

SMART CONTRACT **SECURITY AUDIT**

PENDLE TOKEN







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DISCLAIMER

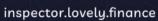
This is a comprehensive report based on our automated and manual examination of cybersecurity vulnerabilities and framework flaws of the project's smart contract. Reading the full analysis report is essential to build your understanding of project's security level. It is crucial to take note, though we have done our best to perform this analysis and report, that you should not rely on the our research and cannot claim what it states or how we created it. Before making any judgments, you have to conduct your own independent research. We will discuss this in more depth in the following disclaimer - please read it fully. DISCLAIMER: You agree to the terms of this disclaimer by reading this report or any portion thereof. Please stop reading this report and remove and delete any copies of this report that you download and/or print if you do not agree to these conditions. Scan and verify report's presence in the GitHub repository by a gr-code on the title page. This report is for non-reliability information only and does not represent investment advice. No one shall be entitled to depend on the report or its contents, and Inspector Lovely and its affiliates shall not be held responsible to you or anyone else, nor shall Inspector Lovely provide any guarantee or representation to any person with regard to the accuracy or integrity of the report. Without any terms, warranties or other conditions other than as set forth in that exclusion and Inspector Lovely excludes hereby all representations, warrants, conditions and other terms (including, without limitation, guarantees implied by the law of satisfactory quality, fitness for purposes and the use of reasonable care and skills). The report is provided as "as is" and does not contain any terms and conditions. Except as legally banned, Inspector Lovely disclaims all responsibility and responsibilities and no claim against Inspector Lovely is made to any amount or type of loss or damages (without limitation, direct, indirect, special, punitive, consequential or pure economic loses or losses) that may be caused by you or any other person, or any damages or damages, including without limitations (whether innocent or negligent). Security analysis is based only on the smart contracts. No applications or operations were reviewed for security. No product code has been reviewed.



AUDIT SCOPE

Name	Code Review and Security Analysis Report for Pendle Token Coin Smart Contract		
Platform	Ethereum		
File 1	PENDLE.sol		
Ethereum Code	0×808507121b80c02388fad14726482e061b8da827		
Audit Date	November 8th, 2023		





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PROPOSED SMART CONTRACT FEATURES

Claimed Feature Detail	Our Observation
	Validated
Tokenomics:	
Name: Pendle	
Symbol: PENDLE	
Decimals: 18	
Ownership control:	Validated
The Governance owner can initiate Configuration changes.	
 The liquidity incentives recipient owner can claim liquidity emissions. 	
 Allows governance to withdraw Ether in a Pendle contract in case of accidental ETH transfer into the contract. 	
 Allows governance to withdraw all IERC20 compatible tokens in a Pendle contract in case of accidental token transfer into the contract. 	
 Allows the pendingGovernance address to finalize the change governance process by the governance owner. 	
 Allows the current governance to set the pendingGovernance address by the governance owner. 	









AUDIT SUMMARY

According to the standard audit assessment, the Customer`s solidity-based smart contracts are "Secured". Also, these contracts contain owner control, which does not make them fully decentralized.



We used various tools like Slither, Solhin,t, and Remix IDE. At the same time, this finding is based on a critical analysis of the manual audit.

All issues found during automated analysis were manually reviewed and applicable vulnerabilities are presented in the Audit Overview section. General overview is presented in AS-IS section and all identified issues can be found in the Audit overview section.

We found 0 critical, 0 high, 0 medium and 0 low, and 0 very low level issues.

Investors Advice: Technical audit of the smart contract does not guarantee the ethical nature of the project. Any owner-controlled functions should be executed by the owner with responsibility. All investors/users are advised to do their due diligence before investing in the project









KEY TECHNICAL METRICS

MAIN CATEGORY	SUBCATEGORY	RESULT
	Solidity version is not specified	Passed
	Solidity version is too old	Passed
	Integer overflow/underflow	Passed
	Function input parameters lack check	Passed
	Function input parameters check bypass	Passed
Contract	Function access control lacks management	Passed
Programming	Critical operation lacks event log	Passed
	Human/contract checks bypass	Passed
	Random number generation/use vulnerability	N/A
	Fallback function misuse	Passed
	Race condition	Passed
	Logical vulnerability	Passed
	Features claimed	Passed
	Other programming issues	Passed
	Function visibility not explicitly declared	Passed
Code	Var. storage location not explicitly declared	Passed
Specification	Use keywords/functions to be deprecated	Passed
	Unused code	Passed
	"Out of Gas" Issue	Passed
Gas Optimization	High consumption 'for/while' loop	Passed
dus Optimization	High consumption 'storage' storage	Passed
	Assert() misuse	Passed
	The maximum limit for mintage is not set	Passed
Business Risk	"Short Address" Attack	Passed
	"Double Spend" Attack	Passed

