\ THE MAKER'S KNIFE

Electronics & Hardware Workbench

User Manual & Onboarding Guide

Field: Electronics & Hardware · Knife 06 of 50 · \ Offline.Ltd

9	2	✓	∞
Tools	Boards Supported	Fully Offline	Free Updates

This manual covers every tool in The Maker’s Knife — a single-file, offline HTML workbench for electronics and embedded hardware. Nine tools span resistor colour codes, Ohm’s law, logic gates, PWM calculation, I²C address reference, a binary clock, 555 timer design, LED circuit simulation, and automatic Arduino/ESP32 code generation. Everything runs in your browser with zero dependencies, zero network calls, and zero data collection.

Version 1.0 · For use with The_Maker_s_Knife.html

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1 Getting Started

The Maker’s Knife is a single HTML file. No installation, no server, no internet connection required. Open the file in any modern browser and you have a full electronics workbench at your fingertips.

System Requirements

Browser	Version	Notes
Chrome / Edge	90+	Recommended. Full support.
Firefox	95+	Full support.
Safari	15+	Full support. macOS and iOS.
Brave / Vivaldi	Latest	Chromium-based; fully compatible.
Internet Explorer	—	Not supported.

How to Open

Double-click **The_Maker_s_Knife.html** or drag it into your browser’s tab bar. The knife loads instantly with no network requests. All state is saved automatically to your browser’s localStorage.

> 🔧 **PRO TIP**
> E-mail this file to yourself. Your electronics bench tools will be waiting on any device, offline, forever.

The Welcome Screen

On first launch, a modal explains that your work is saved automatically in the browser. Use the **Files** tab to export a state file. The knife file and state file are all you need — keep them together. Click **“Got it — open the knife”** to dismiss. The modal won’t appear again.

2 Interface Overview

The Header

The header bar shows the knife's identity: a red backslash brand mark (\), the product name **THE MAKER'S KNIFE**, and on the right, the field category (**Electronics & Hardware**) and the knife number (**Knife 06 of 50**). The left border is accented in the field colour (green).

The Tab Bar

Nine tool tabs on the left: **Resistor**, **Ohm's Law**, **Logic Gates**, **PWM**, **I²C**, **Binary Clock**, **555 Timer**, **LED Lab**. Three system tabs on the right: ■ **Code**, ■ **Files**, **? Help**. The active tab has a red bottom border. On mobile, the bar scrolls horizontally.

Tooltips

Small ■ icons appear next to certain field labels. Hover over them to see a brief explanation of the field's purpose and expected input format.

The Disclaimer Bar

At the bottom of the page: *"All calculations are for reference only. Verify before use in safety-critical circuits."* with a link to Offline.Ltd and the version identifier.

3 Saving & File Management

Every change you make is automatically saved to your browser’s localStorage after a 400ms debounce. No save button needed. An amber dot appears on the Files tab when unsaved changes are pending.

Exporting State

Navigate to ■ **Files** and click **Export State** ↓. A JSON file (maker_knife_state.json) is downloaded containing all your current tool values. Keep this alongside the HTML file.

Importing State

Click **Import State** ↑ and select a previously exported JSON file. All tools are restored to the saved values instantly.

> ⚠ **CAUTION**
> Importing a state file overwrites all current tool values. Export your current state first if you want to keep it.

Clearing All Data

In the **Danger Zone** at the bottom of the Files tab, click **Clear All Data**. A confirmation dialog appears. This erases all saved state and cannot be undone.

> 🔧 **PRO TIP**
> Name your exported state files by project or date — e.g. robot_arm_2025.json or synth_build_march.json. This way you can switch between projects by importing different files.

4 Resistor Colour Code

Tab: **Resistor** Shortcut: **Ctrl+1**

Decode any 4, 5, or 6-band resistor instantly. Select the band count, pick each colour from dropdowns, and see the value, tolerance, and a visual resistor body update in real time. The reverse mode lets you type a value (e.g. 4.7k, 1M, 100) and get the colour band sequence back.

