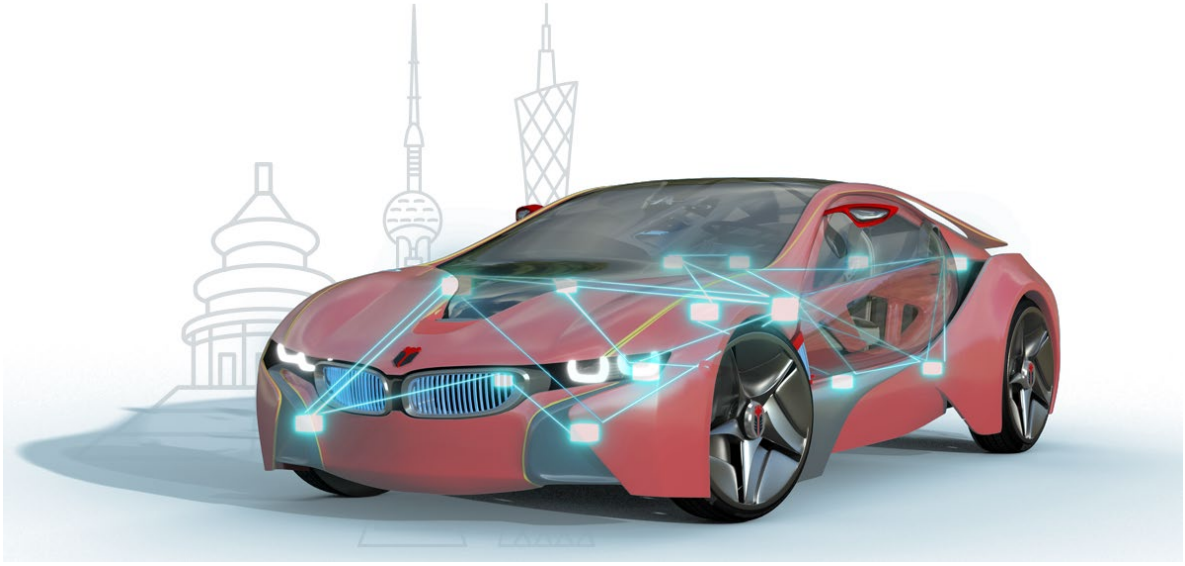
知从木牛基础软件英飞凌 TC4X 产品手册

ZC.MUNIU BASIC SOFTWARE PRODUCT MANUAL BASED ON INFINEON TC4X

知从木牛基础软件平台

ZC.MuNiu Basic Software Platform



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1 功能概述 FUNCTIONAL OVERVIEW

知从.木牛（ZC.MuNiu）为汽车电子控制器产品开发，提供完整的基础软件平台解决方案。该产品参考 AUTOSAR、OSEK 等国际规范，有基于 AUTOSAR ATOP 架构的上位机配置工具，支持上汽、一汽、吉利、广汽、长安、长城等整车厂通讯、诊断、网络管理、启动刷新规范。

