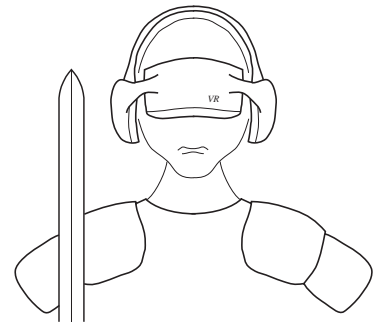


KeyWarrior



Code Mercenaries

**KeyWarrior 8, KeyWarrior 16, KeyWarrior 20,
KeyWarrior Combo O/V, KeyWarrior Flex,
KeyWarrior Operator, KeyWarrior Commander
Universal keyboard controller chips**

1. Features

- USB, ADB™ and AT or PS/2 keyboard interfaces
- Auto detects active interface
- Supports up to 240 keys in 20x12 matrix
- Full USB V1.1 compliance
- Full USB HID 1.1 compliance
- ADB™ extended keyboard compatible
- Supports Power key for ADB™, USB and PS/2
- MF2 compatible with AT or PS/2 interface
- Supports diodes in the key matrix
- User defineable matrix
- In system programmable keymap (Flex, Operator, and Commander family)
- Operator family supports up to eight functions on every key
- Commander family supports 48 macros with up to 31 codes each
- Assignable function shift key to switch to a second matrix table or third table
- Single chip solution with low external component count
- Direct drive for Caps lock, Num lock and Scroll lock LEDs
- Optional mouse function (KeyWarrior Combo) with either optical encoder mechanism (KeyWarrior Combo O) or VersaPoint™ (KeyWarrior Combo V)
- Up to three mouse buttons in keyboard matrix (KeyWarrior Combo only)
- Separate PS/2 and serial port for mouse function (KeyWarrior Combo only)
- Low cost ceramic resonator
- Single +5V power supply
- Low power consumption: 40mA max.
- Available in 40 pin DIL (KeyWarrior 8 and KeyWarrior 16 only) or 48 pin SSOP

1.1 Variants

KeyWarrior is available in a number of variants.

KeyWarrior 4 - Special part, available on request

- 4x4 Key matrix

KeyWarrior 8

- 8x8 Key matrix
- Two function shift keys for three functions per key

KeyWarrior 16

- 16x8 Key matrix
- One function shift key for two functions per key

KeyWarrior 20

- 20x12 Key matrix

KeyWarrior Combo O

- 16x8 Key matrix
- One function shift key for two functions per key
- Mouse function with optical encoder

KeyWarrior Combo V

- 16x8 Key matrix
- One function shift key for two functions per key
- Mouse function with VersaPoint™ sensor

Flex

KeyWarrior Flex controllers do have the same functionality as the basic 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.

There is no KeyWarrior 8 Commander since KeyWarrior 16 Commander does already support 2 Function-Shift keys.

KeyWarrior

2. Functional Overview

The KeyWarrior family of keyboard encoders does combine all keyboard interfaces with any market significance into a single chip. Designing keyboards based on KeyWarrior allows the manufacturer to significantly reduce inventory and production cost.

The manufacturer may choose to equip the keyboard with all interfaces and let the user decide which one to use or produce keyboards with identical electronics that just differ in the cable attached in the last production step.

KeyWarrior uses a single table to translate matrix coordinates to keycodes. The Master Translation Table is customer definable and programmed into the chip permanently before shipping or in case of the Flex, Operator, and Commander controllers it is downloadable via USB into an external EEPROM.

2.1 Power on via USB

If the option to power on a Macintosh via USB is required please contact us. This function is subject to patents held by Apple Computer, Inc.

KeyWarrior

2.2 Product Selection Matrix

Type	Matrix	FN-Keys	Mouse	ext. EEPROM	Codes per key	DIL40	SSOP48	Standard Part *
KeyWarrior 8	8x8	2	-	-	1	√	√	-
KeyWarrior 8 Flex	8x8	2	-	24C02	1	√	√	√
KeyWarrior 8 Operator	8x8	2	-	24C16	8	√	√	√
KeyWarrior 16	16x8	1	-	-	1	√	√	-
KeyWarrior 16 Flex	16x8	1	-	24C02	1	√	√	√
KeyWarrior 16 Operator	16x8	1	-	24C16	8	√	√	√
KeyWarrior 16 Commander	16x8	2	-	24C16	1 **	√	√	√
KeyWarrior 20	20x12	0	-	-	1	-	√	-
KeyWarrior 20 Flex	20x12	0	-	24C02	1	-	√	√
KeyWarrior 20 Operator	20x12	0	-	24C16	8	-	√	√
KeyWarrior 20 Commander	20x12	0	-	24C16	1 **	-	√	√
KeyWarrior CO	16x8	1	√	-	1	-	√	-
KeyWarrior CO Flex	16x8	1	√	24C02	1	-	√	√
KeyWarrior CO Operator	16x8	1	√	24C16	8	-	√	√
KeyWarrior CO Commander	16x8	2	√	24C16	1 **	-	√	√
KeyWarrior CV	16x8	1	√	-	1	-	√	-
KeyWarrior CV Flex	16x8	1	√	24C02	1	-	√	√
KeyWarrior CV Operator	16x8	1	√	24C16	8	-	√	√
KeyWarrior CV Commander	16x8	2	√	24C16	1 **	-	√	√

*) Standard parts are available with no setup cost or minimum order quantities. The non-standard parts may be subject to a setup charge as well as minimum order quantities.

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

KeyWarrior

3.0 Pin Configurations

KeyWarrior 8-P 40 Pin PDIP

D+	1	40	Vcc
D-	2	39	GND
PowerOn	3	38	KeyData
KeyClock	4	37	ADB
NC	5	36	CapsLED
NumLED	6	35	ScrollLED
X7	7	34	X6
X5	8	33	X4
X3	9	32	X2
X1	10	31	X0
NC	11	30	NC
NC	12	29	NC
NC	13	28	NC
NC	14	27	NC
Y7	15	26	Y6
Y5	16	25	Y4
Y3	17	24	Y2
Y1	18	23	Y0
PullToGND	19	22	XOut
GND	20	21	XIn

KeyWarrior 8 Flex-P KeyWarrior 8 Operator-P 40 Pin PDIP

D+	1	40	Vcc
D-	2	39	GND
PowerOn	3	38	KeyData
KeyClock	4	37	ADB
SDA	5	36	CapsLED
NumLED	6	35	ScrollLED
X7	7	34	X6
X5	8	33	X4
X3	9	32	X2
X1	10	31	X0
SCL	11	30	NC
NC	12	29	NC
NC	13	28	NC
NC	14	27	NC
Y7	15	26	Y6
Y5	16	25	Y4
Y3	17	24	Y2
Y1	18	23	Y0
PullToGND	19	22	XOut
GND	20	21	XIn

KeyWarrior 8-S 48 Pin SSOP

D+	1	48	Vcc
D-	2	47	GND
PowerOn	3	46	KeyData
KeyClock	4	45	ADB
NC	5	44	CapsLED
NumLED	6	43	ScrollLED
X7	7	42	X6
X5	8	41	X4
X3	9	40	X2
X1	10	39	X0
NC	11	38	NC
NC	12	37	NC
NC	13	36	NC
NC	14	35	NC
NC	15	34	NC
NC	16	33	NC
Y7	17	32	Y6
Y5	18	31	Y4
Y3	19	30	Y2
Y1	20	29	Y0
NC	21	28	NC
NC	22	27	NC
PullToGND	23	26	XOut
GND	24	25	XIn

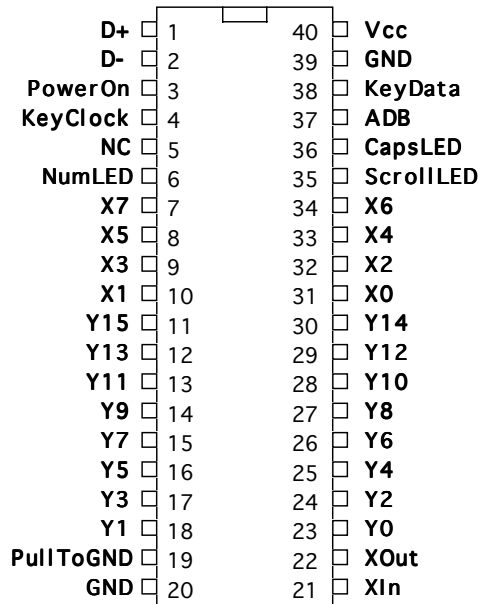
KeyWarrior 8 Flex-S KeyWarrior 8 Operator-S 48 Pin SSOP

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

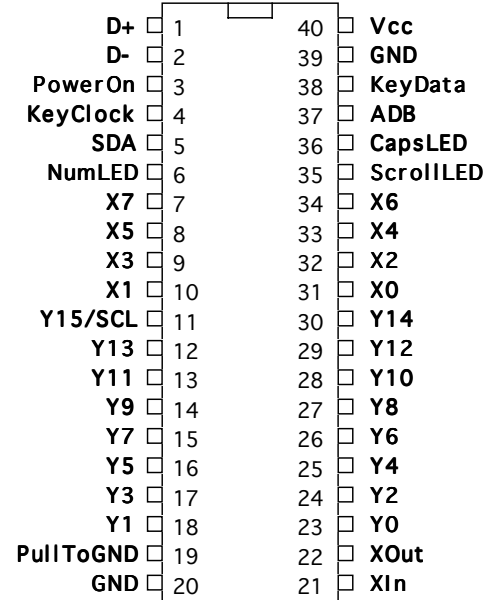
All drawings: TOP VIEW!

KeyWarrior

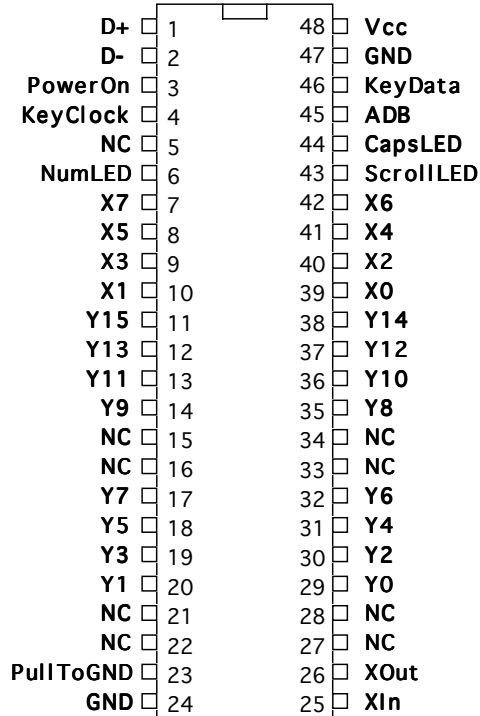
KeyWarrior 16-P 40 Pin PDIP



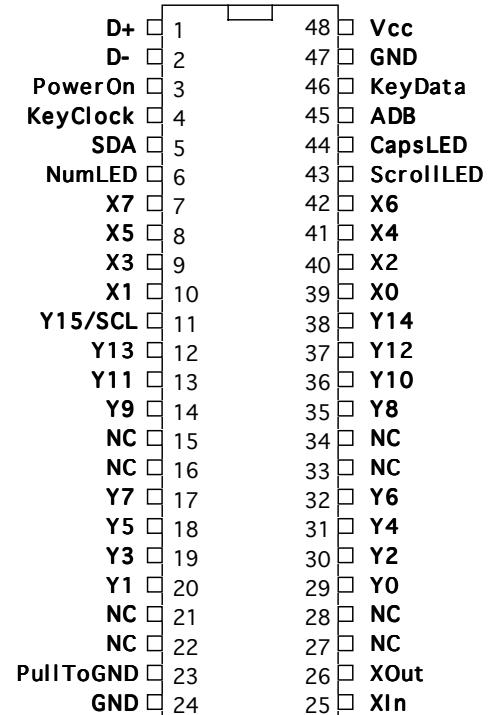
KeyWarrior 16 Flex-P KeyWarrior 16 Operator-P KeyWarrior 16 Commander-P 40 Pin PDIP



KeyWarrior 16-S 48 Pin SSOP



KeyWarrior 16 Flex-S KeyWarrior 16 Operator-S KeyWarrior 16 Commander-S 48 Pin SSOP



All drawings: TOP VIEW!

KeyWarrior

KeyWarrior 20-S 48 Pin SSOP

D+	1	48	Vcc
D-	2	47	GND
PowerOn	3	46	KeyData
KeyClock	4	45	ADB
NC	5	44	CapsLED
NumLED	6	43	ScrollLED
X7	7	42	X6
X5	8	41	X4
X3	9	40	X2
X1	10	39	X0
Y15	11	38	Y14
Y13	12	37	Y12
Y11	13	36	Y10
Y9	14	35	Y8
X11	15	34	X10
X9	16	33	X8
Y7	17	32	Y6
Y5	18	31	Y4
Y3	19	30	Y2
Y1	20	29	Y0
Y19	21	28	Y18
Y17	22	27	Y16
PullToGND	23	26	XOut
GND	24	25	XIn

KeyWarrior 20 Flex-S KeyWarrior 20 Operator-S KeyWarrior 20 Commander-S 48 Pin SSOP

D+	1	48	Vcc
D-	2	47	GND
PowerOn	3	46	KeyData
KeyClock	4	45	ADB
SDA	5	44	CapsLED
NumLED	6	43	ScrollLED
X7	7	42	X6
X5	8	41	X4
X3	9	40	X2
X1	10	39	X0
Y15/SCL	11	38	Y14
Y13	12	37	Y12
Y11	13	36	Y10
Y9	14	35	Y8
X11	15	34	X10
X9	16	33	X8
Y7	17	32	Y6
Y5	18	31	Y4
Y3	19	30	Y2
Y1	20	29	Y0
Y19	21	28	Y18
Y17	22	27	Y16
PullToGND	23	26	XOut
GND	24	25	XIn

All drawings: TOP VIEW!

