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The PC104 Multi-Macro Programmable Keypad Encoder USE104 ver 1.1

The USE104 Keypad Encoder provides an interface between a matrix-type keypad and a computer system with an PC/XT or PC/AT keyboard port or RS232 serial port for a PC104 systems.

The USE104 supports both macros and "TrueShift" codes. A macro is a combination of several codes sent out with one key closure. "TrueShift" (called after ASCII keyboards) is a capabilty to change key-codes (or macros) depending on special "function" or "color" keys. An example is a special blue key which maps Numeric Keypad on laptop computers. With two "function" keys up to three key-codes (or macros) can be assigned to any key. A macro capability allows the USE104 to provide both extended codes (two byte codes with E0 prefix, like "Gray Arrows") and multibyte codes, like "Print Screen".

See our Application Note **AN1 IBM AT and XT Keyboard Operation** for details on standard keyboard operation.

The USE104 also allows us to get non-standard Lower/Upper case combination, like **1/A**, for smal keypads.

The USE104 can be connected to any keypad with a matrix size of up to 12 x 12, and interfaced to a computer through the keyboard port or RS232 serial port. The keypad matrix can be from 1x23 to 12x12, the only constraint being that the total number of leads is not to exceed 24.

The USE104 is powered up from 5 V and it does not need a ± 12 V power supply to get true RS232 compatibility.

It is fully programmable and stores all configuration parameters, such as matrix size, pinout, interface type , Baud rate, and key-codes in the non-volatile memory. Any of these parameters can be changed using the programming utility "**USECON**".

In addition, USE104 can work in parallel with a standard IBM AT/XT keyboard.

Operation of the USE104 and its interfaces

The USE104 encoder has two bi-directional interfaces: RS232, and PC/AT, both can be used for programming. The USE104 can operate either as an RS232 keyboard encoder or as a PC/AT (or PC/XT) compatible keyboard encoder. Depending upon the mode of operation, the USE104 sends a key-code only when a key is pressed ("make"-code), or it can send a code for both key-closure and key-opening ("make"- and "break"-codes). In RS232 mode only "make"-codes are sent, while IBM PC/XT and PC/AT modes require both "make" and "break"codes. In all three modes the USE104 supports "typematic" and "rollover" functions.

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DEBOUNCING. The technique used by the USE104 to debounce the keys is simple: the whole matrix is scanned once every 20 milliseconds, and so is every key in the keypad. Once a closure is detected and registered, multiple closures caused by the bounce do not matter. The next scan comes in 20 milliseconds, which is more than enough for any reasonable bounce to subside, yet fast enough to register any possible fast-repeating (manually done) key-closure.

TYPEMATIC. "Typematic" refers to a function in which the encoder repeatedly sends a "make"-code for a key which is being held down. When it first detects a key-closure it sends a key-code once, and then waits for a specified period of time (the "typematic delay"). If the key is still being held down after the delay expires, it starts sending this key's codes at a specified rate per second (the "typematic period"). It will stop sending key-codes for this key when the key is released or when another key is pressed. Both "typematic delay" and "typematic period" can be defined within USECON. Typematic action can be disabled if necessary by selecting a "typematic period" equal to infinity (see USECON manual).

ROLLOVER. "Rollover" refers to a function in which the encoder transmits the "make"-code for a second key pressed while the first pressed key hasn't been released. If a typematic action is in progress when the second key is pressed, the USE104 stops typematic action for the first key, sends a "make"-code for the second key, and starts sending key-codes for the second key if it is held down for longer than the "typematic delay." "Rollover" action is not limited to two

