CLOCKTOPUS

APPENDIX

Extending, exploring, and understanding Clocktopus

A **Firmware Recipes**
CV LFO, Euclidean rhythms, odd time signatures, waveforms

B **Rhythm Traditions**
West African, South Asian, Balkan, Balinese, Javanese

C **PPQ Compatibility Table**
Roland, Korg, Elektron, Eurorack, Buchla/Serge note

D **Octopus — Science & Culture**
Facts, traditions, and mutual appreciation

Code snippets are illustrative starting points. Test on hardware before use in performance.
Cultural sections are written with epistemic humility — these are living traditions, not museum exhibits.

A · FIRMWARE RECIPES

Extending Clocktopus within its current hardware

All recipes in this section run on Clocktopus hardware as-is, with at most one or two passive components (resistor, capacitor) costing under €0.50.
Each recipe is a standalone addition — drop the function into your sketch and call it.

RECIPE A1 — Tempo-Synced CV LFO Output

What it does:

Outputs a smoothly varying voltage (0–3.3V) on any PWM-capable Teensy pin, with its period locked to a musical division of the current BPM.

Hardware required:

One RC low-pass filter: 10 kΩ resistor + 10 µF electrolytic capacitor (~€0.10 total)
Connect: PWM pin → 10kΩ → output jack Tip. 10µF cap between Tip and GND.
The RC filter smooths the PWM square wave into a slow voltage curve.
Time constant $\tau = RC = 10k\Omega \times 10\mu F = 100ms$ — adequate for LFO rates below ~3 Hz.

Output is 0–3.3V, not 0–5V or ±5V like true Eurorack CV

Many Eurorack CV inputs accept 0–3.3V but are calibrated for ±5V or 0–10V.
This LFO works well for modulating filter cutoff, VCA gain, or pitch (with some range limitation).
For full-range Eurorack CV, an op-amp stage is needed — outside the current BOM.

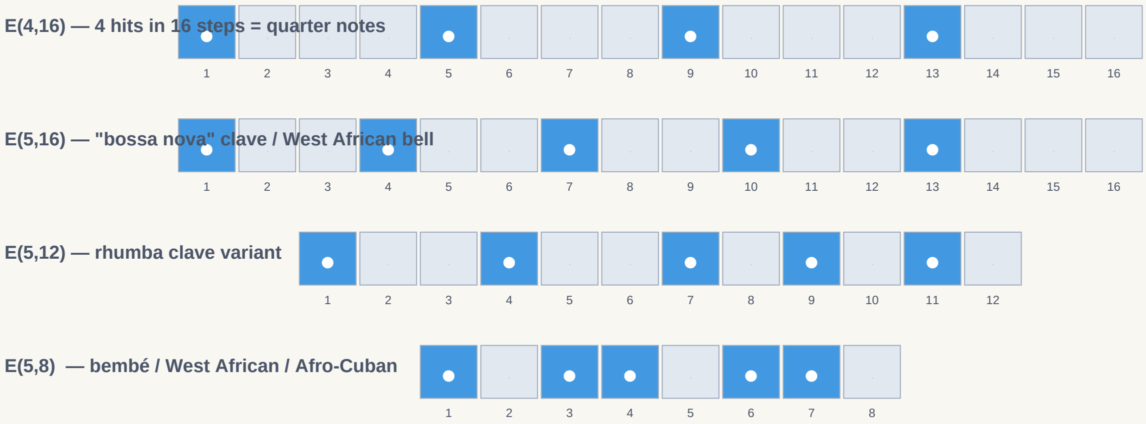
```
// RECIPE A1 — Tempo-synced CV LFO via PWM + RC filter
// Requires: 10kΩ + 10µF on the output pin
#define LFO_PIN 33          // any Teensy 4.1 PWM pin
#define LFO_WAVEFORM 0      // 0=sine  1=triangle  2=ramp up  3=square

void updateLFO() {
  // lfoRateTicks: how many 96ppqn ticks per full LFO cycle
  // e.g. 96 = 1 bar, 48 = half bar, 384 = 4 bars
  static uint32_t lfoRateTicks = 96;
  float phase = (float)(internalTickCount % lfoRateTicks) / (float)lfoRateTicks;
  float norm = 0.0f;  // 0.0 to 1.0
  if      (LFO_WAVEFORM == 0) norm = 0.5f + 0.5f * sinf(phase * 2.0f * PI);
  else if (LFO_WAVEFORM == 1) norm = (phase < 0.5f) ? phase*2.0f : 2.0f-phase*2.0f;
  else if (LFO_WAVEFORM == 2) norm = phase;
  else                        norm = (phase < 0.5f) ? 1.0f : 0.0f;
  analogWrite(LFO_PIN, (uint16_t)(norm * 4095));  // 12-bit PWM
}
// Call updateLFO() from loop() — NOT from the ISR
```

