KENBAK-1 — a KENBAK-uino

Bill of materials · a copy of Mark Wilson's 2011 Arduino KENBAK-1 emulator, from his published source and pin map

Revision: A **Date:** 2026-11-03 **Lines:** 29 **Source:** iconic-machines.fubsypoly.com/kenbak-1/vol-15/

Every part for a KENBAK-uino, in the order of Volume 15's bill of materials: the circuit as Wilson built it, with the part to buy in November 2026 for each line. Two routes are given: a bare ATmega328P with its crystal, load capacitors, reset parts and a USB serial adapter, or an Arduino Nano in their place; lines marked 'bare-chip build only' are not needed with a Nano. The firmware (Wilson's Kenbakuino, MIT licence) costs nothing. Stock and prices were read on 2 November 2026 and change daily; part numbers are examples that meet the specification.

Tick **Ord** when ordered, **Have** when it is in hand and checked against the part number, **Fit** when it is installed. Write the vendor, order number and price on the last page. Alternates for obsolete (EOL) parts are in **bold**.

Same The original part is still a catalogue item. **EOL** The original is discontinued: buy the alternate given. **Spec** The original line is incomplete or out of a data-sheet limit.

Choice A change chosen for a copy.

ORD	HAVE	FIT	QTY	REF. DES.	PART / SPECIFICATION	PART NUMBER	ALTERNATES / SUBSTITUTES	WHERE TO BUY	TAG	NOTES
Semiconductors and modules										
☐	☐	☐	**1**	Processor	**ATmega328P with the Arduino Uno (Optiboot) bootloader** DIP-28; Wilson used an ATmega328	`Microchip ATmega328P-PU`	Arduino Nano (next line)	Mouser www.mouser.com Digi-Key www.digikey.com	**Same**	A blank chip has no bootloader: burn it with an Uno as ISP (Volume 13).
☐	☐	☐	**1**	Processor alternative	**Arduino Nano (ATmega328P, 16 MHz, USB on board)** Replaces the chip, crystal, load caps, reset parts and USB adapter		Clones may need 'ATmega328P (Old Bootloader)'		**Choice**	Pins D8–D13, A0–A5 match: PINS.h unchanged.
☐	☐	☐	**1**	Clock oscillator	**16 MHz HC-49 crystal** Wilson lists the crystal only				**Spec**	Bare-chip build only; its load capacitors are the 'Crystal load' line.
☐	☐	☐	**1**	Data-lamp driver	**74HC595 shift register** DIP-16; see the lamp-resistor line for its current limit	`TI SN74HC595N`		Mouser www.mouser.com Digi-Key www.digikey.com	**Same**	
☐	☐	☐	**2**	Button readers	**74HC165 shift register** DIP-16	`TI SN74HC165N`		Mouser www.mouser.com Digi-Key www.digikey.com	**Same**	
☐	☐	☐	**1**	Clock	**DS1307 real-time clock board** Original: SparkFun Real Time Clock Module, product 99 (retired)	`SparkFun BOB-12708 (DS1307, CR1225 cell)`	**BOB-12708 runs Wilson's code unchanged. Or a DS3231 module with the three DS3231 constants changed in Clock.h (Adafruit 3013, or a ZS-042: next line).**	SparkFun www.sparkfun.com/products/12708	**EOL**	
☐	☐	☐	**(1)**	Clock alternative	**ZS-042 DS3231 module with a CR2032** Trickle-charges the cell (meant for an LIR2032)				**Spec**	With a CR2032, remove the charge resistor (or diode): builders' advice, not the maker's.

ORD	HAVE	FIT	QTY	REF. DES.	PART / SPECIFICATION	PART NUMBER	ALTERNATES / SUBSTITUTES	WHERE TO BUY	TAG	NOTES
☐	☐	☐	**1**	USB power and serial	**5 V USB serial adapter with DTR or RTS reset pin** Wilson's: small mini-USB adapter, +5 / GND / RXD / TXD / RST, make not identified	`Adafruit FTDI Friend (FT232RL, product 284)`	Any 5 V FTDI- or CH340-type adapter with DTR or RTS	Adafruit www.adafruit.com/product/284	Spec	Not needed with a Nano.
☐	☐	☐	**12**	Lamps	**3 mm red LED, diffused, high-efficiency** Faceplate holes 5/32 in (4.0 mm)				Same	

