to determine counts per hundredth of an inch. With the cycles per revolution and distance per revolution set for the

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type of rotopulser and wheel being used on your particular machine, the correction factor should be set to 1.00000 for initial tests. With this initial value of correction factor, the system can then be fine tuned in order to give optimum accuracy.

First, manually jog the guides in until the in limit switch closes. Measure the distance from the guide to the zero point of the machine and write down the length on the unit display. Next manually jog the guides out until the out limit switch closes. Take the same measurements as before. A new correction factor can be calculated as follows:

$$NCF = OCF * (UOT - UIL) / (MOT - MIL)$$

where NCF is the new correction factor

OCF is the old correction factor

UOT is the unit displayed inside length

UIL is the unit displayed outside length

MOT is the measured inside length

MIL is the measured outside length

This new value for correction factor should be entered into the computer. Continue this procedure until the resultant error is less than the tolerance of the system.

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SETUP REFERENCE CHART

PARAMETER	PROMPT	UNITS	FORM	RANGE
Counts Per Revolution	Counts	-	XXXX	100-1000
Distance Per Revolution	diSt.	in/cm	XX.XXX	.25- 20.0 in
Correction Factor	Corr.	-	XX.XXXXX	.9- 1.1
Direction of Travel	dirEction	-	X	0 - 1
Reference Point	rEF.	in/cm	XXX.XXX	0.0-999.999in
Slowdown Distance	SLO. LE.	in/cm	XX.XXX	0.0-999.999in
Lead Distance	LEAd	in/cm	XX.XXX	0.0-999.999in
Inside Tolerance	In. LE.	in/cm	XX.XXX	0.0-999.999in
Outside Tolerance	Out. LE.	in/cm	XX.XXX	0.0-999.999in
Memory Reset	ALL. CLR. LE. FRSH	-	XXXX	1984

→ CLR. LE. FOR 3.02 SPECIAL SOFTWARE

## SYSTEM ERROR CODES

The following are error codes that may be encountered and a description of causes and cures for each.

Error 1 - This error is encountered when the cycles per revolution is attempted to be programmed beyond the limits of 100-1000.

Error 2 - This error is encountered when the distance per revolution is attempted to be programmed beyond the limits of .25-20.0 inches.

Error 3 - This error is encountered when the correction factor is attempted to be programmed beyond the limits of .9-1.1.

Error 4 - This error is encountered when the automatic lead adjustment routine has calculated a negative lead adjustment. Since this is an impossible "real world" condition, this error can only be caused by improper programming or unit operation.

Error 5 - This is an internal error code which indicates some type of internal computer error that requires service.

BACKGAUGE SERIAL INTERFACE SPECIFICATION  
REVISION 2.0

SCOPE

The purpose of this document is to define the hardware and software parameters required to communicate between the Backgauge Computer (BGC) and Main System Computer (MSC).

HARDWARE

Communication is via an RS-232C link at a baud rate of 300. This is a 10 bit format with 1 start bit, 8 data bits and 1 stop bit. There is no parity bit.

LINE DISCIPLINE

The software line discipline is half duplex. The MSC is considered to be the line master. The BGC will not initiate transmission except in response to a message from the MSC. All messages must begin with a STX (02) and end with ETX (03). A checksum byte must follow the ETX. The checksum is computed by taking the 2's compliment of the sum of all of the characters transmitted, excluding the control characters STX, ETX and DLE (16). If the checksum byte equals a control character (STX, ETX, or DLE) then that byte is replaced by 2 bytes. The first byte is the DLE character and the second is the original character plus 16.

A typical exchange between the BGC and the MSC would be as follows:

The MSC will initiate a message:

STX  
Message  
ETX  
Checksum

If a complete message has been received, the BGC will reply with:

STX  
Message  
ETX  
Checksum

If the message was received with an error, the BGC will not respond. The remote computer should retransmit the message after a three second timeout.