Inputs

Field	Description
Band Count	4-band (±5% or ±10%), 5-band (±1% or ±2%), or 6-band (±1% + temp. coeff.)
Band 1–N	Colour selectors for each band (digit, multiplier, tolerance, temp. coeff.)
Value → Bands	Enter a resistance value (e.g. 4.7k) to get the colour sequence
Value Band Count	Choose 4-band or 5-band for the reverse lookup

Outputs

Field	Description
Resistor Value	Calculated resistance in Ω, kΩ, MΩ, or GΩ
Tolerance	Tolerance percentage and temperature coefficient (6-band)
Visual Resistor	Colour-banded ceramic body with leads
Band Sequence	Colour names for reverse lookup

🔧 **PRO TIP**
Always read 5-band resistors from the end closest to the first band. If one band is clearly spaced apart — that’s the tolerance band on the right.

5 Ohm’s Law Calculator

Tab: **Ohm’s Law** Shortcut: **Ctrl+2**

Select what you want to solve for (Voltage, Current, Resistance, or Power), enter any two known values, and the result appears instantly. The VIR triangle diagram highlights the unknown quantity. Works across all four Ohm’s Law relationships.

Inputs

Field	Description
Solve for	V (Voltage), I (Current), R (Resistance), or P (Power)
Known values	Two input fields for the remaining quantities

Formulas Used

Solving For	Formulas
V	$V = I \times R$ $V = P/I$ $V = \sqrt{(P \times R)}$
I	$I = V/R$ $I = P/V$ $I = \sqrt{(P/R)}$
R	$R = V/I$ $R = V^2/P$ $R = P/I^2$
P	$P = V \times I$ $P = V^2/R$ $P = I^2 \times R$

🔧 **PRO TIP**
For power calculations, entering V and R to find P is the fastest way to check if a resistor will overheat — compare P to the resistor’s watt rating.

6 Logic Gate Simulator

Tab: **Logic Gates** Shortcut: **Ctrl+3**

Pick a gate (AND, OR, NOT, NAND, NOR, XOR, XNOR), toggle the inputs with switches, and watch the output bulb and truth table respond live. The active row in the truth table highlights your current input combination.

Gates

Gate	Behaviour
AND	HIGH only when all inputs are HIGH
OR	HIGH when any input is HIGH
NOT	Inverts one input (single input only)
NAND	Inverted AND — LOW only when all inputs are HIGH
NOR	Inverted OR — HIGH only when all inputs are LOW
XOR	HIGH when inputs differ
XNOR	HIGH when inputs are equal

7 PWM Calculator

Tab: **PWM** Shortcut: **Ctrl+4**

Enter frequency, duty cycle, supply voltage, and bit resolution. The waveform preview draws in real time showing 6 cycles with the average voltage as an amber dashed line. Six stat cards show frequency, duty cycle, period, pulse width, average voltage, and timer register value.

Inputs

Field	Description
Frequency (Hz)	Complete on/off cycles per second
Duty Cycle (%)	Fraction of each cycle the signal is HIGH
Supply Voltage (V)	Vcc — the HIGH-level voltage
Resolution (bits)	8-bit = 256 steps (Arduino Uno), 10-bit = 1024 (ESP32)

Presets

Preset	Frequency	Resolution	Voltage
Arduino 3/11	490 Hz	8-bit	5V
Arduino 5/6	980 Hz	8-bit	5V
ESP32	1 kHz	10-bit	3.3V
Servo	50 Hz	16-bit	5V

PRO TIP
Servo control: 50Hz, 5% duty = 1ms pulse (0°), 10% duty = 2ms pulse (180°). Use the Servo preset then adjust duty.

8 I²C Address Reference

Tab: **I²C** Shortcut: **Ctrl+5**

A searchable database of 29 common I²C devices with address, name, type, and notes. Search by device name, address (hex, decimal, or binary), or type. Switch the display format between 0x hex, decimal, and 7-bit binary. The Address Decoder at the bottom identifies unknown addresses from a bus scan.

Features

Feature	Description
Search	Filter by name, address (0x68), decimal, or type
Format toggle	Switch between Hex, Decimal, and Binary display
Address Decoder	Paste any address to identify known devices at that address

🔧 **PRO TIP**
Run `i2cdetect -y 1` on a Raspberry Pi or use an I²C scanner sketch on Arduino to see what addresses respond, then look them up here.

9 Binary Clock

Tab: **Binary Clock** Shortcut: **Ctrl+6**

A real-time clock displayed in binary. Three rows show Hours (5 bits), Minutes (6 bits), and Seconds (6 bits). Green (lit) = 1, dark = 0. Read from left (MSB) to right (LSB) and sum the bit weights. Pause to freeze the display, or Reset to sync back.

