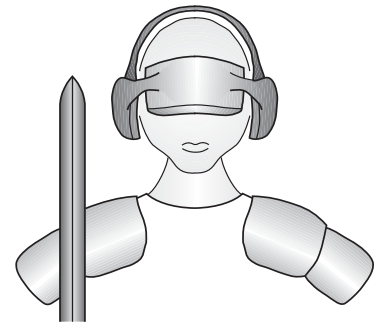


KeyWarrior24

Fixed Program USB Keyboard Controller Family Supplement to the KeyWarrior Data Sheet



Code Mercenaries

1. Features

- USB low speed interface
- Full USB V1.1/2.0 compliance
- Full USB HID 1.1 compliance
- 64 keys in 8x8 matrix or three incremental encoders and 9 keys
- Media control and application keys supported
- Two function shift keys to switch to a second and third key table
- Up to 34 macros with up to 31 keys each
- Factory programmed keyboard layout
- Custom chips for volume production
- Support for Caps lock, Num lock and Scroll lock LEDs on matrix chips
- Single +5V power supply
- Low power consumption: 40mA max.
- Available in 24 pin DIL and SOIC

1.1 Variants

KeyWarrior24 are available in three factory programmed versions with a fixed keyboard layout.

KeyWarrior24-8 and KeyWarrior24-8M support a 8x8 key matrix.

KeyWarrior24-8 is preprogrammed with general keyboard layouts.

KeyWarrior24-8M is preprogrammed with media control keys like "Mute", "Play/Pause" etc. and general keyboard layouts.

KeyWarrior24-S3 supports nine direct connected keys and three incremental encoders to produce key strokes from jog wheels and similar devices. KeyWarrior24-S3 is preprogrammed with media controls and other keys typically used for jog wheels.

Custom variants are available for production volumes.

KeyWarrior24-8

- Supports up to 64 keys in 8x8 matrix
- Preprogrammed with three layouts for general use, POS, and gaming
- Support for Caps lock, Num lock and Scroll lock LEDs
- Supports diodes in the key matrix

KeyWarrior24-8M

- Supports up to 64 keys in 8x8 matrix
- Preprogrammed with three layouts for media control and general use
- Supports Mute, Eject, Play/Pause, Forward, Backward,
- Support for Caps lock, Num lock and Scroll lock LEDs
- Supports diodes in the key matrix

KeyWarrior24-S3

- Supports three incremental encoders
- Encoder pulses turned into key strokes
- Supports nine direct connected keys
- Supports Mute, Eject, Play/Pause, Forward, Backward,
- Preprogrammed for media control and general use

2. Functional Overview

KeyWarrior24 is a low cost variant of the KeyWarrior family. It is primarily designed to reduce hardware requirements and costs for smaller keyboard designs that don't need the complexity of the main KeyWarrior family line.

KeyWarrior24 supports USB only and uses a factory programmed keyboard layout. This reduces the external circuitry to almost zero.

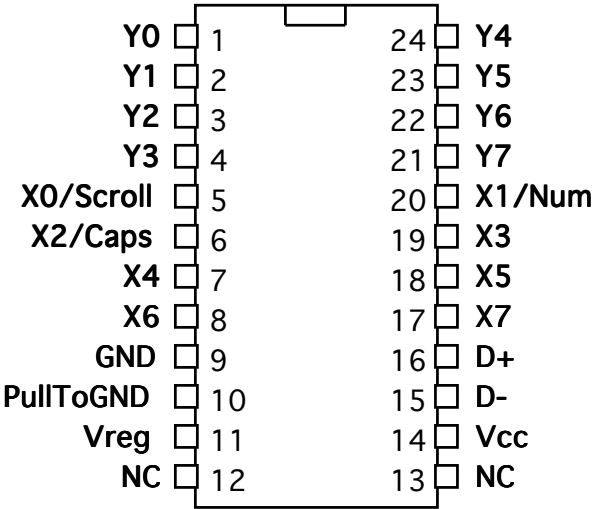
The standard KeyWarrior24 chips are available as off the shelf standard parts with a fixed keyboard layout. For production volumes (>100) it is possible to order KeyWarrior24 with a custom key layout, including up to 34 macros.

KeyWarrior24 implements the KeyWarrior Commander macro function, restricting the number of macros to 34 (instead of 48), while retaining all the other options, like using up to 31 keycodes per macro and assigning each of the macros to any of the 64 keys or three encoders and nine keys and any of the three FN-levels.

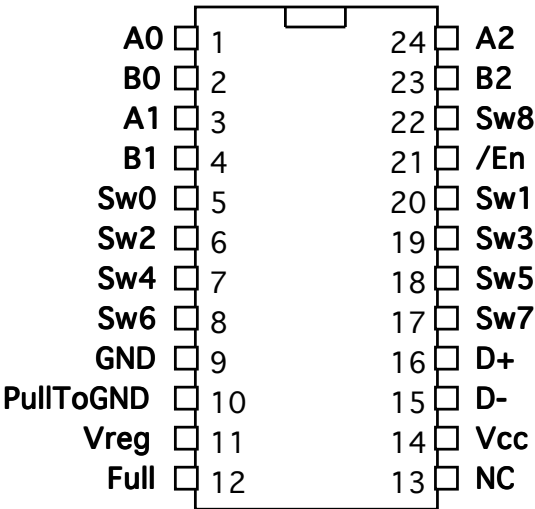
KeyWarrior24

3. Pin Configuration

KeyWarrior24-8-P
KeyWarrior24-8M-P
DIL24
KeyWarrior24-8-S
KeyWarrior24-8M-S
SOIC24



KeyWarrior24-S3-P
DIL24
KeyWarrior24-S3-S
SOIC24



TOP VIEW!

KeyWarrior24

4. Pin Descriptions KeyWarrior24-8/KeyWarrior24-8M

| Name | I/O | Type | Pins | Description |
|--|-----|--|----------------------------|---|
| D+, D- | I/O | special | 16, 15 | USB differential data lines |
| Y0, Y1, Y2, Y3, Y4, Y5, Y6, Y7 | O | open drain outputs | 1, 2, 3, 4, 24, 23, 22, 21 | Y lines for key matrix. These lines are periodically pulled low, between matrix scan they are high impedance. |
| X0/Scroll, X1/Num, X2/Caps, X3, X4, X5, X6, X7 | I/O | inputs with internal pull ups, X0, X1, X2 open drain I/O | 5, 20, 6, 19, 7, 18, 8, 17 | X lines for key matrix. Between matrix scan X0, X1, X2 are used as outputs for the keyboard LEDs |
| PullToGND | I | | 10 | Used during manufacturing, connect to GND |
| GND | | Power supply | 9 | Ground |
| Vcc | | Power supply | 14 | Supply voltage |
| Vreg | O | Regulated 3V out | 11 | Power for D- pullup resistor |
| NC | - | | 12, 13 | do not connect |

4.1 Pin Functions KeyWarrior24-8/8M

D+, D-

Differential data lines of USB. Connect these signals direct to the USB cable or type B plug.

