



# EV22297A03 Datasheet

v1.0

## Revision History

Date	Version	Description	Reviewer
10/2022	V 1.0	First Release Differences between EV22297A02 and EV22297A03: 1. EV22297A03 merges PGND and GND as GND 2. Low-side PWM output doesn't have fault diagnostic function 3. Change the capacitance of CAN Bus C1 to 100nF/50V 4. Change 3.4 EMC test ESD standard to "ISO 10605"	Jason Du

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## Chapter 1 General Information

### 1.1 Introduction

VCU (Vehicle Control Unit) is the master controller for electric and hybrid vehicles. VCU is responsible for the vehicle's power system energy management, power mode management, and electrical auxiliary control. Its core functions include power on/off management, power system management, drive mode management, drive and brake control, auxiliary management, and fault diagnosis.

#### 1.1.1 Functionality

EV22297A03 has the following functions:

Table 1.1.1.1 EV22297A03 Features

Feature
1 Key switch (KEYON)
1 Hardwire wakeup (WAKEUP)
4 Power supply (BATT)
9 5V Outputs
6 CAN Bus ports: CAN_A, CAN_B, CAN_C, CAN_D support ISO CANFD. CAN_E, CAN_F support CAN 2.0A/B and specific frame wake up
1 LIN Bus port
2 FlexRay Bus port
13 Digital signal inputs: 2 channels active high, 11 channels active low
22 Analog signal inputs: 8 channels of 0-5V voltage type input, 6 channels of 0-5V resistor type input, and 8 channels of 0-32V voltage type input
4 Frequency signal inputs
10 High-side driver outputs
26 Low-side driver outputs: 7 configurable as PWM outputs
Hardware watchdog

### 1.1.2 Mechanism

The housing of VCU is formed by aluminum die-casting and assembled with silicone rubber. There is no special treatment or plating on the outside of the housing, no sharp burrs and sharp edges.

The nominal dimensions of the VCU housing are as follows (excluding the female end of the VCU connector, in mm):

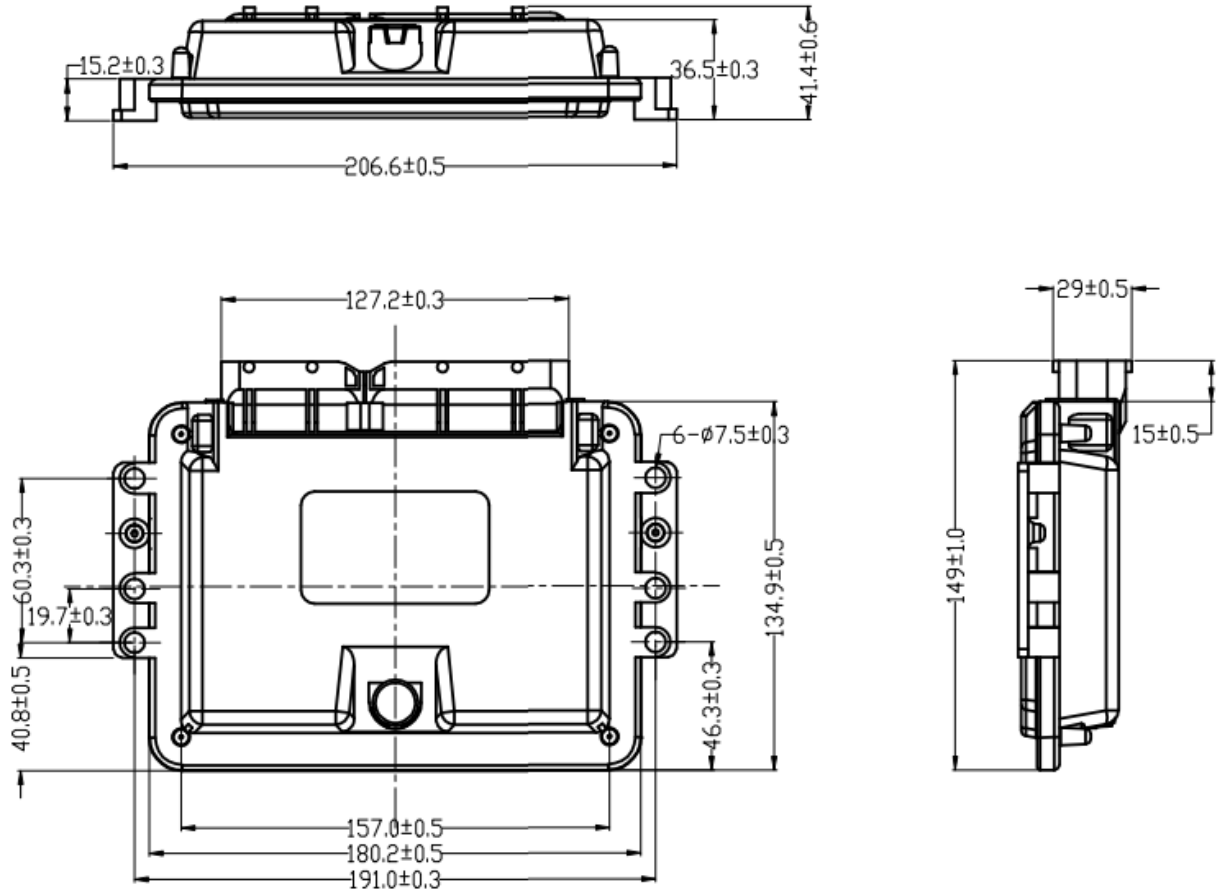


Figure 1 VCU Housing Size

The appearance of the housing is as follows:



## Figure 2 VCU Housing Appearance

The socket model used for disassembling the housing: Torx T15.

The product identification label is affixed to the VCU housing, which contains the product identification code, customer information, date, batch number, serial number, etc.

### 1.1.3 Harness Connector

VCU uses the world-renowned “TE connectivity” brand connector, which is a qualified product that meets the automotive safety level and has 121 pins. The specific models of the connectors are as follows.

Table 1.1.3.1 Harness Connector Info

#	Name	Part number	Supplier	URL
1	PCB Pin Seat	1746979-1	TE	<a href="https://www.te.com/usa-en/product-1746979-1.html">https://www.te.com/usa-en/product-1746979-1.html</a>
2	81P Housing	1473244-1	TE	<a href="https://www.te.com/usa-en/product-1473244-1.html">https://www.te.com/usa-en/product-1473244-1.html</a>
3	40P Housing	1473252-1	TE	<a href="https://www.te.com/usa-en/product-1473252-1.html">https://www.te.com/usa-en/product-1473252-1.html</a>
4	81P Cover Assembly	1473247-1	TE	<a href="https://www.te.com/usa-en/product-1473247-1.html">https://www.te.com/usa-en/product-1473247-1.html</a>
5	40P Cover Assembly	1473255-1	TE	<a href="https://www.te.com/usa-en/product-1473255-1.html">https://www.te.com/usa-en/product-1473255-1.html</a>
6	81P TPA	368382-1	TE	<a href="https://www.te.com/usa-en/product-368382-1.html">https://www.te.com/usa-en/product-368382-1.html</a>
7	40P TPA	368388-1	TE	<a href="https://www.te.com/usa-en/product-368388-1.html">https://www.te.com/usa-en/product-368388-1.html</a>
8	Terminal (wire diameter 0.2-0.35)	5-968220-1 (968220-1)	TE	<a href="https://www.te.com/usa-en/product-5-968220-1.html">https://www.te.com/usa-en/product-5-968220-1.html</a> ( <a href="https://www.te.com/usa-en/product-968220-1.html">https://www.te.com/usa-en/product-968220-1.html</a> )
9	Terminal (wire diameter 0.5-0.75)	5-968221-1 (968221-1)	TE	<a href="https://www.te.com/usa-en/product-5-968221-1.html">https://www.te.com/usa-en/product-5-968221-1.html</a> ( <a href="https://www.te.com/usa-en/product-968221-1.html">https://www.te.com/usa-en/product-968221-1.html</a> )
10	Terminal (wire diameter 0.75-1.0)	964286-2	TE	<a href="https://www.te.com/usa-en/product-964286-2.html">https://www.te.com/usa-en/product-964286-2.html</a>
11	Terminal (wire diameter 1.5-2.5)	964273-2	TE	<a href="https://www.te.com/usa-en/product-964273-2.html">https://www.te.com/usa-en/product-964273-2.html</a>