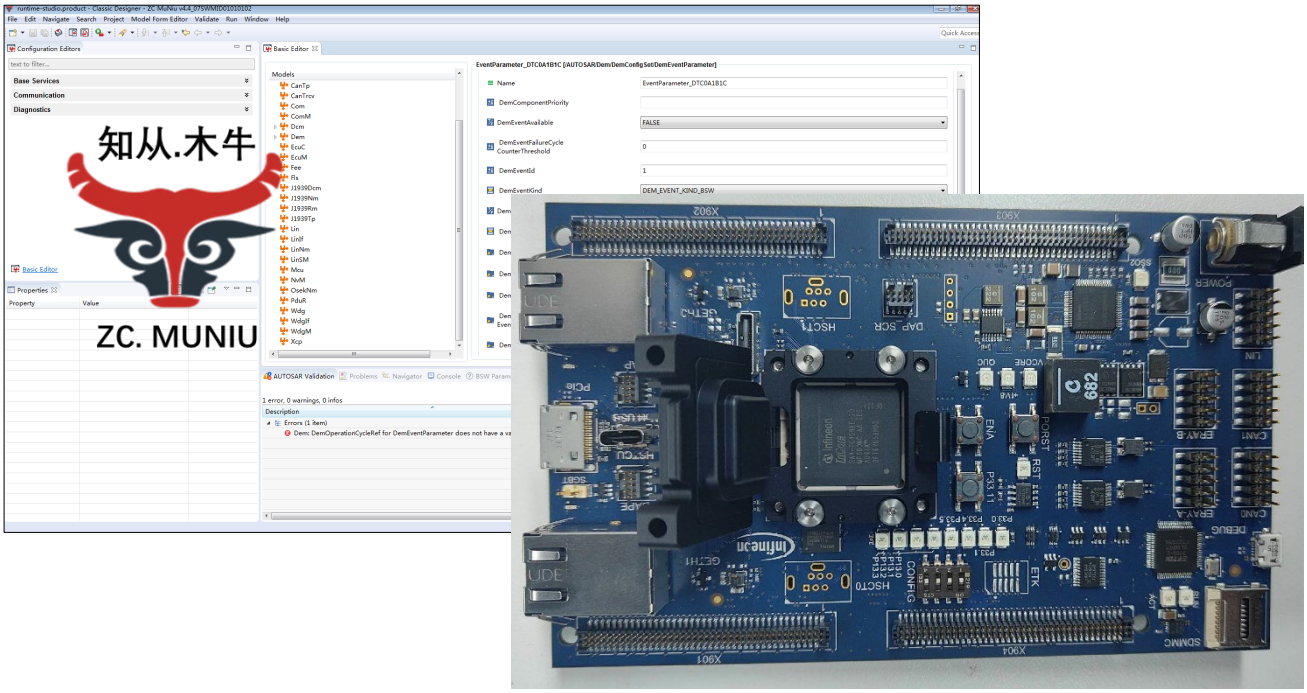
ZC.MuNiu provides a complete basic software platform solution for the development of automotive electronic control units. The product refers to international standards such as AUTOSAR and OSEK, and includes a configuration tool for the upper machine based on the AUTOSAR ATOP architecture, supporting communication, diagnosis, network management, and bootloader and refresh specifications for major vehicle manufacturers such as SAIC Motor, FAW, Geely, GAC Group, Changan Automobile, and Great Wall Motors.

英飞凌 AURIX TC4x 系列微控制器基于 TriCore 1.8 内核，为下一代 ADAS、汽车 E/E 架构和日趋复杂的汽车应用软件架构而设计。英飞凌 AURIX TC4x 系列微控制器支持高速通信接口（ETH 以太网和），为客户提供了新的汽车 E/E 架构所需的性能、吞吐量和灵活性。英飞凌 AURIX TC4x 系列微控制器具备高安全性，符合 ISO 21434 信息安全标准，并能够支持 ISO26262 标准 ASIL-D 功能安全等级应用。

Infineon AURIX TC4x series microcontroller is based on the TriCore 1.8 core and designed for the next generation of ADAS, automotive E/E architecture, and increasingly complex automotive application software architecture. The Infineon AURIX TC4x series microcontrollers support high-speed communication interfaces (ETH Ethernet), providing customers with the performance, throughput, and flexibility required for new automotive E/E architectures. The Infineon AURIX TC4x series microcontroller complies with ISO 21434 information security standard, and can support ISO26262 standard ASIL-D functional safety level application.

上海知从科技作为英飞凌的全球重要合作伙伴和 PDH，为 AURIX TC4x 系列微控制器提供了基础软件平台，主要包括：多核操作系统、通讯协议栈（CAN\LIN）、诊断协议栈(UDS\J1939)、网络管理（OSEK\AUTOSAR）、标定协栈（XCP\CCP）、存储协议栈、复杂驱动模块等，配套知从的 Bootloader 刷新程序和上位机工具，可以根据不同的客户项目要求进行配置和再开发。知从科技提供基础软件产品的同时，也提供控制器基础软件功能实现的开发服务。

Shanghai ZC is important global partner and PDH of Infineon, provides the basic software platform for AURIX TC4x series microcontroller. Mainly includes: muti-core operating system, communication protocol stack (CAN/LIN), diagnostic protocol stack (UDS/J1939), network management (OSEK/AUTOSAR), calibration protocol stack (XCP/CCP), storage protocol stack, complex driver modules, etc., along with ZC's bootloader refresh program and upper machine tool, which can be configured and redeveloped according to different customer project requirements. While providing basic software products, ZC also offers development services for the implementation of control unit basic software functions.



