

Pre-Movement Detector v3.3 - Final Production Specification

The Definitive Implementation Guide with All Ambiguities Resolved

Executive Summary

A momentum-free detection system that identifies crypto assets entering pre-explosive states through structural pressure, behavioral patterns, and timing compression. Requires 2-of-3 independent confirmations, enforces strict microstructure gates, and includes comprehensive risk controls.

Core Innovation: Catch the compression (coil), not the breakout (spring).

1. System Architecture

1.1 Scoring Model (100 points)

A. Structural Signals (45 points)

yaml

derivatives: 20

funding_divergence: 8-12

calculation: $\text{funding_z} < -1.5$ AND $\text{spot} \geq \text{VWAP}(24\text{h})$

z_score: vs 30d mean/std per venue, then venue-median

confirm: $\text{spot_cvd} \geq 0$ OR $\text{perp_cvd} \leq 0$ (8-12h window)

bonus: +2 if negative >6 consecutive 4h periods

venues: Binance, OKX (Coinbase N/A - no perps)

basis_structure: 0-4

signal: near < far (backwardation) with same sign consistency

hedge_filter: if $|\text{near-far}| > 100\text{bps}$ AND $\text{vol} > \text{p80}(30\text{d})$: multiply 0.5

consistency: near & next/quarter same sign required

venues: Binance, OKX futures only

liquidation_asymmetry: 0-4

trigger: shorts:longs $\geq 2:1$ in 24h

cluster: levels within 3% of spot

source: aggregated liquidation feeds

supply_demand: 15

exchange_flows: 8-10

primary: $\text{reserves_7d} \leq -5\%$ across ≥ 3 venues

fallback: proxy_2_of_4 (see section 1.3)

precedence: if ANY reserve feed healthy, prefer primary

stablecoin_dynamics: 0-5 # *Confirmed 0-5, not 0-3*

ratio: USDT/USDC share in quotes trending

health: all majors within $\pm 0.5\%$ of par

check_venues: [Binance, OKX, Coinbase]

REMOVED: miner_behavior (obsolete)

microstructure: 10

liquidity_quality: 6-8

depth: $\geq \text{tier_adjusted}$ (USD within $\pm 2\%$)

spread: $\leq \text{tier_adjusted}$ (bps)

vadr: $\geq \max(\text{percentile}(80, 24\text{h}), \text{tier.vadr_min})$ # *PRECEDENCE RULE*

measurement: primary venue, 60s rolling average

venue_health: 0-2

dispersion: $\text{spread_across_venues} < 0.5\%$

arbitrage: closing < 800ms

venues_required: >=2 healthy for cross-checks

B. Behavioral Patterns (30 points)

yaml

smart_money: 15

whale_accumulation: 6-9

composite: require 2_of_3

- large_print_clustering (detailed in 1.5)
- cvd_residual > 0 with drift < 0.5×ATR
- maker_pull OR hotwallet_decline (optional)

variance: low over 3 days (std < median_30d)

institutional: 0-6

coinbase_premium: (mid_CB - median(mid_others)) / median(mid_others)

smoothing: 5-minute EMA to avoid flicker

cme_gap: optional, delayed data only (not real-time free)

cvd_volume: 15

divergence: 6-8

signal: cvd_residual > 0 (see section 1.6)

price: movement < 0.5×ATR over 12-24h

volume_profile: 0-4

vpoc: migration upward

gaps: being filled

absorption: 0-3

large_sells: absorbed without drop

icebergs: persistent bid refills

C. Catalyst & Compression (25 points)

yaml

compression: 12

volatility: 8-10

bb_width: \leq percentile(10, 30d)

keltner: squeeze > 3 bars

atr: \leq percentile(20, 30d)

failed_breaks: 0-2

v_recovery: within 30min

location: major support/resistance

catalyst: 13

quality_tiers:

tier_1: 9 points (protocol upgrade, major partnership)

tier_2: 6 points (exchange listing, governance)

tier_3: 3 points (conference, report)

timing_multipliers:

imminent_24h: 1.10×

near_48h: 1.04×

medium_7d: 1.02×

distant_30d: 1.00×

Post-Score Modifiers

yaml

social_signal: +3 binary (not scaled)

negative_catalyst: 0.3-0.7× (unlocks, hacks, delistings)

