知道创宇

密级 ★ | 项目组公开

智能合约审计报告

安全状态

安全

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主测人： 知道创宇区块链安全研究团队

版本说明

修订内容	时间	修订者	版本号
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文档信息

文档名称	文档版本	报告编号	保密级别
KST 智能合约审计报告	V1.0		项目组公开

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目录

1. 综述

本次报告有效测试时间是从 2021 年 2 月 26 日开始到 2021 年 3 月 5 日结束，在此期间针对 **KST 智能合约代码**的安全性和规范性进行审计并以此作为报告统计依据。

此次测试中，知道创宇工程师对智能合约的常见漏洞（见第三章节）进行了全面的分析，综合评定为**通过**。

本次智能合约安全审计结果： 通过

由于本次测试过程在非生产环境下进行，所有代码均为最新备份，测试过程均与相关接口人进行沟通，并在操作风险可控的情况下进行相关测试操作，以规避测试过程中的生产运营风险、代码安全风险。

本次审计的报告信息：

报告编号：

报告查询地址链接:

https://attest.im/attestation/searchResult?qurey=

本次审计的目标信息：

条目	描述
Token 名称	KST
代码类型	代币代码、OKExChain 智能合约代码
代码语言	Solidity

合约文件及哈希：

合约文件	MD5

IERC20.sol	215DB3D2B6A3BDE9297D164F8CBD4402
IKswapCallee.sol	959A9CCE3F383AB2BB2223D806DB2E88
IKswapERC20.sol	0FDE1C027002442CE15FA8DCCE0EA3DB
IKswapFactory.sol	BC07A55ED0FDF0B2CF2F0A3F4B1D8B4A
IKswapPair.sol	082EAA3F8353537F205D0F7A3160060D
IKswapRouter01.sol	454BE0CF6A45818DBA7E8F32AE6D2F0B
IKswapRouter02.sol	E2379DCB210D8F6E6064F0DCD55201D7
IWOKT.sol	9C194449A8643CE70A0F963CAF825AFD
KSTToken.sol	9A3CE769D6A3516C0EDFC9481B3859E7
FixedPoint.sol	2A3B1D277C9F7F59823275D9AE16EFF0
KswapLibrary.sol	B8FC318D3C4FAD9A855E24ACF4D0F4BD
KswapOracleLibrary.sol	0EFD697ECEF27655234C13A4BCECEE30
Math.sol	BAF379A423703AB9C461DF6C94D3223B
SafeMath.sol	851CEFB0A22D2AE9240054CA76941739
TransferHelper.sol	B312DFEF05A1E7FDBADE150348591BD0
UQ112x112.sol	7283321879C861E2DAB8C07E021B5E65
Oracle.sol	309786C4F7BB8031E8D2736F1C688A25
DepositPool.sol	5E41C8B0CA31F435E0C52AD9F09BDA18
LiquidityPool.sol	A4BD6DCD81B43016DB8455804BFCE266
TradingPoolV2.sol	A759F8A7651B08107BEFD50D0CEA4B5C

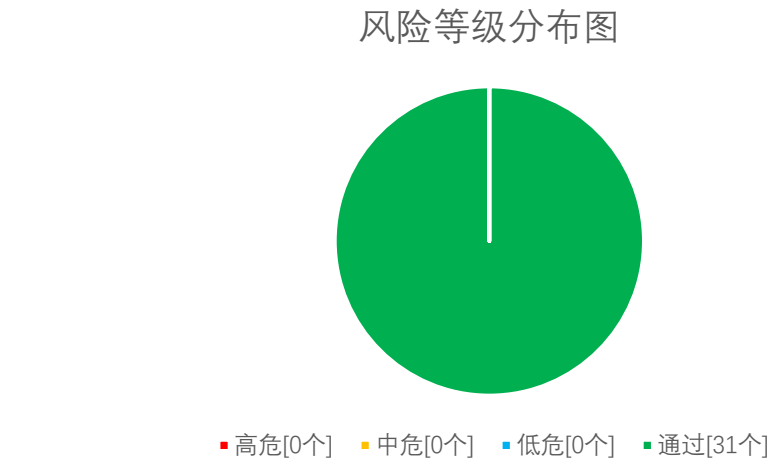
KswapERC20.sol	D2CB99FA7AE9EB8800924E085F2CC298
KswapFactory.sol	BC2EF73484DF5A772DDEAEF2D4EFC0A0
KswapPair.sol	39A157E7395D481037FA49C7F2FD5C94
KswapRouter.sol	BFBF39777AC79F101539DA1C8B39A42C
TimeLock.sol	53FCE806BDE23340635E0204D6F2525B

2. 代码漏洞分析

2.1 漏洞等级分布

本次漏洞风险按等级统计：

安全风险等级个数统计表			
高危	中危	低危	通过
0	0	0	31



2.2 审计结果汇总说明

审计结果			
审计项目	审计内容	状态	描述
业务安全性检测	预言机价格更新	通过	经检测，不存在安全问题。
	质押池质押功能	通过	经检测，不存在安全问题。
	流动性管理功能	通过	经检测，不存在安全问题。
	代币主合约各功能	通过	经检测，不存在安全问题。
代码基本漏洞检测	编译器版本安全	通过	经检测，不存在该安全问题。
	冗余代码	通过	经检测，不存在该安全问题。
	安全算数库的使用	通过	经检测，不存在该安全问题。
	不推荐的编码方式	通过	经检测，不存在该安全问题。
	require/assert 的合理使用	通过	经检测，不存在该安全问题。
	fallback 函数安全	通过	经检测，不存在该安全问题。
	tx.orgin 身份验证	通过	经检测，不存在该安全问题。
	owner 权限控制	通过	经检测，不存在该安全问题。
	gas 消耗检测	通过	经检测，不存在该安全问题。
	call 注入攻击	通过	经检测，不存在该安全问题。
	低级函数安全	通过	经检测，不存在该安全问题。
	增发代币漏洞	通过	经检测，不存在该安全问题。
	访问控制缺陷检测	通过	经检测，不存在该安全问题。
	数值溢出检测	通过	经检测，不存在该安全问题。
	算数精度误差	通过	经检测，不存在该安全问题。
	错误使用随机数检测	通过	经检测，不存在该安全问题。
	不安全的接口使用	通过	经检测，不存在该安全问题。
	变量覆盖	通过	经检测，不存在该安全问题。

	未初始化的存储指针	通过	经检测，不存在该安全问题。
	返回值调用验证	通过	经检测，不存在该安全问题。
	交易顺序依赖检测	通过	经检测，不存在该安全问题。
	时间戳依赖攻击	通过	经检测，不存在该安全问题。
	拒绝服务攻击检测	通过	经检测，不存在该安全问题。
	假充值漏洞检测	通过	经检测，不存在该安全问题。
	重入攻击检测	通过	经检测，不存在该安全问题。
	重放攻击检测	通过	经检测，不存在该安全问题。
	重排攻击检测	通过	经检测，不存在该安全问题。

3. 业务安全性检测

3.1. 预言机价格更新【通过】

审计分析：项目合约使用 Oracle.sol 作为预言机价格同步合约，使用了 update 函数更新 observation 价格。经审计，该处逻辑功能正常，权限控制正确。

```
function update(address tokenA, address tokenB) external {// knownsec 更新观察价格外部调用
address pair = KswapLibrary.pairFor(factory, tokenA, tokenB);// knownsec 更新交易对

Observation storage observation = pairObservations[pair];// knownsec 取出对应交易对观察结构体
uint256 timeElapsed = block.timestamp - observation.timestamp;// knownsec 时间计算
require(timeElapsed >= CYCLE, "KSWAPOracle: PERIOD_NOT_ELAPSED");// knownsec 更新周期检查
(uint256 price0Cumulative, uint256 price1Cumulative, ) =
KswapOracleLibrary.currentCumulativePrices(pair);
observation.timestamp = block.timestamp;// knownsec 时间更新
observation.price0Cumulative = price0Cumulative;
observation.price1Cumulative = price1Cumulative;
}
```

安全建议：无。

3.2. 质押池质押功能【通过】

审计分析：项目合约使用 DepositPool.sol 作为资金质押池，使用 deposit 作为质押功能，同时使用了 safeMath 防止溢出。经审计，该处功能设计逻辑正确，

权限控制正确。

```
    function deposit(uint256 _pid, uint256 _amount) public {// knownsec 质押
        PoolInfo storage pool = poolInfo[_pid];
        UserInfo storage user = userInfo[_pid][msg.sender];
        updatePool(_pid);// knownsec 池更新
        if (user.amount > 0) {
            uint256 pendingAmount =
                user.amount.mul(pool.accKstPerShare).div(1e12).sub(
                    user.rewardDebt
                );
            if (pendingAmount > 0) {
                safeKstTransfer(msg.sender, pendingAmount);// knownsec 质押凭证转
币
                user.accKstAmount = user.accKstAmount.add(pendingAmount);
                pool.allocKstAmount = pool.allocKstAmount.sub(pendingAmount);
            }
        }
        if (_amount > 0) {
            ERC20(pool.token).safeTransferFrom(
                msg.sender,
                address(this),
                _amount
            );// knownsec 质押转币
            user.amount = user.amount.add(_amount);
            pool.totalAmount = pool.totalAmount.add(_amount);
        }
        user.rewardDebt = user.amount.mul(pool.accKstPerShare).div(1e12);
        emit Deposit(msg.sender, _pid, _amount);
    }
```

安全建议：无。

3.3. 流动性管理功能【通过】

审计分析：流动性管理功能主要在 KswapRouter.sol 中实现，经审计，合约内功能逻辑正常合理，权限控制正确。

```
constructor(address _factory, address _WOKT) public {
    factory = _factory;
    WOKT = _WOKT;
}

receive() external payable {
    assert(msg.sender == WOKT); // only accept OKT via fallback from the WOKT contract
}

function setTradingPool(address _tradingPool) public onlyOwner {
    tradingPool = _tradingPool;
}

// **** ADD LIQUIDITY ****
function _addLiquidity(
    address tokenA,
    address tokenB,
    uint256 amountADesired,
    uint256 amountBDesired,
    uint256 amountAMin,
    uint256 amountBMin
) internal virtual returns (uint256 amountA, uint256 amountB) {
    // create the pair if it doesn't exist yet
    if (IKswapFactory(factory).getPair(tokenA, tokenB) == address(0)) {
        IKswapFactory(factory).createPair(tokenA, tokenB);
    }
    (uint256 reserveA, uint256 reserveB) =
```

```
        KswapLibrary.getReserves(factory, tokenA, tokenB);
    if (reserveA == 0 && reserveB == 0) {
        (amountA, amountB) = (amountADesired, amountBDesired);
    } else {
        uint256 amountBOptimal =
            KswapLibrary.quote(amountADesired, reserveA, reserveB);
        if (amountBOptimal <= amountBDesired) {
            require(
                amountBOptimal >= amountBMin,
                "KswapRouter: INSUFFICIENT_B_AMOUNT"
            );
            (amountA, amountB) = (amountADesired, amountBOptimal);
        } else {
            uint256 amountAOptimal =
                KswapLibrary.quote(amountBDesired, reserveB, reserveA);
            assert(amountAOptimal <= amountADesired);
            require(
                amountAOptimal >= amountAMin,
                "KswapRouter: INSUFFICIENT_A_AMOUNT"
            );
            (amountA, amountB) = (amountAOptimal, amountBDesired);
        }
    }
}

function addLiquidity(
    address tokenA,
    address tokenB,
    uint256 amountADesired,
    uint256 amountBDesired,
    uint256 amountAMin,
    uint256 amountBMin,
    address to,
```

```
        uint256 deadline
    )
        external
        virtual
        override
        ensure(deadline)
        returns (
            uint256 amountA,
            uint256 amountB,
            uint256 liquidity
        )
    {
        (amountA, amountB) = _addLiquidity(
            tokenA,
            tokenB,
            amountADesired,
            amountBDesired,
            amountAMin,
            amountBMin
        );
        address pair = KswapLibrary.pairFor(factory, tokenA, tokenB);
        TransferHelper.safeTransferFrom(tokenA, msg.sender, pair, amountA);
        TransferHelper.safeTransferFrom(tokenB, msg.sender, pair, amountB);
        liquidity = IKswapPair(pair).mint(to);
    }
```

安全建议：无。

3.4. 代币主合约各功能【通过】

审计分析：代币主合约 KSTToken.sol，主要发行 KSTToken 代币，经审计，合约内函数设计合理，权限控制正确。

```
    constructor() public ERC20("KSwap Token", "KST") {
        _mint(msg.sender, preMineSupply);
    }

    // mint with max supply
    function mint(address _to, uint256 _amount)
        public
        onlyMinter
        returns (bool)// knownsec 矿工可用 铸币
    {
        if (_amount.add(totalSupply()) > maxSupply) {
            return false;
        }
        _mint(_to, _amount);
        return true;
    }

    function addMinter(address _addMinter) public onlyOwner returns (bool) {// knownsec Owner 可用 矿工增加
        require(
            _addMinter != address(0),
            "KstToken: _addMinter is the zero address"
        );
        return EnumerableSet.add(_minters, _addMinter);
    }

    function delMinter(address _delMinter) public onlyOwner returns (bool) {// knownsec Owner 可用 矿工删除
        require(
            _delMinter != address(0),
            "KstToken: _delMinter is the zero address"
        );
        return EnumerableSet.remove(_minters, _delMinter);
```

```
}
```

安全建议：无。

4. 代码基本漏洞检测

4.1. 编译器版本安全【通过】

检查合约代码实现中是否使用了安全的编译器版本

检测结果：经检测，智能合约代码中制定了编译器版本 0.6.12，不存在该安全问题。

安全建议：无。

4.2. 冗余代码【通过】

检查合约代码实现中是否包含冗余代码

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.3. 安全算数库的使用【通过】

检查合约代码实现中是否使用了 SafeMath 安全算数库

检测结果：经检测，智能合约代码中已使用 SafeMath 安全算数库，不存在该安全问题。

安全建议：无。

4.4. 不推荐的编码方式【通过】

检查合约代码实现中是否有官方不推荐或弃用的编码方式

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.5. require/assert 的合理使用【通过】

检查合约代码实现中 require 和 assert 语句使用的合理性

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.6. fallback 函数安全【通过】

检查合约代码实现中是否正确使用 fallback 函数

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.7. tx.origin 身份验证【通过】

tx.origin 是 Solidity 的一个全局变量，它遍历整个调用栈并返回最初发送调用（或事务）的帐户的地址。在智能合约中使用此变量进行身份验证会使合约容易受到类似网络钓鱼的攻击。

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.8. owner 权限控制【通过】

检查合约代码实现中的 owner 是否具有过高的权限。例如，任意修改其他账户余额等。

检测结果：经检测，智能合约代码中 owner 可设置矿工地址，矿工可增发代币，但由于流动性挖矿功能需求，故通过。

```
function mint(address _to, uint256 _amount)
        public
        onlyMinter
        returns (bool)// knownsec 矿工可用 铸币
    {
        if (_amount.add(totalSupply()) > maxSupply) {
            return false;
        }
        _mint(_to, _amount);
        return true;
    }
```

安全建议：无。

4.9. gas 消耗检测【通过】

检查 gas 的消耗是否超过区块最大限制

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.10. call 注入攻击【通过】

call 函数调用时，应该做严格的权限控制，或直接写死 call 调用的函数。

检测结果：经检测，智能合约代码中不存在该安全问题，调用 call 后已正确校验返回值。

```
function _safeTransfer(
            address token,
```

```
        address to,
        uint256 value
    ) private {
        (bool success, bytes memory data) =
            token.call(abi.encodeWithSelector(SELECTOR, to, value));
        require(
            success && (data.length == 0 || abi.decode(data, (bool))),
            "Kswap: TRANSFER_FAILED"
        );
    }
```

安全建议：无。

4.11. 低级函数安全【通过】

检查合约代码实现中低级函数（call/delegatecall）的使用是否存在安全漏洞

call 函数的执行上下文是在被调用的合约中；而 delegatecall 函数的执行上下文是在当前调用该函数的合约中

检测结果：经检测，智能合约代码中不存在该安全问题，调用 call 后已校验函数返回值。

安全建议：无。

4.12. 增发代币漏洞【通过】

检查在初始化代币总量后，代币合约中是否存在可能使代币总量增加的函数。

检测结果：经检测，智能合约代码中存在增发代币的功能，但由于流动性挖矿功能需要增发代币，故通过。

```
function mint(address _to, uint256 _amount)
        public
        onlyMinter
        returns (bool)// knownsec 矿工可用 铸币
    {
        if (_amount.add(totalSupply()) > maxSupply) {
            return false;
        }
        _mint(_to, _amount);
        return true;
    }
```

安全建议：无。

4.13. 访问控制缺陷检测【通过】

合约中不同函数应设置合理的权限

检查合约中各函数是否正确使用了 public、private 等关键词进行可见性修饰，检查合约是否正确定义并使用了 modifier 对关键函数进行访问限制，避免越权导致的问题。

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.14. 数值溢出检测【通过】

智能合约中的算数问题是指整数溢出和整数下溢。

Solidity 最多能处理 256 位的数字（2^256-1），最大数字增加 1 会溢出得到 0。同样，当数字为无符号类型时，0 减去 1 会下溢得到最大数字值。

整数溢出和下溢不是一种新类型的漏洞，但它们在智能合约中尤其危险。溢

出情况会导致不正确的结果，特别是如果可能性未被预期，可能会影响程序的可靠性和安全性。

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.15. 算术精度误差【通过】

Solidity 作为一门编程语言具备和普通编程语言相似的数据结构设计，比如：变量、常量、函数、数组、函数、结构体等等，Solidity 和普通编程语言也有一个较大的区别——Solidity 没有浮点型，且 Solidity 所有的数值运算结果都只会是整数，不会出现小数的情况，同时也不允许定义小数类型数据。合约中的数值运算必不可少，而数值运算的设计有可能造成相对误差，例如同级运算：5/2*10=20，而 5*10/2=25，从而产生误差，在数据更大时产生的误差也会更大，更明显。

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.16. 错误使用随机数【通过】

智能合约中可能需要使用随机数，虽然 Solidity 提供的函数和变量可以访问明显难以预测的值，如 block.number 和 block.timestamp，但是它们通常或者比看起来更公开，或者受到矿工的影响，即这些随机数在一定程度上是可预测的，所以恶意用户通常可以复制它并依靠其不可预知性来攻击该功能。

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.17. 不安全的接口使用【通过】

检查合约代码实现中是否使用了不安全的接口

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.18. 变量覆盖【通过】

检查合约代码实现中是否存在变量覆盖导致的安全问题

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.19. 未初始化的储存指针【通过】

在 solidity 中允许一个特殊的数据结构为 struct 结构体，而函数内的局部变量默认使用 storage 或 memory 储存。

而存在 storage(存储器)和 memory(内存)是两个不同的概念，solidity 允许指针指向一个未初始化的引用，而未初始化的局部 stroage 会导致变量指向其他储存变量，导致变量覆盖，甚至其他更严重的后果，在开发中应该避免在函数中初始化 struct 变量。

检测结果：经检测，智能合约代码不存在该问题。

安全建议：无。

4.20. 返回值调用验证【通过】

此问题多出现在和转币相关的智能合约中，故又称作静默失败发送或未经检

查发送。

在 Solidity 中存在 transfer()、send()、call.value()等转币方法，都可以用于向某一地址发送代币，其区别在于： transfer 发送失败时会 throw，并且进行状态回滚；只会传递 2300gas 供调用，防止重入攻击；send 发送失败时会返回 false；只会传递 2300gas 供调用，防止重入攻击；call.value 发送失败时会返回 false；传递所有可用 gas 进行调用（可通过传入 gas_value 参数进行限制），不能有效防止重入攻击。