KeyWarrior

KeyWarrior Combo O-S 48 Pin SSOP

D+	1	48	Vcc
D-	2	47	GND
PowerOn	3	46	KeyData
KeyClock	4	45	MouseData
MouseClock/Ser	5	44	CapsLED
NumLED	6	43	ScrollLED
TBY1	7	42	TBY2
TBX1	8	41	TBX2
SerRTS	9	40	ADB1
/TBEn	10	39	ADB2
Y15	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

KeyWarrior Combo V-S 48 Pin SSOP

D+	1	48	Vcc
D-	2	47	GND
PowerOn	3	46	KeyData
KeyClock	4	45	MouseData
MouseClock/Ser	5	44	CapsLED
NumLED	6	43	ScrollLED
North	7	42	South
East	8	41	West
SerRTS	9	40	ADB1
NC	10	39	ADB2
Y15	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

KeyWarrior Combo O Flex-S KeyWarrior Combo O Operator-S KeyWarrior Combo O Commander-S 48 Pin SSOP

D+	1	48	Vcc
D-	2	47	GND
PowerOn	3	46	KeyData
KeyClock	4	45	MouseData
MouseClock/Ser	5	44	CapsLED
NumLED	6	43	ScrollLED
TBY1	7	42	TBY2
TBX1	8	41	TBX2
SerRTS	9	40	ADB1
/TBEn/SDA	10	39	ADB2
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

KeyWarrior Combo V Flex-S KeyWarrior Combo V Operator-S KeyWarrior Combo V Commander-S 48 Pin SSOP

D+	1	48	Vcc
D-	2	47	GND
PowerOn	3	46	KeyData
KeyClock	4	45	MouseData
MouseClock/Ser	5	44	CapsLED
NumLED	6	43	ScrollLED
North	7	42	South
East	8	41	West
SerRTS	9	40	ADB1
SDA	10	39	ADB2
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!

KeyWarrior

4.0 Pin Descriptions KeyWarrior 8 / KeyWarrior 8 Flex / KeyWarrior 8 Operator DIL 40

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	1, 2	USB differential data lines
PowerOn	I	internal Pull Up	3	Power Key input, 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	38	PS/2 and AT interface data line for keyboard
ADB	I/O	OD, internal Pull Up	37	ADB™ bus signal
CapsLED	O	OD, 16mA	36	Drives Caps Lock LED, active low
NumLED	O	OD, 16mA	6	Drives Num Lock LED, active low
ScrollLED	O	OD, 16mA	35	Drives Scroll Lock LED, active low
X[7:0]	I	input, internal Pull Ups	7, 34, 8, 33, 9, 32, 10, 31	Matrix row lines. Inputs to controller
Y[7:0]	O	OD	15, 26, 16, 25, 17, 24, 18, 23	Matrix column lines. Periodically driven to low by the controller to scan the matrix.
SCL	O	OD	11	SCL line for external EEPROM (Flex only)
SDA	I/O	OD, internal Pull Up	5	SDA line for external EEPROM (Flex only)
NC	-	-	5, 11	Unused pin, do not connect (KeyWarrior 8 only)
NC	-	-	11, 30, 12, 29, 13, 28, 14, 27	Unused pin, do not connect
PullToGND	I		19	Used during manufacturing, connect to GND
GND		Power supply	20, 39	Ground
Vcc		Power supply	40	Supply voltage
XOut	O		22	On chip oscillator output
XIn	I		21	On chip oscillator input

4.1 Pin Descriptions KeyWarrior 8 / KeyWarrior 8 Flex / KeyWarrior 8 Operator SSOP 48

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	1, 2	USB differential data lines
PowerOn	I	internal Pull Up	3	Power Key input, 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
ADB	I/O	OD, internal Pull Up	45	ADB™ bus signal
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
X[7:0]	I	input, internal Pull Ups	7, 42, 8, 41, 9, 40, 10, 39	Matrix row lines. Inputs to controller
Y[7:0]	O	OD	17, 32, 18, 31, 19, 30, 20, 29	Matrix column lines. Periodically driven to low by the controller to scan the matrix.
SCL	O	OD	11	SCL line for external EEPROM (Flex only)
SDA	I/O	OD, internal Pull Up	5	SDA line for external EEPROM (Flex only)
NC	-	-	5, 11	Unused pin, do not connect (KeyWarrior 8 only)
NC	-	-	38, 12, 37, 13, 36, 14, 35, 15, 16, 21, 22, 27, 28, 33, 34	Unused pin, do not connect
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

KeyWarrior

4.2 Pin Descriptions KeyWarrior 16 / KeyWarrior 16 Flex / KeyWarrior 16 Operator / KeyWarrior 16 Commander DIL 40

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	1, 2	USB differential data lines
PowerOn	I	internal Pull Up	3	Power Key input, 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	38	PS/2 and AT interface data line for keyboard
ADB	I/O	OD, internal Pull Up	37	ADB™ bus signal
CapsLED	O	OD, 16mA	36	Drives Caps Lock LED, active low
NumLED	O	OD, 16mA	6	Drives Num Lock LED, active low
ScrollLED	O	OD, 16mA	35	Drives Scroll Lock LED, active low
X[7:0]	I	input, internal Pull Ups	7, 34, 8, 33, 9, 32, 10, 31	Matrix row lines. Inputs to controller
Y[14:0]	O	OD	30, 12, 29, 13, 28, 14, 27, 15, 26, 16, 25, 17, 24, 18, 23	Matrix column lines. Periodically driven to low by the controller to scan the matrix.
Y15	O	OD	11	Matrix column line (KeyWarrior 16)
Y15/SCL	O	OD	11	Matrix column line and SCL line for external EEPROM (Flex, Operator, Commander)
NC	-	-	5	Unused pin, do not connect (KeyWarrior 16)
SDA	I/O	OD, internal Pull Up	5	SDA line for external EEPROM (Flex, Operator, Comamnder)
PullToGND	I		19	Used during manufacturing, connect to GND
GND		Power supply	20, 39	Ground
Vcc		Power supply	40	Supply voltage
XOut	O		22	On chip oscillator output
XIn	I		21	On chip oscillator input

KeyWarrior

4.3 Pin Descriptions KeyWarrior 16 / KeyWarrior 16 Flex / KeyWarrior 16 Operator / KeyWarrior 16 Commander SSOP 48

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	1, 2	USB differential data lines
PowerOn	I	internal Pull Up	3	Power Key input, 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
ADB	I/O	OD, internal Pull Up	45	ADB™ bus signal
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
X[7:0]	I	input, internal Pull Ups	7, 42, 8, 41, 9, 40, 10, 39	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 to low by the controller to scan the matrix.
Y15	O	OD	11	Matrix column line (KeyWarrior 16)
Y15/SCL	O	OD	11	Matrix column line and SCL line for external EEPROM (Flex, Operator, Commander)
NC	-	-	5	Unused pin, do not connect (KeyWarrior 16)
SDA	I/O	OD, internal Pull Up	5	SDA line for external EEPROM (Flex, Operator, Commander)
NC	-	-	15, 16, 21, 22, 27, 28, 33, 34	Unused pins, do not connect
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

KeyWarrior

4.4 Pin Descriptions KeyWarrior 20 / KeyWarrior 20 Flex / KeyWarrior 20 Operator / KeyWarrior 20 Commander SSOP 48

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	1, 2	USB differential data lines
PowerOn	I	internal Pull Up	3	Power Key input, 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
ADB	I/O	OD, internal Pull Up	45	ADB™ bus signal
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
X[11:0]	I	input, internal Pull Ups	15, 34, 16, 33, 7, 42, 8, 41, 9, 40, 10, 39	Matrix row lines. Inputs to controller
Y[19:16] Y[14:0]	O	OD	21, 28, 22, 27, 38, 12, 37, 13, 36, 14, 35, 17, 32, 18, 31, 19, 30, 20, 29	Matrix column lines. Periodically driven to low by the controller to scan the matrix.
Y15	O	OD	11	Matrix column line (KeyWarrior 20)
Y15/SCL	O	OD	11	Matrix column line and SCL line for external EEPROM (Flex, Operator, Commander)
NC	-	-	5	Unused pin, do not connect (KeyWarrior 20)
SDA	I/O	OD, internal Pull Up	5	SDA 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

KeyWarrior

4.5 Pin Descriptions KeyWarrior Combo O / KeyWarrior Combo O Flex SSOP 48 / KeyWarrior Combo O Operator / KeyWarrior Combo O Commander SSOP 48

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	1, 2	USB differential data lines
PowerOn	I	internal Pull Up	3	Power Key input, 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/ Ser	I/O	OD, internal Pull Up	5	PS/2 interface clock signal for mouse and data signal for serial port
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
TBY1	I	high impedance input *	7	Y1 signal for optical encoded mechanism
TBY2	I	high impedance input *	42	Y2 signal for optical encoded mechanism (Y1 edges lead Y2 edges for up movement)
TBX1	I	high impedance input *	8	X1 signal for optical encoded mechanism
TBX2	I	high impedance input *	41	X2 signal for optical encoded mechanism (X1 edges lead X2 edges for right movement)
SerRTS	I	high impedance input **	9	Serial port RTS, used to detect serial port and reset mouse
/TBEn	O	OD	10	Active low, used to enable LEDs in trackball mechanism. Requires external driver. (KeyWarrior Combo O)
/TBEn/SDA ***	I/O	OD	10	Active low, used to enable LEDs in trackball mechanism. Requires external driver. Also SDA line for EEPROM (Flex, Operator, Commander)
ADB1, ADB2	I/O	OD	39, 40	ADB™ Data line, tie together
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 (KeyWarrior Combo O)
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

* External pull up resistors may be required, depending on output signal of the quadrature encoder.

** See application circuit for external circuitry

***Due to double use intermittent disabling of trackball LEDs possible when keyboard is operated.

KeyWarrior

4.6 Pin Descriptions KeyWarrior Combo V SSOP 48 / KeyWarrior Combo V Flex SSOP 48 / KeyWarrior Combo V Operator SSOP 48

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	1, 2	USB differential data lines
PowerOn	I	internal Pull Up	3	Power Key input, 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/ Ser	I/O	OD, internal Pull Up	5	PS/2 interface clock signal for mouse and data signal for serial port
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
North	I/O	OD *	7	North input for VersaPoint™ sensor
South	I/O	OD *	42	South input for VersaPoint™ sensor
East	I/O	OD *	8	East input for VersaPoint™ sensor
West	I/O	OD *	41	West input for VersaPoint™ sensor
SerRTS	I	high impedance input *	9	Serial port RTS, used to detect serial port and reset mouse
NC	-	-	10	Unused pin, do not connect (KeyWarrior Combo V)
SDA	I/O	OD **	10	SDA line for external EEPROM (Flex, Operator, Commander)
ADB1, ADB2	I/O	OD	39, 40	ADB™ Data line, tie together
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 to low by the controller to scan the matrix.
Y15	O	OD	11	Matrix column line (KeyWarrior Combo V)
Y15/SCL	I/O	OD **	11	Matrix columns 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

* See application circuit for external circuitry.

** Requires external pull up.

KeyWarrior

4.3 Pin Descriptions

D+, D-

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

PowerOn

Input for power key, also used to determine if device should suspend on power up.

Connect a switch closing to ground here to generate the power key scancode. An internal pull up resistor is activated upon device reset.

At power up KeyWarrior checks this pin before activating the internal pull up. If this pin is tied to +5V with 100K Ω 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 Ω or more, even if no power key will be used.

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/Ser, MouseData (KeyWarrior Combo only)

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

MouseClock doubles as the serial data output, connect this line to a RS232 driver that drives the TXD line of the serial mouse interface.

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

SerRTS (KeyWarrior Combo only)

Serial port RTS signal line input. This pin requires external circuitry as outlined in the application circuit.

Pulling this line low does halt the serial mouse data transmission and resets the mouse when it returns to high.

If the serial mouse port is not used this pin must be pulled low.

ADB (KeyWarrior non-Combo)

Data signal of the ADB™. Connect to the ADB™ data line of the computer. Internal pull up resistor is activated on device reset.

If ADB is not used leave this pin unconnected.

ADB1, ADB2 (KeyWarrior Combo only)

Data signal of the ADB™. KeyWarrior Combo uses two lines to supply sufficient current sinking capability. Tie both lines together and connect to the ADB™ data line of the computer. External weak pull up resistor is required.

If ADB is unused pull these lines high.

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.

X[8:11]

Additional horizontal matrix lines on KeyWarrior20 variants. Internal pull up resistors.

Y[0:15]

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

Y[16:19]

Additional vertical matrix outputs on KeyWarrior 20 variants. Internal pull up resistors approx. 15K Ω .

North, South, East, West (KeyWarrior Combo V only)

An Interlink Electronics VersaPoint™ sensor may be connected here. See application circuit for external circuitry.

TBX1, TBX2, TBY1, TBY2 (KeyWarrior Combo O only)

Inputs for optical quadrature encoded trackball or mouse mechanism. TBX1 falling edge leads TBX2 falling edge for right movement. TBY1 falling edge leads TBY2 falling edge for up movement.

The inputs require either CMOS compatible signals or open drain signals with external pull up resistors.

/TBEn (KeyWarrior Combo O only)

Enable signal for the LEDs of the optical quadrature encoder. Open drain output, requires external drivers for sufficient power to drive the LEDs.

KeyWarrior

/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 recommended 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.

SCL (KeyWarrior 8 Flex/Operator only)

SCL line of the IIC to connect the external EEPROM. External 10K pull up resistor is required.

Y15/SCL (KeyWarrior 16/20 Flex/Operator/Commander and KeyWarrior Combo O/V Flex/Operator/Commander)

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

SDA (KeyWarrior 8/16/20 Flex/Operator/Commander and KeyWarrior Combo V Flex/Operator/Commander)

SDA line of the IIC to connect the external EEPROM. KeyWarrior Combo V Flex requires an external 4K7 pull up resistor on this line.

TBEn/SDA (KeyWarrior Combo O Flex/Operator/Commander)

Combination of /TBEn line to enable the LEDs of the optical encoder and SDA line of the IIC to connect the external EEPROM. Requires an external 4K7 pull up resistor.

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 Win 98.

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.

KeyWarrior

5. Device Operation

KeyWarrior does work with very few external components. No jumpers or circuit changes are necessary to use KeyWarrior with either of the interfaces.

