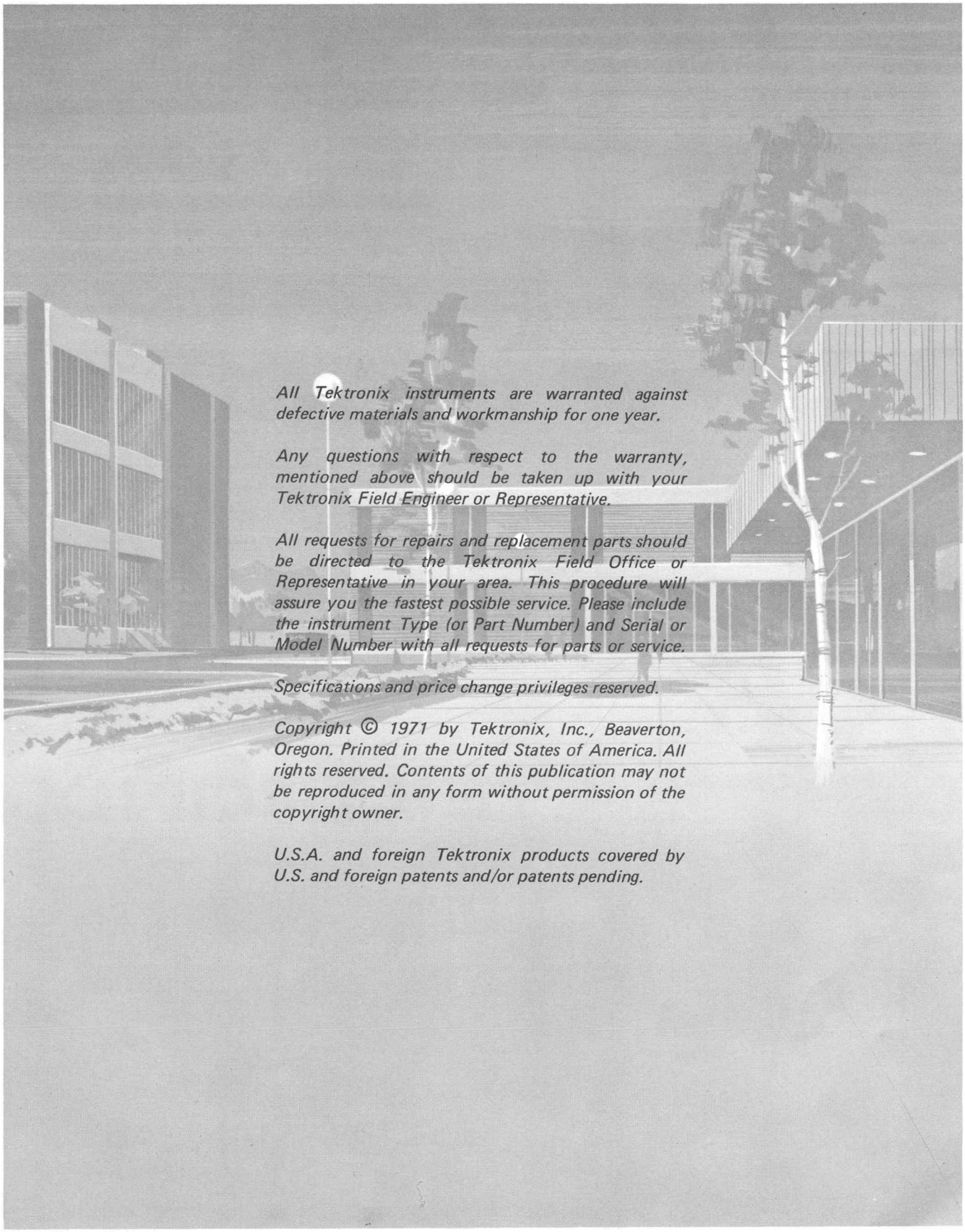
TEKTRONIX®

1711 MACHINE CONTROL UNIT

USERS MANUAL



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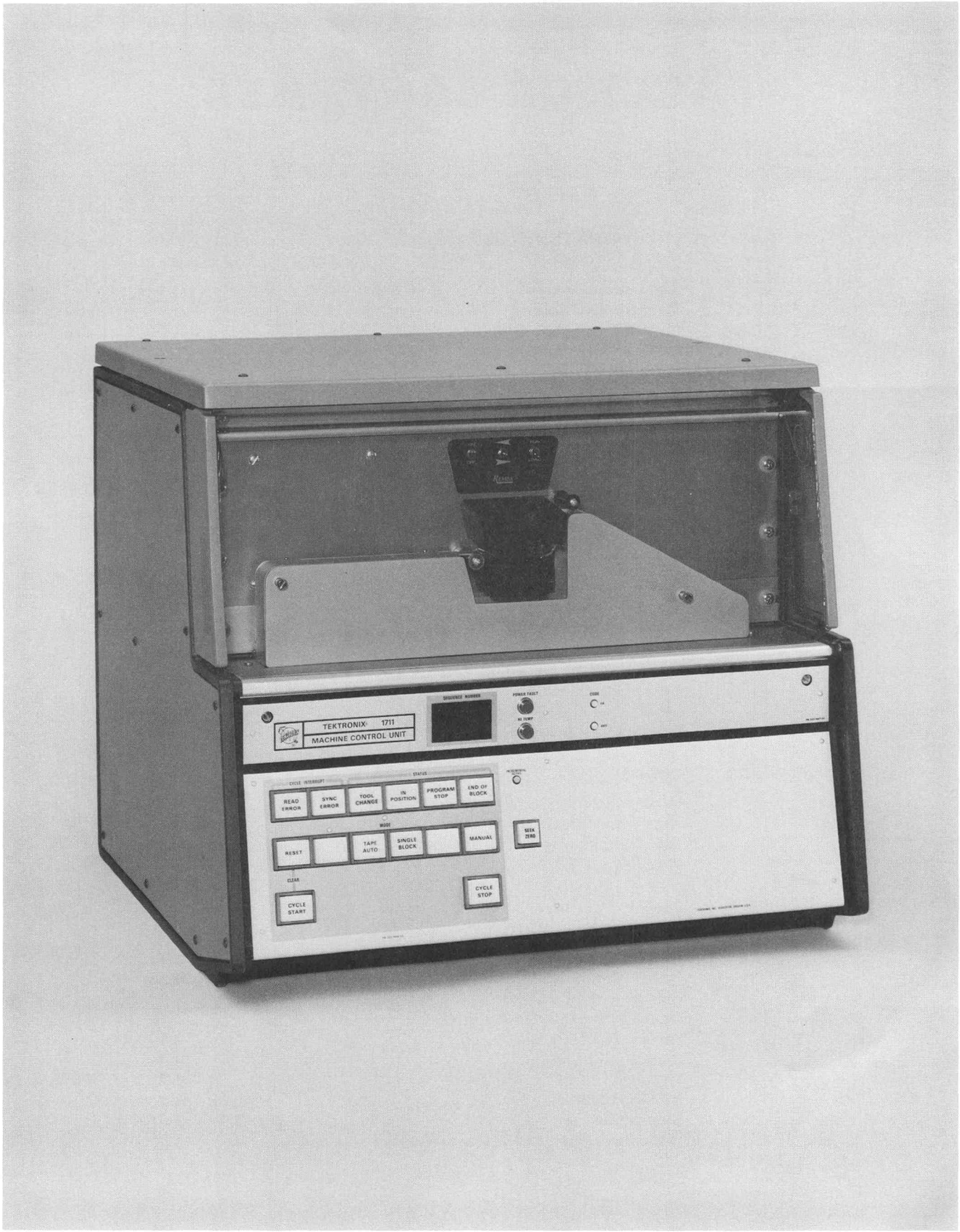

Fig. 1-1. The 1711 Machine Control Unit.

