EAT4A01 Datasheet

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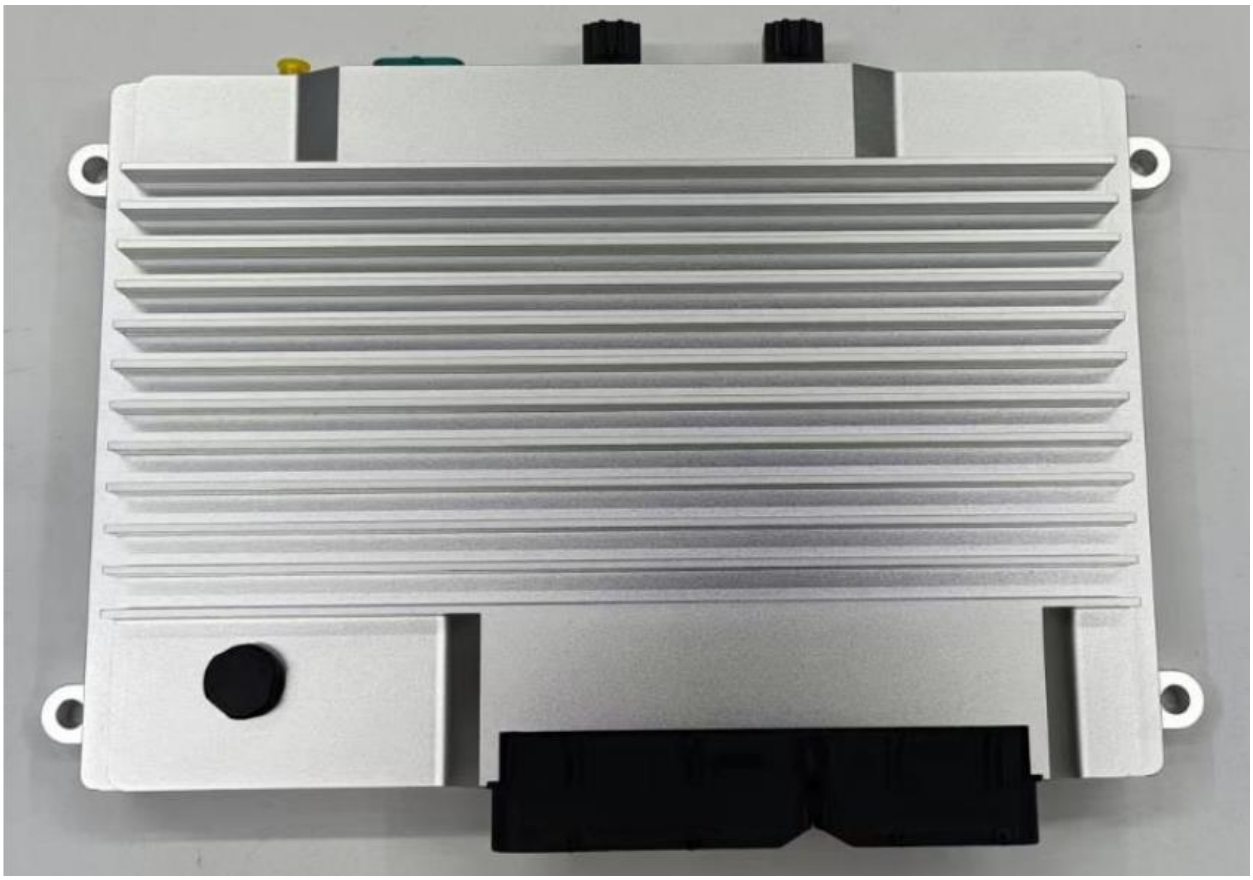
1. Overview

The EAT4A01 automotive intelligent driving computing platform integrates one TI TDA4 chip and one Infineon TC397 chip internally to meet automotive grade applications. It covers the application requirements of passenger car L2/L2.5/L2.9, L4 AVP automatic valet parking and scenario-specific L4 application.



2. Interface

Interface Type	Quantity	Function	Internal Chip	Connector
Camera	6	FPDlink III/GMSL II	SOC	Waterproof Connector
Gigabit Automotive Grade Ethernet	2	1000BASE-T1	Switch	4-chamber waterproof connector
Mbyte Car Ethernet	2	100Base-T1	Switch	
DP	1	Optional		
USB	1	Optional		
M.2 KEY M	1	Optional		
GPS+IMU	1	Optional		
RS232	2	One of the channels is used for Debug	SOC	121PIN-CMC
CANFD	6		SOC	
PPS_IN	1		SOC	
PPS_OUT	2	5V voltage pulse signal	SOC	
CAN/CANFD	8	1 channel with specific frame wake-up	MCU	
LIN	2		MCU	
USS	12	Ultrasonic Radar	MCU	
KEYON	3	1 channel for SOC, 2 channels for MCU		
Digital Inputs	6	Default configuration, 2 way active-high. 4 way active-low	MCU	
Analog Inputs	4	Default configuration, 2 way 5V voltage type, 2 way resistance type	MCU	
Digital low-side output	8	8 channels @ 250mA, including 2 channels supporting PWM	MCU	
5V sensor power supply	2	Maximum current 100mA	MCU	
Power supply positive terminal	6	Redundant power supply design,3 main and 3 backups		
Power Ground	7			

