



Cross - DEX 2

Security Assessment

CertiK Assessed on Nov 3rd, 2025





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Cross - DEX 2

The security assessment was prepared by CertiK.

Executive Summary

TYPES

DEX

ECOSYSTEM

EVM Compatible

METHODS

Manual Review, Static Analysis

LANGUAGE

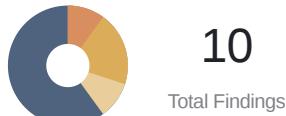
Solidity

TIMELINE

Preliminary comments published on 10/28/2025

Final report published on 11/03/2025

Vulnerability Summary



| | | | |
|----------|--------------------|--------------|----------|
| 10 | 0 | 0 | 0 |
| Resolved | Partially Resolved | Acknowledged | Declined |

0 Centralization

Centralization findings highlight privileged roles & functions and their capabilities, or instances where the project takes custody of users' assets.

0 Critical

Critical risks are those that impact the safe functioning of a platform and must be addressed before launch. Users should not invest in any project with outstanding critical risks.

1 Major

1 Resolved

Major risks may include logical errors that, under specific circumstances, could result in fund losses or loss of project control.

2 Medium

2 Resolved

Medium risks may not pose a direct risk to users' funds, but they can affect the overall functioning of a platform.

1 Minor

1 Resolved

Minor risks can be any of the above, but on a smaller scale. They generally do not compromise the overall integrity of the project, but they may be less efficient than other solutions.

6 Informational

6 Resolved

Informational errors are often recommendations to improve the style of the code or certain operations to fall within industry best practices. They usually do not affect the overall functioning of the code.

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CODEBASE | CROSS - DEX 2

Repository

<https://github.com/to-nexus/dex-contracts/tree/d58873720ecbbfda1530ab056da9ed406883f441>

<https://github.com/to-nexus/dex-contracts/tree/6cca6acc7a617d8080cd99309f67dc6b67beca27/src/>

<https://github.com/to-nexus/dex-contracts/tree/6520fc25245bf92bd92d88478b6c5e9bc7ef9bf7/src>

Commit

[d58873720ecbbfda1530ab056da9ed406883f441](#)

[6cca6acc7a617d8080cd99309f67dc6b67beca27](#)

[6520fc25245bf92bd92d88478b6c5e9bc7ef9bf7](#)

AUDIT SCOPE | CROSS - DEX 2

to-nexus/dex-contracts

 src/CrossDexRouterV2.sol

 src/MarketImplV2.sol

 src/PairImplV2.sol

 src/CrossDexImplV2.sol

 src/Verse8MarketOwner.sol

APPROACH & METHODS | CROSS - DEX 2

This audit was conducted for Cross to evaluate the security and correctness of the smart contracts associated with the Cross - DEX 2 project. The assessment included a comprehensive review of the in-scope smart contracts. The audit was performed using a combination of Manual Review and Static Analysis.

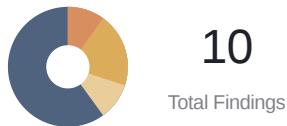
The review process emphasized the following areas:

- Architecture review and threat modeling to understand systemic risks and identify design-level flaws.
- Identification of vulnerabilities through both common and edge-case attack vectors.
- Manual verification of contract logic to ensure alignment with intended design and business requirements.
- Dynamic testing to validate runtime behavior and assess execution risks.
- Assessment of code quality and maintainability, including adherence to current best practices and industry standards.

The audit resulted in findings categorized across multiple severity levels, from informational to critical. To enhance the project's security and long-term robustness, we recommend addressing the identified issues and considering the following general improvements:

- Improve code readability and maintainability by adopting a clean architectural pattern and modular design.
- Strengthen testing coverage, including unit and integration tests for key functionalities and edge cases.
- Maintain meaningful inline comments and documentations.
- Implement clear and transparent documentation for privileged roles and sensitive protocol operations.
- Regularly review and simulate contract behavior against newly emerging attack vectors.

FINDINGS | CROSS - DEX 2



10

0

0

1

2

1

6

Total Findings

Critical

Centralization

Major

Medium

Minor

Informational

This report has been prepared for Cross to identify potential vulnerabilities and security issues within the reviewed codebase. During the course of the audit, a total of 10 issues were identified. Leveraging a combination of Manual Review & Static Analysis the following findings were uncovered:

| ID | Title | Category | Severity | Status |
|--------|--|--------------------------------------|---------------|-----------------------|
| CD2-02 | Quote Reserve Inflation Vulnerability In <code>submitLimitOrder()</code> | Logical Issue, Incorrect Calculation | Major | Resolved |
| CD2-03 | Incorrect Storage Gap Calculation In Upgradeable Contracts | Coding Issue, Volatile Code | Medium | Resolved |
| CD2-04 | Inconsistent Fee Validation Between Market And Pair Contracts | Logical Issue, Inconsistency | Medium | Resolved |
| CD2-06 | Incorrect <code>matchedAt</code> Timestamp Updates In <code>_setLatest()</code> Modifier | Logical Issue | Minor | Resolved |
| CD2-07 | Redundant <code>address()</code> Cast On Already Typed <code>pair</code> Parameter | Code Optimization | Informational | Resolved |
| CD2-08 | Misleading Parameter Name <code>amount</code> In <code>submitBuyMarket()</code> Actually Represents QUOTE Volume | Coding Style, Inconsistency | Informational | Resolved |
| CD2-09 | Unpredictable Token Approval Requirements In <code>submitBuyMarket()</code> Due To Fee Calculation | Inconsistency | Informational | Resolved |
| CD2-10 | Redundant Underscore In Error Message Parameter Name | Coding Style | Informational | Resolved |
| CD2-11 | Incomplete Comment In Pair Contract Modifier | Coding Style | Informational | Resolved |
| CD2-12 | Incorrect Error Type In Reserve Addition Functions | Inconsistency | Informational | Resolved |

CD2-02 | Quote Reserve Inflation Vulnerability In `submitLimitOrder()`

| Category | Severity | Location | Status |
|--------------------------------------|----------|------------------------------------|----------|
| Logical Issue, Incorrect Calculation | Major | src/PairImplV2.sol (base): 298~299 | Resolved |

Description

A vulnerability exists in the `PairImplV2.submitLimitOrder()` function that allows an attacker to inflate the global `quoteReserve` beyond the actual token balance, effectively freezing all subsequent BUY orders and hijacking previously reserved QUOTE tokens.

Attack Vector:

1. **Setup:** Ensure existing BUY liquidity (`quoteReserve = R`)
2. **Attack:** Place a BUY limit order that doesn't match immediately
3. **Exploitation:** The function incorrectly calculates `receivedAmount` using the full contract balance instead of the actual deposited amount

Vulnerable Code:

```

295 uint32 feeBps = _buyerMakerFeeBps();
296 uint256 receivedAmount = QUOTE.balanceOf(address(this)) - mustRemainQuoteAmount
;
297 _addQuoteReserve(order.owner, receivedAmount);
298
// ^ This adds the ENTIRE contract balance to reserves, not just the deposited
amount

```

Impact:

- Global `quoteReserve` becomes inflated (`2R + deposit` vs actual balance `R + deposit`)
- All subsequent BUY orders revert due to insufficient balance checks
- Attacker hijacks previously reserved QUOTE tokens from other users

Scenario

1. Ensure there is existing BUY liquidity so `quoteReserve > 0`
2. From an unprivileged address, place a BUY limit order designed not to match immediately
3. The router transfers exactly `quoteAmount + takerFee` to the pair
4. When `_executeBuyOrder()` runs, it computes `skimQuoteAmount = 0` and no matches occur
5. The function incorrectly calculates `receivedAmount = QUOTE.balanceOf(this) - 0 = R + deposit`
6. This inflates the attacker's reserve by `R + deposit` and global `quoteReserve` becomes `2R + deposit`

7. All subsequent BUY orders revert due to insufficient balance checks

■ Recommendation

Fix the `receivedAmount` calculation to only include the actual deposited and not used QUOTE volume.

Additionally, implement validation to ensure `quoteReserve` never exceeds the actual token balance.

CD2-03 | Incorrect Storage Gap Calculation In Upgradeable Contracts

| Category | Severity | Location | Status |
|-----------------------------|----------|--------------------------------|----------|
| Coding Issue, Volatile Code | Medium | src/PairImplV2.sol (base): 100 | Resolved |

Description

Multiple upgradeable contracts in the codebase contain incorrect storage gap calculations that could lead to storage collisions during upgrades. The gaps are calculated without considering the actual number of storage slots used by the contracts.

For each variable, a storage slot is assigned sequentially. Structs and arrays (except dynamic arrays and mappings) are laid out contiguously, just like individual variables.

Affected Contracts:

- `CrossDexImplV2` : Uses `uint256[44] __gap` but has 8 storage variables (EnumerableMap takes 3 slots)
- `CrossDexRouterV2` : Uses `uint256[44] __gap` but has 7 storage variables (EnumerableSet takes 2 slots)
- `MarketImplV2` : Uses `uint256[42] __gap` but has 10 storage variables (EnumerableMap takes 3 slots)
- `PairImplV2` : Uses `uint256[31] __gap` but has 25 storage variables (List.U256[2] takes 8 slots)

The gaps appear to be arbitrary numbers rather than calculated based on actual storage layout, which creates significant risk for future upgrades.

