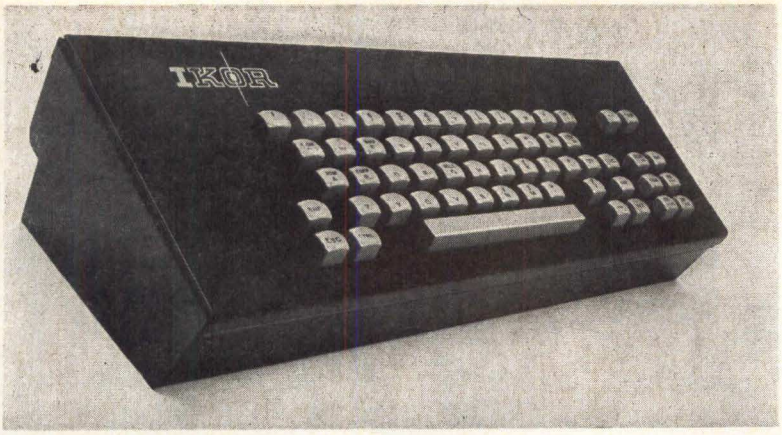
A departure from conventional keyboard operating principles contributes to error-free code generation. Resultant simplicity provides secondary benefits ranging from transmission security to lower system cost.



ELECTRONIC KEYBOARD

A novel approach to keyboard code generation, which provides a simple, but reliable means of rejecting both external and internal noise, including jamming signals, has resulted in a keyboard design that eliminates coding errors in the circuit and reduces the likelihood of operator error. This new keyboard (patents pending), developed by engineers at IKOR, Inc. in the Northwest Industrial Park, Burlington, Mass., is said not only to retain the advantages of the photo-electric systems (no mechanical crossbars or other interconnections), but also to eliminate other problems associated with both photo-electric and electro-mechanical keyboards.

Coding In The Keys

Code functions are incorporated into each key as in photo-electric systems. But here the unique principle introduces system simplification. Transmit and receiver bars, which have a universal function within the system, run between key rows thus servicing more than one row in every case but the top and bottom rows.

Depressing a key produces an AC couple between the transmit-receiver bars and generates a code unique to that key (Figure 1). A closed-loop circuit is effected as each key is depressed, permitting discrimination against any noise not in phase with the keyboard signal generator. As the illustration shows, this technique eliminates the need for mechanical connections between individual keys and other portions of the keyboard. So, in addition to the reduction of coding errors, this system makes it possible to add or replace code functions at any time without any modification whatsoever of the basic circuitry. The transmit and receiver bars perform the same function for **all** keys within the given code format (8-level ASC II code is standard, but others may be employed).

Not only may keys be added at any time, they may be added in any position since the only requirement is that they fall within the keyboard arrangement provided and between the transmit/receiver bar rows.

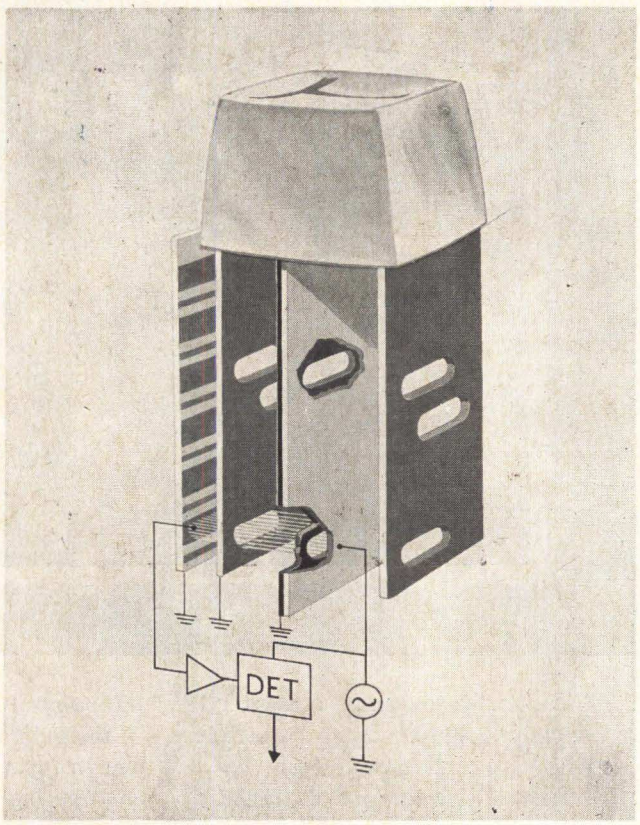


Fig. 1 Principle of Operation: Depressing key produces an AC couple between transmit and receiver bars generating a code unique to that key. A closed-loop circuit permits rejection of noise not in phase with keyboard current generator. Transmit and receiver bars run length of and between key rows. Elimination of mechanical connection to all key positions and the "universal" function of transmit and receiver bars permit any key to be assigned to any position at any time. No change in basic circuitry is involved.

System Compatibility

The IKOR keyboard, with clocked output, interfaces directly with any digital printer, CRT, tape recorder, computer or other information storage system and can provide either serial or parallel inputs to these systems. The basic keyboard contains eleven data and three control channels.

