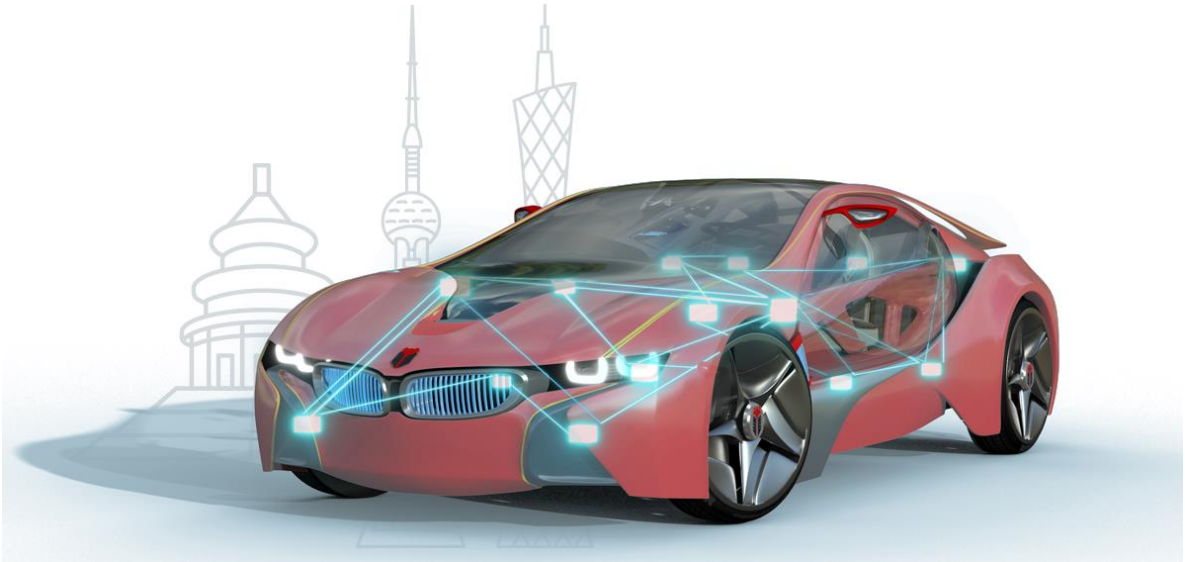
# 知从-云途 YTM32B1H/M 功能安全库 SAFLIB 产品介绍

# ZC-YUNTU YTM32B1H/MXXX FUNCTIONAL SAFETY LIBRARY SAFLIB PRODUCT INTRODUCTION

## 知从-云途木牛功能安全库

## ZC - YunTu MuNiu Functional Safety Library



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### 1 概述 OVERVIEW

YTM32B1H 和 YTM32B1M 系列是基于 ARM Cortex-M 架构的功能安全微控制器系列芯片，最高可达 ASIL D 等级，适配各类电气恶劣环境下的应用场景，还针对成本敏感型应用优化，提供低引脚数选项 。

The YTM32B1H and YTM32B1M series are functional safety microcontroller families based on the ARM Cortex-M architecture, certified to ASIL D safety integrity level. Designed for harsh electrical environments and cost-sensitive applications, they provide low-pin-count configurations and extensive memory/peripheral resources.

这两个系列芯片都拥有丰富的存储、外设及封装配置。其通用的外设与引脚数量，助力开发人员在同系列或跨系列 MCU 间进行轻松移植，充分利用更多存储资源与功能集成优势。这种可扩展性，让开发人员能为终端产品平台标准化选用芯片系列，最大化实现软硬件复用，加快产品推向市场的进程 。

Both series feature unified peripheral interfaces and pin layouts, enabling seamless portability across intra-/inter-series MCUs. This scalability allows developers to standardize chip selection for end-product platforms, maximizing software-hardware reuse and accelerating time-to-market.

知从-云途 SafLib 是上海知从科技有限公司与江苏云途半导体有限公司联合开发的一个功能安全软件库，按照 AUTOSAR CDD（复杂驱动）模块规范进行开发，符合 AUTOSAR CP v4.4 标准要求，支持启动阶段（Startup）和运行时（Run-Time）测试。

ZC-YunTu SafLib is a functional safety software library jointly developed by Shanghai ZhiCong Technology Co., Ltd. and Jiangsu YunTu Semiconductor Co., Ltd. It is developed in accordance with the AUTOSAR CDD (Complex Driver) module specification and complies with the AUTOSAR CP v4.4 standard requirements. It supports startup phase (Startup) and runtime (Run-Time) testing.

SafLib 功能安全软件库，其作用是通过软件实现安全机制检测硬件产品失效，提供了如 SRAM ECC 自检、FLASH ECC 自检、内核自检、时钟自检、DMA 自检、内部看门狗自检等多个检测模块，实现以较低成本对硬件失效的监测和预防，作为硬件安全措施的补充方案被芯片厂商广泛采纳。

SafLib is a functional safety software library that implements safety mechanisms through software to detect hardware product failures. It provides multiple detection modules, such as SRAM ECC self-check, FLASH ECC self-check, kernel self-check, clock self-check, DMA self-check, and internal watchdog self-check, to monitor and prevent hardware failures at a low cost. It is widely adopted by chip manufacturers as a supplementary solution to hardware safety measures.

