# HT82K28A
## Win98 Keyboard Encoder

## Features

- Designed for Windows 95/98/NT
- Supports 3 Windows 95 Keys
- Supports Power, Sleep and Wake-up Windows 98 ACPI functions
- Supports Japanese, Korean and Portuguese
- Supports Japanese DOS/V 106-key keyboard
- Supports code set 1, for PS/2 model 30 keyboard
- Supports code set 2, for PC/AT, PS/2 model 50,60 keyboards
- Supports code set 3, for PS/2 model 80 keyboard
- RC oscillator
- Phantom key detection
- Minimal external components
- Pin-compatible with Holtek HT6547E-2
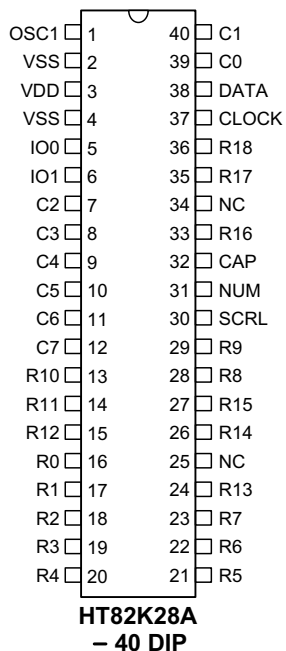- 40-pin DIP/DICE form

## General Description

The HT82K28A is a keyboard encoder especially designed for IBM PC/AT, IBM PS/2 and all compatible machines.

The HT82K28A accepts keyboard inputs and contains a 16-character first-in-first-out buffer in which data is stored. An inexpensive RC oscillator can be used for the system clock. The device offers the advantage of simple implementation in high performance and low cost keyboard applications.

## Pin Assignment

| Pin | # | # | Pin |
|---|---|---|---|
| OSC1 | 1 | 40 | C1 |
| VSS | 2 | 39 | C0 |
| VDD | 3 | 38 | DATA |
| VSS | 4 | 37 | CLOCK |
| IO0 | 5 | 36 | R18 |
| IO1 | 6 | 35 | R17 |
| C2 | 7 | 34 | NC |
| C3 | 8 | 33 | R16 |
| C4 | 9 | 32 | CAP |
| C5 | 10 | 31 | NUM |
| C6 | 11 | 30 | SCRL |
| C7 | 12 | 29 | R9 |
| R10 | 13 | 28 | R8 |
| R11 | 14 | 27 | R15 |
| R12 | 15 | 26 | R14 |
| R0 | 16 | 25 | NC |
| R1 | 17 | 24 | R13 |
| R2 | 18 | 23 | R7 |
| R3 | 19 | 22 | R6 |
| R4 | 20 | 21 | R5 |

**HT82K28A**
**– 40 DIP**

## Pin Description

| Pin No. | Pin Name | I/O | Description |
|---------|----------|-----|-------------|
| 1 | OSC1 | I | System clock input |
| 2, 4 | VSS | — | Negative power supply, ground |
| 3 | VDD | — | Positive power supply |
| 5, 6 | IO0~IO1 | O | Customer defined optional output lines |
| 39, 40, 7~12 | C0~C7 | I | Keyboard matrix scanning input pins |
| 16~23, 28, 29, 13~15 24, 26, 27 33, 35 | R0~R18 | O | Keyboard matrix scanning output pins |
| 25, 34 | NC | — | No connection |
| 30 | SCRL | O | LED pin |
| 31 | NUM | O | LED pin |
| 32 | CAP | O | LED pin |
| 37 | CLOCK | I/O | Synchronous clock signal. Used to clock the transmission data |
| 38 | DATA | I/O | Bidirectional data transmission line |

## Absolute Maximum Ratings

Supply Voltage ............................. 4.75V to 5.25V

Input Voltage ................. $V_{SS}$–0.3V to $V_{DD}$+0.3V

Storage Temperature ................. –55°C to 125°C

Operating Temperature ................... 0°C to 70°C

Note: These are stress ratings only. Stresses exceeding the range specified under ″Absolute Maximum Ratings″ may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

## Electrical Characteristics

Ta=25°C

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{DD}$ | Operating Voltage | — | 4.75 | 5 | 5.25 | V |
| $I_{DD}$ | Operating Current | — | — | 2 | 5 | mA |
| $V_{IL}$ | Input Low Voltage (C0~C7) | — | 0 | — | 0.6 | V |
| | Input Low Voltage (DATA, CLOCK) | — | 0 | — | 0.6 | V |
| $V_{IH}$ | Input High Voltage | — | 3.5 | — | $V_{DD}$ | V |
| $V_{OL}$ | Output Low Voltage (R0~R18) | $I_{OL}$=10mA | — | — | 0.5 | V |
| | Output Low Voltage (DATA, CLOCK) | $I_{OL}$=15mA | — | — | 0.5 | V |
| $R_{ph}$ | Internal Pull-high Resistance (C0~C7) | — | 5 | 10 | 20 | kΩ |
| | Internal Pull-high Resistance (CLOCK, DATA) | — | 2 | 5 | 15 | kΩ |
| $f_{SYS}$ | System Clock | — | — | 4 | — | MHz |

## Functional Description

The HT82K28A basic function is to detect key press and release activity and to transmit the corresponding scan code, as well as make and break codes to the system.

The device also accepts commands from the system and responds to the system if necessary. All communication between the keyboard and the system is managed through the CLOCK and DATA pins.

The keyboard begins to scan for pressed or released keys and commands from the system after the BAT (Basic Assurance Test) has been run.

### Working modes

Three working modes are supported by the HT82K28A. These are setup by the alternate scan code command F0. The various modes are described as follows.

### Mode 1

- Supports code set 1 for PS/2 model 30 keyboards.
- Enters mode1 after an F0 Command is issued followed by a 1".
- Contains an 11 bit data stream, including one start bit (always zero) eight data bits, one parity bit (odd parity) and one stop bit (always one).
- All keys are typematic/make/break as default.
- The working mode can be changed again in this mode, by issuing an F0 command followed by an option. See the F0 command for more detail.