Harness connector is shown below:

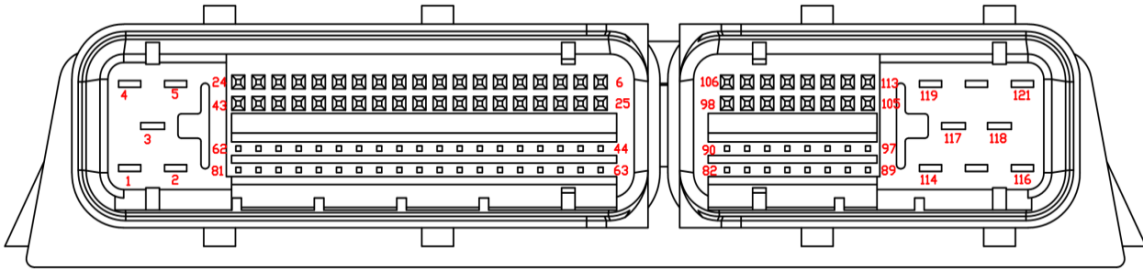


Figure 3 Harness Connector and Pin Distribution Diagram

### 1.1.4 Chip Information

Table 1.1.4.1 Chip Info

Feature	Detail
Micro Control Core	32-bit Infineon TC297TP
Maximum Frequency	300MHZ
Flash	8M
SRAM	728K
EEPROM	512Kbit
SBC	TLF35584QVVS2

### 1.1.5 Power Supply

EV22297A02 requires 4 channels of continuous power supplies (pin1, pin3, pin119, and pin 120), and the VCU is powered on through the key switch (pin24).

Two 5A fuses, one in series with pin1 and pin3, and the other in series with pin119 and pin120 are recommended for EV22297A02 power supply.

### 1.1.6 Bootloader

By default, EV22297A03 is using UDS bootloader.

## Chapter 2 Interface Description

### 2.1 Pin Definition

Table 2.1.1 Pin Definition

Signal Name	PIN	Function	Interface Description	Note
<b>Power Supply</b>				
BATT	1 3	Power Supply	Power Supply 12V/24V	9-32V
	119 120	High & Low Side Output Channels and Digital Frequency Input Channels Power Supply		
5V2	16 22 38	5V Sensor Supply 2	External Sensor 5V Power Supply	Single Channel Output 5V $\pm$ 1%, Sum of Three Channels Maximum 150mA
5V3	19 35 41	5V Sensor Supply 3	External Sensor 5V Power Supply	Single Channel Output 5V $\pm$ 1%, Sum of Three Channels Maximum 150mA
5V4	53 56 59	5V Sensor Supply 4	External Sensor 5V Power Supply	Single Channel Output 5V $\pm$ 1%, Sum of Three Channels Maximum 150mA
GND	4 5 96 97 88 89	Ground	Power Ground	Common ground
GND	42 54 60 74 78	Signal Ground	External 5V Sensor Ground	
<b>Analog Input</b>				
AI01	15	Analog Input 01	Analog Signal Input 0~5V	Voltage Type, 12-Bit Precision
AI02	18	Analog Input 02	Analog Signal Input 0~5V	Voltage Type, 12-Bit Precision
AI03	21	Analog Input 03	Analog Signal Input 0~5V	Voltage Type, 12-Bit Precision
AI04	34	Analog Input 04	Analog Signal Input 0~5V	Voltage Type, 12-Bit Precision
AI05	37	Analog Input 05	Analog Signal Input 0~5V	Voltage Type, 12-Bit Precision
AI06	40	Analog Input 06	Analog Signal Input 0~5V	Voltage Type, 12-Bit Precision
AI08	55	Analog Input 08	Analog Signal Input 0~5V	Voltage Type, 12-Bit Precision
AI09	58	Analog Input 09	Analog Signal Input 0~5V	Voltage Type, 12-Bit Precision
AI07	52	Analog Input 07	Analog Signal Input 0~5V	Resistor Type, 12-Bit Precision
AI11	61	Analog Input 11	Analog Signal Input 0~5V	Resistor Type, 12-Bit Precision
AI12	73	Analog Input 12	Analog Signal Input 0~5V	Resistor Type, 12-Bit Precision
AI13	75	Analog Input 13	Analog Signal Input 0~5V	Resistor Type, 12-Bit Precision
AI14	77	Analog Input 14	Analog Signal Input 0~5V	Resistor Type, 12-Bit Precision



AI15	79	Analog Input 15	Analog Signal Input 0~5V	Resistor Type, 12-Bit Precision
AI16	67	Analog Input 16	Analog Signal Input 0~32V	Voltage Type, 12-Bit Precision
AI17	47	Analog Input 17	Analog Signal Input 0~32V	Voltage Type, 12-Bit Precision
AI18	29	Analog Input 18	Analog Signal Input 0~32V	Voltage Type, 12-Bit Precision
AI19	10	Analog Input 19	Analog Signal Input 0~32V	Voltage Type, 12-Bit Precision
AI20	28	Analog Input 20	Analog Signal Input 0~32V	Voltage Type, 12-Bit Precision
AI21	12	Analog Input 21	Analog Signal Input 0~32V	Voltage Type, 12-Bit Precision
AI22	30	Analog Input 22	Analog Signal Input 0~32V	Voltage Type, 12-Bit Precision
<b>High Voltage Interlock Signal</b>				
AI23	43	High Voltage Interlock Signal Input	Analog Signal Input 0~32V	Voltage Type, 12-Bit Precision
HSO06	90	High Voltage Interlock Signal Output	Rated 0.4A, Peak 0.5A	Voltage High
<b>Power-On Signal</b>				
KEYON/AI27	24	Key Input Signal	Analog Signal Input 0~BATT	12-Bit Precision, Wake-up Threshold>9V
WAKEUP	27	Wake-Up Signal	Digital Signal Input 0~BATT	Wake-up Threshold>9V
<b>Digital Input</b>				
DI11	31	Digital Input 11	Digital Signal Input 0~BATT	Active High (Recommended to Reserve a Not in Use Port to Prevent Entering the Rescue Mode by Mistake)
DI12	68	Digital Input 12	Digital Signal Input 0~BATT	
DI00	66	Digital Input 00	Digital Signal Input 0~BATT	Active Low
DI01	33	Digital Input 01	Digital Signal Input 0~BATT	Active Low
DI02	11	Digital Input 02	Digital Signal Input 0~BATT	Active Low
DI03	70	Digital Input 03	Digital Signal Input 0~BATT	Active Low
DI04	50	Digital Input 04	Digital Signal Input 0~BATT	Active Low
DI05	14	Digital Input 05	Digital Signal Input 0~BATT	Active Low
DI06	69	Digital Input 06	Digital Signal Input 0~BATT	Active Low
DI07	32	Digital Input 07	Digital Signal Input 0~BATT	Active Low
DI08	49	Digital Input 08	Digital Signal Input 0~BATT	Active Low
DI09	48	Digital Input 09	Digital Signal Input 0~BATT	Active Low
DI10	13	Digital Input 10	Digital Signal Input 0~BATT	Active Low
<b>Frequency Input</b>				
SPEED1	71	Frequency Input 1	Frequency Signal Input	Frequency Input Range 1Hz-2KHz
SPEED2	51	Frequency Input 2	Frequency Signal Input	Frequency Input Range 1Hz-2KHz
SPEED3	57	Frequency Input 3	Frequency Signal Input	Frequency Input Range 1Hz-2KHz
SPEED4	76	Frequency Input 4	Frequency Signal Input	Frequency Input Range 1Hz-2KHz
<b>Output Signal</b>				
HSO01	108	High-Side Output 01	Rated 1.5A, Peak 2A	
HSO02	107	High-Side Output 02	Rated 1.5A, Peak 2A	
HSO03	110	High-Side Output 03	Rated 1.5A, Peak 2A	

