

MP54 CONTROLLER MANUAL

(Revised 6/16/86)

INTRODUCTION

The Model MP54 Controller is a special purpose computer designed to control the R-ANGLE Machine built by The Lockformer Company. This machine produces a reinforcing angle that is used on HVAC ductwork. The MP54 acts as the machine operator interface for job programming. It then sequences the solenoid valves of the machine in order to produce the programmed parts.

The MP54 has been designed to be as user-friendly as possible. The operator has to only enter the minimum amount of information required to produce the desired parts. This information includes the type of product, the number of parts required, and the finished length and width of the ductwork. The MP54 then calculates the entire flat pattern layout of the part. If duct attachment holes are required, they are automatically located on even increments on a side at a minimum number of locations, consistent with a maximum spacing specification. The MP54 can also adjust for the bend allowance so that length and width of the frame after bending are the programmed length and width.

SPECIFICATION

| | |
|------------------------|--|
| Resolution | Wheel Circumference/1024 |
| Accuracy | Output turned on within 1 count of correct length. (does not errors of the machine) |
| Maximum Line Speed | 200 FPM |
| Maximum Length of Part | 9999.99 inches |
| Maximum Batch Quantity | 9999 |
| Number of Batches | 50 |
| Number of Patterns | 8 (1,2,3,4,10,20,30,40) |
| Input Power | 115VAc +/- 10%, 50-60Hz, 1 AMP 5-24 VDC, 0.5 Amp (excluding load current) |
| Outputs | 9 (FWD, REV, FAST, Shear, NOTCH, PUNCH GAG, EXIT FEED ROLL, FEED PRES., PRESS PRES.) |
| Inputs | 3;JOG FWD,JOG REV,MOTOR STARTER |
| Length Totalizer | 999999 Feet or Meters |
| Physical Size | 6in X 9IN X 10in |
| Weight | 13 pounds |

HARDWARE DESCRIPTION

FRONT PANEL

Figure 1 shows the layout of the front panel. There is a 16 key keypad and 6 illuminated pushbuttons switches. A 12 character LED display is used to prompt the operator and display status data. The function of each switch and key is as follows:

HOLE

The HOLE key is used to manually cycle the NOTCH output without the GAG output being on. The switch only works when the machine is halted. The lamp of this switch indicates when the NOTCH output is on without the GAG in either the HALT or the RUN modes.

NOTCH

The NOTCH key is used to manually cycle the NOTCH output with the GAG output when the line is in the HALT mode. The GAG output is turned on about 0.1 seconds before the NOTCH output so that it has time to shift into place before the press comes down. The lamp of this switch indicates when the NOTCH and GAG outputs are on together in either the HALT or RUN modes.

SHEAR

The SHEAR key is used to manually cycle the SHEAR output when the line is in the HALT mode. The lamp indicates when the SHEAR output is on in either the HALT or RUN modes. The

SHEAR key also causes a RESET condition in the controller. The RESET condition means that all parts in progress will be terminated and the controller will begin again from the NOTCH press to process the uncompleted parts over again.

METRIC WHEN LIT

The METRIC WHEN LIT key is used to switch between metric and English units of measurement. When the lamp is lit, data is entered and displayed in centimeters (meters for the accumulator). When the lamp is not lit, the data is displayed and entered in inches (feet for the accumulator).

RUN

The RUN key is used to indicate an automatic run of the machine. The green lamp indicates when the controller is in the RUN mode.

HALT

The HALT key is used to abort an automatic run of the machine. The red lamp indicates that the controller is in the HALT mode.

SETUP

The SETUP key is used to enter the SETUP mode which is used to enter semi-permanent information about the particular machine such as die spacing, press cycle times, etc.

END

The END key is used to exit the PROGRAM or SETUP modes and return to the HALT or RUN mode display.

PRG

The PRG key is used to enter the PROGRAM mode which is used to enter batch data on jobs to be run.

