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MADE IN GERMANY

2219 by MechaChain

Audit

Security Assessment
17. April, 2023

For

MECHACHAIN

SolidProof_io

@solidproof_io

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Version	Date	Description
1.0	1. February 2023	• Layout project • Automated- /Manual-Security Testing • Summary
1.1	17. April 2023	• Reaudit

Network

Ethereum

Website

https://mechachain.io

Twitter

https://twitter.com/2219project

https://twitter.com/MechaChain

Description

MechaChain is a 3D play to earn robot combat and space conquest video game called "Mechas". Each Mecha is a collection of NFT representing robot parts. They can be purchased online with the game's crypto-currency called Mechanium, using Ethereum, or by card. These parts once assembled give birth to a controllable robot in a PvP combat video game. The player earns Mechanium by winning battles. He is then able to trade and buy new Mecha parts to become the best MechaChain pilot.

Project Engagement

During the Date of 1 February 2023, **2219 by MechaChain Team** engaged Solidproof.io to audit smart contracts that they created. The engagement was technical in nature and focused on identifying security flaws in the design and implementation of the contracts. They provided Solidproof.io with access to their code repository and whitepaper.

Logo

Contract Link

v1.0

- https://github.com/MechaChain/MechaChain-Smart-Contracts/blob/main/contracts/ERC721/MechaPilots2219V1.sol
- **Commit:** 25de3240d60d787338891a5469e847f353fb491a

v1.1

- https://github.com/MechaChain/MechaChain-Smart-Contracts/blob/main/contracts/ERC721/MechaPilots2219V1.sol
- **Commit:** 1b571e9a61fad16751c43db8bd207cd54d29ab62

Vulnerability & Risk Level

Risk represents the probability that a certain source-threat will exploit vulnerability, and the impact of that event on the organization or system. Risk Level is computed based on CVSS version 3.0.

Level	Value	Vulnerability	Risk (Required Action)
Critical	9 - 10	A vulnerability that can disrupt the contract functioning in a number of scenarios, or creates a risk that the contract may be broken.	Immediate action to reduce risk level.
High	7 – 8.9	A vulnerability that affects the desired outcome when using a contract, or provides the opportunity to use a contract in an unintended way.	Implementation of corrective actions as soon aspossible.
Medium	4 – 6.9	A vulnerability that could affect the desired outcome of executing the contract in a specific scenario.	Implementation of corrective actions in a certain period.
Low	2 – 3.9	A vulnerability that does not have a significant impact on possible scenarios for the use of the contract and is probably subjective.	Implementation of certain corrective actions or accepting the risk.
Informational	0 – 1.9	A vulnerability that have informational character but is not effecting any of the code.	An observation that does not determine a level of risk

Auditing Strategy and Techniques Applied

Throughout the review process, care was taken to evaluate the repository for security-related issues, code quality, and adherence to specification and best practices. To do so, reviewed line-by-line by our team of expert pentesters and smart contract developers, documenting any issues as there were discovered.

Methodology

The auditing process follows a routine series of steps:

1. Code review that includes the following:
   i) Review of the specifications, sources, and instructions provided to SolidProof to make sure we understand the size, scope, and functionality of the smart contract.
   ii) Manual review of code, which is the process of reading source code line-by-line in an attempt to identify potential vulnerabilities.
   iii) Comparison to specification, which is the process of checking whether the code does what the specifications, sources, and instructions provided to SolidProof describe.