HSO04	109	High-Side Output 04	Rated 1.5A, Peak 2A	
HSO05	82	High-Side Output 05	Rated 0.4A, Peak 0.5A	
HSO07	98	High-Side Output 07	Rated 0.4A, Peak 0.5A	
HSO08	106	High-Side Output 08	Rated 0.4A, Peak 0.5A	
HSO09	62	High-Side Output 09	Rated 0.4A, Peak 0.5A	
HSO10	2	High-Side Output 10	Rated 0.4A, Peak 0.5A	
LSO01	114	Low-Side Output 01	Rated 1.5A, Peak 2A	
LSO02	121	Low-Side Output 02	Rated 1.5A, Peak 2A	
LSO03	117	Low-Side Output 03	Rated 1.5A, Peak 2A	
LSO04	115	Low-Side Output 04	Rated 1.5A, Peak 2A	
LSO05	116	Low-Side Output 05	Rated 1.5A, Peak 2A	
LSO06	118	Low-Side Output 06	Rated 1.5A, Peak 2A	
LSO07	112	Low-Side Output 07	Rated 0.8A, Peak 1A	
LSO08	113	Low-Side Output 08	Rated 0.8A, Peak 1A	
LSO09	105	Low-Side Output 09	Rated 0.8A, Peak 1A	
LSO10	95	Low-Side Output 10	Rated 0.8A, Peak 1A	
LSO11	111	Low-Side Output 11	Rated 0.8A, Peak 1A	
LSO12	87	Low-Side Output 12	Rated 0.8A, Peak 1A	
LSO13	84	Low-Side Output 13	Rated 0.4A, Peak 0.5A	
LSO14	92	Low-Side Output 14	Rated 0.4A, Peak 0.5A	
LSO15	91	Low-Side Output 15	Rated 0.4A, Peak 0.5A	
LSO16	83	Low-Side Output 16	Rated 0.4A, Peak 0.5A	
LSO21	100	Low-Side Output 21	Rated 0.16A, Peak 0.2A	Can be configured as PWM output, frequency range 1Hz-2KHz
LSO22	103	Low-Side Output 22	Rated 0.16A, Peak 0.2A	Can be configured as PWM output, frequency range 1Hz-2KHz
LSO23	85	Low-Side Output 23	Rated 0.16A, Peak 0.2A	Can be configured as PWM output, frequency range 1Hz-2KHz
LSO24	93	Low-Side Output 24	Rated 0.16A, Peak 0.2A	Can be configured as PWM output, frequency range 1Hz-2KHz
LSO25	101	Low-Side Output 25	Rated 0.16A, Peak 0.2A	Can be configured as PWM output, frequency range 1Hz-2KHz
LSO26	104	Low-Side Output 26	Rated 0.16A, Peak 0.2A	
LSO27	99	Low-Side Output 27	Rated 0.16A, Peak 0.2A	
LSO28	102	Low-Side Output 28	Rated 0.16A, Peak 0.2A	
LSO29	94	Low-Side Output 29	Rated 0.16A, Peak 0.2A	Can be configured as PWM output, frequency range 1Hz-2KHz
LSO30	86	Low-Side Output 30	Rated 0.16A, Peak 0.2A	Can be configured as PWM output, frequency range 1Hz-2KHz

Serial Communication Interface				
CANA_H	7	CANA_H	Include 120Ohm Terminal Resistance	Support CAN2.0A/B, Support ISO CANFD
CANA_L	8	CANA_L		
CANB_H	45	CANB_H	Include 120Ohm Terminal Resistance	Support CAN2.0A/B, Support ISO CANFD
CANB_L	46	CANB_L		
CANC_H	17	CANC_H	Include 120Ohm Terminal Resistance	Support CAN2.0A/B, Support ISO CANFD
CANC_L	36	CANC_L		
CAND_H	39	CAND_H	Include 120Ohm Terminal Resistance	Support CAN2.0A/B, Support ISO CANFD
CAND_L	20	CAND_L		
CANE_H	64	CANE_H	Include 120Ohm Terminal Resistance	Support CAN2.0A/B, Support CAN Wake-Up at Specific Frame
CANE_L	65	CANE_L		
CANF_H	25	CANF_H	Include 120Ohm Terminal Resistance	Support CAN2.0A/B, Support CAN Wake-Up at Any Frame
CANF_L	26	CANF_L		
CAN_SHILD1	6	CAN Shielded Wire		
CAN_SHILD2	23	CAN Shielded wire		
LIN1	9	LINBUS		
FlexRayA_P	63	FlexRayA Communication P	Include 120Ohm Terminal Resistance	
FlexRayA_N	44	FlexRayA Communication N		
FlexRayB_P	80	FlexRayB Communication P	Include 120Ohm Terminal Resistance	
FlexRayB_N	81	FlexRayB Communication N		
Internal Signal				
AI28	--	Collect Power Supply BATT Voltage	--	12-Bit Precision

## 2.2 Pin Description

### 2.2.1 Analog Signal Input

#### Description

The analog input channel circuits have similar structures, including EMC capacitors, pull-up/pull-down resistors and first-order low-pass filter circuit.

Main difference:

- Resistance of pull-up/pull-down resistor
- Pull-up voltage

#### Schematic

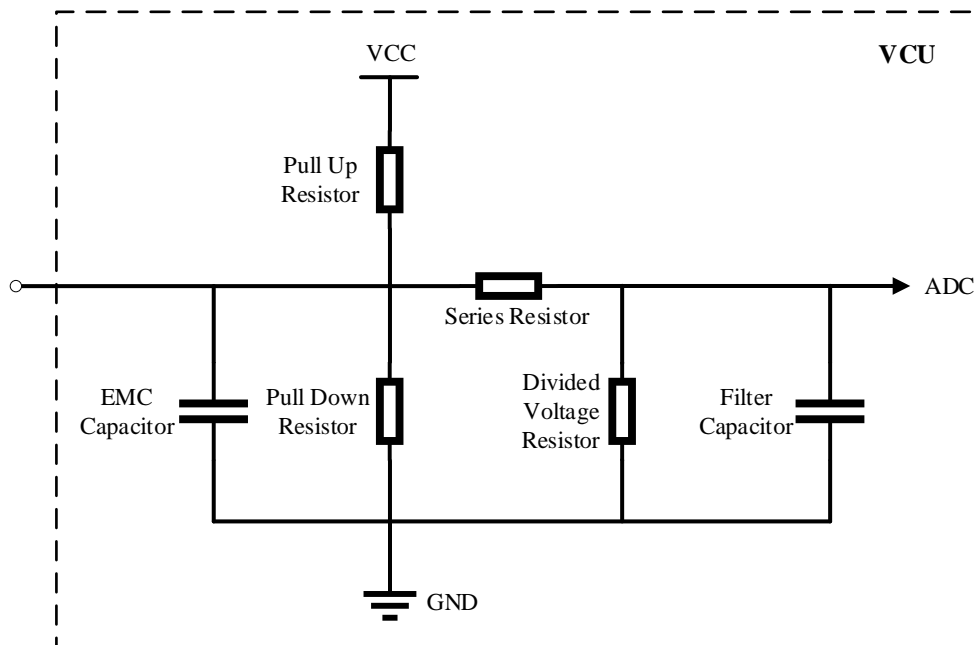


Figure 4 Schematic of Analog Signal Input Channel

Table 2.2.1.1 Analog Signal Input Channel Parameter

Note:1) "--" = Not installed 2)  $U_B$  = BATT voltage 3) AI28 collects BATT voltage signal 4) KEYON is only used as a key signal