BACKGAUGE SERIAL INTERFACE SPECIFICATION  
REVISION 2.0

COMPUTER LINK FUNCTIONS

All messages to and from the BGC are in ASCII. Data must be right justified in a field with leading zeroes or spaces added. For data with decimal points, the decimal point is included at its appropriate location in the data field.

The general form of a message to the BGC is the model number and unit number and a function code followed by a specific number of characters required by that particular function. The 5 functions recognized by the BGC are as follows:

FUNCTION CODE	FUNCTION
0	Poll for unit information
1	Order Entry
2	Down load setup
3	Set output on or off
4	Calibrate the line

BACKGAUGE SERIAL INTERFACE SPECIFICATION  
REVISION 2.0

POLL FOR UNIT INFORMATION

The MSC continuously polls the BGC to determine if the unit is on line. If the unit responds within the 3 second timeout then that unit is considered on line. If a unit is not polled within 15 seconds then that unit's LOCAL light will flash on and off indicating a fault in the serial link. Any faults detected by the BGC will be reported.

The MSC computer message is

byte 1 = 8, model number (hex 38)  
byte 2 = 1-3, unit number  
byte 3 = 0, function code

The BGC will respond with

byte	1 = 8, model number (hex 38)	
byte	2 = 1-3, unit number	
byte	3 = 0, poll response	
byte	4 = operating status	0 = idle 1 = running 2 = memory lost 3 = not calibrated
byte	5 = fault 1	0 = no fault, 1 = fault
byte	6 = fault 2	0 = no fault, 1 = fault
byte	7 = fault 3	0 = no fault, 1 = fault
byte	8 = fault 4	0 = no fault, 1 = fault
byte	9-14 = current position in thousandths (xxxxxx)	

BACKGAUGE SERIAL INTERFACE SPECIFICATION  
REVISION 2.0

ORDER ENTRY

The MSC can load a job into the BGC using function 1. The form of the entry is as follows:

The MSC message is

byte 1 = 8, model number (hex 38)  
byte 2 = 1-3, unit number  
byte 3 = 1, function code  
byte 4-9 = Length in thousands (xxxxxx).

The BGC will respond with

byte 1 = 8, model number (hex 38)  
byte 2 = 1-3, unit number  
byte 3 = 1, Order accepted



BACKGAUGE SERIAL INTERFACE SPECIFICATION  
REVISION 2.0

DOWN LOAD SETUP

The MSC has the ability to program the setup values in the BGC. The form of the entry is as follows:

The MSC message is

byte 1 = 8, model number (hex 38)  
byte 2 = 1-3, unit number  
byte 3 = 2, function code  
byte 4-7 = cycles per revolution (XXXX)  
byte 8-13 = distance per revolution (XX.XXX)  
byte 14-20 = correction factor (X.XXXXX)  
byte 21 = direction of travel (0 or 1)  
byte 22-28 = reference point (XXX.XXX)  
byte 29-35 = slowdown length (XXX.XXX)  
byte 36-42 = lead distance (XXX.XXX)  
byte 43-49 = inside tolerance (XXX.XXX)  
byte 50-56 = outside tolerance (XXX.XXX)

The BGC will respond with

byte 1 = 8, model number (hex 38)  
byte 2 = 1-3, unit number  
byte 3 = 2, Setup accepted

BACKGAUGE SERIAL INTERFACE SPECIFICATION  
REVISION 2.0

SET OUTPUTS ON OR OFF

The MSC can set 4 outputs on or off on the BGC. By asking for output number 5 all 4 outputs can be turned on or off at the same time. The form of the entry is as follows:

The MSC message is

byte 1 = 8, model number (hex 38)  
byte 2 = 1-3, unit number  
byte 3 = 3, function code  
byte 4 = 1-5 output to control (5 = all)  
byte 5 = output state ( 0 = off, 1 = on)

The BGC will respond with

byte 1 = 8, model number (hex 38)  
byte 2 = 1-3, unit number  
byte 3 = 3, output control response.

