HEWLETT hp PACKARD

BUFFERED TELEPRINTER INTERFACE KIT

model 12531B

OPERATING AND SERVICE MANUAL 7 MAR 1969

SECTION I
INTRODUCTION AND DESCRIPTION

1-1. INTRODUCTION.

1-2. Interface Kit 12531B provides for bit-parallel transfer of data between the Computer and interface card, while transfer between the interface card and the Teleprinter is bit-serial. This is a single address I/O card, simultaneous input and output is not possible. The kit consists of the following:

a. Buffered Teleprinter Interface Card (HP Part No. 12531-6001 or 02116-6168).

b. BCS Teleprinter Driver Tape (HP Accessory No. 20017).

c. SIO 4K Teleprinter Driver Tape (HP Accessory No. 20322) or SIO 8K Teleprinter Driver Tape (HP Accessory No. 20323).

d. HP 2116 Buffered Teleprinter Test-Binary Tape (HP Accessory No. 20417).

e. HP 2115/2114 Buffered Teleprinter Test-Binary Tape (HP Accessory No. 20420).

NOTE

Each tape has a suffix letter after the HP Accessory Number. This suffix letter is subject to change depending on the supplied version of the tape.

1-3. Sections II through IV provide installation, programming, and theory of operation for the Buffered Teleprinter Interface Card and Teleprinter operation information. A supplement to this manual contains a description of the diagnostic program contained on the Buffered Teleprinter Test-Binary Tape.

1-4. DESCRIPTION.

1-5. The Buffered Teleprinter Interface Card plugs into any of the interface-card I/O slots of the Computer. The card contains control and interrupt logic for both input and output Computer functions, and eight flip-flops for temporary storage of data. This data is entered into the Computer or transferred to the Teleprinter through the Buffered Teleprinter Interface Card. Eight data bits are transferred between the Computer and interface card in parallel and converted by the card to 11-bit ASCII for transfer between the Teleprinter and interface card in bit-serial (one bit at a time). The least-significant 8-bits of the A or B Register are sent via the I/O Bus Out (IOBO) to the interface card and then to the Teleprinter during output operations. During input operations, a character from the Teleprinter enters the Buffered Teleprinter Card in bit-serial and from the card to the Computer in parallel (8-bits at a time). During output operations 8-bits are transferred from the Computer to the interface card in parallel and from the interface card to the Teleprinter in bit-serial. This card can provide automatic readback from keyboard or paper tape to the Teleprinter without Computer intervention.

1-6. TELEPRINTER DRIVER TAPES.

1-7. BCS TELEPRINTER DRIVER TAPE. The BCS (Basic Control System) Teleprinter Driver Tape is a flexible Input/Output routine which permits transfer of data between the Computer and the Teleprinter. The driver is accessed through the BCS I/O Control subroutine (.IOC.) by a 5-word calling sequence. The driver is made part of the Basic Control System through the use of the Prepare Control System routine which is furnished with each Computer. Refer to Chapter 1 of the HP Computer Basic Control System manual for information on Input/Output programming and to Chapter 4 for information on the processing of the BCS Teleprinter Driver Tape.

1-8. SIO TELEPRINTER DRIVER. The SIO (System Input/Output) Teleprinter Driver (4K or 8K, depending on Computer memory size) is a simple, unbuffered Input/Output routine used by standard software systems (FORTRAN, Assembler, etc.) to permit transfer of data between the Computer and the Teleprinter. The driver is incorporated into the system through the use of the SIO Dump Routine furnished with each Computer. The driver may also be accessed directly by a 3-word calling sequence in the user's program. Refer to Appendix F of the HP Computer Assembler manual for detailed programming and use information for the SIO Teleprinter Driver Tape.

Printed in U.S.A.

395 Page Mill Road, Palo Alto, California 94306 Area Code 415 326-1755 TWX 910-373-1296

Europe: 54 Route Des Acacias, Geneva, Switzerland, Cable: "HEWPACKSA" Tel. (022) 42.81.50

1-9. HP 2752A TELEPRINTER.

1-10. The HP 2752A Teleprinter (Figure 1-1) is an HP-modified Teletype Model ASR33-TC Teletypewriter set and is recommended for applications requiring operation which does not exceed five hours per day or 30 hours per week. The unit is made up of a typewriter, a tape punch, and a tape reader as a single unit. It is furnished with its own floor stand and is usually placed in a location adjacent to the Computer. The following specifications apply to the HP 2752A Teleprinter:

a. Reading and Punching Speed: 10 characters per second.

b. Typing Speed: 100 words per minute.

c. Data Transfer: bit-serial, 8-bit code.

d. Ambient Temperature: 10°C to 40°C (50°F to 104°F).

e. Relative Humidity: 20% to 80%.

f. Power Requirements: 115 vac ±10 percent, 60 ±0.45 Hz or 50 ±0.12 Hz, single phase, 230 watts.

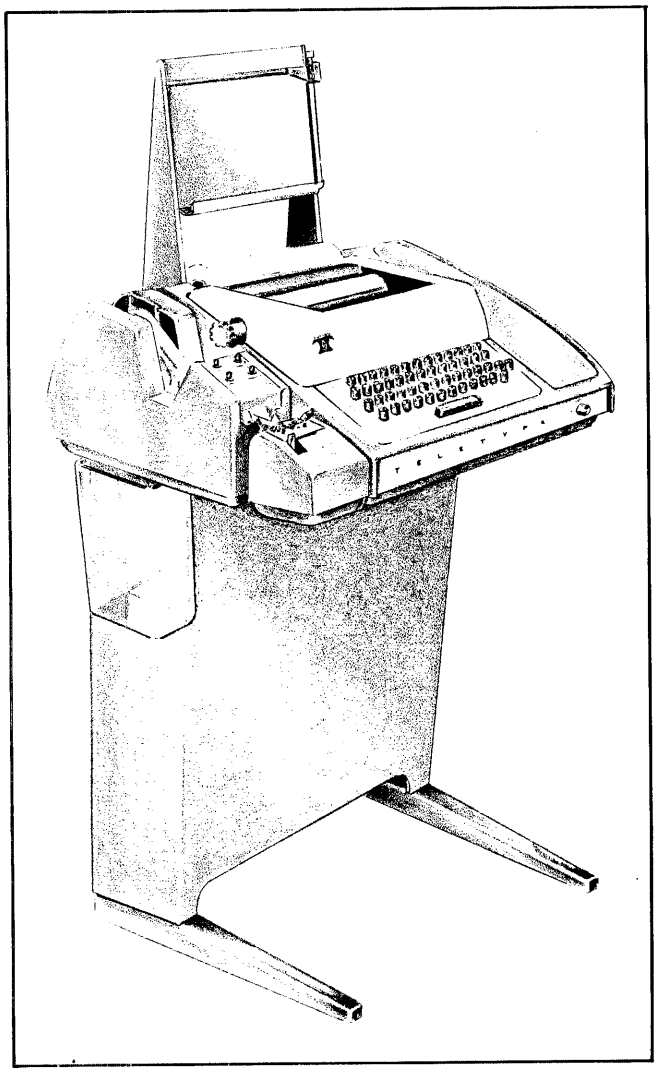


Figure 1-1. HP 2752A Teleprinter

g. Tape Handling Capabilities: 8-channel, 1-inch wide paper tape.

h. Dimensions and Weight (including stand):

Height: 33 inches (838 mm)
Width: 25-1/2 inches (648 mm)
Depth: 18-1/2 inches (470 mm)
Weight: 77 pounds (34,7 kg)

1-11. HP 2754A/B TELEPRINTER.

1-12. The HP 2754A/B Teleprinter (Figure 1-2) is an HP-modified Teletype Model ASR35-AR Teletypewriter Set and is recommended for heavy-use applications where operation exceeds five hours per day or 30 hours per week. It is made up of a typewriter, a tape punch, and a tape reader as a single unit. It is furnished with its own floor stand and is usually placed in a location adjacent to the Computer. The following specifications apply to the HP 2754A/B Teleprinter:

a. Reading and Punching Speed: 10 characters per second.

b. Typing Speed: 100 words per minute.

c. Data Transfer: bit-serial, 8-bit code.

d. Ambient Temperature: 10°C to 40°C (50°F to 104°F).

e. Relative Humidity: 20% to 80%.

f. Power Requirements: 115 vac ±10 percent, 60 ±0.5 Hz, single phase, 350 watts. (Consult factory if 50 Hz operation is desired.)

g. Tape Handling Capabilities: 8-channel, 1-inch wide paper tape.

h. Dimensions and Weight (including stand):

Height: 33-1/2 inches (851 mm)
Width: 40 inches (1016 mm)
Depth: 24 inches (610 mm)
Weight: 225 pounds (102 kg)

NOTE

When using the 2754A/B Teleprinter, the computer program can individually select the teleprinter tape punch, printer or both output devices simultaneously.

1-13. DATA PHONE.

1-14. This board used in this kit may also be used as an I/O Data Phone Interface card, providing ASCII formatted characters are to be used. When using a Data Phone, make the following connections on the 48-pin connector plug:

a. Connect pin Y to pins 4 and D.

b. Connect pin V to pins 16 and T.

1-15. Refer to the Data Phone Interface manual 12563A for a more detailed description.

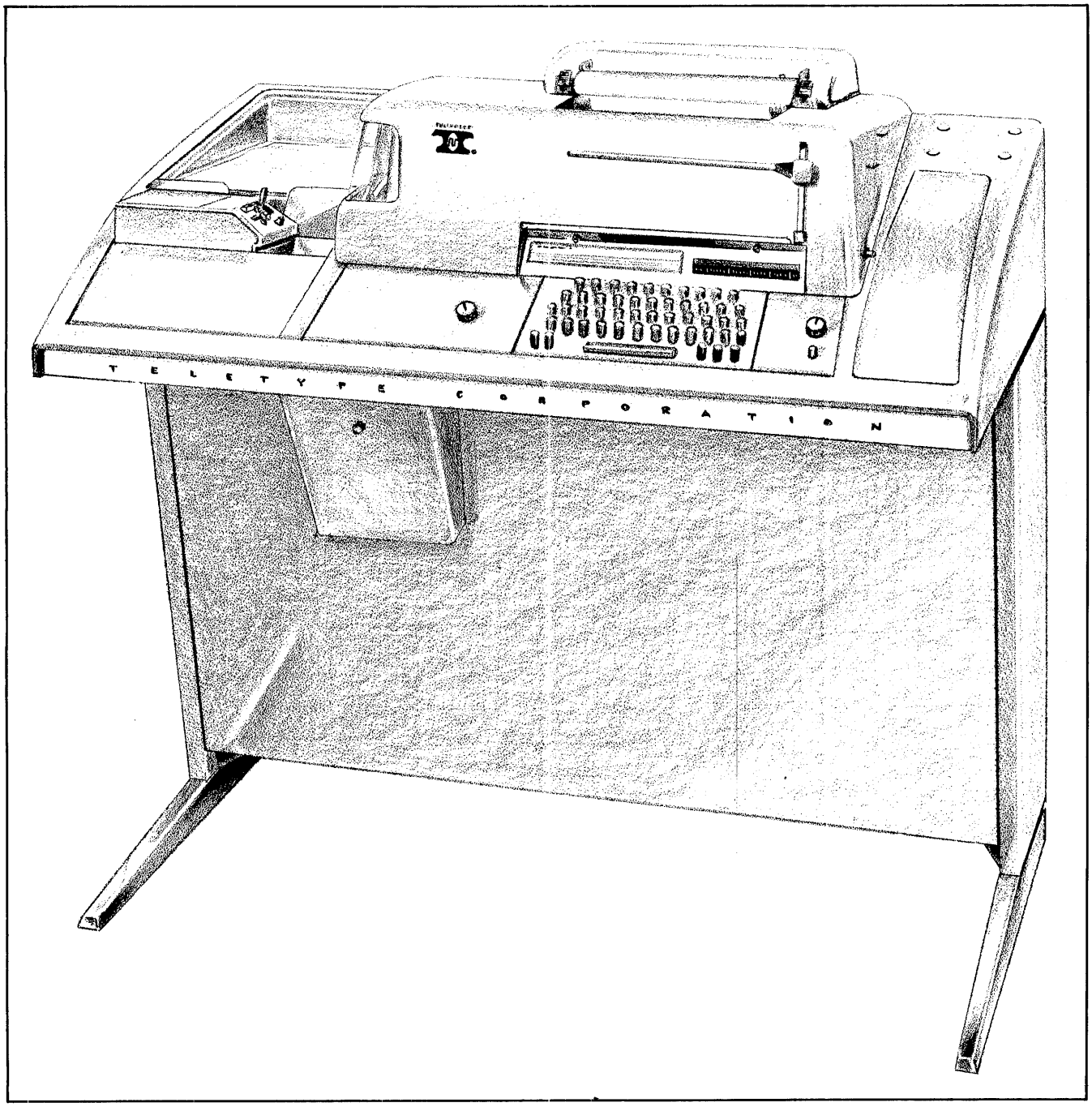


Figure 1-2. HP 2754A/B Teleprinter

SECTION II
INSTALLATION AND PROGRAMMING

2-1. INSTALLATION.

2-2. Refer to the HP 2752A, HP 2754A, or HP 2754B Teleprinter manuals for unpacking, installation, and checkout instructions of the applicable Teleprinter unit. To connect the Teleprinter to the Buffered Teleprinter Interface Card using the cable which is an integral part of the Teleprinter, perform the following:

a. Turn power off.

b. Open the Computer for access to the I/O cards.

c. Plug the Buffered Teleprinter Interface Card into the I/O slot assigned for the particular Computer System.

d. Pass the cable connector from the Teleprinter, marked TELEPRINTER, through the computer opening and to the front of the card. Slide the connector onto the Buffered Teleprinter Interface Card.

e. Close the cover of the Computer.

2-3. After the Teleprinter has been connected to the Computer, run the Teleprinter diagnostic program described in supplement. If the diagnostic program is completed without error, the system operates properly. Refer to Tables 2-1 and 2-2 for leadwire connections between the interface card and the HP 2752A and 2754A/B Teleprinters, respectively.

2-4. TELEPRINTER OPERATION.

2-5. MAIN CONTROL.

2-6. Plug the Teleprinter power cable into the appropriate power source. Operation of the Teleprinter is started and stopped by the LINE/OFF/LOCAL switch on the front panel of the HP 2752A Teleprinter, and by the ON LINE/OFF/LOC. switch on the front panel of the HP 2754A/B Teleprinter. Operation of these switches are as follows:

a. In the OFF position, the motor in the Teleprinter is turned off, preventing its operation.

b. In the LINE position (2752A) or ON LINE position (2754A/B) the Teleprinter is in a full-duplex configuration. This configuration, and the Computer programming subroutines, permit the following types of operation:

1. Transmit data to the Computer manually from the typewriter keyboard while making a printed-page copy. The data can also be punched into tape simultaneously.
2. Receive data from the Computer and provide a printed-page copy. The data can also be punched into tape simultaneously.
3. Transmit data to the Computer from the tape reader while making a printed-page copy. The data transmitted can also be punched into tape simultaneously.

c. In the LOCAL position (2752A) or LOC. position (2754A/B) data cannot be entered into the Computer from the Teleprinter but the following types of operation can be performed:

1. Punch data into tape from the typewriter keyboard while making a printed-page copy.
2. Punch data into tape from the tape reader while making a printed-page copy.
3. Make a printed-page copy of data from the tape reader or the keyboard.

2-7. TAPE READER.

2-8. The tape reader START/STOP/FREE switch performs the following functions:

a. Pressing the START switch when the HP 2752A Teleprinter LINE/OFF/LOCAL switch or HP 2754A/B ON LINE/OFF/LOC. switch is in the LOCAL or LOC. position energizes the tape reader trip coil and the tape reader starts reading the tape. If the switch is in the LINE or ON LINE position, the tape reader trip coil will not energize until a Read Command is issued by the Computer program. When it is issued, the coil energizes and the tape reader starts reading tape. (See Figure 2-1 for a simplified diagram of the switching circuits.)

b. Pressing the STOP switch prevents the tape reader from reading tape.

c. Pressing the FREE switch releases the feed ratchet of the tape reader permitting the tape under the plastic tape lid to move easily for positioning purposes.

2-9. TAPE PUNCH (HP 2752A TELEPRINTER ONLY.

2-10. The tape punch ON/OFF/REL. /B. SP. switch on the 2752A Teleprinter performs the following functions:

a. Pressing the ON switch engages the drive mechanism in the punch through mechanical action. This permits a punching operation on receipt of data from the Computer or the typewriter keyboard.

b. Pressing the OFF switch releases the drive mechanism in the punch, preventing its operation.

c. Pressing the REL. (Release) switch disengages the tape-guide assembly from the feed wheel in the punch, allowing easy removal of tape.

d. Pressing the B. SP. (Back space) switch backspaces the tape one feed hole each time it is pressed.

Table 2-1. Interface Card-to-2752A Teleprinter Leadwire Connections

INTERFACE CARD CONNECTOR PIN	LEADWIRE COLOR CODE	TELEPRINTER CONNECTION	SIGNAL
4, D	Black	Pin 3 of Teleprinter rear connector	Input Data Bit
12, N	Red	+12-volt input on *Card Assy (one end of resistor R1)	+12 volts
14, R	White-Brown	-12-volt input on Card Assy (one end of resistor R3)	-12 volts
16, T	Green-Orange	Pin 7 of Teleprinter rear connector	Output Data Bit
13, P	Yellow	Input to Card Assy (junction of resistors R1 and R2)	Read Command
24, BB	Cable Shield	Gnd connection on Card Assy (emitter of transistor Q2)	Ground

NOTES:

1. Pins 4 & D, 12 & N, 13 & P, 14 & R, 16 & T, and 24 & BB are connected together on Interface Card Connector.

* Card Assy refers to the Printed Circuit Card Assembly added during modification of the Teletype Model ASR33. Refer to the Schematic Diagram in the HP 2752A Teleprinter manual for components specified in this Table.

Table 2-2. Interface Card-to-2754A/B Teleprinter Leadwire Connections

INTERFACE CARD CONNECTOR PIN	LEADWIRE COLOR CODE	TELEPRINTER CONNECTION	SIGNAL
4, D	Black	Terminal T6	Input Data Bit
12, N	Red	+12-volt input on *Card Assy (one end of resistor R1)	+12 volts
14, R	Brown	-12-volt input on Card Assy (one end of resistor R3)	-12 volts
16, T	White	Terminal T7	Output Data Bit
13, P	Yellow	Input to Card Assy (junction of resistors R1 and R2)	Read Command Signal
24, BB	White Black and Cable Shield	Gnd connection on Card Assy (emitter of transistor Q2)	Ground
6, F	Orange	Terminal T8	Punch Control
8, J	Green	Terminal T4	Print Control

NOTES:

1. Pins 4 & D, 12 & N, 13 & P, 14 & R, 16 & T, and 24 & BB are connected together on the Interface Card Connector.

* Card Assy refers to the Printed Circuit Card Assembly added during modification of the Teletype Model ASR35. Refer to the Schematic Diagram in the HP 2754A/B Teleprinter manual for components specified in this Table.

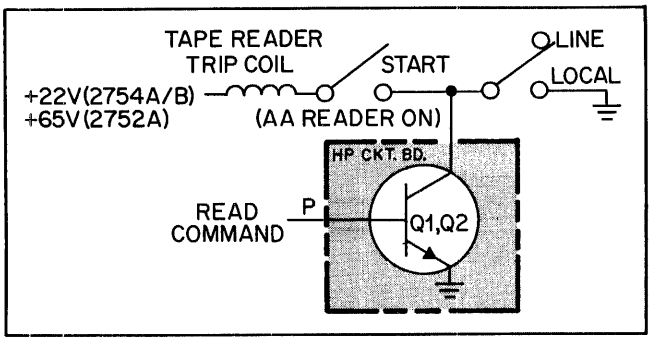


Figure 2-1. Teleprinter Tape Reader Switching Circuit, Simplified Diagram

2-11. MODE SWITCH (HP 2754A/B TELEPRINTER ONLY.

2-12. Although the MODE switch on the 2754A/B Teleprinter contains positions K, KT, T, TTS, and TTR, only positions K, KT, and T can be used. Positions TTS and TTR are mechanically locked out. When the Teleprinter ON LINE/OFF/LOC. switch is in the LOC. position, the K, KT, and T positions of the MODE switch perform the following functions:

a. In the K and KT positions, printed-page copy is typed from either the typewriter keyboard or the tape reader.

b. In the T position, data is punched into tape from either the typewriter keyboard or the tape reader while a printed-page copy is being typed.

2-13. During output operations, with the Teleprinter ON LINE/OFF/LOC. switch in the ON LINE position, the K, KT, and T positions of the MODE switch perform the following functions:

a. In the K position, a printed-page copy of the Computer ASCII output is generated. The tape punch if off, therefore no punch output can take place even if punch is programmed.

b. In the KT position, a printed-page copy of the Computer ASCII output or a punched tape of the Computer binary output is generated. Standard BCS/IOC software restricts the output to one function. Both functions cannot be performed simultaneously. The user may write his own driver software that will do both.

c. In the T position all output data is printed and punched without regard to format content.

2-14. During input operations, with the Teleprinter ON LINE/OFF/LOC. switch in the ON LINE position, the K, KT, and T positions of the MODE switch perform the same functions as output operations if simultaneous output is programmed as in the keyboard function. The keyboard function can be accomplished from the tape reader if the tape is inserted in the reader and the switch set to RUN.

2-15. PROGRAMMING.

2-16. The HP standard software facilities may be used to input data using the 2752A or 2754A/B Teleprinter. The Basic Control System (BCS) includes an Input/Output control subroutine which requires only a simple calling sequence to transfer data between the Computer and the Teleprinter. Refer to Section I, Paragraphs 1-6, 1-7, and 1-8, for programming information using BCS.

2-17. A subroutine may be programmed to perform all necessary operations to input data from the Teleprinter and output data to the Teleprinter. Tables 2-3 through 2-7 illustrate the operations required to input and output data. The Wait for Flag Method (Skip on Flag Set) is used to signal the Computer that a character is available to the Computer or that a character was sent to the Teleprinter.

2-18. The programmer must output a function select code to the Buffered Teleprinter Interface Card before any I/O operation is started. The coding shown in Table 2-3 is the minimum required to input or output one character.

Table 2-3. Program Constants

LABEL	OP CODE	OPERAND	REMARKS
TTY	EQU	nn	WHERE nn IS THE SELECT CODE
DOPU	OCT	110000	DATA OUT PUNCH ONLY
DOPR	OCT	120000	DATA OUT PRINT ONLY
DOPP	OCT	130000	*DATA OUT PRINT AND PUNCH
DINP	OCT	140000	DATA IN, NO PRINT, NO PUNCH
DINPU	OCT	150000	*DATA IN AND PUNCH
DINPR	OCT	160000	DATA IN AND PRINT
DINPP	OCT	170000	*DATA IN, PRINT AND PUNCH
CHAR1	OCT	000000	TEMPORARY DATA
CHAR2	OCT	000000	STORAGE LOCATIONS

*FUNCTIONS NOT USED IN HP STANDARD SOFTWARE.

2-19. SAMPLE PROGRAMS.

2-20. Refer to the following tables for sample programs:

a. Table 2-4, Status Check
b. Table 2-5, Input Program
c. Table 2-6, Input Subroutine
d. Table 2-7, Output Program
e. Table 2-8, Output Subroutine

Table 2-4. Status Check

OP CODE	OPERAND	REMARKS
LIA	SC	PUT BUFFERED DATA INTO A REG
SSA		BUSY?
JMP	*-2	YES, REPEAT LOOP
--		NO, PROGRAM CONTINUATION

Table 2-5. Input Program

OP CODE	OPERAND	REMARKS
CLF	0	INHIBIT INTERRUPT
LDA	DXXXX	LOAD "A" WITH I/O FUNCTION
OTA	TTY	OUTPUT A READ (DATA IN) FUNCTION TO I/O BOARD
JSB	CHRIN	GET A CHARACTER
STA	CHAR1	RETURN WITH CHARACTER IN "A" REGISTER
.	.	
.	.	
.	.	
JSB	CHR IN	GET A CHARACTER
STA	CHAR2	RETURN WITH CHARACTER IN REGISTER "A"
.	.	
.	.	
.	.	

Table 2-6. Input Subroutine

LABEL	OP CODE	OPERAND	REMARKS
†CHRIN	NOP		
	STC	TTY,C	START THE TTY
	SFS	TTY	IS THE FLAG SET ?
	JMP	*-1	NO, STAY IN LOOP
	LIA	TTY	YES, GET CHARACTER
	JMP	CHRIN,I	AND EXIT
†CHARACTER INPUT SUBROUTINE WILL READ AND EXIT WITH ONE CHARACTER IN "A"			

Table 2-7. Output Program

OP CODE	OPERAND	REMARKS
LDA	DXXXX	LOAD "A" WITH I/O FUNCTION
OTA	TTY	OUTPUT A WRITE (DATA OUT) FUNCTION TO I/O BOARD
LDA	CHAR1	LOAD "A" WITH CHARACTER TO BE OUTPUT
JSB	CHROT	OUTPUT A CHARACTER
.	.	
.	.	
.	.	
LDA	CHAR2	LOAD "A" WITH CHARACTER TO BE OUTPUT
JSB	CHROT	OUTPUT A CHARACTER
.	.	
.	.	
.	.	

Table 2-8. Output Subroutine

LABEL	OP CODE	OPERAND	REMARKS
†CHROT	NOP		
	AND	M377	STRIP OFF ANY EXTRANEOUS BITS
	OTA	TTY	OUTPUT DATA
	STC	TTY,C	START THE TTY
	SFS	TTY	IS THE FLAG SET ?
	JMP	*-1	NO, STAY IN LOOP
	JMP	CHROT,I	YES,EXIT
M377	OCT	377	
†CHARACTER OUTPUT SUBROUTINE WILL OUTPUT ONE CHARACTER FROM THE 8 LEAST SIGNIFICANT BITS OF REGISTER "A" AND EXIT			

SECTION III
THEORY OF OPERATION

3-1. GENERAL THEORY OF OPERATION.

3-2. DATA CODES.

3-3. The typewriter portion of the Teleprinter must receive data in ASCII (American Standard Code for Information Interchange) code for it to type readable information. The tape punch will punch whichever code (binary, ASCII, etc.) the Teleprinter receives. However, if the punch is punching data received in a code other than ASCII, the typed copy from the typewriter (which may be typing simultaneously) will not be readable. Refer to the Operating Manual, HP Character Set for the ASCII-code character set. Note that only seven bits are shown used in the code. Whether bit 8 is a logic "one" or "zero" during input operations depends on the parity functions of the particular Teleprinter being used. When reading ASCII coded tapes, programming masks the eighth bit before placing the data in memory so the logic level of the eighth bit is immaterial. During output operations using ASCII code, standard HP software supplied with the Computer automatically sets bit 8 to a logic "one".

3-4. CHARACTER LENGTH.

3-5. Teleprinter design requires that a total of 11 bits of information be transferred between the Computer and the Teleprinter for each character transferred. The bits are transferred one at a time so the basic data unit is a bit. Figure 3-1 depicts a simplified block diagram of data transfer. Of the 11 bits, eight are character bits and three are start and stop bits. These bits are shown as follows:

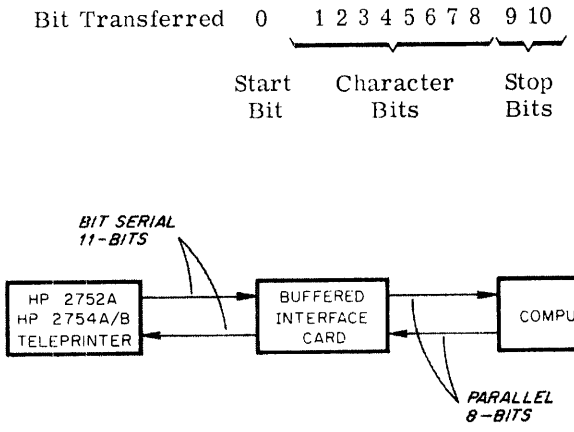


Figure 3-1. Data Transfer Simplified Block Diagram

3-6. INPUT OPERATIONS.

3-7. With the Teleprinter LINE/OFF/LOCAL switch in the LINE position, an input operation can be provided from the Teleprinter in one of two ways.

a. The input can be provided manually from the Teleprinter keyboard.

b. The input can be provided from the tape reader of the Teleprinter.

3-8. When a typewriter key is pressed or the tape reader starts reading tape, a Teleprinter timing cycle is started. This timing cycle establishes a bit transfer rate of 110 bits per second or a maximum character transfer rate of 10 characters (including start and stop bits) per second. Thus, a bit is transferred to the Interface card every 9.09 milliseconds. The first bit from the Teleprinter (the start bit) initiates the interface card timing circuits so that Computer and Teleprinter timing is in synchronization. After a character is transferred to the interface card, Teleprinter timing stops and must be reinitiated to transfer another character. Refer to Figure 3-2 for the signals sent to the Computer for the letter "M" from the tape reader or the typewriter keyboard. In TTY terminology a "1" is a mark and a "0" is a space.

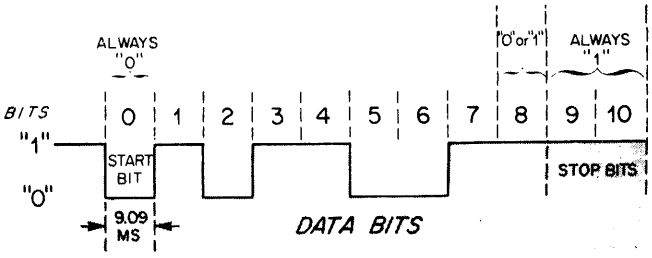


Figure 3-2. Data Bits for Transfer of Letter "M"

3-9. An input operation is enabled by transferring bits 14 and 15 true to the Interface card which sets the IN/OUT flip-flop to the IN state. If printing data as it is input is desired, bit 13 of the control word will also have to be set. Pressing the PRESET pushbutton does the same thing. An input operation is initiated by a Set Control, Clear Flag (STCnn, C) instruction to the interface card for inputs from either the Teleprinter tyepwriter keyboard or tape reader. The STC portion of the instruction causes a Read Command signal to be issued to the Teleprinter when the tape reader is to provide input data. If the typewriter is to be used to input data to the Computer, the tape reader STOP switch is engaged, and the Read Command signal has no effect on the Tape Reader. The STC portion of the instruction also sets the interface card Control Flip-Flop which enables incoming data bits and Flag signals. The CLF portion of the instruction resets the Flag Buffer and Flag Flip-Flops on the interface card to prevent an interrupt signal from being sent to the Computer before data is received from the Teleprinter.

3-10. An LIA or LIB instruction generates an IOI signal to enable parallel transfer of the eight possible data bits representing the character read to the eight least-significant bit positions (bits 0-7) of the A or B

register. To put two characters in the A or B register, and then into a memory location, rotate instructions, ALF or BLF, are used (twice) to rotate the first eight bits into the most-significant bit positions (8 through 15) of the register. An MIA or MIB instruction is then used to transfer the second eight bits from the interface card to the A or B register. An LIA or LIB instruction cannot be used for second-character transfer since these instructions destroy the contents of the register prior to entering data.

3-11. The set or reset condition of the Flag flip-flop may be tested with a Skip on Flag Set (SFS) or a Skip on Flag Clear (SFC) instruction to determine when a character is available to the Computer from the Teleprinter. When using this method, the Interrupt System Enable flip-flop on the I/O Control card must be reset with a Clear Flag (CLF) instruction and a Select Code of 00 (octal).

3-12. OUTPUT OPERATIONS.

3-13. An output operation is enabled by transferring the desired command bits 12, 13 and 15 to the Interface card. This clears the IN/OUT flip-flop and sets the print or punch functions. An output from A (OTA) or an output from B (OTB) instruction must be issued by the Computer program to output 8-bits of data from the eight least-significant bit positions (0-7) of the A or B register to the interface card. The IOO signal which resulted from the OTA/B instruction enables the bits from the A or B register to set the applicable Bit 1 through Bit 8 flip-flops on the interface card.

3-14. Before data transfer to the Teleprinter, the buffered interface card maintains a positive voltage on the input to the Teleprinter. The Computer program initiates an output operation with a STC nn, C command and the first bit to the Teleprinter must be a logic "zero" signal (the start bit). This bit initiates the Teleprinter timing cycle which requires a bit from the Interface card every 9.09 milliseconds until the 11 bits representing the character (including start and stop bits) are received. The timing circuit on the interface card is also initiated to maintain Computer-Teleprinter timing synchronization. After a character is transferred, Teleprinter timing stops and the Interface card must be reinitiated by another STC nn, C command from the Computer for the next character transfer.

3-15. DETAILED THEORY OF OPERATION.

3-16. GENERAL.

3-17. Figure 3-5 depicts the logic diagram for the Buffered Teleprinter Interface Card. For leadwire connections between the interface card and applicable Teleprinter, refer to Figure 3-5 and Tables 2-1 or 2-2. Figure 3-6 depicts the parts location of the Buffered Teleprinter Card.

3-18. Logic diagram reference designations preceded by MC are identified by part number in Section IV and the logic diagram for each Microcircuit Package is shown in Figure 3-7.

3-19. COMPUTER POWER ON.

3-20. When power is initially applied by the POWER switch, on the front panel of the Computer, the POPIO and CRS signals are received simultaneously by the interface card from the I/O Control card. These signals establish initial conditions for operation of the interface card. The POPIO signal is applied to "nand" gate MC16A. All inputs to the "nand" gate are then true and its false output sets the Flag Buffer Flip-Flop (the input to the flip-flop is inverted). At time T2, the ENF signal from the I/O Control card enables "nand" gate MC56B. The output from gate MC56B resets the IRQ flip-flop. The output from gate MC56B is also transferred through "nand" gate MC56D and with the output of the Flag Buffer flip-flop, sets the Flag flip-flop and changes the state of the Counter Reset flip-flop.

