National Standard of the People's Republic of China

GB/T 27930—XXXX

Communication Protocols between Off-board Conductive Charger and Electric Vehicles

Part 2: ChaoJi System

(Draft for Comment)

Promulgated on ××××-××-××　　**Implemented on** ××××-××-××

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Foreword

Communication Protocols between Off-board Conductive Charger and Electric Vehicles (GB/T 27930) is divided into 2 parts:

- Part 1: GB/T2015 System;

- Part 2: ChaoJi System

This part is Part 2 of GB/T 27930.

This part is drafted in accordance with GB/T 1.1-2020.

Please note that some contents in this part may involve patents. The issuing authority of this part does not assume the responsibility for identifying patents.

This part was proposed by and under the jurisdiction of China Electricity Council.

Drafting units of this part:

Main drafters of this part:

Communication Protocols between Off-board Conductive Charger and Electric Vehicles Part 2: ChaoJi System

1 Scope

This part stipulates the definition of communication physical layer, data link layer and application layer between Supply Equipment Communication Controller (hereinafter referred to as SECC) of off-board conductive Charger (hereinafter referred to as Charger) and Electric Vehicle Communication Controller (hereinafter referred to as EVCC) based on Control Area Network (hereinafter referred to as CAN).

This part is applicable to the communication between the charger in charging mode 4 specified in Appendix D of GB/T 18487.1 and the vehicle, and also applies to the communication between the charger and electronic control unit of the vehicle featuring charging control.

2 Normative References

The contents of the following documents form an integral part of this Document through normative references. For the dated references, only the version corresponding to the date is applicable to this Document; for the undated references, the latest version (including all amendments) is applicable to this Document.

GB/T 19596 Terminology of Electric Vehicles

GB/T 29317 Terminology of Electric Vehicle Charging/Battery Swap Infrastructure

GBT18487.1 Electric Vehicle Conductive Charging System Part 1: General Requirements

ISO 11898-1:2003 Road Vehicles - Control Area Network (CAN) Part 1: Data Link Layer and Physical Signaling

SAE J1939-11:2006 Recommented practice for serial control and communication vehicle network Part 11: Physical layer – 250K bits/s, twisted shielded pair

SAE J1939-21:2006 Recommended practice for serial control and communication vehicle network Part 21: Data link layer

3 Terms and Definitions

For the purposes of this Part, terms and definitions as established in GB/T 19596 and GB/T 29317 as well as the following ones apply.

3.1 Frame

A series of data bits that form a complete piece of information.

3.2 CAN data frame

The ordered bit fields necessary for CAN protocol to transmit data, beginning with Start of Frame (SOF) and ending with End of Frame (EOF).

3.3 CAN Message

Send or receive an instance of a parameter group and its parameter data. The sending of a message may require the interaction of one or more CAN data frame(s).

3.4 identifier

The identification part of CAN arbitration field.

3.5 Extended Frame

CAN data frame using 29-bit identifiers as defined in the CAN2.0B specification.

3.6 Priority

A 3-bit field in the identifier, used to set the arbitration priority for the transfer process, with the highest priority at 0 and the lowest priority at 7.

3.7 Parameter Group (PG)

Parameter collection transmitted at the application layer, divided into command class and information class.

3.8 Parameter Group Identification (PGI)

One byte used to uniquely identify one parameter group.

3.9 Protocol Data Unit (PDU)

A specific CAN data frame format.

3.10 Transport Protocol

A mechanism based on the data link layer used to transfer data.

3.11 Electronic Control Unit (ECU)

The electronic control unit, namely on-board computer, consisting of a micro-controller and peripheral circuit.

3.12 Function Module

A business function in energy interaction between the electric vehicle and the charging facility.

3.13 Mandatory Function Module

Function modules that must be equipped with for a complete energy interaction process.

3.14 Optional Function Module

Function modules that are optional for a complete energy interaction process.

3.15 Override Function Module

Function modules that can be re-defined or replaced.

3.16 Function Code (FC)

The number assigned to function modules.

3.17 Function Description Code (FDC)

The number of function module with specific function.

3.18 Information Frame (IF)

CAN data frame at the data link layer used for transmitting valid information or data.

3.19 Control Frame (CF)

CAN data frame at the data link layer for flow control and error management.

3.20 Multi-information Frame Transmission Mode

The mode to transmit one or more frame(s) of data with a frame number by means of automatic retransmission request.

3.21 Long Message

The message transmitted by means of multiple information frames.

3.22 Charging Services

Charging applications determined by both charging scenarios and charging functions.

3.23 Reliable Short Message

Single frame data without frame number transmitted by automatic retransmission request.

3.24 Unreliable Short Message

Single frame data without frame number with no need to transmit by automatic retransmission request.

4 Abbreviated Terms

LM Long Message

SM Short Message

SM_RM Reliable Short Message

SM_URM Unreliable Short Message

SM_ACK Short Frame Acknowledge

LM_ACK Long Frame Acknowledge

LM_NACK Long Frame Negative Acknowledge

LM_EndACK Long Frame End of Acknowledge

5 Physical Layer

The physical layer of CAN communication network adopted herein shall comply with the regulations on physical layer in SAE J1939-11:2006 and SAE J1939-11:2006 to use independent CAN bus and shall support three nodes as SECC, EVCC and Vehicle Adaptor Communication Controller (hereinafter referred to as VACC) with the communication rate of 250 kbit/s.