Pin #	AI	EMC Capacitor (F)	Pull Up Resistor		Pull down Resistor to GND (Ohm)	Series Resistor (Ohm)	Divided Voltage Resistor (Ohm)	Filter Capacitor (F)	Operation Range		Input Range		Conditions / Remarks
			to $U_B$ (Ohm)	to 5V (Ohm)					$V_{low}$	$V_{high}$	Min	Max	
15	AI01	--	--	--	100k	4.7 k	--	100nF	0V	5V	0V	5V	
18	AI02	--	--	--	100k	4.7 k	--	100nF	0V	5V	0V	5V	
21	AI03	--	--	--	100k	4.7 k	--	100nF	0V	5V	0V	5V	
34	AI04	--	--	--	100k	4.7 k	--	100nF	0V	5V	0V	5V	
37	AI05	--	--	--	100k	4.7 k	--	100nF	0V	5V	0V	5V	
40	AI06	--	--	--	100k	4.7 k	--	100nF	0V	5V	0V	5V	

55	AI08	--	--	--	100k	4.7 k	--	100nF	0V	5V	0V	5V	
58	AI09	--	--	--	100k	4.7 k	--	100nF	0V	5V	0V	5V	
52	AI07	--	--	10k	--	4.7 k	--	100nF	0V	5V	0V	5V	
61	AI11	--	--	10k	--	4.7 k	--	100nF	0V	5V	0V	5V	
73	AI12	--	--	10k	--	4.7 k	--	100nF	0V	5V	0V	5V	
75	AI13	--	--	10k	--	4.7 k	--	100nF	0V	5V	0V	5V	
77	AI14	--	--	10k	--	4.7 k	--	100nF	0V	5V	0V	5V	
79	AI15	--	--	10k	--	4.7 k	--	100nF	0V	5V	0V	5V	
67	AI16	--	--	--	100k	100k	16k	100nF	0V	32V	0V	32V	
47	AI17	--	--	--	100k	100k	16k	100nF	0V	32V	0V	32V	
29	AI18	--	--	--	100k	100k	16k	100nF	0V	32V	0V	32V	
10	AI19	--	--	--	100k	100k	16k	100nF	0V	32V	0V	32V	
28	AI20	--	--	--	100k	100k	16k	100nF	0V	32V	0V	32V	
12	AI21	--	--	--	100k	100k	16k	100nF	0V	32V	0V	32V	
30	AI22	--	--	--	100k	100k	16k	100nF	0V	32V	0V	32V	
43	AI23	--	--	--	100k	100k	16k	100nF	0V	32V	0V	32V	
24	KEYON/AI27	--	--	--	100k	100k	16k	100nF	0V	32V	0V	32V	
--	AI28	--	--	--	100k	100k	16k	100nF	0V	32V	0V	32V	

## 2.2.2 Digital Signal Input

### Description

The digital input channel circuits have similar structures, including EMC capacitors, pull-up/pull-down resistors, voltage divider resistors, and a first-order low-pass filter.

Main difference:

- Resistance of pull-up/pull-down resistor
- Selection of pull up/down resistor

### Schematic

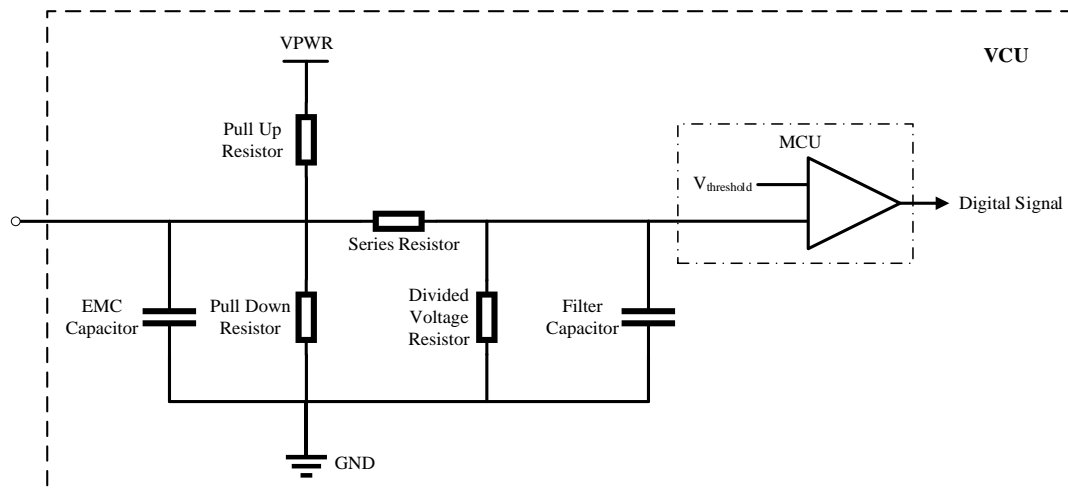


Figure 5 Schematic of Digital Signal Input Channel

Table 2.2.2.1 Digital Signal Input Channel Parameter

Note: 1) "--" = Not installed 2) Pin 119 and pin 120 must be connected to power supply, so that the digital channel can work normally. 3) DI11, DI12 port: It is recommended to reserve an unused port to prevent entering the rescue mode by mistake

Pin #	Description	EMC Cap.	Filter Cap.	Pull Up Resistor to VPWR	Pull Down Resistor	Serial Resistor	Divided Voltage Resistor	Operation Threshold for Input Signal		Input Range		Conditions/Remarks
		(F)	(F)	(Ohm)	(Ohm)	(Ohm)	(Ohm)	Vlow	Vhigh	min	max	
66	DI00	--	10n	137k	--	100k	51k	3V	8V	0V	32V	
33	DI01	--	10n	137k	--	100k	51k	3V	8V	0V	32V	
11	DI02	--	10n	137k	--	100k	51k	3V	8V	0V	32V	
70	DI03	--	10n	137k	--	100k	51k	3V	8V	0V	32V	
50	DI04	--	10n	137k	--	100k	51k	3V	8V	0V	32V	
14	DI05	--	10n	137k	--	100k	51k	3V	8V	0V	32V	
69	DI06	--	10n	137k	--	100k	51k	3V	8V	0V	32V	
32	DI07	--	10n	137k	--	100k	51k	3V	8V	0V	32V	
49	DI08	--	10n	137k	--	100k	51k	3V	8V	0V	32V	
48	DI09	--	10n	137k	--	100k	51k	3V	8V	0V	32V	
13	DI10	--	10n	137k	--	100k	51k	3V	8V	0V	32V	
31	DI11	--	10n	--	100k	100k	33k	4V	9V	0V	32V	
68	DI12	--	10n	--	100k	100k	33k	4V	9V	0V	32V	

### 2.2.3 Frequency Signal Input

#### Description

The frequency input channel circuits have similar structures, including EMC capacitors, pull-up/pull-down resistors, voltage divider resistors and a first-order low-pass filter circuit.