3-21. When power is first applied, the positive pulse of the Control Reset (CRS) signal is received at pin 13 and inverted by "nand" gate MC66A. The output from this gate resets the Control flip-flop, Clock Enable flip-flop and Read flip-flop. This signal also directly resets the Print flip-flop, Punch flip-flop, directly sets the IN/OUT flip-flop to IN, and resets the Divider network through "nand" gates MC94D and MC84A. Therefore the card is always in the Input state after turn on or whenever PRESET is pressed.

3-22. OUTPUT LOGIC.

3-23. INITIAL CONDITIONS. To output data from the Buffered Teleprinter Card the following assumptions are made:

a. The Teleprinter used is an HP 2754A/B Teleprinter. This model is identical to the HP 2752A Teleprinter with the following exceptions:

1. Computer control of punching and printing is not available with the HP 2752A Teleprinter.
2. Manual control of punching output data and printing of all output to the HP 2752A Teleprinter.

b. The Flag Buffer and Flag flip-flops are set by the POPIO pulse when power is initially applied to the Computer or when PRESET is pressed.

c. The IRQ and Control flip-flops are in the reset state.

d. A positive voltage is supplied through pins 16 and T of the interface card to the data line of the Teleprinter.

e. The Teleprinter control switch is ON LINE.

f. The Teleprinter MODE switch is in the KT position for Computer control of output data formatting.

3-24. PROGRAM CONTROL OF PUNCH AND PRINT. Before data is output to the Buffered Teleprinter Card, a control word must be output to select the punch or print or both. When bit 13 of the control word is true, the Teleprinter will print. When bit 12 of the control word is true, the Teleprinter will punch output data. Bit 15 is set true to inform the card that the word is a control word and not a data word.

3-25. To print but not punch data, the control word would be 120000. An OTA or OTB instruction with the select code of the interface card location will output the word. When this instruction is executed, IOO comes true at time T3, T4. This signal is input to "nand" gate MC36C and with the output from the Select Code gate MC46A pin 3, enables "nand" gate MC54A. The IOBO 15 signal is input through pin 74 (86-pin connector) to pin 10 of "nand" gate MC55D. The other input to this "nand" gate is the T3 Buffered signal. Gate MC55D is enabled generating a clock pulse at output pin 8. This clock strobes the In/Out flip-flop, MC124A, to a false state since IOBO 14 is false. The clock pulse also strobes the Print flip-flop, MC114B, to the true state since IOBO 13 is true, and strobes the Punch flip-flop MC114A to the false state because IOBO 12 is false. The In/Out flip-flop, MC124A, is now in the reset condition or output state. Print flip-flop, MC114B, is set true which turns transistor Q6 off. (This transistor shorts the print circuit in the Teleprinter when it is on.) Punch flip-flop MC114A is false, which turns transistor Q7 on shorting the punch circuit in the Teleprinter. Therefore, the Teleprinter will print the output data but will not punch it.

3-26. The data character to be printed on the Teleprinter is output to the interface card from the eight least-significant bits of the A or B Register. This is accomplished by using the OTA or OTB instruction with the select code of the interface card location. The eight most-significant bits must be zero. The IOO signal comes true at time T3, T4. This signal is input to "nand" gate MC36C and with the output from the Select Code gate MC46A pin 3, enables "nand" gate MC54A. The positive-going output from this gate is transferred as one input to "nand" gates MC86A, MC86B, MC86C, MC86D, MC76A, MC76B, MC76C, and MC76D. The Data Register is reset by the output signal from MC54B pin 8, except flip-flop MC124B which is directly set by the signal at time T3. The condition of the IOBO lines 0 through 7 are now directly set into the 8-bit Data Register flip-flops MC95A, MC95B, MC105A, MC105B, MC115A, MC115B, MC 125A, and MC125B. Data is stored in the register flip-flops during time T4. Flip-flop MC85A is held in the 0 (false) state and flip-flop MC85B is held in the 1 (true) state by the false Clock Enable signal.

3-27. The Data Register consists of 11 flip-flops. These flip-flops store input data on the positive-going edge of the clock signal and can be directly set or reset. Now that the character is stored in the Data Register, a STC, C instruction is issued to the interface card with the select code of the location of the card.

3-28. The STC signal is input on pin 22 and transferred through "nand" gate MC36B (see Figure 3-3). The output signal on pin 6 of MC36B sets the Control flip-flop. With the use of the skip flag set method of input/output control, the Control flip-flop has no effect as the signal is only used to enable the interrupt circuits on the card. The interrupt system should have been turned off by a CLF instruction to I/O location 00. The STC signal is also sent to "nand" gate MC104B. Since the In/Out flip-flop is in the Out state, "nand" gate MC34D is enabled. The output from this gate sets the Clock Enable flip-flop. The Clock Enable flip-flop had been reset by the CRS signal (from power turn-on or PRESET) or had been reset at the end of the last character, and has held the Data Register flip-flop MC85A in the reset state and flip-flop MC85B in the set state. Flip-flop MC85B kept "nand" gate MC24C at a state such that transistor Q4 has been held in the off position. When Q4 is in the off position, +12 volts is applied to the Teleprinter through R12 and CR1 keeping the Teleprinter in a true or mark state (normally on, dormant condition). Once the Clock Enable flip-flop has been set, "nand" gate MC55A is enabled and the 872 Hz oscillator pulses are transferred through "nand" gate MC55C to the A, B, C divider network flip-flop MC64A. This network divides the 872 Hz signal down to 109 Hz (slightly lower than the maximum rate of the Teleprinter). The period of 109 Hz is 9.09 milliseconds. The CLF signal enters through "nand" gate MC16C resetting the Flag Buffer flip-flop and Flag flip-flop.

3-29. Pin 9 of the C flip-flop (MC74B) goes false and pin 8 goes true 9.09 milliseconds after the Clock Enable flip-flop was set. For this period of one pulse, the true signal (mark condition) has been held on by the Teleprinter. Since the In line to "nand" gate MC94C is false, the output on pin 11 is true enabling "nand" gate MC84B. Therefore, the output pin 8 of MC84B is false. At the end of the 9.09 millisecond period, pin 8 of MC84B goes true transferring a clock pulse to the Data Register. This clock pulse shifts the Data Register downward one bit. Since flip-flop MC85A was reset to a false state and the bit shifted to flip-flop MC85B, transistor Q4 is turned on. When Q4 is on, a space condition (false) is sent to the Teleprinter. This is the start bit (false bit) which starts all ASCII characters. At the same time, the Divide by 11 divider is incremented by one count by the negative-going edge of the C flip-flop, MC74B pin 9, setting the D flip-flop true. Another 9.09 milliseconds later, the next pulse from the C flip-flop (in the Divide by 8 divider) causes the next bit in the Data Register to shift to flip-flop MC85B and out to the Teleprinter. This procedure is repeated 11 times until bit 11 has been shifted into flip-flop MC85B. Bits 10 and 11 come from flip-flop MC124B which was set true when the Data Register was reset prior to storing the output characters. The output from "nand" gate MC104C has always been high, therefore the Data Register is now all true. On the leading edge of bit 11, divider flip-flops D, E, and G are true and F is false. Since this is an output operation, "nand" gate MC55B is enabled. At T3 of the next machine cycle after the eleventh shift of the Data Register, the output of "nand" gate MC66B goes false, directly resetting the Counter Reset flip-flop MC64B. At T5 of the same machine cycle, SIR (pin 32 of 86-pin connector) enables "nand" gate MC94B. The false output from pin 6 of MC94B enables "nand" gate MC94D. Since $\overline{\text{CRS}}$ is true, the true output from pin 8 of MC94D enables "nand" gate MC84A. The false output from pin 6 of MC84A resets both Dividers, the Clock Enable flip-flop and sets the Flag Buffer flip-flop. This signal remains true only for period T5. At T2 of the next machine cycle, the ENF signal sets the Counter Reset flip-flop to its set state preventing the second Flag pulse. Also at the same time, the Flag flip-flop is set and a request for

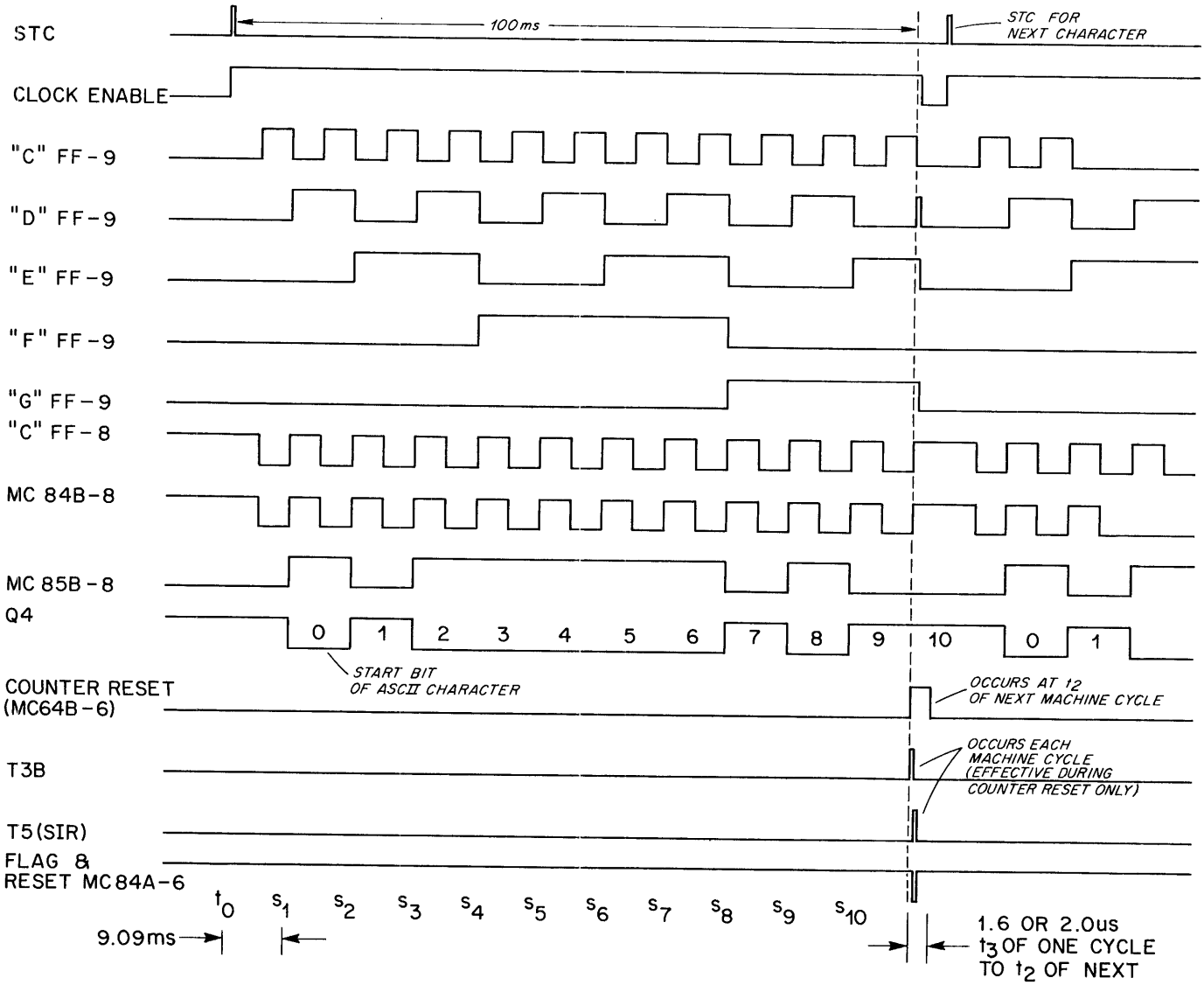


Figure 3-3. Output Timing Diagram

SFS or SFC forces the SKF output to go true. This informs the Computer that the operation is completed and it can now process the next character to the Teleprinter.

3-30. Since the first bit from the interface card is always true (logic 1) it is not necessary to wait until the end of the eleventh bit before issuing a Flag signal to the Computer. Since the Clock Enable flip-flop is turned off, the Teleprinter is resynchronized to the 872 Hz oscillator at the start of each character. Therefore, the maximum speed of the Teleprinter is always available without losing sync with the mechanical mechanism of the Teleprinter. To punch data, rather than print it, bit 12 of the control word is true and bit 13 is false. If printing and punching are desired, bits 12 and 13 are set true. When using an HP 2752A Teleprinter, either bit 12 or bit 13 set true will produce an output, but for any output to occur, one of the bits must be true.

3-31. READ OPERATION.

3-32. The CRS input signal is transferred through pin 13 (86-pin connector) to the input of "nand" gate MC66A. The output of this gate directly sets the In/Out flip-flop, MC124A, to the Input condition, resets the Print flip-flop MC114B, resets the Punch flip-flop MC114A, and resets the Read flip-flop MC24A, MC34B. This turns off the Read Command signal to the Teleprinter through transistor Q5. To generate a read sequence from the Teleprinter, a control word must be output to the interface card. Bit 15 must be set in the control word as it informs the card that the output is a control word. To input data from the Teleprinter, bit 14 must be true. Bit 14 is used to generate the input condition on the interface card. This is accomplished by an OTA or OTB to the Select Code of I/O location of the Buffered Teleprinter Card after the control word has been loaded in the appropriate register. If it is desired to print the data as it is entered, bit 13 of the control word should also be set.

3-33. To read from the Teleprinter tape reader, and print the data on the Teleprinter as it is read in, the control word to be output would be 160000. When the OTA or OTB instruction is implemented, the Select Code for the board location comes true. Since bits 13 and 14 are true, the In/Out flip-flop is set to the In state and the Print flip-flop is set true. Since IOBI 12 is false, the punch flip-flop is set false. At T3B, during the first half of the T3T4 IOO signal, a true signal, through "nand" gates MC46B, MC46D, and MC54B directly resets the Data Register except flip-flop MC124B which is directly set. The true state of the Print flip-flop, MC114B, results in pin 8 going false and the output of "nand" gate MC44B pin 6, true. Since the In/Out flip-flop is in the Input state, two of the three inputs of "nand" gate MC24B are true. The pin 3 input to this gate comes from the Data signal of the Teleprinter through pins 4 and D (48-pin connector), Schmitt-trigger Q1 and Q2, driver Q3 to "nand" gate MC104C. The output of MC104C, pin 11, is inverted through MC104A to pin 3 of MC24B causing MC104D to operate transistor Q4. This outputs data that comes in from the Teleprinter input circuit to its separate output circuit. Since Print inhibit transistor Q6 is off, the data is printed.

3-34. The next instruction issued to the card is STC,C. The Flag is cleared in the normal manner and the STC signal is transferred through "nand" gates MC36B and MC104B (see Figure 3-4). The output of gate MC104B (pin 6) is transferred as a true input to "nand" gate MC34C. The other input from the true side of the In/Out flip-flop enables MC34C. These inputs cause MC34C, pin 11, to set the Read flip-flop. This turns transistor Q5 on, which starts the Teleprinter reader, if its FREE/START/STOP switch is in START. When the first space (false signal) from the Teleprinter causes the Schmitt-trigger to go to the false state, transistor Q3 turns off, setting the output of "nand" gate MC104C false and the output of "nand" gate MC104A true. This signal goes through "nand" gates MC24B and MC104D turning transistor Q4 on,

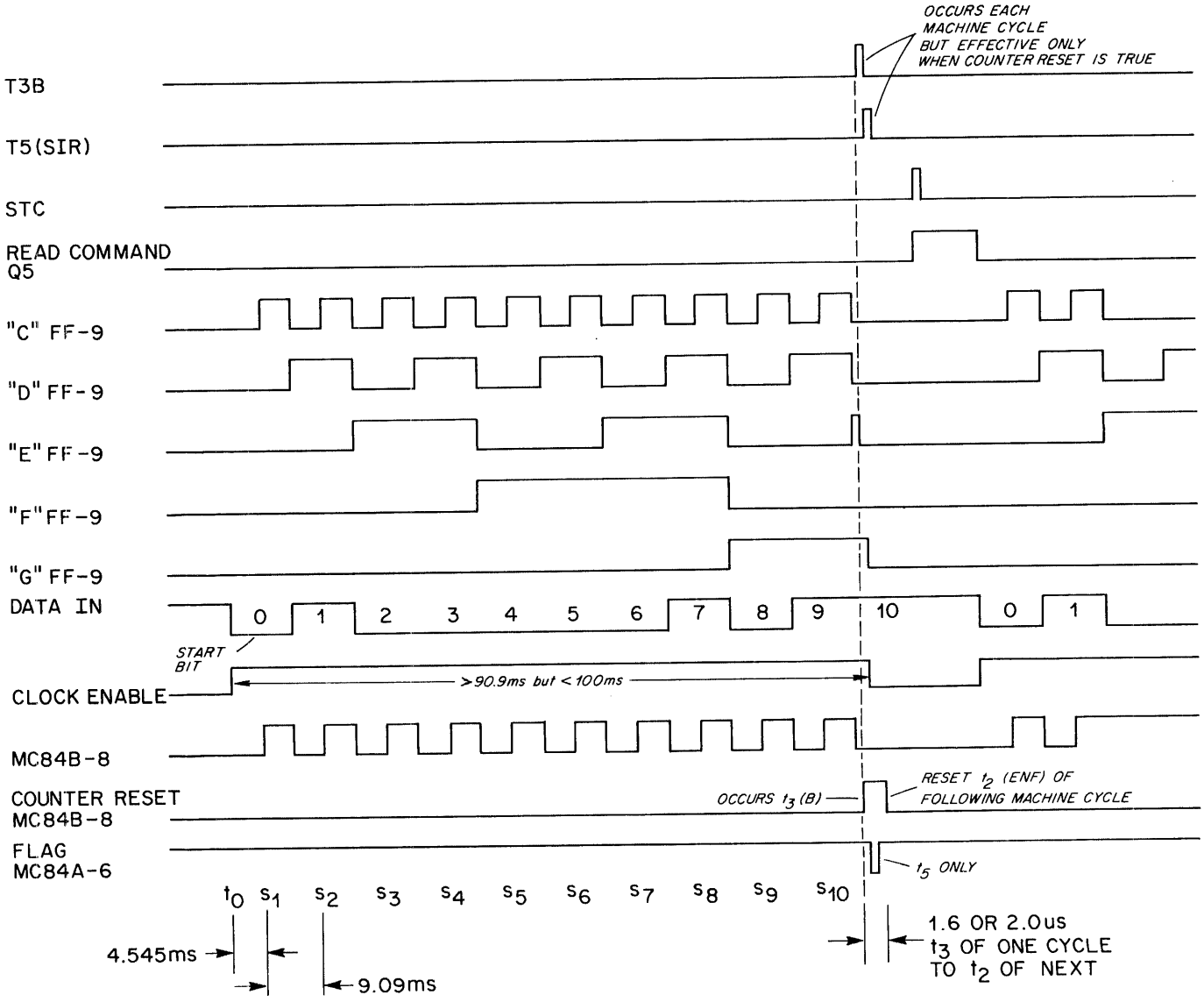


Figure 3-4. Input Timing Diagram

12531-6001 (CARD REV. A-820-6)

SRQ 19 · PRH 23 · IAK 10

SIR 32 · ENF 46 · POPIO 17 · STF 9 · CLF 7 · LSCM 14 · LSCL 16 · IOG(B) 15 · IEN 8 · SFS 25 · SFC 5 · STC 22 · CLC 21 · CRS 13 · IOI 24 · IOBO 14 65 · T3(B) 11 · IOO 20 · IOBO 15 74 · IOBO 13 61 · IOBO 12 57 · -2V · +4.5V · +12V · -12V · GRD

MC56A · MC56C · MC56B · MC56D · MC16A · MC16B · MC16C · MC26B · MC46A · MC46C · MC14B · MC66A · MC36B · MC36A · MC104B · MC34D · MC46B · MC46D · MC54B · MC36C · MC54A · MC55D · MC27A · MC25B · MC35B · MC45A · MC15A · MC14A · MC16D · MC35A · MC45B · MC35C · MC27B · MC17A · MC17B · MC14 · MC17 · MC45D · MC45C · MC25D · MC25C · MC26A · MC26D · MC26C · MC44A · MC44C · MC55A · MC55C · MC64A · MC74A · MC74B · MC75B · MC75A · MC65A · MC65B · MC94C · MC84B · MC94A · MC55B · MC66B · MC94B · MC94D · MC84A · MC34B · MC34C · MC34A · MC24A · MC114B · MC114A · MC44B · MC124A · MC104C · MC25A · MC86A · MC86B · MC86D · MC86C · MC76A · MC76B · MC76D · MC76C

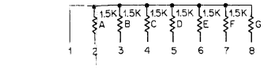
RI7E 1.5K · RI8F 1.5K · RI5D 1.5K · RI4C 1.5K · RI4E 1.5K · RI5F 1.5K · RI4A 1.5K · RI5E 1.5K · RI4F 1.5K · RI7F 1.5K · RI4G 1.5K · RI5B 1.5K · RI5A 1.5K · RI5G 1.5K · RI4B 1.5K · RI5B 1.5K · RI8A 1.5K · RI8B 1.5K · RI7G 1.5K · RI4D 1.5K · R44 348 · R46 1.47K · R47 1.47K · RI8D 1.5K · RI8C 1.5K · RI8E 1.5K · RI7A 1.5K · RI8G 1.5K · RI7B 1.5K · RI7C 1.5K · RI7D 1.5K · R27 10K · RI1 1K · R5 825 · R6 1210 · RI0 4220 · R1 680 · R4 3830 · R3 2150 · R7 261 · R8 10K · R9 4640 · C1 0.22μF

TO MC94B-5 · TO MC64B COUNTER RESET FF · FLAG BUFFER FF · FLAG FF · IRQ FF · CONTROL FF · CLOCK ENABLE FF · DIVIDER ÷8 · ÷11 · "A" FF · "B" FF · "C" FF · "D" FF · "E" FF · "F" FF · "G" FF · FLAG AND RESET · IN/OUT FF · IN · OUT · IOI TO MC96B-6 · TO MC104C-13 FLAG TO DATA REGISTER INPUT · FLGL · IRQL · PRL · SKF · S1R(T5) · COUNTER RESET FF · ENF (T2) · TO TELEPRINTER · PRINT · PUNCH · READ COMMAND · DATA FROM DATA-PHONE · TO PINS *4 AND *D FOR DATA-PHONE · DATA FROM TELEPRINTER · FROM COMPUTER · IOBO 7 · IOBO 6 · IOBO 5 · IOBO 4 · IOBO 3 · IOBO 2 · IOBO 1 · IOBO 0 · TO MC24A-2 READ FF

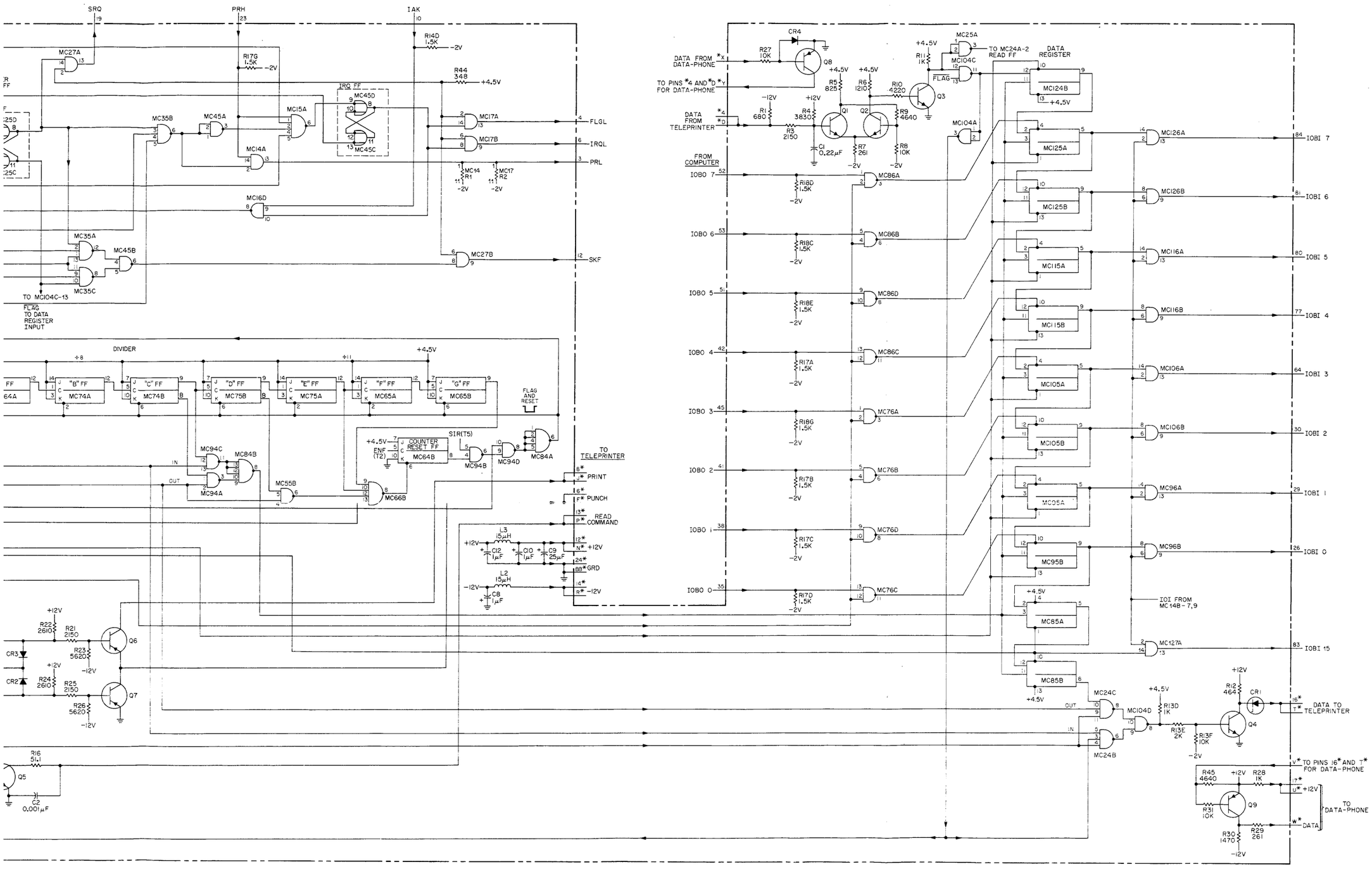
Q1 · Q2 · Q3 · Q5 · Q6 · Q7 · Q8 · Q10 · Q11 · Q12 · CR1 · CR2 · CR3 · CR4 · CR5 · CR6 · CR7 · CR8 · L1 15μH · L2 15μH · L3 15μH · C2 0.001μF · C3 1μF · C4 1μF · C5 22μF · C6 0.056μF · C7 0.056μF · C8 1μF · C9 25μF · C10 1μF · C12 1μF · C13 1μF · C14 1μF · C15-C17 1μF · C18-C23 1μF · R13A 10K · R13B 2K · R13C 1K · R16 511 · R21 2150 · R22 2610 · R23 5620 · R24 2610 · R25 2150 · R26 5620 · R31 1K · R32 1K · R34 4640 · R35 21.5K · R36 100K · R37 12.1K · R38 1780 · R39 1K · R40 1780 · R41 10K · R42 10K · TP1 · W1A · W1B · 872 Hz OSCILLATOR · PRINT FF · PUNCH FF · READ FF · FROM MC25A-3 · EXTERNAL CLOCK · +L

CHANGE	REFERENCE	REVISION/PREFIX
A	6-16 36	820

NOTES:
1. ALL LOGIC IS POSITIVE-TRUE
2. IS EQUIVALENT TO
3. SCHEMATIC DIAGRAM FOR RESISTOR NETWORKS R14, R15, R17 THRU R19:

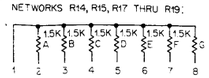


4. SC NE
5. * 4L FF

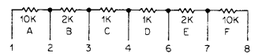


NOTES

1. ALL LOGIC IS POSITIVE-TRUE
2. IS EQUIVALENT TO
3. SCHEMATIC DIAGRAM FOR RESISTOR NETWORKS R14, R15, R17 THRU R19:



4. SCHEMATIC DIAGRAM FOR RESISTOR NETWORK R13.



5. * INDICATES SIGNALS FROM/TO TELEPRINTER VIA 48-PIN CONNECTOR. ALL OTHER SIGNALS ARE FROM/TO COMPUTER VIA 86-PIN CONNECTOR.

Figure 3-5. Buffered Teleprinter, Logic Diagram

TOP

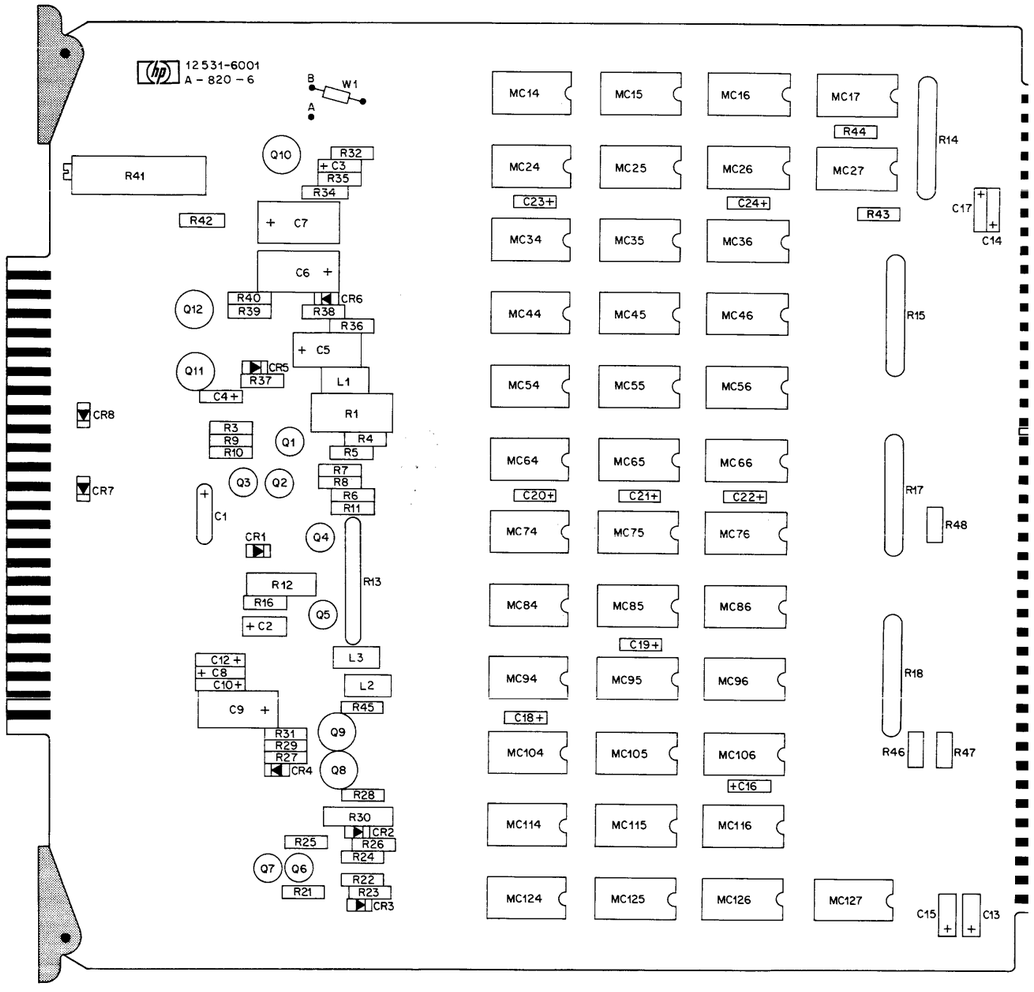


Figure 3-6. Buffered Teleprinter, Part Location Diagram

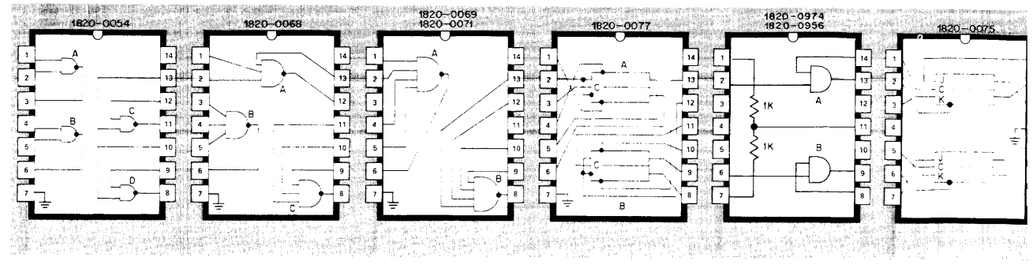


Figure 3-7. Microcircuit Packages, Top View

which transfers the start bit (first false signal) back to the Teleprinter output circuit. At the same time the Clock Enable flip-flop is set by the output of "nand" gate MC34A. The true signal from transistor Q3 is output through "nand" gate MC25A resetting the Read flip-flop. This stops the Teleprinter reader until the Computer is ready for the next character.

3-35. The Clock Enable flip-flop now allows the 872 Hz oscillator signal to start through the A,B,C divider network. Since the input condition is set, "nand" gate MC94C is enabled and the outputs from MC94A and MC55B are always true. At the end of 4.545 milliseconds, the C flip-flop of the divider chain goes true which causes the output of "nand" gate MC94C to go false, and MC84B to go true. This causes the Data Register to shift one character and store the data of the bit of the ASCII word in flip-flop MC124B. This is a zero (false) for the first bit.

3-36. At the end of the other half of the 9.09 milliseconds, the C flip-flop goes false which forces the Divide by 11 divider to step one count. This process continues through the next 10 bits of the ASCII data string entering the card with the shift register storing and shifting the bits in the middle of each bit and incrementing the counter at the end of the bit. At the end of bit 10, the state of divider flip-flops D, E, F, and G become 0, 1, 0, 1, respectively. Because "nand" gate MC55B, pin 6, is true, the output of "nand" gate MC66B goes false after bit 10 at time T3 of the following machine cycle. This forces the Counter Reset flip-flop to be reset which with T5 (through "nand" gate MC94B) resets the entire Divider string and the Clock Enable flip-flop, and sets the Flag flip-flop. Once the signal is detected by the skip flag condition, a LIA or LIB instruction will load the 8-bits of data into the least-significant bits of the A or B Register by enabling IOI, permitting data to pass from the Data Register into the IOBI 0 through 7 lines.

