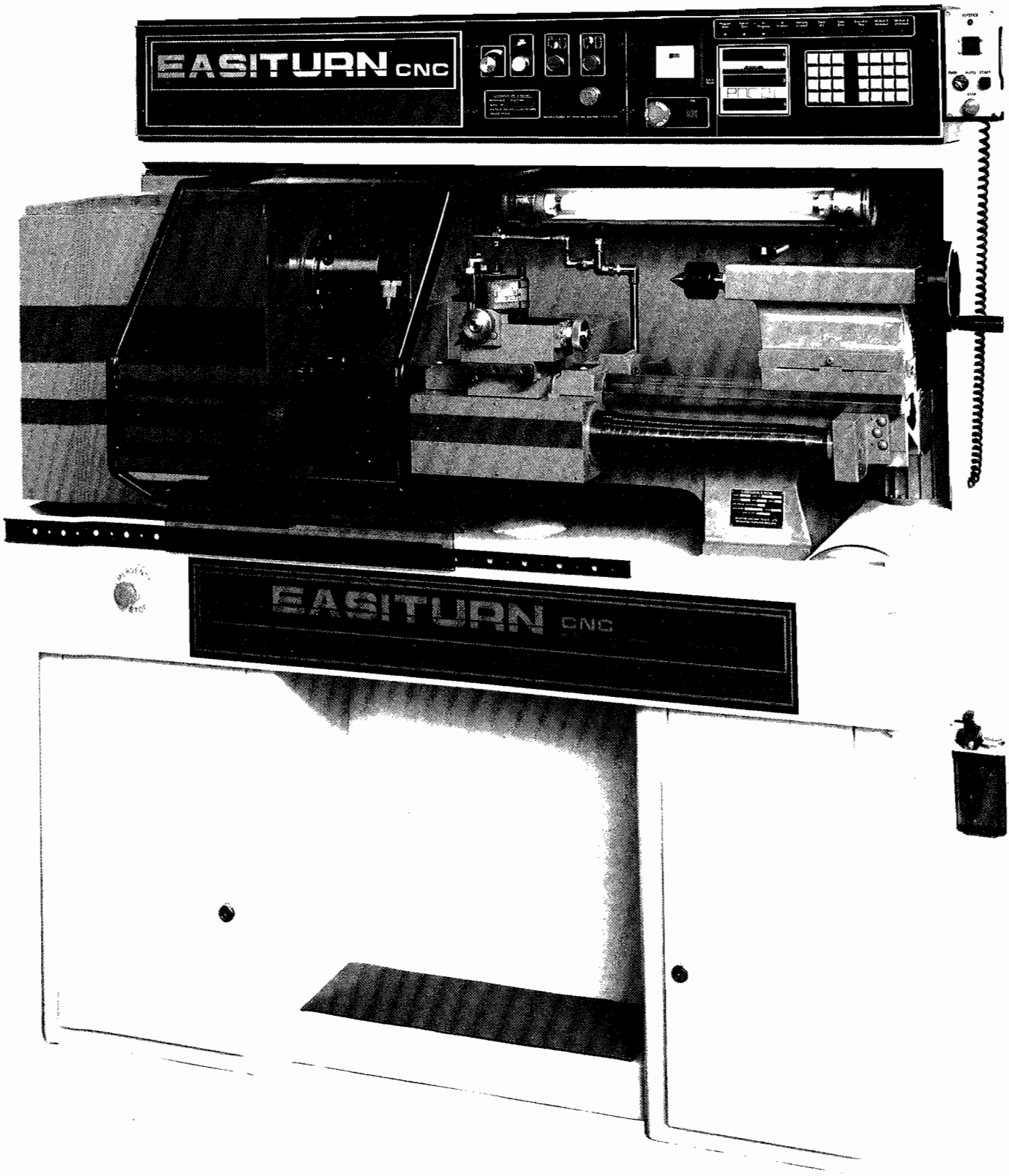

EASITURN CNC
EASITURN CNC

EASITURN CNC PRODUCTION LATHE

General Specifications

Mechanical

Swing over Bed ..... 280 mm (11")
Swing over Saddle Wings .... 240 mm (9½")
Swing over Cross slide .... 170 mm (6¾")
Spindle Bar Capacity ..... 35 mm (1⅜")
Distance Between Centres ... 500 mm (19⅝")
Spindle Nose (Camlock) D1/3
Spindle Taper (Morse) ..... No. 4
Spindle Speeds Stepless 0-2000 r.p.m.
Stepless 0-3000 r.p.m.
Stepless 0-4000 r.p.m.
Tailstock Taper Morse ..... No. 3
Leadscrew/Cross slide Screws . Ballscrews
Screwcutting Pitches ..... 4-40 TPI
Rapid Traverse ..... 1500mm/min.
Tapers 1000:1/1:1000
Feedrates .....Infinitely Variable
Circular Interpolation Radii. 0.25mm/10 cm
Base Height to Centreline ..... 1195 mm
Weight ..... 350 Kilos

Control System

Display Method .. Three 7 Digit Display
Mini Cassette Deck .. Magnetic Tapes
Motor Drives X-Z .... Stepper
Programmable Feed ... 0.005% to 100%
Keyboard ..... 28 Character
Tool Offsets ..... Up to 16 pairs
Program Length ..... 400 Blocks
(1000 Block Availabl
Control System ... North East Electroni
P.N.C. 2C Control Syste
Auxiliary Outputs ..... 8 Outputs
Programmable Inputs.. 8 Programmable
Sequence Holds
Pattern Repeats 99 Times to 4 lev
Tool Wear Compensation .. Programmable
Computer Data Link ..... RS 232C
Joystick ..... Axes Control
Speed Changes ..... Programmable
Format ..... Incremental/Absolute
Metric/Imperial

STANDARD EQUIPMENT

5" 3-Jaw Chuck, Faceplate/Catchplate, Safety Guards, Flood Coolant, Multifix Quick-Change Toolpost & One Toolholder, Centres, Toolkit, Operation and Instruction Manual

EXTRA EQUIPMENT

Printer Link, Option for Hard Copy of Program, Spray Mist Coolant, Bar Feed Power Chucking, C5 Collet Attachment Program Printer, Tool Holders, Auto Lub

Electrical

1 Phase Supply ..... 220/250v/50 Hz
110/115v/60 Hz
Motor (4 pole) AC ..... 1.5 kW

Continued -

EASITURN CLASS "C" MACHINES

COMPUTER INPUT WILL ONLY BE ACCEPTED UP TO 3000 R.P.M.

Installation

The Machine should be set on a firm, level base, preferably concrete.

Lifting

See Diagram attached - Page 4. (Use also as guide).

Cleaning

On delivery the machine will have the bright surfaces coated with a protective solution. This must be removed using a kerosene based solvent, before any attempt is made to move the slides or operate the machine.

Jacking pads to fit

Levelling

Thoroughly clean the bed ways and, using a precision machine level at both ends of the bed, level the machine using the screwed jacking pads at the four corners of the machine base.

Electrical Supply Connection

220 V 60 Hz.

The regular electrical mains power supply to the machine is ~~single~~ phase (~~13 amp.~~) ~~220/250v/50 Hz. or 110/1150/60 Hz.~~ ~~The~~ speed converter on the machine gives a three phase output.

3 ph

Connect the mains supply to the isolator box located at the rear left of the machine (~~Brown/Live, Blue/Neutral, and earth Yellow/Green~~). Only a competent Electrical Engineer should commission the machine.

Pictures

for local and key & equal.

Lubrication

Lubrication to the bed ways via the saddle, to the cross-slide and ball screws is supplied by the '~~one shot~~' automatic lubrication system.

Ensure that the reservoir on the system is full.

~~Pull up the plunger daily for lubrication of the above parts.~~

All slideways should be lightly oiled before movement of the saddle and tailstock.

Oil Type - S A E 10.

Continued -

Operation of the Machine

Having carried out the necessary procedure for the installation of the machine, it is now ready for operation.

Switch on the isolator switch located at the L.H. end of the machine.

To start the spindle, press either of the two directional buttons (green) in the centre of the main operating panel.

First run should be at a slow speed to ensure lubrication and freedom of the moving parts.

The spindle speed can be changed by turning the knob next to the 'start' buttons - clockwise to increase the speed & vice versa.

Start spindle with knob at anti-clockwise limit position.

Movement of the saddle and cross-slide is through the control unit via the two stepper motors (programmed) or by the use of the Joystick controller, having first switched over the Manual Control by using the key-switch on the Joystick control unit.

The Joystick control unit is on a flexible cable so that the Operator can hold the unit in his hand whilst positioning the tool to 'touch on' when setting a datum point.

Toolpost

The Machine is fitted with a 'Multifix' Toolpost which facilitates rapid and accurate toolchanges.

Tools can be pre-set on a setting fixture to ensure that tools are set uniformly and also to the same position after tip changes. Although tool-wear compensation can be programmed through the control unit.

Chuck and Faceplate Mountings

Before mounting a chuck or faceplate, first ensure that the spindle taper and the internal taper of the chuck or faceplate is clean and free from dust or protective covering.

The line on the camlock cams in the spindle nose should be in line with the mark on the spindle O/D when the chuck is loaded to the spindle.

Load the chuck and turn the cam (3) with the key provided in a clockwise direction to tighten and lock the chuck to the spindle nose.

It may be necessary on chucks supplied without the camlock studs fitted, to adjust the studs so that the required cam action is obtained. This can best be set by screwing the studs to the bottom of the thread and then releasing one complete turn.

Continued -

Tailstock Adjustment

The tailstock is set for parallel turning. Taper turning is obtained through the control unit.

Should adjustment be necessary to re-align the tailstock, this can be achieved by using the two adjustment screws at either side of the tailstock body.

Cross-slide Adjustment

Should the cross-slide require adjustment due to wear, the adjusting strip can be reset using the three adjusting screws on the R.H. side of the cross-slide.

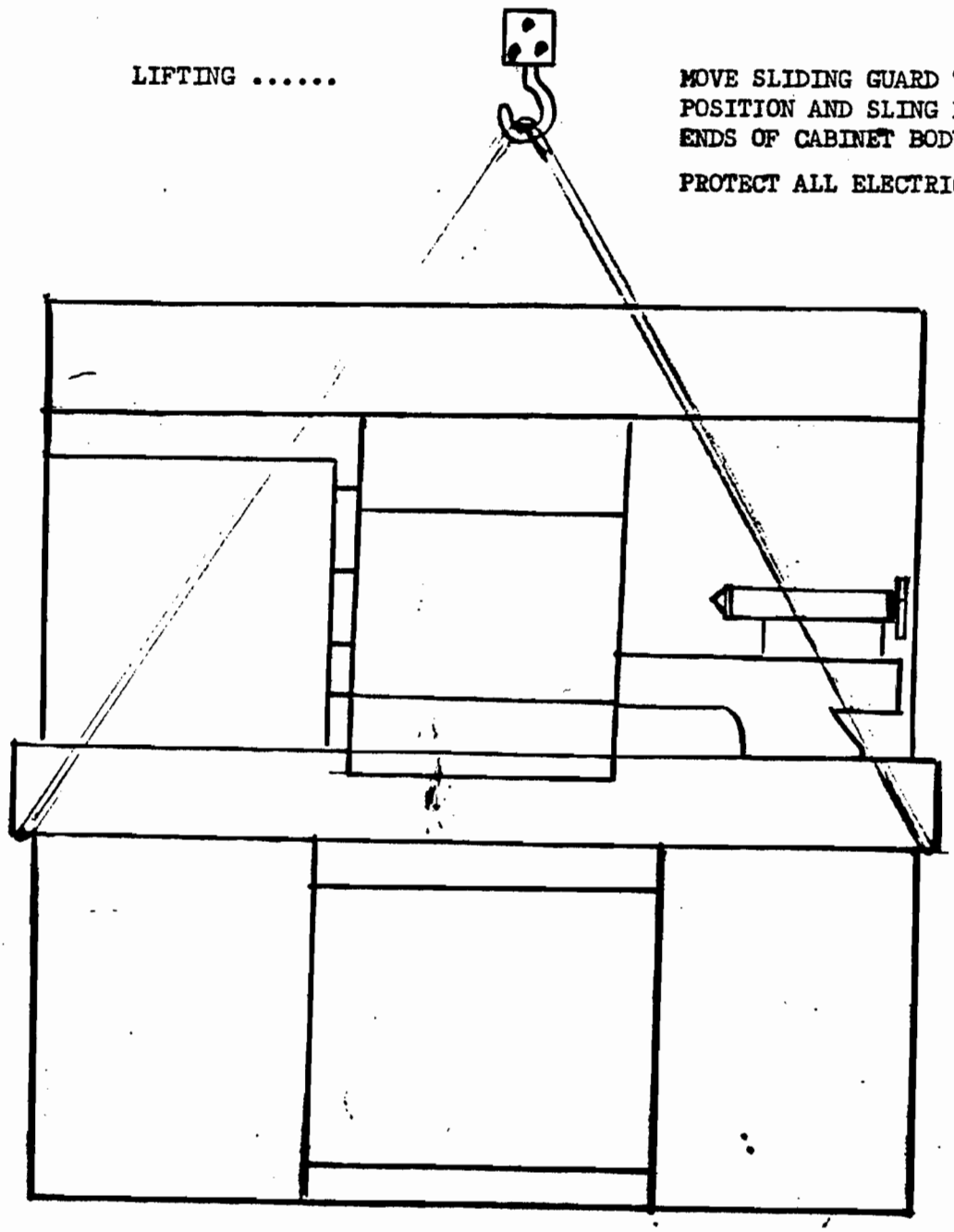
Loosen the three locking nuts and tighten the three Allen screws uniformly to obtain a slight drag when the cross-slide moves. Then re-lock the three lock nuts.

NB. Do not overtighten the three Allen screws.

LIFTING .....

MOVE SLIDING GUARD TO CENTRAL POSITION AND SLING FROM UNDER ENDS OF CABINET BODY.

PROTECT ALL ELECTRICS.



PNC 2C

IMPORTANT

Before applying power to the system ensure that a) the input power is at the correct voltage and b) the drives/machine switches and auxiliary connectors are correctly connected.

The PNC 2C should be properly earthed (grounded) at all tines.

The stepper motor drive boards in the drive unit may sustain severe damage if the motor connections are made or broken with the power still on.

PNC2C's with integral stepping motor drives are equipped with a fan which keeps the drives cool ensuring high reliability. The fan filter must be kept clear, this may be done by using a vacuum cleaner (do not use an air line) to remove the dust etc. The fan filter outer cover may be unclipped.

The digital cassette unit and cassettes may be adversely affected by dust/swarf etc. in consequence care should be taken to keep the cassettes and cassette unit as free from dust as possible. The cassettes should be stored in their cases after first being rewound to the clear leaders.

The display bezel of the PNC2C is made from a special material which is coated with a substance which does not reflect, the display bezel should be cleaned if necessary carefully using a damp cloth, strong degreasing agents and brasso etc. should not be used or the print and coating will be damaged.

Index.

Introduction.

We are pleased to introduce you to this programmable numerical control, which has been designed, developed and manufactured by North East Electronics Ltd.

This low cost, reliable, accurate system is ideal for a wide range of applications which require precise positioning, for example on a variety of machine tools, drilling, milling, engraving, welding and profile burning by laser or conventional methods using rotary and/or x-y tables.

At the heart of this system is a powerful NEE designed computer which gives the PNC 2C the ability to precisely control up to 4 axes of movement with linear and circular interpolation at programmable feedrates. The PNC 2C can also act as a process controller by giving up to 16 programmable auxiliary outputs and monitoring 8 programmable user assigned input signals.

It is North East Electronics policy to continually review and upgrade its products. This PNC 2C is the latest in a line of controllers whose forrunners are working in diverse applications with no small measure of success.

NEE will be pleased to discuss any application not only on existing machines or in production/batch lines or on original equipment but work at the design stage as well.

Description.

The PNC 2C is an extremely versatile continuous path, computer based programmable numerical control unit designed to control via stepper motors a wide variety of machinery where precise control and positioning is required. Related processes and functions can also be controlled by the PNC 2C. The programmaing of stepper motor movements and the process control element is explained fully in this manual. The PNC2C we are confident will be found to be very easy to operate, without the need for the numerous confusing machine codes normally associated with NC equipment.

From the front panel total control is obtained by the following features:

28 - character keyboard for the input of data and commands by an easy to use keyword system.

3 - alpha numeric displays which echo the keyboard entries and during the program execution act as a D.R.O., Digital Readout.

10 - LED, indicators to show machine status.

Integral fast magnetic tape system providing unlimited program storage.

There are various size stepper motor drives which can be supplied, the small size drives can be supplied as in integral feature making the PNC 2C a self contained compact unit. For the larger range of drives an individual housing is required. The PNC 2C is available panel mounted, cabinet mounted or as a free standing unit to suit the customers specific requirements.

North East Electronics provide "tailor made" as well as "standard" control systems by offering a range of optional facilities which will give flexibility over a broad range of applications. The PNC control system is now in use in many different situations ranging from the manufacture of engine components to the manufacture of advanced microchips. The PNC is an ideal system where repeatability of operations are required with accuracy and dependabiltiy.

PNC 2C Operations.

The operations possible on the unit are shown in the operations diagram shown on the pages at the end of this manual. This section of the manual describes in detail the operations that the PNC 2C is capable of, we strongly recommend that the potential user spends some time reading this section in conjunction with the operations diagram to ensure that the maximum use is obtained from the control unit. Many facilities make complex programming easy. Some of the facilities described are options.

General Information.

The PNC 2C has been designed with the user in mind. It is a versatile control system which is very easy to use and does not require a special course to learn how to use it.

The PNC 2C has numerous facilities each of which is selected using a Keyword.
The Keywords identify the facility being used, for example to use the cassette system the Keyword is Cassette and the associated PNC 2C Key which selects the cassette is C. Many of the Keys on the keyboard have multiple functions the precise function of each key being dependant on the operation currently being performed or programmed. A list of Keywords follows:-

Auxiliary	Edit		Serial
Absolute	End of block		Store
All	Erase	Load	Subroutine
Alter	imperiaL		toolSet
Anticlockwise			
	Function		
	xyFeed	Offset	Tool
ADD	zFeed	prinT	
	dFeed		
		Pause	
Cassette			Print
Circle	Input		
Clockwise	Incremental		
Continue	Ignore	Runblock	
Cutter		Repeat	
metriC		Replace	
DELete		Rewind	

The ACCEPT Key is used to Accept data. When keying in information it is Echoed first on display 1, after verification the data should be 'Accepted'.

The 'E' key is used to end each block or line of instructions.

The 'RESET' key is used to reset after an incorrect entry.

The 'O' key stops the machine movement.

NOTE For PNC 2C systems fitted to lathes, in the following examples for Y read Z and for Z read Y.

ZERO facility.

The zero facility is supplied in one of 2 options dependant upon whether the machine to be controlled has fixed datum.

Fixed datum systems.

For machines fitted with a fixed datum the ZERO Key has 2 functions:

a) It establishes a floating datum on one depression
b) It instructs the PNC2C to move the machine to its fixed datum point on 2 consecutive depressions.

At power on fixed datum systems display PNC2C and must be zeroed i.e. sent to machine datum before any other machine movements can be made.