RECIPE A2 — Euclidean Rhythms (Bjorklund Algorithm)

What it does:

Distributes k hits as evenly as possible across n steps — a pattern found in many musical traditions worldwide (see Section B). Named after mathematician Euclid; the algorithm was connected to rhythm by Godfried Toussaint (2004).

Visual examples:

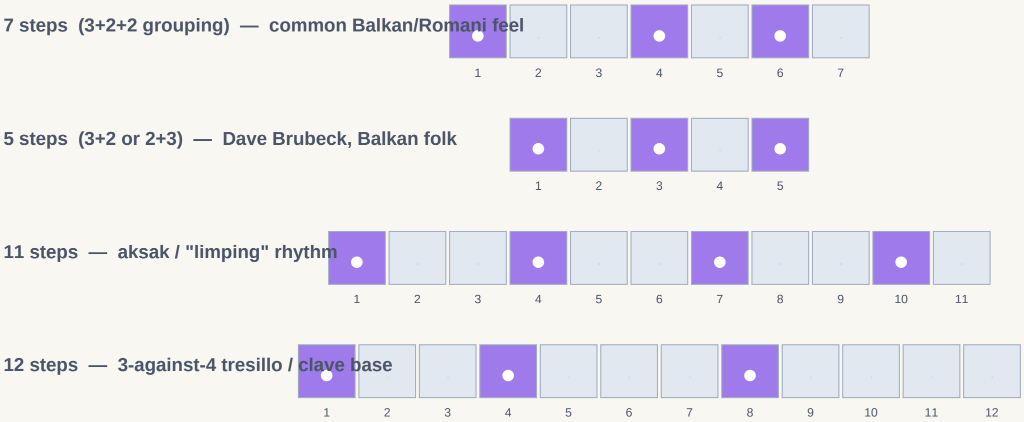



```
// RECIPE A2 — Euclidean rhythm generator
// k = number of hits, n = total steps
bool euclidean(uint8_t step, uint8_t k, uint8_t n) {
  return ((step * k) % n) < k;
}

// Usage in the ISR — replace portTickCount logic for one port:
uint8_t euclidStep[8] = {0};  // per-port step counter
uint8_t euclidK[8]    = {5,5,5,5,5,5,5,5};  // hits per cycle
uint8_t euclidN[8]    = {16,16,8,12,16,16,16,16}; // steps per cycle

// Inside clockISR(), for CV ports:
euclidStep[i] = (euclidStep[i] + 1) % euclidN[i];
bool shouldFire = euclidean(euclidStep[i], euclidK[i], euclidN[i]);
if (shouldFire) { digitalWriteFast(CV_PINS[i], HIGH); }
```

RECIPE A3 — Odd Time Signatures Per Port

What it does:

Each port cycles through a repeating pattern of a different length — a 7-step port and a 4-step port running simultaneously create a natural polyrhythm (7 against 4). Inspired by the 4MS Shuffling Clock Multiplier's relationship-aware outputs.




```
// RECIPE A3 — Per-port pattern length (odd/asymmetric time)
// Each port can have its own cycle length, independent of others
const uint8_t portCycleLen[8] = {7, 7, 5, 5, 4, 4, 12, 12};
// hits within that cycle (Euclidean or hand-crafted):
// Port 0: 7 steps, fire on steps 0,3,5  (3+2+2)
const bool portPattern[8][16] = {
  {1,0,0,1,0,1,0,0,0,0,0,0,0,0,0,0},  // port 0: 7/8 (3+2+2)
  {1,0,0,1,0,1,0,0,0,0,0,0,0,0,0,0},  // port 1: 7/8 (3+2+2)
  {1,0,1,0,1,0,0,0,0,0,0,0,0,0,0,0},  // port 2: 5/8 (2+3)
  {1,1,0,1,0,0,0,0,0,0,0,0,0,0,0,0},  // port 3: 5/8 (3+2)
};
uint8_t patStep[8] = {0};
// In ISR — per port:
patStep[i] = (patStep[i] + 1) % portCycleLen[i];
if (portPattern[i][patStep[i]]) { /* fire */ }
```

⌖ Inspired by: 4MS SCM, Expert Sleepers Disting, Mutable Grids

4MS Shuffling Clock Multiplier: outputs at musically related multiples, with shuffle.

Mutable Instruments Grids: pre-loaded with percussion maps from world music; can randomise.

Expert Sleepers Disting: reconfigurable, includes Euclidean patterns as one of many modes.

These are all worth studying — Clocktopus takes a simpler but philosophically similar path.

B · RHYTHM TRADITIONS OF THE WORLD

Concepts, patterns, and Clocktopus firmware ideas

⌖ A note on how this section was written

These five traditions are chosen for their rhythmic richness and their relevance to Clocktopus features — not as a representative survey of all musical cultures. Each description is drawn from academic and ethnomusicological sources, written mostly in English by researchers who are often outside the traditions they study. This is a limitation, not a credential. Each section points toward practitioners and primary sources where possible. These are living traditions, actively practised and debated by millions of people — a paragraph cannot and should not contain them.

TRADITION 1 — West African timeline patterns (Ewe, Yoruba, Akan)

A note on naming:

"West African rhythm" covers hundreds of distinct ethnic and regional traditions. What is often called "the African bell pattern" in music theory literature is the 12-step timeline played on an iron bell (gankogui), found in Ewe, Fon, and related music of coastal West Africa (modern Ghana, Benin, Togo).

The concept:

The bell pattern is a rhythmic reference: a fixed, repeating cycle that anchors all other parts. Different ensemble parts begin at different points in the same cycle (a concept called "phase" or "hocket" in Western terminology — though those terms flatten what is a richer structural idea in the original context).

12-step Ewe gankogui (iron bell) timeline — E(7,12):

The pattern has 7 hits in 12 pulses. The asymmetry is the feature — it is intentionally "off-centre", creating a sense of forward motion and interlock.

```
// WEST AFRICAN BELL — 12-step Ewe gankogui timeline
const bool ewe_bell[12] = {1,0,1,0,1,1,0,1,0,1,1,0};
// Offset: second drum enters 4 steps later (phase shift)
const bool ewe_bell_offset[12] = {1,0,1,1,0,1,0,1,1,0,1,0};
// portCycleLen[i] = 12, portPattern[i] = ewe_bell
// Another port: portPattern[j] = ewe_bell_offset
// Result: two interlocking parts, filling each other's silences
```

TRADITION 2 — South Asian tala systems (Hindustani and Carnatic)

A note on naming:

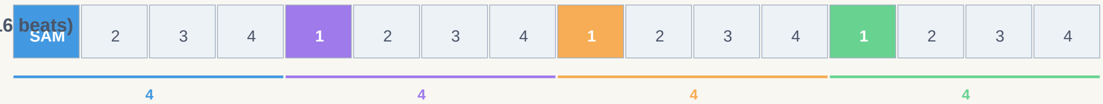
Hindustani (North Indian) and Carnatic (South Indian) are distinct traditions with different tala systems, terminology, and practice. They are not interchangeable. Both are living, transmitted through deep teacher-student (guru-shishya) lineages.

The concept:

A tala is a time cycle, divided into groups (vibhaga/anga). The first beat of the cycle (sam) is the meeting point — where all strands resolve. The tension between arrival at sam and departure from it drives the music forward.

