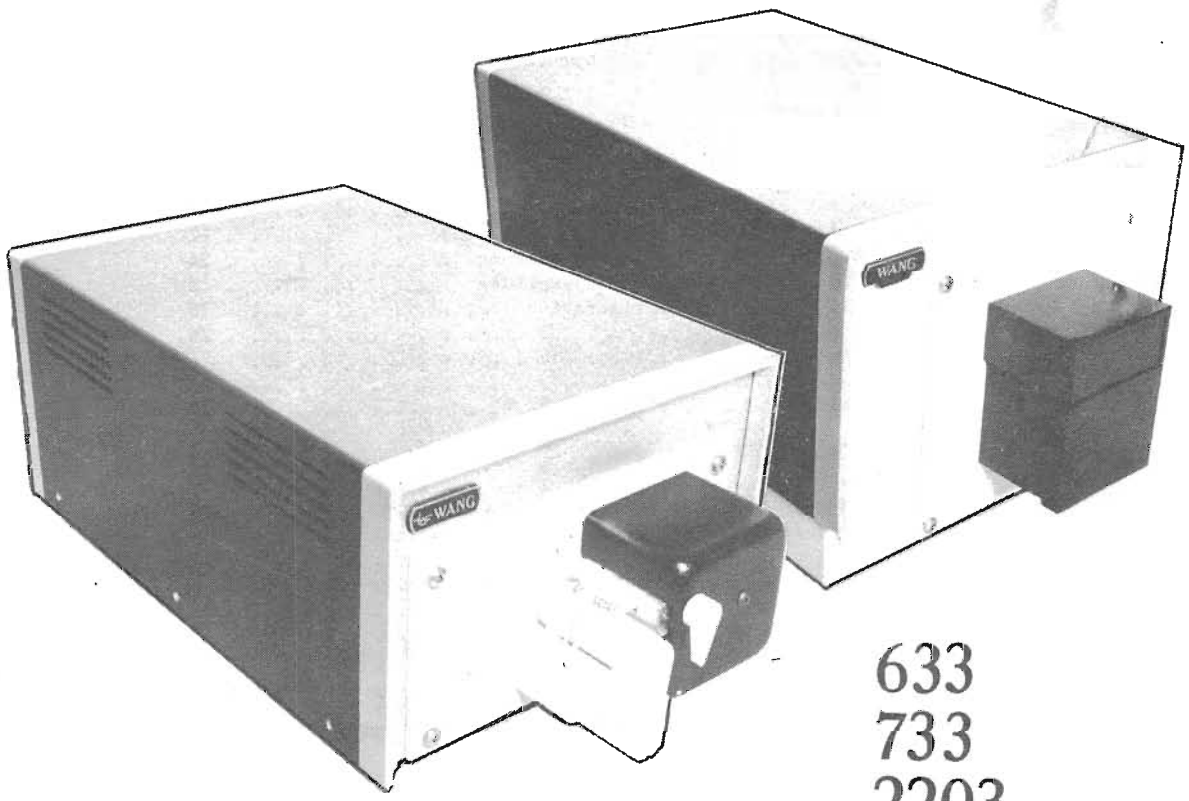
SERVICE BULLETIN NO. 48

EDITED BY PRODUCT SERVICE DEPT.

WANG 603, 703, 633, 733, 2203
PAPER TAPE READERS

3604



633
733
2203

603
703

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Printed in U.S.A.
13-210

WANG 603, 703, 633, 733, 2203
PAPER TAPE READERS

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WANG

603-703-633-733-2203

PAPER TAPE READERS

1. DESCRIPTION

1.1 GENERAL

The WANG models 03 and 33 are ASCII[1] code punched paper tape readers. The *standard* model 03 and 33 versions are described herein. Non-standard versions of the 603, 703, 633, or 733 can be produced per customer requirements. The 2203 is capable of reading narrower, non standard tapes which conform to the specifications listed in paragraph 3.3, page 49.

The models 603, 703, 633, and 733 are addressed by identical[2] keyboard commands, except when combinations of two -03 units or two -33 units are connected to a 600 or 700 system via T connector or model 23 buffer unit. In the case of two readers in one system, a two-position slide switch inside

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[1] American Standard Code for Information Interchange.

[2] See paragraph 3.2.1, page 31, for detailed explanation.

each 603, 703, 633, or 733 reader allows the user to assign one of two unique addresses to each unit:

	READ COMMAND:	TAPE ALIGN:
UNIT #1	GROUP 1, 0000	GROUP 1, 0007
UNIT #2	GROUP 1, 0800	GROUP 1, 0807

Since this address switch has only *two* positions, the maximum number of tape readers per 600/700 system is two.

Except for the difference in reading speeds between the 603/703 and the 633/733/2203, the following describes their system use and interchangeability:

CALCULATOR	USE A:	OR A:
600	→ 603	→ 633
700/720	703	733
2200B	n/a	2203
	Mechanical Readers	Optical Readers

The readers for 600/700 systems can be commanded (GP 1, 0000 or GP I, 0800) to ignore certain codes being read until one of the following codes are encountered: numeric data (digits 0-9), decimal point, or change sign. The 603/703/633/733 then begins to read all paper tape data into the calculator. Upon reading the *first* data code, an internal program enables the reader to also recognize rub out codes.

If four consecutive rub out codes are read on a 603, 703, 633 or 733, the reader *unconditionally* transfers a SEARCH & RETURN XXXX command to the 600/700 calculator. The calculator resumes program control and executes the MARK XXXX subroutine previously stored in the calculator RAM.

If the following ASCII codes are read by a *603* or *633*, they are transferred to the 600 as numeric codes; the instructions they represent are *executed* by the 600.

TELETYPE CHARACTER	ASCII CODE BINARY VALUE	600 CODE	
:	011 1010	00 10	Decimal Point
;	011 1011	00 11	Set Exponent
<	011 1100	00 12	Change Sign
=	011 1101	00 13	(Undefined)
?	011 1111	00 15	CLEAR DISPLAY

Use of the last two codes will cause data in display (CLEAR DISPLAY) or data in registers 00 - 15 (CLEAR Registers 00 - 15) to be destroyed.

If the following ASCII codes are read by a *703* or *733*; they are sent to the 700/720 as numeric codes; the instructions they represent are executed by the 700/720.

TELETYPE CHARACTER	ASCII CODE BINARY VALUE	700/720 COMMAND	
:	011 1010	0701	Set Exponent
;	011 1011	0711	Change Sign
<	011 1100	0712	Decimal Point
=	011 1101	0713	X^2
>	011 1110	0714	Recall Residue
?	011 1111	0715	Clear X

When any code *other than* the above mentioned codes is read on a 603, 703, 633 or a 733, the calculator resumes either program control or user control, depending on the control mode existing at the time the READ or TAPE ALIGN command was issued.

The 600/700 ASCII tape readers can also be commanded (GPI, 0007 or GP1, 0807) to ignore codes being read until an ASCII *carriage return* code is encountered. At that time, the calculator resumes control, and reading of ASCII tape ceases. The only exception to this sequence is if four consecutive rub out codes are read, as explained previously.

The *2203* reads both alpha and numeric ASCII characters from paper tape to the RAM in the 2200B; all unpunched frames and rub out codes are ignored. A carriage return code followed by a line feed code indicates to the 2200B that either the end of a program text line or the end of a unique data entry has occurred. An X-OFF code on paper tape halts reading action and returns control to the 2200B.

An integral part of each 2203 is an I/O board which is inserted in either the 2200B CPU chassis or the 2219 extended I/O chassis. This I/O board has an 8-bank rocker switch for setting the device address. Eight unique device addresses are set aside for the 2203.

The 2203 operational commands and command statements are as follows:

LOAD Command	Used to load *program text lines* in the IMMEDIATE mode.
LOAD Statement	Used to automatically load and execute *program text lines* during the execution of a 2200B program.
DATALOAD Statement	Used to load *data values* from paper tape and store them in designated variables or arrays.

DATALOAD BT Statement	Used to load *data values* from paper tape, ignoring ASCII control characters such as rub out codes, blank frame codes, carriage return and line feed codes, and X-OFF codes. All 8 bits of each character are read. This statement is also used for reading tape in the reverse direction. The DATALOAD BT statement can also be used for reading paper tape punched with non-standard codes or format.

- SPECIFICATIONS -

SPECIFICATION	603, 703	633, 733	2203
TAPE CODE:	8-level ASCII (certain other codes available by request)	Same as 603, 703	8-level ASCII. Any other code system can be used and converted to ASCII by 2200B software control.
READING SPEED:	25 characters/second uni-directional	300 characters/second unidirectional(average)	Same as 633, 733. Also reads in reverse direction.
TYPE OF READER:	Mechanical	Optical	Optical
ENTRY SIZE:	12 digits (MAX)	Same as 603, 703	Maximum possible array size.
SIZE: HEIGHT: WIDTH: DEPTH:	5.5 inches (14.0 cm) 8 inches (20.3 cm) 14 inches (35.6 cm)	Height: 6.5 in(16.5 cm) Width: 7.5 in(19.1 cm) Depth: 11.5 in(29.2 cm) (13.5 in., counting reader head)	Same as 633, 733
WEIGHT:	12 lbs. (5.5 kg)		13 lbs. (5.9 kg)
LINE VOLTAGE REQUIREMENTS:	115 or 230 VAC $\pm$ 10% 50 or 60 Hz	Same as 603, 703	Same as 603, 703
CABLE:	9 ft. (2.74 m) cable with connector to the calculator I/O jack.	Same as 603, 703	Same as 603, 703
OPERATING ENVIRONMENT:	50°F to 104°F (10°C to 40°C) 20% to 80% relative humidity	Same as 603, 703	Same as 603, 703

1.2 READ HEAD DESCRIPTIONS

1.2.1 *Model 603, 703 Mechanical Reading Mechanism*

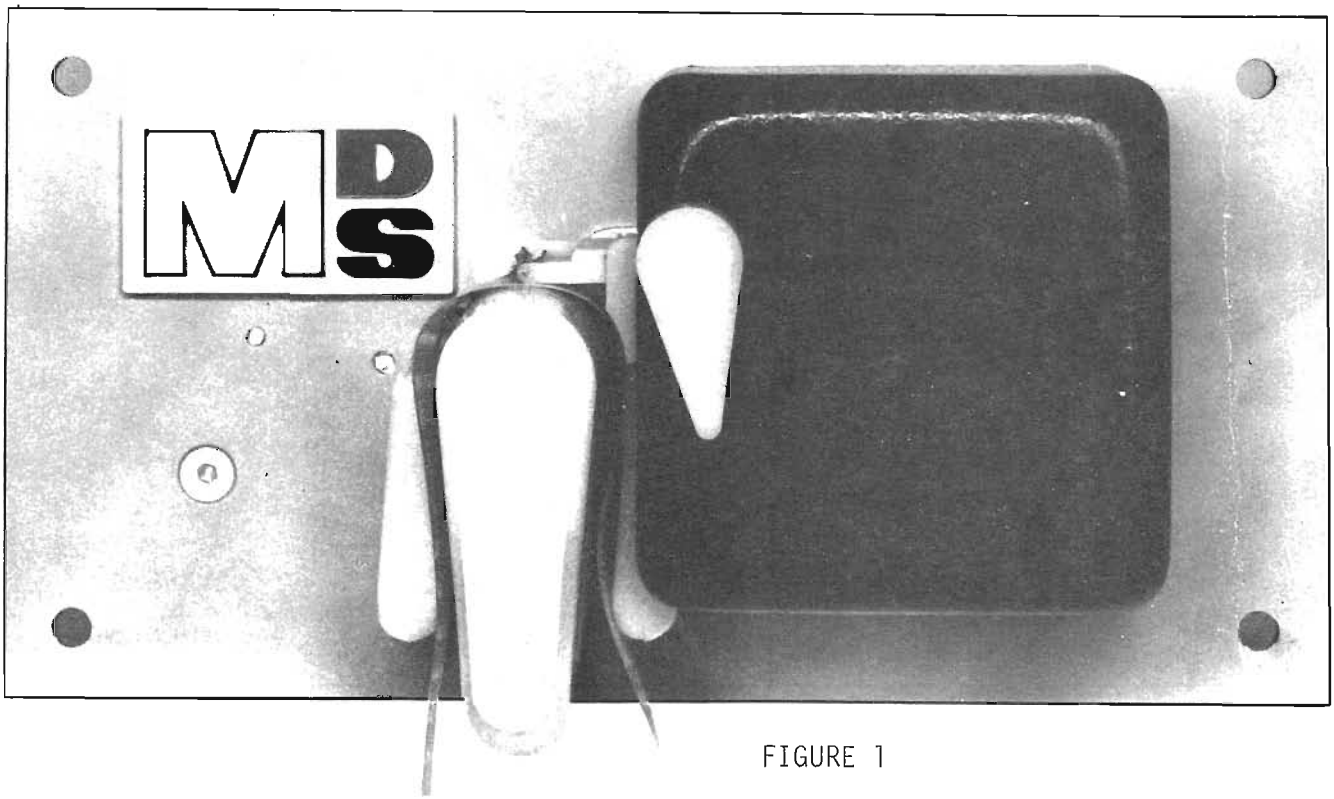


FIGURE 1

1) *Sensing Mechanism* - Data sensing is accomplished by the use of *starwheels*. When a starwheel enters a hole punched on the ASCII tape, an arm carrying the starwheel closes a switch. A sensing switch *remains closed* when a series of holes are sensed in that bit channel. Only when a no-hole condition is sensed is the starwheel raised and that particular sensing switch opens. See Figures 2 and 3, page 10.

2) *Drive Mechanism* - Advancing of ASCII paper tape is accomplished by the use of an electromagnetically driven, cross coupled pawl system. Stepping of the ASCII tape occurs on the spring return stroke of the electromagnet; that is, when voltage is removed from the coil of the electromagnet, a spring action advances the paper tape.

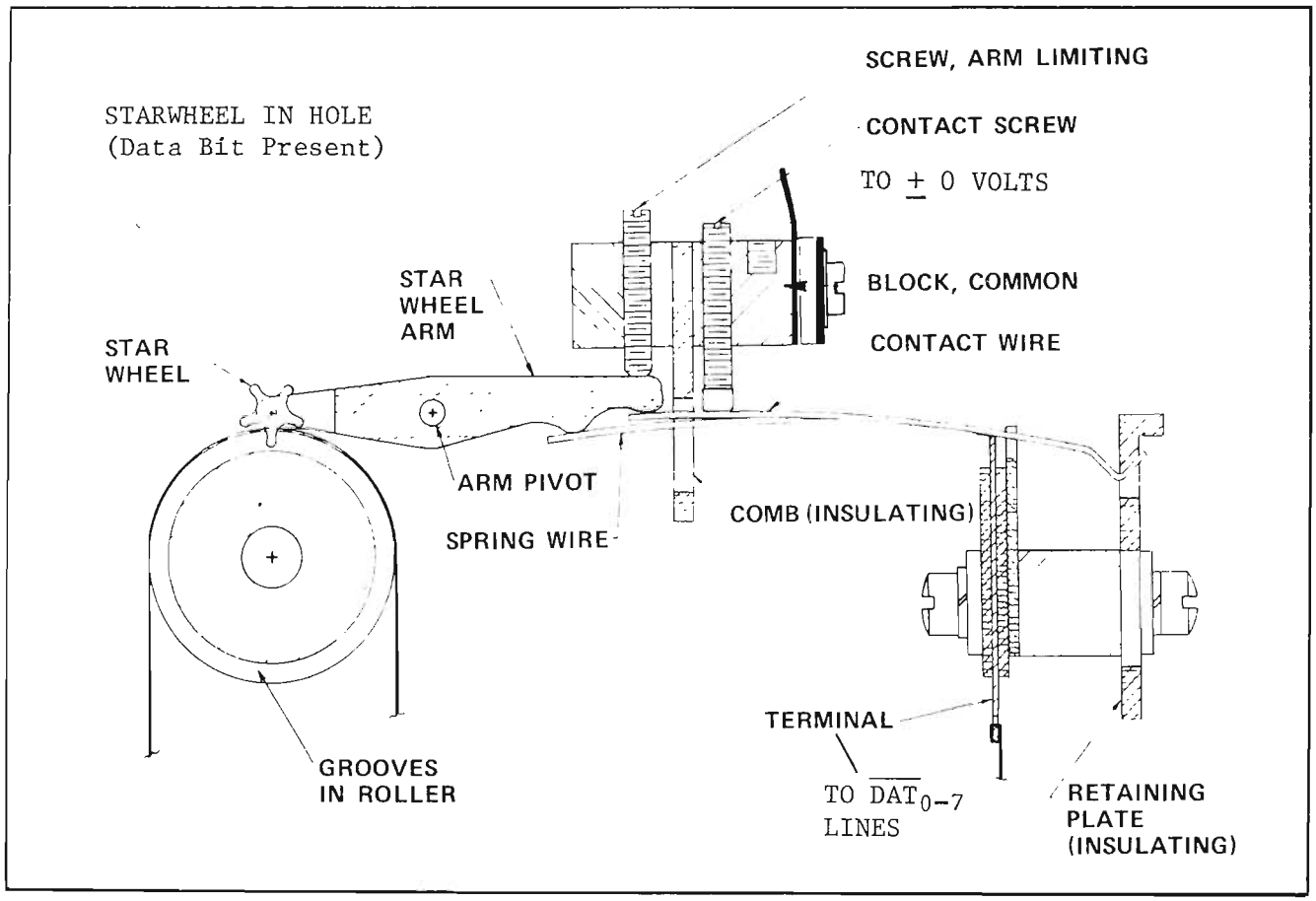


FIGURE 2

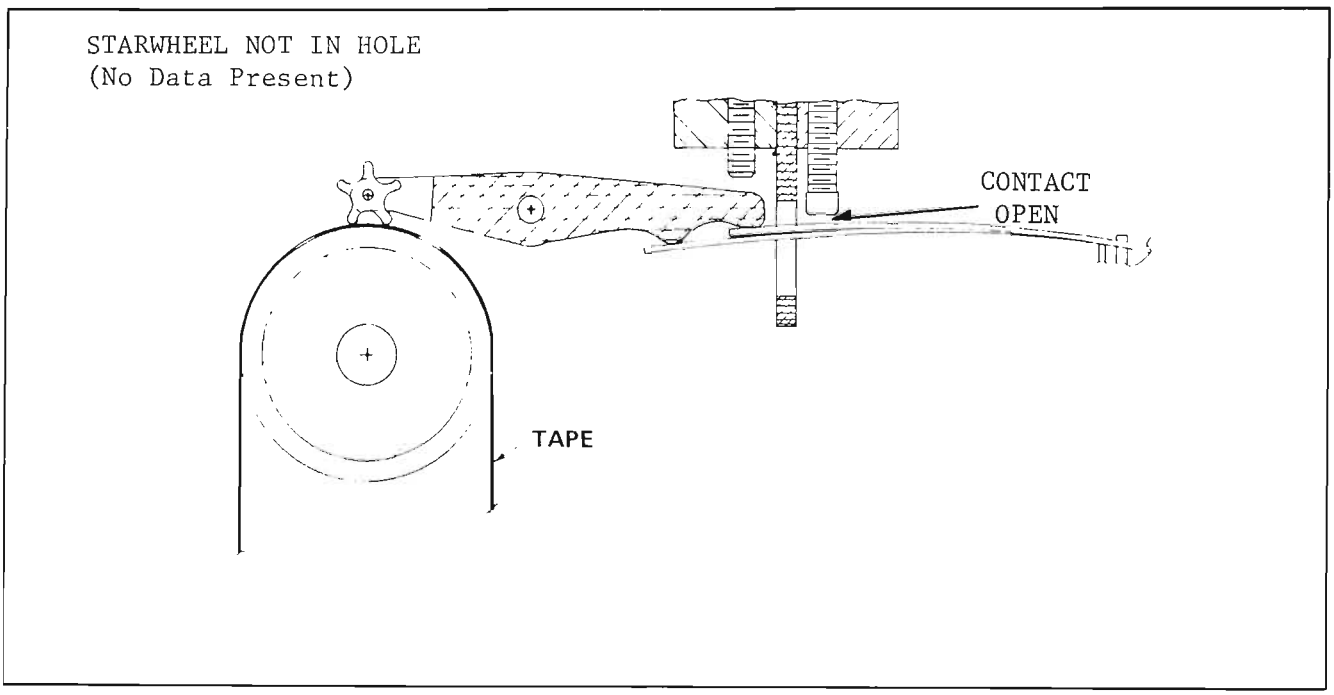


FIGURE 3

Detailed Mechanical Operation:

When starwheel (1) senses hole in paper tape (2), the starwheel arm (3) is rocked counterclockwise under the urging of contact wires (4) which limit on lower surface of contact screw (5). See Figure 4. An electrical circuit is thus completed from common block (6) to terminal (7). The spring wire (8) urges starwheel arm (3) against

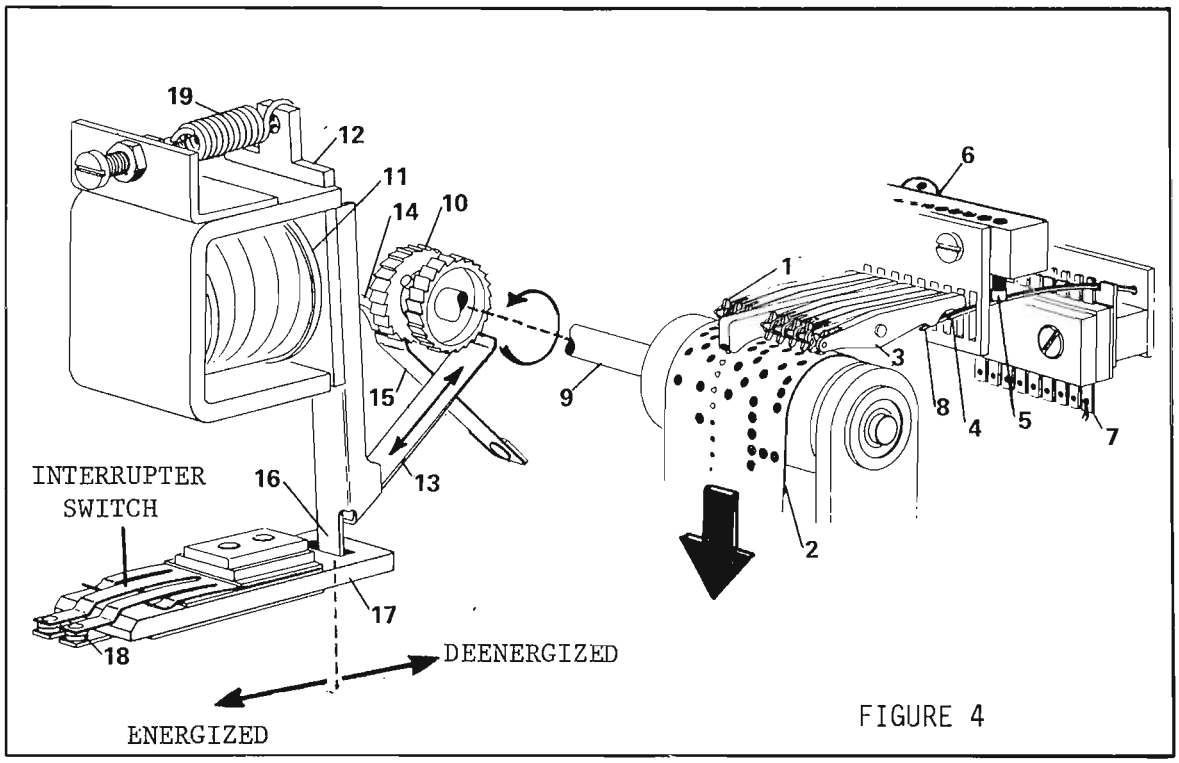


FIGURE 4

arm limiting screw to reduce bounce. Drive shaft (9) extends rearward through panel and carries unidirectional ratchet (10). Energization of coil (11) attracts armature arm (12) and engages pawl blade (13) under next tooth. Pawl depressor (14) disengages opposing pawl blade (15). Tip (16) of armature moves card (17) to open interrupter switch contacts (18).

Upon de-energization of coil (11), pawl blade (13) steps shaft (9) under urging of spring (19). Interrupter switch (18) recloses (near end of armature return) one to two milliseconds after sensing switches have achieved new positions.

3) *Adjustable Resistor*

An adjustable tap wire wound resistor is *factory preset* to provide proper operating voltage and current for the electromagnet. DO NOT TAMPER WITH THIS TAP SETTING; damage to electromagnet coil may result.

4) *Specifications* - (Read Head Only)

(a) General

Number of Tape Channels: Eight channels

Data Hole Size: 0.072" (.183 cm) diameter on 0.100" (.254 cm) centers (EIA Proposed Standards RS-227)

Feed Hole Size: 0.046" (.117 cm) diameter

(b) Contacts

Starwheel Sensing Switches:

1) Eight Form "A" (normally open) bifurcated contacts, (one side common), each consisting of two eutectic silver wires, plus one stainless steel wire for minimizing bounce.

2) Contact bounce less than one millisecond.

3) Contact rate is three amperes steady state.

4) For switching under load, current affects contact life as follows:

CURRENT (ampere)	LIFE no. of switching operations
0.035	200,000,000
0.100	100,000,000
0.500	20,000,000
1.000	5,000,000

Tape Hold Down Switch:

Form "B" contact consisting of one eutectic silver wire and one stainless steel wire.

Interrupter Switch:

1) One switch, consisting of Form "B" (normally closed) bifurcated heavy duty contacts. Current rate is three amperes switching resistive loads.

2) Switch bounce less than one millisecond.

(c) Electromagnetic Drive

Power Requirements: 24 VDC

Pull-In Time: Nominally 14 milliseconds

Drop-Out Time: Nominally 14 milliseconds

Arc Suppression: Diode-resistor network across the electromagnet coil.

*Voltage and Power Adjustments: Adjustable resistor preset to 24 volts is in series with the electromagnet.

(d) Mechanical

Dimensions:

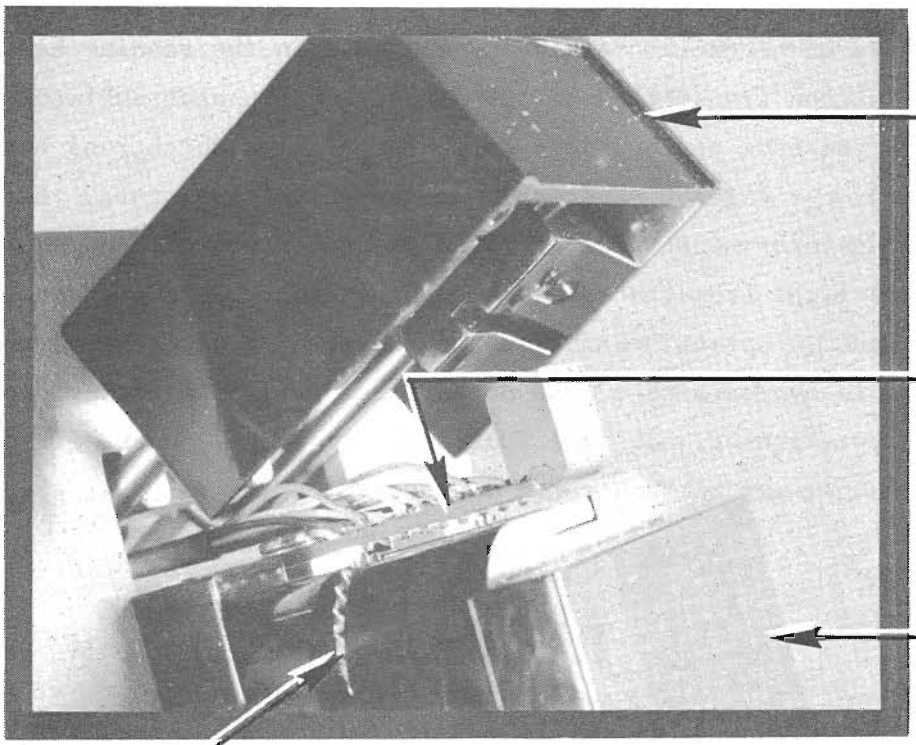
1) 3.5 in (8.89 cm) high, 6.75 in (17.15 cm) wide.

2) Extends 2.63 in (6.67 cm) front of panel, and 2.5 in (6.35 cm) rear of panel.

Weight: 2.50 pounds (1.13 Kg.)

1.2.2 *Model 633, 733, 2203 Optical Reading Mechanism*

FIGURE 5



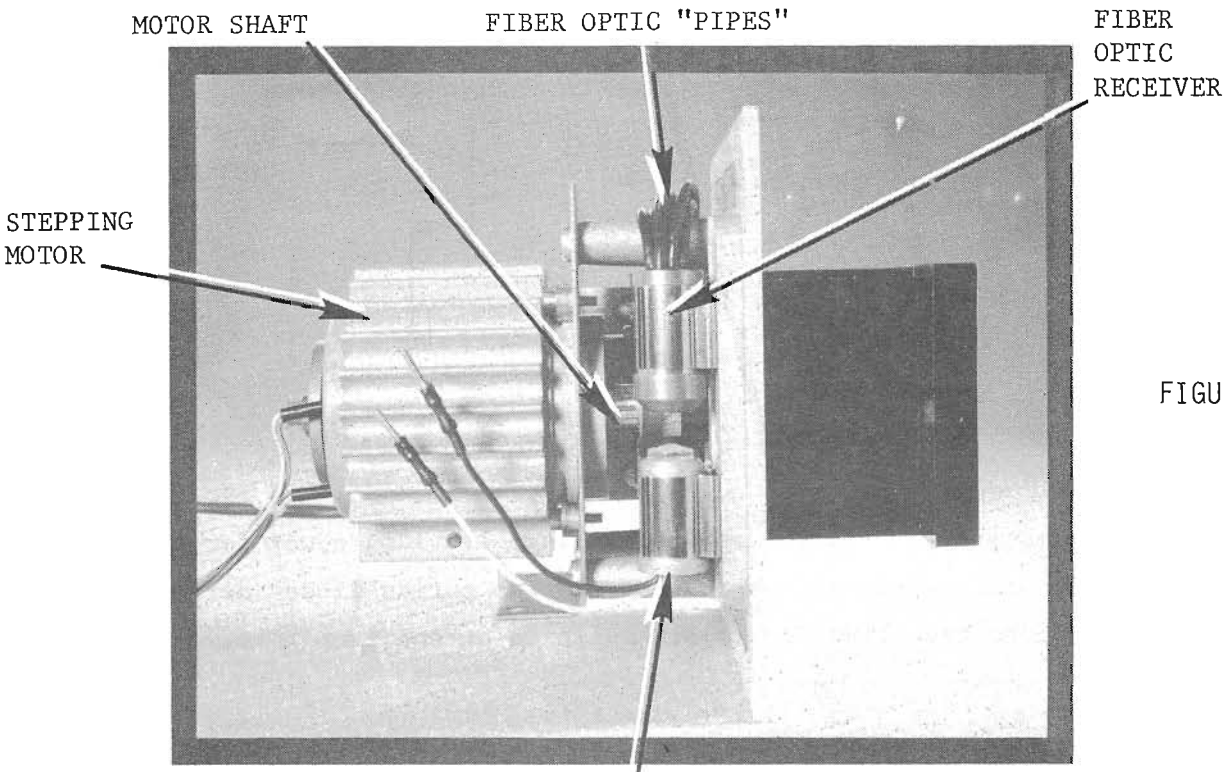
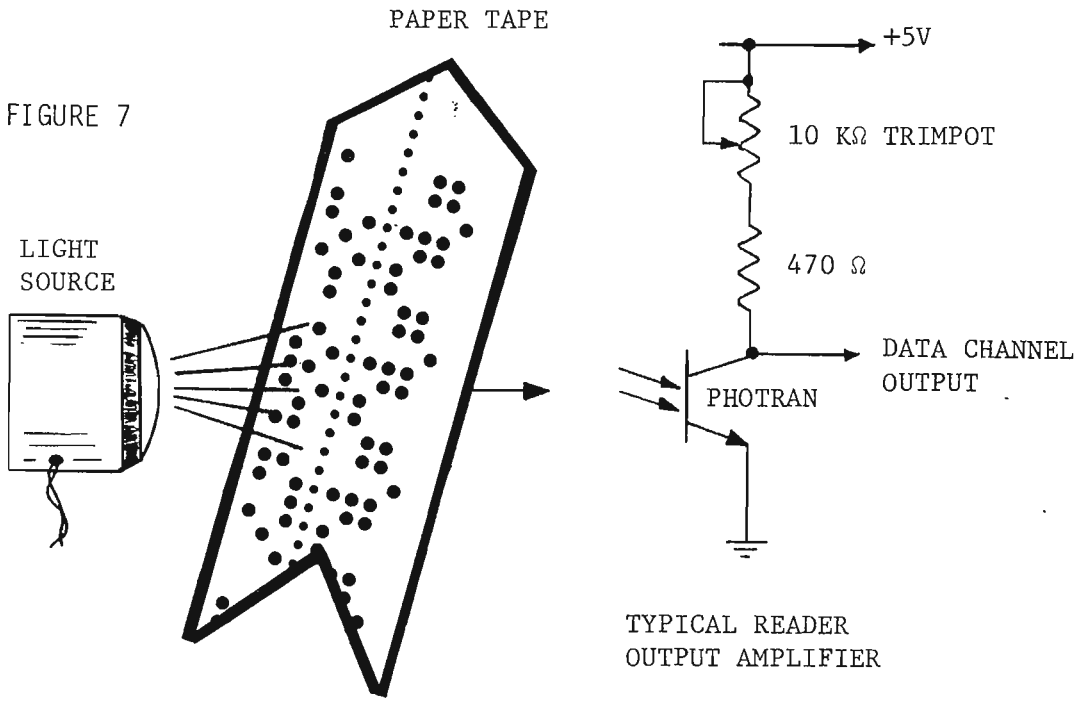


FIGURE 6

1) Sensing Transducer - Light energy is transmitted from a single diffused light source into a fiber-optic receiver. The fiber-optic receiver splits the single source into nine individual fiber-optic "pipes" which are anchored into a fixed steel base in the reading head. Light is then transmitted to the nine element phototransistor array through the code perforations in the paper tape which runs between the fiber-optic light source(s) and the phototransistors. Each phototransistor receives light from *one* data channel; one photran receives light from the sprocket hole channel. To compensate for variations in optical channels, the sensitivity of each photran is adjustable by means of a 10KΩ potentiometer. These potentiometers are factory preset, but if a photran is replaced, a new setting for that channel may be required. See page 82 for adjustment procedure.