SECTION 1
CHARACTERISTICS

Introduction

The Tektronix 1711 Machine Control Unit is designed to translate digital data inputs into servo and switching signals for controlling point-to-point motion and auxiliary functions of 2-axis, point-to-point machines. The basic Machine Control Unit shown in the Frontispiece incorporates integrated circuit logic on modular plug-in circuit cards, power supplies, an operator's console, and a tape reader.

The characteristics that best illustrate the capabilities of the basic 1711 Machine Control Unit are as follows:

Standard Features

a. Two axis point-to-point positioning.

b. Word address, trailing zero, variable block format.

c. Closed loop servo with position feedback from position encoders.

d. Resolution to 0.0001 inch.[1]

e. Automatic control of deceleration.

f. Maximum positioning rate of up to 400 inches per minute (ipm) depending on controlled machine.

g. Four quadrant absolute and incremental programming.

h. Axis departure range of 0 to ±99.9999 inches.

i. Full floating zero.

j. Unidirectional approach incorporating automatic backlash takeup. This feature can be removed at the customer's request.

k. Pushbutton–initiated return of slides to table zero reference position.

l. Included preparatory functions:

1. g90–absolute dimension mode; axis commands are referenced to the floating zero position. Control is set to this mode at turn-on.

2. g91–incremental dimension mode; axis commands are referenced to the point of departure. Control remains in this mode until g90 is decoded or the control is reset.

m. Included miscellaneous functions:

1. m00–programmed stop.

2. m02–end of program.

3. m03–spindle on clockwise.

4. m04–spindle on counterclockwise.

5. m05–spindle off.

6. m06–tool change stop.

7. m07–flood coolant on.

8. m08–mist coolant on.

9. m09–coolant off.

10. m30–end of program, tape rewind.

11. m31–z-cycle inhibit.

Single relay closure outputs are brought to the rear panel connector for m03, m04, m05, m06, m07, m08, and m09.

[1] **Accuracies given apply only to a standard 1711 that is properly adjusted and operating within the temperature ranges specified by the manufacturer.**

Relay closure outputs in BCD form are brought to the rear panel connectors for m00 through m99.

n. The input coding is switchable; EIA RS 244 or RS 358 (ASCII).

o. Z-cycle initiating signal; upon completion of each commanded axis move a relay closure is provided to activate the customer's z-cycle routine. Customer must provide switch closure feedback to indicate completion of cycle.

p. Filtered cooling air maintains cabinet under positive air pressure.

q. Tape reading speed is 150 characters per second with tumble bin.

r. Three digit sequence number readout.

Standard Accessories Include:	Tektronix Part No.
1 1711 User's Manual	070-1275-00
1 1711 Maintenance Manual	070-1276-00
1 Tape Reader Manual	
1 Mating Power Twistlock Connector	131-0170-00
1 Machine Interface Connector	131-0239-00
2 Transducer Interface Mating Connectors	134-0049-00
1 Circuit Card Extender	670-1329-00
1 Check out Tape	

Optional Accessories

Manual timing unit This is a manually controlled (push-button) timing unit for use in operational testing.	067-0031-00
Auxiliary Operating Panel	015-0207-00

No-Cost Options

Metric Operation. Provides calibration in metric units in place of English units.

Leading Zero Programming. This option changes the operation of the 1711 so that leading zeros (in the axis commands) must be programmed, but trailing zeros are not required. This is for those installations where programming trailing zeros in the axis commands is more of a chore than programming leading zeros.[2]

Choice of System Resolution and Positioning Rate. Through wiring changes the 1711 can be provided with 0.0002-inch resolution and a maximum positioning capability of 600 ipm or with 0.001-inch resolution and a maximum positioning capability of 1000 ipm.

Choice of Deceleration Characteristics. The deceleration curve is exponential. The slope of the curve can be changed to give up to 1.75-inch deceleration distance (or up to 500 ms deceleration time, (see Figure 1-2).

Additional Cost Options

Jog Control. Provides direction pushbuttons and variable jog rate control to enable manual positioning of controlled machine slides.

S Functions. Provides spindle speed control. Spindle speed is programmed via two-digit codes with output in Binary-Coded Decimal.

T Functions. Provides programmed selection of tools. Tool selection is programmed via two-digit codes with output in Binary-Coded Decimal.

Mirror Image. Provides mirror image of part in X and/or Y axis.

Fixed Cycle (g80 Series) Initiation. Provides two-digit preparatory function decoding with Binary-Coded Decimal output. Mid and end-of-cycle feedback is required with dwell provided by customer's timer and switches.

Tape Reader With Spoolers (4 inch or 7 inch diameter spools). Provides longer tape handling capability. Thus, the 1711 is not restricted to short tapes, as is the case with the tumble bin.

Manual Data Input. Provides for manual insertion of data for all programmable functions through front panel lever switches.

Data Display. Provides front panel readout display of all programmable data, plus position data for each axis.

