

# KeyWarriorComboH



Code Mercenaries

## Keyboard/Mouse combo controller chip using A/D converter for mouse input Supplement to the KeyWarrior data sheet

### 1. Features

- USB and PS/2 keyboard/mouse interfaces
- Auto detects active interface
- Supports up to 128 keys in 16x8 matrix
- Full USB V1.1/2.0 compliance
- Full USB HID 1.1 compliance
- Supports diodes in the key matrix
- User defineable matrix
- In system programmable keymap (Flex, Operator, and Commander variants)
- Operator variant supports up to eight codes on each key
- Commander variant supports 48 macros with up to 31 codes each
- Assignable function shift keys to switch to a second matrix table or third table (Commander)
- Direct drive for Caps lock, Num lock and Scroll lock LEDs
- Mouse function via two A/D channels, may be used with joysticks of various technologies, including hall sensors
- Dynamic recentering for drift compensation
- Automatic ranging
- Selectable maximum range to compensate range constraints of joystick
- Up to three mouse buttons in keyboard matrix
- Separate PS/2 port for mouse function
- Low cost ceramic resonator
- Single +5V power supply
- Low power consumption: 40mA max.
- Available in 48 pin SSOP package

#### 1.1 Variants

KeyWarriorCH is available in a number of variants.

Preprogrammed chips are available as customer specific versions only.

#### Flex

KeyWarrior Flex controllers do have the same functionality as the preprogrammed variants but store the keycode table in an external EEPROM.

#### Operator

KeyWarrior Operator controllers are a more sophisticated variant of the KeyWarrior Flex controllers. KeyWarrior Operator uses a larger external EEPROM to store up to 8 keycodes for every key in the matrix. This allows to generate key combinations from pressing a single key.

#### Commander

The KeyWarrior Commander chips are the most flexible controllers in the KeyWarrior family. KeyWarrior Commander use an external EEPROM to store the keycode table and allows to assign one of 48 macros to any key.

Each of the macros can be up to 31 keys long and allows any combination of keycodes to shortcut typing or generate special keys.

### 2. Functional Overview

KeyWarrior Combo H combines a keyboard and mouse controller in one chip. Two analog signals are used for cursor control, allowing many kinds of joysticks and other sensors.

USB and PS/2 are supported, the active interface is automatically detected.

The keyboard layout is either factory programmed for custom chips, or can be downloaded via USB into an inexpensive external EEPROM.

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## 2.1 Product Selection Matrix

Type	Matrix	FN-Keys	Mouse	ext. EEPROM	Codes per key	SSOP48	Standard Part *
KeyWarrior CH	16x8	1	√	-	1	√	-
KeyWarrior CH Flex	16x8	1	√	24C02	1	√	√
KeyWarrior CH Operator	16x8	1	√	24C16	8	√	√
KeyWarrior CH Commander	16x8	2	√	24C16	1 **	√	√

\*) Standard parts are available with no setup cost or minimum order quantities. The non-standard parts are subject to a setup charge and minimum order quantities.

\*\*\*) Commander chips do support 48 macros with 31 codes each which can be assigned to any key.

## 3.0 Pin Configurations

**KeyWarriorCH Flex-S  
KeyWarriorCH Operator-S  
KeyWarriorCH Commander-S  
48 Pin SSOP**

D+	1	48	Vcc
D-	2	47	GND
Select	3	46	KeyData
KeyClock	4	45	MouseData
MouseClock	5	44	CapsLED
NumLED	6	43	ScrollLED
CNVST	7	42	SCLK
DOUT	8	41	/EN
NC	9	40	NC
SDA	10	39	Range
Y15/SCL	11	38	Y14
Y13	12	37	Y12
Y11	13	36	Y10
Y9	14	35	Y8
X7	15	34	X6
X5	16	33	X4
Y7	17	32	Y6
Y5	18	31	Y4
Y3	19	30	Y2
Y1	20	29	Y0
X3	21	28	X2
X1	22	27	X0
PullToGND	23	26	XOut
GND	24	25	XIn

**All drawings: TOP VIEW!**

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## 4.0 Pin Descriptions KeyWarrior Combo H / KeyWarrior Combo H Flex / KeyWarrior Combo H Operator / KeyWarrior Combo H Commander