KeyWarrior monitors the interface lines to detect which of the interfaces is active. Only one of the interfaces may be connected at any given time, connecting two or all interfaces at the same time will produce unpredictable results.

Once KeyWarrior has been powered up and has detected its active interface it does start scanning the keyboard matrix. KeyWarrior Combo does also start to decode the mouse sensor information.

5.1 Power Up

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

Before enabling the internal pull ups KeyWarrior checks the status of the PowerOn pin. If this pin is high KeyWarrior will immediately enter the suspend mode which it does leave only upon detecting USB bus activity. When the pin is low KeyWarrior will become active and check the interface signals to find out which interface is in use.

5.2 Active Interface Detection

KeyWarrior checks the interface lines to find which interface is active. Once an active interface for the keyboard part has been detected it starts operating using this interface.

If the USB or ADB are active the mouse part of the KeyWarrior Combo chips does also go active using the same interface.

When the KeyWarrior Combo chip detects it is running on the PS/2 interface the mouse part may be using either PS/2 or serial. In this case the keyboard part may go active while the mouse part remains disabled if there is no PS/2 or serial mouse interface attached.

5.3 Keyboard Scanning

KeyWarrior 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 $t_{debounce}$ KeyWarrior decodes the changes and generates scancodes.

If the internal scancode buffer runs full KeyWarrior does stop scanning the matrix until it has been able to transmit scancodes to the host

computer and place all scancodes into the internal buffer.

5.4 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 5.4.1).

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.

5.4.1 Phantom Keys

Phantom keys do occur when three or more keys 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.

5.5. Protocol Details: USB

KeyWarrior works as a HID compliant keyboard using boot protocol. 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 103, which include the Power key and the = sign in the keypad.

5.6 Protocol Details: ADB™

When running on ADB™ KeyWarrior identifies as an extended keyboard with ISO layout (Handler ID 5). It does also respond to HandlerID 3, which switches the keyboard to a mode in which it reports different scancodes for the left and right modifier keys.

5.7 Protocol Details: PS/2

KeyWarrior is a functional equivalent to a MF2 keyboard. It does implement code sets 1, 2 and 3.

All MF2 commands are implemented with the exception of the mode set commands \$F7-\$FD.

Codeset 3 is not fully implemented, it does always send make/break codes for all keys. This works for most applications.

KeyWarrior

6. Mouse Function

The KeyWarrior Combo chips do intergrate a mouse function with the keyboard encoder. Either a classical trackball or mouse mechanism with optical quadrature encoders or a Interlink Electronic VersaPoint™ force sensor may be used to control the cursor movement.

The mouse buttons are located in the keyboard matrix. Up to three mouse buttons are supported.

6.1 Mouse on USB

If used on the USB KeyWarrior Combo identifies as a composite device with two functions. The mouse function is the second function and works as a HID compliant three button mouse using boot protocol.

6.2 Mouse on ADB™

When used with the ADB™ KeyWarrior works like two separate devices. The mouse part identifies as a standard mouse (HandlerID 1). It does also accept HandlerID 4.

The mouse buttons are reported according to the extended mouse protocol as outlined in the Apple Technote "HW01-ADB The Untold Story: Space Aliens Ate My Mouse".

When running with HandlerID 4 an additional byte is returned which holds the third button and additional bits for the axes.

Preprogrammed functions for the additional buttons are available on request.

6.3 Mouse on PS/2

The mouse function has a separate PS/2 interface. It does work as a standard three button mouse and is compatible with standard system drivers of Windows.

The mouse function defaults to the PS/2 port when the keyboard PS/2 port becomes active and no active mouse port is identified within 2 seconds after this. In this case the mouse function is enabled with the PS/2 port active, no reset identification is send. This will work for hot plugging of the PS/2 mouse port in most cases.

6.4 Mouse on Serial Port

The serial port does use the Logitech M+ serial protocol for three button mice. The third button is reported in a fourth byte. This is compatible with most system drivers, even those expecting MS mouse two button protocol, in this case the driver will ignore the fourth byte.

Other protocols are available on request.

The serial port requires the RTS line to be at a positive voltage for more than 25 milliseconds

before it activates.

6.5 Interface Combinations

KeyWarrior does allow only certain combinations of mouse and keyboard interfaces to be used. The legal combinations are as follows:

USB for both

ADB for both

PS/2 for both

PS/2 for keyboard and serial for mouse

Any other combination will deliver unpredictable results.

KeyWarrior

7. Custom Scancode Tables

KeyWarrior uses a single table to translate the matrix coordinates to USB usage codes.

If running on ADB or PS/2 the USB usage codes are translated to the appropriate scnacodes by fixed tables.

The table that does the translation from matrix coordinates to USB usage codes is customer specified. This table is called the "Master Translation Table". Code Mercenaries does manufacture the KeyWarrior chips with the custom Master Translation Tables.

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

7.1 Function Shift Keys

KeyWarrior allows the definition of a function shift key. If this key is pressed KeyWarrior uses a second 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.

7.2 Mouse buttons

Like the function shift key the mouse buttons are identified by special codes in the Master Translation Table. Please refer to the document "Creating Custom KeyWarrior Scancode Tables" for details.

7.3 Programming a Flex, Operator, or Commander Controller

KeyWarrior Flex, Operator, and Commander controllers may be programmed via the USB from a Macintosh or Win 98 or ME PC. A utility program reads the assembly source file for a Master Translation Table and transmits it to the KeyWarrior Flex, Operator, or Commander controller.

The format of the file for Flex controllers is exactly the same as the file being used to generate the data for preprogrammed versions of the KeyWarrior chips. There are no preprogrammed versions of KeyWarrior that are able to offer the function of the Operator and Commander controllers.

Alternatively the external EEPROM may be programmed in any appropriate device programmer and then inserted into the circuit.

KeyWarrior Flex, Operator and Commander are not intended for applications which provide keyboard function programming options for the

end user. The programmability is available only via the USB and it is intended for factory programming only.

7.4 KeyWarrior Operator Key Definitions

The KeyWarrior Operator controllers allow to program up to 8 key functions onto a single key. Since USB usage codes are used in the Master Translation Table these eight key functions can translate in more than eight scan codes when running on the PS/2 interface.

Any unused key function for any individual key must be programmed as \$00. A \$00 in the Master Translation Table will generate no keycode.

Multiple key functions programmed onto a single key will activate in the sequence as programmed. They do stay active ("pressed") as long as the physical key is pressed.

When the physical key is pressed a sequence of make codes will be generated. Break codes can be generated only when the physical key is released.

This limits the macros to sequences in which multiple keys are pressed at the same time. It is not possible to program multiple keystrokes of the same key function onto one physical key.

If the same modifier key is programmed onto two keys and both are held down a break code for the modifier will be sent as soon as either of the keys is released.

7.5 KeyWarrior Commander Key Definitions

KeyWarrior Commander controllers do use a Master translation Table with a single byte per key, just like the KeyWarrior Flex.

Though a range of special codes (\$B0-\$DF) does allow to assign any key to one of 48 macros. Each of these macros may have up to 31 codes and can be used in one of two modes.

If the mode byte of a macro is \$00 then the macro will work like those of KeyWarrior Operator. No repeating use of the same code is possible and all keycodes will be sent as make codes on key down and break codes on key up. This mode is called "static mode".

A \$01 in the mode byte does activate the "typing mode" which does send a break code immediately after each make code, except for modifier keys (Ctrl, Alt, Shift, GUI). A break code for modifiers is sent either on a special break code in the macro or on release of the key.

Contrary to other KeyWarrior variants all Commander chips with 16x8 matrixes do support two FN keys allowing three function levels for every key. Because of this there is no KeyWarrior 8 Commander.

KeyWarrior

8. DC Characteristics

	Parameter	Min	Max	Units	Remarks
V _{cc}	Operating Voltage	4.35	5.25	V	
I _{cc}	Operating Supply Current		40	mA	
I _{sb}	Suspend mode current		20	μA	Oscillator off
I _{ol}	Sink current on LED pins	7.2	16.5	mA	V _{out} = 1.0V
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 _{jo}	Hi-Z State Data Line Leakage	-10	10	μA	0V < V _{in} < 3.3V
R _{pu}	Bus Pull-up resistance	7.35	7.65	kΩ	7.5kΩ±2%
R _{pd}	Bus Pull-down resistance	14.25	15.75	kΩ	15kΩ±5%

8.1 AC Characteristics

	Parameter	Min	Max	Units	Remarks
t _{cyc}	input clock cycle time	165.0	168.3	ns	
t _{ch}	Clock high time	0.45t _{cyc}		ns	
t _{cl}	Clock low time	0.45t _{cyc}		ns	
USB Driver Characteristics					
t _r	Transition rise time	75		ns	C _{Load} = 50pF
t _r	Transition rise time		300	ns	C _{Load} = 350pF
t _f	Transition fall time	75		ns	C _{Load} = 50pF
t _f	Transition fall time		300	ns	C _{Load} = 350pF
t _{rfm}	Rise/Fall Time matching	80	120	%	
V _{crs}	Output signal crossover voltage	1.3	2.0	V	
USB Data Timing					
t _{drate}	Low Speed Data Rate	1.4777	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 _{eoпр1}	EOP width at receiver	165		ns	Rejects as EOP
t _{eoпр2}	EOP width at receiver	675		ns	Accepts as EOP
t _{eoпрt}	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 available. In this case t_{scan} = 1ms, t_{debounce} = 2x t_{scan} and t_{scansu} = 10μs

KeyWarrior

8.2 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

KeyWarrior

9. Ordering Information

Partname	Order Code	Description	Package
KeyWarrior 8	KW8-P	Keyboard encoder for 8x8 matrix, preprogrammed	PDIP40
KeyWarrior 8	KW8-S	Keyboard encoder for 8x8 matrix, preprogrammed	SSOP48
KeyWarrior 8 Flex	KW8FX-P	Keyboard encoder for 8x8 matrix, external EEPROM	PDIP40
KeyWarrior 8 Flex	KW8FX-S	Keyboard encoder for 8x8 matrix, external EEPROM	SSOP48
KeyWarrior 8 Operator	KW8OP-P	Keyboard encoder for 8x8 matrix, external EEPROM, macros	PDIP40
KeyWarrior 8 Operator	KW8OP-S	Keyboard encoder for 8x8 matrix, external EEPROM, macros	SSOP48
KeyWarrior 16	KW16-P	Keyboard encoder for 16x8 matrix, preprogrammed	PDIP 40
KeyWarrior 16	KW16-S	Keyboard encoder for 16x8 matrix, preprogrammed	SSOP 48
KeyWarrior 16 Flex	KW16FX-P	Keyboard encoder for 16x8 matrix, external EEPROM	PDIP40
KeyWarrior 16 Flex	KW16FX-S	Keyboard encoder for 16x8 matrix, external EEPROM	SSOP48
KeyWarrior 16 Operator	KW16OP-P	Keyboard encoder for 16x8 matrix, external EEPROM, macros	PDIP40
KeyWarrior 16 Operator	KW16OP-S	Keyboard encoder for 16x8 matrix, external EEPROM, macros	SSOP48
KeyWarrior 16 Commander	KW16CM-P	Keyboard encoder for 16x8 matrix, external EEPROM, long macros	PDIP40
KeyWarrior 16 Commander	KW16CM-S	Keyboard encoder for 16x8 matrix, external EEPROM, long macros	SSOP48
KeyWarrior 20	KW20-S	Keyboard encoder for 20x12 matrix, preprogrammed	SSOP48
KeyWarrior 20 Flex	KW20FX-S	Keyboard encoder for 20x12 matrix, external EEPROM	SSOP48
KeyWarrior 20 Operator	KW20OP-S	Keyboard encoder for 20x12 matrix, external EEPROM, macros	SSOP48
KeyWarrior 20 Commander	KW20CM-S	Keyboard encoder for 20x12 matrix, external EEPROM, long macros	SSOP48
KeyWarrior Combo O	KWCO-S	Keyboard plus mouse with optical quadrature encoder, preprog.	SSOP 48
KeyWarrior Combo O Flex	KWCOFX-S	Keyboard plus mouse with optical quadrature encoder, ext. EEPROM	SSOP 48
KeyWarrior Combo O Op	KWCOOP-S	Keyboard plus mouse with optical quadrature enc., EEPROM, macros	SSOP48
KeyWarrior Combo O Cmdr	KWCOCM-S	Keyboard plus mouse with optical quadrature enc., EEPROM, macros	SSOP48
KeyWarriorCombo V	KWCV-S	Keyboard plus mouse with VersaPoint™ sensor, preprogrammed	SSOP48
KeyWarriorCombo V Flex	KWCVFX-S	Keyboard plus mouse with VersaPoint™ sensor, external EEPROM	SSOP 48
KeyWarriorCombo V Op	KWCVOP-S	Keyboard plus mouse with VersaPoint™ sensor, EEPROM, macros	SSOP48
KeyWarriorCombo V Cmdr	KWCVCM-S	Keyboard plus mouse with VersaPoint™ sensor, EEPROM, macros	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 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 controllers are standard parts that may be purchased without any setup costs or minimum order quantities.

9.1 Shipping info

DIL40 chips do come in tubes of 10 each. SSOP48 chips come in tubes of 30 each.

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

KeyWarrior

9.2 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>

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

Following are the ProductIDs:

KeyWarrior 8 Flex	\$0101
KeyWarrior 16 Flex	\$0100
KeyWarrior 20 Flex	\$0102
KeyWarrior Combo V Flex	\$0104
KeyWarrior Combo O Flex	\$0105
KeyWarrior 16 Commander	\$0110
KeyWarrior 20 Commander	\$0112
KeyWarrior Combo V Commander	\$0114
KeyWarrior Combo O Commander	\$0115
KeyWarrior 8 Operator	\$0119
KeyWarrior 16 Operator	\$0118
KeyWarrior 20 Operator	\$011A
KeyWarrior Combo V Operator	\$011C
KeyWarrior Combo O Operator	\$011D

ProductIDs are independent of the package type.