3-37. Since only 10-bits have been shifted, bit 0 is now stored in flip-flop MC85A and bit 10 stored in flip-flop MC124B. Since bit 11 is a known 1 (true), it does not have to be stored or shifted into the Data Register. If the Computer requests another character, another STC, C instruction is issued, energizing the reader, and the circuit then waits for the start bit (false signal) of the next character to restart the divider network and counter.

NOTE

The Buffered Interface Card, HP Part No. 02116-6168 is similar to the Buffered Interface Card, HP Part No. 12531-6001 (A-820-6). For re-order purposes, use the 12531-6001 number. The 02116-6168 card does not have the Status Bit capability.

3-38. If IOBI 15 of the status word is set, the card is currently in the process of inputting or outputting a character. The 8 least-significant bits are not effective in a status check.

SECTION IV
REPLACEABLE PARTS

4-1. INTRODUCTION.

4-2. This section contains information for ordering replacement parts for the Buffered Teleprinter Interface Card. Refer to Table 4-1 for a list of replaceable parts in alpha-numerical order of their reference designations, with a description and HP part number for each part. Table 4-2 lists parts alpha-numerically by their HP part numbers.

4-3. ORDERING INFORMATION.

4-4. To order a replacement part, address the order or inquiry to your local Hewlett-Packard field office. See the list at the rear of this manual for field-office addresses.

4-5. Specify the following information for each part when ordering:

a. Hewlett-Packard part number.

b. Circuit reference designation.

c. Description.

4-6. To order a part not listed in Tables 4-1 and 4-2, give a complete description of the part and include its function and location.

Table 4-1. Reference Designation Index

Reference Designation	HP Part No.	Description
C1	0160-0263	C:FXD CER 0.22UF 20% 50VDCW
C2	0160-0153	C:FXD MY 1000 PF 10% 200VDCW
C3, 4, 8, 10, 12-24	0180-0291	C:FXD ELECT 1UF 10% 35VDCW
C5	0180-0228	C:FXD ELECT 22UF 10% 15VDCW
C6, 7	0160-0165	C:FXD MY 5600 PF 10%
C9	0180-0338	C:FXD ELECT 25UF +75-10% 25VDCW
CR1, 4, 5	1902-0022	DIODE BREAKDOWN: 2.67V
CR2, 3, 7, 8	1910-0030	DIODE: GERMANIUM 100 MA 0.65V
CR6	1901-0040	DIODE: SILICON 30MA 30WV
L1, 2, 3	9140-0082	COIL:FXD RF 15 UH
MC14, 17, 27	1820-0956	INTEGRATED CIRCUIT
MC15	1820-0069	INTEGRATED CIRCUIT
MC16, 25, 34, 36, 45, 46, 55, 56, 76, 86, 94, 104	1820-0054	INTEGRATED CIRCUIT
MC24, 26, 35, 44	1820-0068	INTEGRATED CIRCUIT
MC54, 66, 84	1820-0071	INTEGRATED CIRCUIT
MC64, 65, 74, 75	1820-0075	INTEGRATED CIRCUIT
MC85, 95, 105, 114, 115, 124, 125	1820-0077	INTEGRATED CIRCUIT
MC96, 106, 116, 126, 127	1820-0974	INTEGRATED CIRCUIT
MC106	1820-0974	INTEGRATED CIRCUIT
Q1, 2, 3	1854-0094	TRANSISTOR: SILICON NPN
Q4, 5	1854-0215	TRANSISTOR: SILICON NPN 2N3904
Q6, 7	1853-0036	TRANSISTOR: SILICON PNP
Q8, 9	1853-0058	TRANSISTOR: SILICON PNP
Q10, 11, 12	1854-0094	TRANSISTOR: SILICON NPN
R1	0698-3635	R: FXD MET OX 680 OHM 5% 2W
R3, R21, R25	0698-0084	R:FXD MET FLM 2.15K OHM 1% 1/8W
R4	0698-3153	R:FXD MET FLM 3.83K OHM 1% 1/8W
R5	0757-0421	R:FXD MET FLM 825 OHM 1% 1/8W
R6	0757-0274	R:FXD MET FLM 1.21K OHM 1% 1/8W
R7, 29	0698-3132	R:FXD MET FLM 261 OHM 1% 1/8W
R8, 27, 31, 42	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W
R9, 34, 45	0698-3155	R:FXD MET FLM 4.64K OHM 1% 1/8W
R10	0698-3154	R:FXD MET FLM 4.22K OHM 1% 1/8W
R11, 28, 32, 39, 48	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W
R12	0698-0090	R:FXD MET FLM 464 OHM 1% 1/2W
R13	1810-0008	RESISTOR NETWORK: MET FLM (6 RES)
R14, 15, 17, 18	1810-0020	RESISTOR NETWORK: MET FLM (7 RES)
R16	0757-0394	R:FXD MET FLM 51.1 OHM 1% 1/8W
R22, 24	0698-0085	R:FXD MET FLM 2.61K OHM 1% 1/8W
R23, 26	0757-0200	R:FXD MET FLM 5.62K OHM 1% 1/8W
R30, 46, 47	0757-1078	R:FXD MET FLM 1.47K OHM 1% 1/2W
R35	0757-0199	R:FXD MET FLM 21.5K OHM 1% 1/8W
R36	0757-0465	R:FXD MET FLM 100K OHM 1% 1/8
R37	0757-0444	R:FXD MET FLM 12.1K OHM 1% 1/8W
R38, 40	0757-0278	R:FXD MET FLM 1.78K OHM 1% 1/8W
R41	2100-1660	R:VAR WW LIN 10K OHM 10% 1W
R43	0698-3440	R:FXD MET FLM 196 OHM 1% 1/8W
R44	0698-3445	R:FXD MET FLM 348 OHM 1% 1/8W
W1	8159-0005	JUMPER WIRE

Table 4-2. Replaceable Parts

HP Part No.	Description	Mfr.	Mfr. Part No.	TQ
0160-0153	C:FXD MY 1000 PF 10% 200VDCW	28480	0160-0153	1
0160-0165	C:FXD MY 5600 PF 10%	28480	0160-0165	2
0160-0263	C:FXD CER 0.22UF 20% 50VDCW	56289	5C52B	1
0180-0228	C:FXD ELECT 22 UF 10% 15VDCW	28480	0180-0228	1
0180-0291	C:FXD ELECT 1UF 10% 35VDCW	56289	150D105X9035A2	17
0180-0338	C:FXD ELECT 25UF +75-10% 25VDCW	28480	0180-0338	1
0698-0084	R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084	3
0698-0085	R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085	2
0698-0090	R:FXD MET FLM 464 OHM 1% 1/2W	28480	0698-0090	1
0698-3132	R:FXD MET FLM 261 OHM 1% 1/8W	28480	0698-3132	2
0698-3153	R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153	1
0698-3154	R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154	1
0698-3155	R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155	3
0698-3440	R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440	1
0698-3445	R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445	1
0698-3635	R:FXD MET OX 680 OHM 5% 2W	28480	0698-3635	1
0757-0199	R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199	1
0757-0200	R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200	2
0757-0274	R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274	1
0757-0278	R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278	2
0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280	5
0757-0394	R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394	1
0757-0421	R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421	1
0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442	4
0757-0444	R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444	1
0757-0465	R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465	1
0757-1078	R:FXD MET FLM 1.47K OHM 1% 1/2W	28480	0757-1078	3
1810-0008	RESISTOR NETWORK: MET FLM (6 RES)	28480	1810-0008	1
1810-0020	RESISTOR NETWORK: MET FLM (7 RES)	28480	1810-0020	4
1820-0054	INTEGRATED CIRCUIT	28480	1820-0054	12
1820-0068	INTEGRATED CIRCUIT	28480	1820-0068	4
1820-0069	INTEGRATED CIRCUIT	28480	1820-0069	1
1820-0071	INTEGRATED CIRCUIT	28480	1820-0071	3
1820-0075	INTEGRATED CIRCUIT	28480	1820-0075	4
1820-0077	INTEGRATED CIRCUIT	28480	1820-0077	7
1820-0956	INTEGRATED CIRCUIT	28480	1820-0956	3
1820-0974	INTEGRATED CIRCUIT	28480	1820-0974	5
1853-0036	TRANSISTOR: SILICON PNP	28480	1853-0036	2
1853-0058	TRANSISTOR: SILICON PNP	07263	2N3644	2
1854-0094	TRANSISTOR: SILICON NPN	28480	1854-0094	6
1854-0215	TRANSISTOR: SILICON NPN 2N3904	28480	1854-0215	2
1901-0040	DIODE: SILICON 30MA 30WV	28480	1901-0040	1
1902-0022	DIODE BREAKDOWN: 2.67V	28480	1902-0022	1
1910-0022	DIODE: GERMANIUM 5 WIV	28480	1910-0022	2
1910-0030	DIODE: GERMANIUM 100 MA 0.65V	28480	1910-0030	4
2100-1660	R: VAR WW LIN 10K OHM 10% 1W	28480	2100-1660	1
8159-0005	JUMPER WIRE	28480	8159-0005	1
9140-0082	COIL: FXD RF 15 UH	28480	9140-0082	3
12531-6001	BUFFERED TELEPRINTER	04404	12531-6001	1

HEWLETT hp PACKARD

DIAGNOSTIC TEST
for
BUFFERED TELEPRINTER
Computer Interface Kit

model
12531B

Manual Supplement 7 MAR 1969

CONTENTS

This Supplement applies to:

Diagnostic Tape HP 20420A (for 2114A/15A Computers)
Diagnostic Tape HP 20420B (for 2114A/15A Computers)
Diagnostic Tape HP 20417B (for 2116A/B Computers)
Diagnostic Tape HP 20417C (for 2116A/B Computers)

and

Interface Board HP Part No. 02116-6168
Interface Board HP Part No. 12531-6001

395 Page Mill Road, Palo Alto, California 94306 Area Code 415 326-1755 TWX 910-373-1296
Europe: 54 Route Des Acacias, Geneva, Switzerland, Cable: "HEWPACKSA" Tel. (022) 42.81.50

Printed in U.S.A.

DIAGNOSTIC OPERATING PROCEDURE

1. BUFFERED TELEPRINTER

2. A Diagnostic Test Tape and Diagnostic Listing is furnished with each Buffered Teleprinter Interface Kit. The HP part number of the tape is on a label attached to the tape and/or container. Use this number and the system serial number for correspondence and re-ordering purposes.

3. This Diagnostic Program checks the Buffered Teleprinter Interface Card (HP 02116-6168 or 12531-6001) with an HP 2752A Teleprinter (ASR33) or an HP 2754A/B Teleprinter (ASR35).

4. The program consists of a background control program and four task routines. The first task routine inserts the address of the BUFFERED TELEPRINTER REGISTER into all I/O instructions. The second routine tests the flag, control, and interrupt circuitry and the data register on the Teleprinter Interface Card. The errors are stored, and at the end of the test, the program attempts to print out the errors. If it fails to print, or if bit 1 of the switch register is true, the program will halt where the errors are stored. Pressing DISPLAY MEMORY will show which errors occurred. The third routine tests the tape punch, tape reader, and printer parts of the Teleprinter. All combinations of eight bits are punched out, and this tape is read back while the computer checks the data. Errors are printed out and parts of the tape are also printed out as they are read. The fourth routine tests the printer and the keyboard parts of the Teleprinter. All sixty-four ASCII characters are printed out twice (see tables 1 and 2). The computer then waits for a character from the Teleprinter keyboard (or tape reader), reads in the character and then outputs it to the printer. The operator verifies accuracy.

5. The Buffered Teleprinter Interface Card must be in an unbroken interrupt priority string since the diagnostic tests the interrupt capability of the board.

6. OPERATING PROCEDURE

   a. Buffered Teleprinter Interface Card

      1. Place card in an I/O slot such that every slot of higher priority has either another I/O board or a priority jumper board in it.

2. Connect card to Teleprinter.

3. If 2754A/B Teleprinter, put MODE switch in KT position.

b. Buffered Teleprinter Diagnostic

1. Load diagnostic Test Tape into memory using Basic Binary Loader.

2. Put 000100 into Switch Register.

3. Push LOAD ADDRESS.

4. Put address of Buffered Teleprinter card into Switch Register.

5. Push RUN.

6. Computer will halt with A, B, and T Registers at 102001. This is the beginning of testing.

7. Clear Switch Register.

8. Push RUN (Computer will sit in Run Loop awaiting Switch Register option).

9. Operator must set Switch Register for desired program control option.

7. PROGRAM CONTROL

a. Put Switch 3 of Switch Register in up position. The Computer then performs the Basic Test task routine and halts if an error occurs or if Switch 1 is up. (When Switch 1 is up the Computer will halt at the top of the Error Codes for all basic tests.)

HLT55 - The T-Register = 102055. The A and B Registers = program address which called for the halt. This indicates a failure to print, (i. e., no Flag). Push DISPLAY MEMORY 16 times to display which errors occurred. (The T Register will show 000001 for E01, etc.) The 17th push displays all 1's. Push RUN to return to the main program. Clear Switch Register to terminate basic test.

ERROR CODES

CODE	MEANING
E01	SFC XX true after CLC 0, C instruction
E02	SFS XX false after CLC 0, C instruction
E03	SFC XX false after CLF xx instruction
E04	SFS XX true after CLF XX instruction
E05	SFC XX false after CLF XX and STC XX
E06	SFS XX true after CLF XX and STC XX
E07	No interrupt after STC XX, STF XX, STF 0
E10	SFC XX true after interrupt
E11	SFS XX false after interrupt
E12	Data Clock on Buffered Teleprinter Card too fast
E13	Data Clock on Buffered Teleprinter Card too slow
E14	Data buffer error
E15	Clock Enable flip-flop set
E16	Clock Enable flip-flop not set
E17	Illegal interrupt from teleprinter
IA	Program address at time of E17

NOTE

Only the first 15 error codes (E15) are valid with the 02116-6168 version of the Buffered Teleprinter card. All error codes can occur on the 12531-6001 Buffered Teleprinter card.

b. Put Switch 4 of Switch Register in up position. Program will perform Punch and Read Task routine and Halt.

HLT 2 - A, B and T Registers = 102002. This is the beginning of the punch operation. Turn on punch (if HP 2752A) and push RUN.

HLT 3 - A, B and T Registers = 102003. This is the beginning of the tape reader operation Turn off the punch (HP 2752A), load tape into reader, turn on reader, and push RUN. Since the Printer and Punch can be controlled independently on the 2754A/B but not on the 2752A, the printed output between the two teleprinters will be different. Table 5-1 shows the printout of 2752A Teleprinter and Table 5-2 shows the printout of the 2754A B Teleprinter.

Clear Switch Register to terminate the Punch and Read task routine.

c. Put Switch 5 of Switch Register in up position. Program will perform Print and Keyboard Task routine. At Teleprinter request, the operator must input data from the teleprinter. This same data is transferred through the computer and printed by the teleprinter. Clear Switch Register to terminate Print and Keyboard task routine.

d. Put Switch 0 of Switch Register in up position. Computer will halt.

HLT 0 - T Register = 102000, A, B, M, and P Registers = 100. This is the beginning of the program. Put Teleprinter address in Switch Register and press RUN. (This permits the testing of multiple teleprinters.) Return to paragraph 6b, step 6.

e. With Switch 2 of Switch Register in up position, teleprinter printout is suppressed.

Table 5-1. HP 2752A PRINTOUT

```
BEGIN BASIC TEST

END BASIC TEST

BEGIN PUNCH AND READ

 !"#$%&'()*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←@ABCDEFGHIJKLMNOPQRSTUVWXYZ[   } Printed While Punching Tape
 !"#$%&'()*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←@ABCDEFGHIJKLMNOPQRSTUVWXYZ[
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←@ABCDEFGHIJKLMNOPQRSTUVWXYZ[   } Printed While Reading Tape
 !"#$%&'()*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←@ABCDEFGHIJKLMNOPQRSTUVWXYZ[

END PUNCH AND READ

BEGIN PRINT AND KEYBOARD

@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←
 !"#$%&'()*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←
 !"#$%&'()*+,-./0123456789:;<=>?

USE KEYBOARD SLOWLY (5 CHS./SEC.)

1234567890:-!"#$%&'()*=   } Operator Using Keyboard
QWERTYUIOP←@
ASDFGHJKL;[\+
ZXCVBNM,./↑]<>?

END PRINT AND KEYBOARD
```

Table 5-2. HP 2754A/B PRINTOUT

```
BEGIN BASIC TEST

END BASIC TEST

BEGIN PUNCH AND READ


 !"#$%&'()*+,-./0123456789:;<=>?                                    } Printed While
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←@ABCDEFGHIJKLMNOPQRSTUVWXYZ[       } Punching Tape
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←@ABCDEFGHIJKLMNOPQRSTUVWXYZ[       } Printed While
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←@ABCDEFGHIJKLMNOPQRSTUVWXYZ[       } Reading Tape

END PUNCH AND READ

BEGIN PRINT AND KEYBOARD

@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←
 !"#$%&'()*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]↑←
 !"#$%&'()*+,-./0123456789:;<=>?

USE KEYBOARD SLOWLY (5 CHS./SEC.)

1234567890:-!"#$%&'()*=   }
QWERTYUIOP←@              }  Operator
ASDFGHJKL;[\+             }  Using
ZXCVBNM,./↑]<>?           }  Keyboard

END PRINT AND KEYBOARD
```