[2]**These options require nothing more than a few wire changes.**

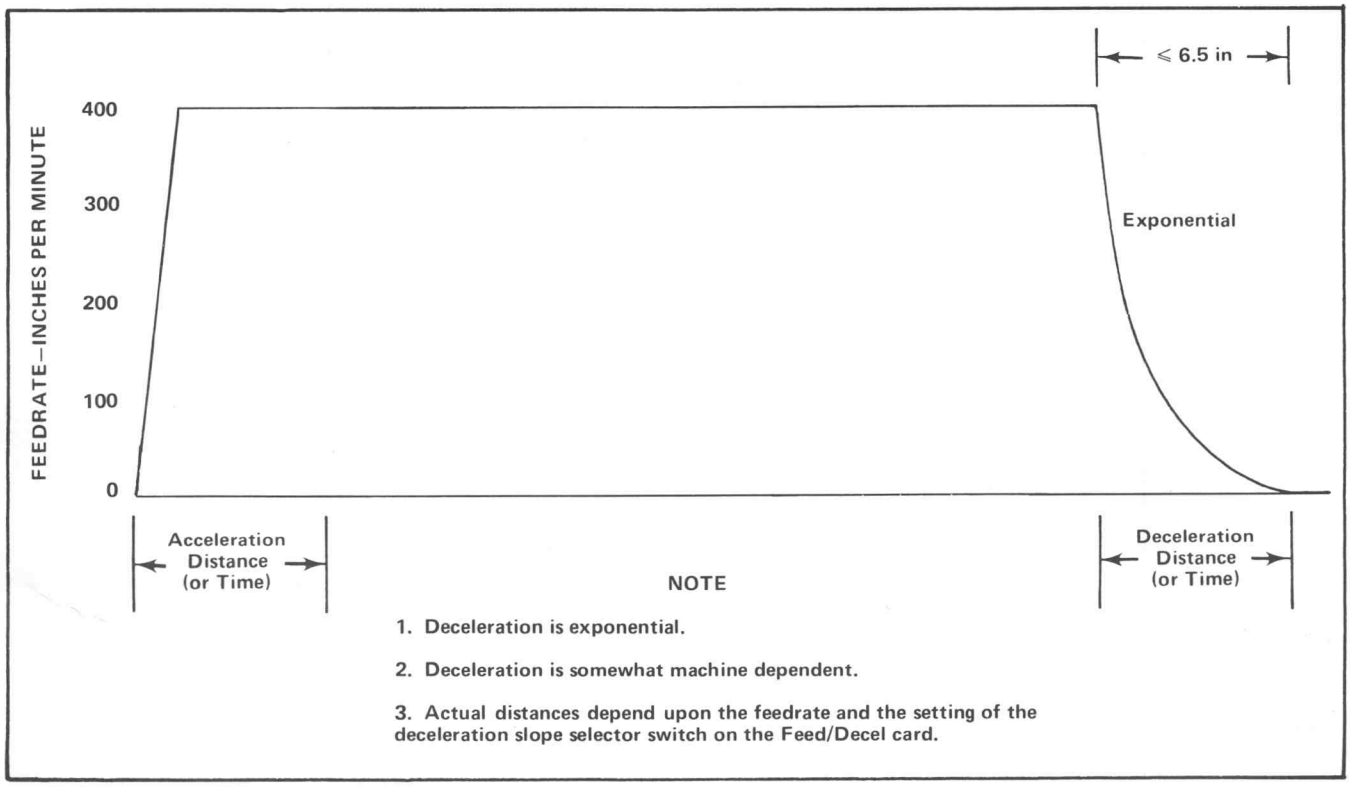

Fig. 1-2. Typical Acceleration/Deceleration Curve for a standard 1711 having a maximum feedrate of 400 inches per minute and 0.0001" resolution.

Sequence Number Search. Permits an operator to dial in a sequence number and cause the control to locate that sequence number on the tape and stop.

Block Repeat. Permits an operator to cause the tape to back up one block and repeat the reading of that block.

Increased Axis Departure. Allows the command range of each axis to be positioned from 0 to ±800 inches.

NOTE

Options from the foregoing listing that are determined to be required in a particular installation should be specified when ordering a 1711.

Control Inputs

The tape control input accepts one-inch wide, eight track punched tape as per EIA RS 244 or RS 358 (ASCII). Word address, variable block format programming is used.

The feedback signals used by the control in conjunction with m, t and g functions are from Form A or Form B relays supplied by the customer.

Input signals from the transducers should be square-wave pulses. The standard control is wired for 2500 encoder pulses per inch of axis travel, but can be wired for the following resolutions and encoder outputs:

CONTROL RESOLUTION	ENCODER PULSES PER INCH
0.0001 inch	5,000
0.0001 inch	10,000
0.0002 inch	1,250
0.0002 inch	2,500
0.0002 inch	5,000
0.001 inch	250
0.001 inch	500
0.001 inch	1,000

Output Signals

The analog output voltages from the X and Y servo cards are designed to drive servo amplifiers and have a maximum output amplitude of +12 to −12 volts. Output impedance is 600 Ω ±15%. Relay closures capable of switching a maximum load of 24 volts at 250 milliamperes are provided for driving miscellaneous (m) functions. The m function drive signals are accessible at the rear panel connectors. In addition, the control supplies +5 V (1 ampere maximum) for the position transducers.

Tabulation of Design Characteristics

The following tables provide the reference information necessary when designing the 1711 into a numerically-controlled machine system.

TABLE 1-1

OPERATING CHARACTERISTICS

Item	Characteristic
System Resolution	0.0001 inch
COMMAND Register Range	−99.9999 to +99.9999 inches each axis
Maximum Slide Departure	±99.9999 inches each axis
POSITION Register Range	−99.9999 to +99.9999 inches
Maximum Positioning Rate	400 inches per minute (.0001 resolution)
Floating Zero	Full Range
Deceleration	Automatic (See Fig. 1-2)
SEQUENCE NUMBER Readout	0 to 999
Basic Clock Rate	3.5 MHz, within 4%
Logic Type	TTL Series 74N logic and TTL 9000 defined in terms of positive logic using the following definitions: Low Voltage Level—Logic 0 High Voltage Level—Logic 1
Input Power Requirements	90 V to 132 V or 180 V to 264 V, 400 W, 48 to 66 Hz.

TABLE 1-2

PHYSICAL CHARACTERISTICS

Item	Characteristic
Height	18.5 inches
Width	20.5 inches
Depth	20.5 inches
Weight	110 pounds
Finish	Vinyl painted, cast aluminum sides, anodized aluminum front panel, top cover is vinyl painted aluminum plate.
Mounting	Four 5/16-inch X 18 tapped holes in the bottom.

TABLE 1-3

ENVIRONMENTAL CHARACTERISTICS

Item	Requirement
Temperature (Ambient)	
Non-operating	−40°C to +60°C
Operating	+10°C to +50°C
During Calibration	+20°C to +30°C, 1/2 hour stabiliztion period required.
Humidity	to 98%

NOTE

If the 1711 is to be operated in an extremely dirty or corrosive atmosphere, maintenance problems can be kept at a minimum by providing the 1711 with a clean air supply piped to the air filter inlet.

SECTION 2
OPERATING INSTRUCTIONS

Introduction

The 1711 Machine Control Unit is a two-axis, four quadrant, point-to-point control. While the control normally interprets dimensions as being absolute, programming a g91 changes it to incremental dimension mode. Commands on the tape that direct machine slide movements to a precise location are planned in accordance with the two-axis coordinate system. Coordinates are given as absolute (or incremental) dimensions with a positive or negative value relative to the zero point. The longitudinal travel of the carriage or tool defines the X-axis. The transverse (cross) travel defines the Y-axis. Through the use of programmable m (miscellaneous) functions, the 1711 can also be programmed to command miscellaneous machine functions such as stopping axis motion, starting coolant, and rotating the table. The number of controlled machine functions and the manner in which they are controlled depend upon the operating mode selected.

