CAN communication protocol

V2.0

一.　Network System Control and Communication Network Protocol

1. Significance and purpose of formulating this agreement

According to the system requirements and actual work needs, this agreement focuses on the communication of each electric control unit of a pure electric mini car, and formulates a control and communication system agreement, which will provide the basis and standards for direct communication of component controllers.

2. Scope of agreement

This protocol is mainly used for communication between various system components of pure electric mini vehicles

3. International specifications and related documents referenced in this agreement

This agreement is based on the requirements of pure electric mini-vehicle systems and with reference to relevant international regulations.

The main international standards adopted and referenced include:

GT / T 19596 Electric Vehicle Terminology

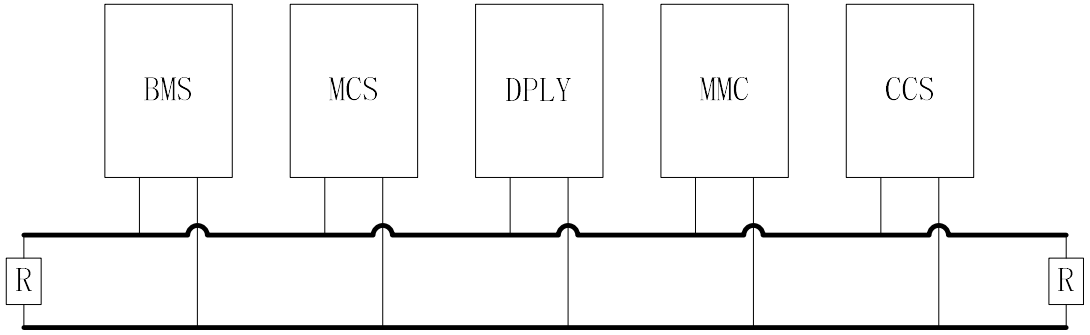
ISO 11898 - International Organization for Standardization ISO Standard, Road Vehicles ---Digital Information Exchange ---CAN2.0 Specification for High-Speed Communication Controller Area Networks .

CAN communication protocol for SAE J1939 commercial vehicle control system LAN

4. Network nodes and topology

The CAN network involves the following communication nodes. The abbreviations and addresses are defined as follows:

name	abbreviation	address	Description
Battery management system	BMS	244（ 0xF4）	
Motor Controller	MCU	239（ 0xEF）	
Instrument display controller	DPLY	40（ 0x28）	
Multimedia controller	MMC	56（ 0x38）	
Car charger	CCS	229（ 0xE5）	
Broadcast address	BCA	80 (0x50)	
Fast charge interface	FCS	\	Output in BMS



Where R is a 120Ω termination resistor.

5. Network hardware requirements

- network system supports hot swap. The power supply should have reverse connection protection and power failure detection functions;
- controller power supply should meet the requirements of the GB/T11858.3 standard. The designed ECU should be able to be used in the range of 130V DC voltage, and it must also be in the external power supply of the vehicle involved, such as 220V AC, 750V fast charging voltage normal work.
- CAN bus communication cable uses shielded twisted pair (flame retardant, 0.5mm), which consists of twisted pairs CAN_H, CAN_L, and shielded CAN_SHLD.
- wiring topology of the network is a line structure that is as compact as possible to avoid cable reflection. The cable connecting the ECU to the bus backbone must be less than 150mm. In order to minimize a standing wave node in the network can not access an equal pitch ,and the node must be greater than 100mm, the access line can not be equal, and the maximum length of the access line should be less than 1M;
- All nodes have optocoupler isolation, and the power supply needs to be isolated;
- Communication cables should be as far as possible from power lines (above 0.5m) and 12V control lines (above 0.1m);
- terminal resistance (120 Ω) is installed at both ends of the network cable and temporarily installed in the MCU and the meter
- cable shielding layer is continuously conducted in the car. It is required that the network socket of each component has a connector of the shielding layer. The grounding method of the shield wire is to select a suitable point for single-point grounding when the vehicle is wired.