9.3 Using ADB

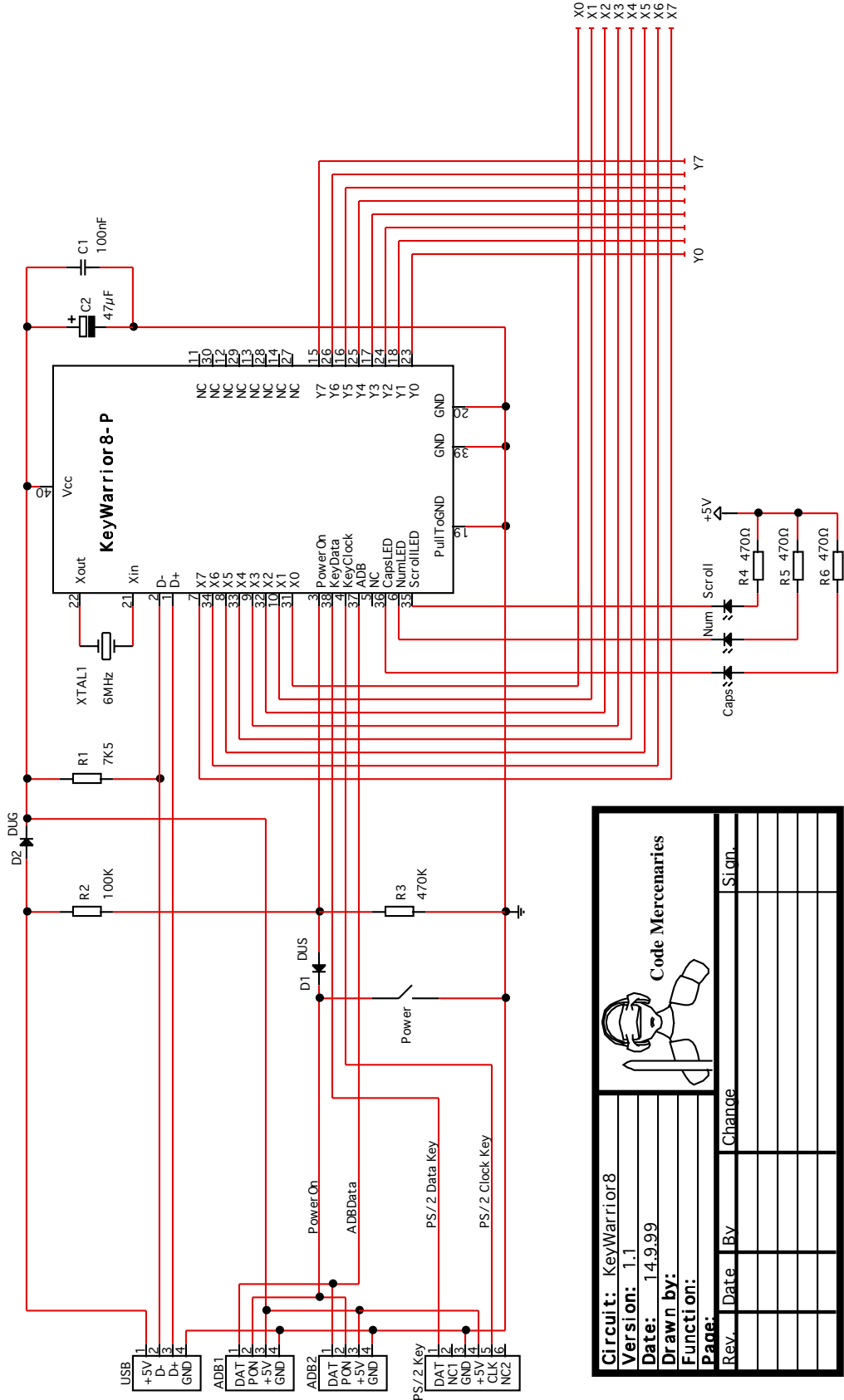
The utilisation of ADB requires a license from Apple Computer Inc.

As of writing of this document the license to use ADB technology costs \$50 annually.

Contact <sw.license@apple.com> for details.

KeyWarrior

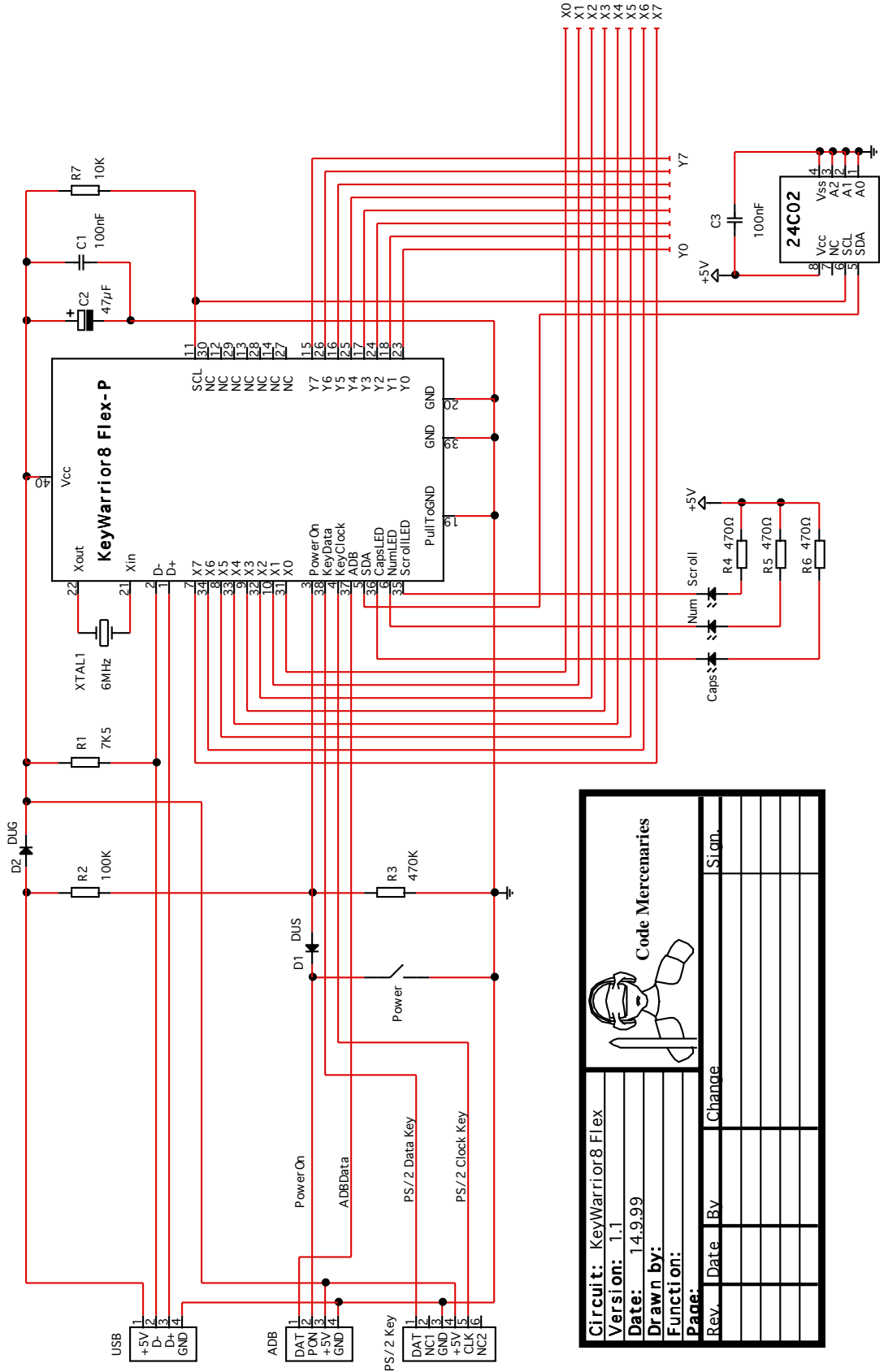
10. Typical Application for KeyWarrior 8



Circuit: KeyWarrior8		 Code Mercenaries		
Version: 1.1				
Date: 14.9.99				
Drawn by:				
Function:				
Page:				
Rev.	Date	By	Change	Sign.

KeyWarrior

10.1 Typical Application for KeyWarrior 8 Flex



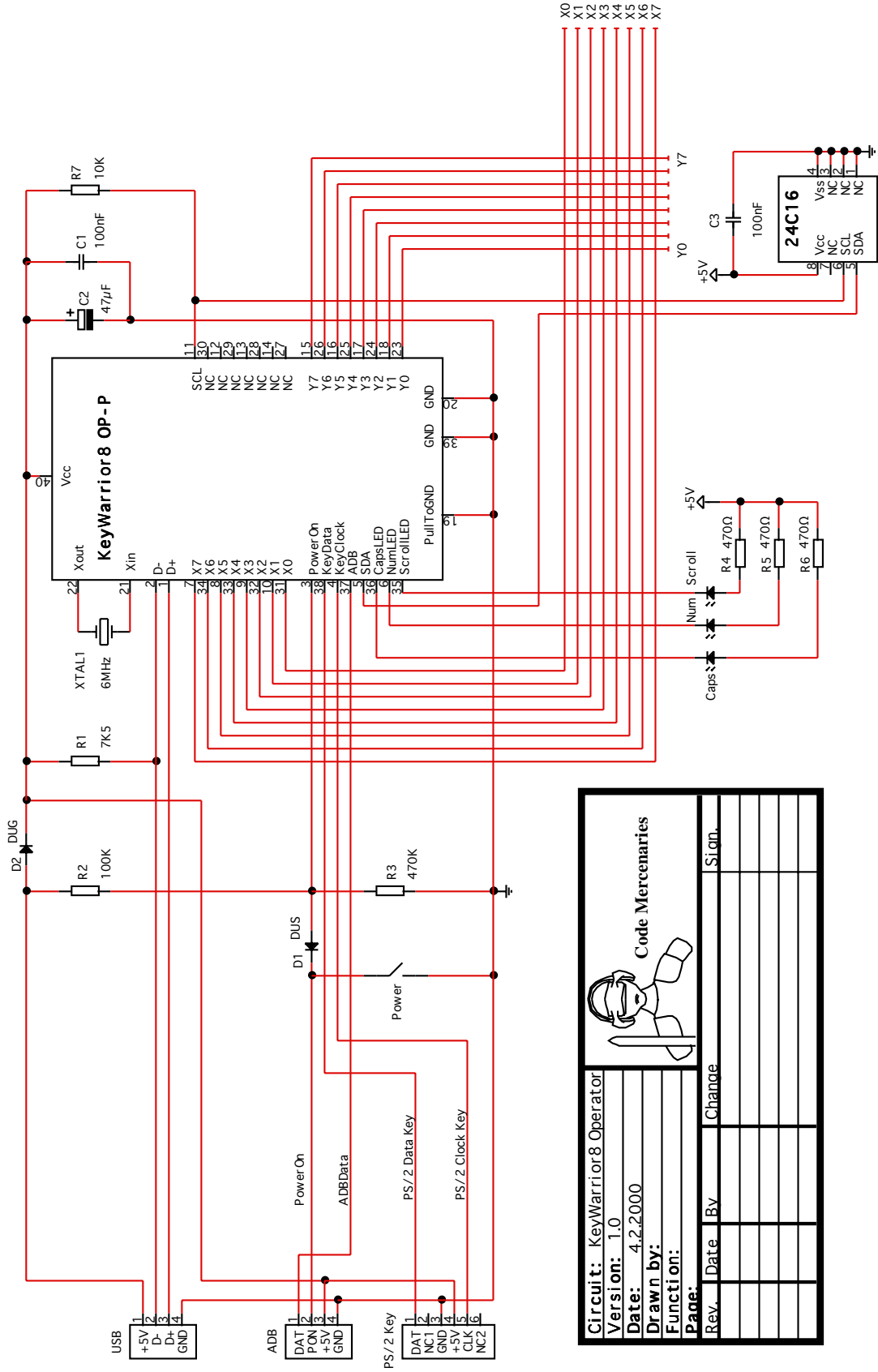
Code Mercenaries

Circuit: KeyWarrior8 Flex
Version: 1.1
Date: 14.9.99
Drawn by:
Function:
Pane:

Rev.	Date	By	Change	Sign.

KeyWarrior

10.2 Typical Application for KeyWarrior 8 Operator



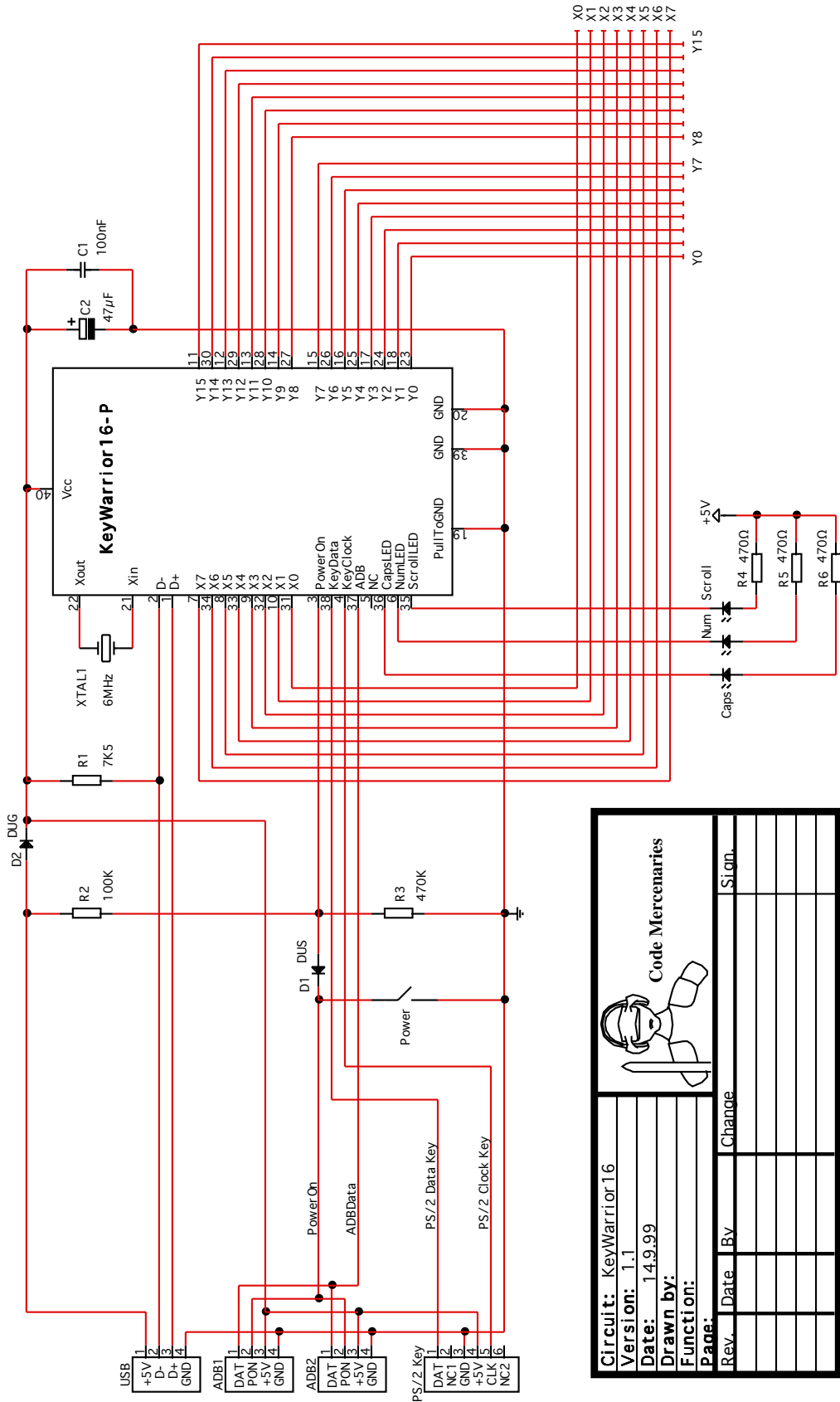
Code Mercenaries

Circuit: KeyWarrior8 Operator
Version: 1.0
Date: 4.2.2000
Drawn by:
Function:
Page:

Rev.	Date	By	Change	Sign.

