MEMO

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COMPUTER
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MICROSYSTEMS & PERIPHERALS GROUP

Subject: TEST OF 88-UIO

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To: TEST, REPAIR

Consult the 88-UIO documentation (attached) for operating information. Below is listed the test procedures for the serial port and the ACR port of the 88-UIO board.

1. SERIAL PORT

The serial port should be tested for teletype (110 baud) and RS 232 9600 baud. Consult the manual for operating information. Note that the I/O options are all selected by plug in jumpers. Note that the same cable is used for TTY or RS 232. When not using handshake lines, jumper pads A to B, C to D.

The port selector switch should be set for Switch 2 OFF for channel 20 and 21 (normal terminal port) Be sure there is no other port set to that address.

2. ACR PORT

The checkout of the ACR port is virtually identical to the method used for the 88-ACR. The I/O cable to the recorder uses the same connections as the 88-ACR cable, but has two extra wires connected for starting and stopping the tape recorder. Use an oscilloscope for monitoring the signals.

a.) While monitoring TP-8 (serial read data) or I.C. L Pin 20, adjust R1 for correct data pulse width (approx. 3.3ms per bit). Use a MITS BASIC tape for this test.

b.) With selector Switch 3 OFF (ACR ports 6 and 7) and multi Boot Loader in place, load MITS BASIC.
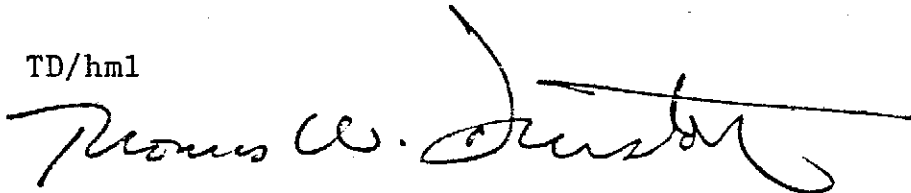
An alternative would be to use a system with ROM BASIC or Disk BASIC and CSAVE and CLOAD as indicated in the next section.

C.) With selector switch 1 in the ON position (KC recording frequencies) CSAVE a program such as "STARTREK". When CSAVING, monitor TP-4 for the 3.3 ms per bit.

Play the tape back into the ACR, and re-adjust R1 for 3.3 ms per bit at TP-8. Then CLOAD the program. The program should load in and function properly.

The last test is checkout of the relay. Use an ohmmeter to check contact closure while executing the BASIC commands OUT 6, 191 (OFF), OUT 6, 127 (ON). This completes testing of the 88-UIO card.

TD/hml

ATTACHED: USING THE 88-UIO BOARD

USING THE 88-UIO BOARD

1. GENERAL

   The four position switch selects the following options as follows:

   SWITCH 1:   OFF - Selects the MITS standard frequencies for recording (2400=1, 1850=0)

   ON - Selects the KC standard frequencies for recording (2400=1, 1200=0)

   SWITCH 2:   OFF - Selects the serial I/O port for address 20 and 21. Use this for main I/O port.

   ON - Selects the serial I/O port for address 30 and 31. Use this for auxiliary I/O port, or when using another I/O board for the console terminal.

   SWITCH 3:   OFF - Selects ACR port address at 6 and 7 (normal)

   ON - Selects ACR port address at 16 and 17 for auxiliary ACR port(not normally used).

   SWITCH 4:   Not used.

2. ACR OPERATION

   (300 Baud only)

   A. I/O set up

   Input from address 006 (or 016 - switch 3 ON):

   ACR status bits - bit 0 low-read
                     data byte ready

                   - bit 7 low-transmit
                     buffer empty

   Output to address 006 (or 016 - switch 3 ON)

Motor Control* - bit 7 low - (0-6 high)
turns motor ON
BASIC: OUT 6, 127

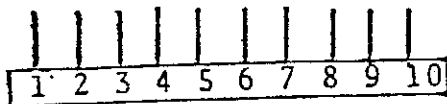bit 6 low (0-5, 7 high)
turns motor OFF
BASIC: OUT 6, 191

Input from address 007 (or 017-switch 3 ON)

- Read data

Output to address 007 (or 017)

- Write data

B. ACR Connector

Pin 1 - Record out- to "MIC or AUX" of
recorder

Pin 2 - Play in - from Speaker or earphone of
recorder

Pin 4 - Ground - shield connection

Pin 6 - Relay contacts*

Pin 7 - Relay contacts*

To connect the motor control circuit to your tape-recorder,
use a Radio Shack #42-2420 cable. Connect one end of the
cable to the center Jack on the ACR connector plate. Connect
the other end of the cable to the "Remote" Jack of the tape
recorder by using an adapter, Radio Shack #274-327.