ENT

The ENT key is the data ENTER key and it is used by the operator to tell the computer to accept the data that is present in the display window.

CLR

The CLR key is the data CLEAR key and is used to erase any key entry that is done before the ENTER key is pressed. It is also used to set the total length accumulator to zero.

MACHINE INTERFACE

There are 9 outputs from the MP54. They are 5 AMP open collector transistors that switch load current to the DC ground when turned on. The function of each output is as follows:

The FWD output is used to turn the machine drive rolls in the forward direction.

The REV output is used to turn the machine drive rolls in the reverse direction.

The FAST output is used to change the speed of the drive rolls. When the FAST output is on, the rolls will turn at high speed when either the FWD or REV outputs are on. When the FAST output is off, the rolls will turn at slow speed when either the FWD or REV outputs are on. The FAST output is always off when FWD is off or when the unit is in the HALT mode. Thus, the machine will only jog in slow speed. In the RUN mode, the FAST output will be on until the distance

to the next operation is less than the SLOWDOWN DISTANCE (see SETUP).

The NOTCH output is used to cycle the notch press. When this output is turned on when the PUNCH GAG output is on, then holes and a corner notch are produced. When the NOTCH output is turned on when the PUNCH GAG is turned off, then only holes are produced.

The PUNCH GAG output is used to select either holes or holes and corner notch when the NOTCH press is cycled.

The EXIT FEED ROLL output is used to turn on a set of drive rolls that remove a sheared part from the machine. The output turns on after every Shear output for the duration of the SHEAR PAUSE time (see SETUP).

The FEED PRESSURE output is on when either the FWD or REV outputs are on.

The PRESS PRESSURE output is on when either the SHEAR, PUNCH, or EXIT FEED ROLL outputs are on.

There are 3 external inputs into the MP54. These are the JOG FWD, JOG REV, and MOTOR STARTER switches. The JOG FWD and JOG REV inputs are only looked at by the computer in the HALT mode, and cause the drive rolls to move in the appropriate direction. The MOTOR STARTER input must be closed before a run is initiated and

must remain closed throughout the run. If the MOTOR STARTER should happen to open during the RUN mode, the MP54 will immediately halt and cannot be run again until the MOTOR STARTER switch is closed.

Material movement is sensed by the MP54 through the rotopulser (rotary pulse generator) which is an incremental optical shaft angle encoder. This device generates a precise number of pulses for each revolution of its shaft. The shaft is coupled to the rolls of the machine so that pulses are generated as the material is moved through the machine. The computer counts these pulses and by knowing and by knowing the distance per revolution of the shaft, the computer can detect the amount of material movement through the machine.

COMPUTER

The heart of the MP54 is the microprocessor and its associated memory components. The operating program of the computer is contained in read-only-memory (ROM) and user data such as setup data and batch data is stored in random-access-memory (RAM). This RAM data is maintained when power is turned off by a re-chargable NICAD battery that are charged each time the unit is turned on. The battery should maintain memory for several weeks in the event that the unit is left off. The battery should last for about 5 years. Should the unit fail to maintain memory on a consistent basis, the battery should be replaced.

MODES OF OPERATION

There are five modes of operation in the MP54--SETUP, PROGRAM, RUN, HALT, and ERROR. These modes are classified into two types, display modes and machine modes. All of the modes are display modes in that they each have their own distinct display formats. The two machine modes are RUN and HALT. It is possible to have the machine in the RUN mode and the display in the PROGRAM mode. This allows the computer to be programmed while running. As entered jobs are being produced, new jobs can be entered into the computer.

SETUP MODE

The SETUP mode is used to enter machine parameters and some seldom changed part parameters. The mode is entered by pressing the SETUP key and is exited by pressing the END key or by stepping through all of the parameters. Table 1 shows these parameters with the prompts used, the range of allowed values, and a place to write in the correct values for your machine. The setup parameters and their function in the machine are as follows:

LENGTH TOTALIZER

The LENGTH TOTALIZER or accumulator indicates the total amount of material that has passed through the machine since the accumulator was last cleared. The operator can only

clear this amount to zero using the CLR key and cannot set it to a value.