如果在代码中没有检查以上 send 和 call.value 转币函数的返回值，合约会继续执行后面的代码，可能由于代币发送失败而导致意外的结果。

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.21. 交易顺序依赖【通过】

由于矿工总是通过代表外部拥有地址（EOA）的代码获取 gas 费用，因此用户可以指定更高的费用以便更快地开展交易。由于 OkexChain 区块链是公开的，每个人都可以看到其他人未决交易的内容。这意味着，如果某个用户提交了一个有价值的解决方案，恶意用户可以窃取该解决方案并以较高的费用复制其交易，以抢占原始解决方案。

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.22. 时间戳依赖攻击【通过】

数据块的时间戳通常来说都是使用矿工的本地时间，而这个时间大约能有 900 秒的范围波动，当其他节点接受一个新区块时，只需要验证时间戳是否晚于之前的区块并且与本地时间误差在 900 秒以内。一个矿工可以通过设置区块的时间戳来尽可能满足有利于他的条件来从中获利。

检查合约代码实现中是否存在有依赖于时间戳的关键功能

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.23. 拒绝服务攻击【通过】

在区块链的世界中，拒绝服务是致命的，遭受该类型攻击的智能合约可能永远无法恢复正常工作状态。导致智能合约拒绝服务的原因可能有很多种，包括在作为交易接收方时的恶意行为，人为增加计算功能所需 gas 导致 gas 耗尽，滥用访问控制访问智能合约的 private 组件，利用混淆和疏忽等等。

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.24. 假充值漏洞【通过】

在代币合约的 transfer 函数对转账发起人(msg.sender)的余额检查用的是 if 判断方式，当 balances[msg.sender] < value 时进入 else 逻辑部分并 return false，最终没有抛出异常，我们认为仅 if/else 这种温和的判断方式在 transfer 这类敏感函数场景中是一种不严谨的编码方式。

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.25. 重入攻击检测【通过】

Solidity 中的 call.value()函数在被用来发送代币的时候会消耗它接收到的所有 gas，当调用 call.value()函数发送代币的操作发生在实际减少发送者账户的余额之前时，就会存在重入攻击的风险。

检测结果：经检测，智能合约代码中不存在该安全问题。

安全建议：无。

4.26. 重放攻击检测【通过】

合约中如果涉及委托管理的需求，应注意验证的不可复用性，避免重放攻击

在资产管理体系中，常有委托管理的情况，委托人将资产给受托人管理，委托人支付一定的费用给受托人。这个业务场景在智能合约中也比较普遍。

检测结果:经检测，智能合约代码中不存在相关漏洞。

安全建议：无。

4.27. 重排攻击检测【通过】

重排攻击是指矿工或其他方试图通过将自己的信息插入列表(list)或映射(mapping)中来与智能合约参与者进行“竞争”，从而使攻击者有机会将自己的信息存储到合约中。

检测结果:经检测，智能合约代码中不存在相关漏洞。

安全建议:无。

5. 附录 A：合约代码

本次测试代码来源：

IERC20.sol

```
// SPDX-License-Identifier: MIT

pragma solidity >=0.5.0;

interface IERC20Kswap {
    event Approval(
        address indexed owner,
        address indexed spender,
        uint256 value
    );
    event Transfer(address indexed from, address indexed to, uint256 value);

    function name() external view returns (string memory);

    function symbol() external view returns (string memory);

    function decimals() external view returns (uint8);

    function totalSupply() external view returns (uint256);

    function balanceOf(address owner) external view returns (uint256);

    function allowance(address owner, address spender)
        external
        view
        returns (uint256);

    function approve(address spender, uint256 value) external returns (bool);

    function transfer(address to, uint256 value) external returns (bool);

    function transferFrom(
        address from,
        address to,
        uint256 value
    ) external returns (bool);
}
```

IKswapCallee.sol

```
// SPDX-License-Identifier: MIT

pragma solidity >=0.5.0;

interface IKswapCallee {
    function KswapCall(
        address sender,
        uint256 amount0,
        uint256 amount1,
        bytes calldata data
    ) external;
}
```

IKswapERC20.sol

```
// SPDX-License-Identifier: MIT

pragma solidity >=0.5.0;

interface IKswapERC20 {
    event Approval(
        address indexed owner,
        address indexed spender,
        uint256 value
    );
    event Transfer(address indexed from, address indexed to, uint256 value);

    function name() external pure returns (string memory);

    function symbol() external pure returns (string memory);

    function decimals() external pure returns (uint8);

    function totalSupply() external view returns (uint256);
```

```
    function balanceOf(address owner) external view returns (uint256);

    function allowance(address owner, address spender)
        external
        view
        returns (uint256);

    function approve(address spender, uint256 value) external returns (bool);

    function transfer(address to, uint256 value) external returns (bool);

    function transferFrom(
        address from,
        address to,
        uint256 value
    ) external returns (bool);

    function DOMAIN_SEPARATOR() external view returns (bytes32);

    function PERMIT_TYPEHASH() external pure returns (bytes32);

    function nonces(address owner) external view returns (uint256);

    function permit(
        address owner,
        address spender,
        uint256 value,
        uint256 deadline,
        uint8 v,
        bytes32 r,
        bytes32 s
    ) external;
}
```

IKswapFactory.sol

```
// SPDX-License-Identifier: MIT

pragma solidity >=0.5.0;

interface IKswapFactory {
    event PairCreated(
        address indexed token0,
        address indexed token1,
        address pair,
        uint256
    );

    function feeTo() external view returns (address);

    function feeToSetter() external view returns (address);

    function feeToRate() external view returns (uint256);

    function getPair(address tokenA, address tokenB)
        external
        view
        returns (address pair);

    function allPairs(uint256) external view returns (address pair);

    function allPairsLength() external view returns (uint256);

    function createPair(address tokenA, address tokenB)
        external
        returns (address pair);

    function setFeeTo(address) external;

    function setFeeToSetter(address) external;

    function setFeeToRate(uint256) external;
}
```

IKswapPair.sol

```
// SPDX-License-Identifier: MIT

pragma solidity >=0.5.0;

interface IKswapPair {
    event Approval(
        address indexed owner,
        address indexed spender,
```

```
        uint256 value
);
event Transfer(address indexed from, address indexed to, uint256 value);

function name() external pure returns (string memory);

function symbol() external pure returns (string memory);

function decimals() external pure returns (uint8);

function totalSupply() external view returns (uint256);

function balanceOf(address owner) external view returns (uint256);

function allowance(address owner, address spender)
        external
        view
        returns (uint256);

function approve(address spender, uint256 value) external returns (bool);

function transfer(address to, uint256 value) external returns (bool);

function transferFrom(
        address from,
        address to,
        uint256 value
) external returns (bool);

function DOMAIN_SEPARATOR() external view returns (bytes32);

function PERMIT_TYPEHASH() external pure returns (bytes32);

function nonces(address owner) external view returns (uint256);

function permit(
        address owner,
        address spender,
        uint256 value,
        uint256 deadline,
        uint8 v,
        bytes32 r,
        bytes32 s
) external;

event Mint(address indexed sender, uint256 amount0, uint256 amount1);
event Burn(
        address indexed sender,
        uint256 amount0,
        uint256 amount1,
        address indexed to
);
event Swap(
        address indexed sender,
        uint256 amount0In,
        uint256 amount1In,
        uint256 amount0Out,
        uint256 amount1Out,
        address indexed to
);
event Sync(uint112 reserve0, uint112 reserve1);

function MINIMUM_LIQUIDITY() external pure returns (uint256);

function factory() external view returns (address);

function token0() external view returns (address);

function token1() external view returns (address);

function getReserves()
        external
        view
        returns (
                uint112 reserve0,
                uint112 reserve1,
                uint32 blockTimestampLast
        );

function price0CumulativeLast() external view returns (uint256);

function price1CumulativeLast() external view returns (uint256);

function kLast() external view returns (uint256);

function mint(address to) external returns (uint256 liquidity);
```

```
    function burn(address to)
        external
        returns (uint256 amount0, uint256 amount1);

    function swap(
        uint256 amount0Out,
        uint256 amount1Out,
        address to,
        bytes calldata data
    ) external;

    function skim(address to) external;

    function sync() external;

    function price(address token, uint256 baseDecimal)
        external
        view
        returns (uint256);

    function initialize(address, address) external;
}
```

IKswapRouter01.sol

```
// SPDX-License-Identifier: MIT

pragma solidity >=0.6.2;

interface IKswapRouter01 {
    function factory() external pure returns (address);

    function WOKT() external pure returns (address);

    function addLiquidity(
        address tokenA,
        address tokenB,
        uint256 amountADesired,
        uint256 amountBDesired,
        uint256 amountAMin,
        uint256 amountBMin,
        address to,
        uint256 deadline
    )
        external
        returns (
            uint256 amountA,
            uint256 amountB,
            uint256 liquidity
        );

    function addLiquidityETH(
        address token,
        uint256 amountTokenDesired,
        uint256 amountTokenMin,
        uint256 amountETHMin,
        address to,
        uint256 deadline
    )
        external
        payable
        returns (
            uint256 amountToken,
            uint256 amountETH,
            uint256 liquidity
        );

    function removeLiquidity(
        address tokenA,
        address tokenB,
        uint256 liquidity,
        uint256 amountAMin,
        uint256 amountBMin,
        address to,
        uint256 deadline
    ) external returns (uint256 amountA, uint256 amountB);

    function removeLiquidityETH(
        address token,
        uint256 liquidity,
        uint256 amountTokenMin,
        uint256 amountETHMin,
        address to,
        uint256 deadline
    ) external returns (uint256 amountToken, uint256 amountETH);
```

```
function removeLiquidityWithPermit(
        address tokenA,
        address tokenB,
        uint256 liquidity,
        uint256 amountAMin,
        uint256 amountBMin,
        address to,
        uint256 deadline,
        bool approveMax,
        uint8 v,
        bytes32 r,
        bytes32 s
) external returns (uint256 amountA, uint256 amountB);

function removeLiquidityETHWithPermit(
        address token,
        uint256 liquidity,
        uint256 amountTokenMin,
        uint256 amountETHMin,
        address to,
        uint256 deadline,
        bool approveMax,
        uint8 v,
        bytes32 r,
        bytes32 s
) external returns (uint256 amountToken, uint256 amountETH);

function swapExactTokensForTokens(
        uint256 amountIn,
        uint256 amountOutMin,
        address[] calldata path,
        address to,
        uint256 deadline
) external returns (uint256[] memory amounts);

function swapTokensForExactTokens(
        uint256 amountOut,
        uint256 amountInMax,
        address[] calldata path,
        address to,
        uint256 deadline
) external returns (uint256[] memory amounts);

function swapExactETHForTokens(
        uint256 amountOutMin,
        address[] calldata path,
        address to,
        uint256 deadline
) external payable returns (uint256[] memory amounts);

function swapTokensForExactETH(
        uint256 amountOut,
        uint256 amountInMax,
        address[] calldata path,
        address to,
        uint256 deadline
) external returns (uint256[] memory amounts);

function swapExactTokensForETH(
        uint256 amountIn,
        uint256 amountOutMin,
        address[] calldata path,
        address to,
        uint256 deadline
) external returns (uint256[] memory amounts);

function swapETHForExactTokens(
        uint256 amountOut,
        address[] calldata path,
        address to,
        uint256 deadline
) external payable returns (uint256[] memory amounts);

function quote(
        uint256 amountA,
        uint256 reserveA,
        uint256 reserveB
) external pure returns (uint256 amountB);

function getAmountOut(
        uint256 amountIn,
        uint256 reserveIn,
        uint256 reserveOut
) external pure returns (uint256 amountOut);

function getAmountIn(
        uint256 amountOut,
```

```
        uint256 reserveIn,
        uint256 reserveOut
    ) external pure returns (uint256 amountIn);

    function getAmountsOut(uint256 amountIn, address[] calldata path)
        external
        view
        returns (uint256[] memory amounts);

    function getAmountsIn(uint256 amountOut, address[] calldata path)
        external
        view
        returns (uint256[] memory amounts);
}
```

IKswapRouter02.sol

```
// SPDX-License-Identifier: MIT

pragma solidity >=0.6.2;

import "./IKswapRouter01.sol";

interface IKswapRouter02 is IKswapRouter01 {
    function tradingPool() external pure returns (address);

    function removeLiquidityETHSupportingFeeOnTransferTokens(
        address token,
        uint256 liquidity,
        uint256 amountTokenMin,
        uint256 amountETHMin,
        address to,
        uint256 deadline
    ) external returns (uint256 amountETH);

    function removeLiquidityETHWithPermitSupportingFeeOnTransferTokens(
        address token,
        uint256 liquidity,
        uint256 amountTokenMin,
        uint256 amountETHMin,
        address to,
        uint256 deadline,
        bool approveMax,
        uint8 v,
        bytes32 r,
        bytes32 s
    ) external returns (uint256 amountETH);

    function swapExactTokensForTokensSupportingFeeOnTransferTokens(
        uint256 amountIn,
        uint256 amountOutMin,
        address[] calldata path,
        address to,
        uint256 deadline
    ) external;

    function swapExactETHForTokensSupportingFeeOnTransferTokens(
        uint256 amountOutMin,
        address[] calldata path,
        address to,
        uint256 deadline
    ) external payable;

    function swapExactTokensForETHSupportingFeeOnTransferTokens(
        uint256 amountIn,
        uint256 amountOutMin,
        address[] calldata path,
        address to,
        uint256 deadline
    ) external;
}
```

IWOKT.sol

```
// SPDX-License-Identifier: MIT

pragma solidity >=0.5.0;

interface IWOKT {
    function deposit() external payable;

    function transfer(address to, uint256 value) external returns (bool);

    function withdraw(uint256) external;
}
```

KSTToken.sol

```
// SPDX-License-Identifier: MIT
pragma solidity =0.6.12;// knownsec  指定编译器版本
pragma experimental ABIEncoderV2;

import "@openzeppelin/contracts/token/ERC20/ERC20.sol";
import "@openzeppelin/contracts/access/Ownable.sol";
import "@openzeppelin/contracts/utils/EnumerableSet.sol";

abstract contract DelegateERC20 is ERC20 {// knownsec  治理  投票合约
    // A record of each accounts delegate
    mapping(address => address) internal _delegates;

    // A checkpoint for marking number of votes from a given block
    struct Checkpoint {
        uint32 fromBlock;
        uint256 votes;
    }

    // A record of votes checkpoints for each account, by index
    mapping(address => mapping(uint32 => Checkpoint)) public checkpoints;

    // The number of checkpoints for each account
    mapping(address => uint32) public numCheckpoints;

    // The EIP-712 typehash for the contract's domain
    bytes32 public constant DOMAIN_TYPEHASH =
        keccak256(
            "EIP712Domain(string name,uint256 chainId,address verifyingContract)"
        );

    // The EIP-712 typehash for the delegation struct used by the contract
    bytes32 public constant DELEGATION_TYPEHASH =
        keccak256("Delegation(address delegatee,uint256 nonce,uint256 expiry)");

    // A record of states for signing / validating signatures
    mapping(address => uint256) public nonces;

    // support delegates mint
    function _mint(address account, uint256 amount) internal virtual override {
        super._mint(account, amount);

        // add delegates to the minter
        _moveDelegates(address(0), _delegates[account], amount);
    }

    function _transfer(
        address sender,
        address recipient,
        uint256 amount
    ) internal virtual override {
        super._transfer(sender, recipient, amount);
        _moveDelegates(_delegates[sender], _delegates[recipient], amount);
    }

    /**
     * @notice Delegate votes from `msg.sender` to `delegatee`
     * @param delegatee The address to delegate votes to
     */
    function delegate(address delegatee) external {
        return _delegate(msg.sender, delegatee);
    }

    /**
     * @notice Delegates votes from signatory to `delegatee`
     * @param delegatee The address to delegate votes to
     * @param nonce The contract state required to match the signature
     * @param expiry The time at which to expire the signature
     * @param v The recovery byte of the signature
     * @param r Half of the ECDSA signature pair
     * @param s Half of the ECDSA signature pair
     */
    function delegateBySig(
        address delegatee,
        uint256 nonce,
        uint256 expiry,
        uint8 v,
        bytes32 r,
        bytes32 s
    ) external {
        bytes32 domainSeparator =
            keccak256(
                abi.encode(
                    DOMAIN_TYPEHASH,
```

```
                keccak256(bytes(name())),
                getChainId(),
                address(this)
            )
        );

    bytes32 structHash =
        keccak256(
            abi.encode(DELEGATION_TYPEHASH, delegatee, nonce, expiry)
        );

    bytes32 digest =
        keccak256(
            abi.encodePacked("\x19\x01", domainSeparator, structHash)
        );

    address signatory = ecrecover(digest, v, r, s);
    require(
        signatory != address(0),
        "KstToken::delegateBySig: invalid signature"
    );
    require(
        nonce == nonces[signatory]++,
        "KstToken::delegateBySig: invalid nonce"
    );
    require(now <= expiry, "KstToken::delegateBySig: signature expired");
    return _delegate(signatory, delegatee);
}

/**
 * @notice Gets the current votes balance for `account`
 * @param account The address to get votes balance
 * @return The number of current votes for `account`
 */
function getCurrentVotes(address account) external view returns (uint256) {
    uint32 nCheckpoints = numCheckpoints[account];
    return
        nCheckpoints > 0 ? checkpoints[account][nCheckpoints - 1].votes : 0;
}

/**
 * @notice Determine the prior number of votes for an account as of a block number
 * @dev Block number must be a finalized block or else this function will revert to prevent misinformation.
 * @param account The address of the account to check
 * @param blockNumber The block number to get the vote balance at
 * @return The number of votes the account had as of the given block
 */
function getPriorVotes(address account, uint256 blockNumber)
    external
    view
    returns (uint256)
{
    require(
        blockNumber < block.number,
        "KstToken::getPriorVotes: not yet determined"
    );

    uint32 nCheckpoints = numCheckpoints[account];
    if (nCheckpoints == 0) {
        return 0;
    }

    // First check most recent balance
    if (checkpoints[account][nCheckpoints - 1].fromBlock <= blockNumber) {
        return checkpoints[account][nCheckpoints - 1].votes;
    }

    // Next check implicit zero balance
    if (checkpoints[account][0].fromBlock > blockNumber) {
        return 0;
    }

    uint32 lower = 0;
    uint32 upper = nCheckpoints - 1;
    while (upper > lower) {
        uint32 center = upper - (upper - lower) / 2; // ceil, avoiding overflow
        Checkpoint memory cp = checkpoints[account][center];
        if (cp.fromBlock == blockNumber) {
            return cp.votes;
        } else if (cp.fromBlock < blockNumber) {
            lower = center;
        } else {
            upper = center - 1;
        }
    }
    return checkpoints[account][lower].votes;
}
```

```
function _delegate(address delegator, address delegatee) internal {
    address currentDelegate = _delegates[delegator];
    uint256 delegatorBalance = balanceOf(delegator); // balance of underlying balances (not scaled);
    _delegates[delegator] = delegatee;

    _moveDelegates(currentDelegate, delegatee, delegatorBalance);

    emit DelegateChanged(delegator, currentDelegate, delegatee);
}

function _moveDelegates(
    address srcRep,
    address dstRep,
    uint256 amount
) internal {
    if (srcRep != dstRep && amount > 0) {
        if (srcRep != address(0)) {
            // decrease old representative
            uint32 srcRepNum = numCheckpoints[srcRep];
            uint256 srcRepOld =
                srcRepNum > 0
                    ? checkpoints[srcRep][srcRepNum - 1].votes
                    : 0;
            uint256 srcRepNew = srcRepOld.sub(amount);
            _writeCheckpoint(srcRep, srcRepNum, srcRepOld, srcRepNew);
        }

        if (dstRep != address(0)) {
            // increase new representative
            uint32 dstRepNum = numCheckpoints[dstRep];
            uint256 dstRepOld =
                dstRepNum > 0
                    ? checkpoints[dstRep][dstRepNum - 1].votes
                    : 0;
            uint256 dstRepNew = dstRepOld.add(amount);
            _writeCheckpoint(dstRep, dstRepNum, dstRepOld, dstRepNew);
        }
    }
}

function _writeCheckpoint(
    address delegatee,
    uint32 nCheckpoints,
    uint256 oldVotes,
    uint256 newVotes
) internal {
    uint32 blockNumber =
        safe32(
            block.number,
            "KstToken::_writeCheckpoint: block number exceeds 32 bits"
        );

    if (
        nCheckpoints > 0 &&
        checkpoints[delegatee][nCheckpoints - 1].fromBlock == blockNumber
    ) {
        checkpoints[delegatee][nCheckpoints - 1].votes = newVotes;
    } else {
        checkpoints[delegatee][nCheckpoints] = Checkpoint(
            blockNumber,
            newVotes
        );
        numCheckpoints[delegatee] = nCheckpoints + 1;
    }

    emit DelegateVotesChanged(delegatee, oldVotes, newVotes);
}

function safe32(uint256 n, string memory errorMessage)
    internal
    pure
    returns (uint32)
{
    require(n < 2**32, errorMessage);
    return uint32(n);
}

function getChainId() internal pure returns (uint256) {
    uint256 chainId;
    assembly {
        chainId := chainid()
    }

    return chainId;
}
```

```
    /// @notice An event thats emitted when an account changes its delegate
    event DelegateChanged(
        address indexed delegator,
        address indexed fromDelegate,
        address indexed toDelegate
    );

    /// @notice An event thats emitted when a delegate account's vote balance changes
    event DelegateVotesChanged(
        address indexed delegate,
        uint256 previousBalance,
        uint256 newBalance
    );
}

contract KSTToken is DelegateERC20, Ownable {// knownsec KSTToken 合约
    uint256 private constant preMineSupply = 100000000 * 1e18;
    uint256 private constant maxSupply = 1000000000 * 1e18; // the total supply

    using EnumerableSet for EnumerableSet.AddressSet;
    EnumerableSet.AddressSet private _minters;

    constructor() public ERC20("KSwap Token", "KST") {
        _mint(msg.sender, preMineSupply);
    }

    // mint with max supply
    function mint(address _to, uint256 _amount)
        public
        onlyMinter
        returns (bool)// knownsec 矿工可用 铸币
    {
        if (_amount.add(totalSupply()) > maxSupply) {
            return false;
        }
        _mint(_to, _amount);
        return true;
    }

    function addMinter(address _addMinter) public onlyOwner returns (bool) {// knownsec Owner 可用 矿工增加
        require(
            _addMinter != address(0),
            "KstToken: _addMinter is the zero address"
        );
        return EnumerableSet.add(_minters, _addMinter);
    }

    function delMinter(address _delMinter) public onlyOwner returns (bool) {// knownsec Owner 可用 矿工减少
        require(
            _delMinter != address(0),
            "KstToken: _delMinter is the zero address"
        );
        return EnumerableSet.remove(_minters, _delMinter);
    }

    function getMinterLength() public view returns (uint256) {// knownsec 矿工数量获取
        return EnumerableSet.length(_minters);
    }

    function isMinter(address account) public view returns (bool) {// knownsec 矿工资格查询
        return EnumerableSet.contains(_minters, account);
    }

    function getMinter(uint256 _index) public view onlyOwner returns (address) {// knownsec Owner 可用 获取下标矿工
        require(
            _index <= getMinterLength() - 1,
            "KstToken: index out of bounds"
        );
        return EnumerableSet.at(_minters, _index);
    }

    // modifier for mint function
    modifier onlyMinter() {// knownsec 矿工修饰器
        require(isMinter(msg.sender), "caller is not the minter");
        _;
    }
}
```