FIGURE 7



Power Requirement - 5 VDC at 450 milliamp provides power for the lamp as well as the phototransistors. Two series diodes derate the lamp voltage from 6.3 to 3.8 volts to extend lamp life.

Phototransistor Array - Output data is obtained from a 9 phototransistor array corresponding to the 8 data channels and the sprocket hole as follows:

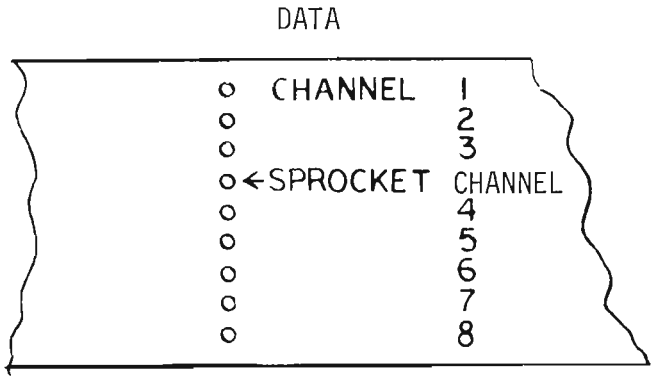


FIGURE 8

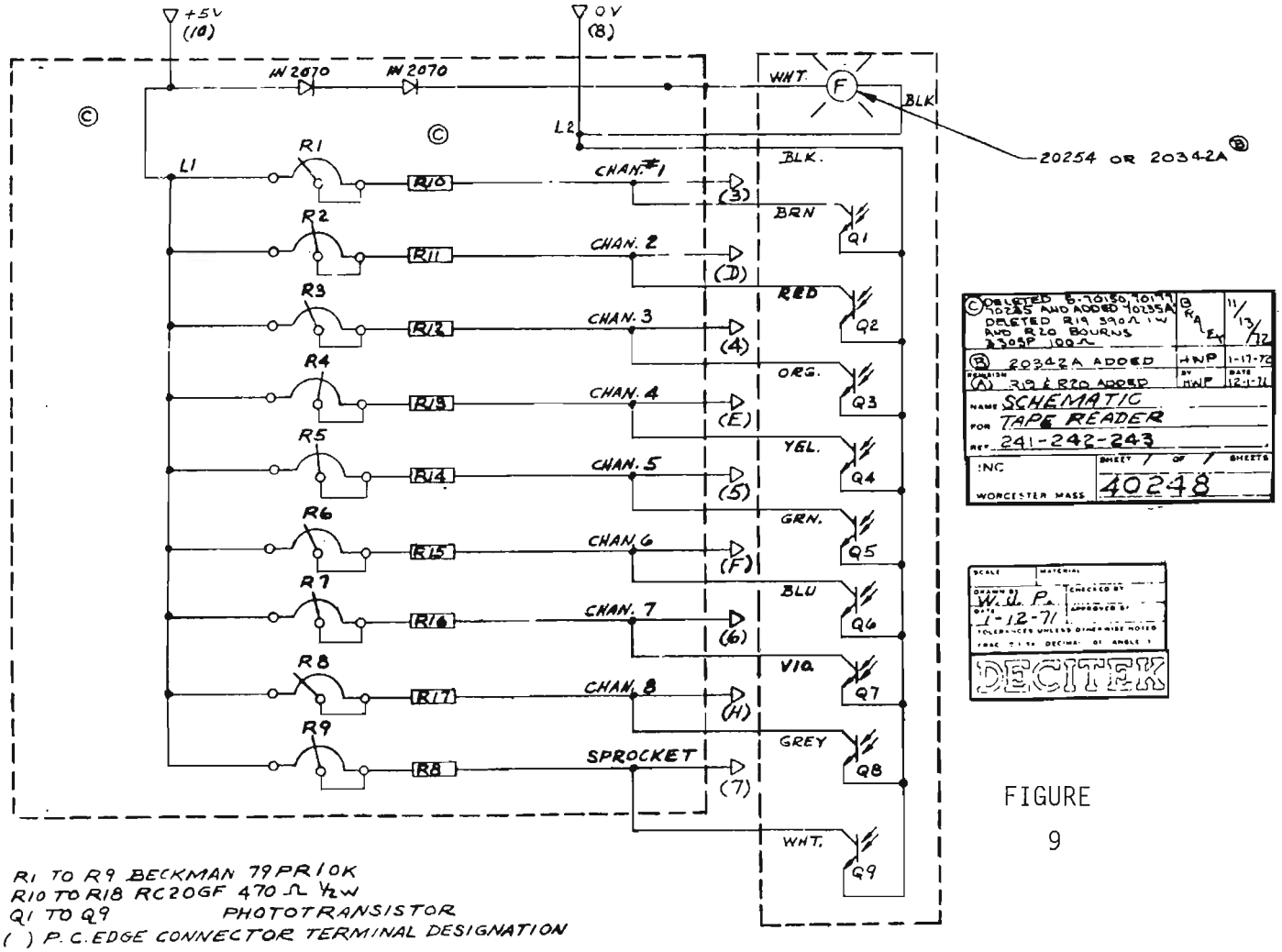


FIGURE 9

2) Drive System - Tape drive torque is provided by a D.C. Hysteresis Stepping Motor with 15° magnetic detents. Torque is then transmitted by a geared pulley fixed to the motor shaft to a timing belt, and then to the two sprocket drive pulleys. The tape is controlled by dual sprockets and is guided over these sprockets by a cover designed to lift for tape insertion, and designed to limit ambient light entrance when closed.

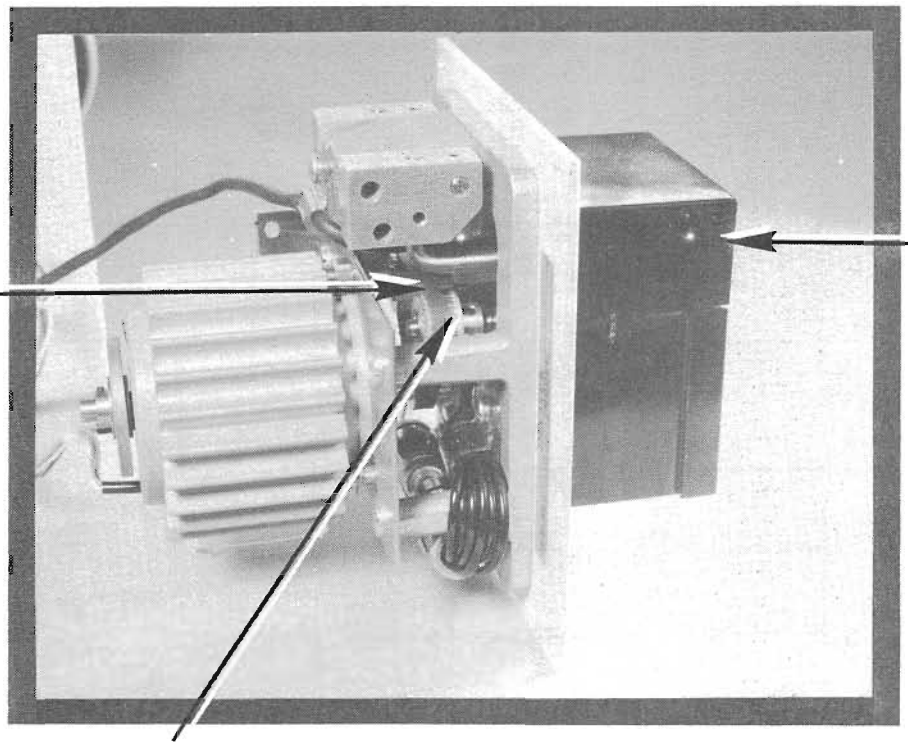


FIGURE 10

Switching Requirements - External switching transistors are connected to drive the stepping motor as shown below.

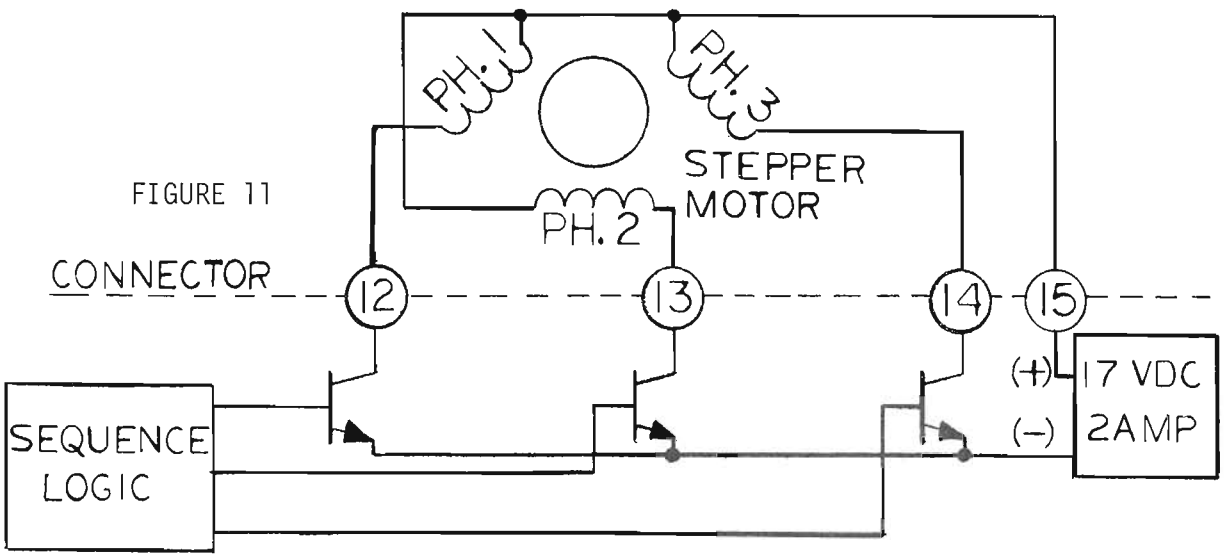


FIGURE 11

Phase Sequence - The motor phase windings are energized and deenergized by external circuit according to the following sequence.

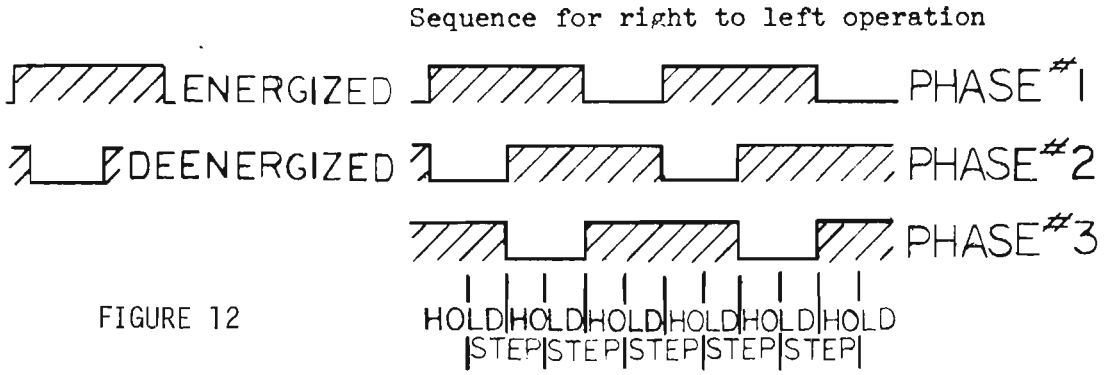


FIGURE 12

NOTE:
At any given time, two phases are energized while the third is deenergized.

3) Specifications - (Read Head Only)

(a) *Tape:*

All standard 5, 6, 7 and 8 level tapes between .002" (.005 cm) and .005" (.013 cm) thick. Opacity must be 40% or greater. Dimensional tolerances must conform to EIA standard RS-227.

(b) *Power Requirements:*

Motor Drive - 17 VDC $\pm$ 0.5 VDC at 2 amperes.

Phototransistors and Lamp - 5.0 VDC $\pm$ 0.1 VDC at 450 milliamperes. Ripple less than 0.01 VRMS.

(c) *Light Sensors:*

9 Silicon Planar Phototransistor array.

(d) *Lamp Life:*

25,000 hours (derated as shown in schematic 40428, page 17)

(e) *Temperature Range:*

0 to 55°C operating
-35 to 80°C non operating

(f) *Weight:*

2 pounds (.906 Kg)

1.3 PHYSICAL LAYOUTS

1.3.1 *Model 603, 703*

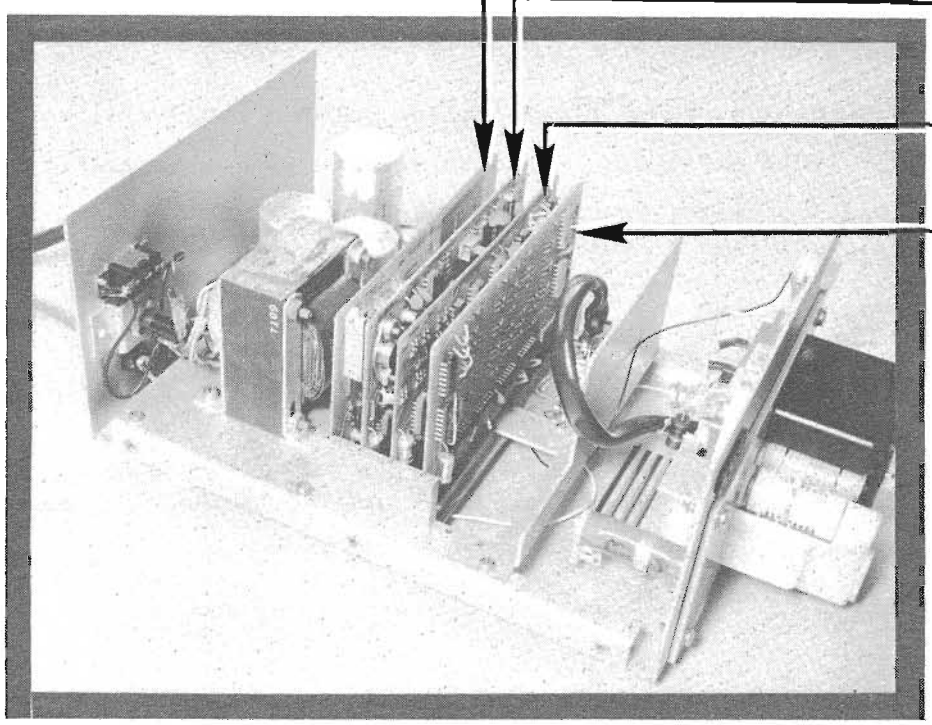


FIGURE 13

1.3.2 *Model 633, 733*

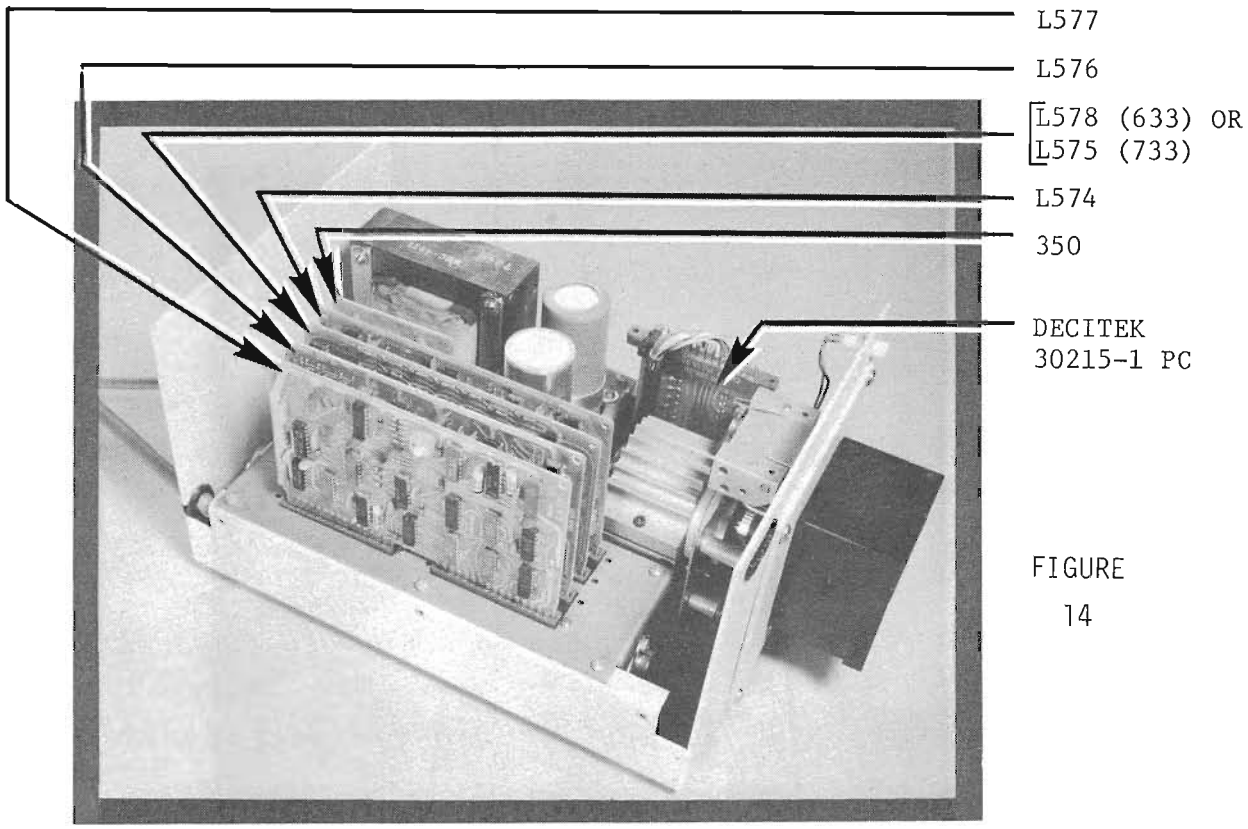


FIGURE
14

1.3.3 *Model 2203*

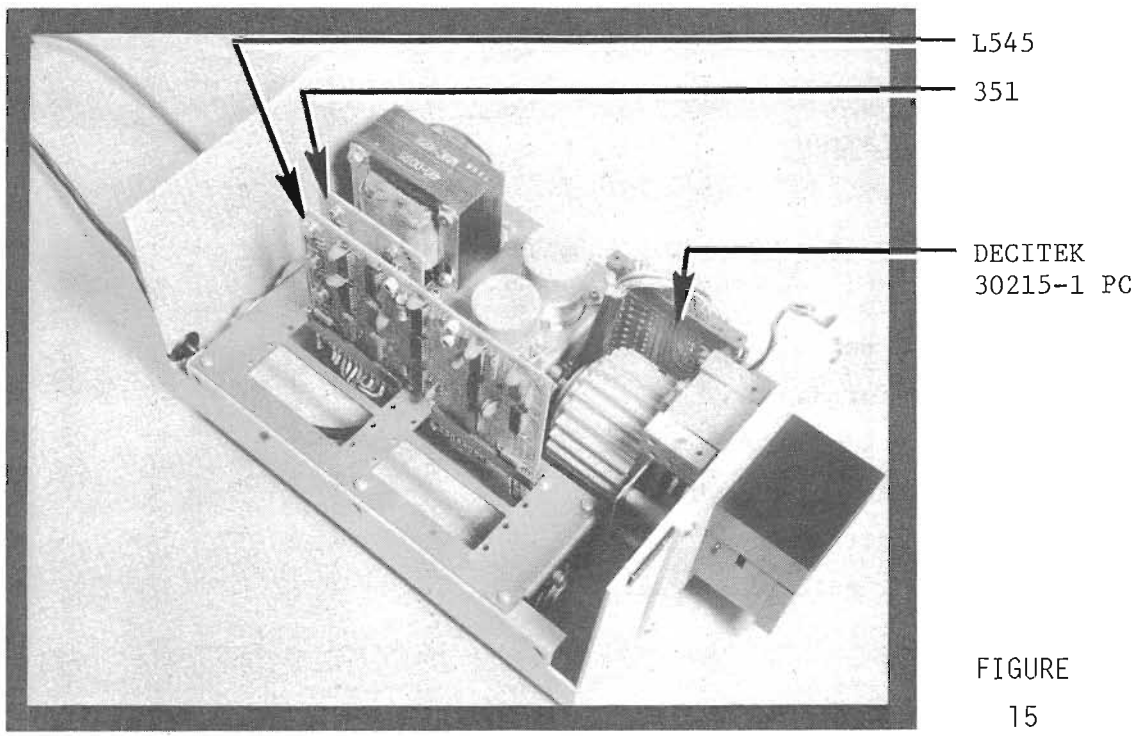


FIGURE
15

1.3.3 *Model 2203 Layout - Continued*

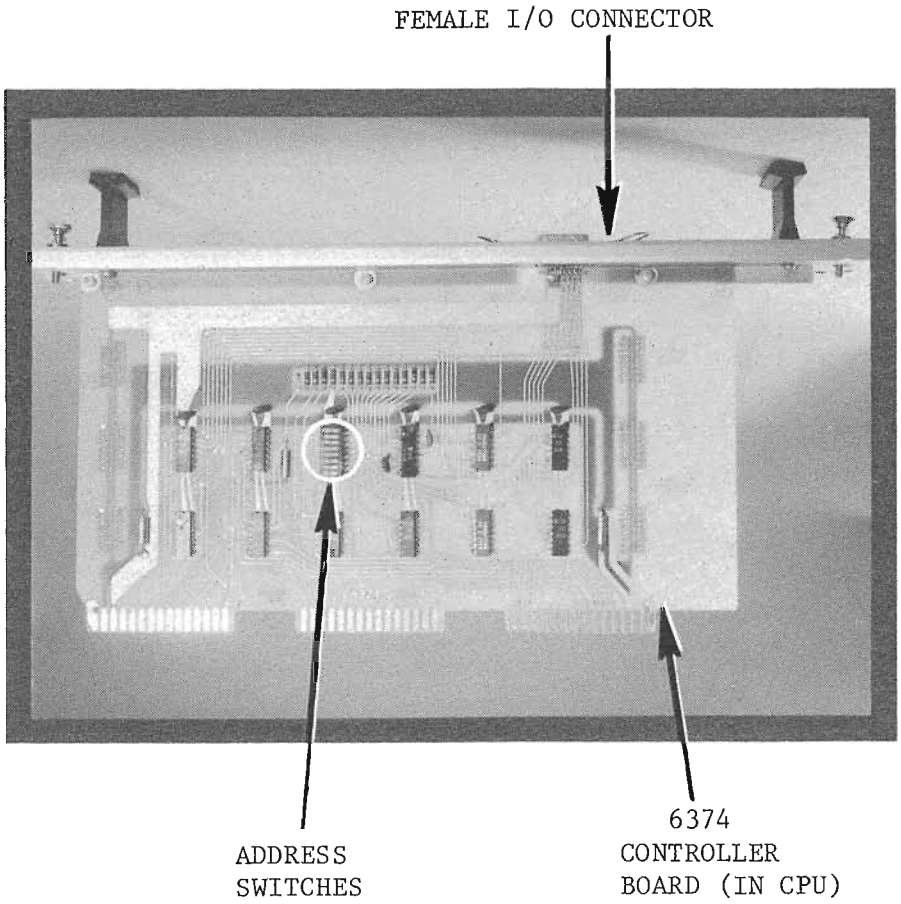


FIGURE 16

2. INSTALLATIONS

2.1 GENERAL (for 603, 703, 633, 733, 2203)

1) Unpack unit.
2) Check for damage.
3) Remove cover (6 phillips flathead screws)
4) Plug in AC line cord.
5) Turn unit on.
6) Check regulated voltages:

603, 703: F560 - 1 PC BOARD

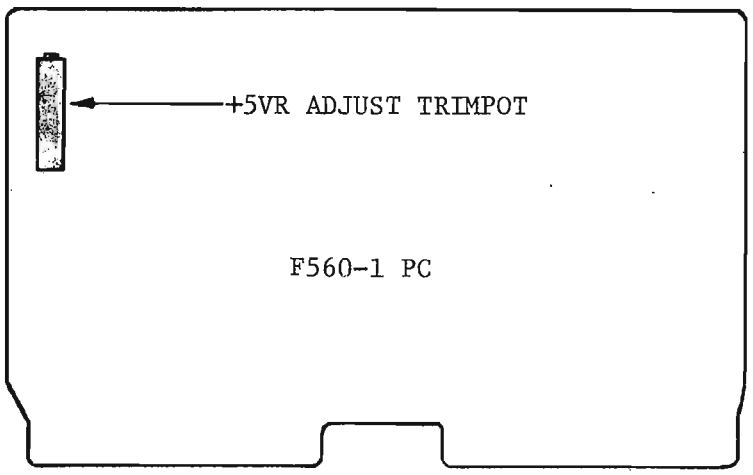
+5 VR @ pin 15_2

+12V @ pin 9_1

-12V @ pin 2_1

$\pm$ 0V @ pin 6_2

FIGURE 17



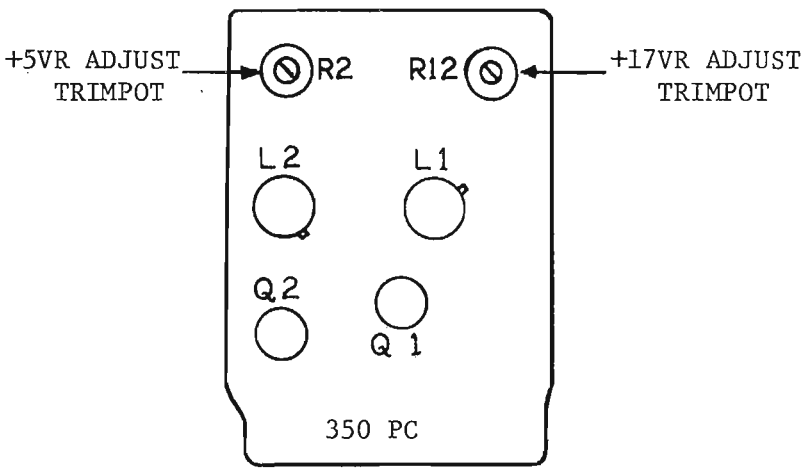
633, 733: 350 PC BOARD

+5 VR @ pin 11

+17VR @ pin 2

$\pm$ 0V @ pin 1

FIGURE 18



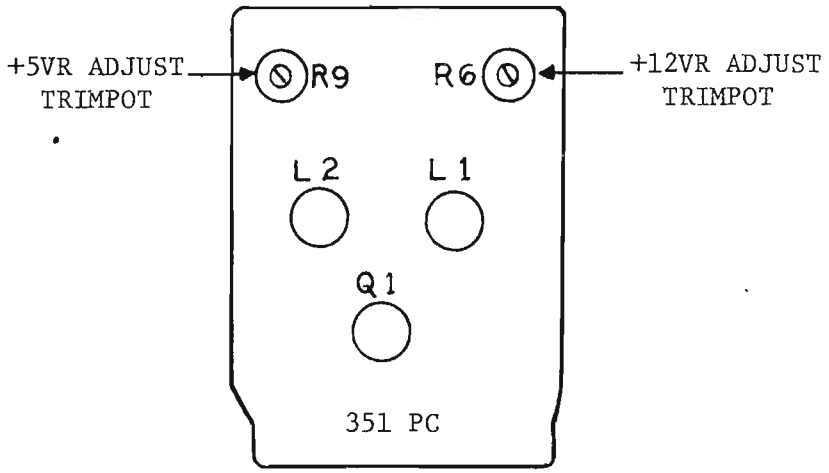
2203: 351 PC BOARD

+5 VR @ pin 11

+12VR @ pin 2

± 0V @ pin 1

FIGURE 19



6) Turn unit off.

2.2 MODEL 603/633 OPERATING CONFIGURATIONS

Connect per Figure 20 or 21 below.

