EF22297B01
Datasheet

Revision History

Date	Version	Description
2021.10	V 1.0	First Release

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Chapter 1 System Introduction

FCU (Fuel cell Control Unit) is a control unit designed to control fuel cells.

1.1 Functionality

EF22297B01 has the following functions:

Table 1 EF22297B01 Features

Feature
1 Key switch (KEYON) 1 Hardwire wakeup (WAKEUP) 4 Power supply (BATT1) 9 5V Outputs 4 CAN Bus ports: 1 CAN supports specific frame wakeup, 3 CANFD 1 LIN Bus port 8 Digital signal inputs: 4 channels active high, 4 channels active low 22 Analog signal inputs: 12 channels of 0-5V voltage type input, 10 channels of 0-5V resistor type input 6 Frequency signal inputs 9 High-side driver outputs: 5 configurable as PWM outputs 22 Low-side driver outputs: 10 configurable as PWM outputs 2 Channels H-bridges 4 Channels Peak and Hold Hardware watchdog

1.2 Material

The shell of FCU is formed by aluminum die-casting and assembled with silicone rubber. There is no special treatment or plating on the outside of the shell, no sharp burrs and sharp edges.
The nominal dimensions of the FCU shell are as follows (excluding the female end of the FCU connector, in mm):

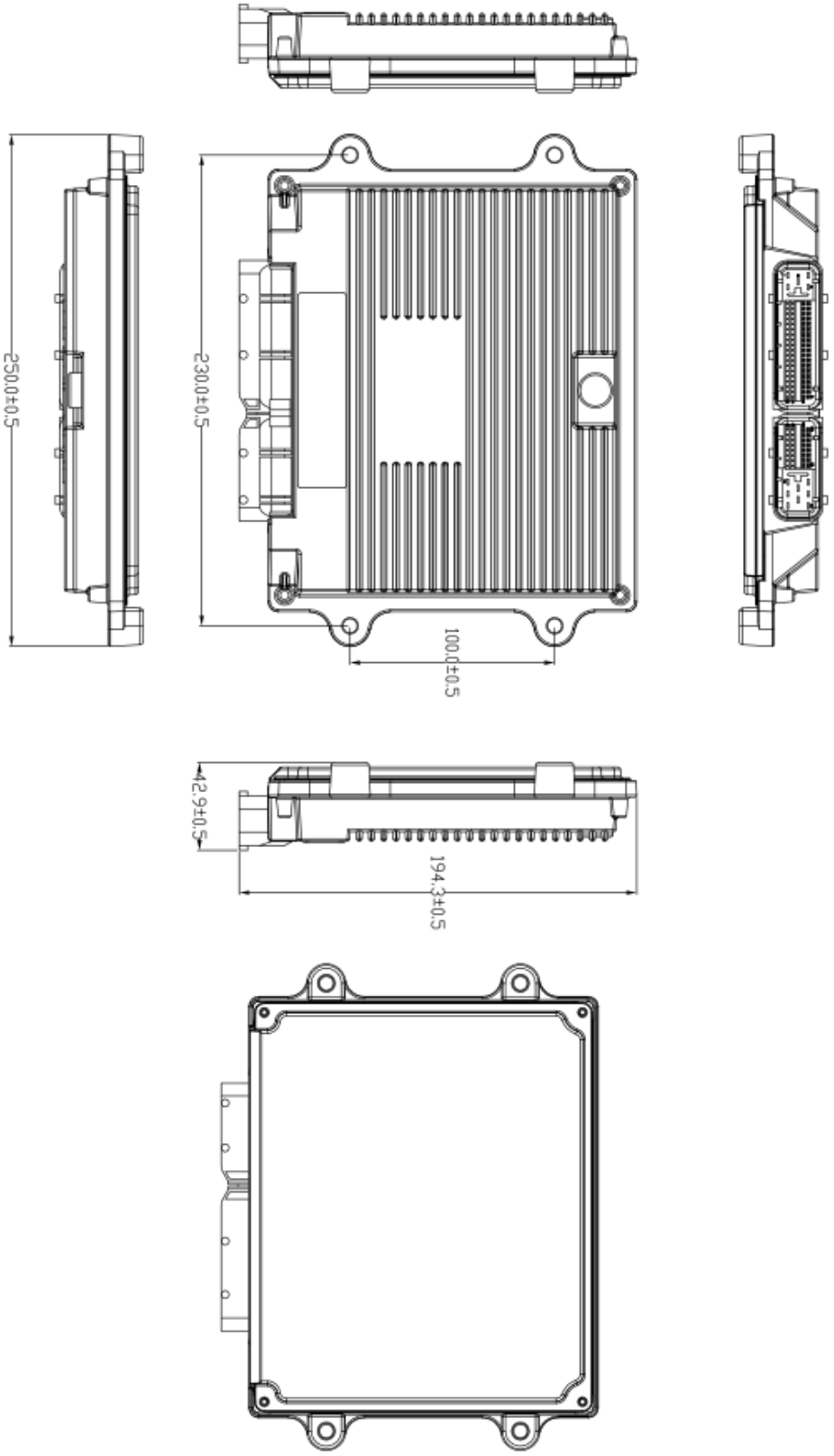


Figure 1 FCU Shell Size

The socket model used for disassembling the shell: Torx T15.
The product identification label is affixed to the FCU shell, which contains the product identification code, customer information, date, batch number, serial number, etc.