The floating datum facility enables a floating datum to be established at any point within the machine limits of movement, this facility enables program data to effectivley be offset.

Non Fixed datum systems.

For non fixed datum machines the ZERO Key enables the machine datum to be established at any point within the machine movement limits.
NOTE- If a datum is established at any point other than at the most negative point of machine movement preprogrammed table limits will not be effective. Additionally it is not possible to move to a point more negative than 0,0.

X,Y,Z,T and associated FEED input.

X,Y,Z,T coordinate dimensions and associated FEEDs may be input either as a single block of data which is to be executed immediately (Manual Data Input) or as blocks of data which forms part of a programmed sequence (LOAD facility).

When coordinate dimensions are keyed into the PNC2C a check is made to ensure that the maximum machine movements are not exceeded, should any be exceeded 'dAtA Err' is displayed. RESET restores normal operation.

The required FEED is keyed in as a percentage of the maximum preset feed in the range 0.005% to 100%. Three separate and independant feeds are programmed, one for the XY (XZ for lathes) axis, one for the Z (Y for the lathes) axis and one for the T axis. If no feed is programmed the default feed (which is application dependant) is assumed.

CIRCULAR movements.

Circular movements may be made using the XY (XZ for lathes) axes. Circular movements are defined by defining the end point of the movement in both axes, selecting CIRCLE and either Clockwise or Anticlockwise, and specifying the centre point of the circle in both axes. Circular movements are limited to 1 quadrant per block.

When circular movements of less than one quadrant are being made it is not necessary to precisely know the coordinates of the end point of the movement in both axes. The PNC2C can 'find' one of the coordinates. If this facility is to be used it must be arranged that the movement passes through the coordinate point of the unknown axis dimension before reaching the coordinate point of the known axis dimension at which point movement ceases, e.g. if the present position is X=0,Y=0 and we wish to make a circular clockwise movement to X=1 when Y is unknown, centred on X=3,Y=0 the Y end point programmed should be between Y=0.1 and Y=2.236 the true end point.

If incorrect i.e. impossible end points, are programmed the PNC2C will move the table continuously in a circle attempting to find the programmed end point, the movement may be stopped by depressing either the movement STOP switch or the 0 key on the PNC2C Keyboard.

AUXILIARY FUNCTIONS.

Auxiliary functions allow user assigned devices to be controlled i.e. switched on and off by the 16 integral PNC2C auxiliary functions. Three types of auxiliary fuinctions may be supplied. The PNC2C specification sheet indicates which types have been fitted. The three types are:

a) ON/OFF
b) MOMENTARY
c) PULSED

a) ON/OFF auxiliaries are set when programmed immediately before any associated movement in the same block is made. If the auxiliary is programmed ON it will remain ON until programmed OFF. Such auxiliaries could be used to for example control lubricant.

b) MOMENTARY auxiliaries are switched ON if programmed to be on only when the machine is at a programmed position. When the axes are moving momentary auxiliaries are always OFF. This type of auxiliary can be used to for example provide a table locking signal or to activate the main drilling head on a drilling machine.

c) PULSED auxiliaries provide a pulse output of 20 milliseconds if programmed ON each time the machine completes a program block.

The PNC2C is equipped with 12 conventional relay auxiliaries and 4 solid state auxiliaries. The solid state auxiliaries should be used to switch AC signals and are particularly useful for driving inductive loads in that they are zero voltage switching and generate little or no electrical interferance.

INPUT facilities.

The PNC2C is equipped to be able to monitor 8 user assigned input signals from external switches. The condition of the switches may be checked to see if they are open or closed during program execution. If the switches are not in the programmed condition sequence execution waits until the switch signals are as programmed before proceeding. Switch levels may be programmed to be closed (ON), open (OFF) or Ignored (don't care).

The auxiliary outputs and the inputs enable the PNC2C to function not only as a precise positioning control system but also as a sequence controller.

RUN facility.

A program that is in PNC2C memory (indicated by the memory loaded indicator) may be run i.e. executed either from the start of the program i.e. block 1, or from any point i.e. block in the program provided that that block does not define a circular movement. If an attempt is made to run a program from a block defining a circular movement 'NO' will be displayed in display 1, depression of the RESET key restores normal operation.

SERIAL facility

Program data may be Loaded into or Stored from the PNC2C from or to an external VDU or computer via a RS232C 3 wire serial interface.

Three operations are possible using the SERIAL facility they are:

a) SERIAL LOAD
b) SERIAL CONTINUE
c) SERIAL STORE

a) SERIAL LOAD enables a program to be loaded into PNC2C memory from the external device either 1 block at a time or as a full program. Any Program previously contained in PNC2C memory is overwritten i.e. destroyed. The format of the program data is shown below.

b) SERIAL CONTINUE enables additional program to be added to a program that already exists in PNC2C memory via the external device. The format of the program data is shown below.

Upon completion of a SERIAL LOAD or a SERIALCONTINUE the PNC2C displays show the program number, how many blocks there are in memory and how much memory remains, for a period of 3 seconds. PNC2C displays then display normal data.

Should too much data be sent to the PNC2C such that the PNC2C memory becomes full 'FULL' is displayed, normal operation can be restored by using the RESET key, the memory will contain only the data received prior to becoming full.

c) SERIAL STORE enables the contents of PNC2C memory to be transmitted to an external device. The memory contents are transmitted as hexadecimal data formatted as shown below.

PNC2C RS232 Interface Specification

The PNC 2C only needs 3 wires to implement an RS232 link. They are Data Transmit, Data Receive and Signal Ground. The connection to the PNC 2C is via a 7 pin DIN socket using pins 7, 6 and 2 for TxDa, RxDa and Ground respectively.

1. All information on the RS232 link will be in the form of ASCII characters.

2. The PNC2C will recognize the following characters:-

<STX>	02	start of transmission
<ETX>	03	end of transmission
E	45H	
A	41H	
C	43H	
X	58H	
Y	59H	
Z	5AH	
F	46H	
+	2BH	
-	2DH	
.	2EH	
0 to 9	30H to 39H	
L	4CH	
R	52H	
S	53H)	
P	50H)	lathe only
D	44H)	
T	45H)	

3. The PNC2C will use the following ASCII characters when transmitting:-

<ACK>	06	acknowledge
<NAK)	15H	not acknowledge
?	3FH	

4. Any information transmitted to the PNC2C must be preceded by <STX> and terminated by <ETX>.

5. When the PNC2C has processed the data and carried out the instructions contained therein, it will respond with either <ACK> (if everything was okay) or <NAK> if some error occurred.

6. If the PNC2C responds with <ACK> then this also indicates that it is waiting for more data from the interface.

7. If an unrecognised character is received by the PNC2C (see 2, above) then it will cause the PNC2C to transmit á "?" once the <ETX> has been received. In this case the PNC2C will not take any action on the received data but will wait for more data from the interface.

PNC2C RS232 Interface Specification (continued)

8. The PNC 2C will respond with (NAK) if the data received constitutes a move to a postion outsides the table limits.

9. The maximum amount of data transmitted to the PNC2C in one go will be one program block.

10. A program block can contain any or all of the following (to a maximum of 140 characters):-

Data	Meaning
X<d>	Move in X axis to position <d>
Y<d>	Move in Y axis to position <d>
FX<p>	Set XY feedrate to <p>
Z<d>	Move in Z axis to position <d>
FZ<p>	Set Z feedrate to <p>
A<n>+	Turn auxiliary <n>on
A<n>-	Turn auxiliary <n> off

where <n> is a number in range 0 to 15
<d> is a decimal number in range 0 to table limit
<p> is a decimal number in range 0.005 to 100

Leading and trailing zeroes are not necessary when specifying <n> <d> <p>.

11. If the program block contains L as the last character (i.e. the character before the <ETX>) then that program block will not be directly executed but will be loaded into the next available slot in the PNC2C's memory.

12. If the transmitted data consists of <STX> R <ETX> then the PNC2C will execute the current program held in its memory and will not respond with <ACK> until the program has been successfully run. The PNC2C will respond with <NAK> if any error occurs during program execution.

13. If the program block transmitted to the PNC2C does not contain the character L, then that block will be directly executed and the PNC2C will respond with <ACK> on successful completion of the block or <NAK> if any error occurred.

14. If the transmitted data consists of <STX> E <ETX> then the PNC2C will clear out any program currently in its memory.

PNC2C RS232 Interface Specification (continued)

15. Example

Suppose the following data was transmitted to the PNC2C

<STX> X12.94 Y15FX25.7 Z140 FZ100 A4+ <ETX>

This would result in the PNC2C moving from its current position to
X = 12.94
Y = 15.0
Z = 140.0

The XY axis would move at a feedrate of 25.7% and the Z axis would move at a feedrate of 100%. Also Auxiliary output 4 would come on at the appropriate time, and the PNC2C would then respond by transmitting <ACK> to the interface.

16. To specify a circular move the following basic format must be adhered to:-

X<d> Y<d> CCX<XCENTRE> Y<YCENTRE> for Clock Wise Moves

or X<d> Y<d> CAX<XCENTRE> Y<YCENTRE> for Anti C.W. Moves

This basic format can be followed by feedrate specifiers, auxiliary moves, Z axis moves, etc in the normal way.

17. If the PNC2C is controlling a lathe then the following format can be used to specify a screwcutting move.

<STX> S<diameter> P<pitch> D<depth> C<no. of cuts> L<length> Z<start posn> <ETX>

18. If the PNC2C is controlling a lathe then the following format can be used to specify a tool change block.

<STX> T<tool No. 0 to 15> <ETX>

Enhanced RS232 Interface Specification

The enhanced RS232 interface is available as an extra cost option on the standard RS232 interface.

1. Repeat Loops

<STX> R<START BLOCK> E<END BLOCK> N<No. OF TIMES> X<OFFSEST> Y<OFFSET> Z<OFFSET> FX<FEED> FY<FEED> FZ<FEED> L<ETX>

Note: Repeat loops are only valid when loaded into memory. All offsets and feeds are optional. Offsets will default to zero if not defined. The optional feed may be used to specify the feedrates at which the repeated blocks are executed.

2. Subroutines

i) Defining subroutines bodies

<STX> SL<N><ETX> (Subroutine Load <N>)

<N> can be in the range of 1 to 99

After issuing this instruction all further load blocks will form part of subroutine <N>.

The load subroutine sequence is terminated by:-

<STX> SE<ETX> (Subroutine End)

Note: Only X,Y,Z moves with their associated feedrates, inputs and auxiliary on/off commands are allowed within the subroutine body. All X,Y,Z moves within the subroutine are relative to the X,Y,Z position when the subroutine is called.

ii) Calling a Subroutine

<STX> SC<N> L<ETX> (Subroutine Call <N>)

Subroutine calls are only valid when loaded into memory.

iii) Erasing a Subroutine

<STX> ES<N><ETX> (Erase Subroutine <N>)

Note: <STX> ESA<ETX> erases all subroutines.

3. Extra Functions

i) Program Scaling

<STX> F3<SCALE> L<ETX>

<SCALE> can be in the range 0.01% to 650%

Has the effect of scaling all suceeding moves by the given scale factor at run time.

This is only valid when loaded into memory

ii) Machine Scaling

<STX> F4<SCALE><ETX>

<SCALE> can be in the range of 0.01% to 650%

This is an overall scale factor which allows a complete program (which may include progrm scales) to be scaled up or down.

This function cannot be loaded into memory.

iii) Reflect in X

<STX> F5L<ETX>

Defines an axis of reflection at the current X position and causes all subsequent X moves to be relected about this axis at run time.

This is only valid when loaded into memory.

iv) Cancel X Reflect

<STX> F6L<ETX>

Cancels the mirroring function 5.
This is only valid when loaded into memory.

v) Reflect in Y

<STX> F7L<ETX>

Defines an axis of reflection at the current Y position and causes all subsequent Y moves to be reflected about this axis at run time.
This is only valid when loaded into memory.

vi) Cancel Y reflect

<STX> F8L<ETX>

Cancel the mirroring function 7
This is only valid when loaded into memory.

vii) Rotation

<STX> FR<ANGLE> L<ETX> (Rotate clockwise to <ANGLE>)

Defines a point of rotation at the current X,Y, position and causes all subsequent X,Y moves to be rotated clockwise by the given angle at run time. The angle is currently restricted to values of 0, 90, 180, or 270 degrees.

This is only valid when loaded into memory.

4. Offsets

<STX> OX<OFFSET> OY<OFFSET> OZ<OFFSET><ETX>

It is only necessary to specify those offset which are to change e.g.

<STX> OZ 31.9 <ETX>

Offsets have the effect of shifting any program moves by the specified distance. Offsets will not have any effect on moves that have not een loaded to memory.

Offsets cannot be loaded into memory.

DATA FORMAT REQUIRED BY PNC2C. (To be added)

DATA FORMAT TRANSMITTED BY PNC2C. (To be added)

LOAD facility

This facility enables PNC2C memory to be 'loaded' using the PNC2C Keyboard. The task to be accomplished is broken down into a sequence of blocks which are then executed consecutively. A block may consist of a point to which the machine should move which is defined using 1,2,3 or 4 coordinates (dependant upon the PNC2C options fitted), and/or the auxiliary setting required and/or the level(s) of input signals required. (Auxiliary functions and the input facility are described elsewhere). A block may also consist of a REPEAT instruction, or a ZERO instruction, or an OFFSET instruction, or a SUBROUTINE call, or a 'PROGRAM SCALE' instruction.

Each block is executed in stages, inputs are first monitored (if included in the block) and when the inputs are as programmed the ON/OFF and momentary auxiliary functions are set (if included in the block) and then the programmed machine movement takes place in all axes simultaneously. When the machine has arrived at the position programmed momentary and pulse auxiliaries operate. We recommend that the program is tabulated in the following manner (PNC2C programming sheets are available for this purpose).

BLK X Y XYF C XC YC Z ZF AUX INPUT

where:

BLK = Block number of instruction

X = X coordinate value of end point of movement

Y = Y coordinate value of end point of movement

XYF = Value which controls the feedrate of the XY axes as a percentage in the range 0.005 (slowest) to 100 (fastest).

C = used if a circular contour is required. If this Key is used the next key must be either C (to define a clockwise contour) or A (to define an anticlockwise contour). The maximum arc possible in 1 block is 1 quadrant.

XC = X coordinate value of circle centre.

YC = Y coordinate value of circle centre.

Z = Z coordinate value of end point of movement.

ZF = value which controls the feedrate of the Z axis as a percentage.

AUX = Auxiliaries setting required.

INPUT= Input signal levels required.

NOTE: Each item of data should first be identified, defined then ACCEPTed when correct, and each block must be ended with E (End of block).

Some program examples are shown at Appendix A.

Three different LOAD operations are possible:

a) LOAD
b) LOAD CONTINUE
c) LOAD ERASE

a)LOAD is used to enter a new program into PHC2C memory. Any previously loaded program is overwritten i.e. destroyed.

b)LOAD CONTINUE enables an existing program to be continued i.e. extended.

Upon completion of a LOAD or a LOAD CONTINUE the PHC2C displays show how many blocks there are in memory and how much memory remains, for a period of 3 seconds after which the PHC2C displays show normal data.

Should too much program data be keyed into the PHC2C such that the memory becomes full 'FULL' is displayed and no more data can be entered, normal operation can be restored by using the RESET Key.

c) LOAD ERASE clears all program data from memory.

CASSETTE operations

The integral magnetic cassette recorder enables programs to be permanently stored for future use

Six different cassette operations are possible:

a) CASSETTE REWIND
b) CASSETTE ERASE
c) CASSETTE LOAD
d) CASSETTE CONTINUE
e) CASSETTE STORE
f) CASSETTE ALTER (to be fitted later)

When the CASSETTE facility is initially selected a check is made to see if there is a cassette in the unit, if not 'NO CASSETTE' is displayed, depression of RESET restores normal operation. If the cassette tape 'clear leader' is detected when a cassette operation is selected the PHC2C runs the cassette for 5 seconds, if the clear leader is still detected 'CASS Er' is displayed, depression of RESET restores normal operation. If the clear leader has passed the cassette read head the selected cassette operation continues. Some cassette tapes have very long clear leaders and it may be necessary to reselect the cassette operation required thus giving the cassette tape a further 5 seconds to pass the clear leader. If the end of tape clear leader is detected during a cassette operation e.g. during CASSETTE LOAD 'CASS Er' is displayed, depression of RESET restores normal operation. Should it be required to STOP the cassette whilst it is in operation (shown by the 'TAPE ON' indicator on the PHC2C front panel being ON) EJECT/RESET should be depressed, depression of RESET restores normal operation.

a) CASSETTE REWIND enables a cassette to be rewound to the start, i.e. to the clear leader, this operation should be performed prior to recording onto a new cassette and it should be performed before a cassette program is loaded into PHC2C memory. The rewind operation may be stopped by pressing the '0'key.

b) CASSETTE ERASE enables a cassette to be erased i.e. cleared of programs. The cassette should first be rewound using CASSETTE REWIND. When a cassette is erased 'P END' is recorded at the start of the cassette to indicate that this is the end of the cassette. The cassette erase operation takes approximately 3 minutes for a 50 ft long cassette tape. We recommend that both sides of new cassettes are initially erased.

c) CASSETTE LOAD.

Cassette Load enables a program which is on the cassette tape to be loaded from the cassette into PNC2C memory. Two depressions of ACCEPT are required to select the load operation at which time P is displayed. The operator may now look for the first cassette program identifier located, by despressing ACCEPT, or alternatively if the cassette program identifier required is known, this may be keyed in, then ACCEPTed at which time the PNC2C will 'read' the cassette tape program identifiers until the desired one is obtained or until a cassette end 'P End' is found or until the cassette end clear leader is found. During the search for the desired cassette program identifier each identifier detected is displayed for 2 seconds.

When the desired identifier is found the cassette unit is stopped and the identifier is displayed. Depression of ACCEPT causes the cassette program to be loaded into PNC2C memory. Depression of any Key other than ACCEPT or RESET causes the PNC2C to locate the next identifier. Depression of RESET restores normal operation.

When data is loaded from the cassette unit into PNC2C memory a check is made on the validity of the data and if an error was detected during the load process 'dAtA Err' is displayed, and the memory will not be loaded. If ACCEPT is depressed the memory will be loaded with suspect data. If RESET is pressed normal operation is resumed.

Cassette data is validated as follows: when a program or an identifier is stored onto the cassette tape an algorithm is computed the result of which is dependant upon the precise data stored. The numerical result of this algorithm is recorded at the end of the data. When the program or identifier data is subsequently loaded into PNC2C memory the same algorithm is computed and the numerical result is compared with the prerecorded value, if a difference is detected 'dAtA Err' is displayed.

d) CASSETTE CONTINUE.

This facility enables program data contained in PNC2C memory to be continued i.e. extended, by a program previously recorded onto tape. This facility enables programs to be 'merged' to form larger programs.

e) CASSETTE STORE

This facility enables program data contained in PNC2C memory to be stored using the integral cassette recorder, onto cassette tape. The program is stored after a cassette identifier has been keyed in and ACCEPTed. The cassette identifier can be from 0 to 6 numerals. If more than 6 numerals are keyed in the last 6 will form the identifier.

Each program is stored as 3 elements separated by blank tape

i) The cassette program identifier
ii) The program
iii) A cassette end 'P End'.

