

INTRODUCTION

The Model MP237 Controller is a special purpose computer designed to control a sheet metal processing machine. The machine converts coiled stock material into cut parts with a variety of notch and hole patterns.

The MP237 has been designed to work with a machine that makes heating, air conditioning, and ventilation (HVAC) duct parts. The MP237 is simple to program; the operator has only to enter the finished length and width. The computer then calculates the required notch pattern based on this information and some internal dimensional constants and the part is ready for production. The MP237 also allows up to 20 programmable hole locations per part.

A simple diagram of the machine is shown in figure 1. The rotopulser, or rotary pulse generator, transmits a pulse to the computer for each linear movement of the material. The computer keeps track of these pulses and then controls the driving rolls and the press solenoids in order to fabricate the patterns that were programmed.

This manual consists of 6 more sections that explain its operation and use. The following is a list of the sections as they appear in this manual:

1. SPECIFICATION
2. HARDWARE DESCRIPTION
3. INPUT/OUTPUT DATA
4. MODES OF OPERATION
 - A. SETUP MODE
 - B. PROGRAM MODE
 - C. ERROR MODES
5. ENTERING A NUMBER
6. CALIBRATION

If the operator is unfamiliar with entering data into the unit, they should proceed to the ENTERING A NUMBER section for more details.

SPECIFICATION

Resolution	.012 inches with a 12 in. wheel
Accuracy	Output turned on within 1 count (does not include machine errors)
Maximum Line Speed	200 FPM
Maximum Length Part	9999.99 inches
Maximum Batch Quantity	9999
Number of Batches	50
Pattern Types	5 (0-4)
Input Power	115VAC +/- 10%, 60 HZ, 1 Amp max 5-24VDC, 1 Amp (excluding loads)
Outputs	7 (FWD, SLOW, REV., SHEAR, P1, P2, P3)
Speed Logic	Non-stop Fwd-Slow Fwd-Fast Fast-Slow
Length Totalizer	999999 FT or Meters
Physical size	6 in. X 9 in. X 10 in. Front panel with 1 in. flange
Weight	13 pounds

HARDWARE DESCRIPTION

Figure 2 shows the layout of the front panel and keys. There is a 16 key keypad, 6 illuminated pushbutton switches, and a 12 digit display. The function of each switch and key is as follows:

MANUAL END NOTCH

The MANUAL END NOTCH key is used to manually cycle the END NOTCH output when the line is in the HALT mode. The lamp indicates when the END NOTCH output is on in both the HALT and RUN modes. For an explanation of different operating modes, see the a MODES OF OPERATION section of this manual.

MANUAL VEE NOTCH

The MANUAL VEE NOTCH key is used to manually cycle the VEE NOTCH output when the line is in the HALT mode. The lamp indicates when the VEE NOTCH output is on in the HALT and RUN modes.

MANUAL SHEAR

The MANUAL 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 means that all parts in progress will be terminated and the controller will re-calculate all the programmed parts. This should be done to put into effect any setup parameters that were changed while the MP237 was running.

METRIC WHEN LIT

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

inches(feet in the accumulator).

RUN

The RUN key is used to initiate 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. The SETUP mode is used to enter semi-permanent data about the machine, such as die spacing, cycle duration, die size, flow direction, etc. This mode is also used to view the accumulator which contains the total number of feet(or meters) run.

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 to enter batch data on the parts to be run.

ENT

The ENT key is the data ENTER key and it is used by the operator to indicate to the computer to take the data that is present in the display window. Refer to the ENTERING A NUMBER section of this manual for more information.

CLR

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

The display on the front panel is a 12 character 7-segment display that is used to show data and prompt the operator for information.

Material movement is sensed by the MP237 through the rotopulser, which is an incremental optical shaft angle encoder. This device generates a precise number of pulses for each revolution of its shaft. On the shaft is a precision measuring wheel which rides on the material. As the material moves through the machine, it turns this wheel and thus causes the rotopulser to generate pulses. The computer counts these pulses and by knowing the counts per revolution of the rotopulser and the circumference of the wheel, the computer can detect the amount of material that has moved through the machine.