Vreg

Regulated 3V output, to be used only for the purpose of powering the USB D- pull up resistor. Do not use this pin as a supply for any other circuit than the pull up resistor.

X0/Scroll, X1/Num, X2/Caps, X[3:7]

Matrix horizontal inputs. These eight lines are read by KeyWarrior to detect pressed keys.

X0, X1, X2 are also used to drive the Scroll, Num, and Caps Lock LEDs. An external driver transistor is required for each LED (see application circuit). The LEDs will glow faintly when a key on the same row is pressed.

Internal pull up resistors are activated on device reset.

Y[0:7]

Vertical matrix outputs. These open drain outputs are periodically pulled low to detect pressed keys. No internal or external pull up resistors.

Pull to GND

This pin is used during production of the KeyWarrior chips, connect to GND.

GND

Power supply ground.

Vcc

Supply voltage.

KeyWarrior24

4.2 Pin Descriptions KeyWarrior24-S3

| Name | I/O | Type | Pins | Description |
|------------------------|-----|---|----------------------------|--|
| D+, D- | I/O | special | 16, 15 | USB differential data lines |
| A0, B0, A1, B1, A2, B2 | I | inputs with internal pull ups | 1, 2, 3, 4, 24, 23, 22, 21 | A, B inputs for three encoders |
| Sw0..Sw8 | I | inputs with internal pull ups | 5, 20, 6, 19, 7, 18, 8, 17 | Inputs for the nine direct connected keys. Switches should close to ground |
| /En | O | open drain output with internal pull up | | Enable output to control power to the encoders, encoders active when low |
| Full | | input, internal weak pull down | 12 | Pull high to reduce encoder resolution to full pulses |
| PullToGND | I | | 10 | Used during manufacturing, connect to GND |
| GND | | Power supply | 9 | Ground |
| Vcc | | Power supply | 14 | Supply voltage |
| Vreg | O | Regulated 3V out | 11 | Power for D- pullup resistor |
| NC | - | | 13 | do not connect |

4.3 Pin Functions KeyWarrior24-S3

D+, D-

Differential data lines of USB. Connect these signals direct to the USB cable or type B plug.

Vreg

Regulated 3V output, to be used only for the purpose of powering the USB D- pull up resistor. Do not use this pin as a supply for any other circuit than the pull up resistor.

A0, B0, A1, B1, A2, B2

Encoder inputs. Up to three incremental encoders with quadrature signals may be connected here. Key generation is triggered on the rising edge of A, the status of B is then used to determine which one of two codes is generated. The assigned keys are pressed and released immediately. Macros can be assigned to encoders.

Internal pull up resistors are activated on device reset.

Sw[0:8]

Inputs for the nine keys. Switches closing to ground should be connected here.

Internal pull up resistors are activated on device reset.

/En

Enable output for the power supply to the encoders. To meet USB standby power specifications it is necessary to disable the power supply to the encoders during USB suspend status. Power to the encoders must be supplied only when this pin is low.

Full

Pulling this pin high reduces the encoder resolution to full pulses, i.e. a key stroke is generated only after a full encoder step with four edges on the A/B lines did happen.

Internal weak pull down resistor.

Pull to GND

This pin is used during production of the KeyWarrior chips, connect to GND.

GND

Power supply ground.

Vcc

Supply voltage.

KeyWarrior24

5. Device Operation

KeyWarrior24 registers as a standard HID keyboard and supports boot protocol. It does not need any special drivers to be installed, standard system drivers are sufficient.

The country code is 0 for not localized hardware, which allows to use a single version of the chip for all international keyboard layouts. Usage codes are defined for 0 to 164, which include the Power key and the = sign in the keypad, as well as the compose keys for Asian languages and several special keys that may or may not be supported by individual operating systems.

In addition the media control keys Mute, Play/Pause, Eject, Fast Forward, Fast Backward,

5.1 Power Up

Every time the supply voltage is applied KeyWarrior24 executes an internal reset sequence. All internal pull up resistors are disabled upon power up and will be activated during the internal reset sequence.

5.2 Keyboard Scanning

KeyWarrior24 scans the keyboard matrix every t_{scan} by sequentially pulling one of the Y lines low and then reading the status at the X lines. When the scan matrix changes status and then remains stable for $t_{debounce}$ KeyWarrior24 decodes the changes and generates scancodes.

On KeyWarrior24-S3 the nine direct connected keys are checked every t_{scan} and are decoded after remaining stable for $t_{debounce}$.

5.2.1 Encoder scanning

KeyWarrior24-S3 scans the encoder inputs at the highest rate possible. The actual rate depends on several parameters and is not static.

The encoder inputs are not debounced. It is not recommended to use mechanical encoders without an external debouncing circuit. Key strokes are generated immediately upon detecting the rising edge on the A signal from an encoder when in Full mode, in quadrant mode a key is generated on every edge on A or B.

5.3 Key Rollover

KeyWarrior supports true n-key rollover. All keys in the matrix may be pressed at the same time without KeyWarrior missing any code. However due to the phantom key effect it can not be guaranteed that combinations of many keys are properly reported (see 5.3.1).

USB has a limitation on how many keys can be reported at the same time. On USB any six keys plus all eight modifiers (GUI, Ctrl, Alt, Shift) may be pressed at the same time. If more than six ordinary keys are pressed an error state is reported. So USB has a 6-key plus modifiers rollover.

5.3.1 Phantom Keys

Phantom keys do occur when three or more keys in a keyboard matrix are pressed in a combination that leads to the matrix reading like a fourth key has been pressed.

To avoid phantom keys diodes may be added to the keys. If diodes are used they have to be put in series with the key switches. The cathodes have to be connected to the Y lines and anodes to X lines.

It is highly recommended to place all modifier keys on a single row or column and put diodes on all of them.

5.4 Custom Scancode Tables

The standard KeyWarrior24 has a fixed key table that is factory programmed. For production volumes it is possible to order KeyWarrior24 with an individual key layout.

KeyWarrior uses a single table to translate the matrix coordinates to USB usage codes. This table is called the "Master Translation Table".

For information on generating the Master Translation Table please refer to the document "Creating Custom KeyWarrior Scancode Tables".

