



EF2275B01



- Micro control unit
 - Infineon TC275T
 - 200MHz
 - 4M Flash
 - 472K SRAM
 - Float Point Capability
- (SBC) Microprocessor: TLF35584QVVS2
- Inputs
 - 22 Analog Inputs
 - 8 Digital Inputs
 - 6 Frequency Inputs
 - 1 Wake-Up Input
- Communication
 - 4 CAN 2.0B Channels
 - 1 LIN
 - CANA, support wake-up function
- Software Watchdog
- Outputs
 - 22 Low Side Drivers (10 of which could be configured as PWM outputs)
 - 9 High Side Drivers (5 of which could be configured as PWM outputs)
 - 2 H-bridges
- Sensor 5V Supply: 9 Channels
- EEPROM Emulation
- 9-32V Operating Voltage
- Environmental
 - Operating temperature: -40°C ~ 110°C
 - ISO16750 Compliant
 - ISO7637 Compliant
- Simulink Model Based Design

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Revision History

Date	Version	Author	Description
2020.9	V 1.0		First release
2020.10	V 1.1		Pin number update
2021.01	V 1.2		Add description of software tool chain
2021.04	V 1.3		Document review

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1 General Information

1.1 FCU Introduction

Fuel Cell Engine (FCE) is a complex, multidisciplinary system, as the control unit for FCEs, FCU needs to have strong computing and processing capabilities and rich collections of I/O to effectively manage and coordinate various of subsystems, to ensure the safe and strong power generation from the battery system for prolonged period of time.

1.2 FCU Features

EF2275B01 Major Functions:

Table 1EF2275B01 Function List

Functions
1 Keyon Signal 1 Hardwire Wakeup 4 channels Power Supply Voltage (BATT1) 9 channels 5V Voltage output 4 channels CAN communication interface: 1 channel CAN supporting specific frame wake-up; 3 channels CANFD 1 channel LIN communication interface 8 Channels Digital signal input ports: 4 channels high effective, 4 channels low effective 22 Analog signal input ports: 12 channels of 0 ~ 5V voltage input, 10 channels of 0 ~ 5V resistance input 6 channels frequency signal input 9 channels High-side drive control output: 5 channels can be configured as PWM output. 22 channels Low-side drive control output: 10 channels can be configured as PWM output. 2 Channels H-Bridges

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4 Channels Peak and Hold
Hardware watchdog

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2 Hardware

2.1 Specification

Supply Voltage	DC 12/24 V (9~32V)
Working Temperature	-40~110°C
Humidity	0~95%, no condensation
Storage Temperature	-45~125°C
Protection Level	IP67
Mechanical Shock	50g
Quiescent Current	<1mA
Expected Life	10 years
Electric Performance	ISO16750, ISO7637 compliance
EMC	CISPR25 compliance
Dimensions	250mm×194mm×37mm
Weight	≤700g
Housing	Die-casting aluminum
Rated Power Consumption	3W

2.2 Dimensions

The shell of FCU is made of aluminum die-casting and assembled with silicone seal. 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):

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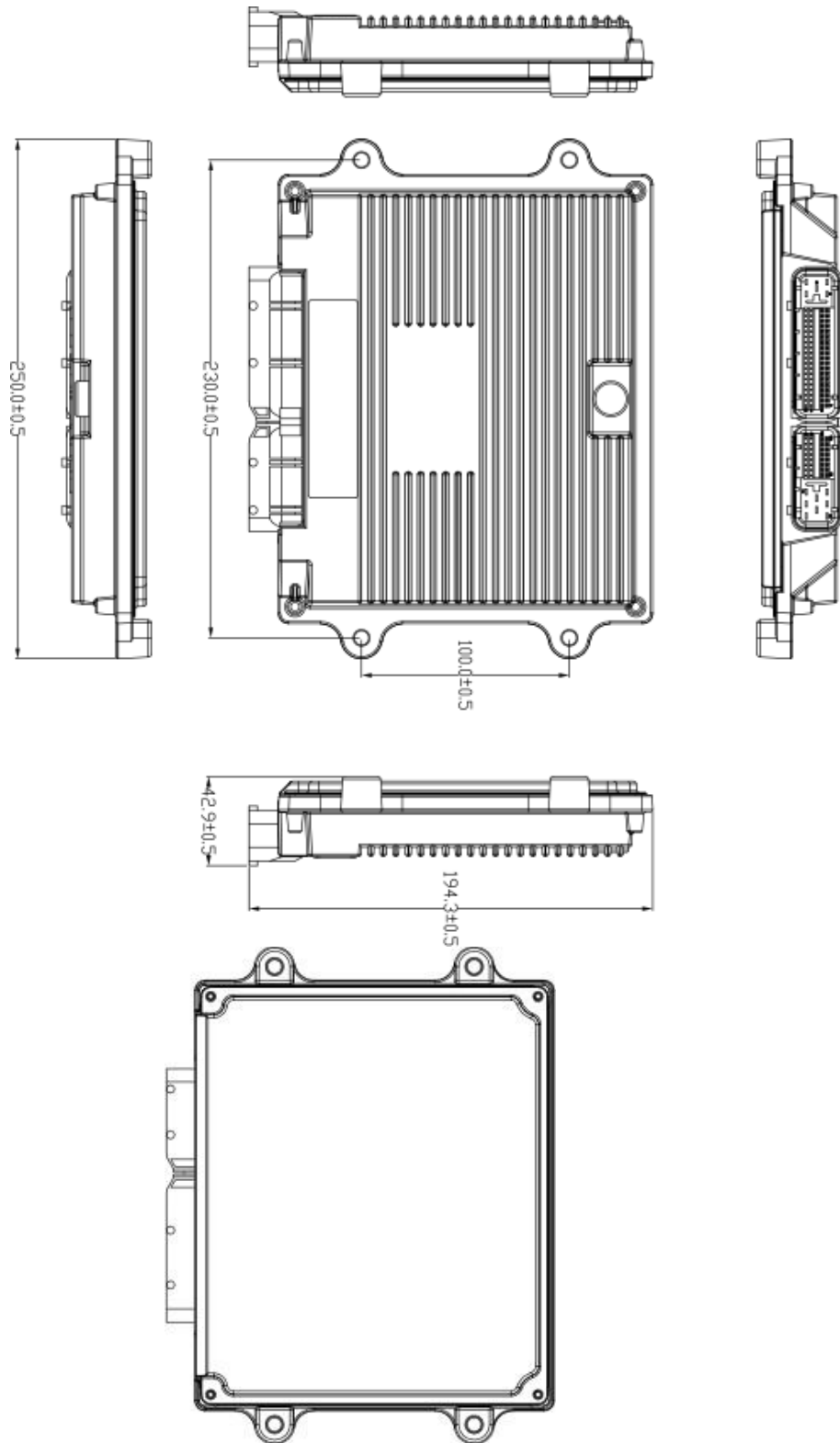