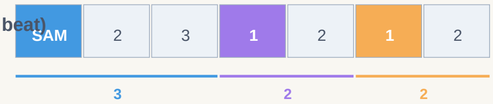
Teentaal (Hindustani) — 16 beats in 4+4+4+4 groups:

Teentaal (16 beats)



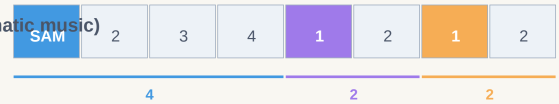
Rupak taal (Hindustani) — 7 beats in 3+2+2 groups:

Rupak taal (7 beats — begins on khali/empty beat)



Adi tala (Carnatic) — 8 beats in 4+2+2 groups:

Adi tala (8 beats — most common in Carnatic music)



Clocktopus idea:

Each vibhaga maps to a Clocktopus port. Ports fire at the downbeat of their group — so Teentaal creates 4 ports at equal intervals, while Rupak creates three ports at unequal intervals (3, then 2, then 2 beats apart).

```
// RUPAK TAAL — 7-beat cycle, groups 3+2+2
// Internal ticks for 7 eighth-notes at 96ppqn: 7 × 12 = 84 ticks
const uint8_t RUPAK_LEN = 84;
const uint8_t rupak_fires[3] = {0, 36, 60}; // tick offsets (3×12, 2×12)

void rupakTrigger(uint8_t port) {
  uint8_t tick = internalTickCount % RUPAK_LEN;
  for (uint8_t g = 0; g < 3; g++) {
    if (tick == rupak_fires[g]) {
      digitalWriteFast(CV_PINS[port], HIGH);
    }
  }
}
```

TRADITION 3 — Balkan and Southeast European asymmetric meter

A note on naming:

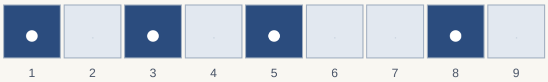
"Balkan" is a geographically and culturally diverse region covering many distinct ethnic, religious, and musical communities (Bulgarian, Romani, Serbian, Turkish, Macedonian, Albanian, Greek, among others). The term "Balkan rhythm" used here refers to a widely shared structural feature — not a single unified tradition.

The concept — aksak ("limping"):

Asymmetric meters built from twos and threes: 7 = 3+2+2 or 2+2+3, 9 = 2+2+2+3 or 3+3+3, 11 = 3+2+3+3. The uneven "limp" is the groove. These meters are not heard as "strange" by practitioners — they are natural, danced, and sung. They feel "off" only from a 4/4-centric listening position.

7/8 (3+2+2) — Macedonian/Bulgarian dance

9/8 (2+2+2+3) — Turkish kars■lama



12/8 (3+2+2+3+2) — Bulgarian horo variant


```
// 7/8 AKSAK — grouped as 3+2+2 (short-long-long feel)
// 7 eighth-notes = 84 internal ticks (7 × 12 at 96ppqn)
const uint8_t aksak7_len = 84;
// Beat positions within the 84-tick cycle:
const uint8_t aksak7_beats[3] = {0, 36, 60}; // 0, 3×12, 5×12

// Firing the "long-short-long" feel on a CV port:
uint8_t tick7 = internalTickCount % aksak7_len;
bool aksak_fire = (tick7==0 || tick7==36 || tick7==60);
if (aksak_fire) { digitalWriteFast(CV_PINS[port], HIGH); }
```

⌖ Aksak patterns can be multiplied across ports for polymetric texture

Port A: 7-step aksak · Port B: 4-step quarter notes → 7-against-4 polyrhythm.

They converge at the least common multiple: 28 steps (4 bars of 7, 7 bars of 4).

This is the same structural principle used in much West African music and Indian tala.

TRADITION 4 — Balinese gamelan and kotekan interlocking

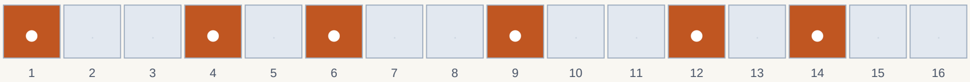
A note on naming:

Balinese gamelan (primarily kebyar style in modern practice) is distinct from Javanese gamelan in structure, sound, performance practice, and cultural role. Both are living court and community arts — not archival music.