For those already familiar with machine control units, the Short-Form operating procedure is given in Fig. 2-1. The following text gives detailed operating instructions.

FUNCTION OF CONTROLS AND INDICATORS

SEQUENCE NUMBER (See frontispiece)

Reads out the sequence number being read by the Tape Reader.

READ ERROR

This pushbutton lights (red) whenever an invalid reading from the tape reader has been detected. Push to cancel the indicator, then back the tape up to the word before the word in which the error occurred.

Operating Mode						
MANUAL	Use Jog Control or machine handwheels. Set machine to desired zero reference point. Set zero by pressing RESET & CYCLE START. If table zero is used as reference, just press SEEK ZERO Pushbutton.					
SINGLE BLOCK		Load tape, turn on Tape Reader	Press SINGLE BLOCK and CYCLE START	Check that machine goes to commanded coordinates.	Press CYCLE START	
TAPE AUTO		Load tape, turn on Tape Reader	Press TAPE AUTO and CYCLE START	If machine stops on programmed stop, take action called for (tool change, etc.)	Press CYCLE START	

NOTE:

Pressing RESET and CYCLE START in sequence clears all the registers and sets the floating zero. If an overshoot error occurs, press CYCLE STOP, the mode switch for the desired mode, then CYCLE START. If this does not clear the error, start the program over. If a read error occurs, back the tape up to the previous block, push the READ ERROR pushbutton, the desired mode switch, and CYCLE START. Do not change modes while the controlled machine is moving.

Fig. 2-1. Short-form operating procedure.

SYNC ERROR

This indicator lights (red) whenever the controlled machine is for some reason unable to comply with the commands. Procedures for correcting sync errors are given later in this section.

POWER FAULT

This lamp lights (red) whenever the power supply is unable to deliver the proper voltage (line voltage either high or low, or trouble in the power supply proper). Turning off the equipment power automatically unlatches the protective devices. After the equipment has been turned off for 5 seconds, turn the power back on and operation should be normal if the conditions that caused the shutdown were momentary.

RESET

In combination with CYCLE START, this pushbutton resets all registers to zero and clears the 1711. The control unit is automatically reset each time the power is turned on.

CYCLE START

This pushbutton executes the operation or sequence of operations that have been selected.

CYCLE STOP

This pushbutton interrupts the sequence of operation selected.

TAPE AUTO

When this pushbutton and CYCLE START are pressed, the 1711 will proceed automatically through programs punched on the tape.

SINGLE BLOCK

Pressing this pushbutton, then pressing CYCLE START, causes the 1711 to read and execute the commands in a single block of tape. This permits the operator to step through the program block-by-block.

MANUAL

Pressing this pushbutton permits conventional manual control of the controlled machine.

END OF BLOCK

This lamp indicates that the reader has completed transferring the data in one block of tape into the 1711.

PROGRAM STOP

This lamp lights whenever the tape reader reads a program stop code.

IN POSITION

Indicates that the controlled machine has reached the commanded position.

SEEK ZERO

This pushbutton causes the controlled machine to move at a fast positioning rate to the axis limits and reset the axes position registers to zero at the moment the controlled machine reaches table zero. This feature requires that the encoders used incorporate a zero reference track.

INCREMENTAL ACTIVE

This lamp indicates the control is operating in incremental mode (due to reading a g91).

EIA, ASCII (behind front panel)

This two-position switch provides selection of input tape coding and illuminates a panel lamp to indicate which of the two settings is being used.

HI TEMP

Indicates (red) when 1711 internal temperature exceeds +50°C.

EXTERNAL CONNECTORS

J401

This connector (See Fig. 2-2) makes the necessary connections to the X-axis transducer.

J411

This connector makes the necessary connections to the Y-axis transducer.

J431

This connector makes the necessary connections to the Machine Interface Unit.

MODES OF OPERATION

The 1711 can be operated in Tape Auto, Tape Single Block and Manual Modes.

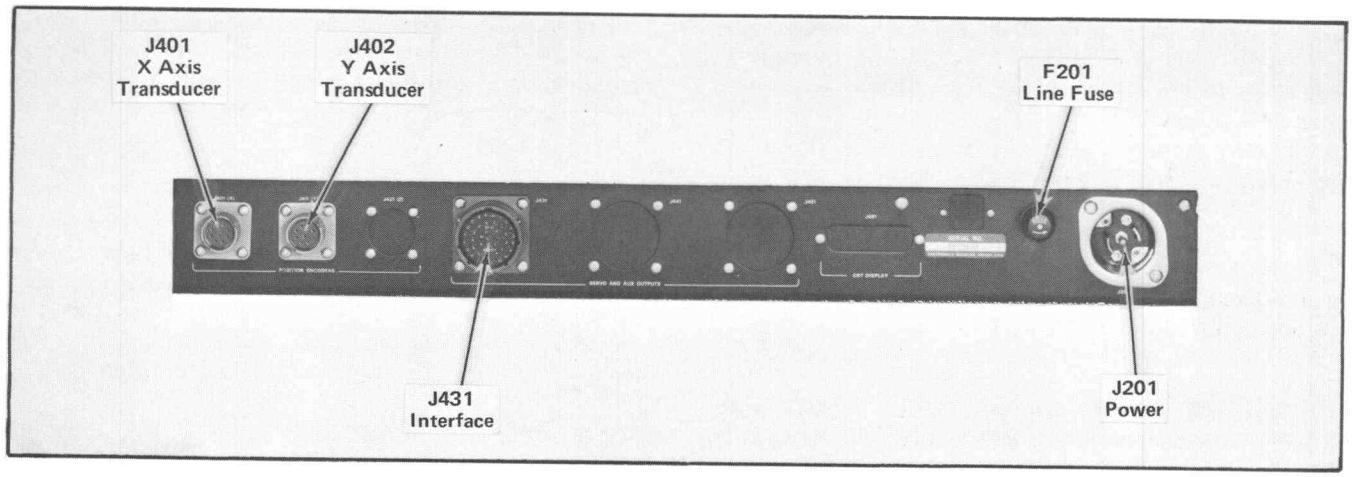

Fig. 2-2. 1711 rear panel connectors.

Tape Auto and Single Block Modes.

In the Tape Auto Mode, the 1711 proceeds through the program on the tape until the program is completed, a tape or sync error is encountered, or the operator interrupts the program. In the Single Block Mode, the 1711 executes the commands in one block of tape, then waits until directed to operate on the next block of tape. To enter either of these modes of operation, press the appropriate pushbutton switch (TAPE AUTO or SINGLE BLOCK). Once the operating mode is selected, pressing the CYCLE START pushbutton executes the program.

Manual Mode.

In the Manual Mode, the operator can position either of the machine slides to a precise location by means of the machine handwheels or jog control.