Overall Audit Result: PASSED



BUSINESS RISK ANALYSIS

CA	TEGORY	RESULT
•	Buy Tax	0%
•	Sell Tax	0%
•	Cannot Buy	Not Detected
•	Cannot Sell	Not Detected
•	Max Tax	0%
•	Modify Tax	Not Detected
•	Fee Check	No
•	Is Honeypot	Not Detected
•	Trading Cooldown	Not Detected
•	Can Pause Trade?	No
•	Pause Transfer?	No
•	Max Tax?	No
•	Is it Anti-whale?	No
•	Is Anti-bot?	Not Detected
•	Is it a Blacklist?	Not Detected
•	Blacklist Check	No
•	Can Mint?	No
•	Is it Proxy?	No
•	Can Take Ownership?	No
•	Hidden Owner?	Not Detected
•	Self Destruction?	Not Detected
•	Auditor Confidence	High

Overall Audit Result: PASSED









CODE QUALITY

This audit scope has 1 smart contract. Smart contract contains Libraries, Smart contracts, inherits, and Interfaces. This is a compact and well written smart contract.

The libraries in Pendle Token are part of its logical algorithm. A library is a different type of smart contract that contains reusable code. Once deployed on the blockchain (only once), it is assigned a specific address and its properties/methods can be reused many times by other contracts in the Pendle Token.

The EtherAuthority team has not provided scenario and unit test scripts, which would have helped to determine the integrity of the code in an automated way.

Code parts are well commented on in the smart contracts. Ethereum's NatSpec commenting style is recommended.

DOCUMENTATION

We were given a Pendle Token smart contract code in the form of an Etherscan web link.

As mentioned above, code parts are well commented on. and the logic is straightforward. So it is easy to quickly understand the programming flow as well as complex code logic. Comments are very helpful in understanding the overall architecture of the protocol.

Another source of information was its official website: https://www.pendle.finance which provided rich information about the project architecture and tokenomics.

USE OF DEPENDENCIES

As per our observation, the libraries are used in this smart contract infrastructure that are based on well-known industry standard open-source projects.

Apart from libraries, its functions are not used in external smart contract calls.









PROJECT WEBSITE PERFORMANCE AUDIT



Browser Timings

- Redirect Duration Connection Duration 0ms 27ms
- 60ms 361ms
- 2.1ms 887ms
- Backend Duration
- 33ms 886ms
- 2.2s

Grade

Α	Performance 100%	Structure 88%
Wah Vitale		

596ms	

Top Issues

IMPECT AUDIT

Avoid enormous network payloads

URL

- https://www.pendle.finance/pendle/wp-content/uploads/2022/09/WAVE0.1.mp4 https://www.pendle.finance/pendle/wp-content/uploads/2022/09/wavE0.t.mp4
 https://www.pendle.finance/pendle/wp-content/uploads/2022/09/new-dawn-scaled.jpg
 https://www.pendle.finance/pendle/wp-content/uploads/2022/07/out.mp4
 https://www.pendle.finance/pendle/wp-content/uploads/2022/07/out.mp4
 https://www.pendle.finance/pendle/wp-content/uploads/2022/08/Frame-736-1.png
 https://www.pendle.finance/uploads/wp-content/uploads/binance_labs.png
 https://www.pendle.finance/uploads/wp-content/uploads/2022/08/mechanism.png
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 https://www.pendle.finance/uploads/wp-con

- https://www.pendie.finance/pendie/wp-content/plugins/elementor/assets/lib/eicons/fonts/eicons.woff2?5.16.0
 https://www.pendie.finance/pendie/wp-content/uploads/2022/09/pexels-mart-production-88692292-copy2-scaled.jpg
- https://www.googletagmanager.com/gtag/js?id=G-2D0FJGFKN3&I=dataLayer&cx=c

