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A KEYBOARD INTERFACE FOR THE JOLT MICROPROCESSOR

The Ohio University Microprocessor Navigation Receiver Base utilizes the JOLT(TM) microcomputer. This keyboard interface is designed to allow data input without use of a teleprinter.

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I. INTRODUCTION

A software-based low-cost Omega navigation system is being developed by Ohio University under sponsorship of the National Aeronautics and Space Administration in conjunction with the Tri-University program.[1] The navigation system consists of an Omega front-end module and a microcomputer module. Such data as present position, way points and time-of-day will be entered into the microcomputer via a keyboard on the front panel.

The keyboard circuit as shown later in this paper has been implemented for the Ohio University Microcomputer Receiver Base, and its operation is proven. Since the JOLT microcomputer is designed for teleprinter communication, additional monitor software will be designed to allow JOLT to operate entirely from this keyboard instead of the teleprinter. A programmable ROM chip is suggested to facilitate this operational mode, required for airborne use of the JOLT system.

In operation, the keyboard will allow JOLT start-up and entry of data for LORAN or OMEGA navigation.

II. THE CIRCUIT

The encoding logic utilizes two eight-bit priority encoders and a quad, two input OR gate,[2] as shown in Figure 1. For a high level on any given input (corresponding to a key press), the correct binary coded number appears at the output, along with a key press (KP) command that goes high for any input. The 10K resistors on the inputs of the encoders are pull-down resistors providing a low-level to the CMOS inputs until pulled high by the appropriate key press. The keyboard used for this circuit was Flex-Key Corporation's 19SK-6, 18 key device, having one common line which connects with one of 18 outputs when a key press occurs.

Keyboard debounce is accomplished through the use of an RC integrator followed by the Schmitt trigger of Figure 1. Input and feedback resistors provide hysteresis such that the output of the second inverter changes state at different points for positive and negative going edges applied to the input. This, along with the time constant of the integrator, provides an effective debounce circuit for the KP command. In practice the exact values for these resistors (and the integrator parts) would be picked by careful selection for a particular keyboard.

Keyboard detail appears in Figure 2. The waveforms at various points in the circuit appear in Figure 3. Notice that the leading edge of the debounced KP command occurs when valid data is present at the outputs so that if this edge is used to latch the data, debouncing of these outputs is unnecessary.

III. IMPLEMENTATION

If the particular microcomputer used has a latch provided on a peripheral interface adaptor (PIA) then the circuit described above, using KP as an interrupt request, will provide all that is needed to get hexidecimal data into the unit from the keyboard. If a latch (external to the microcomputer) is needed, it can easily be implemented by strobing the latch with the leading edge of the debounced KP command.

IV. ALTERNATIVES

The decision to use this method of encoding was based on cost and availability of the necessary components. However, depending on a particular keyboard's switch matrix and the intended application there are other ways to encode. National Semiconductor has IC's for encoding and debouncing different types of keyboards (MM74C922, MM74C923 and MM5740) while Harris Semiconductor manufactures one that encodes a 16-key keyboard but provides no debouncing (HD0165)*. Finally, Figure 4 shows a method of replacing the encoding IC with a diode matrix.

V. VERIFICATION

Figure 5 shows a simple JOLT program to verify keyboard operation. The keyboard routine address 0000 is set into the JOLT IRQ interrupt vector. When keypress occurs, the keyboard data is loaded and then printed on the teleprinter in hexidecimal by the JOLT monitor subroutine WROB. The routine then waits for the next keypress in an endless loop.

VI. REFERNCES

[1] Lilley, R.W., and Salter, R. J., "A Microcomputer Based Low-Cost Omega Navigation System", NASA TM 34, Avionics Engineering Center, Ohio University, Athens, Ohio.

[2] "RCA Integrated Circuits Databook", P-625, RCA Corporation, 1976.

* This is an example of some available encoders but is not intended to be a complete list.