NOTE

If it is necessary to change operating modes before the machine reaches a normal stop, press the CYCLE STOP pushbutton to stop the machine.

FIRST TIME OPERATION

Turn on the Equipment. Since the 1711 relies on the controlled machine for its power source, this means that the controlled machine must be turned on.

CAUTION

Read through these operating instructions before actually operating the equipment.

Establishing the Zero Reference

Floating Zero. The first requirement before machine operation is the establishment of the floating zero point. Generally, the floating zero is set to correspond to the point from which all dimensions originate on the part print or programmer's layout sheet. The full floating zero is coordinated with the slide travel by picking a setup point common to both axes. The point may be placed outside the actual part, but must lie within the machine slide area. Since four-quadrant programming is available, the zero point may be positioned such that the programmed points can have either positive or negative values. (Any inconvenience of handling negative numbers is outweighed by the reduction in arithmetic, since identical numerical values may be used with only the sign having to be changed.)

Absolute (Table) Zero. If the controlled machine is set-up for Seek Zero function (encoders used must incorporate a zero reference track), simply push the SEEK ZERO pushbutton. The 1711 will automatically cause the controlled machine to move at a fast positing rate to the axes limits and reset the axes position registers when the controlled machine reaches table zero. This establishes the absolute zero reference.

If the encoders used do not incorporate a zero reference track, the machine operator must manually position the controlled machine to the lower limits of each axis, backing off from each lower limit one inch, then press the RESET and CYCLE START pushbuttons. The position registers are now cleared, and the zero reference is set one inch from the lower limits of each axis.

The setup position is defined by the programmer. Correct coordinate programming is easier if the programmer thinks in terms of the tool moving in relation to the zero point on a fixed work piece. (If, for example, the programmer wanted the reference point somewhere near the center of the part, then all points from the reference point towards the 3 o'clock position would have positive X values, and all points towards the 9 o'clock position would have negative X values; all points towards the 12 o'clock position would have positive Y values, and all points towards the 6 o'clock position would have negative Y

values. The directions given above are not necessarily true for every installation.) The machine operator must manually position the machine to the defined zero point. Set-up is as follows:

1. Press the Front Panel Manual pushbutton.

2. Using the machine handwheels (if the JOG option has been ordered, use the JOG control) move both axes to the position defined by the programmer.

3. Press the RESET, then the CYCLE START push-buttons. This again clears the control and sets the position registers at the defined floating zero point. (Do not clear the control again until it is necessary to establish a new zero point or to correct a sync error.)

TAPE MODE OPERATION

(TAPE AUTO AND SINGLE BLOCK)

Loading the Tape Reader

If the control unit has a tape reader with spools, follow the loading procedure given in the tape reader instruction manual. If the tape reader uses a tumble bin instead of spools, follow the loading procedure given below:

1. Open the hinged, transparent cover that protects the tape reader. Set the RUN-LOAD switch to LOAD. Loosen the thumbscrews (one on each side) that hold the front cover of the tumble bin in place. Remove the front cover of the tumble bin.

2. Locate the leader portion of the tape. Fold (do not crease) the tape into the tumble bin so that the leader portion and splice are on top. The sprocket holes must be on the side of the tape away from the operator.

3. Route the leader portion of the tape over the plastic rod in the upper left (your left) corner of the tumble bin.

4. About an inch below the drive sprocket, there is a spring projecting from the right side of the read head. Pull this spring toward you about 1/4 inch, or until it snaps into its upper position. This spring releases the lower tape guide. Pull down the lever on the upper side of the lower tape guide, and set the lower tape guide to its open position.

5. Thread the tape over the left tape-guide roller, under the sprocket wheel, and then through the channel between the upper and lower metal guides that lead the tape to the right side of the tumble bin. (The upper-right tape-guide roller is not used.)

6. Push the lower tape guide (under the right side of the sprocket wheel) to its upper position and hold it there. Press down on the tension spring (mentioned in step 4 above) and then push it back into the slot and under the shoulder in the lower tape guide. The spring will now hold the lower tape guide in its upper or closed position.

7. See that the tape is dressed neatly within the guides and tumble bin. Replace the tumble bin front cover. The tape reader is now loaded.

Operation

Turn the equipment and tape reader on. Set the floating zero as previously explained. With the tape properly loaded in the tape reader, press either the TAPE AUTO or SINGLE BLOCK pushbutton, then press the CYCLE START push-button.

NOTE

If a sync error occurs when operating in one of the tape modes, the 1711 automatically goes into a reset condition. To clear the sync error, try pressing CYCLE STOP, then either the TAPE AUTO or SINGLE BLOCK pushbutton, then the CYCLE START pushbutton. This will clear most sync errors. If the foregoing procedure does not clear the sync error, it is necessary to return the controlled machine manually to the zero reference point, return the tape to the beginning, and start the operation over again. The two most probable causes of a sync error are: (1) servos too fast for the encoders, or (2) the controlled machine overshoots a point.

Manual Mode Operation

To obtain manual operation of the machine, simply press the MANUAL pushbutton. This will give complete control of the machine to the operator by means of the machine handwheels. If the controlled machine is moving, either wait until it reaches its normal stop point, or press CYCLE STOP before changing operating modes.

SECTION 3
CODING

Introduction

This section describes the coding requirements for the standard 1711 Machine Control Unit.

Tape Terminology

The following terminology applies to punched tape used in tape-controlled machines.

Character. A character is a set of punched holes that represents a letter, a digit, a punctuation mark, a mathematical symbol, etc.

Row. A row is a path of holes perpendicular to the edge of the tape where the holes for one character are located.

Channel. A channel is a path parallel to the edge of the tape that can contain a hole or no hole, depending on the characters. There are eight channels on the tape used in the 1711.

Word. A word is a combination of characters that represents an axis command, a sequence number, or a function, etc. In the 1711, the first character in each word must be a letter address code; for example:

n049 x143172 y030000 m05

The first word is the sequence number, the next two words are axis commands, and the last word is a miscellaneous function command.

Block. A block is a combination of words that represents one complete sequence of commands. In the 1711, block length is variable, since the block needs to contain only those command words that have changes from the previous block. If only one axis or function is changed from the previous block, the block can consist of only one word.

Tape Format

The standard tape format is binary-coded-decimal, variable block, word address; punched on 8-channel, 1 inch wide tape (see Fig. 3-1) as per EIA standard RS 244A or RS 358. The tape reading speed is 150 characters per second.