The heart of the MP237 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 parameters and batch data is contained in random-access-memory (RAM) that normally would not retain the information when power is off, except that there is a battery in the unit that provides power to the RAMs at all times. This battery should last for about 5 years. Should the unit fail to retain memory on a consistent basis, the battery should be replaced.

INPUT/OUTPUT DATA

There are 7 outputs and 8 inputs to the MP237. The outputs are 5 ampere open collector transistors that switch load current to the DC ground. The function of each input and output is as follows:

OUTPUTS

FORWARD

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

SLOW

Depending on the speed logic selected, this output is used to turn the machine drive rolls at a slower rate of speed. See the SETUP section of this manual for more information.

REVERSE

This output is used to turn the machine drive rolls in a reverse direction.

SHEAR

The SHEAR output is used to cycle the shear or cutoff press.

END NOTCH

The END NOTCH output is used to cycle the end notch press.

VEE NOTCH

The VEE NOTCH output is used to cycle the vee notch press.

HOLE PUNCH

The HOLE PUNCH output is used to cycle the hole punch press.

INPUTS

JOG FORWARD

The JOG FORWARD input allows the operator to jog the metal in the

forward direction. This input is only looked at in the HALT mode and no jogging is allowed while the controller is running.

JOG REVERSE

The JOG REVERSE input allows the operator to jog the metal in the reverse direction. This input is only recognized in the HALT mode.

MOTOR STARTER

The MOTOR STARTER input is used by the MP237 to insure that the systems drive motor has been engaged before performing any operation. This input must be closed for the MP237 to begin a batch and must remain closed throughout the run. If the MOTOR STARTER input opens during a run, the MP237 will enter the HALT mode and cannot be run again until the input is closed.

SHEAR COMPLETE

The SHEAR COMPLETE input is used to indicate that a shear press cycle has been completed. This input is not needed if the shear press cycle is to be timed by the use of the SHR SEC. parameter in the SETUP mode of the MP237. The MP237 will hold the SHEAR output on until it detects a SHEAR COMPLETE or the SHR SEC. time elapses.

END COMPLETE

The END COMPLETE indicates that a end notch press cycle has been completed. The MP237 will activate the END NOTCH output until it detects a END COMPLETE or the P1 SEC. parameter time has elapsed.

VEE COMPLETE

The VEE COMPLETE input indicates that a vee notch press cycle has been completed. The MP237 will activate the VEE NOTCH output until it detects a VEE COMPLETE or the P2 SEC. parameter time has elapsed.

HOLE COMPLETE

The HOLE COMPLETE input indicates that a hole punch press cycle has been completed. The MP237 will activate the HOLE output until it detects a HOLE COMPLETE or the P3 SEC. parameter time has elapsed.

MANUAL HOLE

The MANUAL HOLE input is used to cycle the HOLE output.

MODES OF OPERATION

There are five modes of operation in the MP237: SETUP, PROGRAM, RUN, HALT, and ERROR. It is possible to be in two modes at the same time. It should be clearer to explain the two types of modes that one could encounter. One type can be called the display mode and the other can be called the machine mode. The display modes are SETUP, PROGRAM, RUN, and HALT. This refers to what the computer is showing on the display and what keys it will respond to. The machine modes are RUN and HALT, and they refer to what the machine is doing. The ERROR mode can be entered from any type of mode depending on what the error is. By making this distinction between the two types of modes, an operator can put the machine in the RUN mode and then put the display in the PROGRAM mode and thus program new data while older batches are being run.

SETUP MODE

The SETUP mode is used to enter machine parameters and some seldom changed part parameters. This 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 a table of these parameters with the prompts used, range of allowed values, and a place to write the proper 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 he cannot set it to a number.

COUNTS PER REVOLUTION

The COUNTS PER REVOLUTION parameter is the number of counts per revolution that are contained in the rotopulser being used with the unit. This information is used by the controller to calculate linear movement.