### Mode 2

- Supports code set 2 for PC/AT, PS/2 model 50, 60 keyboards.
- Enters mode 2 after power on.
  The working mode can be changed by an F0 command followed by an option byte 1, 2 or 3. See the F0 command for more details.
- Contains an 11 bit data stream, including one start bit (always zero) eight data bits, one parity bit (odd parity) and one stop bit (always one)
- All keys are typematic/make/break as default.

### Mode 3

- Supports code set 3, for PS/2 model 80 keyboards.
- Enters mode 3 when an F0 command is issued followed by a 3".
- Contains an 11 bit data stream, including one start bit (always zero) eight data bits, one parity bit (odd parity) and one stop bit (always one).

### Buffers

The buffers support the following functions:

- 16-byte FIFO buffer: stores 16 keystrokes scan codes.
- Additional keystrokes will be ignored.
- Response codes, i.e FA/FE... do not occupy buffer positions.

### Basic assurance test – BAT

The following functions are offered by the Basic Assurance Test:

- Turns on LED status indicators.
- Keyboard processor test.
- RAM test.
- Turns off LED status indicators, i.e. the LEDs.
- Reports the BAT result to the system.

Note: During the BAT, activity on the "clock" and "data" line are ignored. The LED′s are turned on at the beginning and turned off at the end of the BAT. The BAT takes a minimum of 450ms after POR and a maximum of 2.5s. The response to a satisfactory BAT completion is ″AA″ and response to BAT failure is an ″FC″ error. The reset keyboard command ″FF″ will also cause the keyboard to execute the BAT. Completion codes are sent between 300 and 500ms after a reset command is acknowledged. After the BAT, the keyboard sets the keys to typematic and make/break, and sets the default typematic rate and delay.

### Power-on

Two important activities take place when power is first applied to the keyboard. The first is the presence of an H/W signal POR (Power-On-Reset) that resets the keyboard processor. The second activity is the running of the self test BAT (Basic Assurance Test) routine.
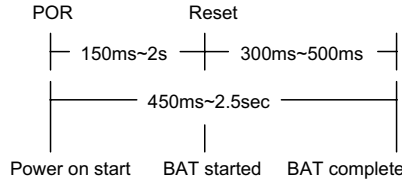


### PC-type/mode/code set

The following table describes the relationship between different computer types, the working mode and the code sets.

| PS/2 30 | mode 1 | code set 1 |
|---------|--------|------------|
| PC-AT | mode 2 | code set 2 |
| PS/2 50 | mode 2 | code set 2 |
| PS/2 60 | mode 2 | code set 2 |
| PS/2 80 | mode 3 | code set 3 |

The mode can be changed between mode 2 & 3.

### Keys

- For code set 1, 2

  All keys except the PAUSE key have a make and break code. The PAUSE key has a make code only.

  The defaults except for PAUSE are make/ break/typematic. In mode 1, 2 and 3 the key type may be changed to be one of the following:
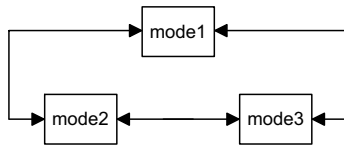


  - Typematic
  - Make/break
  - Make
  - Typematic/make/break

All keys except PAUSE are typematic. Typematic means that the KB keeps sending make codes if the key is held down.

The data report is according to the typematic rate/delay:
Default values are: delay 500ms ± 20%
10.9 char/sec ± 20%

The typematic rate and delay can be modified with the F3 command.

- If two or more keys are held down, only the last key pressed repeats at the typematic rate.

  Typematic operation stops when the last key pressed is released even if other keys are still held down.

  If a key is pressed and held down while keyboard transmission is inhibited, only the first make code is stored in the buffer overflow as a result of typematic action.

Four key types are supported as shown:

| Key type | press | hold | release |
|----------|-------|------|---------|
| Typematic | make1 | make2 | X |
| Make/break | make1 | X | break |
| Make | make1 | X | X |
| Typematic/ make/break | make1 | make2 | break |

Note: "make1" send out only one make code.
"Make2" continue sending out make codes until key is released.
"X" nothing sent out.

- For code set 3
  - Typematic
  - Make/break
  - Make
  - Typematic/make/break
  
  Can be configured by command

### Time interval between phantoms

The time interval between two continuous error codes 00/FF sent while phantom detected= 1000ms ± 20%

**System command table**

| Command | mode 1 | mode 2 | mode 3 |
|---|:---:|:---:|:---:|
| FF – reset | y | y | y |
| FE – resend | y | y | y |
| FD – set key type make | y | y | y |
| FC – set key type make/break | y | y | y |
| FB – set key type typematic | y | y | y |
| FA – set all keys typematic/make/break | y | y | y |
| F9 – set all keys make | y | y | y |
| F8 – set all keys make/break | y | y | y |
| F7 – set all keys typematic | y | y | y |
| F6 – set default | y | y | y |
| F5 – default disabled | y | y | y |
| F4 – enable | y | y | y |
| F3 – set typematic rate/delay | y | y | y |
| F2 – Read ID | y | y | y |
| F1 – | x | x | x |
| F0 – select alternate scan codes | y | y | y |
| EF – | x | x | x |
| EE – Echo | y | y | y |
| ED – set/reset status indicators | y | y | y |

The keyboard should respond within 20ms, except when performing the BAT or executing a reset command.