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	1, 2	USB differential data lines
Select	I	internal Pull Up	3	Detects suspend on power on
KeyClock	I/O	OD, internal Pull Up	4	PS/2 and AT interface clock line for keyboard
KeyData	I/O	OD, internal Pull Up	46	PS/2 and AT interface data line for keyboard
MouseClock	I/O	OD, internal Pull Up	5	PS/2 interface clock signal for mouse
MouseData	I/O	OD, internal Pull Up	45	PS/2 interface data signal for mouse
CapsLED	O	OD, 16mA	44	Drives Caps Lock LED, active low
NumLED	O	OD, 16mA	6	Drives Num Lock LED, active low
ScrollLED	O	OD, 16mA	43	Drives Scroll Lock LED, active low
CNVST	O	OD, internal Pull Up	7	Connect to CNVST pin of MAX1118
SCLK	O	OD, internal Pull Up	42	Connect to SCLK pin of MAX1118
DOUT	I	internal Pull Up	8	Connect to DOUT pin of MAX1118
/EN	O	OD, internal Pull Up	41	Active low enable to switch power to joystick
Range	I	internal Pull Up	39	Pull low to reduce maximum range for joystick
NC			9, 40	Not used, do not connect
X[7:0]	I	input, internal Pull Ups	15, 34, 16, 33, 21, 28, 22, 27	Matrix row lines. Inputs to controller
Y[14:0]	O	OD	38, 12, 37, 13, 36, 14, 35, 17, 32, 18, 31, 19, 30, 20, 29	Matrix column lines. Periodically driven low by the controller to scan the matrix.
Y15	O	OD	11	Matrix column line (factory programmed parts)
Y15/SCL	O	OD	11	Matrix column line and SCL line for external EEPROM (Flex, Operator, Commander)
PullToGND	I		23	Used during manufacturing, connect to GND
GND		Power supply	24,47	Ground
Vcc		Power supply	48	Supply voltage
XOut	O		26	On chip oscillator output
XIn	I		25	On chip oscillator input

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## 4.3 Pin Descriptions

### D+, D-

Differential data lines of USB. Connect these signals direct to the USB cable or a type B plug. D- requires a 7K5 pull up resistor to +5V.

### Select

At power up KeyWarrior checks this pin before activating an internal pull up. If this pin is tied to +5V with 100K $\Omega$  or less KeyWarrior enters a suspend mode which it leaves only when detecting USB bus activity.

When the pin is pulled to Gnd KeyWarrior goes active immediately upon reset. Do not tie this pin directly to Gnd, always use a pull down resistor of 100K $\Omega$  or more.

### KeyClock, KeyData

These two lines are the AT or PS/2 keyboard interface. Connect these signals to the keyboard interface of the host computer.

Internal pull up resistors are activated on device reset.

If PS/2 is not used leave these pins unconnected.

### MouseClock, MouseData

These two lines are the PS/2 mouse interface. Connect these lines to the mouse interface of the host computer.

Internal pull up resistors are activated on device reset.

If PS/2 is not used leave these pins unconnected.

### CapsLED, NumLED, ScrolledLED

Open drain LED driver outputs. Each of these pins is capable of sinking 16mA max. to directly drive a LED indicating the Caps Lock, Number Lock and Scroll Lock status.

Connect LEDs with appropriate resistors to +5V.

### X[0:7]

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

Internal pull up resistors are activated on device reset.

### Y[0:15]

Vertical matrix outputs. These open drain outputs are periodically pulled low to detect pressed keys.

On Flex, Operator, and Commander variants this pin has a double function, see below.

No internal or external pull up resistors.

### Y15/SCL

Combination of Y15 matrix scan line and SCL line of the IIC to connect the external EEPROM. External 10K pull up resistor required.

### SDA

SDA line of the IIC to connect the external EEPROM.

Internal pull up resistor

### CNVST, SCLK, DOUT

Connect these signals to a MAX1118 A/D converter.

Internal pull up resistors.

### /EN

Active low output to enable the power supply to the joystick. Use appropriate driving circuit to switch the power supply to the joystick with this signal to stay within power requirements for suspend mode.

Open drain output with internal pull up resistor.

### Range

Pulling this pin low reduces the joystick range to 50%, i.e. the maximum mouse cursor speed is reached when the stick is moved 50% off its center.

This option should be used if the joystick is mechanically restricted from moving the full electrical range or if the joystick can not reach the corners in diagonal directions (i.e. for sensors like the Fujitsu FID820).

Internal pull up resistor.

### Pull to GND

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

### XOut, XIn

Connection for external oscillator. A 6MHz ceramic resonator may be connected here, no additional components are necessary. The use of a crystal is not supported as the oscillator is optimized for ceramic resonators. An external 6MHz clock may be connected to XIn, XOut has to be left floating in this case.

### GND

Power supply ground.

### Vcc

Supply voltage.

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## **4.4 Flex, Operator, and Commander external EEPROM**

The KeyWarrior Flex, Operator, and Commander controllers need an external EEPROM which contains the Master Translation Table.

In case of the KeyWarrior Flex controllers a 24C02 EEPROM is used (i.e. Fairchild NM24C02N). The KeyWarrior Operator or Commander requires a 24C16 (i.e. Fairchild NM24C16N).

