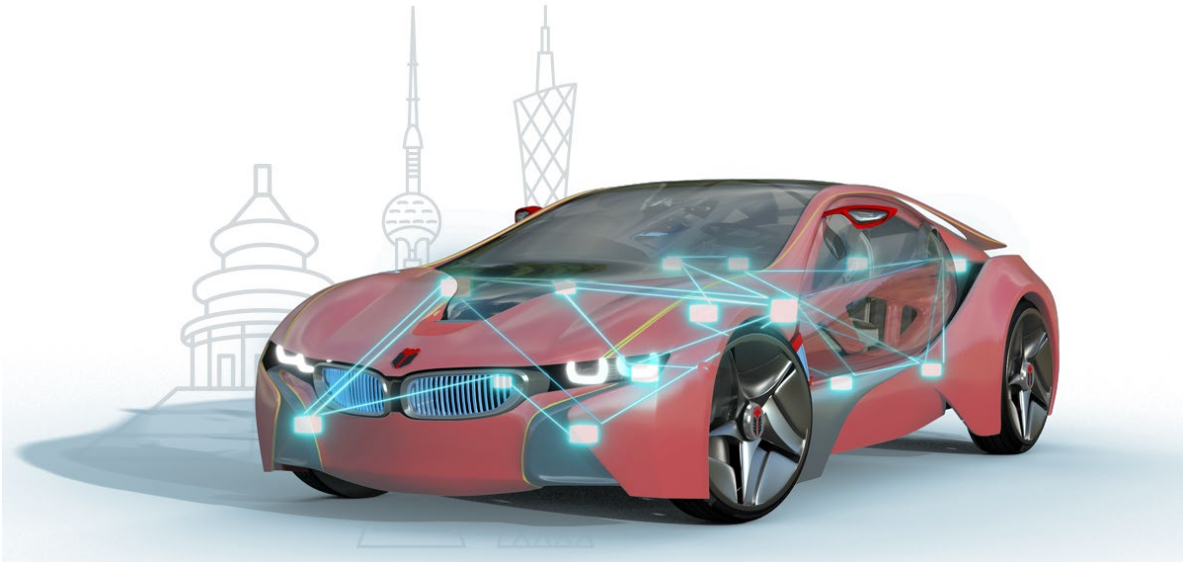
知从青龙 BOOTLOADER 产品手册

知从青龙 BootLoader

ZC.QinLong BootLoader



知从青龙 BOOTLOADER 产品手册

ZC.QINGLONG BOOTLOADER PRODUCT MANUAL

知从青龙 BootLoader

ZC.QinLong BootLoader

1 功能概述 FUNCTION 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 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 flash programming software (BootLoader) by ZCTechnology. Controllers using ZC.QingLong BootLoader can update the application through communication methods such as CAN, LIN, and SPI. Currently, ZC.QingLong BootLoader has supported multiple chips from manufacturers like NXP, Infineon, Renesas, and ST, and complies with the program refreshing specifications of various vehicle manufacturers. It also offers customized development services.

通常每家整车厂都有各自的程序刷新规范，目前知从青龙 BootLoader 支持的整车厂程序刷新规范包括：广汽、长安、上汽、一汽、东风商用车、东风、上海通用、吉利、奇瑞、上汽通用五菱、萨博、长城、北汽新能源等（以上排名不分先后）。

Typically, each vehicle manufacturer has its own specifications for program refreshing. The vehicle manufacturers whose program refreshing specifications are currently supported by ZC.QingLong BootLoader include: GAC (Guangzhou Automobile), Changan, SAIC (Shanghai Automotive Industry Corporation), FAW (First Automobile Works), Dongfeng Commercial Vehicles, Dongfeng, SGMW (SAIC General Motors Wuling), Geely, Chery, SAIC-GM-Wuling, Saab, Great Wall, BAIC New Energy, etc. (listed in no particular order).