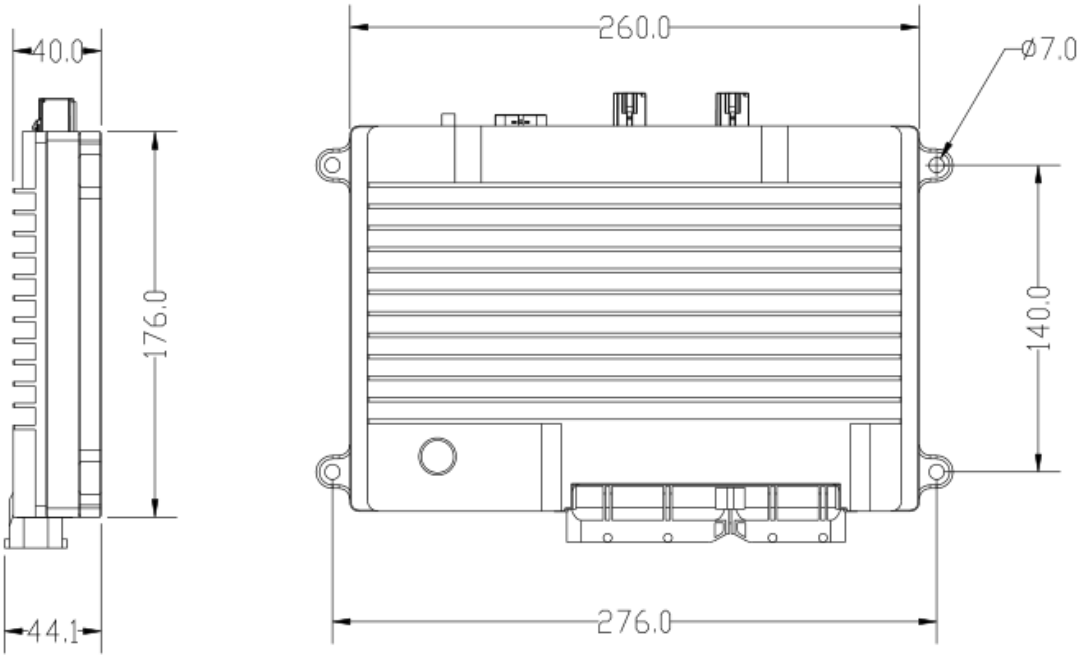
Signal Ground	8			

3. Mechanical

3.1 Dimensions

No special treatment or plating etc. on the outside of the housing shell of the controller, no sharp burrs and sharp edges.

Size: 276mm*176mm*44.1mm;



4. Hardware

The hardware circuit of this computing platform is designed according to the application requirements of the autonomous driving system. The electrical parameters meet the requirements of automotive grade, with a variety of data transmission interfaces to meet the needs of multi-sensor fusion of the autonomous driving system, and the main chip contains a variety of high-performance computing units to fulfill the computing characteristics of sequential and parallel computing for autonomous driving.

4.1 Specifications

Items	Design Metrics
Operating Voltage	DC 9 ~ 36V
Running Space	4GB
Storage Space	64GB
Operating temperature	-40 ~ 85℃
Working humidity	0 ~ 95%, no condensation
Storage temperature	-40 ~ 105℃
Size	276mm*176mm*44.1mm
Protection level	IP67
Heat Dissipation	Passive heat dissipation

4.2 System Main Chip

The TDA4 computing platform is a controller based on the TI TDA4 + Infineon TC397.

Based on the evolved Jacinto™ 7 architecture, the TDA4VM processor family is targeted at ADAS and autonomous vehicle (AV) applications and builds on TI's extensive industry knowledge accumulated over a decade in the ADAS processor market. The unique combination of high-performance computing, deep learning engines, dedicated accelerate design for signal and image processing in a functionally safe target-compliant architecture make the TDA4VM device well suited for multiple industrial applications, such as. Robotics, Machine Vision, Radar, etc. The TDA4VM provides high performance computing for both traditional and deep learning algorithms with an industry leading power/performance ratio and a high level of system integration, enabling scalability and low-cost solution for advanced automotive platforms supporting multiple sensor modes in centralized ECUs or standalone sensors. Key cores include next-generation DSPs with scalar and vector cores, dedicated deep learning and legacy algorithm accelerators, the latest Arm and GPU processors for general-purpose computing, integrated next-generation imaging subsystems (ISPs), video codecs, Ethernet hubs, and isolated MCU island. All of these are protected by automotive-grade safety and security hardware accelerators.

The new generation DSP "C7x" combines TI's industry-leading DSP and EVE cores into one higher-performance core with the addition of floating-point vector computing, enabling backward compatibility with traditional code while simplifying software programming. The new "MMA" deep learning accelerator achieves up to 8 TOPS performance within the industry's lowest power envelope when operating at typical automotive worst-case junction temperatures of 125°C. A dedicated ADAS/AV hardware accelerator provides vision pre-processing as well as distance and motion processing with no impact on system performance.

Items	Design Metrics
CPU	2-Core ARM Cortex-A72, 2.0GHz
Memory	DRAM, LPDDR4-3733, 4GB total memory, inline ECC support
External Storage	eMMC, NOR Flash
Algorithm power	8TOPS
Camera	2 x 4-lane RX and 1 x 4-lane TX interfaces
ISP	TI 7th generation ISP
Ethernet	Integrated Ethernet switch with a total of 8 external ports
PCIE	Up to four 2-lane PCIE Gen3 controllers
Peripheral Interface	1*EDP/DP, 12*UART, 7*SPI, 10*I2C, 16*CAN-FD, 3* PWM, 30* timer, 2*USB
Security	1.0GHz 6-core ARM Cortex-R5F MCU, AEC-Q100, ASIL-D,Embedded Hardware Security Module
Video Encoding	H.264 encoding, H.264/H.265 decoding
Video Output	1 DSI(TX), up to 2.5K
Power consumption	< 8W (AI NET)
Sensors	GNSS/IMU, Camera 4K/1080P, MMW Radar, USR, LiDAR
Processes	16nm FinFET

