Vehicle CAN Communication Protocol

I、 Network system control and communication Network protocol

1. The meaning and purpose of this agreement

According to the system requirements and practical work needs, this agreement focuses on the communication of each ECU of the pure electric vehicle. And formulates the control and communication system agreement, which will provide basis and standard for the direct

communication of component controllers.

2. Scope of application
This agreement is mainly used for the communication among various system components of pure electric subcompact vehicle.

3. International norms and relevant documents for reference in this agreement
1) This agreement is formulated in accordance with the requirements of pure electric subcompact vehicle system and with reference to relevant international standards. The international norms mainly followed And referred to include:
2) GT/T 19596 terms for electric cars
3) ISO 11898 -- ISO standard, road vehicle -- digital information exchange -- CAN2.0 specification for high-speed communication controller LAN.
4) SAE J1939 commercial vehicle control system LAN CAN communication protocol

4. The Network nodes and the topology
The CAN network involves the following communication nodes, whose abbreviations and addresses are defined as follows:

Item	Abbreviations	Address	Instructions
Battery Management System	BMS	244 (0 xf4)	
Motor Controller	MCU	239 (0 xef)	
Instrument Display Controller	DPLY	40 x28 (0)	
Multimedia Controller	MMC	56 (0 x38)	
The Car Charger	CCS	229 (0 xe5)	
The Broadcast Address	BCA	80 (0 x50)	
The Quick Charge Interface	FCS	\	In BMS output
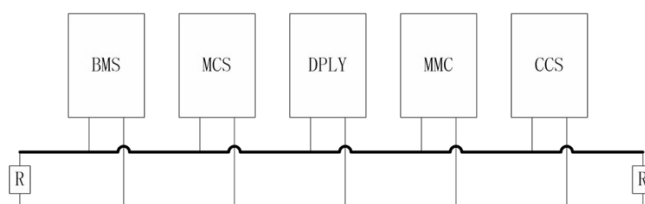
R is 120 Ω terminal to hold
5. Network Hardware Requirements
1) The power supply should have reverse connection protection and power drop detection function.
2) The controller power supply shall comply with the GB/T11858.3 standard, and the designed ECU shall be able to be used within the range of 130V dc voltage, And work normally within the range of the external power supply of the vehicle involved, such as 220V ac and 750V quick charging voltage.
3) The CAN bus communication cable adopts shielded twisted pair (flame retardant, 0.5 mm), which is composed of the twisted pair CAN_H and CAN_L and shielded line CAN_SHLD.
4) The wiring topology of the network should be as compact as possible to avoid cable reflection. The cable connecting the ECU to the bus backbone should be less than 150mm. In order to minimize the Standing wave, nodes cannot be connected at equal intervals in

the network, and the distance between nodes must be greater than 100mm, and the access line equally long, And the maximum length of the access line should be less than 1m.

5) All nodes are isolated by optocoupler and the power supply needs to be isolated.
6) Communication cables should leave the power line (0.5 m) wining and 12 v control line (0.1 m) wining the as far as possible;
7) Resistor (120 Ω) is installed on both ends of the network line, temporary installation in the MCU and instrumentation;
8) The cable shielding layer is continuously conducted in the vehicle, And the network socket of each component is required and the connector of the shielding layer. The When the grounding mode of the shielded wire is the wiring of the vehicle, Select the appropriate single point grounding

6. Transmission Rate and Filling Format
1) Bus transmission rate: 500kbps
2) The fill the format: intel
3) Eserved bytes: bits are filled with 0 by default
4) Data transmission format: msb (bit8) to lsb (bit1), byte to lsb (byte1) to msb (byte8).

7. The Message structure

	P	R	DP	PF	PS	SA	DATA
	3	1	1	8	8	8	0 ~ 64
NOTE1:	P is the priority, set from the highest 0 to the lowest 7. Security is 1, partial function missing is 2, run 3, request 4, display 7. Not according to the node)						
NOTE2:	R is reserved for future development. This standard is set to 0.						
NOTE3:	DP is the data page, which is used to select the auxiliary page for the description of the parameter group. This standard is set to 0.						
NOTE4:	PF is the PDU format, which is used to determine the format of the PDU, as well as the data and corresponding parameter group Numbers.						
NOTE5:	PS value is the target address. (press DPU2 for broadcast message)						
NOTE6:	The SA value is The source address						
NOTE7:	If a given Data length is less than or equal to 8 bytes, all 8 bytes of the Data domain can be used						