The SCL and SDA lines of the EEPROM need to be connected to the appropriate pins of the KeyWarrior controller. The A0, A1 and A2 pins of the 24C02 need to be pulled low.

A single PCB layout is capable of supporting both Flex, Operator, and Commander controllers. The 24C02 and 24C16 are pin compatible and KeyWarrior Flex, Operator, and Commander are pin compatible as well.

KeyWarrior drives the IIC at about 100kHz.

The EEPROM may be either preprogrammed before insertion into the circuit or it can be programmed via the USB.

The utility software for downloading the Master Translation Table via USB is available for MacOS and Windows.

## **4.5 EEPROM potential problem**

Though 24C02 and 24C16 chips originally were defined to have no signal on pin 7 we have found several manufacturers do use this pin for some write protect mechanism.

To avoid problems with these chips we recommend to tie pin 7 to ground, even though it will be not connected on most chips.

## **4.6 Operation and programming details**

For further information please refer to the KeyWarrior main data sheet.

## 5. DC Characteristics

	Parameter	Min	Max	Units	Remarks
V <sub>cc</sub>	Operating Voltage	4.35	5.25	V	
I <sub>cc</sub>	Operating Supply Current		40	mA	
I <sub>sb</sub>	Suspend mode current		20	μA	Oscillator off
I <sub>ol</sub>	Sink current on LED pins	7.2	16.5	mA	V <sub>out</sub> = 1.0V
<b>USB Interface</b>					
V <sub>oh</sub>	Static output high	2.8	3.6	V	15kΩ±5% to GND
V <sub>ol</sub>	Static output low		0.3	V	
V <sub>di</sub>	Differential Input sensitivity	0.2		V	(D+)-(D-)
V <sub>cm</sub>	Differential Input common Mode Range	0.8	2.5	V	
V <sub>se</sub>	Single Ended Transceiver Threshold	0.8	2.0	V	
C <sub>in</sub>	Transceiver capacitance		20	pF	
I <sub>jo</sub>	Hi-Z State Data Line Leakage	-10	10	μA	0V < V <sub>in</sub> < 3.3V
R <sub>pu</sub>	Bus Pull-up resistance	7.35	7.65	kΩ	7.5kΩ±2%
R <sub>pd</sub>	Bus Pull-down resistance	14.25	15.75	kΩ	15kΩ±5%

## 5.1 AC Characteristics

	Parameter	Min	Max	Units	Remarks
t <sub>cyc</sub>	input clock cycle time	165.0	168.3	ns	
t <sub>ch</sub>	Clock high time	0.45t <sub>cyc</sub>		ns	
t <sub>cl</sub>	Clock low time	0.45t <sub>cyc</sub>		ns	
<b>USB Driver Characteristics</b>					
t <sub>r</sub>	Transition rise time	75		ns	C <sub>Load</sub> = 50pF
t <sub>r</sub>	Transition rise time		300	ns	C <sub>Load</sub> = 350pF
t <sub>f</sub>	Transition fall time	75		ns	C <sub>Load</sub> = 50pF
t <sub>f</sub>	Transition fall time		300	ns	C <sub>Load</sub> = 350pF
t <sub>rfm</sub>	Rise/Fall Time matching	80	120	%	
V <sub>crs</sub>	Output signal crossover voltage	1.3	2.0	V	
<b>USB Data Timing</b>					
t <sub>drate</sub>	Low Speed Data Rate	1.4777	1.5225	MBit/s	
t <sub>djr1</sub>	Receiver data jitter tolerance	-75	75	ns	To next transition
t <sub>djr2</sub>	Receiver data jitter tolerance	-45	45	ns	For paired transitions
t <sub>deop</sub>	Differential to EOP transition skew	-40	100	ns	
t <sub>eoпр1</sub>	EOP width at receiver	165		ns	Rejects as EOP
t <sub>eoпр2</sub>	EOP width at receiver	675		ns	Accepts as EOP
t <sub>eoпрt</sub>	Source EOP width	1.25	1.50	μs	
t <sub>udj1</sub>	Differential driver jitter	-95	95	ns	To next transition
t <sub>udj2</sub>	Differential driver jitter	-150	150	ns	To paired transition
<b>Keyboard Matrix Scan Timing</b>					
t <sub>scan</sub>	Scanning interval	4*		ms	
t <sub>scansu</sub>	Matrix drive to read setup time	typ. 40*		μs	
t <sub>debounce</sub>	Debounce time	3x t <sub>scan</sub> *		ms	

\*) A version with fast scanning to better suit rubber dome keyboards is available. In this case t<sub>scan</sub> = 1ms, t<sub>debounce</sub> = 2x t<sub>scan</sub> and t<sub>scansu</sub> = 10μs

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## 5.2 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	60mA
Power Dissipation	300mW
Static Discharge Voltage	>2000V
Latch-up Current	>200mA