AURIX TC4X 木牛基础软件平台
ZC.MUNIU BASIC SOFTWARE PLATFORM FOR AURIX TC4X

2 应用领域 APPLICATION FIELD

木牛基础软件平台可应用于使用英飞凌 TC4x 系列芯片的汽车电子控制器产品开发。例如：
ZC.MuNiu Basic Software Platform can be applied to the development of automotive electronic control unit products using the Infineon TC4x series chips. For example:

- 新能源整车控制器
  New Energy Vehicle Controller
- 域控制器
  Zone Controller
- 智能驾驶控制器
  Intelligent Driving Controller

3 配置环境 CONFIGURATION TOOL

配置环境 Configuration Environment	
Hardware (Chip)	TC4D9XE
Compilers Supported	Tasking_1.1r8
Evaluation Hardware	KIT_TC4D9XE_COM_TRB_S
Debugger	Isystem IC5700（winIDEA 9.21.150）
Configuration Tools	Muniu_v5.1.3
Configuration Environment	Win10 64bit

Tasking_1.1r8 编译器选项 Tasking_1.1r8 Compiler Options	
编译选项 **Compiler Options**	-cs --dep-file="$(*F).d" --misrac-version=2004 -D__CPU__=tc49x -DAPP_SW=AURIX3G_MCAL_APP -DAURIX3G_MCAL_APP=1U "-fD:/ Demo/TriCore Debug (TASKING)/TASKING_C_C___Compiler-Include_paths__-I_.opt" --iso=99 --c++14 --language=+volatile --strict --fp-model=1 -O2 --tradeoff=1 -g -Ctc49x -Y0 -N0 -Z0 --user-mode=hypervisor
链接选项 **Linker Options**	--lsl-file="../Lcf_Tasking_Tricore_Tc.lsl" -Wl-Oc -Wl-OL -Wl-Ot -Wl-Ox -Wl-Oy -Wl--map-file="${BuildArtifactFileBaseName}.map" -Wl-mc -Wl-mf -Wl-mi -Wl-mk -Wl-ml -Wl-mm -Wl-md -Wl-mr -Wl-mu --no-warnings= -Wl--error-limit=42 --fp-model=2 -lrt --lsl-core=vtc --force-c++ -Ctc49x

4 开发背景 DEVELOPMENT BACKGROUND

AUTOSAR 组织成立于 2003 年，主要由欧洲汽车制造商、部件供应商及其他电子、半导体和软件系统公司联合建立。致力于为汽车工业开发一个开放的、标准化的软件架构；希望大家“在标准上合作，在应用上竞争”提高基础平台的稳定，降低成本，提高控制器产品开发质量和速度。2006 年底发布了 2.1 版规范，2008 年发布 3.1 版本开始产品化；后续逐步增加了功能安全，以太网等内容，目前广泛使用 2014 年后发布的 4.2.1 和 4.2.2 版本，以及 4.3.1 版本。

The AUTOSAR organization was established in 2003, primarily by European car manufacturers, parts suppliers, and other electronic, semiconductor, and software system companies. It is dedicated to developing an open, standardized software architecture for the automotive industry; the goal is for everyone to "cooperate on standards and compete in applications," improving the stability of the basic platform, reducing costs, and enhancing the quality and speed of controller product development. The 2.1 version of the specification was released at the end of 2006, and the 3.1 version was released in 2008, marking the beginning of productization; subsequently, functionalities such as functional safety and Ethernet were gradually added. The widely used versions are the 4.2.1 and 4.2.2 released after 2014, as well as the 4.3.1 version.

汽车在电动化、网联化、智能化的大趋势下，电子电器部件日益增多，电气结构越加复杂，整车开发周期不断缩短。平台化、智能化的基础软件起到至关重要。

With the trend of electrification, networking, and intelligence in the automotive industry, the number of electronic and electrical components is increasing, the electrical structure is becoming more complex, and the development cycle of the whole vehicle is continuously shortening. The platform-based, intelligent basic software plays a crucial role.

知从.木牛（ ZC.MuNiu ）为汽车电子控制器产品开发，提供完整的基础软件平台解决方案。该产品符合 AUTOSAR、OSEK 等国际规范，有基于 AUTOSAR ATOP 架构的上位机配置工具，支持上汽、一汽、吉利、广汽、长安、长城等整车厂通讯、诊断、网络管理规范。该平台主要包括：操作系统、通讯协议栈（CAN\LIN）、诊断协议栈(UDS\J1939)、网络管理（OSEK\AUTOSAR）、标定协栈（XCP\CCP）、存储协议栈、复杂驱动模块等，配套知从的 Bootloader 刷新程序和上位机工具，可以根据不同的客户项目要求进行配置和再开发。

ZC.MuNiu provides a complete basic software platform solution for the development of automotive electronic control unit products. The product complies with international standards such as AUTOSAR and OSEK, and has an upper machine configuration tool based on the AUTOSAR ATOP architecture, supporting communication, diagnosis, and network management standards for major vehicle manufacturers such as SAIC, FAW, Geely, GAC, Changan, and Great Wall. The platform mainly includes: operating system, communication protocol stack (CAN/LIN), diagnostic protocol stack (UDS/J1939), network management (OSEK/AUTOSAR), calibration protocol stack (XCP/CCP), storage protocol stack, complex driver modules, etc., along with ZC 's bootloader refresh program and upper machine tool, which can be configured and redeveloped according to different customer project requirements.