II、 Network communication message

1. Battery management system message
1) BMS basic information message 1

sender	Receiver	ID						Cycle (ms)	Data			
		0 x18ff28f4							BYTE	BIT	Data Name	few
BMS	DPLY	P	R	DP	PF	PS	S.A.	100	1	1	Whether the charging cable is connected	0: not connected; 1: the connect
										2	pack charging	Zero: uncharged; 1: charging
										3	failure state	Zero: no power loss; 1: the loss of electricity
										4	pack ready	0: not ready; 1: ready
										5	Discharge contactor state	0: disconnect; 1: closed
										6	Charging contactor status	Zero: disconnection; 1: closed
										7 ~ 8	reserved	
									2		SOC	The effective value is 0~100; Scaling factor, 1% / bit
									3		The total charge and discharge current of battery pack is low byte	Effective value 0~10000, unit A, range (-500~500) A, Offset -5000, scaling factor 0.1a /bit. The current is negative when charged
		6	0	0	255	40	244		4		The total charging and discharging current of 'pack is high byte	
									5		The battery pack's total voltage is depressed by bytes	Effective value 0~10000, unit V, range (0~1000) V, offset 0, scaling factor 0.1v /bit
									6		The total voltage of The battery pack is high in bytes	
									7		failure rating	0 x00: trouble - free 0x01: level 1 fault (severe fault, stop immediately) 0x02: level 2 failure (normal failure, 50% speed limit operation) 0x03: level 3 fault (alarm fault, alarm)
									8		Fault code	See the troubleshooting section

2) BMS basic information message 2

Sender	Receiver	ID						Cycle (ms)	Data				
		0 x18fe28f4							BYTE	BIT	Data Name		few
BMS	DPLY	P	R	DP	PF	PS	SA	100	1		Highest single voltage byte		Effective value is 0~10000, unit mV, scale factor is 1mV/bit
									2		Highest single voltage high byte		
									3		The Lowest single voltage byte		Effective value is 0~10000, unit mV, scale factor is 1mV/bit
									4		Low single voltage high byte		
		6	0	0	254	40	244		5		Monomer maximum temperature		Effective value 0~255, unit ℃, offset -40, scaling factor 1℃/bit
									6		Monomer minimum temperature		Effective value 0~255, unit ℃, offset -40, scaling factor 1℃/bit
									7		The Maximum allowable discharge current low, in bytes		Effective value is 0~10000, unit A, offset 0, scaling factor is 0.1A/bit.
									8		The Maximum allowable discharge current high in bytes		

The state of contactor can be reserved for heating contactor, prefilling contactor and other states to be reported

3) BMS voltage details message
   Report all single battery voltages.
   Xc8 PF starts at 200 (0) and is incremented by 1 for each frame until the data is sent. The PF value is less than 249.

Sender	Receiver	ID						Cycle (ms)	Data				
		0 x18c828f4							BYTE	BIT	Data Name		Remark
BMS	DPLY	P	R	DP	PF	PS	SA	500	1		(pf-200) *4+1 battery highest single voltage high byte		Effective value is 0~10000, unit mV, scale factor is 1mV/bit
									2		(pf-200) *4+1 battery the highest single voltage voltage byte		
									3		(pf-200) *4+2 highest single voltage bytes		
		6	0	0	200	40	244		4		(PF-200) *4+2 batteries with the highest single voltage reduction byte		
									5		(pf-200) *4+3 highest single voltage bytes		
									6		(pf-200) *4+3 batteries with the highest single voltage reduction byte		
									7		(pf-200) *4+4 highest single voltage bytes		
									8		(pf-200) *4+ batteries with the highest single voltage reduction byte		

4) BMS temperature details message
All temperature sampling values are reported
PF starting value 180(0xB4), PF value plus 1 for each frame, until the data is sent. PF value is less than 199.

Sender	Receiver	ID						Cycle (ms)	Data			
		0 x18c828f4						500	BYTE	BIT	Data Name	Remark
BMS	DPLY	P	R	DP	PF	PS	SA		1		(pf-180) *8+1 temperature value of temperature probe	Effective value 0~255, unit ℃, offset -40, scaling factor 1℃/bit
									2		(pf-180) *8+2 temperature values of temperature probes	
									3		(PF-180) *8+3 temperature probes	
		6	0	0	200	40	244		4		(PF - 180) * 8 + 4 temperature the probes	
									5		(pf-180) *8+5 temperature values of temperature probes	
									6		(PF - 180) * 8 + 6 temperature the probes	
									7	1	(pf-180) *8+7 temperature values of temperature probes	
									8		(pf-180) *8+8 temperature values of temperature probes	

5) charging demand message of BMS and charger
BMS: CAN bus communication specification

The Communication specifications:
Data link layer should follow the principle of bus communication rate: 250Kbps
The provisions of data link layer mainly refer to The relevant provisions of can2.0b and J1939.
The 29-bit identifier of CAN extension frame is used and redefined. The following is The assignment table of 29 identifiers.