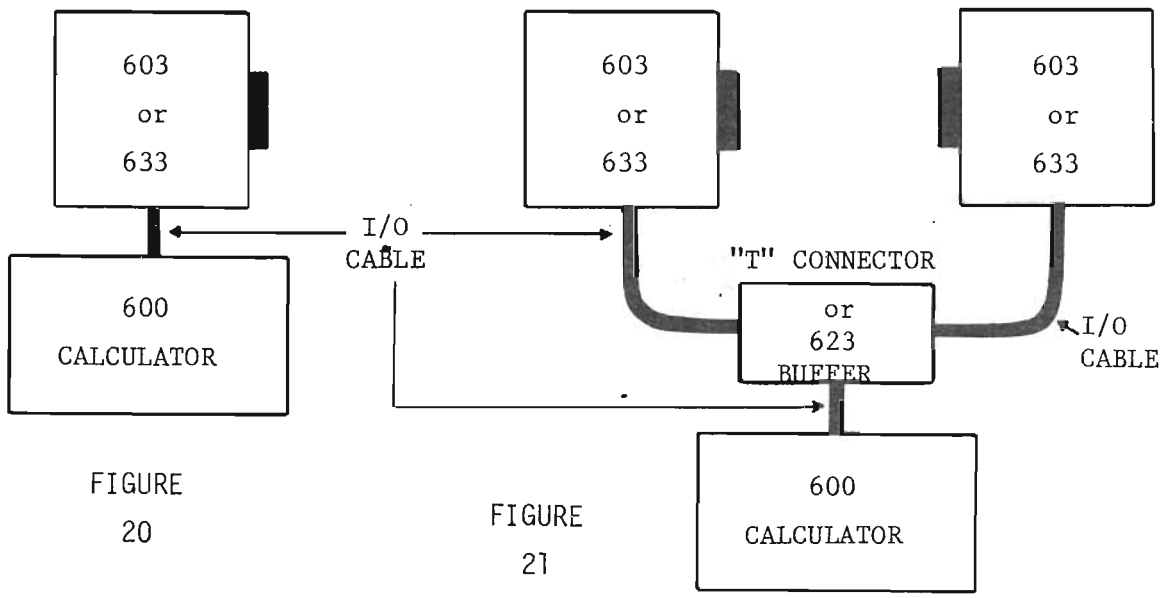


FIGURE 20

FIGURE 21

See paragraph 2.5 for setting address switch (L539 PC).

2.3 MODEL 703/733 OPERATING CONFIGURATIONS

Connect per Figure 22 or 23 below.

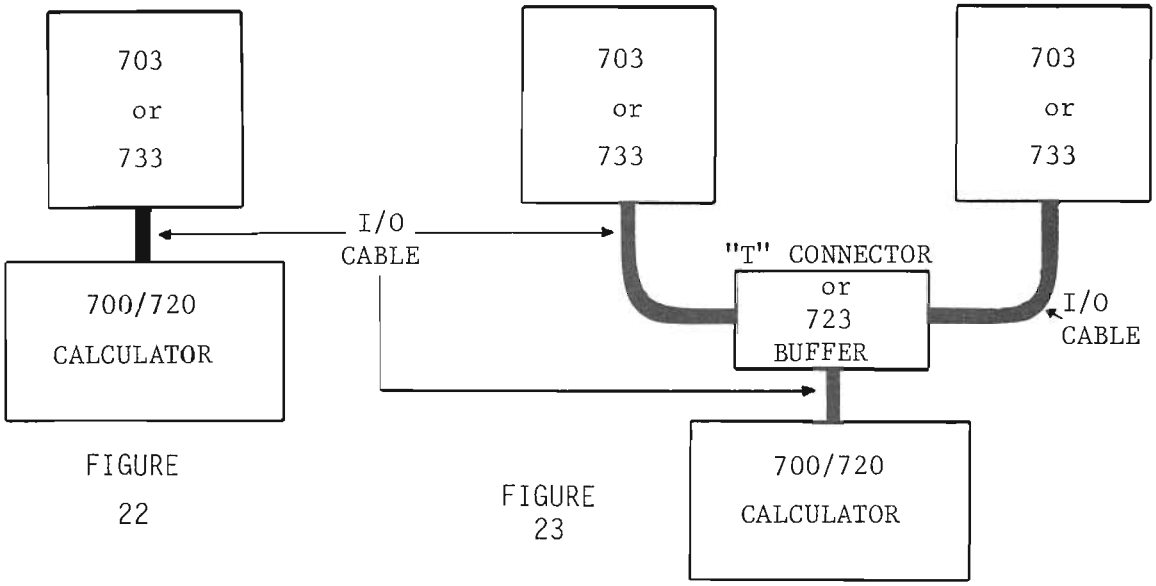


FIGURE 22

FIGURE 23

See paragraph 2.5 for setting address switch (L509 or L539 PC).

2.4 MODEL 2203 OPERATING CONFIGURATION

1) Turn ON/OFF switches on all equipment OFF.

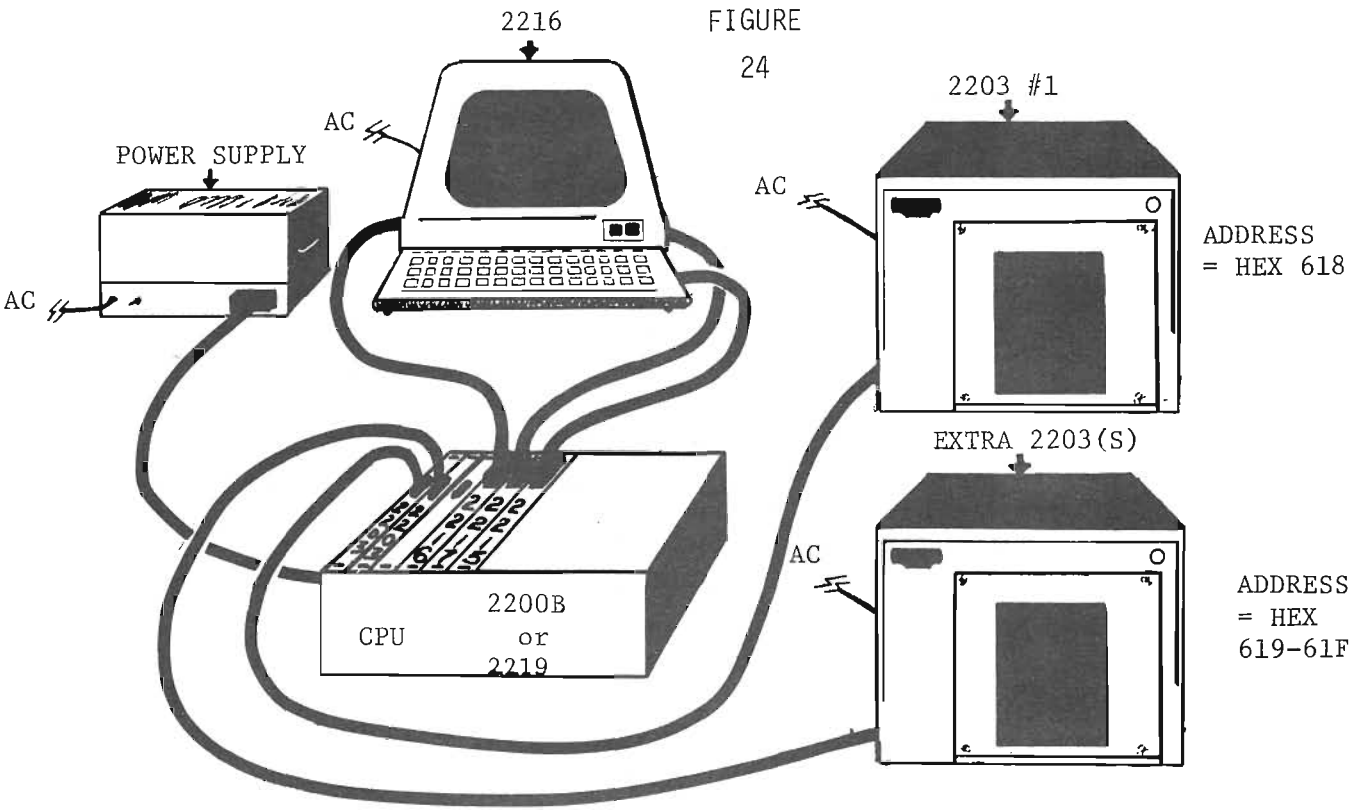


FIGURE 24

2) Plug the 2203 cable connector into the appropriate peripheral connector on the CPU chassis (6374 PC).

3) Plug the 2203 power cord into a wall outlet (line voltage requirement for 2203 is 115/230 volts, 50/60 Hz).

4) Plug the main power cord of the CPU chassis into the power supply unit; plug the line cord of the power supply unit into a wall outlet.

5) Turn ON/OFF switches on all equipment ON. If address switches are set, the system is now ready to use.

*See paragraph 2.5 for setting the 6374 board address switches.

2.5 ADDRESS SWITCHES

2.5.1 *Model 603/703*

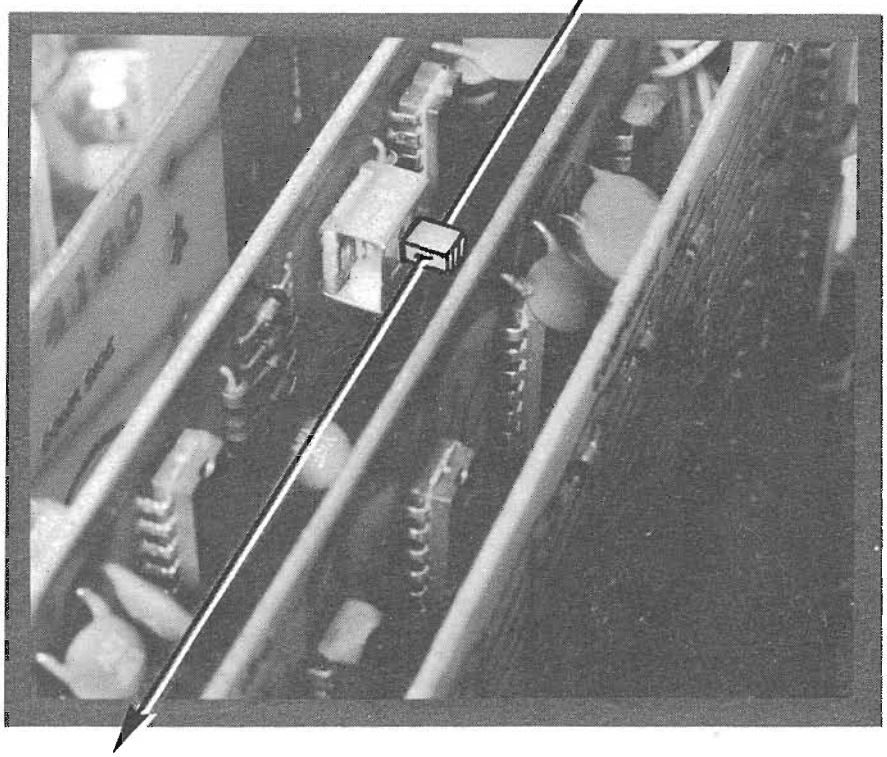


FIGURE 25

2.5.2 *Model 633/733*

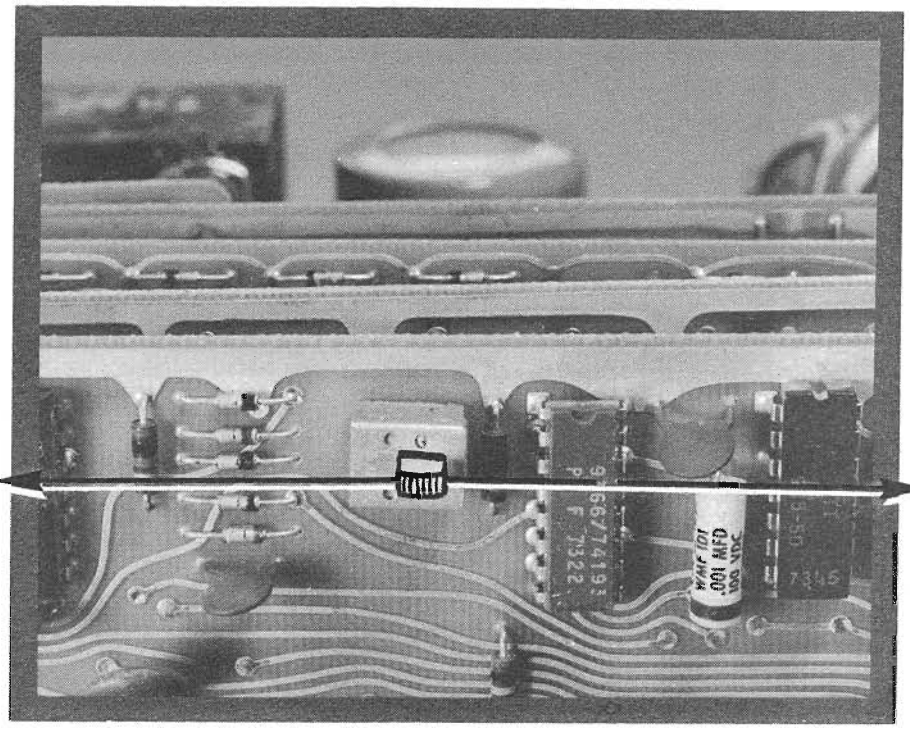


FIGURE 26

2.5.3 *Model 2203*

There are 8 legal address codes for the 2203:

HEX ADDRESS CODE			*READER #
HI ORDER		LO ORDER	
6	1	8_{16}	#1
6	1	9_{16}	#2
6	1	A_{16}	#3
6	1	B_{16}	#4
6	1	C_{16}	#5
6	1	D_{16}	#6
6	1	E_{16}	#7
6	1	F_{16}	#8
MICRO-PROGRAM (2200B)		SWITCH SETTINGS	

*2200B CPU HAS MAX. CAPACITY OF 3 READERS

2219 EXTENDED I/O HAS MAX. CAPACITY OF 8 READERS

(WHEN USED WITH 2215, 2216, 2217)

The 8-bank rocker-type address switch located on the 6374 I/O board is set as shown in the example below.

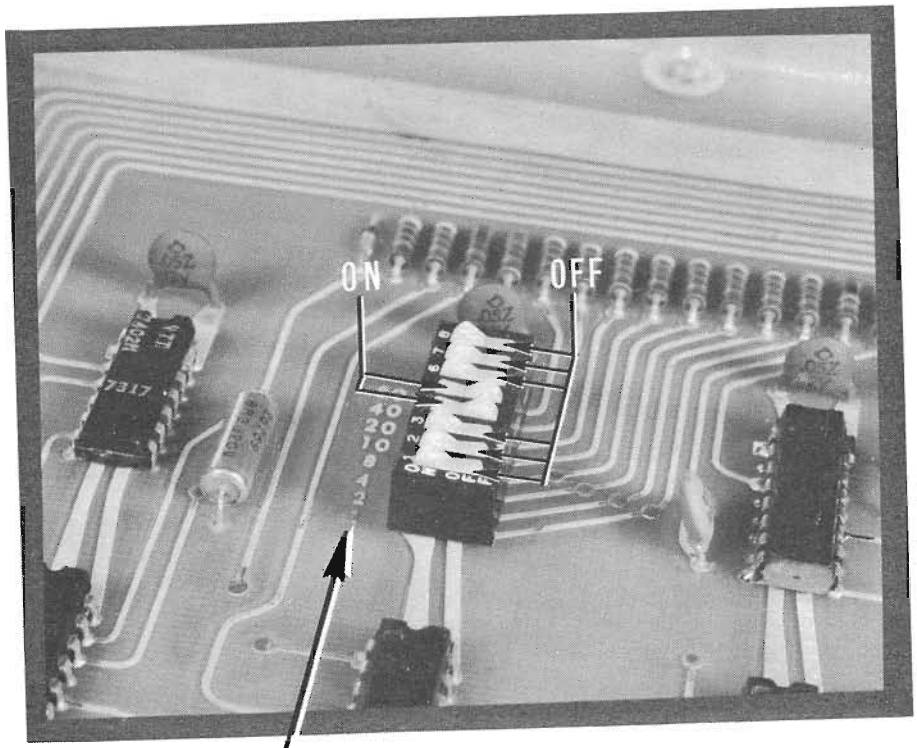
EXAMPLE:

HEX ADDRESS FOR TAPE READER #1 = 618_{16}

6 = MICRO-PROGRAM HEX DIGIT

1 = HIGH ORDER SWITCH

8 = LOW ORDER SWITCH



1, 2, 4, 8 = LOW ORDER SWITCHES

10, 20, 40, 80 = HIGH ORDER SWITCHES

FIGURE 27

2.6 DIAGNOSTIC RUN

See paragraph 3.1.1 (603, 703) or paragraph 3.1.2 (633, 733, 2203) for paper tape insertion directions. Run the appropriate diagnostic test as described in Section 4.

3. UNIT OPERATIONS - SOFTWARE

3.1 TAPE INSERTION

3.1.1 *Models 603, 703 (Mechanical Readers)*

1) Depress the POWER ON switch on the rear panel of the Model 603/703 unit. Turn POWER *on* in the calculator.

2) Turn the loading lever counterclockwise to lift the starwheel mechanism.

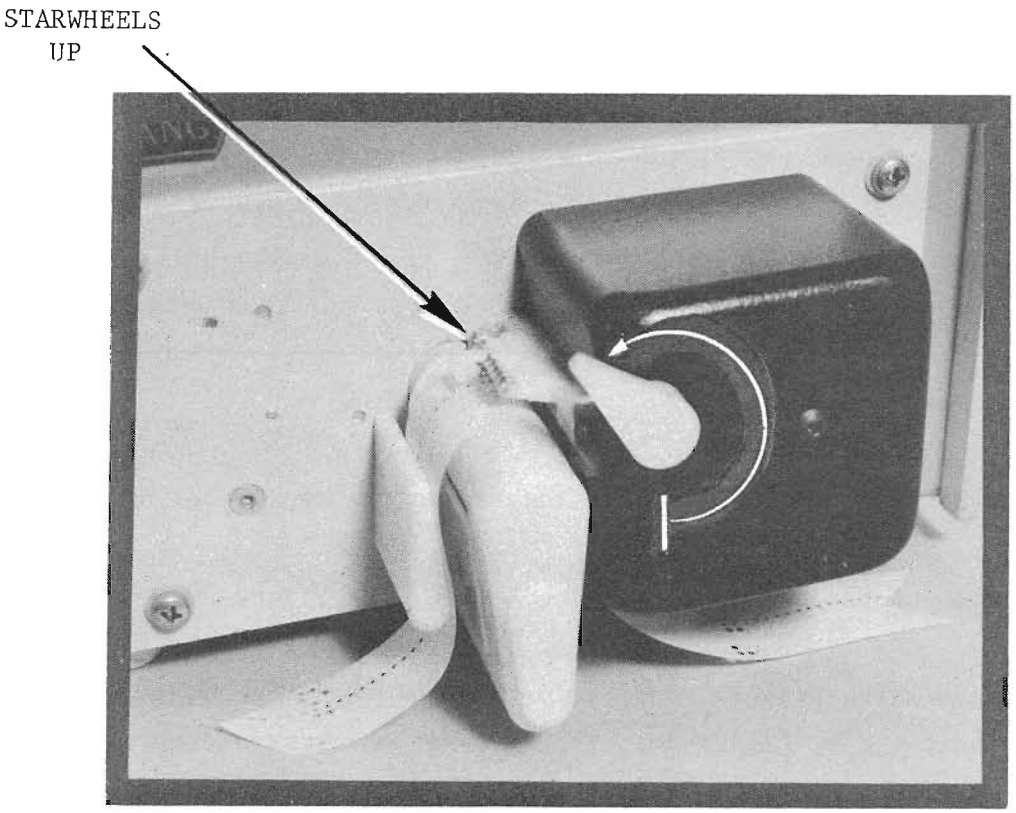


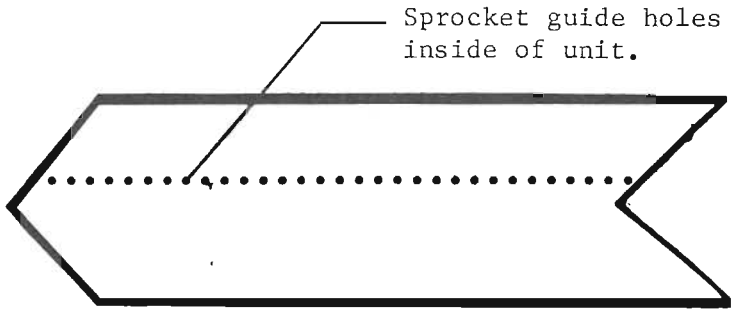
FIGURE 28

3) Insert the paper tape into the mechanism in the direction indicated by Figure 28 above. Most paper tape end pieces are cut indicating the direction of tape movement during a read.

4) After the tape is inserted and aligned on feed holes, turn the loading lever clockwise to lock the reading mechanism into place on the tape.

CAUTION:

It is important that the paper tape be inserted and positioned correctly for accuracy in reading data.



Good ventilation is essential for proper operation of the Model 603/703 units. DO NOT block ventilation ports, or place papers on top of the unit; overheating may result.

FIGURE 29

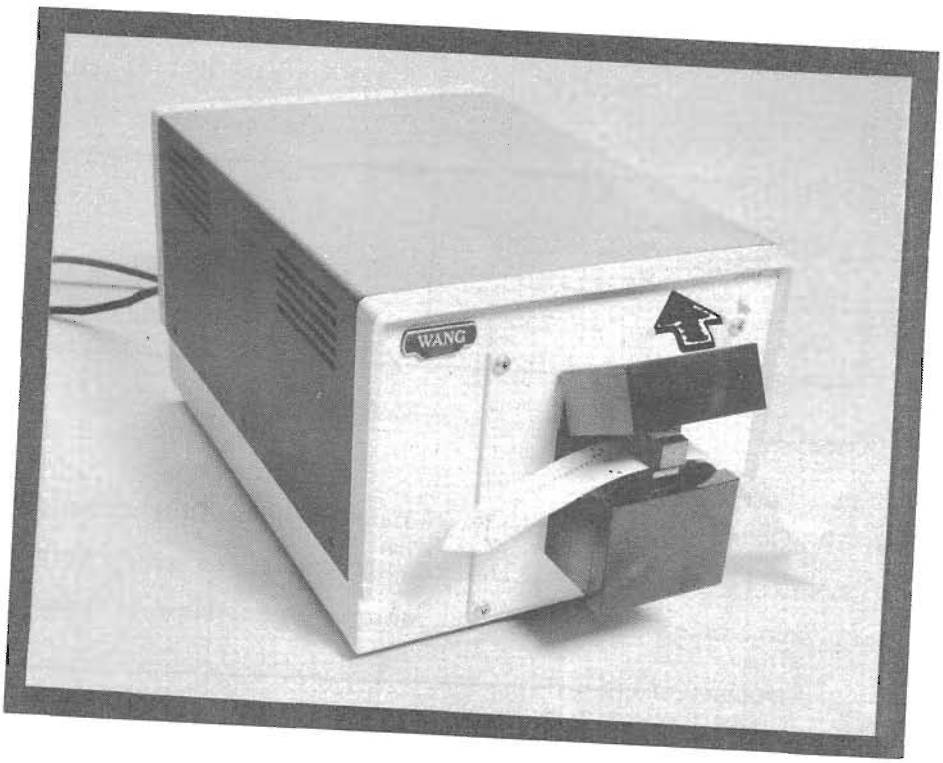
3.1.2 *Models 633, 733, 2203 (Optical Readers)*

1) Switch ON the POWER switch located on the rear panel of the reader.

2) Flip up the hinged reader-head cover (see Figure 30).

3) Insert the punched paper tape into the reader-head, in the direction indicated by Figure 30. The sprocket holes should be positioned so that data channels 1-3 are on the inside of the tape (i.e., closer to the unit) and data channels 4-8 are on the outside of the tape (i.e., further away from the unit). On the 2203, forward reading is from right to left, and reverse reading is from left to right. On the 633 and 733, reading takes place from right to left only (unidirectional).

FIGURE 30



4) After the tape is inserted, flip the reader-head cover back down to its read position.

3.2 COMMANDS

3.2.1 *Models 603, 703, 633, 733*

READ DATA Command:

Series 700 Calculator Instruction	Series 600 Calculator Instruction
GROUP I, 0000 (READER #1) or 0800 (READER #2)	GROUP I, 0000 (READER #1) or 0800 (READER #2)

TAPE ALIGNMENT Command:

Series 700 Calculator Instruction	Series 600 Calculator Instruction
GROUP I, 0007 (READER #1) or 0807 (READER #2)	GROUP I, 0007 (READER #1) or 0807 (READER #2)

RUB-OUT Commands

When the Model 603, 703, 633, 733 comes upon four consecutive ASCII "Rub-Out" codes on paper tape, the reader transfers control back to the calculator, and causes the following search procedure to take place:

In 700 or 720 Series Calculator:	In 600 Series Calculator:
Search Program Memory For Mark 0000	Search Program Memory For Mark 1000

If the search is successful, and a MARK 0000 in the 700/720 is located, (MARK 1000 in Model 600), any program instructions associated with the MARK are carried out. Control does not return to the reader until it is addressed again. If the search for the MARK is not successful, the Program Error light on the calculator illuminates. The calculator PRIME key must be depressed to restore operations.

If a RETURN command is used to end the MARK 0000/MARK 1000 routine, a GO command must occupy the step preceding the RETURN command.

With the GO command included, the RETURN code directs the calculator back to the program step following the Group I 0000 READ DATA command in memory, unlocks the keyboard, and stops the program execution. The program can be continued from that point by keying GO.

If a GO command is *not* included in the routine, and the calculator finds a RETURN code after being directed to MARK 0000/MARK 1000 by the Models 603, 633, 703 or 733, the calculator goes to the program step following the Group I 0000 (READ DATA) command in memory and stops. The keyboard, however, remains locked. Thus the program is interrupted and cannot be restarted without first touching the PRIME key, causing the loss of any data in display. See examples below.

600 PROGRAM

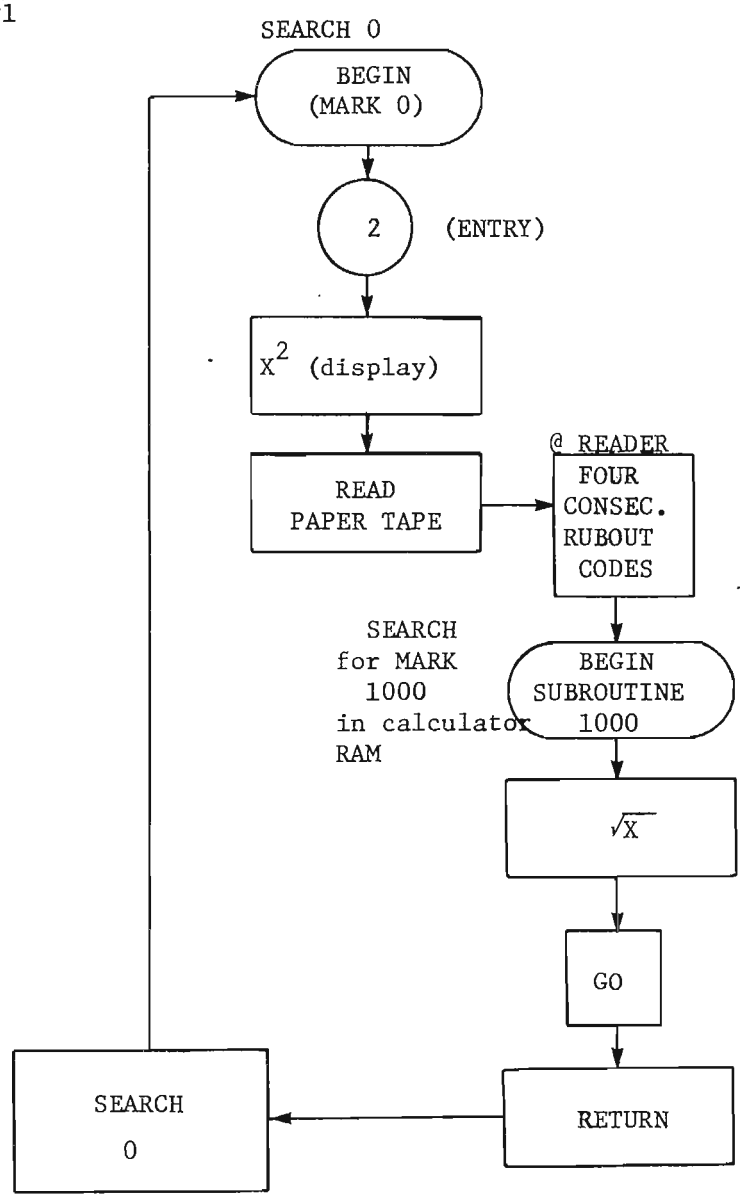
EXAMPLE #1

09	00	Mark	
00	00	0	
00	02	2	
08	12	x^2	
09	02	α	DISPLAY PAUSE
09	03	STOP	
15	13	GROUP 1	READ TAPE
00	00	00	
08	00	SEARCH	
00	00	0	
09	00	MARK	SUBROUTINE
10	00	1000	
08	13	$\sqrt{\ }$ X	
08	03	GO	
09	15	RETURN	
09	14	END PROGRAM	

'2' IN DISPLAY
PROGRAM HALTS
HERE. KEY 'GO'
TO RESUME.

WITHOUT 'GO' CODE
AT STEP BEFORE RETURN
CALCULATOR LOCKS UP.