Main difference:

- Resistance of pull-up/pull-down resistor
- Pull-up or pull-down

#### Schematic

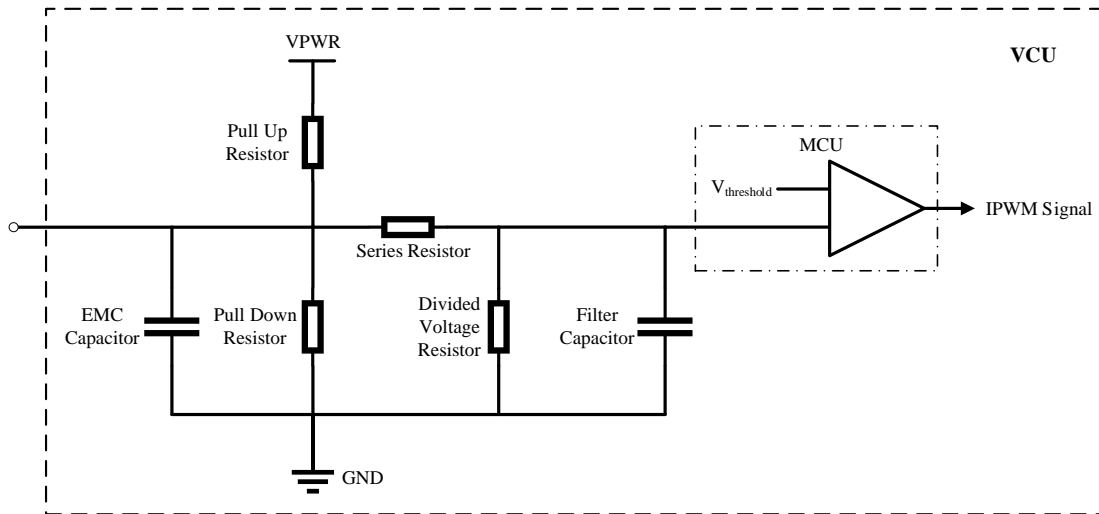


Figure 6 Schematic Diagram of Frequency Signal Input Channel

Table 2.2.3.1 Frequency Signal Input Channel Parameter

Note: 1) "--" = Not installed. 2) Pin 119 and pin 120 must be connected to power supply, so that the digital channel can work normally

Pin #	Description	EMC Cap.	Filter Cap.	Pull Up Resistor to UB	Pull Up Resistor to 5V	Pull Down Resistor	Serial Resistor	Divided Voltage Resistor	Operation Threshold for Input Signal		Input Range	
		(F)	(F)	(Ohm)	(Ohm)	(Ohm)	(Ohm)	(Ohm)	Vlow	Vhigh	min	max
71	SPEED1	--	47p	--	--	100k	100k	3k	4V	9V	0 V	32V
51	SPEED2	--	47p	137k	--	--	100k	51k	3V	8V	0 V	32V
57	SPEED3	--	47p	--	--	100k	100k	3k	4V	9V	0 V	32V
76	SPEED4	--	47p	137k	--	--	100k	51k	3V	8V	0 V	32V

Note: The frequency and duty cycle reference values of the frequency signal input channel are shown in the following table (test conditions: BATT=12V, pulse input amplitude=10V, pulse input offset=5V):

Table 2.2.3.2 Frequency Signal Input Channel Frequency and Duty Cycle Reference Value

Input Frequency	Detection frequency	Input duty cycle	Detection duty cycle	Input duty cycle	Detection duty cycle	Input duty cycle	Detection duty cycle
100Hz	100Hz	10.0%	9.92%	50.0%	49.92%	90.0%	89.92%
1000Hz	1000Hz	10.0%	9.67%	50.0%	49.60%	90.0%	90.32%
2000Hz	2000Hz	10.0%	9.12%	50.0%	49.38%	90.0%	90.32 %

## 2.2.4 High Voltage Interlock

### Description

In vehicle's high-voltage interlock inspection circuit, the VCU can output a high-level signal to the circuit through the pin 90 high-side channel. At the same time, the VCU detects the feedback signal in the circuit through the pin 43 analog input channel to check the security and integrity of the vehicle circuit.

If the high-voltage interlock is not used, pin 90 can be used as a normal high-side output channel, and pin 43 can be used as a 0-32V analog input channel.

### Schematic

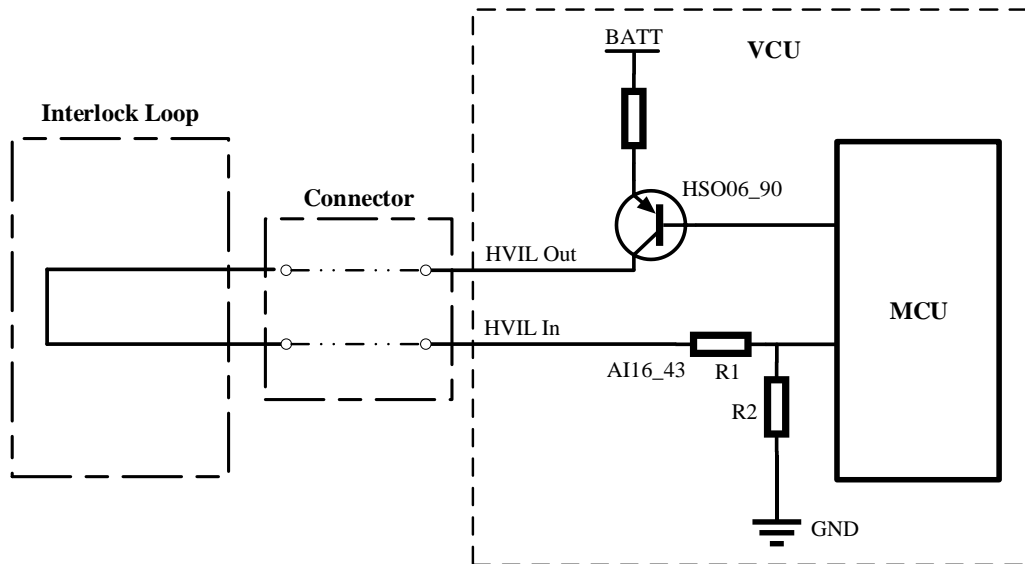


Figure 7 Schematic Diagram of High Voltage Interlock

Table 2.2.4.1 High Voltage Interlock Parameter

Pin #	Description	Resistor(Ohm)	Conditions / Remarks
		$R2/(R1+R2)$	
90	HVIL_OFT: HVIL signal output	--	HSO06
43	HVIL_IPT: HVIL signal feedback	$16K/(100K+16K)$	AI23



## 2.2.5 Low-side Driver

### Description

The low-side drive can be used as a switch for driving peripheral devices, and all low-side drive channels have a fault diagnosis function.