1.3 Harness Connector

FCU 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 2 Harness Connector Info

#	Name	Part number	Supplier	URL
1	PCB Pin Seat	1241434-1	TE	https://www.te.com/usa-en/product-1241434-1.html?q=1241434-1&source=header
2	81P Housing	1473244-1	TE	https://www.te.com/usa-en/product-1473244-1.html
3	40P Housing	1473252-1	TE	https://www.te.com/usa-en/product-1473252-1.html
4	Big Terminal	964274-2	TE	https://www.te.com/usa-en/product-964274-2.html
5	Small Terminal	968220-1	TE	https://www.te.com/usa-en/product-968220-1.html
6	81P Cover Assembly	1473247-1	TE	https://www.te.com/usa-en/product-1473247-1.html
7	40P Cover Assembly	1473255-1	TE	https://www.te.com/usa-en/product-1473255-1.html
8	81P TPA	368382-1	TE	https://www.te.com/usa-en/product-368382-1.html
9	40P TPA	368388-1	TE	https://www.te.com/usa-en/product-368388-1.html

Harness connector is shown below:

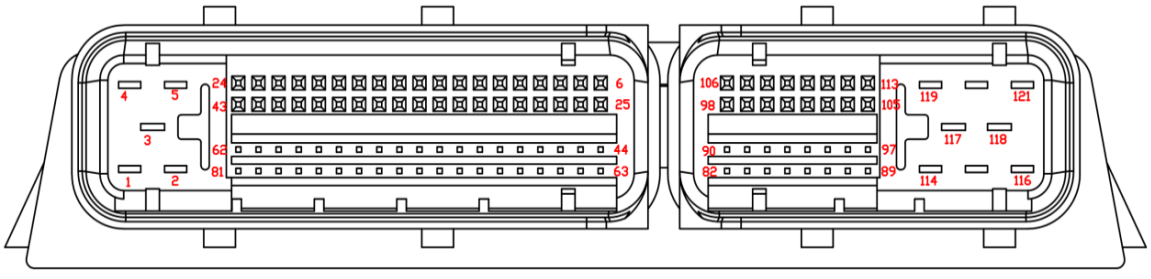


Figure 2 Harness Connector and Pin Distribution Diagram

1.4 Chip Information

Table 3 Chip Info

Feature	Detail
Micro Control Core	32-bit Infineon TC297TP
Maximum Frequency	300MHZ
Flash	8M
SRAM	728K
Floating Point Capability	Yes
SBC Microprocessor	TLF35584QVVS2

1.5 Power Supply

EF22297B01 requires 4 channels of continuous power supplies (pin1, pin3, pin119, and pin 120), and the FCU is powered on through the key switch (pin24).
For the EF22297B01 power supply fuse, we recommend a 30A fuse in series with pin1, pin3, pin119, and pin120.

Chapter 2 Interface Description

2.1 Pin Definition

Table 4 Pin Definition

Signal Name	PIN	Function	Interface Description	Note
Power Supply				
BATT	1 3	Power Supply	Power Supply 12V/24V	9-32V
	119 120	High & Low Side Output Channels Power Supply		
5V2	16 22 38	5V Sensor Supply 2	External Sensor 5V Power Supply	Single Channel Output 5V ± 1%, Sum of Three Channels Maximum 150mA
5V3	19 35 41	5V Sensor Supply 3	External Sensor 5V Power Supply	Single Channel Output 5V ± 1%, Sum of Three Channels Maximum 150mA
5V4	53 56 59	5V Sensor Supply 4	External Sensor 5V Power Supply	Single Channel Output 5V ± 1%, Sum of Three Channels Maximum 150mA
PGND	4 5 96 97 88 89	Ground	Power Ground	
GND	17 20 23 36 39 42 54 57 60 74 76 78 80 81	Signal Ground	External 5V Sensor Ground	
Analog Input				
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

AI18	14	Analog Input 18	Analog Signal Input 0~5V	Voltage Type, 12-Bit Precision
AI19	69	Analog Input 19	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
AI20	28	Analog Input 20	Analog Signal Input 0~5V	Voltage Type, 12-Bit Precision
AI21	13	Analog Input 21	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	43	Analog Input 16	Analog Signal Input 0~5V	Resistor Type, 12-Bit Precision
AI17	50	Analog Input 17	Analog Signal Input 0~5V	Resistor Type, 12-Bit Precision
AI22	32	Analog Input 22	Analog Signal Input 0~5V	Resistor Type, 12-Bit Precision
AI23	72	Analog Input 23	Analog Signal Input 0~5V	Resistor Type, 12-Bit Precision
Power-On Signal				
KEYON	24	Key Input Signal	Analog Signal Input 0~BATT	Wake-up Threshold>9V
WAKEUP	27	Wake-Up Signal	Digital Signal Input 0~BATT	Wake-up Threshold>9V
Digital Input				
DI11	31	Digital Input 11	Digital Signal Input 0~BATT	Active High
DI12	68	Digital Input 12	Digital Signal Input 0~BATT	Active High
DI13	67	Digital Input 13	Digital Signal Input 0~BATT	Active High
DI14	47	Digital Input 14	Digital Signal Input 0~BATT	Active High
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
Frequency Input				
SPEED1	71	Frequency Input 1	Frequency Signal Input	Frequency Input Range 1Hz-2KHz @5V
SPEED2	51	Frequency Input 2	Frequency Signal Input	Frequency Input Range 1Hz-2KHz @5V
SPEED3	12	Frequency Input 3	Frequency Signal Input	Frequency Input Range 1Hz-2KHz @5V
SPEED4	30	Frequency Input 4	Frequency Signal Input	Frequency Input Range 1Hz-2KHz @5V
SPEED5	29	Frequency Input 5	Frequency Signal Input	Frequency Input Range 1Hz-2KHz @24V
SPEED6	10	Frequency Input 6	Frequency Signal Input	Frequency Input Range 1Hz-2KHz @24V
Output Signal				
PeakHold1	44	Hydrogen Injector Driver 1		Peak 7A
PeakHold2	63	Hydrogen Injector Driver 2		Peak 7A

PeakHold3	90	Hydrogen Injector Driver 3		Peak 7A
PeakHold4	6	Hydrogen Injector Driver 4		Peak 7A
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	Can be configured as PWM output, frequency range 1Hz-2KHz
HSO07	98	High-Side Output 07	Rated 0.4A, Peak 0.5A	Can be configured as PWM output, frequency range 1Hz-2KHz
HSO08	106	High-Side Output 08	Rated 0.4A, Peak 0.5A	Can be configured as PWM output, frequency range 1Hz-2KHz
HSO09	62	High-Side Output 09	Rated 0.4A, Peak 0.5A	Can be configured as PWM output, frequency range 1Hz-2KHz
HSO10	2	High-Side Output 10	Rated 0.4A, Peak 0.5A	Can be configured as PWM output, frequency range 1Hz-2KHz
LSO01	114	Low-Side Output 01	Rated 1.5A, Peak 2A	With Freewheeling Diode
LSO02	121	Low-Side Output 02	Rated 1.5A, Peak 2A	With Freewheeling Diode
LSO03	117	Low-Side Output 03	Rated 1.5A, Peak 2A	With Freewheeling Diode
LSO04	115	Low-Side Output 04	Rated 1.5A, Peak 2A	With Freewheeling Diode
LSO05	116	Low-Side Output 05	Rated 1.5A, Peak 2A	With Freewheeling Diode
LSO06	118	Low-Side Output 06	Rated 1.5A, Peak 2A	With Freewheeling Diode
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	
H1-A	84	H-bridge Driver	Rated 3A	H1-A 3A
H1-B	92	H-bridge Driver	Rated 3A	H1-B 3A
H2-A	91	H-bridge Driver	Rated 3A	H2-A 3A
H2-B	83	H-bridge Driver	Rated 3A	H2-B 3A
LSO21	100	Low-Side Output 21	Rated 0.8A, Peak 1A	Can be configured as PWM output, frequency range 1Hz-1KHz, with freewheeling diode
LSO22	103	Low-Side Output 22	Rated 0.8A, Peak 1A	Can be configured as PWM output, frequency range 1Hz-1KHz, with freewheeling diode
LSO23	85	Low-Side Output 23	Rated 0.8A, Peak 1A	Can be configured as PWM output, frequency range