IDENTIFIER11BITS											SRR	IDE	IDENTIFIER EXTENSION18BITS																	
PRIORITY			R	DP	PDU FORMAT (PF)						SRR	IDE	PF		PDU SPECIFIC (PS)								SOURCE ADDRESS (SA)							
3	2	1	1	1	8	7	6	5	4	3			2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
28	27	26	25	24	23	22	21	20	19	18			17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Among them, the priority is 3 bits, which can have 8 priority; R is usually fixed at 0; DP is now fixed at 0; 8-bit PF is the code of the message; Of the eight

PS is the target address or group extension; The 8-bit SA is The source address of sending this message. Holds the each node connected to the network has a name and address that identifies the function of the node and mediates the address, Which is used for data communication of the node each node has at least one function, and there may be multiple nodes with the same function, or one node with multiple functions

CAN network address assignment table:
CAN bus node address is obtained from J1939 standard.

Name of The node	OURCE ADDRESS (SA)
Motor controller（MCU)	239 (0 xef)
Battery management system (BMS)	244 (0 xf4)
Charger control system (CCS)	229 (0 xe5)
Broadcast address (BCA)	80 (0 x50)

Message format:
Report 1: (ID: 0 x1806e5f4)

OUT	IN	ID				Cycle (ms)
BMS	CCS	P	R	DP	PF	1000
		6	0	0	6	

Data		
location	Data name	
BYTE 1	Maximum allowable charging terminal voltage high byte	0.1V/bit offset: 0 example: Vset =3201, corresponding voltage is 320.1v
BYTE 2	Maximum allowable charging terminal voltage low byte	
BYTE 3	Maximum allowed charging current high byte	0.1A/bit offset: 0 example: Iset =582, corresponding current is 58.2a
BYTE 4	Maximum allowed charging current low byte	
BYTE 5	control	0: the charger starts charging.1: battery protection, charger off output.
BYTE 6	keep	
BYTE 7	keep	
BYTE 8	keep	

Report 2: (ID: 0x18FF50E5)

OUT	IN	ID				Cycle (ms)
CCS	BCA	P	R	DP	PF	1000 .
		6	0	0	0XFF	

data		
Location	Data Name	
BYTE1	Output voltage high byte	0.1V/bit offset: 0 example: Vout =3201, corresponding voltage is 320.1v
BYTE2	Output voltage low byte	
BYTE3	Output current high byte	0.1A/bit offset: 0 example: Iout =582, corresponding current is 58.2a. Maximum BIT representation Symbol, 0 for charge, 1 for discharge.
BYTE4	Output current low byte	
BYTE5	STATUS flag	

BYTE6	keep	
BYTE7	keep	
BYTE8	keep	

Status	Logo	Describe
Bit0	Hardware failure	0: normal.1: hardware failure
Bit1	Charger temperature	0: normal.1. Overtemperature protection of charger
Bit2	Input voltage	0: normal input voltage.1: the input voltage is wrong, and the charger stops working
Bit3	Start state	0: the charger detects that the battery voltage enters the starting state.1: off.(used to prevent backconnection of battery)
Bit4	Communicate status	0: normal communication.1: communication receive timeout
Bit5		
Bit6		
Bit7		

Way to work

- BMS sends control information (message 1) to the charger at fixed intervals of 1S. After receiving the information, the charger works according to the voltage and current Settings of message data. If the message is not received within 5 seconds, the communication error state will be entered and the output will be closed.
- The charger sends broadcast information (message 2) every 1S, and the display instrument can display the state of the charger according to the information.
- The charger has a 12V power supply

Motor controller message
1) Controller - instrument) CAN communication protocol

overview

This agreement provides information sent by motor controller to instrument in car CAN network.

Reference standards

SAE J1939-21.

Physical interface

This protocol adopts can2.0b standard, the communication baud rate is 250kbps, and the unused or reserved word saving in data is 0x00.

Protocol data unit (PDU) format

SAE j1939-21 specification provides two PDU formats: PDU1 format (PS for target address) and PDU2 format (PS for group extension), PDU2 for transmission without specific target address, PDU2 format is adopted in this standard.