Main difference:

- Driving current
- With or without PWM function

### Schematic

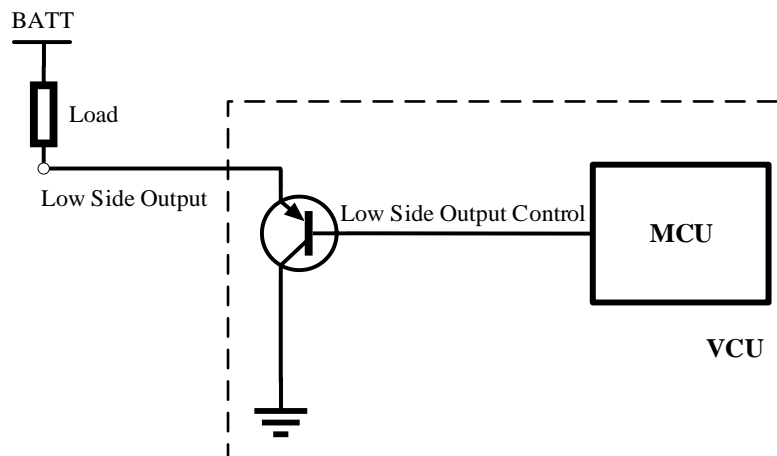


Figure 8 Schematic Diagram of Low-Side Driver Channel

Table 2.2.5.1 Low-Side Driver Channel Parameter

Pin #	Description	EMC Capacitor	Output Current	Free Wheeling Diode	Conditions / Remarks
			Max		
114	LSO01	--	2A	No	
121	LSO02	--	2A	No	
117	LSO03	--	2A	No	
115	LSO04	--	2A	No	
116	LSO05	--	2A	No	
118	LSO06	--	2A	No	
112	LSO07	--	1A	No	
113	LSO08	--	1A	No	
105	LSO09	--	1A	No	
95	LSO10	--	1A	No	
111	LSO11	--	1A	No	
87	LSO12	--	1A	No	
84	LSO13	10nF/50V	0.5A	No	
92	LSO14	10nF/50V	0.5A	No	
91	LSO15	10nF/50V	0.5A	No	

83	LSO16	10nF/50V	0.5A	No	
100	LSO21	--	0.2A	No	OPWM Configurable
103	LSO22	--	0.2A	No	OPWM Configurable
85	LSO23	--	0.2A	No	OPWM Configurable
93	LSO24	--	0.2A	No	OPWM Configurable
101	LSO25	--	0.2A	No	OPWM Configurable
104	LSO26	--	0.2A	No	
99	LSO27	--	0.2A	No	
102	LSO28	--	0.2A	No	
94	LSO29	--	0.2A	No	OPWM Configurable
86	LSO30	--	0.2A	No	OPWM Configurable

Note:

1. "--" = Not installed
2. **The total load of all low-side driver channels should not exceed 5A.**
3. Pin 119 and pin 120 must be connected to power supply to let low-side channels work.

Table 2.2.5.2 Fault diagnosis of low-side driver

Low-Side Driver Channel	Fault	
	Disable	Enable
LSO01、LSO02、LSO03、LSO04、LSO06、LSO07、LSO08、LSO09、LSO10、LSO11、LSO12、LSO13、LSO14、LSO15、LSO16	<ul style="list-style-type: none"> <li>•No load</li> <li>•Short to ground</li> </ul>	<ul style="list-style-type: none"> <li>•Short to power supply</li> </ul>
LSO26、LSO27、LSO28	<ul style="list-style-type: none"> <li>•Short to ground</li> </ul>	<ul style="list-style-type: none"> <li>•Short to power supply</li> </ul>
LSO21、LSO22、LSO23、LSO24、LSO25、LSO29、LSO30	/	/

Note:

- 1) Please refer to EcoCoder manual for the usage of the fault diagnosis function.
- 2) The low-side drive channels have short-circuit protection. When it is enabled, if a channel is short-circuited to the ground, it will automatically activate the short-circuit protection function. This function may cause the channel to have a fault code jump phenomenon in this case, which is normal.
- 3) When LSO21-30 are configured as OPWM, the reference values of frequency and duty cycle are shown in the following table (test conditions: BATT = 12V, load = 24 Ohm, duty cycle is all calculated as positive duty cycle).

Table 2.2.5.3 LSO OPWM Frequency and Duty Cycle Reference Value

Set Frequency	Output Frequency	Set Duty Cycle	Output Duty Cycle	Set Duty Cycle	Output Duty Cycle	Set Duty Cycle	Output Duty Cycle
100Hz	100Hz	10.0%	9.6%	50.0%	49.6%	90.0%	89.6%
1000Hz	1000Hz	10.0%	10.4%	50.0%	50.4%	90.0%	90.4%
2000Hz	2000Hz	10.0%	10.8%	50.0%	50.6%	90.0%	90.8%

## 2.2.6 High-side Driver

### Description

The high-side drive can be used as a switch for driving peripheral devices, and all high-side drive channels have a fault diagnosis function.

Main difference:

- Driving current
- With or without PWM function
- Current leakage
- With or without freewheeling diode

### Schematic

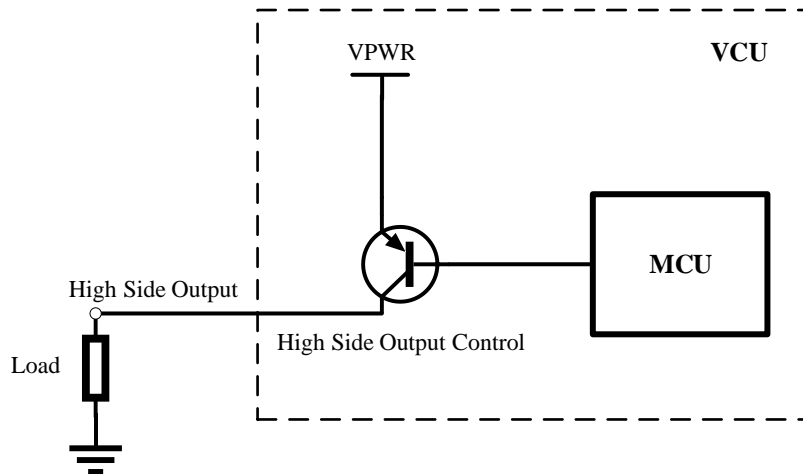


Figure 9 Schematic Diagram of High-Side Driver Channel

Table 2.2.6.1 High-Side Driver Channel Parameter

Pin #	Description	EMC Capacitor	Output current	Leakage Current	Free Wheeling Diode	Conditions / Remarks
			Max(A)	Max(uA)		
108	HSO01	--	2	0.01	Yes	
107	HSO02	--	2	0.01	Yes	
110	HSO03	--	2	0.01	Yes	
109	HSO04	--	2	0.01	Yes	
82	HSO05	10nF/50V	0.5	0.5	Yes	
90	HSO06	10nF/50V	0.5	0.5	Yes	
98	HSO07	10nF/50V	0.5	0.5	Yes	
106	HSO08	10nF/50V	0.5	0.5	Yes	
62	HSO09	10nF/50V	0.5	0.5	Yes	
2	HSO10	10nF/50V	0.5	0.5	Yes	

Note:

1. "--" = Not installed
2. **The total load of all high-side driver channels should not exceed 5A.**
3. Pin 119 and pin 120 must be connected to power supply to let high-side channels work.

Table 2.2.6.2 Fault diagnosis of high-side driver

High-side driver channel	Fault	
	Disable	Enable
HSO01、HSO02、HSO03、HSO04	<ul style="list-style-type: none"> <li>•No load</li> <li>•Short to power supply</li> </ul>	<ul style="list-style-type: none"> <li>•Short to ground</li> </ul>
HSO05、HSO06、HSO07、HSO08、HSO09、HSO10	<ul style="list-style-type: none"> <li>•Short to power supply</li> </ul>	<ul style="list-style-type: none"> <li>•Short to ground</li> </ul>

Note:

- 1) Please refer to EcoCoder manual for the usage of the fault diagnosis function.
- 2) The high-side drive channels have short-circuit protection. When it is enabled, if a channel is short-circuited to the ground, it will automatically activate the short-circuit protection function. This function may cause the channel to have a fault code jump phenomenon in this case, which is normal.