6. Transmission rate and padding format

- bus transfer rate: 250 kbps
- Filling format: Intel
- Reserved bytes: bits are filled with 0 by default
- data transmission formats: Following Bit is the MSB (bit8) to LSB (bit1), Byte according to the LSB (Byte1) to the MSB (Byte8), cross- Byte filling manner as to fill the upper section of the high mode, low-filled lower section.

7. Message structure

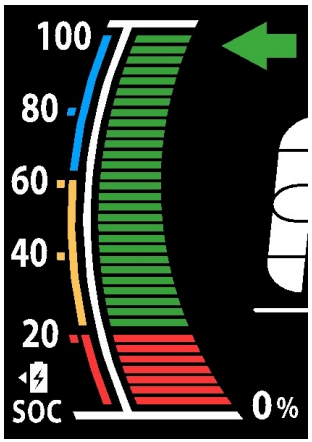
	P	R	DP	PF	PS	SA	DATA
	3	1	1	8	8	8	0 ~ 64
Note 1:	P is the priority and is set from the highest 0 to the lowest 7. Safety is 1, some functions are missing as 2, run 3, request 4, and 7 is displayed. (Determine the priority based on the actual message, not the priority of the node)						
Note 2:	R is a reserved bit for future development. This standard is set to 0.						
Note 3:	DP is a data page, used to select the auxiliary page for parameter group description. This standard is set to 0.						
Note 4:	PF is the PD the U- form, is used to determine the PD the U- format, and the parameter data corresponding to the group number.						
Note 5:	The PS value is the destination address . (For broadcast messages, press DPU2)						
Note 6:	SA value is the source address						
Note 7:	Data field, if the given data length is less than or equal to 8 bytes, all 8 bytes of the data field can be used						

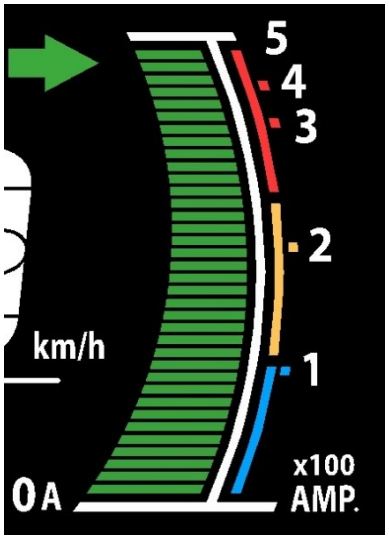
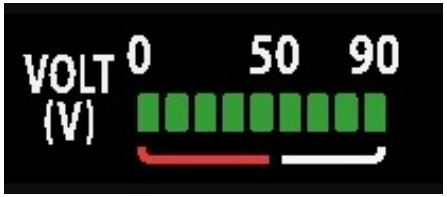
二. Network communication messages

1. Battery Management System Message

1.1 BMS basic information message 1

sender	receiver	ID						cycle (Ms)	data			
BMS	DPLY	0x18FF28F4						100	BYTE	BIT	Data name	Remark
		P	R	DP	PF	PS	SA		1	1	Whether the charging cable is connected	0: Not connected; 1: Connected 
										2	Battery pack charging status	0: Not charging; 1: Charging 
										3	Battery pack power loss	0: No loss of electricity; 1: Loss of electricity 
										4	Battery pack ready status	0: Not ready; 1: Ready
										5	Discharge contactor status	0: open;  1: closed
										6	Charging contactor status	0: open; 1: close
										7~8	Reserved	
									2		SOC	Effective value 0 ~ 100; scale factor 1% / bit

												
									3		Battery pack charge and discharge total current low byte	Valid value is 0 ~ 10000, unit A, range (-500 ~ 500) A, offset -5000, scale factor 0.1A / bit. Negative current during charging
		6	0	0	255	40	244		4		Battery pack charge and discharge total current high byte	