2115A BUFFERED

TELETYPE TEST

Binary Tape - HP20420A

Source Listing- HP20420AL

```
PAGE 0001

0001                    ASMB,A,B,L
** NO ERRORS*
```

```
0001                    ASMB,A,B,L
0002*
0003*
0004*
0005*BUFFERED TELETYPE DIAGNOSTIC
0006*
0007*
0008*
0009*STARTING OCTAL ADDRESS  =  100
0010****
0011*THE FOLLOWING SWITCH REGISTER SETTINGS
0012*ARE USED FOR PROGRAM CONTROL
0013*
0014*BIT  0 = 1  ->  HALT AT BEGINNING OF PROGRAM
0015*BIT  1 = 1  ->  HALT AT ERROR BUFFER
0016*BIT  2 = 1  ->  SUPPRESS MESSAGE PRINTOUT
0017*BIT  3 = 1  ->  PERFORM BASIC TEST ROUTINE
0018*BIT  4 = 1  ->  PERFORM PUNCH AND READ ROUTINE
0019*BIT  5 = 1  ->  PERFORM PRINT AND KEYBOARD ROUTINE
0020****
0021*
0022*
0023*MAIN PROGRAM
0024*
0025  00077                 ORG 77B
0026  00077 102000  END     HLT 0
0027  00100 107700          CLC 0,C       INITIALIZE, INTERRUPT OFF
0028  00101 102501          LIA 1         PUT TTY
0029  00102 010141          AND MSK0        ADDRESS
0030  00103 070277          STA BTA           INTO ALL I/O
0031  00104 014203          JSB INIT            INSTRUCTIONS
0032  00105 064142          LDB M67       PREPARE
0033  00106 060143          LDA HIS         TRAP
0034  00107 070111          STA *+2           FOR
0035  00110 060144          LDA HI              ILLEGAL
0036  00111 070010          STA 10B               INTERRUPT
0037  00112 034111          ISZ *-1                 FROM
0038  00113 002004          INA                       ANOTHER
0039  00114 006006          INB,SZB                     DEVICE
0040  00115 024111          JMP *-4
0041  00116 060401          LDA IIJ       PREPARE ILLEGAL TTY
0042  00117 070000  STA1    STA 0           INTERRUPT TRAP
0043  00120 014720          JSB EOL       LINE FEED
0044  00121 060123          LDA *+2       HALT TO CHOOSE
0045  00122 064123          LDB *+1         SWITCH REGISTER
0046  00123 102001          HLT 1             OPTIONS
0047  00124 014145  MP1     JSB MODE      CHECK SW. REG.
0048  00125 060177          LDA BIT3      PERFORM
0049  00126 000010          SLA             BASIC TEST?
0050  00127 014300          JSB BT        YES.
0051  00130 014145          JSB MODE      NO.  CHECK SW. REG.
0052  00131 060200          LDA BIT4      PERFORM
0053  00132 000010          SLA             PUNCH AND READ?
0054  00133 015024          JSB PAR       YES.
0055  00134 014145          JSB MODE      NO.  CHECK SW. REG.
0056  00135 060201          LDA BIT5      PERFORM
0057  00136 000010          SLA             PRINT AND KEYBOARD?
```

```
0058   00137 015310          JSB PAK       YES.
0059   00140 024124          JMP MP1       NO.
0060   00141 000077   MSK0   OCT 77
0061   00142 177711   M67    OCT 177711
0062   00143 070010   HIS    STA 10B
0063   00144 102010   HI     HLT 10B
0064*
0065*SWITCH REGISTER MONITORED
0066*FOR CURRENT OPERATING MODE
0067*
0068   00145 000000   MODE   NOP           ENTER SUBROUTINE
0069   00146 070173          STA AS0       STORE A
0070   00147 102501          LIA 1         EACH BIT
0071   00150 070174          STA BIT0       FROM THE
0072   00151 001300          RAR              SWITCH REGISTER
0073   00152 070175          STA BIT1          IS ROTATED
0074   00153 001300          RAR                INTO THE
0075   00154 070176          STA BIT2            LEAST SIGNIFICANT
0076   00155 001300          RAR                   POSITION AND
0077   00156 070177          STA BIT3                STORED IN THE
0078   00157 001300          RAR                       STORAGE LOCATION
0079   00160 070200          STA BIT4                    BEARING ITS NAME
0080   00161 001300          RAR
0081   00162 070201          STA BIT5
0082   00163 060174          LDA BIT0      HALT AT BEGINNING
0083   00164 002011          SLA,RSS         OF PROGRAM?
0084   00165 024171          JMP *+4       NO.
0085   00166 060202          LDA HAD       YES.  LOAD A AND B
0086   00167 064202          LDB HAD         WITH 100
0087   00170 024077          JMP END           AND HALT
0088   00171 060173          LDA AS0       RESTORE A
0089   00172 124145          JMP MODE,I    EXIT SUBROUTINE
0090   00173 000000   AS0    OCT 0         TEMPORARY STORAGE
0091   00174 000000   BIT0   OCT 0
0092   00175 000000   BIT1   OCT 0
0093   00176 000000   BIT2   OCT 0
0094   00177 000000   BIT3   OCT 0
0095   00200 000000   BIT4   OCT 0
0096   00201 000000   BIT5   OCT 0
0097   00202 000100   HAD    OCT 100
0098*
0099*
0100*INITIALIZATION ROUTINE
0101*
0102*THIS ROUTINE ADDS THE BUFFERED TELETYPE ADDRESS TO
0103*ALL I/O INSTRUCTIONS.
0104*
0105*
0106   00203 000000   INIT   NOP           ENTER ROUTINE
0107   00204 107700          CLC 0,C       INITIALIZE, INTERRUPT OFF
0108   00205 014270          JSB ADIN      PUT TTY ADDRESS
0109   00206 102300          SFS 0           INTO SFS INSTRUCTIONS
0110   00207 070332          STA SFS1
0111   00210 070341          STA SFS2
0112   00211 070351          STA SFS3
0113   00212 070373          STA SFS4
0114   00213 070462          STA SFS5
```

```
0115   00214 014270          JSB ADIN      PUT TTY ADDRESS
0116   00215 102200          SFC 0           INTO SFC INSTRUCTIONS
0117   00216 070326          STA SFC1
0118   00217 070336          STA SFC2
0119   00220 070346          STA SFC3
0120   00221 070367          STA SFC4
0121   00222 014270          JSB ADIN      PUT TTY ADDRESS
0122   00223 102600          OTA 0           INTO OTA INSTRUCTIONS
0123   00224 070407          STA OTA1
0124   00225 070442          STA OTA2
0125   00226 070661          STA OTA3
0126   00227 070664          STA OTA4
0127   00230 071325          STA OTA5
0128   00231 014270          JSB ADIN      PUT TTY ADDRESS
0129   00232 103700          STC 0,C         INTO STC,C  INSTRUCTIONS
0130   00233 070411          STA STCC1
0131   00234 070665          STA STCC2
0132   00235 071327          STA STCC3
0133   00236 014270          JSB ADIN      PUT TTY ADDRESS
0134   00237 106700          CLC 0           INTO CLC INSTRUCTION
0135   00240 070412          STA CLC1
0136   00241 014270          JSB ADIN      PUT TTY ADDRESS
0137   00242 102700          STC 0           INTO STC INSTRUCTION
0138   00243 070345          STA STC1
0139   00244 014270          JSB ADIN      PUT TTY ADDRESS
0140   00245 103100          CLF 0           INTO CLF INSTRUCTION
0141   00246 070335          STA CLF1
0142   00247 014270          JSB ADIN      PUT TTY ADDRESS
0143   00250 102100          STF 0           INTO STF INSTRUCTION
0144   00251 070360          STA STF1
0145   00252 014270          JSB ADIN      PUT TTY ADDRESS
0146   00253 106500          LIB 0           INTO LIB INSTRUCTIONS
0147   00254 070443          STA LIB1
0148   00255 071070          STA LIB2
0149   00256 071257          STA LIB3
0150   00257 071272          STA LIB4
0151   00260 071300          STA LIB5
0152   00261 071334          STA LIB6
0153   00262 014270          JSB ADIN      PUT TTY ADDRESS
0154   00263 070000          STA 0           INTO STA INSTRUCTIONS
0155   00264 070117          STA STA1
0156   00265 070356          STA STA2
0157   00266 070366          STA STA3
0158   00267 124203          JMP INIT,I    EXIT ROUTINE
0159*
0160*ADDRESS INCLUSION SUBROUTINE.
0161*THE BUFFERED TTY ADDRESS IS PUT INTO
0162*THE INSTRUCTION FOLLOWING JSB ADIN.
0163*
0164   00270 000000  ADIN  NOP           ENTER SUBROUTINE
0165   00271 160270        LDA ADIN,I    BRING I/O INSTRUCTION INTO A
0166   00272 010276        AND MSK1      ADD TTY ADDRESS
0167   00273 030277        IOR BTA         TO INSTRUCTION
0168   00274 034270        ISZ ADIN      EXIT
0169   00275 124270        JMP ADIN,I      SUBROUTINE
0170   00276 177700  MSK1  OCT 177700
0171   00277 000000  BTA   OCT 0         TTY ADDRESS STORAGE
```

```
0172*
0173*
0174*
0175*BASIC TEST ROUTINE
0176*
0177*THE FOLLOWING TESTS THE FLAG, CONTROL,
0178*AND INTERRUPT CIRCUITRY
0179*
0180   00300 000000  BT     NOP
0181   00301 107700         CLC 0,C          INITIALIZE, INTERRUPT OFF
0182   00302 060576         LDA SOYN         RESTORE
0183   00303 070675         STA OYN            OUTPUT CODE
0184   00304 060621         LDA S11          PRINT FIRST
0185   00305 014733         JSR SMPOC          BT MESSAGE
0186   00306 006400         CLR              CLEAR
0187   00307 074570         STB E1             ERROR
0188   00310 074571         STB E2               BUFFER
0189   00311 074572         STB E3
0190   00312 074573         STB E4
0191   00313 074574         STB E5
0192   00314 074575         STB E6
0193   00315 074576         STB E7
0194   00316 074577         STB E10
0195   00317 074600         STB E11
0196   00320 074601         STB E12
0197   00321 074602         STB E13
0198   00322 074603         STB E14
0199   00323 074604         STB E15
0200   00324 074605         STB IA
0201   00325 006004         INR              INCREMENT ERROR CODE
0202   00326 102200  SFC1   SFC 0            FLAG CLEAR?
0203   00327 024331         JMP *+2            NO.
0204   00330 074570         STB E1             YES.  ERROR 1
0205   00331 006004         INR                INCREMENT ERROR CODE
0206   00332 102300  SFS1   SFS 0            FLAG SET?
0207   00333 074571         STB E2             NO.  ERROR 2
0208   00334 006004         INR                YES.
0209   00335 103100  CLF1   CLF 0            CLEAR FLAG
0210   00336 102200  SFC2   SFC 0            FLAG CLEAR?
0211   00337 074572         STB E3             NO.  ERROR 3
0212   00340 006004         INR                YES.
0213   00341 102300  SFS2   SFS 0            FLAG SET?
0214   00342 024344         JMP *+2            NO.
0215   00343 074573         STB E4             YES.  ERROR 4
0216   00344 006004         INR
0217   00345 102700  STC1   STC 0            SET CONTROL
0218   00346 102200  SFC3   SFC 0            FLAG CLEAR?
0219   00347 074574         STB E5             NO.  ERROR 5
0220   00350 006004         INR                YES.
0221   00351 102300  SFS3   SFS 0            FLAG SET?
0222   00352 024354         JMP *+2            NO.
0223   00353 074575         STB E6             YES.  ERROR 6
0224   00354 006004         INR
0225   00355 060400         LDA IJ1          PREPARE TO TEST
0226   00356 070000  STA2   STA 0              INTERRUPT SYSTEM
0227   00357 102100         STF 0            TURN ON INTERRUPT SYSTEM
0228   00360 102100  STF1   STF 0            SET FLAG
```

```
0229  00361 000000          NOP             WAIT FOR
0230  00362 000000          NOP               INTERRUPT
0231  00363 074576          STB E7          NO INTERRUPT - ERROR 7
0232  00364 006004  P1      INB             INTERRUPT ENTRY
0233  00365 064431          LDA IIJ         RENEW ILLEGAL
0234  00366 070000  STA3    STA 0             INTERRUPT TRAP
0235  00367 102200  SFC4    SFC 0           FLAG CLEAR?
0236  00370 024372          JMP *+2           NO.
0237  00371 074577          STB E10           YES.  ERROR 10
0238  00372 006004          INB
0239  00373 102300  SFS4    SFS 0           FLAG SET?
0240  00374 074600          STB E11           NO.  ERROR 11
0241  00375 006004          INB               YES.
0242  00376 074402          STB ERNO        STORE ERROR CODE
0243  00377 024403          JMP TOUT
0244  00400 024364  IJ1     JMP P1
0245  00401 014503  IIJ     JSB ILINT
0246  00402 000000  ERNO    OCT 0           ERROR CODE STORAGE
0247*
0248*THE FOLLOWING TESTS THE TIME FOR OUTPUTING ONE CHARACTER.
0249*
0250  00403 000000  TOUT    NOP
0251  00404 107700          CLC 0,C         INITIALIZE, INTERRUPT OFF
0252  00405 102100          STF 0           INTERRUPT ON
0253  00406 064432          LDA ONN         PUT INTO OUTPUT, NO
0254  00407 102500  OTA1    OTA 0             PRINT, NO PUNCH MODE
0255  00410 064433          LDB TOC1        CHECK
0256  00411 103700  STCC1   STC 0,C           LOWER
0257  00412 106700  CLC1    CLC 0               TIME LIMIT
0258  00413 014461          JSB TOS         FLAG SET?
0259  00414 024416          JMP *+2         YES.  DATA CLOCK TOO FAST
0260  00415 024420          JMP *+3         NO.
0261  00416 064402          LDB ERNO        ERROR 12
0262  00417 074401          STB E12
0263  00420 034402          ISZ ERNO        INCREMENT ERROR CODE
0264  00421 000000          NOP             CHECK UPPER
0265  00422 064434          LDB TOC2          TIME LIMIT
0266  00423 014461          JSB TOS         FLAG SET?
0267  00424 024427          JMP *+3         YES.  TIMING OK
0268  00425 064402          LDB ERNO        NO.  DATA CLOCK TOO SLOW
0269  00426 074402          STB E13           ERROR 13
0270  00427 034402          ISZ ERNO        INCREMENT ERROR CODE
0271  00430 000000          NOP
0272  00431 024435          JMP DT
0273  00432 100000  ONN     OCT 100000      OUTPUT,NO PRINT, NO PUNCH
0274  00433 150000  TOC1    OCT 150000      TIMEOUT CONSTANT 1
0275  00434 177040  TOC2    OCT 177040      TIMEOUT CONSTANT 2
0276*
0277*THE FOLLOWING TESTS THE EIGHT BIT DATA BUFFER.
0278*
0279  00435 000000  DT      NOP
0280  00436 107700          CLC 0,C         INITIALIZE, INTERRUPT OFF
0281  00437 002400          CLA
0282  00440 070457  P2      STA CURWD       OUTPUT THE
0283  00441 010455          AND MSK2          CURRENT
0284  00442 102600  OTA2    OTA 0               WORD
0285  00443 106500  LIB1    LIB 0
```

```
0286   00444 050001          CPA 1          INPUT = OUTPUT ?
0287   00445 024450          JMP P3         YES.
0288   00446 060402          LDA ERNO       NO.  ERROR 14
0289   00447 070503          STA E14
0290   00450 060457  P3      LDA CURWD      INCREMENT
0291   00451 002006          INA,SZA          CURRENT WORD
0292   00452 024440          JMP P2
0293   00453 014472          JSB EBH        HALT AT ERROR BUFFER?
0294   00454 024515          JMP POUT       NO.
0295   00455 000377  MSK2    OCT 377
0296   00456 000200  MSK3    OCT 200
0297   00457 000000  CURWD   OCT 0
0298   00460 000000  NBE     OCT 0
0299*
0300*FLAG TIMEOUT SUBROUTINE
0301*
0302*TIMEOUT CONSTANT IN B
0303*IF "FLAG" BEFORE TIMEOUT, EXIT TO TOS.  IF NOT,
0304*EXIT TO TOS + 1.  ONE ITERATION = 6.4 MICROSEC.
0305*
0306   00461 000000  TOS     NOP            ENTER SUBROUTINE
0307   00462 102300  SFS5    SFS 0          FLAG SET?
0308   00463 024465          JMP *+2
0309   00464 124461          JMP TOS,I      YES.  EXIT THROUGH TOS
0310   00465 006006          INB,SZB        NO.  TIMEOUT YET?
0311   00466 024462          JMP SFS5       NO.  REPEAT
0312   00467 034461          ISZ TOS        YES.  EXIT
0313   00470 000000          NOP              THROUGH
0314   00471 124461          JMP TOS,I          TOS + 1
0315*
0316*ERROR BUFFER HALT SUBROUTINE
0317*
0318   00472 000000  EBH     NOP            ENTER SUBROUTINE
0319   00473 070502          STA AS1        STORE A
0320   00474 014145          JSB MODE       CHECK SW. REG.
0321   00475 060175          LDA BIT1       HALT AT
0322   00476 000010          SLA              ERROR BUFFER?
0323   00477 014564          JSB POF        YES.
0324   00500 060502          LDA AS1        NO.  RESTORE A
0325   00501 124472          JMP EBH,I      EXIT SUBROUTINE
0326   00502 000000  AS1     OCT 0          TEMPORARY STORAGE
0327*
0328*ILLEGAL INTERRUPT SUBROUTINE
0329*
0330*FOR AN ILLEGAL TTY INTERRUPT, THE PROGRAM ADDRESS IS SAVED.
0331*
0332   00503 000000  ILINT   NOP            ENTER SUBROUTINE
0333   00504 070513          STA AS2        STORE A
0334   00505 060503          LDA *-2        STORE PROGRAM ADDRESS
0335   00506 070605          STA IA
0336   00507 060514          LDA IE         STORE
0337   00510 070604          STA E15          ERROR 15
0338   00511 060513          LDA AS2        RESTORE A
0339   00512 124503          JMP ILINT,I    EXIT SUBROUTINE
0340   00513 000000  AS2     OCT 0          TEMPORARY STORAGE
0341   00514 000015  IE      OCT 15
0342*
```

```
0343*THE FOLLOWING PRINTS OUT THE RESULTS OF THE BASIC TEST.
0344*IN CASE OF FAILURE TO PRINT OUT, THE PROGRAM
0345*HALTS AT THE BEGINNING OF THE ERROR BUFFER.
0346*PRESSING "DISPLAY MEMORY" WILL SHOW WHICH ERRORS OCCURED.
0347*
0348   00515 000000  POUT   NOP
0349   00516 107700         CLC 0,C        INITIALIZE, INTERRUPT OFF
0350   00517 006400         CLB
0351   00520 014461         JSB TOS        FLAG SET?
0352   00521 024523         JMP *+2        YES.
0353   00522 014564         JSB POF        NO.  HALT AT ERROR BUFFER
0354   00523 060633         LDA SC2        PREPARE TO
0355   00524 070634         STA M14          PRINT OUT
0356   00525 060635         LDA SI3            ERROR CODES
0357   00526 070527         STA P4
0358   00527 064570  P4     LDB E1         LOAD B WITH
0359   00530 034527         ISZ *-1          ERROR STORAGE
0360   00531 006002         SZB            ZERO?
0361   00532 024536         JMP *+4        NO.
0362   00533 034634         ISZ M14        YES.  PARTIALLY DONE?
0363   00534 024527         JMP P4         NO.
0364   00535 024544         JMP P5         YES.  CHECK INTERRUPT ERRORS
0365   00536 060636         LDA E          PRINT
0366   00537 014654         JSB OYNA         OUT
0367   00540 014701         JSB POUT2          ERROR
0368   00541 014720         JSB EOL              CODE
0369   00542 014472         JSB EBH        HALT AT ERROR BUFFER?
0370   00543 024533         JMP *-10B      NO.
0371   00544 064604  P5     LDB E15        E15 = 0?
0372   00545 006003         SZB,RSS
0373   00546 024560         JMP P6         YES.
0374   00547 060636         LDA E          NO.
0375   00550 014654         JSB OYNA       PRINT OUT
0376   00551 014701         JSB POUT2        ERROR CODE
0377   00552 060653         LDA SI4            AND
0378   00553 014751         JSB MPO              PROGRAM ADDRESS
0379   00554 060605         LDA IA                 WHEN ERROR
0380   00555 014774         JSB OPA                  OCCURRED
0381   00556 014720         JSB EOL        LINE FEED
0382   00557 014720         JSB EOL        LINE FEED
0383   00560 060632  P6     LDA SI2        PRINT SECOND
0384   00561 014733         JSB SMPOC        BT MESSAGE
0385   00562 014472         JSB EBH        HALT AT ERROR BUFFER?
0386   00563 124300         JMP BT,I       NO.  EXIT ROUTINE
0387   00564 000000  POF    NOP
0388   00565 060564         LDA *-1        PUT PROGRAM ADDRSSS
0389   00566 064564         LDB *-2          FOR PRINT FAILURE
0390   00567 102055         HLT 55B            INTO A AND B
0391*
0392*ERROR BUFFER
0393*
0394   00570 000000  E1     OCT 0          SFC  TRUE AFTER   CLC 0,C
0395   00571 000000  E2     OCT 0          SFS FALSE AFTER   CLC 0,C
0396   00572 000000  E3     OCT 0          SFC FALSE AFTER   CLF TTY
0397   00573 000000  E4     OCT 0          SFS  TRUE AFTER   CLF TTY
0398   00574 000000  E5     OCT 0          SFC FALSE AFTER   CLF TTY AND STC
0399   00575 000000  E6     OCT 0          SFS  TRUE AFTER   CLF TTY AND STC
```

```
0400   00576 000000  E7     OCT 0          NO INTERRUPT AFTER  STC TTY,STF 0
0401   00577 000000  E10    OCT 0          SFC  TRUE AFTER INTERRUPT
0402   00600 000000  E11    OCT 0          SFS FALSE AFTER INTERRUPT
0403   00601 000000  E12    OCT 0          DATA CLOCK ON TTY BOARD TOO FAST
0404   00602 000000  E13    OCT 0          DATA CLOCK ON TTY BOARD TOO SLOW
0405   00603 000000  E14    OCT 0          DATA BUFFER ERROR
0406   00604 000000  E15    OCT 0          ILLEGAL INTERRUPT FROM TELETYPE
0407   00605 000000  IA     OCT 0          PROGRAM ADDRESS AT TIME OF E15
0408   00606 177777         OCT 177777     ERROR BUFFER TERMINAITON
0409   00607 024124         JMP MP1        RETURN TO MAIN PROGRAM
0410*
0411   00610 041105  BTM1   ASC 8,BEGIN BASIC TEST
       00611 043511
       00612 047040
       00613 041101
       00614 051511
       00615 041440
       00616 052105
       00617 051524
0412   00620 000000         OCT 0
0413   00621 060510  SI1    LDA BTM1
0414   00622 042516  BTM2   ASC 7,END BASIC TEST
       00623 042040
       00624 041101
       00625 051511
       00626 041440
       00627 052105
       00630 051524
0415   00631 000000         OCT 0
0416   00632 060522  SI2    LDA BTM2
0417   00633 177764  SC2    OCT 177764
0418   00634 000000  M14    OCT 0
0419   00635 064570  SI3    LDB E1
0420   00636 000305  E      OCT 305
0421   00637 020040  PRAD   ASC 11,    PROGRAM ADDRESS =
       00640 020120
       00641 051117
       00642 043522
       00643 040515
       00644 020101
       00645 042104
       00646 051105
       00647 051523
       00650 020075
       00651 020040
0422   00652 000000         OCT 0
0423   00653 060637  SI4    LDA PRAD
0424*
0425*PRINT LEAST SIGNIFICANT 8 BITS OF A.
0426*
0427   00654 000400  OYNA   NOP            ENTER SUBROUTINE
0428   00655 107700         CLC 0,C        INITIALIZE, INTERRUPT OFF
0429   00656 070677         STA AS3        STORE A
0430   00657 074700         STB BS1        STORE B
0431   00660 060675         LDA OYN        PUT BUFFER INTO OUTPUT
0432   00661 102600  OTA3   OTA 0             AND PRINT MODE
0433   00662 060677         LDA AS3        RESTORE A
```

```
0434   00663 010455          AND MSK2       OUTPUT LEAST
0435   00664 102600   OTA4   OTA 0            SIGNIFICANT 8
0436   00665 103700   STCC2  STC 0,C            BITS OF A
0437   00666 006400          CLB
0438   00667 014461          JSB TOS        FLAG SET?
0439   00670 024672          JMP *+2
0440   00671 014564          JSB POF        NO.  HALT AT ERROR BUFFER
0441   00672 060677          LDA AS3        YES.  RESTORE A
0442   00673 064700          LDB BS1        RESTORE B
0443   00674 124654          JMP OYNA,I     EXIT SUBROUTINE
0444   00675 120000   OYN    OCT 120000     OUTPUT,PRINT,NO PUNCH
0445   00676 120000   SOYN   OCT 120000
0446   00677 000000   AS3    OCT 0          TEMPORARY STORAGE
0447   00700 000000   BS1    OCT 0          TEMPORARY STORAGE
0448*
0449*PRINT OUT TWO OCTAL NUMBERS
0450*
0451   00701 000000   POUT2  NOP            ENTER SUBROUTINE
0452   00702 060001          LDA 1          OUTPUT
0453   00703 001100          ARS              FIRST
0454   00704 001100          ARS                NUMBER
0455   00705 001100          ARS
0456   00706 010717          AND MSK5
0457   00707 030716          IOR MSK4
0458   00710 014654          JSB OYNA
0459   00711 060001          LDA 1          OUTPUT
0460   00712 010717          AND MSK5         SECOND
0461   00713 030716          IOR MSK4           NUMBER
0462   00714 014654          JSB OYNA
0463   00715 124701          JMP POUT2,I    EXIT SUBROUTINE
0464   00716 000260   MSK4   OCT 260
0465   00717 000007   MSK5   OCT 7
0466*
0467*END OF LINE SUBROUTINE
0468*
0469   00720 000000   EOL    NOP            ENTER SUBROUTINE
0470   00721 070730          STA AS4        STORE A
0471   00722 060731          LDA CR         CARRIAGE
0472   00723 014654          JSB OYNA         RETURN
0473   00724 060732          LDA LF         LINE
0474   00725 014654          JSB OYNA           FEED
0475   00726 060730          LDA AS4        RESTORE A
0476   00727 124720          JMP EOL,I      EXIT SUBROUIINE
0477   00730 000000   AS4    OCT 0          TEMPORARY STORAGE
0478   00731 000215   CR     OCT 215
0479   00732 000212   LF     OCT 212
0480*
0481*SUPPRESS MESSAGE PRINTOUT CHECK SUBROUTINE
0482*
0483   00733 000000   SMPOC  NOP            ENTER SUBROUTINE
0484   00734 070750          STA AS5        STORE A
0485   00735 014145          JSB MODE       CHECK SW. REG.
0486   00736 060176          LDA BIT2       SUPPRESS EXCESS
0487   00737 002011          SLA,RSS          PRINTING?
0488   00740 024743          JMP *+3        NO.
0489   00741 060750          LDA AS5        YES.  RESTORE A
0490   00742 124733          JMP SMPOC,I    EXIT SUBROUTINE
```

```
0491   00743 050750          LDA AS5       RESTORE A
0492   00744 014751          JSB MPO       PRINT MESSAGE
0493   00745 014720          JSB EOL       LINE FEED
0494   00746 014720          JSB EOL       LINE FEED
0495   00747 124733          JMP SMPOC,I   EXIT SUBROUTINE
0496   00750 000000   AS5    OCT 0         TEMPORARY STORAGE
0497*
0498*MESSAGE PRINTOUT SUBROUTINE
0499*
0500   00751 000000   MPO    NOP           ENTER SUBROUTINE
0501   00752 070753          STA **+1
0502   00753 060000          LDA 0         LOAD A WORD
0503   00754 034753          ISZ *-1
0504   00755 002003          SZA,RSS       WORD = 0?
0505   00756 124751          JMP MPO,I     YES.  EXIT SUBROUTINE
0506   00757 014761          JSB PACO      NO.  PRINT THE WORD
0507   00760 024753          JMP *-5       REPEAT FOR NEXT WORD
0508*
0509*PACKED ASCII CHARACTER OUTPUT SUBROUTINE
0510*MOST SIGNIFICANT 8 BITS OF A REGISTER PRINTED FIRST.
0511*
0512   00761 000000   PACO   NOP           ENTER SUBROUTINE
0513   00762 070773          STA AS6       STORE A
0514   00763 001700          ALF           PRINT
0515   00764 001700          ALF             FIRST
0516   00765 010455          AND MSK2          CHARACTER
0517   00766 014654          JSB OYNA
0518   00767 060773          LDA AS6       PRINT
0519   00770 010455          AND MSK2        SECOND
0520   00771 014654          JSB OYNA          CHARACTER
0521   00772 124761          JMP PACO,I    EXIT SUBROUTINE
0522   00773 000000   AS6    OCT 0         TEMPORARY STORAGE
0523*
0524*OCTAL PRINTOUT OF A
0525*
0526   00774 000000   OPA    NOP           ENTER SUBROUTINE
0527   00775 001200          RAL
0528   00776 071010          STA AS7       STORE A
0529   00777 011011          AND MSK6      PRINT
0530   01000 030716          IOR MSK4        FIRST
0531   01001 014654          JSB OYNA          NUMBER
0532   01002 015012          JSB NXT       PRINT
0533   01003 015012          JSB NXT         NEXT
0534   01004 015012          JSB NXT           FIVE
0535   01005 015012          JSB NXT             NUMBERS
0536   01006 015012          JSB NXT
0537   01007 124774          JMP OPA,I     EXIT SUBROUTINE
0538   01010 000000   AS7    OCT 0         TEMPORARY STORAGE
0539   01011 000001   MSK6   OCT 1
0540*
0541*NEXT OCTAL CHARACTER OUTPUT
0542*
0543   01012 000000   NXT    NOP           ENTER SUBROUTINE
0544   01013 061010          LDA AS7       PREPARE
0545   01014 001200          RAL             THE
0546   01015 001200          RAL               NEXT
0547   01016 001200          RAL                 NUMBER
```

```
0548  01017 071010          STA AS7                FOR
0549  01020 010717          AND MSK5                 OUTPUTING
0550  01021 030716          IOR MSK4
0551  01022 014654          JSB OYNA       OUTPUT
0552  01023 125012          JMP NXT,I      EXIT SUBROUTINE
0553*
0554*
0555*
0556*PUNCH AND READ ROUTINE
0557*
0558*TESTS TAPE PUNCH AND TAPE READER
0559*BY OUTPUTING ALL COMBINATIONS OF
0560*EIGHT BITS AND READING THEM BACK.
0561*
0562  01024 000000  PAR    NOP            ENTER ROUTINE
0563  01025 107700         CLC 0,C        INITIALIZE, INTERRUPT OFF
0564  01026 006400         CLB
0565  01027 014461         JSB TOS        FLAG SET?
0566  01030 025032         JMP *+2        YES.
0567  01031 014564         JSB POF        NO.  HALT AT ERROR BUFFER
0568  01032 061216         LDA SI7        PRINT FIRST
0569  01033 014733         JSB SMPOC        PAR MESSAGE
0570  01034 061036         LDA *+2        HALT TO
0571  01035 065036         LDB *+1          TURN ON
0572  01036 102002         HLT 2              PUNCH
0573  01037 061111         LDA ONY        PREPARE TO
0574  01040 070675         STA OYN          PUNCH TAPE
0575  01041 015232         JSB ZEROS      PUNCH LEADER
0576  01042 003400         CCA            OUTPUT ALL ONES
0577  01043 010455         AND MSK2         AS A BEGINNING
0578  01044 014654         JSB OYNA           INDICATOR
0579  01045 002400         CLA            PUNCH
0580  01046 015242         JSB .64CH        ALL
0581  01047 015242         JSB .64CH          COMBINATIONS
0582  01050 061112         LDA OYY              OF EIGHT
0583  01051 070675         STA OYN                BITS
0584  01052 060730         LDA AS4
0585  01053 015242         JSB .64CH
0586  01054 015242         JSB .64CH
0587  01055 015232         JSB ZEROS      PUNCH
0588  01056 015232         JSB ZEROS        TRAILER
0589  01057 015232         JSB ZEROS
0590  01060 015117         JSB PARE       EXIT ROUTINE?
0591  01061 061063         LDA *+2        NO.  HALT TO
0592  01062 065063         LDB *+1          LOAD TAPE
0593  01063 102003         HLT 3              INTO READER
0594  01064 061116         LDA INN        PREPARE TO
0595  01065 070675         STA OYN          READ
0596  01066 002400         CLA                TAPE
0597  01067 014654         JSB OYNA       READ A
0598  01070 106500  LIB2   LIB 0            CHARACTER
0599  01071 006003         SZB,RSS        CHARACTER = 0?
0600  01072 025067         JMP *-3        YES.  READ NEXT CHARACTER
0601  01073 015253         JSB R64CH      NO.  READ FIRST BLOCK
0602  01074 061113         LDA IYN
0603  01075 070675         STA OYN
0604  01076 061307         LDA AS11
```

```
0605  01077 015253          JSB R64CH     READ SECOND BLOCK
0606  01100 061114          LDA INY
0607  01101 070675          STA OYN
0608  01102 061307          LDA AS11
0609  01103 015253          JSB R64CH     READ THIRD BLOCK
0610  01104 061115          LDA IYY
0611  01105 070675          STA OYN
0612  01106 061307          LDA AS11
0613  01107 015253          JSB R64CH     READ FOURTH BLOCK
0614  01110 025127          JMP P7        EXIT ROUTINE
0615  01111 110000  ONY     OCT 110000    OUTPUT,NO PRINT,PUNCH
0616  01112 130000  OYY     OCT 130000    OUTPUT,PRINT,PUNCH
0617  01113 160000  IYN     OCT 160000    INPUT,PRINT,NO PUNCH
0618  01114 150000  INY     OCT 150000    INPUT,NO PRINT,PUNCH
0619  01115 170000  IYY     OCT 170000    INPUT,PRINT,PUNCH
0620  01116 140000  INN     OCT 140000    INPUT, NO PRINT, NO PUNCH
0621*
0622*PUNCH AND READ EXIT SUBROUTINE
0623*
0624  01117 000000  PARE    NOP           ENTER SUBROUTINE
0625  01120 071135          STA AS8       STORE A
0626  01121 014145          JSB MODE      CHECK SW. REG.
0627  01122 060200          LDA BIT4      EXIT THIS
0628  01123 002011          SLA,RSS         ROUTINE?
0629  01124 025127          JMP *+3       YES.
0630  01125 061135          LDA AS8       NO.  RESTORE A
0631  01126 125117          JMP PARE,I    EXIT SUBROUTINE
0632  01127 060676  P7      LDA SOYN      RESTORE
0633  01130 070675          STA OYN         OUTPUT CODE
0634  01131 014720          JSB EOL       LINE FEED
0635  01132 061231          LDA S18       PRINT SECOND
0636  01133 014733          JSB SMPOC       PAR MESSAGE
0637  01134 125024          JMP PAR,I     EXIT ROUTINE
0638  01135 000000  AS8     OCT 0         TEMPORARY STORAGE
0639*
0640*PRINT OUT ERRORS ROUTINE
0641*
0642  01136 000000  POE     NOP           ENTER SUBROUTINE
0643  01137 071162          STA AS9       STORE A
0644  01140 060675          LDA OYN       SAVE
0645  01141 071163          STA AS10        STATE
0646  01142 060676          LDA SOYN
0647  01143 070675          STA OYN
0648  01144 014720          JSB EOL       LINE FEED
0649  01145 061172          LDA S15       PRINT "OUTPUT ="
0650  01146 014751          JSB MPO
0651  01147 061162          LDA AS9       RESTORE A
0652  01150 014774          JSB OPA       PRINT OCTAL NUMBER
0653  01151 061202          LDA S16       PRINT "INPUT ="
0654  01152 014751          JSB MPO
0655  01153 060001          LDA 1         PRINT OCTAL
0656  01154 014774          JSB OPA         NUMBER
0657  01155 014720          JSB EOL       LINE FEED
0658  01156 061163          LDA AS10      RESTORE
0659  01157 070675          STA OYN         STATE
0660  01160 061162          LDA AS9       RESTORE A
0661  01161 125136          JMP POE,I     EXIT SUBROUTINE
```

```
0662   01162 000000   AS9    OCT 0          TEMPORARY STORAGE
0663   01163 000000   AS10   OCT 0          TEMPORARY STORAGE
0664   01164 047525   00     ASC 5,OUTPUT =
       01165 052120
       01166 052524
       01167 020075
       01170 020040
0665   01171 000000          OCT 0
0666   01172 061164   SI5    LDA 00
0667   01173 020040   0I     ASC 6,     INPUT =
       01174 020040
       01175 044516
       01176 050125
       01177 052040
       01200 036440
0668   01201 000000          OCT 0
0669   01202 061173   SI6    LDA 0I
0670   01203 041105   PARM1  ASC 10,BEGIN PUNCH AND READ
       01204 043511
       01205 047040
       01206 050125
       01207 047103
       01210 044040
       01211 040516
       01212 042040
       01213 051105
       01214 040504
0671   01215 000000          OCT 0
0672   01216 061203   SI7    LDA PARM1
0673   01217 042516   PARM2  ASC 9,END PUNCH AND READ
       01220 042040
       01221 050125
       01222 047103
       01223 044040
       01224 040516
       01225 042040
       01226 051105
       01227 040504
0674   01230 000000          OCT 0
0675   01231 061217   SI8    LDA PARM2
0676*
0677*OUTPUT BLANK TAPE
0678*
0679   01232 000000   ZEROS  NOP            ENTER SUBROUTINE
0680   01233 002400          CLA
0681   01234 065241          LDB SC3
0682   01235 014654          JSB OYNA       OUTPUT ZERO
0683   01236 006006          INB,SZB        32 ZEROS?
0684   01237 025235          JMP *-2        NO.
0685   01240 125232          JMP ZEROS,I    YES.  EXIT SUBROUTINE
0686   01241 177740   SC3    OCT 177740
0687*
0688*INCREMENT AND OUTPUT A REG, 64 TIMES
0689*
0690   01242 000000   .64CH  NOP            ENTER SUBROUTINE
0691   01243 065252          LDB SC4        RESET COUNTER
0692   01244 014654          JSB OYNA       OUTPUT A
```

```
0693   01245 002004          INA             INCREMENT OUTPUT WORD
0694   01246 006006          INB,SZR         64 CHARACTERS?
0695   01247 025244          JMP *-3         NO.
0696   01250 014720          JSB EOL         YES.
0697   01251 125242          JMP .64CH,I     EXIT ROUTINE
0698   01252 177700  SC4     OCT 177700
0699*
0700*READ AND CHECK 64 CHARACTERS
0701*
0702   01253 000000  R64CH   NOP             ENTER SUBROUTINE
0703   01254 065252          LDB SC4         RESET
0704   01255 075306          STB M64           CHARACTER COUNTER
0705   01256 014654  P8      JSB OYNA        READ A
0706   01257 106500  LIB3    LIB 0             CHARACTER
0707   01260 015117          JSB PARE        EXIT ROUTINE?
0708   01261 050001          CPA 1           NO.  ERROR?
0709   01262 025264          JMP *+2         NO.
0710   01263 015136          JSB POE         YES.  PRINT OUT ERROR
0711   01264 002004          INA             INCREMENT REFERENCE
0712   01265 035306          ISZ M64         64 CHARACTERS?
0713   01266 025256          JMP P8          NO.
0714   01267 071307          STA AS11        YES.  STORE A
0715   01270 060731          LDA CR          CHECK FOR
0716   01271 014654          JSB OYNA          CARRIAGE
0717   01272 106500  LIB4    LIB 0               RETURN
0718   01273 050001          CPA 1           ERROR?
0719   01274 025276          JMP *+2         NO.
0720   01275 015136          JSB POE         YES.  PRINT OUT ERROR
0721   01276 060732          LDA LF          CHECK FOR
0722   01277 014654          JSB OYNA          LINE
0723   01300 106500  LIB5    LIB 0               FEED
0724   01301 050001          CPA 1           ERROR?
0725   01302 025304          JMP *+2         NO.
0726   01303 015136          JSB POE         YES.  PRINT OUT ERROR
0727   01304 061307          LDA AS11        RESTORE A
0728   01305 125253          JMP R64CH,I     EXIT SUBROUTINE
0729   01306 177700  M64     OCT 177700
0730   01307 000000  AS11    OCT 0           TEMPORARY STORAGE
0731*
0732*
0733*
0734*PRINT AND KEYBOARD ROUTINE
0735*
0736   01310 000000  PAK     NOP             ENTER ROUTINE
0737   01311 107700          CLC 0,C         INITIALIZE, INTERRUPT OFF
0738   01312 060676          LDA SOYN        PREPARE
0739   01313 070675          STA OYN           TO PRINT
0740   01314 061371          LDA SI9         PRINT FIRST
0741   01315 014733          JSB SMPOC         PAK MESSAGE
0742   01316 015432          JSB PRALL       PRINT 64 ASCII CHARACTERS
0743   01317 015432          JSB PRALL       PRINT 64 ASCII CHARACTERS
0744   01320 014720          JSB EOL         LINE FEED
0745   01321 015340          JSB PAKE        EXIT ROUTINE?
0746   01322 061414          LDA SI10        NO.  PRINT SECOND
0747   01323 014733          JSB SMPOC         PAK MESSAGE
0748   01324 061116  P9      LDA INN         PREPARE TO READ
0749   01325 102600  OTA5    OTA 0             IN FROM KEYBOARD
```

```
0750   01326 015340  P10    JSB PAKE       EXIT ROUTINE?
0751   01327 103700  STCC3  STC 0,C        NO.  WAIT
0752   01330 006400         CLB              FOR INPUT
0753   01331 014461         JSB TOS        ANY INPUT?
0754   01332 025334         JMP *+2        YES.
0755   01333 025326         JMP P10        NO.
0756   01334 106500  LIB6   LIB 0          LOAD DATA INTO B
0757   01335 060001         LDA 1          PUT B INTO A
0758   01336 014654         JSB OYNA       OUTPUT A
0759   01337 025324         JMP P9         READ NEXT CHARACTER
0760*
0761*PRINT AND KEYBOARD EXIT
0762*
0763   01340 000000  PAKE   NOP            ENTER SUBROUTINE
0764   01341 071162         STA AS9        STORE A
0765   01342 014145         JSB MODE       CHECK SW. REG.
0766   01343 060201         LDA BIT5       EXIT THIS
0767   01344 002011         SLA,RSS          ROUTINE?
0768   01345 025350         JMP *+3        YES.
0769   01346 061162         LDA AS9        NO.  RESTORE A
0770   01347 125340         JMP PAKE,I     EXIT SUBROUTINE
0771   01350 014720         JSB EOL
0772   01351 061431         LDA SI11       PRINT THIRD
0773   01352 014733         JSB SMPOC        PAK MESSAGE
0774   01353 125310         JMP PAK,I      EXIT ROUTINE
0775   01354 041105  PAKM1  ASC 12,BEGIN PRINT AND KEYBOARD
       01355 043511
       01356 047040
       01357 050122
       01360 044516
       01361 052040
       01362 040516
       01363 042040
       01364 045505
       01365 054502
       01366 047501
       01367 051104
0776   01370 000000         OCT 0
0777   01371 061354  SI9    LDA PAKM1
0778   01372 052523  PAKM2  ASC 17,USE KEYBOARD SLOWLY (5 CHS./SEC.)
       01373 042440
       01374 045505
       01375 054502
       01376 047501
       01377 051104
       01400 020123
       01401 046117
       01402 053514
       01403 054440
       01404 024065
       01405 020103
       01406 044123
       01407 027057
       01410 051505
       01411 041456
       01412 024440
0779   01413 000000         OCT 0
```

```
0780   01414 061372  SI10  LDA PAKM2
0781   01415 042516  PAKM3 ASC 11,END PRINT AND KEYBOARD
       01416 042040
       01417 050122
       01420 044516
       01421 052040
       01422 040516
       01423 042040
       01424 045505
       01425 054502
       01426 047501
       01427 051104
0782   01430 000000        OCT 0
0783   01431 061415  SI11  LDA PAKM3
0784*
0785*PRINT ALL CHARACTERS SUBROUTINE
0786*
0787   01432 000000  PRALL  NOP           ENTER SUBROUTINE
0788   01433 061440        LDA SC5        PRINT FIRST
0789   01434 015442        JSB .32CH        LINE OF CHARACTERS
0790   01435 061441        LDA SC6        PRINT SECOND
0791   01436 015442        JSB .32CH        LINE OF CHARACTERS
0792   01437 125432        JMP PRALL,I    EXIT SUBROUTINE
0793   01440 000300  SC5   OCT 300
0794   01441 000240  SC6   OCT 240
0795*
0796*PRINT 32 CHARACTERS SUBROUTINE
0797*
0798   01442 000000  .32CH NOP            ENTER SUBROUTINE
0799   01443 075454        STB BS2        STORE B
0800   01444 065241        LDB SC3        RESET COUNTER
0801   01445 014654        JSB OYNA       PRINT A
0802   01446 002004        INA            INCREMENT A
0803   01447 006006        INB,SZB        32 CHARACTERS?
0804   01450 025445        JMP *-3        NO. PRINT NEXT CHARACTER
0805   01451 014720        JSB EOL        YES. LINE FEED
0806   01452 065454        LDB BS2        RESTORE B
0807   01453 125442        JMP .32CH,I    EXIT SUBROUTINE
0808   01454 000000  BS2   OCT 0          TEMPORARY STORAGE
0809                       END
** NO ERRORS*
```