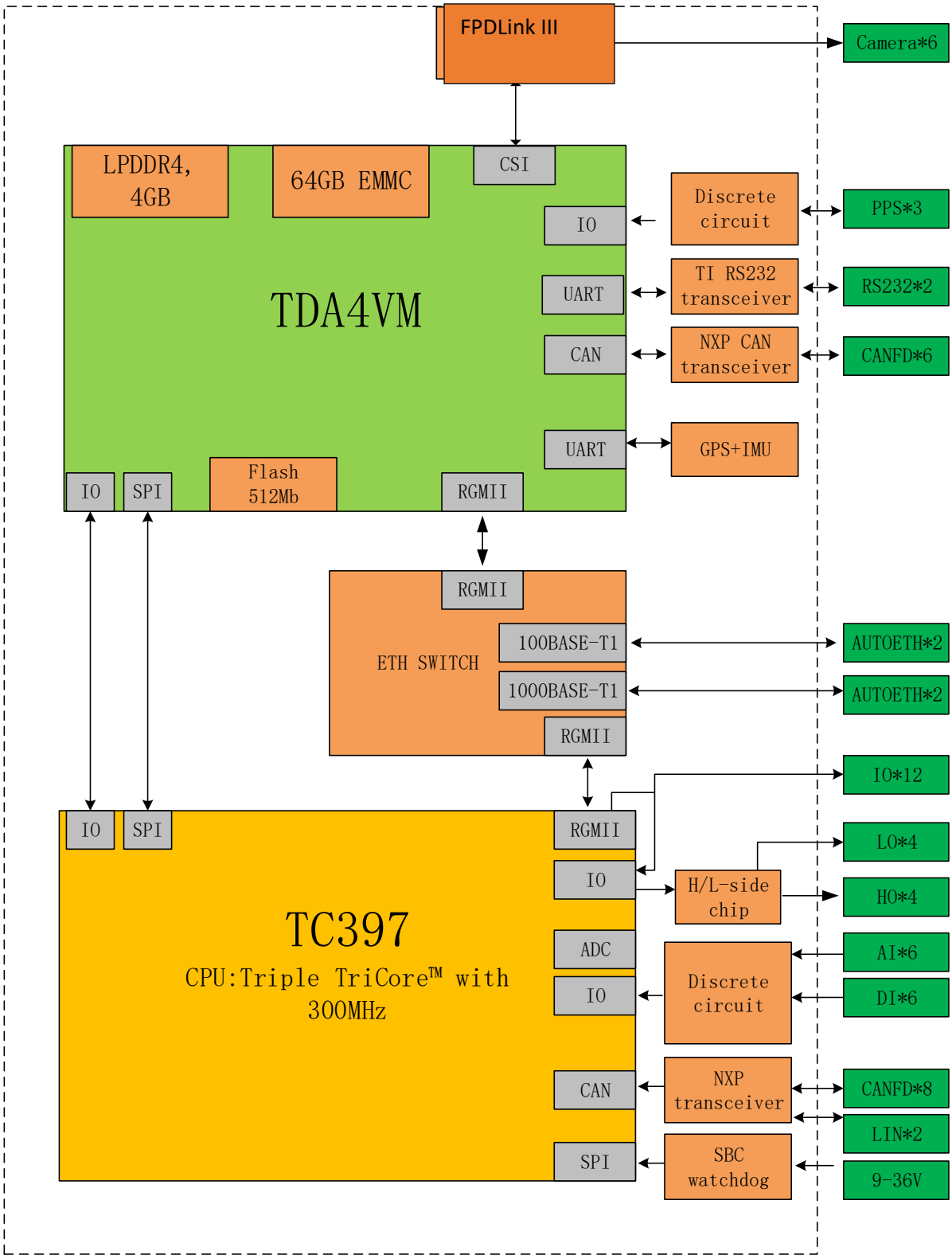
The microcontroller inside the EAT4A01 is Infineon's TC397 series chip, which includes a 300MHz operating frequency 6-core TriCore™ architecture with up to 2.9MB + 16MB Memory and ECC (Error Correction Code) protection RAM, designed based on ISO26262 standard and

supporting the highest security level of ASIL-D. Together with the base chip, it implements the hardware core security architecture design. The chip resources are as follows:

Feature	Detail
Micro Control Core	32-bit Infineon TC397XP
Maximum Frequency	300MHz
Flash	16MB
SRAM	2.9MB
EEPROM	129K
Float Point Capability	Yes
SBC	TLF35584

4.3 Circuit Structure

The hardware circuit structure of EAT4A01 is shown in the following figure.


FPDLink III
Camera*6
LPDDR4, 4GB
64GB EMMC
CSI
IO
Discrete circuit
PPS*3
TDA4VM
UART
TI RS232 transceiver
RS232*2
CAN
NXP CAN transceiver
CANFD*6
UART
GPS+IMU
IO
SPI
Flash 512Mb
RGMII
RGMII
ETH SWITCH
100BASE-T1
AUTOETH*2
1000BASE-T1
AUTOETH*2
RGMII
IO*12
IO
SPI
RGMII
LO*4
IO
H/L-side chip
HO*4
TC397
CPU:Triple TriCore™ with 300MHz
ADC
AI*6
IO
Discrete circuit
DI*6
CAN
NXP transceiver
CANFD*8
LIN*2
SPI
SBC watchdog
9-36V

5. Soc Basic Software

TI TDA4 provides three SDKs, namely Linux SDK, QNX SDK and RTOS SDK. Each SDK is a separate installation package and documentation. As you can see from the name, the DRA829 and TDA4VM share the same set of SDKs, and both the DRA829 and TDA4VM are called J721E. The SDK provides many demos, such as binocular vision, dense optical flow, AVP deep learning, target detection, and so on.

The QNX SDK is used only after the QNX BSP is purchased, and general development is mainly based on the RTOS SDK and occasionally the Linux SDK. These SDKs are all compiled and developed based on the Ubuntu 18.04 64bit environment. The MCU part is also developed in the Ubuntu environment, which makes it difficult to develop the existing common Windows interface MCU. The new version of the SDK also starts to provide tools for Windows environment.

