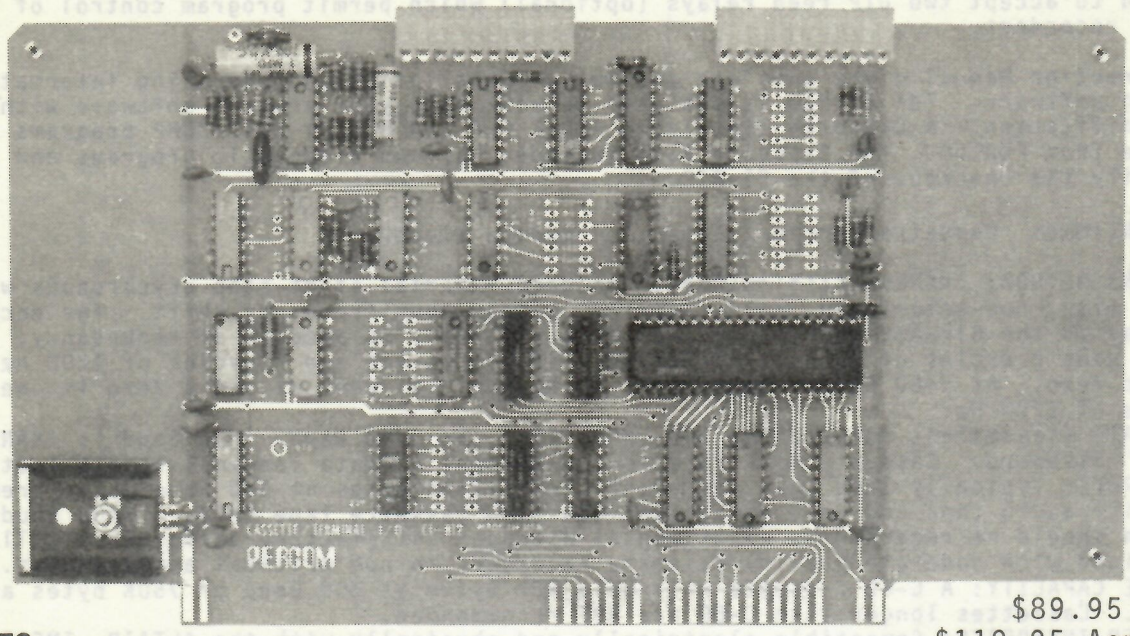
PERCOM

CI-812

CASSETTE/TERMINAL INTERFACE



$89.95 Kit
$119.95 Asmbld

FEATURES

- Includes a 300 to 9600 Baud DATA TERMINAL Interface (RS-232)
- CASSETTE INTERFACE for 30, 60, 120 or 240 Bytes per Second!
- Self-Clocking 'KANSAS CITY'/BIPHASE Cassette Standard
- Phase-locked Data and Clock recovery for Hi Spd reliability
- Works with ORDINARY unmodified AUDIO CASSETTE RECORDERS!
- No Critical adjustments or 'funny' software
- Plug-in Compatible with ALTAIR/IMSAI and S-100 BUSS
- Operate two tape units simultaneously (crossfile)
- Provision for program control of the Cassette (optional)
- Comprehensive Instruction Manual includes Software.

GENERAL DESCRIPTION

The PERCOM CI-812 is the ONLY INTERFACE you need to complete your ALTAIR/IMSAI or similiar computer using the S-100 BUSS Standard! The CI-812 out performs and combines the functions normally requiring two or three more costly interface circuit cards.

In addition to the 300 to 9600 BAUD FULL DUPLEX DATA TERMINAL INTERFACE, the CI-812 contains the most USEFUL, most RELIABLE audio CASSETTE INTERFACE YOU CAN BUY! Data may be recorded and played back on ORDINARY UNMODIFIED CASSETTE RECORDER/PLAYERS at 30, 60, 120 or 240 bytes/second! 30 bytes/second is the 'KANSAS CITY' STANDARD for reliable data interchange; use 120 or 240 bytes/second to quickly load your most frequently used programs.

PERCOM DATA COMPANY 4021 WINDSOR
(214) 276-1968 GARLAND, TEXAS 75042

'peripherals for personal computing'

PHASE-LOCKED and UART data recovery circuits improve data reliability and permit operation at the higher data rates. The CI-812 works well with $30-$100 AUDIO CASSETTE RECORDERS even at 240 bytes per second! This is possible because the encoding technique is based on the reliable Self-Clocking MANCHESTER/BIPHASE Code.

Since the CI-812 Record and Playback circuits are completely independent of one another, it is possible to record on one cassette recorder while reading data from another. This permits crossfile operations such as program editing and assembly. The circuit card is patterned to accept two DIP reed relays (optional) which permit program control of the cassette recorders.

The Instruction Manual gives complete assembly, installation and operating information including software. The CI-812 is designed to work with your present software with little or no modification. A Cassette containing ASCII HEX and BINARY LOAD/DUMP programs is available from PERCOM. The Cassette also includes various diagnostic programs and pattern to simplify the checkout of the CI-812.

SPECIFICATIONS: Cassette/Terminal Interface Module CI-812

ENCODING METHOD: 'KANSAS CITY'/BIPHASE Standard. Serial start-stop asychronous with two stop bits, non-saturating, self-clocking, synchronous frequency shift. The encoding method is the BIPHASE-M or MANCHESTER Code with varying amounts of redundancy. 300 Baud uses 8 cycles of 2400 Hz to define a logic One bit and 4 cycles of 1200 Hz for a logic Zero. At 2400 Baud a logic One is one cycle of 2400 Hz and a Zero is one half cycle of 1200 Hz.

DATA RATE (Cassette): Selectable; 300, 600, 1200, or 2400 Baud. 300 Baud is 'KANSAS CITY' Standard. Cassette data rate is independent of Data Terminal rate selection.

ERROR RATE: Typically less than one error per million bytes at 300 Baud using premium quality audio tape and well maintained $50-$100 Cassette Tape Units. 2400 Baud operation should be regarded as experimental although satisfactory performance will be obtained with moderate quality cassette recorders in non critical applications.

STORAGE CAPACITY: A C-60 Cassette will hold 96K bytes at 300 Baud or 750K bytes at 2400 Baud. Cassettes longer than C-60 are NOT recommended.

COMPUTER INTERFACE: Compatible electrically and physically with the ALTAIR, IMSAI and other computers using the S-100 BUSS. The CI-812 is I/O driven with selectable I/O address. Control and Status is I/O port xxxx xxx0, Data is I/O port xxxx xxx1.

DATA TERMINAL INTERFACE: FULL DUPLEX RS-232 levels at 300, 600, 1200, 2400, 4800, or 9600 Baud. Selection of Cassette or Data Terminal Input is under program control.

CASSETTE AUDIO INTERFACE: Compatible with the EARPLUG output and the AUX or MIC inputs on most portable Cassette Recorder/Players.

POWER REQUIREMENTS:
+8vdc ±1vdc @ 500ma. (obtained from the host computer)
-16vdc ±1vdc @ 20ma. (obtained from the host computer)

PHYSICAL: ALTAIR/IMSAI/S-100 sized circuit card (10"x5.375"). PC card is double-sided 2 oz copper with plated-thru holes on FR4-G10 Epoxy glass. Edge contacts are gold.

PRICES:

CI-812 (kit)	$ 89.95	Cassette/Terminal Interface for ALTAIR/IMSAI type computers
(assembled)	119.95	
I.C. Socket Kit	14.95	Use of IC Sockets not supplied by PERCOM will void warranty
Remote Control Kit	10.95	Permits program control of two cassette recorder/players
Test Cassette	4.95	Contains diagnostic patterns, test tones, and L/D Software.
CI-812 Inst. Manual	4.00	Refunded with CI-812 order.

TERMS: Cash, Check, Money Order, BankAmericard or Master Charge. US Funds only. Add 5% for shipping. We add 10% to COD orders for shipping and handling. Texas Residents add 5% tax. Dealer rates and Group discounts available, Call or write for details. Prices and specifications subject to change without notice.

PERCOM DATA COMPANY

INTRODUCTION

THE PERCOM CI-812 IS THE ONLY INTERFACE YOU NEED TO COMPLETE YOUR ALTAIR/IMSAI OR SIMILIAR COMPUTER USING THE S-1ØØ BUSS STANDARD. THE CI-812 OUT PERFORMS AND COMBINES THE FUNCTIONS NORMALLY REQUIRING TWO OR THREE MORE COSTLY INTERFACE CIRCUIT CARDS.

IN ADDITION TO THE 3ØØ TO 96ØØ BAUD FULL DUPLEX DATA TERMINAL INTERFACE, THE CI-812 CONTAINS THE MOST USEFUL, MOST RELIABLE AUDIO CASSETTE INTERFACE YOU CAN BUY. DATA MAY BE RECORDED AND PLAYED BACK ON ORDINARY UNMODIFIED CASSETTE RECORDER/PLAYERS AT 3Ø, 6Ø, 12Ø OR 24Ø BYTES/SECOND. 3Ø BYTES/SECOND IS THE 'KANSAS CITY' STANDARD FOR RELIABLE DATA INTERCHANGE; USE 12Ø OR 24Ø BYTES/SECOND TO QUICKLY LOAD YOUR MOST FREQUENTLY USED PROGRAMS.

THE CASSETTE INTERFACE IS COMPATIBLE WITH THE 'KANSAS CITY' OR BYTE STANDARD. THIS PARTICULAR TECHNIQUE FOR RECORDING DATA ON AUDIO CASSETTE RECORDERS WAS SELECTED BY A SYMPOSIUM HELD IN KANSAS CITY, MO. IN THE FALL OF 1975. THE STANDARD IS BASED ON THE EXPERIMENTAL WORK OF DON LANCASTER OF SYNERGETICS AND HAROLD MAUCH OF PERCOM DATA CO.

DATA IS RECORDED ON TAPE, BIT SERIAL WITH A START BIT PRECEDING 8 DATA BITS AND TWO OR MORE STOP BITS. THE LOGIC ONE (MARKING STATE) IS IDENTIFIED AS 8 CYCLES OF A 24ØØ HERTZ SIGNAL. THE LOGIC ZERO (SPACING STATE) IS 4 CYCLES OF 12ØØ HERTZ SIGNAL. THE RECOVERED DATA IS SELF CLOCKING, VIRTUALLY ELIMINATING ERRORS CAUSED BY TAPE SPEED VARIATIONS WHICH PLAGUE THE FSK CASSETTE INTERFACES SUCH AS SUDING AND MITS.

ALTHOUGH THE 3ØØ BIT/SECOND (BAUD) RATE WAS CHOSEN TO PROVIDE MAXIMUM RELIABILITY FOR INTERCHANGE OF DATA, THE 'KANSAS CITY' STANDARD IS A HIGHLY (8X) REDUNDANT FORM OF THE BIPHASE-M OR MANCHESTER CODE. A UNIQUE FEATURE OF THE PERCOM CASSETTE INTERFACE IS THE CAPABILITY TO OPERATE AT RATES UP TO 24ØØ BAUD BY CONTROLLING THIS REDUNDANCY. 24ØØ BAUD PERMITS A 4K PROGRAM TO BE LOADED IN LESS THAN 2Ø SECONDS. MOST RELIABLE OPERATION WILL BE OBTAINED AT 3ØØ, 6ØØ OR 12ØØ BAUD.

THIS APPLICATION NOTE CONTAINS INSTRUCTIONS FOR ASSEMBLY, FOR CONNECTION AND USE OF THE CI-812 CASSETTE/TERMINAL INTERFACE.

ASSEMBLY INSTRUCTIONS FOR THE PERCOM CI-812

READ ALL OF THE FOLLOWING INSTRUCTIONS CAREFULLY

BE SURE TO READ THE WARRANTY PARTICULARLY NOTING THE STATEMENTS REGARDING CORROSIVE SOLDER FLUX AND INTEGRATED CIRCUIT SOCKETS.

CHECK THE KIT PARTS AGAINST THE PARTS LIST.

BRUSH BOTH SIDES OF THE PC CARD VIGOROUSLY WITH A DISCARDED TOOTHBRUSH TO REMOVE ANY ETCH SLIVERS WHICH MAY CAUSE INVISIBLE SHORTS.

INSTALL THE COMPONENTS IN THE FOLLOWING ORDER. REFER TO FIGURE 1 FOR COMPONENT LOCATION AND ORIENTATION.

CHECK THE ERRATA SHEETS FOR CHANGES TO THE FOLLOWING PROCEDURE.

RESISTORS:

CHECK	RESISTOR	VALUE	COLOR CODE
( )	R1	47K ¼W	YL VI OR
( )	R2	1ØK	BR BK OR
( )	R3	1ØØK	BR BK YL
( )	R4	1ØK	BR BK OR
( )	R5	68K	BU GR OR
( )	R6	4.7K	YL VI RD
( )	R7	1ØØK	BR BK YL
( )	R8	1ØK	BR BK OR
( )	R9	1ØK	BR BK OR
( )	R1Ø	1ØØK	BR BK YL
( )	R11	1K	BR BK RD
( )	R12	18Ø	BR GY BR
( )	R13	82Ø	GY RD BR
( )	R14	1K	BR BK RD
( )	R15	47Ø	YL VI BR
( )	R16	4.7K	YL VI RD
( )	R17	47K	YL VI OR
( )	R18	18Ø	BR GY BR
( )	R19	1ØK	BR BK OR
( )	R2Ø	1ØK	BR BK OR
( )	R21	1ØØ	BR BK BR
( )	R22	4.7K	YL VI RD
( )	R23	1K	BR BK RD
( )	R24	——	NOT USED
( )	R25	27K	RD VI OR
( )	R26	1K	BR BK RD
( )	R27	1ØK	BR BK OR
( )	R28	1ØK	BR BK OR
( )	R29	2.7K	RD VI RD
( )	R3Ø	1ØK	BR BK OR

BK-BLACK Ø
BR-BROWN 1
RD-RED 2
OR-ORANGE 3
YL-YELLOW 4
GR-GREEN 5
BU-BLUE 6
VI-VIOLET 7
GY-GRAY 8
WH-WHITE 9

CHECK	RESISTOR	VALUE	COLOR CODE
( )	R31	4.7K	YL VI RD
( )	R32	18Ø ½W	BR GY BR
( )	R33		NOT USED

DIODES:

( )	CR1	1N914
( )	CR2	*
( )	CR3	*
( )	CR4	1N759A
( )	CR5	1N914

SOLDER AND CLIP ALL RESISTOR AND DIODE LEADS

CAPACITORS:

CHECK	CAPACITOR	VALUE	TYPE
( )	C1	Ø.Ø47UF	MYLAR
( )	C2	Ø.Ø1UF	DISC
( )	C3	15ØPF	MICA
( )	C4	Ø.Ø47UF	MYLAR
( )	C5	Ø.Ø1UF	DISC
( )	C6	Ø.ØØ1UF OR 75ØPF	DISC
( )	C7	Ø.Ø1UF	DISC
( )	C8	Ø.Ø1UF	DISC
( )	C9	Ø.Ø1UF	DISC
( )	C1Ø	25 OR 3ØUF	ELECTROLYTIC
( )	C11	Ø.Ø1UF	DISC
( )	C12	Ø.Ø1UF	DISC
( )	C13	25 OR 3ØUF	ELECTROLYTIC
( )	C14	Ø.Ø1UF	DISC
( )	C15	Ø.ØØ1UF OR 75ØPF	DISC

TRANSISTORS:

( )	Q1	2N3565	NPN HIB
( )	Q2	2N5449	NPN
( )	Q3	2N5138	PNP HIB

SOLDER AND CLIP THE CAPACITOR AND TRANSISTOR LEADS.