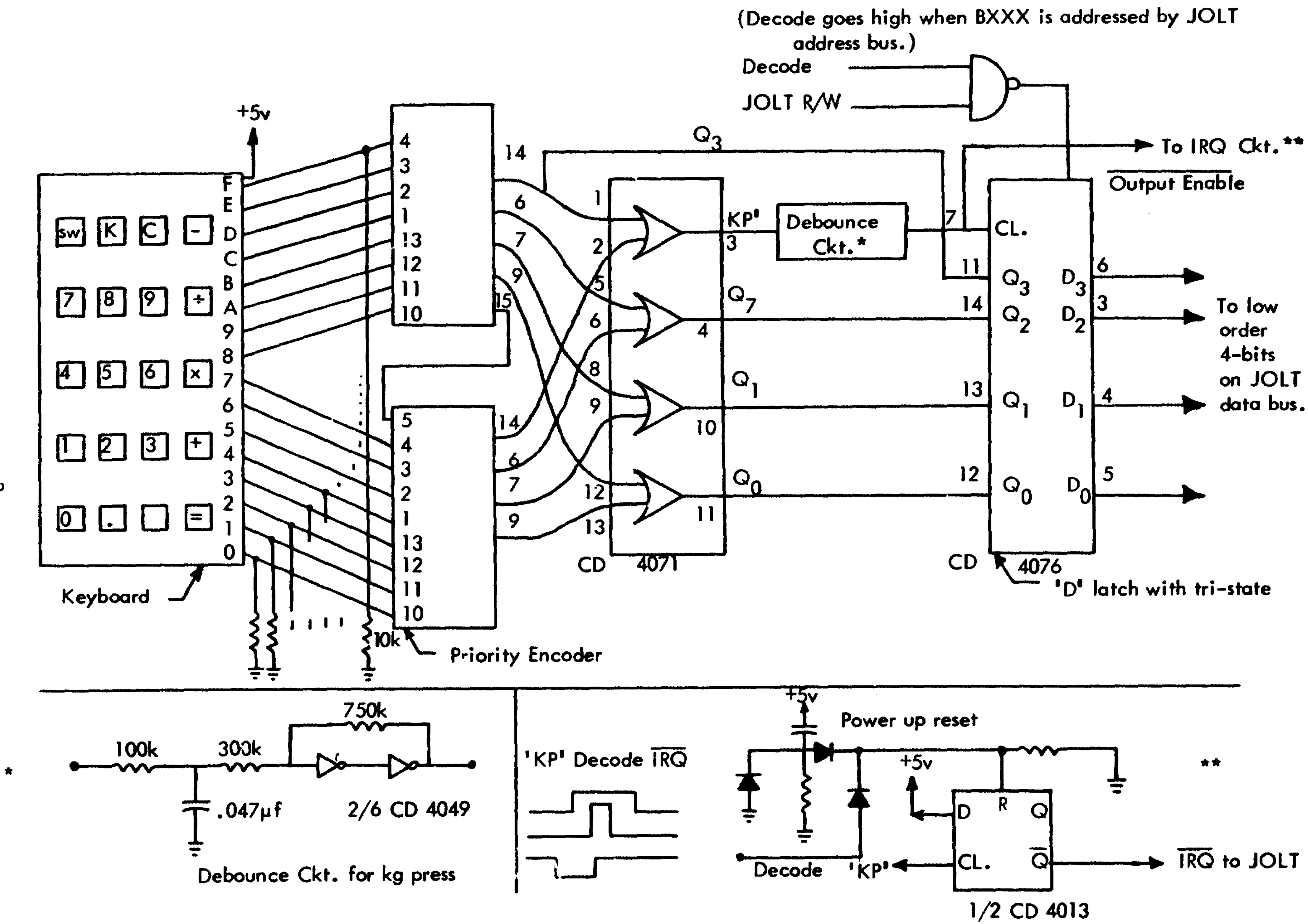

Figure 1. Keyboard Logic Diagram.

Pin connected to pin 6 when key is pressed

Pin	Key
1	=
2	+
3	-
4	+
5	x
6	common
7	9
8	C
9	6
10	3
11	.
12	K
13	8
14	5
15	2
16	0
17	switch
18	switch
19	7
20	4
21	1

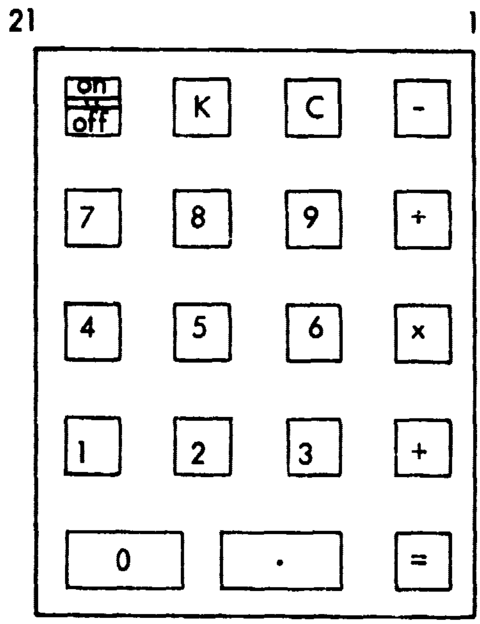

Figure 2. Keyboard Detail.