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10.3 Typical Application for KeyWarrior 16



Circuit: KeyWarrior16

Version: 1.1

Date: 14.9.99

Drawn by:

Function:

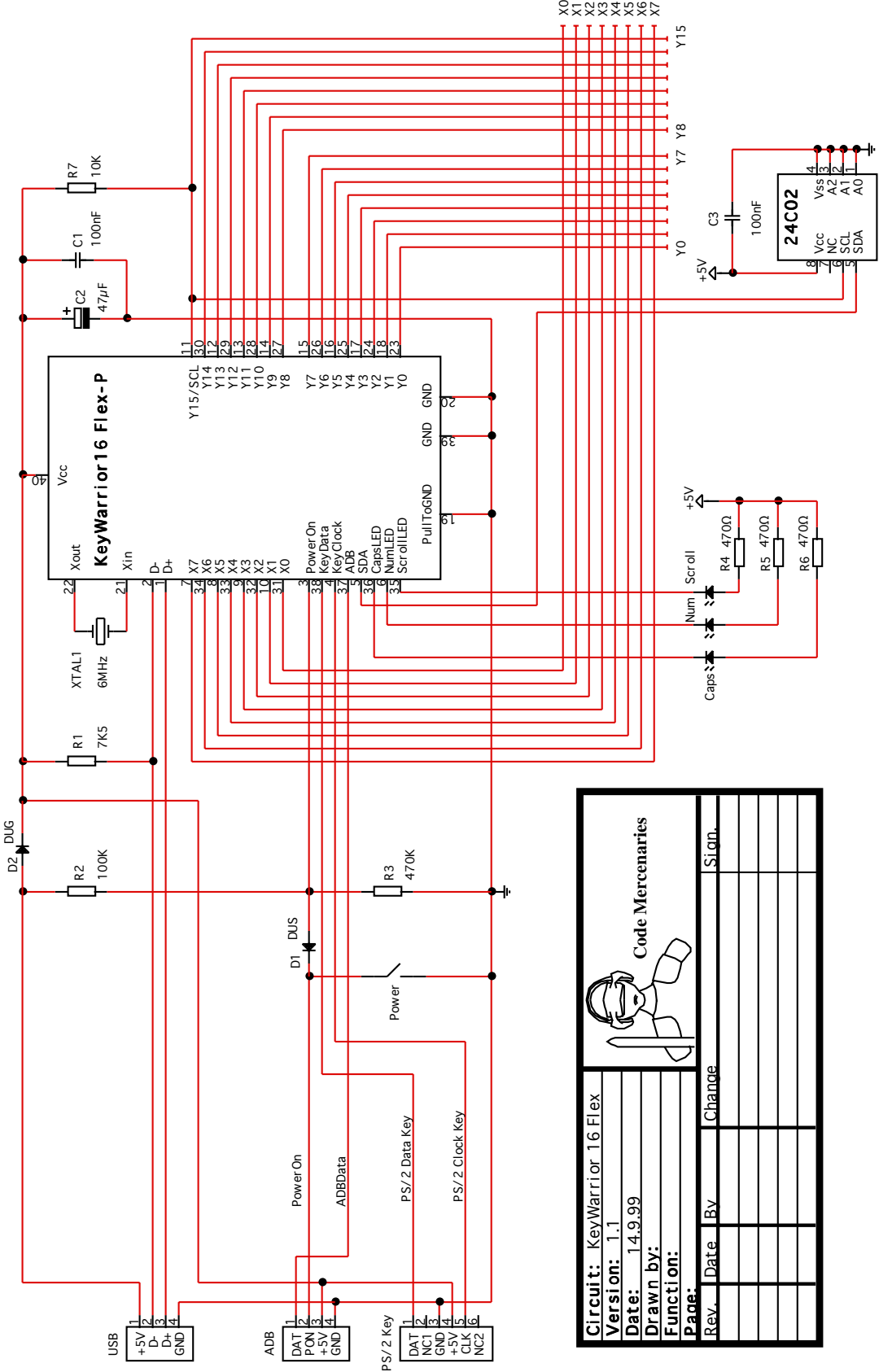
Page:


Code Mercenaries

Rev.	Date	By	Change	Sign.

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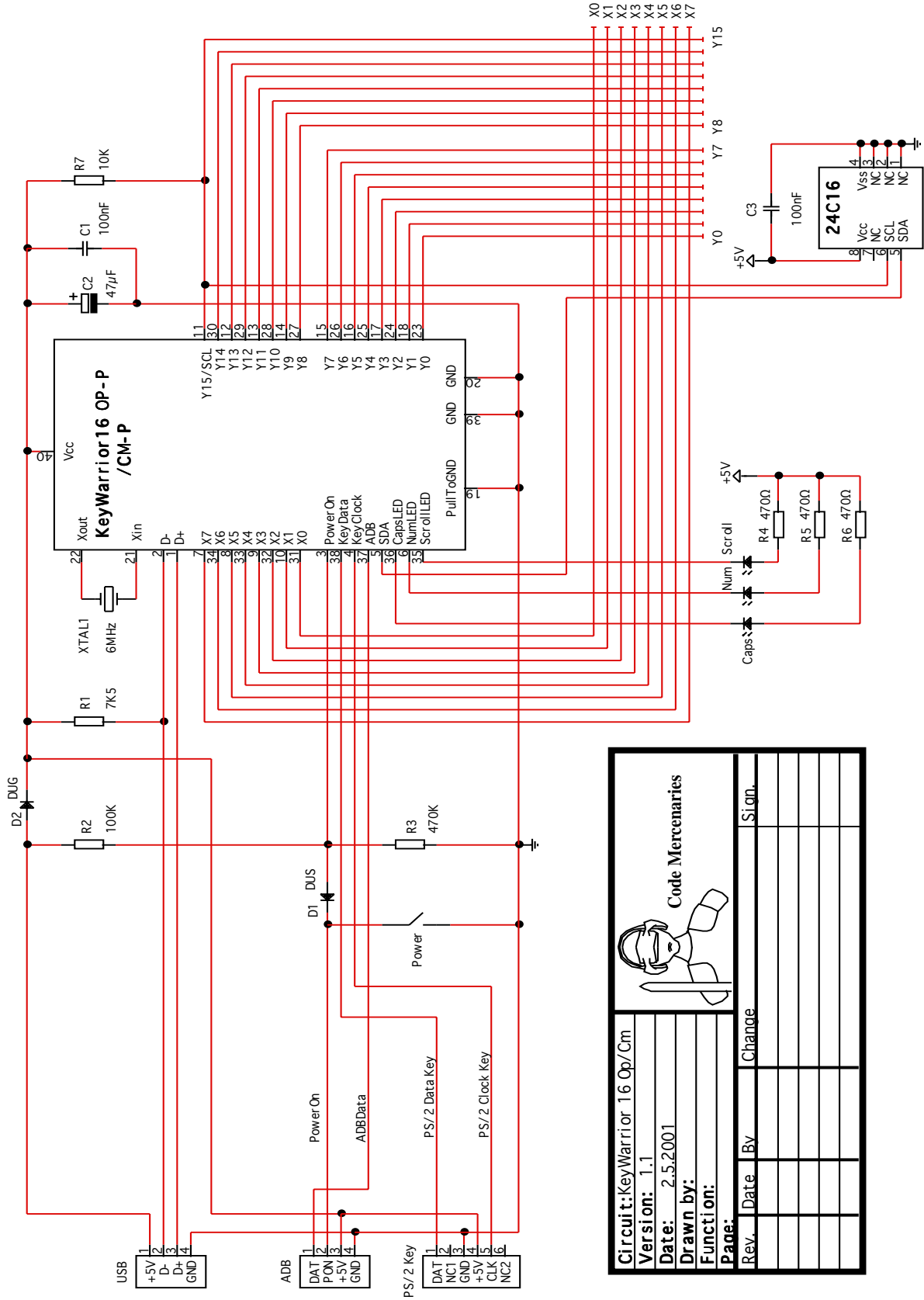
10.4 Typical Application for KeyWarrior 16 Flex




Circuit: KeyWarrior 16 Flex				
Version: 1.1				
Date: 14.9.99				
Drawn by:				
Function:				
Page:				
Rev.	Date	By	Change	Sign.

KeyWarrior

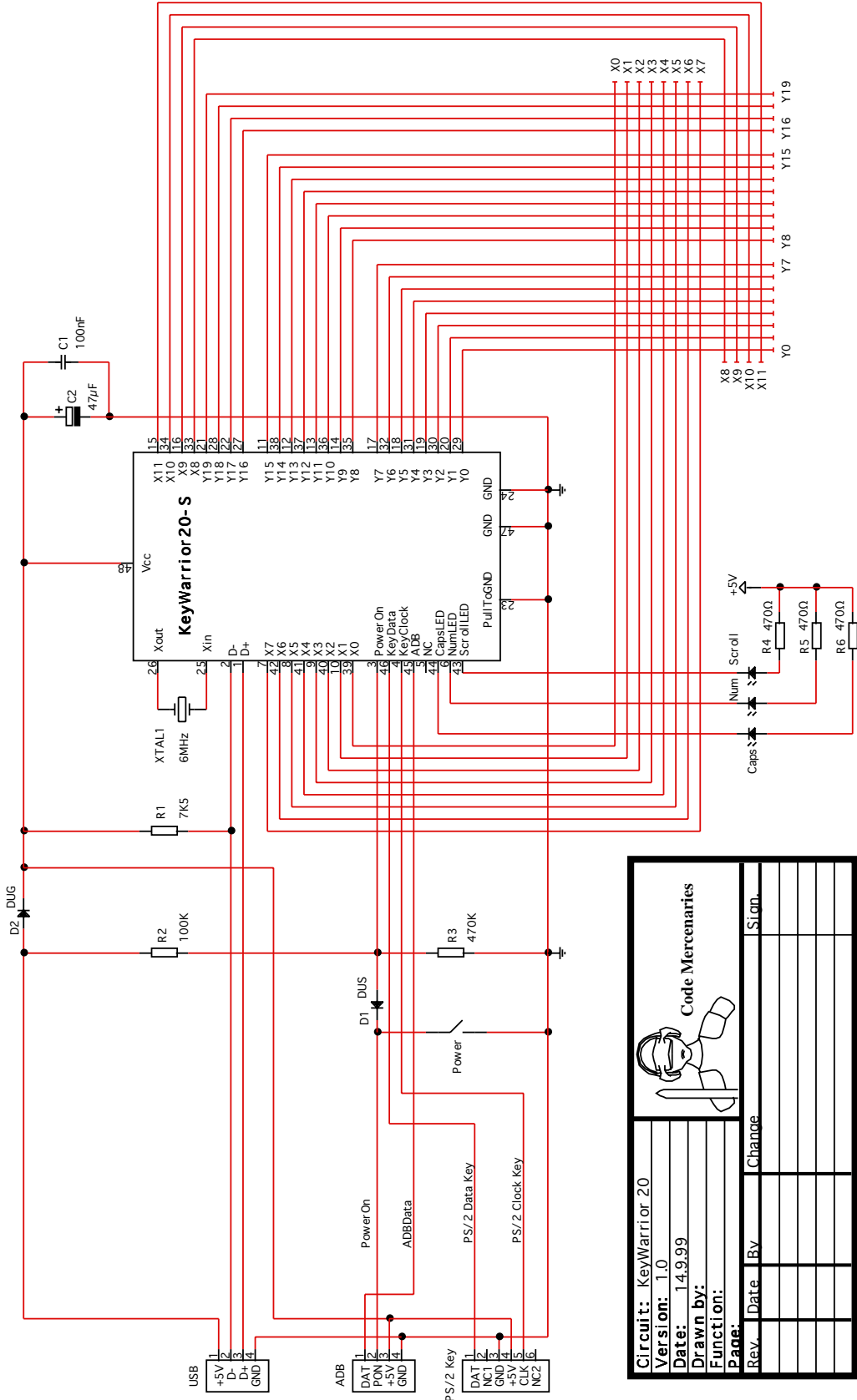
10.5 Typical Application for KeyWarrior 16 Operator or Commander



Circuit: KeyWarrior 16 Op/Cm		 <p>Code Mercenaries</p>			
Version: 1.1				Rev.	By
Date: 2.5.2001				Date	Change
Drawn by:				Sign.	
Function:					
Page:					