2 应用领域 APPLICATION FIELDS

知从青龙 BootLoader 可应用于整车各个域中的控制器程序刷新功能。支持的控制器包括:

ZC.QinLong BootLoaderIt can be applied to the controller program refreshing function in various domains of the vehicle. The supported controllers include:：

- 车身系统 Body System

  车身控制器、空调控制器、车门控制器、网关等

  Body Control Module、 Air Conditioning、 Control Module、Door Control Module
- 动力系统- Gateway Controller- Powertrain System

  发动机控制器、电池管理系统、电机控制器、整车控制器等

  Engine Controller, Battery Management System, Motor Controller, Vehicle Controller
- 底盘系统 Chassis System

  电动助力转向系统、制动防抱死系统、电气稳定系统等

  Electric Power Steering System, Anti-lock Braking System (ABS), Electronic Stability Program (ESP), etc.
- ADAS 系统 ADAS System

  雷达、摄像头系统等

  Radar, Camera System, etc.

3 芯片支持 CHIP SUPPORT

芯片支持 chip support	
NXP	S32K144/MPC5567/MPC5606B/MPC5634/ MPC5644/9S12G128/S12HY64/ 9S12G64/MC9S12VR64/KW36Z512
Infineon	TC397/TC275/TC233/TC264/TC1782/XC2364
Renesas	RH850/V8503385
ST	STM8AF51A/SPC584B

编译器支持 Compiler support	
WindRiver	Diab v5.9.4.0
Tasking	Tasking v6.2r2 / Tasking v4.2r2 / Tasking v2.5r1 / Tasking v3.5r1
GreenHills	GHS v4.2.3 / GHS v7.1.4
HighTec	HighTec v4.6.6.1
Codewarrior	Codewarrior5.1 / CodeWarrior for HCS12(X) v5.2
CS+ for CC	CS+ for CC V3.02.00
Cosmic	Cosmic v4.2.4
S32DS	S32DS_ARM_v2018_R1
IAR	IAR EW for Arm 8.40.1

调试器支持 Debugger Support	
Lauterbach	Lauterbach (Trace32 R.2018.02 / TRACE32 for PowerPC R.2020.02.000121039)
Isystem	Isystem (IC5700)
E1	E1 emulator [R0E000010KCE00]
PE	PE USB Multilink Universal

4 开发背景 DEVELOPMENT BACKGROUD

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. With the electrification, intelligence, connectivity, and sharing of vehicles, the proportion of software development in the automotive industry 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, software update functionality is required in each stage. As a result, customers' demand for software program updates is becoming more and more urgent.

对于整车厂或供应商，BootLoader 是控制器开发必备的功能。并且，不同的整车厂有不同的程序更新规范，同时 BootLoader 驱动又依赖于不同的芯片。因此，为了满足不同的整车厂程序更新规范，又适配不同的芯片，知从科技提供了完整的 BootLoader 解决方案—知从青龙 BootLoader。知从青龙 BootLoader 既适用于不同的整车厂程序更新规范，又适用于不同芯片厂商的芯片，让客户更专注与自己的控制器产品研发。

For vehicle manufacturers or suppliers, the BootLoader is an essential feature for the development of controllers. Moreover, different vehicle manufacturers have different program update specifications, and the BootLoader driver also depends on different chips. Therefore, to meet the program update specifications of various vehicle manufacturers and to be compatible with chips from different chip manufacturers, ZC offers a complete BootLoader solution – ZC.Qinglong BootLoader. ZC.Qinglong BootLoader is suitable for the program update specifications of different vehicle manufacturers and chips from various chip manufacturers, allowing customers to focus more on the development of their own controller products.

5 功能描述 FUNCTION 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

  Compatible with the program update specifications of up to a dozen vehicle manufacturers