The cassette end is stored to enable the end of the recorded tape to be found when additional programs are to be stored, as each cassette tape can contain many programs. When a program is stored the cassette tape is initially rewound for a short time and then the 3 elements are recorded, this removes any previously recorded cassette end.

f) CASSETTE ALTER (option)

Cassette Alter enables a program which is on the cassette tape to be altered. The procedure is to initially load the required program into PNC2C memory, then to alter the program using the EDIT facilities, then to alter the program on cassette tape using the CASSETTE ALTER facility. When cassette alter is accepted the cassette tape is rewound until the start of the program data is located, the tape is then stopped, run forward and the program is recorded onto tape. Care must be taken to ensure that an altered program is not more than 10 blocks longer than the original program. Note a 'cassette end' is not recorded using this facility.

TOOL offsets.

Tool offsets enable the PNC2C to automatically compensate for variations in distance of the cutting point from the datum point for up to 16 different tools.

The precise procedure required to set the tool offsets is dependant upon the type of application, i.e. whether the PNC2C control unit is fitted to a lathe or a milling machine.

LATHE systems.

The procedure to be followed for lathe systems is shown in the PNC2C OPERATIONS DIAGRAM (LATHE)

When T is depressed the current tool number and its associated X and Z offsets are displayed. The current tool can be changed by using the ACCEPT and L Keys. The tool offset can also be changed to compensate for tool wear, this is accomplished by keying in the tool offset errors (as shown in the operations diagram) only and the PNC2C will adjust the current tool offsets accordingly.

The offset for each tool can be set by using the TOOLSET procedure

MILLING systems. (To be added)

EDIT facility

This facility enables a program that is in PNC2C memory to be edited. When the edit mode is selected the operator may choose to display any block of data. Should a block number which does not exist be requested a '?' will be displayed. The program blocksize can then be found by entering too large a number and then reducing the number to a figure that the PNC2C can accept.

Six operations are possible in Edit mode, they are

a) ALTER
b) ADD
c) DELETE
d) REPLACE
e) Increment the displayed block number (ACCEPT)
f) Decrement the displayed block number (L)

a) ALTER The data programmed in any displayed block can be altered using the ALTER facility. The data to be replaced is keyed in together with its identifier, other data contained in the block will remain unchanged. If an attempt is made to change non existing data 'NO' will be displayed, RESET restores normal edit operation.

b) ADD A new block of data may be added to a programmed sequence using the ADD facility. The data is inserted into the sequence immediately before the block being displayed before ADD was depressed, and all subsequent block numbers in the programmed sequence will be incremented by 1.

If it is desired to add a block or a number of blocks to the end of a programmed sequence the LOAD CONTINUE facility should be used.

c) DELETE. A block of data may be deleted from a programmed sequence using the DELETE facility. The block deleted is the block being displayed when the DELETE command is used.

d) REPLACE The current block displayed may be replaced by the REPLACE facility. This facility differs from the Alter facility in that the replaced block is completely deleted and the new block is inserted.

e) The block number being displayed (the current block) may be incremented by 1 using the ACCEPT Key enabling the operator to step through and examine the sequence programmed.

f) The block number being displayed may be decremented by using the L Key enabling an operator to step back through a programmed sequence.

FUNCTION selection.

The PNC2C can be set to function in either an ABSOLUTE or INCREMENTAL mode and in either IMPERIAL or METRIC units. If desired the mode and/or units may be changed any number of times within a programmed sequence.

OFFSET facility.

The PNC2C offset facility enables programmed dimensions to be offset to any point within the machine movement limits. Separate offsets within and outside the programmed sequence are permitted.

REPEAT facility. The repeat facility enables specified sections of a programmed sequence to be repeated with specified offsets. The repeat facility is only available within a programmed sequence. The data required to specify a repeat is:

a) The start block number to be repeated
b) The end block number to be repeated
c) The number of repeats required
d) The required offset dimensions with required FEED changes if any.

Repeats may be programmed up to a nested level of 3, should this level be exceeded 'NESt Err' is displayed, RESET restores normal operation.

When each repeat is programmed the PNC2C checks all the dimensions being repeated adding the programmed offset the programmed number of times to ensure that the machine movement limits are not exceeded, this process may take a few seconds. Should the limits be exceeded 'dAtA Err' is displayed, RESET should be depressed and corrected data be Keyed in.

Repeats from a block defining a circular movement are not permitted, if an attempt is made to program such a repeat 'NO' is displayed, RESET restores normal operation.

SUBROUTINES (option)

The PHC2C may be fitted with user programmable subroutines. A subroutine is a small independant program which can be called from the main program. Within the subroutine, X,Y and Z moves are relative with respect to the last X,Y,Z position before the subroutine was called. A subroutine call can be entered in the main program using the S key followed by a number. The subroutine itself can be entered using the Load Sub sequence shown on the flowcharts. Note that within a subroutine, Repeats, Functions, etc. are not permitted.

Once a subroutine has been loaded the editing facilities of the PHC2C can be used to alter it in the usual way. Up to 99 different subroutines can be used at the same time. Subroutines can be loaded and stored from/to cassette if required.

Example

The following example shows how a subroutine can be used to draw a triangle at different points on the table.

SUBROUTINE 1

X	Y	Z
0	0	1
-10	-20	1
10	-20	1
0	0	1
0	0	0

MAIN PROGRAM

X	Y	Z
40	50	2
SUB	1	
70	30	2
SUB	1	
80	20	2
SUB	1	

Note that negative moves are permitted when loading a subroutine. The advantages of using a subroutine is that a subroutine call takes very little space in memory and the moves used in the subroutine need only be keyed in once. Thus subroutines make more efficient use of memory.

PRINTER facility

The optional PRINTER facility enables a user program or a portion of a user program to be printed on a compatible printer. The printer generally used is an EPSON MX80 with RS232 serial interface.

When the printer facility is first used subsequent to the PMC2C being switched ON the PMC2C requests the date which should be keyed in then 'ACCEPTed'. The program number is then displayed, this may be changed if desired by keying in the new program number. The start block (S.bl) is then requested, if 'A' is pressed at this point ALL the program is printed, alternatively a section of the program is printed if a start block number then an end block number is entered.

APPENDIX A

DEMONSTRATION

MANUAL CONTROL OF MACHINE FUNCTIONS

To EXECUTE a single instruction.

It is possible to manually instruct the PNC 2C to execute a single instruction without altering the information stored. This instruction will not be remembered once it has been performed.

Example 1 - press the following keys:

X 1 . 5 ACCEPT E

This instructs the PNC 2C to move the X axis to an absolute position 1.5 units from datum. The PNC 2C display will then respond with 'RUN ?', pressing the ACCEPT key when RUN is displayed makes the PNC 2C execute the instruction. (You will have noticed that as you pressed the keys DISPLAY 1 echoed your keypresses).

Example 2 - press the following keys:

X 2 . 8 ACCEPT Y 1 . 4 ACCEPT F 2 0 ACCEPT E ACCEPT

This instructs the PNC 2C to move the X axis to 2.8, the Y axis to 1.4 at a feed of 20 per cent. Note that E is used to end the information.

Example 3 - press the following keys:

A 4 ADD E ACCEPT

This instructs the PNC 2C to switch 'ON' auxiliary function no.4. Note that AUXILIARY 4 indicator (above display 2) is on.

Example 4 - press the following keys

A 4 DEL E ACCEPT

This instructs the PNC 2C to switch OFF (DELete) auxiliary function 4 Auxiliary information can be included with X Y and Z coordinate data if desired in a block e.g.

X 5 ACCEPT Y 1 . 4 ACCEPT A 4 ADD E ACCEPT

Example 5

I 0 ADD I 2 ADD E ACCEPT

This instructs the PNC 2C to check if input 0 and input 2 are ON i.e. to check is the switches connected to inputs 0 and 2 are closed. Should input 0 be OFF the PNC 2C will wait for it to become ON whilst displaying 'INPUT 0' in display 1. When input 0 is correct input 2 is checked in a similar manner. The PNC 2C may be 'reset' whilst waiting for an input condition by pressing 'RESET'. As inputs are being 'Keyed in' the first eight status indicators echo the levels programmed. The associated LED is ON if the input is programmed to be ON, OFF if the input is programmed to be OFF, and flashes if the input has not been programmed or is programmed to be ignored.

DEMONSTRATION

To 'LOAD' PMC 2C memory from Keyboard

This example demonstrates how the following profile may be programmed:

We recommend that the program is tabulated in the following manner:

BLK X Y XYF C XC YC Z ZF AUX INPUT
where:
BLK = Block number of instruction
X = X coordinate value of end point of movement.
Y = Y coordinate value of end point of movement.
XYF = Value which controls the feedrate of the XY axes as a percentage in the range 0.0005 (slowest) to 100(fastest).
C = used if a circular contour is required. If this Key is used the next Key must be either C (to define a clockwise contour) or A (to define an anticlockwise contour). The maximum arc possible in 1 block is 1 quadrant.
XC = X coordinate value of circle centre.
YC = Y coordinate value of circle centre.
Z = Z coordinate value of end point of movement.
ZF = value which controls the feedrate of the Z axis as a percentage.
AUX = Auxiliaries setting required.
INPUT= Input signal levels required.
NOTE: Each item of data should first be specified then accepted when correct and all lines must be ended with E (End of block).

EXAMPLE :

Press L, ACCEPT, ACCEPT
then key in the following tabulated data: (for 2 axis PMC 2C's ignore the Z and ZFEED cols)

BLK	X	Y	XYF	C	XC	YC	Z	ZF	AUX	INPUT
1	7	1	40						0,2,4	
2							0.5	10		
3	7.5	2.0	25							
4	8.5									
5	9	1.5	20	C	8.5	1.5			2-	
6	8.5	1		C	8.5	1.5				
7	7	1	25							
8							0	50		
9	0	0	100						0-,4-	

The 'load' operation is ended by pressing L(Load End) ACCEPT. When the PMC 2C memory will be loaded (note that the 'Memory Loaded' indicator is on).

REPEAT PATTERN facility.

This enables selected areas of a program to be repeated at specified offsets. The area of program to be repeated is selected by keying in the Start BLock and End BLock.

Example 7. To continue load i.e. 'add to' the program shown in example 6 above by pressing L, C (Load Continue) ACCEPT then enter information.

R,(Repeat), ACCEPT, 1, ACCEPT, 8, ACCEPT, 2, X, 2 ACCEPT Y, 1, ACCEPT, E(End of block). L,(Load End) ACCEPT

L,(Load End) ACCEPT.

This additional block repeats blocks 1 to 8 inclusive twice, offset by X = 2, Y = 1. Note that whilst keying in the repeat the PNC 2C prompts by asking for the S.bL(start block) E.bL(End block) and rep (the number of repeats).

(See Example 8 demonstrating how to repeat a selected number of blocks with both X offsets and Y offsets).

EXAMPLE 8

This example demonstrates repeating a selected number of blocks both with X offsets and Y offsets:

L ACCEPT

BLK	X	Y	XYF	C	XC	YC	Z	ZF	AUX	INPUT
1	0	0	50				0	20		
2	1	0.5								
3							0.6			
4	2	0.6								
5		1.9								
6	1.8									
7		1.5								
8	1	0.5								
9							0			
10	RPT	2-9,	5	XOFF	1.25					
11	RPT	1-10,	2	YOFF	1.5					

L(Load End) ACCEPT

Note. Blocks 2-9 are repeated a total of 17 times as there is a repeat within a repeat i.e. block 10 which is a repeat block, is repeated by block 11. The PNC 2C permits up to 3 levels of repeats within repeats.

DEMONSTRATION

To 'EDIT' a program that is in PHC 2C memory.

To edit or check through a program press E, the display will show "Edit bl", either key in the required block number then ACCEPT or press ACCEPT to see the first block of information.
Each subsequent depression of ACCEPT advances the block displayed by 1.
Each depression of L(last) decrements the block displayed by 1.

To ADD an additional block press ADD, ACCEPT, then key in the new block of data required, ending with E.

To DELete a block press DEL, ACCEPT.

To Replace a block press R (Replace) and Key in the new block of data, ending with E.

To Alter any item in a block press A (Alter) ACCEPT and key in new data.

The edit operation is ended by pressing RESET.

To RUN a programme that is in PHC 2C memory.

When the stored program is correct press R(run) and the PHC will display 'run bl', press ACCEPT to execute program or key in the 'blk number' desired to begin the program, then ACCEPT. Note it is not possible to run a program from a block which has a circular movement in it.

KEY TO SYSTEM DIAGRAMS

LARGE CHARACTER	EG. S, ACCEPT ETC. ARE SINGLE KEYS PRESSED BY OPERATOR.
( )	MESSAGE DISPLAYED ON PNC.
	FUNCTION OF OPERATION SELECTED
	OPERATION AUTOMATICALLY CARRIED OUT BY PNC.
SMALL UNBOXED TEXT	OPERATION TO BE CARRIED OUT BY OPERATOR

DEMONSTRATION

Using the CASSETTE system.

The cassette system enables programs to be quickly stored for future use thus providing unlimited storage.

First rewind the cassette by pressing:

C(CASS) R(CASS rE) ACCEPT
When the cassette will rewind to the beginning. (This operation may take a couple of minutes).

A Program which is in the PNC 2C memory may be stored onto cassette by pressing

C(CASS) S,(CASS St) ACCEPT(Store ?) ACCEPT (C) 1,2,3, ACCEPT.

The program will be stored onto cassette if there is a cassette in the cassette unit with sufficient tape left.

Note 123 is the cassette number! Any 1 to 6 digit number may be used and it functions as a cassette program identifier.

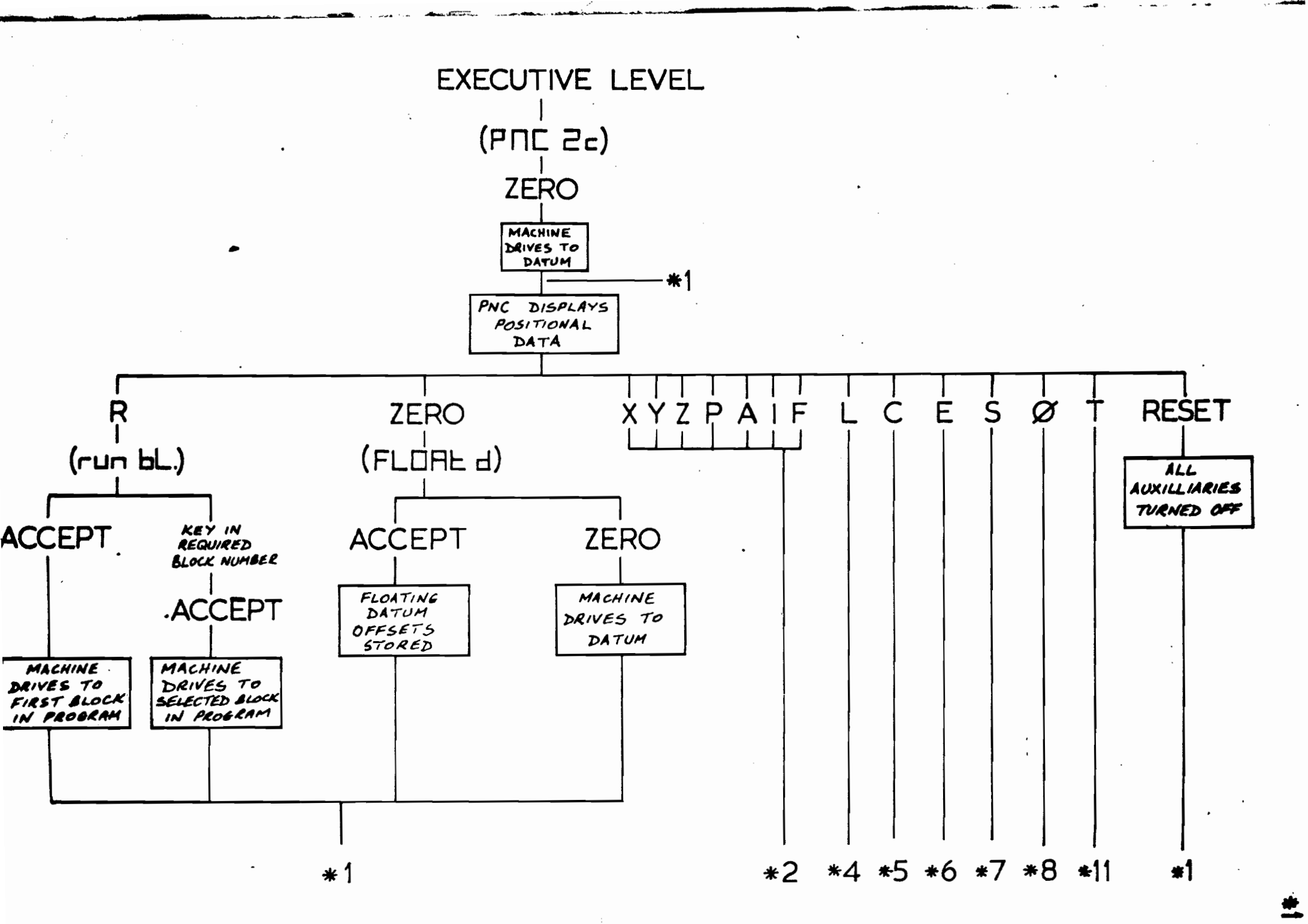
To load the PNC 2C memory from the cassette first rewind the cassette as above then press:

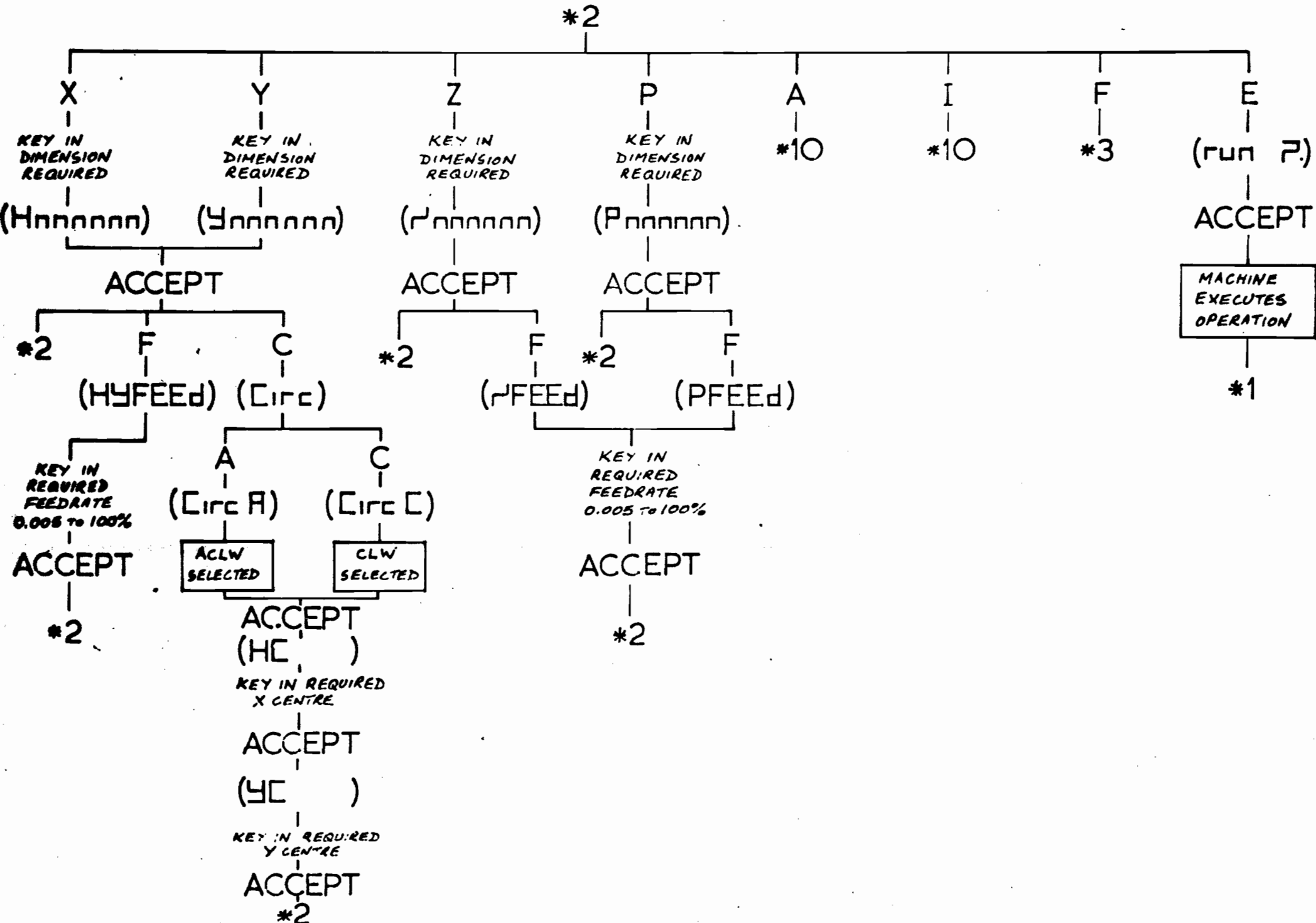
C,(CASS) L, (CASS Ld) ACCEPT (C) 1,2,3, ACCEPT

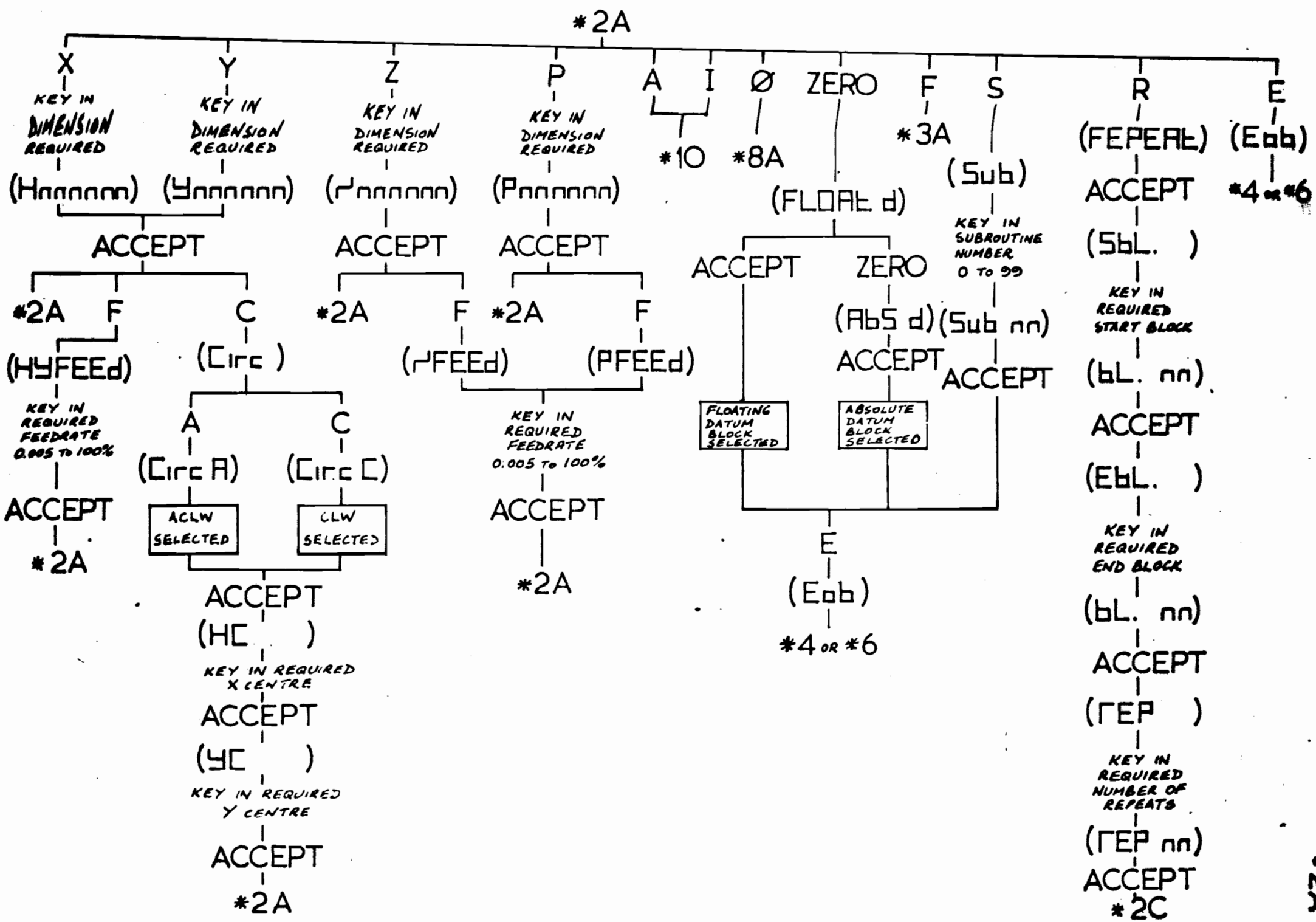
The PNC 2C will locate the cassette number 123 and then stop the cassette. If ACCEPT is pressed the program will be loaded from the cassette unit to PNC 2C memory, if DEL is pressed the PNC 2C will find the next cassette program number stored if one exists. Should the end of recorded tape be found 'C End' is displayed. Pressing RESET restores normal operation.

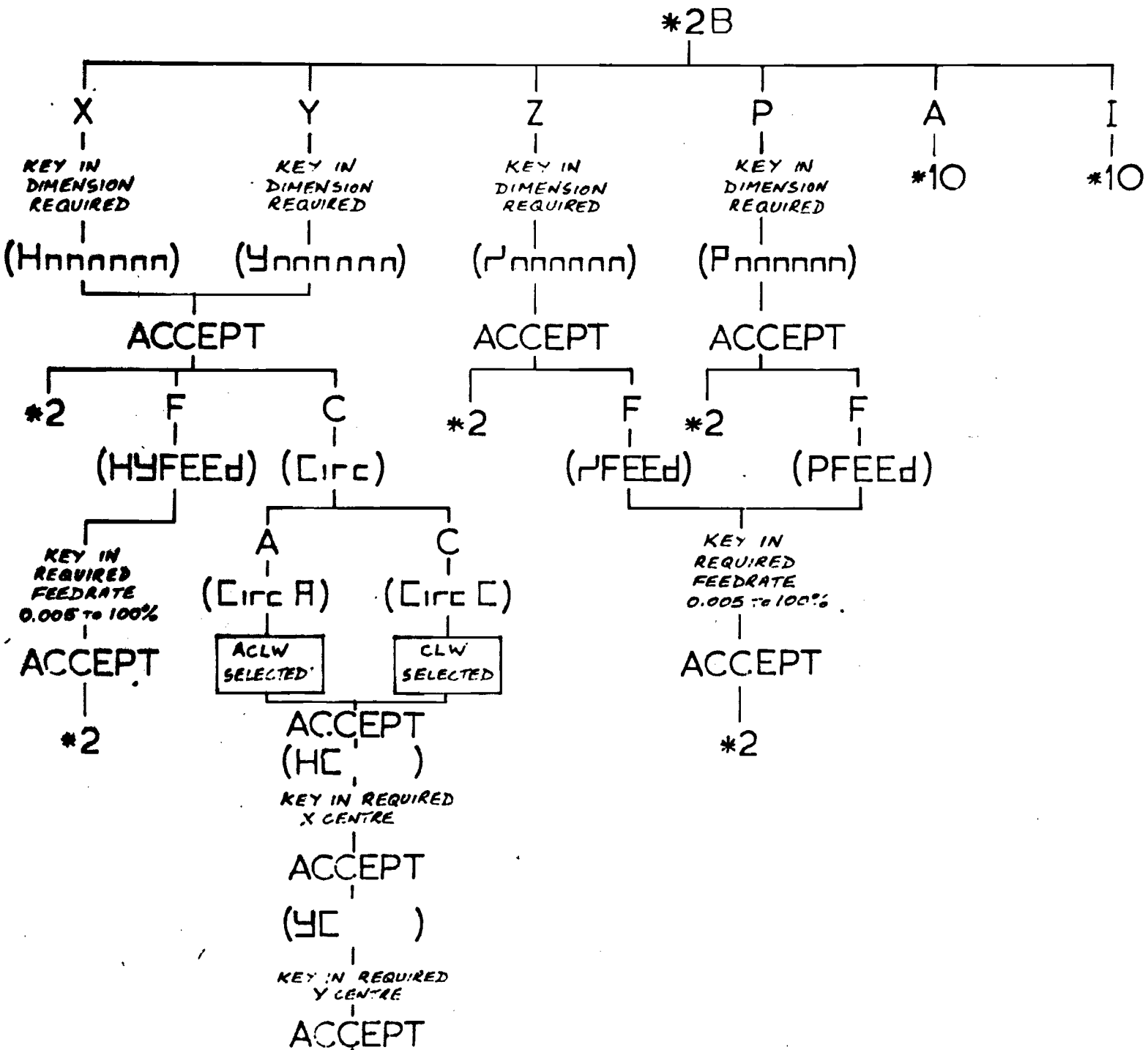
During use the correct operation of the cassette is checked by the PNC 2C, should an error be found the PNC 2C displays and status indicators show the error, RESET restores normal operation.

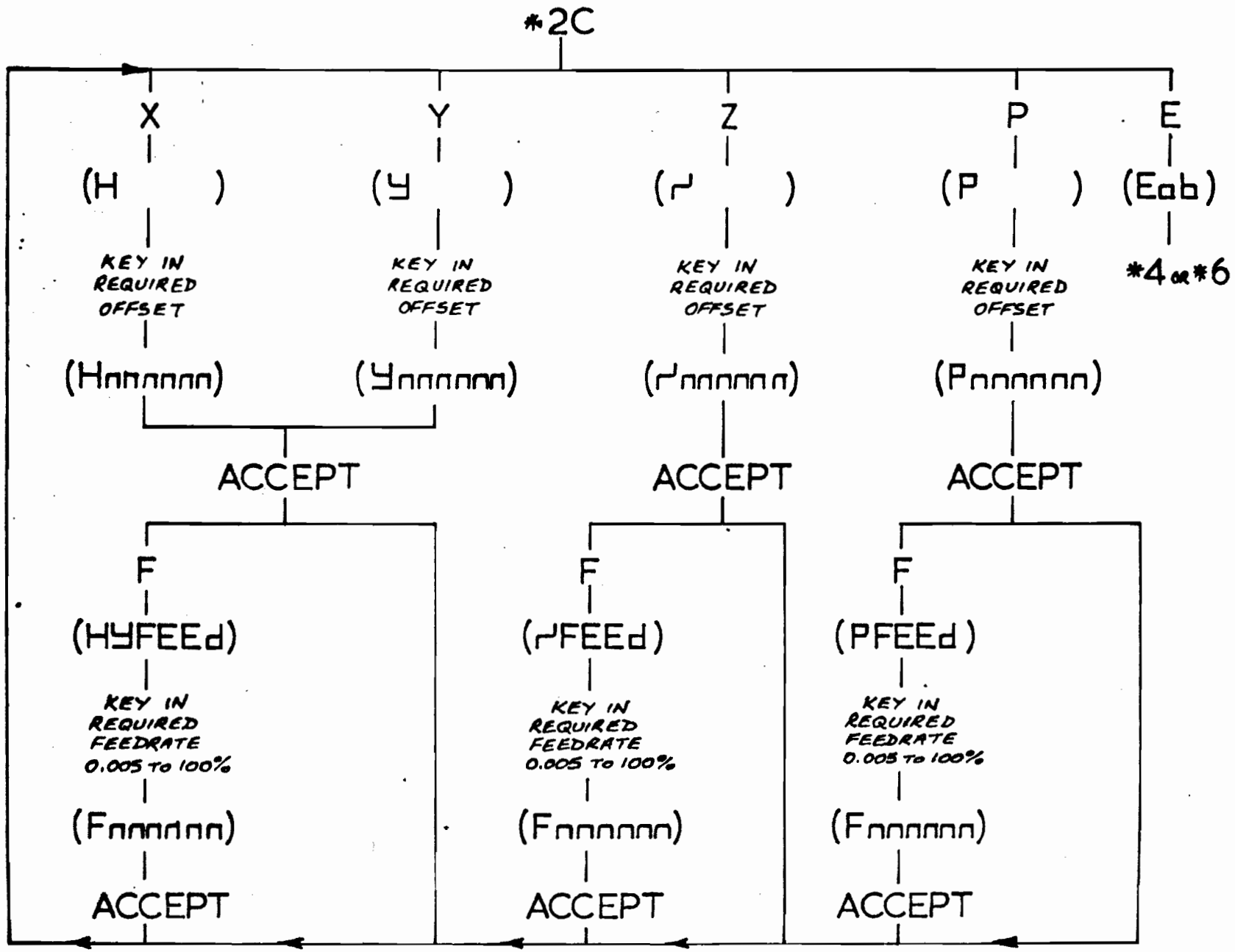
A cassette program may be added to a program in PNC 2C memory using the Cassette Continue facility where L in the previous example is replaced by C.

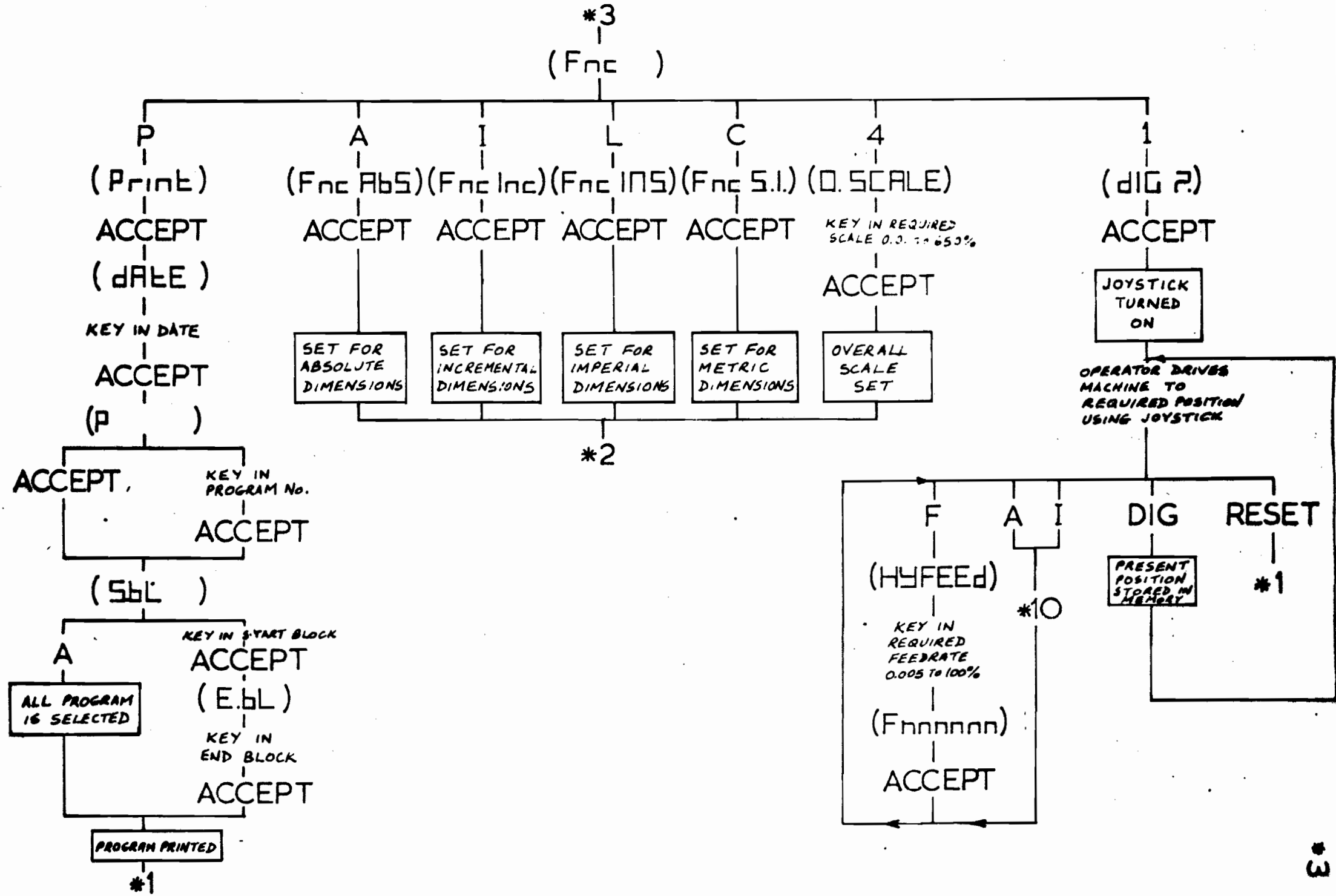

EXECUTIVE LEVEL
(PNC 2c)
ZERO
MACHINE DRIVES TO DATUM
*1
PNC DISPLAYS POSITIONAL DATA
R
(run bL.)
ACCEPT
MACHINE DRIVES TO FIRST BLOCK IN PROGRAM
KEY IN REQUIRED BLOCK NUMBER
.ACCEPT
MACHINE DRIVES TO SELECTED BLOCK IN PROGRAM
ZERO
(FLOAt d)
ACCEPT
FLOATING DATUM OFFSETS STORED
ZERO
MACHINE DRIVES TO DATUM
*1
X Y Z P A I F
*2
L
*4
C
*5
E
*6
S
*7
Ø
*8
T
*11
RESET
ALL AUXILLIARIES TURNED OFF
*1