Passive parts

ORD	HAVE	FIT	QTY	REF. DES.	PART / SPECIFICATION	PART NUMBER	ALTERNATES / SUBSTITUTES	WHERE TO BUY	TAG	NOTES
☐	☐	☐	**12**	Lamp resistors	**8 × 680 Ω–1 kΩ (data); 4 × 220–470 Ω (control)** Wilson used 220 Ω throughout		1 kΩ keeps eight lit lamps at ~24 mA total		Spec	220 Ω on the data lamps exceeds the 74HC595's 70 mA pin limit.
☐	☐	☐	**15**	Button pull-downs	**10 kΩ ¼ W**				Same	
☐	☐	☐	**2**	Crystal load	**22 pF C0G** Not listed by Wilson				Spec	Bare-chip build only.
☐	☐	☐	**1**	Reset pull-up	**10 kΩ** Not listed by Wilson				Spec	Bare-chip build only.
☐	☐	☐	**1**	Auto-reset	**100 nF ceramic, adapter DTR/RST to ATmega pin 1** Not listed by Wilson				Spec	Bare-chip build only.
☐	☐	☐	**4**	Decoupling	**100 nF X7R, one at each chip** Not listed by Wilson				Spec	
☐	☐	☐	**1**	Supply reservoir	**10–47 µF, 10 V or more, across the 5 V input** Not listed by Wilson				Choice	

Front panel and switches

ORD	HAVE	FIT	QTY	REF. DES.	PART / SPECIFICATION	PART NUMBER	ALTERNATES / SUBSTITUTES	WHERE TO BUY	TAG	NOTES
☐	☐	☐	**15**	Keys	**6 × 6 mm through-hole tactile switch, long round plunger** About 13 mm overall; plunger through a 3/16 in (4.8 mm) hole			Tayda www.taydaelectronics.com	Same	Check plunger diameter against the hole.
☐	☐	☐	**0**	Power and lock toggles	**Optional power toggle in the USB 5 V line** Omitted by Wilson; his firmware has no lock input				Choice	
☐	☐	☐	**1 set**	Faceplate	**Wilson's kenbak.ps printed at 100 %** Card or adhesive vinyl; or engraved			funnypolynomial.com www.funnypolynomial.com/software/arduino/ken…	Same	
☐	☐	☐	**1**	Backing plate	**1.5–2 mm acrylic or ABS** Drilled from the drilling guide				Same	

ORD	HAVE	FIT	QTY	REF. DES.	PART / SPECIFICATION	PART NUMBER	ALTERNATES / SUBSTITUTES	WHERE TO BUY	TAG	NOTES
Boards, case and hardware										
☐	☐	☐	**3**	Boards	**Pad-per-hole perfboard, 0.1 in pitch** Wilson's main board: '12-600B Datak'		A small PCB		Same	
☐	☐	☐	**4 (1 + 3)**	Chip sockets	**DIP-28 (0.3 in) × 1, DIP-16 × 3** Machined (turned-pin) only: better contact and retention, robust through re-seating				Same	
☐	☐	☐	**1 lot**	Board-to-board	**0.1 in male headers (straight, right-angle) and female socket strip**				Same	
☐	☐	☐	**1**	Case	**ABS instrument case, about 140 × 110 × 35 mm** Front opening must take the 135 × 31 mm faceplate	`Jaycar HB5970 or Altronics H0472`	Any case that takes the faceplate. A match by size, not Wilson's identified box.	Jaycar www.jaycar.com.au Altronics www.altronics.com.au	Choice	
☐	☐	☐	**1**	Rear panel	**Clear acrylic, cut to the case's rear-panel size**				Choice	
☐	☐	☐	**1**	Cable clamp	**P-clip or cable tie-down on an M3 stand-off** USB cable strain relief				Same	
☐	☐	☐	**1**	Cable	**USB cable to suit the adapter or Nano** Wilson's: USB A to mini-B				Same	
☐	☐	☐	**—**	Sleeving	**Heat-shrink tubing, about 12 mm** Over the two thin daughter boards				Same	
☐	☐	☐	**1**	Cheat sheet	**cheatsheet.html, printed and laminated**			GitHub github.com/funnypolynomial/Kenbakuino	Same	

Orders

VENDOR	ORDER NO.	DATE	TOTAL	RECEIVED	LINES / NOTES

Build total: _____ **Started:** _____ **First power-up:** _____

Notes