MP43 PIN SPOTTER CONTROLLER MANUAL

INTRODUCTION

The Model MP43 Pin Spotter Controller is a special purpose computer designed to control an industrial pin spotting machine in the manufacturing of metal duct work. The pin spotting machine places fastening pins in sheet metal according to a specific set of spacing rules. The spacing rules are:

1. Always put a row of pins three inches from the leading and trailing edges of the sheet of metal.
2. Never space rows of pins less than the minimum spacing.
3. Never put a row of pins closer than three inches from a brake line.
4. Never put rows of pins spaced greater than the specification spacing unless rules 1 thru 3 would be violated.
5. Never put a row of pins greater than six inches from a brake line unless it conflicts with rules 1 thru 4.
6. Always try to put a row of pins three inches from a brake line unless a row of pins could be saved by putting the last row from three to six inches from the brake line.
7. If rules 1 thru 4 result in the specification spacing not being met then make only one row of pins out of specification so that an extra row of pins can be put in by hand.

The MP43 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.

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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 machine from placing pins in the material. The red lamp indicates that the fire and load outputs are off.

RUN

The RUN key is used to allow the pin spotter to place pins in the material. The green lamp indicates that the controller is in the run mode.

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 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.

MANUAL CYCLE

The MANUAL CYCLE key is used to cycle the fire outputs when the unit is in the halt mode. After pressing the manual cycle key, the fire outputs will cycle for their programed time and then the load outputs will cycle. The yellow lamp indicates the unit is cycling the fire or load outputs.

HIGH VEL

The HIGH VEL key has no function but the lamp indicates that the unit is running high velocity parts.

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 programing, running, and manual operation of the unit. In the remote mode the lamp is not illuminated and a main computer controls the programing 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 constants about the machine.

END

The END key is used to exit the SETUP and PROGRAM modes.

PRG

The PRG key is used to enter the PROGRAM mode.

ENT

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

CLR

The CLR key is used to clear an entry made in the SETUP or PROGRAM 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. 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. 12.00

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 displayed is the current direction setting.

MINIMUM ALLOWABLE SPACING

The MINIMUM ALLOWABLE SPACING parameter is the minumum distance allowed between any two rows of pins. The prompt for this parameter is:

SPACE 3.00

Note that the number displayed is the current minimum spacing.

OFFSET LENGTH

The OFFSET LENGTH parameter allows the operator to offset the actual start of the part a set length from the leading edge. This is useful for parts that have a leading edge lock which should not be included in the length measured for a side. The prompt for this parameter is:

oFFSEt 0.00

Note that the number displayed is the current offset length.

FIRE TIME

The FIRE TIME parameter is the time required for the fire output to be on to complete the fire operation. The prompt for this parameter is:

FirE 1.00

Note that the number displayed is the current fire time.

DELAY TIME

The DELAY TIME parameter is the time after the fire output is turned on until the load output is turned on. The prompt for this parameter is:

dELAY 1.00

Note that the number displayed is the current delay time.

LOAD TIME

The LOAD TIME parameter is the time required for the load output to be on to complete the load operation. The prompt for this parameter is:

LoAd 1.00

Note that the number displayed is the current load time

OUTSIDE HIGH VELOCITY LENGTH

The OUTSIDE HIGH VELOCITY LENGTH parameter is the maximum distance that the unit will leave between any two outside rows of pins when manufacturing high velocity ducts. This distance must be equal to or greater than the minimum allowable spacing. The prompt for this parameter is:

Out Hi 3.00

Note that the number displayed is the current outside high length

INSIDE HIGH VELOCITY LENGTH

The INSIDE HIGH VELOCITY LENGTH parameter is the maximum distance that the unit will leave between any two inside rows of pins when manufacturing high velocity ducts. This distance must be equal to or greater than the minimum allowable spacing. The prompt for this parameter is:

In Hi 3.00

Note that the number displayed is the current inside high length.

OUTSIDE LOW VELOCITY LENGTH

The OUTSIDE LOW VELOCITY LENGTH parameter is the maximum distance that the unit will leave between any two outside rows of pins when manufacturing low velocity ducts. This distance must be equal to or greater than the minimum allowable spacing. The prompt for this parameter is:

Out Lo 3.00

Note that the number displayed is the current outside low length.