DISTANCE PER REVOLUTION

The DISTANCE PER REVOLUTION parameter is the distance that the wheel which is attached to the rotopulser travels in one full revolution. This is equal to the circumference of the wheel and is used with the counts per revolution to calculate linear movement.

CORRECTION FACTOR

The CORRECTION FACTOR parameter is used to make minute corrections in the system after the counts 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 of the unit. If the counts per revolution and the distance per revolution are correct, and the machine produces no length error, then a CORRECTION FACTOR of 1.00000 would be used. See the LENGTH CALIBRATION section of this manual for the proper way to calculate your CORRECTION FACTOR.

DIRECTION OF TRAVEL

The DIRECTION OF TRAVEL parameter allows the operator to change the counting direction by selecting either a 0 or a 1. The rotopulser 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. This parameter allows for an easy direction change to achieve the desired material flow.

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 slow speed when a press operation occurs. This parameter has no function when non-stop speed logic is selected.

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. The MP237 will scrap this length each time the line is started from a reset condition, it will not produce any scrap between each batch under normal running conditions.

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.

END NOTCH TO SHEAR DISTANCE

The END NOTCH TO SHEAR DISTANCE is the distance from the center of the end notch die to the center of the shear die. This is usually determined by loading the machine up with material and manually cycling the shear and end notch presses without moving the material. The material is then removed from the machine and the distance from the shear cut to the end notch pattern is measured. If the shear removes a slug of material then half of this slug width must be added to this measurement since the distance specified is from die center to die center.

VEE NOTCH TO SHEAR DISTANCE

The VEE NOTCH TO SHEAR DISTANCE is the distance from the center of the vee notch die to the center of the shear die. The method to determine this distance is the same as with the end notch distance described above.

HOLE PUNCH TO SHEAR DISTANCE

The HOLE PUNCH TO SHEAR DISTANCE is the distance from the center of the hole punch die to the center of the shear die. To determine this distance, use the method described with the end notch to shear distance parameter.

SLUG LENGTH

The SLUG LENGTH parameter is the width of the slug that the shear may remove when it is cycled. This is automatically added to each part run with half being added to the front edge and half added to the rear edge.

SHEAR TIME

The SHEAR TIME parameter sets the time duration of the shear press cycle. The shear output will stay on for this length of time unless a SHEAR COMPLETE is detected.

SHEAR PAUSE

The SHEAR PAUSE parameter is a time delay after the shear press cycle that will allow time for special handling of parts as they exit the machine.

END NOTCH TIME

The END NOTCH TIME parameter sets the time duration of the end notch press cycle. The end notch output will remain on until the time has elapsed or a END NOTCH COMPLETE is detected.

VEE NOTCH TIME

The VEE NOTCH TIME parameter sets the time duration of the vee notch press cycle. The vee notch output will remain on until the

time has elapsed or a VEE NOTCH COMPLETE is detected.

HOLE PUNCH TIME

The HOLE PUNCH TIME parameter sets the time duration of the hole punch press cycle. The hole output will remain on until the time has elapsed or a HOLE COMPLETE is detected.

LEADING EDGE SCRAP LENGTH

The LEADING EDGE SCRAP LENGTH is the distance required on the leading edge of a part to allow for an orderly transition from a shear only part to an end notched part. Since a shear only part does not put a pattern on either the trailing edge of one part or the leading edge of the next part, when the last shear only part was completed, there would not be a pattern on the leading edge of the next part. If that part were to be an end notched part, this parameter will force an automatic double shear so that a piece of scrap will be produced and the first part of the end notch batch will have a notch pattern.

TRAILING EDGE SCRAP LENGTH

The TRAILING EDGE SCRAP LENGTH is similar to the LEADING EDGE SCRAP LENGTH described above except that it applies to the scrap required at the transition from a end notched part to a shear only part.