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10.6 Typical Application for KeyWarrior 20



Code Mercenaries

Circuit: KeyWarrior 20

Version: 1.0

Date: 14.9.99

Drawn by:

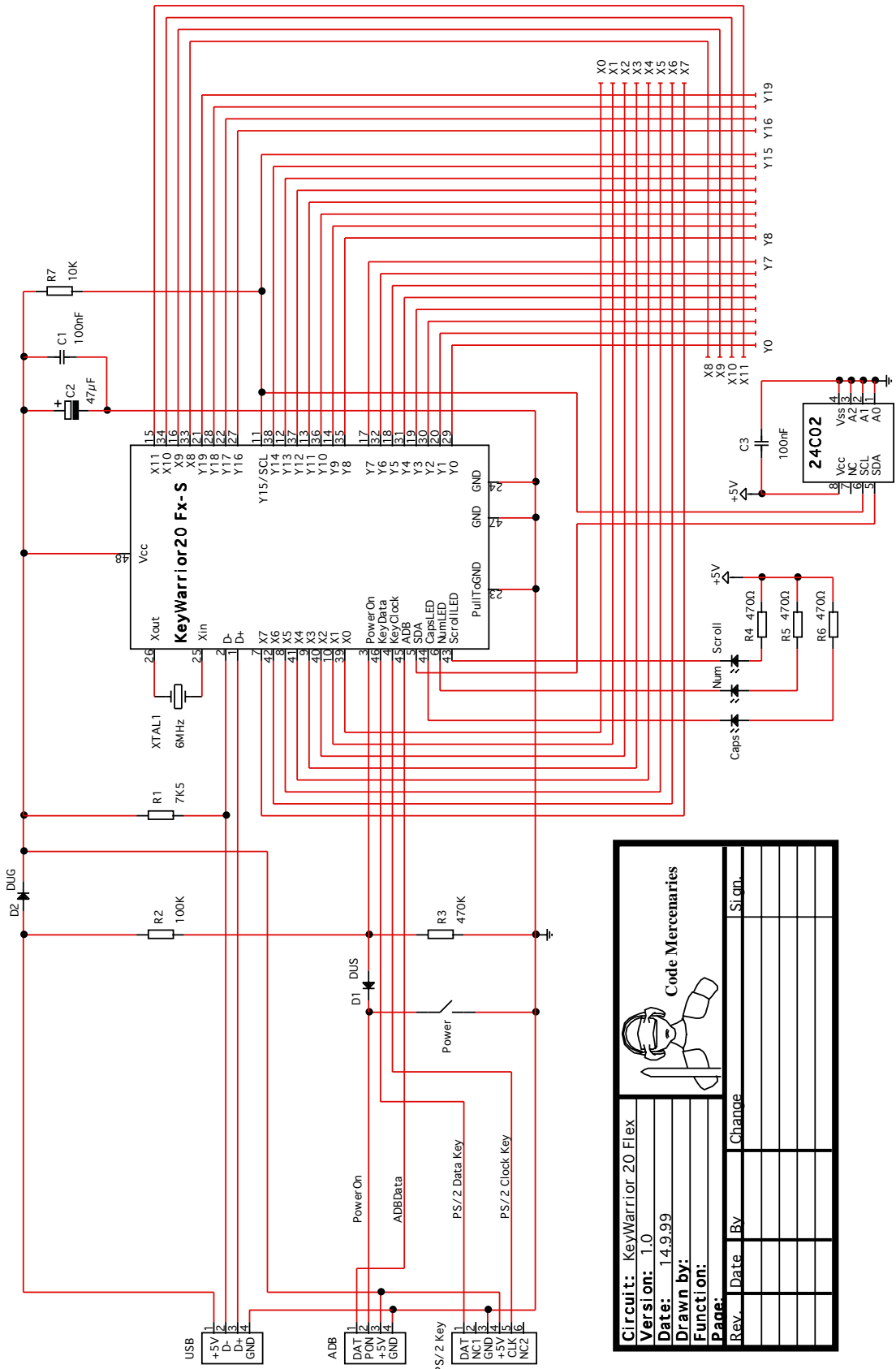
Function:


Para:

Rev.	Date	By	Change	Sl. no.

KeyWarrior

10.7 Typical Application for KeyWarrior 20 Flex



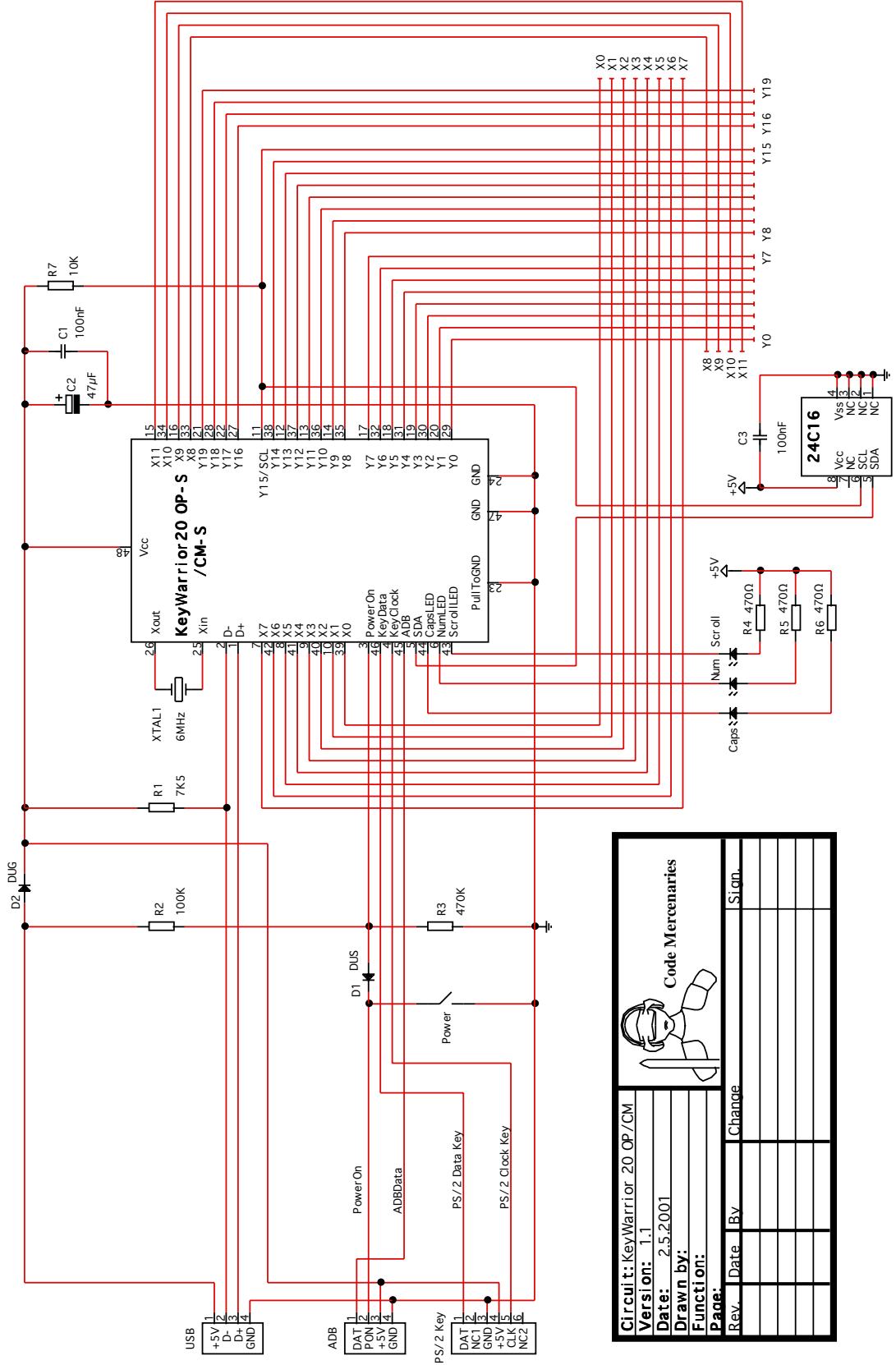


Code Mercenaries

Circuit: KeyWarrior 20 Flex	
Version: 1.0	
Date: 14.9.99	
Drawn by:	
Function:	
Page:	
Rev.	Date
By	Change
Sign.	

KeyWarrior

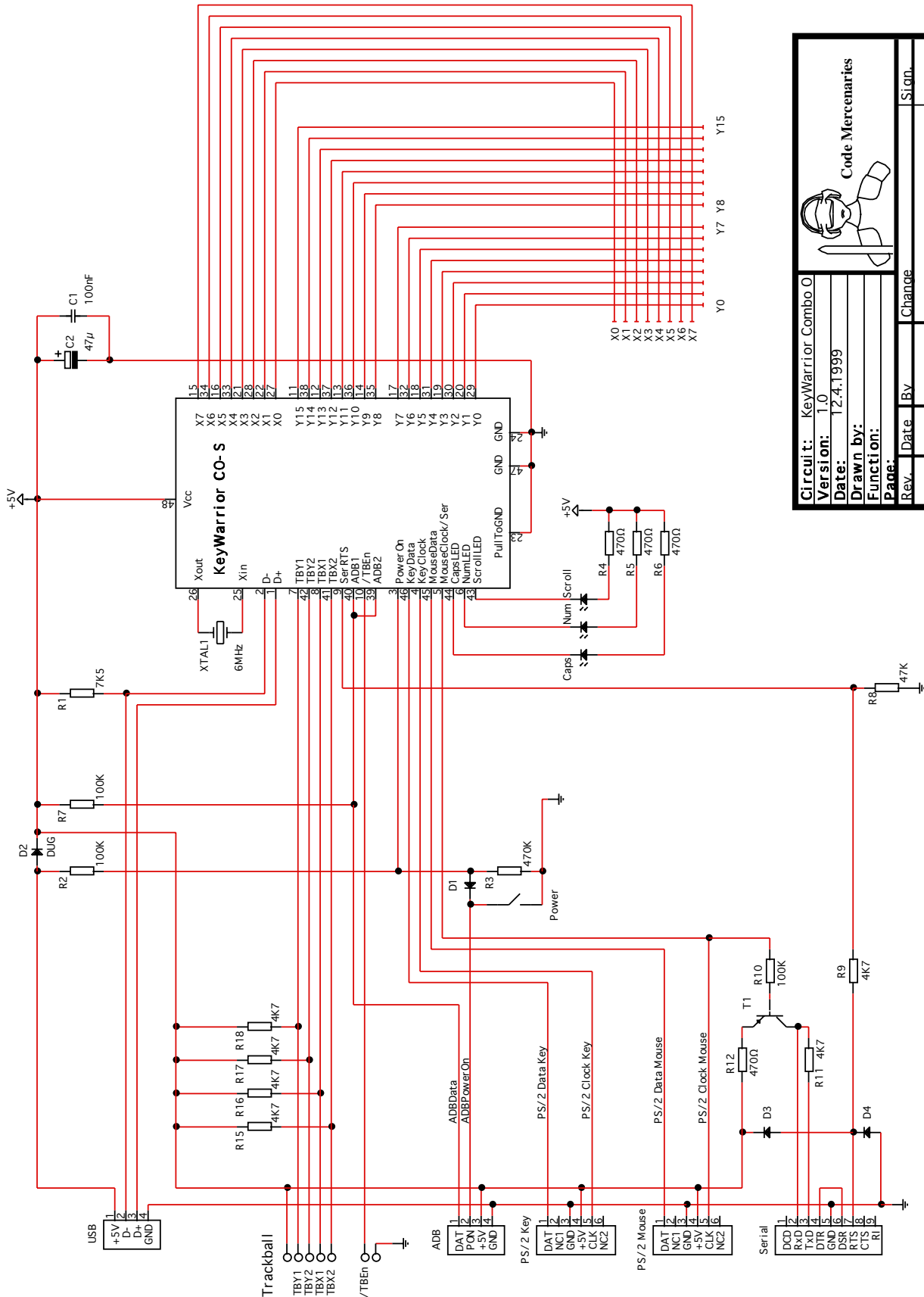
10.8 Typical Application for KeyWarrior 20 Operator or Commander




Circuit: KeyWarrior 20 OP/CM	
Version: 1.1	
Date: 2.5.2001	
Drawn by:	
Function:	
Page:	
Rev.	Date By Change Sign.