5.5 Function Shift Keys

KeyWarrior24 allows the definition of two function shift keys. If one of these keys is pressed KeyWarrior uses a second or third translation table to convert matrix coordinates to USB usage codes. This allows a small keyboard to generate all functions of a full sized keyboard.

The function shift key may be on any coordinate in the matrix, it is assigned by placing a special code in the corresponding table position.

KeyWarrior24

5.6 Macros

KeyWarrior24 supports the KeyWarrior Commander type macros. Up to 34 macros can be defined for custom controllers.

Each macro can contain up to 31 key codes and can work either in a typing mode or stable mode.

For more information on the macros please refer to the document "Creating Custom KeyWarrior Scancode Tables".

5.7 Media Control and Application Keys

KeyWarrior24 supports the most commonly used subset of the USB HID class usage page \$0C (Consumer Controls). These keys are reported via a second interface that specifies usage \$01 for General Consumer Device.

The following keys are supported:

| | |
|--------|-------------------------|
| \$00B3 | Fast forward |
| \$00B4 | Rewind |
| \$00B5 | Skip to next track |
| \$00B6 | Skip to previous track |
| \$00B7 | Stop |
| \$00B8 | Eject |
| \$00CD | Play/Pause |
| \$00E2 | Audio mute |
| \$00E9 | Volume increase |
| \$00EA | Volume decrease |
| \$018A | Launch email reader |
| \$0196 | Launch internet browser |

Availability of these key functions may vary depending on the operating system used.

KeyWarrior24-8M and KeyWarrior24-S3 use these keys in their standard layouts. The functions may be placed on any key including the rotary encoders on KW24-S3.

Other consumer control keys can be made available for custom versions.

KeyWarrior24

6. Key Tables of the Standard KeyWarrior24 Chips

The standard layouts of the KeyWarrior24 chips are intended to be used as fixed selections set by hard wiring the corresponding FN key coordinate, not as optional layouts to be selected by an actual FN key.

6.1 KeyWarrior24-8 Table with no FN key pressed

Generic layout with all main keyboard keys

| | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
|-----------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Y0 | 7& | 8* | 9(| A | B | C | D | E |
| Y1 | 4\$ | 5% | 6^ | F | G | H | I | J |
| Y2 | 1! | 2@ | 3# | K | L | M | N | O |
| Y3 | -_ | 0) | =+ | P | Q | R | S | T |
| Y4 | ,< | .> | /? | U | V | W | X | Y |
| Y5 |]} | up | \ | Z | space | ~ | l-alt | r-alt |
| Y6 | left | down | right | [{ | ;: | '" | l-ctrl | ~ |
| Y7 | FN1 | FN2 | tab | del | caps | esc | l-shft | return |

US keyboard layout

KeyWarrior24-8

6.1.1 KeyWarrior24-8 Table with no FN key pressed / USB Usage Codes

| | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
|-----------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Y0 | \$24 | \$25 | \$26 | \$04 | \$05 | \$06 | \$07 | \$08 |
| Y1 | \$21 | \$22 | \$23 | \$09 | \$0A | \$0B | \$0C | \$0D |
| Y2 | \$1E | \$1F | \$20 | \$0E | \$0F | \$10 | \$11 | \$12 |
| Y3 | \$2D | \$27 | \$2E | \$13 | \$14 | \$15 | \$16 | \$17 |
| Y4 | \$36 | \$37 | \$38 | \$18 | \$19 | \$1A | \$1B | \$1C |
| Y5 | \$30 | \$52 | \$31 | \$1D | \$2C | \$35 | \$E2 | \$E6 |
| Y6 | \$50 | \$51 | \$4F | \$2F | \$33 | \$34 | \$E0 | \$64 |
| Y7 | FN1 | FN2 | \$2B | \$2A | \$39 | \$29 | \$E1 | \$28 |

KeyWarrior24-8

6.1.2 KeyWarrior24-8 Table with FN1 key pressed

Layout for hex, special function, or POS keyboard.

| | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
|-----------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Y0 | num | num/ | num* | num- | A | F1 | F2 | F3 |
| Y1 | num7 | num8 | num9 | num+ | B | F4 | F5 | F6 |
| Y2 | num4 | num5 | num6 | Enter | C | F7 | F8 | F9 |
| Y3 | num1 | num2 | num3 | num= | D | F10 | F11 | F12 |
| Y4 | num0 | space | num. | F | E | alt-F1 | alt-F2 | alt-F3 |
| Y5 | num= | up | num00 | alt-F4 | alt-F5 | alt-F6 | l-alt | r-alt |
| Y6 | left | down | right | alt-F7 | alt-F8 | alt-F9 | l-ctrl | alt-F10 |
| Y7 | FN1 | FN2 | tab | del | alt-F11 | esc | l-shft | return |

US keyboard layout

KeyWarrior24-8

6.1.3 KeyWarrior24-8 Table with FN1 key pressed / USB Usage Codes

| | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
|-----------|------------|------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Y0 | \$53 | \$54 | \$55 | \$56 | \$04 | \$3A | \$3B | \$3C |
| Y1 | \$5F | \$60 | \$61 | \$57 | \$05 | \$3D | \$3E | \$3F |
| Y2 | \$5C | \$5D | \$5E | \$58 | \$06 | \$40 | \$41 | \$42 |
| Y3 | \$59 | \$5A | \$5B | \$86 | \$07 | \$43 | \$44 | \$45 |
| Y4 | \$62 | \$2C | \$63 | \$09 | \$08 | \$E2 \$3A | \$E2 \$3B | \$E2 \$3C |
| Y5 | \$2E | \$52 | \$62 \$62 | \$E2 \$3D | \$E2 \$3E | \$E2 \$3F | \$E2 | \$E6 |
| Y6 | \$50 | \$51 | \$4F | \$E2 \$40 | \$E2 \$41 | \$E2 \$42 | \$E0 | \$E2 \$43 |
| Y7 | FN1 | FN2 | \$2B | \$2A | \$E2 \$44 | \$29 | \$E1 | \$28 |

KeyWarrior24-8

6.1.4 KeyWarrior24-8 Table with FN2 key pressed

Special layout for gaming and other applications.

| | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
|-----------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Y0 | 1! | 2@ | 3# | esc | num | num/ | num* | num- |
| Y1 | 4\$ | 5% | 6^ | § ± | num7 | num8 | num9 | num+ |
| Y2 | 7& | 8* | 9(| - _ | num4 | num5 | num6 | Enter |
| Y3 | 0) | tab | del | = + | num1 | num2 | num3 | num. |
| Y4 | Q | W | E | R | T | pause | up | num0 |
| Y5 | A | S | D | F | G | left | down | right |
| Y6 | Z | X | C | V | B | . > | / ? | space |
| Y7 | FN1 | FN2 | l-shft | l-ctrl | l-alt | r-alt | r-ctrl | r-shft |

