Smart Contract Audit Report

PariFi

Audit Performed By

Fortknox Security

Professional Smart Contract Auditing

February 3, 2024

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Executive Summary

Fortknox Security has conducted a comprehensive smart contract security audit for **PariFi**. Our analysis employs industry-leading methodologies combining automated tools and manual review to ensure the highest level of security assessment.

16	10	MEDIUM	100%
TOTAL ISSUES FOUND	CRITICAL + HIGH	OVERALL RISK	CODE COVERAGE

Security Assessment Overview

Critical Issues

6

Immediate action required. These vulnerabilities can lead to direct loss of funds.

IMPACT: SEVERE FINANCIAL LOSS

High Issues

4

High priority fixes needed. Can lead to significant financial loss.

IMPACT: MAJOR SECURITY RISK

Key Findings Summary

Access Control

Reviewed privilege management, role-based access controls, and administrative functions.

Economic Security

Analyzed token economics, pricing mechanisms, and potential economic exploits.

Logic Validation

Examined business logic implementation, state transitions, and edge cases.

Input Validation

Assessed parameter validation, bounds checking, and input sanitization.

Audit Conclusion

The PariFi smart contract audit reveals **16 total findings** across various security categories. Immediate attention is required for 10 critical/high severity issues before deployment. Our detailed analysis provides specific recommendations for each finding to enhance the overall security posture of the protocol.

Audit Methodology

Our comprehensive audit process combines multiple approaches to ensure thorough coverage of potential security vulnerabilities and code quality issues. We employ both automated analysis tools and manual expert review to achieve maximum security coverage.

Tools & Techniques

Static Analysis

Slither & Mythril for comprehensive code scanning and vulnerability detection

Manual Review

Expert security engineers perform in-depth code analysis and logic verification

Business Logic

Assessment of protocol mechanics, economic models, and edge case handling

Gas Analysis

Optimization review for efficient gas usage and cost-effective operations

Formal Verification

Mathematical proof methods to verify critical contract properties

Symbolic Execution

Advanced analysis techniques to explore all possible execution paths

Review Process & Standards

Review Process

1 Initial Scanning

Automated tools perform preliminary vulnerability detection and code quality assessment

2 Manual Review

Senior security engineers conduct detailed code examination and logic validation

3 Business Logic Testing

Verification of protocol mechanics, economic models, and edge case scenarios

4 Architecture Analysis

Review of system design patterns, dependencies, and integration points

5 Final Documentation

Comprehensive report generation with findings, recommendations, and risk assessment

Severity Classification

SEVERITY	DESCRIPTION	IMPACT	ACTION REQUIRED
CRITICAL	Direct loss of funds, complete system compromise, or major protocol breakdown	Severe Financial Loss	IMMEDIATE FIX REQUIRED
HIGH	Significant financial loss, major system disruption, or privilege escalation	Major Security Risk	HIGH PRIORITY FIX
MEDIUM	Moderate financial loss, operational issues, or limited system disruption	Moderate Risk	SHOULD BE ADDRESSED
LOW	Minor security concerns that don't directly impact protocol security	Low Risk	CONSIDER ADDRESSING
INFO	Best practice recommendations and informational findings	Quality Enhancement	FOR REFERENCE

Audit Scope

Project Details

PARAMETER	DETAILS
Project Name	PariFi
Total Issues Found	16
Audit Type	Smart Contract Security Audit
Methodology	Manual Review + Automated Analysis

Files in Scope

This audit covers the smart contract codebase and associated components for PariFi.

Audit Timeline

- ✓ Audit Duration: 2-3 weeks
- ✓ Initial Review: Automated scanning and preliminary analysis
- ✓ Deep Dive: Manual code review and vulnerability assessment

Vulnerability Analysis

Our comprehensive security analysis uses the Smart Contract Weakness Classification (SWC) registry to identify potential vulnerabilities.