**Command description**

- Default disable – F5
  - Send an acknowledge FA to the system
  - Clear its output buffer, FIFO
  - Set the default key types
  - Set typematic rate/delay as default value
  - Clear the last typematic key
  - Stop scanning and wait for further instruction

- Echo – EE
  - Send an EE to the system
  - Continue scanning if the keyboard is enabled
    Note: This command does not need to feed back the ACK

- Enable – F4
  - Send an ACK to the system
  - Clear output buffer
  - Clear the last typematic key
  - Start scanning

- Invalid command
  - Send an FE to the system
  - No further activities
    Note: No ACK

- Read ID – F2
  - Send an ACK to the system
  - Discontinue scanning
  - 2 byte ID-AB, 83
    The 2nd byte must follow the completion of the first byte within 500ms
  - Resume scanning

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- Resend – FE
  - Send the last code to the system
    Note: * No FA response

- Reset – FF
  - Disable keyboard
  - Send an ACK to the system, the keyboard acknowledges the command with an ACK and ensures the system accepts the ACK before executing the command
  - The system sets CLK=DATA=high for 500μs: acceptance of ACK
  - The system can issue any command to the KB within the 500μs period mentioned above to override FF
  - If no override, the system performs its BAT and enters mode 2 (even if it is set to be mode 3)

- Select alternate scan code – F0
  - Send an ACK to the system
  - Clears both output buffer and the typematic key
  - Accept option byte

- Set all keys – F7, F8, F9, FA
  - FA: Set all keys to typematic/make/break
  - F9: Set all keys to make
  - F8: Set all keys to make/break
  - F7: Set all keys to typematic
  - Send an ACK to the system
  - Clear output buffer
  - Set all keys to the type indicated by the command

- Set default – F6
  - Send an ACK to the system
  - Clear the output buffer
  - Set to default key states: Default key type typematic rate/delay

- Set key type – FB,FC,FD
  - FB : Set key type – Typematic
  - FC : Set key type – Make/Break

- FD : Set key type – Make
- The keyboard responds with ACK, clears its output buffer and prepares to receive key identification
- Key identification is accomplished by the system identifying each key by its scan code value as defined in scan code set3.
- Only scan code set3 values are valid for key identification
- The type of each identified key is set to the value indicated by the command
- These commands can be sent using any scan code set, but affect only the operation of scan code set3

- Set LED – ED
  - Send ACK to the system
  - Discontinue scanning
  - Wait for the option from the system
  - Respond with ACK to the system
  - Set indicator
  - If command comes from the system in place of option, discard the set LED function and then process the new command
  - LED default after power on - all off
  - Set default disable - do not change the LEDs

- Set typematic rate/delay – F3
  - Send an ACK to the system
  - Stop scanning
  - Wait for the system typematic rate and delay
  - Send an ACK to the system
  - Set rate/delay
  - Bit 6,5   delay
  - Bit 4,3,2,1,0 typematic rate
  - Bit 7=0 (always)
    Delay= $(1+\text{bit6,bit5}) \times 250\text{ms}$
    Typematic rate= 1/period
    ...where period= $(8+A) \times (2^{\wedge}B) \times 0.00417$
    ...where A= binary value of bit 2, 1 and 0
    ...where B= binary value of bit 4 and 3

| b4~b0 | Typematic rate | b4~b0 | Typematic rate |
|-------|----------------|-------|----------------|
| 00000 | 30.0 | 10000 | 7.5 |
| 00001 | 26.7 | 10001 | 6.7 |
| 00010 | 24.0 | 10010 | 6.0 |
| 00011 | 21.8 | 10011 | 5.5 |
| 00100 | 20.0 | 10100 | 5.0 |
| 00101 | 18.5 | 10101 | 4.6 |
| 00110 | 17.1 | 10110 | 4.3 |
| 00111 | 16.0 | 10111 | 4.0 |
| 01000 | 15.0 | 11000 | 3.7 |
| 01001 | 13.3 | 11001 | 3.3 |
| 01010 | 12.0 | 11010 | 3.0 |
| 01011 | 10.9 | 11011 | 2.7 |
| 01100 | 10.0 | 11100 | 2.5 |
| 01101 | 9.2 | 11101 | 2.3 |
| 01110 | 8.6 | 11110 | 2.1 |
| 01111 | 8.0 | 11111 | 2.0 |

- Default
  - delay: 500ms± 20%
  - typematic rate=10.9 characters/sec± 20%

**Commands to the system**

00: keyboard detect a error/overrun (set 2, set 3)

AB,83: keyboard ID
AA: BAT completion
FC: BAT failure
EE: Echo
FA: Acknowledge
FE: Resend
FF: Keyboard detects a overrun (set 1)

- FA: Acknowledge
  If the KB (Keyboard) receives any valid input except EE (echo) and resend (FE) then send an FA to the system first.
  If the command is EE, then send an EE back to the system.
  If the command is FE, then send the last key code to system.
  If there is an interrupt while sending FA, the KB discards the FA and accepts the command from the system and processes it.

- 00/FF: Key overrun
  If the keyboard detects an overrun error, the KB sends an overrun error code to the system.
  mode 1: FF
  mode 2,3: 00

- FE: Resend
  The KB issues an FE when there is a parity error in transmission.

**Data communications**

- Data output
  - If CLK=0, no transmission (keyboard inhibited).
  - If CLK=1, DATA=0, no transmission (system request to send).
  - If CLK=1, DATA=1, transmission permitted.
  - Data will be valid before the trailing edge and beyond the leading edge of the clock.
  - The KB checks the clock line for an active level at least every 60ms.
  - If line contention occurs (system brings the clock low before the tenth clock), set clock=data=high.

- Data input
  - The system overrides the clock line for at least 60ms
  - The keyboard checks the state of the clock line at intervals of no more than 10ms
  - If a system request-to-send is detected, the keyboard counts 11 data bits.
  - Data will be valid before the rising edge and beyond the falling edge
  - After the 10th bit, the keyboard checks for an active level on the "data" line. If the line is active it is forced to be inactive, and counts one more bit.
  - Note: This action signals the system that the keyboard has received its data. Upon reception of this signal, the system returns to the ready state, in which it can accept keyboard outputs or goes to the inhibit state until it is ready.

If the keyboard "data" line is found to be at an inactive level following the 10th bit, a frame error has occurred, and the keyboard continues to count until the "data" line becomes active. The keyboard then makes the "data" line inactive and sends a Resend.