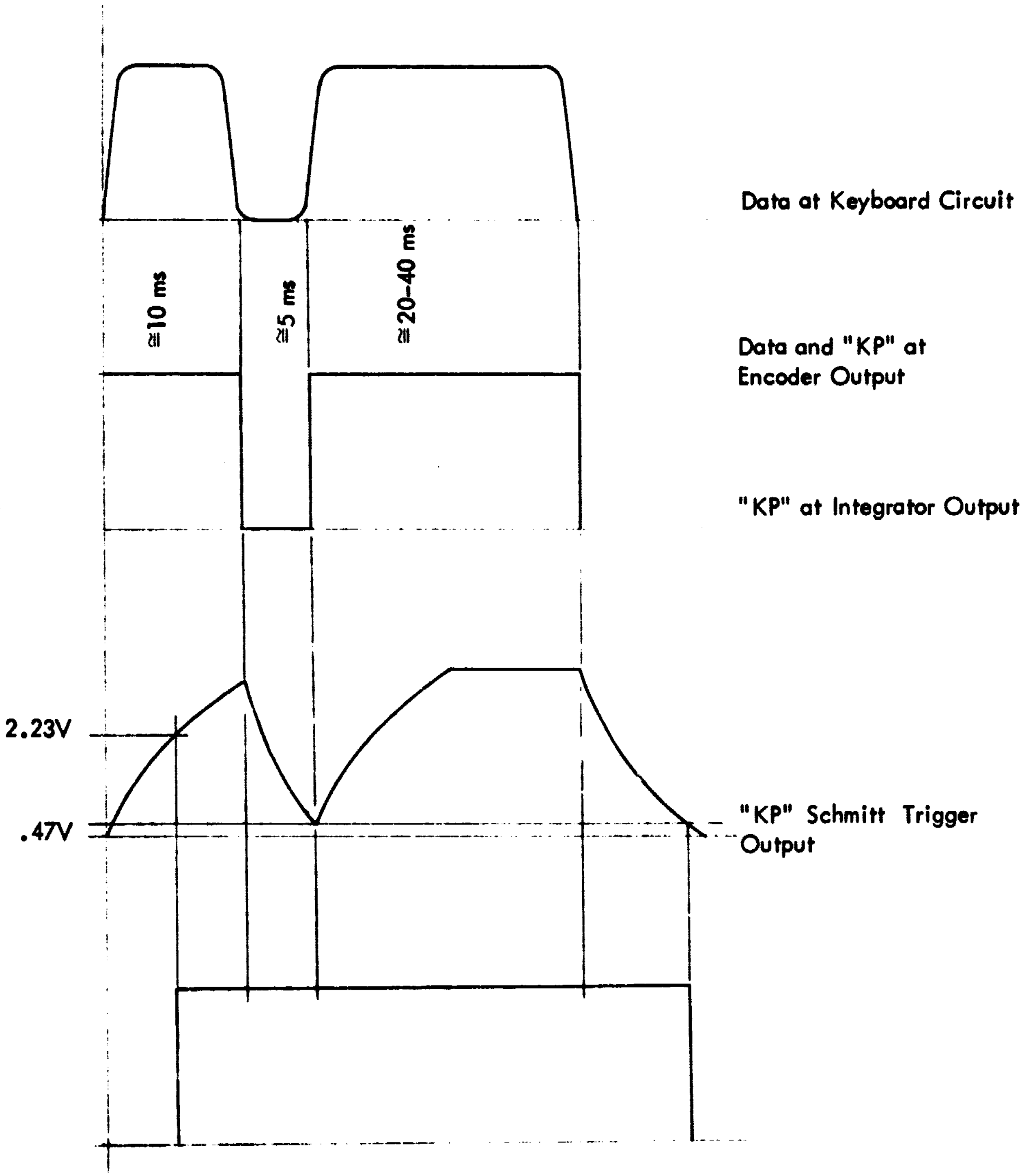

Figure 3. Waveforms at Various Points in the Circuit.

