# RAM Programmable Keyboard Encoder

*Mature keycoder™ product specifications*

## Description

The USAR PlexiCoder™ LTP programmable keyboard encoder allows users to re- define key assignments on the switch matrix. Changes in the defualt key assignments are stored temporarily in the micro-controller's resident RAM and can be downloaded during system power-up or at any time through an application program.

The UR5HCPLX-LTP can be used as a general purpose, versatile Laptop/ Notebook keyboard encoder. Its programmable features will enhance overall system performance by allowing users to switch to alternative keyboard layouts such as the DVORAK, a sorted 'alpha,' or other software-specific layouts. The user can also re-assign the embedded numeric keypad to implement, for example, a telephone keypad or to rearrange numeric key locations to accommodate a left-handed person.

The UR5HCPLX-LTP provides a superior alternative to Terminate-and-Stay-Resident keyboard utility programs that consume precious system memory and machine cycles. Once the user-defined key assignments are loaded, the operation of the UR5HCPLX-LTP is totally transparent to the system and does not interfere with any other system software.

The USAR PlexiCoder™ LTP allows OEMS to accomodate different keyboard configurations while using the same hardware.

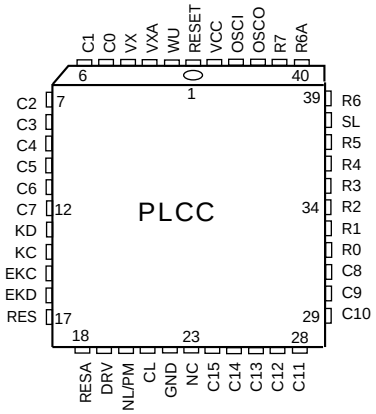
## Features

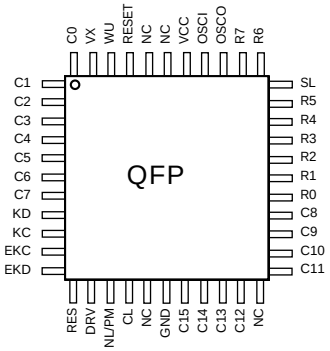
- Single IC programmable Laptop/Notebook keyboard encoder
- Users can switch to alternate keyboard layouts using the same hardware
- AT/PS/2-compatible with Extended Keyboard Protocol support
- "Zero-power" HCMOS microcontroller usually consumes less than 2 µA
- Provides an interface for an external keyboard/keypad or other 8042-compatible devices
- Implements all functions of a standard 101/102 keyboard
- Available in DIP, PLCC, and QFB packages
- Works with 3.0 to 5.5 Volt Power Supply
- Small footprint saves real estate

## Applications

- Hand-Held Computers
- Portable Equipment
- Wearable Computers
- PDAs and Sub-notebooks
- Portable Medical Equipment