Figure 1 FCU Housing size

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Note: The screwdriver model used for disassembling the shell: Torx T15.

A product identification label is affixed to the FCU housing, which contains a product identification code for tracking customer information, date, batch number, serial number, etc.

2.3 Resources of Microcontroller

Table 2 Chip information

Feature	Detail
Micro Control Core	32-bit SAK-TC275TP-64F200W
Maximum Frequency	200MHz
Core Number	3 x Main Core + 1 x Checker Core
Flash	4M
SRAM	472K
Floating Point Capability	Yes
SBC Microprocessor	TLF35584QVVS2

2.4 Power Supply

EF2275B01 requires four continuous power supplies (pin1, pin3 and pin119, pin120), and the FCU is powered on by the key switch (pin24).

EF2275B01 power supply fuse recommends a 30A fuse connected in series with pin1, pin3, pin119 and pin120.

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3 Connector and Pinouts

3.1 Connector Parts

Ecotron FCU use the automotive rated connector, the 121-pin connector made by Tyco Electronics, which meets the automotive safety requirements. The following table lists parts of the connector. The connector kit can be purchased from Ecotron or customers can obtain their own connector parts to make the harness.

Table 3 Connector kits

No.	Name	Part Number	Supplier	Link
1	ECU 121P HDR ASSY-PBT	1746979-1	TE	1746979-1 : MQS Automotive Headers TE Connectivity
2	MQS REC 81P ASSY	1473244-1	TE	1473244-1 : AMP Automotive Housings TE Connectivity
3	MQS 81P LEVER(R) ASSY	1473247-1	TE	1473247-1 : AMP Automotive Connector Caps & Covers TE Connectivity
4	MQS RETAINER HSG FOR 81P	368382-1	TE	368382-1 : MQS Other Automotive Connector Accessories TE Connectivity
5	40POS MIXED MQS REC SEALED	1473252-1	TE	1473252-1 : AMP Automotive Housings TE Connectivity
6	MQS 40P LEVER(L) ASSY	1473255-1	TE	1473255-1 : MQS Automotive Connector Caps & Covers TE Connectivity
7	MQS RETAINER HSG FOR 40P	368388-1	TE	368388-1 : MQS Automotive Connector Locks & Position Assurance TE Connectivity
8	MQS0,63 Sn rec CB unseal. 0,2-0,35	5-968220-1	TE	5-968220-1 : MQS Automotive Terminals TE Connectivity
9	MQS0,63 Sn rec CB unseal. 0,5-0,75	5-968221-1	TE	5-968221-1 : MQS Automotive Terminals TE Connectivity
10	JPT A REC 2.8 Contact SWS Sn	964286-2	TE	964286-2 : AMP TIMER, RECEPTACLE AND TAB TE Connectivity

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11	JPT A REC 2.8 Contact SWS Sn Terminal Transmits 25 – 40 A (Power)	964273-2	TE	964273-2 : AMP TIMER, RECEPTACLE AND TAB TE Connectivity
12	SINGLE WIRE SEAL FOR J.P.T.CON	828904-1	TE	828904-1 : AMP Automotive Seals & Cavity Plugs TE Connectivity
13	SINGLE-WIRE-SEAL(5MM HOLE)	828905-1	TE	828905-1 : AMP Automotive Seals & Cavity Plugs TE Connectivity
14	2,5MM CAVITY PLUG FOR 5,4MM DI	828922-1	TE	828922-1 : AMP Automotive Seals & Cavity Plugs TE Connectivity
15	CAVITY PLUG(ECU 40P&81P ASSY)	936054-1	TE	936054-1 : Automotive Seals & Cavity Plugs TE Connectivity

3.2 Connector View

The connector has two rows with 121 pins. The pin numbers are specified as below.

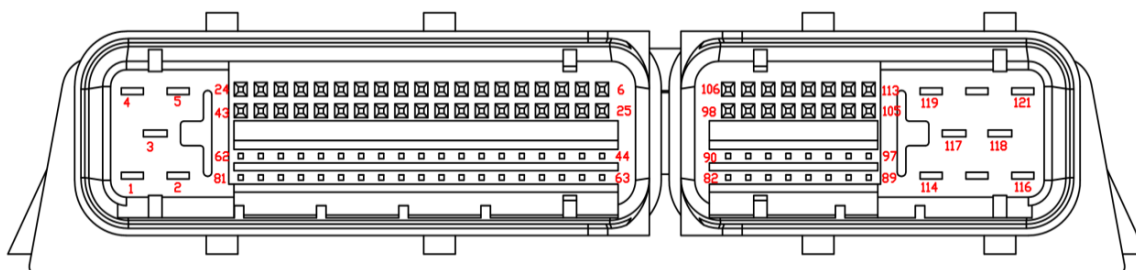


Figure 2 121 Pin connector

3.3 Pinouts

Table 4 Pin definition

Name	Pin #	Function	Description	Remarks
Power and Battery				
BATT	1	Battery		Voltage Range: 9v-32v