Definition: P is priority, R is reserved bit, DP is data page, PF is PDU format, PS is specific PDU, SA is

The source address.

data frame-definition

OUT	IN	ID	cycle	Data		
controll	instrum	ID = 10 f8109a	50	location	data	note

er	ent	P	R	DP	PF	PS	SA	ms	byte	data	note
er	ent							ms	1 byte	Running direction/high/low speed mode selection	Bit1 - bit0: 00 - invalid, A 01 -- before, 10 - back Bit2: Reserved Bit3:1-- low speed running mode, 0-- high speed running mode Bit4 - bit7: reserved
		P	R	DP	PF	PS	SA		2 byte	Low Speed byte	Motor running speed 1 RPM/bit
									3 byte	HighSpeed byte	
									4 byte	Fault code	attached list
									5 byte	Low Power mode	0xAA- low power consumption, others - invalid
		4	0	0	248	16	154		6 byte	Subtotal mileage low byte	0.1 km/bit
									7 byte	Subtotal mileage High byte	
									8 byte	SOC	1% / -

Definition of data frame ii

OUT	IN	ID						cycle	data		
		ID = 10 f8108d							location	data	note
									1 byte	Dc voltage low byte	0.1 V/bit
controller	instrument	P	R	DP	PF	PS	SA	50 ms	2 byte	Dc voltage High byte	
									3 byte	Motor current low byte	0.1 A/bit
									4 byte	Motor current High byte	
									5 byte	Motor temperature low byte	0.1 ℃ / bit
		4	0	0	248	16	141		6 byte	Motor temperature High byte	
									7 ~ 8 Byte	Keep	

Attached: ac controller fault code description

Serial	name of the	Alarm way	handling	Failure countermeasures

number				
01	High pedal fault	The shedding	Don't run	Check alignment of pedals.
02	Precharge failure	One long two short	Don't run	Check whether there is any obvious damage to the power board, check whether the wiring between the power board and the control board is connected reliably.
03	Over current	A long three short	downtime	The first step is to adjust the control parameters, and the second step is to adjust the output torque. If the problem cannot be solved, it will return to the factory for maintenance.
04	Overheat of controller	A long four short	downtime	Check if the fan is working properly and the air duct is smooth.
05	Primary circuit outage	A long five short	downtime	Check the main circuit safety, contactor, emergency stop switch And so on.
06	Current sampling current Road fault	A long six short	downtime	Return to factory for maintenance.
08	BMS fault	A long eight short	downtime	BMS failure or abnormal battery pack.
09	Battery undervoltage	A long nine short	downtime	Need to recharge.
10	The battery pack is overvoltage	A long ten short	downtime	Check whether the battery is normal and reduce the energy return appropriately Feed.
11	Motor overheating	One long, eleven short	downtime	Stop cooling or add motor cooling mode.
13	Accelerator failure	One long, thirteen short	downtime	Check if the accelerator circuit is properly connected. if damaged, need to return to factory for repair.

Three, fault treatment strategy
Add: BMS fault
Fault code: 0xx-bms, 1XX- controller.

Fault level	Fault code	Code meaning	Treatment measures	note
trouble-free	0	Normal mode		
Level 1	1-20	Serious fault	Stop immediately and evacuate	
Level 2	21-60	Common fault	Limit the power to 50%, the vehicle should drive to the proper place within 20 minutes and then stop for professional treatment	
Level 3	61-99.	Alarm failure	Alarm, instrument display	

Description:

1、When more than one level fault occurs at the same time, simply report the highest level of failure code (for example, if both level 1 and level 2 faults occur at the same time, then only report the level 1 failure code).

2、If more than one fault occurs simultaneously in the same fault level, the fault codes are issued in rotation, with a rotation period of 1 second.

Level1 fault

Fault level	fault name	code	Fault description	Treatment measures	parts
Level 1 (1-20)	Severe overtemperature alarm	01	Maximum battery temperature > battery high temperature protection value.	BMS reports motor power limit to 0, break and discharge contactor after 3S	BMS
	Total overvoltage	02	Total voltage > total voltage protection upper limit.	BMS reports motor power limit to 0, break and discharge contactor after 3S	
	Total voltage ultra-low	03	Total voltage < total voltage protection lower limit.	BMS reports motor power limit to 0, break and discharge contactor after 3S	
	Discharge serious overcurrent	04	Discharge current > discharge current protection value serious overcurrent, may be caused by short circuit.	BMS reports motor power limit to 0, break and discharge contactor after 3S	
	Monomer too high	05	The highest single battery voltage > single battery high voltage protection value	BMS reports motor power limit to 0, break and discharge contactor after 3S	
	The monomer is seriously too low	06	The lowest single battery voltage < single battery low voltage	BMS reports motor power limit to 0, break and discharge contactor after	

			protection value	3S	
Insulation resistance is too low	07	Insulation impedance < 30K	BMS reports the motor power limit to 0, break and discharge contactor after 10S	