FLOW DIAGRAM

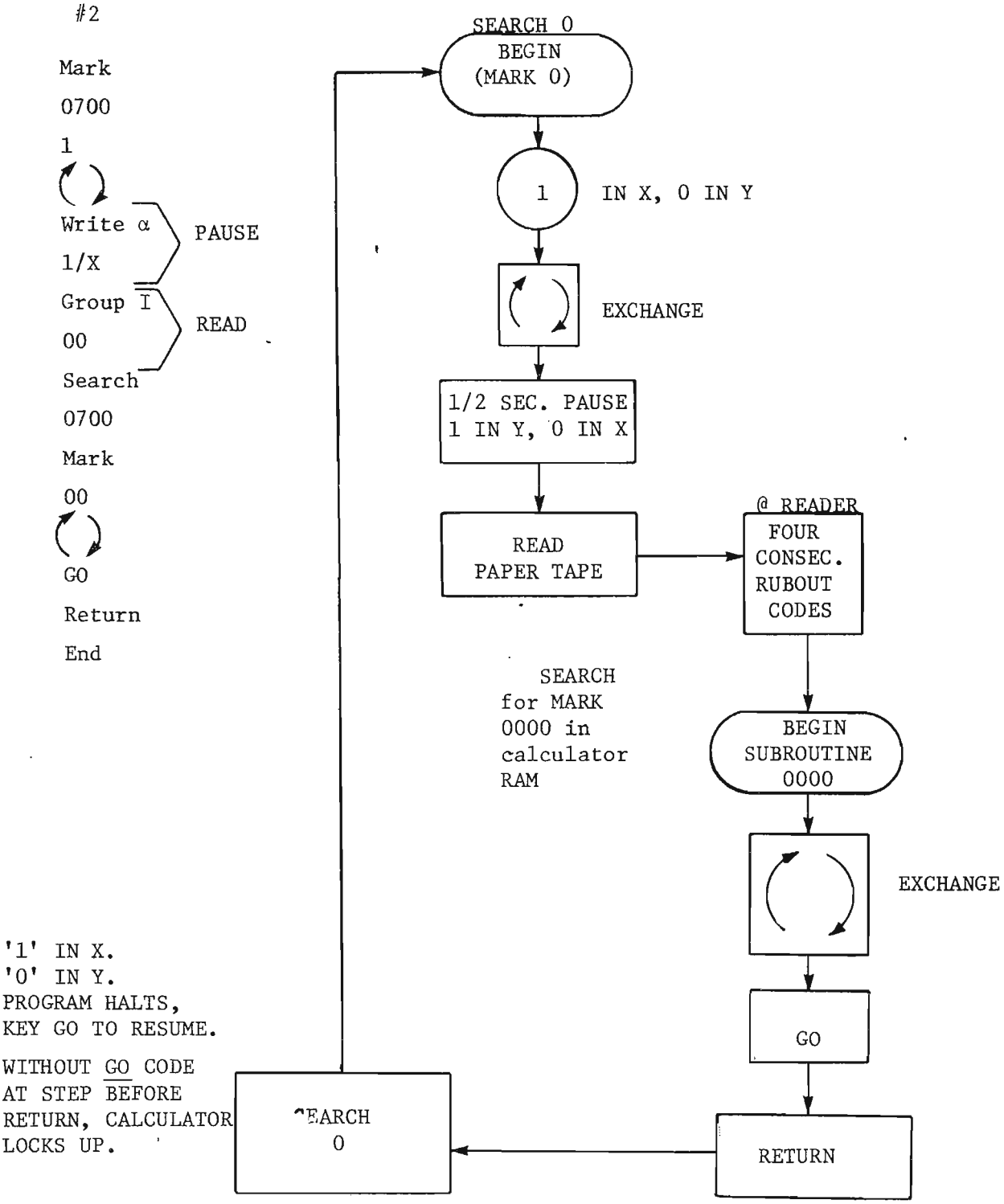


EXAMPLE
#2

Mark
0700
1
Write α
1/X
Group I
00
Search
0700
Mark
00
GO
Return
End

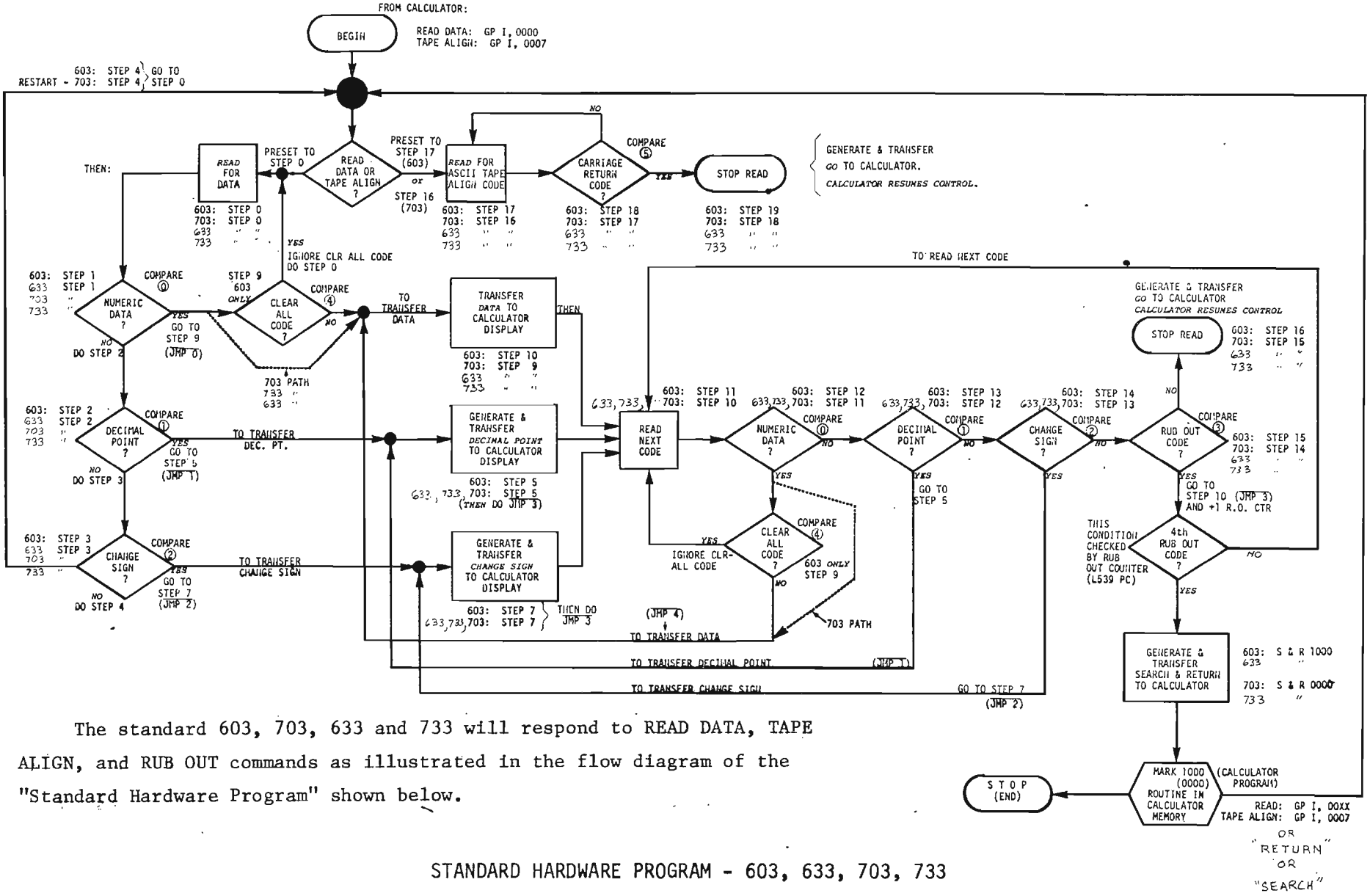
PAUSE

READ



'1' IN X.
'0' IN Y.
PROGRAM HALTS,
KEY GO TO RESUME.

WITHOUT GO CODE
AT STEP BEFORE
RETURN, CALCULATOR
LOCKS UP.



The standard 603, 703, 633 and 733 will respond to READ DATA, TAPE ALIGN, and RUB OUT commands as illustrated in the flow diagram of the "Standard Hardware Program" shown below.

STANDARD HARDWARE PROGRAM - 603, 633, 703, 733

3.2.2 *Model 2203*

1) Device Selection

Because there are a large number of devices available for entering information into the System 2200, it is necessary, when executing a LOAD, DATALOAD, or DATALOAD BT statement, to have some means of identifying the Model 2203 as the device from which data is to be read. In the System 2200 there are three ways of designating, or selecting, a particular device for input.

Each peripheral device in the System 2200 is assigned a unique device address which can be used to identify that device. The lowest device address of the Model 2203 is 618_{16}; thus a LOAD /618 command would instruct the system to begin loading program text from the 2203. The device address must be preceded by a "/".

Alternatively, the device address may be assigned to a particular file number with a SELECT statement. SELECT #1 618, for example, assigns the address of the 2203 (618) to file #1. This file number can then be used in place of the device address when accessing the Model 2203 (in this case, a LOAD #1 command would cause program text to be loaded from the 2203 with address 618). The file number must be an integer from 1 to 6. It is always preceded by a "#".

Finally, if neither the device address nor the file number is given, the system automatically uses the device address of the Console Tape device. Unless otherwise specified, the Console Tape device is normally the tape cassette unit with device address $10A_{16}$. However, it is possible to designate the 2203 as Console Tape device with a SELECT TAPE 618 statement. In this case, a LOAD command with no parameters causes program text to be loaded from the 2203. A further discussion of command parameters follows.

2) Loading *Program Text* in ASCII from Punched Paper Tape

In order to load programs or program segments from a paper tape and store them in memory, either the LOAD command or the LOAD statement may be used. The LOAD command and the LOAD statement have similar general forms; the difference is that in the LOAD command the first and second line number parameters are not included.

General Form: LOAD #n/618, [1st line number] , [2nd line number]

Where:

#n(or)/618	=	the file number or device address of the 2203. Either the device address or the file number to which the address has been assigned (where #n is an integer from 1 to 6) may be specified. If neither is specified, the address of the device currently selected as Console Tape device is used.
1st line number (LOAD statement only)	=	the line number of the first statement line to be deleted from the program currently stored in memory prior to storing the new program. When loading is completed, execution continues automatically at the statement line whose number is equal to the 1st line number. If this line number does not appear in the new program, an error is indicated.
2nd line number (LOAD statement only)	=	the line number of the last statement line to be deleted from the program currently stored in memory prior to storing the new program.

LOAD Command:

The LOAD command is used in Immediate Mode; when it is keyed in, followed by a device address or file number if necessary, it instructs the 2203 to begin reading the program or program segment from paper tape and append it to the last program in memory. No parameters (i.e., 1st and 2nd line numbers) can be specified in the LOAD command, and no statement lines are cleared from memory prior to loading the new program. If line numbers of the new program being loaded from tape are identical to those of the program currently stored in memory, the new lines replace the old lines in memory. After the new program has been loaded, a RUN and an EXECUTE (CR/LF) command must be keyed in in order to begin program execution.

LOAD Command Examples:

```
LOAD /618

SELECT #3 618
LOAD #3
```

LOAD Statement:

The LOAD statement is used to automatically load and execute a new program segment during the execution of a program. The LOAD statement provides the user with three options: either both the first and second line number parameters may be specified, in which case all statement lines in memory between and including these two lines are cleared before the new program is loaded; or the first line number parameter only may be specified, in which case all of memory beginning at this line is cleared; or neither parameter may be specified, in which case the entire memory is cleared prior to loading the new program.

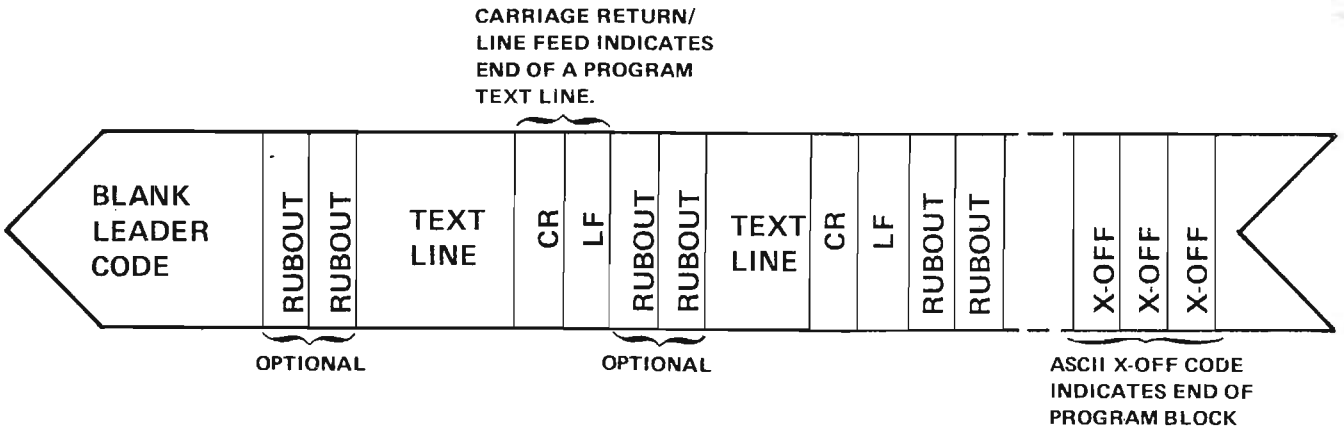
The first statement line number of the program segment being loaded from tape should coincide with the first statement line number specified in the LOAD statement (i.e., if 10 LOAD /618, 100, 200 is specified, the statement line numbers of the program on tape should begin at 100). When the new program has been loaded, program execution automatically begins with the first statement line number specified in the LOAD statement. If no statement line numbers are specified in the LOAD statement, execution begins with the first (lowest) statement line number in memory.

LOAD Statement Examples:

10 LOAD /618	No parameters specified, all memory cleared prior to loading program text from paper tape. After loading, program execution begins automatically at first statement line in memory.
10 SELECT #3 618 20 LOAD #3, 100, 200	Clear System 2200B memory from statement line 100 through line 200 inclusive, then load program from paper tape. After loading, execution begins automatically at statement line 100.
10 SELECT TAPE 618 20 LOAD 100	Clear System 2200B memory beginning at statement line 100, then load program from paper tape. After loading, program execution begins automatically at statement line 100. Since the 2203 was selected as Console Tape device in this example, (SELECT TAPE 618), there is no need for a device address or file number in the LOAD statement.

It must be emphasized that the LOAD statement or command is used *only* for the loading of program text lines from a tape which is punched in ASCII code and which has been formatted according to the specifications of the System 2200B. In general the LOAD statement or command is used to load programs which have previously been saved from a System 2200B.

3) Paper Tape Format For Loading *Program Text Lines*



Under LOAD control, only the first 7 bits of each character on tape are read; the eighth (parity) bit is ignored by the system (i.e., automatically set equal to 0 when loaded). The 2203 ignores all unpunched frames and Rub outs. The Rub outs indicated in the program tape format are, therefore, not required by the 2203. They are, however, required when programs are loaded directly from Teletype, and thus are normally punched when programs are saved on paper tape via teletype.

4) Loading *Data* in Free Format ASCII from Punched Paper Tape

Data is loaded from a paper tape and stored in memory with the DATALOAD statement.

General Form: DATALOAD #n (or) /618, argument list

Where: #n(or)/618 = the file number or device address of the 2203. Either the device address or the file number to which the address has been assigned (where #n is an integer from 1 to 6) may be specified. If neither is specified, the address of the device currently selected as Console Tape device is used.

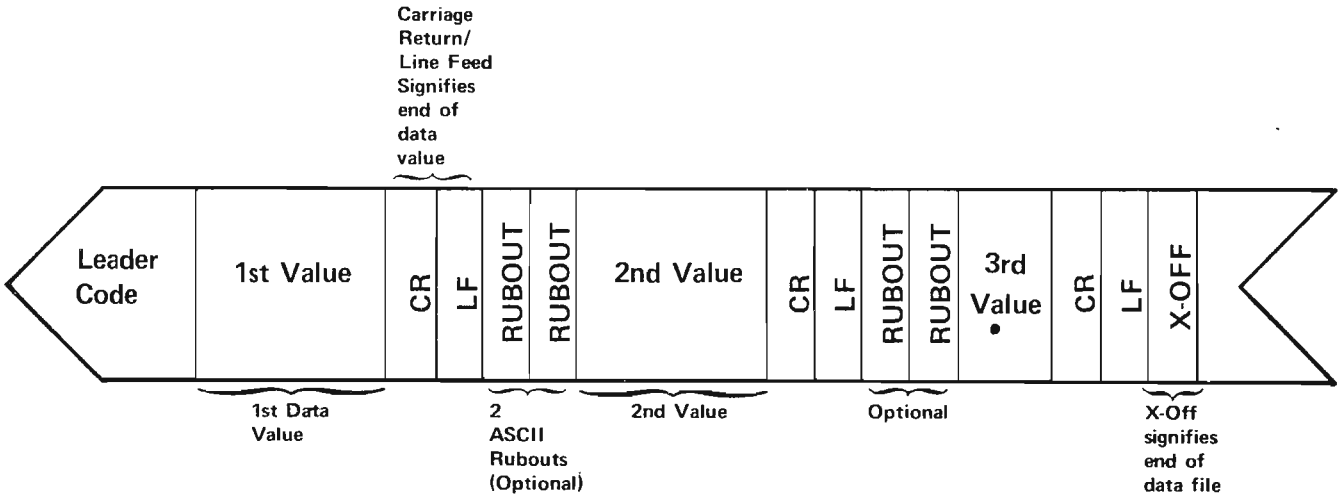
argument list = the numeric, alphanumeric, scalar or array variables (or array elements) to which the data is to be assigned. Numeric or alphanumeric values may be assigned to alphanumeric variables, but values assigned to numeric variables must be legitimate BASIC numbers. Variables in the argument list must be separated by commas. An entire array is specified by the array name followed by left and right parentheses, e.g., A (), B$ ().

The DATALOAD statement instructs the 2203 to begin loading data from the tape and sequentially assign them to the variables or arrays specified in the argument list. The eighth bit of each character is ignored (i.e., automatically set equal to 0 when loaded). Values are read from the tape until all variables have been satisfied or until the end-of-file is encountered (i.e., an X-OFF character is read). When an end-of-file is read, all remaining variables specified in the argument list are left with their current values. An IF END THEN statement in the program causes a valid transfer when the end-of-file is encountered.

NOTE:
Arrays are filled row by row.

Again, it must be emphasized that the DATALOAD statement is used only for loading data from paper tapes which are punched in standard ASCII code and formatted according to System 2200B specifications. In general, the DATALOAD statement is used for loading data which was originally saved from the System 2200B.

5) Paper Tape Format For Data Loading



Alphanumeric and numeric values (in ASCII code) can be stored in alphanumeric variables, but only legitimate BASIC numbers in free-form format (e.g., +34.73, .07E+10, -73.41) should be stored in numeric variables. Carriage Return (CR) and Line Feed (LF) characters are always interpreted as terminators and cannot therefore be loaded and stored from tape as data under DATALOAD control.

Although the indicated Rub outs are *not* required for the 2203 DATALOAD they are required when loading data from a teletype, and are therefore normally punched when saving data on paper tape via teletype.

DATALOAD Examples:

```
10  SELECT #3 618
20  DATALOAD #3,N(),A$,B$
```

Load data from paper tape into numeric array N() and alphanumeric variables A$ and B$.

```
10  DATALOAD /618,A1$(3),X,A$
```

Load and store data in alphanumeric array element A1$(3), numeric variable X, and alphanumeric variable A$.

```
10  SELECT TAPE 618
20  DATALOAD X,Y,A$,B$
```

Since the 2203 has been selected as Console Tape device, no address or file number is necessary in the DATALOAD statement.

DATALOAD SAMPLE PROGRAM

PROGRAM	COMMENTS
`10 DIM A$(5,5)25`	Dimension A$ as a two-dimensional array of 25 (5x5) elements, with a maximum of 25 characters per element.
`40 SELECT #3 618`	Assign device address 618 (i.e., the 2203) to file #3.
`60 DATALOAD#3,A$(),A,B`	Load data from 2203 into array A$ (25 values) and then load data into numeric variables A,B (1 value each).
`70 IF END THEN 150`	Skip to statement 150 when end-of-file (X-OFF) is read, to stop program execution.
`100 B$=A$(1,5)`	Perform operations utilizing values assigned to variables from paper tape.
`140 GOTO 60`	If end-of-file not read, loop back to read in more data.
`150 END`	

DATALOAD BT (BLOCK TAPE)

(Loading Data or Program Text in any Format from Punched Paper Tape)

If data is to be processed from off-line equipment which does not utilize standard ASCII code or the System 2200B paper tape format, the DATALOAD BT statement is used in place of DATALOAD. All 8 bits of each character are read.

The DATALOAD BT statement has two basic functions:

1) To read and store data from a non-formatted tape;
2) To read data in a forward or reverse direction, depending upon whether the "R" parameter is or is not specified.

The DATALOAD BT statement has the following general form:

DATALOAD BT [R] [([N=expression] *,[L={XX / alpha variable}] *,[S={XX / alpha variable}])][#n, / /618,]{alpha variable / alpha array name}

Where: R = reverse direction and read the data in reverse order. If the "R" parameter is not specified, the 2203 automatically reads the tape in the forward direction (i.e., right to left).

N = the number of characters on the tape to be read (1 character = 1 byte = 8 bits). The value of the expression is truncated to an integer value; the value must be ≥ 1.

L = the character which is to be read as the Leader code. If the initial frames contain this character, they are skipped over, and data is read beginning with the first character immediately succeeding the Leader code which is not equal to it. If no Leader code is

specified, data is read beginning with the first character encountered (even if this is a leading blank). A two digit HEX code or an alpha variable may be used for the Leader code. If an alpha variable is used, the first character of its value designates the Leader code.

S = the character which is to be read as the Stop code. When read, this character (8 bits) instructs the 2203 to stop reading data. Control then passes back to the System 2200B, which is positioned to begin execution of the next program statement. The Stop code can be designated by a 2 digit HEX code or an alpha variable. If an alpha variable is used, only the first character of its value is used to specify the Stop code.

#n(or)/618 = the file number or device address of the 2203. Either the device address (618) or the file number to which the address has been assigned (where #n is an integer from 1 to 6) may be specified. If neither is specified, the address of the device currently selected as Console Tape device is used.

alpha variable
alpha array name = a single alpha variable, alpha array name, or alpha array element can be specified to receive the read-in data. An entire alpha array is indicated by an alpha variable followed by left and right parentheses, as A$().

The DATALOAD BT statement causes data or program text to be loaded from a paper tape and stored in a single alpha variable or alpha array specified in the argument list. The entire 8 bits of each character are read and loaded into the alphanumeric string variable or array; the high-order (eighth) bit is *not* zeroed. The 2203 continues loading data or programs until one of the following conditions is met:

1) The designated Stop character is encountered; or
2) The alpha variable or array is full; or
3) The number of characters specified by N are read.

If data is stored in an alphanumeric array, any array elements which are unfilled when reading is terminated retain their original values.

DATALOAD BT Examples:

```
100  DATALOAD BT /618,A$
```

Load data into alphanumeric variable A$. Since no other parameters are specified, data is loaded until A$ has been filled.

```
100  SELECT #1 618
200  DATALOAD BTR (L=FF, S=OD)
     #1, A$(5)
```

Reverse tape direction, begin reading data with 1st character not equal to HEX (FF). Stop reading when HEX code OD is read (or when the array element A$(5) is filled). Store characters in array element A$(5).

```
100  SELECT TAPE 618
200  DATALOAD BT (N=100),A$()
```

Read 1st 100 characters from tape and store in array A$. Since the 2203 has been selected as Console Tape device, no address or file number is necessary in the DATALOAD BT statement.

```
 90  T$="JOHN JONES"
100  SELECT #3 618
200  DATALOAD BT (N=100,L=T$,
     S=OD) #3,A1$
```

Set alpha variable T$ equal to "John Jones". Then, load data from paper tape, beginning with the first character *not* equal to an ASCII "J" (the first character of the value of T$, specified as Leader code). Continue reading data from tape *either* until 100 characters have been read *or* until a character whose code is read (or until the alpha variable A1$ is filled). Store this information in a single alphanumeric variable, A1$.

DATALOAD BT
SAMPLE PROGRAM

The DATALOAD BT statement can be used to load and store data from an unformatted paper tape. The data can then be converted into a form usable by the System 2200B. Suppose, for example, a number of data values punched on paper tape, separated with a single space between each pair of values. The values are punched in ASCII code, but since the paper tape is not formatted according to System 2200B specifications (i.e., Carriage Return and Line Feed characters separating values), it is not possible to use the DATALOAD statement. Use the DATALOAD BT statement, which causes every character in a specified character string to be loaded and stored into an alphanumeric variable or array. Since arithmetic operations can be performed only on values stored in numeric variables or arrays, however, it will be necessary to transfer the values out of the alpha variable, convert them to numeric values, and store them in a numeric array.

One approach might be to load each value from the paper tape into an alphanumeric string variable, T$, then use the CONVERT function to transfer it into a numeric array, A().

Since it is known that each value on tape is followed by a single space character, it is possible to read a single value from the tape simply by specifying the HEX code for space (20) as Stop character in the DATALOAD BT statement. This causes the string of characters up to the space character to be read and stored in the designated alpha variable. The CONVERT function could then be used to convert and transfer each value into the numeric array. A "dummy value" (999 for example) could be punched at the end of the paper tape to indicate the end of data.

A program which does this might be written as follows:

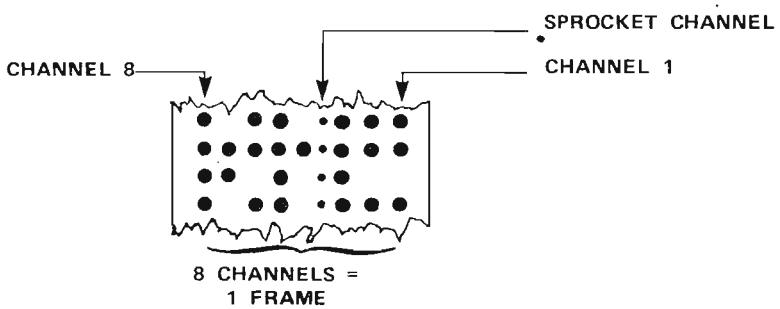
PROGRAM	COMMENTS
10 DIM T$64,A(10)	Dimension alphanumeric string variable T$ to 64 characters (maximum allowable) and numeric array A for 10 elements (a numeric value to be stored in each element).
20 I=0	Initialize counter at 0.
30 T$=" "	Initialize T$ to contain only blanks. When a number of values are to be stored and transferred from an alpha variable or array under DATALOAD BT, the variable or array *must* be re-initialized to contain blanks every time a new value is to be stored in it.
40 I=I+1	Counter incremented.
50 DATALOAD BT (S=20)/618,T$	Read a string of characters from tape and store in T$ until a space character (HEX(20)) is read.

60 CONVERT T$ TO A(I)	The string of ASCII characters representing each number read into T$ is converted into a 2200 internal decimal number and transferred into the numeric array element A(I). The values read in must, however, be ASCII characters representing legitimate BASIC numbers (e.g., 4.2, -57.936, 1.2E -07).
70 IF A(I)=999, THEN 90	When dummy value is read, stop reading tape and exit read loop.
80 GOTO 30	If dummy value not read, loop back to reinitialize T$ and read next value.
90 END	

3.3 PAPER TAPE - GENERAL INFORMATION

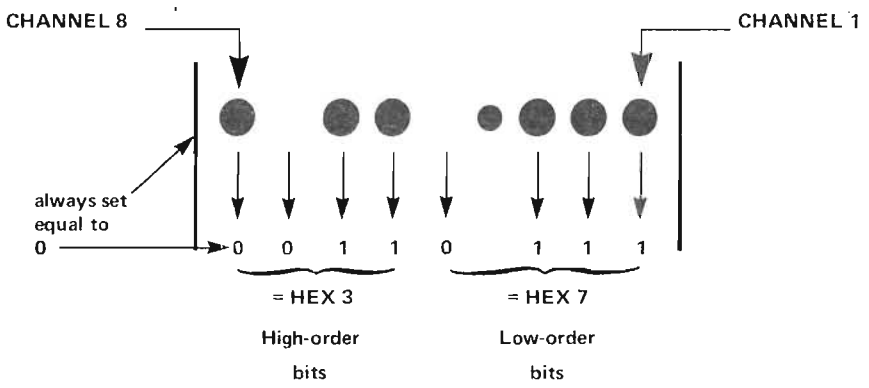
ASCII character code is a standard coding system in which each number, letter, and symbol in the ASCII character set is assigned a unique 8-bit binary code (although in fact only 7 bits are actually used for the code, since the eighth bit is reserved in ASCII for parity). In the System 2200B, the eighth bit is automatically set equal to 0 when read in under LOAD and DATALOAD control; it is actually read only under DATALOAD BT control. This 8-bit binary code is, in turn, translated into a pattern of punches on paper tape.

Consider the following section of a paper tape:



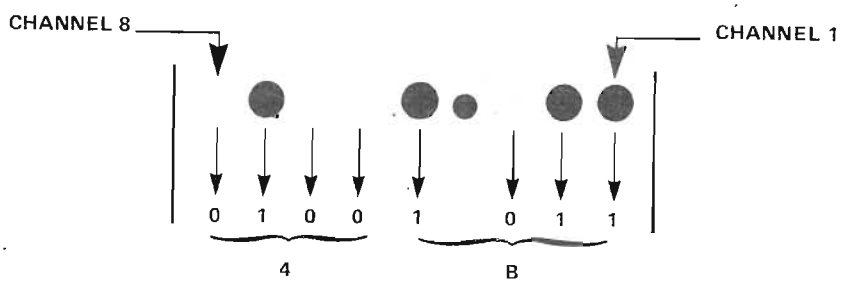
ASCII is expressible as a 2 digit HEX number. In dealing with ASCII codes, it is more efficient to refer to the 2 digit HEX code for a particular character than its equivalent 8-bit binary code.

The 2 digit HEX code for each frame of tape is related to the 8-bit binary code as follows:



As you can see, the right 4 bits of each 8-bit binary value (tape channels 1-4) are represented by the right digit of the 2-bit HEX code; they are referred to as the "low order" bits. The left 4 bits (channels 5-8) are represented by the left digit of the HEX code; they are called the "high order" bits. The binary value in the above frame, then, is expressed in HEX shorthand as 37. HEX 37, like its binary equivalent 00110111_2, is the code for ASCII 7. When reading a tape, convert each frame into a HEX code and then check the table on page for the characters corresponding to these HEX codes.

Letters and symbols are handled in a manner exactly analogous to numbers. The letter K, for example, is assigned the binary code 01001011_2 (HEX 4B) in ASCII. Below, A frame is punched with the letter K.



Tape Size

Standard 8 channel, one inch paper tape, as well as narrower tapes must conform to the following specifications:

1) The sprocket holes must conform to the pin feed mechanism, which handles ten sprocket holes per inch;

2) The sprocket holes must align with the data holes;

3) The ratio between diameter of sprocket hole and diameter of data hole must conform to punched tape standards (EIA standard RS-227).

ASCII CODE LISTING

BASIC SYMBOL	HEX CODE	8-BIT FORM Tape Channels 8 1
LINE FEED (LF)	0A	00001010
CARRIAGE RETURN (CR)	0D	00001101
X-ON	11	00010001
X-OFF	13	00010011
SPACE	20	00100000
!	21	00100001
DOUBLE QUOTE	22	00100010
#	23	00100011
$	24	00100100
%	25	00100101
&	26	00100110
SINGLE QUOTE	27	00100111
(	28	00101000
)	29	00101001
*	2A	00101010
+	2B	00101011
, (comma)	2C	00101100
-	2D	00101101

ASCII CODE LISTING

BASIC SYMBOL	HEX CODE	8-BIT FORM Tape Channels 8 1
. (decimal point)	2E	00101110
/ (slash)	2F	00101111
0	30	00110000
1	31	00110001
2	32	00110010
3	33	00110011
4	34	00110100
5	35	00110101
6	36	00110110
7	37	00110111
8	38	00111000
9	39	00111001
:	3A	00111010
;	3B	00111011
<	3C	00111100
=	3D	00111101
>	3E	00111110
?	3F	00111111
@	40	01000000
A	41	01000001
B	42	01000010
C	43	01000011
D	44	01000100
E	45	01000101
F	46	01000110
G	47	01000111
H	48	01001000
I	49	01001001
J	4A	01001010
K	4B	01001011
L	4C	01001100

ASCII CODE LISTING

BASIC SYMBOL	HEX CODE	8-BIT FORM Tape Channels 8 1
M	4D	01001101
N	4E	01001110
O	4F	01001111
P	50	01010000
Q	51	01010001
R	52	01010010
S	53	01010011
T	54	01010100
U	55	01010101
V	56	01010110
W	57	01010111
X	58	01011000
Y	59	01011001
Z	5A	01011010
[	5B	01011011
]	5D	01011101
↑ (up arrow)	5E	01011110
a	61	01100001
b	62	01100010
c	63	01100011
d	64	01100100
e	65	01100101
f	66	01100110
g	67	01100111
h	68	01101000
i	69	01101001
j	6A	01101010
k	6B	01101011
l	6C	01101100

ASCII CODE LISTING

BASIC SYMBOL	HEX CODE	8-BIT FORM Tape Channels 8 1
m	6D	01101101
n	6E	01101110
o	6F	01101111
p	70	01110000
q	71	01110001
r	72	01110010
s	73	01110011
t	74	01110100
u	75	01110101
v	76	01110110
w	77	01110111
x	78	01111000
y	79	01111001
z	7A	01111010

4. DIAGNOSTICS

4.1 GENERAL DESCRIPTION - 603, 633, 703, 733

This test will direct the 03/33 to read digits 0 through 9, change sign codes, decimal point codes, rub out codes, alpha codes, and carriage return codes. Each entry of data from the tape reader is compared to a value previously stored in a register. If the value read is not identical to the value stored, the test halts and displays the misread data. If the value read is identical to the value stored, the test continues to run. The test repeats after reading 99999999.99 + 4 rub outs.

4.2 OPERATING INSTRUCTIONS (603, 633, 703, 733 TEST)

1) Make loop of ASCII tape; join at blank leader ends.

2) Load paper tape into reader.

3) Load diagnostic cassette into calculator.

4) Rewind, Prime, Tape Ready, Load, Verify.
Verify = 769 (600); verify = 752 (700/720).

5) Search, Search (600); Search, Write Alpha (700/720).

6) Paper tape reading begins. If data read from paper tape does not agree with a compare value from the diagnostic, the program halts, displaying the faulty data.

7) After four consecutive rub out codes have been read, a number is displayed for the duration of the blank leader on paper tape. That number indicates how many complete passes the diagnostic has run. Prime to stop test at any time.