## Pin Descriptions

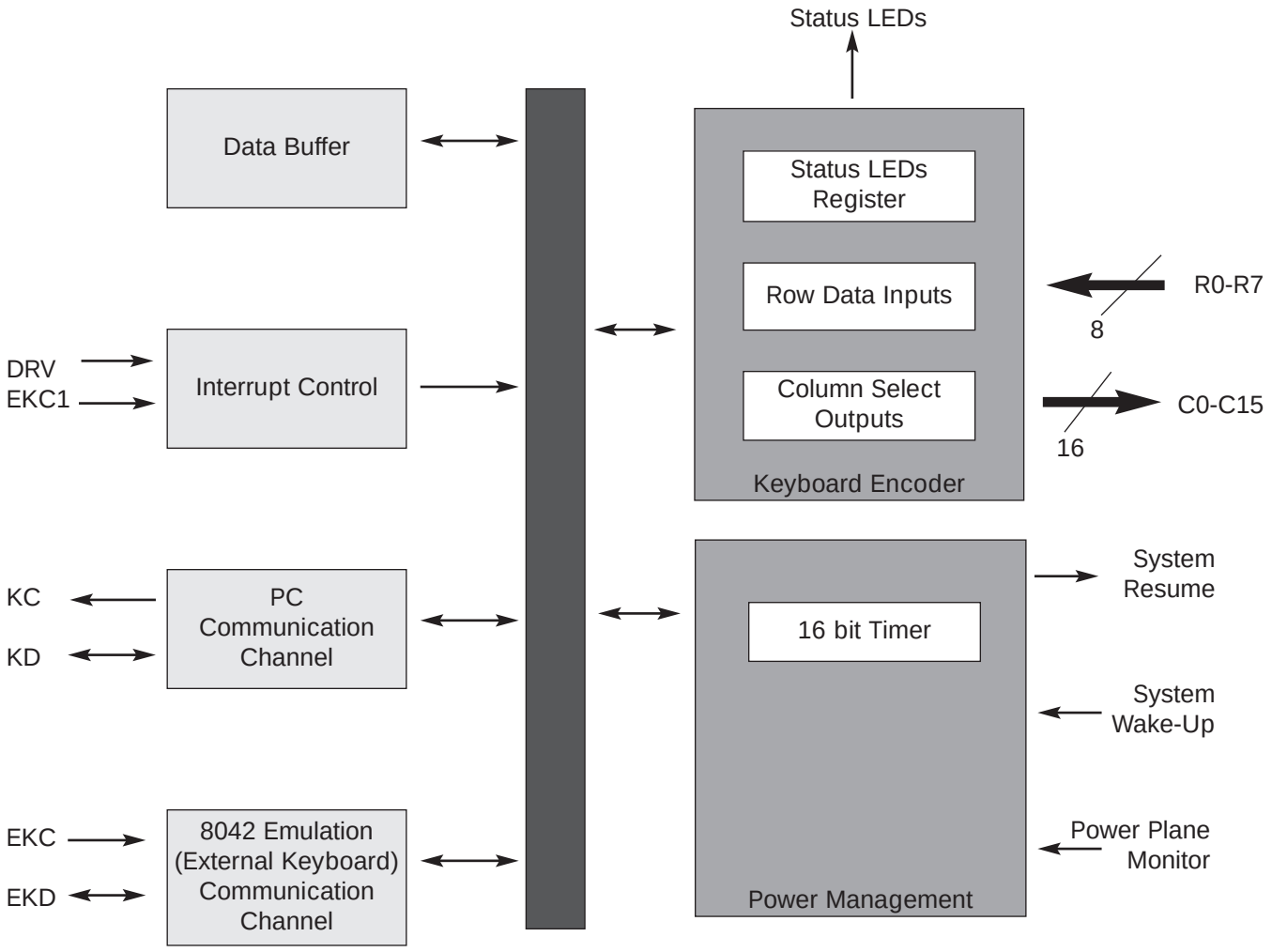


## Ordering Code

| Packages | TA= 0 C to +70 | TA = -40°C to +85°C |
|---|---|---|
| 40-pin, Plastic DIP | UR5HCPLX-P-XX | UR5HCPLX-CP |
| 44-pin, Plastic PLCC | UR5HCPLX-FN-XX | UR5HCPLX-CFN |
| 44-pin, Plastic TQFP | UR5HCPLX-FB-XX | UR5HCPLX-CFB |
| 44-pin, Plastic TQFP | UR5HCPLX-FU-XX | UR5HCPLX-CFU |

## Functional Diagram



## Functional Description

The UR5HCPLX-LTP consists functionally of five major sections (see Functional Diagram, previous page). These are the Keyboard Encoder, the Peripheral Control Unit, the Power Management unit, the PC Communication Channel, and the 8042 Emulation Channel. All sections communicate with each other and operate concurrently.

## Keyboard Encoder

The encoder scans a keyboard organized as an 8 row by 16 column matrix for a maximum of 128 keys. Smaller-size keyboards are supported provided that all unused row lines are pulled to Vcc. When active, the encoder selects 1 of the 16 column lines (C0-C15) every 512 µS and then reads the row data lines (R0-R7). A key closure is detected as a 0 in the corresponding position of the matrix. A complete scan cycle for the entire keyboard takes approximately 9.2 mS. Each key found pressed is debounced for a period of 20 mS. Once the key is verified, the corresponding key code(s) are loaded into the transmit buffer of the PC keyboard communication channel.

*Embedded Numeric Keypad*

The UR5HCPLX-LTP implements an embedded numeric keypad. The Numeric Keypad Function is invoked by pressing the Num Lock Key.

## Pin Definitions

| Mnemonic | DIP | PLCC | QFP | Type | Name and Function |
|---|---|---|---|---|---|
| Vcc | 40 | 44 | 38 | I | Power Supply: 3-5V. |
| Vss | 20 | 22 | 17 | I | Ground |
| OSCI | 39 | 43 | 37 | I | Oscillator Input |
| OSCO | 38 | 42 | 36 | O | Oscillator Output |
| RESET | 1 | 1 | 41 | I | Reset: apply 0 V to provide orderly start up. |
| VX,VXA | 3 | 3,4 | 43 | | Tie to Vcc (On PLCC tie VX to VXA) |
| KC | 13 | 14 | 9 | I/O | Keyboard Clock: this pin connects to PC keyboard port clock line. |
| KD | 12 | 13 | 8 | I/O | Keyboard Data: connects to PC keyboard port data line. |
| EKD | 15 | 16 | 11 | I/O | External Keyboard Data: connects to external keyboard data line. |
| EKC | 14 | 15 | 10 | I/O | External Keyboard Clock: connects to external keyboard clock line. |
| DRV | 17 | 19 | 13 | I | DRV: used in sleep mode |
| R0-R5 | 29-34 | 32-37 | 27-32 | I | Row Data Inputs |
| R6,R7 | 36,35 | 39,41 | 34,35 | I | |
| R6A | | 40 | | | PLCC Package Only-Tie to R6 |
| C0-C7 | 4-11 | 5-12 | 44 1-7 | O | Column Select Outputs: select 1 of 16 columns. |
| C8-C15 | 28-21 | 31-24 | 26-18 | | |
| RES | 16 | 17 | 12 | O | Resume: System Resume Output, provides CPU Wake Up Interrupt |
| RESA | 18 | | | | CC Package Only-Tie to R6 |
| WU | 2 | 2 | 42 | I | Wake up: System Wake up event input |
| NL/PM | 18 | 20 | 14 | I/O | NumLk LED/Power Monitor: Num Lock LED output and Power Monitor input |
| CL | 19 | 21 | 15 | O | Caps Lock LED |
| SL | 35 | 38 | 33 | O | Scroll Lock LED |

## Keyboard Encoder

*Scan Code Table Sets*

The USAR PlexiCoder™ LTP supports all three scan code table sets. Scan Code Sets 1 and 2 are the default sets for PC/XT and AT/PS2 systems respectively. Scan Code Table Set 3 allows the user to program individual key attributes such as Make/Break and Typematic or Single-Touch Action. For more information, refer to USAR's PS/2 Protocol Datasheet or to the IBM Technical Reference Manuals. Custom scan code tables, including macros, are also available.