KeyWarrior

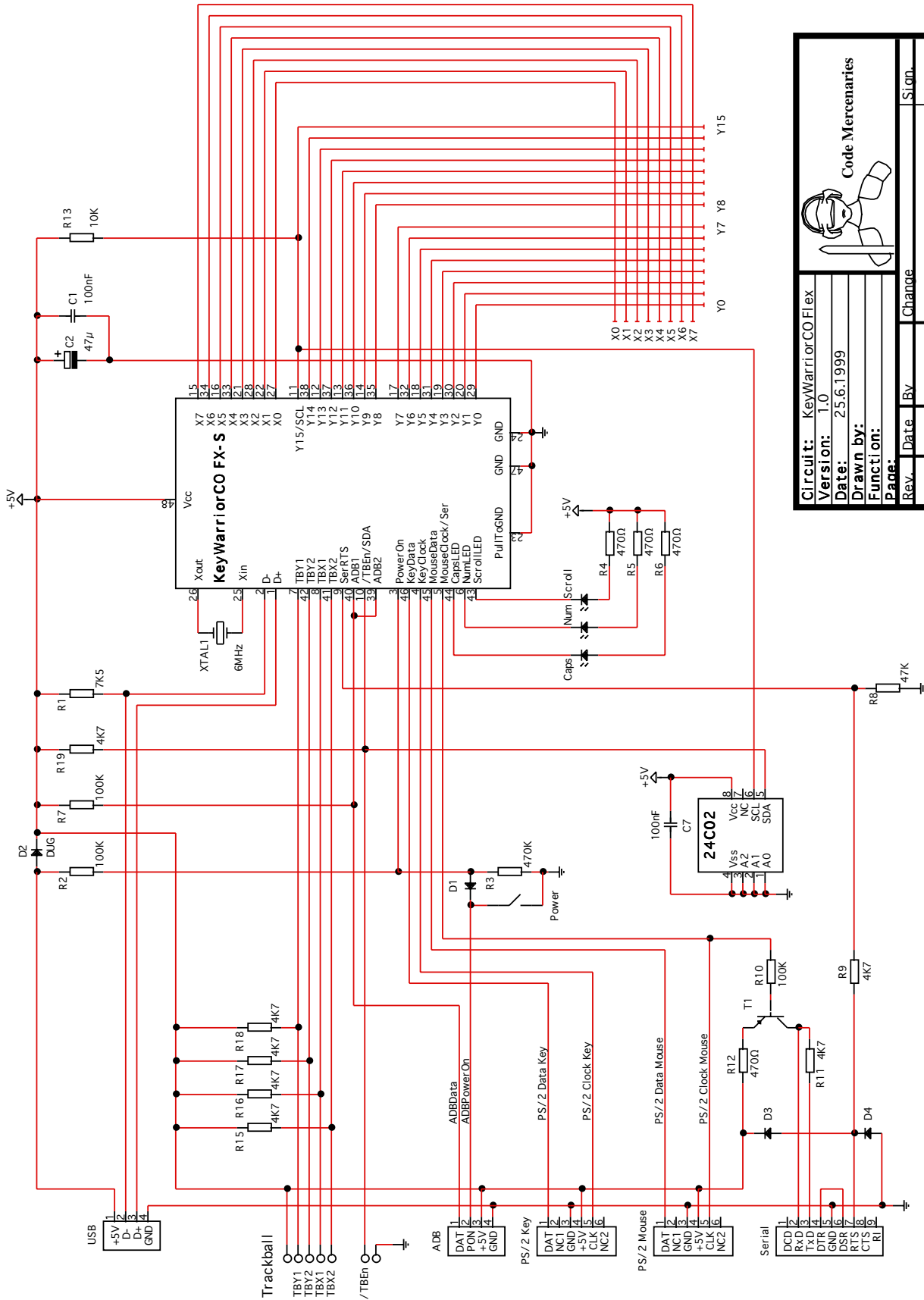
10.9 Typical Application for KeyWarrior Combo O




Circuit: KeyWarrior Combo O		Code Mercenaries	
Version: 1.0			
Date: 12.4.1999			
Drawn by:			
Function:			
Page:	Date	BV	Change
Rev.			

KeyWarrior

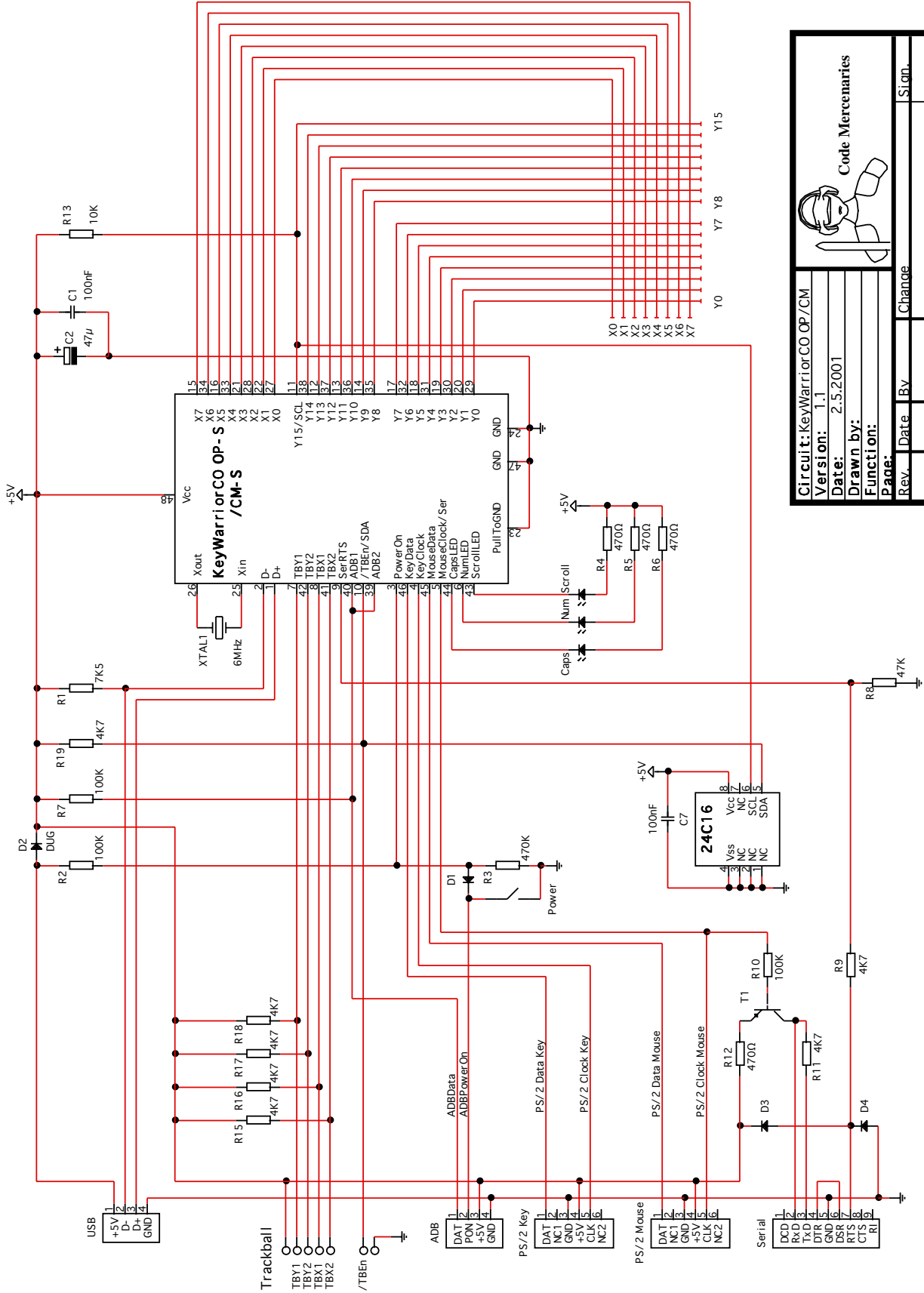
10.10 Typical Application for KeyWarrior Combo O Flex



	
Code Mercenaries	
Circuit: KeyWarriorCOFlex	
Version: 1.0	
Date: 25.6.1999	
Drawn by:	
Function:	
Page:	
Rev.	Date
By	Change
	Sign.

KeyWarrior

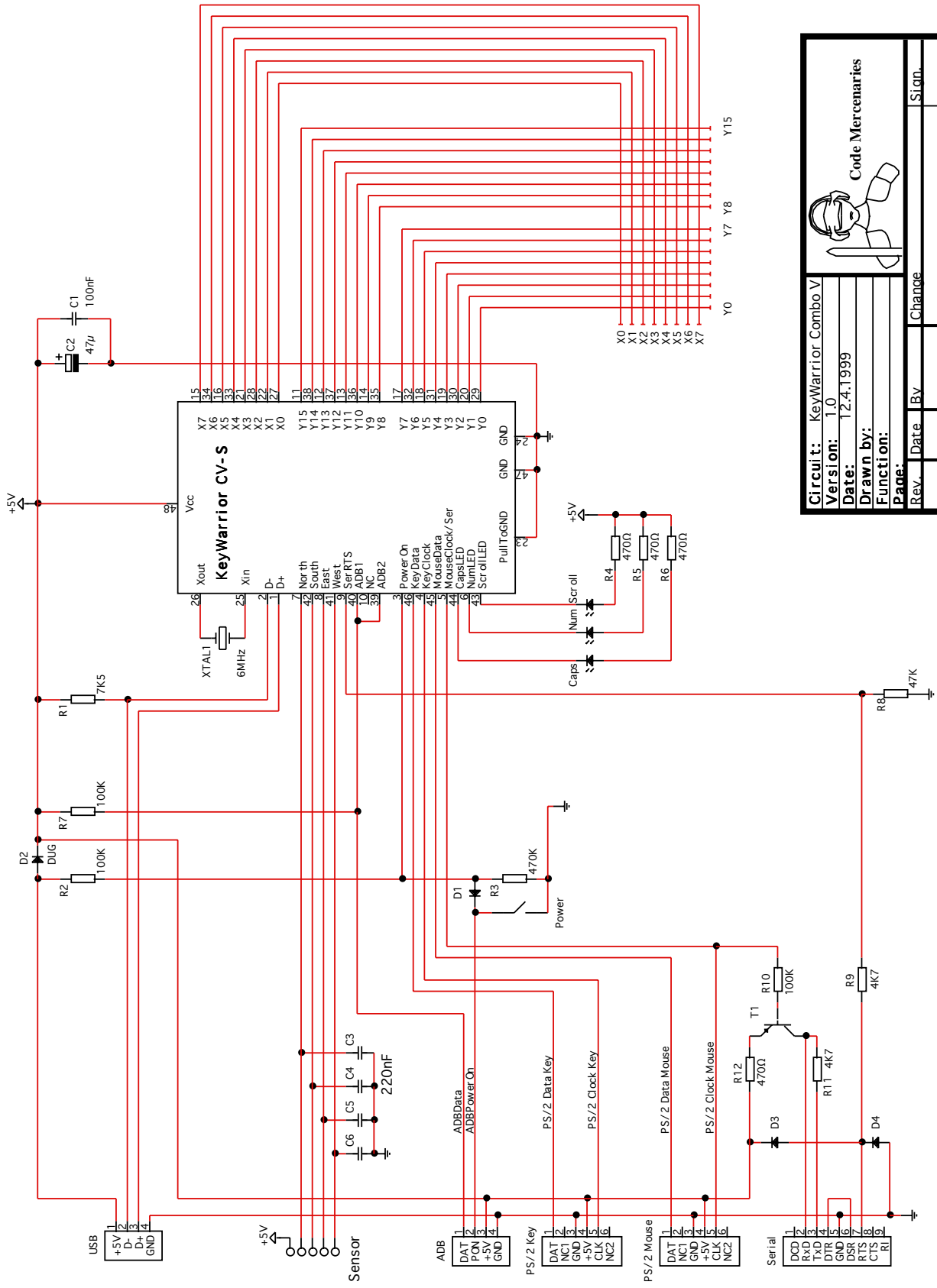
10.11 Typical Application for KeyWarrior Combo O Operator or Commander



		Circuit: KeyWarriorCO OP /CM	
		Version: 1.1	Date: 2.5.2001
Drawn By:		Function:	
Page:		Change	
Rev.	Date	By	Sign.

KeyWarrior

10.12 Typical Application for KeyWarrior Combo V

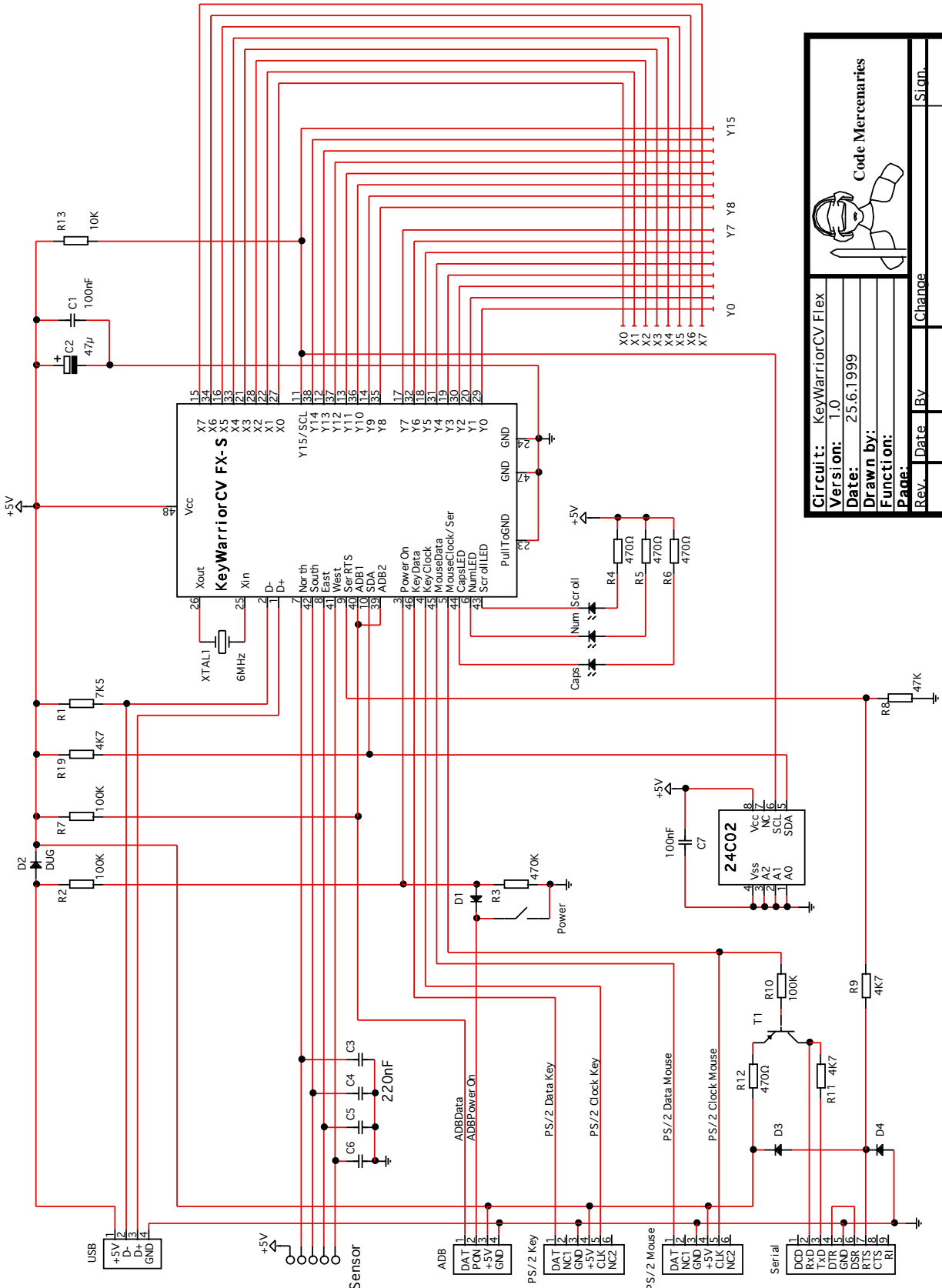


Circuit: KeyWarrior Combo V
Version: 1.0
Date: 12.4.1999
Drawn by:
Function:
Page:

Rev.	Date	By	Change	Sign.