# 2 应用领域 APPLICATION FIELD

SafLib 可应用于有功能安全等级需求的控制器。例如：

The SafLib can be applied to controllers that require functional safety levels.

For example:

- 电机控制器
  Motor Controller
- 电池管理系统(BMS)
  Battery Management System
- 底盘系统应用
  Chassis System Applications
- 电气稳定控制(ESC)
  Electronic Stability Control
- 电动助力转向(EPS)
  Electric Power Steering
- 安全气囊和传感器集成应用
  Chassis Domain Line Control System Applications
- 雷达的应用
  Radar Applications

通过将 SafLib 集成到基于 YTM32B1M/H 的控制器中，可达到 ISO26262 ASIL B – ASIL D 的等级要求。

By integrating the Safety Library into the control based on YTM32B1M/H, it is possible to meet the ISO 26262 ASIL-B (up to ASIL-D) level requirements.

# 3 工具链支持 TOOLCHAIN SUPPORT

| Type | Tool | Version | Description |
|---|---|---|---|
| **Configuration Tool** | ① YCT(Yuntu Config Tool)<br>② 知从木牛配置工具 | ① v2.7.0 or higher version （免费版） | The GUI tool for YUNTU SafLib module configuration, code and application project genation with configuration real-time validation. |
| **IDE/Compilers** | IAR IDE | v9.50 or higher version | For versions older than v9.50, YTM32 MCU device support patches are required. |
| **IDE/Compilers** | VSCode IDE with Ninja, CMake and GCC/IAR/Keil as compiler | v1.80 or higher version | The required Ninja and CMake can be installed when first-time to install YCT online with internet available. |
| **Compilers** | GCC for ARM | v10.3 or higher version | |
| **Debugger** | SEGGER J-INK driver and HW | (Driver) v7.86 or higher(HW) v9.2 or higher | YTM32 MCU devices support patch required for J-Link. |
| | SEGGER Ozone | v3.28 or higher version | The Ozone debug project can be created with the CMake target. |

# 4 发布方式 PUBLICATION METHOD

SafLib 提供两个版本的发布，分别为免费版和收费版。

- 免费 QM 版本

仅包含代码、样例工程和 QM 文档（User Manual，QSG 和 Release Note），支持免费升级。

- 收费 ASIL-B/ASIL-D 版本

在 QM 基础上，新增 Safety Package。包括 Safety Manual、SW DFA、产品证书、外部第三方评估报告、技术支持（基础服务和系统集成）、产品级功能安全认证支持。

SafLib offers two versions: a free version and a paid version.

- Free QM version

Includes only code, sample projects, and QM documentation (User Manual, QSG, and Release Note), with free upgrades available.

- Paid ASIL-B/ASIL-D Version

Based on the QM version, it adds a Safety Package. This includes the Safety Manual, SW DFA, product certificates, external third-party assessment reports, technical support (basic services and system integration), and product-level functional safety certification support.

# 5 开发背景 DEVELOPMENT BACKGROUND

目前，汽车上的电子电气架构越来越复杂，对汽车电子的安全性要求也越来越高，为了满足汽车的安全性需求，汽车功能安全越来越受到重视。提到功能安全，大家首先想到的是功能安全的标准 ISO26262。其中，ISO 26262-5(2018) Clause 8 中介绍了 2 个度量：Single-point fault metric(单点故障度量)和 Latent-fault metric(潜伏故障度量)。根据不同的 ASIL 等级要求，单点故障度量和潜伏故障度量需要达到相应的等级。

Currently, the electronic and electrical architecture of automobiles is becoming increasingly complex, and the safety requirements for automotive electronics are also rising. To meet the safety requirements of automobiles, functional safety is gaining more attention. When it comes to functional safety, the first thing that comes to mind is the functional safety standard ISO 26262. In particular, ISO 26262-5(2018) Clause 8 introduces two metrics: Single-point fault metric (single-point fault metric) and Latent-fault metric (latent fault metric). Depending on the required ASIL level, the single-point fault metric and latent fault metric must meet the corresponding levels.

对于微控制器(MCU，以下简称 MCU)，在电子电气系统中，作为 SEooC(safety element out of context)进行设计开发。MCU 为了满足以上提到的 2 个度量要求，需要实现相应的安全机制。而安全机制可以分配到硬件和软件模块中。MCU 的 SafLib 就是实现分配到软件上的安全机制。