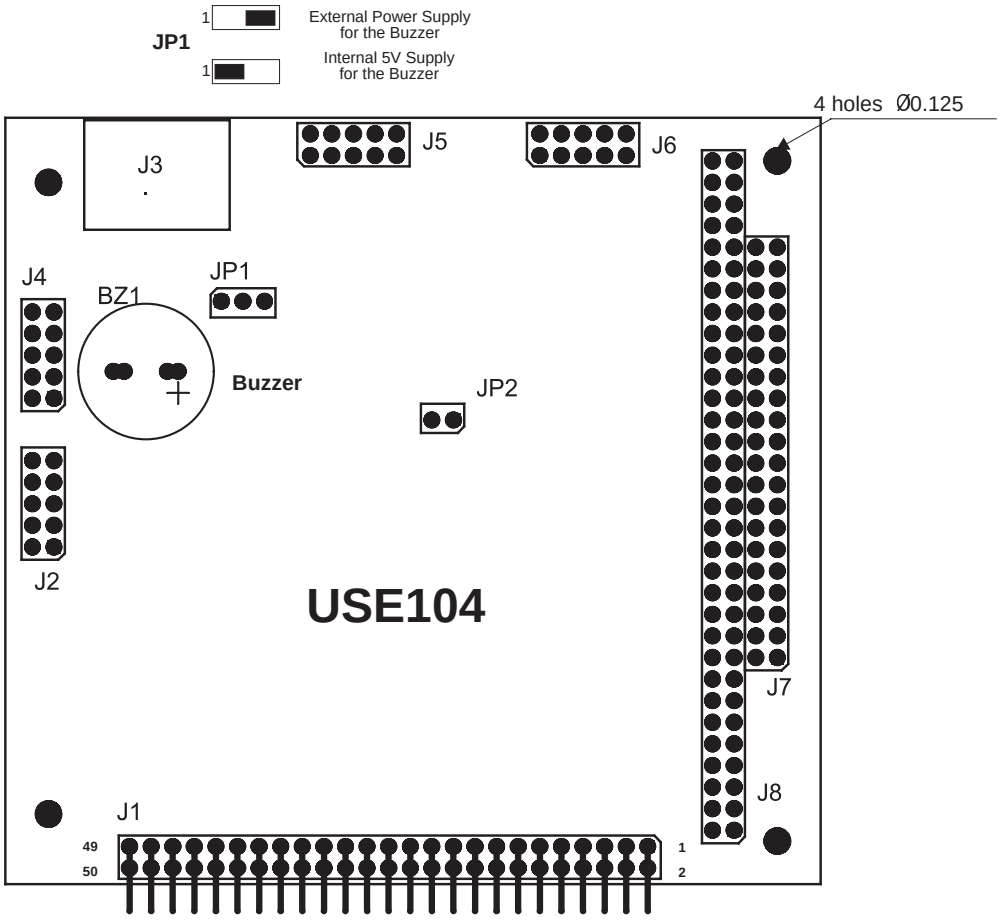

Figure 1

Position of standard and optional connectors

keys. In fact, any number of keys can be "rolled over."
Rollover function is optional and may be disabled while programming the USE104 from USECON program. If the rollover is disabled and you press a second key without releasing the first one, the encoder will disregard the second pressing. If the typematic action was in effect at that moment, the "make"-code will continue to be repeatedly sent for the first pressed key. It will consider the first key released only when no key is pressed anymore.

There are some differences in the way the USE104 functions in RS232, IBM PC/XT and IBM PC/AT modes.

RS232 MODE. In the RS232 mode the USE104 transmits a key-code when a key is pressed and transmits nothing when the key is released. If a key is held down and typematic (or repeating) action is enabled, the USE104 starts sending key-code at the rate specified by "typematic period" after "typematic delay" has expired. It stops sending key-code when the key is released or when a different key is pressed.

PC/XT MODE. In this mode the USE104 treats each key as a Make/Break key. In other words, it sends "make"-code when the key is pressed and it sends "break"-code when the key is released. In PC/XT mode a "make"-code has its Most Significant Bit (MSB) cleared, meaning that the code should be less than 128. The "break"-code is obtained from the "make" by adding 128