KeyWarrior

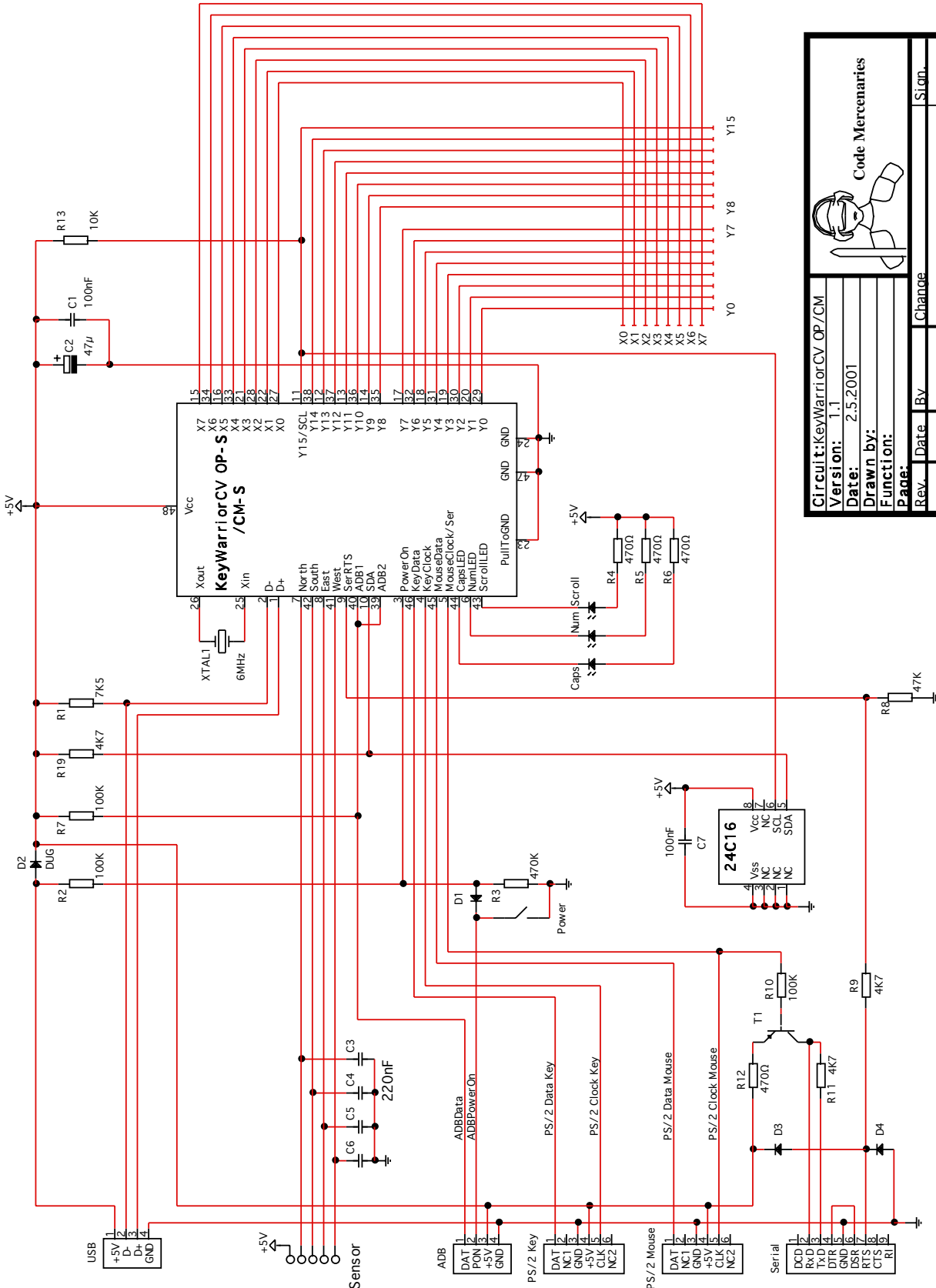
10.13 Typical Application for KeyWarrior Combo V Flex



Circuit: KeyWarriorCV Flex	
Version: 1.0	Code Mercenaries
Date: 25.6.1999	
Drawn by:	
Function:	
Page:	
Rev.	Date
	BY
	Change
	Slan.

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10.14 Typical Application for KeyWarrior Combo V Operator or Commander

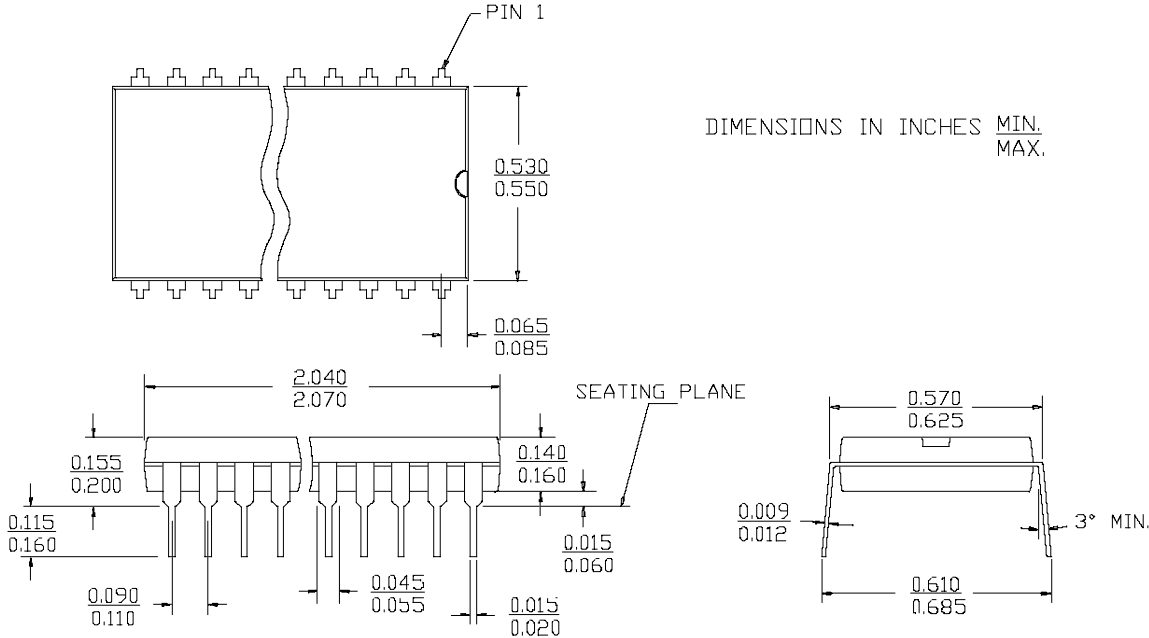


Circuit: KeyWarriorCV OP/CM				
Version:	1.1			
Date:	2.5.2001			
Drawn by:				
Function:				
Page:				
Rev.	Date	By	Change	Slon.

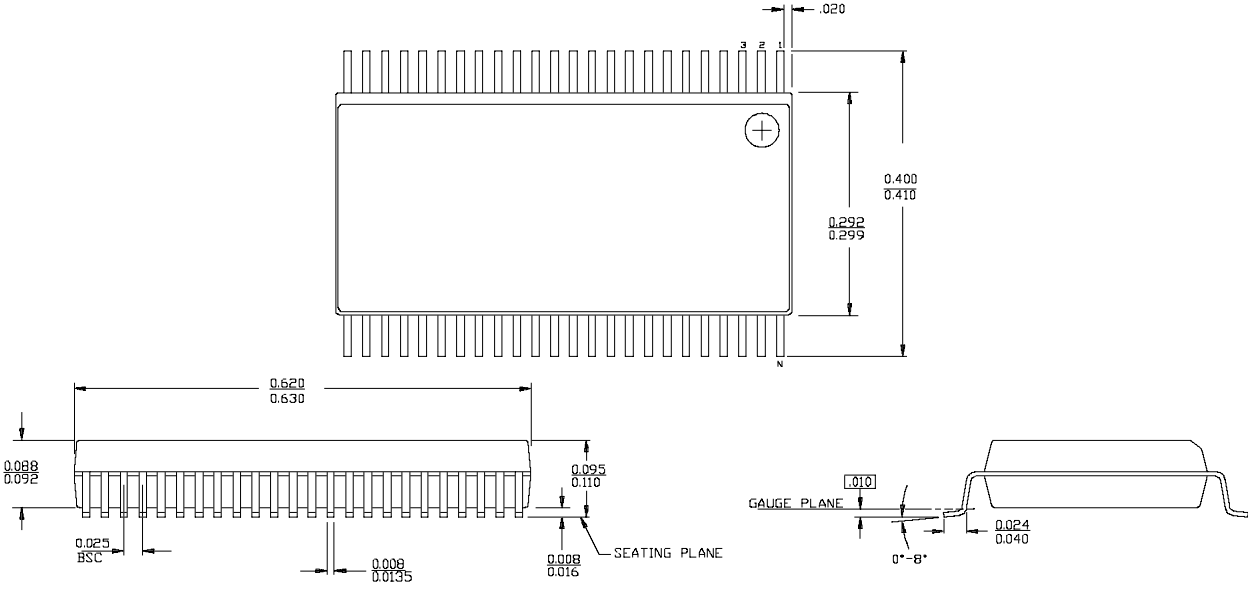
KeyWarrior

11. Package Dimensions

40 Pin PDIP



48 Pin SSOP



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12. 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, serial and ADB lines are less critical. Series resistors of 27Ω and signal to ground capacitors of 27pF may be used alone or in addition to some kind of suppressor device.

12.1 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 oscillator to the chips pins as short as possible.
- Put a 100nF ceramic capacitor right next to the power supply lines and make sure the PCB traces between the chips power pins and the capacitor are as short as possible.
- 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 ADB+PS/2 power supply lines, i.e. don't place the bead behind the diode in the USB power supply line.

13. Revision History

Here are the changes that have been made to KeyWarrior since V1.0.0

1.0.8

- Added Commander variant.
- Removed some redundant code from USB stack to reduce memory use. No change in behaviour.

1.0.7

- Set Scaling on the PS/2 mouse port does now activate a ballistic acceleration for the mouse movement.
- Optimized USB protocol stack for code size and speed. There will be no significant changes in

behaviour.

- Combo chips using PS/2 ports for keyboard and mouse do now accept overlapping commands to both ports. This could cause problems mainly with NT based hosts.
- USB requests SetIdle and GetIdle do now handle keyboard and mouse endpoints separately.
- Initial USB Idle Period for keyboard has been set to 500msec. Formerly it was zero by default causing the keyboard to send reports only on status changes.
- Removed turning on the LEDs when USB is set to unconfigured. This was a feature used during early development and has no practical value in production.
- A second USB Reset after initial configuration of the controller does now disable the keyboard scanning task until the USB device is configured again. For some reason this disturbed MacOS during the boot phase and prevented the Extension Manager from coming up when the space bar was held down during start up.
- Added some delay between receiving a PS/2 mouse command and answering on it. This fixes problems with some badly designed host controllers.
- Fixed an interrupt related problem in the PS/2 mouse function that could under certain timing conditions cause the return of a wrong reply to a command. The correct data byte to be send was overwritten, returning a random reply. This lead to the mouse not being recognized or not properly configured on some hosts.
- Cleaned up USB suspend and wakeup code. Suspend could result in the keyboard not waking up again if a key was pressed at the moment the USB went to sleep.
- When PS/2 is activated by the startup timeout it does no longer require the host to answer on the BAT OK message to activate the PS/2 interface.

1.0.6

- Fixed USB command "GetReport" to properly return either keyboard or mouse report as requested. Former versions did always return the keyboard report.
- Added KeyWarrior4 variant (not a standard part but available on request).
- Fixed IIC routines in the Operator variants to send the page address as part of the command, this had caused problems with Microchip 24LC16.
- Added locking option for the FN keys and

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cleaned up the FN key code a bit (not part of the standard parts, this feature is available for custom chips).

- Fixed a bug in accessing code table 3 for KW8OP causing it to fall back to table 1.
- Changed speed setting for optical mice to maximum on ADB, Serial and USB.
- Fixed a bug on ADB that could crash the controller on Caps Lock down.
- Fixed TBEn handling for Combo O Operator to make sure EEPROM does not get disturbed.
- Set all combos to use CDM mouse protocol. Former versions were using a proprietary protocol.

1.0.5

- Changed stuffing the code into the queue to be an atomic operation, this had caused lost keys with KW8FX when used with the PS/2 port.
- Modified reset behaviour to let controller go active on PS/2 mouse identification. This was necessary to allow controller to work properly if mouse is initialized before keyboard.

1.0.4

- Added Operator variant.
- Fixed a bug that defaulted serial port protocol to MS.
- Fixed a bug with MF2 codeset 1 that generated wrong codes for some keys.
- Increased matrix drive to read setup time from about 10 μ s to 40 μ sec. This eliminates problems with high parasitic capacities in some key matrixes.
- Added a debounce to SerRTS which optimizes EMC.
- Added some delay before answering on PS/2 keyboard commands. This eliminates problems with some older host controllers.

1.0.3

- Added support for Kanji keys.
- Added a timeout to the mouse function that automatically defaults to PS/2 if no mouse port is identified within 2 secs of the keyboard becoming active. This allows hot plugging of the PS/2 mouse port and improves ESD recovery.

1.0.2

- Changed PS/2 mouse protocol to set bit 3 of byte 1. Windows CE did not work with this bit reset.

1.0.1

- Fixed a lockup on PS/2 interfaces that caused the mouse part not to respond on the next host to device request when the keyboard part received a host to device request while the mouse part was still processing a host to device request.

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Code Mercenaries
Guido Körber
Kranoldstr. 6
12051 Berlin
Germany
Tel: x49-30-628 406 00
Fax: x49-30-628 406 03
Mail: support@codemerics.com
Web: www.codemerics.com