知从科技提供基础软件产品的同时，也提供符合 ASPICE Level 3 流程和功能安全 ASILB\D 要求的控制器基础软件功能实现的开发服务，SBC 芯片、BCCIC 芯片各种复杂驱动软件的定制开发。同时，集成知从科技的功能安全产品 SafetyFrame，可以满足功能安全要求。

While providing basic software products, ZC also offers development services for the implementation of controller basic software functions that comply with the ASPICE Level 3 process and functional safety requirements of ASIL B/D. It also provides custom development of various complex driver software for SBC chips and BCCIC chips. At the same time, integrating ZC's functional safety product SafetyFrame can meet functional safety requirements.

知从科技掌握 AUTOSAR 平台软件的开发和应用核心技术，提供本地现场支持，质量好，速度快，成本低。

ZC has mastered the core technology of development and application of AUTOSAR platform software, providing on-site local support, with high quality, fast speed, and low cost.

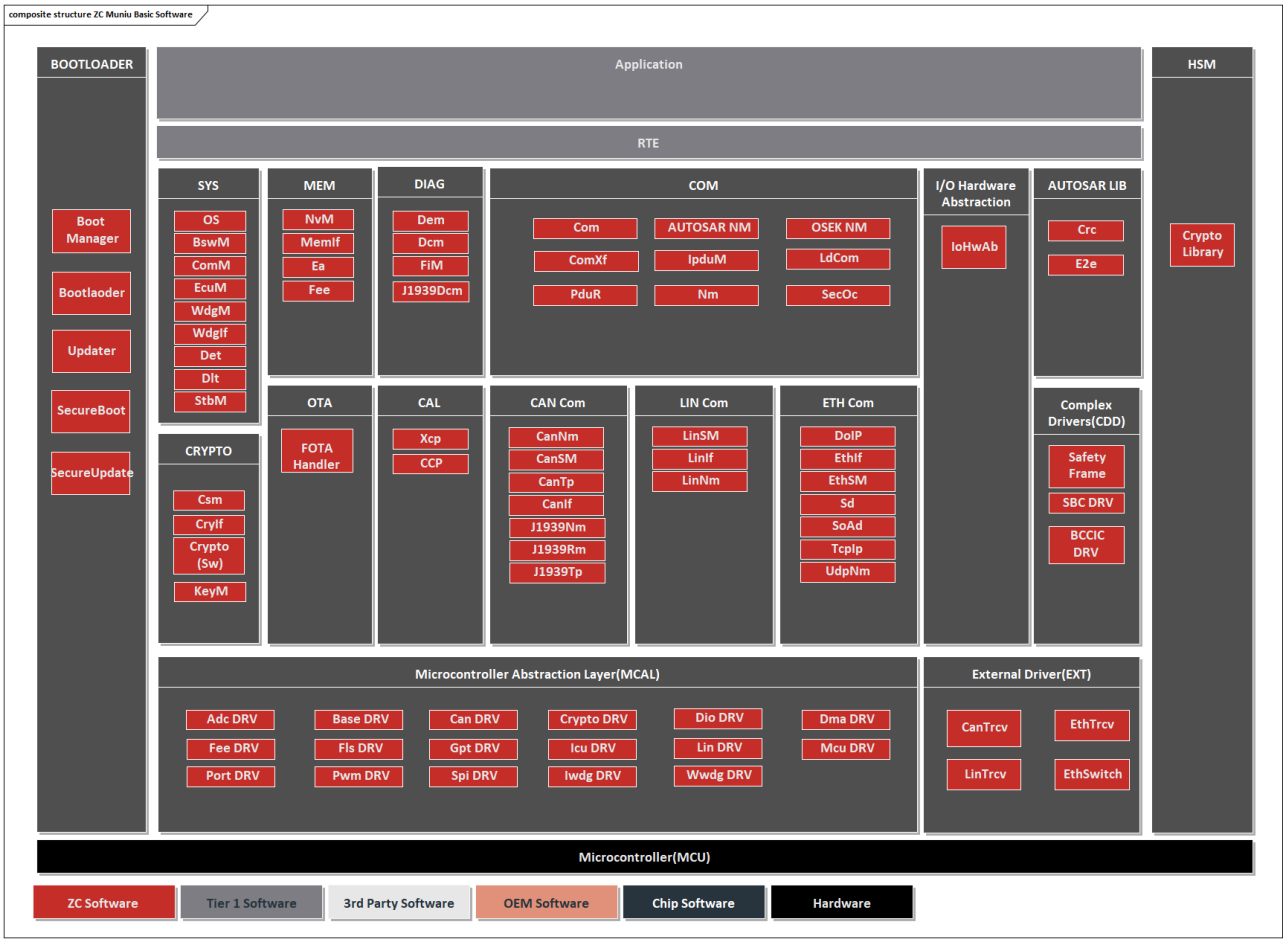
5 功能描述 FUNCTIONAL DESCRIPTION

5.1 产品特点 Product Feature

- 符合 AUTOSAR 4.3.1 版本 Compliant with AUTOSAR 4.3.1 version
- ARTOP 架构上位机配置工具，最高适配 AUTOSAR 4.4.0 版本

  ARTOP architecture upper machine configuration tool, compatible up to AUTOSAR 4.4.0 version
- 多核操作系统 Muti-Core Operating System
- 通讯协议栈 Communication Protocol Stack（CAN\LIN）
- 诊断协议栈 Diagnostic Protocol Stack (UDS\J1939)
- 网络管理 Network Management (OSEK\AUTOSAR）
- 标定协议栈 Calibration Protocol Stack（XCP\CCP）
- 存储协议栈 Storage Protocol Stack
- 加密模块 Cryptography Module（CRYPTO）