FixedPoint.sol

```
// SPDX-License-Identifier: MIT

pragma solidity =0.6.12;
```

```
library FixedPoint {
    // range: [0, 2**112 - 1]
    // resolution: 1 / 2**112
    struct uq112x112 {
        uint224 _x;
    }

    // range: [0, 2**144 - 1]
    // resolution: 1 / 2**112
    struct uq144x112 {
        uint256 _x;
    }

    uint8 private constant RESOLUTION = 112;

    // encode a uint112 as a UQ112x112
    function encode(uint112 x) internal pure returns (uq112x112 memory) {
        return uq112x112(uint224(x) << RESOLUTION);
    }

    // encodes a uint144 as a UQ144x112
    function encode144(uint144 x) internal pure returns (uq144x112 memory) {
        return uq144x112(uint256(x) << RESOLUTION);
    }

    // divide a UQ112x112 by a uint112, returning a UQ112x112
    function div(uq112x112 memory self, uint112 x)
        internal
        pure
        returns (uq112x112 memory)
    {
        require(x != 0, "FixedPoint: DIV_BY_ZERO");
        return uq112x112(self._x / uint224(x));
    }

    // multiply a UQ112x112 by a uint, returning a UQ144x112
    // reverts on overflow
    function mul(uq112x112 memory self, uint256 y)
        internal
        pure
        returns (uq144x112 memory)
    {
        uint256 z;
        require(
            y == 0 || (z = uint256(self._x) * y) / y == uint256(self._x),
            "FixedPoint: MULTIPLICATION_OVERFLOW"
        );
        return uq144x112(z);
    }

    // returns a UQ112x112 which represents the ratio of the numerator to the denominator
    // equivalent to encode(numerator).div(denominator)
    function fraction(uint112 numerator, uint112 denominator)
        internal
        pure
        returns (uq112x112 memory)
    {
        require(denominator > 0, "FixedPoint: DIV_BY_ZERO");
        return uq112x112((uint224(numerator) << RESOLUTION) / denominator);
    }

    // decode a UQ112x112 into a uint112 by truncating after the radix point
    function decode(uq112x112 memory self) internal pure returns (uint112) {
        return uint112(self._x >> RESOLUTION);
    }

    // decode a UQ144x112 into a uint144 by truncating after the radix point
    function decode144(uq144x112 memory self) internal pure returns (uint144) {
        return uint144(self._x >> RESOLUTION);
    }
}
```

KswapLibrary.sol

```
// SPDX-License-Identifier: MIT

pragma solidity >=0.5.0;

import "../interfaces/IKswapPair.sol";

import "./SafeMath.sol";

library KswapLibrary {
    using SafeMathKswap for uint256;

    // returns sorted token addresses, used to handle return values from pairs sorted in this order
```

```
    function sortTokens(address tokenA, address tokenB)
        internal
        pure
        returns (address token0, address token1)
    {
        require(tokenA != tokenB, "KswapLibrary: IDENTICAL_ADDRESSES");
        (token0, token1) = tokenA < tokenB
            ? (tokenA, tokenB)
            : (tokenB, tokenA);
        require(token0 != address(0), "KswapLibrary: ZERO_ADDRESS");
    }

    // calculates the CREATE2 address for a pair without making any external calls
    function pairFor(
        address factory,
        address tokenA,
        address tokenB
    ) internal pure returns (address pair) {
        (address token0, address token1) = sortTokens(tokenA, tokenB);
        pair = address(
            uint256(
                keccak256(
                    abi.encodePacked(
                        hex"ff",
                        factory,
                        keccak256(abi.encodePacked(token0, token1)),
                        hex"7f08f1b43a5b37be17b2d24d4f2c6b1311e19eedc53cc4528f0e72cdfb5d8d37"    //
init code hash
                    )
                )
            )
        );
    }

    // fetches and sorts the reserves for a pair
    function getReserves(
        address factory,
        address tokenA,
        address tokenB
    ) internal view returns (uint256 reserveA, uint256 reserveB) {
        (address token0, ) = sortTokens(tokenA, tokenB);
        (uint256 reserve0, uint256 reserve1, ) =
            IKswapPair(pairFor(factory, tokenA, tokenB)).getReserves();
        (reserveA, reserveB) = tokenA == token0
            ? (reserve0, reserve1)
            : (reserve1, reserve0);
    }

    // given some amount of an asset and pair reserves, returns an equivalent amount of the other asset
    function quote(
        uint256 amountA,
        uint256 reserveA,
        uint256 reserveB
    ) internal pure returns (uint256 amountB) {
        require(amountA > 0, "KswapLibrary: INSUFFICIENT_AMOUNT");
        require(
            reserveA > 0 && reserveB > 0,
            "KswapLibrary: INSUFFICIENT_LIQUIDITY"
        );
        amountB = amountA.mul(reserveB) / reserveA;
    }

    // given an input amount of an asset and pair reserves, returns the maximum output amount of the other asset
    function getAmountOut(
        uint256 amountIn,
        uint256 reserveIn,
        uint256 reserveOut
    ) internal pure returns (uint256 amountOut) {
        require(amountIn > 0, "KswapLibrary: INSUFFICIENT_INPUT_AMOUNT");
        require(
            reserveIn > 0 && reserveOut > 0,
            "KswapLibrary: INSUFFICIENT_LIQUIDITY"
        );
        uint256 amountInWithFee = amountIn.mul(997);
        uint256 numerator = amountInWithFee.mul(reserveOut);
        uint256 denominator = reserveIn.mul(1000).add(amountInWithFee);
        amountOut = numerator / denominator;
    }

    // given an output amount of an asset and pair reserves, returns a required input amount of the other asset
    function getAmountIn(
        uint256 amountOut,
        uint256 reserveIn,
        uint256 reserveOut
    ) internal pure returns (uint256 amountIn) {
        require(amountOut > 0, "KswapLibrary: INSUFFICIENT_OUTPUT_AMOUNT");
        require(
```

```
                reserveIn > 0 && reserveOut > 0,
                "KswapLibrary: INSUFFICIENT_LIQUIDITY"
            );
            uint256 numerator = reserveIn.mul(amountOut).mul(1000);
            uint256 denominator = reserveOut.sub(amountOut).mul(997);
            amountIn = (numerator / denominator).add(1);
        }

        // performs chained getAmountOut calculations on any number of pairs
        function getAmountsOut(
            address factory,
            uint256 amountIn,
            address[] memory path
        ) internal view returns (uint256[] memory amounts) {
            require(path.length >= 2, "KswapLibrary: INVALID_PATH");
            amounts = new uint256[](path.length);
            amounts[0] = amountIn;
            for (uint256 i; i < path.length - 1; i++) {
                (uint256 reserveIn, uint256 reserveOut) =
                    getReserves(factory, path[i], path[i + 1]);
                amounts[i + 1] = getAmountOut(amounts[i], reserveIn, reserveOut);
            }
        }

        // performs chained getAmountIn calculations on any number of pairs
        function getAmountsIn(
            address factory,
            uint256 amountOut,
            address[] memory path
        ) internal view returns (uint256[] memory amounts) {
            require(path.length >= 2, "KswapLibrary: INVALID_PATH");
            amounts = new uint256[](path.length);
            amounts[amounts.length - 1] = amountOut;
            for (uint256 i = path.length - 1; i > 0; i--) {
                (uint256 reserveIn, uint256 reserveOut) =
                    getReserves(factory, path[i - 1], path[i]);
                amounts[i - 1] = getAmountIn(amounts[i], reserveIn, reserveOut);
            }
        }
    }
```

KswapOracleLibrary.sol

```
    // SPDX-License-Identifier: MIT

    pragma solidity =0.6.12;

    import "./FixedPoint.sol";
    import "../interfaces/IKswapPair.sol";

    library KswapOracleLibrary {
        using FixedPoint for *;

        // helper function that returns the current block timestamp within the range of uint32, i.e. [0, 2**32 - 1]
        function currentBlockTimestamp() internal view returns (uint32) {
            return uint32(block.timestamp % 2**32);
        }

        // produces the cumulative price using counterfactuals to save gas and avoid a call to sync.
        function currentCumulativePrices(address pair)
            internal
            view
            returns (
                uint256 price0Cumulative,
                uint256 price1Cumulative,
                uint32 blockTimestamp
            )
        {
            blockTimestamp = currentBlockTimestamp();
            price0Cumulative = IKswapPair(pair).price0CumulativeLast();
            price1Cumulative = IKswapPair(pair).price1CumulativeLast();

            // if time has elapsed since the last update on the pair, mock the accumulated price values
            (uint112 reserve0, uint112 reserve1, uint32 blockTimestampLast) =
                IKswapPair(pair).getReserves();
            if (blockTimestampLast != blockTimestamp) {
                // subtraction overflow is desired
                uint32 timeElapsed = blockTimestamp - blockTimestampLast;
                // addition overflow is desired
                // counterfactual
                price0Cumulative +=
                    uint256(FixedPoint.fraction(reserve1, reserve0)._x) *
                    timeElapsed;
                // counterfactual
                price1Cumulative +=
                    uint256(FixedPoint.fraction(reserve0, reserve1)._x) *
```

```
                timeElapsed;
            }
        }
}
```

Math.sol

```
// SPDX-License-Identifier: MIT

pragma solidity =0.6.12;

// a library for performing various math operations

library Math {
    function min(uint x, uint y) internal pure returns (uint z) {
        z = x < y ? x : y;
    }

    // babylonian method (https://en.wikipedia.org/wiki/Methods_of_computing_square_roots#Babylonian_method)
    function sqrt(uint y) internal pure returns (uint z) {
        if (y > 3) {
            z = y;
            uint x = y / 2 + 1;
            while (x < z) {
                z = x;
                x = (y / x + x) / 2;
            }
        } else if (y != 0) {
            z = 1;
        }
    }
}
```

SafeMath.sol

```
// SPDX-License-Identifier: MIT

pragma solidity =0.6.12;

// a library for performing overflow-safe math, courtesy of DappHub (https://github.com/dapphub/ds-math)

library SafeMathKswap {
    function add(uint256 x, uint256 y) internal pure returns (uint256 z) {
        require((z = x + y) >= x, "ds-math-add-overflow");
    }

    function sub(uint256 x, uint256 y) internal pure returns (uint256 z) {
        require((z = x - y) <= x, "ds-math-sub-underflow");
    }

    function mul(uint256 x, uint256 y) internal pure returns (uint256 z) {
        require(y == 0 || (z = x * y) / y == x, "ds-math-mul-overflow");
    }

    function div(uint256 a, uint256 b) internal pure returns (uint256) {
        return div(a, b, "SafeMath: division by zero");
    }

    function div(
        uint256 a,
        uint256 b,
        string memory errorMessage
    ) internal pure returns (uint256) {
        // Solidity only automatically asserts when dividing by 0
        require(b > 0, errorMessage);
        uint256 c = a / b;
        // assert(a == b * c + a % b); // There is no case in which this doesn't hold

        return c;
    }
}
```

TransferHelper.sol

```
// SPDX-License-Identifier: GPL-3.0-or-later

pragma solidity >=0.6.0;

// helper methods for interacting with ERC20 tokens and sending ETH that do not consistently return true/false
library TransferHelper {
    function safeApprove(address token, address to, uint value) internal {
        // bytes4(keccak256(bytes('approve(address,uint256)')));
        (bool success, bytes memory data) = token.call(abi.encodeWithSelector(0x095ea7b3, to, value));
```

```
        require(success && (data.length == 0 || abi.decode(data, (bool))), 'TransferHelper: APPROVE_FAILED');
    }

    function safeTransfer(address token, address to, uint value) internal {
        // bytes4(keccak256(bytes('transfer(address,uint256)')));
        (bool success, bytes memory data) = token.call(abi.encodeWithSelector(0xa9059cbb, to, value));
        require(success && (data.length == 0 || abi.decode(data, (bool))), 'TransferHelper: TRANSFER_FAILED');
    }

    function safeTransferFrom(address token, address from, address to, uint value) internal {
        // bytes4(keccak256(bytes('transferFrom(address,address,uint256)')));
        (bool success, bytes memory data) = token.call(abi.encodeWithSelector(0x23b872dd, from, to, value));
        require(success && (data.length == 0 || abi.decode(data, (bool))), 'TransferHelper: TRANSFER_FROM_FAILED');
    }

    function safeTransferETH(address to, uint value) internal {
        (bool success,) = to.call{value:value}(new bytes(0));
        require(success, 'TransferHelper: ETH_TRANSFER_FAILED');
    }
}
```

UQ112x112.sol

```
// SPDX-License-Identifier: MIT

pragma solidity =0.6.12;

// a library for handling binary fixed point numbers (https://en.wikipedia.org/wiki/Q_(number_format))

// range: [0, 2**112 - 1]
// resolution: 1 / 2**112

library UQ112x112 {
    uint224 constant Q112 = 2**112;

    // encode a uint112 as a UQ112x112
    function encode(uint112 y) internal pure returns (uint224 z) {
        z = uint224(y) * Q112; // never overflows
    }

    // divide a UQ112x112 by a uint112, returning a UQ112x112
    function uqdiv(uint224 x, uint112 y) internal pure returns (uint224 z) {
        z = x / uint224(y);
    }
}
```

Oracle.sol

```
// SPDX-License-Identifier: MIT

pragma solidity =0.6.12;// knownsec 指定编译器版本

import "@openzeppelin/contracts/math/SafeMath.sol";
import "../libraries/FixedPoint.sol";
import "../libraries/KswapOracleLibrary.sol";
import "../libraries/KswapLibrary.sol";
import "../interfaces/IKswapFactory.sol";

contract Oracle {// knownsec 预言机
    using FixedPoint for *;
    using SafeMath for uint256;// knownsec 安全数学库使用声明

    struct Observation {// knownsec 观察结构体
        uint256 timestamp;
        uint256 price0Cumulative;
        uint256 price1Cumulative;
    }

    address public immutable factory;// knownsec 工厂合约地址
    uint256 public constant CYCLE = 30 minutes;

    // mapping from pair address to a list of price observations of that pair
    mapping(address => Observation) public pairObservations;

    constructor(address factory_) public {// knownsec 初始化赋值工厂合约地址
        factory = factory_;
    }

    function update(address tokenA, address tokenB) external {// knownsec 更新观察价格_外部调用
        address pair = KswapLibrary.pairFor(factory, tokenA, tokenB);// knownsec 更新交易对

        Observation storage observation = pairObservations[pair];// knownsec 取出对应交易对观察结构体
```

```
        uint256 timeElapsed = block.timestamp - observation.timestamp;// knownsec 时间计算
        require(timeElapsed >= CYCLE, "KSWAPOracle: PERIOD_NOT_ELAPSED");// knownsec 更新周期检查
        (uint256 price0Cumulative, uint256 price1Cumulative, ) =
            KswapOracleLibrary.currentCumulativePrices(pair);
        observation.timestamp = block.timestamp;// knownsec 时间更新
        observation.price0Cumulative = price0Cumulative;
        observation.price1Cumulative = price1Cumulative;
    }

    function computeAmountOut(
        uint256 priceCumulativeStart,
        uint256 priceCumulativeEnd,
        uint256 timeElapsed,
        uint256 amountIn
    ) private pure returns (uint256 amountOut) {// knownsec 输出价格计算
        // overflow is desired.
        FixedPoint.uq112x112 memory priceAverage =
            FixedPoint.uq112x112(
                uint224(
                    (priceCumulativeEnd - priceCumulativeStart) / timeElapsed
                )
            );// knownsec 平均价格计算
        amountOut = priceAverage.mul(amountIn).decode144();
    }

    function consult(
        address tokenIn,
        uint256 amountIn,
        address tokenOut
    ) external view returns (uint256 amountOut) {// knownsec 外部询价
        address pair = KswapLibrary.pairFor(factory, tokenIn, tokenOut);
        Observation storage observation = pairObservations[pair];
        uint256 timeElapsed = block.timestamp - observation.timestamp;
        (uint256 price0Cumulative, uint256 price1Cumulative, ) =
            KswapOracleLibrary.currentCumulativePrices(pair);
        (address token0, ) = KswapLibrary.sortTokens(tokenIn, tokenOut);

        if (token0 == tokenIn) {
            return
                computeAmountOut(
                    observation.price0Cumulative,
                    price0Cumulative,
                    timeElapsed,
                    amountIn
                );
        } else {
            return
                computeAmountOut(
                    observation.price1Cumulative,
                    price1Cumulative,
                    timeElapsed,
                    amountIn
                );
        }
    }
}
```