BACKGAUGE SERIAL INTERFACE SPECIFICATION  
REVISION 2.0

CALIBRATE THE SYSTEM

The MSC can command the BGC to calibrate. The form of the entry is as follows:

The MSC message is

byte 1 = 8, model number (hex 38)  
byte 2 = 1-3, unit number  
byte 3 = 4, function code

The BGC will respond with

byte 1 = 8, model number (hex 38)  
byte 2 = 1-3, unit number  
byte 3 = 4, calibrate response.

SOFTWARE CHANGE NOTICE

Model Number MP38

Version Number 3.01-SP

Name Joe Turner

Date 7 / 11 / 90

Reason for change: Bug fix.

Description of change:

Removed JSR RPPARTSTOP (call of routine that waits for the part-on-stop switch to close) after making +12" move before final bend on type 4 parts.

Files Changed:

M38RUNON

LM38VER

SOFTWARE CHANGE NOTICE

Model Number MP38

Version Number 3.02-SP

Name Joe Turner

Date 10 / 19 / 90

Reason for change: Customer request.

Description of change:

Replaced fixed 12.000" move to clear brake with programmable distance.

Defaults to 12.000", changeable in Setup mode (CLEAR LE.).

Files Changed:

M38RAM

M38PMAIN

M38PSET

M38RUNON

M38RMOVE

M38RMISC

LM38VER

\* STANDARD I/O EQUATE POSITIONS

MP38 Special

\* OUTPUT PORT

HEPOUTPUT SET \$1FE6 PIA B PORT

DEMOVEIN	EQU BIT0	move gauge IN
DESPEED	EQU BIT1	slow gauge movement speed
DEMOVEOUT	EQU BIT2	move gauge OUT
DESPARE4	EQU BIT3	not used
DESTOPS	EQU BIT4	turn on Stops
DEBRAKE	EQU BIT5	turn on Bendall Brake
DECONVEYCLUTCH	EQU BIT6	turn on Conveyor Clutch (stops Conveyor)
DESPARE8	EQU BIT7	not used

\* INPUT PORT

HEPINPUT SET \$1FE4 PIA A PORT

IERESET	EQU BIT0	Reset switch
IEPARTSTOP	EQU BIT1	Part against Stops
IEMULTIMODE	EQU BIT2	Multi-bend Mode
IETABLEREF	EQU BIT3	Table Reference
IEBENDTOP	EQU BIT4	Bendall Brake at TOP
IEBENDBOT	EQU BIT5	Bendall Brake at BOTTOM
IESPARE7	EQU BIT6	not used
IESPARE8	EQU BIT7	not used

PAGE

\* ENCODER INPUT PORT

HEI\_INENC EQU \$1FEC

IECNTR	EQU \$0F	BITS 0 - 3
IEDIRECT	EQU \$10	DIRECTION BIT
IEGREAT	EQU \$20	GREATER THAN INTERRUPT
IEEQUAL	EQU \$40	EQUAL INTERRUPT
IEOVRFLW	EQU \$80	OVERFLOW INTERRUPT