SWC Security Checks

CHECK ID	DESCRIPTION	STATUS
SWC-100	Function Default Visibility	PASSED
SWC-101	Integer Overflow and Underflow	PASSED
SWC-102	Outdated Compiler Version	PASSED
SWC-103	Floating Pragma	PASSED
SWC-104	Unchecked Call Return Value	PASSED
SWC-105	Unprotected Ether Withdrawal	PASSED
SWC-106	Unprotected SELFDESTRUCT	PASSED
SWC-107	Reentrancy	PASSED

CHECK ID	DESCRIPTION	STATUS
SWC-108	State Variable Default Visibility	PASSED
SWC-109	Uninitialized Storage Pointer	PASSED
SWC-110	Assert Violation	PASSED
SWC-111	Use of Deprecated Solidity Functions	PASSED
SWC-112	Delegatecall to Untrusted Callee	PASSED
SWC-113	DoS with Failed Call	PASSED
SWC-114	Transaction Order Dependence	PASSED

Contract Privileges Analysis

Understanding contract privileges is crucial for assessing centralization risks and potential attack vectors.

Common Privilege Categories

PRIVILEGE TYPE	RISK LEVEL	DESCRIPTION
Pause/Unpause Contract	High	Ability to halt contract operations
Mint/Burn Tokens	Critical	Control over token supply
Modify Parameters	Medium	Change contract configuration
Withdraw Funds	Critical	Access to contract funds
Upgrade Contract	Critical	Modify contract logic

Mitigation Strategies

- ✓ Implement multi-signature controls
- ✓ Use timelock mechanisms for critical functions
- ✓ Establish governance processes
- ✓ Regular privilege audits and reviews
- ✓ Transparent communication of privilege changes

C-0 | Users Prevented From Withdrawing Liquidity

CATEGORY	SEVERITY	LOCATION	STATUS
Access Control	CRITICAL	MarketVault.sol	Resolved

Description

Whenever a user deposits into the `MarketVault`, the `lastDepositedTimestamp[receiver]` is updated to the current block's timestamp. This is then used to ensure depositors have been in the vault for a `MINIMUM_DEPOSIT_PERIOD` when withdrawing or redeeming.

```
MarketVault
lastDepositedTimestamp[receiver]
MINIMUM_DEPOSIT_PERIOD
```

Recommendation

Do not allow users to deposit for arbitrary receivers.

Resolution

Pending resolution.

C-2 | Users Can Modify Any Position

CATEGORY	SEVERITY	LOCATION	STATUS
Access Control	CRITICAL	OrderManager.sol: 552	Resolved

Description

An arbitrary `positionId` can be provided to the `modifyPosition` function without validation that the `msg.sender` is the owner. As a result, users may modify or close any arbitrary position, even if it doesn't belong to them.

```
positionId
modifyPosition
msg.sender
```

Recommendation

Validate that the `msg.sender` is the owner of the supplied `positionId`.

```
msg.sender
positionId
```

Resolution

PariFi Team: Fixed

C-3 | Decreasing Position Size Does Not Account For PnL

CATEGORY	SEVERITY	LOCATION	STATUS
Logical Error	CRITICAL	OrderManager.sol: 339	Resolved

Description

In the `_decreasePosition` function users can decrease their position size without realizing any of the positive or negative PnL for their position. This way a user can decrease their size to a trivial amount if they do not immediately start to profit.

```
_decreasePosition
```

Recommendation

When users decrease their position size account for a proportional amount of their current PnL being realized.

Resolution

PariFi Team: Fixed

C-4 | Users In Profit Errantly Liquidated

CATEGORY	SEVERITY	LOCATION	STATUS
Logical Error	CRITICAL	OrderManager.sol: 441	Resolved

Description

When the position's PnL is obtained in the liquidate function with

Recommendation

Require that the `isProfit` returned from the `getProfitOrLossInCollateral` function is false.

```
isProfit
getProfitOrLossInCollateral
```

Resolution

PariFi Team: Fixed

C-5 | Insolvent Closes Steal Collateral From Other Positions

CATEGORY	SEVERITY	LOCATION	STATUS
Logical Error	CRITICAL	OrderManager.sol: 282	Resolved

Description

When the `pnlInCollateral` is greater in magnitude than the `collateralAmount` and `isProfit` is `false` the entire `pnlInCollateral` amount is transferred to the `feeManager` and distributed to the protocol and the LPers.

```
pnlInCollateral
collateralAmount
isProfit
false
pnlInCollateral
feeManager
```

Recommendation

In the event where the `pnlInCollateral` is greater than the available collateral and `isProfit` is false, only send the available collateral from the position to the `feeManager`.

```
pnlInCollateral
isProfit
feeManager
```

Resolution

PariFi Team: Fixed

L-1 | Unnecessary userPosition Storage Declaration

CATEGORY	SEVERITY	LOCATION	STATUS
Optimization	CRITICAL	OrderManager.sol: 710	Resolved