2116A BUFFERED

TELEPRINTER TEST

Binary Tape - HP20417B

Source Listing- HP20417BL

```
PAGE 0001

0001                    ASMB,A,B,L
** NO ERRORS*
```

```
0001                    ASMB,A,B,L
0002*
0003*
0004*
0005*BUFFERED TELETYPE DIAGNOSTIC
0006*
0007*
0008*
0009*STARTING OCTAL ADDRESS  =  100
0010****
0011*THE FOLLOWING SWITCH REGISTER SETTINGS
0012*ARE USED FOR PROGRAM CONTROL
0013*
0014*BIT  0 = 1  ->  HALT AT BEGINNING OF PROGRAM
0015*BIT  1 = 1  ->  HALT AT ERROR BUFFER
0016*BIT  2 = 1  ->  SUPPRESS MESSAGE PRINTOUT
0017*BIT  3 = 1  ->  PERFORM BASIC TEST ROUTINE
0018*BIT  4 = 1  ->  PERFORM PUNCH AND READ ROUTINE
0019*BIT  5 = 1  ->  PERFORM PRINT AND KEYBOARD ROUTINE
0020****
0021*
0022*
0023*MAIN PROGRAM
0024*
0025  00077                 ORG 77B
0026  00077 102000  END     HLT 0
0027  00100 107700          CLC 0,C       INITIALIZE, INTERRUPT OFF
0028  00101 102501          LIA 1         PUT TTY
0029  00102 010141          AND MSK0        ADDRESS
0030  00103 070277          STA RTA           INTO ALL I/O
0031  00104 014203          JSB INIT            INSTRUCTIONS
0032  00105 064142          LDB M67       PREPARE
0033  00106 060143          LDA HIS         TRAP
0034  00107 070111          STA **2           FOR
0035  00110 060144          LDA HI              ILLEGAL
0036  00111 070010          STA 10B               INTERRUPT
0037  00112 034111          ISZ *-1                 FROM
0038  00113 002004          INA                       ANOTHER
0039  00114 006006          INB,SZA                     DEVICE
0040  00115 024111          JMP *-4
0041  00116 060401          LDA IIT       PREPARE ILLEGAL TTY
0042  00117 070000  STA1    STA 0           INTERRUPT TRAP
0043  00120 014720          JSB EOL       LINE FEED
0044  00121 060123          LDA **2       HALT TO CHOOSE
0045  00122 064123          LDB **1         SWITCH REGISTER
0046  00123 102001          HLT 1             OPTIONS
0047  00124 014145  MP1     JSB MODE      CHECK SW. REG.
0048  00125 060177          LDA BIT3      PERFORM
0049  00126 000010          SLA             BASIC TEST?
0050  00127 014300          JSB BT        YES.
0051  00130 014145          JSB MODE      NO.  CHECK SW. REG.
0052  00131 060200          LDA BIT4      PERFORM
0053  00132 000010          SLA             PUNCH AND READ?
0054  00133 015024          JSB PAR       YES.
0055  00134 014145          JSB MODE      NO.  CHECK SW. REG.
0056  00135 060201          LDA BIT5      PERFORM
0057  00136 000010          SLA             PRINT AND KEYBOARD?
```

```
0058   00137 015310          JSB PAK       YES.
0059   00140 024124          JMP MP1       NO.
0060   00141 000077  MSK0    OCT 77
0061   00142 177711  M67     OCT 177711
0062   00143 070010  HIS     STA 10B
0063   00144 102010  HI      HLT 10B
0064*
0065*SWITCH REGISTER MONITORED
0066*FOR CURRENT OPERATING MODE
0067*
0068   00145 000000  MODE    NOP           ENTER SUBROUTINE
0069   00146 070173          STA AS0       STORE A
0070   00147 102501          LIA 1         EACH BIT
0071   00150 070174          STA BIT0       FROM THE
0072   00151 001300          RAR             SWITCH REGISTER
0073   00152 070175          STA BIT1         IS ROTATED
0074   00153 001300          RAR                INTO THE
0075   00154 070176          STA BIT2            LEAST SIGNIFICANT
0076   00155 001300          RAR                  POSITION AND
0077   00156 070177          STA BIT3              STORED IN THE
0078   00157 001300          RAR                    STORAGE LOCATION
0079   00160 070200          STA BIT4                 BEARING ITS NAME
0080   00161 001300          RAR
0081   00162 070201          STA BIT5
0082   00163 060174          LDA BIT0      HALT AT BEGINNING
0083   00164 002011          SLA,RSS         OF PROGRAM?
0084   00165 024171          JMP *+4       NO.
0085   00166 060202          LDA HAD       YES.  LOAD A AND B
0086   00167 064202          LDB HAD         WITH 100
0087   00170 024077          JMP END           AND HALT
0088   00171 060173          LDA AS0       RESTORE A
0089   00172 124145          JMP MODE,I    EXIT SUBROUTINE
0090   00173 000000  AS0     OCT 0         TEMPORARY STORAGE
0091   00174 000000  BIT0    OCT 0
0092   00175 000000  BIT1    OCT 0
0093   00176 000000  BIT2    OCT 0
0094   00177 000000  BIT3    OCT 0
0095   00200 000000  BIT4    OCT 0
0096   00201 000000  BIT5    OCT 0
0097   00202 000100  HAD     OCT 100
0098*
0099*
0100*INITIALIZATION ROUTINE
0101*
0102*THIS ROUTINE ADDS THE BUFFERED TELETYPE ADDRESS TO
0103*ALL I/O INSTRUCTIONS.
0104*
0105*
0106   00203 000000  INIT    NOP           ENTER ROUTINE
0107   00204 107700          CLC 0,C       INITIALIZE, INTERRUPT OFF
0108   00205 014270          JSB AUIN      PUT TTY ADDRESS
0109   00206 102300          SFS 0           INTO SFS INSTRUCTIONS
0110   00207 070332          STA SFS1
0111   00210 070341          STA SFS2
0112   00211 070351          STA SFS3
0113   00212 070373          STA SFS4
0114   00213 070452          STA SFS5
```

```
0115  00214 014270          JSB ADIN      PUT TTY ADDRESS
0116  00215 102200          SFC 0           INTO SFC INSTRUCTIONS
0117  00216 070326          STA SFC1
0118  00217 070336          STA SFC2
0119  00220 070346          STA SFC3
0120  00221 070367          STA SFC4
0121  00222 014270          JSB ADIN      PUT TTY ADDRESS
0122  00223 102600          OTA 0           INTO OTA INSTRUCTIONS
0123  00224 070407          STA OTA1
0124  00225 070442          STA OTA2
0125  00226 070661          STA OTA3
0126  00227 070664          STA OTA4
0127  00230 071325          STA OTA5
0128  00231 014270          JSB ADIN      PUT TTY ADDRESS
0129  00232 103700          STC 0,C         INTO STC,C  INSTRUCTIONS
0130  00233 070411          STA STCC1
0131  00234 070665          STA STCC2
0132  00235 071327          STA STCC3
0133  00236 014270          JSB ADIN      PUT TTY ADDRESS
0134  00237 106700          CLC 0           INTO CLC INSTRUCTION
0135  00240 070412          STA CLC1
0136  00241 014270          JSB ADIN      PUT TTY ADDRESS
0137  00242 102700          STC 0           INTO STC INSTRUCTION
0138  00243 070345          STA STC1
0139  00244 014270          JSB ADIN      PUT TTY ADDRESS
0140  00245 103100          CLF 0           INTO CLF INSTRUCTION
0141  00246 070355          STA CLF1
0142  00247 014270          JSB ADIN      PUT TTY ADDRESS
0143  00250 102100          STF 0           INTO STF INSTRUCTION
0144  00251 070360          STA STF1
0145  00252 014270          JSB ADIN      PUT TTY ADDRESS
0146  00253 105500          LIB 0           INTO LIB INSTRUCTIONS
0147  00254 070443          STA LIB1
0148  00255 071070          STA LIB2
0149  00256 071257          STA LIB3
0150  00257 071272          STA LIB4
0151  00260 071300          STA LIB5
0152  00261 071334          STA LIB6
0153  00262 014270          JSB ADIN      PUT TTY ADDRESS
0154  00263 070000          STA 0           INTO STA INSTRUCTIONS
0155  00264 070117          STA STA1
0156  00265 070356          STA STA2
0157  00266 070366          STA STA3
0158  00267 124203          JMP INIT,I    EXIT ROUTINE
0159*
0160*ADDRESS INCLUSION SUBROUTINE.
0161*THE BUFFERED TTY ADDRESS IS PUT INTO
0162*THE INSTRUCTION FOLLOWING JSB ADIN.
0163*
0164  00270 000000  ADIN  NOP           ENTER SUBROUTINE
0165  00271 160270        LDA ADIN,I    BRING I/O INSTRUCTION INTO A
0166  00272 014276        AND MSK1      ADD TTY ADDRESS
0167  00273 030277        IOR BTA         TO INSTRUCTION
0168  00274 034270        ISZ ADIN      EXIT
0169  00275 124270        JMP ADIN,I      SUBROUTINE
0170  00276 177700  MSK1  OCT 177700
0171  00277 000000  BTA   OCT 0         TTY ADDRESS STORAGE
```

```
0172*
0173*
0174*
0175*BASIC TEST ROUTINE
0176*
0177*THE FOLLOWING TESTS THE FLAG, CONTROL,
0178*AND INTERRUPT CIRCUITRY
0179*
0180   00300 000000   BT     NOP
0181   00301 107700          CLC 0,C          INITIALIZE, INTERRUPT OFF
0182   00302 060676          LDA SOYN         RESTORE
0183   00303 070675          STA OYN            OUTPUT CODE
0184   00304 060621          LDA SI1          PRINT FIRST
0185   00305 014733          JSB SMPOC          BT MESSAGE
0186   00306 006400          CLB              CLEAR
0187   00307 074570          STB E1             ERROR
0188   00310 074571          STB E2               BUFFER
0189   00311 074572          STB E3
0190   00312 074573          STB E4
0191   00313 074574          STB E5
0192   00314 074575          STB E6
0193   00315 074576          STB E7
0194   00316 074577          STB E10
0195   00317 074600          STB E11
0196   00320 074601          STB E12
0197   00321 074602          STB E13
0198   00322 074603          STB E14
0199   00323 074604          STB E15
0200   00324 074605          STB IA
0201   00325 006004          INB              INCREMENT ERROR CODE
0202   00326 102200   SFC1   SFC 0            FLAG CLEAR?
0203   00327 024331          JMP *+2            NO.
0204   00330 074570          STB E1             YES.  ERROR 1
0205   00331 006004          INB                INCREMENT ERROR CODE
0206   00332 102300   SFS1   SFS 0            FLAG SET?
0207   00333 074571          STB E2             NO.  ERROR 2
0208   00334 006004          INB                YES.
0209   00335 103100   CLF1   CLF 0            CLEAR FLAG
0210   00336 102200   SFC2   SFC 0            FLAG CLEAR?
0211   00337 074572          STB E3             NO.  ERROR 3
0212   00340 006004          INB                YES.
0213   00341 102300   SFS2   SFS 0            FLAG SET?
0214   00342 024344          JMP *+2            NO.
0215   00343 074573          STB E4             YES.  ERROR 4
0216   00344 006004          INB
0217   00345 102700   STC1   STC 0            SET CONTROL
0218   00346 102200   SFC3   SFC 0            FLAG CLEAR?
0219   00347 074574          STB E5             NO.  ERROR 5
0220   00350 006004          INB                YES.
0221   00351 102300   SFS3   SFS 0            FLAG SET?
0222   00352 024354          JMP *+2            NO.
0223   00353 074575          STB E6             YES.  ERROR 6
0224   00354 006004          INB
0225   00355 060400          LDA IJ1          PREPARE TO TEST
0226   00356 070000   STA2   STA 0              INTERRUPT SYSTEM
0227   00357 102100          STF 0            TURN ON INTERRUPT SYSTEM
0228   00360 102100   STF1   STF 0            SET FLAG
```

```
0229   00361 000000          NOP             WAIT FOR
0230   00362 000000          NOP               INTERRUPT
0231   00363 074576          STB E7          NO INTERRUPT - ERROR 7
0232   00364 006004  P1      INB             INTERRUPT ENTRY
0233   00365 060401          LDA IIJ         RENEW ILLEGAL
0234   00366 070000  STA3    STA 0             INTERRUPT TRAP
0235   00367 102200  SFC4    SFC 0           FLAG CLEAR?
0236   00370 024372          JMP *+2           NO.
0237   00371 074577          STB E10           YES.  ERROR 10
0238   00372 006004          INB
0239   00373 102300  SFS4    SFS 0           FLAG SET?
0240   00374 074600          STB E11           NO.  ERROR 11
0241   00375 006004          INB               YES.
0242   00376 074402          STB ERNO        STORE ERROR CODE
0243   00377 024403          JMP TOUT
0244   00400 024364  IJ1     JMP P1
0245   00401 014503  IIJ     JSB ILINT
0246   00402 000000  ERNO    OCT 0           ERROR CODE STORAGE
0247*
0248*THE FOLLOWING TESTS THE TIME FOR OUTPUTING ONE CHARACTER.
0249*
0250   00403 000000  TOUT    NOP
0251   00404 107700          CLC 0,C         INITIALIZE, INTERRUPT OFF
0252   00405 102100          STF 0           INTERRUPT ON
0253   00406 060432          LDA ONN         PUT INTO OUTPUT, NO
0254   00407 102600  OTA1    OTA 0             PRINT, NO PUNCH MODE
0255   00410 064433          LDB TOC1        CHECK
0256   00411 103700  STCC1   STC 0,C           LOWER
0257   00412 106700  CLC1    CLC 0               TIME LIMIT
0258   00413 014461          JSB TOS         FLAG SET?
0259   00414 024416          JMP *+2         YES.  DATA CLOCK TOO FAST
0260   00415 024420          JMP *+3         NO.
0261   00416 064402          LDB ERNO        ERROR 12
0262   00417 074601          STB E12
0263   00420 034402          ISZ ERNO        INCREMENT ERROR CODE
0264   00421 000000          NOP             CHECK UPPER
0265   00422 064434          LDB TOC2          TIME LIMIT
0266   00423 014461          JSB TOS         FLAG SET?
0267   00424 024427          JMP *+3         YES.  TIMING OK
0268   00425 064402          LDB ERNO        NO.  DATA CLOCK TOO SLOW
0269   00426 074602          STB E13           ERROR 13
0270   00427 034402          ISZ ERNO        INCREMENT ERROR CODE
0271   00430 000000          NOP
0272   00431 024435          JMP DT
0273   00432 100000  ONN     OCT 100000      OUTPUT,NO PRINT, NO PUNCH
0274   00433 142000  TOC1    OCT 142000      TIMEOUT CONSTANT 1
0275   00434 176700  TOC2    OCT 176700      TIMEOUT CONSTANT 2
0276*
0277*THE FOLLOWING TESTS THE EIGHT BIT DATA BUFFER.
0278*
0279   00435 000000  DT      NOP
0280   00436 107700          CLC 0,C         INITIALIZE, INTERRUPT OFF
0281   00437 002400          CLA
0282   00440 070457  P2      STA CURWD       OUTPUT THE
0283   00441 010455          AND MSK2          CURRENT
0284   00442 102600  OTA2    OTA 0               WORD
0285   00443 106500  LIB1    LIB 0
```

```
0286   00444 050001          CPA 1          INPUT = OUTPUT ?
0287   00445 024450          JMP P3         YES.
0288   00446 060402          LDA ERNO       NO.  ERROR 14
0289   00447 070603          STA E14
0290   00450 060457   P3     LDA CURWD      INCREMENT
0291   00451 002006          INA,SZA          CURRENT WORD
0292   00452 024440          JMP P2
0293   00453 014472          JSB EBH        HALT AT ERROR BUFFER?
0294   00454 024515          JMP POUT       NO.
0295   00455 000377   MSK2   OCT 377
0296   00456 000200   MSK3   OCT 200
0297   00457 000000   CURWD  OCT 0
0298   00460 000000   NBE    OCT 0
0299*
0300*FLAG TIMEOUT SUBROUTINE
0301*
0302*TIMEOUT CONSTANT IN B
0303*IF "FLAG" BEFORE TIMEOUT, EXIT TO TOS.  IF NOT,
0304*EXIT TO TOS + 1.  ONE ITERATION = 6.4 MICROSEC.
0305*
0306   00461 000000   TOS    NOP            ENTER SUBROUTINE
0307   00462 102300   SFS5   SFS 0          FLAG SET?
0308   00463 024465          JMP *+2
0309   00464 124461          JMP TOS,I      YES.  EXIT THROUGH TOS
0310   00465 006006          INB,SZB        NO.  TIMEOUT YET?
0311   00466 024462          JMP SFS5       NO.  REPEAT
0312   00467 034461          ISZ TOS        YES.  EXIT
0313   00470 000000          NOP              THROUGH
0314   00471 124461          JMP TOS,I          TOS + 1
0315*
0316*ERROR BUFFER HALT SUBROUTINE
0317*
0318   00472 000000   EBH    NOP            ENTER SUBROUTINE
0319   00473 070502          STA AS1        STORE A
0320   00474 014145          JSB MODE       CHECK SW. REG.
0321   00475 060175          LDA BIT1       HALT AT
0322   00476 000010          SLA              ERROR BUFFER?
0323   00477 014564          JSB POF        YES.
0324   00500 060502          LDA AS1        NO.  RESTORE A
0325   00501 124472          JMP EBH,I      EXIT SUBROUTINE
0326   00502 000000   AS1    OCT 0          TEMPORARY STORAGE
0327*
0328*ILLEGAL INTERRUPT SUBROUTINE
0329*
0330*FOR AN ILLEGAL TTY INTERRUPT, THE PROGRAM ADDRESS IS SAVED.
0331*
0332   00503 000000   ILINT NOP            ENTER SUBROUTINE
0333   00504 070513          STA AS2        STORE A
0334   00505 060503          LDA *-2        STORE PROGRAM ADDRESS
0335   00506 070605          STA IA
0336   00507 060514          LDA IE         STORE
0337   00510 070604          STA E15          ERROR 15
0338   00511 060513          LDA AS2        RESTORE A
0339   00512 124503          JMP ILINT,I    EXIT SUBROUTINE
0340   00513 000000   AS2    OCT 0          TEMPORARY STORAGE
0341   00514 000015   IE     OCT 15
0342*
```

```
0343*THE FOLLOWING PRINTS OUT THE RESULTS OF THE BASIC TEST.
0344*IN CASE OF FAILURE TO PRINT OUT, THE PROGRAM
0345*HALTS AT THE BEGINNING OF THE ERROR BUFFER.
0346*PRESSING "DISPLAY MEMORY" WILL SHOW WHICH ERRORS OCCURED.
0347*
0348   00515 000000  POUT   NOP
0349   00516 107700         CLC 0,C        INITIALIZE, INTERRUPT OFF
0350   00517 006400         CLB
0351   00520 014461         JSB TOS        FLAG SET?
0352   00521 024523         JMP *+2        YES.
0353   00522 014564         JSB POF        NO.  HALT AT ERROR BUFFER
0354   00523 060633         LDA SC2        PREPARE TO
0355   00524 070634         STA M14          PRINT OUT
0356   00525 060635         LDA SI3            ERROR CODES
0357   00526 070527         STA P4
0358   00527 064570  P4     LDB E1         LOAD B WITH
0359   00530 034527         ISZ *-1          ERROR STORAGE
0360   00531 006002         SZB            ZERO?
0361   00532 024536         JMP *+4        NO.
0362   00533 034634         ISZ M14        YES.  PARTIALLY DONE?
0363   00534 024527         JMP P4         NO.
0364   00535 024544         JMP P5         YES.  CHECK INTERRUPT ERRORS
0365   00536 060636         LDA E          PRINT
0366   00537 014654         JSB OYNA         OUT
0367   00540 014701         JSB POUT2          ERROR
0368   00541 014720         JSB EOL              CODE
0369   00542 014472         JSB EBH        HALT AT ERROR BUFFER?
0370   00543 024533         JMP *-10B      NO.
0371   00544 064604  P5     LDB E15        E15 = 0?
0372   00545 006003         SZB,RSS
0373   00546 024560         JMP P6         YES.
0374   00547 060636         LDA E          NO.
0375   00550 014654         JSB OYNA       PRINT OUT
0376   00551 014701         JSB POUT2        ERROR CODE
0377   00552 060653         LDA SI4            AND
0378   00553 014751         JSB MPO              PROGRAM ADDRESS
0379   00554 060605         LDA IA                 WHEN ERROR
0380   00555 014774         JSB OPA                  OCCURRED
0381   00556 014720         JSB EOL        LINE FEED
0382   00557 014720         JSB EOL        LINE FEED
0383   00560 060632  P6     LDA SI2        PRINT SECOND
0384   00561 014733         JSB SMPOC        BT MESSAGE
0385   00562 014472         JSB EBH        HALT AT ERROR BUFFER?
0386   00563 124300         JMP BT,I       NO.  EXIT ROUTINE
0387   00564 000000  POF    NOP
0388   00565 060564         LDA *-1        PUT PROGRAM ADDRSSS
0389   00566 064564         LDB *-2          FOR PRINT FAILURE
0390   00567 102055         HLT 55B            INTO A AND B
0391*
0392*ERROR BUFFER
0393*
0394   00570 000000  E1     OCT 0          SFC  TRUE AFTER   CLC 0,C
0395   00571 000000  E2     OCT 0          SFS FALSE AFTER   CLC 0,C
0396   00572 000000  E3     OCT 0          SFC FALSE AFTER   CLF TTY
0397   00573 000000  E4     OCT 0          SFS  TRUE AFTER   CLF TTY
0398   00574 000000  E5     OCT 0          SFC FALSE AFTER   CLF TTY AND STC
0399   00575 000000  E6     OCT 0          SFS  TRUE AFTER   CLF TTY AND STC
```

```
0400   00576 000000  E7     OCT 0          NO INTERRUPT AFTER  STC TTY,STF 0
0401   00577 000000  E10    OCT 0          SFC  TRUE AFTER INTERRUPT
0402   00600 000000  E11    OCT 0          SFS FALSE AFTER INTERRUPT
0403   00601 000000  E12    OCT 0          DATA CLOCK ON TTY BOARD TOO FAST
0404   00602 000000  E13    OCT 0          DATA CLOCK ON TTY BOARD TOO SLOW
0405   00603 000000  E14    OCT 0          DATA BUFFER ERROR
0406   00604 000000  E15    OCT 0          ILLEGAL INTERRUPT FROM TELETYPE
0407   00605 000000  IA     OCT 0          PROGRAM ADDRESS AT TIME OF E15
0408   00606 177777         OCT 177777     ERROR BUFFER TERMINAITON
0409   00607 024124         JMP MP1        RETURN TO MAIN PROGRAM
0410*
0411   00610 041105  BTM1   ASC 8,BEGIN BASIC TEST
       00611 043511
       00612 047040
       00613 041101
       00614 051511
       00615 041440
       00616 052105
       00617 051524
0412   00620 000000         OCT 0
0413   00621 060610  SI1    LDA BTM1
0414   00622 042516  BTM2   ASC 7,END BASIC TEST
       00623 042040
       00624 041101
       00625 051511
       00626 041440
       00627 052105
       00630 051524
0415   00631 000000         OCT 0
0416   00632 060622  SI2    LDA BTM2
0417   00633 177764  SC2    OCT 177764
0418   00634 000000  M14    OCT 0
0419   00635 064570  SI3    LDB E1
0420   00636 000305  E      OCT 305
0421   00637 020040  PRAD   ASC 11,   PROGRAM ADDRESS =
       00640 020120
       00641 051117
       00642 043522
       00643 040515
       00644 020101
       00645 042104
       00646 051105
       00647 051523
       00650 020075
       00651 020040
0422   00652 000000         OCT 0
0423   00653 060637  SI4    LDA PRAD
0424*
0425*PRINT LEAST SIGNIFICANT 8 BITS OF A.
0426*
0427   00654 000000  OYNA   NOP            ENTER SUBROUTINE
0428   00655 107700         CLC 0,C        INITIALIZE, INTERRUPT OFF
0429   00656 070677         STA AS3        STORE A
0430   00657 074700         STB BS1        STORE B
0431   00660 060675         LDA OYU        PUT BUFFER INTO OUTPUT
0432   00661 102600  OTA3   OTA 0             AND PRINT MODE
0433   00662 060677         LDA AS3        RESTORE A
```

```
0434  00663 014455          AND MSK2      OUTPUT LEAST
0435  00664 102500  OTA4    OTA 0           SIGNIFICANT 8
0436  00665 103700  STCC2   STC 0,C           BITS OF A
0437  00666 006400          CLB
0438  00667 014451          JSB TOS       FLAG SET?
0439  00670 024672          JMP *+2
0440  00671 014564          JSB POF       NO.  HALT AT ERROR BUFFER
0441  00672 060677          LDA AS4       YES.  RESTORE A
0442  00673 064700          LDB BS1       RESTORE B
0443  00674 124654          JMP OYNA,I    EXIT SUBROUTINE
0444  00675 120000  OYN     OCT 120000    OUTPUT,PRINT,NO PUNCH
0445  00676 120000  SOYN    OCT 120000
0446  00677 000000  AS5     OCT 0         TEMPORARY STORAGE
0447  00700 000000  BS1     OCT 0         TEMPORARY STORAGE
0448*
0449*PRINT OUT TWO OCTAL NUMBERS
0450*
0451  00701 000000  POUT2   NOP           ENTER SUBROUTINE
0452  00702 060001          LDA 1         OUTPUT
0453  00703 001100          ARS             FIRST
0454  00704 001100          ARS               NUMBER
0455  00705 001100          ARS
0456  00706 010717          AND MSK5
0457  00707 030716          IOR MSK4
0458  00710 014654          JSB OYNA
0459  00711 060001          LDA 1         OUTPUT
0460  00712 010717          AND MSK5        SECOND
0461  00713 030716          IOR MSK4          NUMBER
0462  00714 014654          JSB OYNA
0463  00715 124701          JMP POUT2,I   EXIT SUBROUTINE
0464  00716 000260  MSK4    OCT 260
0465  00717 000007  MSK5    OCT 7
0466*
0467*END OF LINE SUBROUTINE
0468*
0469  00720 000000  EOL     NOP           ENTER SUBROUTINE
0470  00721 070730          STA AS4       STORE A
0471  00722 060731          LDA CR        CARRIAGE
0472  00723 014654          JSB OYNA        RETURN
0473  00724 060732          LDA LF        LINE
0474  00725 014654          JSB OYNA        FEED
0475  00726 060730          LDA AS4       RESTORE A
0476  00727 124720          JMP EOL,I     EXIT SUBROUTINE
0477  00730 000000  AS4     OCT 0         TEMPORARY STORAGE
0478  00731 000215  CR      OCT 215
0479  00732 000212  LF      OCT 212
0480*
0481*SUPPRESS MESSAGE PRINTOUT CHECK SUBROUTINE
0482*
0483  00733 000000  SMPOC   NOP           ENTER SUBROUTINE
0484  00734 070750          STA AS5       STORE A
0485  00735 014145          JSB MODE      CHECK Sw. REG.
0486  00736 060176          LDA BIT2      SUPPRESS EXCESS
0487  00737 002011          SLA,RSS         PRINTING?
0488  00740 024743          JMP *+3       NO.
0489  00741 060750          LDA AS5       YES.  RESTORE A
0490  00742 124733          JMP SMPOC,I   EXIT SUBROUTINE
```

```
0491   00743 060750          LDA AS5       RESTORE A
0492   00744 014751          JSB MPO       PRINT MESSAGE
0493   00745 014720          JSB EOL       LINE FEED
0494   00746 014720          JSB EOL       LINE FEED
0495   00747 124733          JMP SMPOC,I   EXIT SUBROUTINE
0496   00750 000000  AS5     OCT 0         TEMPORARY STORAGE
0497*
0498*MESSAGE PRINTOUT SUBROUTINE
0499*
0500   00751 000000  MPO     NOP           ENTER SUBROUTINE
0501   00752 070753          STA *+1
0502   00753 060000          LDA 0         LOAD A WORD
0503   00754 034753          ISZ *-1
0504   00755 002003          SZA,RSS       WORD = 0?
0505   00756 124751          JMP MPO,I     YES.  EXIT SUBROUTINE
0506   00757 014761          JSB PACO      NO.  PRINT THE WORD
0507   00760 024753          JMP *-5       REPEAT FOR NEXT WORD
0508*
0509*PACKED ASCII CHARACTER OUTPUT SUBROUTINE
0510*MOST SIGNIFICANT 8 BITS OF A REGISTER PRINTED FIRST.
0511*
0512   00761 000000  PACO    NOP           ENTER SUBROUTINE
0513   00762 070773          STA AS6       STORE A
0514   00763 001700          ALF           PRINT
0515   00764 001700          ALF             FIRST
0516   00765 010455          AND MSK2          CHARACTER
0517   00766 014654          JSB OYNA
0518   00767 060773          LDA AS6       PRINT
0519   00770 010455          AND MSK2        SECOND
0520   00771 014654          JSB OYNA          CHARACTER
0521   00772 124761          JMP PACO,I    EXIT SUBROUTINE
0522   00773 000000  AS6     OCT 0         TEMPORARY STORAGE
0523*
0524*OCTAL PRINTOUT OF A
0525*
0526   00774 000000  OPA     NOP           ENTER SUBROUTINE
0527   00775 001200          RAL
0528   00776 071010          STA AS7       STORE A
0529   00777 011011          AND MSK6      PRINT
0530   01000 030716          IOR MSK4        FIRST
0531   01001 014654          JSB OYNA          NUMBER
0532   01002 015012          JSB NXT       PRINT
0533   01003 015012          JSB NXT         NEXT
0534   01004 015012          JSB NXT           FIVE
0535   01005 015012          JSB NXT             NUMBERS
0536   01006 015012          JSB NXT
0537   01007 124774          JMP OPA,I     EXIT SUBROUTINE
0538   01010 000000  AS7     OCT 0         TEMPORARY STORAGE
0539   01011 000001  MSK6    OCT 1
0540*
0541*NEXT OCTAL CHARACTER OUTPUT
0542*
0543   01012 000000  NXT     NOP           ENTER SUBROUTINE
0544   01013 061010          LDA AS7       PREPARE
0545   01014 001200          RAL             THE
0546   01015 001200          RAL               NEXT
0547   01016 001200          RAL                 NUMBER
```

```
0548  01017 071010          STA AS7                FOR
0549  01020 010717          AND MSK5                 OUTPUTING
0550  01021 030716          IOR MSK4
0551  01022 014654          JSB OYNA       OUTPUT
0552  01023 125012          JMP NXT,I      EXIT SUBROUTINE
0553*
0554*
0555*
0556*PUNCH AND READ ROUTINE
0557*
0558*TESTS TAPE PUNCH AND TAPE READER
0559*BY OUTPUTING ALL COMBINATIONS OF
0560*EIGHT BITS AND READING THEM BACK.
0561*
0562  01024 000000  PAR    NOP            ENTER ROUTINE
0563  01025 107700          CLC 0,C        INITIALIZE, INTERRUPT OFF
0564  01026 006400          CLB
0565  01027 014461          JSB TOS        FLAG SET?
0566  01030 025032          JMP *+2        YES.
0567  01031 014564          JSB POF        NO.  HALT AT ERROR BUFFER
0568  01032 061216          LDA SI7        PRINT FIRST
0569  01033 014733          JSB SMPOC        PAR MESSAGE
0570  01034 061036          LDA *+2        HALT TO
0571  01035 065036          LDB *+1          TURN ON
0572  01036 102002          HLT 2              PUNCH
0573  01037 061111          LDA ONY        PREPARE TO
0574  01040 070675          STA OYN          PUNCH TAPE
0575  01041 015232          JSB ZEROS      PUNCH LEADER
0576  01042 003400          CCA            OUTPUT ALL ONES
0577  01043 010455          AND MSK2         AS A BEGINNING
0578  01044 014654          JSB OYNA           INDICATOR
0579  01045 002400          CLA            PUNCH
0580  01046 015242          JSB .64CH        ALL
0581  01047 015242          JSB .64CH          COMBINATIONS
0582  01050 061112          LDA OYY              OF EIGHT
0583  01051 070675          STA OYN                BITS
0584  01052 060730          LDA AS4
0585  01053 015242          JSB .64CH
0586  01054 015242          JSB .64CH
0587  01055 015232          JSB ZEROS      PUNCH
0588  01056 015232          JSB ZEROS        TRAILER
0589  01057 015232          JSB ZEROS
0590  01060 015117          JSB PARE       EXIT ROUTINE?
0591  01061 061063          LDA *+2        NO.  HALT TO
0592  01062 065063          LDB *+1          LOAD TAPE
0593  01063 102003          HLT 3              INTO READER
0594  01064 061116          LDA INN        PREPARE TO
0595  01065 070675          STA OYN          READ
0596  01066 002400          CLA                TAPE
0597  01067 014654          JSB OYNA       READ A
0598  01070 106500  LIB2    LIB 0            CHARACTER
0599  01071 006003          SZB,RSS        CHARACTER = 0?
0600  01072 025067          JMP *-3        YES.  READ NEXT CHARACTER
0601  01073 015253          JSB R64CH      NO.  READ FIRST BLOCK
0602  01074 061113          LDA IYN
0603  01075 070675          STA OYN
0604  01076 061337          LDA AS11
```

```
0605   01077 015253          JSB R64CH     READ SECOND BLOCK
0606   01100 061114          LDA INY
0607   01101 070675          STA OYN
0608   01102 061307          LDA AS11
0609   01103 015253          JSB R64CH     READ THIRD BLOCK
0610   01104 061115          LDA IYY
0611   01105 070675          STA OYN
0612   01106 061307          LDA AS11
0613   01107 015253          JSB R64CH     READ FOURTH BLOCK
0614   01110 025127          JMP P7        EXIT ROUTINE
0615   01111 110000  ONY      OCT 110000    OUTPUT,NO PRINT,PUNCH
0616   01112 130000  OYY      OCT 130000    OUTPUT,PRINT,PUNCH
0617   01113 160000  IYN      OCT 160000    INPUT,PRINT,NO PUNCH
0618   01114 150000  INY      OCT 150000    INPUT,NO PRINT,PUNCH
0619   01115 170000  IYY      OCT 170000    INPUT,PRINT,PUNCH
0620   01116 140000  INN      OCT 140000    INPUT, NO PRINT, NO PUNCH
0621*
0622*PUNCH AND READ EXIT SUBROUTINE
0623*
0624   01117 000000  PARE     NOP           ENTER SUBROUTINE
0625   01120 071135          STA AS8       STORE A
0626   01121 014145          JSR MODE      CHECK SW. REG.
0627   01122 060200          LDA BIT4      EXIT THIS
0628   01123 002011          SLA,RSS         ROUTINE?
0629   01124 025127          JMP *+3       YES.
0630   01125 061135          LDA AS8       NO.  RESTORE A
0631   01126 125117          JMP PARE,I    EXIT SUBROUTINE
0632   01127 060676  P7       LDA SOYN      RESTORE
0633   01130 070675          STA OYN         OUTPUT CODE
0634   01131 014720          JSB EOL       LINE FEED
0635   01132 061231          LDA SI8       PRINT SECOND
0636   01133 014733          JSB SMPOC       PAR MESSAGE
0637   01134 125024          JMP PAR,I     EXIT ROUTINE
0638   01135 000000  AS8      OCT 0         TEMPORARY STORAGE
0639*
0640*PRINT OUT ERRORS ROUTINE
0641*
0642   01136 000000  POE     NOP           ENTER SUBROUTINE
0643   01137 071152          STA AS9       STORE A
0644   01140 060675          LDA OYN       SAVE
0645   01141 071153          STA AS10        STATE
0646   01142 060676          LDA SOYN
0647   01143 070675          STA OYN
0648   01144 014720          JSB EOL       LINE FEED
0649   01145 061172          LDA SI5       PRINT "OUTPUT ="
0650   01146 014751          JSB MPO
0651   01147 061162          LDA AS9       RESTORE A
0652   01150 014774          JSB OPA       PRINT OCTAL NUMBER
0653   01151 061202          LDA SI6       PRINT "INPUT ="
0654   01152 014751          JSB MPO
0655   01153 060001          LDA 1         PRINT OCTAL
0656   01154 014774          JSB OPA         NUMBER
0657   01155 014720          JSB EOL       LINE FEED
0658   01156 061153          LDA AS10      RESTORE
0659   01157 070675          STA OYN         STATE
0660   01160 061152          LDA AS9       RESTORE A
0661   01161 125136          JMP POE,I     EXIT SUBROUTINE
```

```
0662  01162 000000  AS9    OCT 0          TEMPORARY STORAGE
0663  01163 000000  AS10   OCT 0          TEMPORARY STORAGE
0664  01164 047525  OO     ASC 5,OUTPUT =
      01165 052120
      01166 052524
      01167 020075
      01170 020040
0665  01171 000000         OCT 0
0666  01172 061164  S15    LDA OO
0667  01173 020040  OI     ASC 6,     INPUT =
      01174 020040
      01175 044516
      01176 050125
      01177 052040
      01200 036440
0668  01201 000000         OCT 0
0669  01202 061173  S16    LDA OI
0670  01203 041105  PARM1  ASC 10,BEGIN PUNCH AND READ
      01204 043511
      01205 047040
      01206 050125
      01207 047103
      01210 044040
      01211 040516
      01212 042040
      01213 051105
      01214 040504
0671  01215 000000         OCT 0
0672  01216 061203  S17    LDA PARM1
0673  01217 042516  PARM2  ASC 9,END PUNCH AND READ
      01220 042040
      01221 050125
      01222 047103
      01223 044040
      01224 040516
      01225 042040
      01226 051105
      01227 040504
0674  01230 000000         OCT 0
0675  01231 061217  S18    LDA PARM2
0676*
0677*OUTPUT BLANK TAPE
0678*
0679  01232 000000  ZEROS  NOP            ENTER SUBROUTINE
0680  01233 002400         CLA
0681  01234 065241         LDB SC3
0682  01235 014654         JSB OYNA       OUTPUT ZERO
0683  01236 006006         INB,SZB        32 ZEROS?
0684  01237 025235         JMP *-2        NO.
0685  01240 125232         JMP ZEROS,I    YES.  EXIT SUBROUTINE
0686  01241 177740  SC3    OCT 177740
0687*
0688*INCREMENT AND OUTPUT A REG. 64 TIMES
0689*
0690  01242 000000  .64CH  NOP            ENTER SUBROUTINE
0691  01243 065252         LDB SC4        RESET COUNTER
0692  01244 014654         JSB OYNA       OUTPUT A
```

```
0693   01245 002004          INA             INCREMENT OUTPUT WORD
0694   01246 006006          INB,SZB         64 CHARACTERS?
0695   01247 025244          JMP *-3         NO.
0696   01250 014720          JSB EOL         YES.
0697   01251 125242          JMP .64CH,I     EXIT ROUTINE
0698   01252 177700  SC4     OCT 177700
0699*
0700*READ AND CHECK 64 CHARACTERS
0701*
0702   01253 000000  R64CH   NOP             ENTER SUBROUTINE
0703   01254 065252          LDB SC4         RESET
0704   01255 075306          STB M64           CHARACTER COUNTER
0705   01256 014654  P8      JSB OYNA        READ A
0706   01257 106500  LI83    LIB 0             CHARACTER
0707   01260 015117          JSB PARE        EXIT ROUTINE?
0708   01261 050001          CPA 1           NO.  ERROR?
0709   01262 025264          JMP *+2         NO.
0710   01263 015136          JSB POE         YES.  PRINT OUT ERROR
0711   01264 002004          INA             INCREMENT REFERENCE
0712   01265 035306          ISZ M64         64 CHARACTERS?
0713   01266 025256          JMP P8          NO.
0714   01267 071307          STA AS11        YES.  STORE A
0715   01270 060731          LDA CR          CHECK FOR
0716   01271 014654          JSB OYNA          CARRIAGE
0717   01272 106500  LI84    LIB 0               RETURN
0718   01273 050001          CPA 1           ERROR?
0719   01274 025276          JMP *+2         NO.
0720   01275 015136          JSB POE         YES.  PRINT OUT ERROR
0721   01276 060732          LDA LF          CHECK FOR
0722   01277 014654          JSB OYNA          LINE
0723   01300 106500  LI85    LIB 0               FEED
0724   01301 050001          CPA 1           ERROR?
0725   01302 025304          JMP *+2         NO.
0726   01303 015136          JSB POE         YES.  PRINT OUT ERROR
0727   01304 061307          LDA AS11        RESTORE A
0728   01305 125253          JMP R64CH,I     EXIT SUBROUTINE
0729   01306 177700  M64     OCT 177700
0730   01307 000000  AS11    OCT 0           TEMPORARY STORAGE
0731*
0732*
0733*
0734*PRINT AND KEYBOARD ROUTINE
0735*
0736   01310 000000  PAK     NOP             ENTER ROUTINE
0737   01311 107700          CLC 0,C         INITIALIZE, INTERRUPT OFF
0738   01312 060676          LDA SOYN        PREPARE
0739   01313 070675          STA OYN           TO PRINT
0740   01314 061371          LDA SI9         PRINT FIRST
0741   01315 014733          JSB SMPOC         PAK MESSAGE
0742   01316 015432          JSB PRALL       PRINT 64 ASCII CHARACTERS
0743   01317 015432          JSB PRALL       PRINT 64 ASCII CHARACTERS
0744   01320 014720          JSB EOL         LINE FEED
0745   01321 015340          JSB PAKE        EXIT ROUTINE?
0746   01322 061414          LDA SI10        NO.  PRINT SECOND
0747   01323 014733          JSB SMPOC         PAK MESSAGE
0748   01324 061116  P9      LDA INN         PREPARE TO READ
0749   01325 102600  OTA5    OTA 0             IN FROM KEYBOARD
```

```
0750   01326 015340  P10    JSB PAKE       EXIT ROUTINE?
0751   01327 103700  STCC3  STC 0,C        NO.  WAIT
0752   01330 006400         CLB              FOR INPUT
0753   01331 014461         JSB TOS        ANY INPUT?
0754   01332 025334         JMP *+2        YES.
0755   01333 025326         JMP P10        NO.
0756   01334 106500  LIB6   LIB 0          LOAD DATA INTO B
0757   01335 060001         LDA 1          PUT B INTO A
0758   01336 014654         JSB OYNA       OUTPUT A
0759   01337 025324         JMP P9         READ NEXT CHARACTER
0760*
0761*PRINT AND KEYBOARD EXIT
0762*
0763   01340 000000  PAKE   NOP            ENTER SUBROUTINE
0764   01341 071162         STA AS9        STORE A
0765   01342 014145         JSB MODE       CHECK SW. REG.
0766   01343 060201         LDA BIT5       EXIT THIS
0767   01344 002011         SLA,RSS          ROUTINE?
0768   01345 025350         JMP *+3        YES.
0769   01346 061162         LDA AS9        NO.  RESTORE A
0770   01347 125340         JMP PAKE,I     EXIT SUBROUTINE
0771   01350 014720         JSB EOL
0772   01351 061431         LDA SI11       PRINT THIRD
0773   01352 014733         JSB SMPOC        PAK MESSAGE
0774   01353 125310         JMP PAK,I      EXIT ROUTINE
0775   01354 041105  PAKM1  ASC 12,BEGIN PRINT AND KEYBOARD
       01355 043511
       01356 047040
       01357 050122
       01360 044516
       01361 052040
       01362 040516
       01363 042040
       01364 045505
       01365 054502
       01366 047501
       01367 051104
0776   01370 000000         OCT 0
0777   01371 061354  SI9    LDA PAKM1
0778   01372 052523  PAKM2  ASC 17,USE KEYBOARD SLOWLY (5 CHS./SEC.)
       01373 042440
       01374 045505
       01375 054502
       01376 047501
       01377 051104
       01400 020123
       01401 046117
       01402 053514
       01403 054440
       01404 024065
       01405 020103
       01406 044123
       01407 027057
       01410 051505
       01411 041456
       01412 024440
0779   01413 000000         OCT 0
```

```
0780   01414 061372  SI10  LDA PAKM2
0781   01415 042516  PAKM3 ASC 11,END PRINT AND KEYBOARD
       01416 042040
       01417 050122
       01420 044516
       01421 052040
       01422 040516
       01423 042040
       01424 045505
       01425 054502
       01426 047501
       01427 051104
0782   01430 000000        OCT 0
0783   01431 061415  SI11  LDA PAKM3
0784*
0785*PRINT ALL CHARACTERS SUBROUTINE
0786*
0787   01432 000000  PRALL  NOP          ENTER SUBROUTINE
0788   01433 061440        LDA SC5       PRINT FIRST
0789   01434 015442        JSB .32CH       LINE OF CHARACTERS
0790   01435 061441        LDA SC6       PRINT SECOND
0791   01436 015442        JSB .32CH       LINE OF CHARACTERS
0792   01437 125432        JMP PRALL,I   EXIT SUBROUTINE
0793   01440 000300  SC5   OCT 300
0794   01441 000240  SC6   OCT 240
0795*
0796*PRINT 32 CHARACTERS SUBROUTINE
0797*
0798   01442 000000  .32CH NOP          ENTER SUBROUTINE
0799   01443 075454        STB BS2       STORE B
0800   01444 065241        LDB SC3       RESET COUNTER
0801   01445 014654        JSB OYNA      PRINT A
0802   01446 002004        INA           INCREMENT A
0803   01447 006006        INB,SZB       32 CHARACTERS?
0804   01450 025445        JMP *-3       NO, PRINT NEXT CHARACTER
0805   01451 014720        JSB EOL       YES, LINE FEED
0806   01452 065454        LDB BS2       RESTORE B
0807   01453 125442        JMP .32CH,I   EXIT SUBROUTINE
0808   01454 000000  BS2   OCT 0         TEMPORARY STORAGE
0809                       END
** NO ERRORS*
```

