# 知从青龙 SECUREBOOT 英飞凌 TC2XX 产品手册

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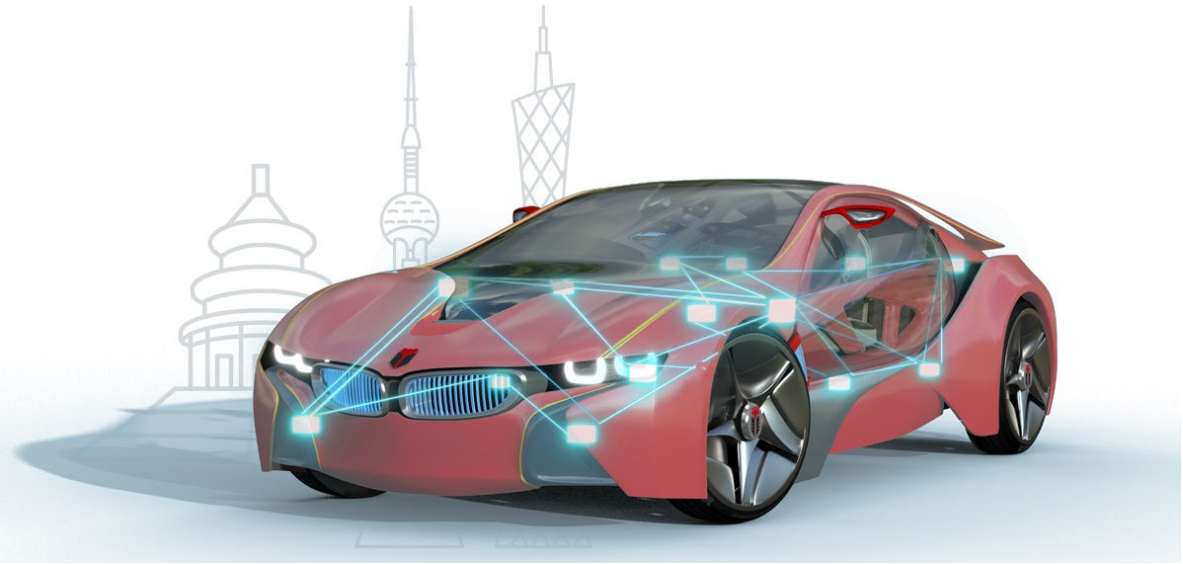
知从青龙 BootLoader

ZC.QingLong BootLoader



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## 1 功能概述 FUNCTIONAL OVERVIEW

知从青龙 BootLoader 是由知从科技自主研发的程序刷新软件(BootLoader)。使用知从青龙 BootLoader 的控制器，可以通过 CAN、LIN、SPI、UART 等通信方式实现应用程序的更新功能。目前，知从青龙 BootLoader 已支持 NXP、Infineon、Renesas、ST 等多家芯片，并且支持多家整车厂程序刷新规范，可提供定制开发服务。

ZC.QingLong BootLoader is a self-developed program refreshing software (BootLoader) by ZC. Controllers using ZC.QingLong BootLoader can achieve the update function of the application program through communication methods such as CAN, LIN, SPI, and UART. ZC.QingLong BootLoader supports chips from NXP, Infineon, Renesas, ST, and other manufacturers, and also supports the program refreshing standards of many car manufacturers, offering customized development services.

知从青龙 SecureBoot 是基于 IFX TC2xx 平台，实现 BootLoader 的 Security 功能。通过实现 SecureBoot，控制器可以识别 BootLoader 程序和应用程序是否被篡改，特别是在 FOTA 过程中，可以保证程序刷新的安全性。

The ZC.QingLong SecureBoot is based on the Infineon TC2xx platform, implementing the security features of the BootLoader. With the implementation of SecureBoot, the controller can detect whether the BootLoader program and application program have been tampered with, especially during the FOTA process, ensuring the security of the program update.