\* ENCODER OUTPUT PORT

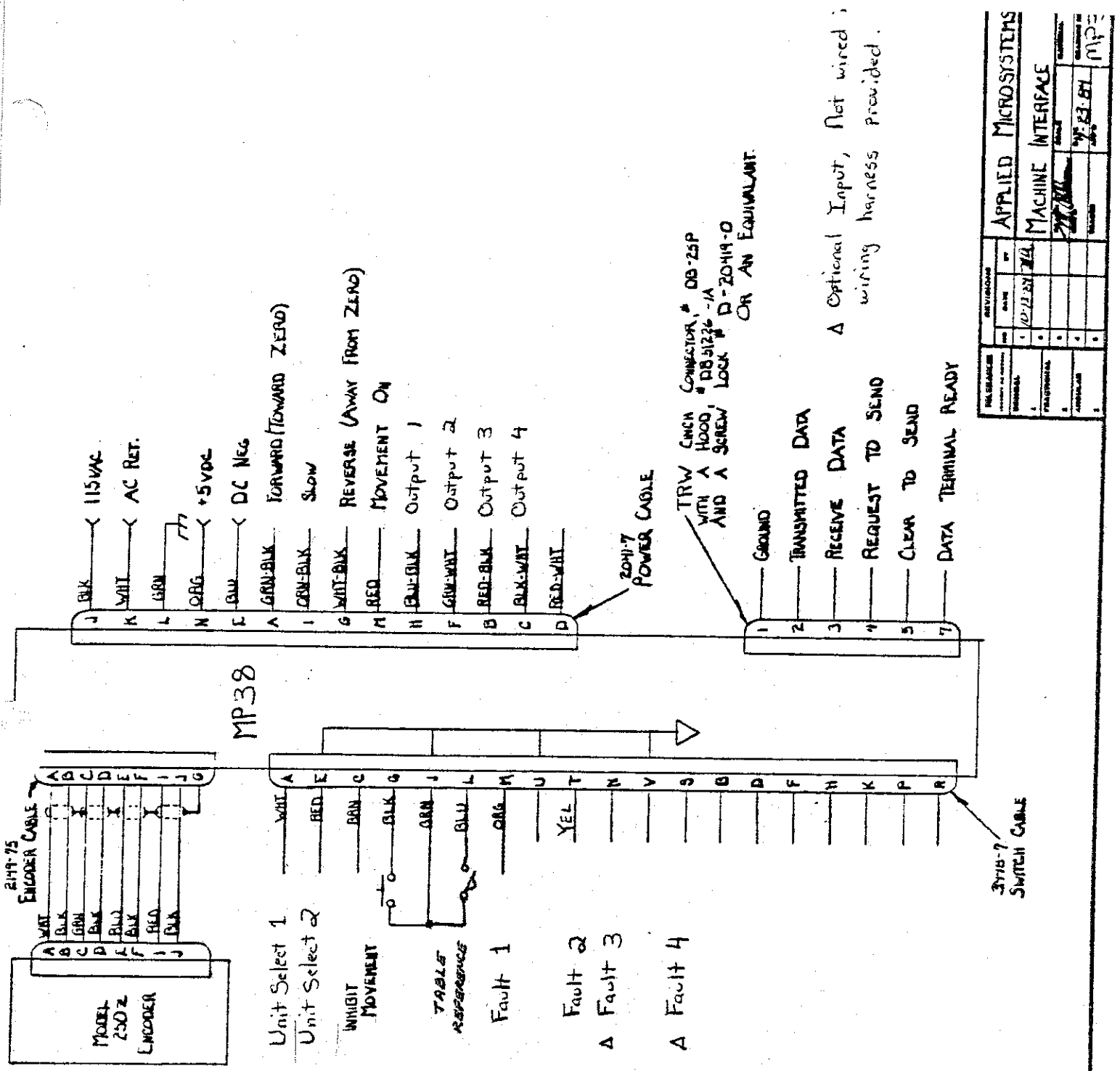
HEPOUTEN EQU \$1FEE

DECMPR	EQU \$0F	COMPARE BITS 0 - 3
DECNTCLR	EQU \$10	COUNTER CLEAR BIT
DELATCLR	EQU \$20	INTERRUPT LATCH CLEAR BIT
DEDIRECT	EQU \$40	DIRECTION BIT

\* DISPLAY PORTS

HEPDIS1 SET \$1FD0 DISPLAY PORT SIDE A  
HEPDIS2 SET \$1FD2 DISPLAY PORT SIDE B

PC



APPLIED MICROSYSTEMS	
DATE	BY
10/11/87	W. B. B. H.
MACHINE INTERFACE	
1	W. B. B. H.
2	W. B. B. H.
3	W. B. B. H.
4	W. B. B. H.
5	W. B. B. H.