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**Digital communication protocols between off-board  
conductive charger and electric vehicle**

非车载传导式充电机与电动汽车之间的数字通信协议

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# Digital communication protocols between off-board conductive charger and electric vehicle

## 1 Scope

This document specifies the definitions and requirements of the controller area network (CAN)-based communication physical layer, data link layer, transport layer, application layer, between the off-board conductive charger's (hereinafter referred to as "charger") equipment communication controller (SECC) and electric vehicle communication controller (EVCC).

This document applies to the communication -- between the charger or the charger & discharger using charging mode 4 and the electric vehicle. It also applies to the communication -- between the charger or charger & discharger and the electronic control unit of the electric vehicle with charging control function. Electric vehicle communication controllers include but are not limited to battery management systems (BMS), as well as in-vehicle systems that need to communicate with the charger to achieve other special functions.

Chapters 5 ~ 11 of this document apply to the charging system, which is specified in Appendix B of GB/T 18487.1-2023 (hereinafter referred to as "category A system"). Chapters 101 ~ 106 apply to the charging system, which is specified in Appendix C of GB/T 18487.1-2023, as well as the charging & discharging system, which is defined in Appendix E (hereinafter referred to as "category B system").

"Vehicle" in this document specifically refers to "electric vehicle".

## 2 Normative references

The contents of the following documents constitute essential provisions of this document through normative references in the text. Among them, for dated reference documents, only the version corresponding to the date applies to this document; for undated reference documents, the latest version (including all amendments) applies to this document.

GB/T 18487.1-2023 Electric vehicle conductive charging system - Part 1: General requirements

GB/T 19596 Terminology of electric vehicles

GB/T 29317 Terminology of electric vehicle charging/battery swap infrastructure

**Extended vehicle identification number; EVIN**

Vehicle identification number (VIN code), or a vehicle identifier with the words I, O, Q designed, to identify vehicle identity information.

Note: Standards related to extended vehicle identification numbers are under consideration.

## 4 Abbreviations

The following abbreviations apply to this document.

LM\_ACK: Long message acknowledgement

LM\_EndofACK: Long message end of acknowledge

LM\_NACK: Long message negative acknowledge

RM\_SM\_ACK: Reliable short message acknowledge

## 5 General principles of category A systems

**5.1** The communication network between the charger and the vehicle is based on CAN2.0B.

**5.2** The CAN communication network, between the charger and the vehicle, shall be composed of two nodes: the charger and the vehicle. In order to achieve the compatibility solution of Appendix G of GB/T 18487.1-2023, adaptor nodes can be added to the communication network; however, between each node, there shall be no conflicts in addresses, PGNs, etc.

**5.3** Data information transmission adopts the format of low byte sent first.

**5.4** The current value during vehicle charging is negative. In public stations, when the vehicle/charger receives a charging current value, which is outside the range of -400 A ~ 0 A, the charging process shall be exited. In private stations, the charger and vehicle can be subject to the negotiation, according to private agreement.

**5.5** In public stations, messages not specified in this document shall not appear on the communication network, between chargers and vehicles. Messages, which are not specified in this document and received by the charger or vehicle, will not be processed.

**5.6** The conversion relationship between the data value and the physical quantity in the message is: physical quantity = Resolution × Data value + Offset.

**5.7** Chargers and vehicles, that implement this document, shall have forward compatibility.

data packet, based on PGN.

**8.3** Use periodic sending and event-driven methods to send data.

**8.4** If multiple PGN data need to be sent to implement a function, all the defined multiple PGN messages must be received, to determine whether the function is successfully sent.

**8.5** When defining a new parameter group, try to put parameters with the same function, parameters with the same or similar transmission cycle, parameters belonging to the same subsystem in the same parameter group. At the same time, the new parameter group must make full use of the data width in 8 bytes; try to put related parameters in the same group; consider extendibility; reserve some bytes or bits for future modifications.

**8.6** When modifying the parameter group defined in Chapter 10, the newly added parameters must be related to the original parameters in the parameter group. Irrelevant parameters shall not be added to the defined PGN in order to save the number of PGN.