*Note Motor Control Relay Contacts normally closed after
Power UP.

3. SIO OPERATION

SK1

A. Baud rate select- seven position jumper

1.)	110 Baud	- connect -	1 - 14	
2.)	300		2 - 13	
3.)	1200		3 - 12	
4.)	2400		4 - 11	
5.)	4800		5 - 10	
6.)	9600		6 - 9	
7.)	19200		7 - 8	

SK2

B. TTY/RS232 Option - 20 pin socket - Orient the 18 pin plug
as shown

TTY - 20 ma loop (MITS wiring on DB25)
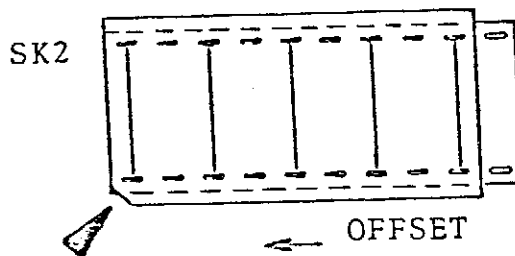
RS232

INTRODUCTION

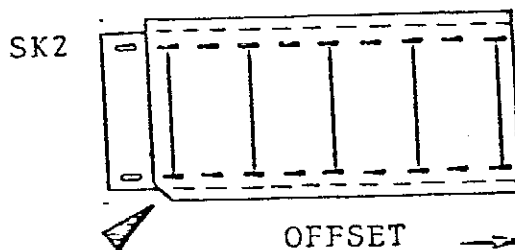The following information explains how to set up and use the ACR with the computer. Contained in this section are general operating procedures, machine language instructions, Altair BASIC operation and motor control circuit operating instructions.

GENERAL OPERATING PROCEDURES

The 88-UIO Audio Recording Interface is designed to be used with any medium quality cassette tape recorder. Music quality recorders generally give better performance than smaller portable recorders. If a stereo recorder is used and tape interchange is desired, it is recommended that only the left channel be used to minimize phase shift due to differences in head alignment. Use only name brand low noise cassette tapes. Off brand and bargain pack tapes may have dropout or mechanical defects that could reduce reliability of data or damage your recorder.

If saving important programs or data on tape, make two recordings on the tape and be sure to remove the record interlock tabs on the back edge of the cassette after recording to prevent accidental erasure of the tape.

Keep recorders and tapes away from power transformers, fluorescent lamps, and other sources of electrical fields and noise, especially when recording or playing tapes.

RECORDING DATA ON TAPE

The proper connection for recording data on tape is from the "RECORD OUT" jack on the computer to the "MIC" or "AUX" jack on your tape recorder. Most cassette tape recorders use a 3.5 mm or 1/8 inch diameter miniature phone jack similar to the type used on the ACR, so a shielded audio cable with miniature phone plugs on each end is all that is required. A suitable cable is Radio Shack #42-2420.

Before data can be recorded on tape, an output program must be entered into the computer. Examples of output programs are the Write Test programs and the CSAVE function of Altair BASIC. Output programs can be stored on Read Only Memories (ROMs) to eliminate the process of entering them manually each time they are needed.

Once the computer has been set up to output data to the ACR, start the recorder in the RECORD mode. Let the tape run at least 30 seconds if

starting from the beginning of the tape, otherwise, 5 seconds minimum. After the tape recorder mechanism and electronics have stabilized, activate the computer to output data.

If your recorder has a turns counter, set it to zero at the beginning of the tape and note the readings at the start and end of the recording. This will make it much easier to locate the desired program on the tape during playback.