DepositPool.sol

```
// SPDX-License-Identifier: MIT
pragma solidity =0.6.12;
pragma experimental ABIEncoderV2;

import "@openzeppelin/contracts/access/Ownable.sol";
import "@openzeppelin/contracts/utils/EnumerableSet.sol";
import "@openzeppelin/contracts/token/ERC20/ERC20.sol";
import "@openzeppelin/contracts/token/ERC20/SafeERC20.sol";
import "@openzeppelin/contracts/math/SafeMath.sol";
import "../KstToken.sol";

contract DepositPool is Ownable {// knownsec 质押池
    using SafeMath for uint256;
    using SafeERC20 for ERC20;

    using EnumerableSet for EnumerableSet.AddressSet;
    EnumerableSet.AddressSet private _tokens;

    // Info of each user.
    struct UserInfo {// knownsec 用户信息
        uint256 amount; // How many LP tokens the user has provided.
        uint256 rewardDebt; // Reward debt.
        uint256 accKstAmount; // How many rewards the user has got.
    }
```

```
    struct UserView {
        uint256 stakedAmount;
        uint256 unclaimedRewards;
        uint256 tokenBalance;
        uint256 accKstAmount;
    }

    // Info of each pool.
    struct PoolInfo {// knownsec 池信息
        address token; // Address of LP token contract.
        uint256 allocPoint; // How many allocation points assigned to this pool. ksts to distribute per block.
        uint256 lastRewardBlock; // Last block number that ksts distribution occurs.
        uint256 accKstPerShare; // Accumulated ksts per share, times 1e12.
        uint256 totalAmount; // Total amount of current pool deposit.
        uint256 allocKstAmount;
        uint256 accKstAmount;
    }

    struct PoolView {
        uint256 pid;
        uint256 allocPoint;
        uint256 lastRewardBlock;
        uint256 rewardsPerBlock;
        uint256 accKstPerShare;
        uint256 allocKstAmount;
        uint256 accKstAmount;
        uint256 totalAmount;
        address token;
        string symbol;
        string name;
        uint8 decimals;
    }

    // The KST Token!
    KSTToken public kst;
    // kst tokens created per block.
    uint256 public kstPerBlock;
    // Info of each pool.
    PoolInfo[] public poolInfo;// knownsec 池信息列表
    // Info of each user that stakes LP tokens.
    mapping(uint256 => mapping(address => UserInfo)) public userInfo;// knownsec 用户信息映射
    // pid corresponding address
    mapping(address => uint256) public tokenOfPid;
    // Total allocation points. Must be the sum of all allocation points in all pools.
    uint256 public totalAllocPoint = 0;
    // The block number when kst mining starts.
    uint256 public startBlock;
    uint256 public halvingPeriod = 2628000; // half year

    event Deposit(address indexed user, uint256 indexed pid, uint256 amount);// knownsec 事件记录
    event Withdraw(address indexed user, uint256 indexed pid, uint256 amount);
    event EmergencyWithdraw(
        address indexed user,
        uint256 indexed pid,
        uint256 amount
    );

    constructor(
        KSTToken _kst,
        uint256 _kstPerBlock,
        uint256 _startBlock
    ) public {// knownsec 初始化构造函数
        kst = _kst;
        kstPerBlock = _kstPerBlock;
        startBlock = _startBlock;
    }

    function phase(uint256 blockNumber) public view returns (uint256) {// knownsec 查询周期段
        if (halvingPeriod == 0) {
            return 0;
        }
        if (blockNumber > startBlock) {
            return (blockNumber.sub(startBlock).sub(1)).div(halvingPeriod);
        }
        return 0;
    }

    function getKstPerBlock(uint256 blockNumber) public view returns (uint256) {
        uint256 _phase = phase(blockNumber);
        return kstPerBlock.div(2**_phase);// knownsec 2^ ((blockNumber-startBlock-1) / 2628000) blockNumber
足够大可能溢出
    }

    function getKstBlockReward(uint256 _lastRewardBlock)
        public
        view
        returns (uint256)// knownsec 区块奖励获取
```

```
{
        uint256 blockReward = 0;
        uint256 lastRewardPhase = phase(_lastRewardBlock);
        uint256 currentPhase = phase(block.number);
        while (lastRewardPhase < currentPhase) {
                lastRewardPhase++;
                uint256 height = lastRewardPhase.mul(halvingPeriod).add(startBlock);
                blockReward = blockReward.add(
                        (height.sub(_lastRewardBlock)).mul(getKstPerBlock(height))
                );
                _lastRewardBlock = height;
        }
        blockReward = blockReward.add(
                (block.number.sub(_lastRewardBlock)).mul(
                        getKstPerBlock(block.number)
                )
        );
        return blockReward;
}

// Add a new lp to the pool. Can only be called by the owner.
function add(
        uint256 _allocPoint,
        address _token,
        bool _withUpdate
) public onlyOwner {// knownsec owner 可用 添加 lp token
        require(_token != address(0), "_token is the zero address");// knownsec token 检查

        require(
                !EnumerableSet.contains(_tokens, _token),
                "_token is already added to the pool"
        );
        // return EnumerableSet.add(_tokens, _token);
        EnumerableSet.add(_tokens, _token);

        if (_withUpdate) {// knownsec  需要更新
                massUpdatePools();
        }
        uint256 lastRewardBlock =
                block.number > startBlock ? block.number : startBlock;// knownsec  上一个奖励块计算
        totalAllocPoint = totalAllocPoint.add(_allocPoint);// knownsec totalAllocPoint 更新
        poolInfo.push(// knownsec  池信息增加
                PoolInfo({
                        token: _token,
                        allocPoint: _allocPoint,
                        lastRewardBlock: lastRewardBlock,
                        accKstPerShare: 0,
                        totalAmount: 0,
                        allocKstAmount: 0,
                        accKstAmount: 0
                })
        );
        tokenOfPid[_token] = getPoolLength() - 1;// knownsec pid 更新
}

// Update the given pool's kst allocation point. Can only be called by the owner.
function set(
        uint256 _pid,
        uint256 _allocPoint,
        bool _withUpdate
) public onlyOwner {
        if (_withUpdate) {
                massUpdatePools();
        }
        totalAllocPoint = totalAllocPoint.sub(poolInfo[_pid].allocPoint).add(
                _allocPoint
        );
        poolInfo[_pid].allocPoint = _allocPoint;
}

// Update reward variables for all pools. Be careful of gas spending!
function massUpdatePools() public {// knownsec  更新所有奖励池
        uint256 length = poolInfo.length;
        for (uint256 pid = 0; pid < length; ++pid) {
                updatePool(pid);
        }
}

// Update reward variables of the given pool to be up-to-date.
function updatePool(uint256 _pid) public {// knownsec  根据 pid 更新池
        PoolInfo storage pool = poolInfo[_pid];
        if (block.number <= pool.lastRewardBlock) {
                return;
        }

        uint256 tokenSupply = ERC20(pool.token).balanceOf(address(this));
        if (tokenSupply == 0) {
```

```
            pool.lastRewardBlock = block.number;
            return;
        }

        uint256 blockReward = getKstBlockReward(pool.lastRewardBlock);

        if (blockReward <= 0) {
            return;
        }

        uint256 kstReward =
            blockReward.mul(pool.allocPoint).div(totalAllocPoint);

        bool minRet = kst.mint(address(this), kstReward);// knownsec 奖励铸币
        if (minRet) {
            pool.accKstPerShare = pool.accKstPerShare.add(
                kstReward.mul(1e12).div(tokenSupply)
            );
            pool.allocKstAmount = pool.allocKstAmount.add(kstReward);
            pool.accKstAmount = pool.allocKstAmount.add(kstReward);
        }
        pool.lastRewardBlock = block.number;
    }

    function deposit(uint256 _pid, uint256 _amount) public {// knownsec 质押
        PoolInfo storage pool = poolInfo[_pid];
        UserInfo storage user = userInfo[_pid][msg.sender];
        updatePool(_pid);// knownsec 池更新
        if (user.amount > 0) {
            uint256 pendingAmount =
                user.amount.mul(pool.accKstPerShare).div(1e12).sub(
                    user.rewardDebt
                );
            if (pendingAmount > 0) {
                safeKstTransfer(msg.sender, pendingAmount);// knownsec 质押凭证转币
                user.accKstAmount = user.accKstAmount.add(pendingAmount);
                pool.allocKstAmount = pool.allocKstAmount.sub(pendingAmount);
            }
        }
        if (_amount > 0) {
            ERC20(pool.token).safeTransferFrom(
                msg.sender,
                address(this),
                _amount
            );// knownsec 质押转币
            user.amount = user.amount.add(_amount);
            pool.totalAmount = pool.totalAmount.add(_amount);
        }
        user.rewardDebt = user.amount.mul(pool.accKstPerShare).div(1e12);
        emit Deposit(msg.sender, _pid, _amount);
    }

    function pendingKst(uint256 _pid, address _user)
        public
        view
        returns (uint256)
    {// knownsec 还未转移的 kst 计算
        require(
            _pid <= poolInfo.length - 1,
            "TradingPool: Can not find this pool"
        );// knownsec pid 校验
        PoolInfo storage pool = poolInfo[_pid];
        UserInfo storage user = userInfo[_pid][_user];
        uint256 accKstPerShare = pool.accKstPerShare;
        uint256 tokenSupply = ERC20(pool.token).balanceOf(address(this));
        if (user.amount > 0) {
            if (block.number > pool.lastRewardBlock) {
                uint256 blockReward = getKstBlockReward(pool.lastRewardBlock);
                uint256 kstReward =
                    blockReward.mul(pool.allocPoint).div(totalAllocPoint);
                accKstPerShare = accKstPerShare.add(
                    kstReward.mul(1e12).div(tokenSupply)
                );
                return
                    user.amount.mul(accKstPerShare).div(1e12).sub(
                        user.rewardDebt
                    );
            }
            if (block.number == pool.lastRewardBlock) {
                return
                    user.amount.mul(accKstPerShare).div(1e12).sub(
                        user.rewardDebt
                    );
            }
        }
        return 0;
    }
```

```
    function withdraw(uint256 _pid, uint256 _amount) public {// knownsec 账户回撤
        PoolInfo storage pool = poolInfo[_pid];
        UserInfo storage user = userInfo[_pid][msg.sender];
        require(user.amount >= _amount, "withdraw: not good");
        updatePool(_pid);
        uint256 pendingAmount =
            user.amount.mul(pool.accKstPerShare).div(1e12).sub(user.rewardDebt);
        if (pendingAmount > 0) {
            safeKstTransfer(msg.sender, pendingAmount);// knownsec 奖励发送
            user.accKstAmount = user.accKstAmount.add(pendingAmount);
            pool.allocKstAmount = pool.allocKstAmount.sub(pendingAmount);
        }
        if (_amount > 0) {
            user.amount = user.amount.sub(_amount);// knownsec 代币不足将报错
            pool.totalAmount = pool.totalAmount.sub(_amount);
            ERC20(pool.token).safeTransfer(msg.sender, _amount);// knownsec 质押代币发送
        }
        user.rewardDebt = user.amount.mul(pool.accKstPerShare).div(1e12);
        emit Withdraw(msg.sender, _pid, _amount);
    }

    function harvestAll() public {// knownsec 全部池进行利息提取
        for (uint256 i = 0; i < poolInfo.length; i++) {
            withdraw(i, 0);
        }
    }

    function emergencyWithdraw(uint256 _pid) public {// knownsec 指定池不要利息紧急回撤
        PoolInfo storage pool = poolInfo[_pid];
        UserInfo storage user = userInfo[_pid][msg.sender];
        uint256 amount = user.amount;
        user.amount = 0;
        user.rewardDebt = 0;
        ERC20(pool.token).safeTransfer(msg.sender, amount);
        pool.totalAmount = pool.totalAmount.sub(amount);
        emit EmergencyWithdraw(msg.sender, _pid, amount);
    }

    // Safe kst transfer function, just in case if rounding error causes pool to not have enough ksts.
    function safeKstTransfer(address _to, uint256 _amount) internal {// knownsec kst 转账
        uint256 kstBalance = kst.balanceOf(address(this));
        if (_amount > kstBalance) {
            kst.transfer(_to, kstBalance);
        } else {
            kst.transfer(_to, _amount);
        }
    }

    // Set the number of kst produced by each block
    function setKstPerBlock(uint256 _newPerBlock) public onlyOwner {// knownsec Owner 可用 设置块奖励数
量
        massUpdatePools();
        kstPerBlock = _newPerBlock;
    }

    function setHalvingPeriod(uint256 _block) public onlyOwner {// knownsec Owner 可用 设置 halvingPeriod
        halvingPeriod = _block;
    }

    function getTokensLength() public view returns (uint256) {// knownsec 获取 token 数量
        return EnumerableSet.length(_tokens);
    }

    function getTokens(uint256 _index) public view returns (address) {// knownsec 获取指定下标 token
        require(
            _index <= getTokensLength() - 1,
            "LiquidityPool: index out of bounds"
        );
        return EnumerableSet.at(_tokens, _index);
    }

    function getPoolLength() public view returns (uint256) {// knownsec 获取池长度
        return poolInfo.length;
    }

    function getAllPools() external view returns (PoolInfo[] memory) {// knownsec 获取池数组信息
        return poolInfo;
    }

    function getPoolView(uint256 pid) public view returns (PoolView memory) {// knownsec 获取指定池数据
        require(pid < poolInfo.length, "pid out of range");
        PoolInfo memory pool = poolInfo[pid];
        ERC20 token = ERC20(pool.token);
        string memory symbol = token.symbol();
        string memory name = token.name();
        uint8 decimals = token.decimals();
```

```
            uint256 rewardsPerBlock =
                pool.allocPoint.mul(kstPerBlock).div(totalAllocPoint);
            return
                PoolView({
                    pid: pid,
                    allocPoint: pool.allocPoint,
                    lastRewardBlock: pool.lastRewardBlock,
                    accKstPerShare: pool.accKstPerShare,
                    rewardsPerBlock: rewardsPerBlock,
                    allocKstAmount: pool.allocKstAmount,
                    accKstAmount: pool.accKstAmount,
                    totalAmount: pool.totalAmount,
                    token: address(token),
                    symbol: symbol,
                    name: name,
                    decimals: decimals
                });
    }

    function getPoolViewByAddress(address token)
        public
        view
        returns (PoolView memory)// knownsec  获取指定地址池数据
    {
        uint256 pid = tokenOfPid[token];
        return getPoolView(pid);
    }

    function getAllPoolViews() external view returns (PoolView[] memory) {// knownsec  获取所有池数据
        PoolView[] memory views = new PoolView[](poolInfo.length);
        for (uint256 i = 0; i < poolInfo.length; i++) {
            views[i] = getPoolView(i);
        }
        return views;
    }

    function getUserView(address token, address account)
        public
        view
        returns (UserView memory)// knownsec  获取指定池用户数据
    {
        uint256 pid = tokenOfPid[token];
        UserInfo memory user = userInfo[pid][account];
        uint256 unclaimedRewards = pendingKst(pid, account);
        uint256 tokenBalance = ERC20(token).balanceOf(account);
        return
            UserView({
                stakedAmount: user.amount,
                unclaimedRewards: unclaimedRewards,
                tokenBalance: tokenBalance,
                accKstAmount: user.accKstAmount
            });
    }

    function getUserViews(address account)
        external
        view
        returns (UserView[] memory)// knownsec  获取所有池用户数据
    {
        address token;
        UserView[] memory views = new UserView[](poolInfo.length);
        for (uint256 i = 0; i < poolInfo.length; i++) {
            token = address(poolInfo[i].token);
            views[i] = getUserView(token, account);
        }
        return views;
    }
}
```