* THESE COMPONENTS ARE PART OF THE REMOTE CONTROL KIT.

INTEGRATED CIRCUITS:

WARNING: THE USE OF SOCKETS FOR MOUNTING THE INTEGRATED CIRCUITS IS NOT RECOMMENDED. MORE SPECIFICALLY, THE USE OF ANY IC SOCKETS NOT SUPPLIED BY PERCOM DATA CO. AUTOMATICALLY VOIDS ANY AND ALL WARRANTIES. IF YOU WISH TO USE SOCKETS, A KIT IS AVAILABLE FROM PERCOM. THESE SOCKETS ARE OF SUBSTANTIALLY HIGHER QUALITY THAN IS USUALLY AVAILABLE THROUGHT THE USUAL OUTLETS.

IF YOU ARE NOT FAMILIAR WITH INTEGRATED CIRCUIT INSERTION AND SOLDERING TECHNIQUES, REFER TO APPENDIX A FOR HANDLING INSTRUCTIONS.

CHECK	IC	TYPE
( )	Z1	LM339
( )	Z2	74LS113
( )	Z3	74197 OR 74LS197
( )	Z4	74153 OR 74LS153
( )	Z5	74197 OR 74LS197
( )	Z6	74197 OR 74LS197
( )	Z7	74LS86
( )	Z8	74LS74
( )	Z9	74LS74
( )	Z1Ø	74157 OR 74LS157
( )	Z11	7474
( )	Z12	74LS1Ø
( )	Z13	74LS74
( )	Z14	74LSØ4
( )	Z15	74LSØØ
( )	Z16	74LSØØ
( )	Z17	25Ø2 OR AY5-1Ø13
( )	Z18	74197 OR 74LS197
( )	Z19	74LS3Ø
( )	Z2Ø	74LSØ4
( )	Z21	74LSØ2
( )	Z22	74367
( )	Z23	74367
( )	Z24	74367

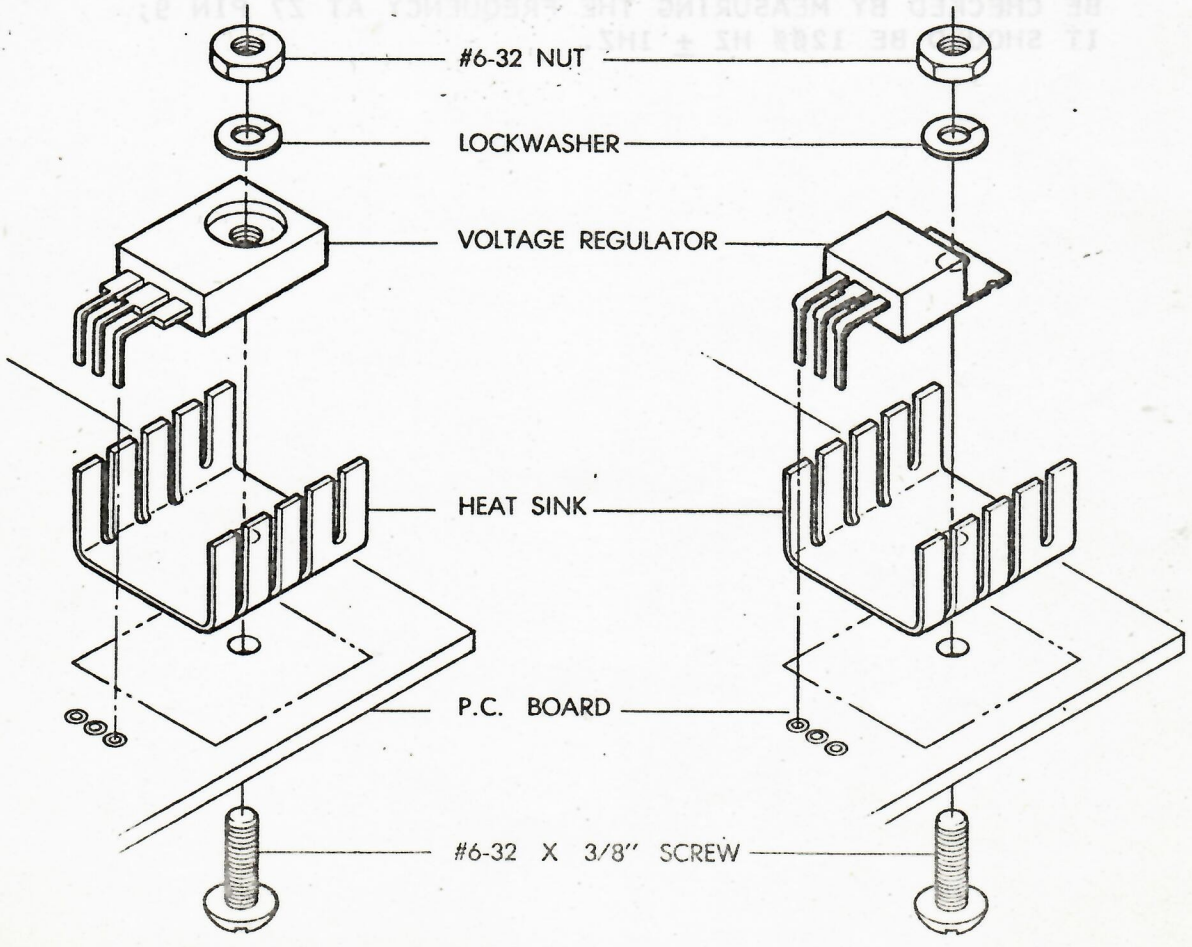
RECHECK ORIENTATION (NOTE THAT ALTERNATE ROWS OF IC'S ARE ORIENTED DIFFERENTLY) AND SOLDER ALL INTEGRATED CIRCUITS

MISC:

(—) 78Ø5 5 VOLT REGULATOR

PLACE THE METAL TAB OF THE REGULATOR OVER THE HOLE IN THE HEAT SINK AREA ON THE LOWER LEFT OF THE CIRCUIT CARD. POSITION THE THREE LEADS OVER THE LEAD FEED THRU HOLES AND NOTE WHERE TO BEND EACH LEAD. BEND EACH LEAD WITH SMALL PLIERS AND CHECK TO SEE THAT WHEN THE LEADS GO THROUGH THE BOARD, THE MOUNTING HOLES LINE UP. INSERT THE 6-32 SCREW FROM THE BOTTOM OF THE BOARD, PLACE THE HEAT SINK OVER THE SCREW FROM THE TOP, INSERT THE REGULATOR LEADS INTO THE BOARD WHILE THE TAB SLIPS OVER THE MACHINE SCREW. USE THE LOCKWASHER AND NUT TO SECURE THE REGULATOR AND HEAT SINK TO THE BOARD. SOLDER THE LEADS AND TRIM.

(—) RT 47K OR 5ØK TRIMMER RESISTOR
SOLDER IN PLACE
(—) TSA 1Ø CONTACT TERMINAL STRIP
(—) TSB 1Ø CONTACT TERMINAL STRIP
SOLDER IN PLACE
( ) CHECK THE ERRATA SHEET AGAIN FOR NECESSARY CHANGES TO THE CIRCUIT



BENDING THE VOLTAGE REGULATOR LEADS

CIRCUIT ADJUSTMENT

IF THE CI-812 WAS ASSEMBLED FROM A KIT IT WILL BE NECESSARY TO ADJUST THE VCO TRIMMER (RT).

( ) INSTALL THE CI-812 INTO YOUR COMPUTER AND APPLY POWER (NO CONNECTION FROM THE CASSETTE PLAYER).
( ) MEASURE THE VOLTAGE AT TP1 (UPPER LEFT HAND CORNER OF CARD) WITH A HIGH IMPEDANCE (2ØK OHMS/VOLT) VOLTMETER (CONNECT THE VOLTMETER RETURN TO TSB-1Ø). IT SHOULD BE APPROXIMATELY 2 VOLTS, NOTE THE EXACT READING.
( ) WITH A CLIP LEAD OR PIECE OF WIRE JUMPER FROM THE BOTTOM END OF R17 TO THE TOP END OF C4.
( ) NOTE THE VOLTMETER READING WHILE ADJUSTING TRIMMER RT. AT SOME POINT IN THE ADJUSTMENT THE VCO WILL "JUMP INTO LOCK" AND THE VOLTAGE AT TP1 WILL FOLLOW THE POT ADJUSTMENT. ADJUST THE POT WHILE "IN LOCK" FOR THE SAME VOLTAGE AS WAS MEASURED EARLIER.
( ) REMOVE THE JUMPER.

IF A FREQUENCY COUNTER IS AVAILABLE THE ADJUSTMENT CAN BE CHECKED BY MEASURING THE FREQUENCY AT Z7 PIN 9; IT SHOULD BE 12ØØ HZ ± 1HZ.

IMPORTANT NOTICE

ERRATA FOR CI-812 CASSETTE/TERMINAL I/O FEBRUARY 14, 1977

1. THE FOLLOWING JUMPER WIRES MUST BE INSTALLED AFTER THE CI-812 KIT IS ASSEMBLED AND SOLDERED. A LENGTH OF #30 INSULATED WIRE HAS BEEN INCLUDED IN THE KIT FOR THIS PURPOSE.

   JUMPER Z15-5 TO Z15-12
   JUMPER Z15-13 TO Z16-12
   JUMPER Z15-11 TO Z17-18

   THE SCHEMATIC IS CORRECT AND REFLECTS THIS MODIFICATION

CONNECTING TO THE CI-812:

CASSETTE RECORDER:

FORTUNATELY NEARLY ANY CASSETTE TAPE RECORDER WILL PERFORM WELL WITH CI-812. THE CASSETTE INTERFACE IS COMPATIBLE WITH THE EARPLUG OUTPUT AND AUX OR MIC INPUTS ON MOST PORTABLE CASSETTE RECORDERS. OTHER TYPES OF RECORDERS MAY REQUIRE SOME KIND OF AMPLIFIER BETWEEN THE RECORDER AND CI-812.

EARPLUG: CONNECT THE TAPE RECORDER EARPLUG TO TSA CONNECTOR PIN 5. CONNECT THE RETURN OR SHIELD TO TSA PIN 4 (GROUND).

AUX: CONNECT THE TAPE RECORDER AUX INPUT TO TSA CONNECTOR PIN 2. CONNECT THE RETURN OR SHIELD TO TSA PIN 3 (GROUND).

MIC: NORMALLY CONNECTION TO THE TAPE RECORDER MICROPHONE INPUT IS NOT NECESSARY. THE AUX INPUT IS PREFERRED SINCE IT OPERATES AT A HIGHER SIGNAL LEVEL AND IS LESS SENSITIVE TO NOISE PICKUP. IF THE MIC INPUT IS USED CONNECT TO THE TSA CONNECTOR PIN 1 (INSTEAD OF PIN 2). CONNECT THE RETURN SHIELD TO TSA PIN 3 (GROUND).

WARNING: SOME RECORDERS HAVE COMMON RETURN CIRCUITS ON THE EARPLUG AND INPUT JACKS WHICH MAY CAUSE GROUND LOOP HUM AND NOISE IF BOTH EARPLUG AND AUX (OR MIC) RETURNS ARE EXTERNALLY GROUNDED. IF THIS IS A PROBLEM, DISCONNECT THE AUX RETURN (SHIELD) AND LEAVE IT DISCONNECTED. THE EARPLUG RETURN WILL PROVIDE THE RETURN CIRCUIT. YOU WILL BE ABLE TO HEAR THE NOISE OR HUM IF A SPEAKER IS CONNECTED TO THE 'SIDETONE' OUTPUT (DESCRIBED LATER).

WARNING: SOME RECORDERS LEAVE THE BUILT-IN MICROPHONE ACTIVE EVEN IF A PLUG IS INSERTED INTO THE AUX JACK. THIS WILL ALLOW ROOM NOISE TO 'CLOBBER' YOUR RECORDING. USE THE MICROPHONE JACK OR STICK A 'DUMMY' PLUG INTO THE MICROPHONE JACK TO KILL THE BUILT-IN MICROPHONE.

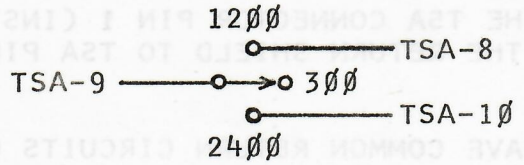
CASSETTE DATA RATE SELECTION:

THE PERCOM CI-812 CASSETTE INTERFACE IS CAPABLE OF OPERATING AT 3ØØ, 6ØØ, 12ØØ OR 24ØØ BAUD. THE DATA RATE IS SELECTED BY PINS 8 AND 1Ø ON THE TSA CONNECTOR. IF NO CONNECTION IS MADE TO EITHER PIN THE CASSETTE INTERFACE IS CONFIGURED FOR 3ØØ BAUD (K.C. STANDARD). FOR OTHER DATA RATES CONNECT THE PINS AS FOLLOWS:

TSA -8	TSA -1Ø	CASSETTE DATA RATE
NC*	NC	3ØØ BAUD
GND#	GND	6ØØ "
GND	NC	12ØØ "
NC	GND	24ØØ "

* NO CONNECTION
# GROUND IS AVAILABLE AT TSA-9

THE DATA RATE IS MOST EASILY CONTROLLED BY CONNECTING A SINGLE POLE 3-POSITION SWITCH AS FOLLOWS:



DATA TERMINAL:
THE CI-812 INCLUDES A FULL DUPLEX DATA TERMINAL INTERFACE AT RS-232 LEVELS FOR 3ØØ, 6ØØ, 12ØØ, 24ØØ, 48ØØ OR 96ØØ BAUD DATA TERMINALS.

( ) CONNECT THE KEYBOARD OR DATA TERMINAL TRANSMITTED DATA (EIA PIN 2) TO TSB-9.
( ) CONNECT THE PRINTER, DISPLAY OR DATA TERMINAL RECEIVED DATA (EIA PIN 3) TO TSB-8.
( ) CONNECT THE DATA TERMINAL SIGNAL RETURN (EIA PIN 7) TO TSB-1Ø. DO NOT CONNECT THE PROTECTIVE GROUND (EIA PIN 1) TO TSB-1Ø, IT SHOULD BE CONNECTED INSTEAD TO THE FRAME OF THE HOST COMPUTER.

THE DATA TERMINAL RATE IS DETERMINED BY AN APPROPRIATE JUMPER IN THE PADS BETWEEN Z9 AND Z1Ø. JUMPER ACROSS THE APPROPRIATE NUMBER. A 7 POLE DIP SWITCH MAY BE INSTALLED IN THE PADS IF DESIRED BUT ONLY ONE SWITCH MAY BE CLOSED AT ANYTIME.

ADDRESS SELECTION:

THE CI-812 RESPONDS TO I/O COMMANDS FROM THE PROCESSOR.

INPORT XXXXXXXØ TRANSFERS INTERFACE STATUS TO THE PROCESSOR.

OUTPORT XXXXXXXØ TRANSFERS CONTROL INSTRUCTIONS TO THE INTERFACE.

INPORT XXXXXXX1 TRANSFERS 8 BITS OF DATA FROM THE INTERFACE TO THE PROCESSOR.