INSIDE LOW VELOCITY LENGTH

The INSIDE LOW VELOCITY LENGTH parameter is the maximum distance that the unit will leave between any two inside rows of pins when manufacturing low velocity ducts. This distance must be equal to or greater than the minimum allowable spacing. The prompt for this parameter is:

In Lo 3.00

Note that the number displayed is the current inside low length.

OUTSIDE SPECIAL VELOCITY LENGTH

The OUTSIDE SPECIAL VELOCITY LENGTH parameter is the maximum distance that the unit will leave between any two outside rows of pins when manufacturing special velocity ducts. This distance must be equal to or greater than the minimum allowable spacing. The prompt for this parameter is:

Out SP 3.00

Note that the number displayed is the current outside special length.

INSIDE SPECIAL VELOCITY LENGTH

The INSIDE SPECIAL VELOCITY LENGTH parameter is the maximum distance that the unit will leave between any two outside rorws of pins when manufacturing special velocity ducts. This distance must be equal to or greater than the minimum allowable spacing. The prompt for this paramter is:

In SP 3.00

Note that the number displayed is the current outside special length.

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

PROGRAM MODE

The PROGRAM MODE is used to enter data about the type of part to be run. A list of the program data parameters and a description of each are as follows:

TYPE OF PART

The TYPE OF PART parameter is used to specify the number of sides the part to be run has. Pressing any numerical key will toggle the display character from 1 to 4 sides. The prompt for this parameter is:

tYPE U

Note that the character displayed is the current part type.

VELOCITY SPECIFICATION

The VELOCITY SPECIFICATION parameter is used to specify the duct air velocity. This enables the unit to use the high, low, or special velocity spacing lengths programed in the setup mode. The prompt for this paramter is:

SPEC Hi

Note that the prompt displayed is the current velocity specification.

LENGTH OF PART

The LENGTH OF PART parameter is the length of the part to run. This parameter is required for all types and velocitys. The prompt for this parameter is:

LE. A 0.00

Note that the number displayed is the current length.

WIDTH OF PART

The WIDTH OF PART parameter is the width of the part to run.

This parameter is required for all types except type 1 parts. The prompt for this parameter is:

LE. B 0.00

Note that the number displayed is the current width.

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 manaul 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 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 and 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:

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.

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 enxt 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 refered 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 it's 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 inches / 1000 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 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.

Length inaccuracies consist of two distinct elements, the repeatability error and the linerity error. The repeatability error results form variations in the mechanics of the machine from one operation to the next. This variation would be the same for 1 inch parts or 100 inch 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 be quite significant on long parts. These two error elements must be seperated 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 it's length carefully measured. A new value for the correction factor can be calculated as follows:

NCF = OCF * (PL / AL)

where NCF is the new correction factor

OCF is the old correction factor

PL is the programed length

AL is the actual length

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

NCF = 1.00000 * (100 / 100.25) or .99751

This new value for the correction factor should be entered into the computer. The above procedure should be repeated until the resultant error is less than the allowable tolerance for the system.

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 by 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 100.00 to 100.06 inch parts being made, the mean value would be 100.03 and the calculation would be:

NCF = .99751 * (100 / 100.03) or .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.

SETUP REFERENCE CHART

PARAMETER	PROMPT	UNITS	FORM	RANGE
Counts Per Revolution	Counts	-	XXXX	100 - 1000
Distance Per Revolution	diSt.	in/cm	XX.XX	.250- 20
Correction Factor	Corr.	-	XX.XXXXX	.90- 1.1
Direction of Travel	dirEction	-	X	0 - 1
Minimum Spacing	SPACE	in/cm	XXX.XX	3.00- 999.99
Offset Length	oFFSEt	in/cm	XXX.XX	0 - 999.99
Fire Time	FirE	seconds	XX.XX	0.01- 99.99
Delay Time	dELAY	seconds	XX.XX	0.01- 99.99
Load Time	LoAd	seconds	XX.XX	0.01- 99.99
Outside High Length	Out Hi	in/cm	XXX.XX	3.00- 999.99
Inside High Length	In Hi	in/cm	XXX.XX	3.00- 999.99
Outside Low Length	Out Lo	in/cm	XXX.XX	3.00- 999.99
Inside Low Length	In Lo	in/cm	XXX.XX	3.00- 999.99
Outside Special Length	Out SP	in/cm	XXX.XX	3.00- 999.99
Inside Special Length	In SP	in/cm	XXX.XX	3.00- 999.99
Memory Reset	FrESh	-	XXXX	1984