The Linux SDK is most often used for bootstrapping, operating systems, and file systems on the A72 core, and is generally only used when modifying this part.

The RTOS SDK is the primary SDK for development on the TDA4VM. because the most important feature of the TDA4VM chip is the heterogeneous multi-core, where the packages for the R5F core, C66x core, and C7x deep learning core are in the RTOS SDK. Use psdk_rtos/scripts/setup_psdk_rtos.sh to install the dependent libraries and download the compiler. Once done, you can go to vision_apps and use ***make sdk*** and ***make vision_apps*** to compile deep learning or camera related demos. RTOS SDK mainly uses an open source compilation framework, concerto, which is based on Makefile and can automatically search for all concerto.mak files in the current directory and analyze the dependencies to compile all the firmware for each core at once.

TI's platform also provides a variety of debugging ways: TF card, serial port, CCS JTAG, Lauterbach, etc.

TF card: As described in the Linux SDK chapter, TDA4 development is generally based on the BOOT partition and rootfs partition of the TF card, which is constantly updated with the programs in the TF card and thus develop A72, C66x, C7x, and R5F.

Serial port: the most classic debugging method is to add printing, TDA4 has multiple serial ports, by default A72 will print out the debugging information of each core through the serial port.

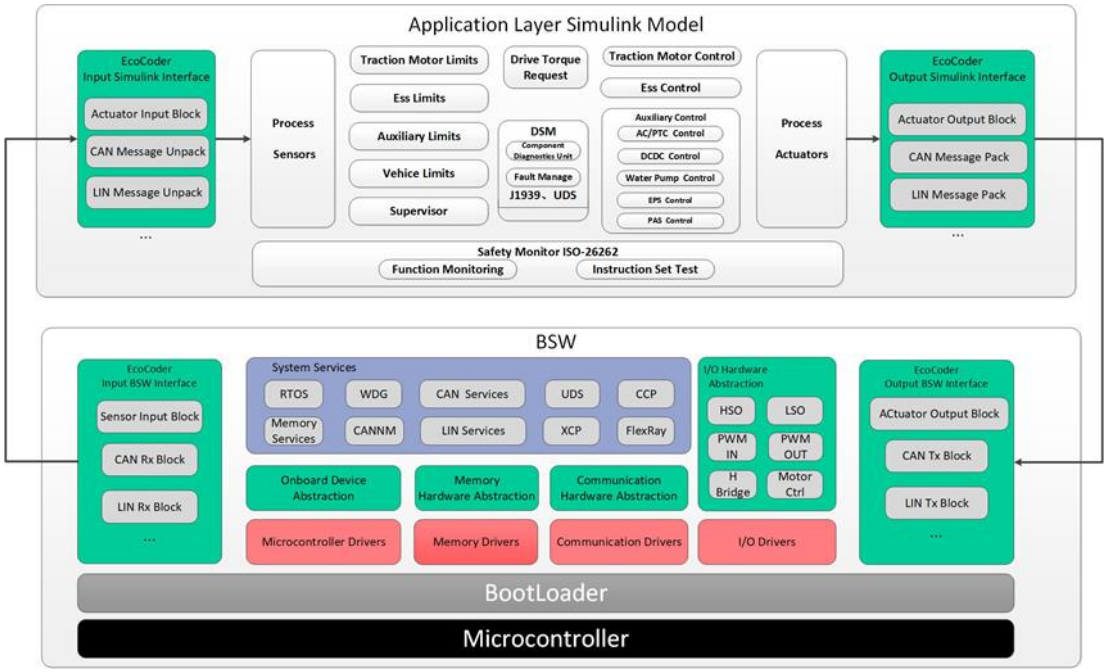
MCU R5F development: MCU R5F can be developed using both ***TF card*** and ***Nor FLASH***. It can be flashed into Nor FLASH through the u-boot command line of the TF card, or through the serial port using the UNIFLASH tool provided by TI.

CCS JTAG debugging: JTAG is almost universal for chip debugging, it can load the code and attach to the running code. CCS is a graphical development and debugging interface provided by TI, but this development interface cannot be used for the compilation and development of the whole SDK. In the TDA4 development process, generally engineers use the TF card to start normally, after the start, attach the JTAG to the running core, load the symbol table for single-step, breakpoints, memory read and write debugging, etc. JTAG needs to use TI's emulator, from the cheapest XDS110 to the most expensive XDS560v2 can be used to debug TDA4, basically there is no difference in debugging speed.

The software architecture of the MCU inside the TDA4 computing platform is designed with reference to the AUTOSAR architecture standard and is divided into an application software layer and basic software layer. The basic software layer is further divided into microcontroller abstraction layer, ECU abstraction layer, service layer and complex drivers. The application layer software and the base software are integrated through EcoCoder, which uses the s-function in Simulink to encapsulate the underlying interface into the Simulink module