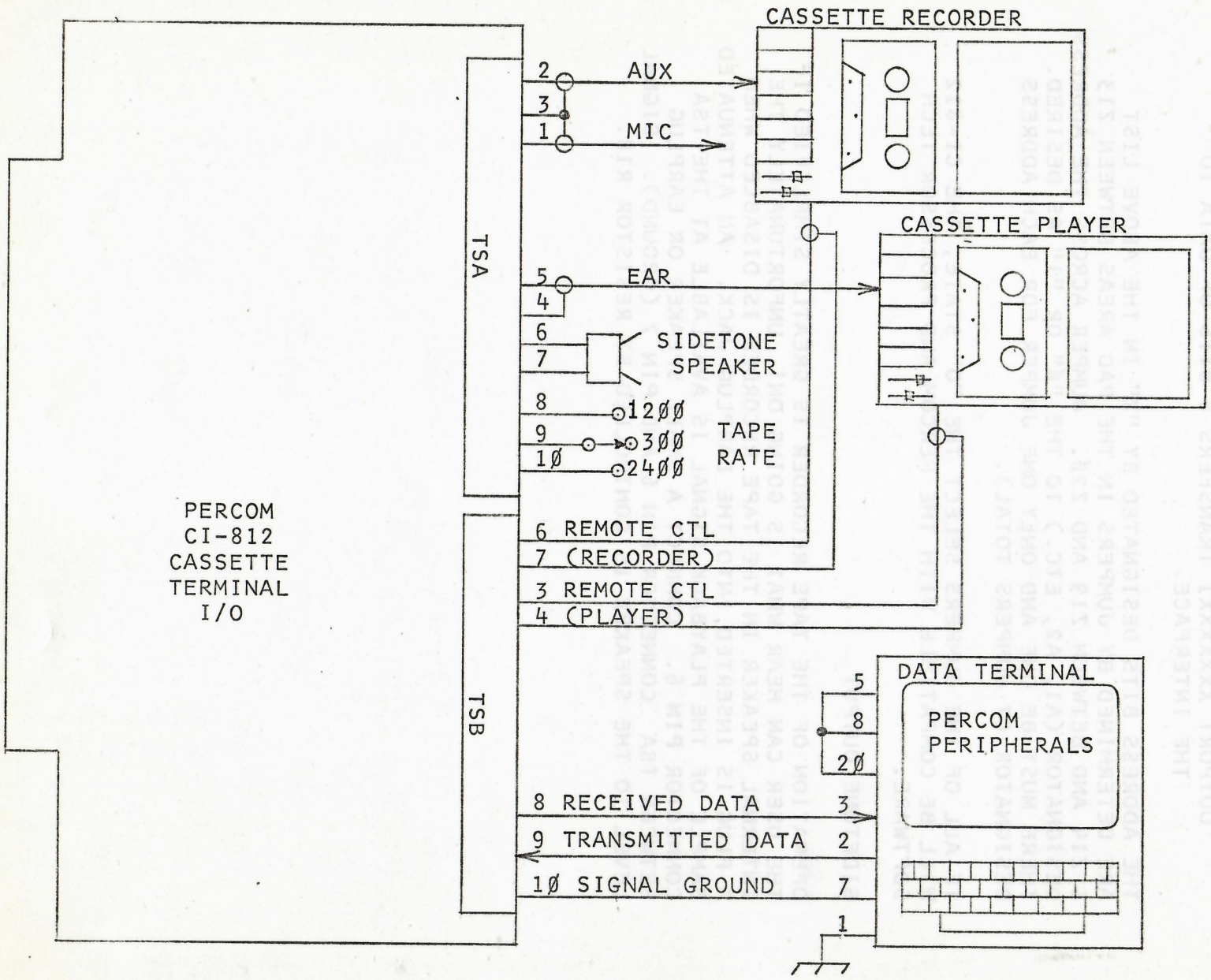
OUTPORT XXXXXXX1 TRANSFERS 8 BITS OF DATA TO THE INTERFACE.

THE ADDRESS BITS DESIGNATED BY "X" IN THE ABOVE LIST ARE DETERMINED BY JUMPERS IN THE PAD AREAS BETWEEN Z13 & Z14 AND BETWEEN Z19 AND Z2Ø. JUMPER ACROSS THE ADDRESS DESIGNATOR (A1, A2, ETC.) TO THE "Ø" OR "1" AS DESIRED. THERE MUST BE ONE AND ONLY ONE JUMPER FOR EACH ADDRESS DESIGNATOR (7 JUMPERS TOTAL).

IF ALL OF THE JUMPERS SELECT THE "0" STATE, THE CI-812 WILL BE COMPATIBLE WITH THE PERCOM AND PROCESSOR TECH SOFTWARE.

SIDETONE OUTPUT

OPERATION OF THE TAPE RECORDER IS GREATLY SIMPLIFIED IF THE USER CAN HEAR WHAT IS GOING ON! UNFORTUNATELY THE INTERNAL SPEAKER IN THE TAPE RECORDER IS DISABLED WHEN A PLUG IS INSERTED INTO THE EARPLUG JACK. AN ATTENUATED SAMPLE OF THE PLAYBACK SIGNAL IS AVAILABLE AT THE TSA CONNECTOR PIN 6. CONNECT A SMALL SPEAKER OR EARPLUG BETWEEN TSA CONNECTOR PIN 6 AND PIN 7 (GROUND). SIGNAL LEVEL TO THE SPEAKER IS CONTROLLED BY RESISTOR R18.



SYSTEM CONFIGUR ION

OPERATING PROCEDURE:

CASSETTE SELECTION AND CARE:

THE CHOICE OF CASSETTE TAPE HAS MORE EFFECT ON PERFORMANCE THAN ALL OTHER FACTORS COMBINED. GET THE VERY BEST TAPE YOU CAN BUY. ANYTHING LESS THAN THE BEST WILL RESULT IN MUCH FRUSTRATION. AVOID USING THE C9Ø AND C12Ø CASSETTES. THE TAPE IS TOO THIN AND FRAGILE. C6Ø AND SHORTER ARE MUCH MORE RUGGED AND RELIABLE.

IF THE CASSETTE IS NOT IN USE IT SHOULD BE STORED IN ITS CONTAINER IN A DUST FREE LOCATION. KEEP THE CASSETTE RECORDER SPOTLESSLY CLEAN. CLEAN THE HEAD, CAPSTAN, AND PINCH ROLLER WITH A CLEANING SOLUTION SUGGESTED BY THE EQUIPMENT MANUFACTURER. DO NOT SMOKE IN THE ROOM IN WHICH THE CASSETTE EQUIPMENT IS USED OR STORED.

IT IS IMPOSSIBLE TO ADEQUATELY STRESS THE IMPORTANCE OF BUYING THE VERY BEST QUALITY TAPE AND THEN KEEPING IT AND THE TAPE UNIT CLEAN.

IT IS RECOMMENDED EACH CASSETTE BE THOROUGHLY TESTED BEFORE USE. REFER TO APPENDIX C FOR INSTRUCTIONS.

RECORDING DATA ON TAPE:

1. DO NOT RECORD ON THE FIRST TWO FEET OF TAPE (15 SEC.). THE LEADER-TAPE SPLICE CAUSES A 'RIPPLE' ON ADJACENT LAYERS WHICH MAY CAUSE ERRORS.

2. PREPARE THE COMPUTER TO OUTPUT THE REQUIRED DATA TO THE CASSETTE INTERFACE. DO NOT BEGIN OUTPUTTING THE DATA JUST YET.

3. PLACE THE CASSETTE RECORDER IN RECORD MODE AND START THE TAPE. TURN ON THE AUTOMATIC LEVEL CONTROL OR ADJUST THE RECORDER FOR PROPER SIGNAL LEVEL.

4. ALLOW THE TAPE TO RUN FOR 3 TO 5 SECONDS. THE RECORDER WILL BE RECORDING A 24ØØ HZ 'LEADIN' TONE ON THE TAPE DURING THIS INTERVAL.

5. WHILE ALLOWING THE TAPE TO RUN, CAUSE THE COMPUTER TO BEGIN TRANSFERRING DATA TO THE CASSETTE INTERFACE.

6. WHEN THE RECORDING IS COMPLETE, LET THE TAPE RUN FOR A FEW SECONDS TO RECORD A 'LEADOUT' TONE.

PLAYBACK:

1. ADJUST THE PLAYBACK SIGNAL LEVEL FOR 4 TO 1Ø VOLTS PEAK-TO-PEAK. MARK THE VOLUME CONTROL SETTING FOR FUTURE REFERENCE. ADJUST THE TONE CONTROL (IF ONE EXISTS) FOR MAXIMUM RESPONSE. THE VOLUME SHOULD BE ADJUSTED WHILE PLAYING THE 24ØØ HZ 'LEADIN' TONE PRECEDING A BLOCK OF DATA.

2. LOCATE THE 'LEADIN' 24ØØ HZ TONE PRECEDING THE DESIRED BLOCK OF DATA. IF A SMALL SPEAKER IS CONNECTED TO THE 'SIDETONE' OUTPUT (TSA CONNECTOR PIN 6), THE TONE CAN BE HEARD WITHOUT PULLING OUT THE EARPLUG LEAD FROM THE CASSETTE PLAYER.

3. BEFORE THE CASSETTE BEGINS OUTPUTTING DATA, PREPARE THE COMPUTER TO ACCEPT THE DATA WHEN IT ARRIVES.

BE CERTAIN THE PLAYBACK IS ONE OR TWO SECONDS INTO THE 'LEADIN' TONE BEFORE ALLOWING THE COMPUTER TO ACCEPT THE PLAYBACK DATA. THIS IS TO AVOID READING THE 'RESIDUALS' FROM PREVIOUS RECORDINGS AND THE 'TRASH' CAUSED BY TURNING THE CASSETTE RECORDER ON AND OFF. SUFFICIENT TIME IS AVAILABLE TO PERFORM THE NECESSARY STEPS IF THE TAPE WAS RECORDED WITH A 3 TO 5 SECOND 'LEADIN' TONE.

4. IF THE RECORDED DATA HAS AN 'END-OF-BLOCK' CODE AT THE END OF THE RECORDED BLOCK OF DATA, THE COMPUTER CAN BE MADE TO AUTOMATICALLY IGNORE THE CASSETTE OUTPUT AFTER THE 'EOB' CODE. IF NO SUCH INDICATION EXISTS, THE USER WILL HAVE TO DISABLE THE COMPUTER BEFORE TURNING OFF THE TAPE TO PREVENT THE TURN-OFF TRANSIENT FROM SENDING CONFUSING 'TRASH' TO THE COMPUTER. OBVIOUSLY A DATA BLOCK TERMINATED WITH SOME FORM OF 'END-OF-BLOCK' INDICATION IS PREFERRED. THE PROGRAM LOADING SOFTWARE CONTAINED IN APPENDIX A PROVIDES PROPER BEGINNING OF BLOCK AND END OF BLOCK INDICATION.

RÉFER TO APPENDIX B FOR INFORMATION ON SEMIAUTOMATIC OPERATION USING THE CASSETTE RECORDER REMOTE CONTROL JACK.

SOFTWARE CONSIDERATIONS:

ATTACHED TO THIS SECTION ARE SEVERAL PROGRAMS WHICH ILLUSTRATE HOW TO USE THE CI-812. THESE PROGRAMS MAY BE USED IN WHOLE OR AS PART OF YOUR SPECIFIC CASSETTE OPERATING SYSTEM. THE DESIGN OF THE CI-812 IS SUCH THAT IT IS COMPATIBLE, INSOFAR AS POSSIBLE, WITH THE SOFTWARE AVAILABLE FROM PROCESSOR TECHNOLOGY AND IMS ASSOCIATES.

THE CI-812 CONTAINS A UART (UNIVERSAL ASYNCHRONOUS RECEIVER TRANSMITTER) WHICH IS USED TO SEND DATA TO AND RECEIVE DATA FROM THE CASSETTE TAPE UNIT(S) AND THE DATA TERMINAL.

THE UART STATUS IS AVAILABLE VIA INPUT PORT XXXXXXXØ THE "X" REPRESENTS ADDRESS SELECTION JUMPERS WHICH MUST BE INSTALLED ON THE CI-812 TO DETERMINE THE DESIRED ADDRESS TO WHICH THE CI-812 WILL RESPOND. THE PERCOM SOFTWARE IS WRITTEN ASSUMING ALL OF THE ADDRESS SELECTION JUMPERS ARE SET FOR "Ø".

INPUT PORT XXXXXXXØ BIT 7 IS UART TRANSMITTER BUFFER READY
" 6 IS UART RECEIVER DATA AVAILABLE
" 5 IS UART RECEIVER OVER RUN
" 4 IS UART RECEIVER FRAMING ERROR
" 3 IS UART RECEIVER PARITY ERROR
" 2 IS NOT USED
" 1 IS NOT USED
" Ø IS NOT USED

NORMALLY ONLY BIT 7 (TBMT) AND BIT 6 (DAV) WILL BE EXAMINED TO DETERMINE UART STATUS.

OUTPUT PORT XXXXXXXØ DETERMINES WHETHER THE UART WILL BE CLOCKED BY THE INTERNAL CLOCK AT THE SELECTED DATA TERMINAL OR CASSETTE DATA RATE OR BY THE CLOCK OBTAINED FROM THE CASSETTE TAPE DURING PLAYBACK. IT ALSO DETERMINES WHETHER THE UART RECEIVER WILL GET DATA FROM THE DATA TERMINAL OR FROM THE CASSETTE.

IF BIT Ø IS "ZERO":

A) THE UART RECEIVER WILL BE CONNECTED TO THE DATA TERMINAL (KEYBOARD)
B) THE CASSETTE PLAYBACK WILL BE IGNORED
C) RELAY K1 (IF INSTALLED) WILL BE OFF (DE-ENERGIZED)
D) THE UART RECEIVER AND TRANSMITTER WILL BE CLOCKED AT A RATE DETERMINED BY THE TERMINAL RATE STRAP ON THE CI-812

SOFTWARE CONT'D.

IF BIT Ø IS "ONE":

A) THE UART RECEIVER WILL BE CONNECTED TO THE CASSETTE DEMODULATOR FOR DATA INPUT
B) THE DATA TERMINAL KEYBOARD WILL BE IGNORED
C) RELAY K1 (IF INSTALLED) WILL BE ON
D) THE UART RECEIVER WILL BE CLOCKED BY A SIGNAL DERIVED FROM THE TAPE RECORDED DATA (SELF CLOCKING)
E) THE UART TRANSMITTER WILL BE CLOCKED AT A RATE DETERMINED BY THE LEVELS ON THE CASSETTE RATE SELECTION INPUTS AT TSA-8 AND TSA-1Ø

IF BIT 1 IS A "ZERO":

A) RELAY K2 (IF INSTALLED) WILL BE OFF
B) THE UART TRANSMITTER WILL GENERATE ONLY ONE STOP BIT (TERMINAL MODE)

IF BIT 1 IS A "ONE":

A) RELAY K2 (IF INSTALLED) WILL BE ON
B) THE UART TRANSMITTER WILL GENERATE TWO STOP BITS (CASSETTE MODE)

BITS 2 THRU 7 ARE NOT USED.

THE LATCHES WHICH STORE BITS Ø AND 1 ARE SET TO "ZERO" BY A POWER-ON-CLEAR OR RESET FROM THE IMSAI COMPUTER FRONT PANEL.

BIT Ø IS USED PRIMARILY TO SWITCH THE UART BETWEEN THE DATA TERMINAL AND THE PLAYBACK CASSETTE.

BIT 1 IS USED TO CONTROL THE RECORDING CASSETTE (IN A TWO CASSETTE SYSTEM) AND DETERMINE THE NUMBER OF STOP BITS TRANSMITTED BY THE UART.