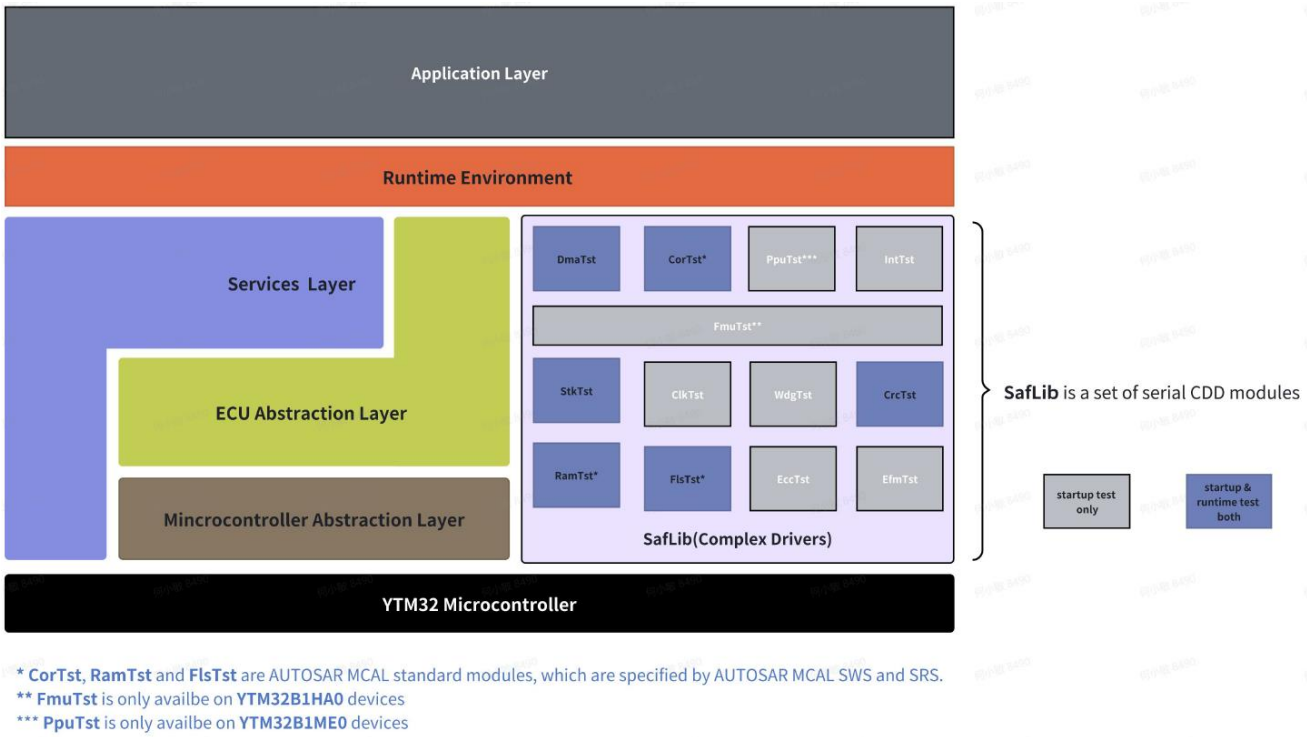
For microcontrollers (MCU, referred to as MCU below), within the electronic and electrical system, they are designed and developed as SEooC (safety element out of context). To meet the aforementioned metric requirements, MCUs need to implement corresponding safety mechanisms. These safety mechanisms can be allocated to both hardware and software modules. The SafLib for MCUs is the implementation of safety mechanisms allocated to software.

| | ASIL B | ASIL C | ASIL D |
|---|---|---|---|
| Single-point fault metric | ≥90 % | ≥97 % | ≥99 % |

| | ASIL B | ASIL C | ASIL D |
|---|---|---|---|
| Latent-fault metric | ≥60 % | ≥80 % | ≥90 % |

# 6 功能描述 FUNCTIONAL DESCRIPTION

## 6.1 产品特点 Product Feature




**SafLib 软件架构框图**

**SafLib Software Architecture Diagram**

- 可作为复杂驱动集成到 AUTOSAR 中
  Can be integrated as a complex driver into AUTOSAR .

- 可集成到非 AUTOSAR 软件架构中，灵活适配
  Can be integrated into non-AUTOSAR software architectures.

- 高安全性：搭配 SafLib 可实现高达 ASIL-D 需求
  High Safety: It can achieve up to ASIL-D requirements when paired with SafLib.

- 高扩展性：各模块可配置满足不同客户的应用需求
  High scalability: Each module can be configured to meet the application requirements of different customers.
  以下是 SafLib 整体包含的模块，基于不同的 MCU，使用到的组件略有差异：
  The following are the modules included in SafLib. The components used vary slightly depending on the MCU:

| SafLib Module | Availability on YTM32 MCU device | | | | Notes |
|---|---|---|---|---|---|
| | YTM32B1MC0 | YTM32B1MD1 | YTM32B1ME0 | YTM32B1HA0 | |
| Cortst | √ | √ | √ | × | 1. HA0 is a daul-core lockstep CM7 core with ASIL-D support, and cannot decouple to run, so no need to run the CorTst .<br>2. it's developed according the the AUTOSAR MCAL spec. |
| RamTst | √ | √ | √ | √ | It's developed according the the AUTOSAR MCAL spec. |
| FlsTst | √ | √ | √ | √ | It's developed according the the AUTOSAR MCAL spec. |
| StkTst | √ | √ | √ | √ | The module implements the software method for stack overflow detection considering its general usage. |
| EfmTst | √ | √ | √ | √ | |
| EccTst | √* | √* | √ | √ | There is no ECC for FlexCAN MB RAM on YTM32B1MC0 and YTM32B1MD1 devices. |
| DmaTst | √ | √ | √ | √ | |
| PpuTst | × | × | √ | × | PPU cannot catch the precise bus error address on YTM32B1HA0 devices due to its CM7 core's cache and instruction pipeline. |
| IntTst | × | × | √ | √ | |
| ClkTst | √ | √ | √ | √ | |
| CrcTst | √ | √ | √ | √ | |
| WdgTst | √ | √ | √ | √ | |
| FmuTst | × | × | × | √ | |

**SafLib 组件列表**

**SafLib Component List**

### 6.1.1 CORTST

CorTst 是 AUTOSAR 标准中用于测试微控制器核心功能的基础软件模块。云途 M 系列 MCU Core 是 CM33 内核，硬件未设计充足的功能安全机制，故采用 CorTst 软件措施对 CPU 内部关键电路失效进行检测。

- 支持启动测试（前台测试）
- 支持运行时测试（后台测试）
- 可覆盖 CM33 内核的永久失效

CorTst is a basic software module used in the AUTOSAR standard to test the core functions of microcontrollers. The YunTu M series MCU core is based on CM33 core. Since the hardware does not have sufficient functional safety mechanisms, CorTst software measures are used to detect failures in critical internal circuits of the CPU.

