Smart Contract Audit Report

GMX-GLV

Audit Performed By

Fortknox Security

Professional Smart Contract Auditing

December 21, 2024

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Executive Summary

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

10	1	LOW	100%
TOTAL ISSUES FOUND	CRITICAL + HIGH	OVERALL RISK	CODE COVERAGE

Security Assessment Overview

Critical Issues

0

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

IMPACT: SEVERE FINANCIAL LOSS

High Issues

1

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 GMX-GLV smart contract audit reveals **10 total findings** across various security categories. Immediate attention is required for 1 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	GMX-GLV
Total Issues Found	10
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 GMX-GLV.

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

H-0 | Execution fee locked in router on cancellation

CATEGORY	SEVERITY	LOCATION	STATUS
Logical Error	HIGH	GlvHandler.sol: 123-224	Resolved

Description

When a user cancels a GLV deposit/withdraw the keeper is set to `msg.sender` instead of account.

```
msg.sender
```

Recommendation

Pass in `account()` instead of `msg.sender` when a user initiates a cancellation.

```
account()
msg.sender
```

Resolution

GMX Team: Resolved.

M-0 | Excess execution fee will be required

CATEGORY	SEVERITY	LOCATION	STATUS
Logical Error	MEDIUM	GasUtils.sol: 343	Resolved

Description

To deposit GM, the long token address must be 0. `if (params.initialLongToken != address(0))`

```
if (params.initialLongToken != address(0))
```

Recommendation

Consider only charging the deposit fee when an underlying long or short has been deposited.

Resolution

GMX Team: Resolved.

M-1 | GLV Withdrawal Callback Gas Cost Ignored

CATEGORY	SEVERITY	LOCATION	STATUS
Logical Error	MEDIUM	GlvWithdrawalUtils: 207	Resolved

Description

For the GLV Withdrawal flow, the callback call is made at the end of `GlvWithdrawalUtils::executeGlvWithdrawal()`.

```
GlvWithdrawalUtils::executeGlvWithdrawal()
```

Recommendation

Move the callback call to before `payExecutionFee`() is called.

```
payExecutionFee
```

Resolution

GMX Team: Resolved.

M-2 | executionFee Should Be Updated

CATEGORY	SEVERITY	LOCATION	STATUS
Logical Error	MEDIUM	GlvWithdrawalUtils.sol	Resolved

Description

The `createGlvWithdrawal` function does not update the `params.executionFee` after recording the transferred `wntAmount` with `recordTransferIn`. As a consequence, users may not receive a full refund when the transferred wnt amount exceeds the provided input value.

```
createGlvWithdrawal
params.executionFee
wntAmount
recordTransferIn
```

Recommendation

Update the `params.executionFee` after recording the transfer.

```
params.executionFee
```

Resolution

GMX Team: Resolved.

M-3 | GLV Used To Exit Illiquid Markets

CATEGORY	SEVERITY	LOCATION	STATUS
Logical Error	MEDIUM	Global	Acknowledged

Description

GLV allows users to essentially swap between GM markets with no fees by triggering a GLV deposit of GM market A and triggering a GLV withdrawal of GM market B.

Recommendation

Consider applying an additional fee to GLV withdrawals to disincentivize this or disallowing GLV deposits when the underlying GM market is illiquid.

Resolution

GMX Team: Acknowledged.

M-4 | GLV Actions Cannot Be Simulated

CATEGORY	SEVERITY	LOCATION	STATUS
Logical Error	MEDIUM	GlvHandler.sol: 232, 241	Resolved

Description

The `simulateExecuteGlvDeposit` and `simulateExecuteGlvWithdrawal` functions have the `onlyController` modifier, however they are not exposed through the `GlvRouter` and therefore cannot be called.

```
simulateExecuteGlvDeposit
simulateExecuteGlvWithdrawal
onlyController
GlvRouter
```

Recommendation

Expose the `simulateExecuteGlvDeposit` and `simulateExecuteGlvWithdrawal` functions through the `GlvRouter`.

```
simulateExecuteGlvDeposit
simulateExecuteGlvWithdrawal
GlvRouter
```

Resolution

GMX Team: Resolved.