1.2 Critical Gates (2-of-3 Required)

yaml

gate_A_funding_divergence:

condition: funding_z < -1.5 AND spot >= VWAP(24h)

z_calculation: 30d window, 4h funding rates

confirm: spot_cvd >= 0 OR perp_cvd <= 0

weight: 0.85

gate_B_supply_squeeze:

primary: exchange_reserves_7d <= -5% across >=3 venues

proxy: 2_of_4 components within 24-48h window

precedence: use primary if ANY reserve feed available

weight: 0.78

gate_C_whale_accumulation:

require: 2_of_3 composite signals

variance: low over 3 days

weight: 0.72

gate_4_volume_confirm: # *Conditional*

trigger: first_15min_bar >= percentile(80, vadr_24h)

required_in: [risk_off, btc_driven] # *ADDITIVE* to 2-of-3

optional_bonus: [risk_on, selective]

1.3 Supply Squeeze Proxy (2-of-4 Required)

yaml

components:

maker_pull:

detect: ask-side liquidity removal

threshold: > percentile(80, 30d)

duration: sustained >= 6h # *LOCKED*

stable_ratio:

signal: USDT/USDC share increasing in quotes

confirm: all majors within $\pm 0.5\%$ of par

window: 6-12h

spot_cvd_steady:

measure: cvd_residual >= 0

price: expansion < $0.5 \times \text{ATR}$

window: 12-24h

bid_refill_asymmetry:

measurement:

- track at: [best_bid, bid-1tick, bid-2tick]
- sample: every 5 seconds
- calculate: median(samples) over 15min windows
- ratio: bid_speed / ask_speed > 1.3

duration: sustained 2-4h # *LOCKED*

requirement: continuous asymmetry (not just average)

gate_passes: if ANY 2 components true within 24-48h

1.4 Liquidity Tiers & Microstructure

yaml

tiers_by_adv_usd:

tier_1: [0, 10M]

depth_2pct: 25k

spread_max: 80bps

vadr_min: 1.50

tier_2: [10M, 50M]

depth_2pct: 50k

spread_max: 65bps

vadr_min: 1.60

tier_3: [50M, 200M]

depth_2pct: 75k

spread_max: 55bps

vadr_min: 1.70

tier_4: [200M, 1B]

depth_2pct: 100k

spread_max: 35bps

vadr_min: 1.75

tier_5: [1B+]

depth_2pct: 150k

spread_max: 25bps

vadr_min: 1.85

microstructure_gates:

depth_spread:

venue: primary (best liquidity)

averaging: 60s rolling to avoid spikes

vadr:

rule: $\geq \max(\text{percentile}(80, 24h), \text{tier.vadr_min})$

qps:

adaptive_max: $\text{clamp}(\text{p95}(\text{qps}_{14d}) \times 1.25, 20, 200)$

fail_if: current > adaptive_max

liquidity_gradient:

calculation: $\text{depth}_{10\text{pct}} / \text{depth}_{1\text{pct}}$

venue: primary venue only (not aggregated)

healthy: ≥ 0.70

unhealthy_action: total_score \times 0.50

cross_exchange_arb:

```
max_spread: 0.5%
timeout: 800ms
venues: [Binance, OKX, Coinbase] when available
broken_action: block_entry
```

1.5 Whale Detection (Composite)

yaml

```
large_print_clustering:
  min_size_usd: 100000
  min_prints_hour: 5
  max_gap_seconds: 300
  direction_consistency: >= 75% # Using aggressor side
  venues_required: >= 2
  window: rolling 60min, update every 5min

dynamic_thresholds:
  BTC: 1000 units
  ETH: 10000 units
  SOL: 50000 units
  default: 1% of daily_volume_units # Units not dollars

composite_requirement: 2_of_3
  1: large_print_clustering (as above)
  2: cvd_residual > 0 AND price_drift < 0.5×ATR
  3: maker_pull OR hotwallet_decline (optional if no data)

variance_check:
  metric: rolling_std(net_units) < median_30d
  window: 3 days
```

1.6 CVD Residualization (Fully Specified)

yaml

normalization:

cvd_norm: $\text{sum}(\text{signed_dollar_flow}) / \text{rolling_dollar_vol_mean}$

vol_norm: $\text{dollar_vol_t} / \text{rolling_dollar_vol_mean}$

window: 200+ observations minimum

regression:

formula: $\text{cvd_norm} \sim \text{vol_norm}$

preprocessing: winsorize both at $\pm 3\sigma$

method: robust linear regression

refit: daily at 00:00 UTC

quality_checks:

if $R^2 < 0.30$ OR observations < 200 :

fallback: use raw normalized_cvd

weight: multiply subscore by 0.5

output:

$\text{cvd_residual} = \text{cvd_norm} - \beta \times \text{vol_norm}$

usage: all CVD checks use residual, not raw

2. Market Dynamics & Risk Controls

2.1 Regime Detection

yaml

regimes:

risk_on:

btc_trend: up (MA50 > MA200)

volatility: decreasing

correlation: < 0.7

half_life: 8 hours

risk_off:

btc_trend: down

volatility: increasing

correlation: > 0.7

half_life: 4 hours

multiplier: alts × 0.6

btc_driven:

correlation: > 0.8

half_life: 5 hours

multiplier: non_btc × 0.6

selective:

correlation: 0.5-0.7

half_life: 6 hours

catalyst_weight: × 1.3

detection:

update_frequency: hourly

window: 30 days for correlation

2.2 Time Decay & Freshness

yaml

decay_function: $\text{score} \times 0.5^{(\text{age_hours} / \text{half_life})}$

freshness_per_feed:

soft_penalty_start: 8 seconds

decay_tau: 30 seconds

hard_fail: 90 seconds

formula: $\exp(-\max(0, \text{age}-\text{soft}) / \text{tau})$

precedence: use WORST multiplier across all feeds

feeds: [funding, trades, depth, basis]

2.3 Market Maker Behavior

yaml

mm_withdrawal_detection:

triggers_all_required:

- quote_updates: drop > 50% from baseline
- spread: widens > 2× in 5 minutes
- depth: symmetric reduction both sides

action:

- pause_all_signals: 30 minutes
- require: manual_review
- log: incident_report

lp_accumulation_pattern:

signals:

- bid_refills: asymmetrically faster
- icebergs: persistent at same level
- spread: tightening despite volume

measurement: per section 1.3 bid_refill_asymmetry

2.4 Contamination & Abort Conditions

yaml

contamination_check:

btc_flash_move:

threshold: $|\text{return}_{5\text{min}}| > 2\%$

action: wait_15min

resume: when avg_pairwise_corr < percentile(80, 30d)

abort_conditions:

btc_crash: -5% in 5 minutes

stablecoin_crisis:

monitor: [USDT, USDC, DAI, BUSD]

depeg: any > 0.5% from par

venues: [Binance, OKX, Coinbase]

exchange_failure: major_down > 30min

correlation_spike: all_assets > 0.95

maintenance_detection:

api_lag: > 5× baseline

orderbook_frozen: > 30 seconds

volume_drop: < 10% of normal

action:

- exclude_venue_from_requirements
- require: ≥ 1 healthy venue for gates
- require: ≥ 2 healthy venues for cross-checks

3. Position Management

3.1 Sizing Framework

yaml

base_allocation: 2% of equity

confidence_multipliers:

score_72_79: 0.50× # Half size learning

score_80_89: 1.00× # Standard

score_90_95: 1.25× # Modest increase

score_95_plus: 1.50× # Maximum

adjustments:

disagreement: 1 - 0.25×stdev(factors)

gates_all_three: 1.5×

gates_funding_supply: 1.2×

gates_funding_only: 0.8×

stop_distance_check:

if stop > 3×ATR:

reduce_size: proportionally

new_asset_mode:

if history < 30 days:

max_size: 0.25×

require_gates: 3_of_3

graduate_after: 90 days AND ≥ 10 signals logged

3.2 Stop Loss Policy

yaml

calculation: max(1.5×ATR, nearest_structure, score_decay_floor)

invalidation_triggers:

gates_drop: from 2 to 1 → exit_immediately

score_crash: -30 points in 1h → exit_50%

regime_change: re_evaluate_all

time_stop: 48h with no profit → exit_75%

3.3 Portfolio Constraints

yaml

correlation_limits:

pairwise_max: 0.65

calculation_window: 30 days

sector_caps:

max_per_sector: 2

sectors:

L1: [BTC, ETH, SOL, ADA, AVAX]

DeFi: [UNI, AAVE, MKR, LDO]

Infrastructure: [LINK, ARB, OP]