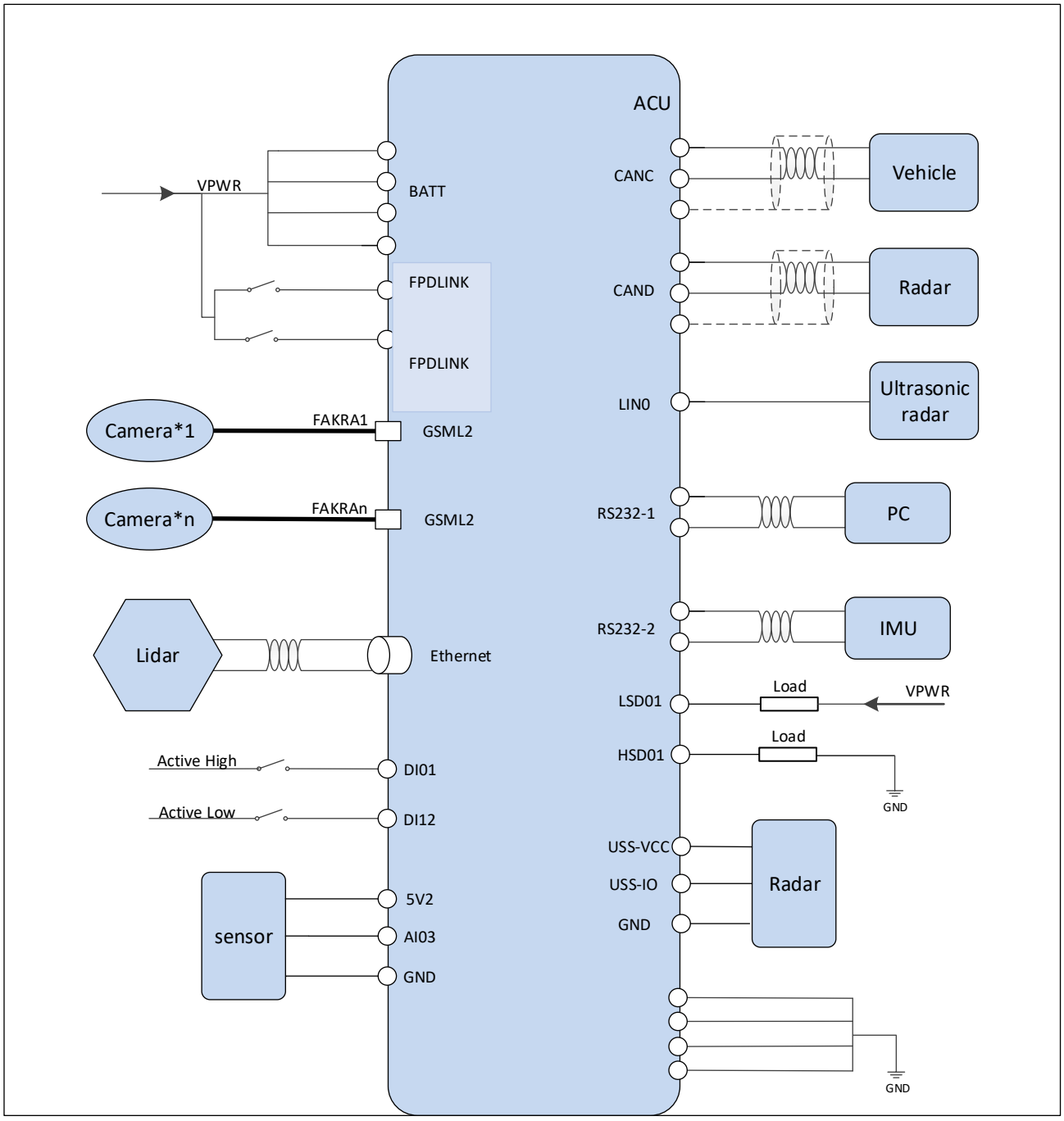
library, so that application developers can use Simulink to build the application layer model. Developers can use Simulink to build application layer models and generate executable program files adapted to TC397 by Simulink with one click.

The EcoCoder encapsulated underlying interface enables reading digital input signals, analog signal status, controlling high and low side outputs, supporting DBC file parsing, protocols such as CCP, UDS, etc., and enabling the definition of observables, calibration variables, NVM variables, etc. The MCU application development is achieved with the calibration software EcoCAL and the flash software EcoFlash.



6. Demo Application

The EAT4A01 is used in the field of autonomous driving and forms the hardware platform of the autonomous driving system with sensors. The common connection methods are shown in the figure below.

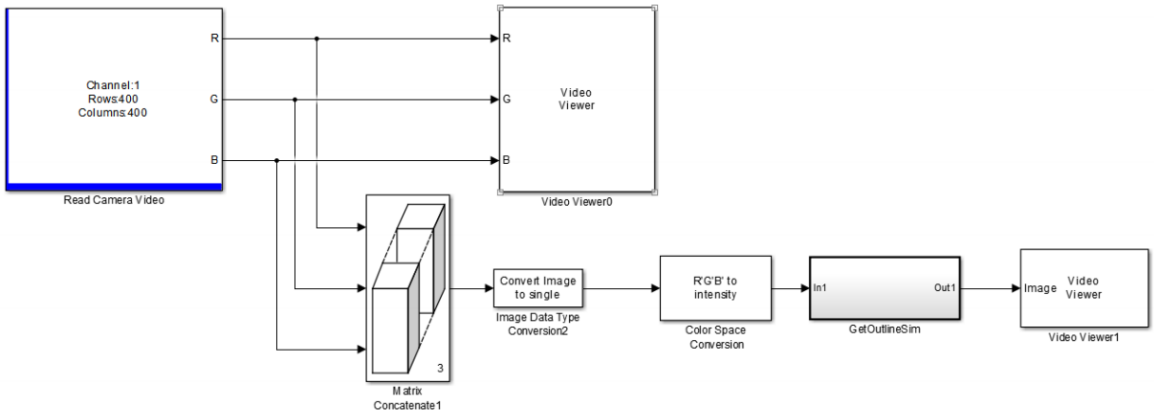


7. Development Tool

A combination of hardware, operating system stacks, and runtime environments are not capable enough to achieve autonomous driving, therefore, users need to develop software that can perform specific functionality and deploy them to EAORA04-D. For autonomous driving processor Orin, development tool is provided: EcoCoder-AI. For MCU Infineon TC297, three development tools are provided: EcoCoder, EcoCAL, and EcoFlash. Developers can select the tools they need.