## 2 应用领域 APPLICATION FIELD

知从青龙 SecureBoot 可应用于使用 TC2xx 系列芯片的控制器程序刷新功能。支持的控制器包括:

The ZC.QingLong SecureBoot can be applied to the controller program update function using the TC2xx series chips. The supported controllers include:

- 车身控制器

  Body Controller

- 网关控制器

  Gateway Controller

- 车载娱乐系统控制器

  In-Vehicle Infotainment System Controller

- 电子驻车制动系统

  Electronic Parking Brake System

- 胎压监测系统

  Tire Pressure Monitoring System

- 电池管理系统

  Battery Management System

- 空调控制系统

  Air Conditioning Control System

- 车窗控制系统

  Window Control System

- 门控系统

  Door Control System

# 3 配置环境 CONFIGURATION ENVIRONMENT

| 配置环境<br>Configuration Environment | |
|---|---|
| **Hardware (Chip)** | TC213<br>TC234 |
| **Compilers Supported** | Tasking v4.2r2<br>Tasking v6.2r2 |
| **Debugger** | Lauterbach (Trace32 R.2018.02)<br>Isystem (IC5700) |

| Tasking 编译器<br>Tasking Compiler | |
|---|---|
| **编译选项<br>Compile Options** | -Ctc23x --lsl-core=vtc -t --iso=99 --language=-gcc,-volatile,+strings --switch=auto --align=0 --default-near-size=8 --default-a0-size=0 --default-a1-size=0 -O2 --tradeoff=4 --compact-max-size=200 -g --source |
| **链接选项<br>Link Options** | -Ctc23x --lsl-core=vtc -t -Wl-o"${PROJ}.hex":IHEX:4 --hex-format=s "../FTDAS01_TC234.lsl" -Wl-OtxycL -Wl--map-file="${PROJ}.mapxml":XML -Wl-mcrfiklSmNOduQ -Wl--error-limit=42 -g |

# 4 开发背景 DEVELOPMENT BACKGROUND

目前，汽车上的电子电气架构越来越复杂，并伴随着汽车的电动化、智能化、网联化、共享化，软件的研发在汽车上占比越来越大。软件更新的频率越来越高。而且，在汽车的整个生命周期中，包括研发阶段、生产阶段、售后阶段，各个阶段都需要实现软件的更新功能。因此，客户对软件程序更新的需求越来越迫切。

Currently, the electronic and electrical architecture of vehicles is becoming increasingly complex. Along with the trends of electrification, intelligence, connectivity, and sharing in the automotive industry, the proportion of software development in vehicles is growing larger. The frequency of software updates is also increasing. Moreover, throughout the entire lifecycle of a vehicle, including the research and development phase, production phase, and after-sales phase, the capability to update software is required at each stage. Therefore, the demand from customers for software program updates is becoming more urgent.

并且，随着车联网的落地，信息安全越来越受重视，芯片作为信息的载体，因此，对芯片中的数据保护尤其重要。知从青龙 SecureBoot 是基于 Infineon TC2xx 平台，实现 BootLoader 的 Security 功能。通过实现 SecureBoot，控制器可以识别 BootLoader 程序和应用程序是否被篡改，特别是在 FOTA 过程中，可以保证程序刷新的安全性。

Furthermore, with the implementation of the Internet of Vehicles, information security is gaining more attention. As chips serve as carriers of information, the protection of data within the chips is particularly important. ZC.QingLong SecureBoot, based on the Infineon TC2xx platform, implements the security features of the BootLoader. By implementing SecureBoot, the controller can detect whether the BootLoader program and application program have been tampered with, especially during the FOTA process, ensuring the security of the program update.

# 5 功能描述 FUNCTIONAL DESCRIPTION

## 5.1 产品特点 Product Features

- 适用于多达十几家整车厂的程序更新规范

Suitable for the program update specifications of up to a dozen car manufacturers

- 支持应用程序和数据的更新功能

Supports update functions for applications and data

- 支持 BootLoader 自更新功能

Supports self-update functionality for BootLoader

- 支持 HIS 规范

Supports HIS specifications

- 支持 CAN/LIN/SPI/UART 等通信

Supports communication via CAN/LIN/SPI/UART, etc.