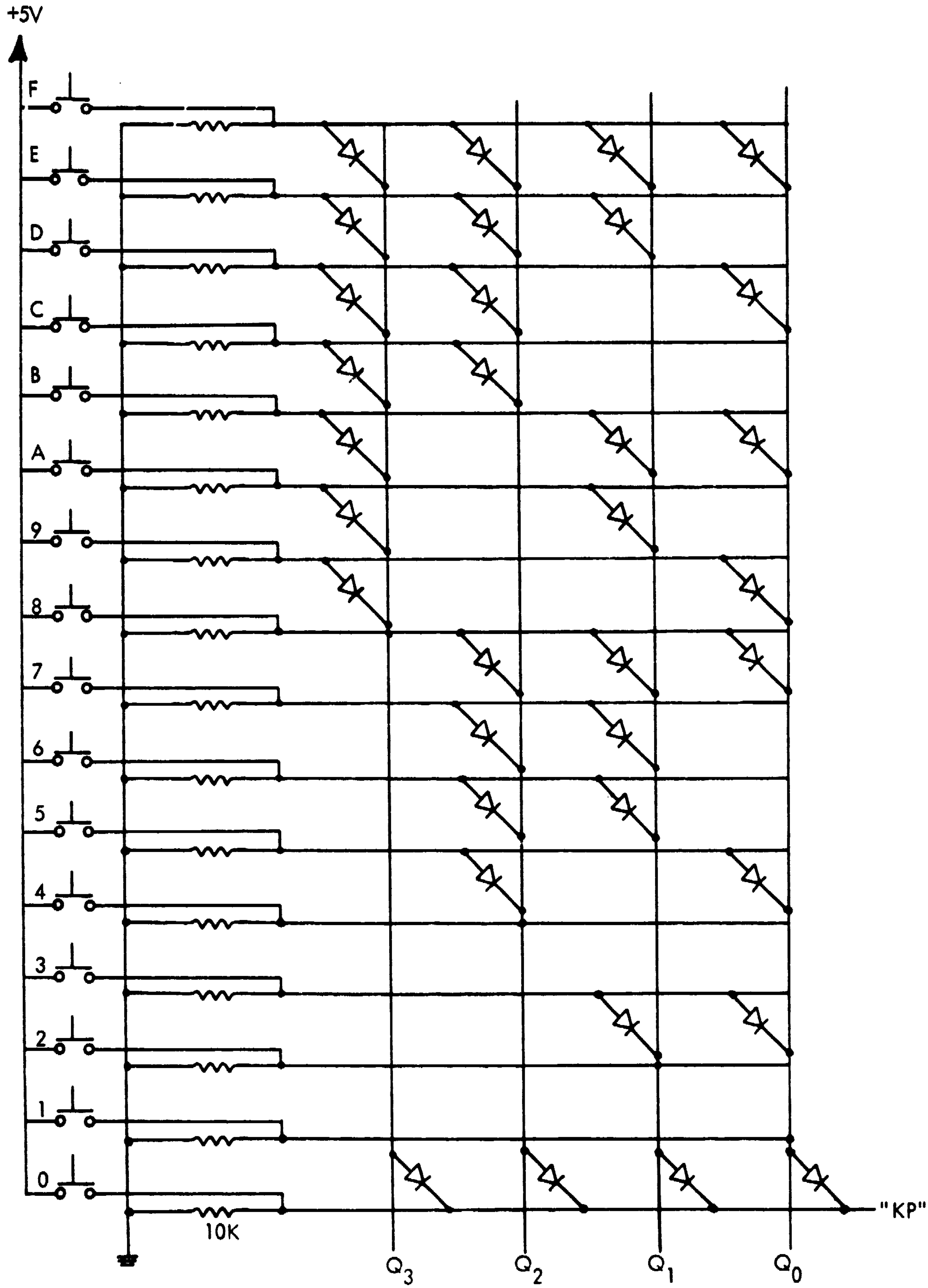

Figure 4. Diode Encoding Matrix.

ADDRESS	CODE	LABEL	OPERATION	OPERAND
0000	AD0080	IBEGIN	LDA	KBD
0003	85A0		STA	SAVE
0005	20A8A72		JSR	CR/LF
0008	A5A0		LDA	SAVE
000A	20B172		JSR	WROB
000D	40		RTI	
000E	4C0E00	SELF	JMP	SELF

SYMBOL LOCATIONS:

SELF	000E
KBD	8000
SAVE	00A0

Figure 5. Program for Testing Keyboard Interface (Memory Mapped).