## 6. Ordering Information

Partname	Order Code	Description	Package
KeyWarriorCombo H		Keyboard plus mouse with A/D input, preprogrammed	SSOP48
KeyWarriorCombo H Flex	KWCHFX-S	Keyboard plus mouse with A/D input, external EEPROM	SSOP 48
KeyWarriorCombo H Op	KWCHOP-S	Keyboard plus mouse with A/D input, external EEPROM, marcos	SSOP48
KeyWarriorCombo H Cmdr	KWCHCM-S	Keyboard plus mouse with A/D input, external EEPROM, marcos	SSOP 48

Preprogrammed KeyWarrior chips are customized to fit the specific keyboard they should drive. For ordering KeyWarrior chips the customer needs to supply the matrix information preferably already formatted as a master translation table.

Code Mercenaries will assign a part number to any specific chip so it can be identified for future orders.

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

KeyWarrior Flex, Operator, and Commander controllers are configured for the specific keyboard by loading the Master Translation Table into an external EEPROM. This can be done by the customer.

KeyWarrior Flex, Operator, and Commander controllers are standard parts that may be purchased without any setup costs or minimum order quantities.

### 6.1 Shipping info

SSOP48 chips come in tubes of 30 each.

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

### 6.2 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](http://www.usb.org)>

KeyWarrior Flex and Operator chips are always shipped with a fixed ProductID and the Code Mercenaries VendorID.

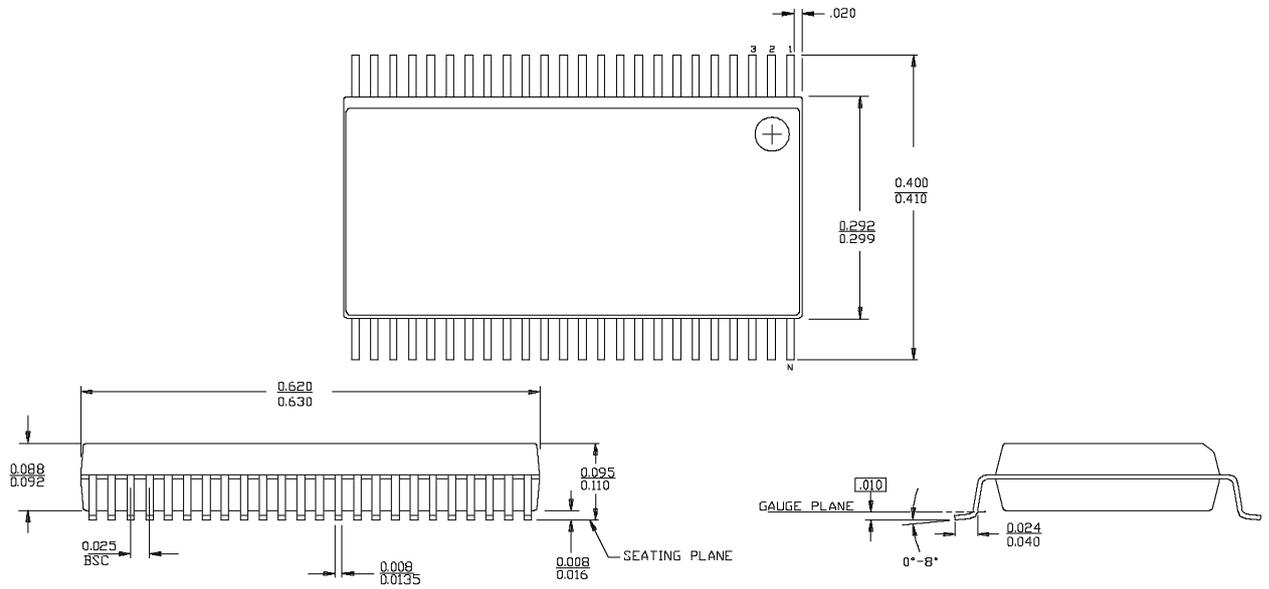
Following are the ProductIDs:

KeyWarrior CH Flex	\$0106
KeyWarrior CH Operator	\$0171
KeyWarrior CH Commander	\$0172



## 8. Package Dimensions

### 48 Pin SSOP



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## 9. 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.

The PS/2 lines are less critical. Series resistors of  $27\Omega$  and signal to ground capacitors of  $27\text{pF}$  may be used alone or in addition to some kind of suppressor device.

### 9.1 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:

- Keep the PCB traces from the resonator to the chip pins as short as possible.
- Put a  $100\text{nF}$  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 power supply lines is advisable. Use separate beads for the USB and the PS/2 power supply lines, i.e. don't place the bead behind the diode in the USB power supply line.

## 10. Revision History

Please refer to the KeyWarrior main data sheet for revision information.

The initial release version of KeyWarrior Combo H is V1.1.1.0

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