2115A/14A BUFFERED TELETYPE TEST

BINARY TAPE - HP20420B

SOURCE TAPE - HP20474B

SOURCE LISTING - HP20420BL

20420B

```
0001                    ASMB,A.B.L
**  NO ERRORS*
```

```
0001                    ASMB,A,B,L
0002*
0003*
0004*
0005*BUFFERED TELETYPE DIAGNOSTIC  2115/14  07/08/68
0006*
0007*
0008*
0009*STARTING OCTAL ADDRESS  =  100
0010****
0011*THE FOLLOWING SWITCH REGISTER SETTINGS
0012*ARE USED FOR PROGRAM CONTROL
0013*
0014*BIT  0 = 1  ->  HALT AT BEGINNING OF PROGRAM
0015*BIT  1 = 1  ->  HALT AT ERROR BUFFER
0016*BIT  2 = 1  ->  SUPPRESS MESSAGE PRINTOUT
0017*BIT  3 = 1  ->  PERFORM BASIC TEST ROUTINE
0018*BIT  4 = 1  ->  PERFORM PUNCH AND READ ROUTINE
0019*BIT  5 = 1  ->  PERFORM PRINT AND KEYBOARD ROUTINE
0020****
0021*
0022*
0023*MAIN PROGRAM
0024*
0025  00077                 ORG 77B
0026  00077 102000  END     HLT 0
0027  00100 107700          CLC 0,C       INITIALIZE, INTERRUPT OFF
0028  00101 102501          LIA 1         PUT TTY
0029  00102 010141          AND MSK0        ADDRESS
0030  00103 070303          STA BTA           INTO ALL I/O
0031  00104 014203          JSB INIT            INSTRUCTIONS
0032  00105 064142          LDB M67       PREPARE
0033  00106 060143          LDA HIS         TRAP
0034  00107 070111          STA *+2           FOR
0035  00110 060144          LDA HI              ILLEGAL
0036  00111 070010          STA 10B               INTERRUPT
0037  00112 034111          ISZ *-1                 FROM
0038  00113 002004          INA                       ANOTHER
0039  00114 006006          INB,SZB                     DEVICE
0040  00115 024111          JMP *-4
0041  00116 060407          LDA IIJ       PREPARE ILLEGAL TTY
0042  00117 070000  STA1    STA 0           INTERRUPT TRAP
0043  00120 014752          JSB EOL       LINE FEED
0044  00121 060123          LDA *+2       HALT TO CHOOSE
0045  00122 064123          LDB *+1         SWITCH REGISTER
0046  00123 102001          HLT 1             OPTIONS
0047  00124 014145  MP1     JSB MODE      CHECK SW. REG.
0048  00125 060177          LDA BIT3      PERFORM
0049  00126 000010          SLA             BASIC TEST?
0050  00127 014304          JSB BT        YES.
0051  00130 014145          JSB MODE      NO.  CHECK SW. REG.
0052  00131 060200          LDA BIT4      PERFORM
0053  00132 000010          SLA             PUNCH AND READ?
0054  00133 015056          JSB PAR       YES.
0055  00134 014145          JSB MODE      NO.  CHECK SW. REG.
0056  00135 060201          LDA BIT5      PERFORM
0057  00136 000010          SLA             PRINT AND KEYBOARD?
```

```
0058   00137 015342          JSB PAK       YES.
0059   00140 024124          JMP MP1       NO.
0060   00141 000077   MSK0   OCT 77
0061   00142 177711   M67    OCT 177711
0062   00143 070010   HIS    STA 10B
0063   00144 102010   HI     HLT 10B
0064*
0065*SWITCH REGISTER MONITORED
0066*FOR CURRENT OPERATING MODE
0067*
0068   00145 000000   MODE   NOP           ENTER SUBROUTINE
0069   00146 070173          STA AS0       STORE A
0070   00147 102501          LIA 1         EACH BIT
0071   00150 070174          STA BIT0       FROM THE
0072   00151 001300          RAR             SWITCH REGISTER
0073   00152 070175          STA BIT1          IS ROTATED
0074   00153 001300          RAR                INTO THE
0075   00154 070176          STA BIT2            LEAST SIGNIFICANT
0076   00155 001300          RAR                  POSITION AND
0077   00156 070177          STA BIT3               STORED IN THE
0078   00157 001300          RAR                      STORAGE LOCATION
0079   00160 070200          STA BIT4                   BEARING ITS NAME
0080   00161 001300          RAR
0081   00162 070201          STA BIT5
0082   00163 060174          LDA BIT0      HALT AT BEGINNING
0083   00164 002011          SLA,RSS         OF PROGRAM?
0084   00165 024171          JMP *+4       NO.
0085   00166 060202          LDA MAD       YES.  LOAD A AND B
0086   00167 064202          LDB MAD         WITH 100
0087   00170 024077          JMP END           AND HALT
0088   00171 060173          LDA AS0       RESTORE A
0089   00172 124145          JMP MODE.I    EXIT SUBROUTINE
0090   00173 000000   AS0    OCT 0         TEMPORARY STORAGE
0091   00174 000000   BIT0   OCT 0
0092   00175 000000   BIT1   OCT 0
0093   00176 000000   BIT2   OCT 0
0094   00177 000000   BIT3   OCT 0
0095   00200 000000   BIT4   OCT 0
0096   00201 000000   BIT5   OCT 0
0097   00202 000100   MAD    OCT 100
0098*
0099*
0100*INITIALIZATION ROUTINE
0101*
0102*THIS ROUTINE ADDS THE BUFFERED TELETYPE ADDRESS TO
0103*ALL I/O INSTRUCTIONS.
0104*
0105*
0106   00203 000000   INIT   NOP           ENTER ROUTINE
0107   00204 107700          CLC 0,C       INITIALIZE, INTERRUPT OFF
0108   00205 014274          JSB ADIN      PUT TTY ADDRESS
0109   00206 102300          SFS 0           INTO SFS INSTRUCTIONS
0110   00207 070340          STA SFS1
0111   00210 070347          STA SFS2
0112   00211 070357          STA SFS3
0113   00212 070401          STA SFS4
0114   00213 070512          STA SFS5
```

```
0115  00214 014274          JSB ADIN      PUT TTY ADDRESS
0116  00215 102200          SFC 0           INTO SFC INSTRUCTIONS
0117  00216 070334          STA SFC1
0118  00217 070344          STA SFC2
0119  00220 070354          STA SFC3
0120  00221 070375          STA SFC4
0121  00222 014274          JSB ADIN      PUT TTY ADDRESS
0122  00223 102600          OTA 0           INTO OTA INSTRUCTIONS
0123  00224 070415          STA OTA1
0124  00225 070450          STA OTA2
0125  00226 070471          STA OTA3
0126  00227 070713          STA OTA4
0127  00230 070716          STA OTA5
0128  00231 071357          STA OTA6
0129  00232 014274          JSB ADIN      PUT TTY ADDRESS
0130  00233 103700          STC 0,C         INTO STC,C  INSTRUCTIONS
0131  00234 070417          STA STCC1
0132  00235 070717          STA STCC2
0133  00236 071361          STA STCC3
0134  00237 014274          JSB ADIN      PUT TTY ADDRESS
0135  00240 106700          CLC 0           INTO CLC INSTRUCTION
0136  00241 070420          STA CLC1
0137  00242 014274          JSB ADIN      PUT TTY ADDRESS
0138  00243 102700          STC 0           INTO STC INSTRUCTION
0139  00244 070353          STA STC1
0140  00245 070500          STA STC2
0141  00246 014274          JSB ADIN      PUT TTY ADDRESS
0142  00247 103100          CLF 0           INTO CLF INSTRUCTION
0143  00250 070343          STA CLF1
0144  00251 014274          JSB ADIN      PUT TTY ADDRESS
0145  00252 102100          STF 0           INTO STF INSTRUCTION
0146  00253 070366          STA STF1
0147  00254 014274          JSB ADIN      PUT TTY ADDRESS
0148  00255 106500          LIB 0           INTO LIB INSTRUCTIONS
0149  00256 070451          STA LIB1
0150  00257 070472          STA LIB2
0151  00260 070501          STA LIB3
0152  00261 071122          STA LIB4
0153  00262 071311          STA LIB5
0154  00263 071324          STA LIB6
0155  00264 071332          STA LIB7
0156  00265 071366          STA LIB8
0157  00266 014274          JSB ADIN      PUT TTY ADDRESS
0158  00267 070000          STA 0           INTO STA INSTRUCTIONS
0159  00270 070117          STA STA1
0160  00271 070364          STA STA2
0161  00272 070374          STA STA3
0162  00273 124203          JMP INIT.I    EXIT ROUTINE
0163*
0164*ADDRESS INCLUSION SUBROLTINE.
0165*THE BUFFERED TTY ADDRESS IS PUT INTO
0166*THE INSTRUCTION FOLLOWING JSB ADIN.
0167*
0168  00274 000000  ADIN  NOP           ENTER SUBROUTINE
0169  00275 160274        LDA ADIN.I    BRING I/O INSTRUCTION INTO A
0170  00276 010302        ANI MSK1      ADD TTY ADDRESS
0171  00277 030303        IOR BTA         TO INSTRUCTION
```

```
0172  00300 034274          ISZ ADIN      EXIT
0173  00301 124274          JMP ADIN.I      SUBROUTINE
0174  00302 177700  MSK1    OCT 177700
0175  00303 000000  BTA     OCT 0         TTY ADDRESS STORAGE
0176*
0177*
0178*
0179*BASIC TEST ROUTINE
0180*
0181*THE FOLLOWING TESTS THE FLAG, CONTROL,
0182*AND INTERRUPT CIRCUITRY
0183*
0184  00304 000000  BT      NOP
0185  00305 107700          CLC 0,C       INITIALIZE, INTERRUPT OFF
0186  00306 060730          LDA SOYN      RESTORE
0187  00307 070727          STA OYN         OUTPUT CODE
0188  00310 060653          LDA SI1       PRINT FIRST
0189  00311 014765          JSB SMPOC       BT MESSAGE
0190  00312 006400          CLB           CLEAR
0191  00313 074620          STB E1          ERROR
0192  00314 074621          STB E2            BUFFER
0193  00315 074622          STB E3
0194  00316 074623          STB E4
0195  00317 074624          STB E5
0196  00320 074625          STB E6
0197  00321 074626          STB E7
0198  00322 074627          STB E10
0199  00323 074630          STB E11
0200  00324 074631          STB E12
0201  00325 074632          STB E13
0202  00326 074633          STB E14
0203  00327 074634          STB E15
0204  00330 074635          STB E16
0205  00331 074636          STB E17
0206  00332 074637          STB IA
0207  00333 006004          INB           INCREMENT ERROR CODE
0208  00334 102200  SFC1    SFC 0         FLAG CLEAR?
0209  00335 024337          JMP *+2         NO.
0210  00336 074620          STB E1          YES.  ERROR 1
0211  00337 006004          INB             INCREMENT ERROR CODE
0212  00340 102300  SFS1    SFS 0         FLAG SET?
0213  00341 074621          STB E2          NO.  ERROR 2
0214  00342 006004          INB             YES.
0215  00343 103100  CLF1    CLF 0         CLEAR FLAG
0216  00344 102200  SFC2    SFC 0         FLAG CLEAR?
0217  00345 074622          STB E3          NO.  ERROR 3
0218  00346 006004          INB             YES.
0219  00347 102300  SFS2    SFS 0         FLAG SET?
0220  00350 024352          JMP *+2         NO.
0221  00351 074623          STB E4          YES.  ERROR 4
0222  00352 006004          INB
0223  00353 102700  STC1    STC 0         SET CONTROL
0224  00354 102200  SFC3    SFC 0         FLAG CLEAR?
0225  00355 074624          STB E5          NO.  ERROR 5
0226  00356 006004          INB             YES.
0227  00357 102300  SFS3    SFS 0         FLAG SET?
0228  00360 024362          JMP *+2         NO.
```

```
0229  00361 074625         STB E6          YES.  ERROR 6
0230  00362 006004         INB
0231  00363 060406         LDA IJ1         PREPARE TO TEST
0232  00364 070000  STA2   STA 0             INTERRUPT SYSTEM
0233  00365 102100         STF 0           TURN ON INTERRUPT SYSTEM
0234  00366 102100  STF1   STF 0           SET FLAG
0235  00367 000000         NOP             WAIT FOR
0236  00370 000000         NOP               INTERRUPT
0237  00371 074626         STB E7          NO INTERRUPT - ERROR 7
0238  00372 006004  P1     INB             INTERRUPT ENTRY
0239  00373 060407         LDA IIJ         RENEW ILLEGAL
0240  00374 070000  STA3   STA 0             INTERRUPT TRAP
0241  00375 102200  SFC4   SFC 0           FLAG CLEAR?
0242  00376 024400         JMP *+2           NO.
0243  00377 074627         STB E10           YES.  ERROR 10
0244  00400 006004         INB
0245  00401 102300  SFS4   SFS 0           FLAG SET?
0246  00402 074630         STB E11           NO.  ERROR 11
0247  00403 006004         INB               YES.
0248  00404 074410         STB ERNO        STORE ERROR CODE
0249  00405 024411         JMP TOUT
0250  00406 024372  IJ1    JMP P1
0251  00407 014533  IIJ    JSB ILINT
0252  00410 000000  ERNO   OCT 0           ERROR CODE STORAGE
0253*
0254*THE FOLLOWING TESTS THE TIME FOR OUTPUTING ONE CHARACTER.
0255*
0256  00411 000000  TOUT   NOP
0257  00412 107700         CLC 0,C         INITIALIZE, INTERRUPT OFF
0258  00413 102100         STF 0           INTERRUPT ON
0259  00414 060440         LDA ONN         PUT INTO OUTPUT, NO
0260  00415 102600  OTA1   OTA 0             PRINT, NO PUNCH MODE
0261  00416 064441         LDB TOC1        CHECK
0262  00417 103700  STCC1  STC 0,C           LOWER
0263  00420 106700  CLC1   CLC 0               TIME LIMIT
0264  00421 014511         JSB TOS         FLAG SET?
0265  00422 024424         JMP *+2         YES.  DATA CLOCK TOO FAST
0266  00423 024426         JMP *+3         NO.
0267  00424 064410         LDB ERNO        ERROR 12
0268  00425 074631         STB E12
0269  00426 034410         ISZ ERNO        INCREMENT ERROR CODE
0270  00427 000000         NOP             CHECK UPPER
0271  00430 064442         LDB TOC2          TIME LIMIT
0272  00431 014511         JSB TOS         FLAG SET?
0273  00432 024435         JMP *+3         YES.  TIMING OK
0274  00433 064410         LDB ERNO        NO.  DATA CLOCK TOO SLOW
0275  00434 074632         STB E13           ERROR 13
0276  00435 034410         ISZ ERNO        INCREMENT ERROR CODE
0277  00436 000000         NOP
0278  00437 024443         JMP DT
0279  00440 100000  ONN    OCT 100000    OUTPUT,NO PRINT, NO PUNCH
0280  00441 150000  TOC1   OCT 150000     TIMEOUT CONSTANT 1
0281  00442 177040  TOC2   OCT 177040     TIMEOUT CONSTANT 2
0282*
0283*THE FOLLOWING TESTS THE EIGHT BIT DATA BUFFER.
0284*
0285  00443 000000  DT     NOP
```

```
0286  00444 107700         CLC 0,C       INITIALIZE, INTERRUPT OFF
0287  00445 002400         CLA
0288  00446 070465  P2     STA CURWD     OUTPUT THE
0289  00447 010463         AND MSK2        CURRENT
0290  00450 102600  OTA2   OTA 0             WORD
0291  00451 106500  LIB1   LIB 0
0292  00452 050001         CPA 1         INPUT = OUTPUT ?
0293  00453 024456         JMP *+3       YES.
0294  00454 060410         LDA ERNO      NO.  ERROR 14
0295  00455 070633         STA E14
0296  00456 060465         LDA CURWD     INCREMENT
0297  00457 002006         INA,SZA         CURRENT WORD
0298  00460 024446         JMP P2
0299  00461 034410         ISZ ERNO      INCREMENT ERROR CODE
0300  00462 024467         JMP CET
0301  00463 000377  MSK2   OCT 377
0302  00464 000200  MSK3   OCT 200
0303  00465 000000  CURWD  OCT 0
0304  00466 000000  NBE    OCT 0
0305*
0306*THE FOLLOWING TESTS THE CLOCK ENABLE FLIP-FLOP
0307*
0308  00467 107700  CET    CLC 0,C       INITIALIZE, INTERRUPT OFF
0309  00470 060440         LDA ONN       PUT BUFFER INTO "OUTPUT, NO
0310  00471 102600  OTA3   OTA 0           PRINT, NO PUNCH" STATE
0311  00472 106500  LIB2   LIB 0         FLIP-FLOP
0312  00473 006021         SSB,RSS         SET?
0313  00474 024477         JMP *+3       NO.
0314  00475 060410         LDA ERNO      YES.  ERROR 15
0315  00476 070634         STA E15
0316  00477 034410         ISZ ERNO      INCREMENT ERROR CODE
0317  00500 102700  STC2   STC 0         SET FLIP-FLOP
0318  00501 106500  LIB3   LIB 0         FLIP-FLOP
0319  00502 006020         SSB             SET?
0320  00503 024506         JMP *+3       YES.
0321  00504 060410         LDA ERNO      NO.  ERROR 16
0322  00505 070635         STA E16
0323  00506 107700         CLC 0,C       INITIALIZE, INTERRUPT OFF
0324  00507 014522         JSB EBH       HALT AT ERROR BUFFER?
0325  00510 024545         JMP POUT      NO.
0326*
0327*FLAG TIMEOUT SUBROUTINE
0328*
0329*TIMEOUT CONSTANT IN B
0330*IF "FLAG" BEFORE TIMEOUT, EXIT TO TOS.  IF NOT,
0331*EXIT TO TOS + 1.  ONE ITERATION = 6.4 MICROSEC.
0332*
0333  00511 000000  TOS    NOP           ENTER SUBROUTINE
0334  00512 102300  SFS5   SFS 0         FLAG SET?
0335  00513 024515         JMP *+2
0336  00514 124511         JMP TOS,I     YES.  EXIT THROUGH TOS
0337  00515 006006         INB,SZB       NO.  TIMEOUT YET?
0338  00516 024512         JMP SFS5      NO.  REPEAT
0339  00517 034511         ISZ TOS       YES.  EXIT
0340  00520 000000         NOP             THROUGH
0341  00521 124511         JMP TOS,I         TOS + 1
0342*
```

```
0343*ERROR BUFFER HALT SUBROUTINE
0344*
0345  00522 000000  EBH   NOP           ENTER SUBROUTINE
0346  00523 070532        STA AS1       STORE A
0347  00524 014145        JSB MODE      CHECK SW. REG.
0348  00525 060175        LDA BIT1      HALT AT
0349  00526 000010        SLA             ERROR BUFFER?
0350  00527 014614        JSB POF       YES.
0351  00530 060532        LDA AS1       NO.  RESTORE A
0352  00531 124522        JMP EBH,I     EXIT SUBROUTINE
0353  00532 000000  AS1   OCT 0         TEMPORARY STORAGE
0354*
0355*ILLEGAL INTERRUPT SUBROUTINE
0356*
0357*FOR AN ILLEGAL TTY INTERRUPT, THE PROGRAM ADDRESS IS SAVED.
0358*
0359  00533 000000  ILINT NOP           ENTER SUBROUTINE
0360  00534 070543        STA AS2       STORE A
0361  00535 060533        LDA *-2       STORE PROGRAM ADDRESS
0362  00536 070637        STA IA
0363  00537 060544        LDA IE        STORE
0364  00540 070636        STA E17         ERROR 17
0365  00541 060543        LDA AS2       RESTORE A
0366  00542 124533        JMP ILINT,I   EXIT SUBROUTINE
0367  00543 000000  AS2   OCT 0         TEMPORARY STORAGE
0368  00544 000017  IE    OCT 17
0369*
0370*THE FOLLOWING PRINTS OUT THE RESULTS OF THE BASIC TEST.
0371*IN CASE OF FAILURE TO PRINT OUT, THE PROGRAM
0372*HALTS AT THE BEGINNING OF THE ERROR BUFFER.
0373*PRESSING "DISPLAY MEMORY" WILL SHOW WHICH ERRORS OCCURED.
0374*
0375  00545 000000  POUT  NOP
0376  00546 107700        CLC 0,C       INITIALIZE, INTERRUPT OFF
0377  00547 006400        CLB
0378  00550 014511        JSB TOS       FLAG SET?
0379  00551 024553        JMP *+2       YES.
0380  00552 014614        JSB POF       NO.  HALT AT ERROR BUFFER
0381  00553 060665        LDA SC2       PREPARE TO
0382  00554 070666        STA M16         PRINT OUT
0383  00555 060667        LDA SI3           ERROR CODES
0384  00556 070557        STA P4
0385  00557 064620  P4    LDB E1        LOAD B WITH
0386  00560 034557        ISZ *-1         ERROR STORAGE
0387  00561 006002        SZB           ZERO?
0388  00562 024566        JMP *+4       NO.
0389  00563 034666        ISZ M16       YES.  PARTIALLY DONE?
0390  00564 024557        JMP P4        NO.
0391  00565 024574        JMP P5        YES.  CHECK INTERRUPT ERRORS
0392  00566 060670        LDA E         PRINT
0393  00567 014706        JSB OYNA        OUT
0394  00570 014733        JSB POUT2         ERROR
0395  00571 014752        JSB EOL             CODE
0396  00572 014522        JSB EBH       HALT AT ERROR BUFFER?
0397  00573 024563        JMP *-10B     NO.
0398  00574 064636  P5    LDB E17       E17 = 0?
0399  00575 006003        SZB,RSS
```

```
0400   00576 024610          JMP P6        YES.
0401   00577 060670          LDA E         NO.
0402   00600 014706          JSB QYNA      PRINT OUT
0403   00601 014733          JSB POUT2       ERROR CODE
0404   00602 060705          LDA SI4           AND
0405   C0603 015003          JSB MPO             PROGRAM ADDRESS
0406   00604 060637          LDA IA                WHEN ERROR
0407   00605 015026          JSB OPA                 OCCURRED
0408   00606 014752          JSB EOL       LINE FEED
0409   00607 014752          JSB EOL       LINE FEED
0410   00610 060664  P6      LDA SI2       PRINT SECOND
0411   00611 014765          JSB SMPOC       BT MESSAGE
0412   00612 014522          JSB EBH       HALT AT ERROR BUFFER?
0413   00613 124304          JMP BT,I      NO.  EXIT ROUTINE
0414   00614 000000  POF     NOP
0415   00615 060614          LDA *-1       PUT PROGRAM ADDRSSS
0416   00616 064614          LDB *-2         FOR PRINT FAILURE
0417   00617 102055          HLT 55B           INTO A AND B
0418*
0419*ERROR BUFFER
0420*
0421   00620 000000  E1      OCT 0         SFC  TRUE AFTER   CLC 0,C
0422   00621 000000  E2      OCT 0         SFS FALSE AFTER   CLC 0,C
0423   00622 000000  E3      OCT 0         SFC FALSE AFTER   CLF TTY
0424   00623 000000  E4      OCT 0         SFS  TRUE AFTER   CLF TTY
0425   00624 000000  E5      OCT 0         SFC FALSE AFTER   CLF TTY AND STC
0426   00625 000000  E6      OCT 0         SFS  TRUE AFTER   CLF TTY AND STC
0427   00626 000000  E7      OCT 0         NO INTERRUPT AFTER  STC TTY,STF 0
0428   00627 000000  E10     OCT 0         SFC  TRUE AFTER INTERRUPT
0429   00630 000000  E11     OCT 0         SFS FALSE AFTER INTERRUPT
0430   00631 000000  E12     OCT 0         DATA CLOCK ON TTY BOARD TOO FAST
0431   00632 000000  E13     OCT 0         DATA CLOCK ON TTY BOARD TOO SLOW
0432   00633 000000  E14     OCT 0         DATA BUFFER ERROR
0433   00634 000000  E15     OCT 0         CLOCK ENABLE FLIP-FLOP SET
0434   00635 000000  E16     OCT 0         CLOCK ENABLE FLIP-FLOP NOT SET
0435   00636 000000  E17     OCT 0         ILLEGAL INTERRUPT FROM TELETYPE
0436   00637 000000  IA      OCT 0         PROGRAM ADDRESS AT TIME OF E17