US keyboard layout

KeyWarrior24-8

6.1.5 KeyWarrior24-8 Table with FN2 key pressed / USB Usage Codes

| | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
|-----------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Y0 | \$1E | \$1F | \$20 | \$29 | \$53 | \$54 | \$55 | \$56 |
| Y1 | \$21 | \$22 | \$23 | \$35 | \$5F | \$60 | \$61 | \$57 |
| Y2 | \$24 | \$25 | \$26 | \$2D | \$5C | \$5D | \$5E | \$58 |
| Y3 | \$27 | \$2B | \$2A | \$2E | \$59 | \$5A | \$5B | \$63 |
| Y4 | \$14 | \$1A | \$08 | \$15 | \$17 | \$48 | \$52 | \$62 |
| Y5 | \$04 | \$16 | \$07 | \$09 | \$0A | \$50 | \$51 | \$4F |
| Y6 | \$1D | \$1B | \$06 | \$19 | \$05 | \$37 | \$38 | \$2C |
| Y7 | FN1 | FN2 | \$E1 | \$E0 | \$E2 | \$E6 | \$E4 | \$E5 |

KeyWarrior24

6.2 KeyWarrior24-8M Table with no FN key pressed

Media control layout

| | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
|-----------|------------|------------|------------------|-----------------|----------------|---------------|---------------|-------------|
| Y0 | eject | vol + | vol - | mute | play/ pause | next track | prev track | fast fwd |
| Y1 | rewind | stop | start brwsr. | start mailer | F1 | F2 | F3 | F4 |
| Y2 | F5 | F6 | F7 | F8 | F9 | F10 | F11 | F12 |
| Y3 | ctrl-X | ctrl-C | ctrl-V | ctrl-Z | ctrl-A | ctrl-O | ctrl-S | ctrl-S |
| Y4 | cmd-X | cmd-C | cmd-V | cmd-Z | cmd-A | cmd-O | cmd-S | cmd-S |
| Y5 | space | up | ctrl- alt-del | Ins | home | pg up | l-alt | r-alt |
| Y6 | left | down | right | del | end | pg dn | l-ctrl | r-ctrl |
| Y7 | FN1 | FN2 | tab | bksp | l-shft | esc | r-shft | return |

US keyboard layout

KeyWarrior24-8

6.2.1 KeyWarrior24-8M Table with no FN key pressed / USB Usage Codes

| | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
|-----------|--------------|--------------|----------------------|--------------|--------------|--------------|--------------|--------------|
| Y0 | CC \$B8 | CC \$E9 | CC \$EA | CC \$E2 | CC \$CD | CC \$B5 | CC \$B6 | CC \$B3 |
| Y1 | CC \$B4 | CC \$B7 | CC \$0196 | CC \$18A | \$3A | \$3B | \$3C | \$3D |
| Y2 | \$3E | \$3F | \$40 | \$41 | \$42 | \$43 | \$44 | \$45 |
| Y3 | \$E0 \$1B | \$E0 \$06 | \$E0 \$19 | \$E0 \$09 | \$E0 \$04 | \$E0 \$12 | \$E0 \$16 | \$E0 \$13 |
| Y4 | \$E3 \$1B | \$E0 \$06 | \$E0 \$19 | \$E3 \$09 | \$E3 \$04 | \$E3 \$12 | \$E3 \$16 | \$E3 \$13 |
| Y5 | \$2C | \$52 | \$E0 \$E2 \$4C | \$49 | \$4A | \$4B | \$E2 | \$E6 |
| Y6 | \$50 | \$51 | \$4F | \$4C | \$4D | \$4E | \$E0 | \$E4 |
| Y7 | FN1 | FN2 | \$2B | \$2A | \$E1 | \$29 | \$E5 | \$28 |

KeyWarrior24-8

6.2.2 KeyWarrior24-8M Table with FN1 key pressed

Layout for general use.

| | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
|-----------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Y0 | 7& | 8* | 9(| A | B | C | D | E |
| Y1 | 4\$ | 5% | 6^ | F | G | H | I | J |
| Y2 | 1! | 2@ | 3# | K | L | M | N | O |
| Y3 | _ | 0) | =+ | P | Q | R | S | T |
| Y4 | ,< | .> | /? | U | V | W | X | Y |
| Y5 |]} | up | \ | Z | space | ~ | l-alt | r-alt |
| Y6 | left | down | right | [{ | :: | ' " | l-ctrl | ~ |
| Y7 | FN1 | FN2 | tab | del | caps | esc | l-shft | return |

US keyboard layout

KeyWarrior24-8

6.2.3 KeyWarrior24-8M Table with FN1 key pressed / USB Usage Codes

| | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
|-----------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Y0 | \$24 | \$25 | \$26 | \$04 | \$05 | \$06 | \$07 | \$08 |
| Y1 | \$21 | \$22 | \$23 | \$09 | \$0A | \$0B | \$0C | \$0D |
| Y2 | \$1E | \$1F | \$20 | \$0E | \$0F | \$10 | \$11 | \$12 |
| Y3 | \$2D | \$27 | \$2E | \$13 | \$14 | \$15 | \$16 | \$17 |
| Y4 | \$36 | \$37 | \$38 | \$18 | \$19 | \$1A | \$1B | \$1C |
| Y5 | \$30 | \$52 | \$31 | \$1D | \$2C | \$35 | \$E2 | \$E6 |
| Y6 | \$50 | \$51 | \$4F | \$2F | \$33 | \$34 | \$E0 | \$64 |
| Y7 | FN1 | FN2 | \$2B | \$2A | \$39 | \$29 | \$E1 | \$28 |

KeyWarrior24-8

6.2.4 KeyWarrior24-8M Table with FN2 key pressed

Special layout for gaming and other applications.

| | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
|-----------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Y0 | 1! | 2@ | 3# | esc | num | num/ | num* | num- |
| Y1 | 4\$ | 5% | 6^ | § ± | num7 | num8 | num9 | num+ |
| Y2 | 7& | 8* | 9(| - _ | num4 | num5 | num6 | Enter |
| Y3 | 0) | tab | del | = + | num1 | num2 | num3 | num. |
| Y4 | Q | W | E | R | T | pause | up | num0 |
| Y5 | A | S | D | F | G | left | down | right |
| Y6 | Z | X | C | V | B | . > | / ? | space |
| Y7 | FN1 | FN2 | l-shft | l-ctrl | l-alt | r-alt | r-ctrl | r-shft |