												
									5		Low total battery voltage	Valid value 0 ~ 10000, unit V, range (0 ~ 1000) V, offset 0, scale factor 0.1V / bit
									6		Battery pack total voltage high byte	
									7		Battery failure level	0x00: No fault 0x01: 1 level failure (severe failure, stop immediately) 0x02: Level 2 fault (common fault, 50% speed limit operation)

												0x03: level 3 fault (alarm fault, alarm) 
									8		error code	See troubleshooting section

1.2 BMS basic information message 2

sender	receiver	ID						cycle (Ms)	data			
		0x18FE28F4							BYTE	BIT	Data name	Remark
		P	R	DP	PF	PS	SA		1		Lowest cell voltage low byte	Valid value is 0 ~ 10000, unit is mV, scale factor is 1mV / bit
									2		Highest unit voltage high byte	
									3		Lowest cell voltage low byte	Valid value is 0 ~ 10000, unit is mV, scale factor is 1mV / bit
		6	0	0	254	40	244		4		Lowest cell voltage high byte	
BMS	DPLY							100	5		Monomer maximum temperature	Valid value 0 ~ 255, unit ℃, offset -40, scale factor 1 ℃ / bit
									6		Monomer minimum temperature	Valid value 0 ~ 255, unit ℃, offset -40, scale factor 1 ℃ / bit
									7		Maximum allowable discharge current low byte	Valid value is 0 ~ 10000, unit A, offset 0, scale factor 0.1A / bit.
									8		Maximum allowable discharge current high byte	

Contactor status can be reserved for heating contactor, pre-charged contactor status reporting

1.3 BMS voltage detail message

Report all battery cell voltages.

The starting value of PF is 200 (0xC8). The PF value is incremented by 1 after each frame is sent until the data is sent. The PF value is less than 249.

sender	receiver	ID						cycle (Ms)	data			
		0x18C828F4							BYTE	BIT	Data name	Remark
		P	R	DP	PF	PS	SA		1		(PF-200) * 4 + 1 battery high cell voltage high byte	Valid value is 0 ~ 10000, unit is mV, scale factor is 1mV / bit
									2		(PF-200) * 4 + 1 battery low cell voltage low byte	
									3		(PF-200) * 4 + 2 battery high cell voltage high byte	
BMS	DPLY	6	0	0	200	40	244	500	4		(PF-200) * 4 + 2 battery low cell voltage maximum byte	
									5		(PF-200) * 4 + 3 battery maximum cell voltage high byte	
									6		(PF-200) * 4 + 3 battery low cell maximum voltage	
									7		(PF-200) * 4 + 4 battery high cell voltage high byte	
									8		(PF-200) * 4 + 4 battery low cell voltage maximum byte	

1.4 BMS temperature detail message

Report all temperature samples

The starting value of PF is 180 (0xB4), and the PF value is increased by 1 after each frame is sent until the data is sent. The PF value is less than 199 .

sender	receiver	ID						cycle (Ms)	data			
		0x18B428F4							BYTE	BIT	Data name	Remark
		P	R	DP	PF	PS	SA		1		(PF-180) * 8 + 1 temperature probe temperature value	
									2		(PF-180) * 8 + 2 temperature probe temperature values	
									3		(PF-180) * 8 + 3 temperature probe temperature values	
BMS	DPLY	6	0	0	200	40	244	500	4		(PF-180) * 8 + 4 temperature probe temperature values	Valid value 0 ~ 255, unit ℃, offset -40, scale factor 1 ℃ / bit
									5		(PF-180) * 8 + 5 temperature probe temperature values	
									6		(PF-180) * 8 + 6 temperature probe temperature values	
									7	1	(PF-180) * 8 + 7 temperature probe temperature values	
									8		(PF-180) * 8 + 8 temperature probe temperature values	