LiquidityPool.sol

```
// SPDX-License-Identifier: MIT
pragma solidity =0.6.12;
pragma experimental ABIEncoderV2;

import "@openzeppelin/contracts/access/Ownable.sol";
import "@openzeppelin/contracts/utils/EnumerableSet.sol";
import "@openzeppelin/contracts/token/ERC20/ERC20.sol";
import "@openzeppelin/contracts/token/ERC20/SafeERC20.sol";
import "@openzeppelin/contracts/math/SafeMath.sol";
import "../KstToken.sol";
import "../interfaces/IKswapPair.sol";

contract LiquidityPool is Ownable {// knownsec  流动性提供池
    using SafeMath for uint256;
    using SafeERC20 for ERC20;
```

```
using EnumerableSet for EnumerableSet.AddressSet;
EnumerableSet.AddressSet private _pairs;

// Info of each user.
struct UserInfo {// knownsec 用户信息
        uint256 amount; // How many LP tokens the user has provided.
        uint256 rewardDebt; // Reward debt.
        uint256 accKstAmount; // How many rewards the user has got.
}

struct UserView {
        uint256 stakedAmount;
        uint256 unclaimedRewards;
        uint256 lpBalance;
        uint256 accKstAmount;
}

// Info of each pool.
struct PoolInfo {// knownsec 池信息
        address lpToken; // Address of LP token contract.
        uint256 allocPoint; // How many allocation points assigned to this pool. ksts to distribute per block.
        uint256 lastRewardBlock; // Last block number that ksts distribution occurs.
        uint256 accKstPerShare; // Accumulated ksts per share, times 1e12.
        uint256 totalAmount; // Total amount of current pool deposit.
        uint256 allocKstAmount;
        uint256 accKstAmount;
}

struct PoolView {
        uint256 pid;
        address lpToken;
        uint256 allocPoint;
        uint256 lastRewardBlock;
        uint256 rewardsPerBlock;
        uint256 accKstPerShare;
        uint256 allocKstAmount;
        uint256 accKstAmount;
        uint256 totalAmount;
        address token0;
        string symbol0;
        string name0;
        uint8 decimals0;
        address token1;
        string symbol1;
        string name1;
        uint8 decimals1;
}

// The KST Token!
KSTToken public kst;
// kst tokens created per block.
uint256 public kstPerBlock;
// Info of each pool.
PoolInfo[] public poolInfo;// knownsec 池信息列表
// Info of each user that stakes LP tokens.
mapping(uint256 => mapping(address => UserInfo)) public userInfo;// knownsec 用户信息映射
// pid corresponding address
mapping(address => uint256) public LpOfPid;
// Total allocation points. Must be the sum of all allocation points in all pools.
uint256 public totalAllocPoint = 0;
// The block number when kst mining starts.
uint256 public startBlock;
uint256 public halvingPeriod = 2628000; // half year

event Deposit(address indexed user, uint256 indexed pid, uint256 amount);// knownsec 事件记录
event Withdraw(address indexed user, uint256 indexed pid, uint256 amount);
event EmergencyWithdraw(
        address indexed user,
        uint256 indexed pid,
        uint256 amount
);

constructor(
        KSTToken _kst,
        uint256 _kstPerBlock,
        uint256 _startBlock
) public {// knownsec 初始化构造函数
        kst = _kst;
        kstPerBlock = _kstPerBlock;
        startBlock = _startBlock;
}

function phase(uint256 blockNumber) public view returns (uint256) {// knownsec 查询周期段
        if (halvingPeriod == 0) {
                return 0;
        }
```

```
        if (blockNumber > startBlock) {
            return (blockNumber.sub(startBlock).sub(1)).div(halvingPeriod);
        }
        return 0;
    }

    function getKstPerBlock(uint256 blockNumber) public view returns (uint256) {
        uint256 _phase = phase(blockNumber);
        return kstPerBlock.div(2**_phase);
    }

    function getKstBlockReward(uint256 _lastRewardBlock)
        public
        view
        returns (uint256)// knownsec  区块奖励获取
    {
        uint256 blockReward = 0;
        uint256 lastRewardPhase = phase(_lastRewardBlock);
        uint256 currentPhase = phase(block.number);
        while (lastRewardPhase < currentPhase) {
            lastRewardPhase++;
            uint256 height = lastRewardPhase.mul(halvingPeriod).add(startBlock);
            blockReward = blockReward.add(
                (height.sub(_lastRewardBlock)).mul(getKstPerBlock(height))
            );
            _lastRewardBlock = height;
        }
        blockReward = blockReward.add(
            (block.number.sub(_lastRewardBlock)).mul(
                getKstPerBlock(block.number)
            )
        );
        return blockReward;
    }

    // Add a new lp to the pool. Can only be called by the owner.
    function add(
        uint256 _allocPoint,
        address _lpToken,
        bool _withUpdate
    ) public onlyOwner {// knownsec owner 可用  添加 lp token
        require(_lpToken != address(0), "_lpToken is the zero address");// knownsec token 检查

        require(
            !EnumerableSet.contains(_pairs, _lpToken),
            "_lpToken is already added to the pool"
        );
        // return EnumerableSet.add(_pairs, _lpToken);
        EnumerableSet.add(_pairs, _lpToken);

        if (_withUpdate) {
            massUpdatePools();
        }
        uint256 lastRewardBlock =
            block.number > startBlock ? block.number : startBlock;// knownsec  上一个奖励块计算
        totalAllocPoint = totalAllocPoint.add(_allocPoint);// knownsec totalAllocPoint 更新
        poolInfo.push(// knownsec  池信息增加
            PoolInfo({
                lpToken: _lpToken,
                allocPoint: _allocPoint,
                lastRewardBlock: lastRewardBlock,
                accKstPerShare: 0,
                totalAmount: 0,
                allocKstAmount: 0,
                accKstAmount: 0
            })
        );
        LpOfPid[_lpToken] = getPoolLength() - 1;// knownsec pid 更新
    }

    // Update the given pool's kst allocation point. Can only be called by the owner.
    function set(
        uint256 _pid,
        uint256 _allocPoint,
        bool _withUpdate
    ) public onlyOwner {
        if (_withUpdate) {
            massUpdatePools();
        }
        totalAllocPoint = totalAllocPoint.sub(poolInfo[_pid].allocPoint).add(
            _allocPoint
        );
        poolInfo[_pid].allocPoint = _allocPoint;
    }

    // Update reward variables for all pools. Be careful of gas spending!
    function massUpdatePools() public {// knownsec  更新所有奖励池
```

```
        uint256 length = poolInfo.length;
        for (uint256 pid = 0; pid < length; ++pid) {
            updatePool(pid);
        }
    }

    // Update reward variables of the given pool to be up-to-date.
    function updatePool(uint256 _pid) public {// knownsec 根据 pid 更新池
        PoolInfo storage pool = poolInfo[_pid];
        if (block.number <= pool.lastRewardBlock) {
            return;
        }

        uint256 lpSupply = ERC20(pool.lpToken).balanceOf(address(this));
        if (lpSupply == 0) {
            pool.lastRewardBlock = block.number;
            return;
        }

        uint256 blockReward = getKstBlockReward(pool.lastRewardBlock);

        if (blockReward <= 0) {
            return;
        }

        uint256 kstReward =
            blockReward.mul(pool.allocPoint).div(totalAllocPoint);

        bool minRet = kst.mint(address(this), kstReward);// knownsec 奖励铸币
        if (minRet) {
            pool.accKstPerShare = pool.accKstPerShare.add(
                kstReward.mul(1e12).div(lpSupply)
            );
            pool.allocKstAmount = pool.allocKstAmount.add(kstReward);
            pool.accKstAmount = pool.allocKstAmount.add(kstReward);
        }
        pool.lastRewardBlock = block.number;
    }

    function deposit(uint256 _pid, uint256 _amount) public {// knownsec 质押
        PoolInfo storage pool = poolInfo[_pid];
        UserInfo storage user = userInfo[_pid][msg.sender];
        updatePool(_pid);// knownsec 池更新
        if (user.amount > 0) {
            uint256 pendingAmount =
                user.amount.mul(pool.accKstPerShare).div(1e12).sub(
                    user.rewardDebt
                );
            if (pendingAmount > 0) {
                safeKstTransfer(msg.sender, pendingAmount);// knownsec 质押凭证转币
                user.accKstAmount = user.accKstAmount.add(pendingAmount);
                pool.allocKstAmount = pool.allocKstAmount.sub(pendingAmount);
            }
        }
        if (_amount > 0) {
            ERC20(pool.lpToken).safeTransferFrom(
                msg.sender,
                address(this),
                _amount
            );// knownsec 质押转币
            user.amount = user.amount.add(_amount);
            pool.totalAmount = pool.totalAmount.add(_amount);
        }
        user.rewardDebt = user.amount.mul(pool.accKstPerShare).div(1e12);
        emit Deposit(msg.sender, _pid, _amount);
    }

    function pendingKst(uint256 _pid, address _user)
        public
        view
        returns (uint256)
    {// knownsec 还未转移的 kst 计算
        require(
            _pid <= poolInfo.length - 1,
            "TradingPool: Can not find this pool"
        );// knownsec pid 校验
        PoolInfo storage pool = poolInfo[_pid];
        UserInfo storage user = userInfo[_pid][_user];
        uint256 accKstPerShare = pool.accKstPerShare;
        uint256 lpSupply = ERC20(pool.lpToken).balanceOf(address(this));
        if (user.amount > 0) {
            if (block.number > pool.lastRewardBlock) {
                uint256 blockReward = getKstBlockReward(pool.lastRewardBlock);
                uint256 kstReward =
                    blockReward.mul(pool.allocPoint).div(totalAllocPoint);
                accKstPerShare = accKstPerShare.add(
                    kstReward.mul(1e12).div(lpSupply)
```

```
                );
                return
                    user.amount.mul(accKstPerShare).div(1e12).sub(
                        user.rewardDebt
                    );
            }
            if (block.number == pool.lastRewardBlock) {
                return
                    user.amount.mul(accKstPerShare).div(1e12).sub(
                        user.rewardDebt
                    );
            }
        }
        return 0;
    }

    function withdraw(uint256 _pid, uint256 _amount) public {// knownsec 账户回撤
        PoolInfo storage pool = poolInfo[_pid];
        UserInfo storage user = userInfo[_pid][msg.sender];
        require(user.amount >= _amount, "withdraw: not good");
        updatePool(_pid);
        uint256 pendingAmount =
            user.amount.mul(pool.accKstPerShare).div(1e12).sub(user.rewardDebt);
        if (pendingAmount > 0) {
            safeKstTransfer(msg.sender, pendingAmount);// knownsec 奖励发送
            user.accKstAmount = user.accKstAmount.add(pendingAmount);
            pool.allocKstAmount = pool.allocKstAmount.sub(pendingAmount);
        }
        if (_amount > 0) {
            user.amount = user.amount.sub(_amount);// knownsec 代币不足将报错
            pool.totalAmount = pool.totalAmount.sub(_amount);
            ERC20(pool.lpToken).safeTransfer(msg.sender, _amount);// knownsec 质押代币发送
        }
        user.rewardDebt = user.amount.mul(pool.accKstPerShare).div(1e12);
        emit Withdraw(msg.sender, _pid, _amount);
    }

    function harvestAll() public {// knownsec 全部池进行利息提取
        for (uint256 i = 0; i < poolInfo.length; i++) {
            withdraw(i, 0);
        }
    }

    function emergencyWithdraw(uint256 _pid) public {// knownsec 指定池不要利息紧急回撤
        PoolInfo storage pool = poolInfo[_pid];
        UserInfo storage user = userInfo[_pid][msg.sender];
        uint256 amount = user.amount;
        user.amount = 0;
        user.rewardDebt = 0;
        ERC20(pool.lpToken).safeTransfer(msg.sender, amount);
        pool.totalAmount = pool.totalAmount.sub(amount);
        emit EmergencyWithdraw(msg.sender, _pid, amount);
    }

    // Safe kst transfer function, just in case if rounding error causes pool to not have enough ksts.
    function safeKstTransfer(address _to, uint256 _amount) internal {// knownsec kst 转账
        uint256 kstBalance = kst.balanceOf(address(this));
        if (_amount > kstBalance) {
            kst.transfer(_to, kstBalance);
        } else {
            kst.transfer(_to, _amount);
        }
    }

    // Set the number of kst produced by each block
    function setKstPerBlock(uint256 _newPerBlock) public onlyOwner {// knownsec Owner 可用 设置块奖励数
量
        massUpdatePools();
        kstPerBlock = _newPerBlock;
    }

    function setHalvingPeriod(uint256 _block) public onlyOwner {// knownsec Owner 可用 设置 halvingPeriod
        halvingPeriod = _block;
    }

    function getPairsLength() public view returns (uint256) {// knownsec 获取 token 数量
        return EnumerableSet.length(_pairs);
    }

    function getPairs(uint256 _index) public view returns (address) {// knownsec 获取指定下标 token
        require(
            _index <= getPairsLength() - 1,
            "LiquidityPool: index out of bounds"
        );
        return EnumerableSet.at(_pairs, _index);
    }
```

```
function getPoolLength() public view returns (uint256) {// knownsec 获取池长度
    return poolInfo.length;
}

function getAllPools() external view returns (PoolInfo[] memory) {// knownsec 获取池数组信息
    return poolInfo;
}

function getPoolView(uint256 pid) public view returns (PoolView memory) {// knownsec 获取指定池数据
    require(pid < poolInfo.length, "pid out of range");
    PoolInfo memory pool = poolInfo[pid];
    address lpToken = pool.lpToken;
    ERC20 token0 = ERC20(IKswapPair(lpToken).token0());
    ERC20 token1 = ERC20(IKswapPair(lpToken).token1());
    string memory symbol0 = token0.symbol();
    string memory name0 = token0.name();
    uint8 decimals0 = token0.decimals();
    string memory symbol1 = token1.symbol();
    string memory name1 = token1.name();
    uint8 decimals1 = token1.decimals();
    uint256 rewardsPerBlock =
        pool.allocPoint.mul(kstPerBlock).div(totalAllocPoint);
    return
        PoolView({
            pid: pid,
            lpToken: lpToken,
            allocPoint: pool.allocPoint,
            lastRewardBlock: pool.lastRewardBlock,
            accKstPerShare: pool.accKstPerShare,
            rewardsPerBlock: rewardsPerBlock,
            allocKstAmount: pool.allocKstAmount,
            accKstAmount: pool.accKstAmount,
            totalAmount: pool.totalAmount,
            token0: address(token0),
            symbol0: symbol0,
            name0: name0,
            decimals0: decimals0,
            token1: address(token1),
            symbol1: symbol1,
            name1: name1,
            decimals1: decimals1
        });
}

function getPoolViewByAddress(address lpToken)
    public
    view
    returns (PoolView memory)// knownsec 获取指定地址池数据
{
    uint256 pid = LpOfPid[lpToken];
    return getPoolView(pid);
}

function getAllPoolViews() external view returns (PoolView[] memory) {// knownsec 获取所有池数据
    PoolView[] memory views = new PoolView[](poolInfo.length);
    for (uint256 i = 0; i < poolInfo.length; i++) {
        views[i] = getPoolView(i);
    }
    return views;
}

function getUserView(address lpToken, address account)
    public
    view
    returns (UserView memory)// knownsec 获取指定池用户数据
{
    uint256 pid = LpOfPid[lpToken];
    UserInfo memory user = userInfo[pid][account];
    uint256 unclaimedRewards = pendingKst(pid, account);
    uint256 lpBalance = ERC20(lpToken).balanceOf(account);
    return
        UserView({
            stakedAmount: user.amount,
            unclaimedRewards: unclaimedRewards,
            lpBalance: lpBalance,
            accKstAmount: user.accKstAmount
        });
}

function getUserViews(address account)
    external
    view
    returns (UserView[] memory)// knownsec 获取所有池用户数据
{
    address lpToken;
    UserView[] memory views = new UserView[](poolInfo.length);
    for (uint256 i = 0; i < poolInfo.length; i++) {
```

```
                lpToken = address(poolInfo[i].lpToken);
                views[i] = getUserView(lpToken, account);
            }
            return views;
        }
}
```