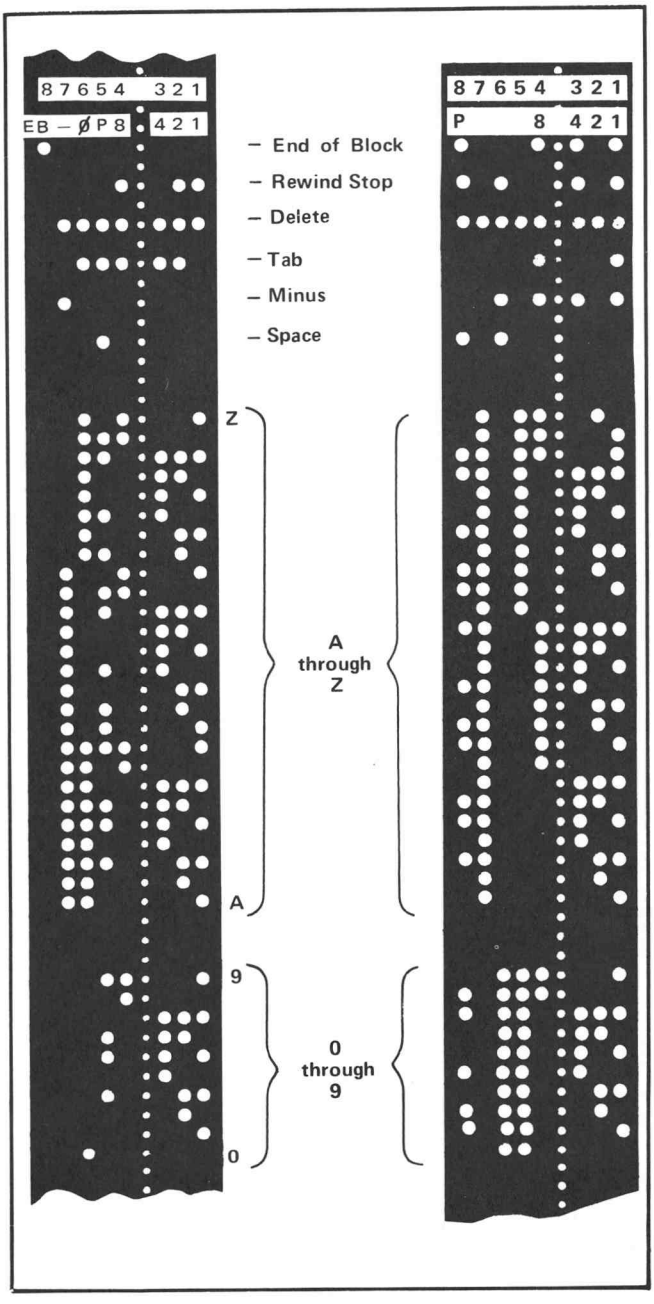

Fig. 3-1. EIA (left) and ASCII (right) coded tapes as used in the 1711. The tape used is eight channel, 1 inch wide.

In the word address system, the letter part of the word gates the word into the proper register.[1] The word order within the block does not affect the operation of the 1711; however, words are normally entered on the programming manuscript[2] (see Fig. 3-2) in the following manner:

n3 g2 x2.4 y2.4 m2 EOB

In the foregoing block, the letters constitute the address part of the words. The n3 indicates a 3-digit sequence number (e.g., n030); it is necessary to program leading zeros as well as trailing zeros in the sequence number. Use of the sequence number is optional; the 1711 will accept tape without sequence numbers. The g2 is a 2-digit preparatory function code. The x2.4 is a 6-digit X-axis coordinate in inches, with two places to the left of the decimal point and four places to the right (the standard 1711 interprets axis commands as being expressed in multiples of one ten-thousandth of an inch). Do not punch the decimal point.

NOTE

Leading zeros before the significant figures need not be programmed in axis commands. The sequence number and all function codes require leading zeros.

The y2.4 follows the same rules as the x2.4 as explained in the preceding paragraph. The m2 is a 2-digit miscellaneous function code (e.g., m02, m30). EOB is the end-of-block code; in the EIA code, this is the only legal hole to ever appear on the tape in channel 8.

Punching the Tape

It is assumed that the program tape for the 1711 will be punched in odd parity, EIA code, on a Friden Flexowriter ® or similar machine. Any coding (such as punched identifiers) in the leader prior to the first EOB will be ignored. If an error is punched into the tape, back the tape up and over-punch the error with the delete code. EOB is an exception to the foregoing. If EOB is inadvertently punched, delete all the tape between the erroneous EOB and the previous EOB (punching the delete code over an EOB results in a parity error). Do not feed blank tape anywhere within the program, as this will cause a parity error. If the tape feed key is accidentally pressed and blank tape is fed within the program blocks, overpunch the blank tape with the delete code.

When punching the tape, the following rules must be observed:

a. Rewind Stop. This code must occur before the first block of tape. Its purpose is to automatically stop the tape reader when the tape is automatically rewinding. This code is punched when the stop code (EIA) key on the Flexowriter is pressed. The stop code in ASCII is the percent (%) sign. Rewind is not used with those 1711 units equipped with a tumble bin.

b. EOB. An end-of-block code must precede the first block. The EOB tells the 1711 that everything that has gone before is finished, and the next block of tape can be read. Thus, it follows that every block must be terminated with an EOB (carriage return) code.

c. Sequence Number. The letter n followed by three digits in any combination can be used as a reference designation for block or sequence locations.

d. Letter Address. A single-letter address must precede each word.

e. Repetitive Words. Need not be re-entered (except m00, m02, and m30).

f. Decimal Points. Decimal points must NOT appear on the tape. The standard 1711 interprets axis commands as being expressed in multiples of one ten-thousandth (0.0001) as previously explained.

g. Plus Signs. Need not be programmed.

h. Minus Signs. Minus signs must be programmed because of the control's four-quadrant programming feature.

i. Leading Zeros. Need not be programmed in axis commands. However, if an axis position command is zero, a zero must be programmed (x0, y0) since the 1711 does not interpret the absence of a number as zero[3]. The sequence number and all function codes require leading as well as trailing zeros.

j. Trailing Zeros. Must be programmed (e.g., x1.1 is programmed as x11000).[3]

[1] The letter-address feature permits the operator to enter the TAB code and other annotations into the tape. So long as the entries are not preceded by one of the address letters, the information will be ignored by the 1711.

[2] Blank 1711 programming manuscript worksheets as shown in Fig. 3-2 can be ordered from Tektronix, Inc., in pads of 100. Order by Tektronix Part No. 070-1277-00.

[3] Trailing zeros can be omitted in the axis commands if the no-cost leading zero option is selected. In j above, the 1.1 is programmed x011 if the control has the leading zero option installed.

TEKTRONIX, INC. POINT-TO-POINT N/C PROGRAMMING MANUSCRIPT

SEQ NO N	PREP FUNC G	AXIS			SPNDL S	TOOL NO T	MISC FUNC M
		X	Y	Z			

Fig. 3-2. Programming worksheet for the 1711.

k. Positioning Rates. Positioning rates are not programmable. (Depending on the controlled machine, a maximum positioning rate of up to 400 inches per minute is standard.)

l. Programmed Stop (m00). The programmed stop occurs after any motions programmed in the block in which the m00 is punched are completed.

m. End of Program-Rewind (m30). This functions is identical with m00 except that automatic tape rewind is also performed.

n. Preparation Mode (g90 and g91). The two listed functions (g90, absolute programming and g91, incremental programming) are the only g functions included in the standard 1711. Additional g functions are available on special order.