- 复杂驱动定制开发 Custom Development of Complex Drivers
- 工程服务 Engineering Services

5.2 软件架构 Software Architecture



知从木牛基础软件平台架构

ZC.MUNIU BASIC SOFTWARE PLATFORM ARCHITECTURE

模块 Module	子模块 Submodule		描述 Description
微控制器底层驱动 Microcontroller Abstraction Layer (MCAL)	Can DRV	CAN 驱动 CAN Driver	实现 AUTOSAR 基础软件中硬件驱动的部分 Implement the hardware driver part in the AUTOSAR basic software.
	CanFD DRV	CANFD 驱动 CANFD Driver	
	Lin DRV	LIN 驱动 LIN Driver	
	Adc DRV	Adc 驱动 Adc Driver	
	Base DRV	Base 驱动 Base Driver	

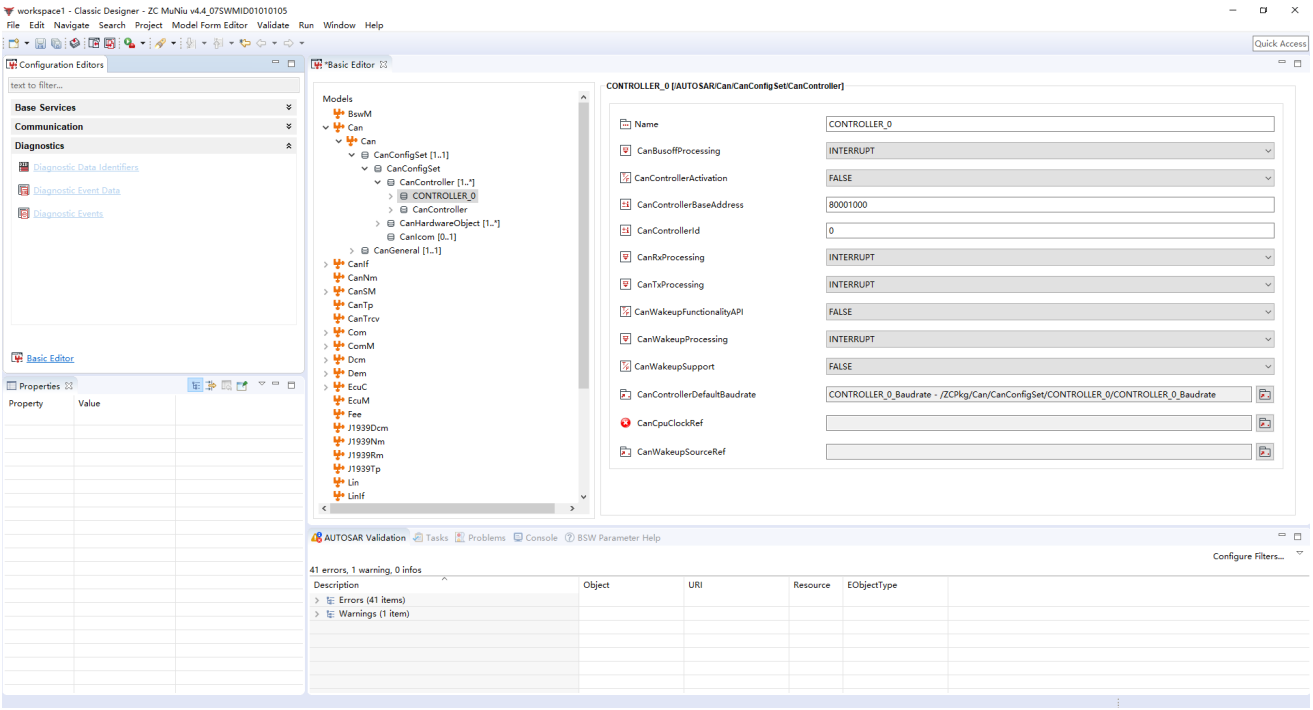
模块 Module	子模块 Submodule		描述 Description
	Crypto DRV	Crypto 驱动 Crypto Driver	
	Dio DRV	Dio 驱动 Dio Driver	
	Fee DRV	Fee 驱动 Fee Driver	
	Fls DRV	Fls 驱动 Fls Driver	
	Gpt DRV	Gpt 驱动 Gpt Driver	
	Icu DRV	Icu 驱动 Icu Driver	
	Mcu DRV	Mcu 驱动 Mcu Driver	
	Port DRV	Port 驱动 Port Driver	
	Pwm DRV	Pwm 驱动 Pwm Driver	
	Spi DRV	Spi 驱动 Spi Driver	
	Iwdg DRV	Iwdg 驱动 Iwdg Driver	
	Wwdg DRV	Wwdg 驱动 Wwdg Driver	
微控制器底层驱动集成包 Microcontroller Abstraction Layer Integrated Package	可集成第三方 MCAL 的集成工程服务包 ZC has an Integrated engineering service package that can be integrated with third-party MCAL.		
外部底层驱动 External Low-Level Driver (EXT)	CanTrcv DRV	CAN收发器驱动 CAN Transceiver Driver	实现外部硬件组件的AUTOSAR基础软件模块 Implement the AUTOSAR basic software module for communication with external hardware
	EthTrcv	Eth收发器驱动 Eth Transceiver Driver	
	LinTrcv	Lin收发器驱动	