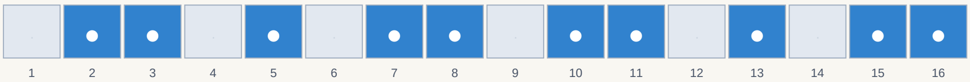
The concept — kotekan (interlocking):

Two parts (polos and sangsih) each play incomplete patterns that interlock to form a single, dense figuration. Neither part makes rhythmic sense alone — they are designed to be heard together. This is fundamentally a social music: the pattern only exists in the cooperative act of playing it.

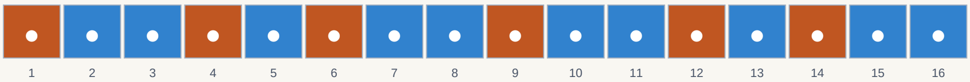
Polos (part 1 — plays the "on" beats):



Sangsih (part 2 — fills the silences):



Combined — every 16th note covered, continuous movement:




```
// KOTEKAN — Balinese interlocking pattern
// Two ports fill each other's silences — together = continuous stream
const bool polos[16]   = {1,0,0,1,0,1,0,0,1,0,0,1,0,1,0,0};
const bool sangsih[16] = {0,1,1,0,1,0,1,1,0,1,1,0,1,0,1,1};
// Port 0: polos, Port 1: sangsih, both at 16th-note tick rate
// Neither sounds complete alone — interlock is the composition
```

TRADITION 5 — Javanese gamelan and colotomic structure

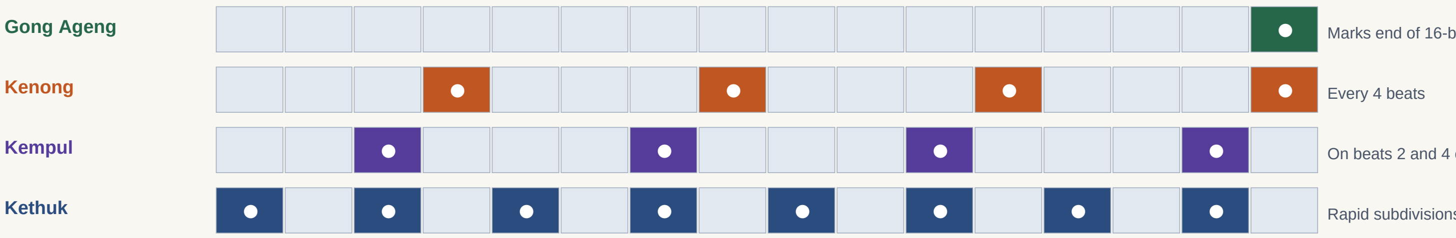
A note on naming:

Javanese gamelan encompasses many distinct styles (court gamelan, pesinden, gamelan sekaten, etc). The description here focuses on one structural principle from Central Javanese court style — the colotomic (punctuating instrument) layer.

The concept — colotomic punctuation:

In Javanese gamelan, large bronze gongs mark the boundaries of time cycles at different levels of scale. The gong ageng strikes the longest cycle (gongan), smaller kenong and kempul mark subdivisions, and the kethuk fills shorter gaps. A single gongan may last minutes — the music exists inside this slow container.

Colotomic hierarchy in Lancaran form (16 beats):



Clocktopus idea:

Assign different ports to fire at different levels of the hierarchy.
Port 1 (slow): whole notes — the "gong ageng" presence.
Port 2–3: quarter notes — kenong/kempul subdivisions.
Port 4–5: 8th or 16th notes — the kethuk rhythm.
This is already the default Clocktopus multi-division layout — the structural idea was embedded in the design before the connection to gamelan was explicit.

⌖ Further reading — these are starting points, not conclusions

Mantle Hood, "The Ethnomusicologist" (1971) — early study of Javanese gamelan.

Godfried Toussaint, "The Geometry of Musical Rhythm" (2013) — Euclidean patterns.