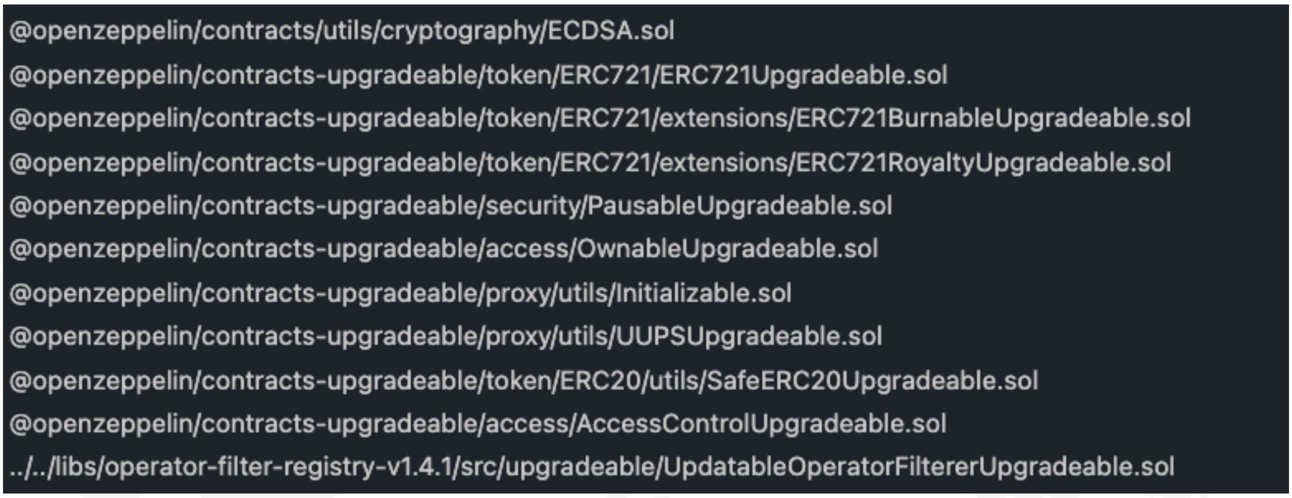
2. Testing and automated analysis that includes the following:
   i) Test coverage analysis, which is the process of determining whether the test cases are actually covering the code and how much code is exercised when we run those test cases.
   ii) Symbolic execution, which is analysing a program to determine what inputs causes each part of a program to execute.

3. Best practices review, which is a review of the smart contracts to improve efficiency, effectiveness, clarify, maintainability, security, and control based on the established industry and academic practices, recommendations, and research.

4. Specific, itemized, actionable recommendations to help you take steps to secure your smart contracts.

Used Code from other Frameworks/Smart Contracts (direct imports)

Imported packages:



```
@openzeppelin/contracts/utils/cryptography/ECDSA.sol
@openzeppelin/contracts-upgradeable/token/ERC721/ERC721Upgradeable.sol
@openzeppelin/contracts-upgradeable/token/ERC721/extensions/ERC721BurnableUpgradeable.sol
@openzeppelin/contracts-upgradeable/token/ERC721/extensions/ERC721RoyaltyUpgradeable.sol
@openzeppelin/contracts-upgradeable/security/PausableUpgradeable.sol
@openzeppelin/contracts-upgradeable/access/OwnableUpgradeable.sol
@openzeppelin/contracts-upgradeable/proxy/utils/Initializable.sol
@openzeppelin/contracts-upgradeable/proxy/utils/UUPSUpgradeable.sol
@openzeppelin/contracts-upgradeable/token/ERC20/utils/SafeERC20Upgradeable.sol
@openzeppelin/contracts-upgradeable/access/AccessControlUpgradeable.sol
../../libs/operator-filter-registry-v1.4.1/src/upgradeable/UpdatableOperatorFiltererUpgradeable.sol
```

Tested Contract Files

This audit covered the following files listed below with a SHA-1 Hash.

A file with a different Hash has been modified, intentionally or otherwise, after the security review. A different Hash could be (but not necessarily) an indication of a changed condition or potential vulnerability that was not within the scope of this review.