模块 Module	子模块 Submodule		描述 Description
		Lin Transceiver Driver	components.
	EthSwitch	Eth交换机驱动 Eth Switch	
系统服务 System Service (SYS)	OS	操作系统 Operating System	实现系统服务的AUTOSAR基础软件模块 Implement the AUTOSAR Basic Software Module for System Services
	BSWM	基础软件模式管理 Basic Software Mode Management	
	COMM	通信管理 Communication Management	
	DET	开发错误追踪 Development Error Tracking	
	ECUM	ECU管理 ECU Management	
	WDGIF	看门狗接口 Watchdog Interface	
	WDGM	看门狗管理器 Watchdog Manager	
	Dlt	诊断日志和跟踪 Diagnostic Log and Trace	
	StbM	同步时基管理器 Synchronized Time-Base Manager	
诊断服务 Diagnostic Service (DIAG)	Dcm	诊断通信管理器 Diagnostic Communication Manager	实现诊断管理的AUTOSAR基础软件协议栈 Implement the AUTOSAR Basic Software Protocol Stack for Diagnostic Management
	Dem	诊断事件管理器 Diagnostic Event Manager	
	FiM	功能抑制管理器 Functional Suppression Manager	
	J1939Dcm	J1939诊断通信管理器 J1939 Diagnostic Communication Manager	
存储服务	EA	EEPROM抽象层	实现非易失性存储管理的基