- 适配知从玄武程序更新工具，提供完整的程序更新解决方案

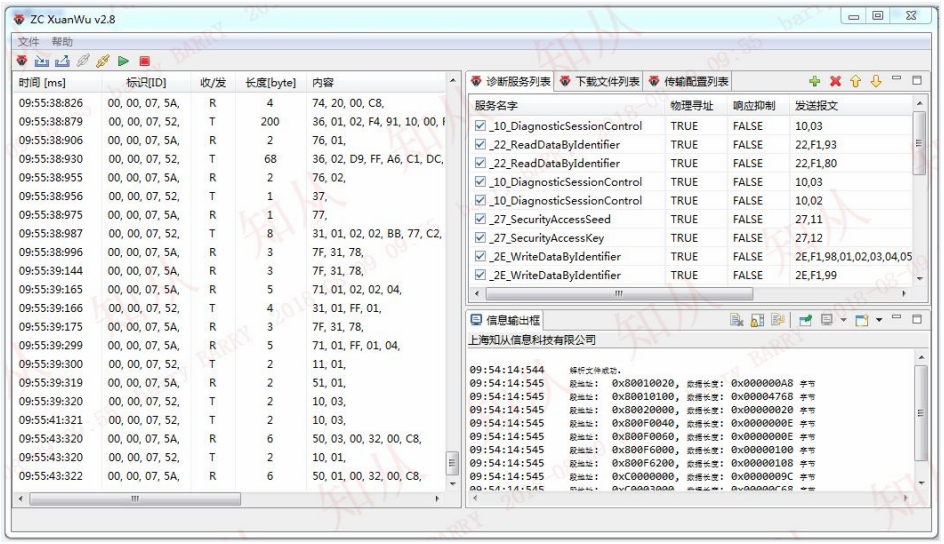
Adapts to ZC.Xuanwu program update tools, offering a complete solution for program updates