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	3	High Side Driver and Low Side Driver Power Supply	Operating Voltage 12v/24v	
	119 120			
5V2	16 32 38	5v Sensor Voltage 2	External Sensor 5v Power Supply	One Port Output: 5v± 1%, 3 Port Max Current: 150ma
5V3	19 35 41	5v Sensor Voltage 3	External Sensor 5v Power Supply	One Port Output: 5v± 1%, 3 Port Max Current: 150ma
5V4	53 56 59	5v Sensor Voltage 4	External Sensor 5v Power Supply	One Port Output: 5v± 1%, 3 Port Max Current: 150ma
PGND	4 5 96 97 88 89	Ground	Power Ground	
GND	17 20 23 36 39 42 54 57 60 74 76	Signal Ground	5v Sensors Ground	

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	78 80 81			
ANALOG INPUT				
AI01	15	Analog Input 01	Analog Input 0~5v	Voltage Type, 12-Bit Accuracy
AI02	18	Analog Input 02	Analog Input 0~5v	Voltage Type, 12-Bit Accuracy
AI03	21	Analog Input 03	Analog Input 0~5v	Voltage Type, 12-Bit Accuracy
AI04	34	Analog Input 04	Analog Input 0~5v	Voltage Type, 12-Bit Accuracy
AI05	37	Analog Input 05	Analog Input 0~5v	Voltage Type, 12-Bit Accuracy
AI06	40	Analog Input 06	Analog Input 0~5v	Voltage Type, 12-Bit Accuracy
AI08	55	Analog Input 08	Analog Input 0~5v	Voltage Type, 12-Bit Accuracy
AI18	14	Analog Input 18	Analog Input 0~5v	Voltage Type, 12-Bit Accuracy
AI19	69	Analog Input 19	Analog Input 0~5v	Voltage Type, 12-Bit Accuracy
AI09	58	Analog Input 09	Analog Input 0~5v	Voltage Type, 12-Bit Accuracy
AI20	28	Analog Input 20	Analog Input 0~5v	Voltage Type, 12-Bit Accuracy
AI21	13	Analog Input 21	Analog Input 0~5v	Voltage Type, 12-Bit Accuracy
AI07	52	Analog Input 07	Analog Input 0~5v	Voltage Type, 12-Bit Accuracy

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AI11	61	Analog Input 11	Analog Input 0~5v	Resistance Type, 12-Bit Accuracy
AI12	73	Analog Input 12	Analog Input 0~5v	Resistance Type, 12-Bit Accuracy
AI13	75	Analog Input 13	Analog Input 0~5v	Resistance Type, 12-Bit Accuracy
AI14	77	Analog Input 14	Analog Input 0~5v	Resistance Type, 12-Bit Accuracy
AI15	79	Analog Input 15	Analog Input 0~5v	Resistance Type, 12-Bit Accuracy
AI16	43	Analog Input 16	Analog Input 0~5v	Resistance Type, 12-Bit Accuracy
AI17	50	Analog Input 17	Analog Input 0~5v	Resistance Type, 12-Bit Accuracy
AI22	32	Analog Input 22	Analog Input 0~5v	Resistance Type, 12-Bit Accuracy
AI23	72	Analog Input 23	Analog Input 0~5v	Resistance Type, 12-Bit Accuracy
POWER ON SIGNAL				
KEYON	24	Keyon Signal	Analog Input 0~Batt	Threshold > 9v
WAKEUP	27	Wake Up Signal	Analog Input 0~Batt	Threshold > 9v
DIGITAL INPUT				
DI11	31	Digital Input 11	Digital Input 0~Batt	High Effective
DI12	68	Digital Input 12	Digital Input 0~Batt	High Effective
DI13	67	Digital Input 13	Digital Input 0~Batt	High Effective
DI14	47	Digital Input 14	Digital Input 0~Batt	High Effective
DI00	66	Digital Input 00	Digital Input 0~Batt	Low Effective
DI01	33	Digital Input 01	Digital Input 0~Batt	Low Effective
DI02	11	Digital Input 02	Digital Input 0~Batt	Low Effective

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DI03	70	Digital Input 03	Digital Input 0~Batt	Low Effective
FREQUENCY INPUT				
SPEED1	71	Frequency Input 1	Frequency Input	Range 1Hz-2kHz @5v
SPEED2	51	Frequency Input 2	Frequency Input	Range 1Hz-2kHz @5v
SPEED3	12	Frequency Input 3	Frequency Input	Range 1Hz-2kHz @5v
SPEED4	30	Frequency Input 4	Frequency Input	Range 1Hz-2kHz @5v
SPEED5	29	Frequency Input 5	Frequency Input	Range 1Hz~2kHz@24v
SPEED6	10	Frequency Input 6	Frequency Input	Range 1Hz~2kHz@24v
OUTPUT SIGNALS				
PEAKHOLD1	44	Hydrogen Injector Drive 1	Peak Current 7A	
PEAKHOLD2	63	Hydrogen Injector Drive 2	Peak Current 7A	
PEAKHOLD3	90	Hydrogen Injector Drive 3	Peak Current 7A	
PEAKHOLD4	6	Hydrogen Injector Drive 4	Peak Current 7A	
HSO01	108	High Side Output 01	Rated Current 1.5a, Peak 2A	
HSO02	107	High Side Output 02	Rated Current 1.5a, Peak 2A	
HSO03	110	High Side Output 03	Rated Current 1.5a, Peak 2A	
HSO04	109	High Side Output 04	Rated Current 1.5a, Peak 2A	
HSO05	82	High Side Output 05	Rated Current 0.4a, Peak 0.5a	Configurable PWM Output, Frequency Range 1Hz-2kHz
HSO07	98	High Side Output 07	Rated Current 0.4a, Peak 0.5a	Configurable PWM Output, Frequency Range 1Hz-2kHz