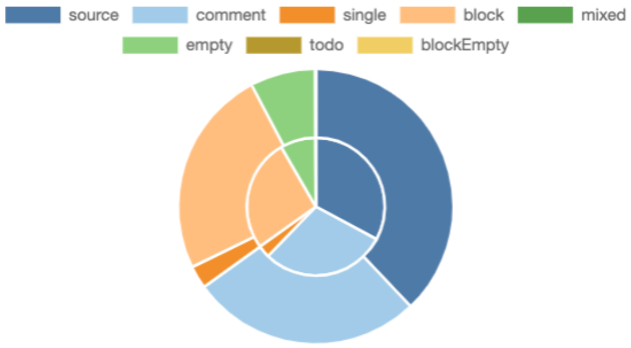
v1.0

File Name	SHA-1 Hash
contracts/MechaPilots2219V1.sol	12827c097c5e02a7cadb88c0659046692ae7f873

Metrics

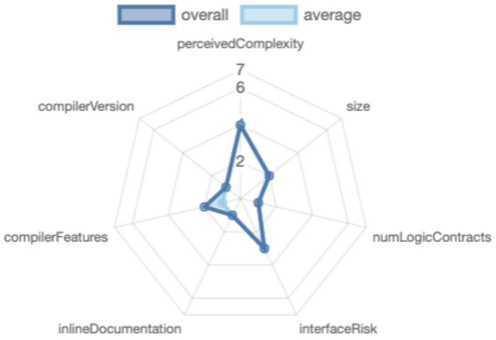
Source Lines

v1.0



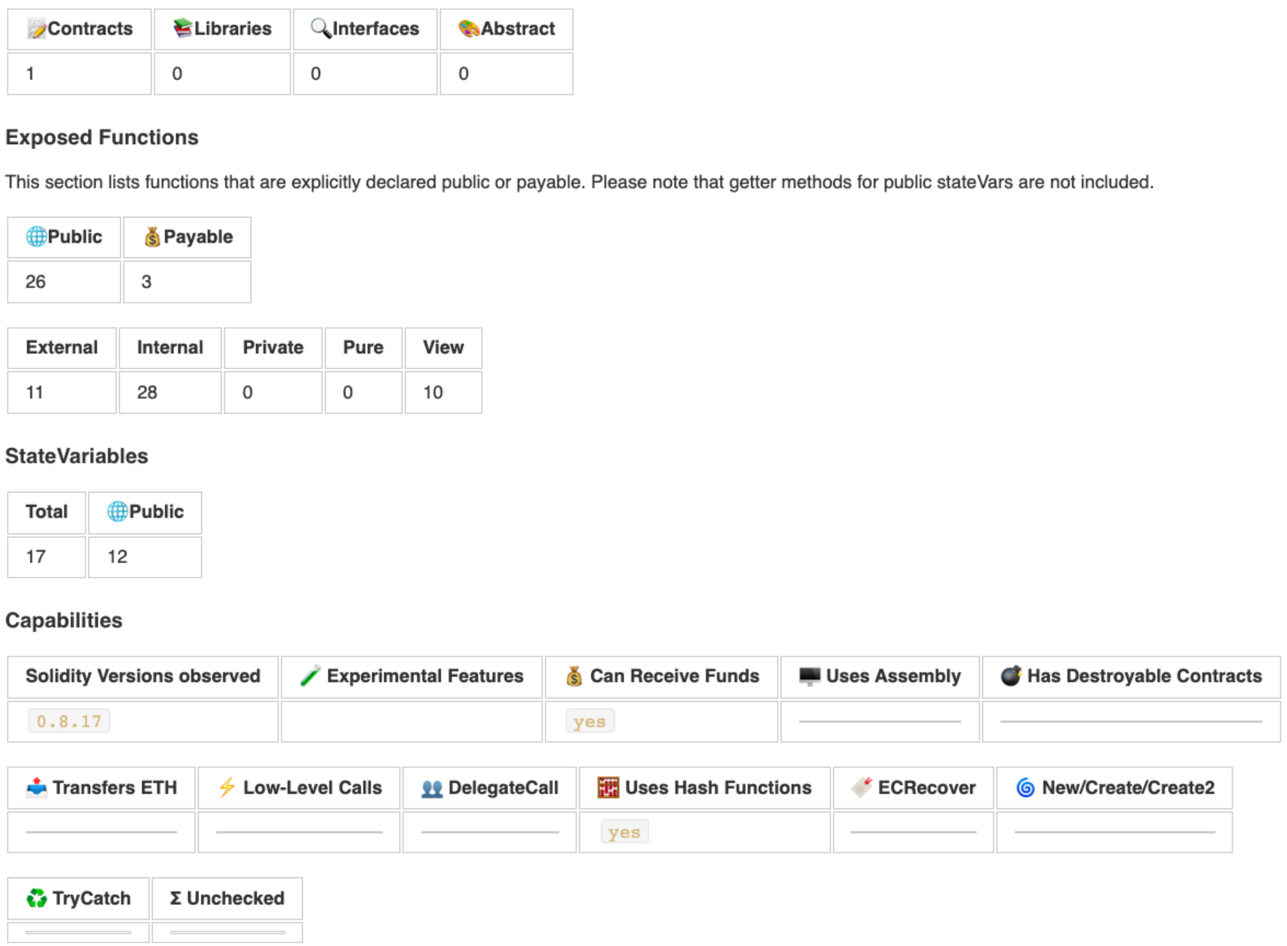
Risk Level

v1.0



Capabilities

Components



📝Contracts	📚Libraries	🔍Interfaces	🎨Abstract
1	0	0	0

Exposed Functions

This section lists functions that are explicitly declared public or payable. Please note that getter methods for public stateVars are not included.

🌐Public	💰Payable
26	3

External	Internal	Private	Pure	View
11	28	0	0	10

StateVariables

Total	🌐Public
17	12

Capabilities

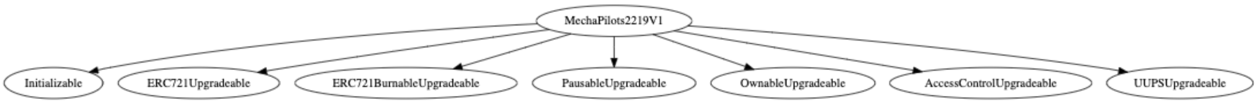
Solidity Versions observed	🧪 Experimental Features	💰 Can Receive Funds	🖥 Uses Assembly	💣 Has Destroyable Contracts
`0.8.17`		`yes`		

📤 Transfers ETH	⚡ Low-Level Calls	👥 DelegateCall	🧮 Uses Hash Functions	🔖 ECRecover	🌀 New/Create/Create2
			`yes`		