THE UART TRANSMITTER SENDS DATA TO THE DATA TERMINAL AND CASSETTE SIMULTANEOUSLY. HOWEVER, THE RATE IS CONTROLLED BY BIT Ø.

THE ABOVE SYSTEM GIVES CONSIDERABLE FLEXIBILITY FOR BOTH SINGLE AND DUAL CASSETTE SYSTEMS. STUDY IT CAREFULLY AND YOU WILL BE ABLE TO CONFIGURE A SYSTEM WHICH IS OPTIMUM FOR YOUR REQUIREMENTS.

SOFTWARE CONT'D.

TO SELECT THE DATA TERMINAL FOR DATA INPUT:

```
        XRA   A
        OUT   Ø
```

TO SELECT AND TURN ON THE CASSETTE FOR DATA INPUT:

```
        MVI   A,1
        OUT   Ø
```

TO TURN ON THE CASSETTE RECORDER (TERMINAL RATE)

```
        MVI   A,2
        OUT   Ø
```

PORT XXXXXXX1 TRANSFERS DATA TO/FROM THE UART

THE FOLLOWING ROUTINE ILLUSTRATES HOW TO READ A BYTE FROM THE CI-812.

```
LOOP    IN    Ø       TEST RECEIVER STATUS (DAV)
        ANI   40H
        JZ    LOOP    DO AGAIN IF NOT READY
        IN    1       GET THE BYTE OR CHARACTER
        RET
```

TO RECORD OR OUTPUT A BYTE FROM THE PROCESSOR ACCUMULATOR:

```
        PUSH  PSW     SAVE THE BYTE
LOOP    IN    Ø       TEST TRANSMITTER STATUS (TBMT)
        ANI   80H
        JZ    LOOP    DO AGAIN IF NOT READY
        POP   PSW     RESTORE THE BYTE
        OUT   1       OUTPUT THE BYTE
        RET
```

BOOTSTRAP LOADER

THE FOLLOWING PROGRAM IS SHORT ENOUGH TO BE CONVENIENTLY LOADED BY HAND USING THE FRONT PANEL SWITCHES ON YOUR ALTAIR OR IMSAI COMPUTER. IT LOADS ONE PAGE (256 BYTES) OF DATA AND IS DESIGNED TO OPERATE WITH THE PERCOM CI-812 CASSETTE I/O AND THE PERCOM TEST CASSETTE WHICH CONTAINS AN INTEL FORMAT CHECKSUM LOADER.

TO USE THIS PROGRAM WITH THE PERCOM TEST CASSETTE, LOAD THE PROGRAM BUT DO NOT START IT RUNNING. START THE CASSETTE TAPE AND LET IT RUN UNTIL YOU ARE ONE OR TWO SECONDS INTO THE NULL CODE LEADER. WHILE THE TAPE IS RUNNING START THE BOOTSTRAP PROGRAM (EXAMINE ADDRESS ØØØØ AND PRESS RUN). WHEN THE LOAD IS COMPLETED THE COMPUTER WILL AUTOMATICALLY BEGIN EXECUTING THE PROGRAM JUST LOADED.

```
                    * PERCOM CASSETTE BOOTSTRAP LOADER (8Ø8Ø)*
ØØØØ  AF              XRA   A
ØØØ1  6F              MOV   L,A        INITIALIZE H&L
ØØØ2  67              MOV   H,A
ØØØ3  3C              INR   A
ØØØ4  D3 ØØ           OUT   Ø          SELECT  CASSETTE INPUT
ØØØ6  DB Ø1           IN    1          CLEAR UART
ØØØ8  31 1D ØØ        LXI   SP,STAK    SETUP RETURN ADDRESS
ØØØB  DB ØØ           IN    Ø          TEST UART STATUS (DAV)
ØØØD  E6 4Ø           ANI   4ØH
ØØØF  C8              RZ               RETURN-NOT READY
ØØ1Ø  DB Ø1           IN    1          GET DATA
ØØ12  24              INR   H          TEST H REGISTER
ØØ13  25              DCR   H
ØØ14  C2 19 ØØ        JNZ   STR        FIRST NON ZERO BYTE IS
ØØ17  67              MOV   H,A        PAGE ADDRESS
ØØ18  C9              RET
ØØ19  77        STR   MOV   M,A        STORE DATA BYTE
ØØ1A  2C              INR   L          BUMP LOAD ADDRESS
ØØ1B  CØ              RNZ              GET NEXT BYTE
ØØ1C  E9              PCHL             ALL DONE - NOW EXECUTE
ØØ1D  Ø8 ØØ           DW    RTN
```

BOOTSTRAP DUMP

THE FOLLOWING PROGRAM WILL RECORD A PAGE (256 BYTES) OF DATA ON CASSETTE IN A FORMAT WHICH MAY SUBSEQUENTLY BE LOADED INTO THE COMPUTER USING THE BOOTSTRAP LOADER DESCRIBED ON THE PREVIOUS PAGE. SET THE DESIRED PAGE ADDRESS UP ON THE FRONT PANEL SWITCHES (SWITCHES 15 THRU 8 ON THE IMS COMPUTER), START THE PROGRAM RUNNING, START THE CASSETTE RECORDING. LET THE TAPE RUN FOR ABOUT 10-15 SECONDS TO RECORD A NULL CODE LEADER THEN PRESS ANY KEY ON YOUR TERMINAL KEYBOARD. AT 300 BAUD IT TAKES APPROXIMATELY 9 SECONDS TO RECORD A 256 BYTE PAGE. LET THE TAPE RUN AN ADDITIONAL 2-3 SECONDS TO ASSURE A CLEAN RUN OUT.

THE DATA TERMINAL RATE SELECTION STRAP MUST BE SET AT THE RATE YOU WISH THE DATA TO BE RECORDED ON CASSETTE.

* PERCOM CASSETTE BOOTSTRAP DUMP (8080) *

```
3D7D  31 FF CF        LXI   SP,SPTR   INITIALIZE STACK POINTER
3D80  DB 01           IN    1         CLEAR UART
3D82  AF        B1    XRA   A
3D83  6F              MOV   L,A       INITIALIZE L
3D84  D3 00           OUT   0         SELECT TERMINAL
3D86  CD A5 3D        CALL  OUT       OUTPUT NULL CODE
3D89  DB 00           IN    0         TEST KEYBOARD STATUS
3D8B  E6 40           ANI   40H
3D8D  CA 82 3D        JZ    B1        DO ANOTHER NULL
3D90  DB 01           IN    1         CLEAR UART
3D92  DB FF           IN    FF        GET PAGE ADDRESS FROM
3D94  D3 FF           OUT   FF        PANEL SWITCHES - ECHO
3D96  67              MOV   H,A       STORE IN H REG
3D97  CD A5 3D        CALL  OUT       OUTPUT PAGE ADDRESS
3D9A  7E        B2    MOV   A,M       GET DATA
3D9B  CD A5 3D        CALL  OUT       OUTPUT
3D9E  2C              INR   L         BUMP ADDRESS
3D9F  C2 9A 3D        JNZ   B2        GET ANOTHER BYTE
3DA2  C3 82 3D        JMP   B1        BACK TO NULL

3DA5  5F        OUT   MOV   E,A       SAVE BYTE
3DA6  DB 00     T1    IN    0         TEST STATUS (TBMT)
3DA8  E6 80           ANI   80H
3DAA  CA A6 3D        JZ    T1        KEEP TESTING UNTIL READY
3DAD  7B              MOV   A,E       RESTORE BYTE
3DAE  D3 01           OUT   1
3DB0  C9              RET
```

PERCOM 8Ø8Ø MONITOR

THE FOLLOWING PROGRAM IS A CASSETTE OPERATING SYSTEM FOR A COMPUTING SYSTEM CONSISTING OF AN 8Ø8Ø (OR Z-8Ø) PROCESSOR, PERCOM CI-812 CASSETTE/TERMINAL I/O, AND A 3ØØ-96ØØ BAUD DATA TERMINAL.

THE PROGRAM IS AVAILABLE ON THE PERCOM TEST CASSETTE WHICH ALSO CONTAINS TEST PATTERNS TO VERIFY THE OPERATION OF THE CASSETTE INTERFACE. IT IS ALSO AVAILABLE ON PROM (17Ø2A OR 52Ø4).

THE PROGRAM STARTS WITH A "PHANTOM JUMP" WHICH WILL PERMIT IT TO BE USED ON COMPUTERS WHICH DO NOT HAVE FRONT PANEL SWITCHES. WE USE THIS PROGRAM WITH THE VECTORGRAPHICS PROM/RAM CARD WHICH HAS PROVISION FOR A PHANTOM JUMP START.

WHEN INITIALIZED, THE OPERATING SYSTEM PROMPTS THE USER WITH A QUESTION MARK (?).

EXAMINE MEMORY: (M)

TO EXAMINE A MEMORY LOCATION, TYPE M, THE ADDRESS LOCATION YOU WISH TO EXAMINE, AND A CARRIAGE RETURN. THE PRINTER WILL RESPOND WITH A RETYPE OF THE ADDRESS AND THE CONTENT OF THAT LOCATION.

YOU MAY EXAMINE SUCCESSIVE MEMORY LOCATIONS BY TYPING N.

TO EXAMINE A RANGE OF MEMORY, TYPE M, THE FIRST ADDRESS, SPACE, THE FINISH ADDRESS, AND A CARRIAGE RETURN.

CHANGE MEMORY: (C)

TO CHANGE A MEMORY LOCATION, FIRST EXAMINE THE LOCATION AS DESCRIBED EARLIER THEN TYPE C. THE PRINTER WILL RETYPE THE LOCATION ADDRESS AND WAIT FOR YOUR CHANGE. YOU MAY CHANGE SUCCESSIVE LOCATIONS BY TYPING A SPACE BETWEEN EACH ENTRY. WHEN YOU WISH TO QUIT, HIT CARRIAGE RETURN.

IF YOU MAKE AN ERROR AND DISCOVER IT BEFORE TYPING THE SPACE OR CARRIAGE RETURN, TYPE A SLASH (/). THE PRINTER WILL TYPE THE CURRENT ADDRESS AND GIVE YOU ANOTHER CHANCE. IF YOU HAVE TYPED THE SPACE, TYPE A CARRIAGE RETURN AND START AGAIN AT THE LOCATION IN ERROR.

LOAD A PROGRAM: (L)

TO LOAD A PROGRAM WHICH IS ON CASSETTE IN INTEL ASCII HEX FORMAT, TYPE L. DURING THE LOAD THE PROGRAM CHECKS TO MAKE SURE THE DATA IS BEING WRITTEN INTO MEMORY CORRECTLY. IF AN ERROR OCCURS THE PROGRAM ABORTS THE LOAD, STOPS THE TAPE (IF REMOTE CONTROL OPTION EXISTS) AND TYPES AN M FOLLOWED BY THE MEMORY ADDRESS WHICH DID NOT LOAD CORRECTLY. THIS WILL OCCUR IF YOU TRY TO LOAD INTO A ROM OR INTO A LOCATION WHERE THERE IS NO MEMORY OR IF THE MEMORY IS DEFECTIVE.

THE PROGRAM ALSO WATCHES FOR CHECKSUM ERRORS. IF A CHECKSUM ERROR OCCURS, THE PRINTER WILL TYPE AN X AND THE LAST ADDRESS LOADED.

YOU CAN USUALLY STOP THE TAPE, EJECT THE CASSETTE AND EXAMINE FOR CONTAMINATES. A PHOTOGRAPHERS AIR BULB IS USEFUL FOR BLOWING OFF DUST AND LINT. REINSTALL THE CASSETTE, REWIND A SHORT DISTANCE, AND START THE LOAD AGAIN. IF IT FAILS AT THE SAME POINT AGAIN, THE TAPE (OR RECORDING) IS DEFECTIVE.

VERIFY: (V)

VERIFY WORKS THE SAME AS A LOAD EXCEPT THAT DATA IS NOT WRITTEN INTO MEMORY IT IS COMPARED WITH THE EXISTING MEMORY CONTENT. IF A MISMATCH OCCURS, THE PRINTER PRINTS AN M AND THE ADDRESS OF THE MISMATCH.

DUMP A PROGRAM: (D)

TO DUMP A SECTION OF MEMORY ONTO TAPE IN THE RE-LOADABLE INTEL ASCII HEX FORMAT, TYPE D, THE START ADDRESS, A SPACE, THE FINISH ADDRESS, AND A CARRIAGE RETURN.

EXECUTE A PROGRAM: (G)

TO SEND THE PROGRAM COUNTER TO A DESIRED PROGRAM TO COMMENCE PROGRAM EXECUTION, TYPE G, THE EXECUTION ADDRESS, AND A CARRIAGE RETURN.

WHEN ENTERING DATA AND ADDRESS INFORMATION FROM THE KEYBOARD IT IS NOT NECESSARY TO TYPE LEADING ZEROS.