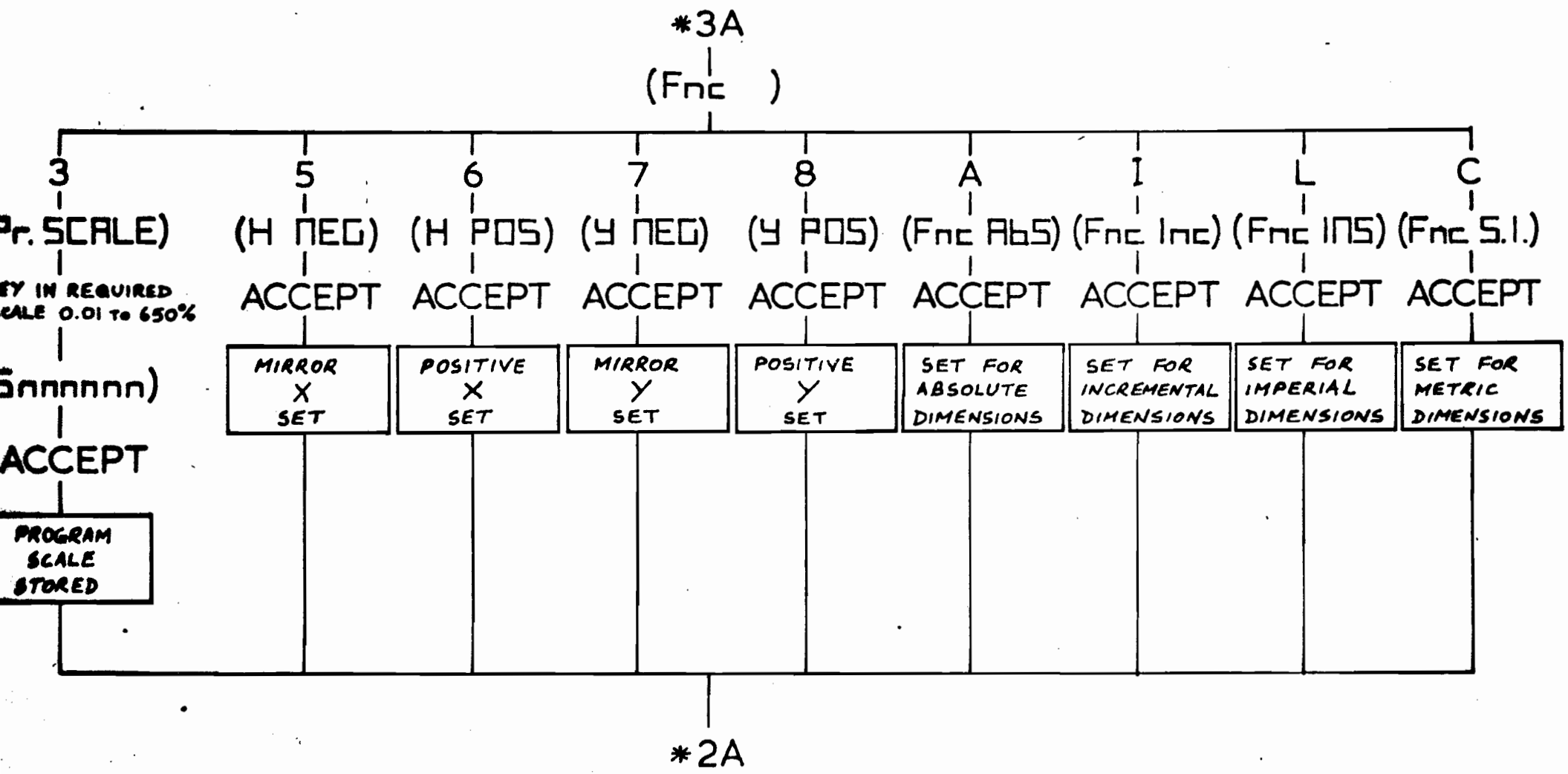

*2
X
Y
Z
P
A
I
F
E
KEY IN DIMENSION REQUIRED
KEY IN DIMENSION REQUIRED
KEY IN DIMENSION REQUIRED
KEY IN DIMENSION REQUIRED
*10
*10
*3
(run P.)
(Hnnnnnn)
(Ynnnnnn)
(Pnnnnnn)
(Pnnnnnn)
ACCEPT
ACCEPT
ACCEPT
ACCEPT
MACHINE EXECUTES OPERATION
*1
*2
F
C
*2
F
*2
F
(HYFEEd)
(Circ)
(PFEEd)
(PFEEd)
A
C
KEY IN REQUIRED FEEDRATE 0.005 to 100%
KEY IN REQUIRED FEEDRATE 0.005 to 100%
(Circ A)
(Circ C)
ACCEPT
ACCEPT
*2
ACLW SELECTED
CLW SELECTED
ACCEPT
(HC)
KEY IN REQUIRED X CENTRE
ACCEPT
(YC)
KEY IN REQUIRED Y CENTRE
ACCEPT
*2

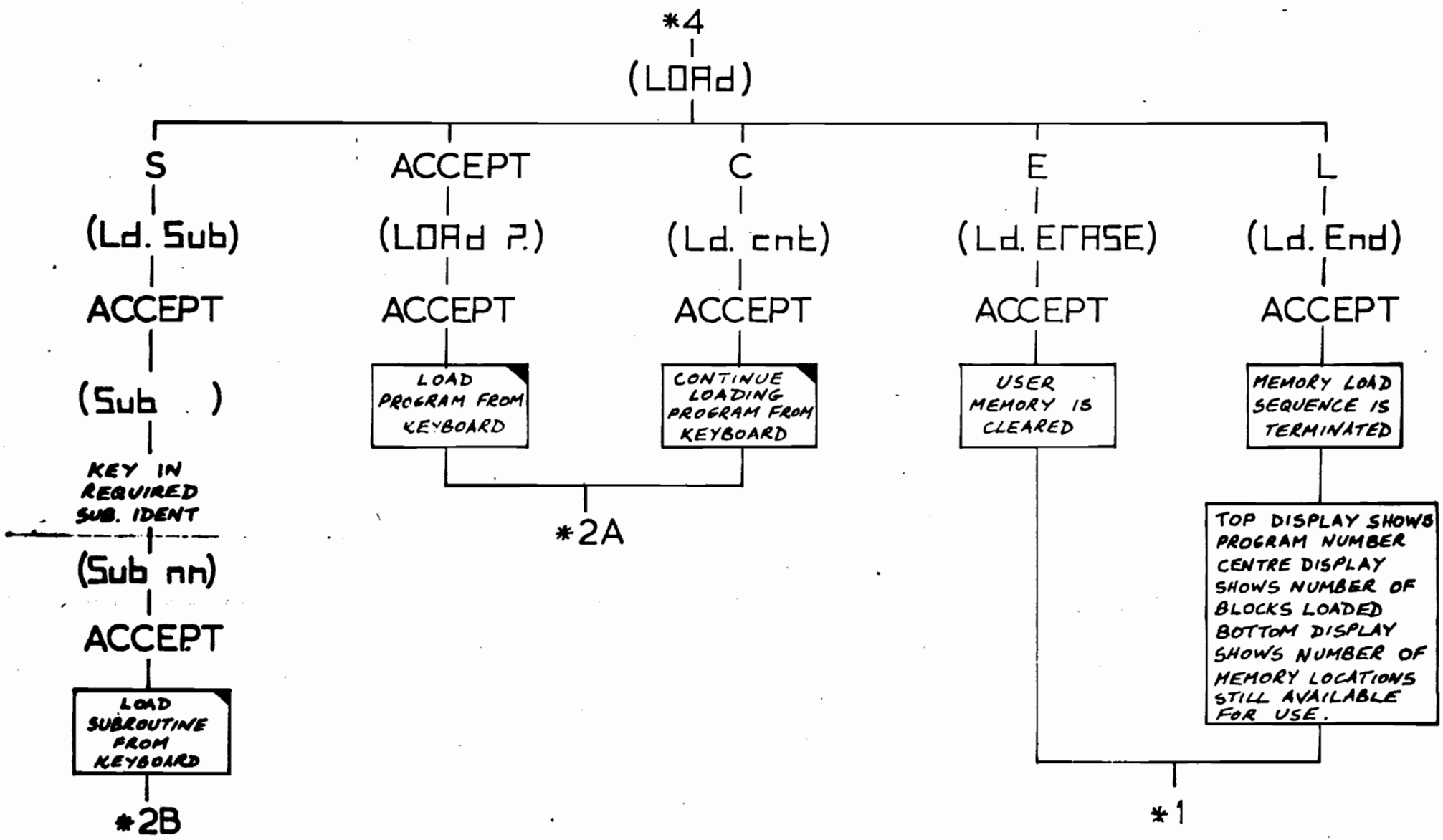

*2A
X
KEY IN DIMENSION REQUIRED
(Hnnnnnn)
Y
KEY IN DIMENSION REQUIRED
(Ynnnnnnn)
Z
KEY IN DIMENSION REQUIRED
(Znnnnnnn)
P
KEY IN DIMENSION REQUIRED
(Pnnnnnnn)
A
I
*10
Ø
*8A
ZERO
(FLOAt d)
F
*3A
S
(Sub)
KEY IN SUBROUTINE NUMBER 0 TO 99
(Sub nn)
R
(FEPEAt)
E
(Eob)
*4 or *6
ACCEPT
*2A
F
(HYFEEd)
KEY IN REQUIRED FEEDRATE 0.005 TO 100%
C
(Circ)
A
(Circ A)
ACLW SELECTED
C
(Circ C)
CLW SELECTED
(HC)
KEY IN REQUIRED X CENTRE
(YC)
KEY IN REQUIRED Y CENTRE
(ZFEEd)
(PFEEd)
KEY IN REQUIRED FEEDRATE 0.005 TO 100%
ACCEPT
*2A
FLOATING DATUM BLOCK SELECTED
ZERO
(AbS d)
ABSOLUTE DATUM BLOCK SELECTED
E
(Eob)
*4 OR *6
(SbL.)
KEY IN REQUIRED START BLOCK
(bL. nn)
(EbL.)
KEY IN REQUIRED END BLOCK
(bL. nn)
(rEP)
KEY IN REQUIRED NUMBER OF REPEATS
(rEP nn)
*2C

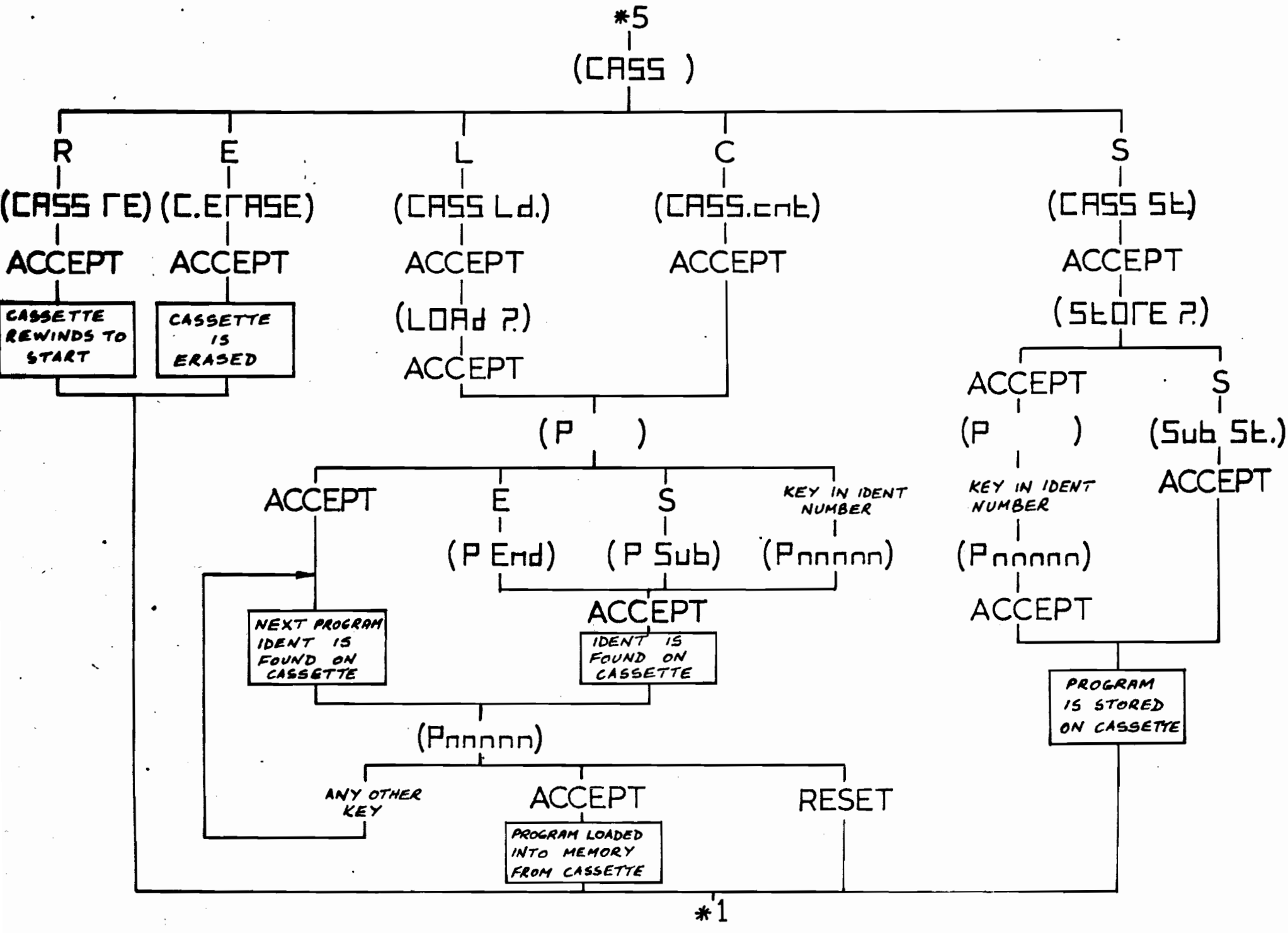

*2B
X
Y
Z
P
A
I
KEY IN DIMENSION REQUIRED
KEY IN DIMENSION REQUIRED
KEY IN DIMENSION REQUIRED
KEY IN DIMENSION REQUIRED
*10
*10
(Hnnnnnn)
(Ynnnnnn)
(Znnnnnn)
(Pnnnnnn)
ACCEPT
ACCEPT
ACCEPT
*2
F
C
*2
F
*2
F
(HYFEEd)
(Circ)
(ZFEEd)
(PFEEd)
KEY IN REQUIRED FEEDRATE 0.005 to 100%
A
C
KEY IN REQUIRED FEEDRATE 0.005 to 100%
ACCEPT
(Circ A)
(Circ C)
ACCEPT
*2
ACLW SELECTED
CLW SELECTED
ACCEPT
(HC)
KEY IN REQUIRED X CENTRE
ACCEPT
(YC)
KEY IN REQUIRED Y CENTRE
ACCEPT

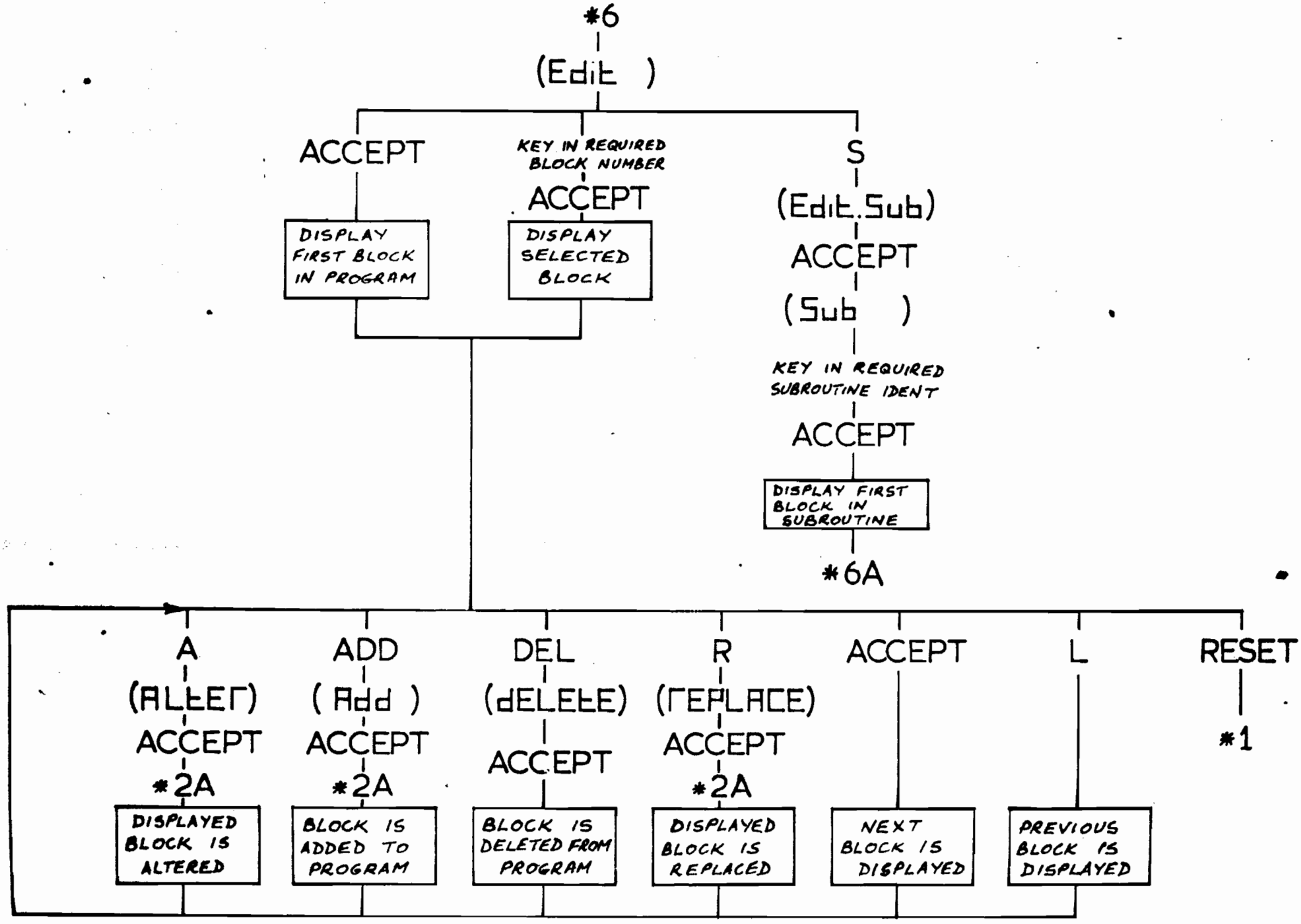

*2C
X
Y
Z
P
E
(H)
(Y)
(Z)
(P)
(Eab)
KEY IN REQUIRED OFFSET
KEY IN REQUIRED OFFSET
KEY IN REQUIRED OFFSET
KEY IN REQUIRED OFFSET
*4 OR *6
(Hnnnnnn)
(Ynnnnnn)
(Znnnnnn)
(Pnnnnnn)
ACCEPT
ACCEPT
ACCEPT
F
F
F
(HYFEEd)
(ZFEEd)
(PFEEd)
KEY IN REQUIRED FEEDRATE 0.005 TO 100%
KEY IN REQUIRED FEEDRATE 0.005 TO 100%
KEY IN REQUIRED FEEDRATE 0.005 TO 100%
(Fnnnnnn)
(Fnnnnnn)
(Fnnnnnn)
ACCEPT
ACCEPT
ACCEPT