LEADING EDGE OFFSET

The LEADING EDGE OFFSET is a distance that is automatically added to the front edge of a part, independent of the part data programed. This distance produces the leading edge lock allowance of the part.

TRAILING EDGE OFFSET

The TRAILING EDGE OFFSET is a distance that is automatically added to the trailing edge of a part, independent of the part data programed. This distance produces the trailing edge lock

allowance of the part.

OUTPUT SPEED LOGIC

The OUTPUT SPEED LOGIC parameter is used to select the type of line that the MP237 will be controlling. By striking any numbered key, the following four choices will be displayed.

NON-STOP

FAST-SLOW

FORWARD-SLOW

FORWARD-FAST

With the correct type of logic displayed, press the enter key to complete the entry. A description of each type is below.

NON-STOP

A NON-STOP line runs continuously in fast and does not slow for any operation. The FORWARD comes on at the start of the run and stays on until the batch is completed or halted. A START LENGTH should be used with this line to allow the line to reach a normal operating speed before any operations occur.

FAST-SLOW

A FAST-SLOW line runs in fast (FORWARD output on) until a slowdown point (an operation point minus the SLOWDOWN LENGTH) is reached. At that point the FORWARD goes off and the SLOW comes on. The SLOW remains on until the operation occurs, then it is turned off as the operation occurs. After the operation is completed the FORWARD output is turned on and the cycle is repeated.

FORWARD-SLOW

A FORWARD-SLOW line runs in fast forward when the FORWARD output is on and slow when the FORWARD and SLOW outputs are on. When a batch is run, the MP237 will turn on the FORWARD output and run in fast until a slowdown point is reached. At that point the SLOW output is also turned on. As the operation occurs both outputs go off and the line is then started with the FORWARD output.

FORWARD-FAST

A FORWARD-FAST line is similar to a FORWARD-SLOW line except when the machine is running in slow, the FORWARD is on; when running in fast the FORWARD and FAST outputs are on. The SLOW output serves as the FAST output when this type of logic is selected.

BATCH HALT

The BATCH HALT function allows the operator to select either an automatic return to the HALT mode after each batch is run or a continuing run of the next batch. In either case the next batch may have been started by the machine with partial patterns being produced but no complete parts will be made if the BATCH HALT is set to YES. This may be required in some installations to allow for packing of the previous batch or for a required change of some downstream machinery because of a dimensional change in the parts being run.

MEMORY RESET OPTION

The MEMORY RESET OPTION, or FRESH, allows the operator to clear all setup and batch parameters by entering the code '1984'. If this code is entered, all batch and setup parameters will have to be re-entered before operation can resume.

SETUP DATA SHEET

<u>PARAMETER</u>	<u>PROMPT</u>	<u>RANGE</u>
LENGTH TOTALIZER	Accu _____	0-999999 (CLEAR ONLY)
COUNTS PER REV.	Counts _____	100-1000
DISTANCE PER REV.	dist. _____	2.5-20 IN
CORRECTION FACTOR	Corr. _____	.9-1.10000
DIRECTION	Direction _____	0 or 1
SLOWDOWN LENGTH	Slo. LE. _____	0-999.99 IN
START LENGTH	Start _____	0-999.99 IN
MINIMUM LENGTH	Least _____	0-999.99 IN
END NOTCH-SHEAR DIST.	P1 LE. _____	0-999.99 IN
VEE NOTCH-SHEAR DIST.	P2 LE. _____	0-999.99 IN
HOLE PUNCH-SHEAR DIST.	P3 LE. _____	0-999.99 IN
SLUG LENGTH	SLU. LE. _____	0-999.99 IN
SHEAR TIME	Shr. SEC. _____	0-99.99 SEC
SHEAR PAUSE	Shr. PAU. _____	0-99.99 SEC
END NOTCH TIME	P1 SEC. _____	0-99.99 SEC
VEE NOTCH TIME	P2 SEC. _____	0-99.99 SEC
HOLE PUNCH TIME	P3 SEC. _____	0-99.99 SEC
LEADING EDGE SCRAP	L. Scr. _____	0-999.99 IN
TRAILING EDGE SCRAP	t. Scr. _____	0-999.99 IN
LEADING EDGE OFFSET	L. OFF. _____	0-999.99 IN
TRAILING EDGE OFFSET	t. OFF. _____	0-999.99 IN
OUTPUT SPEED LOGIC	For-SLO _____	
	For-FSt _____	
	FAST-SLO _____	
	non-STOP _____	(SELECT ONE)
BATCH HALT	HALT _____	YES/NO
MEMORY RESET	FrESH _____	

Table 1.