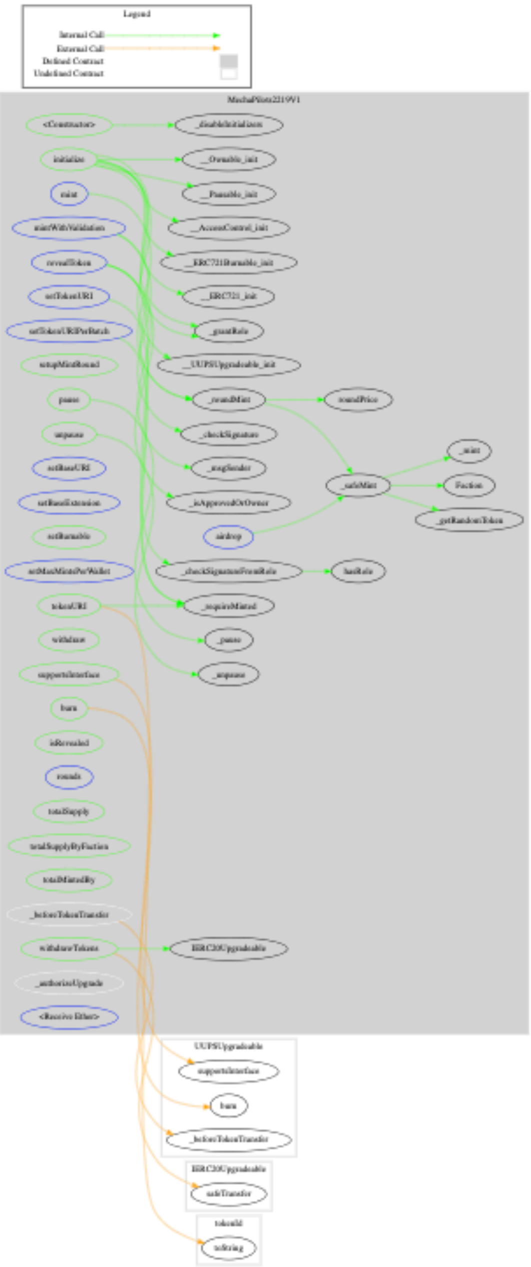
♻️ TryCatch	Σ Unchecked

Inheritance Graph

v1.0



CallGraph
v1.0



Scope of Work/Verify Claims

The above token Team provided us with the files that needs to be tested (Github, Bscscan, Etherscan, files, etc.). The scope of the audit is the main contract (usual the same name as team appended with .sol).

We will verify the following claims:

1. Is contract an upgradeable
2. Correct implementation of Token standard
3. Deployer cannot mint any new tokens
4. Deployer cannot burn or lock user funds
5. Deployer cannot pause the contract
6. Deployer cannot set fees
7. Deployer cannot blacklist/antisnipe addresses
8. Overall checkup (Smart Contract Security)

Is contract an upgradeable

Name	
Is contract an upgradeable?	Yes

Comments:

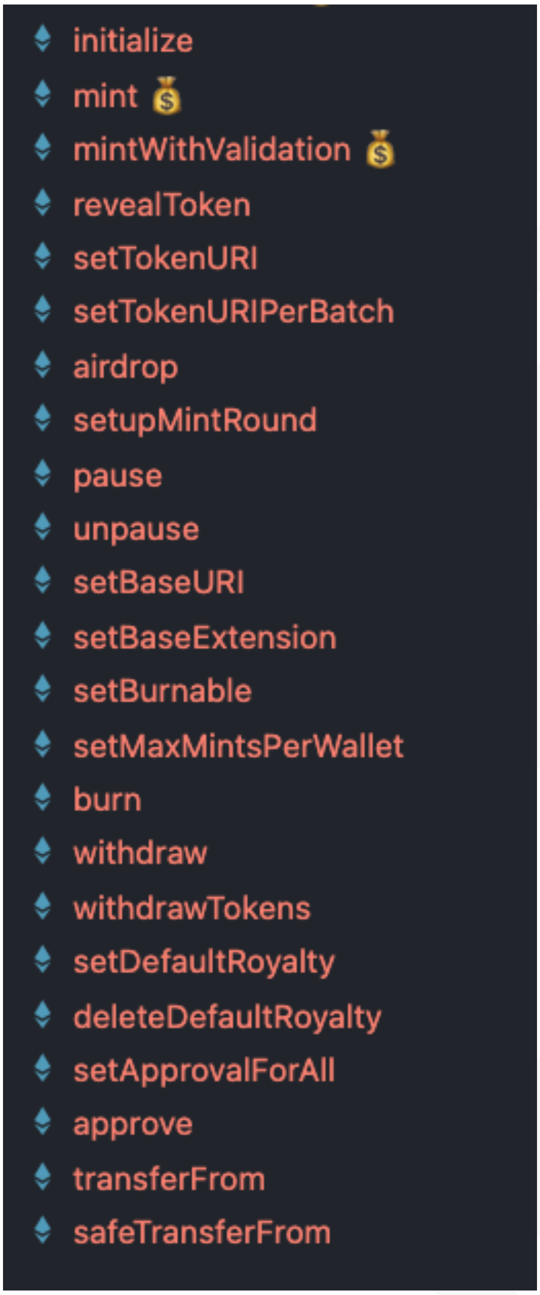
v1.0

- Owner can deploy a new version of the contract which can change any limit and give owner new privileges
    - Be aware of this and do your own research for the contract which is the contract pointing to