*FN Key*

A special FN Key has been implemented to perform the following functions while it is held pressed:

- Function Key F1 becomes F11
- Function Key F2 becomes F12
- Control Left Key becomes Ctrl Right
- Alt Left Key becomes Alt Right

If Num Lock is set:

- Embedded numeric keypad keys become regular keys.

If Num Lock is not set:

- Embedded numeric keypad keys provide the same codes as a numeric keypad when the Num Lock is not set (Arrow keys, PgUp, PgDn, etc.)

## Mode Conontrol

*N-Key Rollover*

In this mode, the code(s) corresponding to each key press is transmitted to the host system as soon as that key is debounced, independent of the release of other keys.

If a key is defined to be Typematic, the corresponding make code(s) will be transmitted while the key is held pressed. When a key is released, the corresponding break code(s) is then transmitted to the host system. If the released key happens to be the most recently pressed, then Typematic action is terminated. There is no limitation in the number of keys that can be held pressed at the same time. However, two or more key closures, occurring within a time interval less than 5 mS, will set an error flag and will not be processed. This procedure protects against effects of accidental key presses.

*"Ghost" Keys*

In any scanned contact switch matrix, whenever three keys defining a rectangle on the switch matrix are held pressed at the same time, a fourth key positioned on the fourth corner of the rectangle is sensed as being pressed. This is known as the "ghost" or "phantom" key problem. Although the problem cannot be totally eliminated without using external hardware, there are methods to neutralize its negative effects for most practical applications. Keys that are intended to be used in combinations or are likely to be pressed at the same time by a fast typist (i.e., keys located in adjacent positions on the keyboard) should be placed in the same row or column of the matrix whenever possible. Shift Keys (Shift, Alt, Ctrl) should not reside in the same row (or column) with any other keys.The USAR PlexiCoder™ LTP has built-in mechanisms to detect the presence of a "ghost" key, thus eliminating the necessity of external hardware.

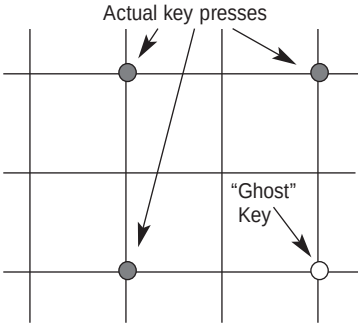



Figure 1: "Ghost" or "Phantom" Key Problem

## Aux (8042) Port

The USAR PlexiCoder™ LTP fully emulates a system's keyboard port, available to a standard 83/101/102 external keyboard or other PS/2 device. Communication with the external device is accomplished by clock and data lines via EKC and EKD pins respectively. A third pin, EKC1 that connects to the Clock Line, interrupts the controller whenever the external device initiates a communication session.

When power is first applied the controller proceeds with the standard reset sequence with the external device. Data and commands initiated from the external device are buffered in the controller's FIFO along with data from the scanned matrix and then presented to the system as if the commands were coming from a single source. After they are acknowledged, commands and data from the system are then transmitted to the external device.

## Mode Control

The USAR PlexiCoder™ LTP implements all the standard functions of communication with a BIOS-compatible PC/XT or AT/PS/2 host system. Two lines, KC and KD, provide bi-directional clock and data signals according to the protocol (PC or AT) selected. In addition, the USAR PlexiCoder™ LTP supports commands from and to the system, as described in the IBM Technical Reference Manuals. The following table shows the commands that the system may send and their value in hex.

| Command | Hex Value |
|---|---|
| Set/Reset Status Indicators | ED |
| Echo | EE |
| Invalid Command | EF |
| Select Alternate Scan Codes | F0 |
| Invalid Command | F1 |
| Read ID | F2 |
| Set Typematic Rate/Delay | F3 |
| Enable | F4 |
| Default Disable | F5 |
| Set Default | F6 |
| *Set All Keys* | |
| ■ Typematic | F7 |
| ■ Make/Break | F8 |
| ■ Make | F9 |
| ■ Typematic/Make/Break | FA |
| *Set Key Type* | |
| ■ Typematic | FB |
| ■ Make/Break | FC |
| ■ Make | FD |
| Resend | FE |
| Reset | FF |

Table 3: Keyboard Commands from the System (AT/PS/2 protocol)

These commands are supported in the AT/PS/2 protocol and can be sent to the keyboard at any time. Mode 1 accepts only the 'reset' command. Commands shown in italics do not affect the operation of the UR5HCPLX-LTP. Nevertheless, they are acknowledged and relayed to the external keyboard when an external standard keyboard is present.

The following table shows the commands that the keyboard may send to the system.

| Command | Hex Value |
|---|---|
| Key Detection Error/Overrun | 00* |
| Keyboard ID | 83AB |
| BAT Completion Code | AA |
| BAT Failure Code | FC |
| Echo | EE |
| Acknowledge (Ack) | FA |
| Resend | FE |
| Key Detection Error/Overrun | FF* |

*Scan Code Set 2

Table 4: Keyboard Commands to the System (AT/PS/2 protocol)

When an external keyboard is connected, commands from the system will also be directed to the external keyboard. Presence or absence of an external keyboard will not affect the normal operation of the USAR PlexiCoder™ LTP.