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 by the machine. There are 50 batches that can be programmed 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 through 10 have been programmed, then it will begin with batch 11. If this is the batch desired, then press the ENT key. If another batch is desired, enter that number. The display will then prompt for the number of pieces required. This can be from 0 to 9999. Entering a 0 will delete that batch. After entering the pieces, the display will prompt for the type, which must be a number between 0 and 4 inclusive. The display will then go through a sequence of prompts, asking for the data required for each particular type.

TYPE 0

A TYPE 0 part is a shear only part. The operator will be prompted with Len. A., which is the total length. The operator will then be prompted for the location of any holes, with up to 20 possible holes per part. To terminate hole location entry, enter a 0 and the next batch will then be ready for programming.

TYPE 1

A TYPE 1 part has end notches but no vee notches. This type part would be used where four pieces would be used to make one cross section of duct. The operator will be prompted for the overall length (LEN. A.) and the location for any holes.

TYPE 2

A TYPE 2 part has end notches and one vee notch and thus forms an L-shaped part when bent. The operator will be prompted with LEN. A., LEN. b., and the location of any holes. LEN. A. is the distance from the leading edge of the metal to first vee notch. LEN. b. is the distance from the first vee to the end of the part. These parameters form the finished width and length of the duct for part types 2 through 4.

TYPE 3

A TYPE 3 part has end notches and 2 vee notches and forms a U-shaped part when bent. The operator will be prompted with LEN. A., LEN. b., and the location of any holes.

TYPE 4

A TYPE 4 part has end notches and 3 vee notches and forms a box-shaped duct when bent. The operator will be prompted with LEN. A., LEN. b., and the location of any holes.

Length A and Length B are the only parameters required for duct production. These values represent the finished width and length; all slug widths, leading and trailing edge allowances and scraps, and notch locations are calculated by the MP237 controller. Figure 3 at the back of this manual shows the pattern type for these types.

ERROR MODE

The MP237 computer can detect certain operational errors and it displays a message that shows 'Error N' where N is the error number. The MP237 will only respond to the CLR key in order to clear the error message. The description of each error type is as follows:

- | | |
|---------|--|
| Error 1 | The number entered is out of range of the CYCLES PER REVOLUTION parameter. |
| Error 2 | The number entered is out of range of the DISTANCE PER REVOLUTION parameter. |
| Error 3 | The number entered is out of range of the CORRECTION FACTOR parameter. |
| Error 4 | The number entered is not a legal batch number. |
| Error 5 | The number entered is not a legal part number. |
| Error 6 | Zero entry is not allowed. |
| Error 7 | No batches are programmed that can be run by the MP237. |
| Error 8 | There is a finite amount of memory in the MP237 controller, so there are some restraints on the number of operations allowed in a specific distance. The MP237 allows up to 200 operations in the work stack before it |

7/15/77 CONTROLLER MANUAL
displays this error. This error is seldom
seen in normal operation.