SECTION 4
SERVICING

Introduction

This servicing procedure lists only the preventive maintenance things that the operator should be able to perform without inadvertently introducing real troubles into the equipment. Detailed maintenance procedures are given in the Maintenance Manual for the 1711.

WARNING

The line voltage input and the supply for the readout lamps exceed 100 volts, and are therefore considered to be dangerous. Do not put hands or tools inside the cabinet unless the danger points have been identified, or adequate safety precautions have been taken. See Fig. 4-1 and Fig. 4-2.

Opening the Equipment Cabinet

Use a screwdriver with a 1/4 inch blade to loosen the quick-release screw fasteners at the upper corners of the control panel. The rear panels and the interior air baffle are held in place by knurled fasteners.

Removing the Tumble Bin

Use a Phillips or Posi-drive screwdriver to remove the six screws shown in Fig. 4-3. Slowly pull the upper part of the tumble bin straight out, shifting it slightly up and down to clear the read head assembly. Once the upper part of the bin is removed, tip the lower part of the bin outward, then carefully remove it.

Reverse the foregoing procedure to re-install the tumble bin.

Removing the Tape Reader

Because of the mechanics involved, the Tape Reader will probably be the major source of trouble in the 1711. It is strongly recommended that the maintenance schedules and procedures given in the Tape Reader instruction manual be observed.

To remove the Tape Reader, it is necessary to first unplug the interconnecting cables that attach to the back of the Tape Reader. See Fig. 4-2. To obtain access to the cable plugs, first turn off the power, then remove the top panel at the rear of the 1711. Next, unlatch the quick-release screw fastener at the top center of the power supply chassis. Swing the power supply chassis out and down. The Tape Reader interconnecting cables and fuse can now be reached.

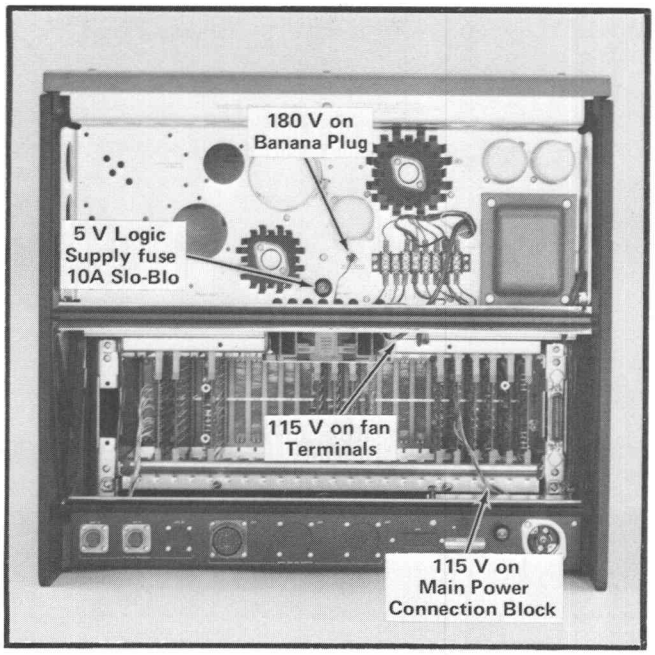

Fig. 4-1. Location of dangerous voltage points.

Changing the Tape Reader Fuse

Get at the fuse as described in the preceding paragraph.

PREVENTIVE MAINTENANCE

General

Preventive maintenance consists of cleaning, visual inspection, and lubrication. Preventive maintenance is generally more economical than corrective maintenance, since it can usually be done at a time convenient to the user. The preventive maintenance schedule established for the instrument should be based on the amount of use and the environment in which the instrument is used. Maintenance procedures for the tape reader are given in the tape reader instruction manual.

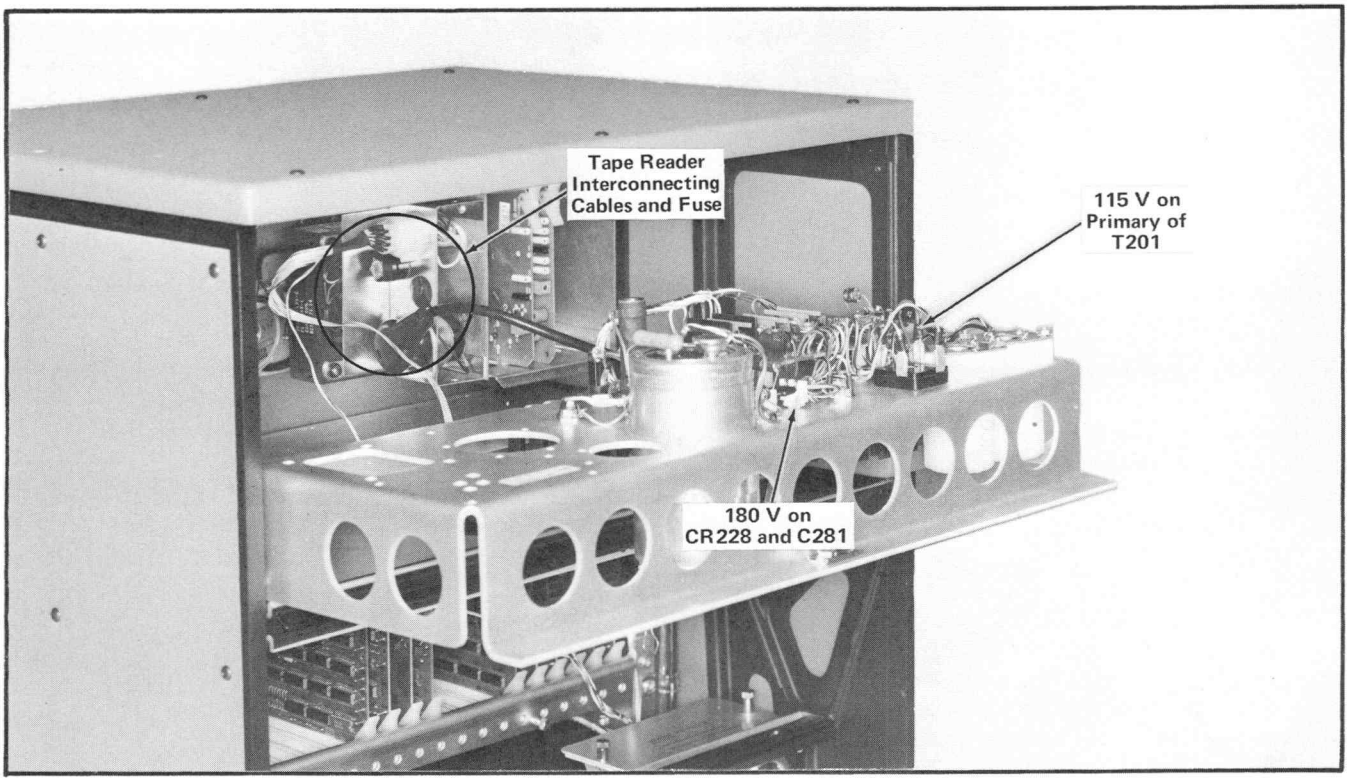

Fig. 4-2. Top-rear view showing power supply chassis and Tape Reader interconnecting cables.