US keyboard layout

KeyWarrior24-8

6.2.5 KeyWarrior24-8M Table with FN2 key pressed / USB Usage Codes

| | X0 | X1 | X2 | X3 | X4 | X5 | X6 | X7 |
|-----------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Y0 | \$1E | \$1F | \$20 | \$29 | \$53 | \$54 | \$55 | \$56 |
| Y1 | \$21 | \$22 | \$23 | \$35 | \$5F | \$60 | \$61 | \$57 |
| Y2 | \$24 | \$25 | \$26 | \$2D | \$5C | \$5D | \$5E | \$58 |
| Y3 | \$27 | \$2B | \$2A | \$2E | \$59 | \$5A | \$5B | \$63 |
| Y4 | \$14 | \$1A | \$08 | \$15 | \$17 | \$48 | \$52 | \$62 |
| Y5 | \$04 | \$16 | \$07 | \$09 | \$0A | \$50 | \$51 | \$4F |
| Y6 | \$1D | \$1B | \$06 | \$19 | \$05 | \$37 | \$38 | \$2C |
| Y7 | FN1 | FN2 | \$E1 | \$E0 | \$E2 | \$E6 | \$E4 | \$E5 |

KeyWarrior24-8

6.3 KeyWarrior24-S3 Table with no FN key pressed

For simplicity of handling KW24S3 uses the same data format for storing the key table as the other KW24 variants. Though only the first two bytes of each level are used.

The first line that usually holds the keys for the Y0 line does contain the codes for Sw0..7. In the second line, usually for Y1, the first six bytes contain the codes for the encoders, byte 7 is unused, byte 8 holds the code for Sw8.

Encoder keys are generated on the rising edge of the A signal. That status of the B signal at that time determines which of the two codes for the encoder is used, to allow different codes for left/right movement.

| | Sw0 | Sw1 | Sw2 | Sw3 | Sw4 | Sw5 | Sw6 | Sw7 |
|-----------|-------------|-------------|---------------|-------------|-------------|-------------|-----|------------|
| Y0 | tab | return | num- enter | space | ins | del | esc | FN1 |
| | B0=0 | B0=1 | B1=0 | B1=1 | B2=0 | B2=1 | - | Sw8 |
| Y1 | right | left | down | up | pg up | pg down | - | FN2 |

6.3.1 KeyWarrior24-S3 Table with no FN key pressed / USB Usage Codes

| | Sw0 | Sw1 | Sw2 | Sw3 | Sw4 | Sw5 | Sw6 | Sw7 |
|-----------|-------------|-------------|-------------|-------------|-------------|-------------|------|------------|
| Y0 | \$2B | \$28 | \$58 | \$2C | \$49 | \$4C | \$29 | FN1 |
| | B0=0 | B0=1 | B1=0 | B1=1 | B2=0 | B2=1 | - | Sw8 |
| Y1 | \$4F | \$50 | \$51 | \$52 | \$4E | \$4B | - | FN2 |

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6.3.2 KeyWarrior24-S3 Table with FN1 key pressed

| | Sw0 | Sw1 | Sw2 | Sw3 | Sw4 | Sw5 | Sw6 | Sw7 |
|-----------|-------------|--------------|---------------|-------------|-------------|-------------|-----|------------|
| Y0 | bksp | return | num- enter | space | ins | del | esc | FN1 |
| | B0=0 | B0=1 | B1=0 | B1=1 | B2=0 | B2=1 | - | Sw8 |
| Y1 | tab | shft- tab | num + | num - | 1 | 2 | - | FN2 |

6.3.3 KeyWarrior24-S3 Table with FN1 key pressed / USB Usage Codes

| | Sw0 | Sw1 | Sw2 | Sw3 | Sw4 | Sw5 | Sw6 | Sw7 |
|-----------|-------------|--------------|-------------|-------------|-------------|-------------|------|------------|
| Y0 | \$2A | \$28 | \$58 | \$2C | \$49 | \$4C | \$29 | FN1 |
| | B0=0 | B0=1 | B1=0 | B1=1 | B2=0 | B2=1 | - | Sw8 |
| Y1 | \$2B | \$E1 \$2B | \$57 | \$56 | \$1E | \$1F | - | FN2 |

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6.3.4 KeyWarrior24-S3 Table with FN2 key pressed

This layout generates medial control and application control keys

| | Sw0 | Sw1 | Sw2 | Sw3 | Sw4 | Sw5 | Sw6 | Sw7 |
|-----------|-------------|-------------|----------------|---------------|-------------|-------------|-------|------------|
| Y0 | eject | mute | play/ pause | stop | fast fwd | rewind | space | FN1 |
| | B0=0 | B0=1 | B1=0 | B1=1 | B2=0 | B2=1 | - | Sw8 |
| Y1 | vol + | vol - | next track | prev track | fast fwd | rewind | - | FN2 |

6.3.5 KeyWarrior24-S3 Table with FN2 key pressed / USB Usage Codes

| | Sw0 | Sw1 | Sw2 | Sw3 | Sw4 | Sw5 | Sw6 | Sw7 |
|-----------|-------------|-------------|-------------|-------------|-------------|-------------|------|------------|
| Y0 | CC \$B8 | CC \$E2 | CC \$CD | CC \$B7 | CC \$B3 | CC \$B4 | \$2C | FN1 |
| | B0=0 | B0=1 | B1=0 | B1=1 | B2=0 | B2=1 | - | Sw8 |
| Y1 | CC \$E9 | CC \$EA | CC \$B5 | CC \$B6 | CC \$B3 | CC \$B4 | - | FN2 |

7. DC Characteristics

| | Parameter | Min | Max | Units | Remarks |
|------------------|--------------------------------------|-------|-------|-----------------|---|
| V _{cc} | Operating Voltage | 4.35 | 5.25 | V | |
| I _{cc} | Operating Supply Current | | 20 | mA | |
| I _{sb} | Suspend mode current | | 25 | μA | Oscillator off |
| I _{ol} | Max sink current on output pins | | 70 | mA | Cummulative across all ports |
| I _{ol} | Sink current on output pins | | 2 | mA | V _{out} = 0.4V |
| R _{up} | Pull-up Resistance | 8 | 24 | kΩ | |
| V _{ith} | Input threshold voltage | 40% | 60% | V _{cc} | All ports, low to high edge |
| V _H | Input hysteresis voltage | 3% | 10% | V _{cc} | |
| | USB Interface | | | | |
| V _{oh} | Static output high | 2.8 | 3.6 | V | 15kΩ±5% to GND |
| V _{ol} | Static output low | | 0.3 | V | |
| V _{di} | Differential Input sensitivity | 0.2 | | V | $(D+) - (D-)$ |
| V _{cm} | Differential Input common Mode Range | 0.8 | 2.5 | V | |
| V _{se} | Single Ended Transceiver Threshold | 0.8 | 2.0 | V | |
| C _{in} | Transceiver capacitance | | 20 | pF | |
| I _{io} | Hi-Z State Data Line Leakage | -10 | 10 | μA | 0V < V _{in} < 3.3V, Hi-Z State |
| R _{pu} | Bus Pull-up resistance | 1.274 | 15.75 | kΩ | 1.3kΩ±2% to V _{reg} |
| R _{pd} | Bus Pull-down resistance | 14.25 | 15.75 | kΩ | 15kΩ±5% |