## Special Keyboard Modes

*Function Key*

The function key is used to invoke the alternate keyboard layouts implemented in the UR5HCPLX-LTP. Alternate layouts can be sustained by pressing the Num Lock key. In this case, the UR5HCPLX-LTP will set the Pad Lock LED output to indicate that the embedded numeric keypad is in effect.

*Program Key*

The Program Key is used to invoke special system functions. Key combinations involving the Program Key do not send codes to the system, but rather invoke peripheral management procedures. A description of the specific functions is presented in the relevant sections of this specification.

## Windows 95 Keys

The UR5HCPLX-LTP supports the three new Windows 95 keys. These keys are: Application Key, Right Windows Key, and Left Windows Key. Unmodified, the Application Key brings up the “pop-up” menu at the current select position. The Application Key, used in conjunction with the Shift Keys (Ctrl, Alt, Shift), can be used for application-specific functions. Both the Left and Right Window Keys will set the focus to the Windows 95 interface. They may also be used as modifier keys.

## Special Handling

*Hot-plug-ins of an External Device*

The UR5HCPLX-LTP will detect the presence of an external device. If an external keyboard or other device was not connected during power-on and is connected at a later time, the encoder will proceed with the normal reset routine in order to properly initialize the external keyboard. After communication has been established, the encoder will continue to check for the presence of the external keyboard. While the external device is connected, the encoder will not enter the sleep mode. If the device is disconnected at a later time, the encoder will be aware of it. If a subsequent connection takes place, the controller will re-initiate a reset sequence. This unique feature allows the user to connect or disconnect an external device at any time without having to reset the system.

*Shift Status LEDs*

The UR5HCPLX-LTP does not provide dedicated outputs for direct drive of status LEDs. Shift status on hand-helds is typically implemented on the LCD panel. Nevertheless, the UR5HCPLX-LTP will internally implement all the commands related to the Shift Status LEDs (Num Lock, Caps Lock and Scroll Lock). Set/Reset Status Indicator Commands from the system will be executed both by the external keyboard and the scanned matrix. For example, if the user presses the Caps Lock Key on either keyboard, the Caps Lock status will take effect on both keyboards. The Shift status flags are properly set after each new connection of an external keyboard. Other PlexiCoders do provide dedicated outputs for direct driving of status LEDs.

*Ctrl and Alt Keys*

The combination of the FN key with either the Ctrl Left or Alt Left Key results in the transmission of the code(s) for Ctrl Right or Alt Right, respectively.

*FN and Num Lock*

The firmware allows the user to move both the FN and Num Lock keys. Because of their special function in selecting the alternate keyboard layouts, care should be taken so they are moved in the same physical location on both layouts.

*Shift Keys*

Relocation of any of the Shift keys (Ctrl, Alt, Shift) may create ‘ghost’ key problems for specific key combinations.

## States of Operation

The UR5HCPLX-LTP has three states of operation implemented to minimize the power consumption of the keyboard subsystem. The following diagram illustrates the three states of operation of the UR5HCPLX-LTP.

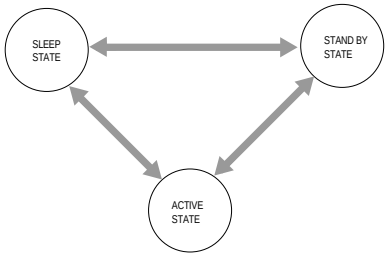



Figure 2: States of operation of the USAR PlexiCoder™LTP

Most of the time the UR5HCPLX-LTP is in the Sleep State. Power consumption in this state is approximately 2 µA at 5 Volt operation. The UR5HCPLX-LTP exits the Sleep State and enters the Active State only when there is an event to process, such as a keystroke, or a command from the system, or data from the external PS/2-compatible device. The UR5HCPLX-LTP enters and stays in the Stand-By State if an external device is connected to the auxiliary port or if one or more LEDs are turned on. In the Stand-By State, the UR5HCPLX-LTP consumes approximately 600 µA at 5 Volts. Transition from one state to the other does not require any input from the system and is fully transparent to the user.

Note: "Self-Power Management" ™ is a feature protected under USAR Systems' patent and copyright rights. Purchase of any version of the UR5HCPLX-LTP encoder conveys a license to utilize the Self Power Management feature only through use of the UR5HCPLX-LTP in a PS/2-compatible keyboard subsystem.

## Using the UR5HCPLX-LTP for System Management Tasks

The USAR PlexiCoder™ LTP can be used as the sole power management IC to control the user- invoked "resume" transition on any system based on PC-compatible chip sets. The low power consumption and the Self-Power Management™ characteristics of the encoder make it suitable to be used as the only peripheral IC that remains powered-on while the system enters into the "suspend" mode. Because the UR5HCPLX-06 controls the user interface (keypad/keyboard), it is naturally positioned in the system to provide "resume" System Management Interrupt (SMI) on any user keystroke. Systems employing the UR5HCPLX-06 can turn off the power to any other peripheral, including the 8042 keyboard controller. System "resume" can be accomplished either by pressing a dedicated key on the keyboard or by pressing any key designated by the designer. Implementation of "Any Key Resume" will result in loss of the first keystroke.