**8.7** Parameter options are divided into mandatory items and optional items. The mandatory item parameters shall send actual data, according to the format specified in this document. Optional item parameters can send actual data, according to the format specified in this document, OR all bits shall be filled with 1 and sent. For all contents in the same message which are optional, the sender does not need to send the message. If it is sent, the actual data shall be sent in the format specified in this document. The optional item parameters that do not send the actual data are filled with 1.

**8.8** The message shall be sent according to the length specified in this document; the undefined bits in the specified length shall be filled with 1.

**8.9** "Untrusted status" is content sent in order to maintain the communication link, when the sender cannot obtain or clarify the current status. The receiver shall ignore and not process the information.

## **9 Overall charging process of category A system**

The entire charging process includes six phases: physical connection completion, low-voltage auxiliary power-on, charging handshake phase, charging parameter configuration phase, charging phase, charging end phase, as shown in Figure 1. After the physical connection and the low-voltage auxiliary power-on is completed, the two parties start communication. At each phase of communication, if the charger and the vehicle do not receive each other's message OR do not receive the correct message within the specified time, it is determined to be timeout (timeout means that the other party's complete data packet or correct data packet is not received within the specified time), the communication process shall comply with the requirements of Appendix A.

<00>: = The charger temperature is normal; <01>: = The charger is overtemperature;  
<10>: = Untrusted status;

Bits 3 ~ 4: Charging connector failure

<00>: = Charging connector is normal; <01>: = Charging connector fault; <10>: = Untrusted status;

Bits 5 ~ 6: Charger internal over-temperature fault

<00>: = The internal temperature of the charger is normal; <01>: = The internal of the charger is overtemperature; <10>: = Untrusted status;

Bits 7 ~ 8: The required power cannot be transferred

<00>: = Power transmission is normal; <01>: Power cannot be transmitted; <10>: = Untrusted status;

Bits 9 ~ 10: Charger emergency stop failure

<00>: = Normal; <01>: = Charger emergency stop; <10>: = Untrusted status;

Bits 11 ~ 12: Other faults

<00>: = Normal; <01>: = Fault; <10>: = Untrusted status.

Bits 13 ~ 14: Self-check faults (including faults that occur during self-check, such as insulation detection, short circuit test, adhesion detection, etc.)

<00>: = Normal; <01>: = Fault; <10>: = Untrusted status.

Bits 15 ~ 16: Pre-charge fault (including pre-charge voltage mismatch, pre-charge fault, etc.)

<00>: = Normal; <01>: = Fault; <10>: = Untrusted status.

### 3) Reasons for SPN3523 charger suspension charging error

Bits 1 ~ 2: Current mismatch

<00>: = Current matching; <01>: = Current mismatch; <10>: = Untrusted status;

Bits 3 ~ 4: Abnormal voltage

<00>: = Normal; <01>: = Abnormal voltage; <10>: = Untrusted status.

Bits 5 ~ 6: Charging parameters mismatch

<00>: = Parameter match; <01>: = Parameter mismatch; <10>: = Untrusted status.

LMS\_T1 between information frames shall be between 1 ms ~ 10 ms.

**15.4.1.7** The "starting frame number to receive" as received by the sender and the "frame sequence number" as received by the receiver shall be less than or equal to the maximum frame sequence number. Otherwise, the sender or receiver sends LM\_NACK and returns "sending failure" information to the application layer. The application layer determines the processing method.

**15.4.1.8** Both the sender and the receiver can send LM\_NACK, to actively terminate the transmission. After receiving LM\_NACK, both parties exit the transmission of long messages; the connection is closed; the receiver does not process the received message.

**15.4.1.9** When three consecutive connection timeouts of the same type occur, the sender and/or receiver shall send LM\_NACK to close the connection; return a "sending failure" message to the application layer, which will decide whether to resend.

**15.4.1.10** Since the information frames of different long messages, which have the same frame sequence number, cannot be distinguished, only one connection is allowed to be established at the same time, that is, a new connection can be established, only when the sender or receiver sends LM\_NACK or the receiver sends LM\_EndofACK.

## **15.4.2 Packet reorganization**

**15.4.2.1** The data length of a long message is greater than 8 bytes; it needs to be split into multiple information frames when sending: In order to ensure that the information frame can be identified and reorganized, the first byte of the information frame data field is defined as the frame serial number of the information frame, the serial number range is 1 ~ 255. The remaining 7 bytes in the data field are used to load the content, which is defined by the application layer message structure (if the data field of the last frame is less than 8 bytes, it is filled with 0xFF).