7.1 AC Characteristics

| | Parameter | Min | Max | Units | Remarks |
|-----------------------|-------------------------------------|------------------------|--------|--------|---------------------------|
| | clock accuracy | -1.5 | +1.5 | % | Derived from USB signal |
| | USB Driver Characteristics | | | | |
| t _r | Transition rise time | 75 | | ns | C _{Load} = 200pF |
| t _r | Transition rise time | | 300 | ns | C _{Load} = 600pF |
| t _f | Transition fall time | 75 | | ns | C _{Load} = 200pF |
| t _f | Transition fall time | | 300 | ns | C _{Load} = 600pF |
| t _{r/m} | Rise/Fall Time matching | 80 | 125 | % | |
| V _{crs} | Output signal crossover voltage | 1.3 | 2.0 | V | |
| | USB Data Timing | | | | |
| t _{drate} | Low Speed Data Rate | 1.4775 | 1.5225 | MBit/s | |
| t _{djr1} | Receiver data jitter tolerance | -75 | 75 | ns | To next transition |
| t _{djr2} | Receiver data jitter tolerance | -45 | 45 | ns | For paired transitions |
| t _{deop} | Differential to EOP transition skew | -40 | 100 | ns | |
| t _{eoпр2} | EOP width at receiver | 670 | | ns | Accepts as EOP |
| t _{eoрt} | Source EOP width | 1.25 | 1.50 | μs | |
| t _{udj1} | Differential driver jitter | -95 | 95 | ns | To next transition |
| t _{udj2} | Differential driver jitter | -150 | 150 | ns | To paired transition |
| | Keyboard Matrix Scan Timing | | | | |
| t _{scan} | Scanning interval | 4* | | ms | |
| t _{scansu} | Matrix drive to read setup time | typ. 40* | | μs | |
| t _{debounce} | Debounce time | 3x t _{scan} * | | ms | |

*) A version with fast scanning to better suit rubber dome keyboards is possible for custom versions. In this case t_{scan} = 1ms, t_{debounce} = 2x t_{scan} and t_{scansu} = 10μs

7.2 Absolute Maximum Ratings

| | |
|---------------------------------------|--------------------|
| Storage Temperature | -65°C to +150°C |
| Ambient Operating Temperature | 0°C to +70°C |
| Supply Voltage on Vcc relative to Vss | -0.5V to +7.0V |
| DC Input Voltage | -0.5V + Vcc + 0.5V |
| Max. Output Current into any Pin | 70mA |
| Power Dissipation | 300mW |
| Static Discharge Voltage | >2000V |
| Latch-up Current | >200mA |

8. Ordering Information

| Partname | Order Code | Description | Package |
|-----------------|------------|---|---------|
| KeyWarrior24-8 | KW24-8-P | Fixed layout standard part | PDIP24 |
| KeyWarrior24-8 | KW24-8-S | Fixed layout standard part | SOIC24 |
| KeyWarrior24-8M | KW24-8M-P | Fixed layout standard part, with media keys | PDIP24 |
| KeyWarrior24-8M | KW24-8M-S | Fixed layout standard part, with media keys | SOIC24 |
| KeyWarrior24-S3 | KW24-S3-P | Fixed layout standard part, for rotary encoders | PDIP24 |
| KeyWarrior24-S3 | KW24-S3-S | Fixed layout standard part, for rotary encoders | SOIC24 |

The standard KeyWarrior24 have a factory programmed key table which can not be changed by the user.

Customized KeyWarrior24 chips can be produced with customer specific key tables if ordered in production volumes.

For the production of a custom KeyWarrior24 the customer needs to supply a key table according to the specs (empty template files are available for download from our website).

Code Mercenaries will assign a part and version number to each customer specific chip so it can be identified for future orders.

Preprogrammed chips are subject to minimum order quantities and setup charges, please contact sales for details.

8.1 Shipping info

DIL24 chips come in tubes of 16 each. SOIC24 chips come in tubes of 31 each.

To assure the safest handling we recommend that you order in multiples of full tubes.

Custom chips can be ordered in full tubes only!

SOIC24 chips are shipped in a moisture barrier bag when ordered in a minimum quantity of one full tube.

8.2 USB VendorID and ProductID

By default all KeyWarrior chips are shipped with the USB VendorID of Code Mercenaries (\$7C0 or decimal 1984).

The ProductID will be assigned by Code Mercenaries.

On request chips can be equipped with the customers VendorID and ProductID. VendorIDs can be obtained from the USB Implementers Forum <www.usb.org>