PROGRAM REFERENCE CHART

PARAMETER	PROMPT	UNITS	FORM	RANGE
Type of Part	tYPE	-	X	1 - 4
Velocity Specification	SPEC	-	XX	Hi, Lo, Sp
Length of Part	LE. A	in/cm	XXX.XX	4.00- 999.99
Width of Part	LE. B	in/cm	XXX.XX	3.00- 999.99

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 programed beyond the limits of 100-1000.

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

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

Error 4 - This error is encountered when a parameter is programed to zero when zero is not allowed for that particular parameter.

Error 5 - This error is encountered when the minimum spacing parameter is programed less than three inches or one of the velocity lengths is programed less than the minimum spacing.

Error 6 - This error is encountered when a run is attempted with invalid or illegal setup or batch data.

Error 7 - This is an internal error code which indicates some type of internal computer error that requires service.

PIN SPOTTER 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 Pin Spotter Computer (PSC) 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 PSC 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 PSC 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 PSC will reply with:

STX
Message
ETX
Checksum

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

PIN SPOTTER SERIAL INTERFACE SPECIFICATION
REVISION 2.0

COMPUTER LINK FUNCTIONS

All messages to and from the PSC 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 PSC is the model number and unit number and a function code followed by a specific number of characters required by that particular function. The 4 functions recognized by the PSC are as follows:

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

POLL FOR UNIT INFORMATION

The MSC continously polls the PSC 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 PSC will be reported.

The MSC computer message is

```
byte 1 = C, model number (hex 43)
byte 2 = 1, unit number
byte 3 = 0, function code
```

The PSC will respond with

```
byte     1 = C, model number (hex 43)
byte     2 = 1, unit number
byte     3 = 0, poll response
byte     4 = operating status  0 = idle
                               1 = running
                               2 = memory lost
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 hundredths (xxxxxx)
```

PIN SPOTTER SERIAL INTERFACE SPECIFICATION
REVISION 2.0

ORDER ENTRY

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

The MSC message is

```
byte      1 = C, model number (hex 43)
byte      2 = 1, unit number
byte      3 = 1, function code
byte      4 = type of part (1-4)
byte      5 = velocity specification  0 - halt unit
                                      1 - high velocity
                                      2 - low velocity
                                      3 - special velocity
byte   6-11 = length of part in hundredths (XXXXXX)
byte  12-17 = width  of part in hundredths (XXXXXX)
```

The PSC will respond with

```
byte 1 = C, model number (hex 43)
byte 2 = 1, unit number
byte 3 = 1, Order accepted
```

DOWN LOAD SETUP

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

The MSC message is

```
byte     1 = C, model number (hex 43)
byte     2 = 1, unit number
byte     3 = 2, function code
byte   4-7 = cycles per revolution (XXXX)
byte  8-12 = distance per revolution (XX.XX)
byte 13-19 = correction factor (X.XXXXX)
byte    20 = direction of travel (0 or 1)
byte 21-25 = fire time (XX.XX)
byte 26-30 = load time (XX.XX)
byte 31-35 = delay time (XX.XX)
byte 36-41 = minimum movement (XXX.XX)
byte 42-47 = offset length (XXX.XX)
byte 48-53 = outside high velocity length (XXX.XX)
byte 54-59 = inside high velocity length (XXX.XX)
byte 60-65 = outside low velocity length (XXX.XX)
byte 66-71 = inside low velocity length (XXX.XX)
byte 72-77 = outside special velocity length (XXX.XX)
byte 78-83 = inside special velocity length (XXX.XX)
```

The PSC will respond with

```
byte 1 = C, model number (hex 43)
byte 2 = 1, unit number
byte 3 = 2, Setup accepted
```