				1Hz-1KHz, with freewheeling diode
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	Can be configured as PWM output, frequency range 1Hz-2KHz
LSO27	99	Low-Side Output 27	Rated 0.16A, Peak 0.2A	Can be configured as PWM output, frequency range 1Hz-2KHz
LSO28	102	Low-Side Output 28	Rated 0.16A, Peak 0.2A	Can be configured as PWM output, frequency range 1Hz-2KHz
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	64	CANA_H	Include 120Ohm Terminal Resistance	Support specific frame wakeup
CANA_L	65	CANA_L		
CANB_H	25	CANB_H	Without 120Ohm Terminal Resistance	
CANB_L	26	CANB_L		
CANC_H	7	CANC_H	Without 120Ohm Terminal Resistance	
CANC_L	8	CANC_L		
CAND_H	45	CAND_H	Without 120Ohm Terminal Resistance	
CAND_L	46	CAND_L		
LIN1	9	LINBUS		
Internal Signal				
AI28	--	Collect Power Supply BATT Voltage	--	12-Bit Precision

Note: The high-side/low-side output current data is tested with standard loads and is only for reference. In real life, situations such as inrush current in load may cause misjudgment for fault diagnosis.

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
- Filter time constant

Schematic

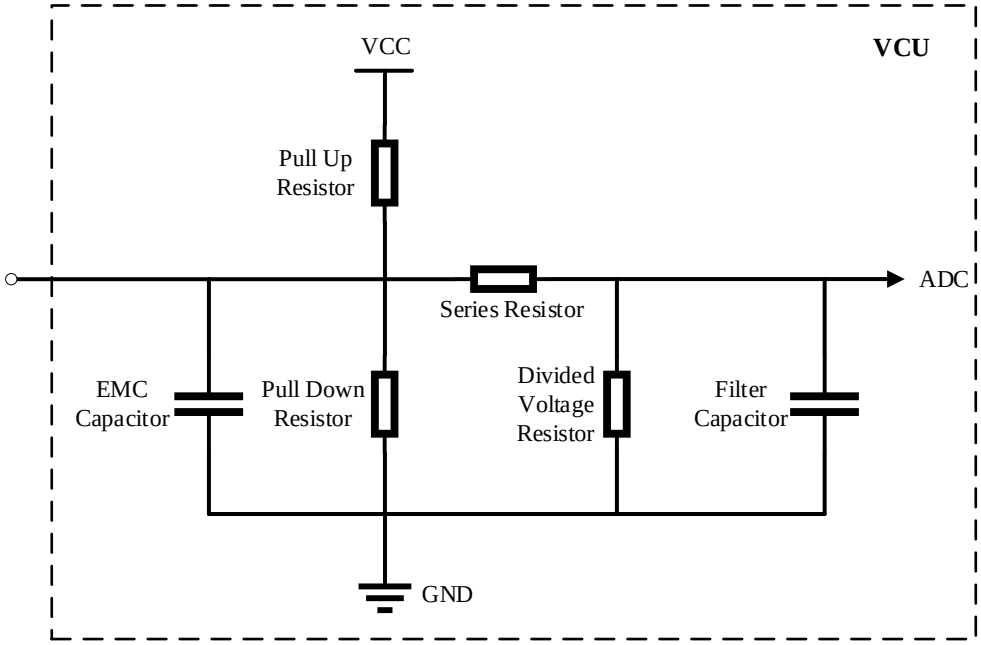


Figure 3 Schematic of Analog Signal Input Channel

Table 5 Analog Signal Input Channel Parameter

Note:1) "--" = Not installed 2) U_B = BATT voltage 3) AI28 gathers BATT voltage signal

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

AI08	--	--	--	100K	4.7K	--	100nF	0V	5V	0V	5V	
AI09	--	--	--	100K	4.7K	--	100nF	0V	5V	0V	5V	
AI18	--	--	--	100K	4.7K	--	100nF	0V	5V	0V	5V	
AI19	--	--	--	100K	4.7K	--	100nF	0V	5V	0V	5V	
AI20	--	--	--	100K	4.7K	--	100nF	0V	5V	0V	5V	
AI21	--	--	--	100K	4.7K	--	100nF	0V	5V	0V	5V	
AI07	--	--	10k	--	4.7K	--	100nF	0V	5V	0V	5V	
AI11	--	--	10k	--	4.7K	--	100nF	0V	5V	0V	5V	
AI12	--	--	10k	--	4.7K	--	100nF	0V	5V	0V	5V	
AI13	--	--	10k	--	4.7K	--	100nF	0V	5V	0V	5V	
AI14	--	--	10k	--	4.7K	--	100nF	0V	5V	0V	5V	
AI15	--	--	10k	--	4.7K	--	100nF	0V	5V	0V	5V	
AI16	--	--	10k	--	4.7K	--	100nF	0V	5V	0V	5V	
AI17	--	--	10k	--	4.7K	--	100nF	0V	5V	0V	5V	
AI22	--	--	10k	--	4.7K	--	100nF	0V	5V	0V	5V	
AI23	--	--	10k	--	4.7K	--	100nF	0V	5V	0V	5V	
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
- Filter time constant