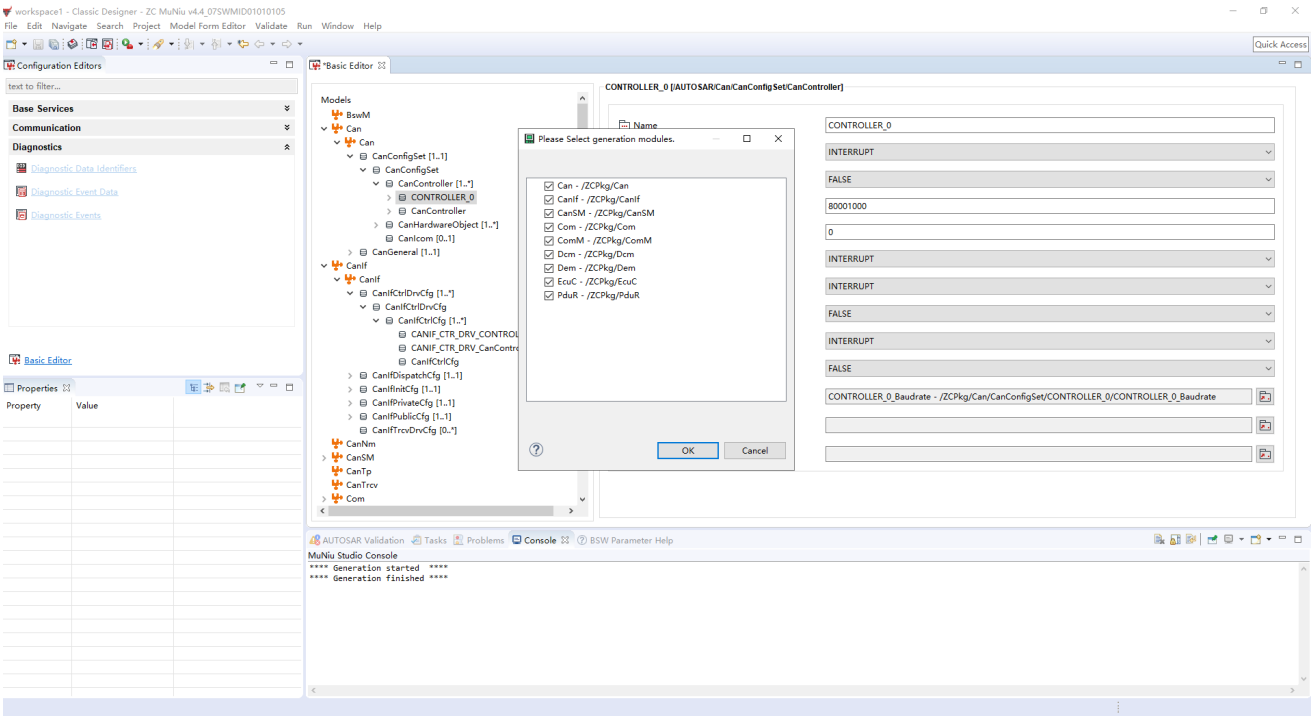
模块 Module	子模块 Submodule		描述 Description
Memory Service (MEM)	FEE	Flash 的 EEPROM 模 拟器	础软件协议栈 Implement the Basic Software Protocol Stack for Non-Volatile Storage Management
	MEMIF	存储器抽象层接口	
	NVM	NVRAM管理器	
通信服务 Communication Service (COM)	COM	通信 Communication	实现通信管理的基础软件协议栈 Implement the basic software protocol stack for communication management.
	AUTOSAR NM	网络管理接口 Network Management Interface	
	OSEK NM	OSEK网络管理 Network Management Interface	
	PduR	PDU路由 PDU Routing	
	ComXf	COM通信序列化 COM Based Transformer	
	IpduM	I-PDU多路复用 I-PDU Multiplexer	
	LdCom	大数据信号通信 Large Data COM	
	Nm	网络管理 Network Management	
	SecOc	安全车载通信 Secure Onboard Communication	
CAN通信 CAN Communication	CANIF	CAN接口 CAN Interface	实现CAN通信的AUTOSAR基础软件模块 Implement the AUTOSAR basic software module for CAN Communication.
	CANNM	CAN网络管理 CAN Network Management	
	CANSM	CAN状态管理器 CAN State Manager	
	CANTP	CAN传输协议 CAN Transmission Protocol	
	J1939Nm	J1939网络管理 J1939 Network Management	
	J1939Rm	J1939请求消息管理	

模块 Module	子模块 Submodule		描述 Description
		J1939 Request Manager	
	J1939Tp	J1939传输协议 J1939 Transmission Protocol	
ETH通信 ETH Communication	DoIP	IP诊断协议 IP Diagnostic Protocol	实现ETH通信的AUTOSAR基础软件模块 Implement the AUTOSAR basic software module for ETH Communication.
	EthIf	ETH接口 ETH Interface	
	EthSM	ETH状态管理器 ETH State Manager	
	Sd	服务发现 Service Discovery	
	SoAd	Socket适配器 Socket Adapter	
	TcpIp	TCP IP协议栈 TCP IP Protocol Stack	
	UdpNm	UDP网络管理 UDP Network Management	
复杂驱动 Complex Driver (CDD)	SBC DRV	电源芯片驱动 Power Chip Driver	实现复杂驱动功能的AUTOSAR基础软件模块 Implement the AUTOSAR basic software module for Complex Driver
	BCCIC DRV	电池管理系统采样芯片驱动 Battery Management System Sampling Chip Driver	
	Safety Frame	功能安全框架 Safety Frame	
… …			