NOTCH TO SHEAR DISTANCE

The NOTCH TO SHEAR DISTANCE is the distance from the center of the notch die to the center of the shear die.

SLOWDOWN DISTANCE

The SLOWDOWN DISTANCE is the length required for the machine to dependably shift from fast speed to slow speed so that the material is moving at a slow speed when the operation occurs. This distance cannot be set to zero.

SHEAR TIME

The SHEAR TIME parameter sets the duration of the shear press cycle.

NOTCH TIME

The NOTCH TIME sets the time duration of the notch press cycle.

PAUSE TIME

The PAUSE TIME is a time delay after a shear press cycle

before the machine proceeds to the next part. It also sets the time that the exit feed rolls are turned on after each shear cycle.

BATCH HALT

The BATCH HALT function allows the operator to select either an automatic return to the HALT mode after each batch is completed or an automatic continuation to the next batch. In either case, the next batch will be started and be partially completed when the last part of the previous batch is cut off. The operator presses 0 or 1 to get a NO or YES state.

BEND ALLOWANCE

The BEND ALLOWANCE is the distance that a section will "grow" when a 90 degree bend is made at a notch. On a U shaped part, if the distance between notches is length W, when the outside sections are bent up to 90 degrees, the inside distance between these two sections will be length W plus 2 times the BEND ALLOWANCE. The proper number of bend allowances are subtracted from the programed length and width when the flat pattern is calculated so that the inside dimension of the frame after bending matches the programed length and width.

MAXIMUM SPACING

The MAXIMUM SPACING dimension is the largest spacing between

holes that the operator will tolerate. The computer will use this value to determine a spacing for each side that does not exceed the MAXIMUM SPACING and is the least number of holes.

CORRECTION FACTOR

The CORRECTION FACTOR is a constant that allows for the calibration of the system so that the programed length is the actual length. Finding the initial value of the CORRECTION FACTOR involves knowing the circumference of the measuring wheel or the drive roll and the counts per revolution of the rotopulser. The formula for calculating the CORRECTION FACTOR is:

CORRECTION FACTOR = .01 inches

$$\frac{\text{[circumference/counts/rev]}}{\text{[circumference/counts/rev]}}$$

Corrections as fine as 0.001% can be made.

MINIMUM LENGTH

The MINIMUM LENGTH parameter allows for a limit to be set for the smallest part that could be run through the machine. This factor may be necessary if short parts can jam the shear die.

START LENGTH

The START LENGTH is used to specify the distance that the line should move before making an initial notch or shear when the line is reset. This is normally set to 1 inch and it assures that all operations are done with the same stopping delays. This small piece of scrap would only occur when the line was reset and not each time that a new job is started.

SLUG LENGTH

The SLUG LENGTH is the length of the slug that the shear may remove from the metal when cycled. This may also include the length of any leading and trailing tab allowance. This length is added to the total length of the part, half to the front edge and half to the rear edge.

DIRECTION

The DIRECTION parameter is used to change the direction of count of the rotopulser. The entry is either a zero or a one. The direction should be set such that as material moves with the FWD output the count should go to a larger number.

FRESH

The FRESH function is used to give the computer a fresh

start and totally erase all of its memory. This would erase all of the setup data and all of the batch data. This function would only be used if there were a problem with the computer that might be due to some erroneous data in memory. Before having the unit serviced, it is worth trying to correct the problem by clearing memory with the FRESH function. This function can only be implemented by entering the value 1984. If entered, all data will be erased and the SETUP mode will be entered.

PROGRAM MODE

The PROGRAM mode is used to enter batch information on the parts that are to be run. A batch is defined as a quantity of a particular part that the operator wishes to produce. There are 50 batches that can be programed at any one time. As batches are completed, new batch data can be entered in the place of completed batches.