Schematic

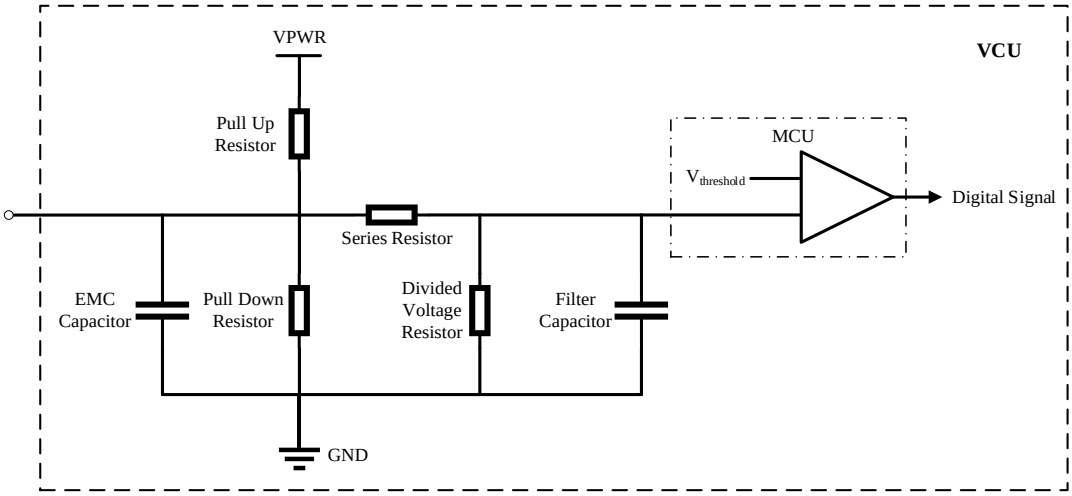


Figure 4 Schematic of Digital Signal Input Channel

Table 6 Digital Signal Input Channel Parameter

Note: 1) "--" = Not installed 2) U_B = BATT voltage 3) KEYON only for key signal

DI	EMC Capacitor	Filter Capacitor	Pull Up Resistor		Pull Down Resistor	Series Resistor	Divided Voltage Resistor	Operation Threshold for Input Signal		Input Range		Conditions/ Remarks
	(F)	(F)	to U_B(Ohm)	to 5V(Ohm)	(Ohm)	(Ohm)	(Ohm)	V_{low}	V_{high}	Min	Max	
DI11	--	10nF	--	--	100k	100k	33k	3V	9V	0V	U_B	
DI12	--	10nF	--	--	100k	100k	33k	3V	9V	0V	U_B	
DI13	--	10nF	--	--	100k	100k	33k	3V	9V	0V	U_B	
DI14	--	10nF	--	--	100k	100k	33k	3V	9V	0V	U_B	
DI00	--	10nF	137K	--	--	100k	51k	3V	9V	0V	U_B	
DI01	--	10nF	137K	--	--	100k	51k	3V	9V	0V	U_B	
DI02	--	10nF	137K	--	--	100k	51k	3V	9V	0V	U_B	
DI03	--	10nF	137K	--	--	100k	51k	3V	9V	0V	U_B	
KEYON	--	100 nF	--	--	100k	100k	16k	3V	9V	0V	U_B	Wakeup Signal

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
- Selection of pull up/down
- Filter time constant
-

Schematic

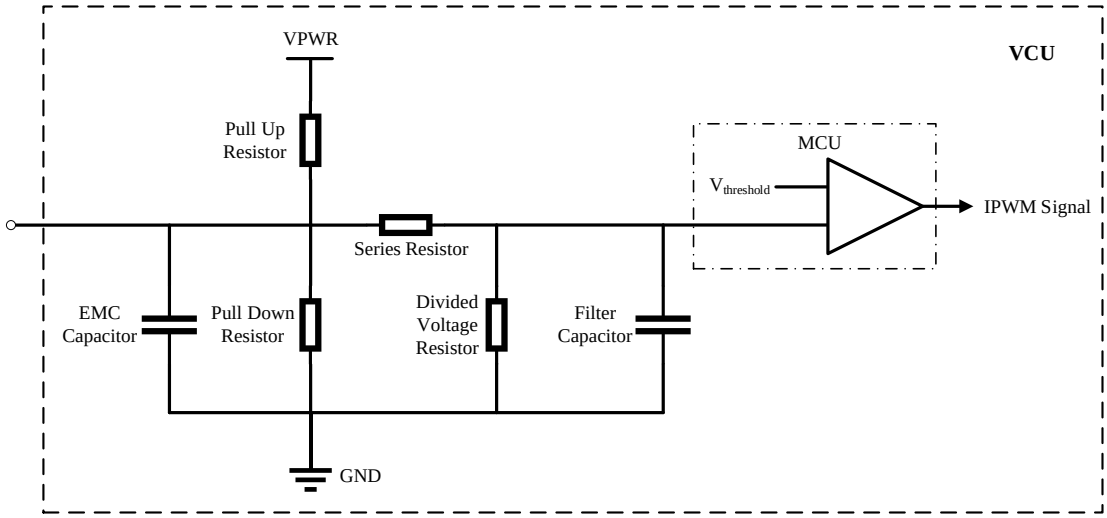


Figure 5 Schematic Diagram of Frequency Signal Input Channel

Table 7 Frequency Signal Input Channel Parameter

Pin #	SPEED	EMC Capacitor	Filter Capacitor	Pull Up Resistor		Pull Down Resistor	Series Resistor	Divided Voltage Resistor	Operation Threshold for Input Signal		Input Range	
		(F)	(F)	to U_B(Ohm)	to 5V(Ohm)	(Ohm)	(Ohm)	(Ohm)	V_{low}	V_{high}	Min	Max
71	SPEED1	--	10n	--	--	100k	100k	200k	2 V	3.5V	0V	5V
51	SPEED2	--	10n	--	--	100k	100k	200k	2V	3.5V	0V	5V
12	SPEED3	--	10n	--	--	100k	100k	200k	2 V	3.5V	0V	5V
30	SPEED4	--	10n	--	--	100k	100k	200k	2V	3.5V	0V	5V
29	SPEED5	--	10n	--	--	100k	100k	33k	3V	9V	0V	24V
10	SPEED6	--	10n	137k	--	--	100k	51k	3V	9V	0V	24V

Note:

1) "--" = Not installed
2) U_B = BATT voltage
3) 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 8 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 **H-Bridge**

The H-bridge is a DC motor control driver that can reverse the voltage/current at both ends of the connected loads or output terminals. All channels have fault diagnosis function.