Shift or control keys permit selection of the 7 channels assigned to those modes. Normally, activation of a key generates a 7-bit code plus 1 bit for odd or even parity. A strobe output (flag) is provided at the interface connector in the form of a voltage change so that only when all character bits have reached equilibrium can the information be "cleared" for transmission.

Independent upper-case code generation permits keyboard users to specify and utilize only those functions desired with the provision for addition (or changes) at any subsequent time.

Virtues Of Simplicity

Although the principal objective was to reduce coding errors, the simplicity of the system allows some equally significant secondary benefits:

• **Keyboard arrangements** are exceptionally flexible since the complete coding function is delegated to the key itself. Typical keyboard arrangements, shown in Figure 2, range from 44 keys plus space bar, to over 80 keys. Standard alphanumeric arrangements are used to capitalize on operator familiarity, but any arrangement is possible. Numerical (or adding machine) functions can be conveniently grouped separately. This can be of advantage when keyboard entries are made by operators who are not familiar with touch-typing of numbers or when adding machine operations are to be performed. System cost is lower in terms of initial keyboard price and also because of minimal maintenance requirements. Mechanical wear is limited to sliding of the keys in their guide and to the life of the return spring (rated at 1 x 10^7 operations, minimum). Also, there is inherent zero "bounce" in the key, comparable to high performance keys that cost approximately $10 per key (thus involving close to $500 for a 44 to 50 key system over and above cost of any other components). In production quantities, the basic keyboard is marketable at under $200 and in small quantities is only slightly more than $300.

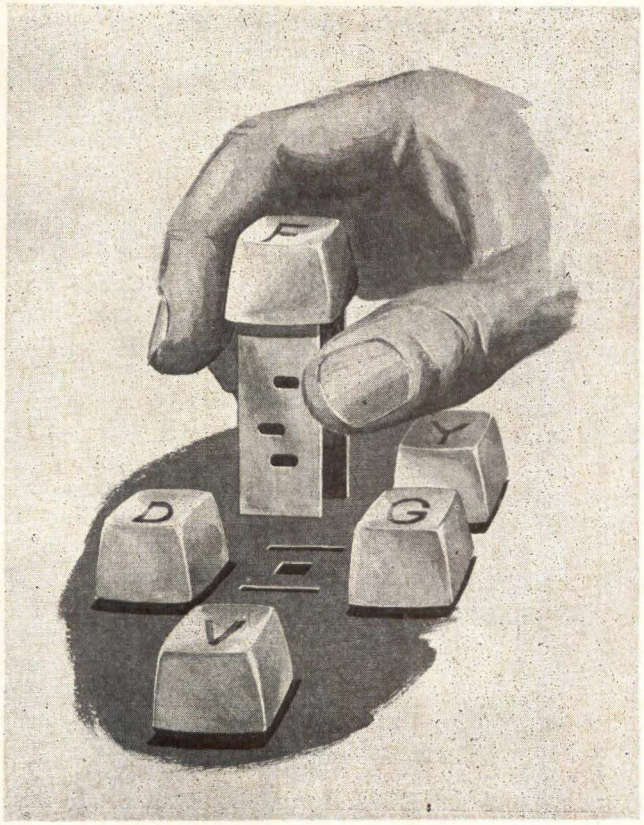


Fig. 2 Key Replacement/Addition: Since each key is its own code generator, simple addition or modification of functions (keys) can be made economically at any time. New key is merely snapped into position. All key positions on standard keyboard are filled with "dummy" keys and dustcaps so that full key capability may be utilized whenever desired. Illustration also indicates how new principle permits key mounting without wobble or play.

• **Mechanical design** is said to approximate the most desirable electric typewriters currently available. Ideal key spacing, solid-feel and responsiveness were designed into the system to reduce coding errors due to operator error as well as to circuitry. Similarity in handling between the new keyboard and electric typewriters eliminates the need for special operator training.

The new electronic operating principle plus the key mechanism permit speeds not common with other keyboards. At a demonstration for COMPUTER DESIGN, the keyboard "drove" a standard Teletype printer at approximately 90 words per minute, illustrating its capability for tie-in with other "hard copy" or visual display systems. The keyboard is electronically interlocked to prevent transmission of errors that result from striking more than one key at a time or striking keys at rates in excess of 40 characters per second.

• **Transmission security** is provided as a result of the system's low power drain and low radiation level. Only milliwatts of power are utilized by the keyboard so there is no longer any definable spike to signal the beginning of code generation. In an era of sophisticated "bugging" (between companies as well as countries) this improved security factor may be a most important secondary benefit.

Low radiation level and ability to reject spurious signals also means that when these keyboards are used in multiple station complexes or as part of a time-shared system they will not "talk" to each other or to other equipment.

Code Lockout For Multiple Code Format Use

The IKOR keyboard (Model 6000) is normally supplied without its housing for direct incorporation into specific system packages. Since the keyboard is compatible with basic ASC II code or can be supplied to any truth table within the limits of the eleven (11) channels available for coding, provision is made for mechanical lockout of selected keys. This can be accomplished with a mask plate when more than one coded output is provided and it is desired to prevent transmission of codes not acceptable to the receiver.

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