4.3 RESULTS (603, 633, 703, 733 TEST)

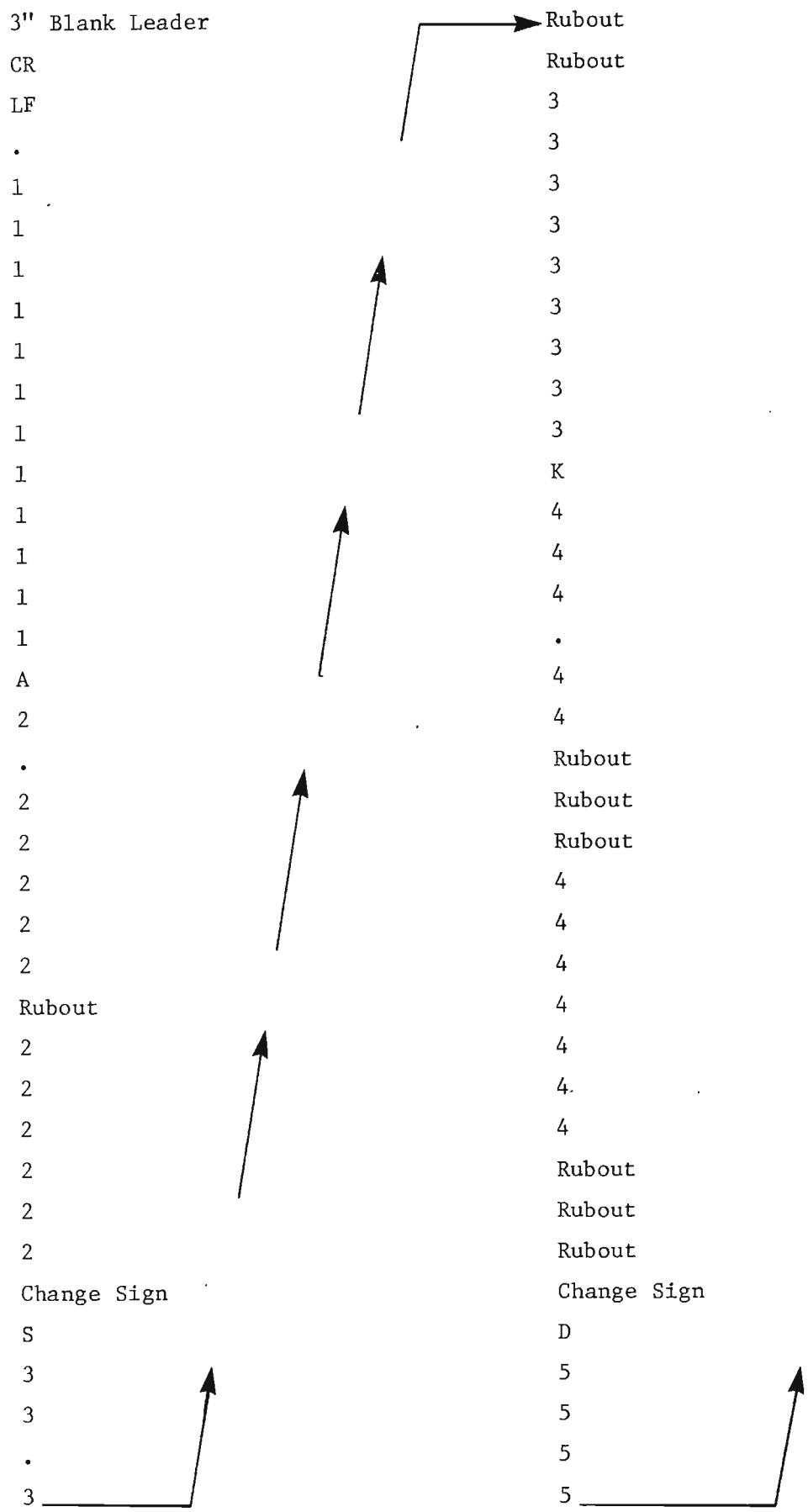
The following should appear in display during one complete pass:

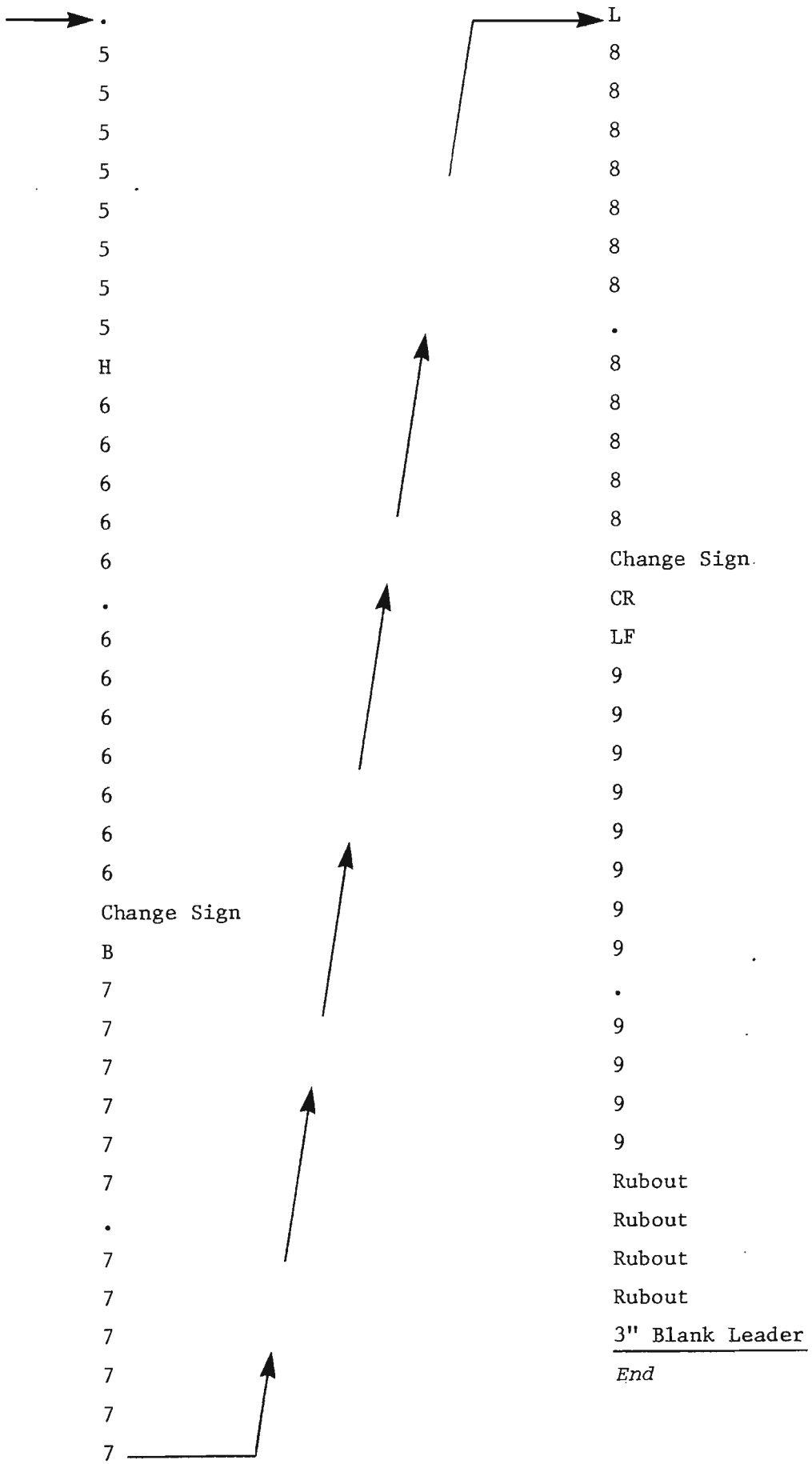
```
+.1111111111
-2.222222222
+33.33333333
-444.4444444
+5555.555555
-66666.66666
+777777.7777
-8888888.888
+99999999.99
Pass #
```

If the test halts with X display blank (700/720) or with a blank display in the 600, the rub out recognition and/or counting circuitry has failed causing an erroneous SEARCH for MARK 0000 (700/720) or SEARCH for MARK 1000 (600).

If the 703/733 test halts with 9 in the X and Y displays, the reader carriage return function is defective.

4.4 DATA PUNCHED ON PAPER TAPE - 603/633/703/733 TEST




.
5
5
5
5
5
5
5
5
H
6
6
6
6
6
6
6
.
6
6
6
6
6
6
Change Sign
B
7
7
7
7
7
.
7
7
7
7
7
7
L
8
8
8
8
8
8
8
.
8
8
8
8
8
Change Sign
CR
LF
9
9
9
9
9
9
9
9
.
9
9
9
9
Rubout
Rubout
Rubout
Rubout
3" Blank Leader
End

4.5 DIAGNOSTIC PROGRAM LISTINGS FOR 603/633/703/733

4.5.1 *603/633 Diagnostic*

```
0000  09 00    *  M
0001  08 00    *  S
0002  09 01    *  SI
0003  00 02    E2
0004  09 00    *  M
0005  00 01    E1
0006  15 13    D13
0007  00 07    E7
0008  09 00    *  M
0009  00 09    E9
0010  00 09    E9
0011  08 15    *  ½
0012  06 14    SI14
0013  09 01    *  SI
0014  00 00    F0
0015  09 00    *  M
0016  00 02    E2
0017  15 13    D13
0018  00 00    F0
0019  09 05    *  J₆
0020  08 00    *  S
0021  00 12    E12
0022  06 15    SI15
0023  09 02    *  α
0024  08 04    *  J₀
0025  08 00    *  S
0026  00 07    F7
0027  00 01    E1
0028  00 00    E0
0029  04 15    ×15
0030  00 01    E1
0031  00 00    E0
0032  04 14    ×14
0033  02 15    +15
0034  00 12    F12
0035  09 01    *  SI
0036  00 00    E0
0037  15 13    D13
0038  00 00    F0
0039  09 05    *  J₆
0040  08 00    *  S
0041  00 12    E12
0042  09 02    *  α
0043  08 04    *  J₀
0044  08 00    *  S
0045  00 07    E7
0046  00 12    E12
0047  09 01    *  SI
0048  00 00    E0
0049  00 01    E1
0050  00 00    F0
0051  04 15    ×15
0052  00 01    E1
0053  00 00    E0
0054  04 14    ×14
0055  02 15    +15
0056  06 00    ST0
0057  08 00    *  S
0058  00 02    E2
0059  09 00    *  M
0060  00 12    E12
0061  08 00    *  S
0062  00 07    E7
0063  09 03    *  SP
0064  09 00    *  M
0065  00 07    E7
0066  09 03    *  SP
0067  09 03    *  SP
0068  09 00    *  M
0069  10 00    f0
0070  09 05    *  J6
0071  08 00    *  S
0072  00 07    E7
0073  09 02    *  α
0074  08 04    *  J0
0075  08 00    *  S
0076  00 07    E7
0077  00 01    E1
0078  02 02    +2
0079  08 00    *  S
0080  00 01    E1
0081  09 14    *  EP
```

4.5.2 *703/733 Diagnostic*

```
0000  04 08
0001  04 12
0002  04 04
0003  00 11
0004  04 08
0005  07 00
0006  07 09
0007  06 04
0008  04 09
0009  00 07
0010  05 09
0011  05 15
0012  05 15
0013  07 01
0014  04 00
0015  00 11
0016  04 05
0017  00 11
0018  06 04
0019  04 12
0020  06 15
0021  07 09
0022  06 15
0023  06 04
0024  04 04
0025  00 00
0026  07 01
0027  04 04
0028  00 01
0029  07 01
0030  04 04
0031  00 02
0032  04 07
0033  07 01
0034  04 08
0035  07 01
0036  04 09
0037  00 00
0038  05 09
0039  05 15
0040  05 15
0041  04 05
0042  00 02
0043  06 04
0044  07 01
0045  07 00
0046  07 11
0047  06 02
0048  06 05
0049  04 04
0050  00 02
0051  04 05
0052  00 01
0053  06 04
0054  07 01
0055  06 00
0056  04 05
0057  00 02
0058  06 06
0059  04 04
0060  00 01
0061  06 02
0062  04 05
0063  00 00
0064  06 02
0065  04 07
0066  07 01
0067  04 08
0068  00 00
0069  05 09
0070  07 15
0071  05 15
0072  06 15
0073  04 07
0074  07 00
0075  05 12
```

4.6 OPERATING INSTRUCTIONS - 2203 TEST

1) Make loop of ASCII tape; join at blank leader ends.

2) Load paper tape into reader.

3) Load diagnostic cassette into 2217 tape drive.

4) Rewind, Load, Execute.

5) When finished loading tape blocks, Run, Execute.

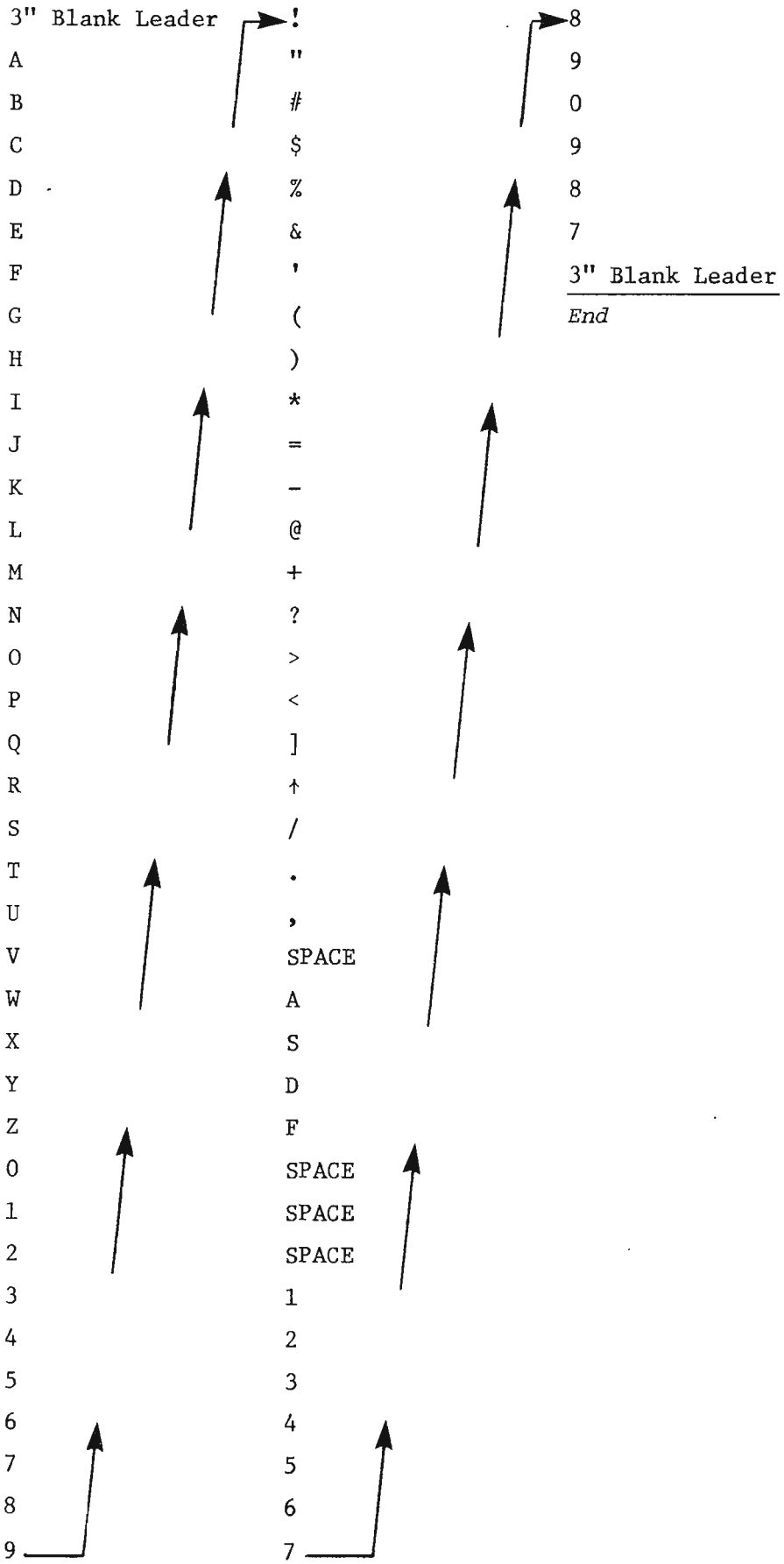
4.7 RESULTS

The following should appear in the 2216 display screen:

```
2203 PAPER TAPE READER DIAGNOSTIC
FUNCTION KEYS CONTROL THIS PROGRAM
KEYS 0 THROUGH 4 FOR 2203 EXERCISE
KEY 0 PAPER TAPE READ DISPLAY PATTERNS
KEY 1 READ FORWARD/BACKWARD RAPIDLY
KEY 2 READ AND COMPARE LOOP TAPE
KEY 3 READ AND COMPARE LOOP TAPE (REVERSE)
KEY 4 (TEST OF PAPER TAPE MICRO-CODE)
      USES SPECIAL PAPER TAPE
KEY 14 BACKWARD READ PAPER TAPE
KEY 15 DESCRIPTION OF FUNCTION KEY

STOP SELECT DESIRED FUNCTION
:
```

4.8 DATA PUNCHED ON PAPER TAPE - 2203 TEST



5. MAINTENANCE

5.1 ELECTRICAL ADJUSTMENTS - (603, 703)

See page 23 for voltage checks.

5.2 MECHANICAL ADJUSTMENTS - (603, 703)

5.2.1 *Lubrication*

The Paper Tape Reader should be lubricated every three months:

The following should be greased at the specified locations. See Figure 41A.

(a) Armature at pivot point (7) - moderate grease.
(b) Detent roller (6) - moderate grease.
(c) Drive pawl tips at ratchet (4) - moderate grease.
(d) Pawl depressor tips (3) - moderate grease.
(e) Spring at anchor points of armature and screw (8) - very light.
(f) Interrupter switch card at cam end (1) - very light.
(g) Interrupter switch card at pressure finger (2) - very light.

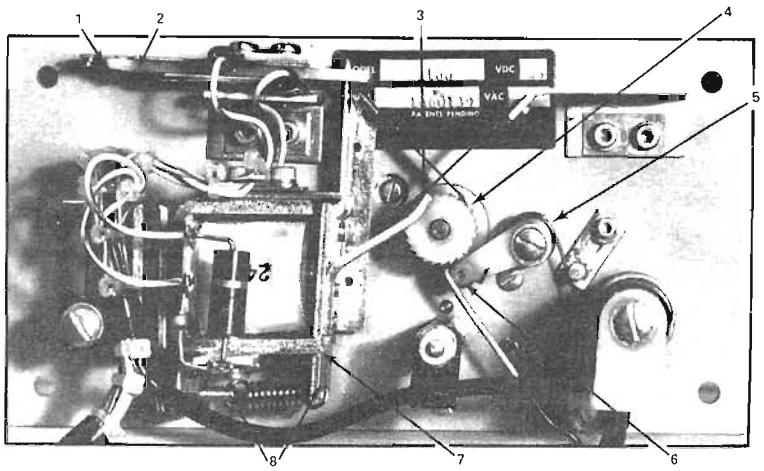


FIGURE 41A

Lubricate the Detent Arm Pivot on the Eccentric Post with one drop of oil. See Figure 41B (5).

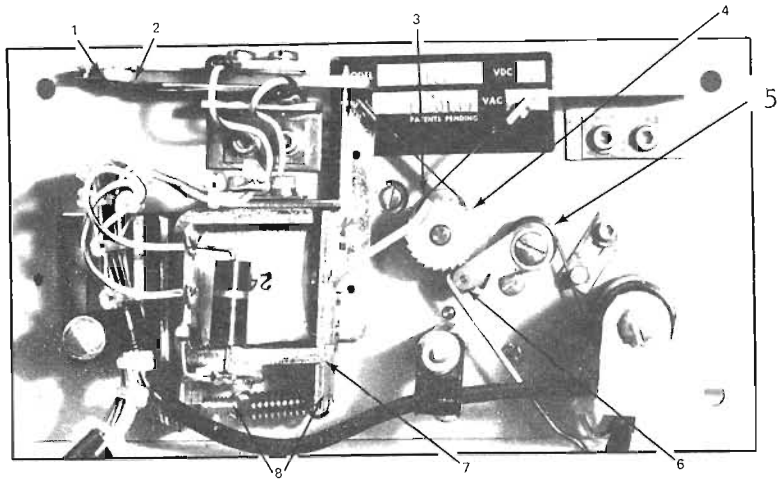


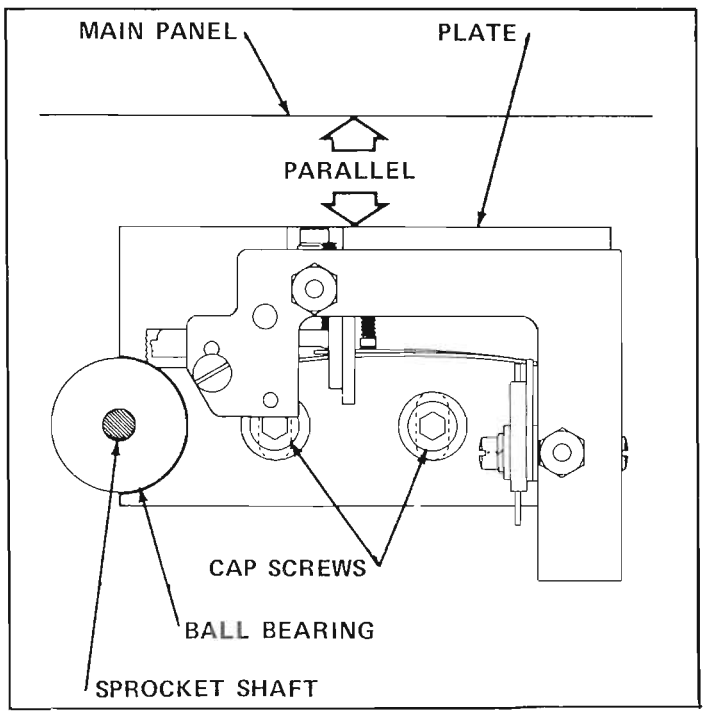
FIGURE
41B

5.2.2 *Adjustments*

1) Starwheel Sensing Head

(a) To check or adjust the sensing head, remove knob and cover using a .05" hex driver and a 5/64" hex driver.

(b) Position the starwheel sensing head so that the upper edge of the plate is visually parallel to the upper edge of the main panel. See Figure 42.



STARWHEEL
SENSING HEAD
ALIGNMENT

FIGURE
42

(c) To adjust the position of the sensing head, loosen the two socket head cap screws sufficiently to rotate the sensing head clockwise or counterclockwise. Maintain slight pressure to the left to keep the head assembly against the outside diameter of the sprocket shaft ball bearing. This is required to maintain starwheel alignment with the sprocket shaft assembly.

(d) Tighten the two cap screws securely.

2) Sprocket Shaft And Detent Arm

> NOTE:
> The detent arm prevents rotation of the sprocket during energization of the drive magnets. See Figure 43.

(a) Install prepunched tape over sprocket drum.

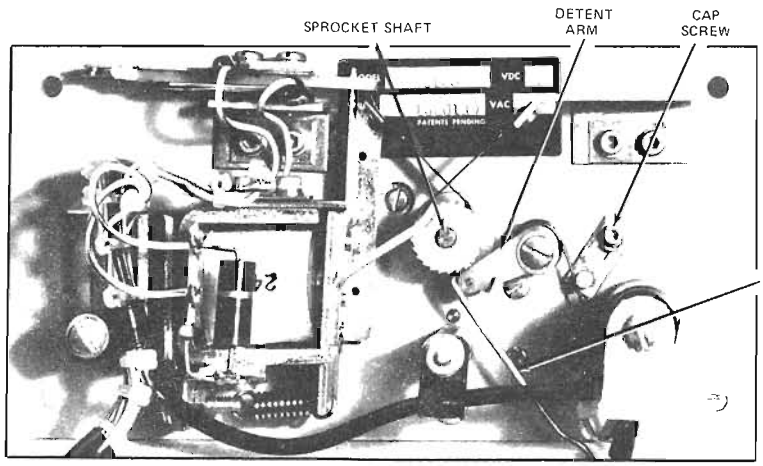


FIGURE 43

SPROCKET SHAFT AND DETENT ARM

(b) Position the detent arm so that the starwheel straddles the area between the holes with a distance equal from the two points of the starwheel riding the tape to the distance between the preceding and following hole edges. See Figure 44.

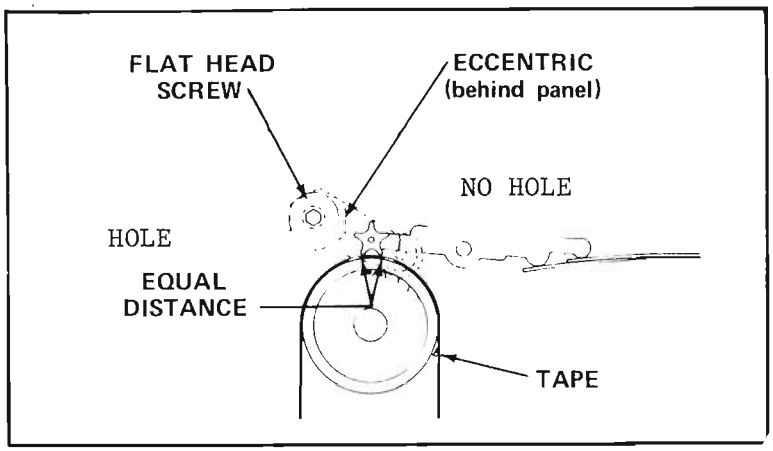


FIGURE 44

DETENT ARM AND STARWHEEL POSITION ADJUSTMENT

(c) To adjust the detent arm, loosen the flat head screw and rotate the eccentric so that the sprocket shaft is positioned for correct tape hole alignment with the starwheels. Tighten flat head screw. See Figure 44.

> NOTE:
> When making this adjustment, loosen lock screws of the magnet assembly and position magnet so that the two pawls are disengaged.

3) Detent Arm Spring Adjustment

(a) Check tension of the detent arm spring. See Figure 43. Using a 0-36 oz (0-1000 grams) spring scale, the tension required to start moving the detent arm away from the ratchet is 12 ounces $\pm$ 1/2 oz. (336 grams $\pm$ 14 grams).

(b) To adjust detent arm spring tension, loosen cap screw and re-position spring post assembly; tighten cap screw. See Figure 43.

(c) Repeat step (a).

4) Armature Gap Clearance

(a) The correct air gap clearance is established by assembling a 0.013" (.033 cm) (nominal) shim between the armature limit and magnet housing. See Figure 45. With the armature manually energized, the air gap should be checked with both a 0.003" (.0076 cm) and 0.005" (.0127 cm) feeler gauge. The 0.003" (.0076 cm) gauge should pass freely between the core and the armature. The 0.005" (.0127 cm) gauge should be tight.

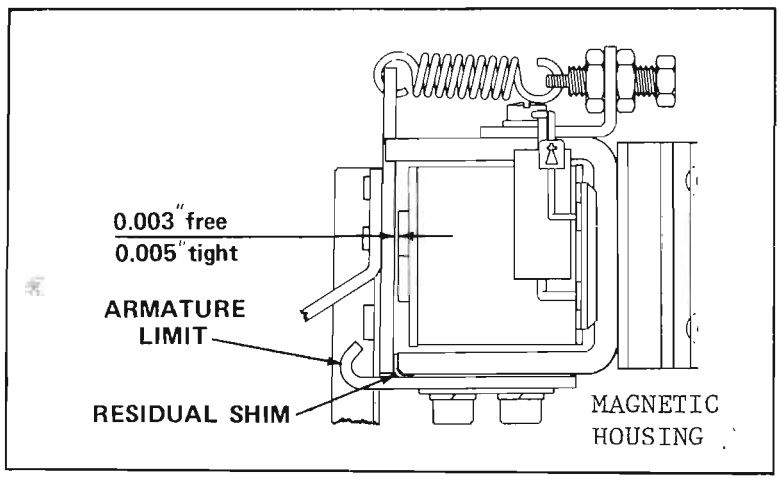


FIGURE 45

ARMATURE GAP CLEARANCE ADJUSTMENT

(b) To adjust air gap clearance, change the residual shim to obtain the 0.004" (.0102 cm) minimum and 0.006" (.0152 cm) maximum gap. Residual shims are available in the following thicknesses:

SIZE	MOHAWK PART NO.
0.003"	119114-5
0.005"	119114-1
0.007"	119114-2
0.010"	119114-3
0.013"	119114-4

(c) If shim is changed, readjust armature travel. See page 66.

5) Armature Travel Adjustment

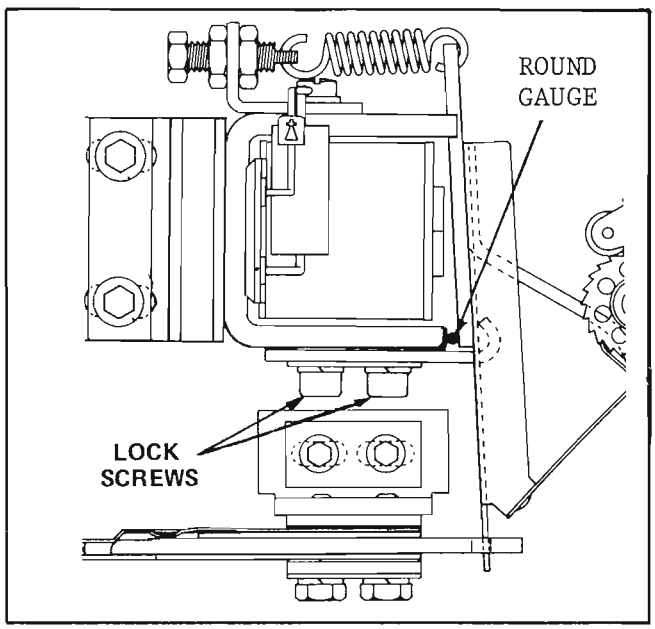
(a) The clearance between the armature and the residual shim determines the stroke or travel of the armature.

> NOTE:
> Excessive clearance would affect pick time of the armature during energization of the coil. Insufficient clearance, in addition to affecting pick time, may limit travel of the armature and thus prevent normal stepping.

(b) In order to have sufficient travel to pick the ratchet tooth and operate the interrupter switch with the required safety factor, the clearance between the armature and residual shim is set at 0.062" (.158 cm). This is measured with a .062" (.158 cm) round gauge. See Figure 46.

(c) If necessary to change or correct this adjustment, loosen the two lock screws under the coil which assemble the armature limit and residual shim to the magnet housing. Insert the round gauge between the armature and the shim and press the armature limit against the armature, closing up all clearances.

(d) Tighten the two lock screws and remove the round gauge.