12 CHARACTER DISPLAY

7	8	9	setup
4	5	6	end
1	2	3	prg
clr	0	.	ent

MANUAL END NOTCH
MANUAL VEE NOTCH
MANUAL SHEAR
METRIC WHEN LIT
RUN
HALT

FIGURE 2

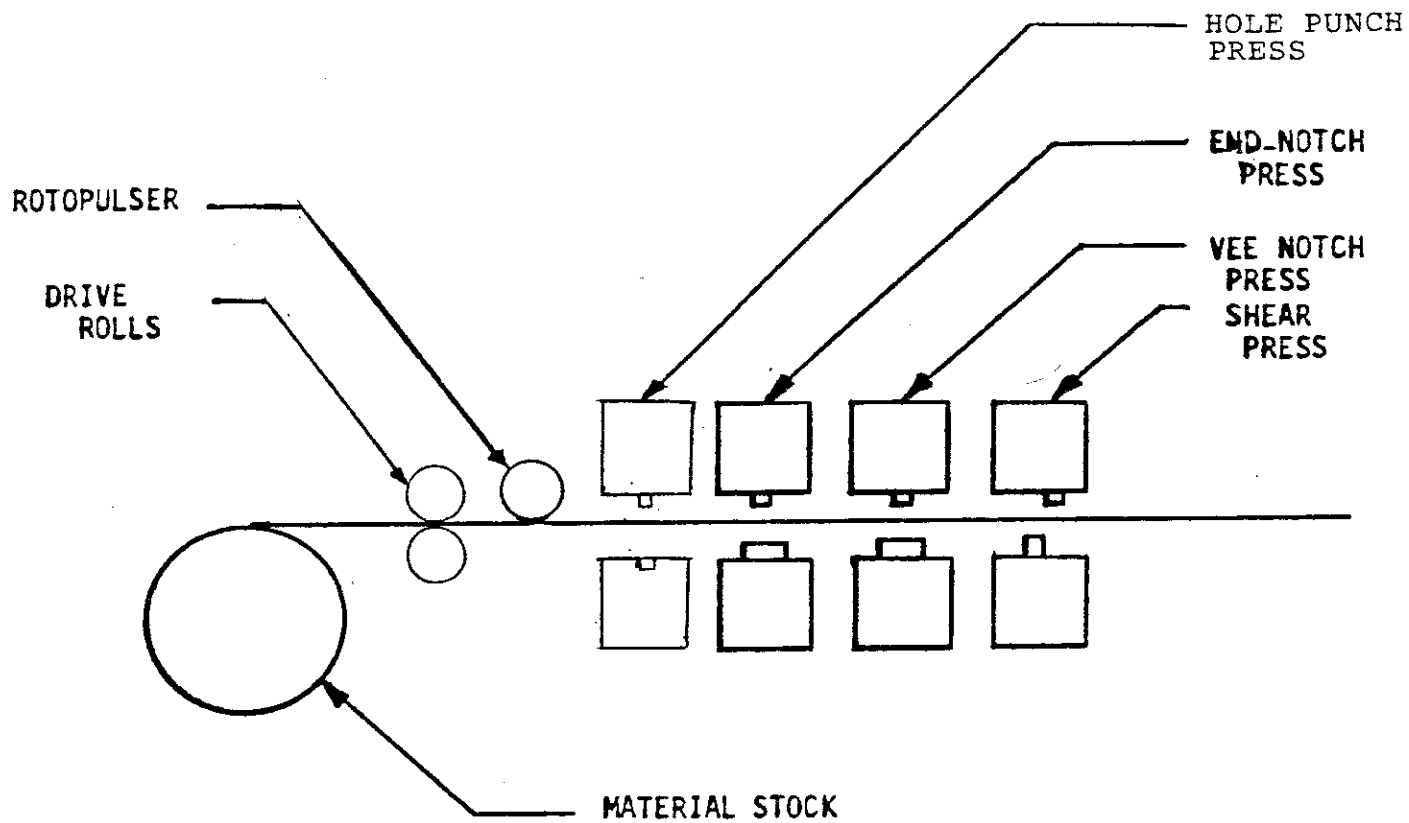


FIGURE 1.

