

THERMODYNAMIC SAMPLING UNIT

Z1

Extropic's first scaled-up thermodynamic chip. It samples from an energy-based model directly in hardware, using pbits: small circuits that turn the thermal noise of ordinary transistors into programmable randomness.



Z1 · EXTROPIC PRODUCT IMAGE

269,568

PBITS

8

CORES

>50 MHz

SAMPLING RATE

<1 W

POWER

SPECIFICATIONS

WHAT'S ON THE DIE

PBITS	269,568
CORES	8
COUPLING PARAMETERS	215,904
CONNECTIVITY	Sparse graph; each pbit connects directly to 16 neighbours
MODEL	Ising model, a type of energy-based model
ALGORITHM	Chromatic Gibbs sampling, run in place on the chip
SAMPLING RATE	Over 50 MHz
POWER	Under 1 W
SIZE	Under 12 mm per side
STATUS	Taped out, summer 2026; early access 2027

HOW IT WORKS

A NETWORK OF WEIGHTED COINS

A pbit outputs 0 or 1 at random, like a weighted coin, and the weighting can be programmed. Z1 wires 269,568 of them into a sparse graph in which each pbit is directly connected to sixteen neighbours, and the chip's 215,904 coupling parameters program how pbits influence one another. Together they define an Ising model.

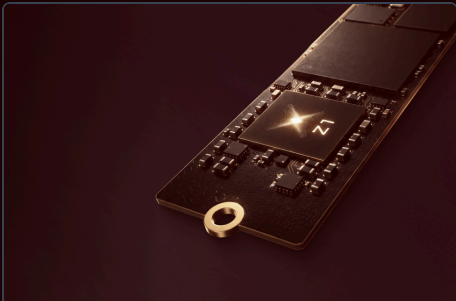
Z1 runs chromatic Gibbs sampling in place: groups of pbits that don't share a connection update at the same time, each according to its neighbours' current states. The result is samples from the model's thermal equilibrium state, at a sampling rate of over 50 MHz.

Z1 stores and processes information in the same place. Extropic says this greatly lowers the energy conventional chips lose shuttling bits to memory and back, and that it is what lets 269,568 pbits fit on a chip under 12 mm per side that draws under 1 W.

FROM THE EDGE TO THE DATA CENTRE

Z1 SYSTEMS

Extropic plans to put Z1 in three systems: a compute stick for devices at the edge, an accelerator card for servers, and a cluster built from those cards.



EDGE

Z1 THERMO COMPUTE STICK

FORM FACTOR	M.2
Z1 CHIPS	2
PBITS	Over 500,000
EARLY ACCESS	2027

For low-power edge applications such as augmented reality and robotics.



SERVERS AND WORKSTATIONS

Z1 ACCELERATOR CARD

FORM FACTOR	Standard PCIe card
Z1 CHIPS	16
PBITS	Over 4,000,000
EARLY ACCESS	2027

Slots in beside other accelerators, so one server can run workloads across thermodynamic and classical compute.

PLANNED · 2027

One billion+

1,000,000,000+ PBITS IN ONE CLUSTER

RESEARCH AT SCALE

THERMO COMPUTE CLUSTER

BUILT FROM	Z1 accelerator cards
PBITS	Over 1,000,000,000
PLANNED	2027

Extropic's planned first large-scale thermodynamic computing cluster, for research into algorithms at greater scale.

SOFTWARE

PROGRAMMING THE STACK

THRML	Open-source library for thermodynamic hypergraphical models. Uses JAX to simulate TSUs and to train energy-based models. Live since fall 2025.
TORX	Open-source framework for stochastic differentiable programming. Hardware-agnostic: runs on XTR-0 today and on Z1 next.
THERMALIZERS	Compiler that turns Torx programs into energy-based models that map onto thermodynamic hardware such as Z1. Announced with a whitepaper in summer 2026.
SIMULATOR API	Early-access API that runs Torx and THRML programs on high-performance GPU simulators of Z1.

EARLY ACCESS 2027 Z1 sticks, cards and clusters. Developers can start today with Torx, THRML and the simulator API. More at extropic.ai/hardware.