- Support for startup testing (front-end testing)
- Supports runtime testing (background testing)
- Permanent failure covering the CM33 core

### 6.1.2 RAMTST

RamTst 是 AUTOSAR 标准的 BSW MCAL 存储器测试相关模块。其工作原理是利用不同算法来测试 RAM 内存单元物理健康状况。

- 实现低（60%）、中（90%）、高（99%）三种检测覆盖度要求
- 支持启动测试（前台测试）
- 支持运行时测试（后台测试）
- 可覆盖 YTM32 系列片上 SRAM 的单点故障检测与诊断

RamTst is a module related to memory testing for BSW MCAL in the AUTOSAR standard. It works by using different algorithms to test the physical health of RAM memory cells.

- Achieve three levels of detection coverage requirements: low (60%), medium (90%), and high (99%).
- Single-point fault detection and diagnosis covering the YTM32 series on-chip SRAM

### 6.1.3 FLSTST

FlsTst 是 AUTOSAR 标准里 MCAL 存储器测试相关模块，提供了测试非易失性内存的算法。FlsTst 旨在测试 flash 内容的完整性。测试结果基于计算出的 CRC 值与预期的 CRC 值之间的 CRC 比较。

- 可对每个分区进行独立测试
- 支持启动测试（前台测试）
- 支持运行时测试（后台测试）
- 支持 CRC8、CRC16、CRC32 算法选择

FlsTst is a module related to MCAL memory testing in the AUTOSAR standard, which provides algorithms for testing non-volatile memory. FlsTst is designed to test the integrity of the flash contents.Test results are based on a CRC comparison between the computed CRC value and an expected CRC value.

- Independent testing of each partition
- Supports startup testing (foreground testing)
- Supports runtime testing (background testing)
- Supports CRC8, CRC16, and CRC32 algorithm selection

### 6.1.4 STKTST

StkTst(Stack Test)模块检测堆栈溢出，通过计算堆栈检测区的校验和，并将其与预期原始值进行比较，从而实现堆栈完整性检测。

- 支持带 OS 的堆栈溢出检测
- 支持启动测试
- 支持运行时测试

- 可覆盖 YTM32 系列运行时系统失效检测与诊断

The StkTst (Stack Test) module detects stack overflows by calculating the checksum of the stack detection area and comparing it with the expected original value to verify stack integrity.

- Supports stack overflow detection with OS
- Supports startup testing
- Supports runtime testing
- Covers YTM32 series runtime system failure detection and diagnosis

### 6.1.5 EFMTST

EfmTst 用于对 EFM(flash controller)保护功能进行自检，包括写保护机制检测、指令解锁功能、写使能保护。

- 支持启动测试
- 可覆盖 YTM32 系列 FLASH 存储器的擦除和编程保护功能安全机制的潜在故障检测与诊断

EfmTst is used for self-testing of EFM (flash controller) protection functions, including write protection mechanism detection, command unlock function, and write enable protection.

- Supports startup testing
- Can cover potential fault detection and diagnosis of the erase and program protection function safety mechanisms of YTM32 series FLASH memory

### 6.1.6 ECCTST

EccTst 提供内存 ECC 自检服务，检测片上存储器硬件 ECC 的永久故障，包括 Flash ECC、SRAM ECC、和 CAN 消息缓冲区 RAM ECC。 这些不同的存储器在 YTM32 设备上具有不同的 ECC 实现和可用性。

- 支持启动测试
- 可覆盖 YTM32 系列 MCU 各类功能安全相关存储器 ECC 的潜在故障检查与诊断

EccTst provides memory ECC self-test services to detect permanent failures in on-chip memory hardware ECC, including Flash ECC, SRAM ECC, and CAN message buffer RAM ECC. These different memories have different ECC implementations and availability on YTM32 devices.

- Supports boot testing
- Covers potential fault detection and diagnosis of ECC in various functional safety-related memory types across the YTM32 series of MCUs.

### 6.1.7 DMATST

DmaTst 模块是为 DMA（直接内存访问）功能自检而开发的，作为内存（闪存和 SRAM）和外设之间或内存到内存之间安全关键数据移动的重要软件安全机制。

- 支持启动测试（DMA 通道错误检测机制自检）
- 支持运行时测试（数据搬运功能测试，需占用 1/2 DMA 通道）
- 可覆盖 YTM32 系列 DMA 模块的单点故障检测与诊断

The DmaTst module was developed for self-testing of DMA (Direct Memory Access) functions and serves as an important software security mechanism for the secure transfer of critical data between memory (flash memory and SRAM) and peripherals or between memory locations.