7.1 EcoCoder-AI

EcoCoder-AI is a powerful automatic code generation library based on Matlab / Simulink that links directly to the target controller. EcoCoder-AI integrates code generation, compilation and one-click generation of executable files. In addition, the control model based on Simulink can be directly converted into an ROS-based executable program suitable for the target controller and downloaded to the target controller. For details, please refer to EcoCoder-AI Manual.



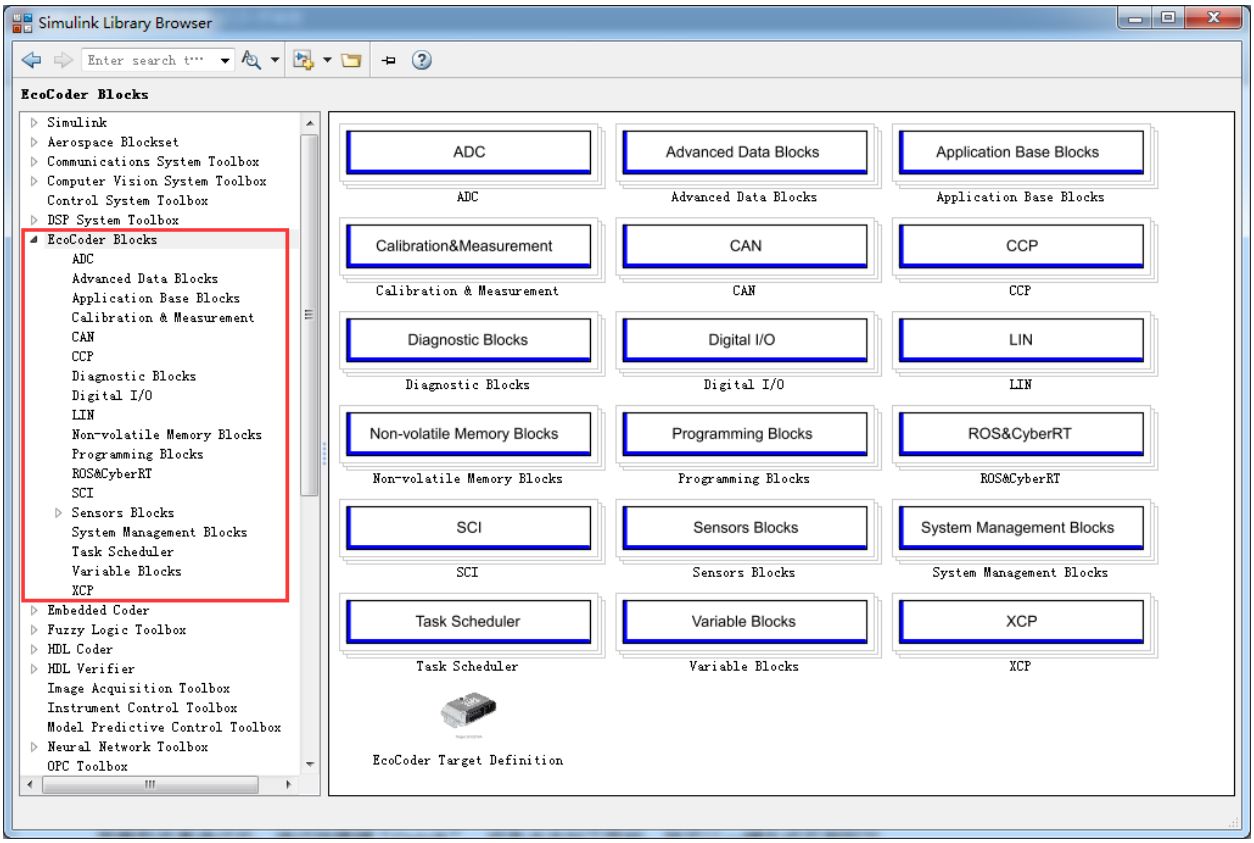
7.2 EcoCoder

EcoCoder is an application development tool for the control system, which makes it easier for users to develop embedded application software in the Simulink environment. It expands the resources of Simulink and Real-Time Workshop embedded encoders to generate the necessary code module and automatically configures and optimizes code generation. By encapsulating the

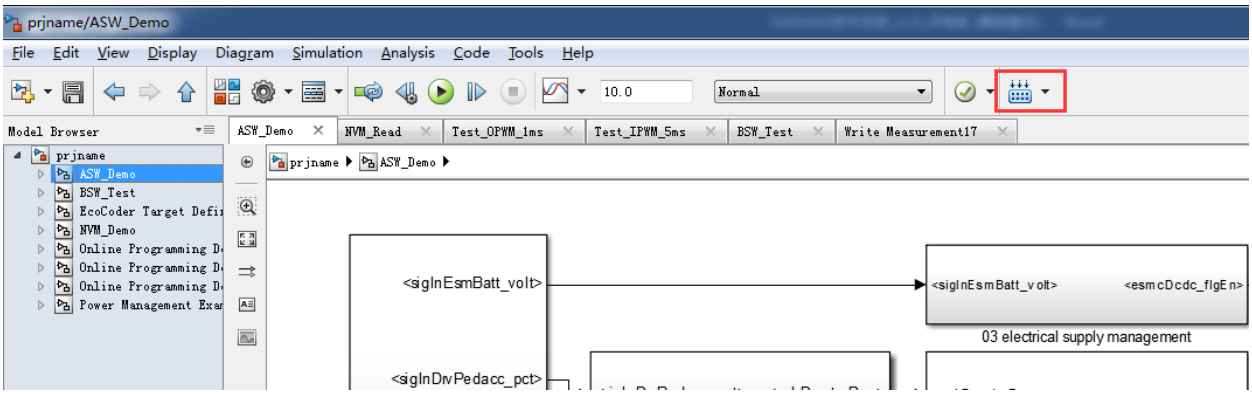
low-level software library to s-functions, EcoCoder allows developers to use low-level software interfaces by model-based-design method and configure basic parameters. It can generate executable files and data description files with one click and provide .a2l file address update tool.