SET OUTPUTS ON OR OFF

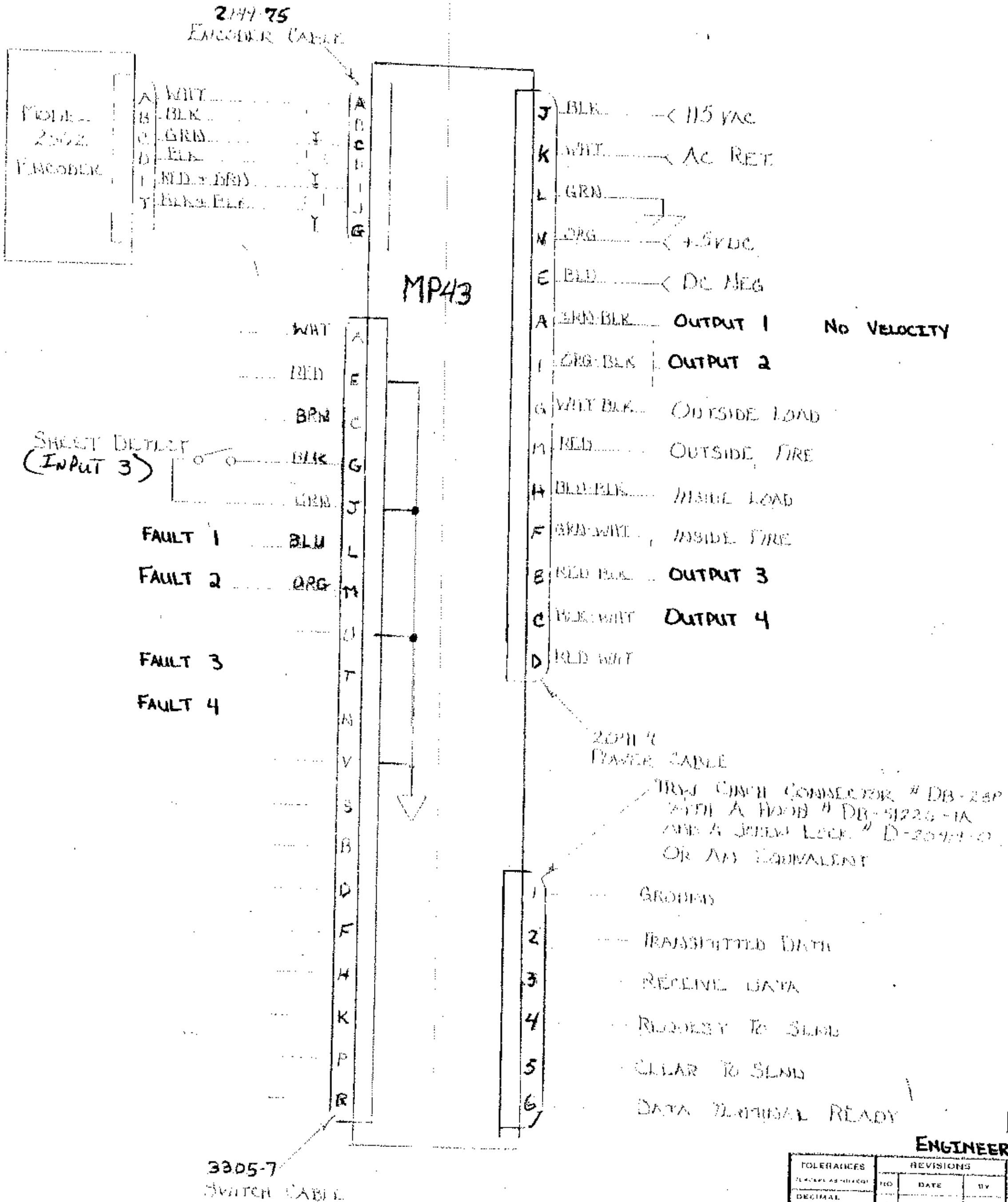
The MSC can set 4 outputs on or off on the PSC. By asking for output number 5 all 4 outputs can be turned on or off at the same time. The form of the entry is as follows:

The MSC message is

byte 1 = C, model number (hex 43)
byte 2 = 1, 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 PSC will respond with

byte 1 = C, model number (hex 43)
byte 2 = 1, unit number
byte 3 = 3, output control response.