- Supports startup testing (self-testing of the DMA channel error detection mechanism)
- Supports runtime testing (data transfer functionality testing, requiring 1/2 DMA channel)
- Covers single-point fault detection and diagnosis for the YTM32 series DMA modules

### 6.1.8 PPUTST

PpuTst 模块作为软件安全措施来测试硬件 PPU 模块的保护能力，PPU（外设保护单元）模块用于保护定义的内存映射地址。可保护关键配置寄存器不被意外修改。

- 支持启动测试
- 可覆盖 YTM32 系列 PPU 模块潜在故障检测与诊断

The PpuTst module is a software security measure that tests the protection capabilities of the hardware PPU module. The PPU (Peripheral Protection Unit) module is used to protect defined memory-mapped addresses. It protects critical configuration registers from accidental modification.

- Supports startup testing
- Covers potential fault detection and diagnosis of YTM32 series PPU modules

### 6.1.9 INTTST

IntTst 用于测试 INTM（中断监视器）模块，INTM 用于监控和检测安全关键的外设 IRQ 中断延迟超时（interrupt latency timeout）故障。

- 支持最多 4 个外设中断的监控
- 支持启动测试
- 可覆盖 YTM32 系列 INTM 模块潜在故障检测与诊断

IntTst is used to test the INTM (interrupt monitor) module, which monitors and detects faults related to safety-critical peripheral IRQ interrupt latency timeouts.

- Supports monitoring of up to four peripheral interrupts
- Supports startup testing
- Covers potential fault detection and diagnosis of YTM32 series INTM modules

### 6.1.10 CLKTST

ClkTst 用于检测 CMU（时钟监控单元）功能是否正常。CMU 用于监视系统和外设模块工作所需的各种参考/功能时钟异常，包括校验时钟的时钟丢失、参考时钟的时钟丢失和校验时钟的频率失调。

- 支持启动测试
- 可覆盖 YTM32 系列 CMU 模块的潜在故障检测与诊断

ClkTst is used to detect whether the CMU (clock monitoring unit) is functioning normally. The CMU monitors various reference/functional clock anomalies required for the operation of the system and peripheral modules, including clock loss of the calibration clock, clock loss of the reference clock, and frequency deviation of the calibration clock.

- Supports startup testing
- Covers potential fault detection and diagnosis of YTM32 series CMU modules

### 6.1.11 CRCTST

CrcTst 用于测试 CRC/PCRC 模块的功能，以及对寄存器配置完整性的检查。

- 支持启动测试（CRC 功能自检）
- 支持运行时测试（外设/配置寄存器数据一致性检测）
- 可覆盖 YTM32 系列 CRC 模块潜伏故障检测与诊断

CrcTst is used to test the functionality of the CRC/PCRC module and check the integrity of the register configuration.

- Supports startup testing (CRC self-test)
- Supports runtime testing (peripheral/configuration register data consistency check)
- Covers latent fault detection and diagnosis of the YTM32 series CRC module

### 6.1.12 WDGTST

YTM32 设备上有两类

1. WDG（内部看门狗）是一个标准的 16/32 位看门狗定时器，支持窗口模式，只监控内部 CPU 核心。
2. EWDG（外部看门狗）是一个 8 位看门狗定时器，可以同时监控内部 CPU 核心和外部安全关键输入信号，即使内部 CPU 卡死（get stuck），它也可以触发 ECU 系统复位或将控制信号作为系统级安全措施输出给系统级安全管理器。

- 支持内部看门狗和外部看门狗两种功能
- 支持启动测试
- 可覆盖 YTM32 系列内部看门狗和外部看门狗的潜在故障检查与诊断

There are two types of devices on the YTM32

1. WDG (internal watchdog) is a standard 16/32-bit watchdog timer that supports window mode and only monitors the internal CPU core.
2. EWDG (External Watchdog) is an 8-bit watchdog timer that can simultaneously monitor the internal CPU core and external safety-critical input signals. Even if the internal CPU becomes stuck, it can trigger an ECU system reset or output control signals as system-level safety measures to the system-level safety manager.

- Supports both internal and external watchdog functions
- Supports startup testing
- Can cover potential fault detection and diagnosis for both the internal and external watchdogs of the YTM32 series

### 6.1.13 FMUTST

FMU 是芯片集中收集和处理错误的模块，仅 Hx 系列支持。FmuTst 模块用于检测 FMU 功能是否正常，以确保在后续安全应用中能够正常发挥作用。

- 支持 FMU 寄存器锁和访问保护功能检测
- 支持 FMU 配置状态故障注入测试
- 支持 FMU Alarm 功能验证
- 支持 FMU NMI 功能验证
- 支持 FMU 错误信号输出功能验证
- 支持 FMU 外接错误信号输入功能验证
- 支持启动测试
- 可覆盖 YTM32H 系列 FMU 模块潜在故障检测与诊断