*Power Planes Control*

In a typical system, the UR5HCPLX-06 will control built-in peripherals such as the keyboard matrix, digital potentiometers for LCD contrast and brightness, LEDs and an optional external PS/2-compatible device. The UR5HCPLX-06 can be powered by its own power line without contributing any significant load to the system battery. Any other interconnected peripheral, including the 8042 keyboard controller, the LEDs and the external keyboard, can be powered by a switched power plane that can be switched off whenever the system enters the "suspend" mode.

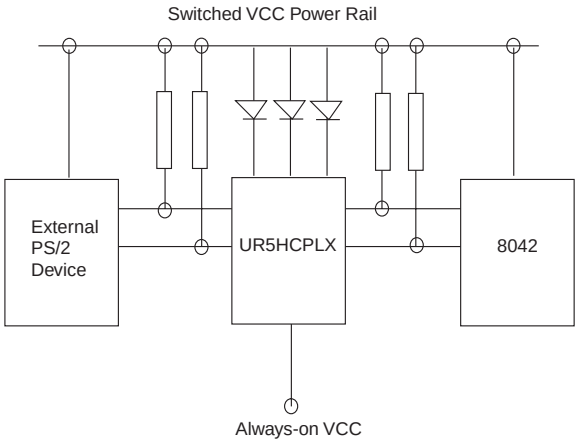



Figure 3: UR5HCPLX-06 interconnected with switched rail powered devices.

Switching off devices that are interconnected with powered devices through signal lines will cause leakage currents unless certain precautions are taken. Leakage currents will increase power consumption and defeat the purpose of power management. The UR5HCPLX-06 provides built-in features that make it capable of properly handling situations of interconnections with powered-down devices

## Using the UR5HCPLX-LTP for System Management Tasks, Cont.

### *The USAR PlexiCoder™ Switched Power Plane Monitor*

The UR5HCPLX-LTP is primarily connected to two switched active devices: The external keyboard and the 8042 keyboard controller. Signal lines connected to these devices are normally open collector. The UR5HCPLX-LTP will monitor the voltage of the switched power plane. When the power plane is switched off all participating open collector outputs are driven to low, preventing leakage currents and noise-induced signals through the floating inputs.

### *Devices Switched Off*

In order to control leakage currents when interconnecting powered devices with unpowered ones, designers should make sure that the switched-off power plane voltage drops all the way to ground (within 50 mV). Floating unpowered lines may indicate uncontrolled current paths and will prevent any system from achieving optimized power consumption.

### *External Keyboard and 8042 Communications*

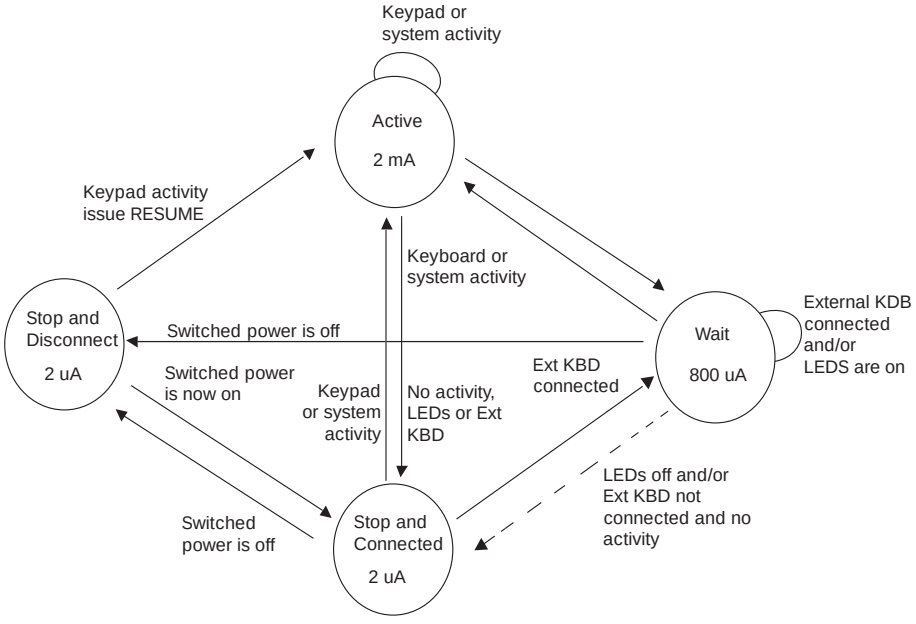
When the system turns off the switched power rail the encoder will drive both clock and data lines to low, preventing any further communication with the external device and the 8042-type keyboard controller. If the system re-establishes power both to the 8042 and the external device, the UR5HCPLX-LTP should be notified through a wake-up pulse provided by the system. If the 8042 is not powered off, the wake-up information can be provided through a command from the system.

### *System Resume Call*

The UR5HCPLX-LTP provides an output that will signal the system to resume when a user presses a key when the system is in the suspend mode and power has been switched off to the switched power rail. Note that the system may resume upon other signals originating from other system functions.

### *Self Power Management™ States of the USAR PlexiCoder™*

The following diagram shows the power management states of the USAR PlexiCoder™ and the power consumption associated with each state.