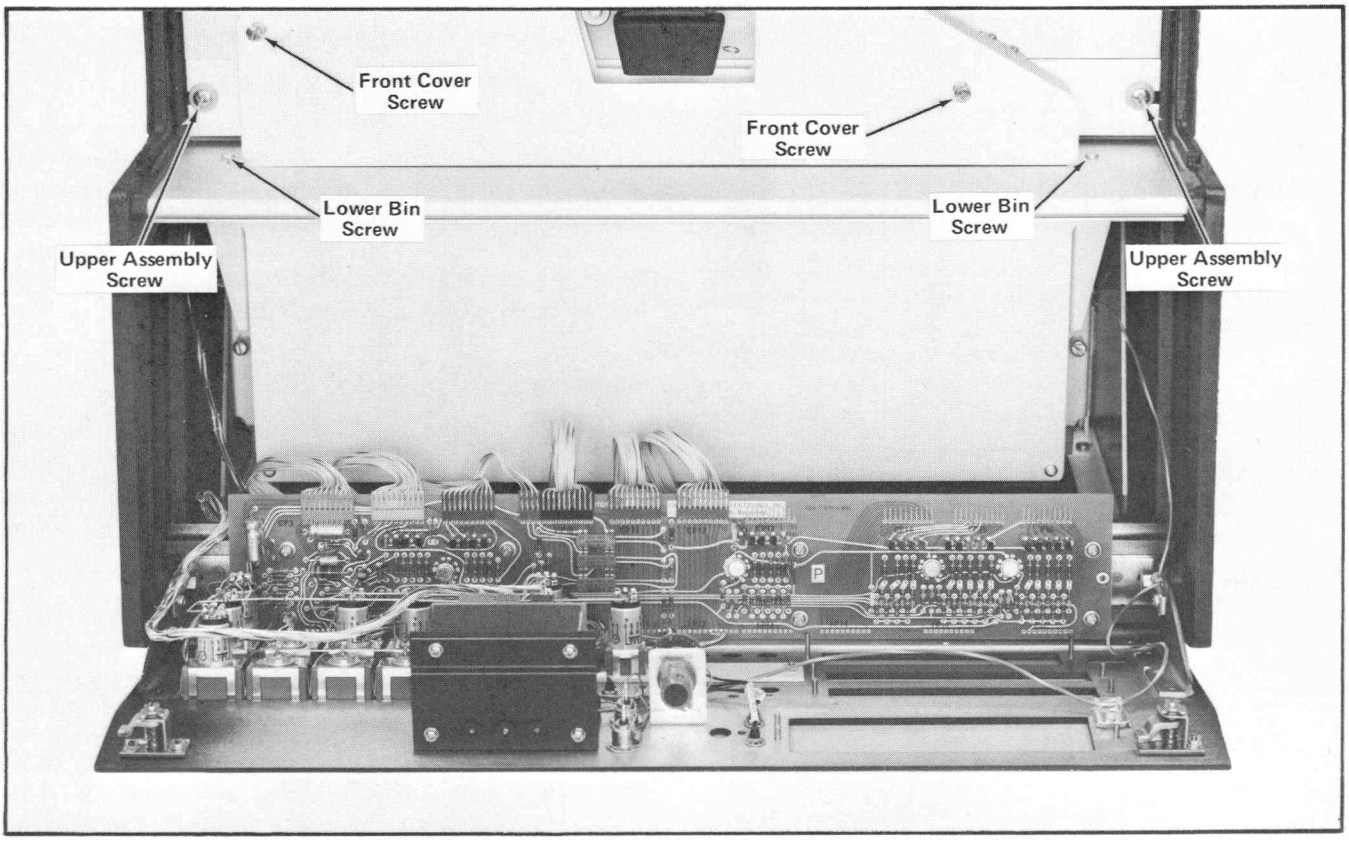

Fig. 4-3. Location of screws holding tumble bin in place.

Cleaning

Clean the air filter as often as operating conditions require. If it is found that the air filter gets loaded with dirt every few days, or if the instrument is used in a corrosive atmosphere, it is desirable to pipe a supply of clean dry air directly to the air filter inlet.

Maintenance problems can be kept at a minimum if dirt and corrosive vapors can be kept out of the equipment. Dirt on the components acts as a thermal insulating blanket (preventing efficient heat dissipation) and may provide electrical conducting paths. Corrosive vapors usually attack switch contacts first, then the plug-in circuit card connectors, and finally the etched circuitry where it is vulnerable. The fan keeps the cabinet slightly pressurized, helping to keep foreign matter out of the cabinet, but if the air filter gets dirt laden, or if the atmosphere is corrosive, trouble will eventually result.

Clean the instrument by loosening accumulated dust with a dry, soft paint brush of 1/2 or 1 inch size. Remove the loosened dirt with a vacuum cleaner. The nozzle on the vacuum cleaner hose should be a narrow plastic nozzle, such as those used for cleaning steam radiators. Hardened dirt and grease can be removed with a cotton-tipped swab or a soft cloth dampened with water and a mild detergent solution (such as Kelite or Spray White). Abrasive cleaners should not be used.

CAUTION

Since the 1711 is generally used in an environment where there are conductive metal chips or abrasive materials about, do not use compressed air for cleaning these instruments. Be careful not to short connectors when cleaning the wire-wrap connector board. Do not permit water to get inside controls or shaft bushings. Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Some chemicals to avoid are benzene, toluene, xylene, and acetone.

Visual Inspection

After a thorough cleaning, the instrument should be carefully inspected for such defects as damaged parts, frayed cables, loose connections, and dirty circuit card contacts. (Use a non-abrasive pencil eraser to polish any corrosion or dirt off the circuit card contacts.) The remedy for most visible defects is obvious; however, if heat-damaged parts are discovered, the cause of overheating should be determined before the damaged parts are replaced, otherwise the damage may be repeated.

Lubrication

The tape reader should be lubricated in accordance with the instructions given in the tape reader instruction manual.

Integrated Circuit and Transistor Checks

The integrated circuits and transistors in the 1711 are soldered in place and should be removed only by authorized maintenance personnel in the course of corrective maintenance. The circuits within the instrument provide the only satisfactory check on transistor and integrated circuit performance.