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HSO08	106	High Side Output 08	Rated Current 0.4a, Peak 0.5a	Configurable PWM Output, Frequency Range 1Hz-2kHz
HSO09	62	High Side Output 09	Rated Current 0.4a, Peak 0.5a	Configurable PWM Output, Frequency Range 1Hz-2kHz
HSO10	2	High Side Output 10	Rated Current 0.4a, Peak 0.5a	Configurable PWM Output, Frequency Range 1Hz-2kHz
LSO01	114	Low Side Output 01	Rated Current 1.5a, Peak 2A	With Freewheeling Diode
LSO02	121	Low Side Output 02	Rated Current 1.5a, Peak 2A	With Freewheeling Diode
LSO03	117	Low Side Output 03	Rated Current 1.5a, Peak 2A	With Freewheeling Diode
LSO04	115	Low Side Output 04	Rated Current 1.5a, Peak 2A	With Freewheeling Diode
LSO05	116	Low Side Output 05	Rated Current 1.5a, Peak 2A	With Freewheeling Diode
LSO06	118	Low Side Output 06	Rated Current 1.5a, Peak 2A	With Freewheeling Diode
LSO07	112	Low Side Output 07	Rated Current 0.8A, Peak 1A	
LSO08	113	Low Side Output 08	Rated Current 0.8A, Peak 1A	
LSO09	105	Low Side Output 09	Rated Current 0.8A, Peak 1A	
LSO10	95	Low Side Output 10	Rated Current 0.8A, Peak 1A	
LSO11	111	Low Side Output 11	Rated Current 0.8A, Peak 1A	
LSO12	87	Low Side Output 12	Rated Current 0.8A, Peak 1A	

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H1-A	84	H-Bridge Driver	Rated Current 3a	H1-A 3a
H1-B	92	H-Bridge Driver	Rated Current 3a	H1-V 3a
H2-A	91	H-Bridge Driver	Rated Current 3a	H2-A 3a
H2-B	83	H-Bridge Driver	Rated Current 3a	H2-B 3a
LSO21	100	Low Side Driver Output 21	Rated Current 0.8A, Peak 1A	Configurable PWM Output, Frequency Range 1Hz- 1kHz, With Freewheeling Diode
LSO22	103	Low Side Driver Output 22	Rated Current 0.8A, Peak 1A	Configurable PWM Output, Frequency Range 1Hz- 1kHz, With Freewheeling Diode
LSO23	85	Low Side Driver Output 23	Rated Current 0.8A, Peak 1A	Configurable PWM Output, Frequency Range 1Hz- 1kHz, With Freewheeling Diode
LSO24	93	Low Side Driver Output 24	Rated Current 0.16A, Peak 0.2A	Configurable PWM Output, Frequency Range 1Hz-2kHz
LSO25	101	Low Side Driver Output 25	Rated Current 0.16A, Peak 0.2A	Configurable PWM Output, Frequency Range 1Hz-2kHz
LSO26	104	Low Side Driver Output 26	Rated Current 0.16A, Peak 0.2A	Configurable PWM Output, Frequency Range 1Hz-2kHz
LSO27	99	Low Side Driver Output 27	Rated Current 0.16A, Peak 0.2A	Configurable PWM Output, Frequency Range 1Hz-2kHz
LSO28	102	Low Side Driver Output 28	Rated Current 0.16A, Peak 0.2A	Configurable PWM Output, Frequency Range 1Hz-2kHz
LSO29	94	Low Side Driver Output 29	Rated Current 0.16A, Peak 0.2A	Configurable PWM Output, Frequency Range 1Hz-2kHz
LSO30	86	Low Side Driver Output 30	Rated Current 0.16A, Peak 0.2A	Configurable PWM Output, Frequency Range 1Hz-2kHz

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CANA_H	64	CANA_H	Including 120ohm Terminating Resistor	Support Specific Frame Wakeup
CANA_L	65	CANA_L		
CANB_H	25	CANA_H	No 120ohm Terminating Resistor	Support Specific Frame Wakeup
CANB_L	26	CANA_L		
CANC_H	7	CANA_H	No 120ohm Terminating Resistor	Support Specific Frame Wakeup
CANC_L	8	CANA_L		
CAND_H	45	CANA_H	No 120ohm Terminating Resistor	Support Specific Frame Wakeup
CAND_L	46	CANA_L		
LIN1	9	LIN Bus		
INTERNAL SIGNAL				
AI28	--	Collect the Power Supply Batt Voltage		12 Bit Accuracy

3.4 Function Description and Application Note

3.4.1 Analog Input Signal

Function description

The analog input channel circuit has the same structure, including EMC capacitors, pull-up/pull-down resistors, and a first-order low-pass filter circuit.

The main differences:

- The resistance of the pull-up/pull-down resistor
- Pull up voltage
- Filter time constant

Schematic diagram

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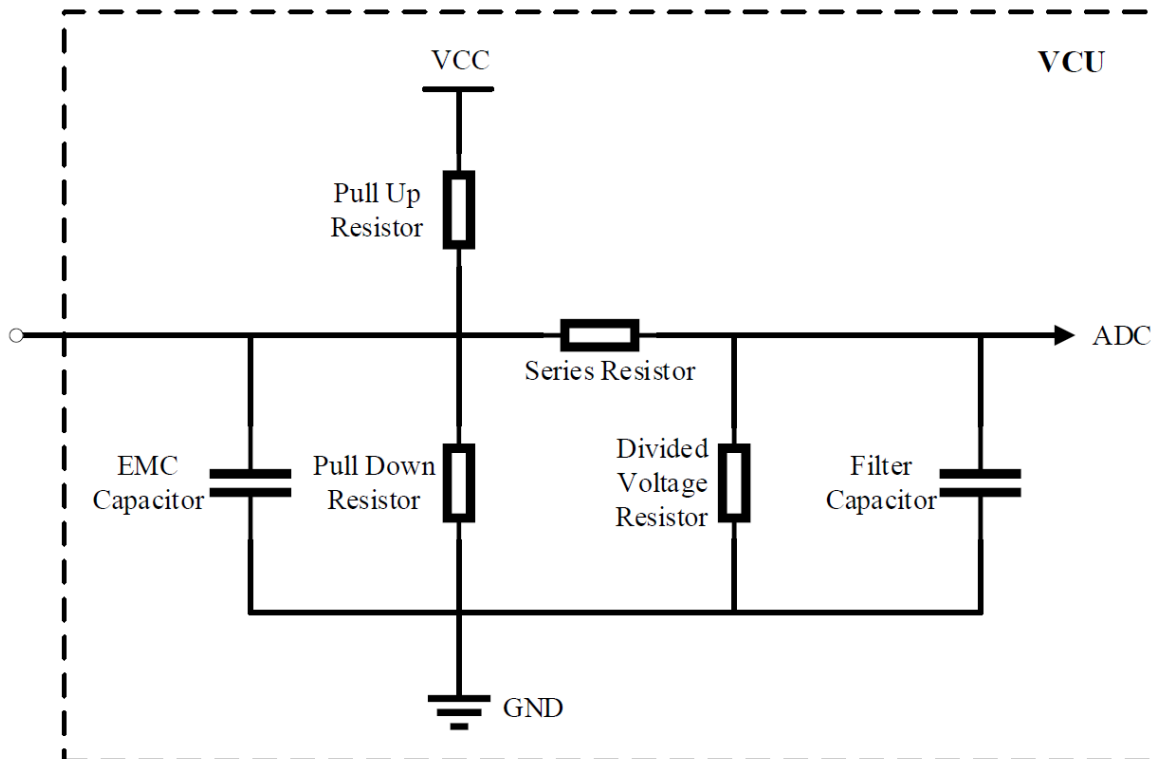