## Sample Key Map for the UR5HCPLX-LTP

| Rows (R0–R7) \ Columns (C0–C15) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | Win C | Q | W | E | T | Win B | | | ` | ~ | ArLt | ArDn | End | \| \ | PgUp |
| 1 | | ! 1 | | | | Y | | Lft Shft | | | U KP4 | I KP5 | O KP6 | P KP- | { [ | |
| 2 | Lft Ctrl | Esc | @ 2 | R | # 3 | ^ 6 | | | | | | &/7 KP7 | */8 KP8 | )/0 KP* | _ - | BkSp |
| 3 | | F2 | F4 | F6 | $ 4 | % 5 | | | Win A | | | F8 | F11 | (/9 KP9 | + = | Pause |
| 4 | | F1 | F3 | F5 | F12 | F7 | | Rt Shft | | | Nm Lk | F9 | F10 | Prt Scn | ScLk | Ins |
| 5 | | Lft Shft | A | | Space | N | | | | Lft Alt | J KP1 | K KP2 | L KP3 | Enter | " ' | Del |
| 6 | Rt Ctrl | Z | S | D | F | G | | | | | H KPO | M , | < KP+ | ;/: } | } | Home |
| 7 | | Caps | X | C | V | B | I | | | Rt Alt | Tab | ArUp | >/. KP | Ar Rt | ?// KP/ | PgDn |

## Sample Keyboard Layout

## Extended Protocol

The Extended Protocol is an enhancement to the IBM standard keyboard communication protocol created by USAR. Among other implementations, it allows user-defined key assignments, as well as the support of an auxiliary device such as an 101 keyboard or another compatible pointing device. The Extended Protocol is upward-compatible with the IBM standard keyboard communications protocol, allowing the UR5HCPLX-LTP to be used with any existing AT/PS/2 BIOS system.

## Commands from the System

The Extended Protocol implements a new set of commands from the System. These commands consist of three or more bytes and can be sent to the keyboard from the system at any time. The first byte is always EFh or FIh. Both of these bytes are defined as Invalid Commands in the standard IBM keyboard communication protocol. The encoder does not acknowledge the first reception of the EFh or FIh command. Instead, it returns a Resend command and continues its prior scanning state. If the system re-transmits the same command byte, the encoder acknowledges with an ACK and waits for the remaining bytes. Each byte in the command sequence is acknowledged within 20 mS, except when the encoder is performing the BAT or is executing a reset command. Transmission of the whole command sequence from the system must be complete within 200 mS.

The Following is a list of the Extended Protocol Commands and their descriptions.

| Command | Hex Value |
|---|---|
| Define Key Assignments | EF EF E7 |
| Define Matrix Block | EF EF E8 |
| Reserved | F1 F1 XX |
| Set Defaults | EF EF F5 |

Extended Protocol Commands from the System

These commands are supported in addition to the standard set of Commands from the System, as described in this product specification and in the IBM Technical Reference Manuals

*Define Key Assignments (Hex EF E7)*

The Define Key Assignment command instructs the UR5HCPLX-LTP to assign new key numbers along with their associated scan codes and properties to a specific location on the keyboard matrix.

The UR5HCPLX-LTP changes the default key number assignments of a specific key matrix location when it receives a valid command code sequence from the system. The command sequence begins with EFh sent twice, followed by the command byte (E7h). After receiving E7h, the encoder responds with ACK, suspends scanning, clears the output buffer and waits for the two option bytes from the system. These bytes contain the rest of the assignment parameters. The structure of the four-byte command sequence is shown in the following table:

| Byte | Hex | Description |
|---|---|---|
| 1,2 | EF, EF | Command Prefix |
| 3 | E7 | Command |
| 4 | 0-126 | Key Number |
| 5 | 0-127 | Matrix Location |

Command Sequence

## Commands, Cont.

The USAR Key Number Table on the following page lists the valid key numbers along with their corresponding legends.

One key can be assigned to each location on the scanned switch matrix. “KP” on the legend refers to the numeric keypad which is enacted when the Num Lock is pressed. Key Numbers 109 through 124 are key combinations most often used in Laptop keyboard designs. The properties of Key Numbers can not be split. For example, if Key Number 112 is moved, both the character “U” and the Num Lock key enacted “4” will be moved.

The Matrix Location is calculated according to the following formula:
Matrix Location =
Row#+(Column#X8)

It is the responsibility of the controlling system software to provide valid Matrix Location values. In other words, the software must assign locations on the matrix where an actual switch exists. Invalid assignments will not take effect.

The UR5HCPLX-LTP will respond to each parameter byte with ACK. Acknowledgment of the last option byte will indicate acknowledgment of the command. Nevertheless, the new key assignment will not take place and scanning will not be resumed until the Enable Command (F4h) is issued by the system.

Transmission of the complete command sequence must be accomplished within 200 mS. If the command sequence is not completed within this time frame, or if any of the option bytes has an out-of-range value, the command is aborted. If another command is received in place of any of the option bytes, execution of the Define Key Assignment Command will be stopped and the new command will be processed instead.