TradingPoolV2.sol

```
// SPDX-License-Identifier: MIT
pragma solidity =0.6.12;
pragma experimental ABIEncoderV2;

import "@openzeppelin/contracts/access/Ownable.sol";
import "@openzeppelin/contracts/utils/EnumerableSet.sol";
import "@openzeppelin/contracts/token/ERC20/IERC20.sol";
import "@openzeppelin/contracts/token/ERC20/ERC20.sol";
import "@openzeppelin/contracts/token/ERC20/SafeERC20.sol";
import "@openzeppelin/contracts/math/SafeMath.sol";
import "../KstToken.sol";
import "../interfaces/IKswapPair.sol";
import "../interfaces/IKswapFactory.sol";
import "../libraries/KswapLibrary.sol";

interface IOracle {
    function update(address tokenA, address tokenB) external;

    function consult(
        address tokenIn,
        uint256 amountIn,
        address tokenOut
    ) external view returns (uint256 amountOut);
}

contract TradingPool is Ownable {// knownsec  交易池
    using SafeMath for uint256;
    using SafeERC20 for IERC20;

    using EnumerableSet for EnumerableSet.AddressSet;
    EnumerableSet.AddressSet private _pairs;

    // Info of each user.
    struct UserInfo {// knownsec  用户信息
        uint256 quantity;
        uint256 accQuantity;
        uint256 pendingReward;
        uint256 rewardDebt; // Reward debt.
        uint256 accKstAmount; // How many rewards the user has got.
    }

    struct UserView {
        uint256 quantity;
        uint256 accQuantity;
        uint256 unclaimedRewards;
        uint256 accKstAmount;
    }

    // Info of each pool.
    struct PoolInfo {// knownsec  池信息
        address pair; // Address of LP token contract.
        uint256 allocPoint; // How many allocation points assigned to this pool. ksts to distribute per block.
        uint256 lastRewardBlock; // Last block number that ksts distribution occurs.
        uint256 accKstPerShare; // Accumulated ksts per share, times 1e12.
        uint256 quantity;
        uint256 accQuantity;
        uint256 allocKstAmount;
        uint256 accKstAmount;
    }

    struct PoolView {
        uint256 pid;
        address pair;
        uint256 allocPoint;
        uint256 lastRewardBlock;
        uint256 rewardsPerBlock;
        uint256 accKstPerShare;
        uint256 allocKstAmount;
        uint256 accKstAmount;
        uint256 quantity;
        uint256 accQuantity;
        address token0;
        string symbol0;
        string name0;
        uint8 decimals0;
        address token1;
        string symbol1;
```

```
        string name1;
        uint8 decimals1;
    }

    // The KST Token!
    KSTToken public kst;
    // kst tokens created per block.
    uint256 public kstPerBlock;
    // Info of each pool.
    PoolInfo[] public poolInfo;// knownsec 池信息列表
    // Info of each user that stakes LP tokens.
    mapping(uint256 => mapping(address => UserInfo)) public userInfo;// knownsec 用户信息映射
    // pid corresponding address
    mapping(address => uint256) public pairOfPid;
    // Total allocation points. Must be the sum of all allocation points in all pools.
    uint256 public totalAllocPoint = 0;
    uint256 public totalQuantity = 0;
    IOracle public oracle;
    // router address
    address public router;
    // factory address
    IKswapFactory public factory;
    address public targetToken;
    // The block number when kst mining starts.
    uint256 public startBlock;
    uint256 public halvingPeriod = 2628000; // half year

    event Swap(address indexed user, uint256 indexed pid, uint256 amount);// knownsec 事件记录
    event Withdraw(address indexed user, uint256 indexed pid, uint256 amount);
    event EmergencyWithdraw(
        address indexed user,
        uint256 indexed pid,
        uint256 amount
    );

    constructor(
        KSTToken _kst,
        IKswapFactory _factory,
        IOracle _oracle,
        address _router,
        address _targetToken,
        uint256 _kstPerBlock,
        uint256 _startBlock
    ) public {// knownsec 初始化构造函数
        kst = _kst;
        factory = _factory;
        oracle = _oracle;
        router = _router;
        targetToken = _targetToken;
        kstPerBlock = _kstPerBlock;
        startBlock = _startBlock;
    }

    function phase(uint256 blockNumber) public view returns (uint256) {// knownsec 查询周期段
        if (halvingPeriod == 0) {
            return 0;
        }
        if (blockNumber > startBlock) {
            return (blockNumber.sub(startBlock).sub(1)).div(halvingPeriod);
        }
        return 0;
    }

    function getKstPerBlock(uint256 blockNumber) public view returns (uint256) {
        uint256 _phase = phase(blockNumber);
        return kstPerBlock.div(2**_phase);
    }

    function getKstBlockReward(uint256 _lastRewardBlock)
        public
        view
        returns (uint256)// knownsec 区块奖励获取
    {
        uint256 blockReward = 0;
        uint256 lastRewardPhase = phase(_lastRewardBlock);
        uint256 currentPhase = phase(block.number);
        while (lastRewardPhase < currentPhase) {
            lastRewardPhase++;
            uint256 height = lastRewardPhase.mul(halvingPeriod).add(startBlock);
            blockReward = blockReward.add(
                (height.sub(_lastRewardBlock)).mul(getKstPerBlock(height))
            );
            _lastRewardBlock = height;
        }
        blockReward = blockReward.add(
            (block.number.sub(_lastRewardBlock)).mul(
                getKstPerBlock(block.number)
```

```
            )
        );
        return blockReward;
    }

    // Only tokens in the whitelist can mine KST
    function addWhitelist(address _addToken) public onlyOwner returns (bool) {// knownsec owner 可用 白名单添加
        require(
            _addToken != address(0),
            "TradingPool: token is the zero address"
        );// knownsec token 检查
        return EnumerableSet.add(_pairs, _addToken);
    }

    function delWhitelist(address _delToken) public onlyOwner returns (bool) {// knownsec owner 可用 白名单删除
        require(
            _delToken != address(0),
            "TradingPool: token is the zero address"
        );
        return EnumerableSet.remove(_pairs, _delToken);
    }

    function getWhitelistLength() public view returns (uint256) {// knownsec 白名单长度获取
        return EnumerableSet.length(_pairs);
    }

    function isWhitelist(address _token) public view returns (bool) {// knownsec 白名单资格查询
        return EnumerableSet.contains(_pairs, _token);
    }

    function getWhitelist(uint256 _index) public view returns (address) {// knownsec 白名单列表获取
        require(
            _index <= getWhitelistLength() - 1,
            "TradingPool: index out of bounds"
        );
        return EnumerableSet.at(_pairs, _index);
    }

    // Add a new pair to the pool. Can only be called by the owner.
    function add(
        uint256 _allocPoint,
        address _pair,
        bool _withUpdate
    ) public onlyOwner {// knownsec owner 可用 添加配对合约
        require(_pair != address(0), "_pair is the zero address");// knownsec token 检查

        require(
            !EnumerableSet.contains(_pairs, _pair),
            "_pair is already added to the pool"
        );
        // return EnumerableSet.add(_pairs, _pair);
        EnumerableSet.add(_pairs, _pair);

        if (_withUpdate) {// knownsec 需要更新
            massUpdatePools();
        }
        uint256 lastRewardBlock =
            block.number > startBlock ? block.number : startBlock;// knownsec 上一个奖励块计算
        totalAllocPoint = totalAllocPoint.add(_allocPoint);// knownsec totalAllocPoint 更新
        poolInfo.push(// knownsec 池信息增加
            PoolInfo({
                pair: _pair,
                allocPoint: _allocPoint,
                lastRewardBlock: lastRewardBlock,
                accKstPerShare: 0,
                quantity: 0,
                accQuantity: 0,
                allocKstAmount: 0,
                accKstAmount: 0
            })
        );
        pairOfPid[_pair] = getPoolLength() - 1;// knownsec pid 更新
    }

    // Update the given pool's kst allocation point. Can only be called by the owner.
    function set(
        uint256 _pid,
        uint256 _allocPoint,
        bool _withUpdate
    ) public onlyOwner {
        if (_withUpdate) {
            massUpdatePools();
        }
        totalAllocPoint = totalAllocPoint.sub(poolInfo[_pid].allocPoint).add(
            _allocPoint
```

```
        );
        poolInfo[_pid].allocPoint = _allocPoint;
    }

    // Update reward variables for all pools. Be careful of gas spending!
    function massUpdatePools() public {// knownsec 更新所有奖励池
        uint256 length = poolInfo.length;
        for (uint256 pid = 0; pid < length; ++pid) {
            updatePool(pid);
        }
    }

    // Update reward variables of the given pool to be up-to-date.
    function updatePool(uint256 _pid) public {// knownsec 根据 pid 更新池
        PoolInfo storage pool = poolInfo[_pid];
        if (block.number <= pool.lastRewardBlock) {
            return;
        }

        if (pool.quantity == 0) {
            pool.lastRewardBlock = block.number;
            return;
        }

        uint256 blockReward = getKstBlockReward(pool.lastRewardBlock);

        if (blockReward <= 0) {
            return;
        }

        uint256 kstReward =
            blockReward.mul(pool.allocPoint).div(totalAllocPoint);

        bool minRet = kst.mint(address(this), kstReward);// knownsec 奖励铸币
        if (minRet) {
            pool.accKstPerShare = pool.accKstPerShare.add(
                kstReward.mul(1e12).div(pool.quantity)
            );
            pool.allocKstAmount = pool.allocKstAmount.add(kstReward);
            pool.accKstAmount = pool.allocKstAmount.add(kstReward);
        }
        pool.lastRewardBlock = block.number;
    }

    function swap(// knownsec 换币
        address account,
        address input,
        address output,
        uint256 amount
    ) public onlyRouter returns (bool) {// knownsec 路由合约可用
        require(
            account != address(0),// knownsec 输入检查
            "TradingPool: swap account is zero address"
        );
        require(input != address(0), "TradingPool: swap input is zero address");
        require(
            output != address(0),
            "TradingPool: swap output is zero address"
        );

        if (getPoolLength() <= 0) {
            return false;
        }
        if (!isWhitelist(input) || !isWhitelist(output)) {
            return false;
        }

        address pair = KswapLibrary.pairFor(address(factory), input, output);// knownsec 获取交易对

        PoolInfo storage pool = poolInfo[pairOfPid[pair]];// knownsec 获取池对象
        // If it does not exist or the allocPoint is 0 then return
        if (pool.pair != pair || pool.allocPoint <= 0) {
            return false;
        }

        uint256 quantity = getQuantity(output, amount, targetToken);// knownsec 转换量计算
        if (quantity <= 0) {
            return false;
        }

        updatePool(pairOfPid[pair]);

        UserInfo storage user = userInfo[pairOfPid[pair]][account];// knownsec 用户对象获取
        if (user.quantity > 0) {
            uint256 pendingReward =
                user.quantity.mul(pool.accKstPerShare).div(1e12).sub(
```

```
                    user.rewardDebt
                );// knownsec  用户奖励计算
            if (pendingReward > 0) {
                user.pendingReward = pendingReward;
            }
        }

        if (quantity > 0) {// knownsec swap
            pool.quantity = pool.quantity.add(quantity);
            pool.accQuantity = pool.accQuantity.add(quantity);
            totalQuantity = totalQuantity.add(quantity);
            user.quantity = user.quantity.add(quantity);
            user.accQuantity = user.accQuantity.add(quantity);
        }
        user.rewardDebt = user.quantity.mul(pool.accKstPerShare).div(1e12);
        emit Swap(account, pairOfPid[pair], quantity);// knownsec  时间记录

        return true;
    }

    function pendingKst(uint256 _pid, address _user)
        public
        view
        returns (uint256)
    {// knownsec  还未转移的 kst 计算
        require(
            _pid <= poolInfo.length - 1,
            "TradingPool: Can not find this pool"
        );

        PoolInfo storage pool = poolInfo[_pid];
        UserInfo storage user = userInfo[_pid][_user];
        uint256 accKstPerShare = pool.accKstPerShare;

        if (user.quantity > 0) {
            if (block.number > pool.lastRewardBlock) {
                uint256 blockReward = getKstBlockReward(pool.lastRewardBlock);
                uint256 kstReward =
                    blockReward.mul(pool.allocPoint).div(totalAllocPoint);
                accKstPerShare = accKstPerShare.add(
                    kstReward.mul(1e12).div(pool.quantity)
                );
                return
                    user.pendingReward.add(
                        user.quantity.mul(accKstPerShare).div(1e12).sub(
                            user.rewardDebt
                        )
                    );
            }
            if (block.number == pool.lastRewardBlock) {
                return
                    user.pendingReward.add(
                        user.quantity.mul(accKstPerShare).div(1e12).sub(
                            user.rewardDebt
                        )
                    );
            }
        }
        return 0;
    }

    function withdraw(uint256 _pid) public {// knownsec  账户回撤
        PoolInfo storage pool = poolInfo[_pid];
        UserInfo storage user = userInfo[_pid][msg.sender];

        updatePool(_pid);
        uint256 pendingAmount = pendingKst(_pid, msg.sender);

        if (pendingAmount > 0) {
            safeKstTransfer(msg.sender, pendingAmount);// knownsec  奖励发送
            pool.quantity = pool.quantity.sub(user.quantity);
            pool.allocKstAmount = pool.allocKstAmount.sub(pendingAmount);
            user.accKstAmount = user.accKstAmount.add(pendingAmount);
            user.quantity = 0;
            user.rewardDebt = 0;
            user.accKstAmount = user.accKstAmount.add(pendingAmount);
        }
        emit Withdraw(msg.sender, _pid, pendingAmount);
    }

    function harvestAll() public {// knownsec  全部池进行利息提取
        for (uint256 i = 0; i < poolInfo.length; i++) {
            withdraw(i);
        }
    }

    function emergencyWithdraw(uint256 _pid) public {// knownsec  指定池不要利息紧急回撤
```

```
        PoolInfo storage pool = poolInfo[_pid];
        UserInfo storage user = userInfo[_pid][msg.sender];
        safeKstTransfer(msg.sender, user.pendingReward);

        pool.quantity = pool.quantity.sub(user.quantity);
        pool.allocKstAmount = pool.allocKstAmount.sub(user.pendingReward);
        user.accKstAmount = user.accKstAmount.add(user.pendingReward);
        user.quantity = 0;
        user.rewardDebt = 0;
        user.accKstAmount = user.accKstAmount.add(user.pendingReward);
        emit EmergencyWithdraw(msg.sender, _pid, user.quantity);
    }

    // Safe kst transfer function, just in case if rounding error causes pool to not have enough ksts.
    function safeKstTransfer(address _to, uint256 _amount) internal {// knownsec kst 转账
        uint256 kstBalance = kst.balanceOf(address(this));
        if (_amount > kstBalance) {
            kst.transfer(_to, kstBalance);
        } else {
            kst.transfer(_to, _amount);
        }
    }

    // Set the number of kst produced by each block
    function setKstPerBlock(uint256 _newPerBlock) public onlyOwner {// knownsec Owner 可用 设置块奖励数量
        massUpdatePools();
        kstPerBlock = _newPerBlock;
    }

    function setHalvingPeriod(uint256 _block) public onlyOwner {// knownsec Owner 可用 设置 halvingPeriod
        halvingPeriod = _block;
    }

    function setRouter(address newRouter) public onlyOwner {// knownsec Owner 可用 设置路由合约
        require(
            newRouter != address(0),
            "TradingPool: new router is the zero address"
        );
        router = newRouter;
    }

    function setOracle(IOracle _oracle) public onlyOwner {// knownsec Owner 可用 设置预言机地址
        require(
            address(_oracle) != address(0),
            "TradingPool: new oracle is the zero address"
        );
        oracle = _oracle;
    }

    function getPairsLength() public view returns (uint256) {// knownsec 获取 配对合约长度
        return EnumerableSet.length(_pairs);
    }

    function getPairs(uint256 _index) public view returns (address) {// knownsec 获取指定下标配对合约
        require(
            _index <= getPairsLength() - 1,
            "LiquidityPool: index out of bounds"
        );
        return EnumerableSet.at(_pairs, _index);
    }

    function getPoolLength() public view returns (uint256) {// knownsec 获取池长度
        return poolInfo.length;
    }

    function getAllPools() external view returns (PoolInfo[] memory) {// knownsec 获取池信息列表
        return poolInfo;
    }

    function getPoolView(uint256 pid) public view returns (PoolView memory) {// knownsec 获取指定 pid 池信息
        require(pid < poolInfo.length, "pid out of range");
        PoolInfo memory pool = poolInfo[pid];
        address pair = address(pool.pair);
        ERC20 token0 = ERC20(IKswapPair(pair).token0());
        ERC20 token1 = ERC20(IKswapPair(pair).token1());
        string memory symbol0 = token0.symbol();
        string memory name0 = token0.name();
        uint8 decimals0 = token0.decimals();
        string memory symbol1 = token1.symbol();
        string memory name1 = token1.name();
        uint8 decimals1 = token1.decimals();
        uint256 rewardsPerBlock =
            pool.allocPoint.mul(kstPerBlock).div(totalAllocPoint);
        return
            PoolView({
```

```
                pid: pid,
                pair: pair,
                allocPoint: pool.allocPoint,
                lastRewardBlock: pool.lastRewardBlock,
                accKstPerShare: pool.accKstPerShare,
                rewardsPerBlock: rewardsPerBlock,
                allocKstAmount: pool.allocKstAmount,
                accKstAmount: pool.accKstAmount,
                quantity: pool.quantity,
                accQuantity: pool.accQuantity,
                token0: address(token0),
                symbol0: symbol0,
                name0: name0,
                decimals0: decimals0,
                token1: address(token1),
                symbol1: symbol1,
                name1: name1,
                decimals1: decimals1
            });
    }

    function getPoolViewByAddress(address pair)
        public
        view
        returns (PoolView memory)
    {
        uint256 pid = pairOfPid[pair];
        return getPoolView(pid);
    }

    function getAllPoolViews() external view returns (PoolView[] memory) {
        PoolView[] memory views = new PoolView[](poolInfo.length);
        for (uint256 i = 0; i < poolInfo.length; i++) {
            views[i] = getPoolView(i);
        }
        return views;
    }

    function getUserView(address pair, address account)
        public
        view
        returns (UserView memory)
    {
        uint256 pid = pairOfPid[pair];
        UserInfo memory user = userInfo[pid][account];
        uint256 unclaimedRewards = pendingKst(pid, account);
        return
            UserView({
                quantity: user.quantity,
                accQuantity: user.accQuantity,
                unclaimedRewards: unclaimedRewards,
                accKstAmount: user.accKstAmount
            });
    }

    function getUserViews(address account)
        external
        view
        returns (UserView[] memory)
    {
        address pair;
        UserView[] memory views = new UserView[](poolInfo.length);
        for (uint256 i = 0; i < poolInfo.length; i++) {
            pair = address(poolInfo[i].pair);
            views[i] = getUserView(pair, account);
        }
        return views;
    }

    modifier onlyRouter() {
        require(msg.sender == router, "TradingPool: caller is not the router");
        _;
    }

    function getQuantity(
        address outputToken,
        uint256 outputAmount,
        address anchorToken
    ) public view returns (uint256) {
        uint256 quantity = 0;
        if (outputToken == anchorToken) {
            quantity = outputAmount;
        } else if (
            IKswapFactory(factory).getPair(outputToken, anchorToken) !=
            address(0)
        ) {
            quantity = IOracle(oracle).consult(
```

```
                    outputToken,
                    outputAmount,
                    anchorToken
                );
            } else {
                uint256 length = getWhitelistLength();
                for (uint256 index = 0; index < length; index++) {
                    address intermediate = getWhitelist(index);
                    if (
                        IKswapFactory(factory).getPair(outputToken, intermediate) !=
                        address(0) &&
                        IKswapFactory(factory).getPair(intermediate, anchorToken) !=
                        address(0)
                    ) {
                        uint256 interQuantity =
                            IOracle(oracle).consult(
                                outputToken,
                                outputAmount,
                                intermediate
                            );
                        quantity = IOracle(oracle).consult(
                            intermediate,
                            interQuantity,
                            anchorToken
                        );
                        break;
                    }
                }
            }
            return quantity;
        }
}
```

KswapERC20.sol

```
// SPDX-License-Identifier: MIT

pragma solidity =0.6.12;// knownsec  指定编译器版本

import "../libraries/SafeMath.sol";

contract KswapERC20 {
    using SafeMathKswap for uint256;

    string public constant name = "KSwap LP Token";
    string public constant symbol = "KLP";
    uint8 public constant decimals = 18;
    uint256 public totalSupply;
    mapping(address => uint256) public balanceOf;// knownse  账户余额
    mapping(address => mapping(address => uint256)) public allowance;// knownsec  审批额度

    bytes32 public DOMAIN_SEPARATOR;
    // keccak256("Permit(address owner,address spender,uint256 value,uint256 nonce,uint256 deadline)");
    bytes32 public constant PERMIT_TYPEHASH =
        0x6e71edae12b1b97f4d1f60370fef10105fa2faae0126114a169c64845d6126c9;
    mapping(address => uint256) public nonces;

    event Approval(
        address indexed owner,
        address indexed spender,
        uint256 value
    );
    event Transfer(address indexed from, address indexed to, uint256 value);

    constructor() public {
        uint256 chainId;
        assembly {
            chainId := chainid()// knownsec  利用汇编获取当前链 id
        }
        DOMAIN_SEPARATOR = keccak256(
            abi.encode(
                keccak256(
                    "EIP712Domain(string name,string version,uint256 chainId,address verifyingContract)"
                ),
                keccak256(bytes(name)),
                keccak256(bytes("1")),
                chainId,
                address(this)
            )
        );
    }

    function _mint(address to, uint256 value) internal {// knownsec  铸币函数  内部使用
        totalSupply = totalSupply.add(value);
        balanceOf[to] = balanceOf[to].add(value);
        emit Transfer(address(0), to, value);
```

```
    }

    function _burn(address from, uint256 value) internal {// knownsec 烧币函数 内部使用
        balanceOf[from] = balanceOf[from].sub(value);
        totalSupply = totalSupply.sub(value);
        emit Transfer(from, address(0), value);
    }

    function _approve(
        address owner,
        address spender,
        uint256 value
    ) private {// knownsec 授权函数 私有
        allowance[owner][spender] = value;
        emit Approval(owner, spender, value);
    }

    function _transfer(
        address from,
        address to,
        uint256 value
    ) private {// knownsec 转账 私有
        balanceOf[from] = balanceOf[from].sub(value);
        balanceOf[to] = balanceOf[to].add(value);
        emit Transfer(from, to, value);
    }

    function approve(address spender, uint256 value) external returns (bool) {// knownsec 外部调用 授权
        _approve(msg.sender, spender, value);
        return true;
    }

    function transfer(address to, uint256 value) external returns (bool) {// knownsec 外部调用 转账
        _transfer(msg.sender, to, value);
        return true;
    }

    function transferFrom(
        address from,
        address to,
        uint256 value
    ) external returns (bool) {// knownsec 外部调用 利用授权转账
        if (allowance[from][msg.sender] != uint256(-1)) {
            allowance[from][msg.sender] = allowance[from][msg.sender].sub(
                value
            );
        }
        _transfer(from, to, value);
        return true;
    }

    function permit(
        address owner,
        address spender,
        uint256 value,
        uint256 deadline,
        uint8 v,
        bytes32 r,
        bytes32 s
    ) external {
        require(deadline >= block.timestamp, "Kswap: EXPIRED");
        bytes32 digest =
            keccak256(
                abi.encodePacked(
                    "\x19\x01",
                    DOMAIN_SEPARATOR,
                    keccak256(
                        abi.encode(
                            PERMIT_TYPEHASH,
                            owner,
                            spender,
                            value,
                            nonces[owner]++,
                            deadline
                        )
                    )
                )
            );
        address recoveredAddress = ecrecover(digest, v, r, s);
        require(
            recoveredAddress != address(0) && recoveredAddress == owner,
            "Kswap: INVALID_SIGNATURE"
        );
        _approve(owner, spender, value);
    }
}
```

KswapFactory.sol

```
// SPDX-License-Identifier: MIT

pragma solidity =0.6.12;// knownsec 指定编译器版本

import "../interfaces/IKswapFactory.sol";
import "../libraries/SafeMath.sol";
import "./KswapPair.sol";

contract KswapFactory is IKswapFactory {// knownsec 工厂合约
    using SafeMathKswap for uint256;

    address public override feeTo;
    address public override feeToSetter;
    uint256 public override feeToRate;

    mapping(address => mapping(address => address)) public override getPair;
    address[] public override allPairs;

    event PairCreated(
        address indexed token0,
        address indexed
        ,
        address pair,
        uint256
    );

    constructor(address _feeToSetter) public {
        feeToSetter = _feeToSetter;// knownsec 初始化设置手续费地址
    }

    function allPairsLength() external view override returns (uint256) {
        return allPairs.length;
    }

    function pairCodeHash() external pure returns (bytes32) {
        return keccak256(type(KswapPair).creationCode);
    }

    function createPair(address tokenA, address tokenB)
        external
        override
        returns (address pair)// knownsec 创建交易对
    {
        require(tokenA != tokenB, "Kswap: IDENTICAL_ADDRESSES");
        (address token0, address token1) =
            tokenA < tokenB ? (tokenA, tokenB) : (tokenB, tokenA);
        require(token0 != address(0), "Kswap: ZERO_ADDRESS");
        require(getPair[token0][token1] == address(0), "Kswap: PAIR_EXISTS"); // single check is sufficient
        bytes memory bytecode = type(KswapPair).creationCode;
        bytes32 salt = keccak256(abi.encodePacked(token0, token1));
        assembly {
            pair := create2(0, add(bytecode, 32), mload(bytecode), salt)
        }
        KswapPair(pair).initialize(token0, token1);
        getPair[token0][token1] = pair;
        getPair[token1][token0] = pair; // populate mapping in the reverse direction
        allPairs.push(pair);
        emit PairCreated(token0, token1, pair, allPairs.length);
    }

    function setFeeTo(address _feeTo) external override {// knownsec 设置 FeeTo 地址、feeToSetter 可用 外部
        require(msg.sender == feeToSetter, "Kswap: FORBIDDEN");
        feeTo = _feeTo;
    }

    function setFeeToSetter(address _feeToSetter) external override {// knownsec 转移 feeToSetter 权限、feeToSetter 可用 外部
        require(msg.sender == feeToSetter, "Kswap: FORBIDDEN");
        feeToSetter = _feeToSetter;
    }

    function setFeeToRate(uint256 _rate) external override {// knownsec 设置 FeeToRate、feeToSetter 可用 外部
        require(msg.sender == feeToSetter, "MdexSwapFactory: FORBIDDEN");
        require(_rate > 0, "MdexSwapFactory: FEE_TO_RATE_OVERFLOW");
        feeToRate = _rate.sub(1);
    }
}
```