SIZE

- 786KB 786KB
- 111KB
- 93.4KB
- 88.9KB

Level of Criticality

RISK LEVEL	DESCRIPTION
Critical	Critical vulnerabilities are usually straightforward to exploit and can lead to token loss etc.
High	High-level vulnerabilities are difficult to exploit; however, they also have significant impact on smart contract execution, e.g. public access to crucial
Medium-level vulnerabilities are important to fix; however, they can't lead to tokens lose	
Low	Low-level vulnerabilities are mostly related to outdated, unused etc. code snippets, that can't have significant impact on execution
Lowest / Code Style / Best Practice	Lowest-level vulnerabilities, code style violations and info statements can't affect smart contract execution and can be ignored.









AUDIT FINDINGS TABLE

	Total	Resolved	UnResolved	Acknowledged
High Severity Issues Found	o	0	•	0
Moderate Severity Issues Found	o	0	0	0
Medium Severity Issues	0	0	0	0
Low Severity Issues	0	•	0	0
Informational Observations	o	0	•	0

The Pendle Token - Audit report identifies 0 issues with varying severity levels, discovered through manual review and static analysis techniques, alongside rigorous code reviews, highlighting the need for further investigation and vulnerability identification.

The smart contract is considered to **pass the audit**, as of the audit date, if no high severity or moderate severity issues are found.



AUDIT FINDINGS

Critical Severity

No Critical severity vulnerabilities were found.

High Severity

No High severity vulnerabilities were found.

Medium

No Medium severity vulnerabilities were found.

Low

No Low severity vulnerabilities were found.

Very Low / Informational /

No Very Low severity vulnerabilities were found.

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CENTRALIZATION

This smart contract has some functions that can be executed by the Admin (Owner) only. If the admin wallet's private key is compromised, then it would create trouble. Following are Admin functions:

PENDLE.sol

- initiateConfigChanges: The Governance owner can initiate Configuration changes.
- claimLiquidityEmissions: The liquidity incentives recipient owner can claim liquidity emissions.

Withdrawable.sol

- withdrawEther: Allows governance to withdraw Ether in a Pendle contract in case of accidental ETH transfer into the contract.
- withdrawToken: Allows governance to withdraw all IERC20 compatible tokens in a Pendle contract in case of accidental token transfer into the contract.

Permissions.sol

- claimGovernance: Allows the pendingGovernance address to finalize the change governance process by the governance owner.
- transferGovernance: Allows the current governance to set the pendingGovernance address by the governance owner.

To make the smart contract 100% decentralized, we suggest renouncing ownership of the smart contract once its function is completed.



CONCLUSION

We were given a contract code in the form of <u>Etherscan</u> web links. And we have used all possible tests based on given objects as files. We had not observed any issues in the smart contracts. So, it's good to go for the production.

Since possible test cases can be unlimited for such smart contracts protocol, we provide no such guarantee of future outcomes. We have used all the latest static tools and manual observations to cover maximum possible test cases to scan everything.

Smart contracts within the scope were manually reviewed and analyzed with static analysis tools. Smart Contract's high-level description of functionality was presented in the As-is overview section of the report.

Audit report contains all found security vulnerabilities and other issues in the reviewed code.

Security state of the reviewed smart contract, based on standard audit procedure scope, is "Secured".









ADDENDUM

Code Flow Diagram

PENDLE Token









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SECURITY ASSESSMENT REPORT

Slither is a Solidity static analysis framework that uses vulnerability detectors, displays contract details and provides an API for writing custom analyses. It helps developers identify vulnerabilities, improve code comprehension, and prototype custom analyses quickly. The analysis includes a report with warnings and errors, allowing developers to quickly prototype and fix issues.

We did the analysis of the project together. Below are the results.