Jeff Pressing, "Cognitive Complexity of Music" — polyrhythm cognition.

The best learning is from teachers who carry these traditions.

C · PPQ COMPATIBILITY TABLE

Desktop instruments, Eurorack modules, and system notes

Always verify with your specific device firmware version

PPQ rates can change between firmware updates. Some devices have different sync modes selectable in settings (e.g. "MIDI clock" vs "DIN sync" vs "trigger in").

Many instruments will silently ignore clock if they are set to SEND rather than RECEIVE.

"MIDI 24 PPQ" rows: set the Clocktopus MIDI port to MIDI(24) preset.

DEVICE	MIDI PPQ	CONNECTOR	NOTES
ROLAND			
TR-909	24	5-pin DIN	MIDI + DIN sync. DIN sync = 24ppq with start/stop. Classic.
TR-808	24	5-pin DIN	DIN sync only (no MIDI). Uses 24ppq pulse + start/stop lines.
TR-606	24	3.5mm mono	Clock In/Out. 24ppq pulse. No MIDI.
TB-303	—	3.5mm mono	No MIDI. Proprietary DIN sync — external sync with caution.
TR-8S	24	5-pin DIN	Full MIDI clock. Internal/external selectable.
MC-707	24	5-pin DIN + USB	MIDI clock master/secondary. USB MIDI also works.
KORG			
Volca series	2 (sync) / 24 (MIDI)	3.5mm mono + 5-pin DIN	Sync port = 2ppq; DIN MIDI port = 24ppq. Use CV port with Volca preset.
minilogue xd	24	5-pin DIN	Full MIDI clock receive. Solid sync.
monologue	24	5-pin DIN	MIDI clock receive + sync in/out (3.5mm, 2ppq).
electribe 2	24	5-pin DIN	MIDI clock receive. External sync mode in settings.
SQ-64	24	5-pin DIN + USB	Sequencer. MIDI clock receive. USB MIDI host.
YAMAHA			
Digitone / Syntakt / Octatrack	24	5-pin DIN + USB	Elektron devices: robust MIDI clock, configurable receive/send.
reface DX/CP/CS	24	5-pin DIN + USB	MIDI clock receive for arpeggiator sync.
ARTURIA			
KeyStep Pro	24	TRS Type B + 5-pin DIN	TRS outputs are Type B. Use included adapter. Clock in/out.
BeatStep Pro	24	TRS Type B	TRS Type B. Clock in/out. CV/gate also available.
MiniFreak	24	5-pin DIN + USB	Full MIDI clock. LFO sync to clock.
NOVATION			
Circuit Tracks	24	TRS Type B + USB	TRS Type B. Sessions sync to external MIDI clock.
Circuit Rhythm	24	TRS Type B + USB	TRS Type B. MIDI clock in supported.
Peak / Summit	24	5-pin DIN	Clock sync for arpeggiator and modulations.
ELEKTRON			
Digitakt	24	5-pin DIN + USB	MIDI clock in/out. Tight sync, programmable MIDI tracks.
Octatrack	24	5-pin DIN	MIDI clock in/out + DIN sync. Very configurable.
Analog Rytm	24	5-pin DIN	MIDI clock in. Drum synthesiser + sampler.

AKAI

MPC One/Live	24	5-pin DIN + USB	MIDI clock in/out. "External sync" mode in settings.
Force	24	5-pin DIN + USB	Full MIDI clock and USB MIDI.

MOOG

Moog DFAM	—	3.5mm mono	CV/gate only. No MIDI. Accepts 0-5V trigger clock.
Moog Subharmonicon	24	TRS Type A + 5-pin DIN	MIDI clock in. 3.5mm TRS Type A for MIDI.
Subsequent 37	24	5-pin DIN	MIDI clock for arpeggiator and LFO sync.

NATIVE INSTRUMENTS

Maschine Mk3	24	USB only	USB MIDI only. No 5-pin DIN. Clock in/out in software.
Traktor S4	24	USB only	MIDI clock via USB. Also generates MIDI clock.