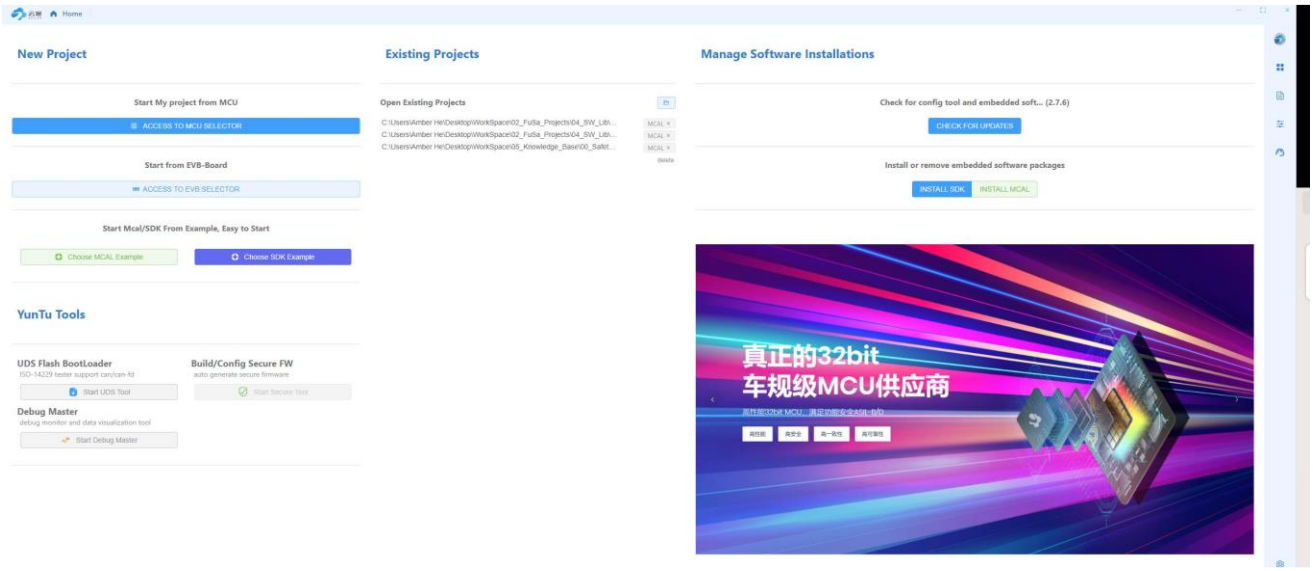
FMU is a module that centrally collects and processes errors on the chip, and is only supported by the Hx series. The FmuTst module is used to verify the functionality of the FMU to ensure it operates properly in subsequent safety applications.

- Supports detection of FMU register lock and access protection functionality
- Supports FMU configuration state fault injection testing
- Supports verification of FMU alarm functionality
- Supports verification of FMU NMI functionality
- Supports verification of FMU error signal output functionality
- Supports verification of FMU external error signal input functionality
- Supports startup testing
- Can cover potential fault detection and diagnosis for FMU modules in the YTM32H series

### 6.2 云途 YCT 配置工具介绍 Introduction to the YCT Configuration Tool

云途 YCT 是一款云途自研的一站式用户交互平台，支持云途车规 MCU 产品配套的软件（SDK/MCAL/SafLib）配置、代码和应用工程师生成、应用开发、文件下载、UDS 以及 OTA 等功能。

YunTu YCT is a one-stop user interaction platform developed by YunTu that supports software (SDK/MCAL/SafLib) configuration, code and application engineer generation, application development, file download, UDS, OTA, and other functions for YunTu's automotive-grade MCU products.