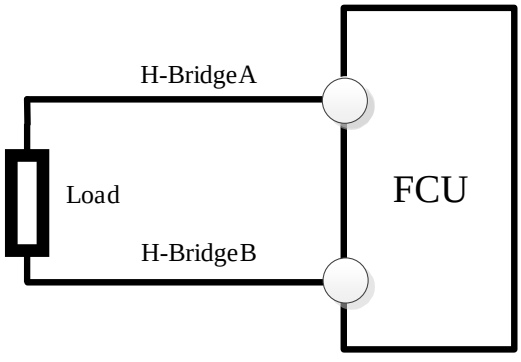


Figure 6 H-bridge Working Principle

Table 9 H-bridge Output Parameter Table

	parameters	Output Frequency
H1-A	24V 3A	Low Frequency: 2Hz-1KHz
H1-B		High Frequency: 8KHz-10KHz
H2-A	24V 3A	Low Frequency: 2Hz-1KHz
H2-B		High Frequency: 8KHz-10KHz

2.2.5 **Low-side Driver**

Description

The low-side driver is a low-side switch controlled by SPI and GPIO. All channels have fault diagnosis function.

Main difference:

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

Schematic

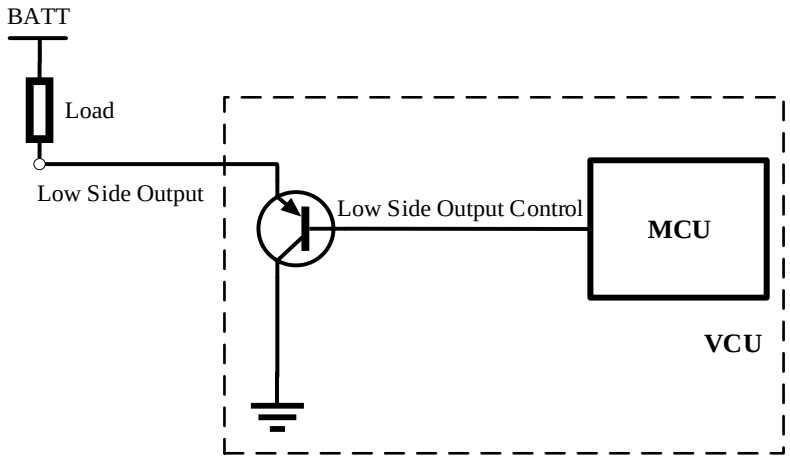


Figure 7 Schematic Diagram of Low-Side Driver Channel

Table 10 Low-Side Driver Channel Parameter

Pin #	LSO	EMC Capacitor	Output Current	Free Wheeling Diode	Conditions / Remarks
		(F)	Max		
114	LSO01	100n	2A	YES	
121	LSO02	100n	2A	YES	
117	LSO03	100n	2A	YES	
115	LSO04	100n	2A	YES	
116	LSO05	100n	2A	YES	
118	LSO06	100n	2A	YES	

112	LSO07	100n	1A	No	
113	LSO08	100n	1A	No	
105	LSO09	100n	1A	No	
95	LSO10	100n	1A	No	
111	LSO11	100n	1A	No	
87	LSO12	100n	1A	No	
100	LSO21	100n	1A	YES	OPWM Configurable
103	LSO22	100n	1A	YES	OPWM Configurable
85	LSO23	100n	1A	YES	OPWM Configurable
93	LSO24	100n	0.2A	YES	OPWM Configurable
101	LSO25	100n	0.2A	YES	OPWM Configurable
104	LSO26	100n	0.2A	YES	OPWM Configurable
99	LSO27	100n	0.2A	YES	OPWM Configurable
102	LSO28	100n	0.2A	YES	OPWM Configurable
94	LSO29	100n	0.2A	YES	OPWM Configurable
86	LSO30	100n	0.2A	YES	OPWM Configurable

Note:
When the low-side drive channel is configured as OPWM, the reference values of frequency and duty cycle are shown in the following table (test conditions: BATT=24V, load=24 Ohms, the duty cycle is all calculated as positive duty cycle).

Table 11 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 driver is a high-side switch controlled by GPIO. All channels have fault diagnosis function.

Main difference:

- Driving current
- With or without PWM function

Schematic

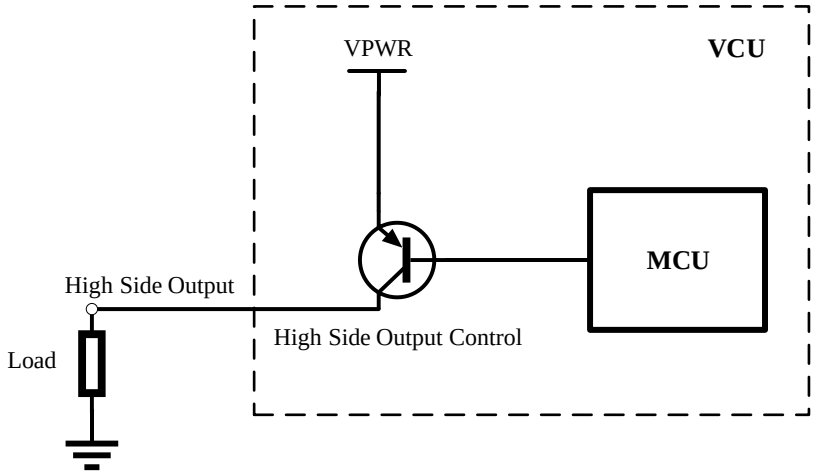


Figure 8 Schematic Diagram of High-Side Driver Channel

Table 12 High-Side Driver Channel Parameter

Pin #	HSO	EMC Capacitor	Output current	Free Wheeling Diode	Conditions / Remarks
		(F)	Max (A)		
108	HSO01	10n	2A	No	
107	HSO02	10n	2A	No	
110	HSO03	10n	2A	No	
109	HSO04	10n	2A	No	
82	HSO05	10n	0.5A	YES	OPWM Configurable
98	HSO07	10n	0.5A	YES	OPWM Configurable
106	HSO08	10n	0.5A	YES	OPWM Configurable
62	HSO09	10n	0.5A	YES	OPWM Configurable
2	HSO10	10n	0.5A	YES	OPWM Configurable

2.2.7 PeakHold Driver Output

Description

PeakHold driver is widely used in high-power solenoid valve control. Compared with traditional control methods, PeakHold can speed up system response. Its principle is to output a large current in a short period of time at the beginning of the drive to speed up the opening of the solenoid valve. After reaching the operating point, it reduces the current and keep the power on.