NOTICE: IN THIS PROGRAM, THE RATE AT WHICH DATA IS RECORDED ON CASSETTE IS THE SAME AS THE SELECTED DATA TERMINAL RATE. THE PROGRAM <u>DOES NOT</u> SWITCH TO THE CASSETTE RATE WHEN DUMPING TO CASSETTE.

```
                    * PERCOM 8Ø8Ø MONITOR*

CØØØ  C3 Ø3 CØ          JMP   STRT       PHANTOM JUMP
CØØ3  DB Ø1      STRT    IN    1          CLEAR UART RECEIVER
CØØ5  31 FF CF           LXI   SP,SPTR    SET STACK POINTER
CØØ8  CD ØE CØ           CALL  MON
CØØB  C3 Ø3 CØ           JMP   STRT
CØØE  AF         MON     XRA   A          SELECT TERMINAL KEYBOARD
CØØF  D3 ØØ              OUT   Ø
CØ11  CD DE C1           CALL  CRLF
CØ14  3E 3F              MVI   A, '?'
CØ16  CD CE C1           CALL  TTYO
CØ19  CD 9F C1           CALL  CIN        GET COMMAND CHARACTER
CØ1C  F5                 PUSH  PSW
CØ1D  CD CC C1           CALL  SPCE
CØ2Ø  F1                 POP   PSW
CØ21  FE 44              CPI   'D'
CØ23  CA 92 CØ           JZ    DUMP       RELOADABLE PROGRAM DUMP
CØ26  FE 4E              CPI   'N'
CØ28  CA 8E CØ           JZ    NXT        EXAMINE NEXT LOCATION
CØ2B  FE 4C              CPI   'L'
CØ2D  CA Ø3 C1           JZ    LOAD       LOAD PROGRAM
CØ3Ø  FE 56              CPI   'V'
CØ32  CA Ø3 C1           JZ    LOAD       VERIFY LOAD
CØ35  FE 4D              CPI   'M'
CØ37  CA 46 CØ           JZ    MEM        EXAMINE MEMORY
CØ3A  FE 43              CPI   'C'
CØ3C  CA 67 CØ           JZ    CNG        CHANGE MEMORY
CØ3F  FE 47              CPI   'G'
CØ41  CØ                 RNZ
CØ42  CD C8 CØ           CALL  AHEX       GET EXECUTION ADDRESS
CØ45  E9                 PCHL
                    * MEMORY DISPLAY*
CØ46  CD DD CØ   MEM     CALL  SETUP      GET START/FINISH ADDRESS
CØ49  CD EF CØ   M1      CALL  LNTH       CALCULATE LENGTH
CØ4C  AF                 XRA   A          CHECK FOR ZERO LENGTH
CØ4D  B8                 CMP   B
CØ4E  C8                 RZ               QUIT IF ZERO
CØ4F  CD 5Ø C1           CALL  ADD        OUTPUT ADDRESS
CØ52  CD CC C1           CALL  SPCE       SPACE
CØ55  CD CC C1   M2      CALL  SPCE       SPACE
CØ58  7E                 MOV   A,M        GET DATA
CØ59  CD AD C1           CALL  HEXOUT     CONVERT TO ASCII HEX-OUTPUT
CØ5C  23                 INX   H          BUMP MEMORY ADDRESS
CØ5D  Ø5                 DCR   B          DECREMENT BYTE COUNT
CØ5E  C2 55 CØ           JNZ   M2         NOT DONE? - DO AGAIN
CØ61  CD DE C1           CALL  CRLF       CARRIAGE RETURN, LINE FEED
CØ64  C3 49 CØ           JMP   M1         DO NEXT LINE
                    * CHANGE MEMORY*
CØ67  2B         CNG     DCX   H          POSITION MEMORY ADDRESS
CØ68  Ø6 1Ø      C1      MVI   B,1ØH      SET UP BYTE COUNT
CØ6A  CD DE C1           CALL  CRLF
CØ6D  CD 5Ø C1           CALL  ADD        OUTPUT CURRENT ADDRESS
CØ7Ø  CD CC C1           CALL  SPCE       DOUBLE SPACE
```

```
C073  CD CC C1          CALL  SPCE
C076  EB          C2    XCHG
C077  CD C8 C0          CALL  AHEX      GET NEW DATA
C07A  EB                XCHG
C07B  FE 2F             CPI   '/'       SLASH MEANS "ABORT THIS
C07D  CA 68 C0          JZ    C1        CHANGE AND DO AGAIN"
C080  73                MOV   M,E       STORE DATA IN MEMORY
C081  23                INX   H         BUMP MEMORY ADDRESS
C082  54                MOV   D,H       SAVE MEMORY ADDRESS
C083  5D                MOV   E,L
C084  FE 0D             CPI   0DH       CHECK FOR CARRIAGE RETURN
C086  C8                RZ              QUIT IF CR
C087  05                DCR   B         DECREMENT BYTE COUNT
C088  C2 76 C0          JNZ   C2        NOT ZERO? - GET ANOTHER BYTE
C08B  C3 68 C0          JMP   C1        START A NEW LINE

C08E  13          NXT   INX   D         UPDATE LIMIT ADDRESS
C08F  C3 49 C0          JMP   M1        EXAMINE NEXT MEMORY LOCATION
                  * CHECKSUM DUMP PROGRAM*
C092  CD DD C0    DUMP  CALL  SETUP     GET START/FINISH ADDRESS
C095  3E 02             MVI   A,02H     TURN ON CASSETTE RECORDER
C097  D3 00             OUT   0
C099  CD DE C1    D1    CALL  CRLF
C09C  0E 00             MVI   C,0       CLEAR CHECKSUM
C09E  3E 3A             MVI   A,':'     GET BLOCK HEADER
C0A0  CD CE C1          CALL  TTYO      OUTPUT
C0A3  CD EF C0          CALL  LNTH      CALCULATE BLOCK LENGTH
C0A6  78                MOV   A,B
C0A7  CD AD C1          CALL  HEXOUT    OUTPUT
C0AA  CA DE C1          JZ    CRLF      QUIT IF ZERO LENGTH
C0AD  CD 50 C1          CALL  ADD       OUTPUT ADDRESS
C0B0  AF                XRA   A
C0B1  CD AD C1          CALL  HEXOUT    OUTPUT BLOCK TYPE (00)
C0B4  7E          D2    MOV   A,M       GET DATA
C0B5  CD AD C1          CALL  HEXOUT    OUTPUT
C0B8  23                INX   H         BUMP MEMORY ADDRESS
C0B9  05                DCR   B         DECREMENT BYTE COUNT
C0BA  C2 B4 C0          JNZ   D2        NOT ZERO?-GET ANOTHER BYTE
C0BD  AF                XRA   A
C0BE  91                SUB   C         CALCULATE CHECKSUM
C0BF  CD AD C1          CALL  HEXOUT    OUTPUT CHECKSUM
C0C2  C3 99 C0          JMP   D1        START A NEW LINE
                  * INPUT ASCII - CONVERT TO BINARY*
C0C8  21 00 00    AHEX  LXI   H,0       CLEAR H AND L
C0CB  CD 9F C1    A1    CALL  CIN       INPUT A CHARACTER
C0CE  FE 30             CPI   '0'       RETURN IF CHARACTER IS
C0D0  D8                RC              ASCII '0' OR LESS
C0D1  29                DAD             SHIFT H AND L LEFT
C0D2  29                DAD             4 PLACES
C0D3  29                DAD
C0D4  29                DAD
C0D5  CD 97 C1          CALL  HEX       CONVERT CHAR TO BINARY
C0D8  85                ADD   L         COMBINE WITH PREVIOUS
C0D9  6F                MOV   L,A       RESULT
```

```
CØDA  C3 CB CØ          JMP   A1          DO AGAIN

CØDD  CD C8 CØ  SETUP   CALL  AHEX        GET START ADDRESS
CØEØ  5D                MOV   E,L         SAVE IN D AND E
CØE1  54                MOV   D,H
CØE2  FE ØD             CPI   ØDH         CHECK FOR CR
CØE4  CA EB CØ          JZ    S1          RETURN IF CR VIA CRLF
CØE7  CD C8 CØ          CALL  AHEX        GET FINISH ADDRESS
CØEA  EB                XCHG
CØEB  13        S1      INX   D           ADJUST FINISH ADDRESS
CØEC  C3 DE C1          JMP   CRLF        RETURN VIA CRLF
                * CALCULATE BLOCK LENGTH *
CØEF  7B        LNTH    MOV   A,E
CØFØ  95                SUB   L
CØF1  47                MOV   B,A
CØF2  7A                MOV   A,D
CØF3  9C                SBB   H
CØF4  3E 1Ø             MVI   A,1ØH
CØF6  C2 FB CØ          JNZ   L1
CØF9  B8                CMP   B
CØFA  DØ                RNC
CØFB  47        L1      MOV   B,A
CØFC  C9                RET
               ***CASSETTE CHECKSUM LOADER***
C1ØØ  31 FF CF          LXI   SP, SPTR
C1Ø3  57        LOAD    MOV   D, A
C1Ø4  3E Ø1             MVI   A, Ø1H
C1Ø6  D3 ØØ             OUT   Ø
C1Ø8  CD 9F C1  READ    CALL  CIN         CHECK FOR BLOCK HEADER
C1ØB  FE 3A             CPI   ':'
C1ØD  C2 Ø8 C1          JNZ   READ
C11Ø  ØE ØØ             MVI   C,Ø         CLEAR CHECKSUM
C112  CD 8Ø C1          CALL  CHAR        GET BLOCK LENGTH
C115  47                MOV   B,A
C116  CA 58 C1          JZ    HXND        QUIT IF ZERO LENGTH
C119  CD 8Ø C1          CALL  CHAR        GET ADDRESS (MSB)
C11C  67                MOV   H, A
C11D  CD 8Ø C1          CALL  CHAR        GET ADDRESS (LSB)
C12Ø  6F                MOV   L,A
C121  CD 8Ø C1          CALL  CHAR        THROW AWAY BLOCK TYPE
C124  CD 8Ø C1  LOOP    CALL  CHAR        GET DATA
C127  5F                MOV   E, A
C128  7A                MOV   A, D        IS THIS A VERIFY?
C129  FE 56             CPI   'V'
C12B  7B                MOV   A, E
C12C  CA 3Ø C1          JZ    L1          VERIFY BYPASS
C12F  77                MOV   M, A        WRITE DATA TO MEMORY
C13Ø  BE        L1      CMP   M           CHECK THE WRITE
C131  1E 4D             MVI   E,'M'       ERROR MESSAGE
C133  C2 43 C1          JNZ   ERR
C136  23                INX   H           BUMP MEMORY POINTER
C137  Ø5                DCR   B           BUMP BLOCK LENGTH
C138  C2 24 C1          JNZ   LOOP        NOT DONE?  DO AGAIN
```

```
C13B  CD 8Ø C1          CALL  CHAR        GET CHECKSUM
C13E  1E 58             MVI   E, 'X'      ERROR MESSAGE
C14Ø  CA Ø8 C1          JZ    READ        NO ERROR? DO NEXT BLOCK
                  ***ERROR PRINTOUT***
C143  AF          ERR   XRA   A           TURN OFF CASSETTE
C144  D3 ØØ            OUT   Ø
C146  CD DE C1          CALL  CRLF
C149  7B                MOV   A, E        PRINT ERROR MESSAGE
C14A  CD CE C1          CALL  TTYO
C14D  CD CC C1          CALL  SPCE        RETURN VIA SPACE
C15Ø  7C          ADD   MOV   A, H        OUTPUT ADDRESS
C151  CD AD C1          CALL  HEXOUT
C154  7D                MOV   A, L
C155  C3 AD C1          JMP   HEXOUT
C158  7A          HXND  MOV   A, D        CHECK FOR READ MODE
C159  FE 52             CPI   'R'         (NO EXECUTION)
C15B  C8                RZ
C15C  CD 9F C1          CALL  CIN         RETURN IF CR
C15F  FE ØD             CPI   ØDH
C161  C8                RZ
C162  CD 83 C1          CALL  CHAR1       GET EXECUTION ADDRESS
C165  67                MOV   H, A
C166  CD 8Ø C1          CALL  CHAR
C169  6F                MOV   L, A
C16A  CD 8Ø C1          CALL  CHAR        CHECK CHECKSUM
C16D  1E 58             MVI   E, 'X'
C16F  C2 43 C1          JNZ   ERR         CHECKSUM ERROR
C172  AF                XRA   A           TURN OFF CASSETTE
C173  D3 ØØ             OUT   Ø
C175  F1                POP   PSW
C176  E9                PCHL              EXECUTE
                  ***GET 2 CHAR & CONVERT TO BINARY BYTE***
C18Ø  CD 9F C1    CHAR  CALL  CIN
C183  CD 97 C1    CHAR1 CALL  HEX
C186  Ø7                RLC
C187  17                RAL
C188  17                RAL
C189  17                RAL
C18A  5F                MOV   E, A
C18B  CD 9F C1          CALL  CIN
C18E  CD 97 C1          CALL  HEX
C191  83                ADD   E
C192  5F                MOV   E, A
C193  81                ADD   C
C194  4F                MOV   C, A
C195  7B                MOV   A, E
C196  C9                RET
C197  D6 3Ø       HEX   SUI   3ØH
C199  FE ØA             CPI   ØAH
C19B  D8                RC
C19C  D6 Ø7             SUI   Ø7H
C19E  C9                RET
C19F  DB ØØ       CIN   IN    Ø           TERMINAL/CASSETTE INPUT
```

```
C1A1  E6 4Ø          ANI   4ØH
C1A3  CA 9F C1       JZ    CIN
C1A6  DB Ø1          IN    1
C1A8  D3 Ø1          OUT   1
C1AA  E6 7F          ANI   7FH
C1AC  C9             RET
                  * CONVERT BYTE TO 2 ASCII HEX CHAR*
C1AD  F5       HEXOUT PUSH PSW
C1AE  ØF             RRC
C1AF  ØF             RRC
C1BØ  ØF             RRC
C1B1  ØF             RRC
C1B2  CD BE C1       CALL  HEXO
C1B5  F1             POP   PSW
C1B6  F5             PUSH  PSW
C1B7  CD BE C1       CALL  HEXO
C1BA  F1             POP   PSW
C1BB  81             ADD   C
C1BC  4F             MOV   C, A
C1BD  C9             RET
C1BE  E6 ØF    HEXO  ANI   ØFH
C1CØ  C6 3Ø          ADI   3ØH
C1C2  FE 3A          CPI   3AH
C1C4  DA CE C1       JC    TTYO
C1C7  C6 Ø7          ADI   Ø7H
C1C9  C3 CE C1       JMP   TTYO
C1CC  3E 2Ø    SPCE  MVI   A, 2ØH
C1CE  F5       TTYO  PUSH  PSW          TERMINAL/CASSETTE OUTPUT
C1CF  DB ØØ    TI    IN    Ø
C1D1  Ø7             RLC
C1D2  D2 CF C1       JNC   T1
C1D5  Ø7 ØØ          RLC   NOP
C1D7  DA Ø3 CØ       JC    STRT
C1DA  F1             POP   PSW
C1DB  D3 Ø1          OUT   1
C1DD  C9             RET
C1DE  3E ØD    CRLF  MVI   A, ØDH
C1EØ  CD CE C1       CALL  TTYO
C1E3  3E ØA          MVI   A, ØAH
C1E5  CD CE C1       CALL  TTYO
C1E8  AF             XRA   A
C1E9  C3 CE C1       JMP   TTYO
```

THEORY OF OPERATION

REFER TO THE SCHEMATIC DIAGRAM THROUGHOUT THE FOLLOWING DESCRIPTION.

SHEET 1 OF THE SCHEMATIC IS THE CASSETTE AND TERMINAL INTERFACE CIRCUIT; SHEET 2 IS THE INTERFACE TO THE ALTAIR (S-1ØØ) BUS.

RECORD CIRCUIT:

THE UART (Z-17) IS THE PRIMARY INTERFACE BETWEEN THE COMPUTER BUS AND THE CASSETTE AND TERMINAL INTERFACE. THE TRANSMITTER SECTION OF THE UART RECEIVES PARALLEL DATA FROM THE PROCESSOR BUS VIA BUFFERS Z22 AND Z23 AND TRANSMITS SERIALLY TO THE DATA TERMINAL (VIA THE RS-232 INTERFACE CIRCUIT Z3 AND RELATED RESISTORS) AND TO THE CASSETTE MODULATOR Z2. Z15-A INVERTS THE SERIAL DATA FROM THE UART. WHEN Z15-3 IS LOW, J-K FLIP-FLOP Z2-A IS PREVENTED FROM TOGGLING AND THE Q OUTPUT IS FORCED TO THE HIGH STATE. Z2-B DIVIDES THE 48ØØHZ CLOCK BY TWO PRODUCING A 24ØØ HZ SQUARE WAVE AT Z2-9. WHEN Z15-3 IS HIGH, FLIP-FLOP Z2-A IS PERMITTED TO TOGGLE WHICH INHIBITS THE TOGGLING OF Z2-B ON EVERY OTHER CLOCK PULSE. THE NET RESULT IS THAT THE OUTPUT OF Z2-9 IS NOW A 12ØØ HZ SQUARE WAVE. WHEN DATA FROM THE UART IS A LOGIC ONE BIT, A 24ØØ HZ SIGNAL IS GENERATED AND WHEN THE DATA IS A LOGIC ZERO, A 12ØØ HZ SIGNAL IS GENERATED.

THE UART TRANSMITTER IS CLOCKED BY A SIGNAL DERIVED FROM THE PROCESSOR 2MHZ OSCILLATOR. THE RATE MAY BE CONTROLLED BY THE TERMINAL RATE STRAPPING OR BY THE CASSETTE RATE SELECTION AT TSA-8 AND TSA-1Ø. MULTIPLEXER Z1Ø-C DETERMINES WHICH SELECTION WILL CLOCK THE UART. IF FLIP-FLOP LATCH Z11-B IS SET, THE UART TRANSMITTER WILL BE CLOCKED BY THE OUTPUT OF MULTIPLEXER Z4-A WHICH IS CONTROLLED BY THE CASSETTE RATE SELECTION. IF Z11-B IS RESET, THE UART TRANSMITTER WILL BE CLOCKED AT THE RATE DETERMINED BY THE "TERMINAL RATE" STRAP. Z11-B IS SET OR RESET BY AN OUTPUT INSTRUCTION FROM THE PROCESSOR.