1.5 BMS charging request message

sender	receiver	ID						cycle (Ms)	data			
		0x18FFE5F4							BYTE	BIT	Data name	Remark
		P	R	DP	PF	PS	SA		1		Lowest byte of maximum allowable charging voltage	Resolution 0.1V, offset 0
									2		Highest byte of maximum allowable charging voltage	
B MS	CCS	6	0	0	255	229	244	1000	3		Maximum Allowable Charge Current Low Byte	Resolution 0.1V, offset 0
									4		Maximum allowable charging current high byte	
									5		control	B it1: 0: The charger starts charging; 1: battery protection, turn off charging B it2 ~ 8: Reserved
									6..8		Reserved at 0x00	

1.6 Charger feedback information message

		0x18FF50E5							BYTE	BIT	Data name	Remark
		P	R	DP	PF	PS	SA		1		Output voltage low byte	Resolution 0.1V / bit, offset 0
									2		Output voltage high byte	
		6	0	0	255	80	229		3		Output current low byte	Resolution 0.1A / bit, offset 0
									4		Output current high byte	
CCS								1000	5	1	hardware malfunction	0-normal; 1-hardware failure
										2	Charger temperature failure	0: Normal; 1: Over-temperature protection of charger
										3	Low voltage limited power mode	0: The input voltage is normal; 1: The input voltage is too low to enter the low power mode
										4	Input voltage status	0: Input voltage is normal; 1: Input overvoltage or undervoltage fault
										5	Output overcurrent	0: The output current is normal; 1: The output is overcurrent
										6	Startup state	0: Charger is off 1: in charging state
										7	Communication status	0: communication is normal; 1: communication reception timeout
										8	Battery connection status	0: Battery connection is normal 1: Battery is reversed or not connected
									6..8		Reserved at 0x00	

2. The motor controller messages

2.1 Motor controller and instrument communication message 1

sender	receiver	ID						cycle (Ms)	data			
		0x1 8 F 560EF							BYTE	BIT	Data name	Remark
MCU	DPLY	P	R	DP	PF	PS	SA	50	1	1~2	Gear status	B it 2 -bit 1 : 00-- invalid, 01-- forward, 10-- back
										3	Brake state	0--no brake; 1--with brake
										4 ~ 5	Operating mode	B it5-bit4: 00 — default mode; 01 — economic mode ; 10 — high speed

												mode; SPORT 11 — reserved
										6	Controller status	0 — not ready; 1 — ready READY
										7	Limited power state	0 — normal operation; 1 — reduced power operation
										8	Reserved	
									2		error code	See controller fault code description
									3		Motor speed low byte	1rpm / bit, offset 0 8888 rpm
									4		High speed of motor speed	
									5		Subtotal mileage low byte	0.1km / bit with an offset of 0
		6	0	0	24 5	96	239		6		Subtotal mileage high byte	
									7		Speed	1kph / bit, offset 0 888 km/h
									8		Reserved	

2.2 Motor controller and instrument communication message 2

sender	receiver	ID						cycle (Ms)	data			
		0x18FA60EF							BYTE	BIT	Data name	Remark
		P	R	DP	PF	PS	SA		1		Low battery voltage	0.1V / bit, offset 0
									2		Battery voltage high byte	
									3		Motor current low byte	0.1 A / bit, offset 0
									4		Motor current high byte	
MCU	DPLY	6	0	0	2 50	96	239	50	5		Low motor temperature byte	0.1° C /bit,
									6		Motor temperature high byte	offset 0. Over 130 ℃ 
									7		Controller temperature low byte	0.1° C /bit,
									8		Controller temperature high byte	offset 0. Over 70 ℃ 

3. The multimedia controller messages

sender	receiver	ID						cycle (Ms)	data			
		0x18FF5028							BYTE	BIT	Data name	Remark
		P	R	DP	PF	PS	SA		1	1.2	User mode:	B it2-bit1: 00: Normal 01: Economy 10: Sport 11: Reserved
MMC	MCU							1000	1	3 ... 8	Reserved	
									2			
		6	0	0	255	80	40		3			
									4			
									5			
									6..8			