**15.4.2.2** After receiving all information frames, the receiver shall reorganize them back to the original information, according to the frame sequence number from small to large (starting from 1).

## **15.4.3 Connection management**

### **15.4.3.1 Overview**

The connection in the multi-information frame transmission mode is a temporary link, which is established between two nodes, for the purpose of transmitting long messages. The connection management specifies the establishment of the connection (see 15.4.3.2), data transmission (see 15.4.3.3), the closing of the connection (see 15.4.3.3). See 15.4.3.4). The long message transmission, which is specified in this document, is point-to-point; its connection management includes:

- Before the connection is established, both the sender and the receiver shall confirm

that the counter recording the frame sequence number is 0, where the sender counter is used to record the frame sequence number to be sent next; the receiver counter is used to record the starting frame sequence number to be received next time;

- The sender sends an information frame, which has a frame number 0, to request to establish a connection. After the receiver responds and confirms, the connection is successfully established;
- After the connection is established, the sender sends the information frame according to the received response acknowledgement; after the transmission is completed, it waits for the receiver's next response acknowledgement or end acknowledgement.

#### **15.4.3.2 Establishment of connection**

The sender sends an information frame, which has a frame number 0, to request to establish a connection. The receiver can choose to receive or refuse to establish a connection:

- If the receiver chooses to receive, it shall send LM\_ACK; meanwhile the LM\_ACK shall contain the receiver's "starting frame number to be received", "total number of frames to be received". The connection is established successfully;
- When the receiver cannot receive the information frame, due to lack of resources or storage space, it shall send LM\_NACK to refuse to establish the connection. The establishment of connection fails.

#### **15.4.3.3 Data transmission**

**15.4.3.3.1** During the data transmission process, the receiver adjusts the data flow control between nodes, by setting the "starting frame number to be received" and "total number of frames to be received" of LM\_ACK. The sender sends data as required.

**15.4.3.3.2** The requirements for pausing and resuming data flow are as follows:

- When the receiver pauses the data stream, the "total number of frames to be received" in LM\_ACK shall be set to 1; the "starting frame number to be received" shall be set to the last frame number of the previous reception. The sender shall send the information frame as required (each time the receiver sends LM\_ACK, the sender responds once); the receiver does not process the data frame after receiving it;
- When the receiver resumes the data flow, it will set the "starting frame number to be received" in LM\_ACK to the frame number of the next frame previously received; reset the "total number of frames to be received" according to its own receiving and processing capabilities, until finishing the reception of all

information frames.

#### **15.4.3.4 Closing of connection**

The sender's connection closure includes the following situations:

- Complete the data transmission of the entire long message and receive LM\_EndofACK;
- Actively send LM\_NACK (for example, the sender actively terminates the transmission before the transmission is completed, or three consecutive connection timeouts of the same type cause transmission failure, etc.);
- Receive LM\_NACK.

The receiver's connection closure includes the following situations:

- Send LM\_EndofACK, after completing the data transmission of the entire long message;
- Send LM\_NACK (if the receiver wants to stop communication early, three consecutive connection timeouts of the same type cause transmission failure, etc.);
- Receive LM\_NACK.

#### **15.4.3.5 Connection timeout**

Timeouts during long message transmission include the following situations.

- After the receiver sends LM\_ACK, if the information frame with the correct frame sequence number is not received within the LMS\_T2 time, it is a timeout. After the timeout, an LM\_ACK is sent to notify the sender to resend. After three consecutive timeouts, an LM\_NACK is sent to close the connection.
- When the receiver has continuously received information frames, if the next information frame is not received within LMS\_T2 time, after receiving an information frame, it is a timeout. After the timeout, an LM\_ACK is sent, to notify the sender to resend. After three consecutive timeouts, an LM\_NACK is sent to close the connection.
- When the sender requests to establish a connection, if no response acknowledgement from the receiver is received, within LMS\_T2 time after sending the information frame, which has a frame number 0, it is a timeout. After the timeout, the sender resends the information frame, which has a frame number 0. After 3 consecutive occurrences of timeout, it sends the LM\_NACK, to close the connection.
- After the sender completes all the information frames, that need to be transmitted

