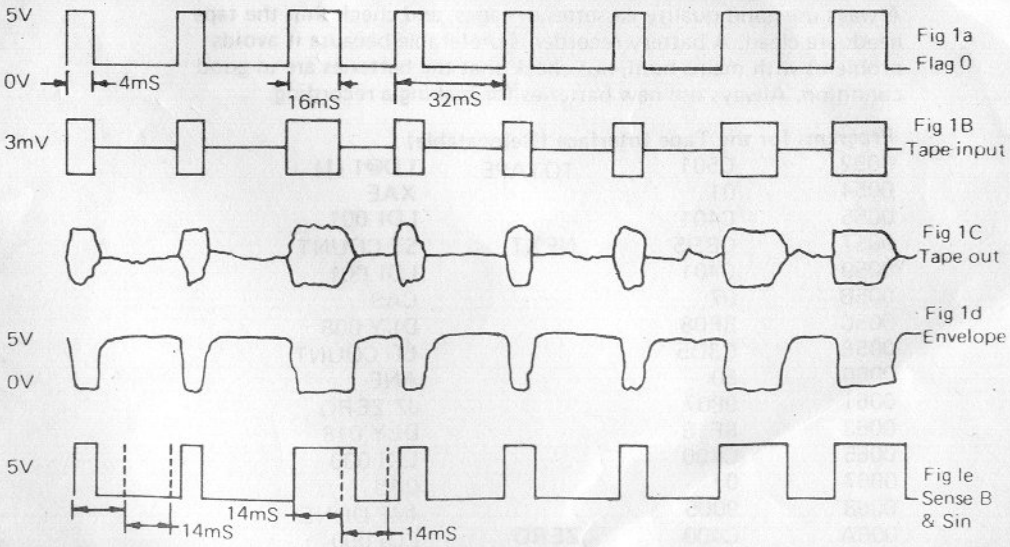
A Simple Tape Interface for the MK14

The hardware and software described below form a simple system for storing programs or data on a tape recorder and then reloading them anywhere in RAM memory. Programs can be relocated if they use suitable addressing modes.

Writing to tape The software reads the contents of the next address pointed to by the pointer register P1 and scans the bits from right to left pulsing flag 0 high for 4mS if the bit is a zero and for 16mS if it is a one. The leading edges of these pulses are separated by 32mS. If the byte was C4 (binary 11000100) and we connected an oscilloscope to flag 0, we would observe the waveform shown in Fig. 1a. The hardware contains a gated 1KHz oscillator which is controlled by flag 0. The e WRITE LED is also controlled by flag 0. The output of the oscillator is shown in Fig. 1b and this is connected to the input of the tape recorder. Notice how the flag 0 pulses are mixed with the output of the oscillator to give a zero-centred waveform. This reduces recording distortion and allows an automatic volume control recorder to adopt a higher input sensitivity. When all the bits of the byte have been scanned, the software increments P1 and repeats the process with the next byte. The system stores 4 bytes per second. When all the bytes have been scanned, control is returned to the monitor by the instruction XPPC3.

Reading from tape Typical output (C4) from the tape recorder is shown in Fig. 1c. This is amplified and demodulated by the hardware to give a waveform like than shown in Fig. 1d. This is then squared off by a CMOS gate to give the signal shown in Fig. 1e which is connected to SENSE B and SIN. The software cycles in a tight loop until SENSE B goes high, waits for 14mS, and then reads what is present on SIN into the extension register (from the right). The program waits a further 14mS before returning to the previous tight loop. When eight bits have been read into the extension register it will contain the original byte (C4). The software stores this at the next location pointed to by P1, increments P1, and returns to the tight loop to await the first bit of the next byte. Since the software has no way of knowing then the playback has finished, it is up to the user to press the RESET button, when the READ LED ceases to flash.



Operation of the tape interface

Writing to tape:

1. Put the number of bytes to be stored in location OFF5 (in OFF8 if you are using the new monitor). This will be a hex number not exceeding 256_{10}. If one wanted to store seventy bytes one would enter 46.
   (NB: to store the full 256 bytes one should enter 00).
2. Put the starting address of the program to be stored in OFF9 and OFFA (P1H and P1L).
3. Enter the starting address of the TOTAPE routine (0052 in new monitor).
4. If desired make a short voice recording indicating the nature of the programe to be stored. Connect the tape interface to the recorder.
5. Start recording and after about five seconds press GO (GO-GO-TERM for old monitor).
6. When the WRITE LED has ceased flashing turn off the tape recorder.

Reloding from tape:

1. Put the starting address of where the program on tape is to be reloded in OFF9 and OFFA (P1H and P1L).
2. Enter the starting address of the FRTAPE routine (007C in new monitor).
3. Start the recorder playing back. Wait until after the switch on click which follows the voice header before pressing GO. It is essential to wait until after this click as it might get read as a zero bit and cause an error.
4. When the READ LED has stopped flashing press RESET and turn off the tape recorder.