Bit Weights

Row	Bit Weights (left→right)	Example
Hours	16 8 4 2 1	14 = 01110
Minutes	32 16 8 4 2 1	35 = 100011
Seconds	32 16 8 4 2 1	59 = 111011

🔧 **PRO TIP**
This is how microcontroller RTC registers work internally — each time value is stored as a binary integer, with each output pin driven by one bit of the register.

10 555 Timer Studio

Tab: **555 Timer** Shortcut: **Ctrl+7**

Design astable oscillators and monostable one-shots with a live waveform canvas. Enter R1, R2, and C values to see frequency, period, duty cycle, high/low times, and exponential charge/discharge curves with ⅓/⅔ Vcc threshold markers.

Modes

Mode	Description	Key Formula
Astable	Free-running oscillator. Output toggles continuously.	f = 1.44 / ((R1 + 2×R2) × C)
Monostable	One-shot. Single trigger produces one output pulse.	T = 1.1 × R1 × C

Inputs

Field	Description
R1 (kΩ)	Resistor between Vcc and discharge (pin 7). Min 1kΩ recommended.
R2 (kΩ)	Resistor between discharge and threshold. Controls duty cycle. Astable only.
C (µF)	Timing capacitor. Larger = slower oscillation.
Vcc (V)	Supply voltage.

Cross-Tool Bridges

Use **Send frequency → PWM tab** to transfer the calculated frequency and duty cycle directly to the PWM calculator. Use **Look up R1 bands → Resistor tab** to find the colour code for your R1 value. Nearest standard E24 resistor and capacitor values are displayed automatically.

🔧 **PRO TIP**
For 50% duty in astable mode, bypass R2 with a diode (1N4148). The charge path goes through R1 only, the discharge through R2 only, giving equal on/off times when R1 ≈ R2.

11 LED Circuit Lab

Tab: **LED Lab** Shortcut: **Ctrl+8**

Design LED circuits visually. Choose an LED colour (each pre-fills a typical forward voltage), set supply voltage and desired current, and the lab calculates the perfect current-limiting resistor. The LED on screen glows with brightness proportional to current, and the schematic shows the full battery→resistor→LED→ground circuit.

LED Colours

Colour	Typical Vf	Notes
Red	1.8V	Standard indicator LED
Orange	2.0V	
Yellow	2.1V	
Green	2.2V	
Blue	3.2V	Higher Vf — needs more supply headroom
White	3.0V	Higher Vf
IR	1.2V	Infrared — not visible to human eye
UV	3.3V	Ultraviolet — highest Vf

Outputs

Field	Description
Resistor (Exact)	Calculated from R = (Vs – Vf×n) / I
Nearest E24	Closest standard E24 resistor value
Actual Current	Current with the nearest E24 resistor
Resistor Power	Power dissipated in the resistor (mW)
LED Power	Power consumed by the LED (mW)
Min Rating	Minimum wattage rating needed (¼W, ½W, 1W+)
Colour Bands	Resistor colour bands for the nearest E24 value

⚠ **CAUTION**
If the supply voltage is too low for the number of LEDs in series, the lab shows an error. Reduce the series count or increase the supply voltage.

🔧 **PRO TIP**
White and blue LEDs have higher Vf (~3.0–3.2V), so they need a higher supply voltage or fewer LEDs in series.

12 Code Generator

Tab: ■ **Code** Shortcut: **Ctrl+9**

Select any tool as the source and the Code Generator writes a complete, commented Arduino or ESP32 sketch with your current values baked in. One click to copy the code to your clipboard, ready to paste into the Arduino IDE.

Sources

Source	Output
PWM	analogWrite (Arduino) or LEDC (ESP32) sketch with frequency, duty, and pin
Resistor	#define with value and colour-band comment
I²C	Wire.beginTransmission snippet for the selected device
Logic Gates	digitalRead/digitalWrite block for the current gate
555 Timer	tone() or timer interrupt code
LED Circuit	Full LED + resistor setup sketch with blink demo
Workbench	All tools combined into one master sketch

Board Targets

Board	Key Differences
Arduino Uno	analogWrite, 9600 baud, Wire.begin(), standard pin numbers
ESP32	LEDC API, 115200 baud, Wire.begin(21,22), ESP32 pin numbers

🔧 **PRO TIP**
Use Workbench mode when you've dialled in values across multiple tools. It generates a single .ino file with all your component definitions, pin assignments, and setup code combined.