It may be helpful to monitor the recording by listening with an earphone. While recording, plug an earphone into the "EXT SPKR" on "MONITOR" jack. Note that while data is being recorded, the tone is buzzing, indicating that data is modulating the tone. A steady tone indicates that no data is being recorded.

Most cassette tape recorders use automatic record level circuitry which simplifies recording since neither the volume or tone controls have any effect upon the signal. The ACR is designed to operate with this type of recorder or may be used with manually adjusted record level circuits. If using a unit with a manually adjusted record level, set the control for maximum undistorted record level.

PLAYING IN DATA FROM TAPE

The proper connection for playing in data from tape into the ACR is from the "SPKR," "MONITOR" or "LINE OUT" jack of your tape recorder to the "PLAY IN" jack on the computer. Use the Radio Shack cable or equivalent as described in Paragraph 2-3.

Before data can be loaded into the computer, an input or load program must be entered into the computer. Examples of input programs are the Read Test programs, the CLOAD function of Altair BASIC (page 27), or the BASIC Bootstrap Loader. These programs may be put on Read Only Memories (ROMs) to eliminate the process of entering them manually each time they are needed.

Once the computer has been set up to load data from the tape, cue the tape to a point about 5 to 10 seconds before the desired data begins. Start the tape recorder in the run (PLAY) mode and activate the input program.

The volume control should be at least 1/3 volume, with maximum volume preferable. The tone control should also be set at maximum.

KANSAS CITY STANDARD PRINCIPLE*

The Kansas City Standard for audio cassette data interchange is based upon the use of a frequency shift modulation method from which serial clock data can be extracted at rates of up to 300 baud. The system is intended to be used with low to medium cost cassette recorders incorporating electrical stop and start capability which may be operated under program control.

The technique provides for long and short term tape speed variation, limitations in bandwidth due to effects such as tape misalignment, and the necessity to retain low cost and low complexity of the hardware. The technique allows for potential operation at higher tape speed than the nominal 1.875 inch/s (4.75 cm/s).

A mark (logical one) bit consists of eight cycles at a frequency of 2400 Hz.

A space (logical zero) bit consists of four cycles at a frequency of 1200 Hz.

A recorded character consists of a space as a start bit, eight data bits, and two or more marks as stop bits.

The interval between characters consists of an unspecified amount of time at the mark frequency. In this respect, the data format is similar to that of asynchronous data communication.

The eight data bits are organized so that the least significant bit is first, most significant bit last followed (optionally) by a parity bit. The total number of significant bits and the parity bit cannot exceed eight.

Where less than eight data bits are used, the unused bits (following the optional parity bit) at the end of the character are mark bits (2400 Hz).

*This article first appeared in the February, 1976, issue of BYTE. Copyright 1976, BYTE Publications, Inc., Peterborough, NH, USA. All rights reserved. Reprinted in part by permission.

Data will be organized in blocks of arbitrary and optionally variable length preceded by a minimum of five seconds of marks.

To avoid errors due to splicing and wrinkling, the beginning of the first data block will occur no sooner than 30 seconds from the start of clear leader.

The contents of the data block are not specified.

The data block ends after the stop bits of the final character.

Bit clocking information may be extracted from the recorded waveform, which is always an integer multiple of the bit rate regardless of tape speed. This permits the recovery and retiming of data by means of a UART, which requires a clock of sixteen times the bit rate although other simple circuitry may be used.

A reliable bandwidth of 3000Hz is assumed in choosing mark and space frequencies due to the head misalignment expected between various cassette recorders. The recording technique is a similar form of Manchester or bifrequency code which has a long history of reliability in the computer industry.

The Phase Locked Loop (PLL) requires adjustment on new units or in case the tape speed during playback is grossly different than when the tape was recorded.

ACR ALIGNMENT PROCEDURE

There are three methods listed for alignment of the ACR. If an oscilloscope is available, the first method should be used; if only a voltmeter is available, use the second method.

I. Alignment with an Oscilloscope

Read over the section in this manual on using the ACR; then record the "Output Test Program" for approximately 15 minutes (one side of a C-30 cassette).

Once this is accomplished, rewind the tape and begin playing it back into the computer. For this purpose, no input program is necessary.