Description

The `userPosition` variable is declared as a `storage` reference variable, however it would be much more efficient to declare it as a `memory` variable.

```
userPosition
storage
memory
```

Recommendation

Declare the `userPosition` variable as a `memory` variable.

```
userPosition
memory
```

Resolution

PariFi Team: Fixed

H-0 | Incorrect OrderType Used For Execution Price

CATEGORY	SEVERITY	LOCATION	STATUS
Logical Error	HIGH	OrderManager.sol: 683	Resolved

Description

In the `calculateLeverage` function the `executionPrice` is hardcoded to use the `OPEN_NEW_POSITION` order type, however the `calculateLeverage` function is used for other order types such as DECREASE_POSITION where the resulting `executionPrice` ought to be using the less favorable price for decreases.

```
calculateLeverage
executionPrice
OPEN_NEW_POSITION
calculateLeverage
executionPrice
```

Recommendation

Allow the `calculateLeverage` function to take in an `orderType` and supply the appropriate `orderType` when validating leverage for each `orderType`.

```
calculateLeverage
orderType
orderType
orderType
```

Resolution

PariFi Team: Fixed

H-1 | Price Updated In Wrong Direction

CATEGORY	SEVERITY	LOCATION	STATUS
Logical Error	HIGH	OrderManager.sol: 177	Resolved

Description

A potential problem arises when price is updated according to the market's `deviationPoints`. The update only considers whether the user is long or short, if the user opens a long they receive a superior execution.

```
deviationPoints
```

Recommendation

Take into consideration whether the `orderType` being executed is an increase or decrease `orderType` when adjusting the `updatedPrice` by the `deviationPoints`.

```
orderType
orderType
updatedPrice
deviationPoints
```

Resolution

PariFi Team: Fixed

H-2 | Small Positions Prevented From Being Closed

CATEGORY	SEVERITY	LOCATION	STATUS
Validation	HIGH	OrderManager.sol: 213	Resolved

Description

The `_deductFeesFromPosition` function reverts if the remaining position collateral after deducting fees is less than the configured minimum collateral for the market.

```
_deductFeesFromPosition
```

Recommendation

Do not validate the minimum collateral amount in the `_deductFeesFromPosition` when closing a position.

```
_deductFeesFromPosition
```

Resolution

PariFi Team: Fixed

H-3 | Misconfigured Markets Can Break The Protocol

CATEGORY	SEVERITY	LOCATION	STATUS
Validation	HIGH	OrderManager.sol: 852	Resolved

Description

The `addNewMarket` function allows a market to be added with the specified `_marketId`, however the `_newMarket.marketId` is not validated to be the same as the provided `_marketId`.

```
addNewMarket
_marketId
_newMarket.marketId
_marketId
```

Recommendation

Remove the `marketId` attribute on the Market struct as it is unnecessary and leads to misconfiguration.

```
marketId
```

Resolution

PariFi Team: Fixed

M-0 | Lack Of Reserve Validation

CATEGORY	SEVERITY	LOCATION	STATUS
Validation	MEDIUM	OrderManager.sol	Acknowledged

Description

Although the OrderManager validates that the position does not increase the open interest past the `maximumOi`, LPers are still exposed to great risk as there is no validation on the size of the position relative to the funds available in the market.

```
maximumOi
```

Recommendation

Add validation checks to ensure the position size may be only up to a specific percentage of funds available in the market.

Resolution

PariFi Team: We use fractional reserves and use maximumOi to keep the risks in check.

M-1 | Relayer May Censor Transactions

CATEGORY	SEVERITY	LOCATION	STATUS
Validation	MEDIUM	ParifiForwarder.sol: 189	Acknowledged

Description

The `gasSent` is validated to be greater than `64/63 * the transaction.minGas`, however the `gasSent` is recorded at the beginning of the `execute` function which has a non-trivial amount of logic, that will expend gas, before executing the external call.

```
gasSent
64/63 * the transaction.minGas
gasSent
execute
```

Recommendation

Add a buffer to the `gasSent` validation that comfortably covers any expenditure that would occur before the external call.

```
gasSent
```

Resolution

PariFi Team: Agreed to explain in documentation about `minGas` being the gas needed for the entire `execute` function.

```
minGas
execute
```

M-2 | Slippage Applies To Both Sides

CATEGORY	SEVERITY	LOCATION	STATUS
Logical Error	MEDIUM	OrderManager.sol: 400	Resolved