- 支持多家芯片厂商的芯片

  Supports chips from multiple chip manufacturers

- 支持行业中主流的编译器

  Compatible with mainstream compilers in the industry

- 支持应用程序和数据的更新功能

  Supports update functions for applications and data

- 支持 HIS 规范

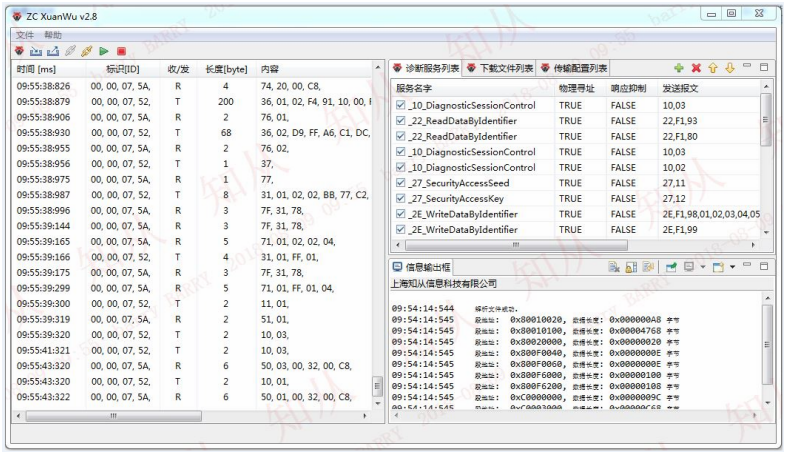
  Supports HIS specifications

- 支持 CAN/LIN/SPI 等通信

  Supports communication via CAN/LIN/SPI, etc

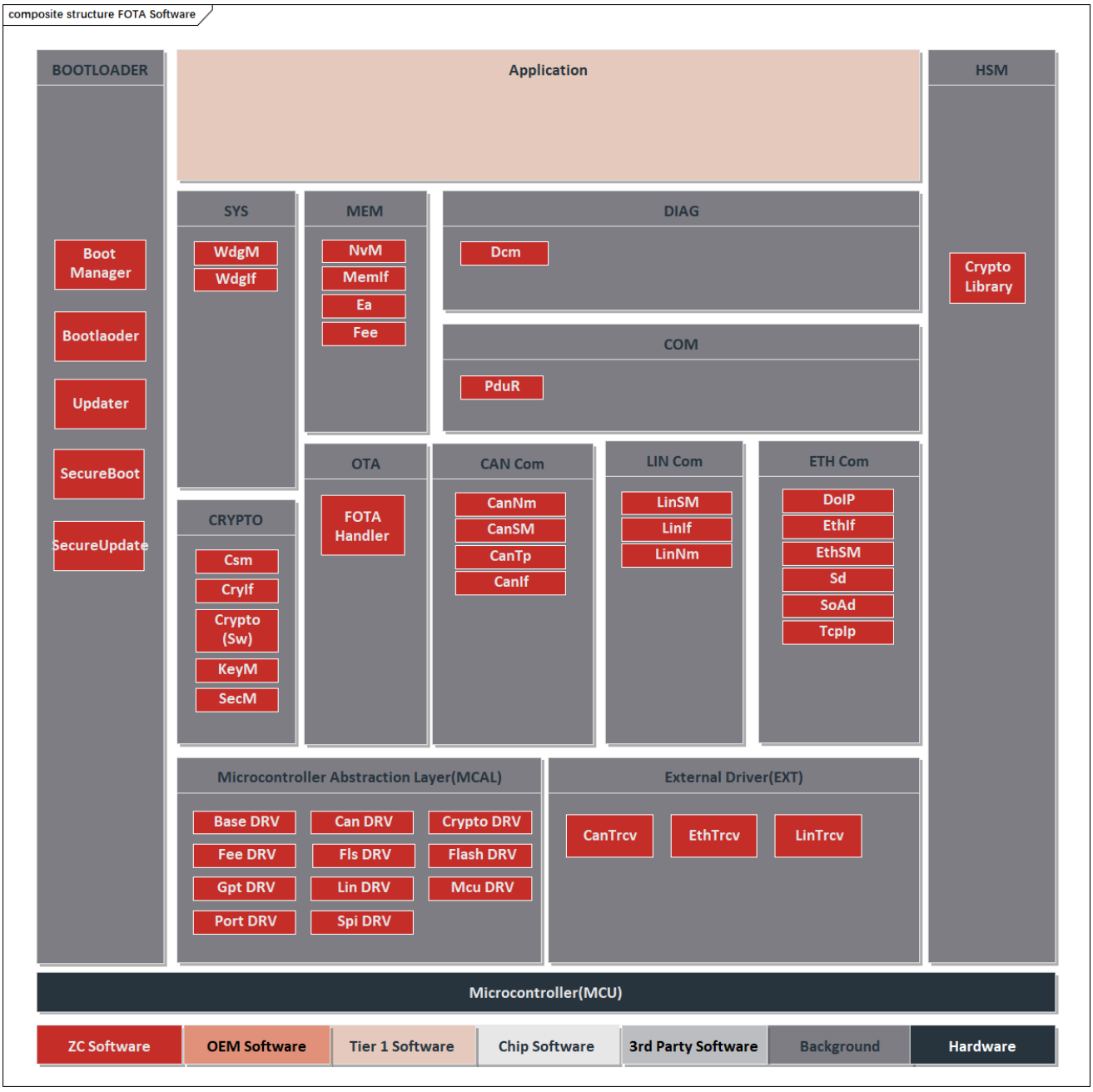
- 适配知从玄武程序更新工具，提供完整的程序更新解决方案

  Adapted to ZC Xuanwu program update tools, providing a complete program update solution



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

5.2 软件架构 Software Architecture



FOTA 系统架构
FOTA SYSTEM ARCHITECTURE

知从青龙 FOTA 系统架构支持 CAN、LIN、SPI、Ethernet 通信场景下的 FOTA 功能，通过 Dcm 模块实现 UDS 报文解析和诊断刷写，并通过适配 Crypto Library 实现各 OEM 规范的信息安全需求。以下为各模块的功能描述：

- Bootloader

  BootManager 模块提供 FOTA 启动管理功能，支持适配软硬件 SecureBoot 功能，通过烧录和刷写存储 Bootloader 和 Application 的期望 MAC 值，启动阶段 SecureBoot 通过计算比较 Bootloader 和 Application 的 MAC 执行软件完整性校验，保证软件安全需求。

- Can Com

  Can 模块支持 CAN、CANFD 通信功能。

- Spi Com

  Spi 模块支持主从刷写功能，通过适配 5、6、7 线硬件配置，可支持多种 SPI 通信刷写模式。

- Ethernet Com

  DoIP 模块基于 TCP/IP 协议实现 Ethernet 通信收发功能，满足 ISO 13400 标准定义。通过车辆识别、路由激活、诊断消息功能实现 UDS 刷写流程，实现 Ethernet OTA 功能。

- Dcm

  Dcm 模块基于通信模块支持实现诊断功能，满足 ISO 14229 以及 ISO 15765 标准定义。

- Crypto、HSM

  Ethernet OTA 支持适配木牛加密库功能，支持非对称加密算法和加密算法结合实现安全刷写功能，适配证书认证功能满足安全诊断功能，适配 HSM 提高信息安全功能的稳定性和校验速度。

The Qinglong Ethernet FOTA system architecture supports the FOTA function in communication scenarios such as CAN, LIN, SPI, and Ethernet. It realizes the parsing of UDS messages and diagnostic programming through the Dcm module, and meets the information security requirements of various OEM specifications by adapting to the Crypto Library. The following are the functional descriptions of each module:

- Bootloader

  The BootManager module provides FOTA startup management functions and supports the adaptation of hardware and software SecureBoot functions. It stores the expected MAC values of the Bootloader and Application through programming and flashing. During the startup phase, SecureBoot performs software integrity verification by calculating and comparing the MACs of the Bootloader and Application to ensure software security requirements.

- Can Com

  The Can module supports CAN and CANFD communication functions.

- Spi Com

The Spi module supports the master-slave programming function. By adapting to the hardware configurations of 5, 6, and 7 wires, it can support multiple SPI communication programming modes.

- Ethernet Com

  The DoIP module realizes the Ethernet communication sending and receiving functions based on the TCP/IP protocol, meeting the definition of the ISO 13400 standard. It implements the UDS flashing process through vehicle identification, routing activation, and diagnostic message functions, thereby achieving the Ethernet OTA function.

- Dcm

  The Dcm module realizes the diagnostic function based on the support of the communication module, meeting the definitions of ISO 14229 and ISO 15765 standards.

- Crypto, HSM

The Ethernet OTA supports the adaptation of the Muniu Crypto Library functions. It combines asymmetric encryption algorithms with other encryption algorithms to achieve the secure flashing function. It adapts to the certificate authentication function to meet the security diagnostic requirements and adapts to the HSM to improve the stability and verification speed of the Cybersecurity function.