4. Instrument controller message

5, charger packets

sender	receiver	ID						cycle (Ms)	data			
CCS		0x18FF50E5						1000	BYTE	BIT	Data name	Remark
		P	R	DP	PF	PS	SA		1		Output voltage low byte	Resolution 0.1V / bit, offset 0
									2		Output voltage high byte	
		6	0	0	255	80	229		3		Output current low byte	Resolution 0.1A / bit, offset 0
									4		Output current high byte	
									5	1	hardware malfunction	0-normal; 1-hardware failure
										2	Charger temperature failure	0: Normal; 1: Over-temperature protection of charger
										3	Low voltage limited power mode	0: The input voltage is normal; 1: The input voltage is too low to enter the low power mode
										4	Input voltage status	0: Input voltage is normal; 1: Input overvoltage or undervoltage fault
										5	Output overcurrent	0: The output current is normal; 1: The output is overcurrent
										6	Startup state	0: Charger is off 1: in charging state
										7	Communication status	0: communication is normal; 1: communication reception timeout
										8	Battery connection status	0: Battery connection is normal 1: Battery is reversed or not connected
									6..8		Reserved at 0x00	

The charger comes with **12V** voltage.

三. the fault handling strategy

Attachment: BMS failure

Fault code: 0XX-BMS, 1XX-controller.

Failure level	error code	Code meaning	Treatment	Remark
Trouble-free	0	Normal mode		
First level	1-20	Serious failure	Stop now and evacuate passengers	
Secondary	21-60	Common fault	Limit power to 50% After the vehicle travels to a proper position within 20 minutes, the parking lot is reported to a professional	
Third level	61-99	Alarm failure	Alarm, instrument display	

Description:

1. When multiple levels of faults occur at the same time, as long as the highest-level fault code is reported (for example, if the first-level and second-level faults occur at the same time, only the first-level fault code is reported).

2. If multiple faults occur at the same time in the same fault level, the fault code is issued in turn, and the rotation period is 1 second.

1. First-level failure

Failure level	Fault name	Code	Fault description	Treatment	component
First level (1-20)	Severe over temperature alarm	01	Maximum battery temperature > Battery high temperature protection value .	BMS reports that the motor's limited power reaches 0, 3S and then breaks the discharge contactor	BMS
	The total voltage ultra- high	02	Total voltage > upper limit of total voltage protection.	BMS reports that the motor's limited power reaches 0, 3S and then breaks the discharge contactor	
	The total voltage ultra low	03	Total voltage < lower limit of total voltage protection.	BMS reports that the motor's limited power reaches 0, 3S and then breaks the discharge contactor	
	Severe discharge overcurrent	0 4	Discharge current > Discharge current protection value Severe overcurrent may be caused by a short circuit.	BMS reports that the motor's limited power reaches 0, 3S and then breaks the discharge contactor	
	Severely high monomer	05	Maximum voltage of battery cell > High voltage protection value of battery cell	BMS reports that the motor's limited power reaches 0, 3S and then breaks the discharge contactor	
	Monomer is too low	06	Lowest voltage of battery cell < protection value of low voltage of battery cell	BMS reports that the motor's limited power reaches 0, 3S and then breaks the discharge contactor	
	Insulation resistance is too low	07	Insulation resistance < 30K	BMS reports that the motor's limit power reaches 0,10S and the discharge contactor is disconnected	