Moreover, ImplV2s don't comply with Impl. For example, in `MarketImplV2` the field `_feeConfig` overwrites `feeBps`. Upgrading contract is expected to expand the existing storage, not overwrite.

Recommendation

Recalculate storage gaps based on actual storage usage:

1. Count all non-constant storage variables in each contract
2. Calculate remaining slots needed to reach 50 slots (standard practice)
3. Use consistent gap calculation methodology across all contracts
4. Consider using automated tools like `slither` to verify storage layout
5. Always expand the storage instead of fields reordering and overwriting

CD2-04 | Inconsistent Fee Validation Between Market And Pair Contracts

| Category | Severity | Location | Status |
|------------------------------|----------|--------------------------------------|----------|
| Logical Issue, Inconsistency | Medium | src/MarketImplV2.sol (base): 174~179 | Resolved |

Description

There are multiple inconsistencies in fee validation between the Market and Pair contracts that could lead to unpredictable fee behavior.

Issues Identified:

1. Missing validation in Market initialization:

```
// MarketImplV2.initialize() - no taker >= maker validation  
// Only range checks, no logical fee structure validation
```

2. Unpredictable fee resolution with `NO_FEE_BPS`:

```
// PairImplV2._resolveEffectiveFees()  
feeInfos.sellerMakerFeeBps = feeConfig.sellerMakerFeeBps == NO_FEE_BPS  
    ? defaultFeeBps.sellerMakerFeeBps : feeConfig.sellerMakerFeeBps;
```

If both Market and Pair use `NO_FEE_BPS`, the actual fee becomes unpredictable.

3. Missing validation in Pair's `_setFeeBps()`:

```
// PairImplV2._setFeeBps() - only checks local values  
// Doesn't validate against Market's default fees when using NO_FEE_BPS
```

This creates a situation where fee structures can be logically invalid after resolution, breaking the `taker >= maker` invariant.

Recommendation

Consider removing `NO_FEE_BPS` ambiguity by requiring explicit fee values at both Market and Pair levels.

CD2-06 | Incorrect `matchedAt` Timestamp Updates In `_setLatest()` Modifier

| Category | Severity | Location | Status |
|---------------|----------|------------------------------------|----------|
| Logical Issue | Minor | src/PairImplV2.sol (base): 120~123 | Resolved |

Description

The `setLatest` modifier incorrectly updates the `matchedAt` timestamp even when no actual trades occurred during the function execution. This creates misleading market data and inaccurate trading activity indicators.

Problem Details:

```
modifier setLatest() {
    _;
    _setLatest(); // Always called regardless of matching activity
}

function _setLatest() private {
    uint256 _latestPrice;
    assembly {
        _latestPrice := tload(_matchedPriceSlot)
    }
    if (_latestPrice != 0 && _latestPrice != matchedPrice) matchedPrice =
    _latestPrice;
    if (matchedAt != block.timestamp) matchedAt = block.timestamp; // Always updates
}
```

The `_setLatest()` function is called after `_matchSellOrder()` and `_matchBuyOrder()` executions, but it unconditionally updates `matchedAt` to the current block timestamp even if:

- No orders were matched

This creates false signals about market activity and could mislead external systems monitoring trading patterns.

Recommendation

Modify the `setLatest` modifier to only update timestamps when actual trades occurred.

This ensures `matchedAt` accurately reflects actual trading activity rather than just matching attempts.

CD2-07 Redundant `address()` Cast On Already Typed `pair` Parameter

| Category | Severity | Location | Status |
|-------------------|-----------------|--|------------|
| Code Optimization | ● Informational | src/CrossDexRouterV2.sol (base): 147, 166, 167, 187, 188 | ● Resolved |

Description

The code contains redundant casting of the `pair` parameter to `address` when it's already an address type. This occurs in multiple locations throughout the router contract.

The `pair` parameter is already declared as `address pair` in the function signatures, making the `address(pair)` cast unnecessary.

Recommendation

Remove the redundant `address()` casts and use the `pair` parameter directly.

CD2-08 Misleading Parameter Name `amount` In `submitBuyMarket()`

Actually Represents QUOTE Volume

| Category | Severity | Location | Status |
|-----------------------------|-----------------|--------------------------------------|------------|
| Coding Style, Inconsistency | ● Informational | src/CrossDexRouterV2.sol (base): 174 | ● Resolved |

Description

The `submitBuyMarket()` function uses a misleading parameter name `amount` that actually represents the volume in QUOTE tokens rather than the BASE amount.

This naming inconsistency can lead to developer confusion and potential integration errors.

Recommendation

Rename the parameter to clearly indicate it represents QUOTE volume.

Alternatively, consider using more descriptive parameter names throughout the contract for better clarity.