KswapPair.sol

```
// SPDX-License-Identifier: MIT
```

```
pragma solidity =0.6.12;

import "./KswapERC20.sol";
import "../libraries/Math.sol";
import "../libraries/UQ112x112.sol";
import "../interfaces/IERC20.sol";
import "../interfaces/IKswapFactory.sol";
import "../interfaces/IKswapCallee.sol";

contract KswapPair is KswapERC20 {// knownsec  配对合约
    using SafeMathKswap for uint256;
    using UQ112x112 for uint224;

    uint256 public constant MINIMUM_LIQUIDITY = 10**3;
    bytes4 private constant SELECTOR =
        bytes4(keccak256(bytes("transfer(address,uint256)")));

    address public factory;
    address public token0;
    address public token1;

    uint112 private reserve0; // uses single storage slot, accessible via getReserves
    uint112 private reserve1; // uses single storage slot, accessible via getReserves
    uint32 private blockTimestampLast; // uses single storage slot, accessible via getReserves

    uint256 public price0CumulativeLast;
    uint256 public price1CumulativeLast;
    uint256 public kLast; // reserve0 * reserve1, as of immediately after the most recent liquidity event

    uint256 private unlocked = 1;
    modifier lock() {
        require(unlocked == 1, "Kswap: LOCKED");
        unlocked = 0;
        _;
        unlocked = 1;
    }

    function getReserves()
        public
        view
        returns (
            uint112 _reserve0,
            uint112 _reserve1,
            uint32 _blockTimestampLast
        )
    {
        _reserve0 = reserve0;
        _reserve1 = reserve1;
        _blockTimestampLast = blockTimestampLast;
    }

    function _safeTransfer(
        address token,
        address to,
        uint256 value
    ) private {
        (bool success, bytes memory data) =
            token.call(abi.encodeWithSelector(SELECTOR, to, value));
        require(
            success && (data.length == 0 || abi.decode(data, (bool))),
            "Kswap: TRANSFER_FAILED"
        );
    }

    event Mint(address indexed sender, uint256 amount0, uint256 amount1);
    event Burn(
        address indexed sender,
        uint256 amount0,
        uint256 amount1,
        address indexed to
    );
    event Swap(
        address indexed sender,
        uint256 amount0In,
        uint256 amount1In,
        uint256 amount0Out,
        uint256 amount1Out,
        address indexed to
    );
    event Sync(uint112 reserve0, uint112 reserve1);

    constructor() public {
        factory = msg.sender;
    }

    // called once by the factory at time of deployment
    function initialize(address _token0, address _token1) external {
```

```
        require(msg.sender == factory, "Kswap: FORBIDDEN"); // sufficient check
        token0 = _token0;
        token1 = _token1;
    }

    // update reserves and, on the first call per block, price accumulators
    function _update(
        uint256 balance0,
        uint256 balance1,
        uint112 _reserve0,
        uint112 _reserve1
    ) private {
        require(
            balance0 <= uint112(-1) && balance1 <= uint112(-1),
            "Kswap: OVERFLOW"
        );
        uint32 blockTimestamp = uint32(block.timestamp % 2**32);
        uint32 timeElapsed = blockTimestamp - blockTimestampLast; // overflow is desired
        if (timeElapsed > 0 && _reserve0 != 0 && _reserve1 != 0) {
            // * never overflows, and + overflow is desired
            price0CumulativeLast +=
                uint256(UQ112x112.encode(_reserve1).uqdiv(_reserve0)) *
                timeElapsed;
            price1CumulativeLast +=
                uint256(UQ112x112.encode(_reserve0).uqdiv(_reserve1)) *
                timeElapsed;
        }
        reserve0 = uint112(balance0);
        reserve1 = uint112(balance1);
        blockTimestampLast = blockTimestamp;
        emit Sync(reserve0, reserve1);
    }

    // if fee is on, mint liquidity equivalent to 1/6th of the growth in sqrt(k)
    function _mintFee(uint112 _reserve0, uint112 _reserve1)
        private
        returns (bool feeOn)
    {
        address feeTo = IKswapFactory(factory).feeTo();
        feeOn = feeTo != address(0);
        uint256 _kLast = kLast; // gas savings
        if (feeOn) {
            if (_kLast != 0) {
                uint256 rootK = Math.sqrt(uint256(_reserve0).mul(_reserve1));
                uint256 rootKLast = Math.sqrt(_kLast);
                if (rootK > rootKLast) {
                    uint256 numerator = totalSupply.mul(rootK.sub(rootKLast));
                    uint256 denominator =
                        rootK.mul(IKswapFactory(factory).feeToRate()).add(
                            rootKLast
                        );
                    uint256 liquidity = numerator / denominator;
                    if (liquidity > 0) _mint(feeTo, liquidity);
                }
            }
        } else if (_kLast != 0) {
            kLast = 0;
        }
    }

    // this low-level function should be called from a contract which performs important safety checks
    function mint(address to) external lock returns (uint256 liquidity) {
        (uint112 _reserve0, uint112 _reserve1, ) = getReserves(); // gas savings
        uint256 balance0 = IERC20Kswap(token0).balanceOf(address(this));
        uint256 balance1 = IERC20Kswap(token1).balanceOf(address(this));
        uint256 amount0 = balance0.sub(_reserve0);
        uint256 amount1 = balance1.sub(_reserve1);

        bool feeOn = _mintFee(_reserve0, _reserve1);
        uint256 _totalSupply = totalSupply; // gas savings, must be defined here since totalSupply can update in
_mintFee
        if (_totalSupply == 0) {
            liquidity = Math.sqrt(amount0.mul(amount1)).sub(MINIMUM_LIQUIDITY);
            _mint(address(0), MINIMUM_LIQUIDITY); // permanently lock the first MINIMUM_LIQUIDITY
tokens
        } else {
            liquidity = Math.min(
                amount0.mul(_totalSupply) / _reserve0,
                amount1.mul(_totalSupply) / _reserve1
            );
        }
        require(liquidity > 0, "Kswap: INSUFFICIENT_LIQUIDITY_MINTED");
        _mint(to, liquidity);

        _update(balance0, balance1, _reserve0, _reserve1);
        if (feeOn) kLast = uint256(reserve0).mul(reserve1); // reserve0 and reserve1 are up-to-date
        emit Mint(msg.sender, amount0, amount1);
```

```
    }

    // this low-level function should be called from a contract which performs important safety checks
    function burn(address to)
        external
        lock
        returns (uint256 amount0, uint256 amount1)
    {
        (uint112 _reserve0, uint112 _reserve1, ) = getReserves(); // gas savings
        address _token0 = token0; // gas savings
        address _token1 = token1; // gas savings
        uint256 balance0 = IERC20Kswap(_token0).balanceOf(address(this));
        uint256 balance1 = IERC20Kswap(_token1).balanceOf(address(this));
        uint256 liquidity = balanceOf[address(this)];

        bool feeOn = _mintFee(_reserve0, _reserve1);
        uint256 _totalSupply = totalSupply; // gas savings, must be defined here since totalSupply can update in
_mintFee
        amount0 = liquidity.mul(balance0) / _totalSupply; // using balances ensures pro-rata distribution
        amount1 = liquidity.mul(balance1) / _totalSupply; // using balances ensures pro-rata distribution
        require(
            amount0 > 0 && amount1 > 0,
            "Kswap: INSUFFICIENT_LIQUIDITY_BURNED"
        );
        _burn(address(this), liquidity);
        _safeTransfer(_token0, to, amount0);
        _safeTransfer(_token1, to, amount1);
        balance0 = IERC20Kswap(_token0).balanceOf(address(this));
        balance1 = IERC20Kswap(_token1).balanceOf(address(this));

        _update(balance0, balance1, _reserve0, _reserve1);
        if (feeOn) kLast = uint256(reserve0).mul(reserve1); // reserve0 and reserve1 are up-to-date
        emit Burn(msg.sender, amount0, amount1, to);
    }

    // this low-level function should be called from a contract which performs important safety checks
    function swap(
        uint256 amount0Out,
        uint256 amount1Out,
        address to,
        bytes calldata data
    ) external lock {
        require(
            amount0Out > 0 || amount1Out > 0,
            "Kswap: INSUFFICIENT_OUTPUT_AMOUNT"
        );
        (uint112 _reserve0, uint112 _reserve1, ) = getReserves(); // gas savings
        require(
            amount0Out < _reserve0 && amount1Out < _reserve1,
            "Kswap: INSUFFICIENT_LIQUIDITY"
        );

        uint256 balance0;
        uint256 balance1;
        {
            // scope for _token{0,1}, avoids stack too deep errors
            address _token0 = token0;
            address _token1 = token1;
            require(to != _token0 && to != _token1, "Kswap: INVALID_TO");
            if (amount0Out > 0) _safeTransfer(_token0, to, amount0Out); // optimistically transfer tokens
            if (amount1Out > 0) _safeTransfer(_token1, to, amount1Out); // optimistically transfer tokens
            if (data.length > 0)
                IKswapCallee(to).KswapCall(
                    msg.sender,
                    amount0Out,
                    amount1Out,
                    data
                );
            balance0 = IERC20Kswap(_token0).balanceOf(address(this));
            balance1 = IERC20Kswap(_token1).balanceOf(address(this));
        }
        uint256 amount0In =
            balance0 > _reserve0 - amount0Out
                ? balance0 - (_reserve0 - amount0Out)
                : 0;
        uint256 amount1In =
            balance1 > _reserve1 - amount1Out
                ? balance1 - (_reserve1 - amount1Out)
                : 0;
        require(
            amount0In > 0 || amount1In > 0,
            "Kswap: INSUFFICIENT_INPUT_AMOUNT"
        );
        {
            // scope for reserve{0,1}Adjusted, avoids stack too deep errors
            uint256 balance0Adjusted = balance0.mul(1000).sub(amount0In.mul(3));
            uint256 balance1Adjusted = balance1.mul(1000).sub(amount1In.mul(3));
```

```
                require(
                    balance0Adjusted.mul(balance1Adjusted) >=
                        uint256(_reserve0).mul(_reserve1).mul(1000**2),
                    "Kswap: K"
                );
            }

            _update(balance0, balance1, _reserve0, _reserve1);
            emit Swap(msg.sender, amount0In, amount1In, amount0Out, amount1Out, to);
        }

        // force balances to match reserves
        function skim(address to) external lock {
            address _token0 = token0; // gas savings
            address _token1 = token1; // gas savings
            _safeTransfer(
                _token0,
                to,
                IERC20Kswap(_token0).balanceOf(address(this)).sub(reserve0)
            );
            _safeTransfer(
                _token1,
                to,
                IERC20Kswap(_token1).balanceOf(address(this)).sub(reserve1)
            );
        }

        // force reserves to match balances
        function sync() external lock {
            _update(
                IERC20Kswap(token0).balanceOf(address(this)),
                IERC20Kswap(token1).balanceOf(address(this)),
                reserve0,
                reserve1
            );
        }

        function price(address token, uint256 baseDecimal)
            public
            view
            returns (uint256)
        {
            if (
                (token0 != token && token1 != token) ||
                0 == reserve0 ||
                0 == reserve1
            ) {
                return 0;
            }
            if (token0 == token) {
                return uint256(reserve1).mul(baseDecimal).div(uint256(reserve0));
            } else {
                return uint256(reserve0).mul(baseDecimal).div(uint256(reserve1));
            }
        }
}
```