TEENAGE ENGINEERING

OP-1 field	24	TRS Type A + USB	MIDI clock in on TRS Type A. Solid sync in sequencer mode.
OP-Z	24	TRS Type A + USB	MIDI clock in via TRS. Can also be master clock.

EURORACK MODULES — Clock input conventions

Eurorack has no universal clock standard. Modules accept pulse/trigger inputs at whatever rate they need. The table below lists common inputs and their typical PPQ.

MAKE NOISE			
René sequencer	4 or 24	3.5mm mono	Configurable. 24ppq gives full resolution.
Maths	any	3.5mm mono	Accepts any trigger/gate for cycle triggering.
TEMPI (clock mod)	1–48	3.5mm mono	Clock multiplier/divider. Very flexible.
MUTABLE INSTRUMENTS			
Grids	4–24	3.5mm mono	Accepts clock input, runs Euclidean maps internally.
Tides	any	3.5mm mono	Trigger input resets/advances the oscillator.
Stages	any	3.5mm mono	Clock divider or trigger input for segments.
INTELLIJEL			
Metropolix	24	3.5mm mono	Full MIDI clock in. Also 1ppq/4ppq gate input.
Plonk	—	3.5mm mono	Trigger-only. No clock needed.
4ms COMPANY			
SWN (Spherical Wavetable)	any	3.5mm mono	Clock/trigger input for wavetable animation.
Shuffling Clock Multiplier	4	3.5mm mono	4ppq default. Outputs multiples/divisions.
DOEPFER			
A-147 VCLFO	any	3.5mm mono	Clock sync input for LFO rate.
A-154 Seq Controller	4–24	3.5mm mono	Configurable clock in.
NOISE ENGINEERING			
Mimetic Digitalis	1–96	3.5mm mono	Configurable clock in. Step advance or direct.
Ataraxic Translatron	any	3.5mm mono	Trigger-in for step advance.
TIPTOP AUDIO			
Trigger Riot	1–24	3.5mm mono	Clock in. Euclidean sequencer. Very flexible.
EXPRESSIVE E / ERICA SYNTHS			
Erica Synths Drum Sequencer	4–24	3.5mm mono	Clock in. 24ppq or 4ppq configurable.

BUCHLA AND SERGE — A different connector and a different philosophy

Both Buchla (Don Buchla, San Francisco, 1960s) and Serge (Serge Tcherepnin, CalArts, 1970s) use 4mm banana jacks — not 3.5mm Eurorack jacks.

But the connector is the smaller difference:

Buchla systems typically operate at 0–15V signal levels, not the 0–5V or ±5V of Eurorack. Control voltages are often 0–10V. Clock signals may be 10V pulses. Connecting Clocktopus CV outputs (5V) to Buchla inputs directly risks underdriving them or, in some configurations, damaging modules.

■ Do not connect Clocktopus CV outputs to Buchla or Serge without research

Verify the input voltage specification for each specific Buchla/Serge module.

A level-shifting module (or dedicated Eurorack ↔ Buchla adapter) may be needed.

D · OCTOPUS — SCIENCE AND CULTURE

Facts, traditions, and mutual appreciation across ocean and land

⌖ A note on this section

Octopus science is genuinely exciting and rapidly advancing.

The cultural entries draw from written sources — many coastal communities have knowledge of octopus that is held in oral tradition and practice, not in the texts this survey draws from.

We acknowledge this gap rather than paper over it.

The Pacific Giant Octopus (North Pacific Ocean)

Enteroctopus dofleini is the largest octopus species, reaching arm spans over 4 metres.

Found from Japan and Korea to California and Alaska, it lives in cold, shallow to mid-depth water.

Research by Jennifer Mather and Roland Anderson (1990s, Seattle Aquarium) documented what they described as individual personality differences in captive octopuses — curiosity, playfulness, wariness — behaviours that were controversial at the time and are now more widely accepted.

Each arm contains about two-thirds of its neurons (~300 million of ~500 million total), allowing semi-autonomous arm movement — the arm "thinks" locally before reporting to the central brain.