Gaming: [IMX, AXS, SAND]

beta_budget:

total_beta_to_btc: <= 2.0

concentration:

max_single_position: 5% of equity

max_total_exposure: 20% of equity

application:

timing: after scoring & gates, before alerts

recheck: every scan cycle

tiebreak: by ADV, then symbol

4. Temporal & Alert Management

4.1 Temporal Adjustments

yaml

empirical_learning:

enabled: true

min_observations: 100

default_multiplier: 0.90 # Until sufficient data

update_frequency: monthly

tracked_periods:

friday_afternoon_utc: [baseline 0.70]

sunday_evening_utc: [baseline 0.80]

monday_asia_open: [baseline 1.10]

pre_monthly_expiry: [baseline 0.50]

low_liquidity_handling:

detection:

volume < 30% of median_30d OR

spread > 2× typical OR

depth < 50% typical

adjustments:

require_volume_confirm: true

max_position: 0.5×

min_stop: 2×ATR

4.2 Alert Governance

yaml

limits:

base_per_hour: 3

base_per_day: 10

high_volatility_per_hour: 6 *# when vol > p90*

quality_control:

if success_rate < 50%:

increase_min_score: +10 for day

if alerts_today > 5 AND success < 40%:

increase_min_score: +15

ranking:

simultaneous_signals: emit_top_2_only

tiebreak: by_adv_then_symbol

operator_fatigue:

max_decisions_hour: 10

force_break_after: 4 hours

minimum_break: 30 minutes

manual_override:

when: score > 90 AND gates < 2

action: alert_only *# No prompt for action*

5. Learning & Calibration

5.1 Pattern Monitoring

yaml

pattern_exhaustion:

track_per_pattern: [funding_squeeze, supply_drain, compression_break]

calculation:

success_rate_30d: baseline

success_rate_7d: recent

if recent < 0.7 × baseline:

confidence: × 0.6

require: additional_gate

edge_decay_monitor:

windows: [7d, 30d, 90d]

for_each_window:

expected: score_to_probability(avg_score)

actual: profitable_count / total_count

if actual/expected < 0.8:

action: reduce_all_positions_50%

alert: "EDGE DEGRADING"

5.2 Execution Quality

yaml

tracking:

per_signal:

- intended_entry vs actual_entry

- slippage_bps

- time_to_fill_ms

if avg_slippage > 30bps:

- tighten_spread_requirements

- reduce_all_sizes: × 0.75

recovery:

conditions: 20_good_trades OR 48_hours

method: gradual_increase_to_normal

5.3 Isotonic Calibration

yaml

requirements:

minimum_data: 90 days

minimum_samples: 100 per score_bucket

output:

score → P(move > 5%)

per_regime: separate_curves

update:

frequency: monthly

method: isotonic_regression

constraint: monotonic_increasing

6. Data Requirements

6.1 Required Feeds (Free/Keyless)

yaml

exchanges:

primary: [Binance, OKX, Coinbase]

binance:

- funding_rates: ✓
- open_interest: ✓
- futures_basis: ✓ (near, next, quarter)
- spot_trades: ✓ (for CVD)
- orderbook_depth: ✓ (L1, L2)

okx:

- funding_rates: ✓
- open_interest: ✓
- futures_basis: ✓
- spot_trades: ✓
- orderbook_depth: ✓

coinbase:

- funding_rates: X (N/A - no perps)
- open_interest: X (N/A)
- futures_basis: X (N/A)
- spot_trades: ✓
- orderbook_depth: ✓

aggregators:

- CoinGecko: market_caps, categories
- Free catalysts: manual_curation

6.2 Data Quality Requirements

yaml

percentile_engine:

windows: [14d short, 30d long]

update: every 4 hours

computation: per-asset, per-venue where applicable

preprocessing: winsorize at $\pm 3\sigma$ before percentile calc

point_in_time: all_data_timestamped

cache_ttl: ≥ 300 seconds

circuit_breakers: per_provider

fallback_logic: defined_per_metric

6.3 Measurement Cadences

yaml

rolling_percentiles: update every 4h

cvd_regression: refit daily at 00:00 UTC

whale_clustering: 60min window, update every 5min

bid_refill_asymmetry: 15min windows, 5s samples

regime_detection: hourly

temporal_multipliers: monthly with 100+ observations

7. Implementation Checklist

7.1 Phase 1 (Core)

- ☐ Percentile engine with winsorization
- ☐ 2-of-3 gate system with precedence rules
- ☐ CVD residualization with R^2 checks
- ☐ Freshness penalties (worst feed wins)
- ☐ Base scoring (100 points)