Place the oscilloscope to view the signal at L-pin 20. The scope should be set at approximately 2v/div. vertically and 1ms/div. horizontally.

Trim pot R1 should now be adjusted for a +5 volt peak-to-peak square wave.

The signal should be symmetrical; high period = low period; and at a 300 BAUD setting it will be approximately 3.3ms per period (bit).

II. Alignment with Voltmeter

To align your ACR, you may use an easy and accurate method utilizing a voltmeter. The principle being applied is that a D.C. voltmeter reads average voltage, and if you are measuring a square wave, you will read half the peak to peak voltage.

STEP 1: When the output test program in the 88-ACR manual is run (with or without recorder) the voltage on pin 25 (Transmit Data) of the UART should read about 2.5 volts DC, halfway between Logic 0 (0 volts) and Logic 1 (+5 volts). Note the exact voltage.

STEP 2: A--Deposit in memory:

ADDR	DATA	
000	333	Input to ACC
001	007	ACR Data Addr.

   B--Examine 000
   C--Single Step twice

This should allow you to examine data from I/O port #7. Data lights 0-7 will indicate the data being received from the recorder (when properly adjusted). This process may be used to examine data or status information from any I/O board--just change the address number.

STEP 3: Play the tape with the output test program recorded on it. Slowly adjust so that the recorded data (125) shows on the data lights. Now measure "L" pin 20 (receive data) of the UART (I.C. "L") and carefully adjust to the voltage noted in Step 1, about 2.5 volts DC. This adjusts the demodulator.

III. Alignment without an Oscilloscope or Voltmeter (Requires Altair with Front Panel)

Read over the section in this manual on "Using the ACR"; then record the "Output Test Program" for approximately 15 minutes (one side of a C-30 cassette).

The "Input Test Program" should now be loaded into the computer.

Once this is accomplished, begin playing the tape into the computer as described in the section on Using the ACR.

With the system functioning normally, if trim pot is not adjusted properly, address lights A0, A1 & A2 <u>only</u> will be lighted.

Using an insulated alignment tool or insulated screwdriver, slowly adjust R1 back and forth until all of the address lights A0 through A7 light, indicating the Test Word is being received properly.

There will be approximately 2 turns of travel where this occurs. Find the end points where the signal is lost and set the pot exactly in the center of this area of travel.

The following programs for test and I/O require front panel functions such as Deposit, Examine, STOP/RUN.

If these programs are to be used without a front panel, the "USR" functions of BASIC must be implemented. Consult the BASIC manual for more information for using "POKE", "PEKE", and "USR".

I/O PROGRAMS FOR THE ACR

Write Program, 38 Bytes

Writing data on tape through the ACR is accomplished by first specifying the start address of data and the end address of data. Then a test byte (000 in this program) is written, followed by data output. The last portion of the program tests to see if the program has transmitted the last byte of data. If it has, the program jumps to the last positions in memory, and is observed by a change in the address lights on the front panel. If the program has not outputted the last data byte, the H & L registers are incremented by 1 and the program outputs the next byte. This program is placed in the upper portion of 4K memory with a starting address of 017,000. The location may be changed, but be sure to change all jump addresses accordingly. After recording data that includes program information, write down the start and end address on the tape cartridge along with the name and test byte of the program for identification.

When recording data at the beginning of a cassette tape, record at least 15 seconds of steady tone before running the write program (to get past the plastic leader and wrinkles in the beginning of the tape). Also, if recording more than one batch of data, leave at least 5 seconds of steady tone between batches. This program is written for ACR addresses of 6 & 7.