Schematic

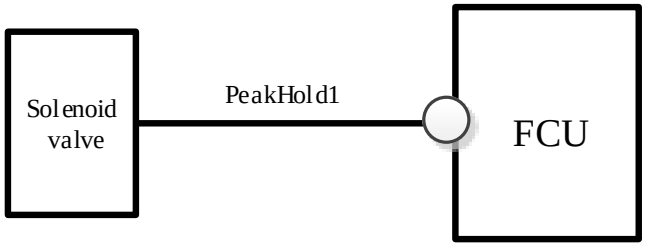


Figure 9 PeakHold Driver Principle Diagram

Table 13 PeakHold Interface Parameter List

Pin #	PeakHold	Output current
		Max
44	PeakHold1	7A
63	PeakHold2	7A
90	PeakHold3	7A
6	PeakHold4	7A

2.2.8 **CAN Bus**

Description

CAN interface circuit is used for communication between FCU and other vehicle's ECUs. Its communication speed can reach 1Mbit/s. CANA supports wakeup in any frame. CANB, CANC, CAND support CANFD.

Schematic

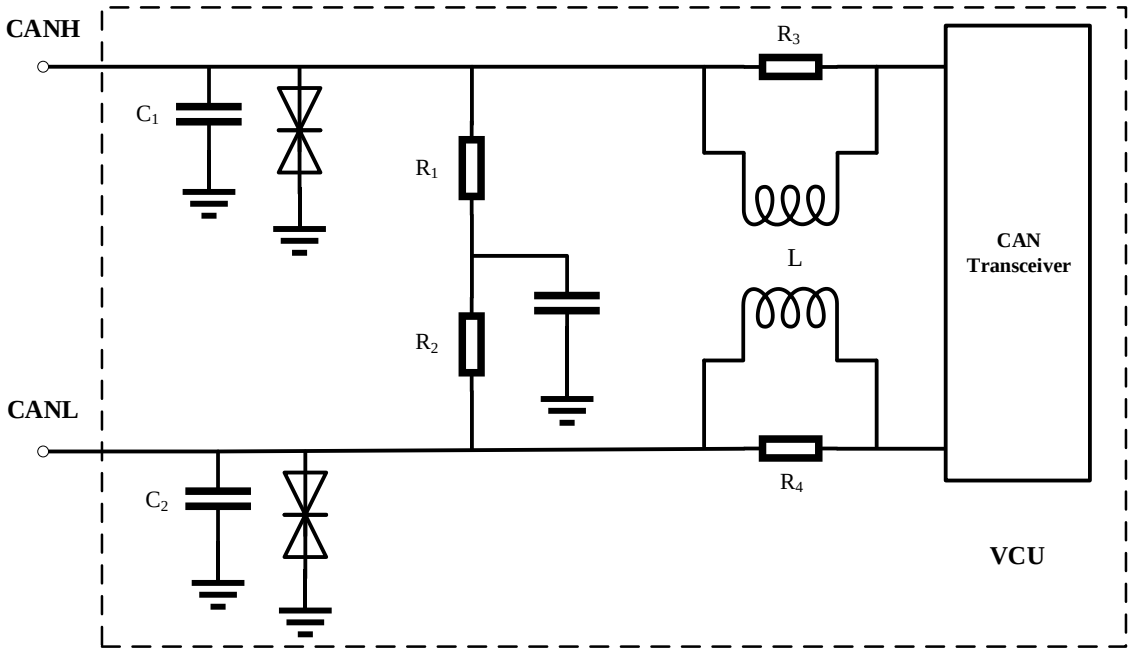


Figure 10 CAN Bus Schematic

Table 14 CAN Bus Parameter

CAN	EMC Capacitor C_1, C_2 (F)	R_1, R_2 (Ohm)	Choke L	Conditions / Remarks
CANA H	4.7nF/50V	60	Yes	Support specific frame wakeup
CANA L	4.7nF/50V	60		
CANB H	4.7nF/50V	--	Yes	Support CANFD
CANB L	4.7nF/50V	--		
CANC H	4.7nF/50V	--	Yes	Support CANFD
CANC L	4.7nF/50V	--		
CAND H	4.7nF/50V	--	Yes	Support CANFD
CAND L	4.7nF/50V	--		

2.2.9 **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. LIN supports wakeup function.

Schematic

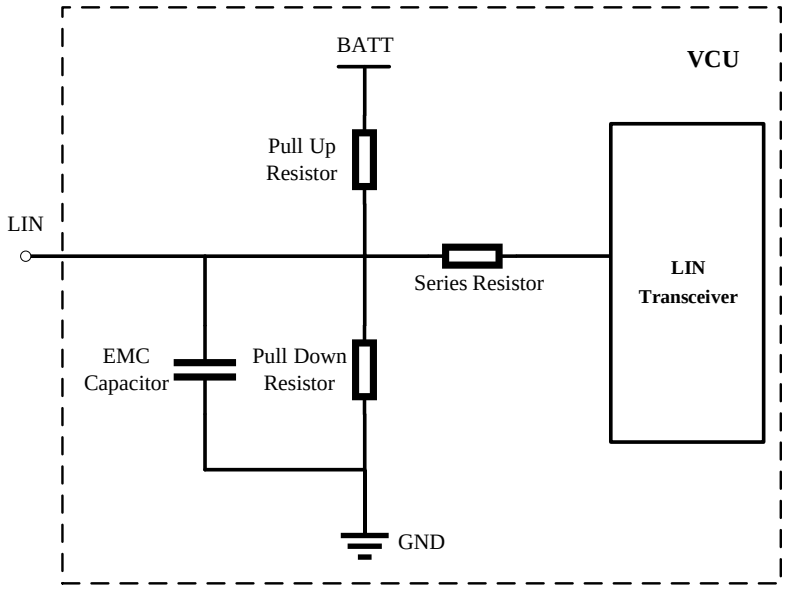


Figure 11 LIN Bus Schematic

Table 15 LIN Bus Parameter

LIN	EMC Capacitor (F)	Pull Up Resistor to U_B (Ohm)	Pull Down Resistor to GND (Ohm)	Series Resistor (Ohm)	Conditions / Remarks
LIN1	100nF/50V	1k	--	--	