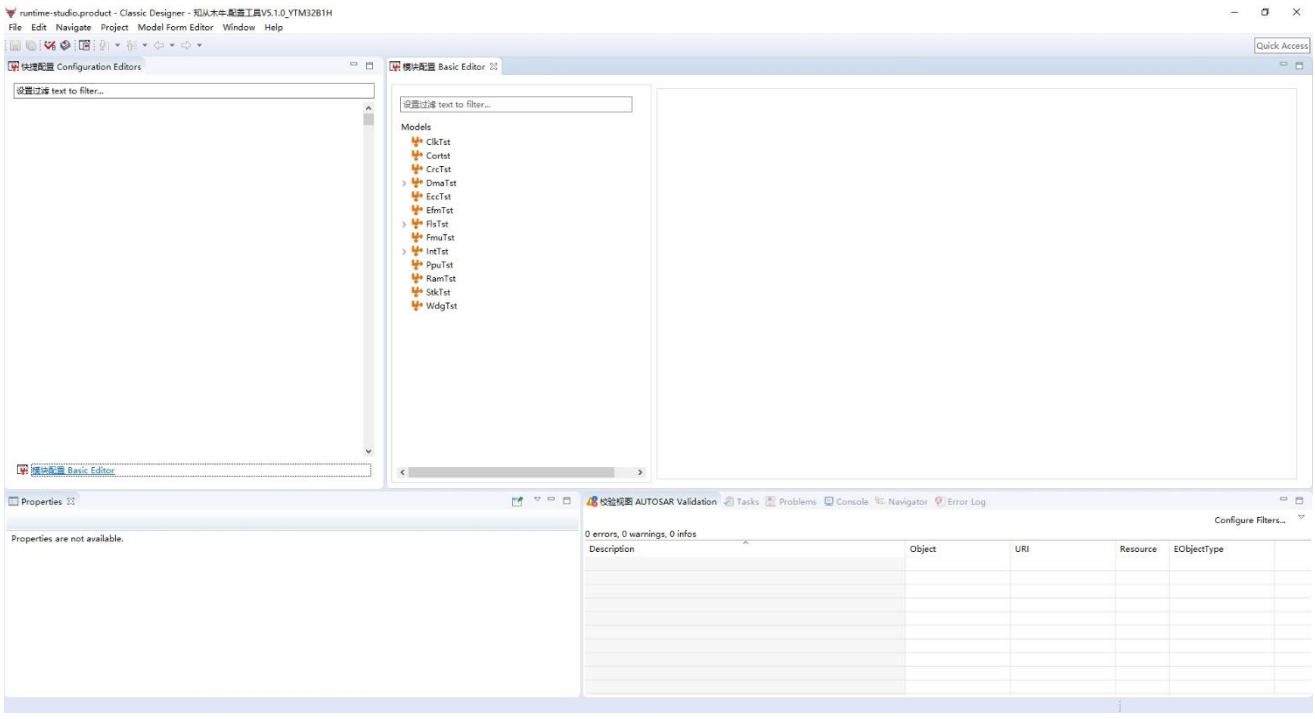

**云途（YCT Yun Config Tool）UI 界面**
**YCT Configuration Tool UI Interface**

### 6.3 知从木牛配置工具介绍 Introduce to the ZC.MuNiu Configuration Tool

知从木牛配置工具基于最新的 ARTOP 架构开发，支持最新的 AUTOSAR R21-11 标准的 基础软件配置工具，提供全套的 BSW 配置和 RTE 生成等功能。目前知从 AUTOSAR 标准的 BSW、复杂驱动、SafetyFrame、CryptoLibrary 等基础软件产品都采用该配置工具。该方案兼 容业界

主流的标准，包括系统功能设计，ECU 功能映射和组件配置，运行时环境自动代码生 成等一系列的工具套件，提供了一套经过实践验证的、开发可重用 ECU 应用软件的基础，可以同 Vector，EB 等工具交叉配合使用。

The ZC.MuNiu Configuration Tool is developed based on the latest ARTOP architecture and supports the latest AUTOSAR R21-11 standard as a basic software configuration tool, providing comprehensive BSW configuration and RTE generation functions. Currently, ZC's AUTOSAR-standard BSW, complex drivers, SafetyFrame, CryptoLibrary, and other basic software products all utilize this configuration tool. This solution is compatible with industry-standard specifications, including system functional design, ECU functional mapping, component configuration, and automatic code generation for runtime environments, providing a proven foundation for developing reusable ECU application software. It can be used in conjunction with tools such as Vector and EB.




**知从木牛配置工具 UI 界面**

**ZC.MuNiu Configuration Tool UI Interface**

# 7 过程文档 PROCESS DOCUMENTATION

| 开发流程 Development Process | 文档描述 Document Description |
|---|---|
| **软件需求分析 Software Requirement Analysis** | 软件的需求分析 Software Requirements Analysis |
| **软件架构设计 Software Architecture Design** | 软件架构说明书 Software Architecture Specification |
| | 软件相关失效分析文档（DFA） Software Dependent Failure Analysis Document |
| | 软件设计失效模式和影响分析文档（DFMEA） Software Design Failure Mode and Effects Analysis Document |
| | SafLib 软件安全手册 SafLib SW Safety Manual |
| **软件详细设计和单元设计 Detailed Software Design and Unit Design** | 软件详细设计说明书 Software Detailed Design Document |
| **软件单元测试 Software Unit Testing** | 单元测试的 QAC 分析报告 Unit Test QAC Analysis Report |
| | Tessy 测试报告 Tessy Test Report |
| **软件集成和集成测试 Software Integration and Integration Testing** | 用户手册 pdf User Manual (PDF) |
| | 集成测试报告 Integration Test Report |
| | 资源分析报告 Resource Analysis Report |
| | 木牛.SafetyLibrary 配置工具使用指导书 MuNiu.SafetyLibrary Configuration Tool User Guide |
| **软件系统测试 Software System Testing** | 软件测试报告 Software Test Report |
| **发布** | 发布文档 |

| 开发流程<br>Development Process | 文档描述<br>Document Description |
| --- | --- |
| **Release** | Release Documentation |

# 8 功能安全 FUNCTIONAL SAFETY

## 8.1 功能安全证书 Functional Safety Certificate

(1) **Certificate**

(2) Number of Certificate: **ZP/C053/24**

(3) Product: **YTM32B1MC0x series up to ASIL B as an SEooC**

(4) Company: **Jiangsu Yuntu Microelectronics Co., Ltd.**

(5) Address: **Room 808, Floor 8, Building A10, No.777 Jianzhu West Road, Binhu District, Wuxi, Jiangsu Province, PR China**

Production facility: **Series production in accordance with ISO 26262:2018 part 7 is the responsibility of the certificate holder and is not part of this certificate**

(6) The design and construction of this products and any acceptable variation thereto are specified in the schedule to this certificate.

(7) The certification body of DEKRA Testing and Certification GmbH certifies that these products have been found to comply with the essential requirements pursuant to the standard(s) referred in section 8. The examination and test results are recorded in the test and assessment report FSAR21062024_YTMICRO_MC0x_V1.