Features:

- Users develop embedded application software in the Simulink environment.
- Application developers can focus on control strategy development without knowing all the information about hardware.
- By encapsulating the low-level software library to s-functions, EcoCoder enables developers to use the low-level software interfaces and configure parameters using the model-based-design method.
- Executable file and data description file can be generated by one click, and an .a2l file address update tool is provided. During the generation, the code generated by the model is integrated with the low-level software automatically in the background, then makefile is used to call the compiler to generate executables.



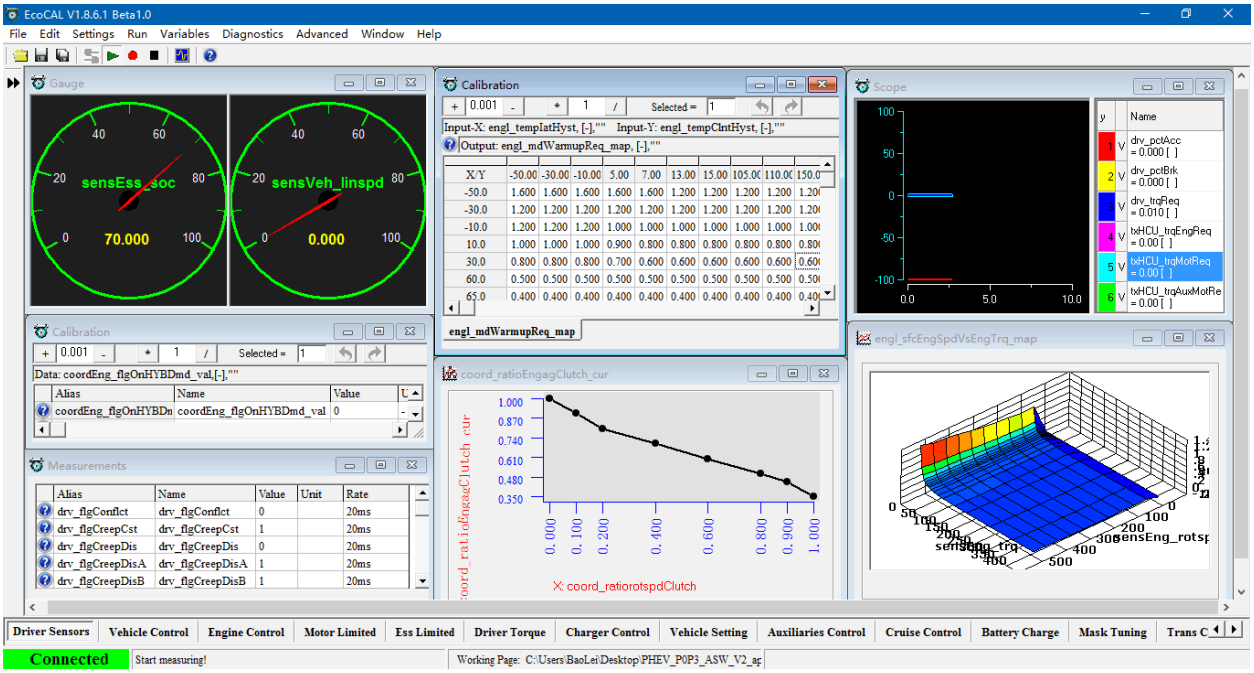
After compilation of the model, use the shortcut “Ctrl + B” or click the button shown below, the flash-able file will be generated.



Developers can use EcoCoder to develop application software for MCU in EAORA04. Please refer to EcoCoder User Manual.

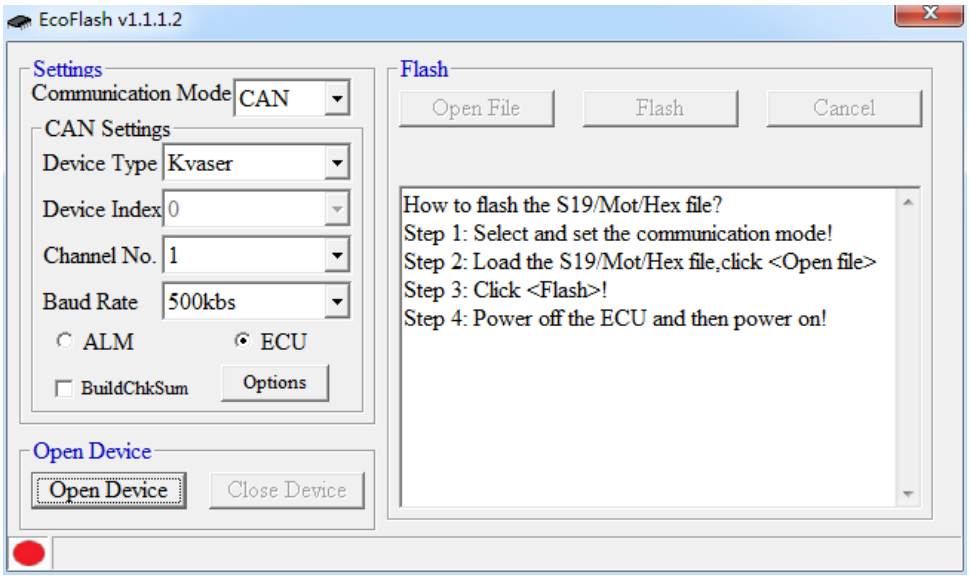
7.3 EcoCAL

EcoCAL is a PC-side calibration software based on the CCP protocol. By loading .a2l and .hex files, to achieve real-time observation and online calibration. It can assist control strategy development engineers to debug and calibrate application software. Please refer to EcoCAL User Manual for more details.