- When the receiver receives a message, that is not listed in the status transition table or does not satisfy the message interaction sequence (such as receiving messages from other functional modules in one functional module), the message will not be processed.
- When the receiver receives "reserved" parameters, the "reserved" data will not be processed.
- If a charging abnormality occurs in the vehicle or charger, a suspension message consistent with the cause of the suspension shall be sent; the current charging communication process shall be exited or the phase acknowledgement process of the next functional module FDC shall be entered. When receiving the suspension message, the vehicle or charger shall perform the charging suspension process, in accordance with the requirements of C.4.9, C.4.10, C.4.11 in GB/T 18487.1-2023; the current charging communication process shall be exited or the phase acknowledgement process of the next functional module FDC shall be entered.
- When the vehicle or charger receives the other party's suspension message during the execution of function negotiation, parameter configuration, authentication function module FDC, if there are no special requirements, it shall turn off all timers and exit the current charging communication process. If during execution of reservation, system self-check, power supply mode, pre-charging and energy transfer function module FDC, it receives the other party's suspension message, meanwhile the "service statistics" function module negotiation is successful during function negotiation, it will transfer to the execution of the "service statistics" function module FDC.
- If the vehicle or charger encounters an abnormality in the execution of function negotiation, parameter configuration, authentication function module FDC, it sends a suspension message. If there are no special requirements, it shall turn off all timers and exit the current charging communication process. If abnormality occurs during the execution of reservation, system self-check, power supply mode, pre-charging and energy transfer function module FDC, meanwhile the "service statistics" function module negotiation is successful during function negotiation, then after sending the suspension message, it shall transfer to the execution of the "service statistics" function module FDC.

**16.3.5** When the application layer hands over the message to be sent to the transport layer, it defines it as "reliable message" and "unreliable message", according to application requirements. For "unreliable messages", it may specify the "periodic sending time" parameter. For "reliable messages", it may specify the "maximum sending time".

**16.3.6** After receiving the "sending failure" information uploaded by the bottom layer, the application layer shall interrupt the current application, perform operations such as suspending charging and restarting the charging module.

to the provisions of B.4.3 in GB/T 18487.1-2023.

- <sup>d</sup> In addition to meeting the requirements of GB/T 18487.1-2023, the basis for charging parameter matching shall also be defined by the charging operator. Other matching conditions can also be defined by the charging operator.
- <sup>e</sup> Whether the vehicle performs time synchronized operations is determined by its own working mode or working conditions.
- <sup>f</sup> After updating the parameters of the BCP message, the vehicle should send at least 2 more frames of BCP messages with updated parameters.
- <sup>g</sup> After receiving the BRO message, the charger shall judge again whether the charging parameters are appropriate, based on the last BCP message received.
- <sup>h</sup> In order to ensure compatibility, before the charger receives the BSM message, charging shall not be suspended due to the BSM message timeout. If the charger does not receive the next frame of BSM message, for more than 5 seconds after receiving the BSM message, it is a timeout error. In this case, the charger shall send an error message to end charging; meanwhile it shall not reconnect, without re-plugging and unplugging the gun.
- <sup>i</sup> The charging end conditions of the charger include the preset conditions being met (time, amount, SOC, etc.), the operator making a stop process (pressing the stop button, swiping the card for settlement, etc.), other end conditions specified in GB/T 18487.1-2023.
- <sup>j</sup> The charging end conditions of the vehicle include the battery being fully charged and other end conditions, which are specified in GB/T 18487.1-2023.
- <sup>k</sup> If the vehicle stops charging after receiving the CST message, the vehicle shall stop sending BST messages after sending 5 to 10 frames of BST messages; send BSD messages periodically. If the vehicle actively stops charging, it shall stop sending BST messages after receiving the CST message; send BSD messages periodically.
- <sup>l</sup> If the charger stops charging after receiving the BST message, the charger sends CST messages periodically and determines whether to receive the BSD message at the same time. If the charger actively stops charging, it shall continue to determine whether to receive the BSD message, after receiving the BST message.

### **Figure A.1 -- Normal charging communication flow chart (continued)**

#### **A.2 Message timeout processing flow of category A system**

The message timeout communication process of category A system is as shown in Figure A.2 ~ Figure A.3.

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