CD2-09 | Unpredictable Token Approval Requirements In `submitBuyMarket()` Due To Fee Calculation

| Category | Severity | Location | Status |
|---------------|-----------------|--------------------------------------|------------|
| Inconsistency | ● Informational | src/CrossDexRouterV2.sol (base): 188 | ● Resolved |

Description

The `submitBuyMarket()` function requires users to approve an unpredictable amount of QUOTE tokens because the actual transfer amount includes dynamically calculated fees. This creates user experience issues as users cannot know the exact approval amount beforehand.

The `_calculateRequireBuyVolume()` function adds the buyer taker fee to the base amount, meaning users must either:

- Over-approve significantly to account for maximum possible fees
- Use infinite approvals (security risk)

Recommendation

Implement one of the following solutions:

1. Add a **view function** to calculate required approval amount:

```
function getRequiredBuyVolume(address pair, uint256 quoteAmount) external view
returns (uint256) {
    return _calculateRequireBuyVolume(pair, quoteAmount);
}
```

2. Document the **maximum fee percentage** and implement the approval calculation on the UI.

CD2-10 | Redundant Underscore In Error Message Parameter Name

| Category | Severity | Location | Status |
|--------------|-----------------|--------------------------------------|------------|
| Coding Style | ● Informational | src/CrossDexRouterV2.sol (base): 238 | ● Resolved |

Description

The `setMaxMatchCount()` function in `CrossDexRouterV2` uses a redundant underscore prefix in the error message parameter name, creating inconsistency with other validation checks in the same contract.

Recommendation

Remove the redundant underscore from the error message parameter name to maintain consistency.

CD2-11 | Incomplete Comment In Pair Contract Modifier

| Category | Severity | Location | Status |
|--------------|-----------------|--------------------------------|------------|
| Coding Style | ● Informational | src/PairImplV2.sol (base): 105 | ● Resolved |

Description

The comment in the `onlyOwner` modifier of `PairImplV2` is incomplete and potentially misleading. The "owner" is missing.

Recommendation

Complete the comment to clearly explain the ownership relationship.

CD2-12 | Incorrect Error Type In Reserve Addition Functions

| Category | Severity | Location | Status |
|---------------|-----------------|-------------------------------------|------------|
| Inconsistency | ● Informational | src/PairImplV2.sol (base): 654, 672 | ● Resolved |

Description

The reserve addition functions in `PairImplV2` use `PairInvalidAccountReserve` error when they should use `PairInvalidReserve`, as these functions deal with global reserve overflow rather than account-specific issues.

The `PairInvalidAccountReserve` error is designed for account-specific reserve issues, but these functions are checking for global reserve overflow which affects the entire contract.

Recommendation

Use the appropriate `PairInvalidReserve` error for global reserve overflow checks.

This ensures consistent error handling where account-specific errors are used for account operations and contract-level errors for global state issues.

OPTIMIZATIONS | CROSS - DEX 2

| ID | Title | Category | Severity | Status |
|--------|---|-------------------|--------------|---|
| CD2-01 | Unnecessary <input checked="" type="checkbox"/> Blocks For Loop Increments In Solidity 0.8.22+ | Code Optimization | Optimization | <input checked="" type="radio"/> Acknowledged |

CD2-01 Unnecessary `unchecked` Blocks For Loop Increments In Solidity 0.8.22+

| Category | Severity | Location | Status |
|-------------------|--|--|--|
| Code Optimization | ● Optimization | src/CrossDexRouterV2.sol (base): 254–256 | ● Acknowledged |

Description

Multiple contracts contain unnecessary `unchecked` blocks for loop counter increments, which provide no gas savings in [Solidity 0.8.22](#) and later versions.

Recommendation

Remove the unnecessary `unchecked` blocks and use standard for-loop syntax for better code readability.

This maintains the same gas efficiency while improving code clarity and reducing visual noise. The Solidity compiler is smart enough to optimize these increments without explicit `unchecked` blocks.

APPENDIX | CROSS - DEX 2

Finding Categories

| Categories | Description |
|-----------------------|--|
| Coding Style | Coding Style findings may not affect code behavior, but indicate areas where coding practices can be improved to make the code more understandable and maintainable. |
| Coding Issue | Coding Issue findings are about general code quality including, but not limited to, coding mistakes, compile errors, and performance issues. |
| Incorrect Calculation | Incorrect Calculation findings are about issues in numeric computation such as rounding errors, overflows, out-of-bounds and any computation that is not intended. |
| Inconsistency | Inconsistency findings refer to different parts of code that are not consistent or code that does not behave according to its specification. |
| Volatile Code | Volatile Code findings refer to segments of code that behave unexpectedly on certain edge cases and may result in vulnerabilities. |
| Logical Issue | Logical Issue findings indicate general implementation issues related to the program logic. |

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