Define Matrix Block (EFh, E8h)

The “Define Matrix Block” command allows a user to assign a group of keys to the sequential matrix locations. To activate the Define Matrix Block mode, the system must send a command from the system. The command is the following: EFh, EFh, E8h, Start_Location, Length, Key Number_Block, CheckSum. The table below describes the elements of the above command. Set default key assignments (EFh, F5h)

The Set Default Assignments (Efh, F5h)

The Set Default AssignmentsCommand acts as the default Disable (F5h) Command of the standard protocol. In addition, it restores key assignments on the switch matrix to their default values. Default key assignments are also restored until the encoder receives the Enable (F4h) Command.

| Byte | Hex | Description | Details |
|---|---|---|---|
| 1 | EF | Prefix | |
| 2 | EF | Prefix | |
| 3 | E8 | Command | |
| 4 | XXX | Start Location | The start number of the Matrix Location; valid range = 0...127 |
| 5 | XXX | Length | Length of Keyboard_Block; valid range = 0...127 |
| 6 | XX,...XX | Key Number_Block | Keynumber indexed by its location on the Matrix. Key Number_Block = Keynumber (Start Location),...,-Keynumber (Start_Loc + Length) |
| 7 | XXX | Check _Sum | Verification byte=remainder {[Start_Loc + Length of all Keynum. (1) + Keynum. (Length)]/256} |