**Data stream**

| Mode 1,2,3 | |
|---|---|
| B1: | start bit always 0 |
| B2: | data bit 0 |
| b3: | data bit 1 |
| b4: | data bit 2 |
| b5: | data bit 3 |
| B6 | data bit 4 |
| b7: | data bit 5 |
| b8: | data bit 6 |
| b9: | data bit 7 |
| b10: | parity bit (odd par) |
| b11: | stop bit always 1 |

Note: The parity bit is either 1 or 0, and the 8 data bits, plus the parity bit, always have an odd number of 1 s.

**Key code set 1**

| Key Number | Make/Break Code | Key Number | Make/Break Code |
|:---:|:---:|:---:|:---:|
| 1 | 29 / A9 | 50 | 30 / B0 |
| 2 | 02 / 82 | 51 | 31 / B1 |
| 3 | 03 / 83 | 52 | 32 / B2 |
| 4 | 04 / 84 | 53 | 33 / B3 |
| 5 | 05 / 85 | 54 | 34 / B4 |
| 6 | 06 / 86 | 55 | 35 / B5 |
| 7 | 07 / 87 | 56 | 73 / F3 |
| 8 | 08 / 88 | 57 | 36 / B6 |
| 9 | 09 / 89 | 58 | 1D / 9D |
| 10 | 0A / 8A | 60 | 38 / B8 |
| 11 | 0B / 8B | 61 | 39 / B9 |
| 12 | 0C / 8C | 62 | E0 38 / E0 B8 |
| 13 | 0D / 8D | 64 | E0 1D / E0 9D |
| 14 | 7D / FD | 90 | 45 / C5 |
| 15 | 0E / 8E | 91 | 47 / C7 |
| 16 | 0F / 8F | 92 | 4B / CB |
| 17 | 10 / 90 | 93 | 4F / CF |
| 18 | 11 / 91 | 96 | 48 / C8 |
| 19 | 12 / 92 | 97 | 4C / CC |
| 20 | 13 / 93 | 98 | 50 / D0 |
| 21 | 14 / 94 | 99 | 52 / D2 |
| 22 | 15 / 95 | 100 | 37 / B7 |
| 23 | 16 / 96 | 101 | 49 / C9 |
| 24 | 17 / 97 | 102 | 4D / CD |
| 25 | 18 / 98 | 103 | 51 / D1 |
| 26 | 19 / 99 | 104 | 53 / D3 |
| 27 | 1A / 9A | 105 | 4A / CA |
| 28 | 1B / 9B | 106 | 4E / CE |
| 29 | 2B / AB | 107 | 7E / FE |
| 30 | 3A / BA | 108 | E0 1C / E0 9C |
| 31 | 1E / 9E | 110 | 01 / 81 |
| 32 | 1F / 9F | 112 | 3B / BB |
| 33 | 20 / A0 | 113 | 3C / BC |
| 34 | 21 / A1 | 114 | 3D / BD |
| 35 | 22 / A2 | 115 | 3E / BE |
| 36 | 23 / A3 | 116 | 3F / BF |
| 37 | 24 / A4 | 117 | 40 / C0 |
| 38 | 25 / A5 | 118 | 41 / C1 |
| 39 | 26 / A6 | 119 | 42 / C2 |
| 40 | 27 / A7 | 120 | 43 / C3 |
| 41 | 28 / A8 | 121 | 44 / C4 |
| 42 | 2B / AB | 122 | 57 / D7 |
| 43 | 1C / 9C | 123 | 58 / D8 |
| 44 | 2A / AA | 125 | 46 / C6 |
| 45 | 56 / D6 | 131 | 7B / FB |
| 46 | 2C / AC | 132 | 79 / F9 |
| 47 | 2D / AD | 133 | 70 / F0 |
| 48 | 2E / AE | | |
| 49 | 2F / AF | | |

**Key code set 1**

| Key Number | Base Case Shift+Num | Left-Shift | Right-Shift | Num Lock |
|---|---|---|---|---|
| 75 | E0 52 /E0 D2 | E0 AA E0 52 /E0 D2 E0 2A | E0 B6 E0 52 /E0 D2 E0 36 | E0 2A E0 52 /E0 D2 E0 AA |
| 76 | E0 53 /E0 D3 | E0 AA E0 53 /E0 D3 E0 2A | E0 B6 E0 53 /E0 D3 E0 36 | E0 2A E0 53 /E0 D3 E0 AA |
| 79 | E0 4B /E0 CB | E0 AA E0 4B /E0 CB E0 2A | E0 B6 E0 4B /E0 CB E0 36 | E0 2A E0 4B /E0 CB E0 AA |
| 80 | E0 47 /E0 C7 | E0 AA E0 47 /E0 C7 E0 2A | E0 B6 E0 47 /E0 C7 E0 36 | E0 2A E0 47 /E0 C7 E0 AA |
| 81 | E0 4F /E0 CF | E0 AA E0 4F /E0 CF E0 2A | E0 B6 E0 4F /E0 CF E0 36 | E0 2A E0 4F E0 CF E0 AA |
| 83 | E0 48 /E0 C8 | E0 AA E0 48 /E0 C8 E0 2A | E0 B6 E0 48 /E0 C8 E0 36 | E0 2A E0 48 E0 C8 E0 AA |
| 84 | E0 50 /E0 D0 | E0 AA E0 50 /E0 D0 E0 2A | E0 B6 E0 50 /E0 D0 E0 36 | E0 2A E0 50 /E0 D0 E0 AA |
| 85 | E0 49 /E0 C9 | E0 AA E0 49 /E0 C9 E0 2A | E0 B6 E0 49 /E0 C9 E0 36 | E0 2A E0 49 /E0 C9 E0 AA |
| 86 | E0 51 /E0 D1 | E0 AA E0 51 /E0 D1 E0 2A | E0 B6 E0 51 /E0 D1 E0 36 | E0 2A E0 51 E0 D1 E0 AA |
| 89 | E0 4D /E0 CD | E0 AA E0 4D /E0 CD E0 2A | E0 B6 E0 4D /E0 CD E0 36 | E0 2A E0 4D E0 CD E0 AA |
| L Win | E0 5B | E0 AA E0 5B | E0 B6 E0 5B | E0 2A E0 5B |
| L Win | /E0 DB | /E0 DB E0 2A | /E0 DB E0 36 | /E0 DB E0 AA |
| R Win | E0 5C | E0 AA E0 5C | E0 B6 E0 5C | E0 2A E0 5C |
| R Win | /E0 DC | /E0 DC E0 2A | /E0 DC E0 36 | /E0 DC E0 AA |
| APP | E0 5D | E0 AA E0 5D | E0 B6 E0 5D | E0 2A E0 5D |
| APP | /E0 DD | /E0 DD E0 2A | /E0 DD E0 36 | /E0 DD E0 AA |
| When both shift keys are held down: key number 75 | Both Shift E0 AA E0 B6 E0 52/E0 D2 E0 2A E0 36 | | | |