- 支持对称加密 SHA256 和 AES128 算法

  Supports symmetric encryption algorithms SHA256 and AES128

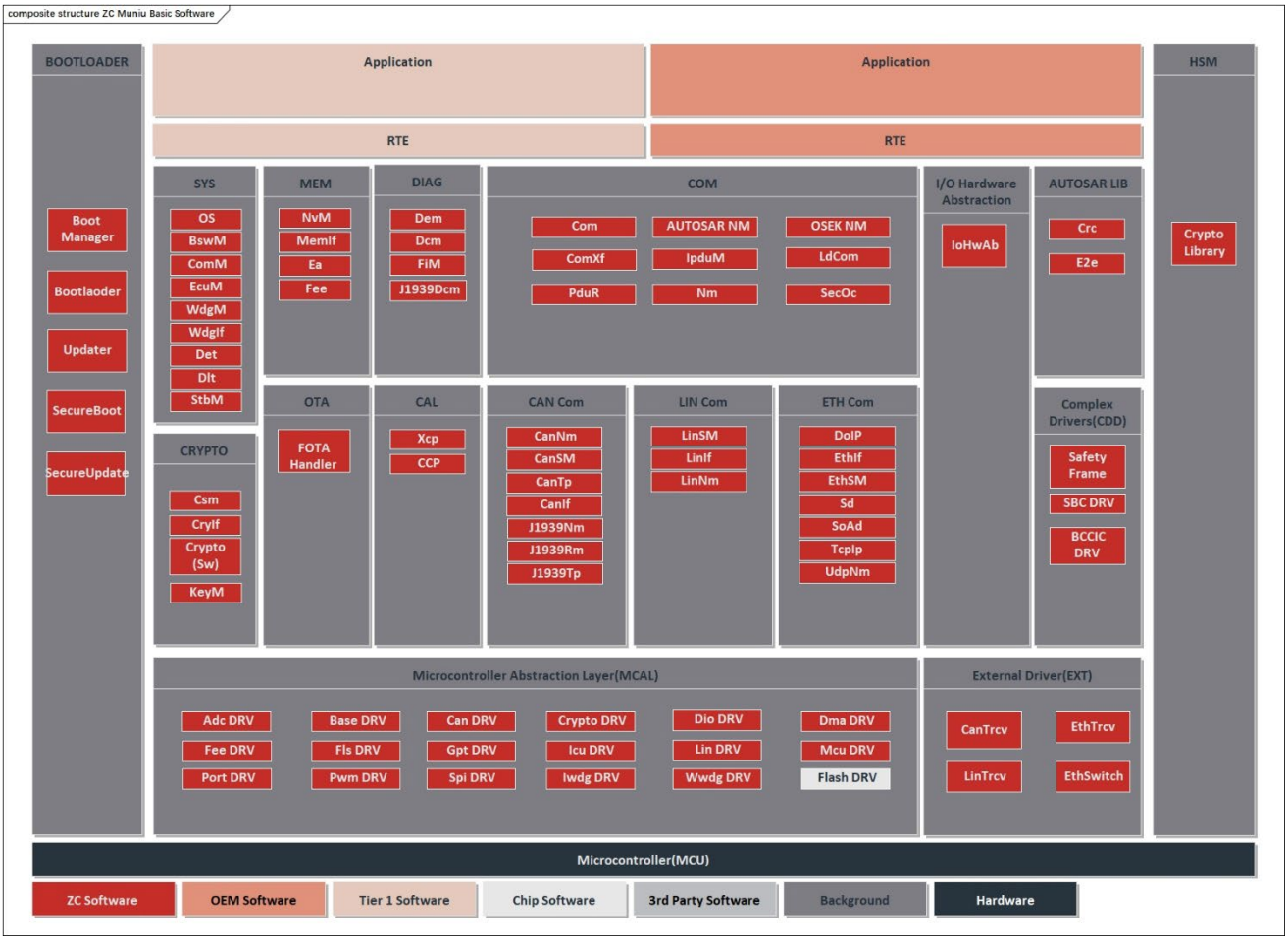
- 支持非对称加密 ECC 和 RSA 算法

  Supports asymmetric encryption algorithms ECC and RSA




知从玄武—程序更新工具
ZC.XuanWu—Software Update Tool

## 5.2 软件架构 Software Architecture

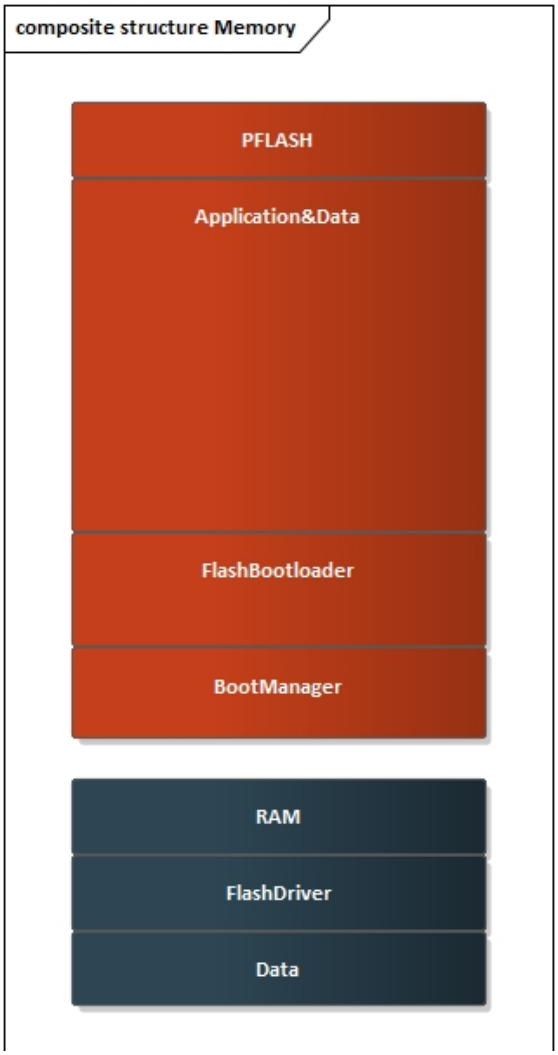


知从青龙 BootLoader 软件实现分层架构，分为硬件驱动层(HwDrv)、ECU 抽象层(EcuAbstr)、系统服务层(SysSer)以及 Boot 管理层(BootManager)。并将整个软件进行模块化，其中：