L-0 | Feature validation occurs before try-catch

CATEGORY	SEVERITY	LOCATION	STATUS
Logical Error	LOW	GlvHandler.sol: 43	Resolved

Description

The GLV functions validate whether a feature is enabled before entering the try-catch block. This means that if the feature is not enabled, the execution will revert instead of cancelling the order.

Recommendation

To address this issue, it is advisable to move the feature validation check inside the try-catch block, similar to how it is implemented in other functions for both GLV deposits and withdrawals.

Resolution

GMX Team: Resolved.

L-1 | DoS Via Type Casting

CATEGORY	SEVERITY	LOCATION	STATUS
DoS	LOW	GlvUtils: 128	Acknowledged

Description

`_getGlvMarketValue()` calls `getPoolValueInfo()` to determine the pool value for each market. The issue is that `_getGlvMarketValue()` will cast pool value to a `uint256`. However, pool value can potentially be a negative value if the PnL and impact pool are large enough.
`_getGlvMarketValue()` is called in a loop inside of `getGlvValue()`, which, in turn, is called in the GLV deposit, withdrawal, and shift flow.

```
_getGlvMarketValue()
getPoolValueInfo()
_getGlvMarketValue()
uint256
_getGlvMarketValue()
getGlvValue()
```

Recommendation

Do not cast pool value to a `uint256`. This will allow for a more accurate calculation of the true value of the GLV market.

```
uint256
```

Resolution

GMX Team: Acknowledged.

L-2 | GLV Deposit Config Added Twice

CATEGORY	SEVERITY	LOCATION	STATUS
Superfluous Code	LOW	Config: 453-455	Resolved

Description

In `Config.sol`, `CREATE_GLV_DEPOSIT_FEATURE_DISABLED`, `CANCEL_GLV_WITHDRAWAL_FEATURE_DISABLED`, and `EXECUTE_GLV_DEPOSIT_FEATURE_DISABLED` are all assigned twice. This is an unnecessary operation that wastes gas, and can be removed.

```
Config.sol
CREATE_GLV_DEPOSIT_FEATURE_DISABLED
CANCEL_GLV_WITHDRAWAL_FEATURE_DISABLED
EXECUTE_GLV_DEPOSIT_FEATURE_DISABLED
```

Recommendation

Remove the extra assignment from the `Config.sol`.

```
Config.sol
```

Resolution

GMX Team: Resolved.

L-3 | Shifting Is Allowed To Same Market

CATEGORY	SEVERITY	LOCATION	STATUS
Validation	LOW	GlvShiftUtils.sol: 71	Acknowledged

Description

Keepers have the ability to initiate a shift from one market to another. However, there is a missing validation to ensure that both markets are not the same.

Recommendation

Implement a check to revert the transaction if both the `fromMarket` and `toMarket` are the same.

```
fromMarket
toMarket
```

Resolution

GMX Team: Acknowledged.

Summary of Recommendations

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

Priority Matrix

ISSUE ID	TITLE	SEVERITY	PRIORITY
H-0	Execution fee locked in router on cancellation	HIGH	High
M-0	Excess execution fee will be required	MEDIUM	Medium
M-1	GLV Withdrawal Callback Gas Cost Ignored	MEDIUM	Medium
M-2	executionFee Should Be Updated	MEDIUM	Medium
M-3	GLV Used To Exit Illiquid Markets	MEDIUM	Medium
M-4	GLV Actions Cannot Be Simulated	MEDIUM	Medium
L-0	Feature validation occurs before try-catch	LOW	Low
L-1	DoS Via Type Casting	LOW	Low
L-2	GLV Deposit Config Added Twice	LOW	Low
L-3	Shifting Is Allowed To Same Market	LOW	Low

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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