The PROGRAM mode is entered by pressing the PRG key and is exited by pressing the END key. The first entry required is the batch number. It is initially set to the first empty batch number after the batch that is currently being run. If you are running batch 1 and batches 2 thru 10 have been programed, then it will begin with batch 11. If this is the batch desired, press ENT. If another batch is desired, then enter that number. The display will then prompt for the TYPE which can be 1, 2, 3, 4, 10, 20, 30, or 40. After entering the TYPE, the display will prompt for the number of pieces required. This can be from 0 to 9999. Entering 0 would be used to delete a batch that was previously entered but not now desired. The display will then prompt for the LENGTH dimension and then the WIDTH dimension in the case of types other than 1 or 10.

The types of parts available are as follows:

| | |
|--------|-------------------------|
| TYPE 1 | 1 section with no holes |
| TYPE 2 | 2 section with no holes |

| | |
|---------|-------------------------|
| TYPE 3 | 3 section with no holes |
| TYPE 4 | 4 section with no holes |
| TYPE 10 | 1 section with holes |
| TYPE 20 | 2 section with holes |
| TYPE 30 | 3 section with holes |
| TYPE 40 | 4 section with holes |

RUN MODE

The RUN mode is used to actually produce the parts that have been programed. The mode is entered by pressing the RUN key and is exited by pressing the HALT key. It is also exited when a batch is completed provided that a BATCH HALT option is specified. If not, then the RUN mode is exited when all programed batches are completed.

There are two conditions that the RUN mode can be entered. The first is the RESET condition which means that the computer will begin processing material from the furthest required press and that the material from that point to the shear will be scrapped. The second condition is the NON-RESET condition which means that the computer will pick up from where it left off last and no scrap will be generated.

If in the RESET condition, the display will prompt for a batch number to be run. If the number is correct, then press RUN a second time. If a different batch is desired, enter the new number and then RUN. If in the NON-RESET condition, no prompt will be given and the line will continue normally.

The RESET condition occurs under the following conditions:

1. From the first time the unit is turned on
2. When any manual cycle of a press occurs
3. When all programed parts have been run

4. When the length counter is greater than the next shear length.

Once set running, batches will be run in numerical order provided that they are programed. The programed batches are searched for in ascending order until batch 50 is reached. Then the search is begun over starting at batch 1.

When the computer starts into the RUN mode, it sets up all of the operations that are required from a point 24 before the notch press to the shear. These operations are placed in the WORK STACK in the computer. The length of the work stack is 200 operations. This should handle all practical applications of this machine. If impractical numbers are entered, such as very long lengths or very short MAXIMUM SPACINGS, it is possible to exceed the 200 operation limit. If this occurs, then an ERROR 9 will result.

SETUP DATA SHEET

| Parameter | PROMPT | VALUE | RANGE |
|----------------------|-----------|-------|-----------------------|
| LENGTH COUNTER | Accu | ----- | 0-999999 (clear only) |
| NOTCH-SHEAR DISTANCE | P1 LEN | ----- | .01-999.99 Inches |
| SLOWDOWN LENGTH | LE SLO | ----- | .01-999.99 Inches |
| SHEAR TIME | SH SEC | ----- | .01-99.99 Seconds |
| NOTCH TIME | P1 SEC | ----- | .01-99.99 Seconds |
| PAUSE TIME | PAUSE | ----- | .01-99.99 Seconds |
| BATCH HALT | ba HALt | ----- | yES or No (0 or 1) |
| BEND ALLOWANCE | bENd | ----- | 0-999.99 Inches |
| MAXIMUM SPACING | SPACE | ----- | 0-999.99 Inches |
| CORRECTION FACTOR | corr | ----- | .20000-5.00000 |
| MINIMUM LENGTH | LEASt | ----- | 0-999.99 Inches |
| START LENGTH | StArT | ----- | .01-999.99 Inches |
| SLUG LENGTH | LE SLU | ----- | 0-999.99 Inches |
| DIRECTION | dirEction | ----- | 0 or 1 (toggle) |
| FRESH START | FRESH | | 1984 only |