13 Keyboard Shortcuts

`Ctrl + 1`	Resistor Colour Code
`Ctrl + 2`	Ohm’s Law
`Ctrl + 3`	Logic Gates
`Ctrl + 4`	PWM Calculator
`Ctrl + 5`	I²C Reference
`Ctrl + 6`	Binary Clock
`Ctrl + 7`	555 Timer Studio
`Ctrl + 8`	LED Circuit Lab
`Ctrl + 9`	Code Generator
`Ctrl + S`	Export State
`Ctrl + H`	Help
`Esc`	Close modal

14 Troubleshooting

JavaScript is Disabled

The knife requires JavaScript to function. Enable it in your browser settings. All code runs locally — no data is sent anywhere.

State Not Saving

Your browser’s localStorage may be full or disabled. Check your browser’s privacy settings. In private/incognito mode, localStorage is cleared when the window closes.

Tab Bar Overflow on Mobile

The tab bar scrolls horizontally on narrow screens. Swipe left/right to access all tabs. Use keyboard shortcuts on desktop for faster navigation.

Import Rejected

The JSON file must be valid JSON exported from The Maker’s Knife. Files from other knives or corrupted files will fail silently. Re-export from the original source.

PWM Canvas Blank

The PWM and 555 Timer waveform canvases need a visible panel to calculate width. If the canvas appears blank, click the tab again or resize the window.

555 Timer Shows Unexpected Duty Cycle

In standard astable mode, the duty cycle is always >50% because both R1 and R2 are in the charge path. To achieve 50% duty, bypass R2 with a diode (see the Help tab).

LED Lab Shows Error

If the total forward voltage drop (Vf × LED count) exceeds the supply voltage, there is no valid resistor value. Reduce the number of LEDs or increase supply voltage.

15 Accuracy & Limitations

Tool	Typical Accuracy	Notes
Resistor Code	Exact	Matches IEC 60062 standard colour code
Ohm’s Law	Exact	Pure arithmetic — no rounding applied to inputs
Logic Gates	Exact	Boolean algebra, deterministic
PWM	Exact	Timer value rounded to nearest integer
I²C Reference	Reference only	Addresses may vary with chip configuration
Binary Clock	System clock	Accuracy depends on your device’s system clock
555 Timer	Ideal model	Does not model ESR, leakage, or comparator delay
LED Lab	Typical Vf	Forward voltage varies by manufacturer and temperature
Code Generator	Template	Pin numbers may need adjustment for your board

⚠ **CAUTION**
All calculations are for reference and educational use only. Always verify critical values with a multimeter or oscilloscope before using in safety-critical circuits. The Maker’s Knife is not a substitute for professional engineering validation.

16 Glossary

Astable	A 555 timer mode that oscillates continuously between HIGH and LOW without external triggering.
Duty Cycle	The percentage of one period during which a signal is HIGH. 50% = equal on/off time.
E24 Series	A standard set of 24 preferred resistor/capacitor values per decade, ensuring any value is within 5% of a standard part.
ESR	Equivalent Series Resistance. Parasitic resistance in a capacitor that affects high-frequency performance.
Forward Voltage (Vf)	The voltage drop across an LED when it is conducting. Varies by colour and material.
I²C	Inter-Integrated Circuit. A two-wire serial bus (SDA + SCL) for connecting peripherals to microcontrollers.
LEDC	LED Control. The ESP32's hardware PWM peripheral, supporting configurable frequency and resolution.
Logic Gate	A digital circuit that performs a Boolean function on one or more binary inputs to produce a single output.
LSB	Least Significant Bit. The rightmost bit in a binary number, representing the smallest value (1).
Monostable	A 555 timer mode that produces a single output pulse of defined duration when triggered.
MSB	Most Significant Bit. The leftmost bit in a binary number, representing the largest value.
Multiplier Band	The resistor band that indicates the power of 10 to multiply the digit value by.
Ohm's Law	V = IR. The fundamental relationship between voltage, current, and resistance in a circuit.
PWM	Pulse Width Modulation. Rapidly switching a signal between HIGH and LOW to simulate analog voltage levels.
Pull-up Resistor	A resistor connected between a signal line and Vcc to ensure a defined HIGH state when the line is not actively driven.
RTC	Real-Time Clock. A hardware clock IC that keeps time even when the main processor is powered off.

Tolerance	The maximum deviation from the stated resistance value, expressed as a percentage (±1%, ±5%, etc.).
Truth Table	A table showing all possible input combinations for a logic gate and the resulting output for each.

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