THE UART TRANSMITTER OUTPUTS A SERIAL BIT STREAM CONSISTING OF A START BIT, EIGHT DATA BITS, AND ONE OR MORE STOP BITS. THE MINIMUM NUMBER OF STOP BITS PRODUCED IS CONTROLLED BY Z11-A. WHEN Z11-A IS RESET THE UART TRANSMITTER WILL PRODUCE AS FEW AS ONE STOP BIT. THIS IS THE NORMAL MODE FOR OUTPUTTING DATA TO THE TERMINAL. TO MINIMIZE CASSETTE "OVERSPEED" PROBLEMS, DATA RECORDED ON CASSETTE SHOULD HAVE A MINIMUM OF TWO STOP BITS. IF Z11-A IS SET, THE UART TRANSMITTER WILL PRODUCE A MINIMUM OF TWO STOP BITS. Z11-A IS SET OR RESET BY AN OUTPUT INSTRUCTION FROM THE PROCESSOR.

THE TIMING OF THE UART IS SUCH THAT AT 3ØØ BAUD, A LOGIC ONE DATA BIT IS 8 CYCLES OF 24ØØ HZ AND A LOGIC ZERO BIT IS 4 CYCLES OF 12ØØ HZ. AT THE HIGHER DATA RATES, THE 24ØØ HZ AND 12ØØ HZ TONES REMAIN BUT THE NUMBER OF CYCLES PER DATA BIT IS PROGRESSIVELY REDUCED UNTIL AT 24ØØ BAUD A LOGIC ONE IS ONE CYCLE OF 24ØØ HZ AND A LOGIC ZERO IS ONE HALF CYCLE OF 12ØØ HZ. THIS IS THE POPULAR MANCHESTER OR BIPHASE CODE.

THE SQUARE WAVE IS FILTERED AND ATTENUATED BY R15, R16, R17, C5 AND IS FED TO THE AUXILIARY OR MICROPHONE INPUTS OF THE CASSETTE RECORDER.

THE MODULATOR CLOCK (48ØØ HZ) IS DERIVED FROM THE 2MHZ SOURCE ON THE PROCESSOR CARD.

PLAYBACK CIRCUIT:

THE SIGNAL FROM THE TAPE PLAYER EARPHONE OUTPUT IS SHAPED INTO A SQUARE WAVE BY SIGNAL CONDITIONER Z1-C, R7, R8 AND RELATED COMPONENTS. EXCLUSIVE - OR GATE Z7-A, R26, AND C6 CONVERT THE SQUARE WAVE INTO A STRING OF NARROW PULSES. Z6 AND Z13 RECOVER THE DATA, Z8 RECOVERS THE TIMING INFORMATION (CLOCK).

Z6 IS A "DEAD-ENDED" DIVIDER. IT BEHAVES AS A RETRIGGERABLE ONE-SHOT. WHEN THE 24ØØ HZ SIGNAL IS RECEIVED, THE DIVIDER IS CONSTANTLY RESET (RETRIGGERED) BEFORE IT IS ALLOWED TO "DEAD-END" (TIME OUT). THIS CAUSES Z13-5 (Q OUTPUT) TO REMAIN HIGH. WHEN THE 12ØØ HZ SIGNAL IS RECEIVED, THE DIVIDER IS ALLOWED TO DEAD-END (TIME OUT). SINCE Z13-A IS CLOCKED BY THE SAME PULSE WHICH RESETS (TRIGGERS) THE DIVIDER AND SINCE THE OUTPUT FROM Z12-C IS LOW WHEN THE TRIGGER PULSE OCCURS, Z13-A WILL BE CLOCKED LOW AND WILL STAY LOW FOR THE DURATION OF THE 12ØØ HZ SIGNAL. Z13-A REMOVES THE DISSYMMETRY FROM THE RECOVERED DATA WAVEFORM.

Z8-B BEHAVES AS A SIMPLE DIVIDE-BY-TWO WHEN THE 24ØØ HZ SIGNAL IS RECEIVED BECAUSE THE OUTPUT FROM Z12-C IS HIGH. WHEN 12ØØ HZ IS BEING RECEIVED, THE FALLING EDGE OF Z12-12 CREATES A PULSE VIA C15 AND R25 WHICH RESETS Z8-A. THIS CAUSES Z8-A TO BEHAVE AS A DIVIDE-BY-ONE (NO DIVISION) SO THE OUTPUT OF Z8-A IS THE SAME FREQUENCY (24ØØ HZ) WHEN EITHER THE 12ØØ HZ OR 24ØØ HZ SIGNAL IS RECEIVED. Z8-B ASSURES THE SIGNAL FED TO THE PHASE DETECTOR (Z7-1Ø) IS A SYMMETRICAL SQUARE WAVE.

EXCLUSIVE-OR GATE Z7-C ACTS AS A PHASE DETECTOR FOR THE PHASE LOCKED LOOP (PLL) MADE UP OF VOLTAGE CONTROLLED OSCILLATOR (VCO) Z1-A, DIVIDERS Z5, Z9-A AND RELATED COMPONENTS. THE PLL FOLLOWS THE RECOVERED CLOCK (Z8-5) AND ACTS AS FREQUENCY MULTIPLIER TO PROVIDE THE 16X CLOCK REQUIRED BY THE UART RECEIVER. THE VCO NOMINAL FREQUENCY IS 38.4 KHZ. Z5 DIVIDES THE VCO OUTPUT BY SIXTEEN. Z4-6 ACTS AS A MULTIPLEXER TO SELECT THE APPROPRIATE FREQUENCY TO DRIVE THE UART RECEIVER CLOCK DEPENDING ON THE DESIRED DATA RATE:

3ØØ	BAUD	SELECTS	THE	48ØØ	HZ	POINT	ON	THE	DIVIDER		
6ØØ	"	"	"	96ØØ	"	"	"	"	"		
12ØØ	"	"	"	192ØØ	"	"	"	"	"		
24ØØ	"	"	"	384ØØ	"	OUTPUT	FROM	THE	VCO		

THE UART RECEIVER ACCPTS DATA FROM EITHER THE RS-232 DATA TERMINAL OR THE CASSETTE DATA RECOVERY CIRCUIT DESCRIBED EARLIER. Z1Ø-A IS A 2 INPUT MULTIPLEXER USED TO SELECT DATA TERMINAL INPUT OR CASSETTE INPUT. THE DESIRED INPUT IS SELECTED BY FLIP-FLOP LATCH Z11-B WHICH IS SET OR RESET BY AN OUTPUT INSTRUCTION FROM THE PROCESSOR.

THE UART RECEIVER MAY BE CLOCKED BY THE SIGNAL DERIVED FROM THE VCO OR FROM A SIGNAL DERIVED FROM THE PROCESSOR 2MHZ OSCILLATOR. THE SELECTION IS VIA Z1Ø-B.

ALTAIR (S-1ØØ) BUS INTERFACE CIRCUIT:

THE I/O ADDRESS TO WHICH THE CI-812 WILL RESPOND IS CONTROLLED BY JUMPERS BETWEEN Z14, Z2Ø AND THE INPUTS OF Z19. IF THE OUTPUT OF THE INVERTER IS JUMPERED TO Z19, THE CI-812 WILL REACT ONLY IF THAT ADDRESS BIT IS A "ZERO". IF THE INPUT OF THE INVERTER IS JUMPERED TO Z19, THE CI-812 WILL REACT ONLY IF THAT ADDRESS BIT IS A "ONE".

DURING PROPERLY ADDRESSED OUTPUT INSTRUCTIONS FROM THE PROCESSOR, DATA WILL BE STROBED INTO EITHER THE UART TRANSMITTER BUFFER (TDS) OR INTO THE CONTROL LATCHES (Z-11) DEPENDING ON THE LEVEL OF ADDRESS LINE AØ. IF AØ IS A "ZERO" THE DATA WILL BE STROBED INTO THE CONTROL LATCHES (VIA Z16-6). IF AØ IS A "ONE", THE DATA WILL BE STROBED INTO THE UART TRANSMITTER BUFFER (VIA Z16-8).

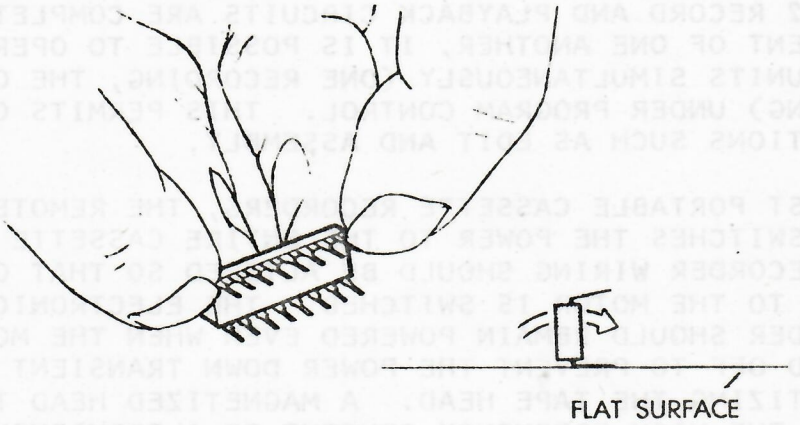
DURING PROPERLY ADDRESSED INPUT INSTRUCTIONS FROM THE PROCESSOR, EITHER THE UART STATUS OR THE RECEIVED DATA WILL BE ENABLED ONTO THE PROCESSOR INPUT DATA BUS. IF AØ IS A "ZERO", THE UART STATUS WILL BE CONNECTED TO THE PROCESSOR INPUT DATA BUS (VIA Z16-3). IT AØ IS A "ONE", THE RECEIVED DATA WILL BE CONNECTED TO THE PROCESSOR INPUT DATA BUS (VIA Z16-11). WHENEVER THE RECEIVED DATA IS READ BY THE PROCESSOR, THE DATA AVAILABLE STATUS WILL BE RESET BY Z15-11.

Z22, 23, 24 ARE 3-STATE BUFFERS WHICH INTERFACE TO THE PROCESSOR INPUT AND OUTPUT DATA BUS.

APPENDIX A

LOADING DIP (DUAL IN-LINE PACKAGE) DEVICES

MOST DIP DEVICES HAVE THEIR LEADS SPREAD SO THAT THEY CAN NOT BE DROPPED STRAIGHT INTO THE BOARD. HOLD THE SIDE OF THE CHIP FIRMLY AGAINST THE FLAT SURFACE WITH BOTH HANDS, ROTATE IT A SHORT DISTANCE TOWARD ITS PINS UNTIL IT IS IN A FULL VERTICAL POSITION. THIS WILL PUT ITS BODY AT A RIGHT ANGLE TO THE ROW OF PINS. PLACE THE OTHER ROW OF PINS ON THE FLAT SURFACE AND REPEAT THE PROCESS AS ABOVE.



(1) ORIENT THE DEVICE PROPERLY. PIN 1 IS INDICATED BY A SMALL EMBOSSED DOT ON THE TOP SURFACE OF THE DEVICE AT ONE CORNER. PINS ARE NUMBERED COUNTERCLOCKWISE FROM PIN 1.

(2) INSERT THE PINS ON ONE SIDE OF THE DEVICE INTO THEIR HOLES ON THE PRINTED CIRCUIT CARD. DO NOT PRESS THE PINS ALL THE WAY IN, BUT STOP WHEN THEY ARE JUST STARTING TO EMERGE FROM THE OPPOSITE SIDE OF THE CARD.

(3) EXERT A SIDEWAYS PRESSURE ON THE PINS AT THE OTHER SIDE OF THE DEVICE BY PRESSING AGAINST THEM WHERE THEY ARE STILL WIDE BELOW THE BEND. BRING THIS ROW OF PINS INTO ALIGNMENT WITH ITS HOLES IN THE PRINTED CIRCUIT CARD AND INSERT THEM AN EQUAL DISTANCE, UNTIL THEY BEGIN TO EMERGE.

(4) PRESS THE DEVICE STRAIGHT DOWN UNTIL IT SEATS ON THE POINTS WHERE THE PINS WIDEN.

(5) TURN THE CARD OVER AND SELECT TWO PINS AT OPPOSITE CORNERS OF THE DEVICE. USING A FINGERNAIL OR A PAIR OF LONG-NOSE PLIERS, PUSH THESE PINS OUTWARDS UNTIL THEY ARE BENT AT A 45 DEGREE ANGLE TO THE SURFACE OF THE CARD. THIS WILL SECURE THE DEVICE UNTIL IT IS SOLDERED.

APPENDIX B:

REMOTE CONTROL:

MOST CASSETTE RECORDERS HAVE A REMOTE CONTROL INPUT WHICH SIMPLY TURNS THE POWER TO THE CASSETTE UNIT ON OR OFF. THIS INPUT CAN BE EASILY SWITCHED WITH A RELAY DRIVEN BY THE COMPUTER PROGRAM. THE CI-812 INCLUDES PROVISION FOR TWO DIP REED RELAYS (EXTRA COST OPTION) WHICH MAY BE CONTROLLED BY COMMANDS FROM THE PROCESSOR. SINCE THE CI-812 RECORD AND PLAYBACK CIRCUITS ARE COMPLETELY INDEPENDENT OF ONE ANOTHER, IT IS POSSIBLE TO OPERATE TWO TAPE UNITS SIMULTANEOUSLY (ONE RECORDING, THE OTHER READING) UNDER PROGRAM CONTROL. THIS PERMITS CROSS FILE OPERATIONS SUCH AS EDIT AND ASSEMBLY.

IN MOST PORTABLE CASSETTE RECORDERS, THE REMOTE CONTROL JACK SWITCHES THE POWER TO THE ENTIRE CASSETTE RECORDER. THE RECORDER WIRING SHOULD BE ALTERED SO THAT ONLY THE POWER TO THE MOTOR IS SWITCHED. THE ELECTRONICS OF THE RECORDER SHOULD REMAIN POWERED EVEN WHEN THE MOTOR IS TURNED OFF TO PREVENT THE POWER DOWN TRANSIENT FROM MAGNETIZING THE TAPE HEAD. A MAGNETIZED HEAD TENDS TO ERASE THE HIGH FREQUENCY CONTENT OF A PREVIOUSLY RECORDED TAPE EACH TIME THE TAPE IS PLAYED.

MOST CASSETTE TAPE RECORDERS REQUIRE FROM ONE TO THREE SECONDS TO STABLIZE AFTER THE REMOTE CONTROL IS TURNED ON. CARE SHOULD BE TAKEN TO PREVENT THE 'TRASH' GENERATED DURING THIS STABILIZING PERIOD FROM CONFUSING THE COMPUTER OR ITS PROGRAM. THE FOLLOWING PROGRAMS SUGGEST HOW TO HANDLE THESE 'TRASH' INTERVALS.

TO BE QUITE FRANK, REMOTE CONTROL IS OF VERY LIMITED VALUE WHEN USED WITH THE ORDINARY CASSETTE RECORDER. YOU HAVE TO PUSH ONE OR MORE BUTTONS MANUALLY BEFORE YOU CAN BEGIN TO USE THE REMOTE INPUT. FURTHERMORE THE START UP TIME OF MOST CASSETTE RECORDERS IS SO LONG YOU WILL PROBABLY SPEND MORE TIME GENERATING AND BYPASSING INTERRECORD GAPS THAN WRITING AND READING DATA.