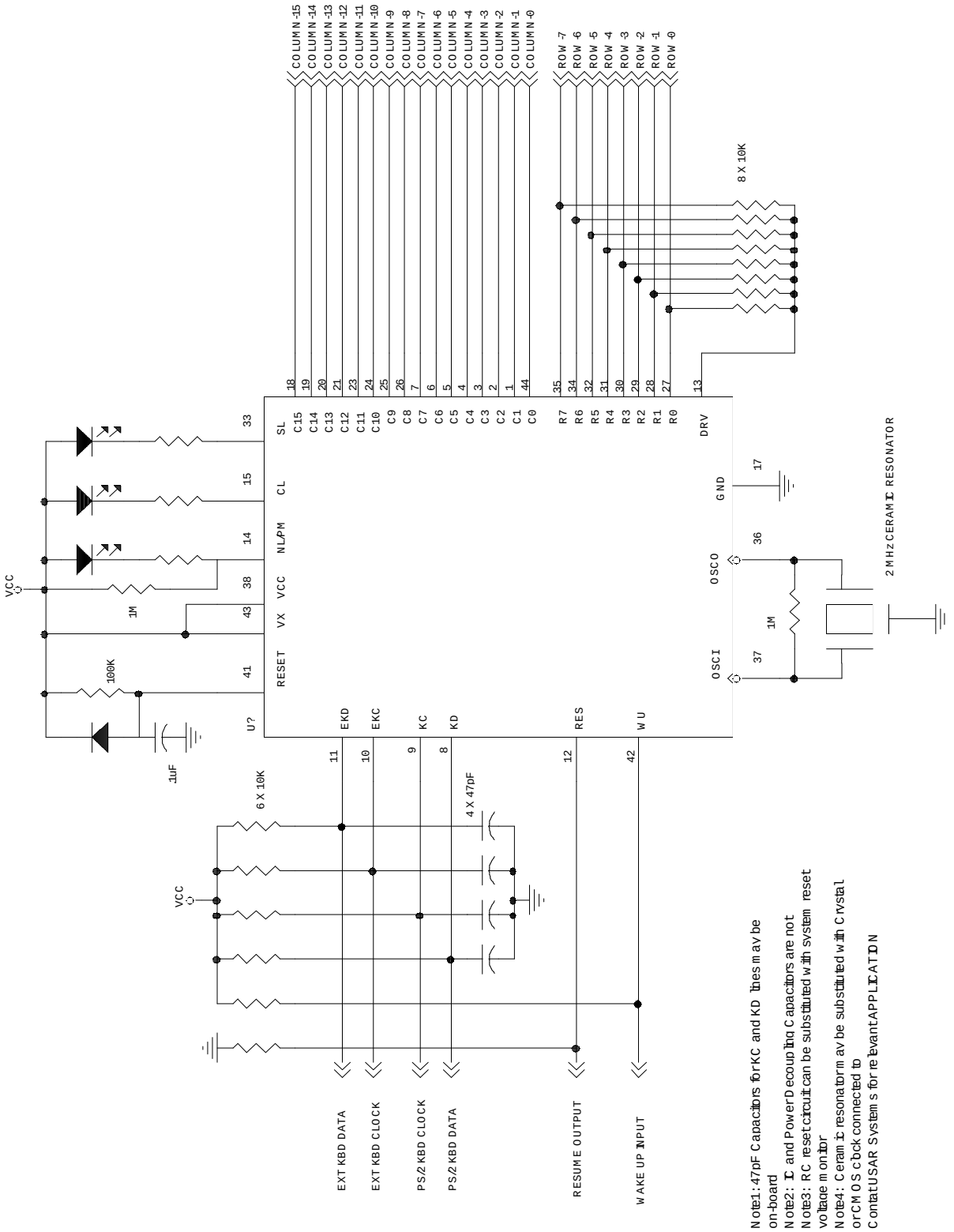
Table 5: Define Matrix Block Command

Note: Start_Location+Length-1, i.e., the last key’s location, must be < 127

## USAR Key Numbers

| Key # | Legend | Key # | Legend | Key # | Legend |
|---|---|---|---|---|---|
| 0 | No Key | 42 | LShift | 84 | F 0/Ins |
| 1 | ‘/~ | 43 | Z | 85 | F ./Del |
| 2 | 1/! | 44 | X | 86 | F - |
| 3 | 2/@ | 45 | C | 87 | F Enter |
| 4 | 3/# | 46 | V | 88 | RAlt |
| 5 | 4/$ | 47 | B | 89 | RCntrl |
| 6 | 5/% | 48 | N | 90 | F / |
| 7 | 6/^ | 49 | M | 91 | Insert |
| 8 | 7/& | 50 | ,/< | 92 | Delete` |
| 9 | 8/* | 51 | ./> | 93 | LArw |
| 10 | 9/( | 52 | //? | 94 | Home |
| 11 | 0/) | 53 | RShift | 95 | End |
| 12 | -/_ | 54 | LCntrl | 96 | UpArw |
| 13 | =/+ | 55 | LAlt | 97 | DnArw |
| 14 | BckSpc | 56 | Space | 98 | PgUp |
| 15 | Tab | 57 | NumLk | 99 | PgDn |
| 16 | Q | 58 | ESC | 100 | RArw |
| 17 | W | 59 | F1 | 101 | L Win Key |
| 18 | E | 60 | F2 | 102 | R Win Key |
| 19 | R | 61 | F3 | 103 | Win Ap Key |
| 20 | T | 62 | F4 | 104 | PrntScr |
| 21 | Y | 63 | F5 | 105 | Pause/Brk |
| 22 | U | 64 | F6 | 106 | Break |
| 23 | I | 65 | F7 | 107 | Function |
| 24 | O | 66 | F8 | 108 | |
| 25 | P | 67 | F9 | 109 | KP J/1 |
| 26 | [/{ | 68 | F10 | 110 | KP K/2 |
| 27 | ]/} | 69 | F11 | 111 | KP L/3 |
| 28 | \/\| | 70 | F12 | 112 | KP U/4 |
| 29 | CapsLk | 71 | SysReq | 113 | KP I/5 |
| 30 | A | 72 | ScrLk | 114 | KP O/6 |
| 31 | S | 73 | * | 115 | KP 7/7 |
| 32 | D | 74 | KP + | 116 | KP 8/8 |
| 33 | F | 75 | KP 1/End | 117 | KP 9/9 |
| 34 | G | 76 | 2/DnArw | 118 | KP M/0 |
| 35 | H | 77 | 3/PgDn | 119 | KP O/* |
| 36 | J | 78 | 4/LArw | 120 | KP P/- |
| 37 | K | 79 | F5 | 121 | KP ;/+ |
| 38 | L | 80 | 6/RArw | 122 | Enter |
| 39 | ;/: | 81 | 7/Home | 123 | KP ./. |
| 40 | ‘/” | 82 | 8/UpArw | 124 | KP /// |
| 41 | Enter | 83 | 9/PgUp | | |

## Suggested Interfacing for UR5HCPLX- LTP



## Electrical Specifications

### Absolute Maximum Ratings

| Ratings | Symbol | Value | Unit |
|---|---|---|---|
| Supply Voltage | Vdd | -0.3 to +7.0 | V |
| Input Voltage | Vin | Vss -0.3 to Vdd +0.3 | V |
| Current Drain per Pin (not including Vss or Vdd) | I | 25 | mA |
| Operating Temperature | Ta | T low to T high | ° C |
| UR5HCPLX-xx | | 0 to +70 | |
| UR5HCPLX-Cxx | | -40 to +85 | |
| Storage Temperature Range | Tstg | -65 to +150 | ° C |

### Thermal Characteristics

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistence | Tja | | ° C per W |
| ■ Plastic | | 60 | |
| ■ Plcc | | 70 | |

### DC Electrical Characteristics (Vdd=5.0 Vdc +/-10%, Vss=0 Vdc, Temperature range=T low to T high unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Output Voltage (I load<10µA) | Vol | | | 0.1 | V |
| | Voh | Vdd–0.1 | | | |
| Output High Voltage (I load=0.8mA) | Voh | Vdd–0.8 | | | V |
| Output Low Voltage (I load=1.6mA) | Vol: | | | 0.4 | V |
| Input High Voltage | Vih | 0.7xVdd | | Vdd | V |
| Input Low Voltage | Vil | Vss | | 0.2xVdd | V |
| User Mode Current | Ipp | | 5 | 10 | mA |
| Data Retention Mode (0 to 70°C) | Vrm | 2.0 | | | V |
| Supply Current (Run) | Idd | | 2.5 | 3.5 | mA |
| (Wait) | | | 0.8 | 1.5 | mA |
| (Stop) | | | 2.0 | 50 | µA |
| I/O Ports Hi-Z Leakage Current | Iil | | | +/-10 | µA |
| Input Current | Iin | | | +/- 1 | µA |
| I/O Port Capacitance | Cio | | 8 | 12 | pF |

### Control Timing (Vdd=5.0 Vdc +/-10%, Vss=0 Vdc, Temperature range=T low to T high unless otherwise noted)

| Characteristic | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Frequency of Operation | fosc | | | MHz |
| ■ Crystal Option | | | 2.0 | |
| ■ External Clock Option | | dc | 2.0 | |
| Cycle Time | tcyc | 1000 | | ns |
| Crystal Oscillator Startup Time | toxov | | 100 | ms |
| Stop Recovery Startup Time | tilch | | 100 | ms |
| RESET Pulse Width | trl | 8 | | tcyc |
| Interrupt Pulse Width Low | tlih | 125 | | ns |
| Interrupt Pulse Period | tilil | * | | tcyc |
| OSC1 Pulse Width | toh, tol | 90 | | ns |

*The minimum period $t_{ILIL}$ should not be less than the number of cycle times it takes to execute the interrupt service routine plus 21 tcyc.

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