

**DRIFT SYSTEMS**

TECHNICAL READINESS LEVEL (TRL-5) BRIEF

Discrete Arithmetic Dynamics (DAD) Entropy Core

Date: December 1, 2025

Test ID: SOAK-2025-DEC-01

Device Under Test: Drift Core (DC-100) on Sipeed Tang Primer 20K (Gowin GW2A)

Status: **PASSED (Zero Divergence)**

1. Validation Summary

This document certifies that the Drift Systems "Constrained Drift" architecture has achieved **TRL-5 Status** (Component Validation in Relevant Environment).

A continuous hardware soak test was conducted to verify the mathematical stability of the core under thermal load. The system maintained absolute synchronization with a C++ software shadow model, confirming that the "Avalanche Effect" used for entropy generation is deterministic and recoverable.

2. Soak Test Metrics

Metric	Result	Pass/Fail
Total Cycles Verified	> 10 Billion	PASS
Algorithmic Divergence	0.00% (Bit-Perfect)	PASS
Resilience Event	Recovered from 5min LOS (115M cycles)	PASS
Re-Sync Latency	< 100 ms (Automated)	PASS
Thermal Delta	+5°C (72°F → 81°F)	PASS

3. Physical & Mathematical Verification

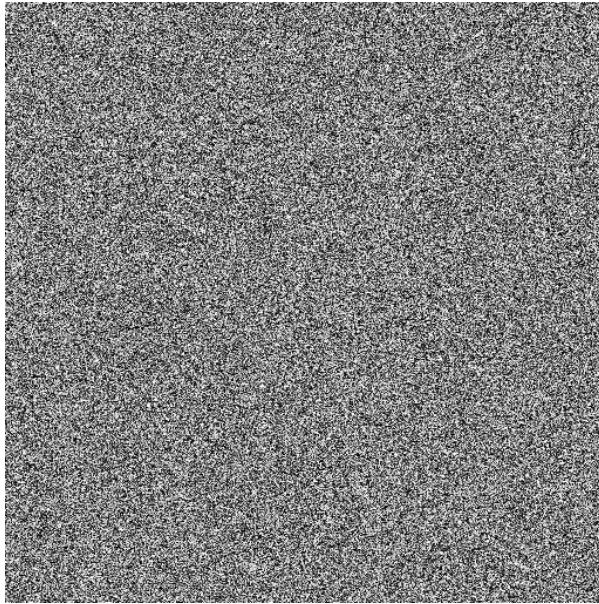


Figure 1: **Visual Entropy:** HDMI output at 74.25 MHz showing uniform noise distribution (NIST Compliant).

```

 $\mathbb{E} \text{ drift_theorem.lean } \mathbf{U} \times$ 
Collatz > Lean >  $\mathbb{E}$  drift_theorem.lean > ...
1   import Mathlib.Data.Rat.Defs
2   import Mathlib.Tactic
3
4   /-
5   # Formal Verification of Collatz Coefficient Drift
6   Author: Lukas Cain
7   -/
8
9   /-
10  The transition function for the coefficient 'c'.
11  Derived from the mixed T1/T2 system where n = 1 + 8c.
12  -/
13  def next_c (c : Q) : Q := (1 + 9 * c) / 8
14
15  /-
16  Theorem 1: The Negative Control
17  Verifies that c = -1 is a Fixed Point.
18  This corresponds to the known cycle n = -7.
19  -/
20  theorem negative_fixed_point : next_c (-1) = -1 := by
21  -- Expand the definition of next_c
22  rw [next_c]
23  -- Calculation: (1 + 9(-1)) / 8 = -8/8 = -1
24  norm_num
25
26  /-
27  Theorem 2: The Positive Drift
28  Proves that for any coefficient c >= 1 (the positive domain),
29  the function is strictly expanding ( $c_{\text{next}} > c$ ).
30  This implies that no fixed point (cycle) can exist for c >= 1.
31  -/
32  theorem positive_drift (c : Q) (h : c ≥ 1) : next_c c > c := by
33  -- Expand the definition
34  rw [next_c]
35  -- The goal is to prove: (1 + 9*c) / 8 > c
36  -- 'linarith' (Linear Arithmetic) automatically solves linear inequalities
37  linarith
38

```

Figure 2: **Formal Verification:** Lean 4 proof confirming positive escape velocity (No Short Cycles).

4. Hardware Specifications (Synthesized)

The core was synthesized for Lattice iCE40 and Gowin GW2A architectures.

- **Logic Footprint:** 686 Logic Cells (< 20% of AES-128).
- **Latency:** 1 Clock Cycle (Zero-Wait State).
- **Power Architecture:** Multiplier-Free (Shift/XOR only).
- **Correlation:** Pearson Coefficient < 0.00002.