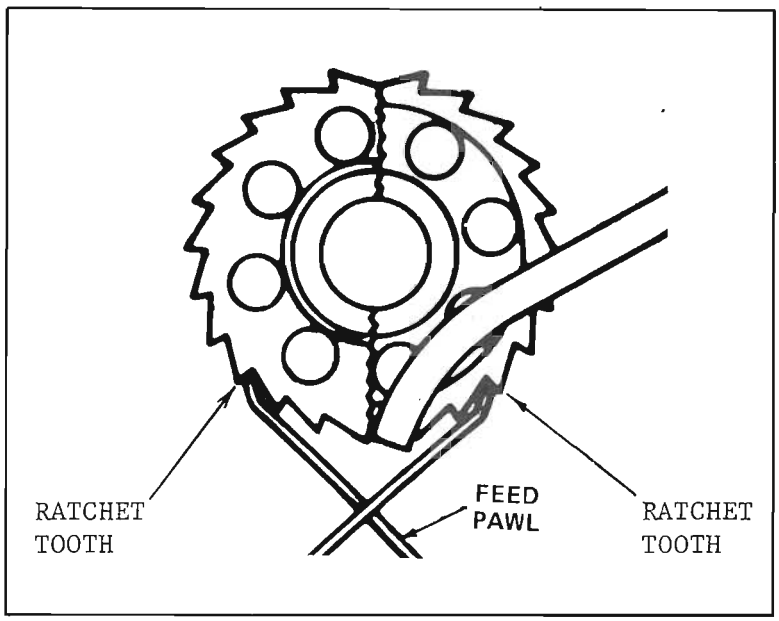
ARMATURE
TRAVEL
ADJUSTMENT

FIGURE
46

6) Feed Pawl Adjustment

(a) Check position of feed pawls in relation to the ratchet. The pawls should lay into the third notch of the ratchet from the bottom center position.

(b) The pawl must be adjusted so that it butts against the ratchet tooth. It must also be free to re-engage with the same tooth when momentarily displaced. See Figure 47.

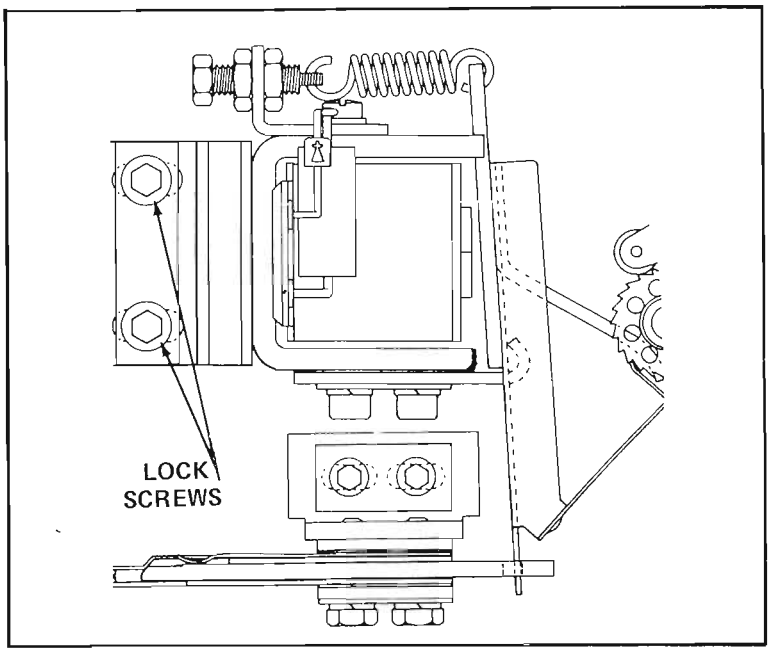


FEED PAWL ADJUSTMENT
FIGURE 47

(c) To reposition the pawl in relation to the ratchet, it is necessary to reposition the magnet assembly. Two lock screws secure the magnet assembly housing to the main plate. By loosening these screws, the assembly can be adjusted into the correct position. See Figure 48.

MAGNET
AND
FEED PAWL

FIGURE
48



7) Feed Pawl Tension

(a) The blade tension of the feed pawl against the ratchet is 95 grams (3.39 oz). See Figure 49. This is measured at the tip of the pawl and is the gram tension required to start moving pawl away from the ratchet. Use a 50-250 gram gauge.

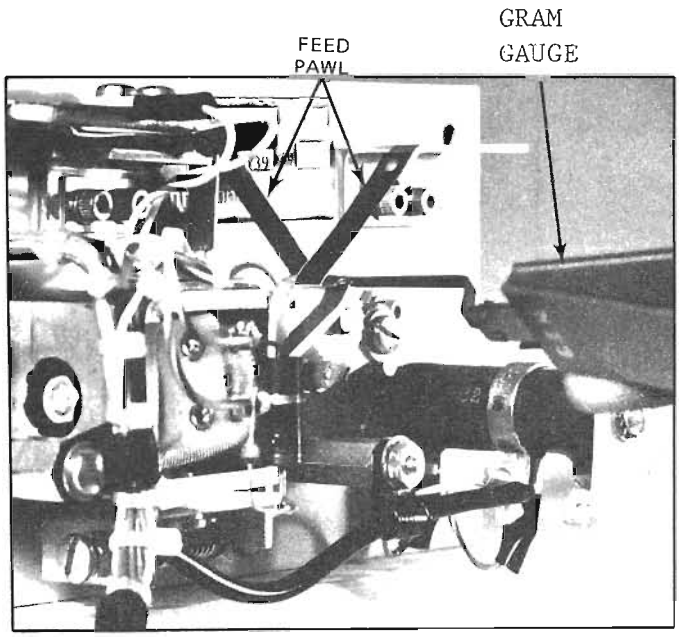


FIGURE
49

FEED PAWL TENSION ADJUSTMENT

(b) The tension can be increased by forming the pawl slightly at its base where it is assembled to the armature extension.

8) Depressor Pawl Adjustment

(a) The depressor pawl disengages the opposing pawl during energization of the armature so that the ratchet can rotate during de-energization. See Figure 50. The tip of the opposing pawl should clear the ratchet by approximately 0.010" (.0254 cm) and re-engage after the first third of the tooth has passed the tip of the pawl during the rotation of the sprocket shaft assembly. Use a .010" flat gauge.

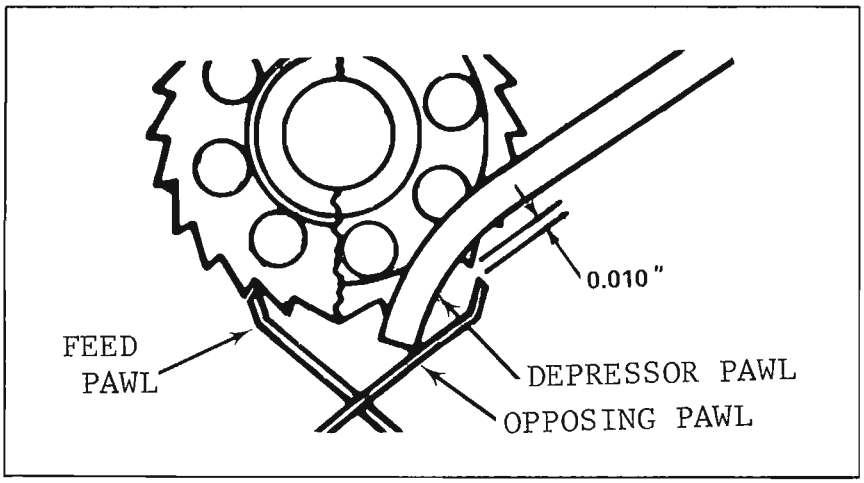
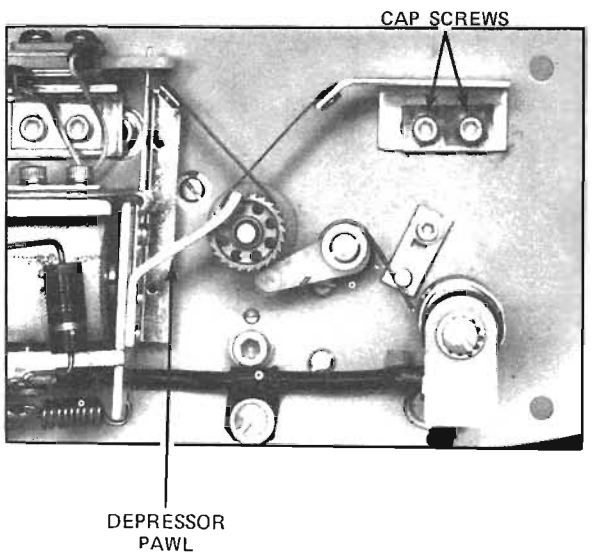


FIGURE 50 - DEPRESSOR ADJUSTMENT

(b) If adjustment is required, loosen the two cap screws. See Figure 51.

DEPRESSOR PAWL ALIGNMENT

FIGURE 51

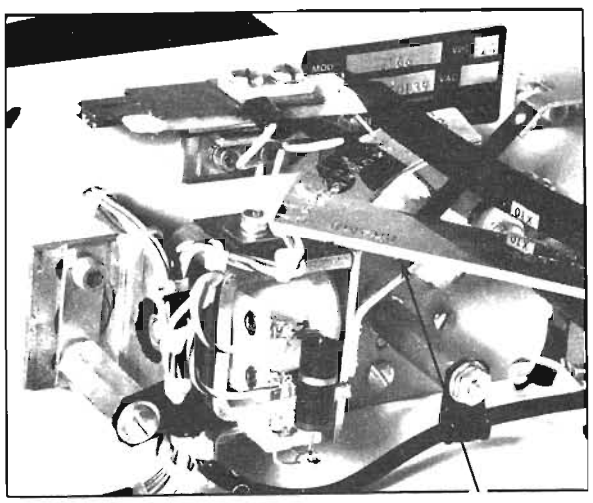


(c) Repeat step (a) and tighten the two cap screws.

9) Armature Spring Tension

> NOTE:
> The armature spring provides the driving force which advances the sprocket and tape upon de-energization of the electromagnet.

(a) The armature spring tension is 420 grams (15 oz). See Figure 52. This measurement is made at the tip of the armature extension and is measured at the point where the armature starts to move. Use a 0-650 gram gauge.



GRAM GAUGE

ARMATURE SPRING TENSION CHECK

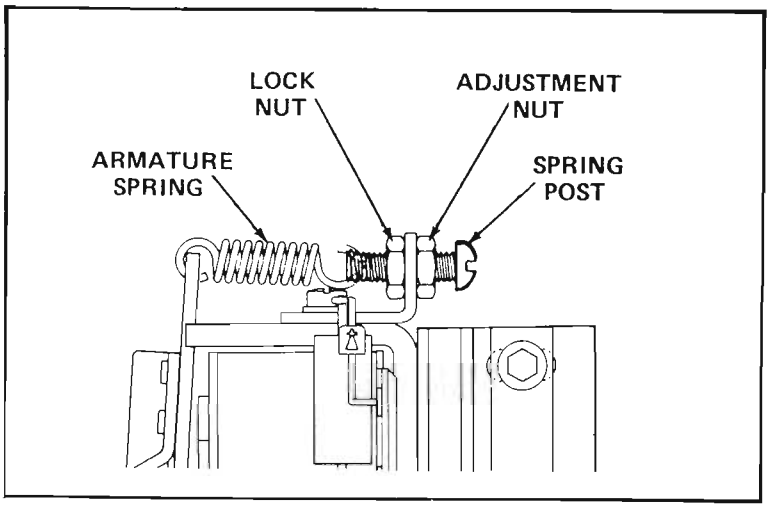
FIGURE 52

(b) To adjust, loosen the lock nut of the armature spring post and increase or decrease tension by turning adjustment nut as required. See Figure 53.

(c) Secure lock nut after assuring adjustment is correct.

> NOTE:
> Assure that spring loop is perpendicular to end of armature so that spring tension is not creating side pressure in the spring hole.

FIGURE 53 - ARMATURE SPRING TENSION ADJUSTMENT



10) Interrupter Switch

> NOTE:
> The interrupter switch is designed to open at the point where the feed pawl engages with the next ratchet tooth during attraction of the armature.

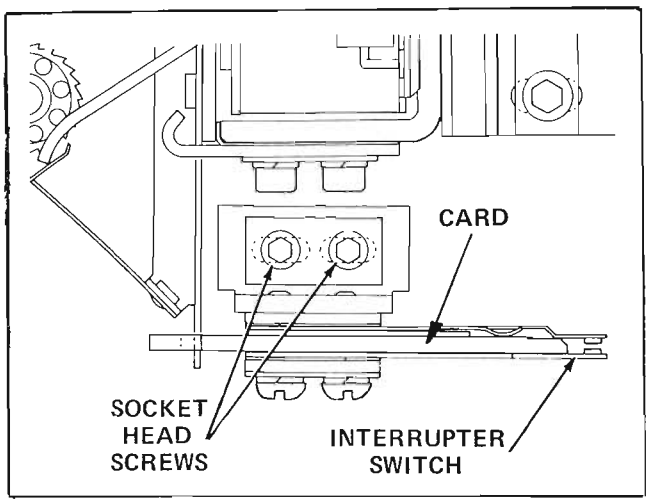
(a) To adjust, loosen two socket head mounting screws. See Figure 54. With ohm meter or buzzer connected across the interrupter terminals, manually operate armature. Adjust switch to break at point where the feed pawl snaps into next tooth.

(b) Tighten the two socket head screws.

(c) To check the interrupter switch remake timing, manually operate the interrupter switch card.

ARMATURE
ADJUSTMENT

FIGURE
54



NOTE:

Release of the card will result in the switch remaking, which should occur within the last one quarter tooth of the ratchet. This assures that the interrupter will not remake before the sprocket shaft has been stepped.

11) Interrupter Switch Blade Tension

(a) Check interrupter switch blade tension at contact. Check each blade individually. The contact should not break at 25 grams (.89 oz) but should break at 35 grams (1.25 oz). Use a 10-80 gram gauge. See Figure 55.

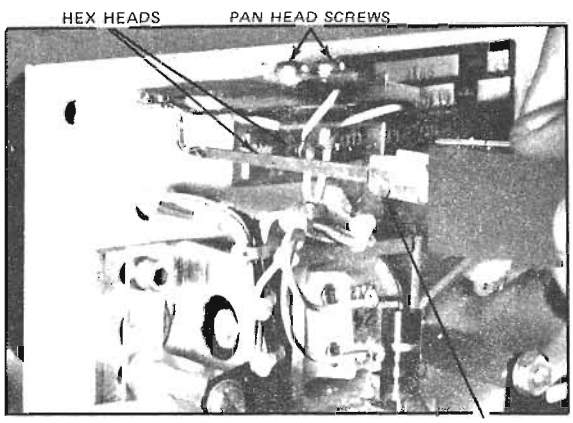


FIGURE 55

INTERRUPTER SWITCH BLADE TENSION ADJUSTMENT

(b) To adjust, loosen the two pan head mounting screws sufficiently to permit forming of switch blades as required to obtain proper tension. Securely tighten the two screws. See Figure 54.

12) Interrupter Switch Gap Adjustment

> NOTE:
> Standard paper tape readers are equipped with a "B" type switch which consists of a common and normally closed contact.

Check "B" type switch gap with card fully engaged between interrupter contacts. Gap should be 0.018" (.0457 cm) - 0.020" (.0508 cm). See Figure 56.

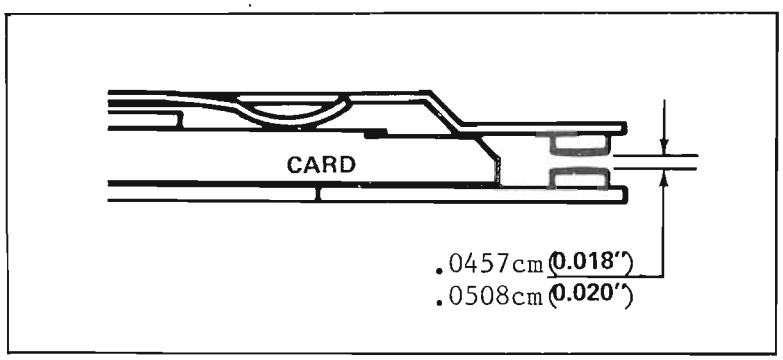


FIGURE 56
"B" SWITCH ADJUSTMENT

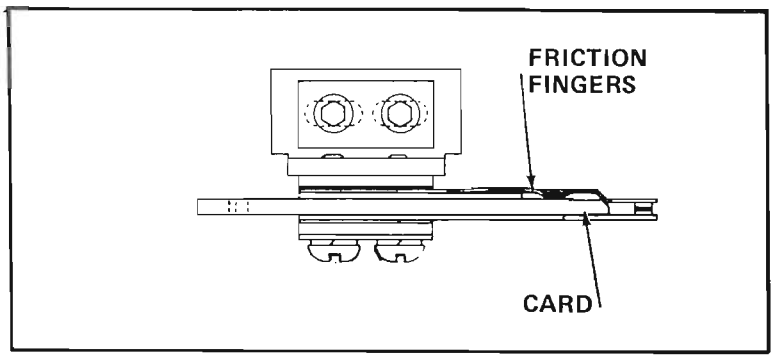
12) Interrupter Switch Card Tension

(a) Remove armature spring. See Figure 53.

(b) The free slide tension of the interrupter switch card should be 56-70 grams (2-2.5 oz).

(c) Bend the friction fingers against the card for free slide tension. See Figure 57.

(d) Replace armature spring. See Figure 53.



INTERRUPTER SWITCH TENSION ADJUSTMENT

FIGURE 57

14) Starwheel Arm Clearance From Drum

(a) The starwheel arms are adjusted to provide 0.006 inch (.0152 cm) clearance between the arm and sprocket drum. With a 0.004 inch (.0102 cm) tape passing under the arm, minimal wear of the tape or the arm will occur. This also provides for acceptance of splicing patches, thus eliminating inaccuracies in reading. See Figure 58.

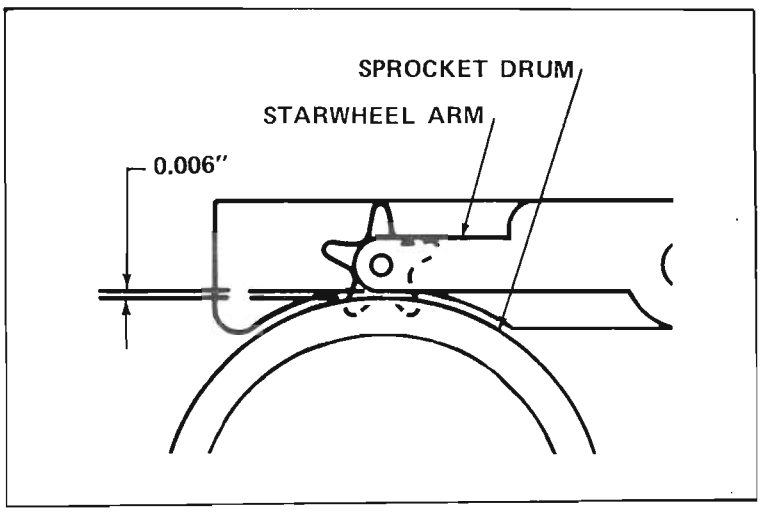


FIGURE 58

STARWHEEL ARM CLEARANCE

(b) The down position of the starwheel is controlled by the limit screw. By adjusting the two end position arms (1 and 8) then aligning the center arms (2 through 7), the clearance can be equalized. Use a .035" hex driver. The limit screws are locked in position by a nylon pellet and lock screws. See Figure 59.

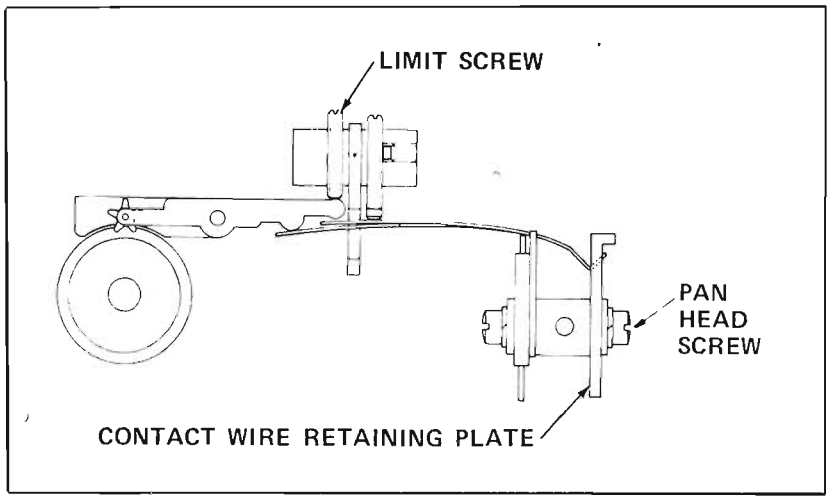


FIGURE 59

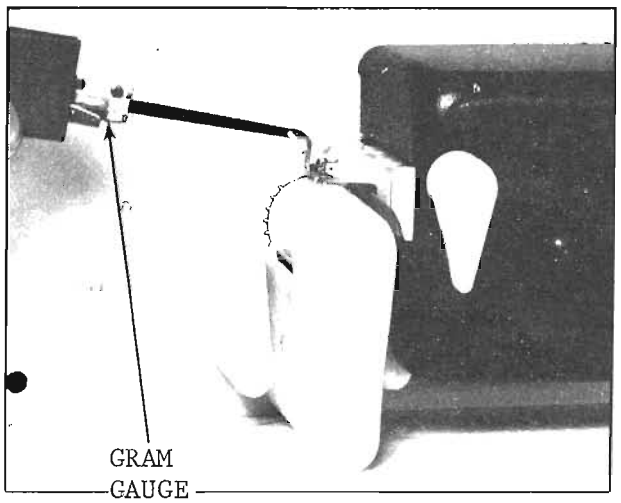
STARWHEEL ARM ADJUSTMENT

15) Starwheel Arm Spring Tension

(a) The starwheel arm spring tension is obtained by raising or lowering the contact wire retaining plate. See Figure 59. The retaining plate is adjusted so that 25 grams (.893 oz) applied under the starwheel arm at the pivot of the starwheel will not break continuity between the common input and the starwheel contact wire. Apply 30-35 grams (1.07-1.25 oz) at the same point will raise the starwheel arm and break the circuit. See Figure 60.

(b) To change spring tension, loosen the two pan head screws. A slight change in the position of the retainer plate will greatly increase or decrease the contact spring tension. See Figure 59.

(c) Tighten the two pan head screws.



STARWHEEL
ARM SPRING
TENSION
ADJUSTMENT

FIGURE
60

(d) Check the No. 1 and No. 8 positions for specified tension. If adjustment is made, assure that the contact retaining plate is positioned squarely in the sensing head.

> NOTE:
> If the retaining plate is tilted, the contact wires will twist and not lay evenly in the sensing head. This can cause a cross-over of the contact wires with their stainless steel spring wires.

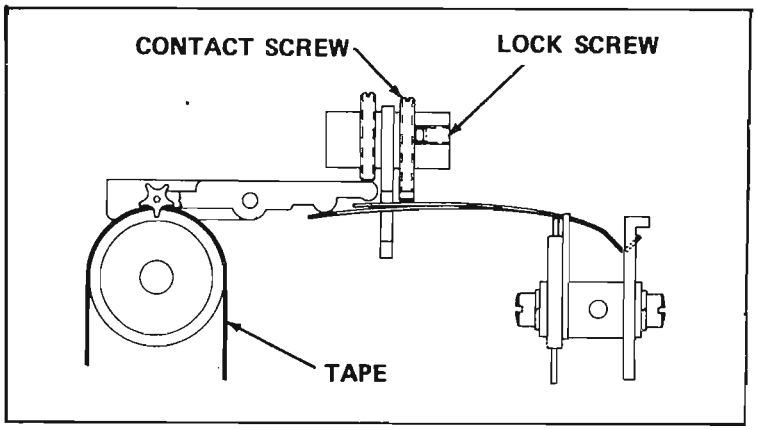
16) Starwheel Contact Screws

> NOTE:
> The starwheel contact screws act as the common electrical contact for each of the eight star-wheel arms as well as the tape hold-down arm.

(a) To adjust the starwheel contacts, it is necessary to loosen the lock screws. See Figure 61.

(b) Insert pre-punched tape over sprocket drum.

(c) With starwheel in hole, adjust contact screw by backing off until buzzer or meter indicates that the contact opened.



STARWHEEL CONTACTS ADJUSTMENT

FIGURE 61

(d) Remake contact, then turn contact screw three quarters turn more. See Figure 61.

(e) Advance tape to no-hole position and check for gap between contact wire and contact screw. Gap should be 0.015" (.038 cm) - 0.020" (.0508 cm). See Figure 62.

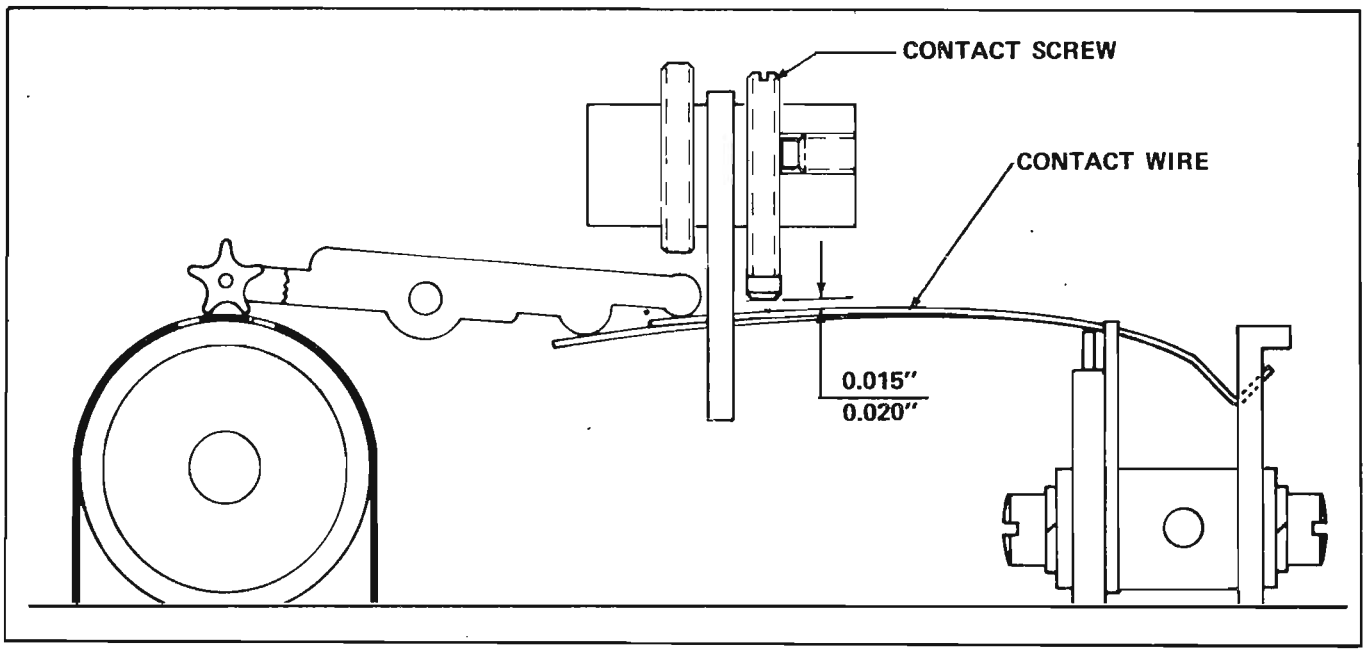


FIGURE 62 - CONTACT WIRE AND CONTACT SCREW GAP ADJUSTMENT

NOTE:

If gap is insufficient, the starwheel arm tension is probably excessive, causing unnecessary flexing of the starwheel contact wires, rechecking will be necessary.

(f) Tighten the lock screw.

5.3 MECHANICAL READ HEAD-ASSEMBLY DRAWINGS

See facing page.

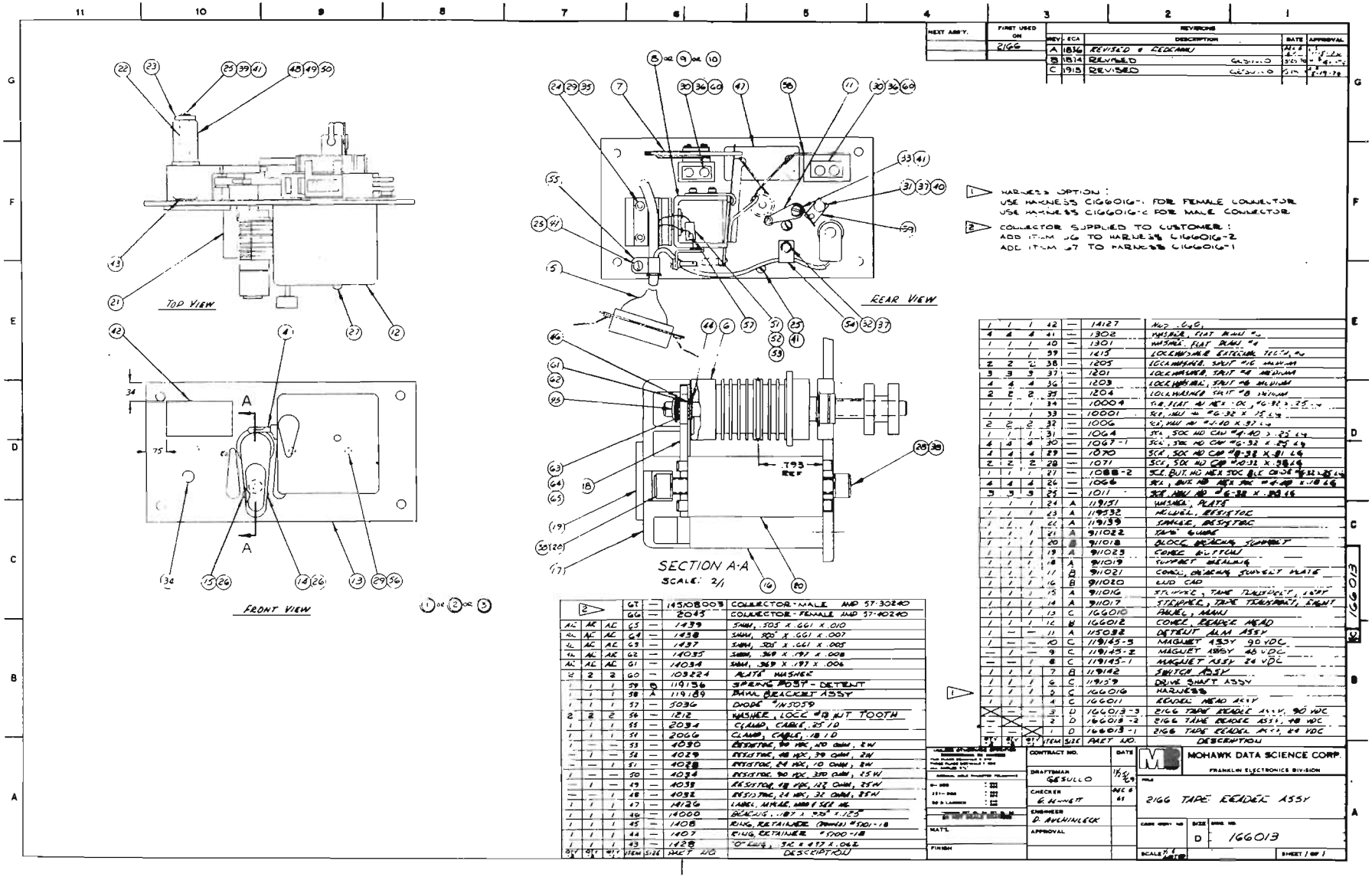
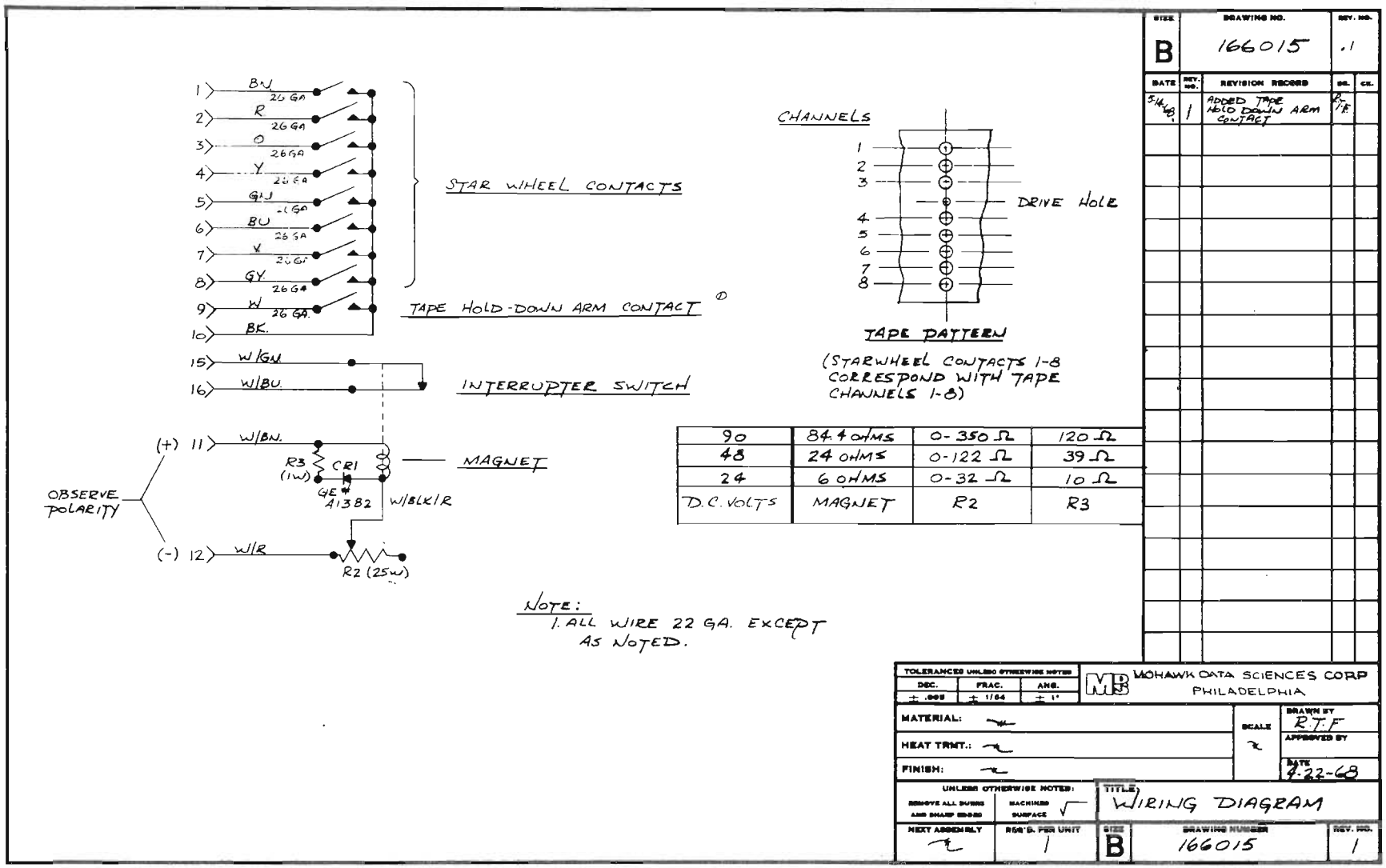
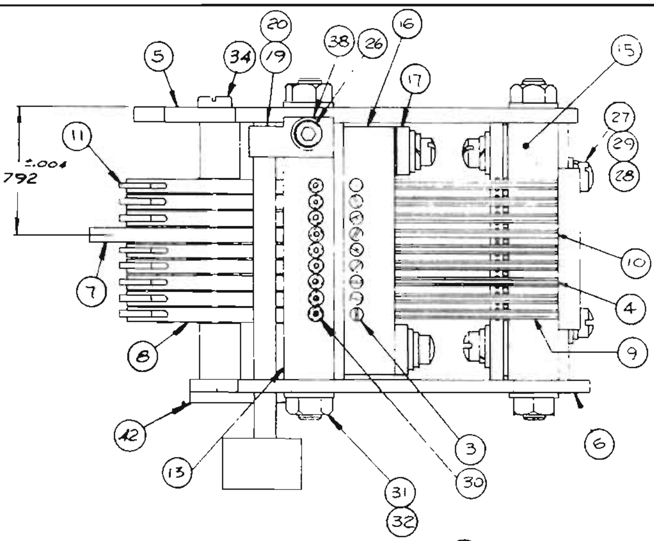


FIGURE 63 - Paper Tape Reader Model 2166, Assembly Engineering Drawing.