### 2.2.7 CAN Bus

#### Description

CAN interface circuit is used for communication between VCU and other vehicle electronic controllers, and the communication speed can reach 1Mbit/s. CAN\_A, CA\_B, CAN\_C, CAN\_D support ISO CANFD. CAN\_E, CAN\_F support specific frame wake up.

#### Schematic

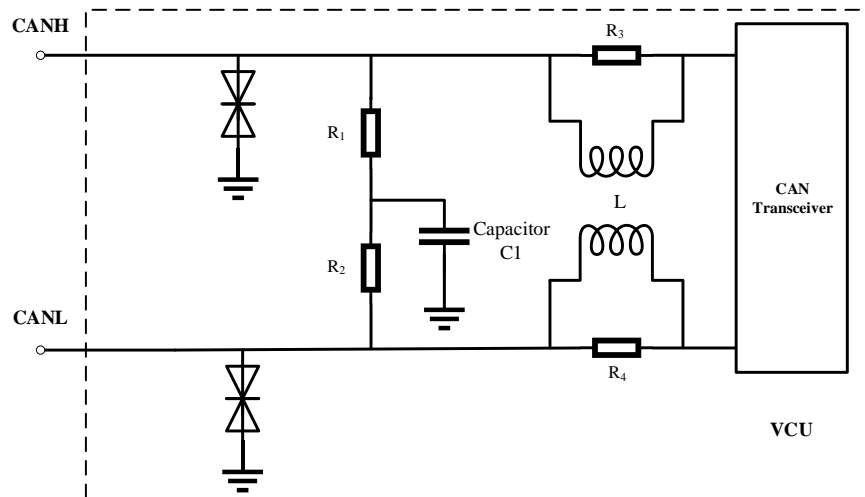


Figure 10 CAN Bus Schematic

Table 2.2.7.1 CAN Bus Parameter

Pin #	Description	Capacitor C1	R1, R2 (Ohm)	Choke L	Conditions / Remarks
7	CANA H	100nF/50V	60	Yes	Support CAN2.0A/B, Support ISO CANFD
8	CANA L		60		
45	CANB H	100nF/50V	60	Yes	Support CAN2.0A/B, Support ISO CANFD
46	CANB L		60		
17	CANC H	100nF/50V	60	Yes	Support CAN2.0A/B, Support ISO CANFD
36	CANC L		60		
39	CAND H	100nF/50V	60	Yes	Support CAN2.0A/B, Support ISO CANFD
20	CAND L		60		
64	CANE H	100nF/50V	60	Yes	Support CAN2.0A/B, support CAN wake-up at specific frame
65	CANE L		60		
25	CANF H	100nF/50V	60	Yes	Support CAN2.0A/B, support CAN wake-up at any frame
26	CANF L		60		

### 2.2.8 LIN Bus

#### Description

LIN (Local Interconnect Network) bus supports master/slave node communication mode and has the function of short-circuit protection to the power supply.

#### Schematic

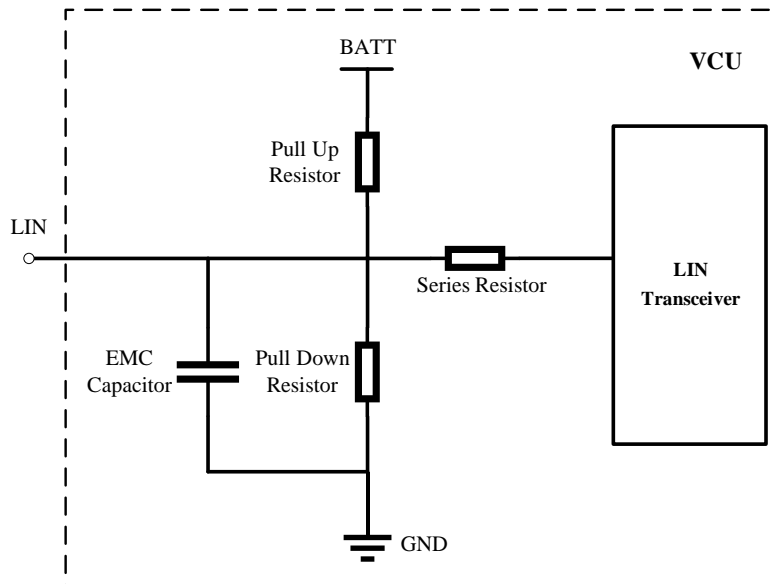


Figure 11 LIN Bus Schematic

Table 2.2.8.1 LIN Bus Parameter

Pin #	LIN	EMC Capacitor	Pull Up Resistor	Pull Down Resistor	Series Resistor	Conditions / Remarks
			to $U_B$ (Ohm)	to GND (Ohm)	(Ohm)	
9	LIN1	1nF/50V	1k	--	--	--

### 2.2.9 FlexRay Bus

#### Description

FlexRay is a high-speed, deterministic, fault-tolerant bus technology for automobiles. It combines event triggering and time triggering and has the characteristics of efficient network utilization and system flexibility.

#### Schematic

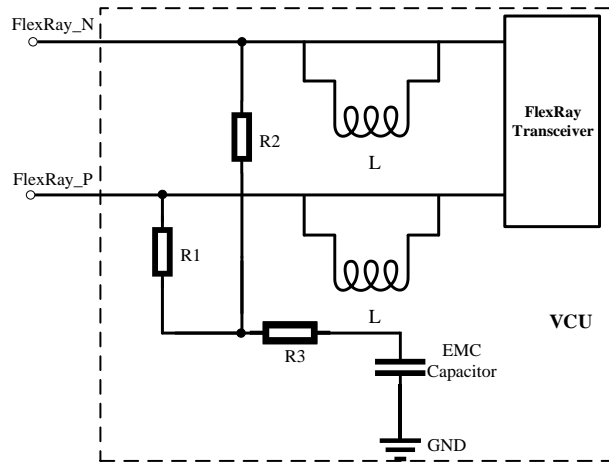


Figure 12 FlexRay Bus Schematic

Table 2.2.9.1 FlexRay Bus Parameter

Note: "--" = not installed.