Figure 3 Schematic diagram of analog input channel

Note: 1) "--" means not installed. 2) UB represents the BATT voltage of the power supply. 3) AI28 collects BATT voltage signals.

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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	

Table 5 Analog input channel parameter table

3.4.2 Digital Input Signal

Function description

The digital input channel circuit has the same structure, including EMC capacitors, pull-up/pull-down resistors, voltage divider resistors, and a first-order low-pass filter circuit.

The main differences:

- The resistance of the pull-up/pull-down resistor
- Pull-up/drop-down selection
- Filter time constant

Schematic diagram

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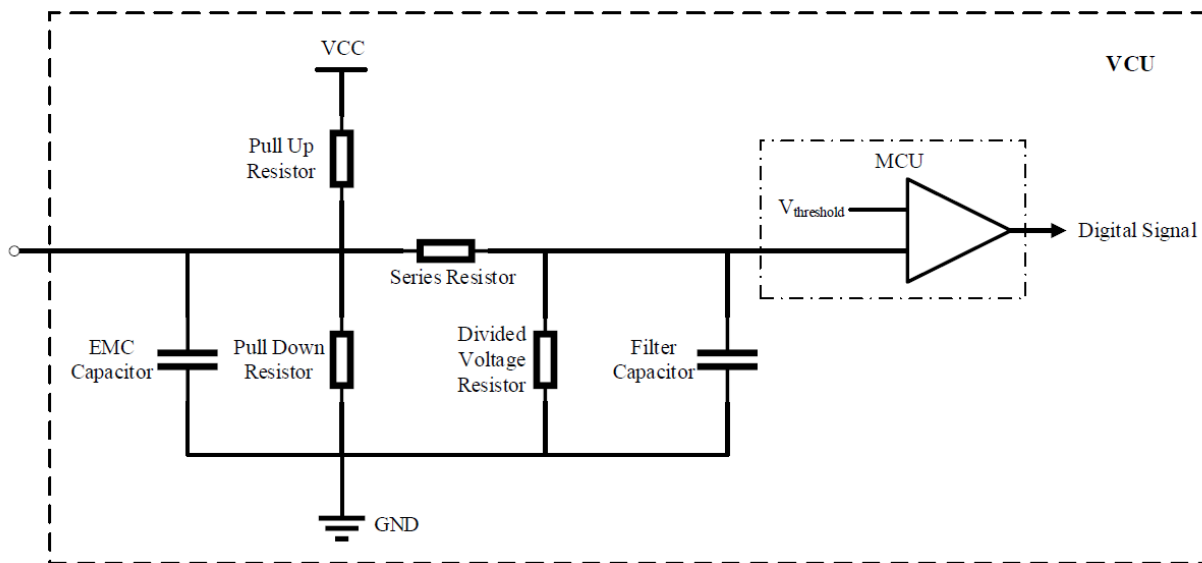


Figure 4 Schematic diagram of digital input channel

Note: 1) "--" means not installed. 2) UB represents the BATT voltage of the power supply. 3) KEYON only serves as a 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

Table 6 Digital input channel parameter table

3.4.3 Frequency Input Signal

Function description

The frequency input channel circuit has the same structure, including EMC capacitors, pull-up/pull-down resistors, voltage divider resistors and first-order low-pass filter

Wave circuit.

The main differences:

- The resistance of the pull-up/pull-down resistor

- Pull-up/drop-down selection
- Filter time constant

Schematic diagram

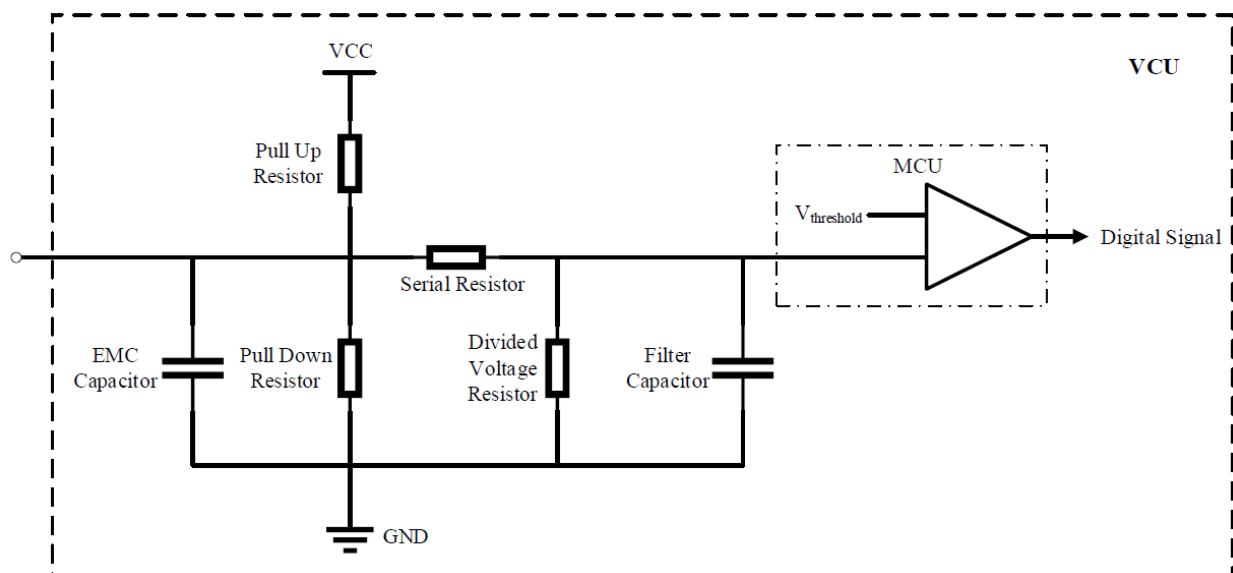


Figure 5 Schematic diagram of frequency signal input channel

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

Table 7 Frequency signal input channel parameter table

Note:

- 1) "--" means it is not installed.
- 2) UB represents the BATT voltage of the power supply.
- 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-Frequency and Duty Cycle Reference Value of Frequency Signal Input Channel

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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 %

Table 8 Frequency and duty cycle reference

3.4.4 H-bridge

Function description

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

Schematic diagram

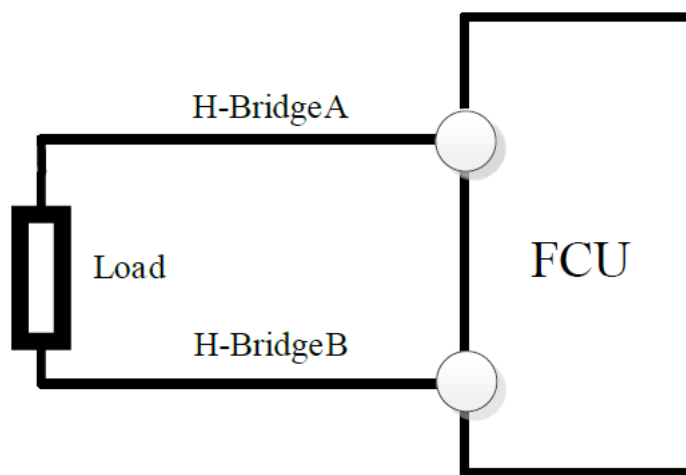


Figure 6 H-bridge working principle

H-bridges	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

Table 9 H-bridge output parameter table

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3.4.5 Low Side Drivers

Function description

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

The main differences:

- Different drive current
- With or without PWM function
- With or without freewheeling diode

Schematic diagram

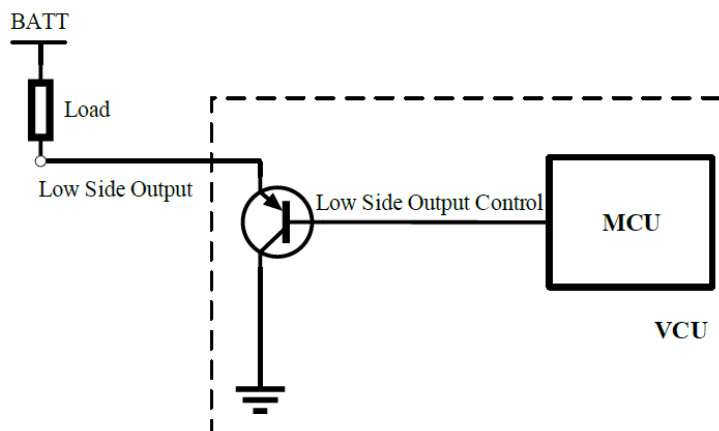


Figure 7 Schematic diagram of low-side drive channel

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Pin #	LSO	EMC Capacitor (F)	Output Current Max	Free Wheeling Diode	Conditions / Remarks
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

Table 10 Low-side drive channel parameter table

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 ohm, duty cycle is all calculated as positive duty cycle)

Set frequency	Actual output frequency	Set duty cycle	Actual Output duty cycle	Set duty cycle	Actual Output duty cycle	Set duty cycle	Actual 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%

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2000Hz	2000Hz	10.0%	10.8%	50.0%	50.6%	90.0%	90.8%
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Table 11 reference values of frequency and duty cycle

3.4.6 High Side Drivers

Function description

The high-side driver is a high-side switch controlled by GPIO, and all channels have a fault diagnosis function.

The main differences:

- Drive current
- With or without PWM function

Schematic diagram

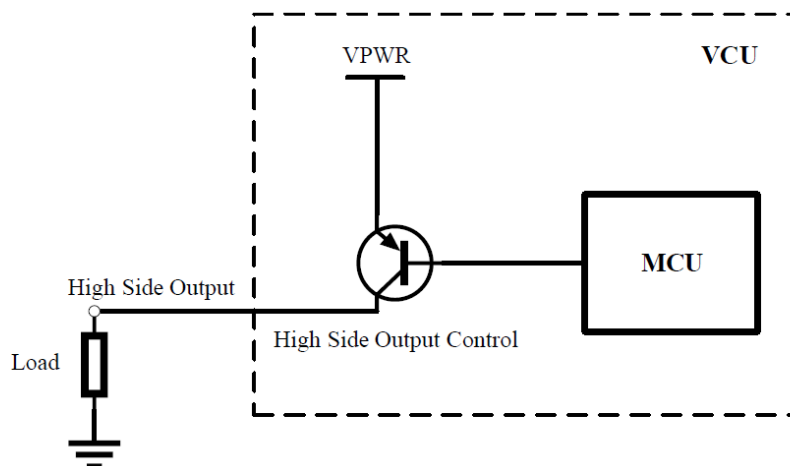


Figure 8 Schematic diagram of high-side drive channel

Pin #	HSO	EMC Capacitor(F)	Max output Current (A)	Free Wheeling Diode	Conditions/Remarks
108	HSO01	10n	2A	No	
107	HSO02	10n	2A	No	

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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

Table 12 High-side drive channel parameter table

3.4.7 PeakHold Driver Output

Function description

PeakHold drive is widely used in high-power solenoid valve control. Compared with traditional control methods, PeakHold can speed up system response. The principle is to output a large current within a short period of time at the start of driving to speed up the opening speed of the solenoid valve and reduce the current after reaching the operating point to maintain the open state.