KswapRouter.sol

```
// SPDX-License-Identifier: MIT

pragma solidity =0.6.12;

import "@openzeppelin/contracts/access/Ownable.sol";
import "../libraries/KswapLibrary.sol";
import "../libraries/SafeMath.sol";
import "../libraries/TransferHelper.sol";
import "../interfaces/IKswapRouter02.sol";
import "../interfaces/IKswapFactory.sol";
import "../interfaces/IERC20.sol";
import "../interfaces/IWOKT.sol";

interface ITradingPool {
    function swap(
        address account,
        address input,
        address output,
        uint256 amount
    ) external returns (bool);
}

contract KswapRouter is IKswapRouter02, Ownable {// knownsec  路由合约
    using SafeMathKswap for uint256;

    address public immutable override factory;
    address public immutable override WOKT;
```

```
    address public override tradingPool;

    modifier ensure(uint256 deadline) {
        require(deadline >= block.timestamp, "KswapRouter: EXPIRED");
        _;
    }

    constructor(address _factory, address _WOKT) public {
        factory = _factory;
        WOKT = _WOKT;
    }

    receive() external payable {
        assert(msg.sender == WOKT); // only accept OKT via fallback from the WOKT contract
    }

    function setTradingPool(address _tradingPool) public onlyOwner {
        tradingPool = _tradingPool;
    }

    // **** ADD LIQUIDITY ****
    function _addLiquidity(
        address tokenA,
        address tokenB,
        uint256 amountADesired,
        uint256 amountBDesired,
        uint256 amountAMin,
        uint256 amountBMin
    ) internal virtual returns (uint256 amountA, uint256 amountB) {
        // create the pair if it doesn't exist yet
        if (IKswapFactory(factory).getPair(tokenA, tokenB) == address(0)) {
            IKswapFactory(factory).createPair(tokenA, tokenB);
        }
        (uint256 reserveA, uint256 reserveB) =
            KswapLibrary.getReserves(factory, tokenA, tokenB);
        if (reserveA == 0 && reserveB == 0) {
            (amountA, amountB) = (amountADesired, amountBDesired);
        } else {
            uint256 amountBOptimal =
                KswapLibrary.quote(amountADesired, reserveA, reserveB);
            if (amountBOptimal <= amountBDesired) {
                require(
                    amountBOptimal >= amountBMin,
                    "KswapRouter: INSUFFICIENT_B_AMOUNT"
                );
                (amountA, amountB) = (amountADesired, amountBOptimal);
            } else {
                uint256 amountAOptimal =
                    KswapLibrary.quote(amountBDesired, reserveB, reserveA);
                assert(amountAOptimal <= amountADesired);
                require(
                    amountAOptimal >= amountAMin,
                    "KswapRouter: INSUFFICIENT_A_AMOUNT"
                );
                (amountA, amountB) = (amountAOptimal, amountBDesired);
            }
        }
    }

    function addLiquidity(
        address tokenA,
        address tokenB,
        uint256 amountADesired,
        uint256 amountBDesired,
        uint256 amountAMin,
        uint256 amountBMin,
        address to,
        uint256 deadline
    )
        external
        virtual
        override
        ensure(deadline)
        returns (
            uint256 amountA,
            uint256 amountB,
            uint256 liquidity
        )
    {
        (amountA, amountB) = _addLiquidity(
            tokenA,
            tokenB,
            amountADesired,
            amountBDesired,
            amountAMin,
            amountBMin
        );
```

```
        address pair = KswapLibrary.pairFor(factory, tokenA, tokenB);
        TransferHelper.safeTransferFrom(tokenA, msg.sender, pair, amountA);
        TransferHelper.safeTransferFrom(tokenB, msg.sender, pair, amountB);
        liquidity = IKswapPair(pair).mint(to);
    }

    function addLiquidityETH(
        address token,
        uint256 amountTokenDesired,
        uint256 amountTokenMin,
        uint256 amountETHMin,
        address to,
        uint256 deadline
    )
        external
        payable
        virtual
        override
        ensure(deadline)
        returns (
            uint256 amountToken,
            uint256 amountETH,
            uint256 liquidity
        )
    {
        (amountToken, amountETH) = _addLiquidity(
            token,
            WOKT,
            amountTokenDesired,
            msg.value,
            amountTokenMin,
            amountETHMin
        );
        address pair = KswapLibrary.pairFor(factory, token, WOKT);
        TransferHelper.safeTransferFrom(token, msg.sender, pair, amountToken);
        IWOKT(WOKT).deposit{value: amountETH}();
        assert(IWOKT(WOKT).transfer(pair, amountETH));
        liquidity = IKswapPair(pair).mint(to);
        // refund dust eth, if any
        if (msg.value > amountETH)
            TransferHelper.safeTransferETH(msg.sender, msg.value - amountETH);
    }

    // **** REMOVE LIQUIDITY ****
    function removeLiquidity(
        address tokenA,
        address tokenB,
        uint256 liquidity,
        uint256 amountAMin,
        uint256 amountBMin,
        address to,
        uint256 deadline
    )
        public
        virtual
        override
        ensure(deadline)
        returns (uint256 amountA, uint256 amountB)
    {
        address pair = KswapLibrary.pairFor(factory, tokenA, tokenB);
        IKswapPair(pair).transferFrom(msg.sender, pair, liquidity); // send liquidity to pair
        (uint256 amount0, uint256 amount1) = IKswapPair(pair).burn(to);
        (address token0, ) = KswapLibrary.sortTokens(tokenA, tokenB);
        (amountA, amountB) = tokenA == token0
            ? (amount0, amount1)
            : (amount1, amount0);
        require(amountA >= amountAMin, "KswapRouter: INSUFFICIENT_A_AMOUNT");
        require(amountB >= amountBMin, "KswapRouter: INSUFFICIENT_B_AMOUNT");
    }

    function removeLiquidityETH(
        address token,
        uint256 liquidity,
        uint256 amountTokenMin,
        uint256 amountETHMin,
        address to,
        uint256 deadline
    )
        public
        virtual
        override
        ensure(deadline)
        returns (uint256 amountToken, uint256 amountETH)
    {
        (amountToken, amountETH) = removeLiquidity(
            token,
            WOKT,
```

```
            liquidity,
            amountTokenMin,
            amountETHMin,
            address(this),
            deadline
        );
        TransferHelper.safeTransfer(token, to, amountToken);
        IWOKT(WOKT).withdraw(amountETH);
        TransferHelper.safeTransferETH(to, amountETH);
    }

    function removeLiquidityWithPermit(
        address tokenA,
        address tokenB,
        uint256 liquidity,
        uint256 amountAMin,
        uint256 amountBMin,
        address to,
        uint256 deadline,
        bool approveMax,
        uint8 v,
        bytes32 r,
        bytes32 s
    ) external virtual override returns (uint256 amountA, uint256 amountB) {
        address pair = KswapLibrary.pairFor(factory, tokenA, tokenB);
        uint256 value = approveMax ? uint256(-1) : liquidity;
        IKswapPair(pair).permit(
            msg.sender,
            address(this),
            value,
            deadline,
            v,
            r,
            s
        );
        (amountA, amountB) = removeLiquidity(
            tokenA,
            tokenB,
            liquidity,
            amountAMin,
            amountBMin,
            to,
            deadline
        );
    }

    function removeLiquidityETHWithPermit(
        address token,
        uint256 liquidity,
        uint256 amountTokenMin,
        uint256 amountETHMin,
        address to,
        uint256 deadline,
        bool approveMax,
        uint8 v,
        bytes32 r,
        bytes32 s
    )
        external
        virtual
        override
        returns (uint256 amountToken, uint256 amountETH)
    {
        address pair = KswapLibrary.pairFor(factory, token, WOKT);
        uint256 value = approveMax ? uint256(-1) : liquidity;
        IKswapPair(pair).permit(
            msg.sender,
            address(this),
            value,
            deadline,
            v,
            r,
            s
        );
        (amountToken, amountETH) = removeLiquidityETH(
            token,
            liquidity,
            amountTokenMin,
            amountETHMin,
            to,
            deadline
        );
    }

    // **** REMOVE LIQUIDITY (supporting fee-on-transfer tokens) ****
    function removeLiquidityETHSupportingFeeOnTransferTokens(
        address token,
```

```
        uint256 liquidity,
        uint256 amountTokenMin,
        uint256 amountETHMin,
        address to,
        uint256 deadline
    ) public virtual override ensure(deadline) returns (uint256 amountETH) {
        (, amountETH) = removeLiquidity(
            token,
            WOKT,
            liquidity,
            amountTokenMin,
            amountETHMin,
            address(this),
            deadline
        );
        TransferHelper.safeTransfer(
            token,
            to,
            IERC20Kswap(token).balanceOf(address(this))
        );
        IWOKT(WOKT).withdraw(amountETH);
        TransferHelper.safeTransferETH(to, amountETH);
    }

    function removeLiquidityETHWithPermitSupportingFeeOnTransferTokens(
        address token,
        uint256 liquidity,
        uint256 amountTokenMin,
        uint256 amountETHMin,
        address to,
        uint256 deadline,
        bool approveMax,
        uint8 v,
        bytes32 r,
        bytes32 s
    ) external virtual override returns (uint256 amountETH) {
        address pair = KswapLibrary.pairFor(factory, token, WOKT);
        uint256 value = approveMax ? uint256(-1) : liquidity;
        IKswapPair(pair).permit(
            msg.sender,
            address(this),
            value,
            deadline,
            v,
            r,
            s
        );
        amountETH = removeLiquidityETHSupportingFeeOnTransferTokens(
            token,
            liquidity,
            amountTokenMin,
            amountETHMin,
            to,
            deadline
        );
    }

    // **** SWAP ****
    // requires the initial amount to have already been sent to the first pair
    function _swap(
        uint256[] memory amounts,
        address[] memory path,
        address _to
    ) internal virtual {
        for (uint256 i; i < path.length - 1; i++) {
            (address input, address output) = (path[i], path[i + 1]);
            (address token0, ) = KswapLibrary.sortTokens(input, output);
            uint256 amountOut = amounts[i + 1];
            if (tradingPool != address(0)) {
                ITradingPool(tradingPool).swap(
                    msg.sender,
                    input,
                    output,
                    amountOut
                );
            }
            (uint256 amount0Out, uint256 amount1Out) =
                input == token0
                    ? (uint256(0), amountOut)
                    : (amountOut, uint256(0));
            address to =
                i < path.length - 2
                    ? KswapLibrary.pairFor(factory, output, path[i + 2])
                    : _to;
            IKswapPair(KswapLibrary.pairFor(factory, input, output)).swap(
                amount0Out,
                amount1Out,
```

```
                to,
                new bytes(0)
            );
        }
    }

    function swapExactTokensForTokens(
        uint256 amountIn,
        uint256 amountOutMin,
        address[] calldata path,
        address to,
        uint256 deadline
    )
        external
        virtual
        override
        ensure(deadline)
        returns (uint256[] memory amounts)
    {
        amounts = KswapLibrary.getAmountsOut(factory, amountIn, path);
        require(
            amounts[amounts.length - 1] >= amountOutMin,
            "KswapRouter: INSUFFICIENT_OUTPUT_AMOUNT"
        );
        TransferHelper.safeTransferFrom(
            path[0],
            msg.sender,
            KswapLibrary.pairFor(factory, path[0], path[1]),
            amounts[0]
        );
        _swap(amounts, path, to);
    }

    function swapTokensForExactTokens(
        uint256 amountOut,
        uint256 amountInMax,
        address[] calldata path,
        address to,
        uint256 deadline
    )
        external
        virtual
        override
        ensure(deadline)
        returns (uint256[] memory amounts)
    {
        amounts = KswapLibrary.getAmountsIn(factory, amountOut, path);
        require(
            amounts[0] <= amountInMax,
            "KswapRouter: EXCESSIVE_INPUT_AMOUNT"
        );
        TransferHelper.safeTransferFrom(
            path[0],
            msg.sender,
            KswapLibrary.pairFor(factory, path[0], path[1]),
            amounts[0]
        );
        _swap(amounts, path, to);
    }

    function swapExactETHForTokens(
        uint256 amountOutMin,
        address[] calldata path,
        address to,
        uint256 deadline
    )
        external
        payable
        virtual
        override
        ensure(deadline)
        returns (uint256[] memory amounts)
    {
        require(path[0] == WOKT, "KswapRouter: INVALID_PATH");
        amounts = KswapLibrary.getAmountsOut(factory, msg.value, path);
        require(
            amounts[amounts.length - 1] >= amountOutMin,
            "KswapRouter: INSUFFICIENT_OUTPUT_AMOUNT"
        );
        IWOKT(WOKT).deposit{value: amounts[0]}();
        assert(
            IWOKT(WOKT).transfer(
                KswapLibrary.pairFor(factory, path[0], path[1]),
                amounts[0]
            )
        );
        _swap(amounts, path, to);
```

```
    }

    function swapTokensForExactETH(
        uint256 amountOut,
        uint256 amountInMax,
        address[] calldata path,
        address to,
        uint256 deadline
    )
        external
        virtual
        override
        ensure(deadline)
        returns (uint256[] memory amounts)
    {
        require(path[path.length - 1] == WOKT, "KswapRouter: INVALID_PATH");
        amounts = KswapLibrary.getAmountsIn(factory, amountOut, path);
        require(
            amounts[0] <= amountInMax,
            "KswapRouter: EXCESSIVE_INPUT_AMOUNT"
        );
        TransferHelper.safeTransferFrom(
            path[0],
            msg.sender,
            KswapLibrary.pairFor(factory, path[0], path[1]),
            amounts[0]
        );
        _swap(amounts, path, address(this));
        IWOKT(WOKT).withdraw(amounts[amounts.length - 1]);
        TransferHelper.safeTransferETH(to, amounts[amounts.length - 1]);
    }

    function swapExactTokensForETH(
        uint256 amountIn,
        uint256 amountOutMin,
        address[] calldata path,
        address to,
        uint256 deadline
    )
        external
        virtual
        override
        ensure(deadline)
        returns (uint256[] memory amounts)
    {
        require(path[path.length - 1] == WOKT, "KswapRouter: INVALID_PATH");
        amounts = KswapLibrary.getAmountsOut(factory, amountIn, path);
        require(
            amounts[amounts.length - 1] >= amountOutMin,
            "KswapRouter: INSUFFICIENT_OUTPUT_AMOUNT"
        );
        TransferHelper.safeTransferFrom(
            path[0],
            msg.sender,
            KswapLibrary.pairFor(factory, path[0], path[1]),
            amounts[0]
        );
        _swap(amounts, path, address(this));
        IWOKT(WOKT).withdraw(amounts[amounts.length - 1]);
        TransferHelper.safeTransferETH(to, amounts[amounts.length - 1]);
    }

    function swapETHForExactTokens(
        uint256 amountOut,
        address[] calldata path,
        address to,
        uint256 deadline
    )
        external
        payable
        virtual
        override
        ensure(deadline)
        returns (uint256[] memory amounts)
    {
        require(path[0] == WOKT, "KswapRouter: INVALID_PATH");
        amounts = KswapLibrary.getAmountsIn(factory, amountOut, path);
        require(amounts[0] <= msg.value, "KswapRouter: EXCESSIVE_INPUT_AMOUNT");
        IWOKT(WOKT).deposit{value: amounts[0]}();
        assert(
            IWOKT(WOKT).transfer(
                KswapLibrary.pairFor(factory, path[0], path[1]),
                amounts[0]
            )
        );
        _swap(amounts, path, to);
        // refund dust eth, if any
```

```
        if (msg.value > amounts[0])
            TransferHelper.safeTransferETH(msg.sender, msg.value - amounts[0]);
    }

    // **** SWAP (supporting fee-on-transfer tokens) ****
    // requires the initial amount to have already been sent to the first pair
    function _swapSupportingFeeOnTransferTokens(
        address[] memory path,
        address _to
    ) internal virtual {
        for (uint256 i; i < path.length - 1; i++) {
            (address input, address output) = (path[i], path[i + 1]);
            (address token0, ) = KswapLibrary.sortTokens(input, output);
            IKswapPair pair =
                IKswapPair(KswapLibrary.pairFor(factory, input, output));
            uint256 amountInput;
            uint256 amountOutput;
            {
                // scope to avoid stack too deep errors
                (uint256 reserve0, uint256 reserve1, ) = pair.getReserves();
                (uint256 reserveInput, uint256 reserveOutput) =
                    input == token0
                        ? (reserve0, reserve1)
                        : (reserve1, reserve0);
                amountInput = IERC20Kswap(input).balanceOf(address(pair)).sub(
                    reserveInput
                );
                amountOutput = KswapLibrary.getAmountOut(
                    amountInput,
                    reserveInput,
                    reserveOutput
                );
            }
            if (tradingPool != address(0)) {
                ITradingPool(tradingPool).swap(
                    msg.sender,
                    input,
                    output,
                    amountOutput
                );
            }
            (uint256 amount0Out, uint256 amount1Out) =
                input == token0
                    ? (uint256(0), amountOutput)
                    : (amountOutput, uint256(0));
            address to =
                i < path.length - 2
                    ? KswapLibrary.pairFor(factory, output, path[i + 2])
                    : _to;
            pair.swap(amount0Out, amount1Out, to, new bytes(0));
        }
    }

    function swapExactTokensForTokensSupportingFeeOnTransferTokens(
        uint256 amountIn,
        uint256 amountOutMin,
        address[] calldata path,
        address to,
        uint256 deadline
    ) external virtual override ensure(deadline) {
        TransferHelper.safeTransferFrom(
            path[0],
            msg.sender,
            KswapLibrary.pairFor(factory, path[0], path[1]),
            amountIn
        );
        uint256 balanceBefore =
            IERC20Kswap(path[path.length - 1]).balanceOf(to);
        _swapSupportingFeeOnTransferTokens(path, to);
        require(
            IERC20Kswap(path[path.length - 1]).balanceOf(to).sub(
                balanceBefore
            ) >= amountOutMin,
            "KswapRouter: INSUFFICIENT_OUTPUT_AMOUNT"
        );
    }

    function swapExactETHForTokensSupportingFeeOnTransferTokens(
        uint256 amountOutMin,
        address[] calldata path,
        address to,
        uint256 deadline
    ) external payable virtual override ensure(deadline) {
        require(path[0] == WOKT, "KswapRouter: INVALID_PATH");
        uint256 amountIn = msg.value;
        IWOKT(WOKT).deposit{value: amountIn}();
        assert(
```

```
                IWOKT(WOKT).transfer(
                    KswapLibrary.pairFor(factory, path[0], path[1]),
                    amountIn
                )
            );
            uint256 balanceBefore =
                IERC20Kswap(path[path.length - 1]).balanceOf(to);
            _swapSupportingFeeOnTransferTokens(path, to);
            require(
                IERC20Kswap(path[path.length - 1]).balanceOf(to).sub(
                    balanceBefore
                ) >= amountOutMin,
                "KswapRouter: INSUFFICIENT_OUTPUT_AMOUNT"
            );
        }

        function swapExactTokensForETHSupportingFeeOnTransferTokens(
            uint256 amountIn,
            uint256 amountOutMin,
            address[] calldata path,
            address to,
            uint256 deadline
        ) external virtual override ensure(deadline) {
            require(path[path.length - 1] == WOKT, "KswapRouter: INVALID_PATH");
            TransferHelper.safeTransferFrom(
                path[0],
                msg.sender,
                KswapLibrary.pairFor(factory, path[0], path[1]),
                amountIn
            );
            _swapSupportingFeeOnTransferTokens(path, address(this));
            uint256 amountOut = IERC20Kswap(WOKT).balanceOf(address(this));
            require(
                amountOut >= amountOutMin,
                "KswapRouter: INSUFFICIENT_OUTPUT_AMOUNT"
            );
            IWOKT(WOKT).withdraw(amountOut);
            TransferHelper.safeTransferETH(to, amountOut);
        }

        // **** LIBRARY FUNCTIONS ****
        function quote(
            uint256 amountA,
            uint256 reserveA,
            uint256 reserveB
        ) public pure virtual override returns (uint256 amountB) {
            return KswapLibrary.quote(amountA, reserveA, reserveB);
        }

        function getAmountOut(
            uint256 amountIn,
            uint256 reserveIn,
            uint256 reserveOut
        ) public pure virtual override returns (uint256 amountOut) {
            return KswapLibrary.getAmountOut(amountIn, reserveIn, reserveOut);
        }

        function getAmountIn(
            uint256 amountOut,
            uint256 reserveIn,
            uint256 reserveOut
        ) public pure virtual override returns (uint256 amountIn) {
            return KswapLibrary.getAmountIn(amountOut, reserveIn, reserveOut);
        }

        function getAmountsOut(uint256 amountIn, address[] memory path)
            public
            view
            virtual
            override
            returns (uint256[] memory amounts)
        {
            return KswapLibrary.getAmountsOut(factory, amountIn, path);
        }

        function getAmountsIn(uint256 amountOut, address[] memory path)
            public
            view
            virtual
            override
            returns (uint256[] memory amounts)
        {
            return KswapLibrary.getAmountsIn(factory, amountOut, path);
        }
    }
```

TimeLock.sol

```
// SPDX-License-Identifier: MIT

pragma solidity =0.6.12;

import "@openzeppelin/contracts/math/SafeMath.sol";
import "@openzeppelin/contracts/token/ERC20/IERC20.sol";
import "@openzeppelin/contracts/token/ERC20/SafeERC20.sol";

contract TeamTimeLock {// knownsec 治理 提案生效时间锁
    using SafeMath for uint256;
    using SafeERC20 for IERC20;

    IERC20 public token;
    uint256 public constant PERIOD = 30 days;
    uint256 public constant CYCLE_TIMES = 24;
    uint256 public fixedQuantity; // Monthly rewards are fixed
    uint256 public startTime;
    uint256 public delay;
    uint256 public cycle; // cycle already received
    uint256 public hasReward; // Rewards already withdrawn
    address public beneficiary;
    string public introduce;

    event WithDraw(
        address indexed operator,
        address indexed to,
        uint256 amount
    );

    constructor(
        address _beneficiary,
        address _token,
        uint256 _fixedQuantity,
        uint256 _startTime,
        uint256 _delay,
        string memory _introduce
    ) public {
        require(
            _beneficiary != address(0) && _token != address(0),
            "TimeLock: zero address"
        );
        require(_fixedQuantity > 0, "TimeLock: fixedQuantity is zero");
        beneficiary = _beneficiary;
        token = IERC20(_token);
        fixedQuantity = _fixedQuantity;
        delay = _delay;
        startTime = _startTime.add(_delay);
        introduce = _introduce;
    }

    function getBalance() public view returns (uint256) {
        return token.balanceOf(address(this));
    }

    function getReward() public view returns (uint256) {
        // Has ended or not started
        if (cycle >= CYCLE_TIMES || block.timestamp <= startTime) {
            return 0;
        }
        uint256 pCycle = (block.timestamp.sub(startTime)).div(PERIOD);
        if (pCycle >= CYCLE_TIMES) {
            return token.balanceOf(address(this));
        }
        return pCycle.sub(cycle).mul(fixedQuantity);
    }

    function withDraw() external {
        uint256 reward = getReward();
        require(reward > 0, "TimeLock: no reward");
        uint256 pCycle = (block.timestamp.sub(startTime)).div(PERIOD);
        cycle = pCycle >= CYCLE_TIMES ? CYCLE_TIMES : pCycle;
        hasReward = hasReward.add(reward);
        token.safeTransfer(beneficiary, reward);
        emit WithDraw(msg.sender, beneficiary, reward);
    }

    // Update beneficiary address by the previous beneficiary.
    function setBeneficiary(address _newBeneficiary) public {
        require(msg.sender == beneficiary, "Not beneficiary");
        beneficiary = _newBeneficiary;
    }
}
```

6. 附录 B：安全风险评级标准

智能合约漏洞评级标准	
漏洞评级	**漏洞评级说明**
高危漏洞	能直接造成代币合约或用户资金损失的漏洞，如：能造成代币价值归零的数值溢出漏洞、能造成交易所损失代币的假充值漏洞、能造成合约账户损失代币的重入漏洞等； 能造成代币合约归属权丢失的漏洞，如：关键函数的访问控制缺陷、call 注入导致关键函数访问控制绕过等； 能造成代币合约无法正常工作的漏洞，如：因向恶意地址发送代币导致的拒绝服务漏洞、因 gas 耗尽导致的拒绝服务漏洞。
中危漏洞	需要特定地址才能触发的高风险漏洞，如代币合约拥有者才能触发的数值溢出漏洞等；非关键函数的访问控制缺陷、不能造成直接资金损失的逻辑设计缺陷等。
低危漏洞	难以被触发的漏洞、触发之后危害有限的漏洞，如需要大量代币才能触发的数值溢出漏洞、触发数值溢出后攻击者无法直接获利的漏洞、通过指定高 gas 触发的事务顺序依赖风险等。

7. 附录 C：智能合约安全审计工具简介

6.1 Manticore

Manticore 是一个分析二进制文件和智能合约的符号执行工具，Manticore 包含一个符号以太坊虚拟机（EVM），一个 EVM 反汇编器/汇编器以及一个用于自动编译和分析 Solidity 的方便界面。它还集成了 Ethersplay，用于 EVM 字节码的 Bit of Traits of Bits 可视化反汇编程序，用于可视化分析。 与二进制文件一样，Manticore 提供了一个简单的命令行界面和一个用于分析 EVM 字节码的 Python API。

6.2 Oyente

Oyente 是一个智能合约分析工具，Oyente 可以用来检测智能合约中常见的 bug，比如 reentrancy、事务排序依赖等等。更方便的是，Oyente 的设计是模块化的，所以这让高级用户可以实现并插入他们自己的检测逻辑，以检查他们的合约中自定义的属性。

6.3 securify.sh

Securify 可以验证以太坊智能合约常见的安全问题，例如交易乱序和缺少输入验证，它在全自动化的同时分析程序所有可能的执行路径，此外，Securify 还具有用于指定漏洞的特定语言，这使 Securify 能够随时关注当前的安全性和其他可靠性问题。

6.4 Echidna

Echidna 是一个为了对 EVM 代码进行模糊测试而设计的 Haskell 库。

6.5 MAIAN

MAIAN 是一个用于查找以太坊智能合约漏洞的自动化工具，Maian 处理合

约的字节码，并尝试建立一系列交易以找出并确认错误。

6.6 ethersplay

ethersplay 是一个 EVM 反汇编器，其中包含了相关分析工具。

6.7 ida-evm

ida-evm 是一个针对以太坊虚拟机（EVM）的 IDA 处理器模块。

6.8 Remix-ide

Remix 是一款基于浏览器的编译器和 IDE，可让用户使用 Solidity 语言构建以太坊合约并调试交易。

6.9 知道创宇区块链安全审计人员专用工具包

知道创宇渗透测试人员专用工具包，由知道创宇渗透测试工程师研发，收集和使用，包含专用于测试人员的批量自动测试工具，自主研发的工具、脚本或利用工具等。

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