The ZC.QingLong BootLoader software implements a layered architecture, which is divided into the Hardware Driver Layer (HwDrv), ECU Abstraction Layer (EcuAbstr), System Service Layer (SysSer), and Boot Management Layer (BootManager). The entire software is modularized, where:

- HwDrv
  硬件驱动层实现芯片的硬件模块驱动，依赖于具体的芯片，不同的芯片需要替换此层的驱动。
  The Hardware Driver Layer implements the drivers for the chip's hardware modules and is dependent on the specific chip. Different chips require replacement of the drivers in this layer
- EcuAbstr
  ECU 抽象层是对 ECU 的抽象，包含 MCU 外部的驱动。
  The ECU Abstraction Layer is an abstraction of the ECU, including drivers external to the MCU。
- SysSer
  系统服务层实现通信、诊断、内存管理、看门狗管理、安全管理等功能。
  The System Service Layer implements functions such as communication, diagnostics, memory management, watchdog management, and security management.
- BootManager
  Boot 管理层实现整个 BootLoader 软件模块的调度管理，并实现与应用程序的接口管理等。
  The Boot Management Layer is responsible for the scheduling management of the entire BootLoader software module and for managing the interfaces with the application programs.

## 5.3 内存结构 Memory Structure




ECU 的内存分为 PFLASH 和 RAM，PFLASH 区分为 Application&Data 和 BootLoader 区，RAM 区分为 FLASH Driver 和 Data。

The ECU's memory is divided into PFLASH and RAM. PFLASH is further divided into Application & Data and BootLoader areas, while RAM is divided into FLASH Driver and Data areas.

## 5.4 安全刷写与安全启动 Secure Flashing and Secure Boot

知从青龙 SecureBoot 支持安全刷写与安全启动功能。

ZC.QingLong SecureBoot supports the functions of secure flashing and secure booting

- 安全刷写 Secure Flashing:

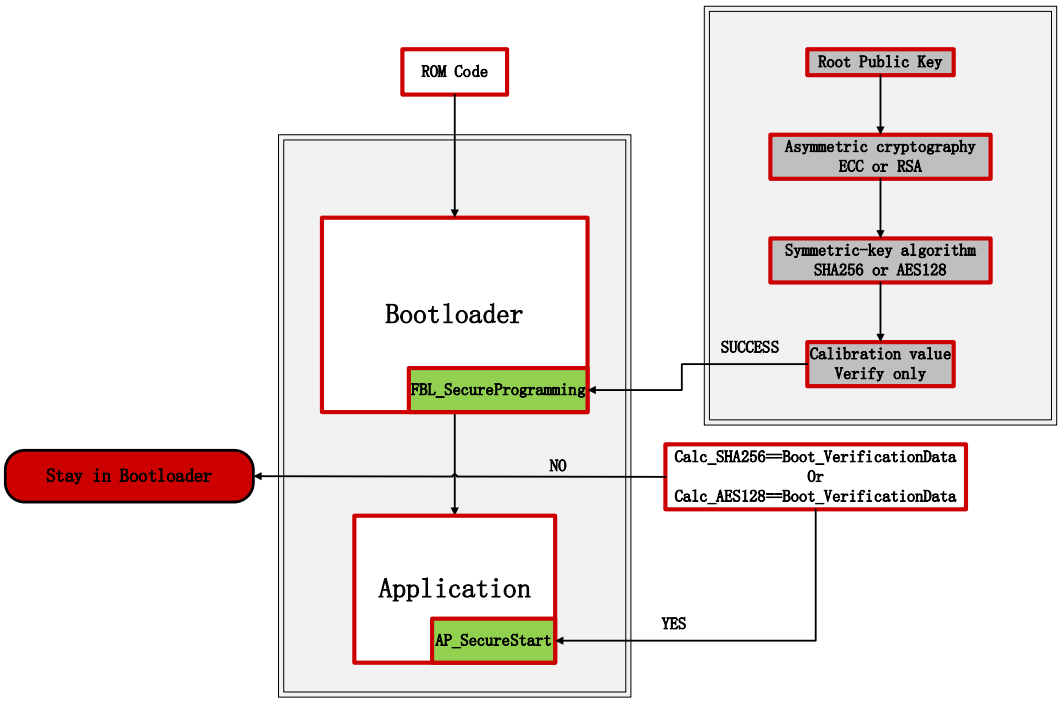
知从青龙 SecureBoot 根据存储在非易失性存储器的 Root Public Key，通过非对称加密算法 ECC 或 RSA，对数据的真实性校验。若校验成功则通过对称加密算法 SHA256 或 AES128 对数据完整性进行校验，保证安全刷写流程。