Schematic diagram

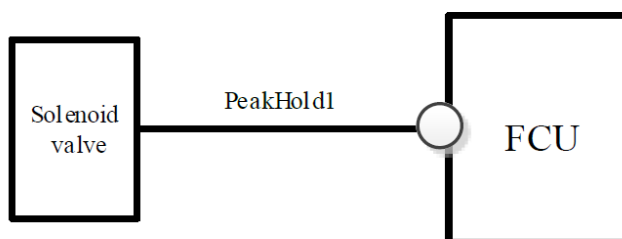


Figure 9 PeakHold drive principle diagram

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

Table 13 PeakHold interface parameter list

3.4.8 CAN Bus

Function description

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The CAN interface is used for the communication between the FCU and other on-board electronic controllers, and the communication rate can reach up to 1Mbps. 1 CANA supports wake-up on any frame. 3 CANB, CANC, CAND support CANFD.

Schematic diagram

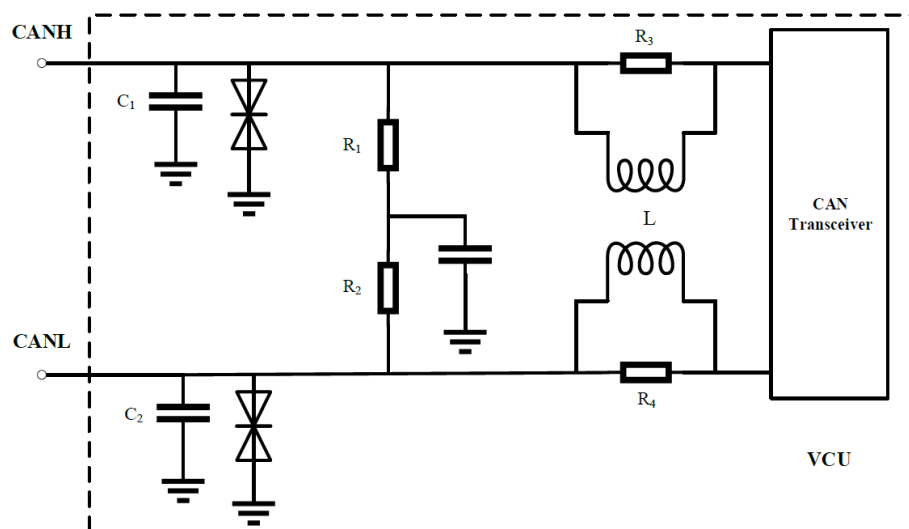


Figure 10 Schematic diagram of CAN interface

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	Yes	Support specific frame wakeup
CANB H	4.7nF/50V	--	Yes	Support specific frame wakeup
CANB L	4.7nF/50V			Support specific frame wakeup
CANC H	4.7nF/50V	--	Yes	Support specific frame wakeup

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CANC L	4.7nF/50V			Support specific frame wakeup
CAND H	4.7nF/50V	--	Yes	Support specific frame wakeup
CAND L	4.7nF/50V			Support specific frame wakeup

Table 14 CAN interface parameter table

3.4.9 LIN Bus

Function description

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

Schematic diagram

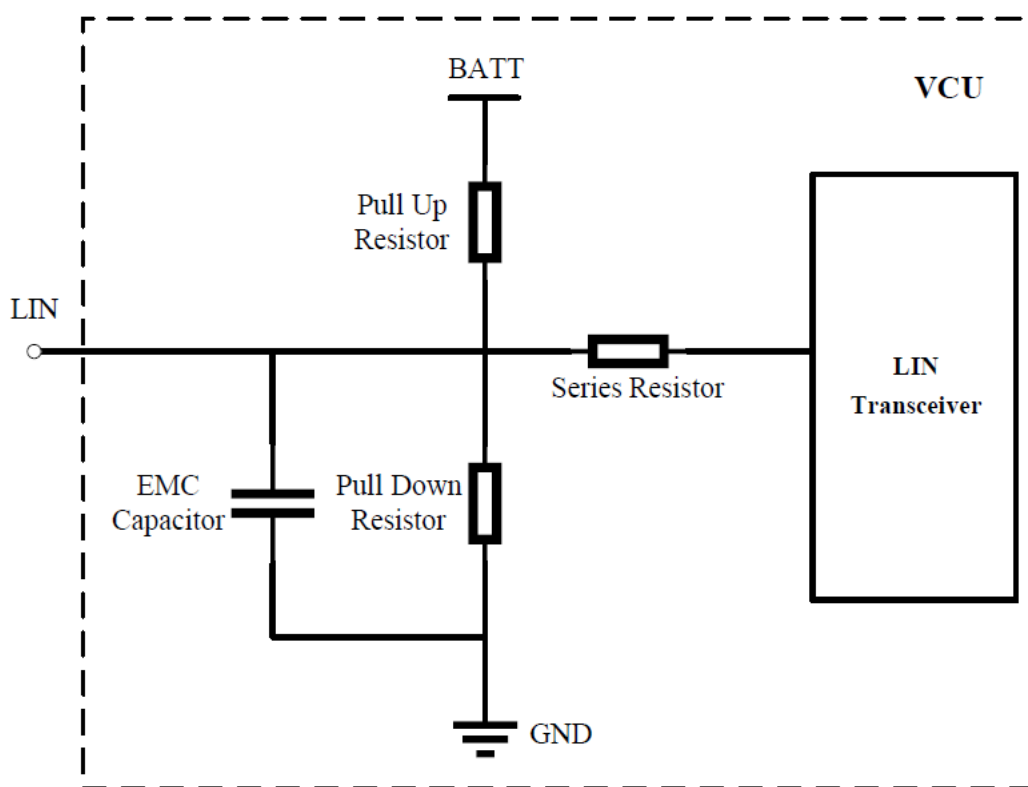


Figure 11 Schematic diagram of LIN interface

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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	--	--	

Table 15 LIN interface parameter table

3.4.10 5V Voltage Output

Function description

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

- Precision 5V output for internal IC power supply
- 9 sensor 5V power supply output
- Reverse connection protection, short circuit protection, over temperature protection

Pin #	Supply Voltage	I _{max} (A)	Output Voltage
16 22 38	5V supply voltage 2	Sum of maximum of 3ports: 150mA	One channel output:5V± 1%
19 35 41	5V supply voltage 3	Sum of maximum of 3ports: 150mA	One channel output:5V± 1%
53 56 59	5V supply voltage 4	Sum of maximum of 3ports: 150mA	One channel output:5V± 1%

Table 16 5V sensor power output parameter table

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4 Installation Requirement

Ecotron recommends installing the FCU in the cockpit. If the OEM wants to install the FCU in other locations, the corresponding installation location should be evaluated by Ecotron's engineers and the vehicle manufacturer's engineers.