TAG	MNEMONIC	ADDRESS	OCTAL CODE	EXPLANATION
	LXI	017,000	041	Load immediate H & L register pair
		1	xxx	Lo starting address of
		2		Hi data to be written
	LXI	3	001	Load immediate B & C register pair
		4	xxx	Lo end address of
		5	xxx	Hi data to be written
	MVI	6	076	Move immediate to accumulator
		7	000	Test byte to be written at beginning
	OUT	017,010	323	Output data from accumulator
		11	007	Data channel # of ACR
TEST	IN	12	333	Input data to accumulator
		13	006	Status channel # of ACR
	RLC	14	000	Input data to accumulator
	JC	15	332	Jump if carry (D7 not true)
		16	012	To "TEST"
		17	017	
	MOV	017,020	176	Move contents of memory specified by
				H & L register to accumulator
	OUT	21	323	Output data from accumulator
		22	007	Data channel # of ACR
	MOV	23	175	Move contents of L register to accumulato
	CMP	24	271	Compare accumulator vs B register
	JNZ	25	302	Jump if not zero (L≠B)
		26	040	To "NEXT"
		27	017	
	MOV	017,030	174	Move contents of H register to accumulato
	CMP	31	270	Compare accumulator vs C registor
	JNZ	32	302	Jump if not zero (H ≠ C)
		33	040	To "NEXT"
		34	017	
		35	303	Jump (if L = B and (H = C)
		36	375	To "END"
		37	017	
NEXT	INX	017,040	043	Increment register pair H&L
	JMP	1	303	Jump
		2	012	To "TEST"
		3	017	
END	JMP	017,375	303	Jump (loop to self)
		376	375	To "END"
		377	017	

Read Program - 48 Bytes

As in the write program, start and end addresses of incoming data are speci-
fied first. Next, the program looks for the test byte (000 in this program).
Once the test byte is detected, the program inputs data and stores it in memory
as specified by the H & L registers. The next portion of the program tests
to see if the end memory address has been filled. · If it has, the program
jumps to the last positions in memory, and· is observed by a change in the ad-
dress lights on the front panel. If .it is not the end, then the program
increments H & L by 1 and jumps back to input another data byte. This pro-
gram is placed in the upper portion of 4K of memory with a starting address
of 017,000. The location may be changed, but be sure to change all jump
addresses accordingly. When reading data back in, the tape and program should
be started a few seconds before the start of data.

TAG	MNEMONIC	ADDRESS	OCTAL CODE	EXPLANATION
	LXI	017,000	041	Load immediate H & L register pair
		1	xxx	Lo starting address of ·
		2	xxx	Hi data to be read
	LXI	3	001	Load immediate B&C register pair
		4	xxx	Lo end address of
		5	xxx	Hi data to be read
TSTBT	IN	6	333	Input data to accumulator
		7	006	Status channel ≠ of ACR ..
	RRC	017,010	017	Rotate accumulator right (test D0 true
	JC	11	332	Jump if carry (D0 not true)
		12	006	
		13	017	To "TSTBT"
	IN	14	000	Input data to accumulator
		15	007	Data channel ≠ of ACR
	CPI	16	376	Compare immediate with test byte
				vs. accumulator
		17	000	Test byte
	JNZ	017,020	302	Jump if not zero (test byte≠input byte
		21	006	To "TSTBT"
		22	017	
TEST	IN	23	333	Input data to accumulator
		24	006	Status channel ≠ of ACR
	RRC	25	017	Rotate accumulator right (test D0 true
	JC	26	332	Jump if carry (DO not true)
		27	023	To "TEST"
		017,030	017	
DATA	IN	31	333	Input data to accumulator
		32	007	Data channel ≠ of ACR
	MOV	33	167	Move contents of accumulator to memory address specified by H and L register
	MOV	34	175	Move contents of L register to accumu
	CMP	35	271	Compare accumulator vs B register
	JNZ	36	302	Jump if not zero (L ≠ B)
		37	051	To "NEXT"
		017,040	017	
	MOV	41	174	Move contents of H register to accumu
	CMP	42	270	Compare accumulator vs C register
	JNZ	43	302	Jump if not zero (H ≠ C)

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		44	051	To "NEXT"
		45	017	
	JMP	46	303	Jump (if L = B and H = C)
		47	375	To "END"
		017,050	017	
NEXT	INX	51	043	Increment H & L register pair
	JMP	52	303	Jump
		53	023	To "TEST"
		54	017	
END	JMP	017,375	303	Jump (loop to self)
		376	375	To "END"
		377	017	

OUTPUT TEST PROGRAM (Use with a front panel type Altair)

.The following is a listing of the output program used to write
test data onto tape.   This will be used for the alignment of the
ACR Demodulator.   The program may be used with any memory size, 25(
words or larger.