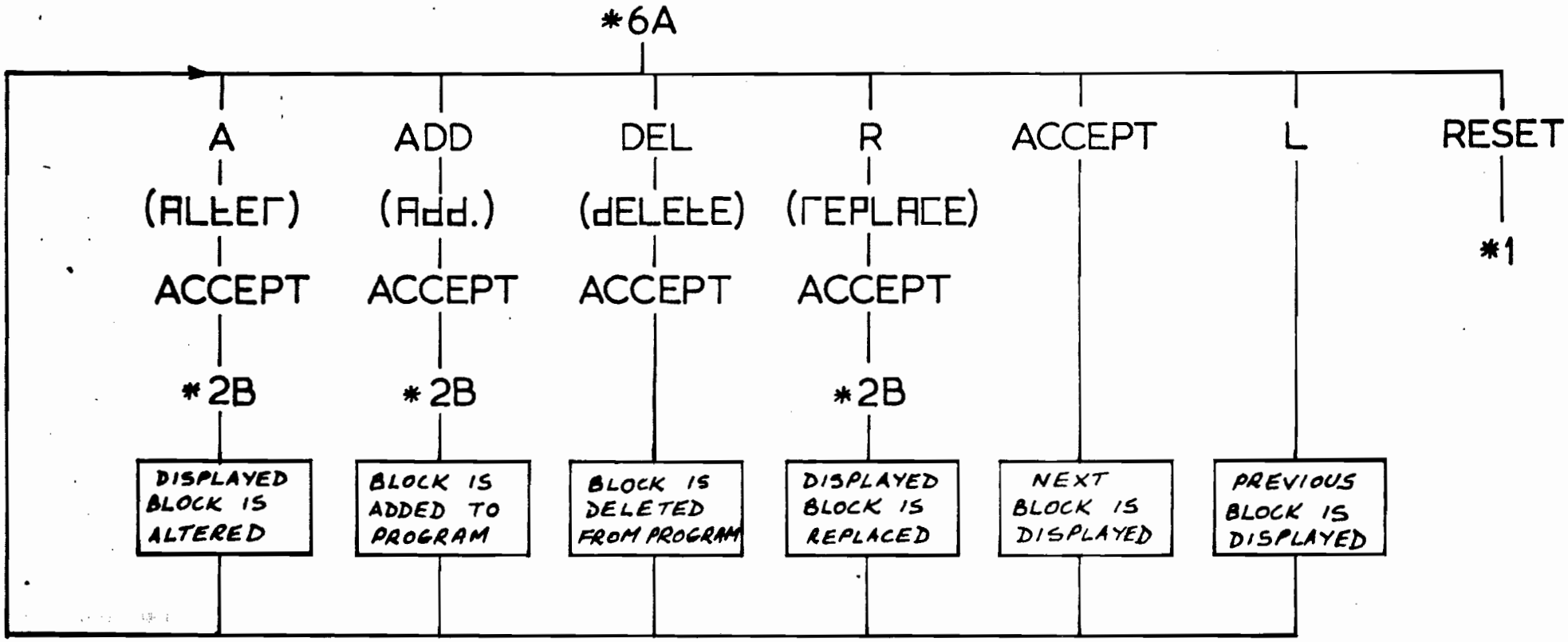

*3
(Fnc)
P
(Print)
ACCEPT
(dAtE)
KEY IN DATE
ACCEPT
(P)
ACCEPT,
KEY IN PROGRAM No.
ACCEPT
(SbL)
A
ALL PROGRAM IS SELECTED
KEY IN START BLOCK
ACCEPT
(E.bL)
KEY IN END BLOCK
ACCEPT
PROGRAM PRINTED
*1
A
(Fnc Abs)
ACCEPT
SET FOR ABSOLUTE DIMENSIONS
I
(Fnc Inc)
ACCEPT
SET FOR INCREMENTAL DIMENSIONS
L
(Fnc INS)
ACCEPT
SET FOR IMPERIAL DIMENSIONS
C
(Fnc S.I.)
ACCEPT
SET FOR METRIC DIMENSIONS
4
(0. SCALE)
KEY IN REQUIRED SCALE 0.0 to 650%
ACCEPT
OVERALL SCALE SET
*2
1
(dIG P.)
ACCEPT
JOYSTICK TURNED ON
OPERATOR DRIVES MACHINE TO REQUIRED POSITION USING JOYSTICK
F
(HYFEEd)
KEY IN REQUIRED FEEDRATE 0.005 to 100%
(Fnnnnnn)
ACCEPT
A I
*10
DIG
PRESENT POSITION STORED IN MEMORY
RESET
*1
*3

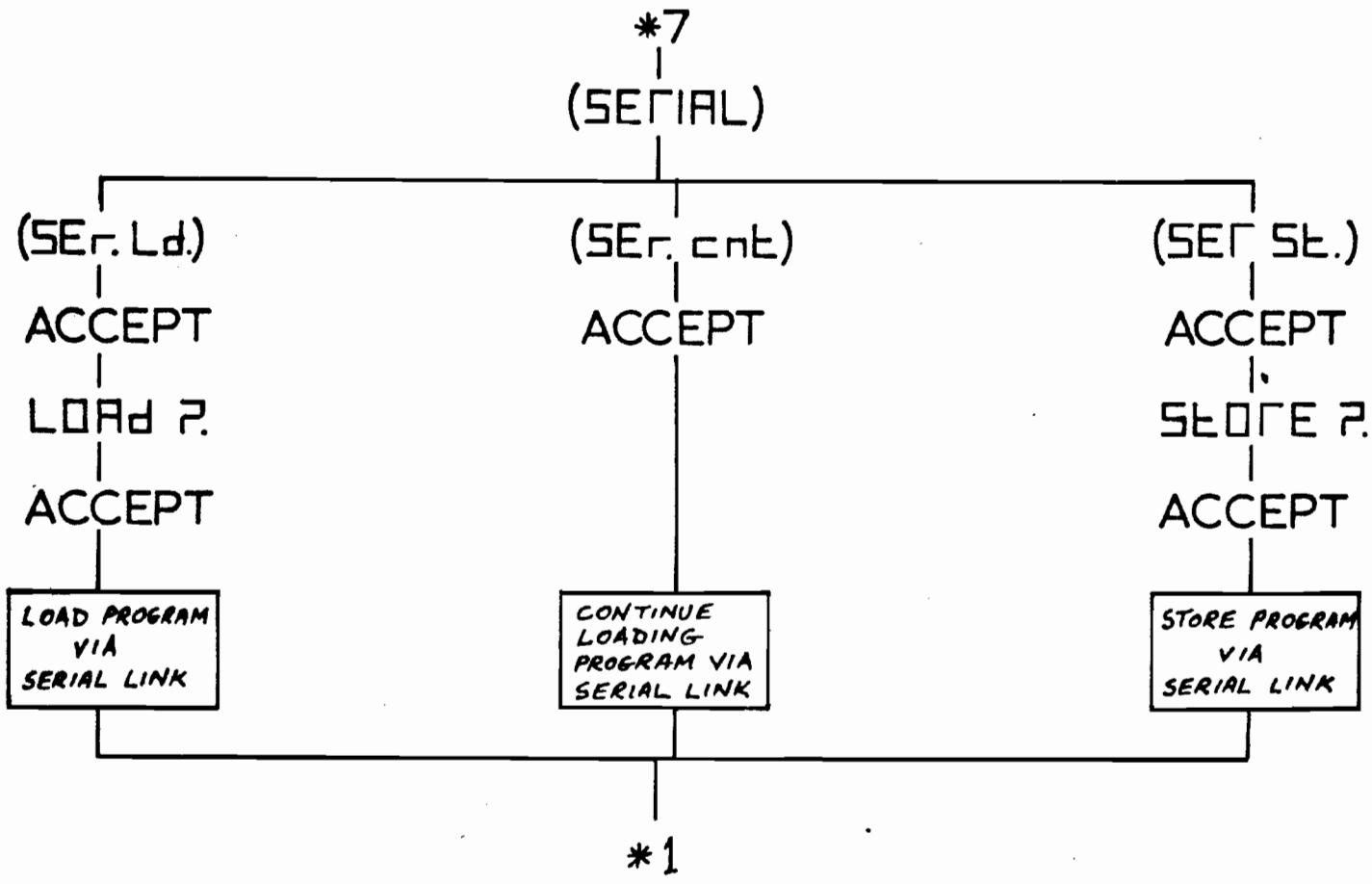

*3A
(Fnc)
3
5
6
7
8
A
I
L
C
Pr. SCALE)
(H NEG)
(H POS)
(Y NEG)
(Y POS)
(Fnc Abs)
(Fnc Inc)
(Fnc INS)
(Fnc S.I.)
EY IN REQUIRED
CALE 0.01 to 650%
ACCEPT
ACCEPT
ACCEPT
ACCEPT
ACCEPT
ACCEPT
ACCEPT
ACCEPT
ACCEPT
5nnnnnn)
ACCEPT
MIRROR X SET
POSITIVE X SET
MIRROR Y SET
POSITIVE Y SET
SET FOR ABSOLUTE DIMENSIONS
SET FOR INCREMENTAL DIMENSIONS
SET FOR IMPERIAL DIMENSIONS
SET FOR METRIC DIMENSIONS
PROGRAM SCALE STORED
*2A

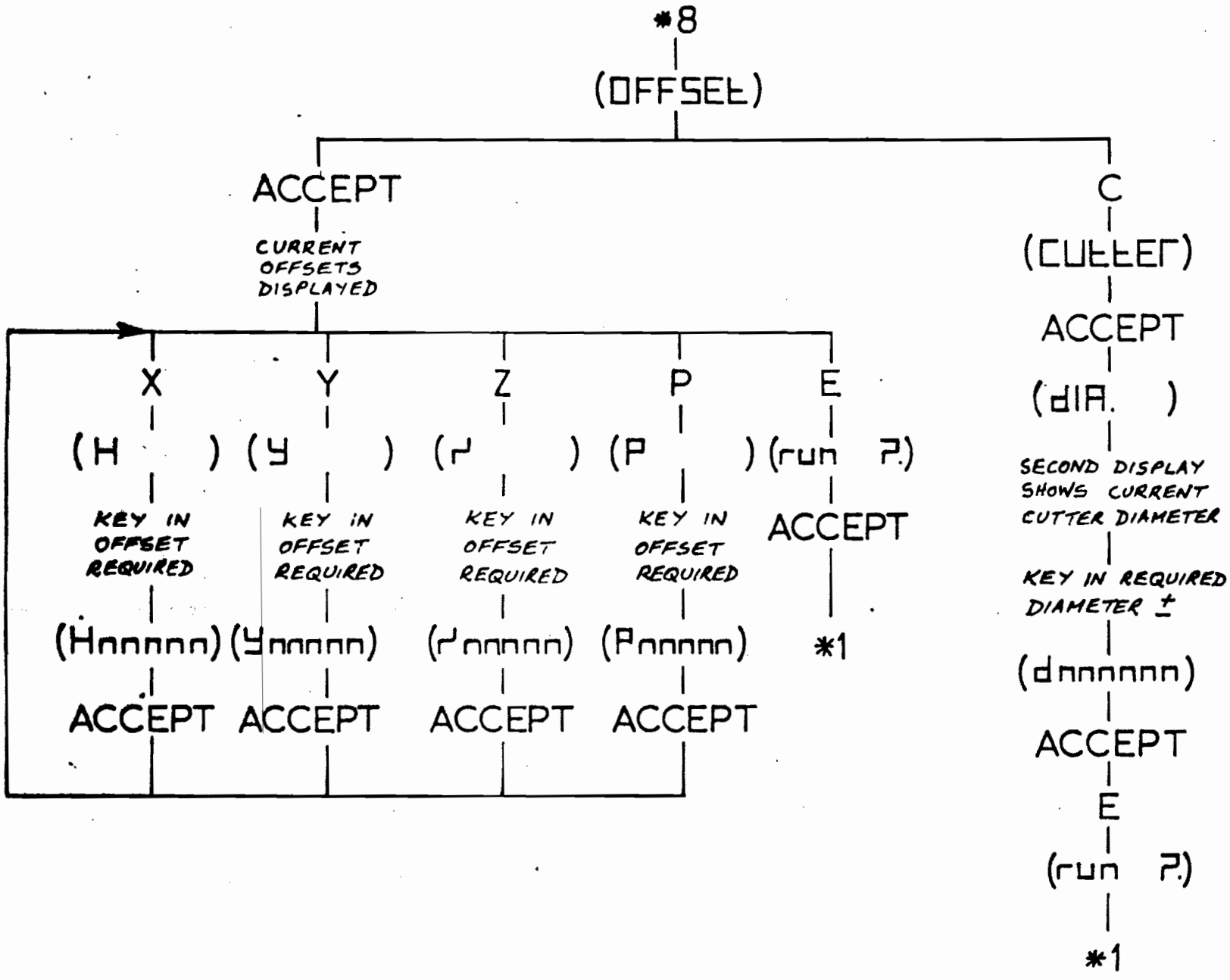

*4
(LOAd)
S
(Ld. Sub)
ACCEPT
(Sub)
KEY IN REQUIRED SUB. IDENT
(Sub nn)
ACCEPT
LOAD SUBROUTINE FROM KEYBOARD
*2B
ACCEPT
(LOAd ?)
ACCEPT
LOAD PROGRAM FROM KEYBOARD
C
(Ld. cnt)
ACCEPT
CONTINUE LOADING PROGRAM FROM KEYBOARD
*2A
E
(Ld. ERASE)
ACCEPT
USER MEMORY IS CLEARED
L
(Ld. End)
ACCEPT
MEMORY LOAD SEQUENCE IS TERMINATED
TOP DISPLAY SHOWS PROGRAM NUMBER CENTRE DISPLAY SHOWS NUMBER OF BLOCKS LOADED BOTTOM DISPLAY SHOWS NUMBER OF MEMORY LOCATIONS STILL AVAILABLE FOR USE.
*1

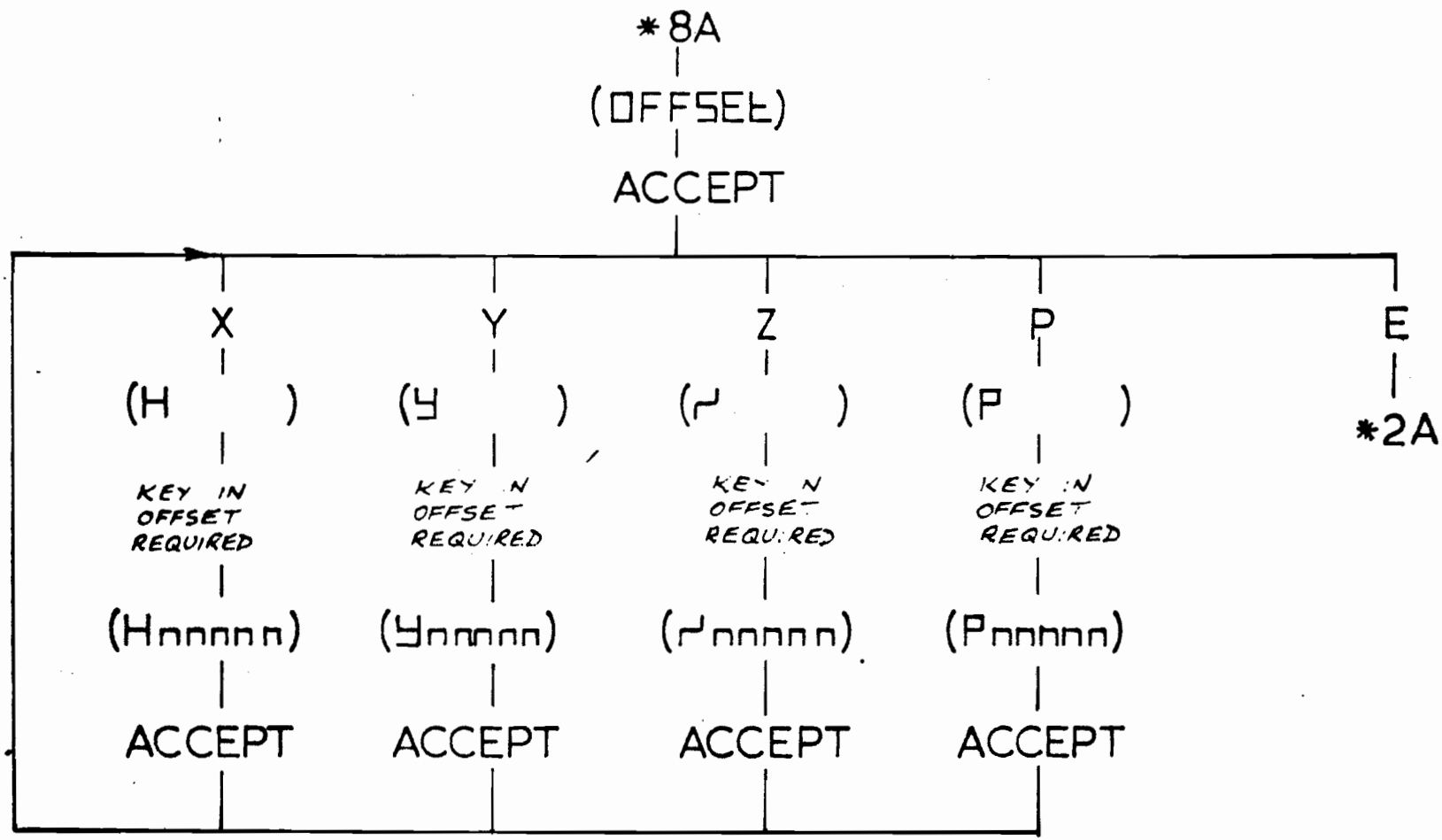

*5
(CASS)
R
E
L
C
S
(CASS rE)
(C.ErASE)
(CASS Ld.)
(CASS.cnt)
(CASS St)
ACCEPT
ACCEPT
ACCEPT
ACCEPT
ACCEPT
(LOAd ?)
(StOrE ?)
CASSETTE REWINDS TO START
CASSETTE IS ERASED
ACCEPT
ACCEPT
S
(P)
(P)
(Sub St.)
KEY IN IDENT NUMBER
KEY IN IDENT NUMBER
ACCEPT
ACCEPT
E
S
(P End)
(P Sub)
(Pnnnnn)
(Pnnnnn)
ACCEPT
ACCEPT
NEXT PROGRAM IDENT IS FOUND ON CASSETTE
IDENT IS FOUND ON CASSETTE
PROGRAM IS STORED ON CASSETTE
(Pnnnnn)
ANY OTHER KEY
ACCEPT
RESET
PROGRAM LOADED INTO MEMORY FROM CASSETTE
*1
*5