5.3 运行过程 Operation Process

- 知从青龙 BootLoader 支持 HIS 的规范，BootLoader 运行过程如下：
  ZC.Qinglong BootLoader supports the HIS specifications, and the operation process is as follows:：

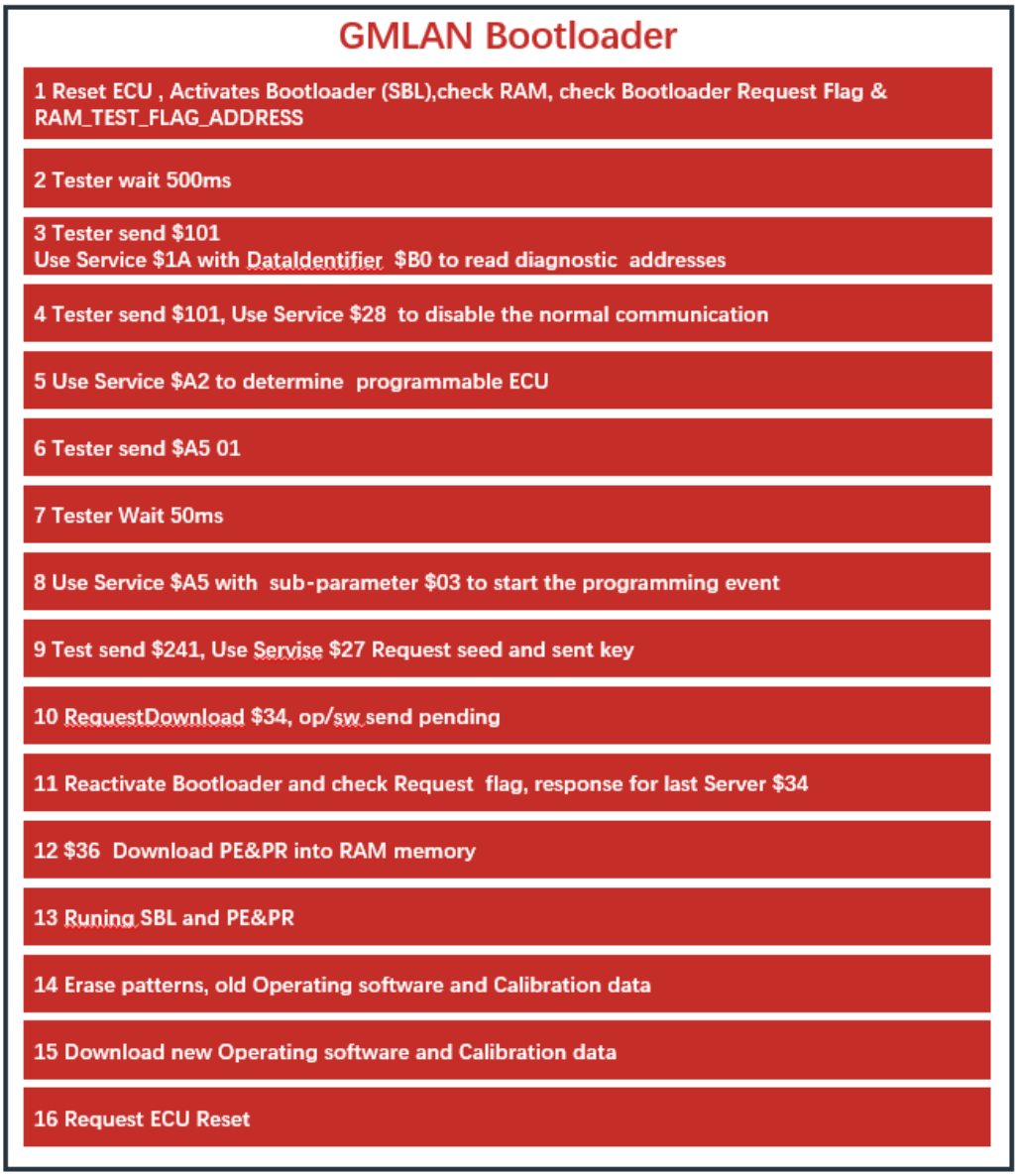
1. Boot Manage

- 1-1 Power on
- 1-2 Boot request
- 1-3 Jump into App, Extended diagnostic session
- 1-4 Check programming pre conditions, Control DTC setting : off
- 1-5 Disable non-diagnostic communication, programming session, reset ECU , jump into SBL