CAREFULLY CONSIDER YOUR INTENDED USE OF THE REMOTE CONTROL FUNCTION. IT MAY NOT BE AS WORTHWILE AS IT FIRST APPEARS.

WHEN CONTROLLING THE CASSETTE RECORDER REMOTELY, IT IS NECESSARY TO ALLOW SUFFICIENT TIME FOR THE RECORDER SPEED AND AMPLIFIERS TO STABILIZE BEFORE RECORDING OR READING DATA. THE FOLLOWING ROUTINES ILLUSTRATE SUGGESTED PROCEDURE.

IN THESE ROUTINES OUTPUT PORT Ø BIT Ø CONTROLS RELAY K1 WHICH SHOULD BE USED TO CONTROL THE REMOTE INPUT OF THE CASSETTE PLAYER. PORT Ø BIT 1 CONTROLS RELAY K2 WHICH IN TURN SHOULD BE USED TO CONTROL THE CASSETTE RECORDER. IF ONLY ONE CASSETTE UNIT IS USED FOR BOTH RECORD AND PLAYBACK FUNCTIONS, THE ROUTINES SHOULD BE APPROPRIATELY MODIFIED. REFER TO THE SECTION ON SOFTWARE CONSIDERATIONS.

```
:THIS PROGRAM STARTS THE RECORDER THEN WAITS
:5 SECONDS TO ALLOW THE RECORDER TO STABILIZE
:
        MVI     A,H'02'     TURN ON THE RECORDER (PORT Ø BIT 1)
        OUT     Ø
        XRA     A           SET UP 5 SEC DELAY LOOP
        MOV     B,A
        MVI     C,H'A'      ADJUST C REG TO VARY TIME
WAIT    DCR     A           THIS IS THE DELAY LOOP
        JNZ     WAIT
        DCR     B
        JNZ     WAIT
        DCR     C
        JNZ     WAIT
:
        CALL    RECORD      RECORD THE FILE
:NOW TURN OFF THE RECORDER
        XRA     A
        OUT     Ø
        RET


:THIS PROGRAM STARTS THE TAPE PLAYER THEN REQUIRES
:THAT THE FILE BE PRECEDED BY 1.5 "TRASH FREE" SECONDS
:
        MVI     A,H'01'     TURN ON THE PLAYER (PORT Ø, BIT Ø)
        OUT     Ø
RST     XRA     A           SET UP 1.5 SEC TIMEOUT
        MOV     B,A
        MOV     C,A
        IN      1           RESET DATA READY
DLY     IN      Ø           TEST FOR "TRASH"
        ANI     H'40'
        JNZ     RST         RESTART TIMEOUT IF TRASH
        DCR     C
        JNZ     DLY
        DCR     B
        JNZ     DLY
:
        CALL    READ        READ THE FILE
:NOW TURN OFF THE PLAYER
        XRA     A
        OUT     Ø
        RET
```

APPENDIX C:

'CERTIFYING' THE TAPE:

FOR BEST RESULTS A TAPE CASSETTE SHOULD BE TESTED BEFORE USE TO DETERMINE IF IT CONTAINS FLAWS WHICH WILL CREATE ERRORS. COMPUTER GRADE TAPE IS SUBJECTED TO A SERIES OF TESTS WHICH 'CERTIFY' ITS FREEDOM FROM SUCH ERROR PRODUCING FLAWS. SINCE 'CERTIFIED' CASSETTES SELL FOR TWO TO FOUR TIMES THE PRICE OF HIGH QUALITY AUDIO CASSETTES, YOU WILL PROBABLY PREFER TO TEST THE QUALITY AUDIO CASSETTES YOURSELF. THE TEST TO BE DESCRIBED IS NOT AS THOROUGH AS THE COMPUTER GRADE CERTIFICATION PROCEDURE BUT IT IS MORE THAN ADEQUATE FOR THE HOBBYIST.

THE PROCEDURE IS SIMPLY TO RECORD A CONTINUOUS SIGNAL ON TAPE THEN PLAY BACK AT REDUCED LEVEL AND LET THE CASSETTE INTERFACE WATCH FOR LOSS OF SIGNAL. IF THE TAPE PASSES THE TEST AT REDUCED PLAYBACK LEVEL IT IS ALMOST CERTAIN TO BE ADEQUATE UNDER NORMAL LEVEL CONDITIONS.

PROCEDURE:

1. RECORD A CONTINUOUS 24ØØ HZ TONE AT NORMAL OPERATING LEVEL ON THE CASSETTE. THIS CAN BE DONE BY CONNECTING THE TAPE RECORDER TO THE CI-812 CASSETTE INTERFACE SINCE THE INTERFACE GENERATES A 24ØØ HZ SIGNAL WHEN IDLE.

2. LOAD THE FOLLOWING PROGRAM INTO YOUR COMPUTER.

ADDRESS	DATA		INSTRUCTION		REMARKS
ØØØØ	3E Ø1		MVI	A, Ø1	SELECT CASSETTE INPUT
ØØØ2	D3 ØØ		OUT	Ø	
ØØØ4	DB Ø1		IN	1	CLEAR UART RECEIVER
ØØØ6	DB ØØ	LP	IN	Ø	TEST STATUS (DAV)
ØØØ8	E6 4Ø		ANI	4ØH	
ØØØA	CA Ø6 ØØ		JZ	LP	DO AGAIN IF OK
ØØØD	AF		XRA	A	TURN OFF CASSETTE
ØØØE	D3 ØØ		OUT	Ø	
ØØ1Ø			HLT		HALT THE PROCESSOR

3. CONNECT THE CASSETTE PLAYER TO THE EARPLUG INPUT OF THE CI-812.

4. REDUCE THE PLAYBACK SIGNAL LEVEL TO HALF OF THE NORMAL LEVEL.

5. START THE TAPE AND LET IT RUN FOR TWO TO THREE SECONDS.

6. NOW START THE COMPUTER EXECUTING THE ABOVE PROGRAM. AS LONG AS THERE ARE NO FLAWS IN THE TAPE THE PROGRAM WILL CONTINUE TO EXECUTE.

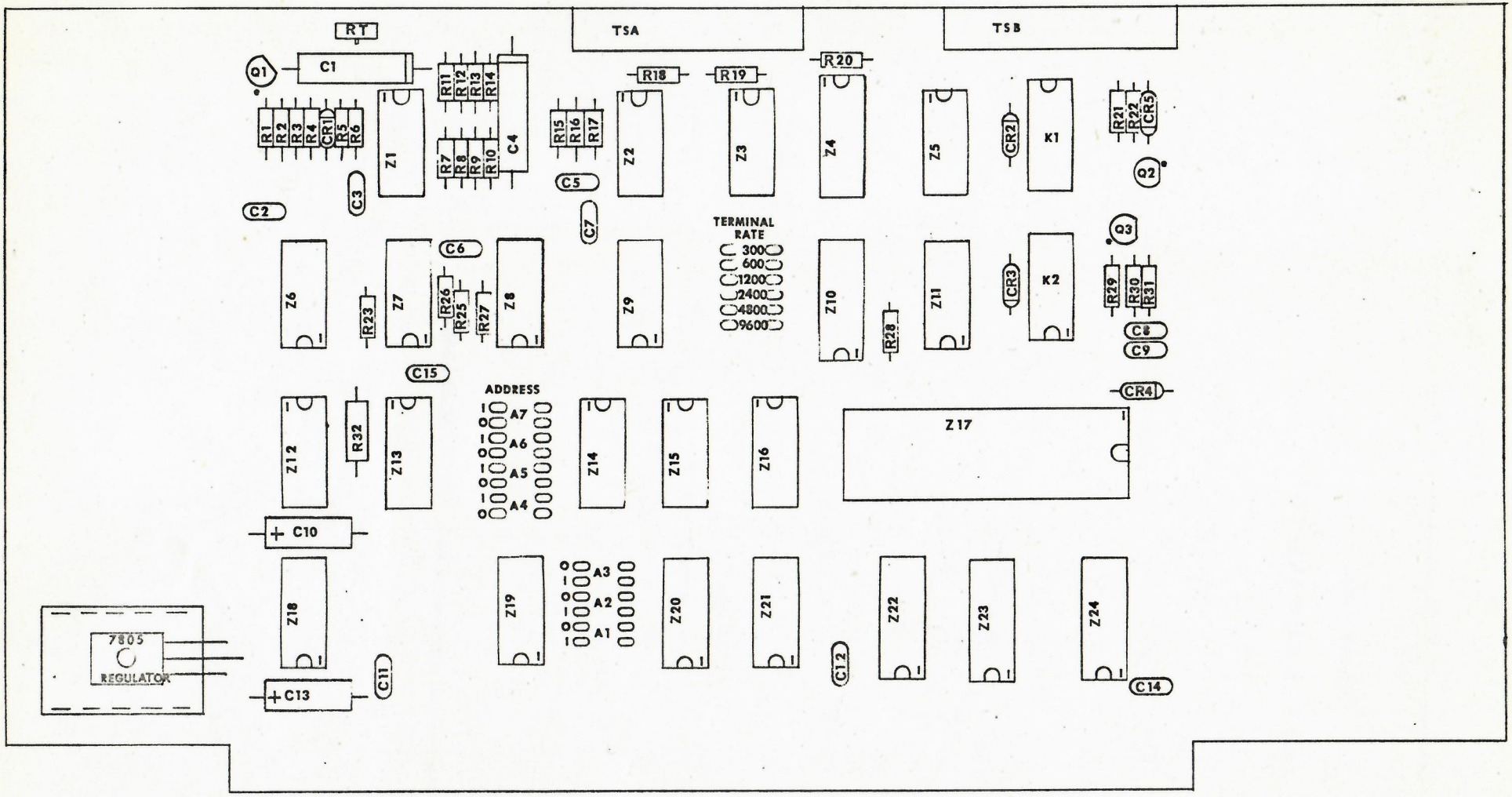
CERTIFICATION PROCEDURE CONT'D.

7. WHEN A FLAW IS ENCOUNTERED THE CASSETTE PLAYER WILL TURN OFF (ASSUMING THE REMOTE CONTROL OPTION IS INSTALLED) AND THE PROCESSOR WILL ENTER A HALT STATE.

EXPECT THE PROCESSOR TO HALT AT THE BEGINNING AND END OF TAPE.

MANY TIMES ERRORS ARE CAUSED BY LINT FIBERS AND DUST WHICH CAN BE REMOVED WITH TWEEZERS OR AN AIR BLAST. IF THE ERROR IS CAUSED BY A PERMANENT FLAW IN THE TAPE THE LOCATION CAN BE NOTED AND AVOIDED. THE GOOD PORTIONS OF A TAPE WITH FLAWS CAN ALSO BE RESPOOLED INTO ANOTHER CASSETTE CASE. EMPTY CASSETTE CASES ARE AVAILABLE FROM RADIO SHACK AND OTHER SOURCES.

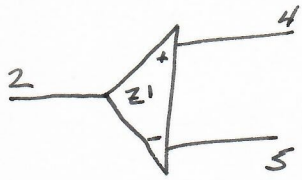
WE HAVE HAD EXCELLENT RESULTS WITH MEMOREX MRX2 AND SCOTCH HE CASSETTE TAPE. C3Ø AND C45 ARE PREFERRED LENGTHS. THERE MAY BE OTHER EQUALLY SUITABLE BRANDS. CRITICALLY EXAMINE THE PRESSURE PAD OF A PROSPECTIVE CASSETTE. AN OVERSIZED PAD SUCH AS IS USED ON THE MEMOREX MRX2 IS PREFERRED FOR UNIFORM TAPE-TO-HEAD CONTACT. THE PAD SHOULD ALSO BE FREE OF LUMPS AND LOOSE LINT PARTICLES.



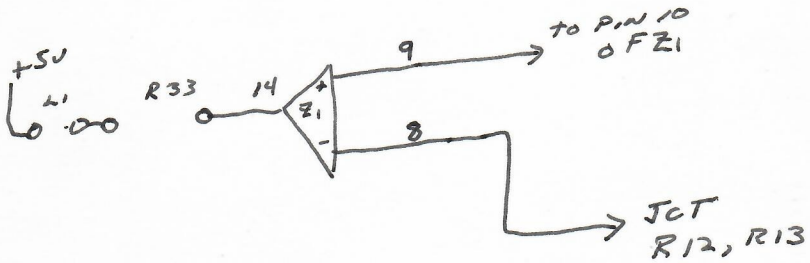
C1-812 ASSEMBLY DRAWING		
SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
PERCOM DATA CO		
		DRAWING NUMBER