| Key Number | Base | +Left-Shift | +Right-Shift |
|---|---|---|---|
| 95 | E0 35 /E0 B5 | E0 AA E0 35 /E0 B5 E0 2A | E0 B6 E0 35 /E0 B5 E0 36 |
| when both shift keys are held down: key number 95 | Both Shift E0 AA E0 B6 E0 35 /E0 B5 E0 2A E0 36 | | |

| Key Number | Base | +Left-Shift | +Right-Shift |
|---|---|---|---|
| 124 | E0 2A E0 37 /E0 B7 E0 AA | E0 37 /E0 B7 | 54/D4 |

| Key Number | Base | +Ctrl |
|---|---|---|
| 126 | E1 1D 45 E1 9D C5 | E0 46 E0 C6 |
| This key is not typematic, all associated scan codes occur on the make code. | | |

| ACPI Key | Make | Break | Windows Virtual Key |
|---|---|---|---|
| Power | E0 5E | E0 DE | N/A |
| Sleep | E0 5F | E0 DF | N/A |
| Wake | E0 63 | E0 E3 | N/A |

**Key code set 2**

| Key Number | Make/Break Code | Key Number | Make/Break Code |
|:---:|:---:|:---:|:---:|
| 1 | 0E / F0 0E | 50 | 32 / F0 32 |
| 2 | 16 / F0 16 | 51 | 31 / F0 31 |
| 3 | 1E / F0 1E | 52 | 3A / F0 3A |
| 4 | 26 / F0 26 | 53 | 41 / F0 41 |
| 5 | 25 / F0 25 | 54 | 49 / F0 49 |
| 6 | 2E / F0 2E | 55 | 4A / F0 4A |
| 7 | 36 / F0 36 | 56 | 51 / F0 51 |
| 8 | 3D / F0 3D | 57 | 59 / F0 59 |
| 9 | 3E / F0 3E | 58 | 14 / F0 14 |
| 10 | 46 / F0 46 | 60 | 11 / F0 11 |
| 11 | 45 / F0 45 | 61 | 29 / F0 29 |
| 12 | 4E / F0 4E | 62 | E0 11 / E0 F0 11 |
| 13 | 55 / F0 55 | 64 | E0 14 / E0 F0 14 |
| 14 | 6A / F0 6A | 90 | 77 / F0 77 |
| 15 | 66 / F0 66 | 91 | 6C / F0 6C |
| 16 | 0D / F0 0D | 92 | 6B / F0 6B |
| 17 | 15 / F0 15 | 93 | 69 / F0 69 |
| 18 | 1D / F0 1D | 96 | 75 / F0 75 |
| 19 | 24 / F0 24 | 97 | 73 / F0 73 |
| 20 | 2D / F0 2D | 98 | 72 / F0 72 |
| 21 | 2C / F0 2C | 99 | 70 / F0 70 |
| 22 | 35 / F0 35 | 100 | 7C / F0 7C |
| 23 | 3C / F0 3C | 101 | 7D / F0 7D |
| 24 | 43 / F0 43 | 102 | 74 / F0 74 |
| 25 | 44 / F0 44 | 103 | 7A / F0 7A |
| 26 | 4D / F0 4D | 104 | 71 / F0 71 |
| 27 | 54 / F0 54 | 105 | 7B / F0 7B |
| 28 | 5B / F0 5B | 106 | 79 / F0 79 |
| 29 | 5D / F0 5D | 107 | 6D / F0 6D |
| 30 | 58 / F0 58 | 108 | E0 5A / E0 F0 5A |
| 31 | 1C / F0 1C | 110 | 76 / F0 76 |
| 32 | 1B / F0 1B | 112 | 05 / F0 05 |
| 33 | 23 / F0 23 | 113 | 06 / F0 06 |
| 34 | 2B / F0 2B | 114 | 04 / F0 04 |
| 35 | 34 / F0 34 | 115 | 0C / F0 0C |
| 36 | 33 / F0 33 | 116 | 03 / F0 03 |
| 37 | 3B / F0 3B | 117 | 0B / F0 0B |
| 38 | 42 / F0 42 | 118 | 83 / F0 83 |
| 39 | 4B / F0 4B | 119 | 0A / F0 0A |
| 40 | 4C / F0 4C | 120 | 01 / F0 01 |
| 41 | 52 / F0 52 | 121 | 09 / F0 09 |
| 42 | 5D / F0 5D | 122 | 78 / F0 78 |
| 43 | 5A / F0 5A | 123 | 07 / F0 07 |
| 44 | 12 / F0 12 | 125 | 7E / F0 7E |
| 45 | 61 / F0 61 | 131 | 67 / F0 67 |
| 46 | 1A / F0 1A | 132 | 64 / F0 64 |
| 47 | 22 / F0 22 | 133 | 13 / F0 13 |
| 48 | 21 / F0 21 | | |
| 49 | 2A / F0 2A | | |