90	84.4 OHMS	0-350 Ω	120 Ω
48	24 OHMS	0-122 Ω	39 Ω
24	6 OHMS	0-32 Ω	10 Ω
D.C. VOLTS	MAGNET	R2	R3

FIGURE 64 - Paper Tape Reader Model 2166, Schematic Diagram.

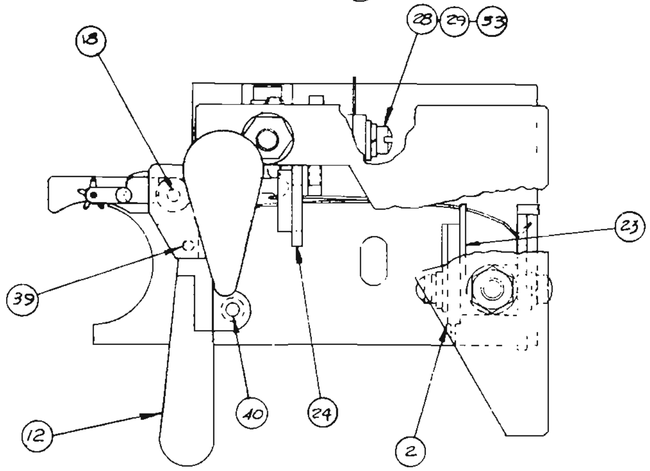


QTY	ITEM	SIZE	PART Nº	DESCRIPTION
✓	1	C	166011	READER HEAD ASSY
1	2	B	119124	TERMINAL BLOCK ASSY
9	3	A	119117	CONTACT ASSY
8	4	A	153235	CONTACT WIRE
1	5	B	911011	PLATE, READ HEAD
1	6	C	0400125102	PLATE, END SUPPORT
1	7	B	911025	HOLD DOWN ARM
8	8	B	119111	ARM, PIVOT-STAR WHEEL
17	9	A	119049-1	CONTACT WIRE
1	10	A	119049-2	CONTACT WIRE
8	11	A	119011	STARWHEEL
1	12	A	911015	PIVOT BLOCK ASSY
1	13	A	119078	BAR, ADJ SCR SUPPORT
1	14	A	911051	CAM, STAR WHL PIVOT
1	15	A	119083	BAR, SPACER-END SPT
1	16	A	119080	BLOCK, CONT ADJUSTING
2	17	A	119081	SPACER, INSULATING
1	18	A	119053	SHAFT, PIVOT
1	19	A	119116	SPRING, DETENT
1	20	A	119147	BRACKET, CAM LIMITING
9	21	A	119115	PLUG, SCREW LOCK
1	22	A	119023	PLATE, CONT ADJUSTING

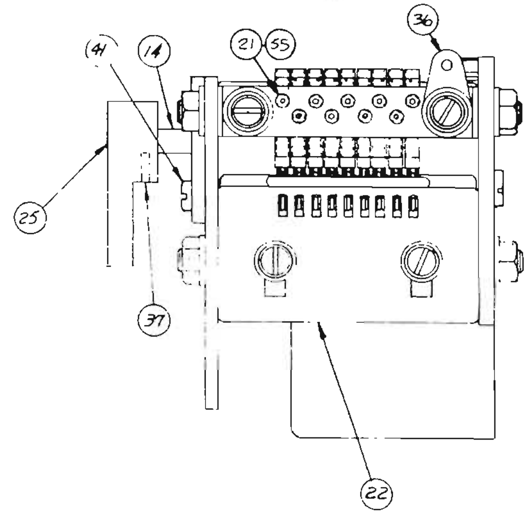
QTY	ITEM	SIZE	PART Nº	DESCRIPTION
1	23	A	119032	PLATE, WIRE LOCATOR
1	24	A	119079	PLATE, WIRE GUIDE
1	25	A	911053	KNOB, STAR WHL CAM
1	26	—	1202	WASHER, LOCK, SPLIT #5
4	27	—	1056	SCR, FIL HD, #4-40 X.38 LG
6	28	—	1201	WASHER, LOCK, SPLIT #4
6	29	—	1301	WASHER, FLAT #4
9	30	—	10044	SCR, SET #2-56 X.50 LG
4	31	—	1103	NUT, HEX #6-32
4	32	—	1207	WASHER, LOCK INT TOOTH #6
2	33	—	1059	SCR, FIL HD #4-40 X.75 LG
1	34	—	10090	SCR, PAN HD #4 X.31 TYPE "B"
9	35	—	1060	SCR, SET #3-48 X.12 LG.
1	36	—	2077	SOLDER LUG
1	37	—	1058	SCR, SET #4-40 X.38 LG.
1	38	—	1061	SCR, SCH CAP #3-48 X.19 LG
1	39	A	911029-1	ARM PIVOT - TAPE SW.
1	40	—	1035	SCR. FLAT HD #4-40 X.25
1	41	—	1012	SCR, PAN HD #6-32 X.50 LG
1	42	A	911051	COVER-BACKUP PLATE

C 166011 B

DATE	LTR	REVISION RECORD	CH.	BY
4/6/69	A	ECA 1836	J.G.	L.L. 1/19/70
8/4/70	B	ECA 1943	F.G.	L.L. 8/5/70



1



TOLERANCES UNLESS OTHERWISE NOTED			MOHAWK DATA SCIENCES CORP. PHILADELPHIA	
DEC. ±.005	FRAC. ±1/64	ANG. ±1°		
MATERIAL:			SCALE 2/1	DRAWN BY GESULLO
HEAT TRMT				APPROVED BY
FINISH:				DATE 12/4/69
UNLESS OTHERWISE NOTED: REMOVE ALL BURRS AND SHARP EDGES	MACHINED SURFACE √		TITLE: READER HEAD ASSY	
NEXT ASSEMBLY	REQ'D. PER UNIT		SIZE C	DRAWING NUMBER 166011 · REV. NO. B

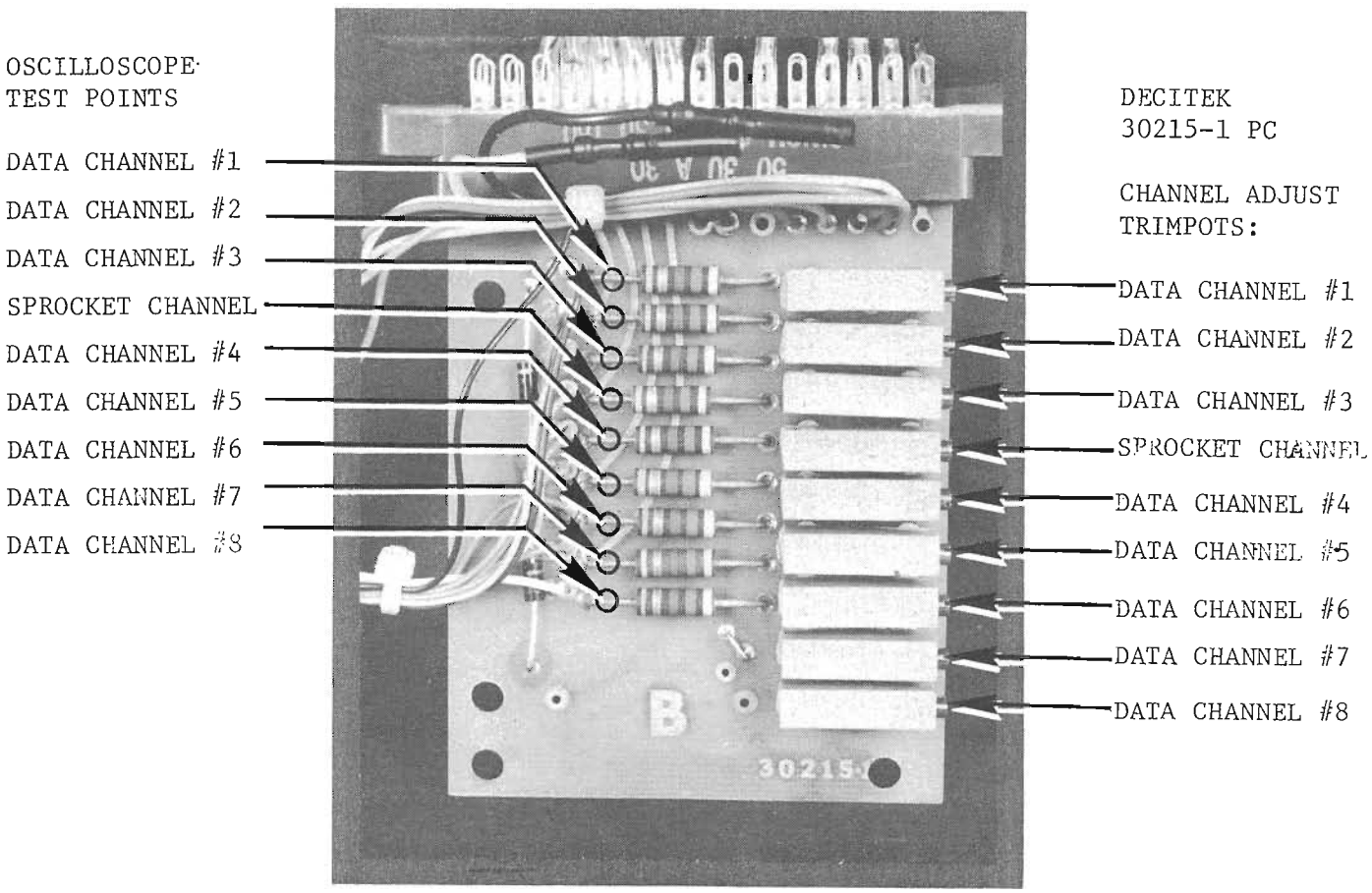
FIGURE 65 Paper Tape Reader Model 2166, Reader Head Assembly Engineering Drawing.

5.4 ELECTRICAL ADJUSTMENTS - (633, 733, 2203)

1) See pages 23, 24 for voltage checks.

2) Phototransistor Adjustment - Each phototransistor channel contains a 10K potentiometer to compensate for variations among the optical channels. The channels are adjusted individually to set each phototransistor output sufficiently low (< +0.7V) when a tape hole is present and sufficiently high (≥ +3.0V) when no hole is present. In applications where the sprocket signal is used to strobe data, the sprocket signal potentiometer must be adjusted to make certain data is present on all channels before the leading edge of the sprocket signal arrives.

FIGURE 66



These adjustments are made according to the following procedure:

(a) Using a loop of 100% opaque, all-hole tape, the reader is operated in a closed loop (continuous read).

(b) The external load connected to each phototransistor output is provided on the Decitek electronics card. With all-hole tape each photran output is a rectangular wave have a frequency equal to the reader speed.

5.5 CLEANING PROCEDURE - OPTICAL READER HEADS

A Tape Reader Cleaner Kit is included with each Optical High Speed Paper Tape Reader. The kit includes a brush, rectangular pieces of lint-free plastic wiper strips, and a bottle of tape reader cleaner (inhibited 1-1-1 Trichloroethane).

The frequency with which cleaning is required depends upon the cleanliness of the environment and the condition of the tapes being used, particularly in the area of tape splices. However, it is recommended that the reader be cleaned weekly for the first three or four weeks. Thereafter, the cleaning schedule should be adjusted according to the amount of dirt picked up by the lens wiper.

Cleaning Procedure:

1) Use the brush to remove dust from both inside and outside the reader cover housing.

2) Saturate approximately one inch of the center of the lens wiper strip with tape reader cleaner solution.

3) Stretch the lens wiper strip to decrease its thickness so that it fits between the phototransistor array and the fiber optic termination plate, inside the reader head.

4) Decrease the stretch to a point where the wipe contacts the upper and lower surfaces with a wiping action.

5) Move the wipe back and forth in the direction of tape travel 30 or 40 times.

> NOTE:
> Movement of the wiper strip should be relatively easy. If movement is difficult, stretch the wiper.

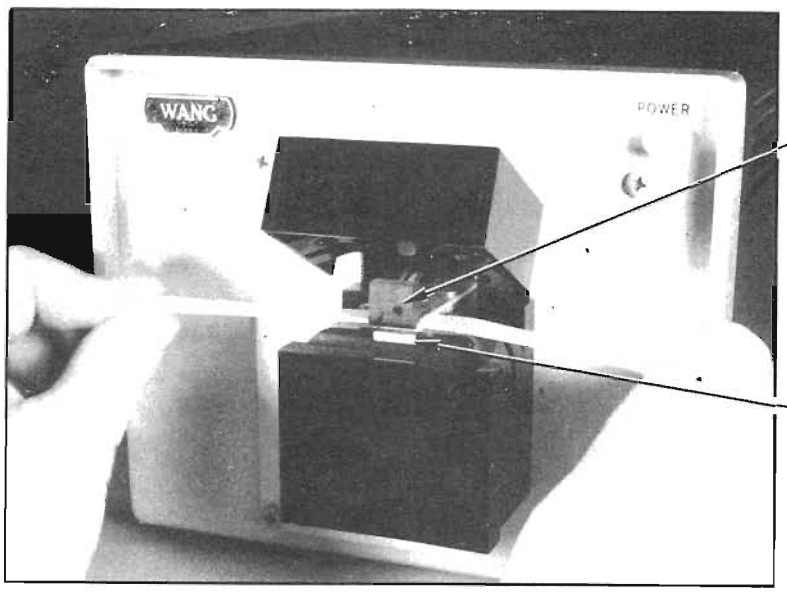


FIGURE 67

6) Remove the wiper and inspect for dirt.

7) Saturate the center section of another wiper strip with solvent.

8) Insert and move the strip back and forth 10 or 20 times.

9) Remove the wiper strip and inspect it for dirt. If no dirt has been collected, the reader head is clean. If dirt is present on the wiper, repeat steps 7 and 8 until no dirt appears.

6. APPENDIX

6.1 STANDARD HARDWARE PROGRAMS

The following is a list of connections between the program counter and the step count decoder of the 603, 703, 633, and 733. The terminal points are etched on the right component side of the PC boards called out below. On the 603 and 703, these connections are jumper wires; on the 633 and 733, these connections are etches.

MODEL 603; L510-1 PC		MODEL 703; L510-1 PC: MODEL 633; L578 PC: MODEL 733; L575 PC:	
FROM TERMINAL #	TO TERMINAL #	FROM TERMINAL #	TO TERMINAL #
0	RD (READ)	0	RD (READ)
1	C0 (COMPARE 0)	1	C0 (COMPARE 0)
2	C1 (COMPARE 1)	2	C1 (COMPARE 1)
3	C2 (COMPARE 2)	3	C2 (COMPARE 2)
4	RST (RESTART)	4	RST (RESTART)
5	DP (GENERATE DECIMAL PT)	5	DP (GENERATE DECIMAL PT)
6	J3 (JUMP 3)	6	J3 (JUMP 3)
7	CSG (GENERATE CHANGE SIGN)	7	CSG (GENERATE CHANGE SIGN)
8	J3 (JUMP 3)	8	J3 (JUMP 3)
9	C4 (COMPARE 4)	9	TRAN (TRANSFER)
10	TRAN (TRANSFER)	10	RD (READ)
11	RD (READ)	11	C0 (COMPARE 0)
12	C0 (COMPARE 0)	12	C1 (COMPARE 1)
13	C1 (COMPARE 1)	13	C2 (COMPARE 2)
14	C2 (COMPARE 2)	14	C3 (COMPARE 3)
15	C3 (COMPARE 3)	15	GO (GENERATE GO)
16	GO (GENERATE GO)	16	RD (READ)
17	RD (READ)	17	C5 (COMPARE 5)
18	C5 (COMPARE 5)	18	GO (GENERATE GO)
19	GO (GENERATE GO)	19	no connection

6.2 2203 WIRE RUN LIST

WIRE IDENT. (SIGNAL)	WIRE RUN						
	L545		351		READER		CABLE (14 PIN)
$\overline{ARST}$	14_1		6-F				
CH_1	3_2						2
2	4_2						3
3	5_2						4
4	6_2						5
5	7_2						6
6	8_2						7
7	9_2						8
8	10_2						9
$\overline{CH_1}$	C_2				3		
$\overline{2}$	D_2				D		
$\overline{3}$	E_2				4		
$\overline{4}$	F_2				E		
$\overline{5}$	H_2				5		
$\overline{6}$	J_2				F		
$\overline{7}$	K_2				6		
$\overline{8}$	L_2				H		
RRDY	9_1						1
$\overline{JPR}$	4_1				7		
STEP	13_1						11
Q_1B	S_2						
Q_2B	N_2						
Q_3B	M_2						
$\pm$0V	C_1-13_2	Q1E	15-5	Q2E	8	Q3E	12,13,14
+5V	B_1-14_2		17-M		10		

WIRE IDENT. (SIGNAL)	WIRE RUN						
	L545		351		READER		CABLE (14 PIN)
(±0V)			A-1				
+17V			2-B		15		
VB_1			14-R				
VE_1			12-N				
VB_2			5-E				
VE_2			3-C				
+10V		V_1C	13-P	+14K Cap			
+26V		V_2C	4-D	+2.6K Cap			
Q_1C					14		
Q_2C					13		
Q_3C					12		
REV	15_1						10

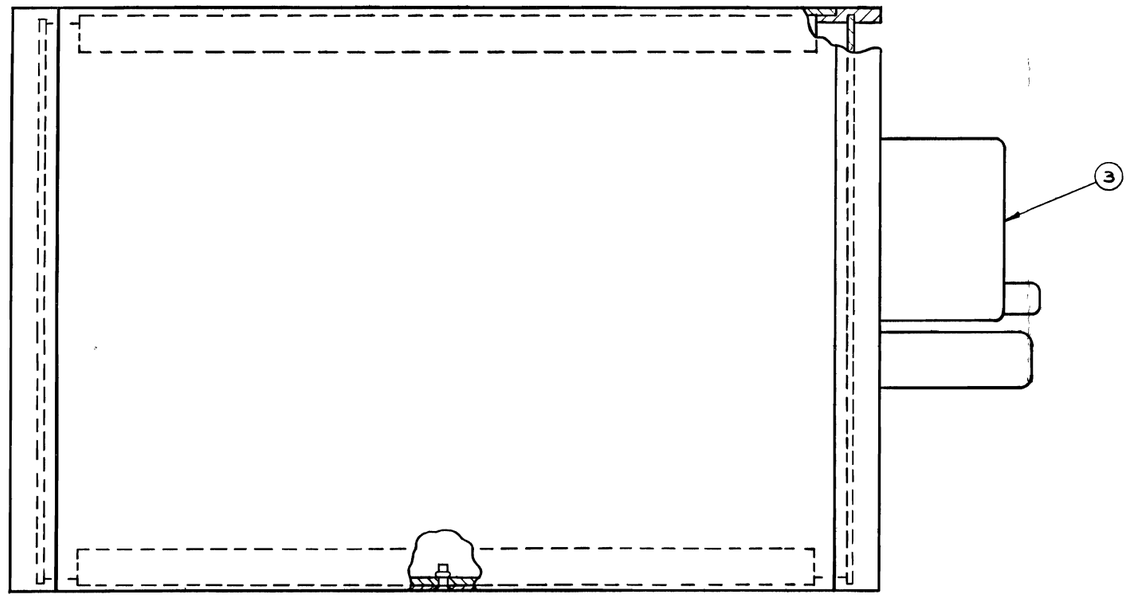
6.3 ASSEMBLY DRAWINGS

DO NOT SCALE

HOLE LEGEND

	HOLE DIA	TOL.
DRILLED OR PUNCHED HOLE TOLERANCES:	0135 to .125	+.003 −.001
	.126 to .250	+.004 −.001
	.251 to .500	+.005 −.001

IDENT.	DESCRIPTION	QTY.
A		



WANG PART NO	ITEM	QTY.	NAME	MATERIAL	DESCRIPTION
	3	1	CHASSIS ASSY		SEE DWG D6100-13
451-2049	2	1	COVER, WELDMENT		SEE DWG D6100-6
650-3125	1	6	SCR, FLT HD	SL OX	#4-32 x 3/8 LG PN HD

Qty. Per Unit	FIRST USED ON	ASSY USED ON

WANG LABORATORIES, INC. TEWKSBURY, MASS. U.S.A.

	BY	DATE	APPROVED BY	DATE
DWN	LE	1-14-71	E ENGR	
CHK	[illegible]	1-20-71	M ENGR	1-20-71
E C CONTROL			MFG ENGR	

MATERIAL

MODEL NO. 703

SEE ENGRG SPECIFICATIONS No. ES-1001

FINISH

TOL EX AS NOTED .XX ± .010 FRAC ± 1/64 125 .XXX ± .005 ANG. ± 1°30' FINISH

TITLE MAIN ASSY

SCALE 1/1 SHT 1 OF 1

WANG PART NUMBER	SIZE	DRAWING NUMBER	REV
	D	6100-14	0

NO	REVISION	BY	DATE

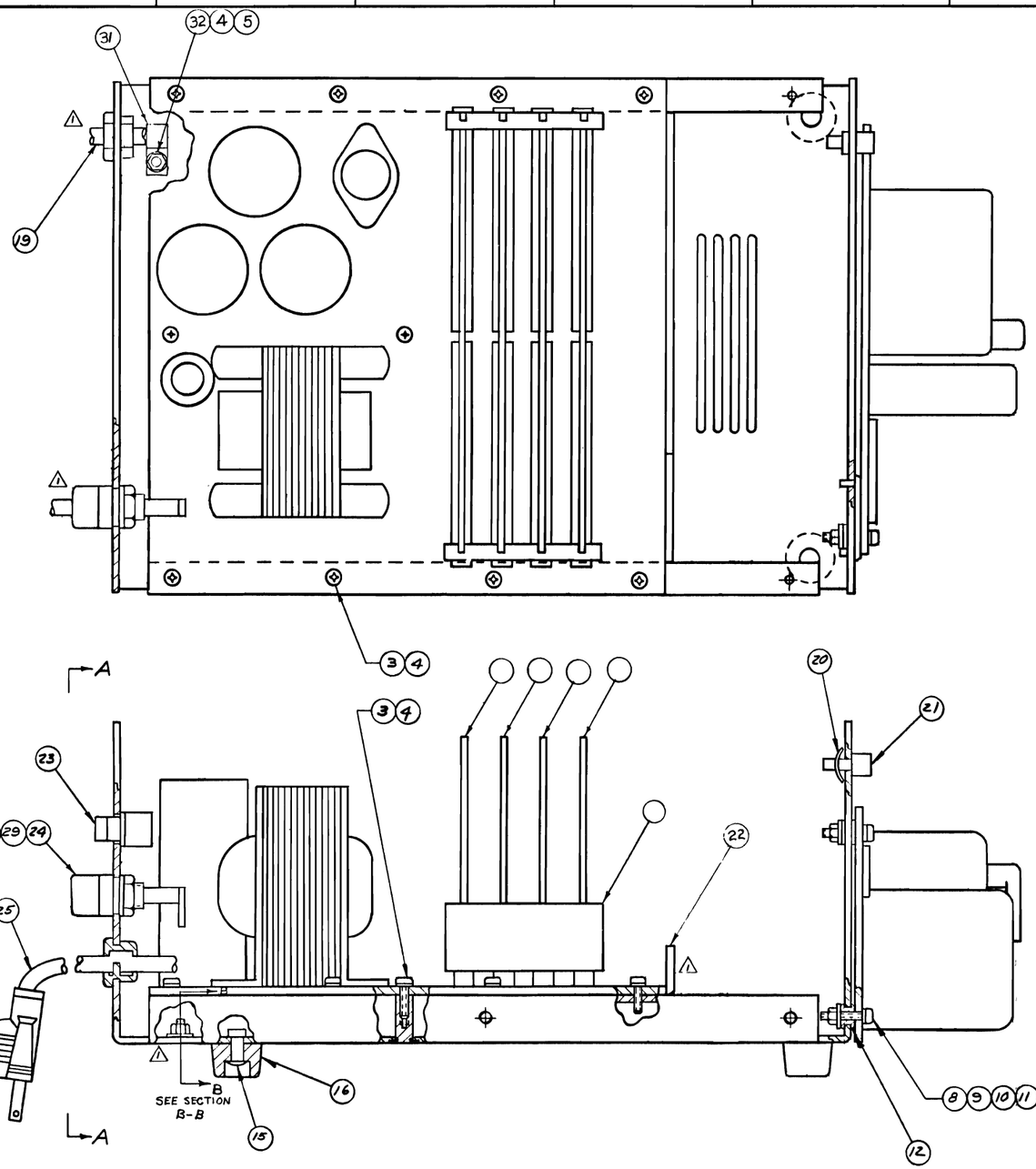
D 6100-14

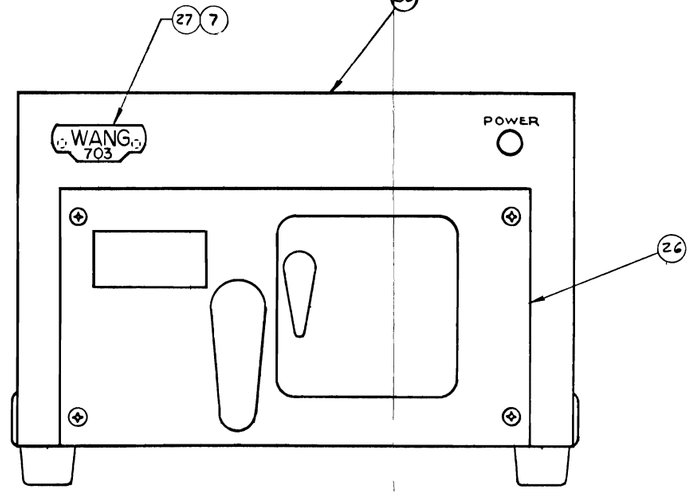
DO NOT SCALE

NOTES:
1. ITEM 26 INCLUDES THE 57 SERIES 36 PIN AMPHENOL CONNECTORS (1 MALE & 1 FEMALE) AS PART OF THE UNIT.
   a. DISASSEMBLE FEMALE CONNECTOR FROM ITEM 26
   b. ASSEMBLE MALE CONNECTOR TO ITEM 26
2. REVERSING CONNECTORS FACILITATES TAPE READER INSTALLATION AND REMOVAL

HOLE LEGEND		
DRILLED OR PUNCHED HOLE TOLERANCES.	HOLE DIA	TOL.
	0135 to .125	+.003 −.001
	126 to .250	+.004 −.001
	251 to .500	+.005 −.001

IDENT.	DESCRIPTION	QTY.
A		





REVISION	BY	DATE
1 REVISED PER ECN# 3668 SMB	ALK	6-19-73

WANG PART NO.		ITEM	QTY.	NAME	MATERIAL	DESCRIPTION
Qty. Per Unit	FIRST USED ON	ASSY USED ON				
1	D6100-14	D6100-14		WANG LABORATORIES, INC. TEWKSBURY, MASS. U.S.A.		

	BY	DATE	APPROVED BY	DATE
DWN	DB	1-12-71	E ENGR	
CHK	ALK	1-22-71	M ENGR ALK	1-28-71
E. C CONTROL			MFG ENGR	

MATERIAL

MODEL NO. 703

SEE ENGRG SPECIFICATIONS No.