5.3 配置工具 Configuration Tool



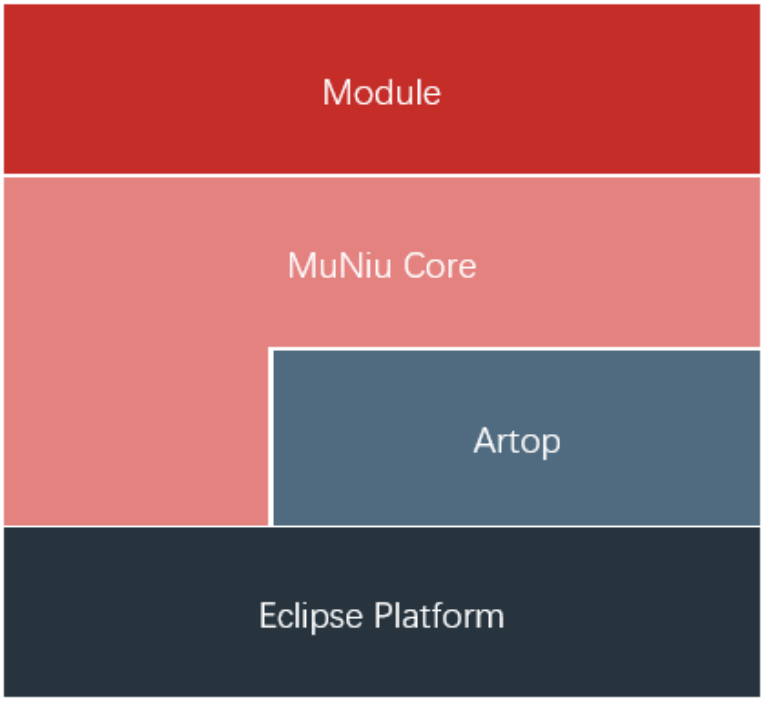
木牛配置工具主界面
MUNIU CONFIGURATION TOOL MAIN INTERFACE



木牛配置工具生成配置代码
MUNIU CONFIGURATION TOOL GENERATES CONFIGURATION CODE

为了满足客户的不同项目需求，提高基础软件平台的扩展性，木牛基础软件平台实现了各个模块可配置性，并且实现了配置工具。客户可根据不同需求，在配置工具上完成各个模块的配置工作，可生成配置代码文件，将生成的配置文件集成到工程中即可。

To meet the diverse project requirements of customers and enhance the scalability of the basic software platform, the MuNiu basic software platform has implemented the configurability of each module and has also developed a configuration tool. Customers can complete the configuration of each module according to different needs on the configuration tool, generate configuration code files, and integrate the generated configuration files into the project.



木牛配置工具架构
ZC.MUNIU CONFIGURATION TOOL ARCHITECTURE

木牛基础软件平台的配置工具是基于 Eclipse 平台，并基于 ARTOP 架构，实现 AUTOSAR 模型和 ARXML 的解析。MuNiu Core 完成配置工具的 UI 界面，在 MuNiu Core 之上的 Module，实现 AUTOSAR 各个模块的配置。配置完成后，可生成各个模块的配置代码。

ZC.MuNiu basic software platform configuration tool is based on the Eclipse platform and is built on the ARTOP architecture, which implements the parsing of the AUTOSAR model and ARXML. ZC.MuNiu Core completes the UI interface of the configuration tool, and the Module on top of ZC.MuNiu Core realizes the configuration of each AUTOSAR module. After the configuration is completed, the configuration code for each module can be generated.

6 过程文档 PROCESS DOCUMENTATION

开发流程 Development Process	文档描述 Documentation Description
需求收集 Requirement Collection	客户需求文档 Customer Requirement Document
软件需求分析 Software Requirement Analysis	需求分析文档 Requirement Analysis Document
	软件需求追踪表 Software Requirement Traceability Matrix
	问题沟通表 Issue Communication Form
软件架构设计 Software Architectural Design	软件架构说明书 Software Architecture Specification
	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	软件详细设计说明书 Software Detailed Design Specification
	配置工具设计文档 Configuration Tool Design Document
	软件详细设计追踪表 Software Detailed Design Traceability Matrix
	软件详细设计评审表 Software Detailed Design Review Form
软件单元测试 Software Unit Testing	QAC 分析报告 QAC Analysis Report
	Tessy 测试报告 Tessy Test 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

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

7 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6824926号

软件名称：知从木牛基础软件平台
[简称：知从木牛]
V4.4

著作权人：上海知从科技有限公司

开发完成日期：2020年06月18日

首次发表日期：2020年09月30日

权利取得方式：原始取得

权利范围：全部权利

登记号：2021SR0100609

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2021年01月19日

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