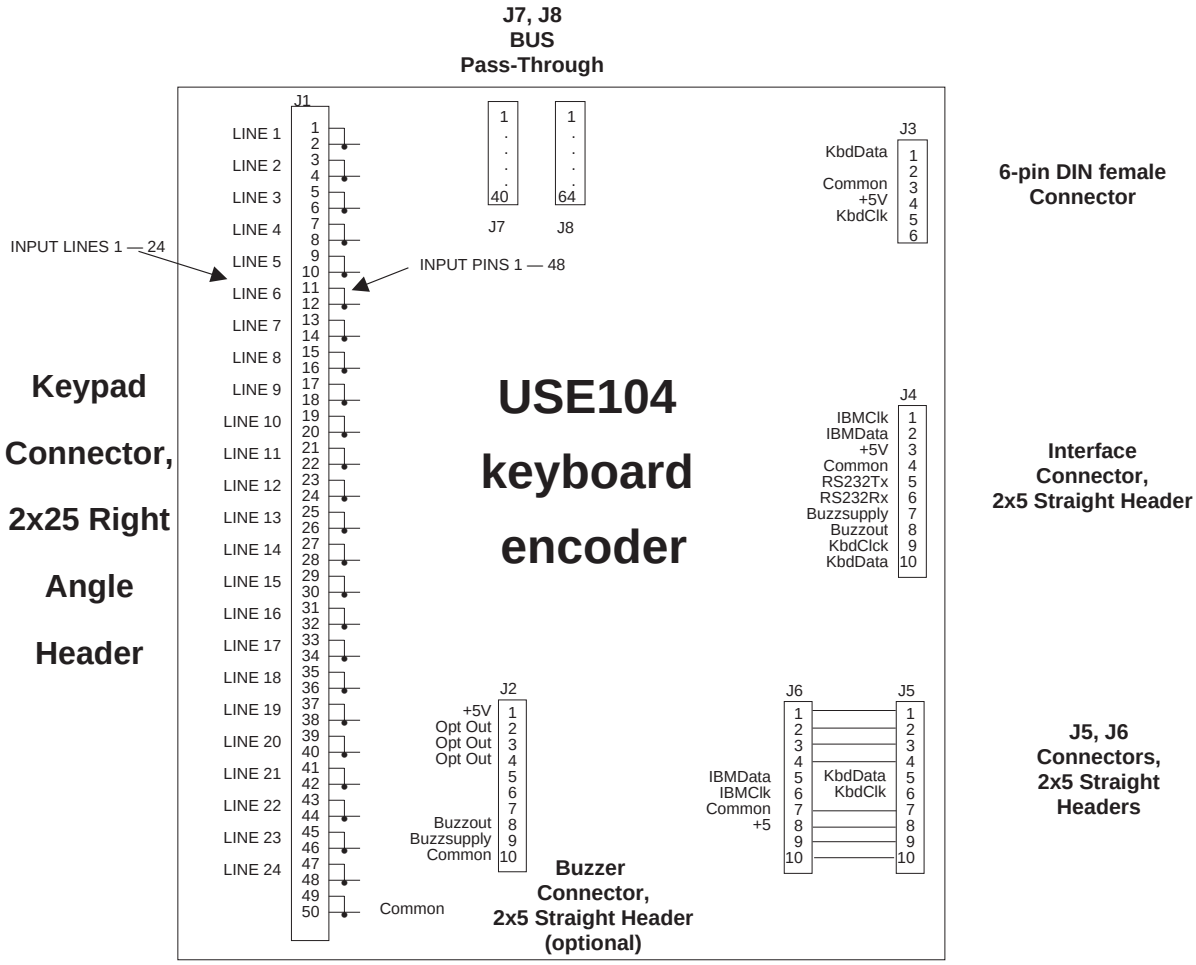

Figure 2
USE104 Connection Diagram

(setting the MSB). If typematic action is enabled, “make”-code is periodically sent while the key is pressed and single “break”-code is sent when the key is released.

PC/AT MODE. In PC/AT mode the USE104 also handles each key as Make/Break, but here the “break”-code consists of two bytes: a special “break”-prefix (hex F0) and the “make”-code for that key. The typematic action is similar to that of a PC/XT mode.

Please note that although both PC/AT and PC/XT modes have the same connector pinout there are substantial differences between the two protocols. The USE104 must always be configured for the type of computer it is connected to.

”FUNCTION” KEYS (”True Shift” or “color” keys). They should not be confused with “F1 – F12” keys on the standard keyboard, which are regular keys, like ”A” or “Z”. See our Appl. Note **AN1 IBM AT and XT Keyboard Operation** for details. We will call “TrueShift” keys “function” here.

Up to two keys can be designated as function keys, “Func1” and ”Func2”. Their purpose is to direct the encoder to send different codes for a key, depending on which function key is being pressed along with it. Any key can be selected as a function key (see “ASSIGN FUNC KEYS” option description in the **USECON** manual). The function key does not have a code to send out. All other keys can have three codes: normal and two shifted. For pressed function keys the encoder will not send out any codes; instead it will be waiting for any other key to be pressed along with it and will send one out of three possible codes, depending on the function key pressed.