The requirements for FCU installation are as follows:

- 1) The installation of the FCU and the wiring harness should be firm and reliable, and there should be no looseness. Avoid supporting the wiring harness by the FCU. At the same time, the arrangement of the FCU wiring harness should be protected to avoid 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 FCU work.
- 3) Keep away from the location where the temperature of the enclosure itself may exceed 85°C(185°F). At the same time, prevent the heat released by surrounding parts from radiating to the FCU.
- 4) Avoid installing the FCU in locations where oil, moisture, and water droplets are easy to splash.
- 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 vehicle body.
- 6) Avoid installing the FCU near the location where it is likely to expose to the battery or other acid-alkaline solutions that easily leak out, and where the FCU is easily corroded.
- 7) Avoid installing the FCU near the positive terminal of the battery and the ignition power terminal.
- 8) The FCU should be installed in the horizontal and vertical position according to the connector downwards and maintain a certain angle to avoid water inflow from the connector. In the horizontal direction, the recommended installation angle is -170° to -10°. In the vertical direction, the recommended installation angle is -170°~ -10°, as shown below.

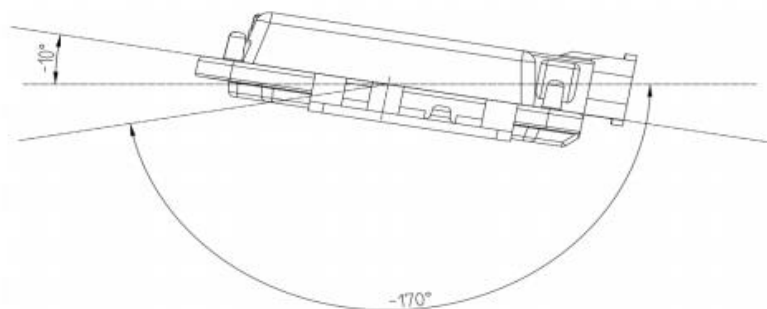


Figure 12 Horizontal installation angle

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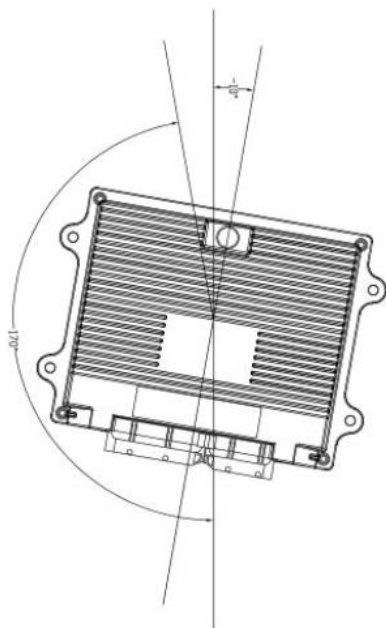


Figure 13 Vertical installation angle

Ecotron recommends using six installation points of the FCU itself for installation and fixation. It is recommended to use metal materials such as aluminum alloy for the mounting bracket, and there should be a reliable electrical connection between housing and the vehicle body through the bracket. If other materials are used, the customer must ensure that it can meet the FCU's requirements for vibration, heat dissipation, temperature, EMC, etc. If there is any deviation, it needs to be confirmed with Ecotron.

The FCU system adopts the vehicle body grounding method, and its specific requirement is to directly connect the ground wire in the wiring harness to the vehicle body and ensure a reliable electrical connection.

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5 Appendix: Test Standard

These tables are extracted from third party test report.

For complete report, please email support@ecotron.ai.

Environmental Test Standards

Topic	Test standard
Electrical operation during cycling ambient temperature	ISO16750-4
Ambient storage temperature	ISO16750-4
High and low temperature test	ISO16750-4
Thermal shock	ISO16750-4
Humid heat – cyclic test	ISO16750-4
Damp heat, steady-state test	ISO16750-4
Dust and particulate	IP67
Splash test	ISO16750-4
Leakage and function test	ISO16750-4
Corrosion test	ISO16750-4
Fluids and chemicals	IP66
Mechanical shock / Pot hole test	ISO16750-3
Vibration	ISO16750-3
Drop	ISO16750-3

EMC Test Standards

Topic	Test requirement
Conducted emission test-voltage method	CISPR 25:2008
Conducted emission test Current probe method	CISPR 25:2008

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Radiated emission test-ALSE method	CISPR 25:2008
Bulk current injection	ISO 11452-4:2011
Absorber-lined shielded enclosure	ISO 11452-2:2004
CI on the signal line transient interference	ISO 7637-3 2007
Voltage transient emissions test	ISO 7637-2:2011
Signal line transient conducted immunity test	ISO 7637-3:2007
Immunity to magnetic field	ISO 11452-8:2007

Electrical Performance Tests Standards

Topic	Test Standard
Over voltage test	ISO16750-2
Reverse polarity protection test	ISO16750-2
AC voltage superposition test	ISO16750-2
Supply voltage slow down test	ISO16750-2
Voltage transient drop test	ISO16750-2
Reset performance test	NA
Starting voltage test	ISO16750-2
Quiescent current measurement test	Average quiescent current $\leq 1\text{mA}$
Single - wire open circuit test	ISO16750-2
Multi - line open circuit test	ISO16750-2
Short-circuit protection	ISO16750-2
Insulation resistance	ISO16750-2