Level2 fault

Fault level	fault name	code	Fault description	Treatment measures	parts
secondary (21-60)	Overtemperature alarm	21	Maximum battery temperature > battery high temperature alarm value	BMS report, motor power limit to 50%	BMS
	Alarm if the temperature is too low	22	Battery minimum temperature < battery low temperature alarm value	BMS report, motor power limit to 50%	
	High single voltage	23	Highest single battery voltage > single battery high voltage alarm value	BMS report, motor power limit to 50%	
	Monomer voltage	24	The lowest single battery voltage < single battery low voltage alarm value	BMS report, motor power limit to 50%	
	Current flow	25	Discharge current < discharge current alarm value	BMS report, motor power limit to 50%	
	Internal communication failure of BMS	26	Abnormal communication between BMS master control module and slave control module	BMS report, motor power limit to 50%	
	SOC is low	27	SOC < 10%	BMS report, motor power limit to 50%	
	The battery pressure difference is large	28	Maximum and minimum voltage difference of single cell > voltage difference limit	BMS report, motor power limit to 50%	
	Large battery temperature difference	29	The maximum and minimum temperature difference of the battery > temperature difference limit value	BMS report, motor power limit to 50%	

Level 3 fault

Fault level	fault name	code	Fault description	Treatment measures	parts
Level 3 (61-99),	SOC is low	61	SOC < 30%	The meter shows fault code	BMS
	The battery voltage difference is large	62	The highest and lowest voltage difference of single battery > voltage difference alarm value	The meter shows fault code	
	The battery temperature difference is large	63	The highest and lowest temperature difference value of the battery > temperature difference alarm value	The meter shows fault code	
	Charger hardware	64	BMS receives feedback from the charger and	BMS requests the charger to stop	

	failure		reports corresponding faults	charging, and the meter shows fault code	
	Temperature failure of charger	65	BMS receives feedback from the charger and reports corresponding faults	BMS requests the charger to stop charging, and the meter shows fault code	
	Charging electromechanical voltage limit power failure	66	BMS receives feedback from the charger and reports corresponding faults	BMS requests the charger to stop charging, and the meter shows fault code	
	Charger input voltage failure	67	BMS receives feedback from the charger and reports corresponding faults	BMS requests the charger to stop charging, and the meter shows fault code	
	Charger output overcurrent	68	BMS receives feedback from the charger and reports corresponding faults	BMS requests the charger to stop charging, and the meter shows fault code	
	Starting failure of charger	69	BMS receives feedback from the charger and reports corresponding faults	BMS requests the charger to stop charging, and the meter shows fault code	
	Communication failure of charger	70	BMS receives feedback from the charger and reports corresponding faults	BMS requests the charger to stop charging, and the meter shows fault code	
	Battery connection failure of charger	71	BMS receives feedback from the charger and reports corresponding faults	BMS requests the charger to stop charging, and the meter shows fault code	

Attached: ac motor controller fault code description

Serial number	Name	Alarm way	handling	Failure countermeasures
101	High pedal fault	The shedding	Don't run	Check pedals and alignment
102	Precharge failure	one long and two short	Don't run	Check whether there is any obvious damage to the power board, check whether the wiring between the power board and the control board is connected reliably.
103	Over current	one long and three short	downtime	The first step is to adjust the control parameters, and the second step is to adjust the output torque. If the problem cannot be solved, it will return to the factory for maintenance.
104	Overheat of controller	one long and four short	downtime	Check if the fan is working properly and the air duct is smooth.
105	Primary circuit outage	one long and five short	downtime	Check the main circuit safety, contactor, emergency stop switch, etc.

106	Current sampling circuit failure	one long and six short	downtime	Return to factory for maintenance.
107	Encoder fault	one long and seven short	downtime	Check the cable harness of encoder, check whether the encoder is damaged.
108	BMS fault	one long and eight short	downtime	BMS failure or abnormal battery pack.
109	Battery undervoltage	one long and nine short	downtime	Need to recharge.
110	The battery pack is overvoltage	one long and ten short	downtime	Check whether the battery is normal and reduce the energy feedback appropriately.
111	Motor overheating	one long and eleven short	downtime	shut-down cooling or add motor cooling mode.
113	Accelerator failure	one long and thirteen short	downtime	Check if the accelerator circuit is properly connected. If damaged, return to factory for repair.