0437   00640 177777          OCT 177777    ERROR BUFFER TERMINAITON
0438   00641 024124          JMP MP1       RETURN TO MAIN PROGRAM
0439*
0440   00642 041105  BTM1    ASC 8,BEGIN BASIC TEST
       00643 043511
       00644 047040
       00645 041101
       00646 051511
       00647 041440
       00650 052105
       00651 051524
0441   00652 000000          OCT 0
0442   00653 060642  SI1     LDA BTM1
0443   00654 042516  BTM2    ASC 7,END BASIC TEST
       00655 042040
       00656 041101
       00657 051511
       00660 041440
       00661 052105
       00662 051524
```

```
0444  00663 000000          OCT 0
0445  00664 060654  SI2     LDA BTM2
0446  00665 177762  SC2     OCT 177762
0447  00666 000000  M16     OCT 0
0448  00667 064620  SI3     LDB E1
0449  00670 000305  E       OCT 305
0450  00671 020040  PRAD    ASC 11,    PROGRAM ADDRESS =
      00672 020122
      00673 051117
      00674 043522
      00675 040515
      00676 020101
      00677 042104
      00700 051105
      00701 051523
      00702 020075
      00703 020040
0451  00704 000000          OCT 0
0452  00705 060671  SI4     LDA PRAD
0453*
0454*PRINT LEAST SIGNIFICANT 8 BITS OF A.
0455*
0456  00706 000000  OYNA    NOP             ENTER SUBROUTINE
0457  00707 107700          CLC 0,C         INITIALIZE, INTERRUPT OFF
0458  00710 070731          STA AS3         STORE A
0459  00711 074732          STB BS1         STORE B
0460  00712 060727          LDA OYN         PUT BUFFER INTO OUTPUT
0461  00713 102600  OTA4    OTA 0             AND PRINT MODE
0462  00714 060731          LDA AS3         RESTORE A
0463  00715 010463          AND MSK2        OUTPUT LEAST
0464  00716 102600  OTA5    OTA 0             SIGNIFICANT 8
0465  00717 103700  STCC2   STC 0,C             BITS OF A
0466  00720 006400          CLB
0467  00721 014511          JSB TOS         FLAG SET?
0468  00722 024724          JMP *+2
0469  00723 014614          JSB POF         NO.  HALT AT ERROR BUFFER
0470  00724 060731          LDA AS3         YES.  RESTORE A
0471  00725 064732          LDB BS1         RESTORE B
0472  00726 124706          JMP OYNA.I      EXIT SUBROUTINE
0473  00727 120000  OYN     OCT 120000      OUTPUT,PRINT,NO PUNCH
0474  00730 120000  SOYN    OCT 120000
0475  00731 000000  AS3     OCT 0           TEMPORARY STORAGE
0476  00732 000000  BS1     OCT 0           TEMPORARY STORAGE
0477*
0478*PRINT OUT TWO OCTAL NUMBERS
0479*
0480  00733 000000  POLT2   NOP             ENTER SUBROUTINE
0481  00734 060001          LDA 1           OUTPUT
0482  00735 001100          ARS               FIRST
0483  00736 001100          ARS                 NUMBER
0484  00737 001100          ARS
0485  00740 010751          AND MSK5
0486  00741 030750          IOR MSK4
0487  00742 014706          JSB OYNA
0488  00743 060001          LDA 1           OUTPUT
0489  00744 010751          AND MSK5          SECOND
0490  00745 030750          IOR MSK4            NUMBER
```

```
0491  00746 014706          JSB OYNA
0492  00747 124733          JMP POUT2,I  EXIT SUBROUTINE
0493  00750 000260  MSK4    OCT 260
0494  00751 000007  MSK5    OCT 7
0495*
0496*END OF LINE SUBROUTINE
0497*
0498  00752 000000  EOL     NOP          ENTER SUBROUTINE
0499  00753 070762          STA AS4      STORE A
0500  00754 060763          LDA CR       CARRIAGE
0501  00755 014706          JSB OYNA       RETURN
0502  00756 060764          LDA LF       LINE
0503  00757 014706          JSB OYNA       FEED
0504  00760 060762          LDA AS4      RESTORE A
0505  00761 124752          JMP EOL,I    EXIT SUBROUIINE
0506  00762 000000  AS4     OCT 0        TEMPORARY STORAGE
0507  00763 000215  CR      OCT 215
0508  00764 000212  LF      OCT 212
0509*
0510*SUPPRESS MESSAGE PRINTOUT CHECK SUBROUTINE
0511*
0512  00765 000000  SMPOC   NOP          ENTER SUBROUTINE
0513  00766 071002          STA AS5      STORE A
0514  00767 014145          JSB MODE     CHECK SW. REG.
0515  00770 060176          LDA BIT2     SUPPRESS EXCESS
0516  00771 002011          SLA,RSS        PRINTING?
0517  00772 024775          JMP *+3      NO.
0518  00773 061002          LDA AS5      YES.  RESTORE A
0519  00774 124765          JMP SMPOC,I  EXIT SUBROUTINE
0520  00775 061002          LDA AS5      RESTORE A
0521  00776 015003          JSB MPO      PRINT MESSAGE
0522  00777 014752          JSB EOL      LINE FEED
0523  01000 014752          JSB EOL      LINE FEED
0524  01001 124765          JMP SMPOC,I  EXIT SUBROUTINE
0525  01002 000000  AS5     OCT 0        TEMPORARY STORAGE
0526*
0527*MESSAGE PRINTOUT SUBROUTINE
0528*
0529  01003 000000  MPO     NOP          ENTER SUBROUTINE
0530  01004 071005          STA *+1
0531  01005 060000          LDA 0        LOAD A WORD
0532  01006 035005          ISZ *-1
0533  01007 002003          SZA,RSS      WORD = 0?
0534  01010 125003          JMP MPO,I    YES.  EXIT SUBROUTINE
0535  01011 015013          JSB PACO     NO.  PRINT THE WORD
0536  01012 025005          JMP *-5      REPEAT FOR NEXT WORD
0537*
0538*PACKED ASCII CHARACTER OUTPUT SUBROUTINE
0539*MOST SIGNIFICANT 8 BITS OF A REGISTER PRINTED FIRST.
0540*
0541  01013 000000  PACO    NOP          ENTER SUBROUTINE
0542  01014 071025          STA AS6      STORE A
0543  01015 001700          ALF          PRINT
0544  01016 001700          ALF            FIRST
0545  01017 010463          AND MSK2         CHARACTER
0546  01020 014706          JSB OYNA
0547  01021 061025          LDA AS6      PRINT
```

```
0548   01022 010463          AND MSK2        SECOND
0549   01023 014706          JSB OYNA          CHARACTER
0550   01024 125013          JMP PACO.I      EXIT SUBROUTINE
0551   01025 000000  AS6     OCT 0           TEMPORARY STORAGE
0552*
0553*OCTAL PRINTOUT OF A
0554*
0555   01026 000000  OPA     NOP             ENTER SUBROUTINE
0556   01027 001200          RAL
0557   01030 071042          STA AS7         STORE A
0558   01031 011043          AND MSK6        PRINT
0559   01032 030750          IOR MSK4          FIRST
0560   01033 014706          JSB OYNA            NUMBER
0561   01034 015044          JSB NXT         PRINT
0562   01035 015044          JSB NXT           NEXT
0563   01036 015044          JSB NXT             FIVE
0564   01037 015044          JSB NXT               NUMBERS
0565   01040 015044          JSB NXT
0566   01041 125026          JMP OPA,I       EXIT SUBROUTINE
0567   01042 000000  AS7     OCT 0           TEMPORARY STORAGE
0568   01043 000001  MSK6    OCT 1
0569*
0570*NEXT OCTAL CHARACTER OUTPUT
0571*
0572   01044 000000  NXT     NOP             ENTER SUBROUTINE
0573   01045 061042          LDA AS7         PREPARE
0574   01046 001200          RAL               THE
0575   01047 001200          RAL                 NEXT
0576   01050 001200          RAL                   NUMBER
0577   01051 071042          STA AS7                 FOR
0578   01052 010751          AND MSK5                  OUTPUTING
0579   01053 030750          IOR MSK4
0580   01054 014706          JSB OYNA        OUTPUT
0581   01055 125044          JMP NXT,I       EXIT SUBROUTINE
0582*
0583*
0584*
0585*PUNCH AND READ ROUTINE
0586*
0587*TESTS TAPE PUNCH AND TAPE READER
0588*BY OUTPUTING ALL COMBINATIONS OF
0589*EIGHT BITS AND READING THEM BACK.
0590*
0591   01056 000000  PAR     NOP             ENTER ROUTINE
0592   01057 107700          CLC 0,C         INITIALIZE, INTERRUPT OFF
0593   01060 006400          CLB
0594   01061 014511          JSB TOS         FLAG SET?
0595   01062 025064          JMP *+2         YES.
0596   01063 014614          JSB POF         NO.  HALT AT ERROR BUFFER
0597   01064 061250          LDA SI7         PRINT FIRST
0598   01065 014765          JSB SMPOC         PAR MESSAGE
0599   01066 061070          LDA *+2         HALT TO
0600   01067 065070          LDB *+1           TURN ON
0601   01070 102002          HLT 2               PUNCH
0602   01071 061143          LDA ONY         PREPARE TO
0603   01072 070727          STA OYN           PUNCH TAPE
0604   01073 015264          JSB ZEROS       PUNCH LEADER
```

```
0605   01074 003400          CCA             OUTPUT ALL ONES
0606   01075 010463          AND MSK2          AS A BEGINNING
0607   01076 014706          JSB OYNA            INDICATOR
0608   01077 002400          CLA             PUNCH
0609   01100 015274          JSB .64CH         ALL
0610   01101 015274          JSB .64CH           COMBINATIONS
0611   01102 061144          LDA OYY               OF EIGHT
0612   01103 070727          STA OYN                 BITS
0613   01104 060762          LDA AS4
0614   01105 015274          JSB .64CH
0615   01106 015274          JSB .64CH
0616   01107 015264          JSB ZEROR       PUNCH
0617   01110 015264          JSB ZEROR         TRAILER
0618   01111 015264          JSB ZEROR
0619   01112 015151          JSB PARE        EXIT ROUTINE?
0620   01113 061115          LDA *+2         NO.  HALT TO
0621   01114 065115          LDB *+1           LOAD TAPE
0622   01115 102003          HLT 3               INTO READER
0623   01116 061150          LDA INN         PREPARE TO
0624   01117 070727          STA OYN           READ
0625   01120 002400          CLA                 TAPE
0626   01121 014706          JSB OYNA        READ A
0627   01122 106000  LIB4    LIB 0             CHARACTER
0628   01123 006003          SZB,RSS         CHARACTER = 0?
0629   01124 025121          JMP *-3         YES.  READ NEXT CHARACTER
0630   01125 015305          JSB R64CH       NO.  READ FIRST BLOCK
0631   01126 061145          LDA IYN
0632   01127 070727          STA OYN
0633   01130 061341          LDA AS11
0634   01131 015305          JSB R64CH       READ SECOND BLOCK
0635   01132 061146          LDA INY
0636   01133 070727          STA OYN
0637   01134 061341          LDA AS11
0638   01135 015305          JSB R64CH       READ THIRD BLOCK
0639   01136 061147          LDA IYY
0640   01137 070727          STA OYN
0641   01140 061341          LDA AS11
0642   01141 015305          JSB R64CH       READ FOURTH BLOCK
0643   01142 025161          JMP P7          EXIT ROUTINE
0644   01143 110000  ONY     OCT 110000      OUTPUT,NO PRINT,PUNCH
0645   01144 130000  OYY     OCT 130000      OUTPUT,PRINT,PUNCH
0646   01145 160000  IYN     OCT 160000      INPUT,PRINT,NO PUNCH
0647   01146 150000  INY     OCT 150000      INPUT,NO PRINT,PUNCH
0648   01147 170000  IYY     OCT 170000      INPUT,PRINT,PUNCH
0649   01150 140000  INN     OCT 140000      INPUT, NO PRINT, NO PUNCH
0650*
0651*PUNCH AND READ EXIT SUBROUTINE
0652*
0653   01151 000000  PARE    NOP             ENTER SUBROUTINE
0654   01152 071167          STA AS8         STORE A
0655   01153 014145          JSB MODE        CHECK SW. REG.
0656   01154 060200          LDA BIT4        EXIT THIS
0657   01155 002011          SLA,RSS           ROUTINE?
0658   01156 025161          JMP *+3         YES.
0659   01157 061167          LDA AS8         NO.  RESTORE A
0660   01160 125151          JMP PARE.I      EXIT SUBROUTINE
0661   01161 060730  P7      LDA SOYN        RESTORE
```

```
0662  01162 070727          STA OYN         OUTPUT CODE
0663  01163 014752          JSB EOL         LINE FEED
0664  01164 061263          LDA SI8         PRINT SECOND
0665  01165 014765          JSB SMPOC         PAR MESSAGE
0666  01166 125056          JMP PAR,I       EXIT ROUTINE
0667  01167 000000  AS8      OCT 0           TEMPORARY STORAGE
0668*
0669*PRINT OUT ERRORS ROUTINE
0670*
0671  01170 000000  POE      NOP             ENTER SUBROUTINE
0672  01171 071214          STA AS9         STORE A
0673  01172 060727          LDA OYN         SAVE
0674  01173 071215          STA AS10          STATE
0675  01174 060730          LDA SOYN
0676  01175 070727          STA OYN
0677  01176 014752          JSB EOL         LINE FEED
0678  01177 061224          LDA SI5         PRINT "OUTPUT ="
0679  01200 015003          JSB MPO
0680  01201 061214          LDA AS9         RESTORE A
0681  01202 015026          JSB OPA         PRINT OCTAL NUMBER
0682  01203 061234          LDA SI6         PRINT "INPUT ="
0683  01204 015003          JSB MPO
0684  01205 060001          LDA 1           PRINT OCTAL
0685  01206 015026          JSB OPA           NUMBER
0686  01207 014752          JSB EOL         LINE FEED
0687  01210 061215          LDA AS10        RESTORE
0688  01211 070727          STA OYN           STATE
0689  01212 061214          LDA AS9         RESTORE A
0690  01213 125170          JMP POE,I       EXIT SUBROUTINE
0691  01214 000000  AS9      OCT 0           TEMPORARY STORAGE
0692  01215 000000  AS10     OCT 0           TEMPORARY STORAGE
0693  01216 047525  OO       ASC 5,OUTPUT =
      01217 052120
      01220 052524
      01221 020075
      01222 020040
0694  01223 000000           OCT 0
0695  01224 061216  SI5      LDA OO
0696  01225 020040  OI       ASC 6,     INPUT =
      01226 020040
      01227 044516
      01230 050125
      01231 052040
      01232 036440
0697  01233 000000           OCT 0
0698  01234 061225  SI6      LDA OI
0699  01235 041105  PARM1    ASC 10,BEGIN PUNCH AND READ
      01236 043511
      01237 047040
      01240 050125
      01241 047103
      01242 044040
      01243 040516
      01244 042040
      01245 051105
      01246 040504
0700  01247 000000           OCT 0
```

```
0701  01250 061235  SI7   LDA PARM1
0702  01251 042516  PARM2 ASC 9,END PUNCH AND READ
      01252 042040
      01253 050125
      01254 047103
      01255 044040
      01256 040516
      01257 042040
      01260 051105
      01261 040504
0703  01262 000000        OCT 0
0704  01263 061251  SI8   LDA PARM2
0705*
0706*OUTPUT BLANK TAPE
0707*
0708  01264 000000  ZEROS NOP           ENTER SUBROUTINE
0709  01265 002400        CLA
0710  01266 065273        LDB SC3
0711  01267 014706        JSB OYNA      OUTPUT ZERO
0712  01270 006006        INB,SZB       32 ZEROS?
0713  01271 025267        JMP *-2       NO.
0714  01272 125264        JMP ZEROS,I   YES.  EXIT SUBROUTINE
0715  01273 177740  SC3   OCT 177740
0716*
0717*INCREMENT AND OUTPUT A REG. 64 TIMES
0718*
0719  01274 000000  .64CH NOP           ENTER SUBROUTINE
0720  01275 065304        LDB SC4       RESET COUNTER
0721  01276 014706        JSB OYNA      OUTPUT A
0722  01277 002004        INA           INCREMENT OUTPUT WORD
0723  01300 006006        INB,SZB       64 CHARACTERS?
0724  01301 025276        JMP *-3       NO.
0725  01302 014752        JSB EOL       YES.
0726  01303 125274        JMP .64CH,I   EXIT ROUTINE
0727  01304 177700  SC4   OCT 177700
0728*
0729*READ AND CHECK 64 CHARACTERS
0730*
0731  01305 000000  R64CH NOP           ENTER SUBROUTINE
0732  01306 065304        LDB SC4       RESET
0733  01307 075340        STB M64         CHARACTER COUNTER
0734  01310 014706  P8    JSB OYNA      READ A
0735  01311 106500  LIB5  LIB 0            CHARACTER
0736  01312 015151        JSB PARE      EXIT ROUTINE?
0737  01313 050001        CPA 1         NO.  ERROR?
0738  01314 025316        JMP *+2       NO.
0739  01315 015170        JSB POE       YES.  PRINT OUT ERROR
0740  01316 002004        INA           INCREMENT REFERENCE
0741  01317 035340        ISZ M64       64 CHARACTERS?
0742  01320 025310        JMP P8        NO.
0743  01321 071341        STA AS11      YES.  STORE A
0744  01322 060763        LDA CR        CHECK FOR
0745  01323 014706        JSB OYNA        CARRIAGE
0746  01324 106500  LIB6  LIB 0             RETURN
0747  01325 050001        CPA 1         ERROR?
0748  01326 025330        JMP *+2       NO.
0749  01327 015170        JSB POE       YES.  PRINT OUT ERROR
```

```
0750  01330 060764         LDA LF        CHECK FOR
0751  01331 014706         JSB OYNA        LINE
0752  01332 106500  LIB7   LIB 0             FEED
0753  01333 050001         CPA 1         ERROR?
0754  01334 025336         JMP *+2       NO.
0755  01335 015170         JSB POE       YES.  PRINT OUT ERROR
0756  01336 061341         LDA AS11      RESTORE A
0757  01337 125305         JMP R64CH,I   EXIT SUBROUTINE
0758  01340 177700  M64    OCT 177700
0759  01341 000000  AS11   OCT 0          TEMPORARY STORAGE
0760*
0761*
0762*
0763*PRINT AND KEYBOARD ROUTINE
0764*
0765  01342 000000  PAK    NOP           ENTER ROUTINE
0766  01343 107700         CLC 0,C       INITIALIZE, INTERRUPT OFF
0767  01344 060730         LDA SOYN      PREPARE
0768  01345 070727         STA OYN         TO PRINT
0769  01346 061423         LDA SI9       PRINT FIRST
0770  01347 014765         JSB SMPOC       PAK MESSAGE
0771  01350 015464         JSB PRALI     PRINT 64 ASCII CHARACTERS
0772  01351 015464         JSB PRALI     PRINT 64 ASCII CHARACTERS
0773  01352 014752         JSB EOL       LINE FEED
0774  01353 015372         JSB PAKE      EXIT ROUTINE?
0775  01354 061446         LDA SI10      NO.  PRINT SECOND
0776  01355 014765         JSB SMPOC       PAK MESSAGE
0777  01356 061150  P9     LDA INN       PREPARE TO READ
0778  01357 102600  OTA6   OTA 0           IN FROM KEYBOARD
0779  01360 015372  P10    JSB PAKE      EXIT ROUTINE?
0780  01361 103700  STCC3  STC 0,C       NO.  WAIT
0781  01362 006400         CLB             FOR INPUT
0782  01363 014511         JSB TOS       ANY INPUT?
0783  01364 025366         JMP *+2       YES.
0784  01365 025360         JMP P10       NO.
0785  01366 106500  LIB8   LIB 0          LOAD DATA INTO B
0786  01367 060001         LDA 1         PUT B INTO A
0787  01370 014706         JSB OYNA      OUTPUT A
0788  01371 025356         JMP P9        READ NEXT CHARACTER
0789*
0790*PRINT AND KEYBOARD EXIT
0791*
0792  01372 000000  PAKE   NOP           ENTER SUBROUTINE
0793  01373 071214         STA AS9       STORE A
0794  01374 014145         JSB MODE      CHECK SW. REG.
0795  01375 060201         LDA BIT5      EXIT THIS
0796  01376 002011         SLA,RSS         ROUTINE?
0797  01377 025402         JMP *+3       YES.
0798  01400 061214         LDA AS9       NO.  RESTORE A
0799  01401 125372         JMP PAKE.I    EXIT SUBROUTINE
0800  01402 014752         JSB EOL
0801  01403 061463         LDA SI11      PRINT THIRD
0802  01404 014765         JSB SMPOC       PAK MESSAGE
0803  01405 125342         JMP PAK,I     EXIT ROUTINE
0804  01406 041105  PAKM1  ASC 12,BEGIN  PRINT AND KEYBOARD
      01407 043511
      01410 047040
```

```
       01411 050122
       01412 044516
       01413 052040
       01414 040516
       01415 042040
       01416 045505
       01417 054502
       01420 047501
       01421 051104
0805   01422 000000          OCT 0
0806   01423 061406  SI9     LDA PAKM1
0807   01424 052523  PAKM2   ASC 17,USE KEYBOARD SLOWLY (5 CHS./SEC.)
       01425 042440
       01426 045505
       01427 054502
       01430 047501
       01431 051104
       01432 020123
       01433 046117
       01434 053514
       01435 054440
       01436 024065
       01437 020103
       01440 044123
       01441 027057
       01442 051505
       01443 041456
       01444 024440
0808   01445 000000          OCT 0
0809   01446 061424  SI10    LDA PAKM2
0810   01447 042516  PAKM3   ASC 11,END PRINT AND KEYBOARD
       01450 042040
       01451 050122
       01452 044516
       01453 052040
       01454 040516
       01455 042040
       01456 045505
       01457 054502
       01460 047501
       01461 051104
0811   01462 000000          OCT 0
0812   01463 061447  SI11    LDA PAKM3
0813*
0814*PRINT ALL CHARACTERS SUBROUTINE
0815*
0816   01464 000000  PRALL   NOP           ENTER SUBROUTINE
0817   01465 061472          LDA SC5       PRINT FIRST
0818   01466 015474          JSB .32CH       LINE OF CHARACTERS
0819   01467 061473          LDA SC6       PRINT SECOND
0820   01470 015474          JSB .32CH       LINE OF CHARACTERS
0821   01471 125464          JMP PRALL,I   EXIT SUBROUTINE
0822   01472 000300  SC5     OCT 300
0823   01473 000240  SC6     OCT 240
0824*
0825*PRINT 32 CHARACTERS SUBROUTINE
0826*
```

```
0827   01474 000000  .32CH NOP           ENTER SUBROUTINE
0828   01475 075506        STB BS2       STORE B
0829   01476 065273        LDB SC3       RESET COUNTER
0830   01477 014706        JSB OYNA      PRINT A
0831   01500 002004        INA           INCREMENT A
0832   01501 006006        INB,SZB       32 CHARACTERS?
0833   01502 025477        JMP *-3       NO. PRINT NEXT CHARACTER
0834   01503 014752        JSB EOL       YES. LINE FEED
0835   01504 065506        LDB BS2       RESTORE B
0836   01505 125474        JMP .32CH,I   EXIT SUBROUTINE
0837   01506 000000  BS2   OCT 0         TEMPORARY STORAGE
0838                       END
** NO ERRORS*
```