MACHINE CONFIGURATION

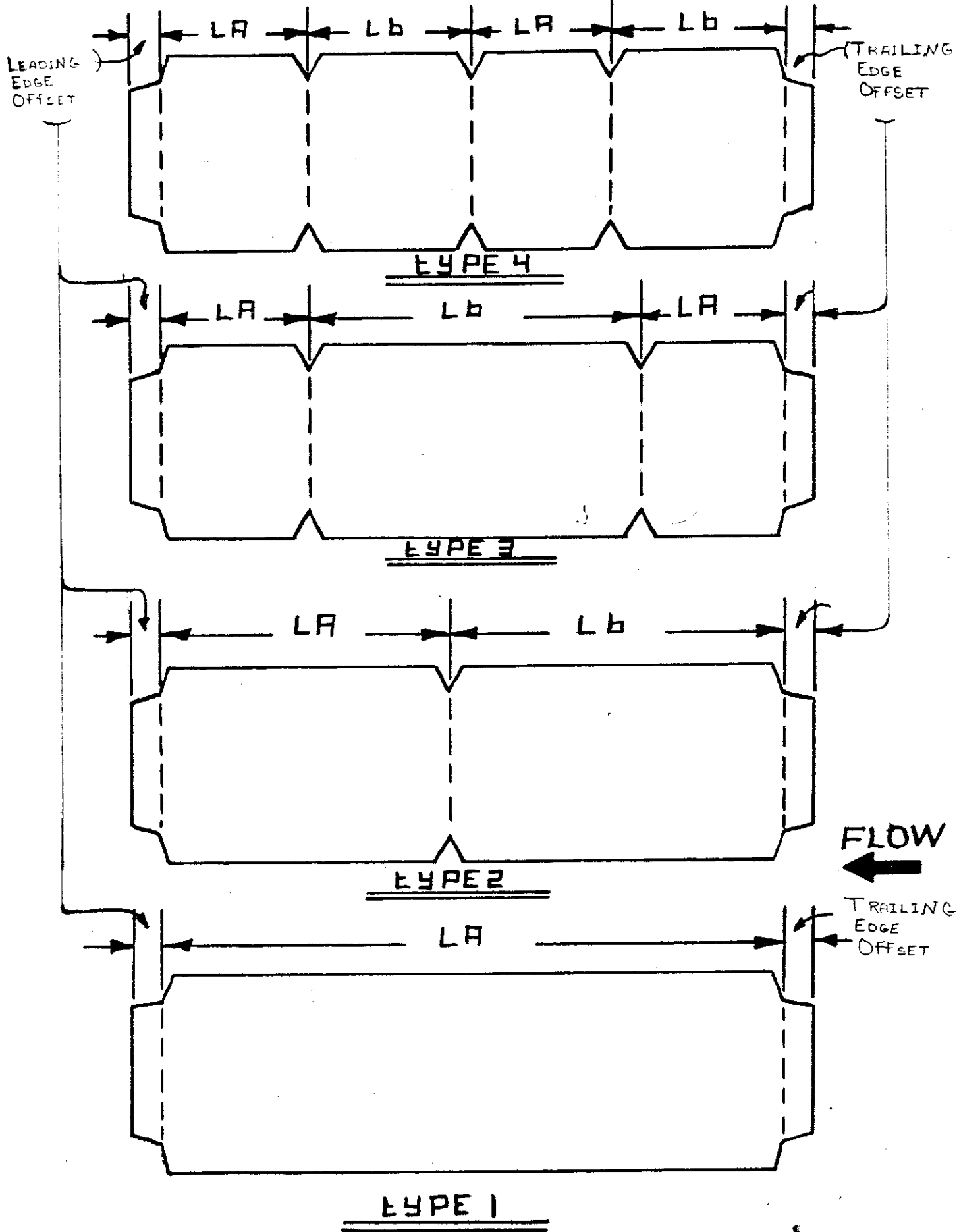
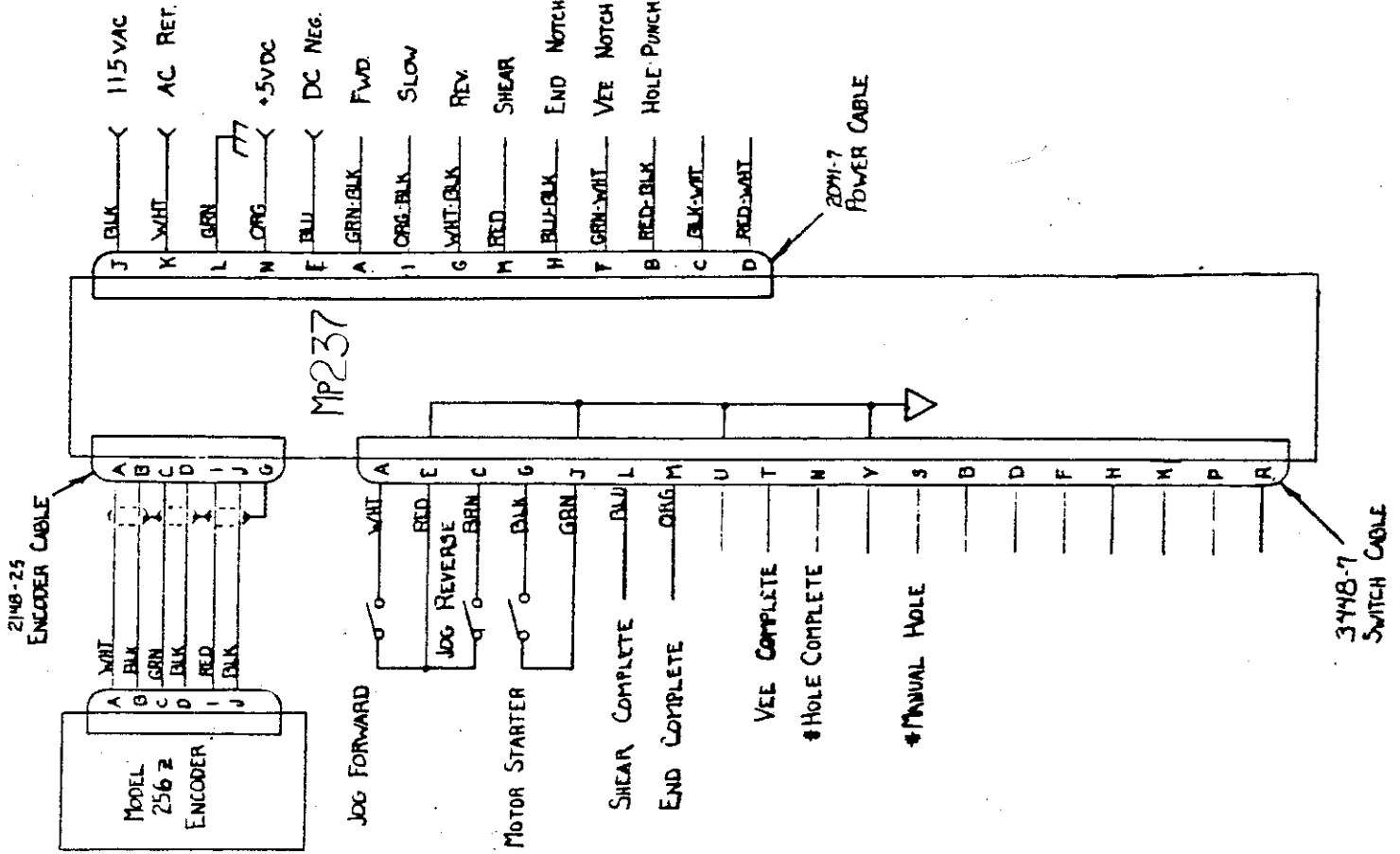


FIGURE 3. TYPES 1-4

324 DELETE NOTES
 1-7-95
 1-13-95



NOTES:
 * OPTIONAL INPUT, NOT WIRED IN
 * WIRING HARNESS PROVIDED.

STD. CONTACT

REVISED	DATE	BY
1	3/17/95	---
2	---	---
3	---	---

APPLIED MICROSYSTEMS INC
 MACHINE INTERFACE 237