General Comments:

The system is intended for use with the high impedance (monitor) output of the tape recorder. If there is only a low impedance (loudspeaker) output, things should still work although the volume control setting may be critical.
Always use good quality cassettes or tapes, and check that the tape heads are clean. A battery recorder is preferable because it avoids problems with mains hum, but check that the batteries are in good condition. Always use new batteries for making a recording.

Programs for the Tape Interface (Relocatable)

```
0052  C501   TOTAPE:  LD@1 (1)
0054  01               XAE
0055  C401             LDI 001
0057  CBD5   NEXT:    ST COUNT
0059  C401             LDI 001
005B  07               CAS
005C  8F08             DLY 008
005E  C3D5             LD COUNT
0060  50               ANE
0061  9807             JZ ZERO
0063  8F18             DLY 018
0065  C400             LDI 000
0067  07               CAS
0068  9005             JMP DONE
006A  C400   ZERO:     LDI 000
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```
006C    07              CAS
006D    8F18            DLY 018
006F    8F20    DONE:   DLY 020
0071    C3D5            LD COUNT
0073    F3D5            ADD COUNT
0075    9CE0            JNZ NEXT
0077    BBD6            DLD LEN
0079    9CD7            JNZ TOTAPE
007B    3F              XPPC 3
007C    C408    FRTAPE: LDI 008
007E    CBD5            ST COUNT
0080    06      LOOP:   CSA
0081    D420            ANI 020
0083    98FB            JZ LOOP
0085    8F1C            DLY 01C
0087    19              SIO
0088    8F1C            DLY 01C
008A    BBD5            DLD COUNT
008C    9CF2            JNZ LOOP
008E    40              LDE
008F    CD01            ST@1 (1)
0091    90E9            JMP FRTAPE

0FF4    COUNT = D5 (3)          (OFF7 in new monitor)
0FF5    LEN=D6 (3)              (OFF8 in new monitor)
0FF9,0FFA  STARTING ADDRESS
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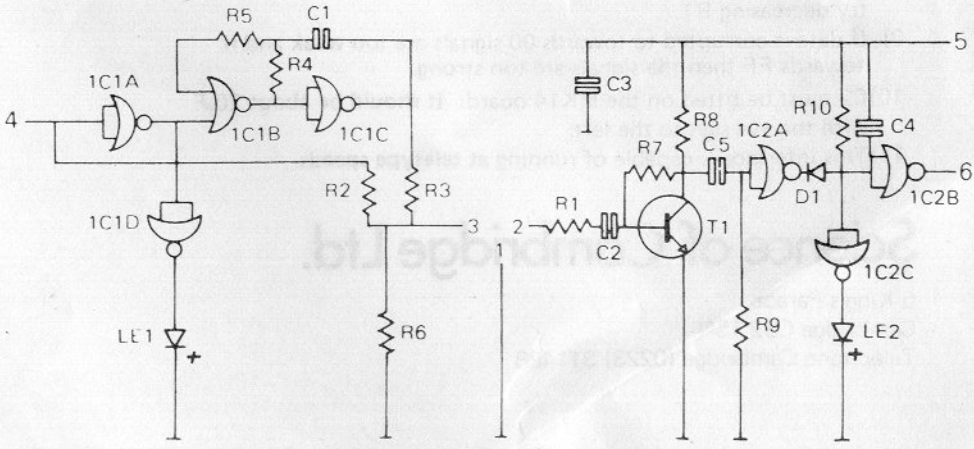
R1	27K	C1	10N
R2	IM	C2	10N
R3	470K	C3	100N (optional)
R4	27K	C4	10N
R5	150K	C5	2N2
R6	150	D1	
R7	4M7	LE1	NSL5057
R8	27K	LE2	NSL5057
R9	4M7	T1	2N2926G
R10	150K	1C1	4001
		1C2	4001



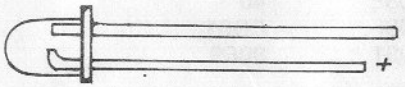
Edge connector details

1. earth
2. tape output
3. tape input
4. flag zero (30 on MK14 edge connector)
5. + 5V
6. SENSE B and SIN (27 and 28 on MK14 edge connector)

Extra Notes on Construction

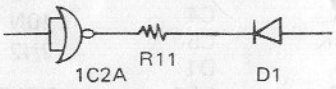
1) The white band on D1 is the positive end.
2) On some boards two positions are marked for C4. The position in the centre of the board is for C5.
3) The connections for the transistor are as shown below.
4) In some boards the +ve sign for the LEDS is the wrong way round. It should be on the left.
5) The polarity of the LEDS is as shown below.

2N2926
Transistor



LED

6) On later boards there is an extra 27K resistor in series with D1. This improves the noise immunity.



7) Cheap foreign recorders may require an input of about 100mV. To get this larger signal increase R6 to 2K7.
8) If the output level from your tape recorder is less than 200mV try decreasing R1.
9) If data is corrupted to towards 00 signals are too weak and if towards FF then the signals are too strong.
10) C2 must be fitted on the MK14 board. It should be about 20μF with the +ve sign to the left.
11) This interface is capable of running at teletype speeds.

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