Pin #	FlexRay	EMC Capacitor	R1	R2	R3	Conditions / Remarks
			(Ohm)	(Ohm)	(Ohm)	
63	FlexRayA_P	10nF/50V	60	60	0	--
44	FlexRayA_N					
80	FlexRayB_P	10nF/50V	60	60	0	--
81	FlexRayB_N					

### 2.2.10 5V Output

#### Description

The 5V voltage output channel can provide 5V power supply voltage for external sensors and has the following functions:

- Accurate 5V output for internal IC power supply
- 9 Channels of sensor 5V power supply output
- Invert connection protection, short circuit protection, over-temperature protection

Table 2.2.10.1 5V Sensor Power Output Parameter

Pin #	Description	I <sub>max</sub> (mA)	Output Voltage
16 22 38	5V supply voltage 2	Sum of Three Channels Maximum 150mA	Single Channel Output 5V±1%

19 35 41	5V supply voltage 3	Sum of Three Channels Maximum 150mA	Single Channel Output 5V±1%
53 56 59	5V supply voltage 4	Sum of Three Channels Maximum 150mA	Single Channel Output 5V±1%

## Chapter 3 Technical Performance

### 3.1 Electrical Characteristics

Item	Design Specifications
Operating Voltage	DC 12 V / 24v (9~32v)
Operating Temperature	-40 °C ~85 °C
Working Humidity	0~95%, No Condensation
Storage Temperature	-40 °C ~85 °C
Quiescent Current	<1mA
Rated Power Consumption	3 W (Not Including Load)
Protection Level	IP67
Weight	≤ 700g
Controller Size	207×150×42mm
Material	Die-Cast Aluminum
Housing	Equipped With Waterproof Breathable Valve, Good Heat Dissipation



### 3.2 Electrical Performance Standard

Item	Test Standard
Direct Current Supply Voltage	ISO 16750-2
Overvoltage (12V, High Temperature)	ISO 16750-2
Slow Decrease and Increase of Supply Voltage	ISO 16750-2
Superimposed Alternating Voltage	ISO 16750-2
Reversed Voltage	ISO 16750-2
Low Voltage Reset Features	ISO 16750-2
Low Voltage Start Features	ISO 16750-2
Open Circuit Tests – Single Line Interruption	ISO 16750-2
Open Circuit Tests – Multiple Line Interruption	ISO 16750-2
Short Circuit Protection	ISO 16750-2
Withstand Voltage	ISO 16750-2
Insulation Resistance	ISO 16750-2

### 3.3 Environmental Standards

Item	Test Standard
Waterproof (IP67)	IEC/EN 60529
Dustproof (IP67)	ISO 20653
Salt Spray Leakage Function and Corrosion Test	ISO 16750-4
Mechanical Shock Test	ISO 16750-3
Vibration Test	ISO 16750-3
Drop Test	ISO 16750-3
Temperature Shock	ISO 16750- 4
Electrical Operation at Circulating Ambient Temperature	ISO 16750-4
High and Low Temperature Operation Experiment	ISO 16750-4
High and Low Temperature Experiment	ISO 16750-4
Temperature and Humidity Cycle	IEC 60068-2-30
Constant Temperature and Humidity	ISO 16750-4

### 3.4 EMC Test Standard

Item	Test Standard
Voltage Transient Emissions Test	ISO7637-2
Conducted Emission (CE-V)	CISPR25
Conducted Emission (CE-C)	CISPR25
Radiation Emission (RE-ALSE)	CISPR25
Radiation Immunity Experiment (I/O)-ICC	ISO7637-3
Radiation Immunity Experiment BCI-Substitution Method	ISO11452-4
Radiation Immunity Experiment (RI)	ISO11452-2
Low Frequency Magnetic Field Immunity	ISO11452-8
ESD	ISO10605

## Chapter 4 Installation Requirements

It is recommended to install the VCU in the cockpit. If the OEM wants to assemble the VCU in another location, Ecotron's engineers and the OEM's engineers should evaluate the corresponding installation location together.

The precautions for VCU installation are as follows:

1. The VCU and wiring harness installation should be firm and reliable, and there should be no looseness. Avoid supporting the wiring harness by VCU. At the same time, the arrangement of the VCU wiring harness should prevent and protect all wires in the wiring harness from damage due to wear and to overheat.
2. Try to avoid installing in places where dust is easy to gather. A large amount of dust accumulation will affect the reliability of VCU work.
3. VCU should keep away from the location where the temperature of the housing itself may exceed 85°C. At the same time, it is necessary to prevent the surrounding parts from releasing heat to the VCU.
4. Avoid installing the VCU 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 VCU and avoid installing the VCU at the resonance point of the car body.
6. Avoid installing the VCU 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 VCU power terminal.
7. VCU 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  $-170^{\circ}$  to  $-10^{\circ}$ , as shown in Figure 13 below. In the vertical direction, the recommended installation angle is  $-170^{\circ}$  to  $-10^{\circ}$ , as shown in Figure 14 below.

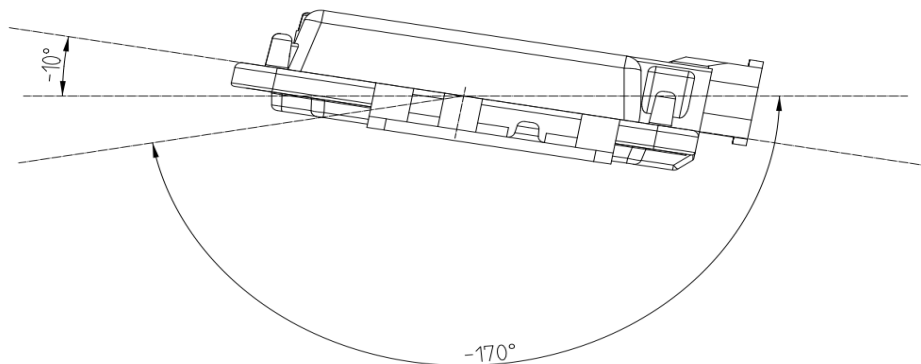


Figure 13 Horizontal Installation Angle

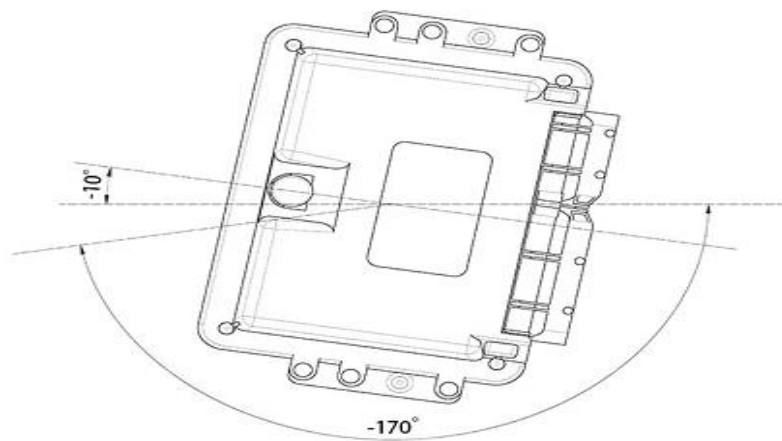
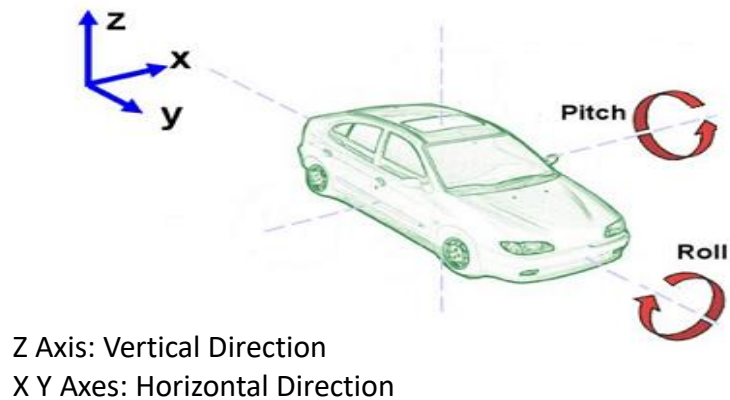


Figure 14 Vertical Installation Angle

Ecotron recommends using the six installation points on the VCU for installation and fixation. It is recommended to use metal materials such as aluminum alloy for the mounting bracket. 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 they can meet the requirements of VCU for vibration, heat dissipation, temperature, EMC, etc. If there is any deviation, it needs to be confirmed with Ecotron.

The VCU system adopts Ground through the vehicle's body. The specific requirement is to directly connect the ground wire in the wiring harness to the vehicle's body and ensure reliable electrical connections.