MACRO CODES. USE104 supports macro codes. Macro is a sequence of several key-codes sent out by pressing just one key. Every key can be a macro key and have up to three macros (selectable via function keys) assigned to it. More then 7 Kbytes of EEPROM are available for the macros.

PARALLEL KEYBOARD. Keypads are usually designed into equipment not requiring touch typing (such as industrial controllers, medical equipment, etc). However, some applications require regular typing along with entering special information from a keypad.

Another example is an industrial device where a designer wants to give an operator only limited access to a system’s resources while a field service engineer will need more access to run diagnostics or make reconfigurations.

For such cases an external keyboard handling capability is extremely useful.

The USE104 can be connected as a “wedge” device with IBM keyboard plugged into it for both AT and XT interface modes. The USE104 provides bi-directional retranslation of information between computer and the keyboard. If the user presses a key on a keypad, the USE104 will send its own key-codes as well. This way, both the USE104 and a standard keyboard can operate at the same time (or in “parallel”).The retranslation is fully transparent so the keyboard operates as usual, including LED indicators. Another USE104 can be plugged in instead of the keyboard. Actually, any number of them can be daisy-chained.

This feature allows you to have multiple keypads in different locations connected to the same computer.

To plug an external keyboard into the USE104, use either a J6 DIN5 connector (allows to plug keyboard directly) or pins assigned for this purpose in J2 or J7 connectors (you will need a special cable).

BUZZER. This option allows you to produce a beep (or another audible signal) for every key-closure on the keypad (but not on the parallel keyboard). Optionally the beep can be either on first key-closure only or every time the “make”

code is sent when the typematic action is in progress.

Both on board and external “self-drive” type buzzers can be used. In the first case you can either use an external power supply (BUZZSUPPLY input, see Fig. 2), or 5V already used in the USE104. The USE104 board can accommodate buzzers with lead spacing of either 0.2" or 0.3" such as **TMB** or **HMB** types from **STAR MICRONICS** or similar. The external/internal power supply option is selected by the jumper JP1.

If you use an external buzzer, the USE104 provides an “open collector” output “BUZZOUT”, (Fig. 2) which allows you to connect a buzzer with maximum ratings up to 20 V/100 mA. The output provides a single negative pulse 60 msec duration.You can also use this output to control other types of signaling devices.

POWER SUPPLY. The USE104 requires a single + 5 V DC power supply. Typical current consumption (without external buzzer) is below 25 mA.

STANDARD CONNECTORS. There are four dual-row 0.1" headers – J1, J4,J5 and J6 and mini DIN 6-pin female connectors J3 (the same type used in IBM PS2 compatibles for connectin keyboards).

J1 is a 2x25 right-angle header that provides connections to a keypad. The pins in both rows are connected in parallel so that a keypad with two connector tails, or two or more separate keypads, can be connected to the USE104 without mechanical restrictions.

J4 is a straight 2x5 header. It provides outputs for RS232, PC/XT or PC/AT interfaces to computer, and power supply connections. Pin 9 is removed to serve as a key.

J3 allows to plug a standard PS2 keyboard to work in parallel with the USE104.

J5 allows to plug-in a keyboard with AMPRO/Real Time Devices compatible connector to work in parallel with the USE104

J6 allows the connection of the USE104 to keyboard input of AMPRO/Real Time Devices compatible PC104 system.

OPTIONAL CONNECTORS

J2 (1x3 header) has the output for the external buzzer and the input for an external power supply for optional built-in buzzer.

J7 and J8 are pass through connectors for PC104 bus.

Figure 1 shows the position of all the connectors for the USE104. **Figure 2** shows the pinouts for all the connectors.

PROGRAMMING THE ENCODER. The USE104 is programmed with **USECON** (**USE**104 **CON**figuration utility) to set or change any its parameters, such as interface type, Baud rate, keypad pinout, etc. It also allows users to save or recall all parameters to or from a disk file. The programming can be done either through keyboard port (by connecting the USE 104 between PC/PC104 and keyboard as a”wedge” device) or through COM1/COM2 serial port.

A **PROGRAMMING ADAPTER** is available for the USE104 programming through a serial port. It comes with a power supply and a special cabling. The adapter plugs into connector J4 on the USE104 and into the male 9-pin DB9 port connector of the PC’s serial port.

NOTE Selection of the programming port has no effect on interface type, so the USE 104 can be programmed through the keyboard and have RS232 interface selected or vice versa.