**Key code set 2**

| Key Number | Base Case Shift+Num | Left-Shift | Right-Shift | Num Lock |
|---|---|---|---|---|
| 75 | E0 70<br>/E0 F0 72 | E0 F0 12 E0 70<br>/E0 F0 70 E0 12 | E0 F0 59 E0 70<br>/E0 F0 70 E0 59 | E0 12 E0 70<br>/E0 F0 70 E0 F0 12 |
| 76 | E0 71<br>/E0 F0 71 | E0 F0 12 E0 71<br>/E0 F0 71 E0 12 | E0 F0 59 E0 71<br>/E0 F0 71 E0 59 | E0 12 E0 71<br>/E0 F0 71 E0 F0 12 |
| 79 | E0 6B<br>/E0 F0 6B | E0 F0 12 E0 70<br>/E0 F0 6B E0 12 | E0 F0 59 E0 6B<br>/E0 F0 6B E0 59 | E0 12 E0 6B<br>/E0 F0 6B E0 F0 12 |
| 80 | E0 6C<br>/E0 F0 6C | E0 F0 12 E0 70<br>/E0 F0 6C E0 12 | E0 F0 59 E0 6C<br>/E0 F0 6C E0 59 | E0 12 E0 6C<br>/E0 F0 6C E0 F0 12 |
| 81 | E0 69<br>/E0 F0 69 | E0 F0 12 E0 70<br>/E0 F0 69 E0 12 | E0 F0 59 E0 69<br>/E0 F0 69 E0 59 | E0 12 E0 69<br>/E0 F0 69 E0 F0 12 |
| 83 | E0 75<br>/E0 F0 75 | E0 F0 12 E0 70<br>/E0 F0 75 E0 12 | E0 F0 59 E0 75<br>/E0 F0 75 E0 59 | E0 12 E0 75<br>/E0 F0 75 E0 F0 12 |
| 84 | E0 72<br>/E0 F0 72 | E0 F0 12 E0 70<br>/E0 F0 72 E0 12 | E0 F0 59 E0 72<br>/E0 F0 72 E0 59 | E0 12 E0 72<br>/E0 F0 72 E0 F0 12 |
| 85 | E0 7D<br>/E0 F0 7D | E0 F0 12 E0 70<br>/E0 F0 7D E0 12 | E0 F0 59 E0 7D<br>/E0 F0 7D E0 59 | E0 12 E0 7D<br>/E0 F0 7D E0 F0 12 |
| 86 | E0 7A<br>/E0 F0 7A | E0 F0 12 E0 70<br>/E0 F0 7A E0 12 | E0 F0 59 E0 7A<br>/E0 F0 7A E0 59 | E0 12 E0 7A<br>/E0 F0 7A E0 F0 12 |
| 89 | E0 74<br>/E0 F0 74 | E0 F0 12 E0 70<br>/E0 F0 74 E0 12 | E0 F0 59 E0 74<br>/E0 F0 74 E0 59 | E0 12 E0 74<br>/E0 F0 74 E0 F0 12 |
| L Win | E0 1F<br>/E0 F0 1F | E0 F0 12 1F<br>/E0 F0 1F E0 12 | E0 F0 59 E0 1F<br>/E0 F0 1F E0 59 | E0 12 E0 1F<br>/E0 F0 1F E0 F0 12 |
| R Win | E0 27<br>/E0 F0 27 | E0 F0 12 27<br>/E0 F0 27 E0 12 | E0 F0 59 E0 27<br>/E0 F0 27 E0 59 | E0 59 E0 27<br>/E0 F0 27 E0 F0 12 |
| APP | E0 2F<br>/E0 F0 2F | E0 F0 12 2F<br>/E0 F0 2F E0 12 | E0 F0 59 E0 2F<br>/E0 F0 2F E0 59 | E0 59 E0 2F<br>/E0 F0 2F E0 F0 59 |
| When both shift keys are held down:<br>key number 75 | | | Both Shift<br>E0 F0 12 E0 F0 59 E0 70<br>/E0 F0 70 E0 12 E0 59 | |

| Key Number | Base | +Left-Shift | +Right-Shift |
|---|---|---|---|
| 95 | E0 4A<br>/E0 F0 4A | E0 F0 12 E0 4A<br>/E0 F0 4A E0 12 | E0 F0 59 E0 4A<br>/E0 F0 4A E0 59 |
| When both shift keys are held down:<br>key number 95 | | Both Shift<br>E0 F0 12 E0 F0 59 E0 4A<br>/E0 F0 4A E0 12 E0 59 | |

| Key Number | Base | +Shift / +Ctrl | +Alt |
|---|---|---|---|
| 124 | E0 12 E0 7C<br>/E0 F0 7C E0 12 | E0 7C<br>/E0 F0 7C | 84 / F0 84 |

| Key Number | Base | +Ctrl |
|---|---|---|
| 126 | E1 14 77 E1 F0 14 F0 77 | E0 7E E0 F0 7E |
| Note: this key is not typematic, all associated scan codes occur on the make of the key. | | |

| ACPI key | Make | Break | Windows Virtual Key |
|---|---|---|---|
| Power | E0 37 | E0 F0 37 | N/A |
| Sleep | E0 3F | E0 F0 3F | N/A |
| Wake | E0 5E | E0 F0 5E | N/A |