FINISH

TOL. EX. AS NOTED .XX ± .010 FRAC. ± 1/64 .XXX ± .005 ANG. ± 1°30' FINISH 125

TITLE CHASSIS ASSY

SCALE 1/1 SHT 1 OF 2

WANG PART NUMBER	SIZE	DRAWING NUMBER	REV.
	D	6100-13	1

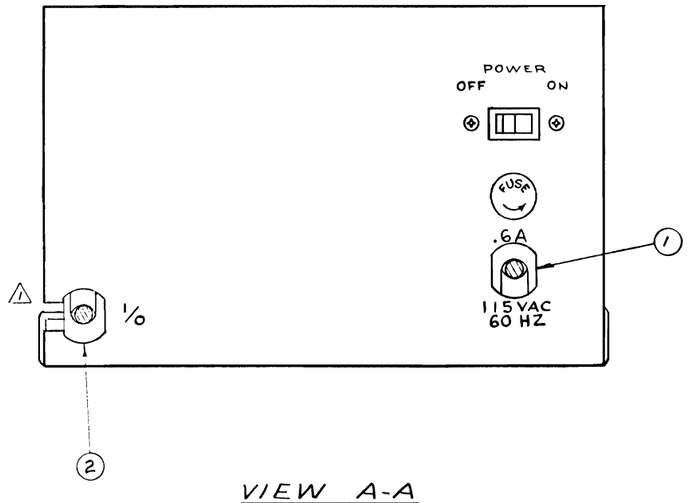
D 6100-13

DO NOT SCALE

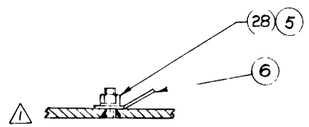
HOLE LEGEND

	HOLE DIA	TOL
DRILLED OR PUNCHED HOLE TOLERANCES	.0135 to .125	± .1
	.126 to .250	± .01
	.251 to .500	± .015

DPNT	DESCRIPTION	QTY
A		



VIEW A-A



SECTION B-B

360-9000	33	1	WASHER LOCK		FOR #6 SCREW
653-3000	32	1	FLAT WASHER		#6
654-1253	31	1	CABLE CLAMP		5/16"
451-1048	30	1	CHASSIS (SILK SCREEN)		SEE DWG D6100-2
360-1006 SB	29	1	FUSE .6 AMP SLO BLO		
653-3003	28	1	WASHER, LOCK		#3 SPLIT
450-0807	27	1	WANG NAMETAG		SEE DWG CE500-1049
725-0012	26	1	TAPE READER		
420-1000	25	1	CORD POWER 3 COND		
360-0000	24	1	FUSE HOLDER 90° CONTACT		
325-0013	23	1	SWITCH, SGL-SAW		
	22	1	CHASSIS PLT ASSY		SEE DWG D6100-12
370-0024	21	1	WHITE LAMP		#1829
370-1002	20	1	LAMP LOCK CLIP		
220-0038	19	1	CABLE		SEE DWG C6100-26
655-0202	16	4	FOOT, WHT		
651-0402	15	4	RIVET, AVDEL		3/16 DIA 1 THK
654-1215	12	4	GROMMET, MINOR		
652-4000	11	4	NUT, HEX		#6-32
653-4004	10	4	WASHER, NYLON		#8
652-4001	9	4	WASHER, LOCK		#8 INT TOOTH
650-4120	8	4	SCR, PAN HD		#8-32 X 3/8 LG PN DR
680-0106	7	AR	LOCTITE 704		
659-1006	6	1	GRND LUG		#8
652-3000	5	2	NUT, HEX		#4-40
653-3001	4	11	WASHER, LOCK		#4 INT TOOTH
650-3120	3	10	SCR, PAN HD		#4-40 X 3/8 LG PN DR
654-1205	2	1	GROMMET		SHEET
654-1238	1	1	GROMMET, NEYCO LINE CORD		SHEET
WANG PART NO		ITEM	QTY	NAME	MATERIAL DESCRIPTION

Qty. Per Unit	FIRST USED ON	ASSY USED ON
1	D6100-19	D6100-19

WANG LABORATORIES, INC. TEWKSBURY MASS U.S.A.

	BY	DATE	APPROVED BY	DATE
DWN	[illegible]	[illegible]	E ENGR	
CHK	[illegible]	[illegible]	M ENGR	1-23-71
MATERIAL			E C CONTROL	MFG ENGR

MODEL NO 703

SEE ENGRG SPECIFICATIONS No.

TITLE CHASSIS ASSY

FINISH

TOL EX AS NOTED
XX ± .010 FRAC ± 1/64 125
XXX ± .005 ANG ± 1°30' FINISH √

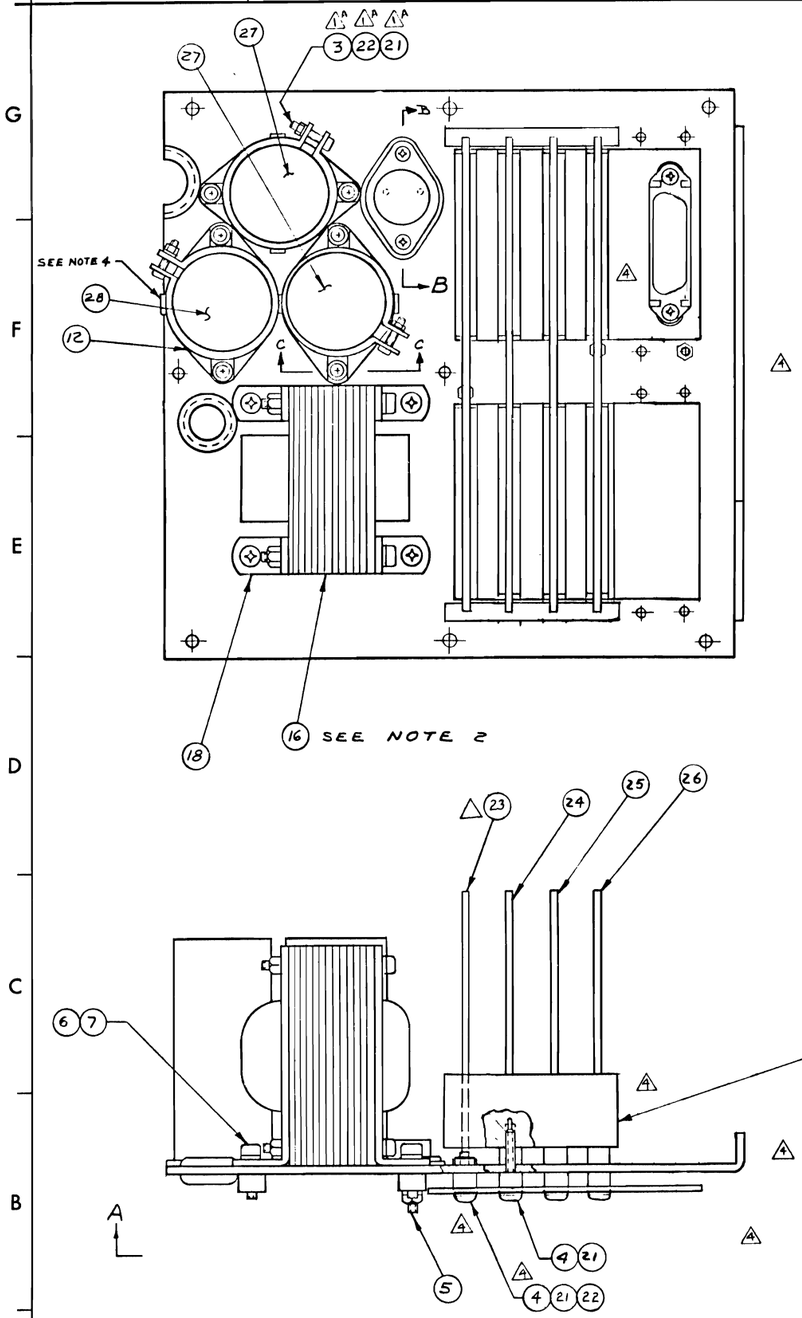
SCALE 1/1 SHT 2 OF 2

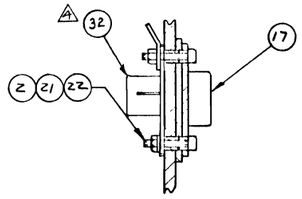
WANG PART NUMBER	SIZE	DRAWING NUMBER	REV
•	D	6100-13	1

NO	REVISION	BY	DATE
1	REVISED PER ECN# 3628 SMB	AVK	1-13-71

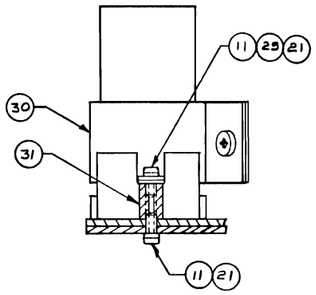
D6100-13

DO NOT SCALE

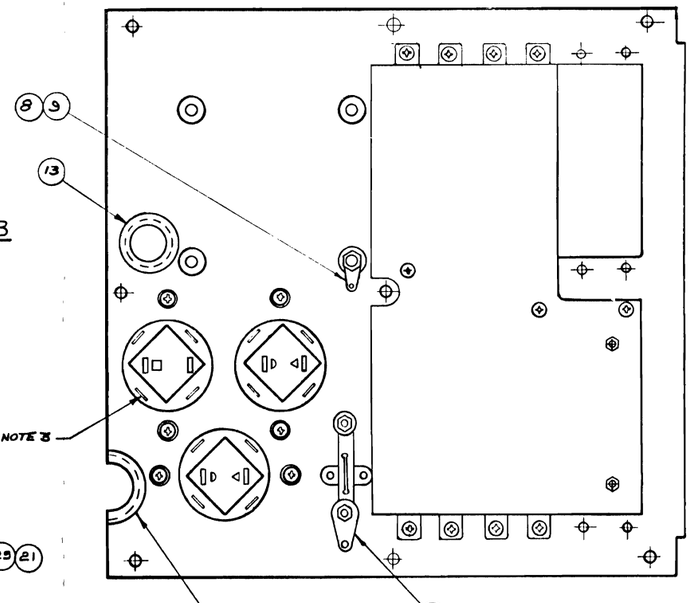




SECTION B-B



SECTION C-C



VIEW A-A

HOLE LEGEND			
DRILLED OR PUNCHED HOLE TOLERANCES	HOLE DIA	TOL	
	0135 to 125	± .003	
	126 to 250	± .004	
	251 to 500	± .005	

IDENT	DESCRIPTION	QTY
A		

NOTES:
1. CUT ITEM 15 TO FIT AS SHOWN AND CEMENT IN PLACE WITH ITEM 19.
2. REMOVE WINDING COVERS FROM BOTH SIDES AND INSTALL ITEM 18 4 PLACES AS SHOWN USING EXISTING HARDWARE
3. DO NOT TWIST CAPACITOR TABS
4. CLIP 2 TABS ON EACH CLAMP (ITEM 30) AS SHOWN

WANG PART NO	ITEM	QTY	NAME	MATERIAL	DESCRIPTION
375-9014	32	1	INSULATOR		WECKESSER TM-1
462-0023	31	6	SPACER		#4-40 X 1/2 LG.
300-9009	30	3	CLAMP, CAP		
653-2001	29	6	WASHER FLT.		#4
300-3045	28	1	CAP. 14K - 12V		
300-3019	27	2	CAP. 6K-20V		
210-L511	26	1	PC BOARD L511 ASSY		
210-L510	25	1	PC BOARD L510 ASSY		
210-L539	24	1	PC BOARD L539 ASSY.		
210-F560-1	23	1	PC BOARD F560-1 ASSY		
652-2000	22	11	NUT, HEX		#9-32
653-2002	21	26	WASHER, LOCK		#9 INT TOOTH
465-1220	20	2	LOGIBLOCK GUIDE BRKT		
350-0008	19	8	CONNECTOR		
451-4112	18	4	BRKT, TRANSFORMER		
375-1008	17	1	TRANSISTOR (90251)		W/MTG. KIT
410-0062	16	1	TRANSFORMER (MMC3535-1)		SEE DWG C5068-69
	15				
660-0106	14	AR	LOCTITE 4M		
654-1203	13	2	GROMMET		
300-9000	12	3	CAP. MTG. PLT.	ANODIC	
650-2100	11	12	SCR. PAN HD.		#4-40 X 1/4 LG. 1/4 DR.
654-1004	10	1	GRND LUG		#4
654-1008	9	1	GRND LUG		#8
652-4000	8	1	NUT, HEX	S.S.	#8-32
653-4001	7	3	WASHER, LOCK		#8 INT TOOTH
650-4120	6	3	SCR, PAN HD		#8-32 X 3/4 LG PH DR
650-4165	5	1	SCR, PAN HD		#8-32 X 1 1/2 LG PH DR
650-2200	4	10	SCR, PAN HD		#4-40 X 1/2 LG PH DR
650-2160	3	3	SCR, PAN HD		#4-40 X 3/8 LG PH DR
650-2120	2	2	SCR, PAN HD		#4-40 X 3/16 LG PH DR
452-2054	1	1	CHASSIS PLT		SEE DWG D6100-10

Qty. Per Unit	FIRST USED ON	ASSY USED ON
1	D6100-13	D6100-14

WANG LABORATORIES, INC. TEWKSBURY MASS U.S.A.

	BY	DATE	APPROVED BY	DATE
DWN	[illegible]	[illegible]	E ENGR	
CHK	[illegible]	[illegible]	M ENGR/PLC	[illegible]
E C CONTROL			MFG ENGR	

MATERIAL

MODEL NO. 703

SEE ENGRG SPECIFICATIONS No.

FINISH

TOL EX AS NOTED
XX ± .010 FRAC ± 1/64 125
XXX ± .005 ANG ± 1°30' FINISH

TITLE CHASSIS PLT ASSY

SCALE 1/1 SHT 1 OF 1

WANG PART NUMBER D 6100-12 SIZE 4 DRAWING NUMBER

D 6100-12

NO	REVISION	BY	DATE
1A	ECN# 2100 ADDED	[illegible]	[illegible]
1B	WAS: 9TX. 11		
1C	WAS: 9TX. 18		
1D	WAS: W.L.N.S 651-0401, 9TX.G NAME, POP RIVET DESC. 1/8 DIA. x 3/16 LENG.		
1E	WAS: W.L.N.S 650-2165 9TX. 8		
2	ECN# 2209 WAS, MMC-3535	[illegible]	[illegible]
3	ECN# 2269 WAS: W.L.N.S 210-L509 P.C. BOARD ASSY.	[illegible]	1-10-72
4	ECN# 3684-A SEE FOR REV. 4 REFER TO THIS ECN 4TH 6TH	[illegible]	[illegible]

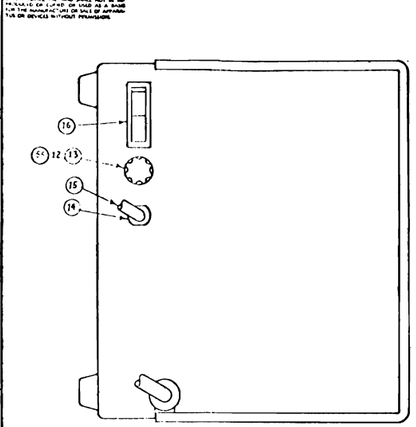
DO NOT SCALE

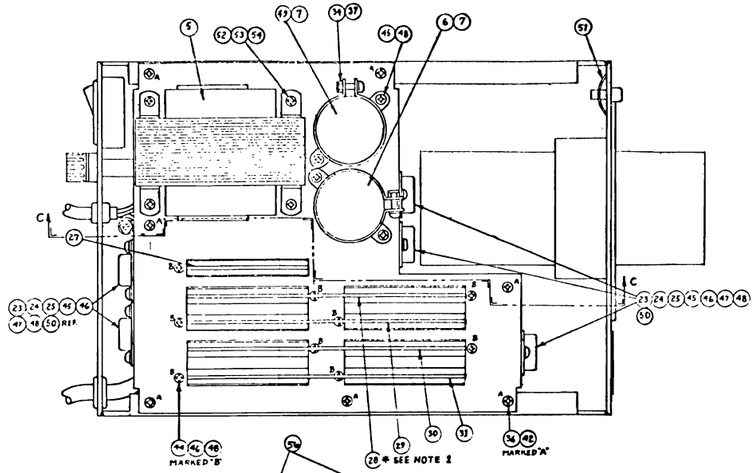
NOTES:
1. MODEL 733 A3 SHOWN, MODEL 633 USE P.C. CARD W/P # 510-L578
2. NOT SHOWN IS INTERNAL CONN. TO CONNECT DECITECH. PRINTER TO CHASSIS PLATE
3. MODEL 733 MODEL 633 TO USE #450-0893 NAME TAG

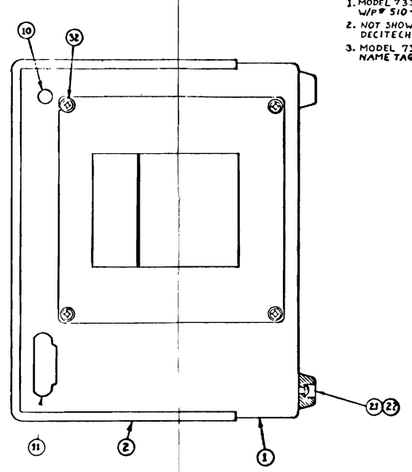
HOLE LEGEND

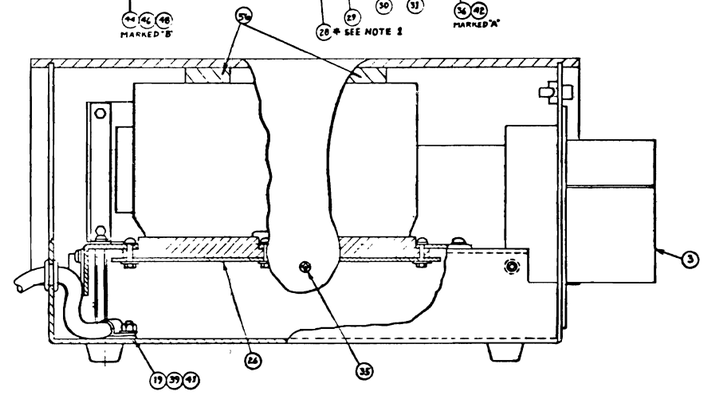
	HOLE DIA.	TOL.
DRILLED OR	.8125 to .150	±.002
PUNCHED HOLE	.126 to .250	±.003
TOLERANCES	.251 to .500	±.004

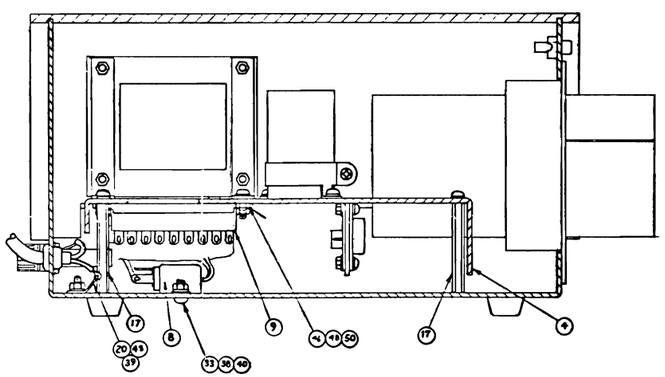
QTY.	DESCRIPTION	QTY
A		











SECTION C-C

660-0060	56	2	SPONGE RUBBER		1"WIDE x ¼"THK x 3½"LG
366-9000	55		FUSE HARDWARE		
653-4001	54	4	WASHER, LOCK		#8 INT. TOOTH
653-4000	53	4	WASHER, FLAT		#8
650-4120	52	4	SCREW, PAN HD		#8-32 x ¾ LG PH DR.
370-1002	51	1	LAMP CLIP		
654-1004	50	6	GROUND LUG		#4
300-3040	49	1	CAPACITOR		4,000 MF 50V ELECTROLYTIC
653-2002	48	25	WASHER LOCK		#6 INT. TOOTH
653-2000	47	10	WASHER, FLAT		#6
652-2000	46	21	NUT, HEX		#4-40
650-2120	45	14	SCREW PAN HD		#4-40 x ¾ LG. PH. DR.
650-2200	44	9	SCREW PAN HD.		#4-40 x ⅝ LG. PH. DR.
653-3003	43	1	WASHER LOCK		#6 SPLIT
653-3001	42	7	WASHER LOCK		#6 INT. TOOTH
653-3000	41	1	WASHER FLAT		#6
653-3002	40	2	WASHER FLAT (NYLON)		#6
652-3000	39	2	NUT, HEX.		#6-32
652-3002	38	2	NUT, HEX (NYLON)		#6-32
652-0032	37	2	NUT LOCKING		#6-32 KEPS
650-3120	36	7	SCREW PAN HD.		#6-32 x ⅜ LG. PH. DR.
650-3125	35	6	SCREW FLAT HD		#6-32 x ⅜ LG BLACK OXIDE
650-3160	34	2	SCREW PAN HD		#6-32 x ½ LG PH. DR.
650-3205	33	2	SCREW (NYLON)		#6-32 x ⅝ LG PH DR.
650-4124	32	4	SCREW (PANEL)		#8-32 x ⅜ WANG BEIGE
510-L577	31	1	L577 MOD.		
510-L576	30	1	L576 MOD.		
510-L575	29	1	L575 MOD.		
510-L574	28	1	L574 MOD.		
510-0350	27	1	350 MOD.		
	26	1	436 MODULE WITH CABLE ASSY		
653-0006	25	5	MICA INSULATOR (LARGE)		
375-9014	24	5	INSULATOR, TRANSISTOR		WECKESSER TM-4
375-1008	23	5	TRANSISTOR		40251 SILICON
651-0402	22	4	RIVET		ALUM #12-10613 ⅛ DIA ⅜ LG
655-0202	21	4	FOOT		RFC 2084 W
654-1006	20	1	GROUND LUG		#6
654-1254	19	1	CABLE CLAMP		⅝"
	18				
462-0028	17	2	STAND OFF		MFR SMITH 8431 2"LG
	16	1	ON-OFF SWITCH		
420-1000	15	1	AC POWER CORD		
654-1200	14	1	STRAIN RELIEF		HEYCO # SRSP-9
360-1006 5B	13	1	FUSE		6/10 AMP SLO-BLO 250V.
360-0000	12	1	FUSE HOLDER 90°		
450-0689	11	1	NAME TAG (WANG)		MODEL 733
370-0004	10	1	LIGHT (WHITE)		1762
310-0009	9	1	TERMINAL STRIP		9 TERM
410-2001	8	1	LINE FILTER		2 AMP 2 BZ
300-9009	7	2	CAPACITOR CLAMP		CMC-22
300-3045	6	1	CAPACITOR		14,000 MF 12V ELECTROLYTIC
410-	5	1	TRANSFORMER		MICRO PIMAC # 4921-1
462-2116	4	1	CHASSIS PLATE		SEE DWG # C6422-213
725-0036	3	1	TAPE UNIT		DECITEK # 243
461-2049	2	1	COVER WELDMENT & FINISH		SEE DWG # D-60100-Cp
451-1078	1	1	CHASSIS FINISH & SILK SCREENING		SEE DWG # C6422-212
MFG. PART NO.	ITEM	QTY.	NAME	MATERIAL	DESCRIPTION

	BY	DATE	APPROVED BY
DRAWN	AFM	1-1971	ENGR
CHK	AMSM		MFG ENGR
E C CONTROL			MFG ENGR ALK 1/24/72

WANG LABORATORIES, INC. TEWKSBURY, MASS. U.S.A.

MATERIAL: //
MODEL NO: 733-633
SEE SPECIFICATIONS No. 6.5-1001
FINISH: //
TOL. ±1 AS NOTED
.XX ± .010 FRAC. ± 1/64
.XXX ± .005 FRAC. ± 1/128 ANGLE ± 1°

TITLE: CHASSIS ASS'Y

E 6422-225 0

WANG PART NO. | DRAWING NUMBER | REV.

REVISION

COPY

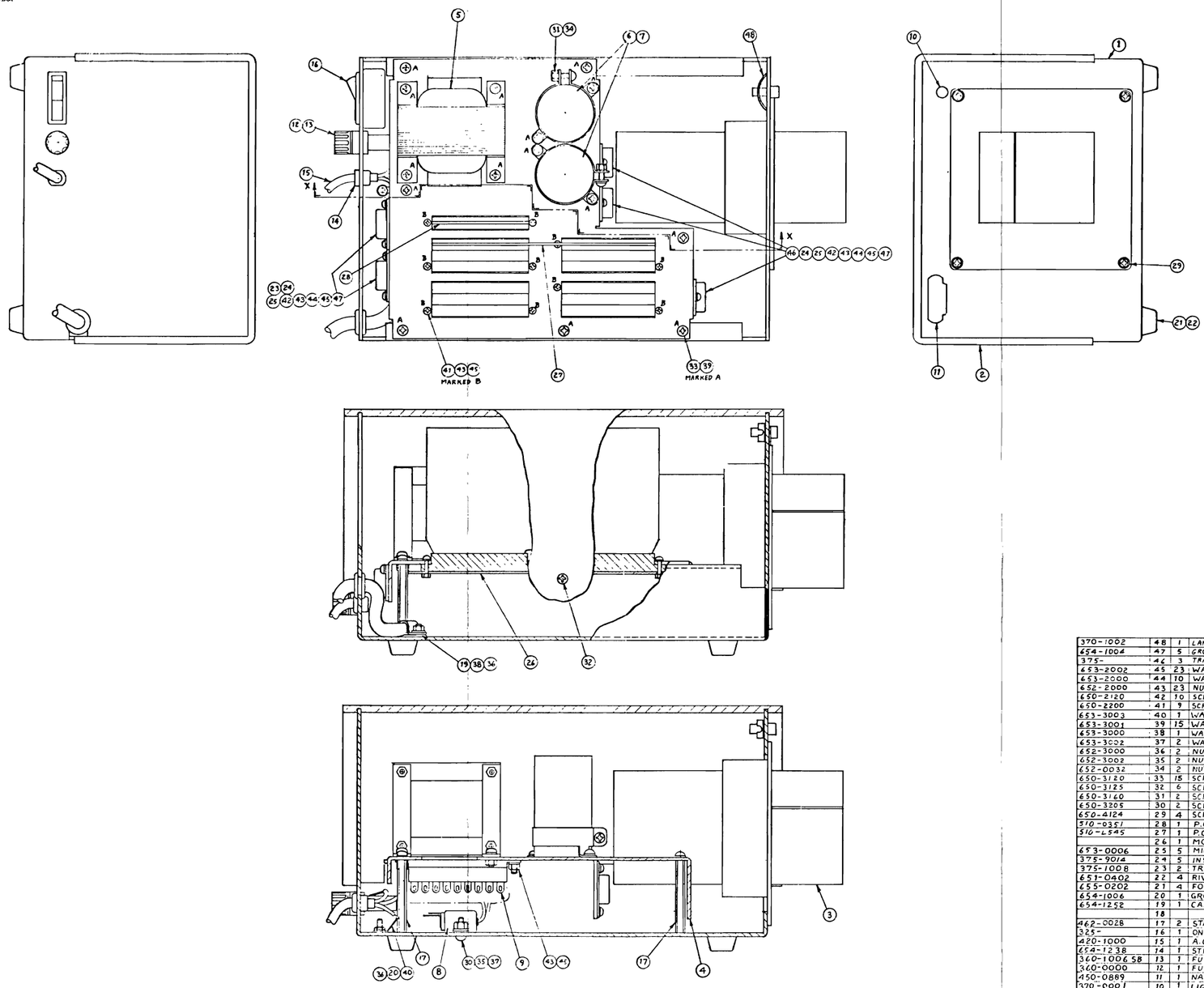
E 6422-

DO NOT SCALE

HOLE LEGEND

DRILLED OR PUNCHED HOLE TOLERANCES	HOLE DIA.	TOL.
	.015 to .125	± .003
	.126 to .250	± .004
	.251 to .500	± .005

IDENT	DESCRIPTION	QTY
A		



370-1002	48	1	LAMP CLIP		
654-1004	47	5	GROUND LUG		#4
375-	46	3	TRANSISTOR		2N3055
653-2002	45	23	WASHER, LOCK		#4 INT. TOOTH
653-2000	44	10	WASHER, FLAT		#4
652-2000	43	23	NUT, HEX		#4-40
650-2120	42	10	SCREW, PAN HD.		#4-40 X 3/8 LG.
650-2200	41	9	SCREW, PAN HD.		#4-40 X 5/8 LG.
653-3003	40	1	WASHER, LOCK		#6 SPLIT
653-3001	39	15	WASHER, LOCK		#6 INT TOOTH
653-3000	38	1	WASHER, FLAT		#6
653-3002	37	2	WASHER, FLAT (NYLON)		#6
652-3000	36	2	NUT, HEX.		#6-32
652-3002	35	2	NUT, HEX. (NYLON)		#6-32
652-0032	34	2	NUT, LOCKING		#6-32 KEPS
650-3120	33	15	SCREW, PAN HD.		#6-32 x 3/16 LG PH. DR.
650-3125	32	6	SCREW, FLAT HD.		#6-32 x 3/16 LG BLACK OXIDE
650-3160	31	2	SCREW, PAN HD.		#6-32 x 1/2 LG PH. DR.
650-3205	30	2	SCREW, (NYLON)		#6-32 x 5/16 LG PH. DR.
650-4124	29	4	SCREW (PANEL)		#8-32 x 3/16 LG (WANG BEIGE)
570-0351	28	1	P.C. BOARD		
516-2545	27	1	P.C. BOARD		
	26	1	MOTHER BOARD		
653-0006	25	5	MICA INSULATOR (LARGE)		
375-9014	24	5	INSULATOR, TRANSISTOR		WEC KESSER TM-1
375-1008	23	2	TRANSISTOR		40251 SILICON
651-0402	22	4	RIVET		AVDEL #1210613 3/16 DIA 3/16 LG
655-0202	21	4	FOOT		REC 2084 W
654-1006	20	1	GROUND LUG		#6
654-1252	19	1	CABLE CLAMP		3/16"
	18				
462-0028	17	2	STAND OFF		2" HEX. SMITH # 8431
325-	16	1	ON-OFF SWITCH		
420-1000	15	1	A.C. POWER CORD		
654-1238	14	1	STRAIN RELIEF		HEYCO # SRSP-4
360-1006 SB	13	1	FUSE		6/10 AMP SLO BLO
360-0000	12	1	FUSE HOLDER 90°		
450-0889	11	1	NAME TAG (WANG)		MODEL 2203
370-0001	10	1	LIGHT (WHITE)		1705-A
310-0009	9	1	TERMINAL STRIP		9 TERM
410-2001	8	1	LINE FILTER		2 AMP
506-9002	7	2	CAPACITOR CLAMP		
100-3019	6	2	CAPACITOR		6000 MF 20V ELECTROLYTIC
110-	5	1	TRANSFORMER		MERRIMAC # MMC-4991
412-2116	4	1	CHASSIS PLATE		SEE DWG # CE422-213
1[illegible]-0036	3	1	TAPE UNIT		DECITEK # 243
491-2049	2	1	COVER WELDMENT & FINISH		SEE DWG # DE100-6
419-1078	1	1	CHASSIS FINISH & SILK SCREEN		SEE DWG # DE422-212
WANG PART NO.	ITEM	QTY	NAME	MATERIAL	DESCRIPTION

REVISIONS					
NO.	FINISHED DR.	ASSY. WELDM.	BY	DATE	APPROVED BY	DATE
			DWN AFM		ENGR	
			CHK WM	1/27/78	MFG ENGR GLK	1/27/78
			E C CONTROL		MFG ENGR	

WANG LABORATORIES, INC. TEWKSBURY MASS. U.S.A.

MATERIAL —//—

MODEL NO 2203

MIL SPEC SPECIFICATIONS N/A E2-1001

FINISH —//—

TOL. ON ALL ANGLES: XX ± .010 MACH. FINISH; XXX ± .005 ANG. FINISH

SCALE 1 SHT 1 OF 1

TITLE CHASSIS ASS'Y

E 422-224 O

WANG PART NUMBER — REV.