7.2 Phase 2 (Safety)

- ☐ MM withdrawal detection (30min pause)
- ☐ Portfolio correlation limits with pruning
- ☐ Contamination checks (15min cooldown)
- ☐ Liquidity gradient filter (0.7 ratio)
- ☐ Venue health with degradation handling

7.3 Phase 3 (Intelligence)

- ☐ Composite whale detection (2-of-3)
- ☐ Supply squeeze proxy (2-of-4)
- ☐ Bid refill asymmetry measurement
- ☐ Temporal learning engine
- ☐ Pattern exhaustion tracking

7.4 Phase 4 (Polish)

- ☐ Execution quality tracking
- ☐ Isotonic calibration
- ☐ Alert governance (volatility-aware)

- ☐ Operator fatigue limits
 - ☐ Recovery conditions
-

8. Operating Manual

8.1 Launch Protocol

yaml

week_1_4:

position_size: 30% of calculated

paper_trade: parallel

gates_required: 3_of_3

week_5_12:

position_size: 50% of calculated

gates_required: 2_of_3

review: weekly

week_13+:

position_size: gradual_to_100%

gates: standard_2_of_3

review: daily_edge_decay

8.2 Version Control

yaml

freeze_period: 30 days minimum between changes

change_process:

1. propose_with_backtest
2. paper_trade_30_days
3. gradual_rollout

emergency_only:

- critical_bug_fixes
- abort_condition_updates

9. Test Acceptance Criteria

9.1 Unit Tests

- ☐ Percentile monotonicity with window edges
- ☐ CVD winsorization and fallback at $R^2 < 0.30$
- ☐ Whale clustering logic (size, count, gap, consistency)
- ☐ Bid refill speed calculation at fixed price levels
- ☐ VADR precedence: $\max(p80, \text{tier_min})$

9.2 Integration Tests

- ☐ 2-of-3 before volume-confirm sequencing
- ☐ Venue degradation with ≥ 1 healthy requirement
- ☐ Portfolio pruning after gates, before alerts
- ☐ Regime transitions with position re-evaluation
- ☐ Clock drift handling in freshness calc

9.3 System Tests

- ☐ Pattern exhaustion degrades confidence
- ☐ Edge decay triggers position reduction
- ☐ Slippage $> 30\text{bps}$ tightens requirements
- ☐ New asset graduates after 90d AND 10 signals
- ☐ Manual override produces alert-only

10. Expected Performance Envelope

yaml

realistic_targets:

hit_rate: 48-55%

risk_reward: 1:1.8

max_drawdown: 15-18%

sharpe_ratio: 1.2-1.5

by_regime:

risk_on: {hit_rate: 55%, avg_gain: 12%}

risk_off: {hit_rate: 45%, avg_gain: 8%}

btc_driven: {hit_rate: 50%, avg_gain: 10%}

selective: {hit_rate: 52%, avg_gain: 15%}

system_lifetime: 12-18 months before major recalibration

Appendix A: Precedence Rules Summary

1. **VADR Gate:** Use

max(percentile(80, 24h), tier.vadr_min)
2. **Supply Squeeze:** If ANY reserve feed available, use primary; else proxy
3. **Freshness:** Worst feed multiplier wins (most conservative)
4. **Venue Health:** Need ≥ 1 for gates, ≥ 2 for cross-checks
5. **Volume Confirm:** In risk_off/btc_driven, ADDITIVE to 2-of-3 (not replacement)
6. **Portfolio Caps:** Apply after scoring/gates, before alerts
7. **Gradient Ratio:** Calculated on primary venue only

Appendix B: Data Availability Matrix

Signal	Binance	OKX	Coinbase	Fallback
Funding	✓	✓	✗	Skip CB
OI	✓	✓	✗	Skip CB
Basis	✓	✓	✗	Skip CB
Spot Trades	✓	✓	✓	Required
Depth	✓	✓	✓	Required
CME Gap	Delayed	Delayed	✗	Optional
Hot-wallet	✗	✗	✗	Use maker-pull

This v3.3 specification incorporates all technical clarifications and precedence rules. Every ambiguity has been resolved with concrete definitions, timing windows, and measurement methods. This is the buildable version.