2116A/B BUFFERED TELEPRINTER TEST

BINARY TAPE - HP20417C

SOURCE TAPE - HP20471C

SOURCE LISTING - HP20417CL

```
0001                    ASMB,A.B.L
** NO ERRORS*
```

```
0001                    ASMB,A.B.L
0002*
0003*
0004*
0005*BUFFERED TELETYPE DIAGNOSTIC  2116  07/08/68
0006*
0007*
0008*
0009*STARTING OCTAL ADDRESS  =  100
0010****
0011*THE FOLLOWING SWITCH REGISTER SETTINGS
0012*ARE USED FOR PROGRAM CONTROL
0013*
0014*BIT  0 = 1  ->  HALT AT BEGINNING OF PROGRAM
0015*BIT  1 = 1  ->  HALT AT ERROR BUFFER
0016*BIT  2 = 1  ->  SUPPRESS MESSAGE PRINTOUT
0017*BIT  3 = 1  ->  PERFORM BASIC TEST ROUTINE
0018*BIT  4 = 1  ->  PERFORM PUNCH AND READ ROUTINE
0019*BIT  5 = 1  ->  PERFORM PRINT AND KEYBOARD ROUTINE
0020****
0021*
0022*
0023*MAIN PROGRAM
0024*
0025  00077                 ORG 77B
0026  00077 102000  ENI     HLT 0
0027  00100 107700          CLC 0,C       INITIALIZE, INTERRUPT OFF
0028  00101 102501          LIA 1         PUT TTY
0029  00102 010141          ANI MSK0        ADDRESS
0030  00103 070303          STA BTA           INTO ALL I/O
0031  00104 014203          JSB INIT            INSTRUCTIONS
0032  00105 064142          LDB M67       PREPARE
0033  00106 060143          LDA HIS         TRAP
0034  00107 070111          STA *+2           FOR
0035  00110 060144          LDA HI              ILLEGAL
0036  00111 070010          STA 10B               INTERRUPT
0037  00112 034111          ISZ *-1                 FROM
0038  00113 002004          INA                       ANOTHER
0039  00114 006006          INB,SZB                     DEVICE
0040  00115 024111          JMP *-4
0041  00116 060407          LDA IIJ       PREPARE ILLEGAL TTY
0042  00117 070000  STA1    STA 0           INTERRUPT TRAP
0043  00120 014752          JSB EOL       LINE FEED
0044  00121 060123          LDA *+2       HALT TO CHOOSE
0045  00122 064123          LDB *+1         SWITCH REGISTER
0046  00123 102001          HLT 1             OPTIONS
0047  00124 014145  MP1     JSB MODE      CHECK SW. REG.
0048  00125 060177          LDA BIT3      PERFORM
0049  00126 000010          SLA             BASIC TEST?
0050  00127 014304          JSB BT        YES.
0051  00130 014145          JSB MODE      NO.  CHECK SW. REG.
0052  00131 060200          LDA BIT4      PERFORM
0053  00132 000010          SLA             PUNCH AND READ?
0054  00133 015056          JSB PAR       YES.
0055  00134 014145          JSB MODE      NO.  CHECK SW. REG.
0056  00135 060201          LDA BIT5      PERFORM
0057  00136 000010          SLA             PRINT AND KEYBOARD?
```

```
0058   00137 015342          JSB PAK       YES.
0059   00140 024124          JMP MP1       NO.
0060   00141 000077  MSK0    OCT 77
0061   00142 177711  M67     OCT 177711
0062   00143 070010  HIS     STA 10B
0063   00144 102010  HI      HLT 10B
0064*
0065*SWITCH REGISTER MONITORED
0066*FOR CURRENT OPERATING MODE
0067*
0068   00145 000000  MODE    NOP           ENTER SUBROUTINE
0069   00146 070173          STA AS0       STORE A
0070   00147 102501          LIA 1         EACH BIT
0071   00150 070174          STA BIT0       FROM THE
0072   00151 001300          RAR             SWITCH REGISTER
0073   00152 070175          STA BIT1         IS ROTATED
0074   00153 001300          RAR               INTO THE
0075   00154 070176          STA BIT2           LEAST SIGNIFICANT
0076   00155 001300          RAR                 POSITION AND
0077   00156 070177          STA BIT3             STORED IN THE
0078   00157 001300          RAR                   STORAGE LOCATION
0079   00160 070200          STA BIT4               BEARING ITS NAME
0080   00161 001300          RAR
0081   00162 070201          STA BIT5
0082   00163 060174          LDA BIT0      HALT AT BEGINNING
0083   00164 002011          SLA,RSS         OF PROGRAM?
0084   00165 024171          JMP *+4       NO.
0085   00166 060202          LDA HAD       YES.  LOAD A AND B
0086   00167 064202          LDB HAD         WITH 100
0087   00170 024077          JMP END           AND HALT
0088   00171 060173          LDA AS0       RESTORE A
0089   00172 124145          JMP MODE.I    EXIT SUBROUTINE
0090   00173 000000  AS0     OCT 0         TEMPORARY STORAGE
0091   00174 000000  BIT0    OCT 0
0092   00175 000000  BIT1    OCT 0
0093   00176 000000  BIT2    OCT 0
0094   00177 000000  BIT3    OCT 0
0095   00200 000000  BIT4    OCT 0
0096   00201 000000  BIT5    OCT 0
0097   00202 000100  HAD     OCT 100
0098*
0099*
0100*INITIALIZATION ROUTINE
0101*
0102*THIS ROUTINE ADDS THE BUFFERED TELETYPE ADDRESS TO
0103*ALL I/O INSTRUCTIONS.
0104*
0105*
0106   00203 000000  INIT    NOP           ENTER ROUTINE
0107   00204 107700          CLC 0,C       INITIALIZE, INTERRUPT OFF
0108   00205 014274          JSB ADIN      PUT TTY ADDRESS
0109   00206 102300          SFS 0           INTO SFS INSTRUCTIONS
0110   00207 070340          STA SFS1
0111   00210 070347          STA SFS2
0112   00211 070357          STA SFS3
0113   00212 070401          STA SFS4
0114   00213 070512          STA SFS5
```

```
0115  00214 014274          JSB ADIN      PUT TTY ADDRESS
0116  00215 102200          SFC 0           INTO SFC INSTRUCTIONS
0117  00216 070334          STA SFC1
0118  00217 070344          STA SFC2
0119  00220 070354          STA SFC3
0120  00221 070375          STA SFC4
0121  00222 014274          JSB ADIN      PUT TTY ADDRESS
0122  00223 102600          OTA 0           INTO OTA INSTRUCTIONS
0123  00224 070415          STA OTA1
0124  00225 070450          STA OTA2
0125  00226 070471          STA OTA3
0126  00227 070713          STA OTA4
0127  00230 070716          STA OTA5
0128  00231 071357          STA OTA6
0129  00232 014274          JSB ADIN      PUT TTY ADDRESS
0130  00233 103700          STC 0,C         INTO STC,C  INSTRUCTIONS
0131  00234 070417          STA STCC1
0132  00235 070717          STA STCC2
0133  00236 071361          STA STCC3
0134  00237 014274          JSB ADIN      PUT TTY ADDRESS
0135  00240 106700          CLC 0           INTO CLC INSTRUCTION
0136  00241 070420          STA CLC1
0137  00242 014274          JSB ADIN      PUT TTY ADDRESS
0138  00243 102700          STC 0           INTO STC INSTRUCTION
0139  00244 070353          STA STC1
0140  00245 070500          STA STC2
0141  00246 014274          JSB ADIN      PUT TTY ADDRESS
0142  00247 103100          CLF 0           INTO CLF INSTRUCTION
0143  00250 070343          STA CLF1
0144  00251 014274          JSB ADIN      PUT TTY ADDRESS
0145  00252 102100          STF 0           INTO STF INSTRUCTION
0146  00253 070366          STA STF1
0147  00254 014274          JSB ADIN      PUT TTY ADDRESS
0148  00255 106500          LIB 0           INTO LIB INSTRUCTIONS
0149  00256 070451          STA LIB1
0150  00257 070472          STA LIB2
0151  00260 070501          STA LIB3
0152  00261 071122          STA LIB4
0153  00262 071311          STA LIB5
0154  00263 071324          STA LIB6
0155  00264 071332          STA LIB7
0156  00265 071366          STA LIB8
0157  00266 014274          JSB ADIN      PUT TTY ADDRESS
0158  00267 070000          STA 0           INTO STA INSTRUCTIONS
0159  00270 070117          STA STA1
0160  00271 070364          STA STA2
0161  00272 070374          STA STA3
0162  00273 124203          JMP INIT.I    EXIT ROUTINE
0163*
0164*ADDRESS INCLUSION SUBROUTINE.
0165*THE BUFFERED TTY ADDRESS IS PUT INTO
0166*THE INSTRUCTION FOLLOWING JSB ADIN.
0167*
0168  00274 000000  ADIN  NOP           ENTER SUBROUTINE
0169  00275 160274         LDA ADIN.I   BRING I/O INSTRUCTION INTO A
0170  00276 010302         AND MSK1     ADD TTY ADDRESS
0171  00277 030303         IOR BTA        TO INSTRUCTION
```

```
0172   00300 034274          ISZ ADIN      EXIT
0173   00301 124274          JMP ADIN.I      SUBROUTINE
0174   00302 177700   MSK1   OCT 177700
0175   00303 000000   BTA    OCT 0         TTY ADDRESS STORAGE
0176*
0177*
0178*
0179*BASIC TEST ROUTINE
0180*
0181*THE FOLLOWING TESTS THE FLAG, CONTROL,
0182*AND INTERRUPT CIRCUITRY
0183*
0184   00304 000000   BT     NOP
0185   00305 107700          CLC 0,C       INITIALIZE, INTERRUPT OFF
0186   00306 060730          LDA SOYN      RESTORE
0187   00307 070727          STA OYN         OUTPUT CODE
0188   00310 060653          LDA SI1       PRINT FIRST
0189   00311 014765          JSB SMPOC       BT MESSAGE
0190   00312 006400          CLB           CLEAR
0191   00313 074620          STB E1          ERROR
0192   00314 074621          STB E2            BUFFER
0193   00315 074622          STB E3
0194   00316 074623          STB E4
0195   00317 074624          STB E5
0196   00320 074625          STB E6
0197   00321 074626          STB E7
0198   00322 074627          STB E10
0199   00323 074630          STB E11
0200   00324 074631          STB E12
0201   00325 074632          STB E13
0202   00326 074633          STB E14
0203   00327 074634          STB E15
0204   00330 074635          STB E16
0205   00331 074636          STB E17
0206   00332 074637          STB IA
0207   00333 006004          INB           INCREMENT ERROR CODE
0208   00334 102200   SFC1   SFC 0         FLAG CLEAR?
0209   00335 024337          JMP *+2          NO.
0210   00336 074620          STB E1           YES.  ERROR 1
0211   00337 006004          INB              INCREMENT ERROR CODE
0212   00340 102300   SFS1   SFS 0         FLAG SET?
0213   00341 074621          STB E2           NO.  ERROR 2
0214   00342 006004          INB              YES.
0215   00343 103100   CLF1   CLF 0         CLEAR FLAG
0216   00344 102200   SFC2   SFC 0         FLAG CLEAR?
0217   00345 074622          STB E3           NO.  ERROR 3
0218   00346 006004          INB              YES.
0219   00347 102300   SFS2   SFS 0         FLAG SET?
0220   00350 024352          JMP *+2          NO.
0221   00351 074623          STB E4           YES.  ERROR 4
0222   00352 006004          INB
0223   00353 102700   STC1   STC 0         SET CONTROL
0224   00354 102200   SFC3   SFC 0         FLAG CLEAR?
0225   00355 074624          STB E5           NO.  ERROR 5
0226   00356 006004          INB              YES.
0227   00357 102300   SFS3   SFS 0         FLAG SET?
0228   00360 024362          JMP *+2          NO.
```

```
0229  00361 074625          STB E6          YES.  ERROR 6
0230  00362 006004          INB
0231  00363 060406          LDA IJ1         PREPARE TO TEST
0232  00364 070000  STA2    STA 0             INTERRUPT SYSTEM
0233  00365 102100          STF 0           TURN ON INTERRUPT SYSTEM
0234  00366 102100  STF1    STF 0           SET FLAG
0235  00367 000000          NOP             WAIT FOR
0236  00370 000000          NOP               INTERRUPT
0237  00371 074626          STB E7          NO INTERRUPT - ERROR 7
0238  00372 006004  P1      INB             INTERRUPT ENTRY
0239  00373 060407          LDA IIJ         RENEW ILLEGAL
0240  00374 070000  STA3    STA 0             INTERRUPT TRAP
0241  00375 102200  SFC4    SFC 0           FLAG CLEAR?
0242  00376 024400          JMP *+2           NO.
0243  00377 074627          STB E10           YES.  ERROR 10
0244  00400 006004          INB
0245  00401 102300  SFS4    SFS 0           FLAG SET?
0246  00402 074630          STB E11           NO.  ERROR 11
0247  00403 006004          INB               YES.
0248  00404 074410          STB ERNO        STORE ERROR CODE
0249  00405 024411          JMP TOUT
0250  00406 024372  IJ1     JMP P1
0251  00407 014533  IIJ     JSB ILINT
0252  00410 000000  ERNO    OCT 0           ERROR CODE STORAGE
0253*
0254*THE FOLLOWING TESTS THE TIME FOR OUTPUTING ONE CHARACTER.
0255*
0256  00411 000000  TOUT    NOP
0257  00412 107700          CLC 0,C         INITIALIZE, INTERRUPT OFF
0258  00413 102100          STF 0           INTERRUPT ON
0259  00414 060440          LDA ONN         PUT INTO OUTPUT, NO
0260  00415 102600  OTA1    OTA 0             PRINT, NO PUNCH MODE
0261  00416 064441          LDB TOC1        CHECK
0262  00417 103700  STCC1   STC 0,C           LOWER
0263  00420 106700  CLC1    CLC 0               TIME LIMIT
0264  00421 014511          JSB TOS         FLAG SET?
0265  00422 024424          JMP *+2         YES.  DATA CLOCK TOO FAST
0266  00423 024426          JMP *+3         NO.
0267  00424 064410          LDB ERNO        ERROR 12
0268  00425 074631          STB E12
0269  00426 034410          ISZ ERNO        INCREMENT ERROR CODE
0270  00427 000000          NOP             CHECK UPPER
0271  00430 064442          LDB TOC2          TIME LIMIT
0272  00431 014511          JSB TOS         FLAG SET?
0273  00432 024435          JMP *+3         YES.  TIMING OK
0274  00433 064410          LDB ERNO        NO.  DATA CLOCK TOO SLOW
0275  00434 074632          STB E13           ERROR 13
0276  00435 034410          ISZ ERNO        INCREMENT ERROR CODE
0277  00436 000000          NOP
0278  00437 024443          JMP DT
0279  00440 100000  ONN     OCT 100000      OUTPUT,NO PRINT, NO PUNCH
0280  00441 142000  TOC1    OCT 142000      TIMEOUT CONSTANT 1
0281  00442 176700  TOC2    OCT 176700      TIMEOUT CONSTANT 2
0282*
0283*THE FOLLOWING TESTS THE EIGHT BIT DATA BUFFER.
0284*
0285  00443 000000  DT      NOP
```

```
0286  00444 107700          CLC 0,C       INITIALIZE, INTERRUPT OFF
0287  00445 002400          CLA
0288  00446 070465  P2      STA CURWD     OUTPUT THE
0289  00447 010463          AND MSK2        CURRENT
0290  00450 102600  OTA2    OTA 0             WORD
0291  00451 106500  LIB1    LIB 0
0292  00452 050001          CPA 1         INPUT = OUTPUT ?
0293  00453 024456          JMP *+3       YES.
0294  00454 060410          LDA ERNO      NO.  ERROR 14
0295  00455 070633          STA E14
0296  00456 060465          LDA CURWD     INCREMENT
0297  00457 002006          INA,SZA         CURRENT WORD
0298  00460 024446          JMP P2
0299  00461 034410          ISZ ERNO      INCREMENT ERROR CODE
0300  00462 024467          JMP CET
0301  00463 000377  MSK2    OCT 377
0302  00464 000200  MSK3    OCT 200
0303  00465 000000  CURWD   OCT 0
0304  00466 000000  NBE     OCT 0
0305*
0306*THE FOLLOWING TESTS THE CLOCK ENABLE FLIP-FLOP
0307*
0308  00467 107700  CET     CLC 0,C       INITIALIZE, INTERRUPT OFF
0309  00470 060440          LDA ONN       PUT BUFFER INTO "OUTPUT, NO
0310  00471 102600  OTA3    OTA 0           PRINT, NO PUNCH" STATE
0311  00472 106500  LIB2    LIB 0         FLIP-FLOP
0312  00473 006021          SSB,RSS         SET?
0313  00474 024477          JMP *+3       NO.
0314  00475 060410          LDA ERNO      YES.  ERROR 15
0315  00476 070634          STA E15
0316  00477 034410          ISZ ERNO      INCREMENT ERROR CODE
0317  00500 102700  STC2    STC 0         SET FLIP-FLOP
0318  00501 106500  LIB3    LIB 0         FLIP-FLOP
0319  00502 006020          SSB             SET?
0320  00503 024506          JMP *+3       YES.
0321  00504 060410          LDA ERNO      NO.  ERROR 16
0322  00505 070635          STA E16
0323  00506 107700          CLC 0,C       INITIALIZE, INTERRUPT OFF
0324  00507 014522          JSB EBH       HALT AT ERROR BUFFER?
0325  00510 024545          JMP POUT      NO.
0326*
0327*FLAG TIMEOUT SUBROUTINE
0328*
0329*TIMEOUT CONSTANT IN B
0330*IF "FLAG" BEFORE TIMEOUT, EXIT TO TOS.  IF NOT,
0331*EXIT TO TOS + 1.  ONE ITERATION = 6.4 MICROSEC.
0332*
0333  00511 000000  TOS     NOP           ENTER SUBROUTINE
0334  00512 102300  SFS5    SFS 0         FLAG SET?
0335  00513 024515          JMP *+2
0336  00514 124511          JMP TOS,I     YES.  EXIT THROUGH TOS
0337  00515 006006          INB,SZB       NO.  TIMEOUT YET?
0338  00516 024512          JMP SFS5      NO.  REPEAT
0339  00517 034511          ISZ TOS       YES.  EXIT
0340  00520 000000          NOP             THROUGH
0341  00521 124511          JMP TOS,I         TOS + 1
0342*
```

```
0343*ERROR BUFFER HALT SUBROUTINE
0344*
0345  00522 000000  EBH   NOP           ENTER SUBROUTINE
0346  00523 070532        STA AS1       STORE A
0347  00524 014145        JSB MODE      CHECK SW. REG.
0348  00525 060175        LDA BIT1      HALT AT
0349  00526 000010        SLA             ERROR BUFFER?
0350  00527 014614        JSB POF       YES.
0351  00530 060532        LDA AS1       NO.  RESTORE A
0352  00531 124522        JMP EBH,I     EXIT SUBROUTINE
0353  00532 000000  AS1   OCT 0         TEMPORARY STORAGE
0354*
0355*ILLEGAL INTERRUPT SUBROUTINE
0356*
0357*FOR AN ILLEGAL TTY INTERRUPT, THE PROGRAM ADDRESS IS SAVED.
0358*
0359  00533 000000  ILINT NOP           ENTER SUBROUTINE
0360  00534 070543        STA AS2       STORE A
0361  00535 060533        LDA *-2       STORE PROGRAM ADDRESS
0362  00536 070637        STA IA
0363  00537 060544        LDA IE        STORE
0364  00540 070636        STA E17         ERROR 17
0365  00541 060543        LDA AS2       RESTORE A
0366  00542 124533        JMP ILINT,I   EXIT SUBROUTINE
0367  00543 000000  AS2   OCT 0         TEMPORARY STORAGE
0368  00544 000017  IE    OCT 17
0369*
0370*THE FOLLOWING PRINTS OUT THE RESULTS OF THE BASIC TEST.
0371*IN CASE OF FAILURE TO PRINT OUT, THE PROGRAM
0372*HALTS AT THE BEGINNING OF THE ERROR BUFFER.
0373*PRESSING "DISPLAY MEMORY" WILL SHOW WHICH ERRORS OCCURED.
0374*
0375  00545 000000  POLT  NOP
0376  00546 107700        CLC 0,C       INITIALIZE, INTERRUPT OFF
0377  00547 006400        CLB
0378  00550 014511        JSB TOS       FLAG SET?
0379  00551 024553        JMP *+2       YES.
0380  00552 014614        JSB POF       NO.  HALT AT ERROR BUFFER
0381  00553 060665        LDA SC2       PREPARE TO
0382  00554 070666        STA M16         PRINT OUT
0383  00555 060667        LDA SI3           ERROR CODES
0384  00556 070557        STA P4
0385  00557 064620  P4    LDB E1        LOAD B WITH
0386  00560 034557        ISZ *-1         ERROR STORAGE
0387  00561 006002        SZB           ZERO?
0388  00562 024566        JMP *+4       NO.
0389  00563 034666        ISZ M16       YES.  PARTIALLY DONE?
0390  00564 024557        JMP P4        NO.
0391  00565 024574        JMP P5        YES.  CHECK INTERRUPT ERRORS
0392  00566 060670        LDA E         PRINT
0393  00567 014706        JSB OYNA        OUT
0394  00570 014733        JSB POUT2         ERROR
0395  00571 014752        JSB EOL             CODE
0396  00572 014522        JSB EBH       HALT AT ERROR BUFFER?
0397  00573 024563        JMP *-10H     NO.
0398  00574 064636  P5    LDB E17       E17 = 0?
0399  00575 006003        SZB,RSS
```

```
0400   00576 024610          JMP P6        YES.
0401   00577 060670          LDA E         NO.
0402   00600 014706          JSB OYNA      PRINT OUT
0403   00601 014733          JSB POUT2       ERROR CODE
0404   00602 060705          LDA SI4           AND
0405   00603 015003          JSB MPO             PROGRAM ADDRESS
0406   00604 060637          LDA IA                WHEN ERROR
0407   00605 015026          JSB OPA                 OCCURRED
0408   00606 014752          JSB EOL       LINE FEED
0409   00607 014752          JSB EOL       LINE FEED
0410   00610 060664  P6      LDA SI2       PRINT SECOND
0411   00611 014765          JSB SMPOC       BT MESSAGE
0412   00612 014522          JSB EBH       HALT AT ERROR BUFFER?
0413   00613 124304          JMP BT,I      NO.  EXIT ROUTINE
0414   00614 000000  POF     NOP
0415   00615 060614          LDA *-1       PUT PROGRAM ADDRSSS
0416   00616 064614          LDB *-2         FOR PRINT FAILURE
0417   00617 102055          HLT 55B           INTO A AND B
0418*
0419*ERROR BUFFER
0420*
0421   00620 000000  E1      OCT 0         SFC  TRUE AFTER   CLC 0,C
0422   00621 000000  E2      OCT 0         SFS FALSE AFTER   CLC 0,C
0423   00622 000000  E3      OCT 0         SFC FALSE AFTER   CLF TTY
0424   00623 000000  E4      OCT 0         SFS  TRUE AFTER   CLF TTY
0425   00624 000000  E5      OCT 0         SFC FALSE AFTER   CLF TTY AND STC
0426   00625 000000  E6      OCT 0         SFS  TRUE AFTER   CLF TTY AND STC
0427   00626 000000  E7      OCT 0         NO INTERRUPT AFTER  STC TTY,STF 0
0428   00627 000000  E10     OCT 0         SFC  TRUE AFTER INTERRUPT
0429   00630 000000  E11     OCT 0         SFS FALSE AFTER INTERRUPT
0430   00631 000000  E12     OCT 0         DATA CLOCK ON TTY BOARD TOO FAST
0431   00632 000000  E13     OCT 0         DATA CLOCK ON TTY BOARD TOO SLOW
0432   00633 000000  E14     OCT 0         DATA BUFFER ERROR
0433   00634 000000  E15     OCT 0         CLOCK ENABLE FLIP-FLOP SET
0434   00635 000000  E16     OCT 0         CLOCK ENABLE FLIP-FLOP NOT SET
0435   00636 000000  E17     OCT 0         ILLEGAL INTERRUPT FROM TELETYPE
0436   00637 000000  IA      OCT 0         PROGRAM ADDRESS AT TIME OF E17
0437   00640 177777          OCT 177777    ERROR BUFFER TERMINAITON
0438   00641 024124          JMP MP1       RETURN TO MAIN PROGRAM
0439*
0440   00642 041105  BTM1    ASC 8,BEGIN BASIC TEST
       00643 043511
       00644 047040
       00645 041101
       00646 051511
       00647 041440
       00650 052105
       00651 051524
0441   00652 000000          OCT 0
0442   00653 060642  SI1     LDA BTM1
0443   00654 042516  BTM2    ASC 7,END BASIC TEST
       00655 042040
       00656 041101
       00657 051511
       00660 041440
       00661 052105
       00662 051524
```

```
0444   00663 000000          OCT 0
0445   00664 060654   SI2    LDA BTM2
0446   00665 177762   SC2    OCT 177762
0447   00666 000000   M16    OCT 0
0448   00667 064620   SI3    LDB E1
0449   00670 000305   E      OCT 305
0450   00671 020040   PRAD   ASC 11,    PROGRAM ADDRESS =
       00672 020120
       00673 051117
       00674 043522
       00675 040515
       00676 020101
       00677 042104
       00700 051105
       00701 051523
       00702 020075
       00703 020040
0451   00704 000000          OCT 0
0452   00705 060671   SI4    LDA PRAD
0453*
0454*PRINT LEAST SIGNIFICANT 8 BITS OF A.
0455*
0456   00706 000000   OYNA   NOP             ENTER SUBROUTINE
0457   00707 107700          CLC 0,C         INITIALIZE, INTERRUPT OFF
0458   00710 070731          STA AS3         STORE A
0459   00711 074732          STB BS1         STORE B
0460   00712 060727          LDA OYN         PUT BUFFER INTO OUTPUT
0461   00713 102600   OTA4   OTA 0              AND PRINT MODE
0462   00714 060731          LDA AS3         RESTORE A
0463   00715 010463          AND MSK2        OUTPUT LEAST
0464   00716 102600   OTA5   OTA 0              SIGNIFICANT 8
0465   00717 103700   STCC2  STC 0,C               BITS OF A
0466   00720 006400          CLB
0467   00721 014511          JSB TOS         FLAG SET?
0468   00722 024724          JMP *+2
0469   00723 014614          JSB POF         NO.  HALT AT ERROR BUFFER
0470   00724 060731          LDA AS3         YES.  RESTORE A
0471   00725 064732          LDB BS1         RESTORE B
0472   00726 124706          JMP OYNA.I      EXIT SUBROUTINE
0473   00727 120000   OYN    OCT 120000      OUTPUT,PRINT,NO PUNCH
0474   00730 120000   SOYN   OCT 120000
0475   00731 000000   AS3    OCT 0           TEMPORARY STORAGE
0476   00732 000000   BS1    OCT 0           TEMPORARY STORAGE
0477*
0478*PRINT OUT TWO OCTAL NUMBERS
0479*
0480   00733 000000   POUT2  NOP             ENTER SUBROUTINE
0481   00734 060001          LDA 1           OUTPUT
0482   00735 001100          ARS               FIRST
0483   00736 001100          ARS                  NUMBER
0484   00737 001100          ARS
0485   00740 010751          AND MSK5
0486   00741 030750          IOR MSK4
0487   00742 014706          JSB OYNA
0488   00743 060001          LDA 1           OUTPUT
0489   00744 010751          AND MSK5          SECOND
0490   00745 030750          IOR MSK4             NUMBER
```

```
0491   00746 014706          JSB OYNA
0492   00747 124733          JMP POUT2,I   EXIT SUBROUTINE
0493   00750 000260   MSK4   OCT 260
0494   00751 000007   MSK5   OCT 7
0495*
0496*END OF LINE SUBROUTINE
0497*
0498   00752 000000   EOL    NOP           ENTER SUBROUTINE
0499   00753 070762          STA AS4       STORE A
0500   00754 060763          LDA CR        CARRIAGE
0501   00755 014706          JSB OYNA        RETURN
0502   00756 060764          LDA LF        LINE
0503   00757 014706          JSB OYNA        FEED
0504   00760 060762          LDA AS4       RESTORE A
0505   00761 124752          JMP EOL,I     EXIT SUBROUTINE
0506   00762 000000   AS4    OCT 0         TEMPORARY STORAGE
0507   00763 000215   CR     OCT 215
0508   00764 000212   LF     OCT 212
0509*
0510*SUPPRESS MESSAGE PRINTOUT CHECK SUBROUTINE
0511*
0512   00765 000000   SMPOC  NOP           ENTER SUBROUTINE
0513   00766 071002          STA AS5       STORE A
0514   00767 014145          JSB MODE      CHECK SW. REG.
0515   00770 060176          LDA BIT2      SUPPRESS EXCESS
0516   00771 002011          SLA,RSS         PRINTING?
0517   00772 024775          JMP *+3       NO.
0518   00773 061002          LDA AS5       YES.  RESTORE A
0519   00774 124765          JMP SMPOC,I   EXIT SUBROUTINE
0520   00775 061002          LDA AS5       RESTORE A
0521   00776 015003          JSB MPO       PRINT MESSAGE
0522   00777 014752          JSB EOL       LINE FEED
0523   01000 014752          JSB EOL       LINE FEED
0524   01001 124765          JMP SMPOC,I   EXIT SUBROUTINE
0525   01002 000000   AS5    OCT 0         TEMPORARY STORAGE
0526*
0527*MESSAGE PRINTOUT SUBROUTINE
0528*
0529   01003 000000   MPO    NOP           ENTER SUBROUTINE
0530   01004 071005          STA *+1
0531   01005 060000          LDA 0         LOAD A WORD
0532   01006 035005          ISZ *-1
0533   01007 002003          SZA,RSS       WORD = 0?
0534   01010 125003          JMP MPO,I     YES.  EXIT SUBROUTINE
0535   01011 015013          JSB PACO      NO.  PRINT THE WORD
0536   01012 025005          JMP *-5       REPEAT FOR NEXT WORD
0537*
0538*PACKED ASCII CHARACTER OUTPUT SUBROUTINE
0539*MOST SIGNIFICANT 8 BITS OF A REGISTER PRINTED FIRST.
0540*
0541   01013 000000   PACO   NOP           ENTER SUBROUTINE
0542   01014 071025          STA AS6       STORE A
0543   01015 001700          ALF           PRINT
0544   01016 001700          ALF             FIRST
0545   01017 010463          AND MSK2          CHARACTER
0546   01020 014706          JSB OYNA
0547   01021 061025          LDA AS6       PRINT
```

```
0548   01022 010463          AND MSK2        SECOND
0549   01023 014706          JSB OYNA          CHARACTER
0550   01024 125013          JMP PACO.I      EXIT SUBROUTINE
0551   01025 000000  AS6     OCT 0           TEMPORARY STORAGE
0552*
0553*OCTAL PRINTOUT OF A
0554*
0555   01026 000000  OPA     NOP             ENTER SUBROUTINE
0556   01027 001200          RAL
0557   01030 071042          STA AS7         STORE A
0558   01031 011043          AND MSK6        PRINT
0559   01032 030750          IOR MSK4          FIRST
0560   01033 014706          JSB OYNA            NUMBER
0561   01034 015044          JSB NXT         PRINT
0562   01035 015044          JSB NXT           NEXT
0563   01036 015044          JSB NXT             FIVE
0564   01037 015044          JSB NXT               NUMBERS
0565   01040 015044          JSB NXT
0566   01041 125026          JMP OPA,I       EXIT SUBROUTINE
0567   01042 000000  AS7     OCT 0           TEMPORARY STORAGE
0568   01043 000001  MSK6    OCT 1
0569*
0570*NEXT OCTAL CHARACTER OUTPUT
0571*
0572   01044 000000  NXT     NOP             ENTER SUBROUTINE
0573   01045 061042          LDA AS7         PREPARE
0574   01046 001200          RAL               THE
0575   01047 001200          RAL                 NEXT
0576   01050 001200          RAL                   NUMBER
0577   01051 071042          STA AS7                 FOR
0578   01052 010751          AND MSK5                  OUTPUTING
0579   01053 030750          IOR MSK4
0580   01054 014706          JSB OYNA        OUTPUT
0581   01055 125044          JMP NXT,I       EXIT SUBROUTINE
0582*
0583*
0584*
0585*PUNCH AND READ ROUTINE
0586*
0587*TESTS TAPE PUNCH AND TAPE READER
0588*BY OUTPUTING ALL COMBINATIONS OF
0589*EIGHT BITS AND READING THEM BACK.
0590*
0591   01056 000000  PAR     NOP             ENTER ROUTINE
0592   01057 107700          CLC 0,C         INITIALIZE, INTERRUPT OFF
0593   01060 006400          CLB
0594   01061 014511          JSB TOS         FLAG SET?
0595   01062 025064          JMP *+2         YES.
0596   01063 014614          JSB POF         NO.  HALT AT ERROR BUFFER
0597   01064 061250          LDA S17         PRINT FIRST
0598   01065 014765          JSB SMPOC         PAR MESSAGE
0599   01066 061070          LDA *+2         HALT TO
0600   01067 065070          LDB *+1           TURN ON
0601   01070 102002          HLT 2               PUNCH
0602   01071 061143          LDA ONY         PREPARE TO
0603   01072 070727          STA OYN           PUNCH TAPE
0604   01073 015264          JSB ZEROS       PUNCH LEADER
```

```
0605  01074 003400         CCA             OUTPUT ALL ONES
0606  01075 010463         ANE MSK2          AS A BEGINNING
0607  01076 014706         JSB OYNA            INDICATOR
0608  01077 002400         CLA             PUNCH
0609  01100 015274         JSB .64CH         ALL
0610  01101 015274         JSB .64CH           COMBINATIONS
0611  01102 061144         LDA OYY               OF EIGHT
0612  01103 070727         STA OYN                 BITS
0613  01104 060762         LDA AS4
0614  01105 015274         JSB .64CH
0615  01106 015274         JSB .64CH
0616  01107 015264         JSB ZEROS       PUNCH
0617  01110 015264         JSB ZEROS         TRAILER
0618  01111 015264         JSB ZEROS
0619  01112 015151         JSB PARE        EXIT ROUTINE?
0620  01113 061115         LDA *+2         NO.  HALT TO
0621  01114 065115         LDB *+1           LOAD TAPE
0622  01115 102003         HLT 3               INTO READER
0623  01116 061150         LDA INN         PREPARE TO
0624  01117 070727         STA OYN           READ
0625  01120 002400         CLA                 TAPE
0626  01121 014706         JSB OYNA        READ A
0627  01122 106500 LIB4    LIB 0             CHARACTER
0628  01123 006003         SZB,RSS         CHARACTER = 0?
0629  01124 025121         JMP *-3         YES.  READ NEXT CHARACTER
0630  01125 015305         JSB R64CH       NO.  READ FIRST BLOCK
0631  01126 061145         LDA IYN
0632  01127 070727         STA OYN
0633  01130 061341         LDA AS11
0634  01131 015305         JSB R64CH       READ SECOND BLOCK
0635  01132 061146         LDA INY
0636  01133 070727         STA OYN
0637  01134 061341         LDA AS11
0638  01135 015305         JSB R64CH       READ THIRD BLOCK
0639  01136 061147         LDA IYY
0640  01137 070727         STA OYN
0641  01140 061341         LDA AS11
0642  01141 015305         JSB R64CH       READ FOURTH BLOCK
0643  01142 025161         JMP P7          EXIT ROUTINE
0644  01143 110000 ONY     OCT 110000      OUTPUT,NO PRINT,PUNCH
0645  01144 130000 OYY     OCT 130000      OUTPUT,PRINT,PUNCH
0646  01145 160000 IYN     OCT 160000      INPUT,PRINT,NO PUNCH
0647  01146 150000 INY     OCT 150000      INPUT,NO PRINT,PUNCH
0648  01147 170000 IYY     OCT 170000      INPUT,PRINT,PUNCH
0649  01150 140000 INN     OCT 140000      INPUT, NO PRINT, NO PUNCH
0650*
0651*PUNCH AND READ EXIT SUBROUTINE
0652*
0653  01151 000000 PARE    NOP             ENTER SUBROUTINE
0654  01152 071167         STA AS8         STORE A
0655  01153 014145         JSB MODE        CHECK SW. REG.
0656  01154 060200         LDA BIT4        EXIT THIS
0657  01155 002011         SLA,RSS           ROUTINE?
0658  01156 025161         JMP *+3         YES.
0659  01157 061167         LDA AS8         NO.  RESTORE A
0660  01160 125151         JMP PARE.I      EXIT SUBROUTINE
0661  01161 060730 P7      LDA SOYN        RESTORE
```

```
0662  01162 070727          STA OYN         OUTPUT CODE
0663  01163 014752          JSB EOL         LINE FEED
0664  01164 061263          LDA SI8         PRINT SECOND
0665  01165 014765          JSB SMPOC         PAR MESSAGE
0666  01166 125056          JMP PAR,I       EXIT ROUTINE
0667  01167 000000  AS8      OCT 0           TEMPORARY STORAGE
0668*
0669*PRINT OUT ERRORS ROUTINE
0670*
0671  01170 000000  POE      NOP             ENTER SUBROUTINE
0672  01171 071214          STA AS9         STORE A
0673  01172 060727          LDA OYN         SAVE
0674  01173 071215          STA AS10          STATE
0675  01174 060730          LDA SOYN
0676  01175 070727          STA OYN
0677  01176 014752          JSB EOL         LINE FEED
0678  01177 061224          LDA SI5         PRINT "OUTPUT ="
0679  01200 015003          JSB MPO
0680  01201 061214          LDA AS9         RESTORE A
0681  01202 015026          JSB OPA         PRINT OCTAL NUMBER
0682  01203 061234          LDA SI6         PRINT "INPUT ="
0683  01204 015003          JSB MPO
0684  01205 060001          LDA 1           PRINT OCTAL
0685  01206 015026          JSB OPA           NUMBER
0686  01207 014752          JSB EOL         LINE FEED
0687  01210 061215          LDA AS10        RESTORE
0688  01211 070727          STA OYN           STATE
0689  01212 061214          LDA AS9         RESTORE A
0690  01213 125170          JMP POE,I       EXIT SUBROUTINE
0691  01214 000000  AS9      OCT 0           TEMPORARY STORAGE
0692  01215 000000  AS10     OCT 0           TEMPORARY STORAGE
0693  01216 047525  OO       ASC 5,OUTPUT =
      01217 052120
      01220 052524
      01221 020075
      01222 020040
0694  01223 000000          OCT 0
0695  01224 061216  SI5      LDA OO
0696  01225 020040  OI       ASC 6,     INPUT =
      01226 020040
      01227 044516
      01230 050125
      01231 052040
      01232 036440
0697  01233 000000          OCT 0
0698  01234 061225  SI6      LDA OI
0699  01235 041105  PARM1    ASC 10,BFGIN PUNCH AND READ
      01236 043511
      01237 047040
      01240 050125
      01241 047103
      01242 044040
      01243 040516
      01244 042040
      01245 051105
      01246 040504
0700  01247 000000          OCT 0
```

```
0701   01250 061235  SI7    LDA PARM1
0702   01251 042516  PARM2  ASC 9,END PUNCH AND READ
       01252 042040
       01253 050125
       01254 047103
       01255 044040
       01256 040516
       01257 042040
       01260 051105
       01261 040504
0703   01262 000000         OCT 0
0704   01263 061251  SI8    LDA PARM2
0705*
0706*OUTPUT BLANK TAPE
0707*
0708   01264 000000  ZEROS  NOP           ENTER SUBROUTINE
0709   01265 002400         CLA
0710   01266 065273         LDB SC3
0711   01267 014706         JSB OYNA      OUTPUT ZERO
0712   01270 006006         INB,SZB       32 ZEROS?
0713   01271 025267         JMP *-2       NO.
0714   01272 125264         JMP ZEROS,I   YES.  EXIT SUBROUTINE
0715   01273 177740  SC3    OCT 177740
0716*
0717*INCREMENT AND OUTPUT A REG. 64 TIMES
0718*
0719   01274 000000  .64CH  NOP           ENTER SUBROUTINE
0720   01275 065304         LDB SC4       RESET COUNTER
0721   01276 014706         JSB OYNA      OUTPUT A
0722   01277 002004         INA           INCREMENT OUTPUT WORD
0723   01300 006006         INB,SZB       64 CHARACTERS?
0724   01301 025276         JMP *-3       NO.
0725   01302 014752         JSB EOL       YES.
0726   01303 125274         JMP .64CH,I   EXIT ROUTINE
0727   01304 177700  SC4    OCT 177700
0728*
0729*READ AND CHECK 64 CHARACTERS
0730*
0731   01305 000000  R64CH  NOP           ENTER SUBROUTINE
0732   01306 065304         LDB SC4       RESET
0733   01307 075340         STB M64         CHARACTER COUNTER
0734   01310 014706  P8     JSB OYNA      READ A
0735   01311 106500  LIB5   LIB 0           CHARACTER
0736   01312 015151         JSB PARE      EXIT ROUTINE?
0737   01313 050001         CPA 1         NO.  ERROR?
0738   01314 025316         JMP *+2       NO.
0739   01315 015170         JSB POE       YES.  PRINT OUT ERROR
0740   01316 002004         INA           INCREMENT REFERENCE
0741   01317 035340         ISZ M64       64 CHARACTERS?
0742   01320 025310         JMP P8        NO.
0743   01321 071341         STA ASI1      YES.  STORE A
0744   01322 060763         LDA CR        CHECK FOR
0745   01323 014706         JSB OYNA        CARRIAGE
0746   01324 106500  LIB6   LIB 0             RETURN
0747   01325 050001         CPA 1         ERROR?
0748   01326 025330         JMP *+2       NO.
0749   01327 015170         JSB POE       YES.  PRINT OUT ERROR
```

```
0750  01330 060764         LDA LF        CHECK FOR
0751  01331 014706         JSB OYNA        LINE
0752  01332 106500  LIB7   LIB 0             FEED
0753  01333 050001         CPA 1         ERROR?
0754  01334 025336         JMP *+2       NO.
0755  01335 015170         JSB POE       YES.  PRINT OUT ERROR
0756  01336 061341         LDA AS11      RESTORE A
0757  01337 125305         JMP R64CH,I   EXIT SUBROUTINE
0758  01340 177700  M64    OCT 177700
0759  01341 000000  AS11   OCT 0          TEMPORARY STORAGE
0760*
0761*
0762*
0763*PRINT AND KEYBOARD ROUTINE
0764*
0765  01342 000000  PAK    NOP           ENTER ROUTINE
0766  01343 107700         CLC 0,C       INITIALIZE, INTERRUPT OFF
0767  01344 060730         LDA SOYN      PREPARE
0768  01345 070727         STA OYN         TO PRINT
0769  01346 061423         LDA SI9       PRINT FIRST
0770  01347 014765         JSB SMPOO       PAK MESSAGE
0771  01350 015464         JSB PRALI     PRINT 64 ASCII CHARACTERS
0772  01351 015464         JSB PRALI     PRINT 64 ASCII CHARACTERS
0773  01352 014752         JSB EOL       LINE FEED
0774  01353 015372         JSB PAKE      EXIT ROUTINE?
0775  01354 061446         LDA SI10      NO.  PRINT SECOND
0776  01355 014765         JSB SMPOO       PAK MESSAGE
0777  01356 061150  P9     LDA INN       PREPARE TO READ
0778  01357 102600  OTA6   OTA 0           IN FROM KEYBOARD
0779  01360 015372  P10    JSB PAKE      EXIT ROUTINE?
0780  01361 103700  STCC3  STC 0,C       NO.  WAIT
0781  01362 006400         CLB             FOR INPUT
0782  01363 014511         JSB TOS       ANY INPUT?
0783  01364 025366         JMP *+2       YES.
0784  01365 025360         JMP P10       NO.
0785  01366 106500  LIB8   LIB 0          LOAD DATA INTO B
0786  01367 060001         LDA 1         PUT B INTO A
0787  01370 014706         JSB OYNA      OUTPUT A
0788  01371 025356         JMP P9        READ NEXT CHARACTER
0789*
0790*PRINT AND KEYBOARD EXIT
0791*
0792  01372 000000  PAKE   NOP           ENTER SUBROUTINE
0793  01373 071214         STA AS9       STORE A
0794  01374 014145         JSB MODE      CHECK SW. REG.
0795  01375 060201         LDA BIT5      EXIT THIS
0796  01376 002011         SLA,RSS         ROUTINE?
0797  01377 025402         JMP *+3       YES.
0798  01400 061214         LDA AS9       NO.  RESTORE A
0799  01401 125372         JMP PAKE.I    EXIT SUBROUTINE
0800  01402 014752         JSB EOL
0801  01403 061463         LDA SI11      PRINT THIRD
0802  01404 014765         JSB SMPOO       PAK MESSAGE
0803  01405 125342         JMP PAK,I     EXIT ROUTINE
0804  01406 041105  PAKM1  ASC 12,BEGIN PRINT AND KEYBOARD
      01407 043511
      01410 047040
```

```
      01411 050122
      01412 044516
      01413 052040
      01414 040516
      01415 042040
      01416 045505
      01417 054502
      01420 047501
      01421 051104
0805  01422 000000          OCT 0
0806  01423 061406  SIS     LDA PAKM1
0807  01424 052523  PAKM2   ASC 17,USE KEYBOARD SLOWLY (5 CHS./SEC.)
      01425 042440
      01426 045505
      01427 054502
      01430 047501
      01431 051104
      01432 020123
      01433 046117
      01434 053514
      01435 054440
      01436 024065
      01437 020103
      01440 044123
      01441 027057
      01442 051505
      01443 041456
      01444 024440
0808  01445 000000          OCT 0
0809  01446 061424  SI10    LDA PAKM2
0810  01447 042516  PAKM3   ASC 11,END PRINT AND KEYBOARD
      01450 042040
      01451 050122
      01452 044516
      01453 052040
      01454 040516
      01455 042040
      01456 045505
      01457 054502
      01460 047501
      01461 051104
0811  01462 000000          OCT 0
0812  01463 061447  SI11    LDA PAKM3
0813*
0814*PRINT ALL CHARACTERS SUBROUTINE
0815*
0816  01464 000000  PRALL    NOP             ENTER SUBROUTINE
0817  01465 061472          LDA SC5         PRINT FIRST
0818  01466 015474          JSB .32CH         LINE OF CHARACTERS
0819  01467 061473          LDA SC6         PRINT SECOND
0820  01470 015474          JSB .32CH         LINE OF CHARACTERS
0821  01471 125464          JMP PRALL,I     EXIT SUBROUTINE
0822  01472 000300  SC5     OCT 300
0823  01473 000240  SC6     OCT 240
0824*
0825*PRINT 32 CHARACTERS SUBROUTINE
0826*
```

```
0827   01474 000000  .32CH NOP           ENTER SUBROUTINE
0828   01475 075506        STB BS2       STORE B
0829   01476 065273        LDB SC3       RESET COUNTER
0830   01477 014706        JSB OYNA      PRINT A
0831   01500 002004        INA           INCREMENT A
0832   01501 006006        INB,SZB       32 CHARACTERS?
0833   01502 025477        JMP *-3       NO. PRINT NEXT CHARACTER
0834   01503 014752        JSB EOL       YES. LINE FEED
0835   01504 065506        LDB BS2       RESTORE B
0836   01505 125474        JMP .32CH,I   EXIT SUBROUTINE
0837   01506 000000  BS2   OCT 0         TEMPORARY STORAGE
0838                       END
** NO ERRORS*
```