Correct implementation of Token standard

ERC721				
Function	**Description**	**Exist**	**Tested**	**Verified**
BalanceOf	Count all NFTs assigned to an owner	✓	✓	✓
OwnerOf	Find the owner of an NFT	✓	✓	✓
SafeTransferFrom	Transfers the ownership of an NFT from one address to another address	✓	✓	✓
SafeTransferFrom	See above - Difference is that this function has an extra data parameter	✓	✓	✓
TransferFrom	Transfer ownership of an NFT	✓	✓	✓
Approve	Change or reaffirm the approved address for an NFT	✓	✓	✓
SetApprovalForAll	Enable or disable approval for a third party ("operator") to manage all of \`msg.sender\`'s assets	✓	✓	✓
GetApproved	Get the approved address for a single NFT	✓	✓	✓
IsApprovedForAll	Query if an address is an authorized operator for another address	✓	✓	✓
SupportsInterface	Query if a contract implements an interface	✓	✓	✓
Name	Provides information about the name	✓	✓	✓
Symbol	Provides information about the symbol	✓	✓	✓
TokenURI	Provides information about the TokenUri	✓	✓	✓

Write functions of contract v1.1



initialize
mint 💰
mintWithValidation 💰
revealToken
setTokenURI
setTokenURIPerBatch
airdrop
setupMintRound
pause
unpause
setBaseURI
setBaseExtension
setBurnable
setMaxMintsPerWallet
burn
withdraw
withdrawTokens
setDefaultRoyalty
deleteDefaultRoyalty
setApprovalForAll
approve
transferFrom
safeTransferFrom

Deployer cannot mint any new tokens

Name	Exist	Tested	Status
Deployer can mint	✓	✓	✗
Max / Total Supply			2219

Comments:

v1.1

- Owner can mint new tokens at any time by airdropping but not more than the MAX_SUPPLY.
- Owner can also setup the mint round in which they are able to set the duration and the price of the round to any arbitrary number.

Deployer cannot burn or lock user funds

Name	Exist	Tested	Status
Deployer can lock	✓	✓	✗
Deployer cannot burn	✓	✓	✓

Comments:

v1.1

- Owner can lock user funds by
    - Setting max mints per wallet wallet amount to 0

- Tokens can be burned by msg.sender
- Owner can Enable/Disable burning

Deployer cannot pause the contract

Name	Exist	Tested	Status
Deployer can pause	✓	✓	✗

Comments:

v1.1

- Owner can pause contract

Deployer cannot set fees

Name	Exist	Tested	Status
Deployer cannot set fees over 25%	–	–	–
Deployer cannot set fees to nearly 100% or to 100%	–	–	–

Deployer can blacklist/antisnipe addresses

Name	Exist	Tested	Status
Deployer cannot blacklist/antisnipe addresses	–	–	–

Overall checkup (Smart Contract Security)

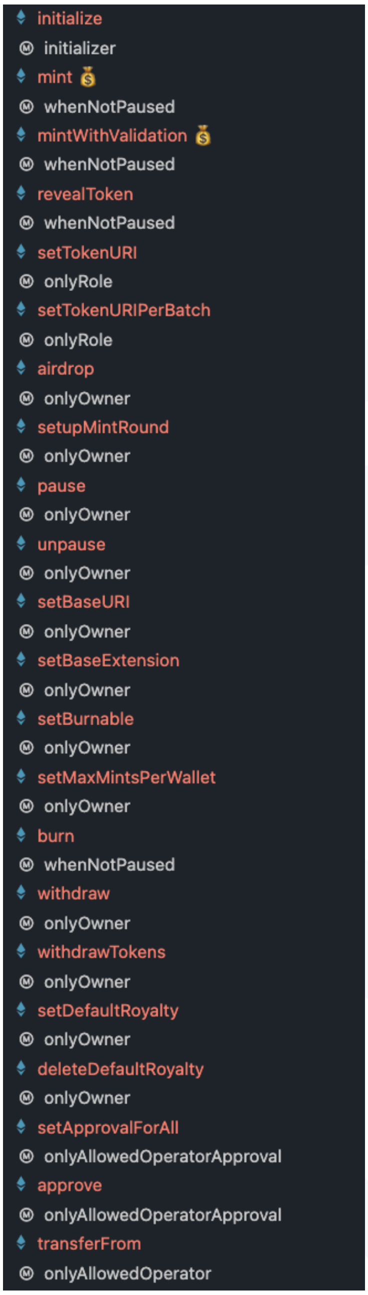
Tested	Verified
✓	✓

Legend

Attribute	Symbol
Verified / Checked	✓
Partly Verified	⚑
Unverified / Not checked	✗
Not available	–