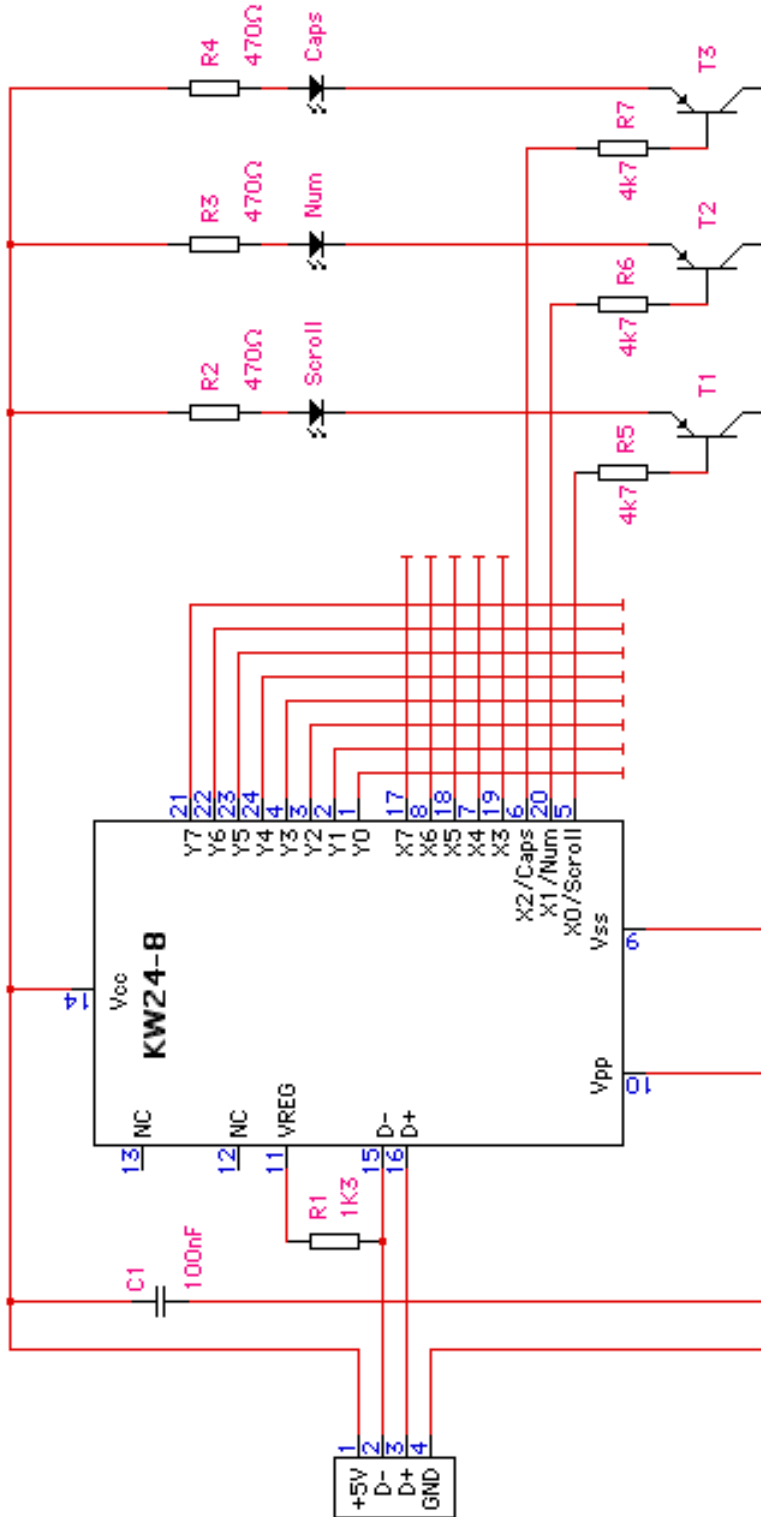
The ProductID for the standard KeyWarrior24 chips are:


| | |
|-----------------|--------|
| KeyWarrior24-8 | \$0220 |
| KeyWarrior24-8M | \$0221 |
| KeyWarrior24-S3 | \$0222 |

ProductIDs are independent of the package type.

KeyWarrior24

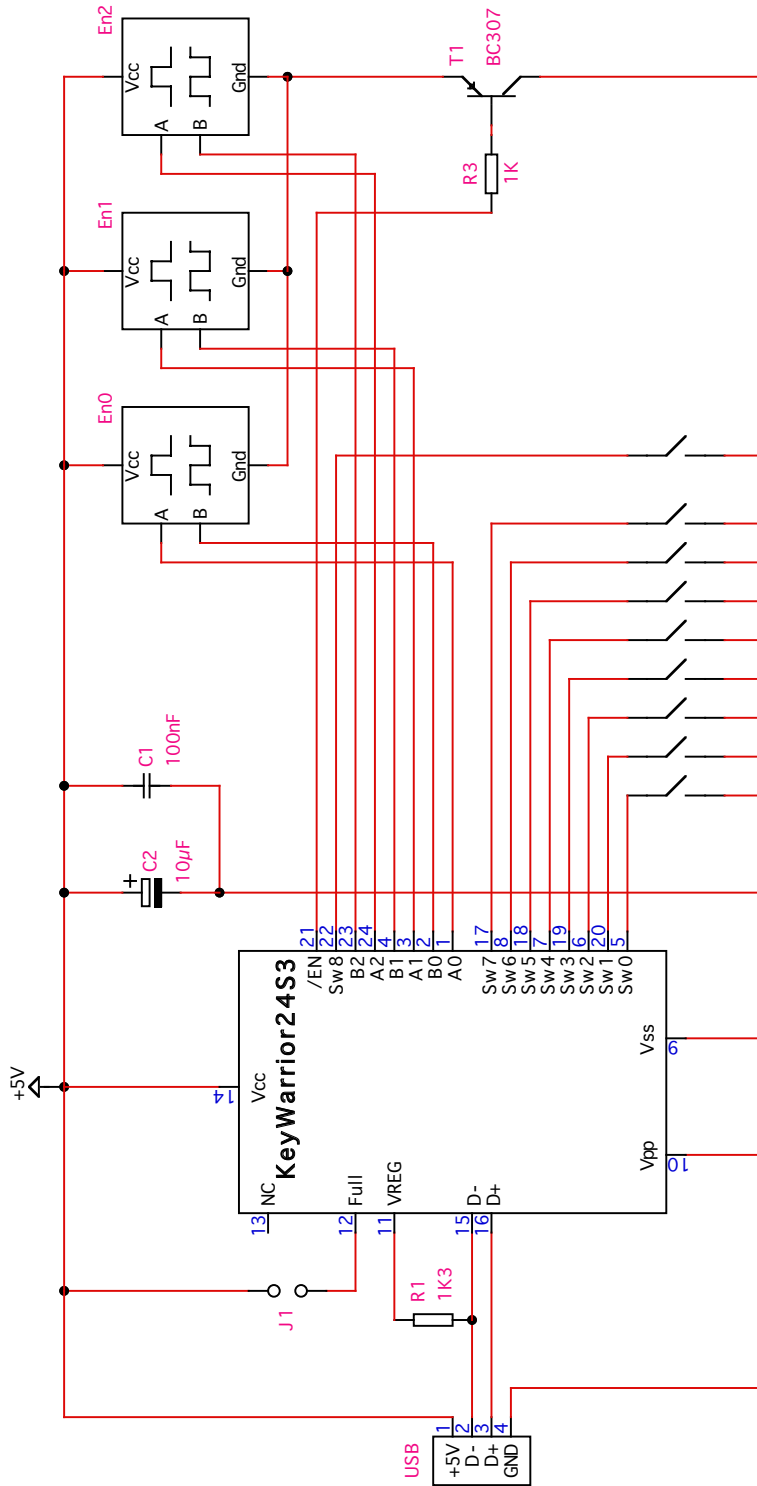
9 Typical Application for KeyWarrior24-8/KeyWarrior24-8M




| | | | |
|--|------|--------------------------------|--------|
|  | | Circuit: KeyWarrior24-8 | |
| | | Version: V1.0 | |
| Date: 17.3.2009 | | Change | |
| Drawn by: TheBug | | Sign. | |
| Function: | | | |
| Page: | | | |
| Rev. | Date | By | Change |
| | | | |
| | | | |
| | | | |
| | | | |

R2...7 and T1...3 are only required if lock LEDs are used.