ZC.QingLong SecureBoot uses the Root Public Key stored in non-volatile memory, and verifies the authenticity of the data through asymmetric encryption algorithms such as ECC or RSA. If the verification is successful, it then checks the integrity of the data through symmetric encryption algorithms like SHA256 or AES128, ensuring the secure flashing process.

- 安全启动 Secure Boot:

芯片上电启动到跳转入 Application 的过程中，知从青龙 SecureBoot 支持安全启动功能，通过对称加密算法 SHA256 或 AES128 对 Boot 和 Application 应用程序进行安全验证，保证程序安全启动。

During the process from power-on to jumping into the Application, ZC.QingLong SecureBoot supports the secure boot function. It verifies the security of the Boot and Application programs through symmetric encryption algorithms like SHA256 or AES128, ensuring the program starts securely.



# 6 过程文档 PROCESS DOCUMENTATION

| 开发流程<br>Development Process | 文档描述<br>Document Description |
|---|---|
| **需求收集<br>Requirement Collection** | 顾客的需求文档<br>Customer Requirement Document |
| **软件需求分析<br>Software Requirement Analysis** | 需求分析<br>Requirement Analysis |
| | 需求分析规格书<br>Requirement Analysis Specification |
| | 软件需求追踪表<br>Software Requirement Traceability Matrix |
| | 客户的问题沟通表<br>Customer Issue Communication Form |
| **软件架构设计<br>Software Architecture Design** | 软件架构说明书<br>Software Architecture Manual |
| | 软件架构的追踪表<br>Software Architecture Traceability Table |
| **软件详细设计和单元设计<br>Software Detailed Design and Unit Design** | BootLoader 详细设计说明书<br>BootLoaderBootLoader Detailed Design Manual |
| | 配置工具设计<br>Configuration Tool Design |
| | 软件详细设计追踪表<br>Software Detailed Design Traceability Table |
| | BootLoader 详细设计评审<br>BootLoader Detailed Design Review |
| **软件单元测试<br>Software Unit Testing** | QAC 分析报告<br>QACAnalysis Report |
| | Tessy 测试报告<br>Tessy Test Report |
| | 软件单元验证策略<br>Software Unit Verification Strategy |
| **软件集成和集成测试** | 集成策略<br>Integration Strategy |
| | 集成手册<br>Integration Manual |

| 开发流程<br>Development Process | 文档描述<br>Document Description |
| --- | --- |
| **Software Integration and Integration Testing** | 集成测试策略<br>Integration Test Strategy |
| | 集成测试报告<br>Integration Test Report |
| | 资源分析报告<br>Resource Analysis Report |
| **软件系统测试<br>Software System Testing** | BootLoader 软件测试报告<br>BootLoader BootLoader Software Test Report |
| | BootLoader 软件测试报告评审<br>BootLoader BootLoader Software Test Report Review |
| **发布<br>Release** | 发布文档<br>Release Documentation |