This program will record the test byte (125) until the progran
is manually stopped.   The program is written using I/O address 6
for status and I/O address 7 for data.   If your board address has
been wired differently, change the program accordingly.

ADDRESS LOCATION (octal)	OCTAL CODE	MNEMONIC	DESCRIPTION
200	333	IN	Input
201	006	---	I/O Port Status Address
202	007	RLC	Rotate accumulator left
203	332	JC	Jump if carry
204	200	---	Lo ⎫
205	000	---	Hi ⎭ Address jumped to if zero accumulator
206	076	MVI	Move immediate to A
207	125	---	TEST BYTE
210	323	OUT	Output
211	007	---	I/O Port Data Address
212	303	JMP	Jump unconditional
213	200	---	Lo ⎫
214	000	---	Hi ⎭ Starting address of routine

INPUT TEST PROGRAM (Use with a front panel type Altair)

The following is a listing of the program for playback of the Output Test Program. This program will also be used for the alignment of the ACR Demodulator. It is written using the same I/O port addresses as the other program stated above, and should be changed accordingly if necessary.

ADDRESS LOCATION (octal)	OCTAL CODE	MNEMONIC	DESCRIPTION
000	333	IN	Input
001	006	---	I/O Port Status Address
002	017	RRC	Rotate accumulator right
003	332	JC	Jump if carry
004	000	---	Lo
005	000	---	Hi — Address jumped to if zero accumulator
006	333	IN	Input
007	007	---	I/O Port Data Address
010	356	XRI	Exclusive Or Immediate with A
011	125	---	Exclusive Or Test Word
012	312	JZ	Jump on zero
013	300	---	Lo
014	000	---	Hi — Address jumped to if zero accumulator (Hi Addr. Test Prog.)
015	303	JMP	Jump unconditional
016	000	---	Lo
017	000	---	Hi — Address jumped to if zero accumulator

(cont.)

ADDRESS LOCATION (octal)	OCTAL CODE	MNEMONIC	DESCRIPTION
300	257	XRA	Exclusive Or register with A
301	062	STA	Store A direct
302	376	---	Lo— First address to be zeroed out
303	000	---	Hi—
304	062	STA	Store A direct
305	377	---	Lo— Second address to be zeroed out
306	000	---	Hi—
307	072	LDA	Load A direct
310	376	---	Lo— Address of data for above
311	000	---	Hi—
312	306	ADI	Add immediate to A
313	001	---	Data to be added
314	062	STA	Store A direct
315	376	---	Lo— Address for above to be stored
316	000	---	Hi—
317	322	JNC	Jump on no carry
320	337	---	Lo— Address to be jumped to for above
321	000	---	Hi—
322	072	LDA	Load A direct
323	377	---	Lo— Address of data for above
324	000	---	Hi—

(cont.)

(cont.)

ADDRESS LOCATION (octal)	OCTAL CODE	MNEMONIC	DESCRIPTION
325	306	ADI	Add immediate to A
326	001	---	Data to be added
327	062	STA	Store A direct
330	377	---	Lo ⎫
331	000	---	Hi ⎭ Address for above to be stored
332	356	XRI	Exclusive Or immediate with A
333	006	---	Data to be Ex-Ored
334	312	JZ	Jump on zero
335	000	---	Lo ⎫
336	000	---	Hi ⎭ Address jumped to if zero accumulator
337	333	IN	Input
340	006	---	I/O Port Status Address
341	017	RRC	Rotate accumulator right
342	332	JC	Jump if carry
343	307	---	Lo ⎫
344	000	---	Hi ⎭ Address jumped to if zero accumulator
345	333	IN	Input
346	007	---	I/O Port Data Address
317	356	XRI	Exclusive Or immediate with A

(cont.)

(cont.)

ADDRESS LOCATION (octal)	OCTAL CODE	MNEMONIC	DESCRIPTION
350	125	---	Data to be Ex-Ored (Test Byte)
351	312	JZ	Jump on zero
352	300	---	Lo⎤
353	000	---	Hi⎦ Address jumped to if zero accumulator...
354	303	JMP	Jump unconditional
355	000	---	Lo⎤
356	000	---	Hi⎦ Jump to this address if A is not zero