9.1 Typical Application for KeyWarrior24-S3



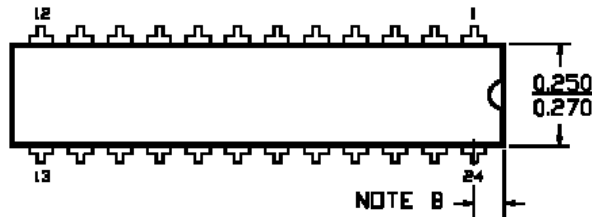
Close J1 to set full pulse resolution for encoders

| | | | |
|--------------------------------|------|---|--------|
| Circuit: KeyWarrior24S3 | |  Code Mercenaries | |
| Version: 1.1 | | | |
| Date: 25.10.2011 | | | |
| Drawn by: | | | |
| Function: | | | |
| Page: | | | |
| Rev. | Date | By | Change |
| | | | Sign. |
| | | | |
| | | | |
| | | | |

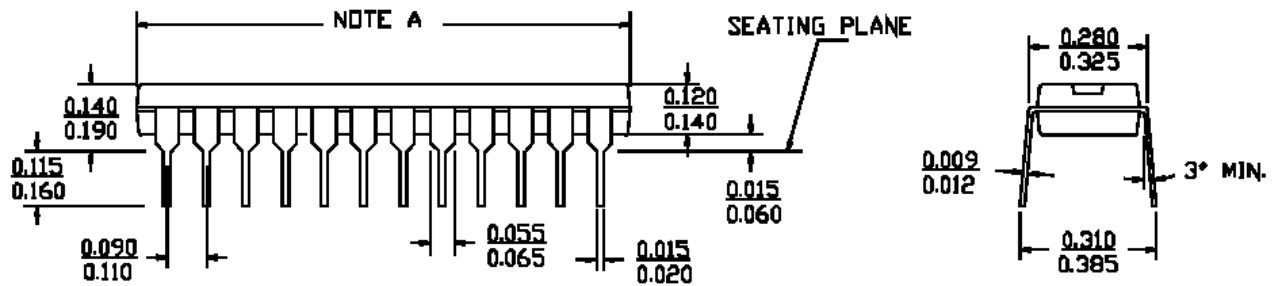
10 Package Dimensions

24 Pin DIL

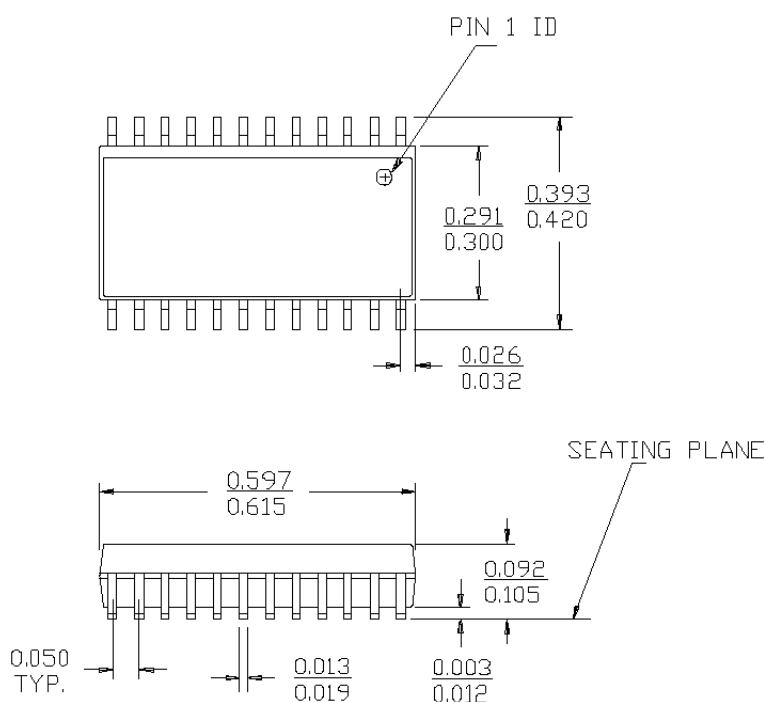
DIMENSIONS IN INCHES MIN.
MAX.



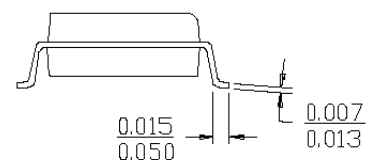
| | P 13 | P 13A |
|--------|------------------------------|------------------------------|
| NOTE A | <u>1.170</u> <u>1.200</u> | <u>1.230</u> <u>1.260</u> |
| NOTE B | <u>0.030</u> <u>0.050</u> | <u>0.060</u> <u>0.080</u> |



24 Pin SOIC



DIMENSIONS IN INCHES MIN.
MAX.
LEAD COPLANARITY 0.004 MAX.



KeyWarrior24

11. ESD Considerations

KeyWarrior has an internal ESD protection to withstand discharges of more than 2000V without permanent damage. However ESD may disrupt normal operation of the chip and cause it to exhibit erratic behaviour.

For the typical office environment the 2000V protection is normally sufficient. Though for industrial use additional measures may be necessary.

When adding ESD protection to the signals special care must be taken on the USB signal lines. The USB has very low tolerance for additional resistance or capacitance introduced on the USB differential signals.

11.1 EMC Considerations

KeyWarrior uses relatively low power levels and so it causes few EMC problems.

To avoid any EMC problems the following rules should followed:

- Put a 100nF ceramic capacitor right next to the power supply pins and make sure the PCB traces between the chips power pins and the capacitor are as short as possible.
- Run the power supply lines first to the capacitor, then to the chip.
- Make the matrix lines only as long as absolutely necessary.

Adding a ferrite bead to the +5V and ground power supply lines is advisable.

12. Revision History

This is a supplemental data sheet to the KeyWarrior data sheet. Please refer to the main data sheet for the revision history.

V1.1.1.4 is the initial release version of the KeyWarrior24-8.

V1.1.1.B is the initial release version of KeyWarrior24-8M and KeyWarrior24-S3.

V1.1.1.C added the quadrant mode for KW24-S3.

13. RoHS compatibility

RoHS compatible parts are indicated by a "R" being appended to the version number.

I.e. a KeyWarrior24-8 in DIL24 package will have a marking as follows if it is RoHS compatible:

KW24-8-S

V1.1.1.4R

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