2. Secondary failure

Failure level	Fault name	Code	Fault description	Treatment	component
Second -level (21-60)	High temperature alarm	twenty one	Maximum battery temperature > Battery high temperature alarm value	BMS report, motor limit power to 50%	BMS
	Low temperature alarm	twenty two	Lowest battery temperature < low battery alarm value	BMS report, motor limit power to 50%	
	High cell voltage	twenty three	Maximum voltage of battery cell > High voltage alarm value of battery cell	BMS report, motor limit power to 50%	
	Low cell voltage	twenty four	Lowest voltage of battery cell < low voltage alarm value of battery cell	BMS report, motor limit power to 50%	
	Current overcurrent	25	Discharge current < discharge current alarm value	BMS report, motor limit power to 50%	
	BMS internal communication failure	26	The communication between the BMS master control module and the slave control module is abnormal.	BMS report, motor limit power to 50%	
	Low SOC	27	SOC <10%	BMS report, motor limit power to 50%	
	Large battery voltage difference	28	Battery cell maximum and minimum voltage difference value > Differential pressure limit value	BMS report, motor limit power to 50%	
	Large battery temperature difference	29	Battery maximum and minimum temperature difference value > temperature difference limit value	BMS report, motor limit power to 50%	

3. Three levels of failure

Failure level	Fault name	Code	Fault description	Treatment	component
Three -level (61-99)	Low SOC	61	SOC <30%	Meter displays fault code	BMS
	Large battery voltage difference	62	Battery cell maximum and minimum voltage difference value > pressure difference alarm value	Meter displays fault code	
	Large temperature difference between batteries	63	Battery maximum and minimum temperature difference > temperature difference alarm value	Meter displays fault code	
	Charger hardware failure	64	BMS accepts feedback from charger and reports corresponding fault	BMS requests the charger to stop charging, the meter displays a fault code	
	Charger temperature failure	65	BMS accepts feedback from charger and reports corresponding fault	BMS requests the charger to stop charging, the meter displays a fault code	
	Charger voltage limit power failure	66	BMS accepts feedback from charger and reports corresponding fault	BMS requests the charger to stop charging, the meter displays a fault code	
	Charger input	67	BMS accepts feedback from charger and	BMS requests the charger to stop charging,	

	voltage failure		reports corresponding fault	the meter displays a fault code	
	Charger output overcurrent	68	BMS accepts feedback from charger and reports corresponding fault	BMS requests the charger to stop charging, the meter displays a fault code	
	Charger startup failure	69	BMS accepts feedback from charger and reports corresponding fault	BMS requests the charger to stop charging, the meter displays a fault code	
	Charger communication failure	70	BMS accepts feedback from charger and reports corresponding fault	BMS requests the charger to stop charging, the meter displays a fault code	
	Charger battery connection failure	71	BMS accepts feedback from charger and reports corresponding fault	BMS requests the charger to stop charging, the meter displays a fault code	

Attachment: AC motor controller fault code description

Numbering	name	Alarm method	Processing method	Countermeasures
101	High pedal failure	Changming	Not running	Check pedal and return
102	Precharge failure	One long and two short	Not running	Check the power board for obvious damage, and check whether the cable between the power board and the control board is reliably connected.
103	Overcurrent	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.
104	Controller	One long and	Downtime	Check whether the fan is working normally and the air duct is

	is overheating	four short		smooth.
105	Main circuit power failure	One long and five short	Downtime	Check the main circuit fuse, contactor, emergency stop switch, etc.
106	Fault in current sampling circuit	One long and six short	Downtime	Return to factory for repair.
107	Encoder failure	One long and seven short	Downtime	Check the encoder wiring harness and check if the encoder is damaged.
108	BMS failure	One long and eight short	Downtime	The BMS is faulty or the battery pack is abnormal.
109	Battery pack undervoltage	One long and nine short	Downtime	Need to be charged.
110	Battery pack overvoltage	One long ten short	Downtime	Check whether the battery is normal and reduce the energy feedback appropriately.
111	Motor overheating	One long eleven short	Downtime	Stop cooling or increase the heat dissipation mode of the motor.
113	Accelerator failure	One long and 13 short	Downtime	Check that the accelerator circuit is connected properly. If damaged, return to factory for repair.