Slither Log >> PENDLE.sol



```
Address.isContract(address) (PENDLE.sol#26-35) uses assembly
- INLINE ASM (PENDLE.sol#33)
Address._verifyCallResult(bool,bytes,string) (PENDLE.sol#171-188) uses assembly
- INLINE ASM (PENDLE.sol#180-183)
PENDLE.getChainId() (PENDLE.sol#1852-1058) uses assembly
- INLINE ASM (PENDLE.sol#1854-1856)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#assembly-usage
Address.functionCall(address,bytes) (PENDLE.sol#79-81) is never used and should be removed Address.functionCallWithValue(address,bytes,uint256) (PENDLE.sol#104-106) is never used and should be removed Address.functionDelegateCall(address,bytes) (PENDLE.sol#153-155) is never used and should be removed Address.functionDelegateCall(address,bytes) (PENDLE.sol#153-155) is never used and should be removed Address.functionDelegateCall(address,bytes) (PENDLE.sol#163-169) is never used and should be removed Address.functionStaticCall(address,bytes) (PENDLE.sol#129-131) is never used and should be removed Address.functionStaticCall(address,bytes,string) (PENDLE.sol#139-145) is never used and should be removed Address.sendValue(address,uint256) (PENDLE.sol#39-195) is never used and should be removed SafeERC20.safeApprove(IERC20,address,uint256) (PENDLE.sol#479-488) is never used and should be removed SafeERC20.safeIncreaseAllowance(IERC20,address,uint256) (PENDLE.sol#499-498) is never used and should be removed SafeERC20.safeIncreaseAllowance(IERC20,address,uint256) (PENDLE.sol#499-493) is never used and should be removed SafeMath.div(uint256,uint256) (PENDLE.sol#434-437) is never used and should be removed SafeMath.mod(uint256,uint256) (PENDLE.sol#434-437) is never used and should be removed SafeMath.mod(uint256,uint256) (PENDLE.sol#454-457) is never used and should be removed SafeMath.tryAdd(uint256,uint256) (PENDLE.sol#304-307) is never used and should be removed SafeMath.tryMod(uint256,uint256) (PENDLE.sol#343-437) is never used and should be removed SafeMath.tryMod(uint256,uint256) (PENDLE.sol#343-437) is never used and should be removed SafeMath.tryMod(uint256,uint256) (PENDLE.sol#304-307) is never used and should be removed SafeMath.tryMod(uint256,uint256) (PENDLE.sol#304-307) is never used and should be removed SafeMath.tryMod(uint256,uint256) (PENDLE.sol#329-297) is never used and should be removed SafeMath.trySub(uint256,uint256) (PENDLE.sol#32) is never used and should be removed Pendemath.trySub(uint256,uint25
  Pragma version>=0.6.2<0.8.0 (PENDLE.sol#3) is too complex
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#incorrect-versions-of-solidity
Low level call in Address.sendValue(address,uint256) (PENDLE.sol#53-59):

- (success) = recipient.call{value: amount}{) (PENDLE.sol#57)
Low level call in Address.functionCallWithValue(address,bytes,uint256,string) (PENDLE.sol#114-121):

- (success,returndata) = target.call{value: value}(data) (PENDLE.sol#139-145):

- (success,returndata) = target.staticcall(data) (PENDLE.sol#143)
Low level call in Address.functionDelegateCall(address,bytes,string) (PENDLE.sol#163-169):

- (success,returndata) = target.delegateCall(data) (PENDLE.sol#167)
Low level call in Withdrawable.withdrawEther(uint256,address) (PENDLE.sol#623-627):

- (success) = sendTo.call{value: amount}{} (PENDLE.sol#624)
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#low-level-calls
  Parameter Permissions.transferGovernance(address)._governance (PENDLE.sol#603) is not in mixedCase
Parameter PENDLE.initiateConfigChanges(uint256,uint256,address,bool)._emissionRateMultiplierNumerator (PENDLE.sol#1061) is not i
  Parameter PENDLE.initiateConfigChanges(uint256,uint256,address,bool)._liquidityIncentivesRecipient (PENDLE.sol#1063) is not in mixedCase
  Redicase
Parameter PENDLE.initiateConfigChanges(uint256,uint256,address,bool)._isBurningAllowed (PENDLE.sol#1064) is not in mixedCase
Constant PENDLE.isPendleToken (PENDLE.sol#660) is not in UPPER_CASE_WITH_UNDERSCORES
Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#conformance-to-solidity-naming-conventions
   PENDLE.slitherConstructorConstantVariables() (PENDLE.sol#651-1151) uses literals with too many digits:
  - INITIAL_LIQUIDITY_EMISSION = 1200000 * 1e18 (PENDLE.sol#669)

Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#too-many-digits
 PENDLE.startTime (PENDLE.sol#681) should be immutable
Permissions.initializer (PENDLE.sol#567) should be immutable
 Reference: https://github.com/crytic/slither/wiki/Detector-Documentation#state-variables-that-could-be-declared-immutable PENDLE.sol analyzed (8 contracts with 84 detectors), 44 result(s) found
```