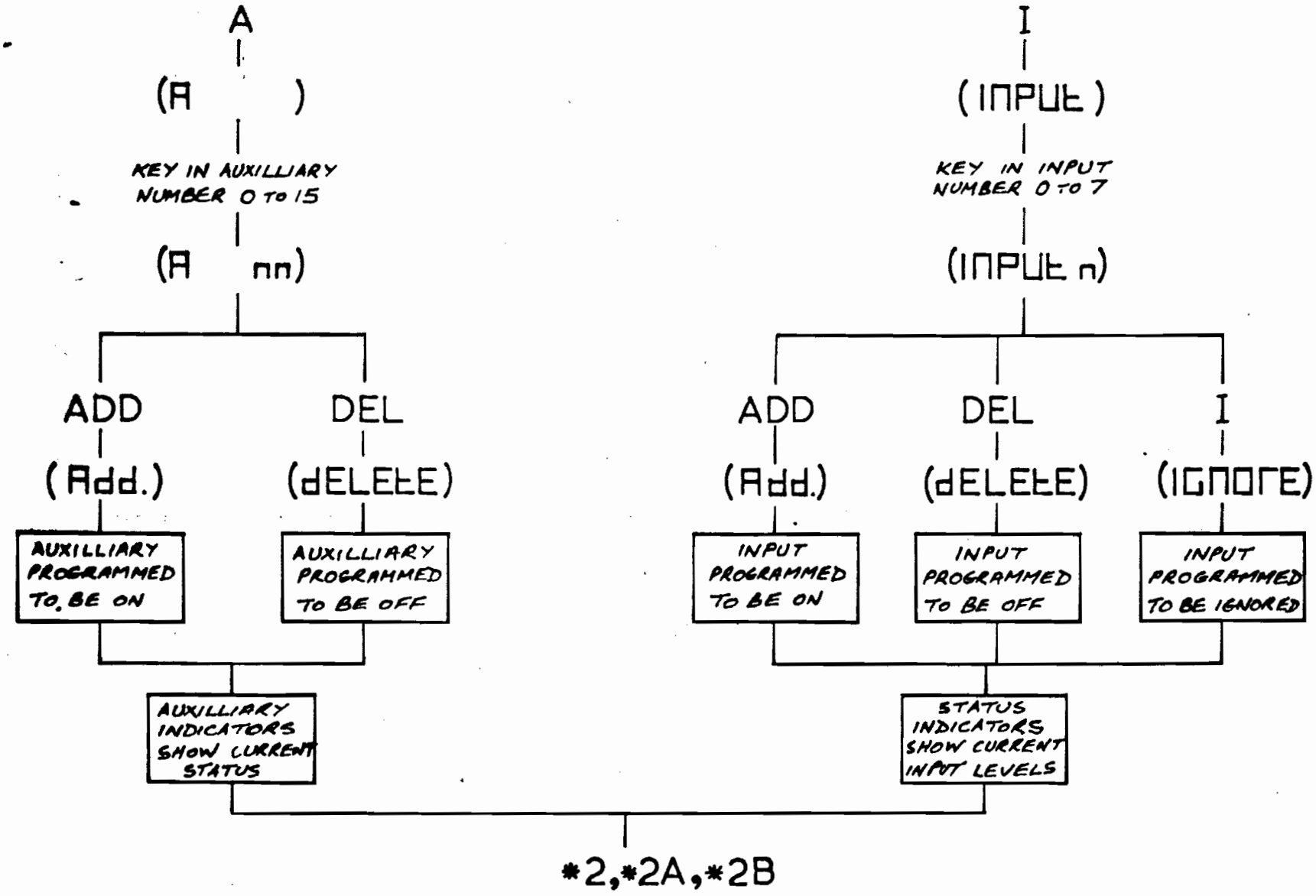

*6
(Edit)
ACCEPT
DISPLAY FIRST BLOCK IN PROGRAM
KEY IN REQUIRED BLOCK NUMBER
ACCEPT
DISPLAY SELECTED BLOCK
S
(Edit.Sub)
ACCEPT
(Sub)
KEY IN REQUIRED SUBROUTINE IDENT
ACCEPT
DISPLAY FIRST BLOCK IN SUBROUTINE
*6A
A
(ALTER)
ACCEPT
*2A
DISPLAYED BLOCK IS ALTERED
ADD
(Add)
ACCEPT
*2A
BLOCK IS ADDED TO PROGRAM
DEL
(dELETE)
ACCEPT
BLOCK IS DELETED FROM PROGRAM
R
(rEPLACE)
ACCEPT
*2A
DISPLAYED BLOCK IS REPLACED
ACCEPT
NEXT BLOCK IS DISPLAYED
L
PREVIOUS BLOCK IS DISPLAYED
RESET
*1

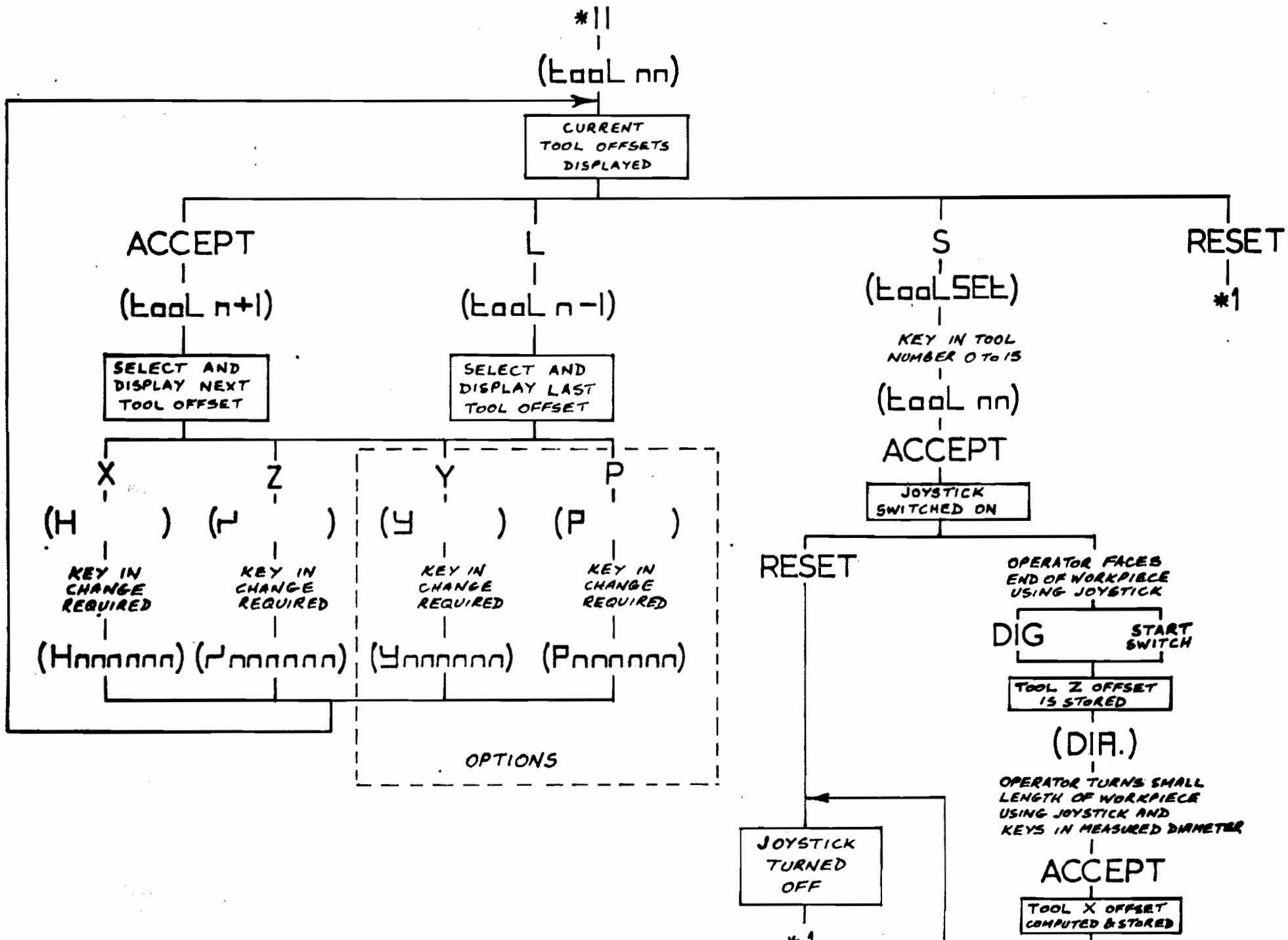

*6A
A
(ALTER)
ACCEPT
*2B
DISPLAYED BLOCK IS ALTERED
ADD
(Add.)
ACCEPT
*2B
BLOCK IS ADDED TO PROGRAM
DEL
(dELETE)
ACCEPT
BLOCK IS DELETED FROM PROGRAM
R
(REPLACE)
ACCEPT
*2B
DISPLAYED BLOCK IS REPLACED
ACCEPT
NEXT BLOCK IS DISPLAYED
L
PREVIOUS BLOCK IS DISPLAYED
RESET
*1


*7
(SERIAL)
(SEr. Ld.)
ACCEPT
LOAd ?.
ACCEPT
LOAD PROGRAM VIA SERIAL LINK
(SEr. cnt)
ACCEPT
CONTINUE LOADING PROGRAM VIA SERIAL LINK
(SEr St.)
ACCEPT
StOrE ?.
ACCEPT
STORE PROGRAM VIA SERIAL LINK
*1


*8
(OFFSET)
ACCEPT
CURRENT OFFSETS DISPLAYED
X
Y
Z
P
E
(H)
(Y)
(r)
(P)
(run P.)
KEY IN OFFSET REQUIRED
KEY IN OFFSET REQUIRED
KEY IN OFFSET REQUIRED
KEY IN OFFSET REQUIRED
ACCEPT
(Hnnnnn)
(Ynnnnn)
(rnnnnn)
(Pnnnnn)
*1
ACCEPT
ACCEPT
ACCEPT
ACCEPT
C
(CUTTER)
ACCEPT
(dIA.)
SECOND DISPLAY SHOWS CURRENT CUTTER DIAMETER
KEY IN REQUIRED DIAMETER ±
(dnnnnnn)
ACCEPT
E
(run P.)
*1


*8A
(OFFSET)
ACCEPT
X
Y
Z
P
E
(H)
(Y)
(r)
(P)
*2A
KEY IN OFFSET REQUIRED
KEY IN OFFSET REQUIRED
KEY IN OFFSET REQUIRED
KEY IN OFFSET REQUIRED
(Hnnnnn)
(Ynnnnn)
(rnnnnn)
(Pnnnnn)
ACCEPT
ACCEPT
ACCEPT
ACCEPT


A
(A)
KEY IN AUXILLIARY NUMBER 0 TO 15
(A nn)
ADD
DEL
(Add.)
(dELEtE)
AUXILLIARY PROGRAMMED TO BE ON
AUXILLIARY PROGRAMMED TO BE OFF
AUXILLIARY INDICATORS SHOW CURRENT STATUS
I
(INPUt)
KEY IN INPUT NUMBER 0 TO 7
(INPUt n)
ADD
DEL
I
(Add.)
(dELEtE)
(IGnOrE)
INPUT PROGRAMMED TO BE ON
INPUT PROGRAMMED TO BE OFF
INPUT PROGRAMMED TO BE IGNORED
STATUS INDICATORS SHOW CURRENT INPUT LEVELS
*2,*2A,*2B


*11
(tooL nn)
CURRENT TOOL OFFSETS DISPLAYED
ACCEPT
L
S
RESET
(tooL n+1)
(tooL n-1)
(tooLSEt)
*1
SELECT AND DISPLAY NEXT TOOL OFFSET
SELECT AND DISPLAY LAST TOOL OFFSET
KEY IN TOOL NUMBER 0 to 15
(tooL nn)
ACCEPT
X
Z
Y
P
(H)
(Z)
(Y)
(P)
KEY IN CHANGE REQUIRED
KEY IN CHANGE REQUIRED
KEY IN CHANGE REQUIRED
KEY IN CHANGE REQUIRED
(Hnnnnnn)
(Znnnnnn)
(Ynnnnnn)
(Pnnnnnn)
OPTIONS
JOYSTICK SWITCHED ON
RESET
OPERATOR FACES END OF WORKPIECE USING JOYSTICK
DIG
START SWITCH
TOOL Z OFFSET IS STORED
(DIA.)
OPERATOR TURNS SMALL LENGTH OF WORKPIECE USING JOYSTICK AND KEYS IN MEASURED DIAMETER
ACCEPT
TOOL X OFFSET COMPUTED & STORED
JOYSTICK TURNED OFF
*1

DENFORD

EASITURN

CNC LATHE

START- UP AND PROGRAMMING PROCEDURES

DENFORD EASITURN

START UP PROCEDURE

1. Power up the machine via the isolator switches.
2. Press the GREEN ON BUTTON.
3. Put the machine in MANUAL MODE, then set the key operation to MANUAL MODE on the joy stick control box.
4. Ensure that the Tailstock is positioned as far to the RH end of the machine as possible then Press the ZERO BUTTON - this drives the machine carriage to its limits and to tool reference points.
5. Press the F (function) KEY, press ACCEPT followed by C (S.I. Units), then ACCEPT.
6. Press E to enter this information into the control, then ACCEPT.
7. Switch on the spindle (GREEN BUTTON) and adjust to the required spindle speed in rev/min.
8. Finally press R (run) followed by ACCEPT.

   To stabalise the RPM reading on the LED display - PRESS O

   Switch off thye spindle speed at this point before proceeding

TOOL SETING MODE (Through JOY STICK MODE)

1. Press T (tool) followed by ACCEPT, then press S (set) followed by ACCEPT.
2. Press 1 (tool number) followed by ACCEPT.
3. The RED LIGHT should now be on at the JOY STICK hand mode control.
4. Place the workpiece in the chuck and clamp. Place the tool in the toolpost and set to the correct centre height.
5. Switch on the spindle to run in a CCW. direction - towards the operator.
6. Using the JOY STICK control drive the saddle towards the chuck (Z-) direction.

7. Using the JOY STICK control take a light cut off the end of the bar (X-) direction. Proceed slowly and carefully when cutting until you are familliar with the controls.

8. Press the START BUTTON (on joy stick control panel) this changes Z to 0.

9. Enter dia. via the MDI control - DO NOT PRESS ACCEPT. Using the joy stick again drive the tool to touch on the outside diameter.

10. Again using the joy stick, drive the tool away from the workpiece in the Z+ direction to clear the end of the workpiece.

11. Press E (enter), followed by ACCEPT. The display will now show the radius value for the diameter just turned.

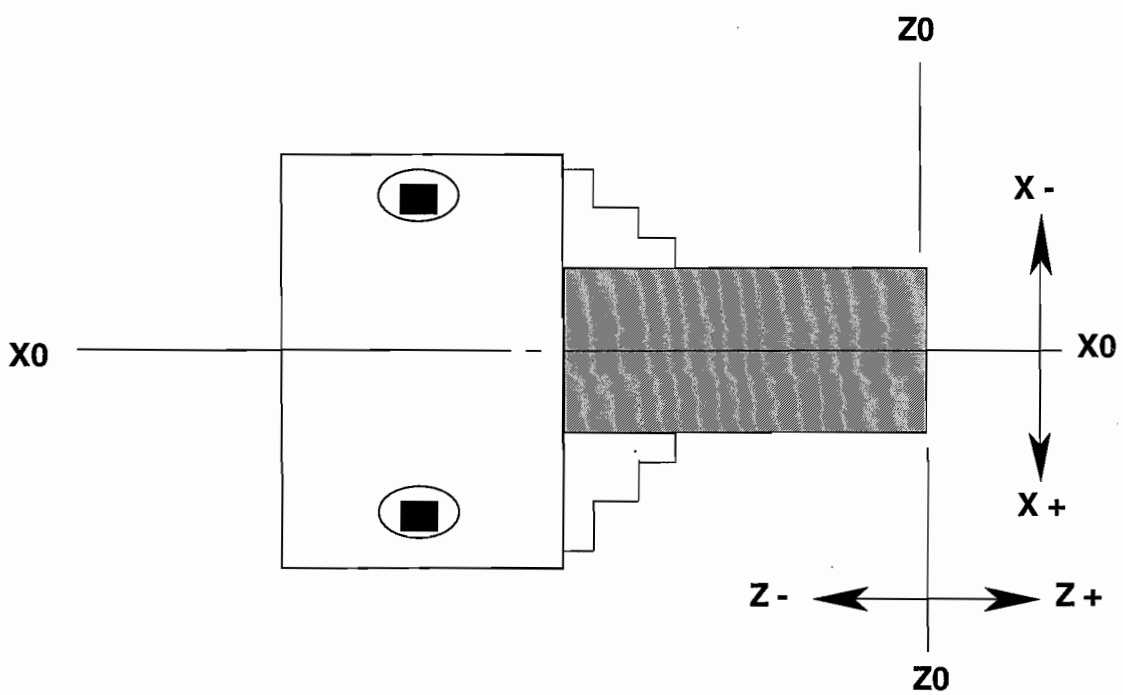
12. The joy stick is now cancelled and the RED LIGHT is OFF. The control is now ready for program entry.

FEED RATES

F100 = 100% (1500mm / min)

Example :- F6 = $\frac{6 \times 1500}{100}$ = 90 mm / min.

AXIS DESIGNATIONS



EDITING

To add a BLOCK in the EDIT MODE follow the procedure below:-

Press ADD ACCEPT

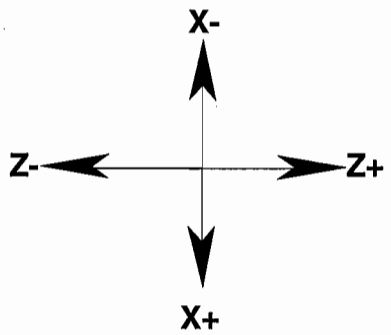
Then key in the information i.e. X10 ACCEPT F10 ACCEPT E

To alter information in a BLOCK:-

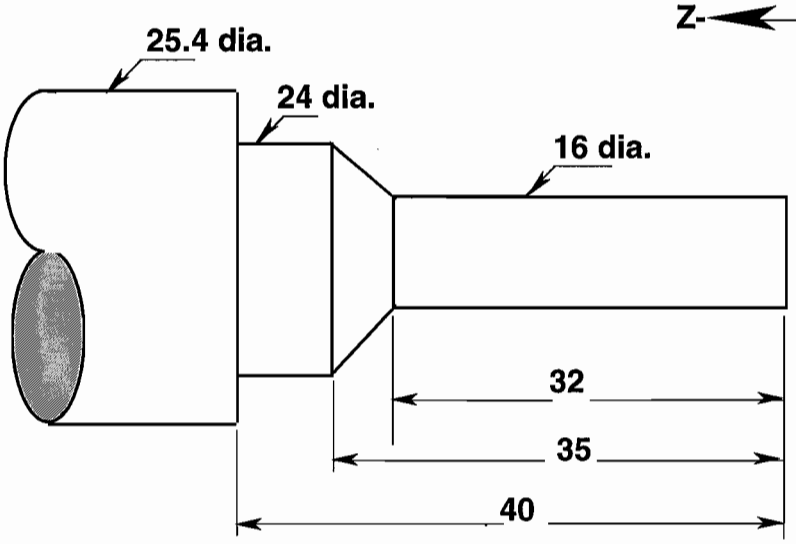
Press A ACCEPT

This does not alter information which has not been keyed in, in the same block.

PROGRAMMING EASITURN



PROGRAM 1



ENTERING PROGRAM

L ACCEPT ACCEPT

F C ACCEPT (metric units - mms)

F A ACCEPT (absolute programming)

So far no blocks have been used, the above are simply instructions to the machine.