Modifiers and public functions

v1.1



```
initialize
initializer
mint 💰
whenNotPaused
mintWithValidation 💰
whenNotPaused
revealToken
whenNotPaused
setTokenURI
onlyRole
setTokenURIPerBatch
onlyRole
airdrop
onlyOwner
setupMintRound
onlyOwner
pause
onlyOwner
unpause
onlyOwner
setBaseURI
onlyOwner
setBaseExtension
onlyOwner
setBurnable
onlyOwner
setMaxMintsPerWallet
onlyOwner
burn
whenNotPaused
withdraw
onlyOwner
withdrawTokens
onlyOwner
setDefaultRoyalty
onlyOwner
deleteDefaultRoyalty
onlyOwner
setApprovalForAll
onlyAllowedOperatorApproval
approve
onlyAllowedOperatorApproval
transferFrom
onlyAllowedOperator
```

Ownership/Authority Privileges

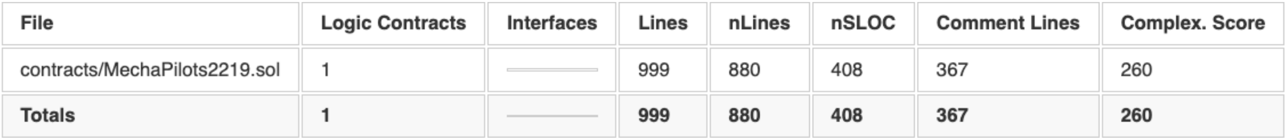
- Set base URI and Extension
- Enable/Disable burning
- Airdrop Tokens
- Set/Delete default royalty to any arbitrary value
- Only Allowed Operator can get the approval
- Only Allowed operator addresses will be able to send tokens using the contract
- Owner can withdraw native network and other ERC20 tokens from the contract.

- There are several authorities which are authorized to call some functions, that means, if the owner is renounced, another address will still be authorized to call functions
  - Be aware of this

Please check if an OnlyOwner or similar restrictive modifier has been forgotten.

Source Units in Scope

v1.1



File	Logic Contracts	Interfaces	Lines	nLines	nSLOC	Comment Lines	Complex. Score
contracts/MechaPilots2219.sol	1	—	999	880	408	367	260
Totals	**1**	—	**999**	**880**	**408**	**367**	**260**

Legend

Attribute	Description
Lines	total lines of the source unit
nLines	normalised lines of the source unit (e.g. normalises functions spanning multiple lines)
nSLOC	normalised source lines of code (only source-code lines; no comments, no blank lines)
Comment Lines	lines containing single or block comments
Complexity Score	a custom complexity score derived from code statements that are known to introduce code complexity (branches, loops, calls, external interfaces, ...)

Audit Results

Critical issues

No critical issues

High issues

No high issues

Medium issues

No medium issues

Low issues

Issue	File	Type	Line	Description
#1	Main	Missing Zero Address Validation (missing-zero-check)	528, 541	Check that the address is not zero
#2	Main	Weak Randomisation	893	It is the best practice to use off-chain randomisation so that the values could not be predicted and randomness stays its course.

Informational issues

Issue	File	Type	Line	Description
#1	Main	NatSpec documentation missing	—	If you started to comment your code, also comment all other functions, variables etc.

Audit Comments

We recommend you to use the special form of comments (NatSpec Format, Follow link for more information https://docs.soliditylang.org/en/latest/natspec-format.html) for your contracts to provide rich documentation for functions, return variables and more. This helps investors to make clear what that variables, functions etc. do.