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

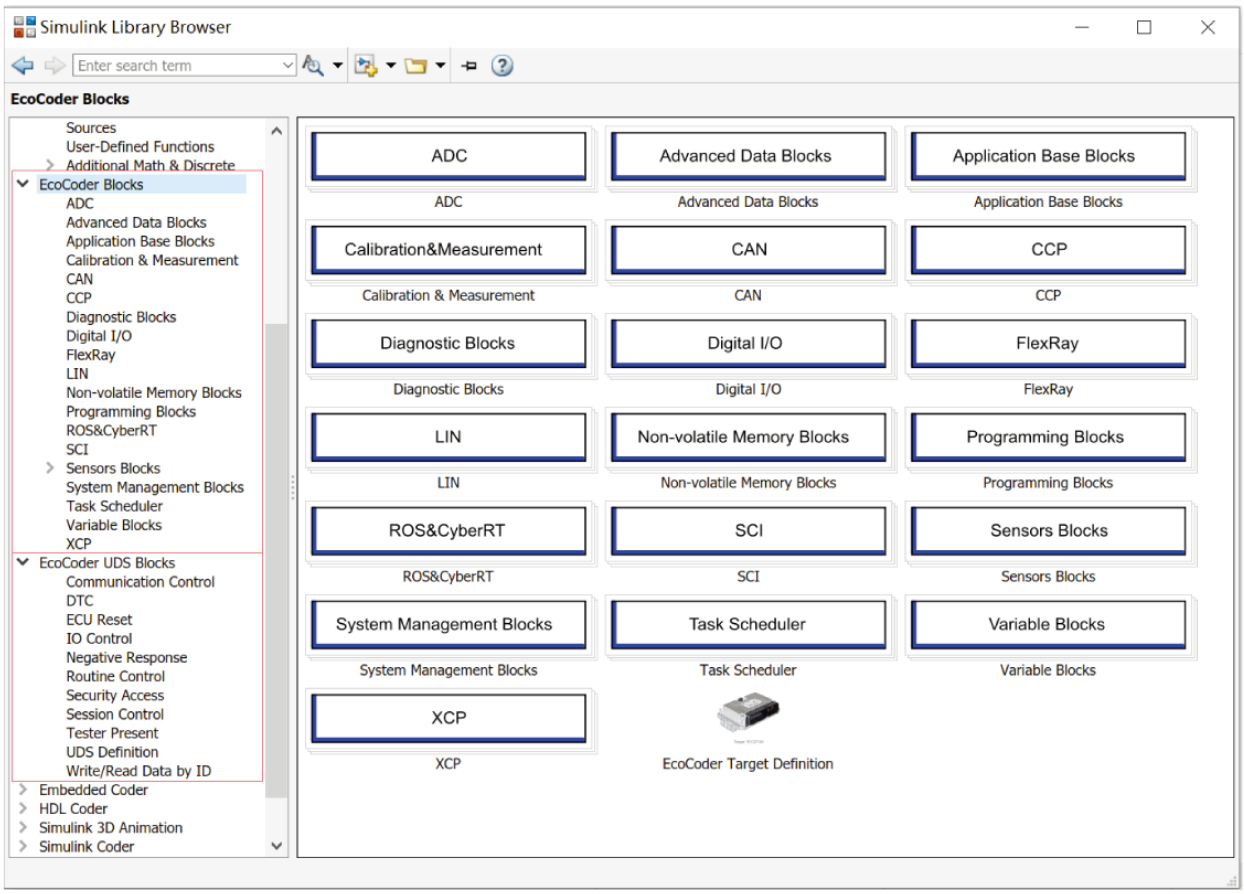
Table 16 5V Sensor Power Output Parameter

Pin #	Description	Imax(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 Software Tools

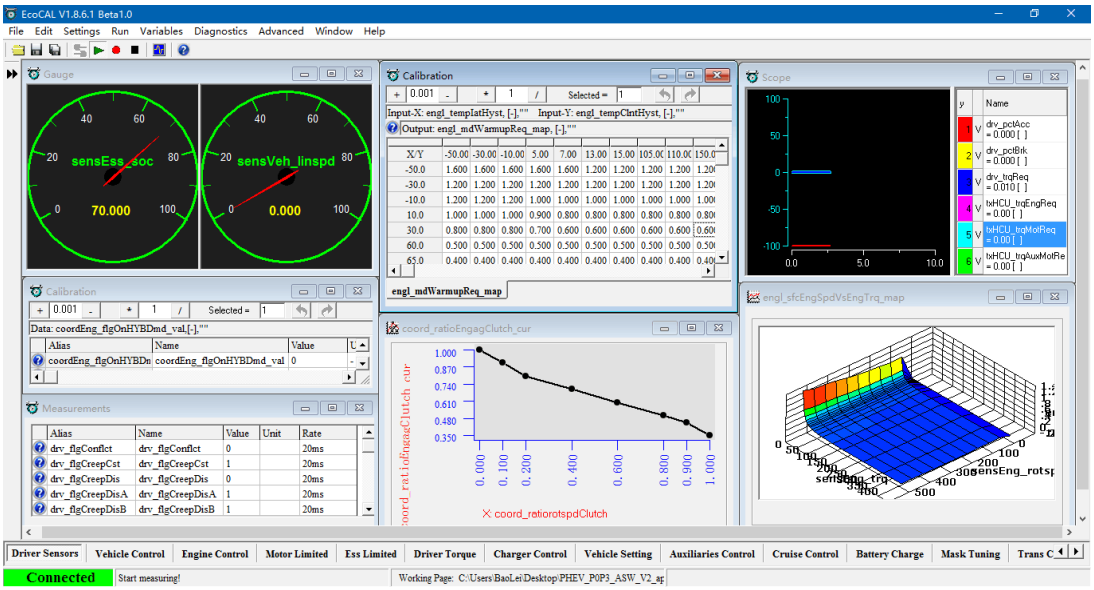
3.1 Automatic Code Generation Tool - EcoCoder

EcoCoder is an application development tool for the control system, which makes it more convenient for users to develop embedded application layer programs in the Simulink environment. It expands the resources of Simulink and Real-Time Workshop embedded encoders to generate necessary code blocks and automatically configures and optimizes code generation. EcoCoder encapsulates the basic software library as s-function, so that developers can use the basic software interface and configure some basic parameters in a graphical way. From the application layer model, executable files and data description files can be generated with one click and provides the address updating tool for A2L.
For details, please refer to the "EcoCoder Manual."