B1 T 1 ACCEPT E **(T 1 is tool N0. 1, E denotes end of block)**

B2 X 12 ACCEPT Z 3 ACCEPT F100 ACCEPT E **(the tool moves to 12mm from centre of workpiece and 3mm from end face) - NOTE:- All dimentions are positive(+) so no sign is necessary).**

B3 Z -40 ACCEPT F 8 ACCEPT E **(Tool moves to - 40mm from end of bar at a feed rate of 8% of 1500mm/min. (120mm /min) at a dia of 24mm.**

B4 X 12.5 ACCEPT E **(Tool moves away from workpiece 0.5mm to clear 24mm dia.).**

B5 Z 3 ACCEPT F100 ACCEPT E **(Tool moves to 3mm from end of bar at a feed rate of 1500mm / min.).**

B6 X 9 ACCEPT E (Position tool to turn 18mm dia)

B7 Z -32 ACCEPT F6 ACCEPT E (Turns 18mm dia. x 32mm long - roughing cut).

B8 X A S ACCEPT E (Clears tool)

B9 Z 3 ACCEPT E (Returns tool to 3mm from end of workpiece)

B10 X 8 ACCEPT E (Tool positioned to turn 16mm dia.)

B11 Z-32 ACCEPT F8 ACCEPT (Turns 16mm dia x32mm long)

B12 X12 ACCEPT Z-35 ACCEPT F4 ACCEPT E (Turns taper)

B13 Z 3 ACCEPT F100 ACCEPT E (Tool returns to 3mm from workpiece end at rapid traverse)

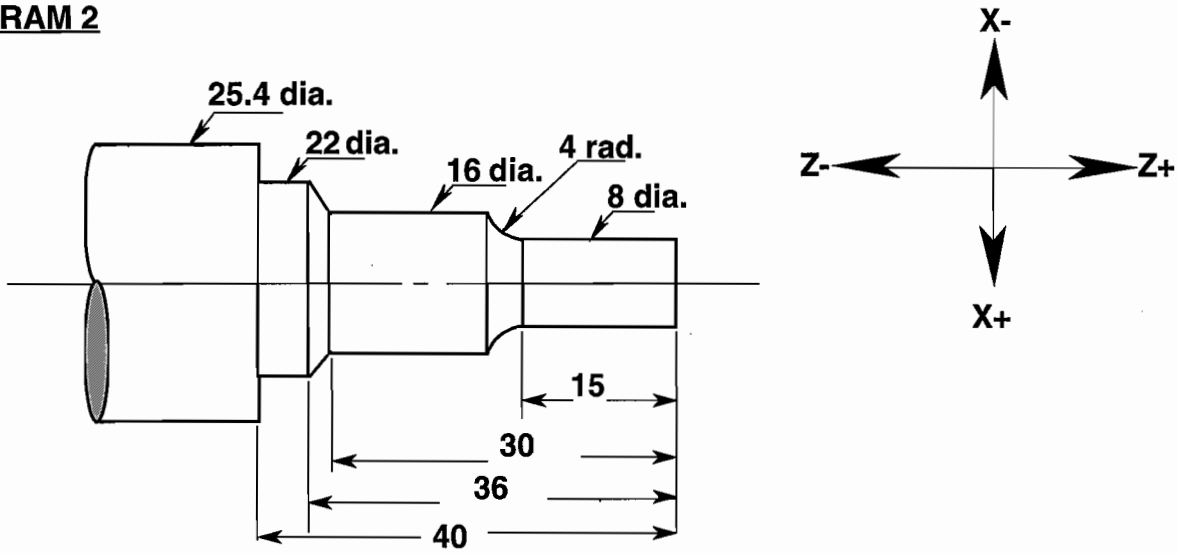
L ACCEPT

E ACCEPT (Program loaded and accepted.)

Program Check

Program goes to block 1. Check each block, if correct readout ACCEPT. Check blocks through to end of program ACCEPT after each one.

PROGRAM 2



L ACCEPT ACCEPT

F C ACCEPT (metric)

F A ACCEPT (absolute)

B1 T 1 ACCEPT E (tool number)

B2 X12 ACCEPT Z3 ACCEPT F 100 ACCEPT E (Tool moves to 24mm dia and 3mm away from the end of the workpiece.)

B3 Z-40 ACCEPT F8 ACCEPT E (turns 24 dia. x 40mm long)

B4 X 12.5 ACCEPT F100 ACCEPT E (tool moves to 25 dia. to clear)

B5 Z3 ACCEPT F100 ACCEPT E (Tool moves 3mm clear of end of workpiece)

B6 X9 ACCEPT E (Tool moves to 18mm dia)

B7 Z-30 ACCEPT F6 ACCEPT E (Turns 18mm dia. x 30mm long)

B8 X 9.5 ACCEPT E (Tool moves to 19mm dia. to clear)

B9 Z3 ACCEPT F100 ACCEPT E (Tool moves 3mm clear of end of workpiece)

B10 X5 ACCEPT E (Tool moves to 10 mm dia.)

B11 Z-15 ACCEPT F8 ACCEPT E (Turns 10mm. dia. x 15mm. long)

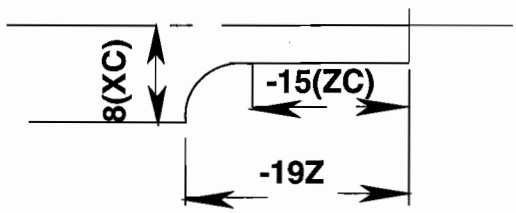
B12 X5.5 ACCEPT F100 ACCEPT E (Tool moves to 11dia. to clear)

B13 Z3 ACCEPT E (Tool moves 3mm. clear of end of workpiece)

B14 X4 ACCEPT E (Tool moves to 8mm dia.)

B15 Z-15 ACCEPT F6 ACCEPT E (Turns 8mm dia. x 15mm long)

B16 X8 ACCEPT Z-19 ACCEPT F4 ACCEPT C A ACCEPT (displayX C) 8 ACCEPT (now displayZC) -15 ACCEPT E (turns 4mm rad. in anti- clockwise mode)



B17 X8 ACCEPT E (Tool moves to 16mm dia.)

B18 Z-30 ACCEPT F6 ACCEPT E (Turns 16mm dia. x 30mm long)

B19 X11 ACCEPT Z-36 ACCEPT F4 ACCEPT E (Turns taper)

B20 X11 ACCEPT E (Tool moves to 22mm dia.)

B21 Z-40 ACCEPT E (Turns 22mm dia. x4mm long)

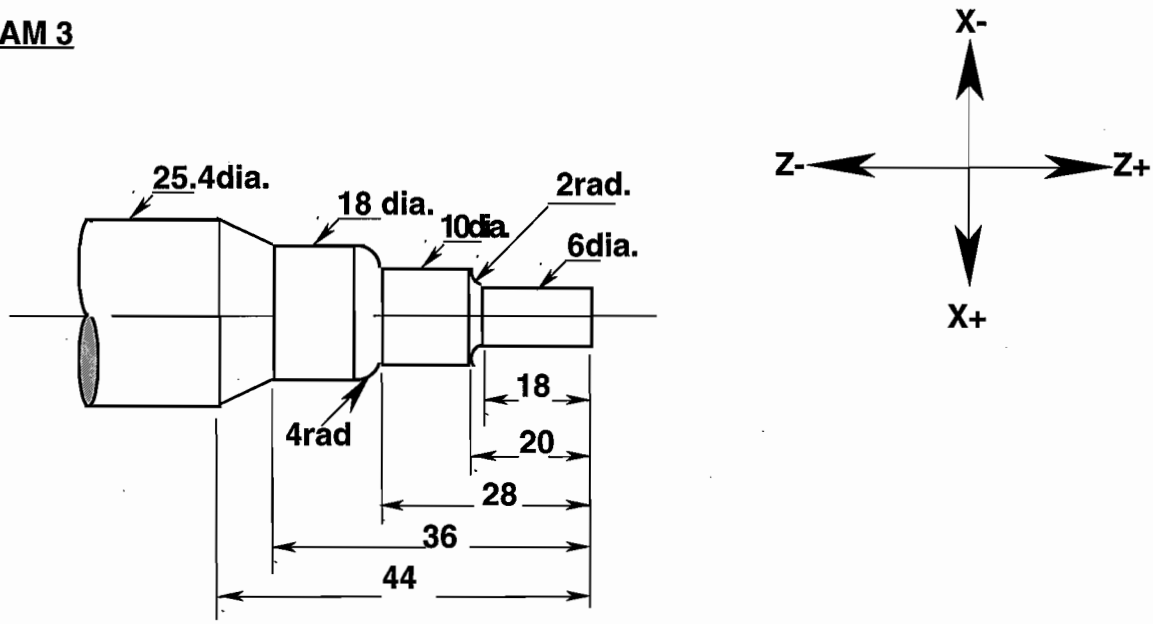
B22 X11.5 ACCEPT E (Tool moves to 23mm dia. to clear)

B23 Z3 ACCEPT F100 ACCEPT E (Tool moves 3mm clear of end of workpiece)

L ACCEPT

E ACCEPT

PROGRAM 3



LOAD ACCEPT ACCEPT

F C ACCEPT

F A ACCEPT

B1 T1 ACCEPT E (Tool No.)

B2 X9.5 ACCEPT Z3 ACCEPT F100 ACCEPT E (Tool moves to 19 dia)

B3 Z-36 ACCEPT F10 ACCEPT E (Turns 19 dia x 36 long)

B4 X10 ACCEPT F100 ACCEPT E (Tool moves to 20 dia. to clear)

B5 Z3 ACCEPT F100 ACCEPT E (tool clears end of workpiece)

B6 X5.5 ACCEPT F100 ACCEPT E (tool moves to 11mm dia.)

B7 Z-28 ACCEPT F10 ACCEPT E (Turns 11mm dia x 28 mm long)

B8 X6.5 ACCEPT E (tool moves to 13mm dia.)

B9 Z3 ACCEPT F100 ACCEPT E (tool clears end of workpiece)

B10 X3.5 ACCEPT F100 ACCEPT E (tool moves to 7mm dia.)

B11 Z-18 ACCEPT F10 ACCEPT E (Turns 7mm dia x 18mm long)

B12 X3.6 ACCEPT F100 ACCEPT E (tool moves to 7.2mm dia.to clear)

B13 Z3 ACCEPT E (tool clears end of workpiece)

B14 X3 ACCEPT F10 ACCEPT E (tool moves to 6mm dia)

B15 Z-18 ACCEPT F10 ACCEPT E (Turns 6mm dia. x18mm long)

B16 X5 ACCEPT Z-20 ACCEPT F4 ACCEPT CA ACCEPT (XC displays) 5 ACCEPT (ZC displays) -18 ACCEPT E (turns 2mm rad.)

B17 Z-28 ACCEPT F10 ACCEPT E (Turns 10mm dia x8mm long)

B18 X9 ACCEPT Z-32 ACCEPT F4 ACCEPT CC ACCEPT 5 ACCEPT Z-32 ACCEPT E (Circular interpolation)

B19 Z-36 ACCEPT F10 ACCEPT E (Turns 18mm dia x4mm long)

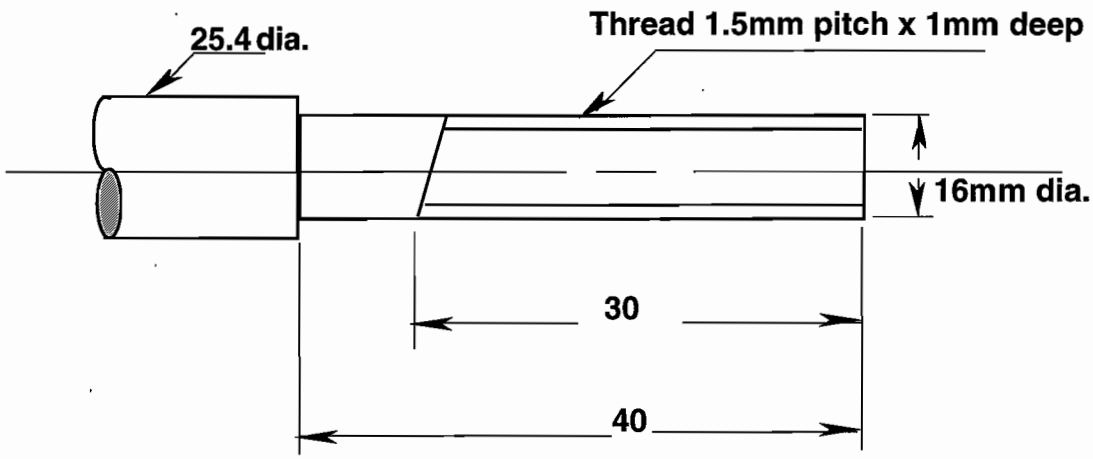
B20 X12.7 ACCEPT Z-44 ACCEPT F10 ACCEPT E (Turns taper)

B21 Z3 ACCEPT F100 ACCEPT E (Tool clears end of workpiece)

L ACCEPT

E ACCEPT

PROGRAM 4



LOAD ACCEPT ACCEPT

F C ACCEPT

F A ACCEPT

B1 T1 ACCEPT E (Tool No.)

B2 X10 ACCEPT Z 3 ACCEPT F100 ACCEPT E (Tool goes to 20mm dia.)

B3 Z-40 ACCEPT F10 ACCEPT E (Turns 20mm dia. x 40mm long)

B4 Z3 ACCEPT F100 ACCEPT E (Tool clears end of workpiece)

B5 X8 ACCEPT F100 ACCEPT E (Tool moves to 16mm dia.)

B6 Z-40 ACCEPT F10 ACCEPT E (Turns 16mm x 40mm long)

B7 X25 ACCEPT F15 ACCEPT E (Tool moves to 50mm dia. to clear)

B8 Z25 ACCEPT F100 ACCEPT E (Tool moves to Z25 to clear)

B9 T2 ACCEPT E (Tool change for screwcutting)

B10 X8 ACCEPT Z1 ACCEPT F100 ACCEPT E (Tool moves to 16mm dia)

B11 S ACCEPT DIA. 16 ACCEPT

PITCH 1.5 ACCEPT

(Screwcutting Data)

DEPTH	1 ACCEPT
CUTS	20 ACCEPT
LENGTH	-30 ACCEPT
START	0 ACCEPT

E

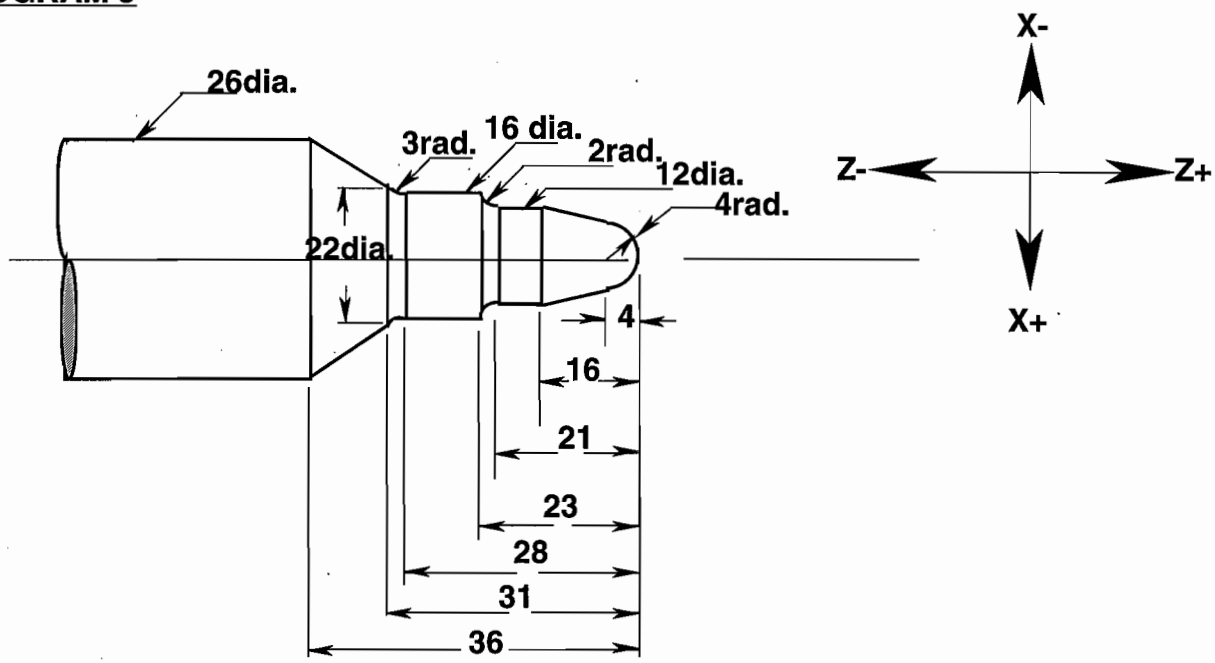
B12 X25 ACCEPT Z50 ACCEPT F100 ACCEPT E (Tool moves to clear)

L ACCEPT

E ACCEPT

NOTE : Spindle speed approx 200 r.p.m.

PROGRAM 5



LOAD ACCEPT ACCEPT

F C ACCEPT

F A ACCEPT

B1 T 1 ACCEPT E (tool No.)

B2 X11 ACCEPT Z3 ACCEPT F100 ACCEPT E (Tool moves to 22dia.)

B3 Z-31 ACCEPT F10 ACCEPT E (Turns 22 dia. x 31mm long)

B4 Z3 ACCEPT F100 ACCEPT E (Tool clears end of workpiece)

B5 X8.5 ACCEPT F100 ACCEPT E (Tool moves to 17mm dia.)

B6 Z-28 ACCEPT F10 ACCEPT E (Turns 17mm dia x 28 mm long)

B7 Z3 ACCEPT F100 ACCEPT E (Tool clears end of workpiece)

B8 X6.5 ACCEPT F100 ACCEPT E (Tool moves to 13mm dia.)

B9 Z-21 ACEPT F10 ACCEPT E (Turns 13mm dia. x 21mm long)

B10 Z3 ACCEPT F100 ACCEPT E (Tool clears end of workpiece)

B11 X4.5 ACCEPT F100 ACCEPT E (Tool moves to 9mm dia.)

B12 Z-4 ACCEPT F10 ACCEPT E (Turns 9mm dia. x 4mm long)

B13 Z3 ACCEPT F100 ACCEPT E (Tool clears end of workpiece)

B14 X0 ACCEPT Z0 ACCEPT F100 ACCEPT E (Tool moves to zero positions)

B15 X4 ACCEPT Z-4 ACCEPT Z-4 ACCEPT C C ACCEPT (XC displayed) 0 ACCEPT (ZC displayed) -4 ACCEPT E (Turns 4mm rad. C-Clockwise)

B16 X6 ACCEPT Z-16 ACCEPT F10 ACCEPT E (Turns taper)

B17 Z-21 ACCEPT F10 ACCEPT E (Turns 12 dia. x 5mm long))

B18 X8 ACCEPT Z-23 ACCEPT F4 ACCEPT CA ACCEPT XC displayed) 8 ACCEPT (ZC displayed) -21 ACCEPT E (Turns 2mm rad.)

B19 Z-28 ACCEPT F10 ACCEPT E (Turns 16mm x 5mm long)

B20 X11 ACCEPT Z-31 ACCEPT F4 ACCEPT CA ACCEPT (XC displayed) 11 ACCEPT (ZC displayed) -28 ACCEPT E (Turns 3mm rad.)

B21 X13 ACCEPT Z-36 ACCEPT F10 ACCEPT E (Turns taper)

B22 Z3 ACCEPT F100 ACCEPT E (Tool clears end of workpiece)

LOAD ACCEPT

E ACCEPT