The Mimic Octopus (Indonesia, Indo-Pacific)

Thaumoctopus mimicus, first documented in 1998 off Sulawesi, Indonesia, performs active imitation of other species — flatfish, lionfish, banded sea snakes — apparently selecting which animal to mimic based on predator type. (Norman, Finn & Tregenza, 2001.)

This is one of only a small number of documented cases of flexible, context-dependent mimicry in a non-vertebrate animal.

Indonesian coastal fishers have long-standing familiarity with this species; the academic "discovery" was a formal documentation, not a first encounter.

The Blue-Ringed Octopus (Indian Ocean and South Pacific)

Hapalochlaena species are among the most venomous animals on Earth, yet rarely larger than 15cm.

Their venom (tetrodotoxin, also found in pufferfish) has no known antidote — yet bites are extremely rare in practice, as the animal is typically docile and only bites when provoked.

Their vivid blue rings are iridescent, not pigmented — structural colour from chromatophores and iridophores, appearing and intensifying when the animal is alarmed. At rest, the rings are nearly invisible. This is an honest warning signal, not permanent advertisement.

Found from Japan to Australia, and throughout the Indian Ocean.

The Common Octopus (Mediterranean, Atlantic, Indian Ocean)

Octopus vulgaris may be the most studied octopus. Pliny the Elder described its behaviour in "Naturalis Historia" (77 CE) — a 2,000-year written record of observation.

Mediterranean fishing communities have practised octopus fishing for at least this long, using clay pots (called "octopus pots" or polychnia) as artificial dens since antiquity.

Modern neuroscience work (Packard, Wells, Young at the Marine Biological Station, Plymouth) established much of what we know about cephalopod learning and memory through the mid-20th century.

Octopus vulgaris can navigate mazes, unscrew jars, and demonstrate long-term memory — findings that contributed to EU legislation (2010) extending research animal protections to cephalopods.

OCTOPUS IN CULTURE — Selected perspectives across peoples and oceans

⌖ On this section's limitations

The sources below are drawn from written, largely English-language records. Living oral traditions and indigenous knowledge systems are far richer than any secondary survey can represent. These entries are invitations to look further, not summaries that should be taken as complete or definitive.

Japan — Tako (■■)

Octopus (tako) has been a food, cultural symbol, and subject of art in Japan for centuries. Katsushika Hokusai's "Dream of the Fisherman's Wife" (1814) is perhaps the most internationally known image, though its cultural context within shunga (erotic woodblock art) is often stripped away in Western citations. In everyday contemporary Japan, tako is common in takoyaki (octopus balls), sushi, and festival street food — an ingredient that connects ancient fishing traditions to daily life.

Aotearoa New Zealand — He'e and M■ori tradition

In te reo M■ori, the octopus is wheke. In traditional M■ori worldview, octopus (along with other sea creatures) exists within a relational framework connecting the human (tangata) and natural worlds, rather than as a resource to be classified and extracted.

The image of the octopus — multiple extending arms from a central body — appears in some discussions of whakapapa (genealogical connection) as a structural metaphor, though how formally this applies varies by iwi (tribal group) and teacher.

Ancient Mediterranean — Greek and Roman observation

Aristotle wrote detailed observations of octopus in "Historia Animalium" (~350 BCE), including descriptions of colour change and the use of the hectocotylus arm in reproduction — though he misidentified its function. Pliny the Elder (77 CE) described octopus behaviour with a mixture of accurate observation and legend that reflects the limits and practices of natural history at the time. Both records remind us that careful observation of these animals predates modern science by millennia.

Indigenous Pacific Northwest — Haida and neighbouring peoples

Among the Haida people of Haida Gwaii (off the coast of what is now called British Columbia), the octopus (skil) appears in formline art — the distinctive Northwest Coast visual language — as a creature of transformation and the deep. As with all Haida formline subjects, the visual representation is a carrier of story and relationship, not mere decoration.

The deep-sea octopus appears in oral traditions connecting the human world to the ocean world. These traditions are alive, transmitted by artists and knowledge-keepers — not past-tense artefacts.

The octopus does not need a clock to move eight arms in concert.
Each arm knows what it needs to know. We are still learning how.

— Clocktopus Appendix, March 2026