# 7 功能安全 FUNCTIONAL SAFETY

## 1. 功能安全评估报告 Functional Safety Assessment Report

## 2. 功能安全证书 Functional Safety Certificate

SGS

SGS TÜV SAAR

**CERTIFICATE NO FS/71/220/23/1031**
*ZERTIFIKAT NR.:*

**PAGE 1/1**
*SEITE(N)*

**LICENCE HOLDER & MANUFACTURER**
*GENEHMIGUNGSINHABER & HERSTELLER*

Shanghai ZC Technology Co., Ltd.
Building C, 888 Huanhu West 2nd Road,
Pudong New Area,
Shanghai,
P.R. China

| PROJECT NO/-ID<br>*PROJEKT-NR/-ID* | LICENSED TEST MARK<br>*GENEHMIGTES PRÜFZEICHEN* | CERT. REPORT NO.<br>*ZERTIFIKATSBERICHT NR.* |
|---|---|---|
| T4A8-AU01 | SGS TÜV SAAR ASIL D COMPLIANT Functional Safety ISO 26262 www.sgs-tuv-saar.com | T4A80002 is an integral part of this certificate. *ist ein integraler Bestandteil dieses Zertifikats.* |

**Certified product(s)**
*Zertifizierte(s) Produkt(e)*
SafetyFrame
Version 2.1.0

**Tested according to**
*Geprüft nach*
ISO 26262-2:2018
ISO 26262-6:2018
ISO 26262-8:2018
ISO 26262-9:2018

**Technical Data and Parameter**
*Technische Daten und Parameter*
The judgement of the achieved functional safety for the above-mentioned SafetyFrame Software is "accepted" according to above mentioned standards ASIL D requirements.

The SafetyFrame Software is suitable for integration into systems up to ASIL D.

The certificate is based on voluntary tests. The compliance of the certified product against the requirements of above listed functional safety standards was evaluated. Any changes to the design, components or processing may require repetition of some parts of the certification to retain the certification. All applicable requirements of the testing and certification regulations of SGS-TÜV Saar GmbH have to be complied, see www.sgs-tuv-saar.com/tcr-muc and www.sgs-tuv-saar.com/gtc-muc

**Certification Body for Functional Safety & Cyber Security SGS-TÜV Saar GmbH**
*Zertifizierungsstelle für Funktionale Sicherheit & Cyber Sicherheit*

Reference to SGS Certification Database

Munich, Feb 22, 2023
Gudrun Neumann

SGS-TÜV Saar GmbH, Hofmannstr. 50, 81379 München, *Deutschland* / Germany
Website: www.sgs-tuv-saar.com
E-Mail: fs@sgs.com

CERTIFICATE

# 8 证书 CERTIFICATE

中华人民共和国国家版权局

计算机软件著作权登记证书

证书号：软著登字第3073051号

软 件 名 称：知从青龙bootloader软件
[简称：青龙]
V1.0

著 作 权 人：上海知从科技有限公司

开发完成日期：2018年01月04日

首次发表日期：2018年01月10日

权利取得方式：原始取得

权 利 范 围：全部权利

登 记 号：2018SR743956

根据《计算机软件保护条例》和《计算机软件著作权登记办法》的规定，经中国版权保护中心审核，对以上事项予以登记。

中华人民共和国国家版权局
计算机软件著作权登记专用章
2018年09月13日

No. 02965607

青龙软件著作权登记证书
QINGLONG SOFTWARE COPYRIGHT REGISTRATION CERTIFICATE

中国软件产品评估 CSPE CSIA CHINA SOFTWARE PRODUCTS EVALUATION

# 软件产品证书

经评估，知从青龙bootloader软件V1.0 符合《进一步鼓励软件产业和集成电路产业发展的若干政策》和《软件产品评估标准》（T/SIA003 2017）的有关规定，评估为软件产品，特发此证。

申请企业：上海知从科技有限公司
软件类别：沪RC-2019-3315
证书编号：嵌入式应用软件
有 效 期：五年

评估机构：上海市软件行业协会
日期：二〇一九 年 九 月 廿五 日

上海市软件行业协会 软件产品评估证书专用章

青龙软件产品登记证书
QINGLONG SOFTWARE PRODUCT REGISTRATION CERTIFICATE