Table 1. Setup Mode Data Sheet

ERROR MODE

The MP54 computer can detect certain operational errors and it displays a message that shows "Error N" where N is the error number. The MP54 will only respond to the CLR key in this mode. The description of each error is as follows:

| | |
|---------|--|
| Error 0 | Number entered is out of range |
| Error 1 | Zero entry is not allowed |
| Error 5 | Direction number not 0 or 1 |
| Error 6 | Illegal type number |
| Error 9 | More than 200 operations in the work stack |

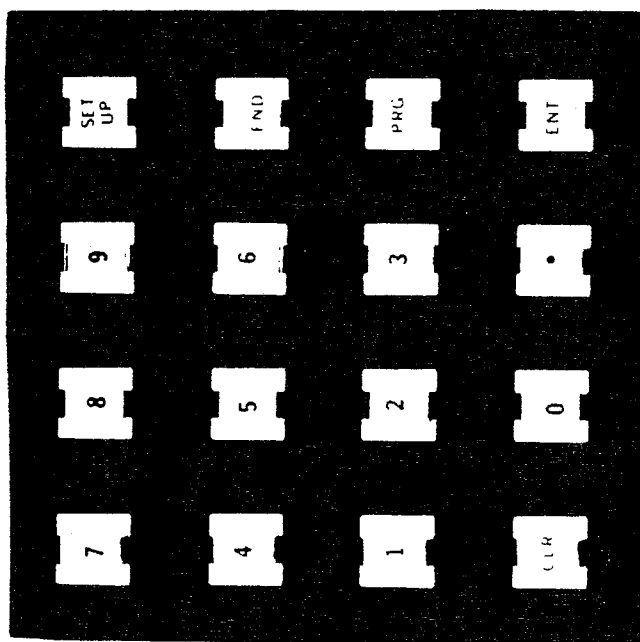
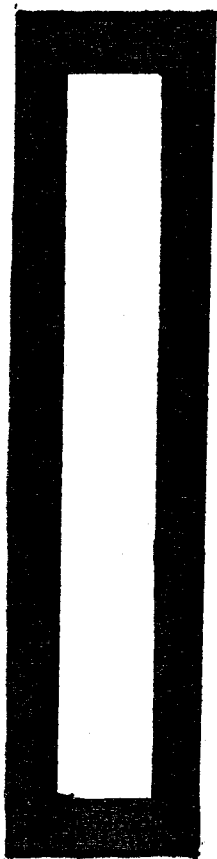
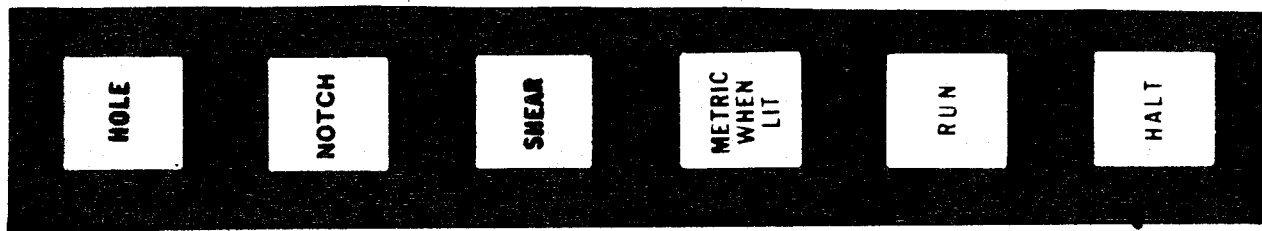
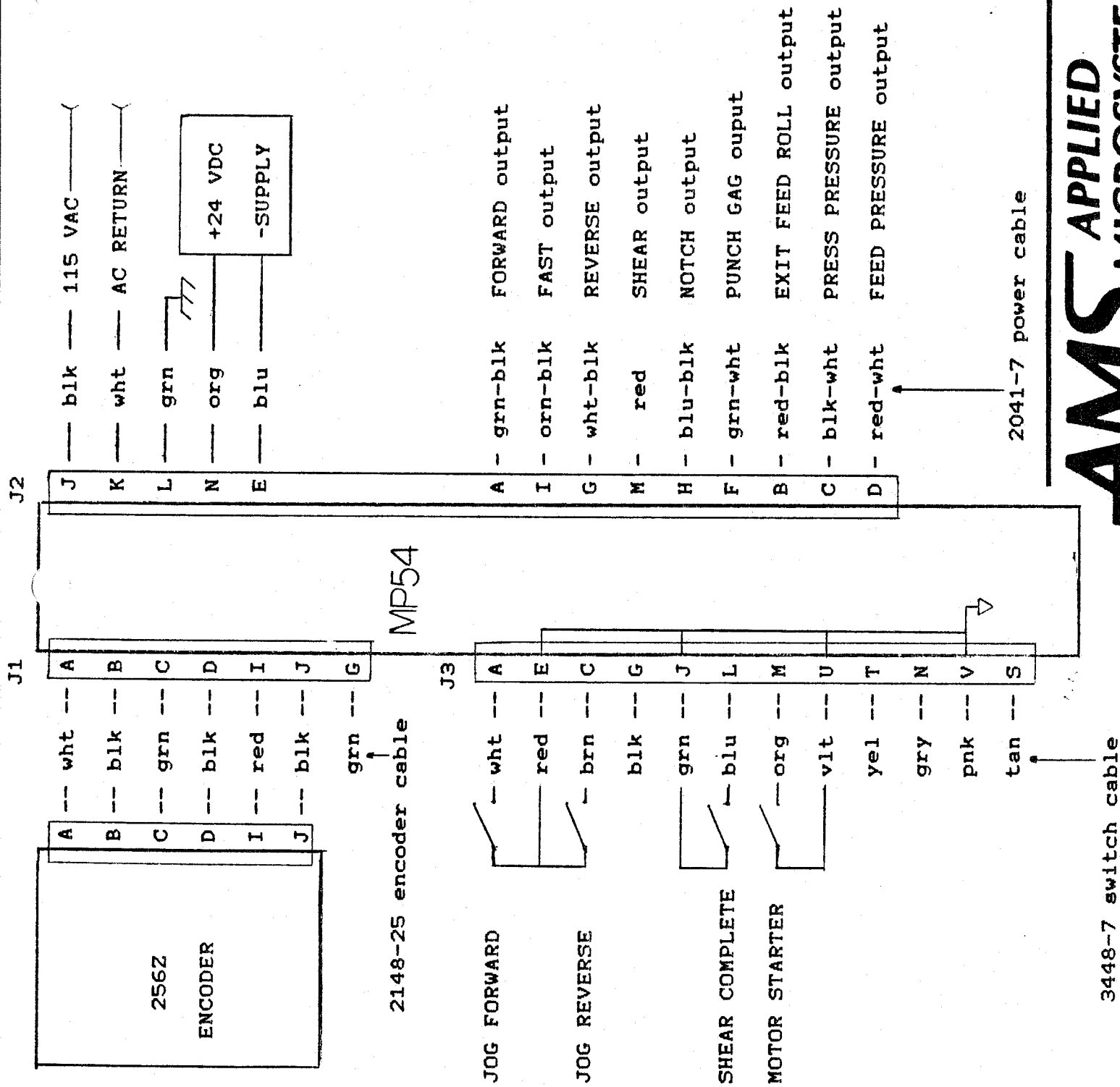


FIGURE 1. MP54 FRONT PANEL LAYOUT



AMS APPLIED MICROSYSTEMS