**Key code set 3**

| Key # | Make/ Break Code | Note | Default Key State | Key # | Make/ Break Code | Note | Default Key State |
|---|---|---|---|---|---|---|---|
| 1 | 0E / F0 0E | | Typematic | 57 | 59 / F0 59 | | Make/Break |
| 2 | 16 / F0 16 | | Typematic | 58 | 11 / F0 11 | * | Make/Break |
| 3 | 1E / F0 1E | | Typematic | 60 | 19 / F0 19 | * | Make/Break |
| 4 | 26 / F0 26 | | Typematic | 61 | 29 / F0 29 | | Typematic |
| 5 | 25 / F0 25 | | Typematic | 62 | 39 / F0 39 | * | Make Only |
| 6 | 2E / F0 2E | | Typematic | 64 | 58 / E0 58 | * | Make Only |
| 7 | 36 / F0 36 | | Typematic | 75 | 67 / F0 67 | * | Make Only |
| 8 | 3D / F0 3D | | Typematic | 76 | 64 / F0 64 | * | Typematic |
| 9 | 3E / F0 3E | | Typematic | 79 | 61 / F0 61 | * | Typematic |
| 10 | 46 / F0 46 | | Typematic | 80 | 6E / F0 6E | * | Make Only |
| 11 | 45 / F0 45 | | Typematic | 81 | 65 / F0 65 | * | Make Only |
| 12 | 4E / F0 4E | | Typematic | 83 | 63 / F0 63 | * | Typematic |
| 13 | 55 / F0 55 | | Typematic | 84 | 60 / F0 60 | * | Typematic |
| 14 | 5D / F0 5D | * | Typematic | 85 | 6F / F0 60 | * | Make Only |
| 15 | 66 / F0 66 | | Typematic | 86 | 6D / F0 6D | * | Make Only |
| 16 | 0D / F0 0D | | Typematic | 89 | 6A / F0 6A | * | Typematic |
| 17 | 15 / F0 15 | | Typematic | 90 | 76 / F0 76 | * | Make Only |
| 18 | 1D / F0 1D | | Typematic | 91 | 6C / F0 6C | | Make Only |
| 19 | 24 / F0 24 | | Typematic | 92 | 6B / F0 6B | | Make Only |
| 20 | 2D / F0 2D | | Typematic | 93 | 69 / F0 69 | | Make Only |
| 21 | 2C / F0 2C | | Typematic | 95 | 77 / F0 77 | * | Make Only |
| 22 | 35 / F0 35 | | Typematic | 96 | 75 / F0 75 | | Make Only |
| 23 | 3C / F0 3C | | Typematic | 97 | 73 / F0 73 | | Make Only |
| 24 | 43 / F0 43 | | Typematic | 98 | 72 / F0 72 | | Make Only |
| 25 | 44 / F0 44 | | Typematic | 99 | 70 / F0 70 | | Make Only |
| 26 | 4D / F0 4D | | Typematic | 100 | 7E / F0 7E | | Make Only |
| 27 | 54 / F0 54 | | Typematic | 101 | 7D / F0 7D | | Make Only |
| 28 | 5B / F0 5B | | Typematic | 102 | 74 / F0 74 | | Make Only |
| 29 | 5C / F0 5C | | Typematic | 103 | 7A / F0 7A | | Make Only |
| 30 | 14 / F0 14 | | Make/Break | 104 | 71 / F0 71 | | Make Only |

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| Key # | Make/ Break Code | Note | Default Key State | Key # | Make/ Break Code | Note | Default Key State |
|---|---|---|---|---|---|---|---|
| 31 | 1C / F0 1C | | Typematic | 105 | 84 / F0 84 | * | Make Only |
| 32 | 1B / F0 1B | | Typematic | 106 | 7C / F0 7C | * | Typematic |
| 33 | 23 / F0 23 | | Typematic | 107 | 7B/ F0 7B | * | Make Only |
| 34 | 2B / F0 2B | | Typematic | 108 | 79 / F0 79 | * | Make Only |
| 35 | 34 / F0 34 | | Typematic | 110 | 08 / F0 08 | * | Make Only |
| 36 | 33 / F0 33 | | Typematic | 112 | 07 / F0 07 | * | Make Only |
| 37 | 3B / F0 3B | | Typematic | 113 | 0F / F0 0F | * | Make Only |
| 38 | 42 / F0 42 | | Typematic | 114 | 17 / F0 17 | * | Make Only |
| 39 | 4B / F0 4B | | Typematic | 115 | 1F / F0 1F | * | Make Only |
| 40 | 4C / F0 4C | | Typematic | 116 | 27 / F0 27 | * | Make Only |
| 41 | 52 / F0 52 | | Typematic | 117 | 2F / F0 2F | * | Make Only |
| 42 | 5D / F0 5D | * | Typematic | 118 | 37 / F0 /37 | * | Make Only |
| 43 | 5A / F0 5A | | Typematic | 119 | 3F / F0 3F | * | Make Only |
| 44 | 12 / F0 12 | | Make/Break | 120 | 47 / F0 47 | * | Make Only |
| 45 | 13 / F0 13 | * | Typematic | 121 | 4F / F0 4F | * | Make Only |
| 46 | 1A / F0 1A | | Typematic | 122 | 56 / F0 56 | * | Make Only |
| 47 | 22 / F0 22 | | Typematic | 123 | 5E / F0 5E | * | Make Only |
| 48 | 21 / F0 21 | | Typematic | 124 | 57 / F0 57 | * | Make Only |
| 49 | 2A / F0 2A | | Typematic | 125 | 5F / F0 5F | * | Make Only |
| 50 | 32 / F0 32 | | Typematic | 126 | 62 / F0 62 | * | Make Only |
| 51 | 31 / F0 31 | | Typematic | 131 | 85 / F0 85 | * | Make Only |
| 52 | 3A / F0 3A | | Typematic | 132 | 86 / F0 86 | * | Make Only |
| 53 | 41 / F0 41 | | Typematic | 133 | 87 / F0 87 | * | Make Only |
| 54 | 49 / F0 49 | | Typematic | L Win | 8B / F0 8B | * | Make/Break |
| 55 | 4A / F0 4A | | Typematic | R Win | 8C / F0 8C | * | Make/Break |
| 56 | 51/ F0 51 | | Typematic | APP | 8D / F0 8D | * | Make/Break |