2. Bootloader

- 2-1 Security access : read seed and send key
- 2-2 Write data by identifier : fingerprint
- 2-3 Request download, download flash driver, check routine
- 2-4 Erase Application block
- 2-5 Request download
- 2-6 Transfer data
- 2-7 Request transfer exit
- 2-8 Write segments replay steps 2-5 to 2-7
- 2-9 Check routine
- 2-10 Write next block, replay steps 2-4 to 2-9
- 2-11 Check reprogramming dependencies
- 2-12 Erase Flash Driver
- 2-13 ECU reset

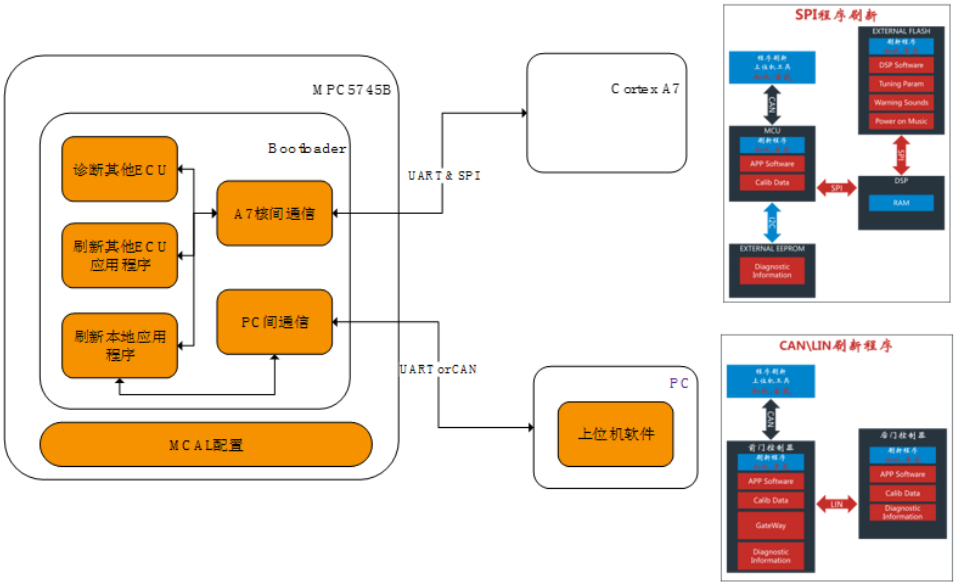
- 知从青龙 BootLoader 支持通用汽车的程序更新规范，运行过程如下：
  The ZC.Qinglong BootLoader is compliant with General Motors' program update specifications, and JKJIJN the operational process is as follows:



5.4 通信协议支持 Communication Protocol Support

知从青龙 BootLoader 支持 CAN/LIN/SPI 等通信协议，满足不同的客户需求。

The ZC.Qinglong BootLoader supports communication protocols such as CAN, LIN, and SPI, meeting the diverse needs of customers.。



6 过程文档 PROCESS DOCUMENTATION

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

开发流程 Development Process	文档描述 Document Description
Software Integrationand Integration Testing	集成测试策略 Integration Testing Strategy
	集成测试报告 Integration Testing Report
	资源分析报告 Resource Analysis Report
软件认可测试 Software Acceptance Testing	BootLoader 软件测试报告 BootLoaderSoftware Test Report
	BootLoader 软件测试报告评审 BootLoaderSoftware Test Report Review
发布 Release	发布文档 Release Documentation

7 功能安全 FUNCTIONAL SAFETY

a) 功能安全评估报告 Functional Safety Assessment Report

b) 功能安全证书 Functional Safety Certificate

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

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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 *PROJEKT-NR/-ID*	LICENSED TEST MARK *GENEHMIGTES PRÜFZEICHEN*	CERT. REPORT NO. *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

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

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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 二十五 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 COPYRIGHT REGISTRATION CERTIFICATE

公众号 业务联系

成为全球领先的汽车基础软件公司
To Be the Global Leading Automotive Basic Software Company