ENGEL PINSPOTTER

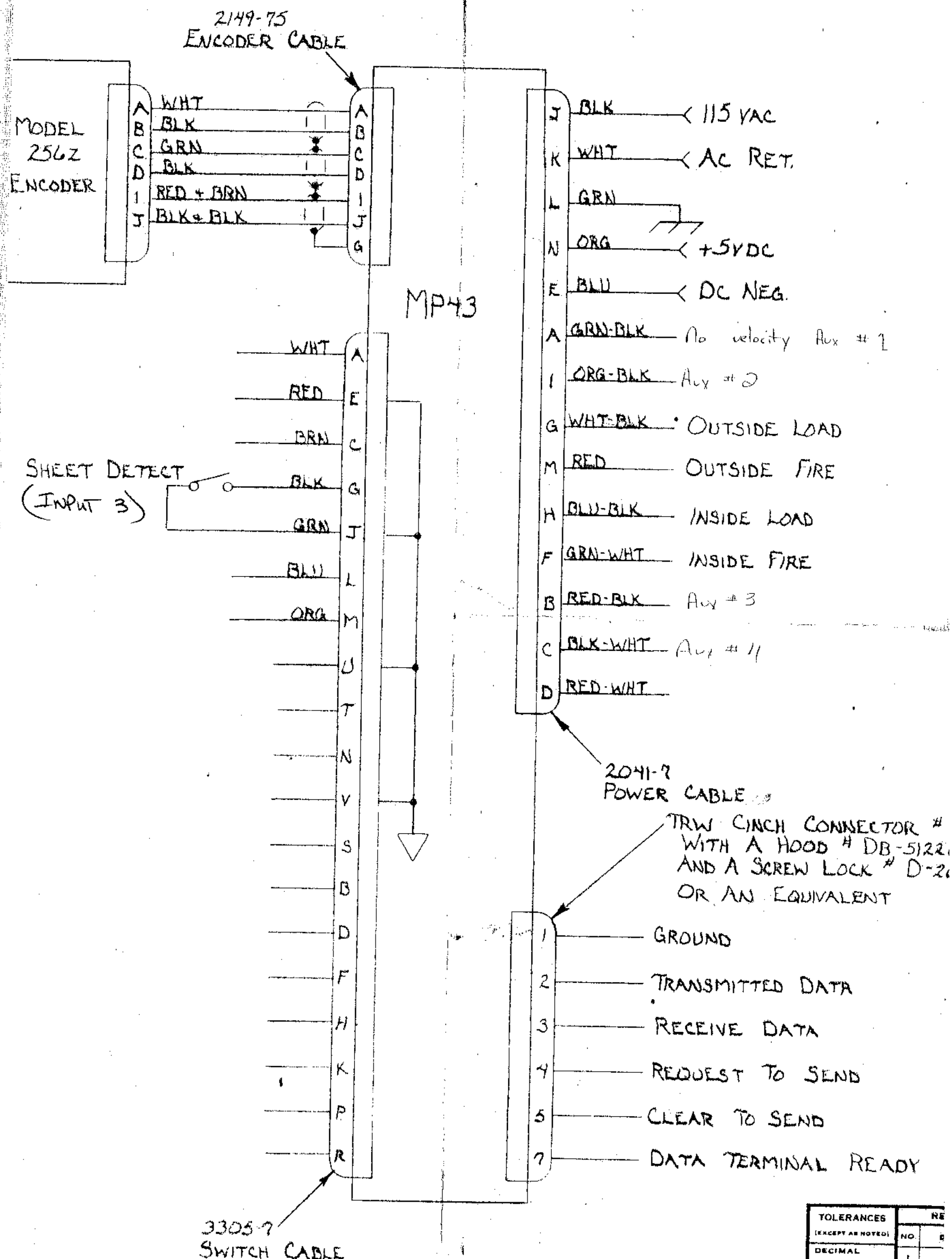
ENGINEERING MASTER 10/17/85

APPLIED MICROSYSTEMS

MACHINE INTERFACE

TOLERANCES | REVISIONS | DECIMAL | FRACTIONAL | ANGULAR | DRAWN BY | CHKD | TRACED | SCALE | DATE | APPD | MATERIAL | DRAWING NO.

MP43



TOLERANCES (EXCEPT AS NOTED)	NO.
DECIMAL ±	1
	2
FRACTIONAL ±	3
	3
ANGULAR ±	4
	5