* Different from code set 2

## Timing Diagrams

### Data output
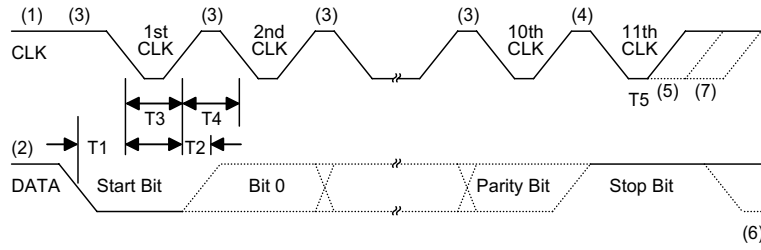


| | Timing Parameter | Min/Max |
|---|---|---|
| T1 | DATA transition to the falling edge of CLK | 5/25 μsec |
| T2 | Rising edge of CLK to DATA transition | 5/T4-5 μsec |
| T3 | Duration of CLK inactive | 30/50 μsec |
| T4 | Duration of CLK active | 30/50 μsec |
| T5 | Time to auxiliary device inhibit after clock 11 to ensure the auxiliary device does not start another transmission | >0/50 μsec |

### Keyboard data input
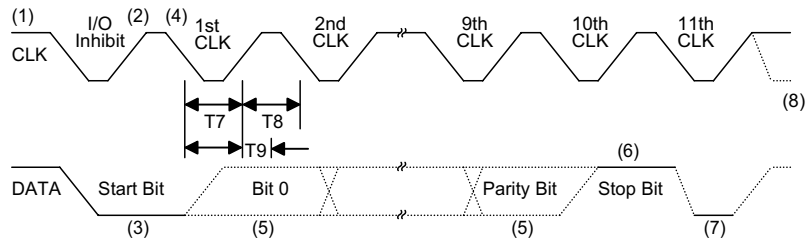


| | Timing Parameter | Min/Max |
|---|---|---|
| T7 | Duration of CLK inactive | 30/50 μsec |
| T8 | Duration of CLK active | 30/50 μsec |
| T9 | Time from inactive to active CLK transition, used to time when the auxiliary device samples DATA | 5/25 μsec |

## Application Circuits
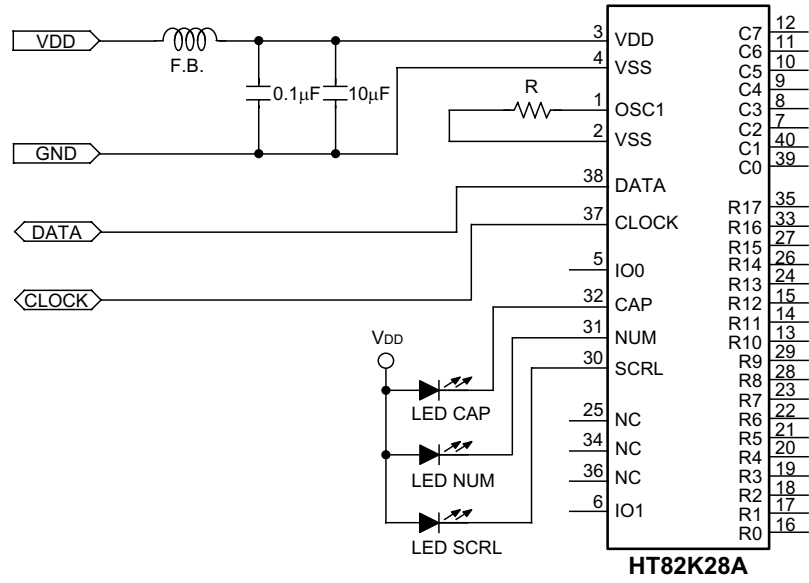
**Standard Holtek Win98 keyboard**

| | C7 | C6 | C5 | C4 | C3 | C2 | C1 | C0 |
|---|---|---|---|---|---|---|---|---|
| R0 | F5 | L-CTRL | WAKE-UP | R-CTRL | SLEEP | | POWER | PAUSE |
| R1 | ! 1 | ~ | K131 | Z | ESC | A | TAB | Q |
| R2 | @ 2 | F1 | K132 | X | K45 | S | CAP LOCK | W |
| R3 | # 3 | F2 | K133 | C | F4 | D | F3 | E |
| R4 | $ 4 | % 5 | B | V | G | F | T | R |
| R5 | & 7 | ^ 6 | N | M | H | J | Y | U |
| R6 | * 8 | + = | K56 | < , | F6 | K | } ] | I |
| R7 | ( 9 | F8 | APP | > . | | L | F7 | O |
| R8 | ) 0 | _ - | ? / | K42 | " ' | : ; | { [ | P |
| R9 | PRINT | | R-ALT | | L-ALT | | | SCR LOCK |
| R10 | F10 | F9 | F12 | ENTER | F11 | \| \ | BS | K14 |
| R11 | POWER | DEL | DOWN Arrow | NUM LOCK | SPACE | NUM 1 | NUM 4 | NUM 7 |
| R12 | SLEEP | INSERT | RIGHT Arrow | NUM / | NUM 0 | NUM 2 | NUM 5 | NUM 8 |
| R13 | PG DN | PG UP | NUM - | NUM * | NUM . | NUM 3 | NUM 6 | NUM 9 |
| R14 | END | HOME | LEFT Arrow | | UP Arrow | NUM ENTER | K107 | NUM + |
| R15 | | | K94 | | | R-SHF | L-SHF | WAKE UP |
| R16 | K129 | | | | | | L-WIN | K130 |
| R17 | | K109 | | | | R-WIN | | |

The above key code is according to the Microsoft specification except for the following keys.

| Key No | Code Set 1 Make/Break | | Code Set 2 Make/Break | | Code Set 3 Make/Break | |
|--------|------|------|------|--------|------|--------|
| 14 | 7D | FD | 6A | F0 6A | 5D | F0 5D |
| 94 | 7C | FC | 68 | F0 68 | 68 | F0 68 |
| 109 | 78 | F8 | 63 | F0 63 | 78 | F0 78 |
| 129 | F1 | | F1 | | F1 | |
| 130 | F0 | | F2 | | F2 | |