7.4 EcoFlash

EcoFlash is PC-side software working with BootLoader to flash target program files. It uses CAN communication protocol CCP/UDS, and support.s19, .mot and .hex files.

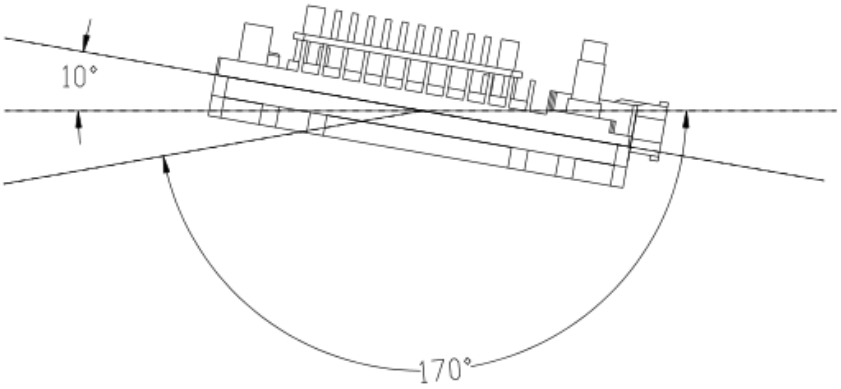


8. Installation Requirements

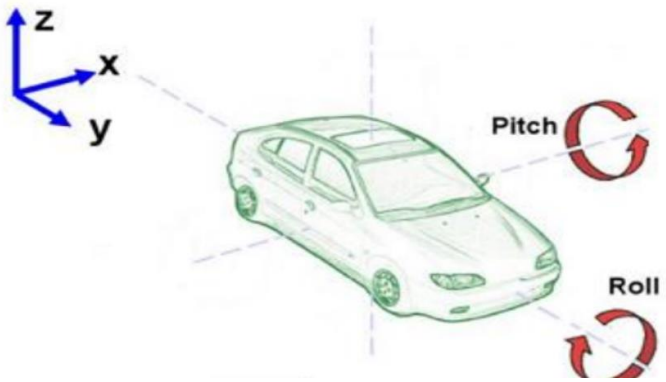
It is recommended to install the ADCU in the cockpit. If the OEM wants to assemble the ADCU in another location, the corresponding installation location should be evaluated by Ecotron's engineers and the OEM's engineers.

The precautions for ADCU installation are as follows:

1. The installation of ADCU and wiring harness should be firm and reliable, and there should be no looseness. Avoid supporting the wiring harness by ADCU. At the same time, the arrangement of ADCU wiring harness should prevent and protect all wires in the wiring harness from damage due to wear and overheating.
2. Try to avoid installing in places where dust is easy to gather, a large amount of dust accumulation will affect the reliability of ADCU work.
3. ADCU should keep away from the location where the temperature of the shell itself may exceed 70°C. At the same time, it is necessary to prevent the surrounding parts from releasing heat to the ADCU.



4. Avoid installing the ADCU in locations where oil, moisture, and water droplets are likely to splash on it.
5. Avoid the possibility of additional mechanical shock and external impact due to the installation position and fixing method of the ADCU and avoid installing the ADCU at the resonance point of the car body.
6. Avoid installing the ADCU where it may come into contact with the battery or other parts that are prone to seepage of acid and alkaline solutions, and near the ADCU power terminal.
7. Avoid installing the ADCU where it may come into contact with the positive terminal of Battery and the ignition power terminal.
8. ADCU should be installed in the horizontal and vertical position according to the connector downwards and maintain a certain angle to prevent water from entering the connector. In the horizontal direction, the recommended installation angle is -170° to -10°, as shown in Figure below. In the vertical direction, the recommended installation angle is -170°~ -10°, as shown in Figure below.



Z Axis: Vertical Direction

X Y Axes: Horizontal Direction

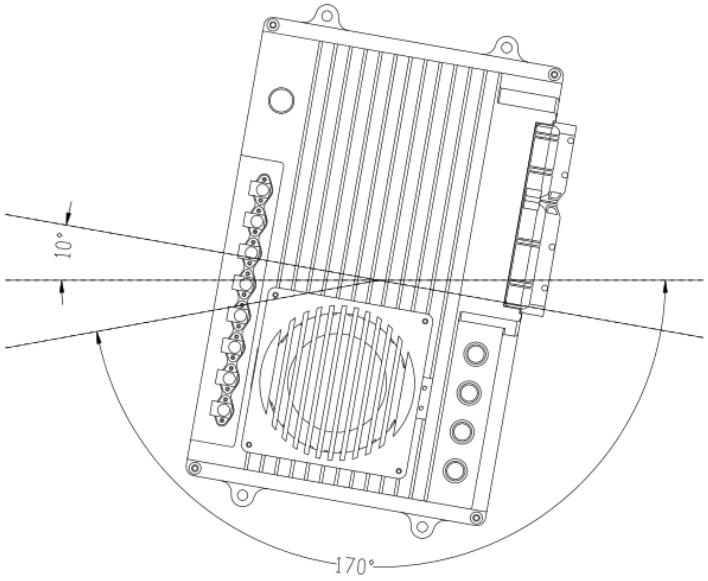


Figure: Vertical Installation Angle

Ecotron recommends using the 4 installation points on the ADCU for installation and fixation. It is recommended to use metal materials such as aluminum alloy for the mounting bracket, and the housing should have a reliable electrical connection with the vehicle body through the

bracket. If other materials are used, the customer must ensure that it can meet the requirements of ADCU for vibration, heat dissipation, temperature, EMC, etc. If there is any deviation, it needs to be confirmed with Ecotron.

9. High-speed signal lines such as harness installation, network cables, video cables, etc. should keep away from areas of high voltage, radiation interference such as motors, battery packs, DCDCs as far as possible.