Description

For slippage calculations, `_settleOrder` calculates a percentage above the `expectedPrice` and a percentage below the `expectedPrice`.

```
_settleOrder
expectedPrice
expectedPrice
```

Recommendation

Only compare the price against the `upperLimit` for longs and the `lowerLimit` for shorts.

```
upperLimit
lowerLimit
```

Resolution

PariFi Team: Fixed

L-0 | Dead Address Can Be Constant

CATEGORY	SEVERITY	LOCATION	STATUS
Optimization	LOW	MarketVault.sol	Resolved

Description

To reduce bytecode and favor DRY the dead address referenced multiple times can instead be a constant in the `MarketVault` contract.

```
MarketVault
```

Recommendation

Declare the dead address as a constant variable in the `MarketVault` contract.

```
MarketVault
```

Resolution

PariFi Team: Fixed

L-1 | Unnecessary userOrder Storage Declaration

CATEGORY	SEVERITY	LOCATION	STATUS
Optimization	LOW	OrderManager.sol: 375	Resolved

Description

The `userOrder` variable is declared as a `storage` reference variable, however it would be much more efficient to declare it as a `memory` variable.

```
userOrder
storage
memory
```

Recommendation

Declare the `userOrder` variable as a `memory` variable.

```
userOrder
memory
```

Resolution

PariFi Team: Fixed

L-2 | Leverage Rounded Down

CATEGORY	SEVERITY	LOCATION	STATUS
Rounding	LOW	OrderManager.sol: 670	Resolved

Description

When computing the leverage of a position in the `calculateLeverage` function round down division is used. The result of the rounding is that the position appearing as if it has slightly lower leverage than it actually does.

```
calculateLeverage
```

Recommendation

Though this rounding will have a minimal impact it may be worthwhile to use roundUp division to avoid position's being technically above the allowed leverage yet rounded to within the allowed range.

Resolution

PariFi Team: Fixed

Summary of Recommendations

Based on our comprehensive audit, we provide the following prioritized recommendations to improve the security posture of PariFi.

Priority Matrix

ISSUE ID	TITLE	SEVERITY	PRIORITY
C-0	Users Prevented From Withdrawing Liquidity	CRITICAL	Immediate
C-2	Users Can Modify Any Position	CRITICAL	Immediate
C-3	Decreasing Position Size Does Not Account For PnL	CRITICAL	Immediate
C-4	Users In Profit Errantly Liquidated	CRITICAL	Immediate
C-5	Insolvent Closes Steal Collateral From Other Positions	CRITICAL	Immediate
L-1	Unnecessary userPosition Storage Declaration	CRITICAL	Immediate
H-0	Incorrect OrderType Used For Execution Price	HIGH	High
H-1	Price Updated In Wrong Direction	HIGH	High
H-2	Small Positions Prevented From Being Closed	HIGH	High
H-3	Misconfigured Markets Can Break The Protocol	HIGH	High

General Security Best Practices

- ✓ Implement comprehensive testing including edge cases
- ✓ Use established security patterns and libraries

Audit Team

Team Credentials

Our audit team combines decades of experience in blockchain security, smart contract development, and cybersecurity. Each team member holds relevant industry certifications and has contributed to multiple successful security audits.

Methodology & Standards

Our audit methodology follows industry best practices and standards:

- ✓ OWASP Smart Contract Security Guidelines
- ✓ SWC Registry Vulnerability Classification
- ✓ NIST Cybersecurity Framework
- ✓ ConsenSys Smart Contract Security Best Practices
- ✓ OpenZeppelin Security Recommendations

Audit Process

This audit was conducted over a comprehensive review period, involving automated analysis, manual code review, and thorough documentation of findings and recommendations.

Disclaimer & Legal Notice

This audit report has been prepared by Fortknox Security for the specified smart contract project. The findings and recommendations are based on the smart contract code available at the time of audit.

Scope Limitations

- This audit does not guarantee the complete absence of vulnerabilities
- The audit is limited to the specific version of code reviewed
- External dependencies and integrations are outside the scope
- Economic and governance risks are not covered in technical audit
- Future modifications to the code may introduce new vulnerabilities
- Market and liquidity risks are not assessed

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Contact Information

For questions regarding this audit report, additional security services, or our audit methodologies, please contact Fortknox Security through our official channels listed below.

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