(8) The requirements are assured by compliance with the following standard(s):

**ISO 26262:2018 part 2, part 4, part 5, part 8, part 9, part 11**

(9) This certificate only relates to the design, examination and tests of the specified products in accordance with the mentioned standard(s). Further requirements apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(10) This certificate is valid until 2029-10-01

DEKRA Testing and Certification GmbH
Stuttgart, 2024-10-02

Managing Director

Page 1 of 2 of ZP/C053/24
This certificate may only be published in its entirety and without any change.
DEKRA Testing and Certification GmbH, Handwerkstraße 15, 70565 Stuttgart, Germany
Certification Body: Dinnendahlstraße 9, 44809 Bochum, Germany
Telephone +49.234.3696-400, Fax +49.234.3696-110, DTC-Certification-Body@dekra.com

**YTM32B1MCx ASIL-B 证书**

**YTM32B1MCx ASIL-B Certificate**

(1) **Certificate**

(2) Number of Certificate: **ZP/C011/23 N1** replaces ZP/C011/23

(3) Product: **YTM32B1ME05G0MLQT, YTM32B1ME05G0MLLT, YTM32B1ME05G0MLHT, YTM32B1ME05G0MLHIT, YTM32B1MD14G0MLLT, YTM32B1MD14G0MLHT and YTM32B1MD14G0MLHIT up to ASIL B as a SEooC**

(4) Company: **Suzhou Yuntu Microelectronics Co., Ltd.**

(5) Address: **North Building, Tiandu Commercial Plaza, No.211, Changjiang Road, High-tech Zone, Suzhou, Jiangsu, China**

(6) The design and construction of this products and any acceptable variation thereto are specified in the schedule to this certificate.

(7) The certification body of DEKRA Testing and Certification GmbH certifies that these products have been found to comply with the essential requirements pursuant to the standard(s) referred in section 8. The examination and test results are recorded in the test and assessment report **FSAR_26102022_V2_YTMICRO**.

(8) The essential requirements are assured by compliance with the following standard(s) and guideline(s) on application of ISO 26262 to semiconductors:

**ISO 26262-2:2018** **ISO 26262-4:2018** **ISO 26262-5:2018**
**ISO 26262-8:2018** **ISO 26262-9:2018** **ISO 26262-11:2018**

(9) This certificate only relates to the design, examination and tests of the specified products in accordance with the mentioned standard(s). Further requirements apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(10) This certificate is valid until 2028-07-20

DEKRA Testing and Certification GmbH
Stuttgart, 2023-07-21

Managing Director

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**YTM32B1ME0x/MD1x ASIL-B 证书**

**YTM32B1ME0x/MD1x ASIL-B Certificate**

(1) **Certificate**

(2) Number of Certificate: **ZP/C022/24**

(3) Product: **YTM32B1HA0x series up to ASIL D as an SEooC**

(4) Company: **Jiangsu Yuntu Microelectronics Co., Ltd.**

(5) Address: **Room 808, Floor 8, Building A10, No.777 Jianzhu West Road, Binhu District, Wuxi, Jiangsu Province, PR China**

Production facility: **Series production in accordance with ISO 26262:2018 part 7 is the responsibility of the certificate holder and is not part of this certificate**

(6) The design and construction of this products and any acceptable variation thereto are specified in the schedule to this certificate.

(7) The certification body of DEKRA Testing and Certification GmbH certifies that these products have been found to comply with the essential requirements pursuant to the standard(s) referred in section 8. The examination and test results are recorded in the test and assessment report FSAR15012024_YTMICRO_HA0x_V1.

(8) The requirements are assured by compliance with the following standard(s):

**Development: ISO 26262:2018 part 2, part 4, part 5, part 8, part 9, part 11**
**Production: N/A**

(9) This certificate only relates to the design, examination and tests of the specified products in accordance with the mentioned standard(s). Further requirements apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(10) This certificate is valid until 2029-05-20

DEKRA Testing and Certification GmbH
Stuttgart, 2024-05-21

Managing Director

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**YTM32B1HA0x ASIL-D 证书**

**YTM32B1HA0x ASIL-D Certificate**

(1) **Certificate**

(2) Number of Certificate: **ZP/C036/25**

(3) Product: **SafLib as an SEooC in applications up to ASIL D**

(4) Company: **Jiangsu Yuntu Microelectronics Co., Ltd.**

(5) Address: **Room 808, Floor 8, Building A10, No.777 Jianzhu West Road, Binhu District, Wuxi, Jiangsu Province, PR China**

Production facility: **Series production in accordance with ISO 26262:2018 part 7 is the responsibility of the certificate holder and is not part of this certificate**

(6) The design and construction of this products and any acceptable variation thereto are specified in the schedule to this certificate.

(7) The certification body of DEKRA Testing and Certification GmbH certifies that these products have been found to comply with the essential requirements pursuant to the standard(s) referred in section 8. The examination and test results are recorded in the test and assessment report "FSAR_19092024_V1_YTMicro_SafLib".

(8) The requirements are assured by compliance with the following standard(s):

**Development: ISO 26262:2018 part 2, part 4, part 6, part 8, part 9**
**Production: N/A**

(9) This certificate only relates to the design, examination and tests of the specified products in accordance with the mentioned standard(s). Further requirements apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(10) This certificate is valid until 2030-08-04

DEKRA Testing and Certification GmbH
Stuttgart, 2025-08-05

Managing Director

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DEKRA Testing and Certification GmbH, Handwerkstraße 15, 70565 Stuttgart, Germany
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**YT SafLib ASIL-D 证书**

**YT SafLib ASIL-D Certificate**