17. April 2023:

- There is still an owner (Owner still has not renounced ownership)
- Owner can deploy a new version of the contract which can change any limit and give owner new privileges
- Read whole report and modifiers section for more information

SWC Attacks

ID	Title	Relationships	Status
SWC-136	Unencrypted Private Data On-Chain	CWE-767: Access to Critical Private Variable via Public Method	PASSED
SWC-135	Code With No Effects	CWE-1164: Irrelevant Code	PASSED
SWC-134	Message call with hardcoded gas amount	CWE-655: Improper Initialization	PASSED
SWC-133	Hash Collisions With Multiple Variable Length Arguments	CWE-294: Authentication Bypass by Capture-replay	PASSED
SWC-132	Unexpected Ether balance	CWE-667: Improper Locking	PASSED
SWC-131	Presence of unused variables	CWE-1164: Irrelevant Code	PASSED
SWC-130	Right-To-Left-Override control character (U+202E)	CWE-451: User Interface (UI) Misrepresentation of Critical Information	PASSED
SWC-129	Typographical Error	CWE-480: Use of Incorrect Operator	PASSED
SWC-128	DoS With Block Gas Limit	CWE-400: Uncontrolled Resource Consumption	PASSED

SWC-127	Arbitrary Jump with Function Type Variable	CWE-695: Use of Low-Level Functionality	PASSED
SWC-125	Incorrect Inheritance Order	CWE-696: Incorrect Behavior Order	PASSED
SWC-124	Write to Arbitrary Storage Location	CWE-123: Write-what-where Condition	PASSED
SWC-123	Requirement Violation	CWE-573: Improper Following of Specification by Caller	PASSED
SWC-122	Lack of Proper Signature Verification	CWE-345: Insufficient Verification of Data Authenticity	PASSED
SWC-121	Missing Protection against Signature Replay Attacks	CWE-347: Improper Verification of Cryptographic Signature	PASSED
SWC-120	Weak Sources of Randomness from Chain Attributes	CWE-330: Use of Insufficiently Random Values	PASSED
SWC-119	Shadowing State Variables	CWE-710: Improper Adherence to Coding Standards	PASSED
SWC-118	Incorrect Constructor Name	CWE-665: Improper Initialization	PASSED
SWC-117	Signature Malleability	CWE-347: Improper Verification of Cryptographic Signature	PASSED

SWC-116	Timestamp Dependence	CWE-829: Inclusion of Functionality from Untrusted Control Sphere	PASSED
SWC-115	Authorization through tx.origin	CWE-477: Use of Obsolete Function	PASSED
SWC-114	Transaction Order Dependence	CWE-362: Concurrent Execution using Shared Resource with Improper Synchronization ('Race Condition')	PASSED
SWC-113	DoS with Failed Call	CWE-703: Improper Check or Handling of Exceptional Conditions	PASSED
SWC-112	Delegatecall to Untrusted Callee	CWE-829: Inclusion of Functionality from Untrusted Control Sphere	PASSED
SWC-111	Use of Deprecated Solidity Functions	CWE-477: Use of Obsolete Function	PASSED
SWC-110	Assert Violation	CWE-670: Always-Incorrect Control Flow Implementation	PASSED
SWC-109	Uninitialized Storage Pointer	CWE-824: Access of Uninitialized Pointer	PASSED
SWC-108	State Variable Default Visibility	CWE-710: Improper Adherence to Coding Standards	PASSED
SWC-107	Reentrancy	CWE-841: Improper Enforcement of Behavioral Workflow	PASSED
SWC-106	Unprotected SELFDESTRUCT Instruction	CWE-284: Improper Access Control	PASSED

SWC-105	Unprotected Ether Withdrawal	CWE-284: Improper Access Control	PASSED
SWC-104	Unchecked Call Return Value	CWE-252: Unchecked Return Value	PASSED
SWC-103	Floating Pragma	CWE-664: Improper Control of a Resource Through its Lifetime	PASSED
SWC-102	Outdated Compiler Version	CWE-937: Using Components with Known Vulnerabilities	PASSED
SWC-101	Integer Overflow and Underflow	CWE-682: Incorrect Calculation	PASSED
SWC-100	Function Default Visibility	CWE-710: Improper Adherence to Coding Standards	PASSED

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