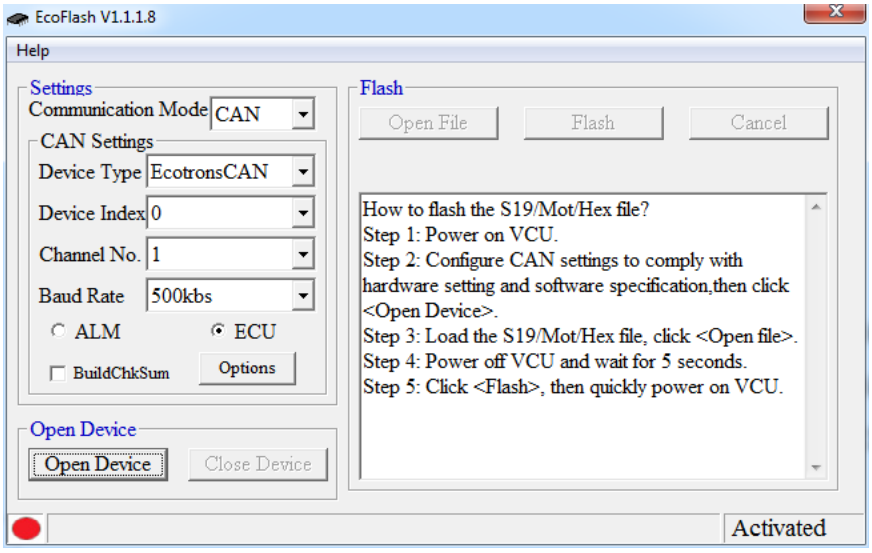
3.2 Calibration Tool – EcoCAL

EcoCAL is a professional calibration measurement tool developed by ECOTRON. It has the functions of real-time measurement, real-time recording, online calibration, data playback, and offline writing. EcoCAL is based on the CCP protocol and uses CAN bus for data communication. For details, please refer to the "EcoCAL Manual for EV."



3.3 Program Flashing Tool – EcoFlash

ECOTRON develops EcoFlash, a host computer software with BootLoader to flash program target files online. Its CAN communication protocol uses the CCP protocol, and it supports flashing in target files such as S19, mot, hex, etc.
For details, please refer to the "EcoFlash User Manual."



Chapter 4 Technical Performance

4.1 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	250×194×37mm
Material	Die-Cast Aluminum
Shell	Equipped With Waterproof Breathable Valve, Good Heat Dissipation

4.2 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

4.3 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

4.4 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	GMW3097

Chapter 5 Installation Requirements

It is recommended to install the FCU in the cockpit. If the OEM wants to assemble the FCU in another location, ECOTRON's engineers and the OEM's engineers should evaluate the corresponding installation location together.
The precautions for FCU installation are as follows:

1. The FCU and wiring harness installation should be firm and reliable, and there should be no looseness. Avoid supporting the wiring harness by FCU. At the same time, the arrangement of the FCU 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 FCU work.
3. FCU should keep away from the location where the temperature of the shell itself may exceed 85°C. At the same time, it is necessary to prevent the surrounding parts from releasing heat to the FCU.
4. Avoid installing the FCU 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 FCU and avoid installing the FCU at the resonance point of the car body.
6. Avoid installing the FCU 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 FCU power terminal.
7. FCU 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 12 below. In the vertical direction, the recommended installation angle is -170°~ -10°, as shown in Figure 13 below.

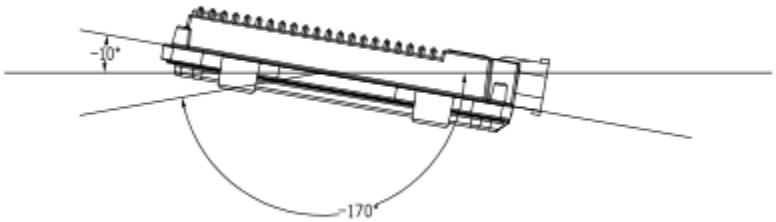
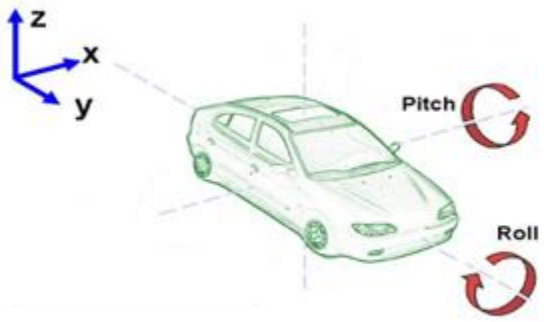


Figure 12 Horizontal Installation Angle



Z Axis: Vertical Direction
X Y Axes: Horizontal Direction

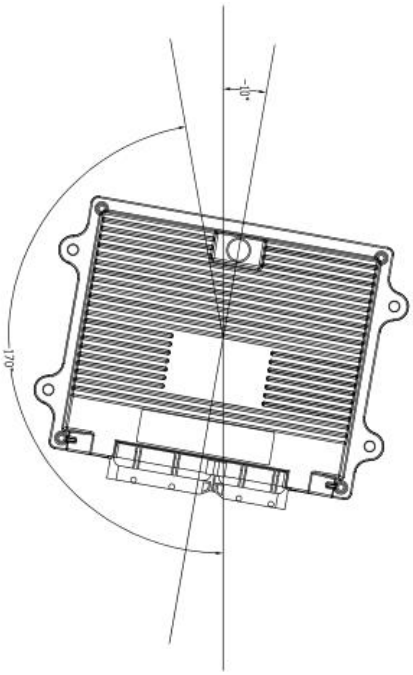


Figure 13 Vertical Installation Angle

ECOTRON recommends using the six installation points on the FCU 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 FCU for vibration, heat dissipation, temperature, EMC, etc. If there is any deviation, it needs to be confirmed with ECOTRON.

The FCU 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.