SOLIDITY STATIC ANALYSIS

Static code analysis is used to identify many common coding problems before a program is released. It involves examining the code manually or using tools to automate the process. Static code analysis tools can automatically scan the code without executing it.

PENDLE.sol

Check-effects-interaction:

Potential violation of Checks-Effects-Interaction pattern in Address.functionCallWithValue(address,bytes,uint256,string): Could potentially lead to re-entrancy vulnerability. Note: Modifiers are currently not considered by this static analysis.

more

Pos: 114:4:

Check-effects-interaction:

Potential violation of Checks-Effects-Interaction pattern in Withdrawable.withdrawEther(uint256,address payable): Could potentially lead to re-entrancy vulnerability. Note: Modifiers are currently not considered by this static analysis.

more

Pos: 623:4:

Inline assembly:

The Contract uses inline assembly, this is only advised in rare cases. Additionally static analysis modules do not parse inline Assembly, this can lead to wrong analysis results.

more

Pos: 1054:8:



Block timestamp:

Use of "block.timestamp": "block.timestamp" can be influenced by miners to a certain degree. That means that a miner can "choose" the block.timestamp, to a certain degree, to change the outcome of a transaction in the mined block.

Pos: 1130:18:

Low level calls:

Use of "call": should be avoided whenever possible. It can lead to unexpected behavior if return value is not handled properly. Please use Direct Calls via specifying the called contract's interface.

more

Pos: 624:27:

Gas costs:

Gas requirement of function PENDLE.claimLiquidityEmissions is infinite: If the gas requirement of a function is higher than the block gas limit, it cannot be executed. Please avoid loops in your functions or actions that modify large areas of storage (this includes clearing or copying arrays in storage)

Pos: 1102:4:

Similar variable names:

PENDLE._mint(address,uint256): Variables have very similar names "account" and "amount". Note: Modifiers are currently not considered by this static analysis. Pos: 1137:50:

Guard conditions:

Use "assert(x)" if you never ever want x to be false, not in any circumstance (apart from a bug in your code). Use "require(x)" if x can be false, due to e.g. invalid input or a failing external component.

more

Pos: 984:8:



COMPLIANCE ANALYSIS

Linters are the utility tools that analyze the given source code and report programming errors, bugs, and stylistic errors. For the Solidity language, there are some linter tools available that a developer can use to improve the quality of their Solidity contracts.

PENDLE.sol

Compiler version >=0.6.2 <0.8.0 does not satisfy the ^0.5.8 semver requirement

Error message for require is too long

Pos: 9:57

Error message for require is too long

Pos: 9:114

Error message for require is too long

Error message for require is too long

Pos: 9:163

Error message for require is too long Pos: 9:362

Error message for require is too long

Pos: 9:483

Error message for require is too long

Explicitly mark visibility in function (Set ignoreConstructors to true if using solidity >=0.7.0)

Contract has 19 states declarations but allowed no more than 15

Pos: 1:650

Constant name must be in capitalized SNAKE_CASE

Pos: 5:659

Constant name must be in capitalized SNAKE_CASE

Pos: 5:660

Constant name must be in capitalized SNAKE_CASE

Constant name must be in capitalized SNAKE_CASE Pos: 5:662

Explicitly mark visibility in function (Set ignoreConstructors to true if using solidity >=0.7.0)

Avoid making time-based decisions in your business logic

Pos: 21:757

Avoid making time-based decisions in your business logic

Avoid using inline assembly. It is acceptable only in rare cases

Avoid making time-based decisions in your business logic

Pos: 34:1076

Avoid making time-based decisions in your business logic

Avoid making time-based decisions in your business logic

Pos: 19:1129



SOFTWARE ANALYSIS RESULT

This software reported many false positive results and some are informational issues. So, those issues can be safely ignored.

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