Memo From

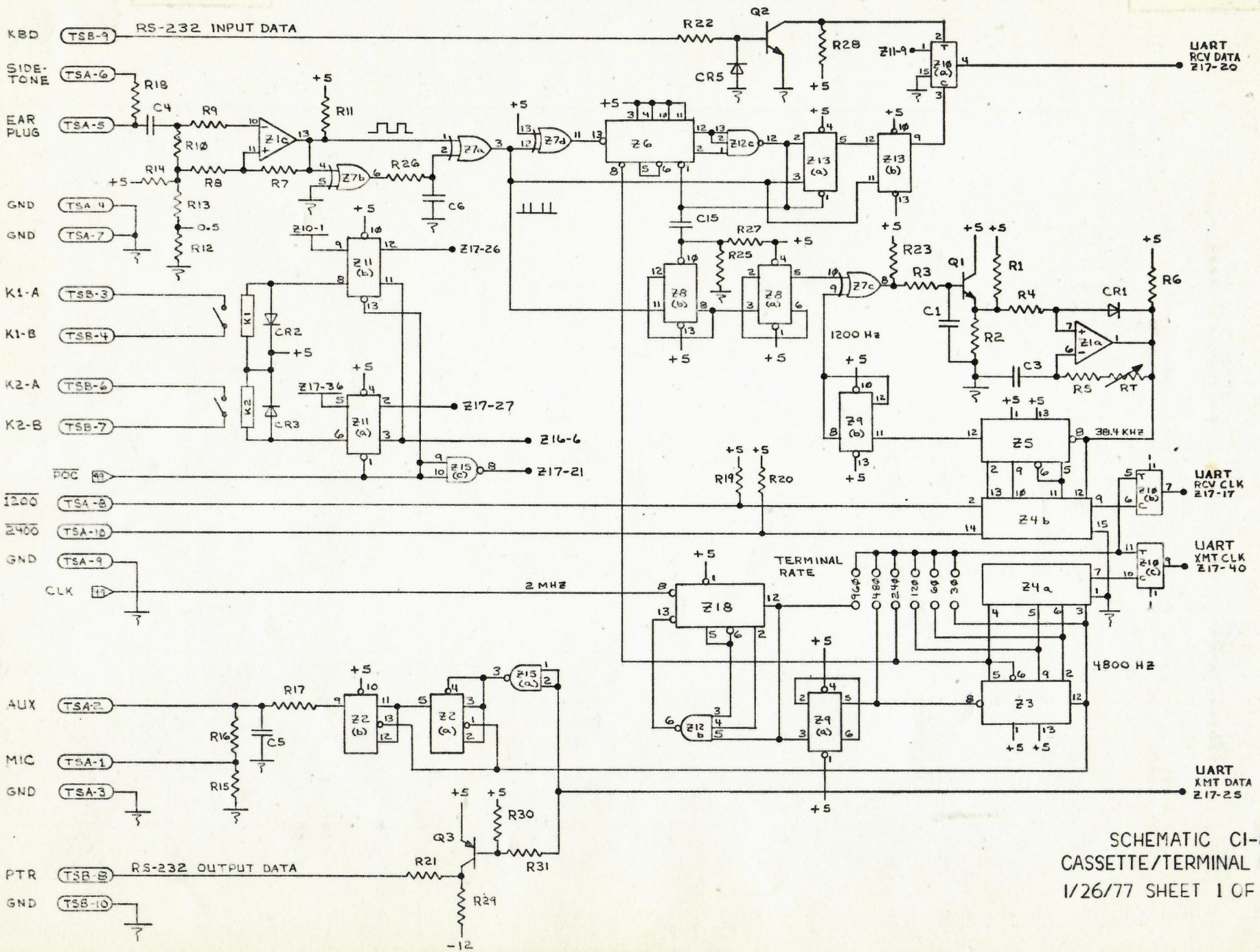
PAUL HARRINGTON



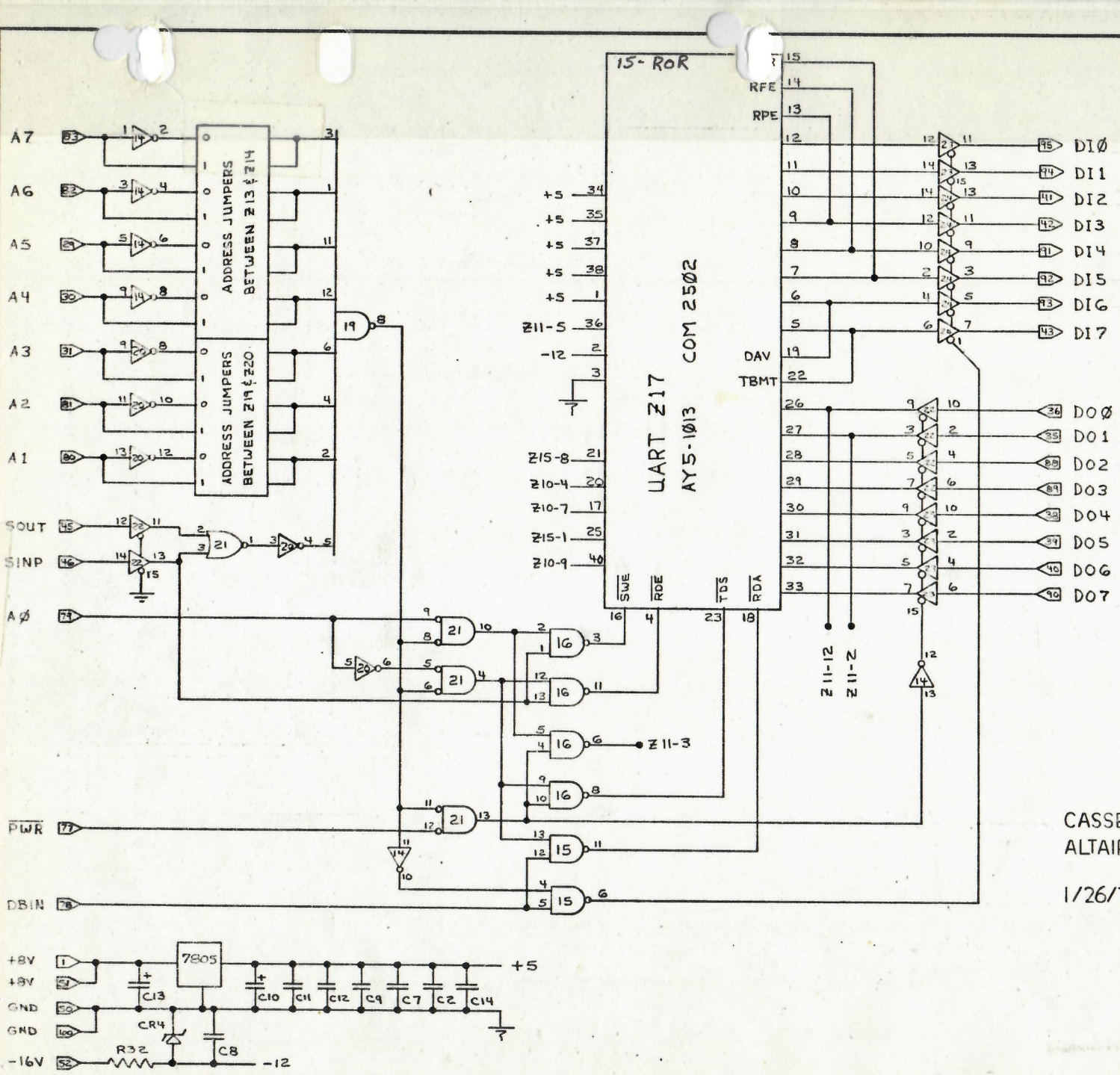
(FREE CIRCUIT)



EXISTING CIRCUIT NOT IN CI-812 PRINT



SCHEMATIC CI-812
CASSETTE/TERMINAL I/O
1/26/77 SHEET 1 OF 2



SCHEMATIC CI-812
CASSETTE/TERMINAL I/O
ALTAIR BUSS INTERFACE

1/26/77 SHEET 2 OF 2

REV A 2-14-77 H.M

LIST OF MATERIALS - PERCOM CI-812 CASSETTE/TERMINAL INTERFACE

ITEM	DESCRIPTION	PART NO.	MFR.	DESIGNATOR	QTY	VENDOR	EACH	TOTAL
1	P. C. Board	CI-812			1			
2	Heat Sink 1.2"x 1"	6106-14	THM		1			
3	Screw 6-32 x ½"				1			
4	Nut6-32 x ¼"				1			
5	Washer #6 lock				1			
6	Integrated Circuit	74LS00N		Z15, 16	2			
7	" "	74LS02N		Z21	1			
8	" "	74LS04N		Z14, 20	2			
9	" "	74LS10N		Z12	1			
10	" "	74LS30N		Z19	1			
11	" "	74LS74N		Z8, 9, 13	3			
12	" "	7474N		Z11	1			
13	" "	74LS86N		Z7	1			
14	" "	74LS113N		Z2	1			
15	" "	74LS153N		Z4	1			
16	" "	74LS157N		Z10	1			
17	" "	74LS197N		Z3,5,6,18	4			
18	" "	74367N (8097)		Z22,23,24	3			
19	" "	339N		Z1	1			
20	UART	2502 (AY5-1013)		Z17	1			
21	Transistor	PN3565		Q1	1			
22	"	PN5449		Q2	1			
23	"	PN5138		Q3	1			
24	Diode	IN914		CR1,5	2			
25	"	IN759A		CR4	1			
26	Regulator	7805 (LM340T-5)			1			
27	Connector	09-52-3101	Molex	TSA,B	2			
28	Resistors 180 ohm ½W CC or CF			R32	1			
29	" 100 ohm ¼w CC or CF			R21	1			
30	" 180 "			R12,18	2			
31	" 470 "			R15	1			
32	" 820 "			R13	1			
33	" 1K "			R11,14,23,26	4			
34	" 2.7K "			R29	1			
35	" 4.7K "			R6,16,22,31	4			

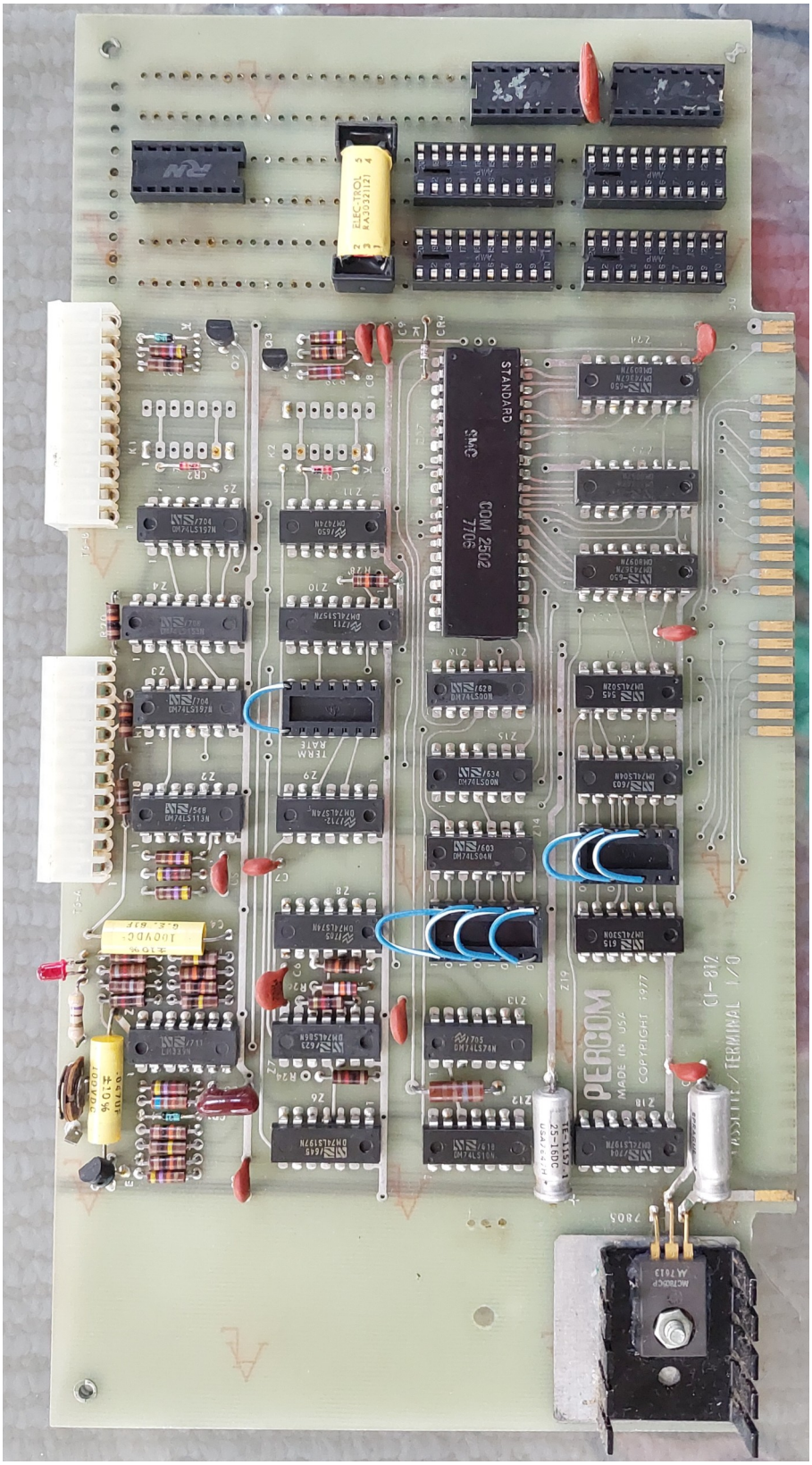
PERCOM DATA CO.

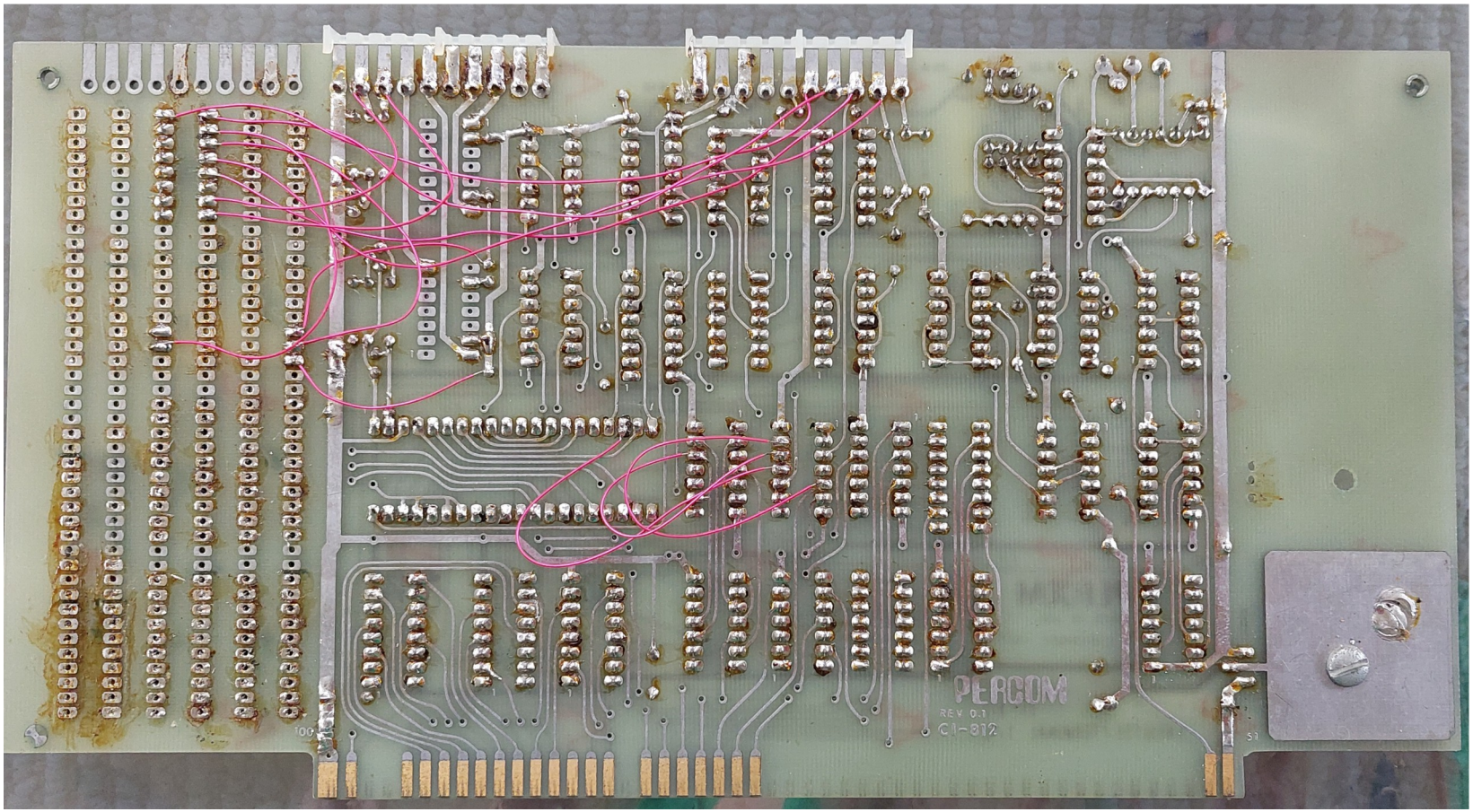
LIST OF MATERIALS - PERCOM CI-812 CASSETTE/TERMINAL INTERFACE

ITEM	DESCRIPTION	PART NO.	MFR	DESIGNATOR	QTY	VENDOR	EACH	TOTAL
36	Resistors 10K ohm ¼w CC or CF			R2,4,8,9,19,20, R27,28,30	9			
37	" 27K "			R25	1			
38	" 47K "			R1,17	2			
39	" 100K "			R3,7,10	3			
40	" 68K "			R5	1			
41	Capacitors .047 uf 100v Mylar	WMF 1S47	CD	C1,4	2			
42	" 25uf 16v Elect.	500D	SPG	C10,13	2			
43	" 150 pf CM05			C3	1			
44	" 750 pf Disc	5GA	SPG	C6,15	2			
45	" .01 ufd Disc	HY-420/520	"	C2,5,7,8,9 C11,C12,C14	8			
46	Trim Pot 50K Trimmer pot.			RT	1			

PERCOM DATA CO.

To Roger Arrick, Tyler Texas
From Paul Harrington III, Versailles, KY
2024

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