In order to reduce the influence of external interference on bus communication, CAN communication network adopted in this part shall be networked and routed with twisted shielded pair. The shielding layer of CAN communication line shall be grounded at charger side, and the corresponding shielding layer of CAN communication line at the vehicle side shall also be grounded at the end of CAN bus.

6 Data Link Layer

6.1 Frame Format

Devices adopted in this part shall use the 29-bit identifier of CAN expanded frame, and the corresponding definition of specific allocation for each bit shall conform to relevant provisions of SAE J1939-21:2006.

6.2 Protocol Data Unit

Each CAN data frame contains a single protocol data unit (PDU), as shown in Table 1. The protocol data unit consists of seven parts, namely, priority, expanded data page, data page, PDU format, PDU specific, source address and data field.

Table 1 Protocol Data Unit

P	EDP	DP	PF	PS	SA	DATA
						…
3	1	1	8	8	8	0-64

Data Format Requirements:
1) P refers to priority: Set from the highest 0 to the lowest 7.
2) EDP refers to expanded data page: for future extended use, 0 for this part.
3) DP refers to data page: used to select auxiliary page described by parameter group, 0 for this part.
4) PF refers to PDU-format message type: Used to confirm PDU format as well as the number of parameter group corresponding to data field.
5) PS refers to PDU-specific format: PS value depends on PDU format. PDU1 format is adopted in this part and PS value is the target address.
6) SA refers to source address: the source address of data frame.
7) DATA refers to data field: For definitions of data field with different message types, see 8.2 in this part for details.

6.3 Address Allocation

Network Address is used to ensure the uniqueness of the information identifier and to indicate the source of the information. SECC, EVCC and adaptors are defined as non-configurable address that are fixed in ECU's program code. Any means including service tool can not change its source address. The address allocation of SECC, EVCC and VACC are shown in Table 2.

Table 2 Address Allocation

Node	Preferred Address
SECC	86(56H)
EVCC	244(F4H)
VACC	201(C9H)

6.4 Frame Type

The frame types specified in this part include 2 types, namely information frame and control frame.

7 Version Negotiation

7.1 General Description

Version negotiation is the guiding part of communication protocol, and the negotiation principle, message definition and information interaction process remain unchanged. During the process of version negotiation, the charger and vehicle should decide the version number of communication protocol through negotiations. The detailed description of version negotiation is shown in Table 3.

Table 3 General Description of Version Negotiation

Serial No.	Item	Description Information
1	Name	Version Negotiation
2	Target	Communication protocol version number decided by charger and vehicle through negotiation.
3	Description	After the establishment of communication link, both sides negotiate communication protocol version, the vehicle detects whether the version sent by the charger is supported and returns the negotiation results. The charger shall first send the highest protocol version number it supports: - If the vehicle supports this version and confirm to communicate with this version, a “Negotiation Succeeded” message will be returned to the charger; - If the vehicle does not support this version and this version is lower than the minimum version supported by the vehicle, a “Negotiation Failed” message will be returned to the charger; - If the vehicle does not support this version and this version is higher than the minimum version supported by the vehicle, a “Continue Negotiation” message together with expected version number will be returned to the charger; After the charger receives the “Continue Negotiation” message, - If the current version sent is the minimum version supported by the charger, continue sending the current version and wait for the timeout negotiation failed; - If the charger supports the desired version by the vehicle, send the version number and the negotiation is successful; If the pile does not support the desired version by the vehicle, send the highest version lower than the current version and continue negotiation.
4	Precondition	The physical connection is completed and the communication link is established.
5	Requirements	To improve the compatibility, the charger and vehicle can support multiple versions of the communication protocol. If the negotiation is successful, both sides support the same protocol version, or else, the negotiation is failed. The communication protocol version number is composed of CAN type, major version number, minor version number and temporary version number. - The current CAN type is CAN2.0, which can be extended to CANFD, CANXL, etc.; - In general, the major version number is updated when there are structural changes in the communication protocol (such as changes in functional modules); - The secondary version number is updated when the communication protocol has a major function change; - The temporary version is only used for demonstration projects and testing temporary use; and the temporary version number is 0 in the official release.
6	End Condition	Negotiation Succeeded: The vehicle sends “Negotiation Succeeded”, both sides exchange information in accordance with the agreed protocol version. Negotiation Failed, including: - Version Negotiation Failed, the vehicle sends “Negotiation Failed”, both sides exit the communication process; - Version Negotiation Timeout, the vehicle sends “Negotiation Failed”, both sides exit the communication process.

7.2 Message Definition

The data link layer of a version-negotiated interaction message shall meet the requirements stipulated in Chapter 6 hereof. The version negotiation process includes messages of “Charger Protocol Version” and “Vehicle Negotiation Results”, as the frame format defined in Table 4 and Table 5.

Table 4 Frame Format of Charger Protocol Version

Protocol Data Unit	P	EDP	DP	PF	PS	SA	Data Field							
Bit	3	1	1	8	8	8	8	8	8	8	8	8	8	8
Definition	0x03	0	0	0x3C	0xF4 (Destination Address)	0x56 (Source Address)	Follow the definition in Table 6.							

Table 5 Frame Format of Vehicle Negotiation Results

Protocol Data Unit	P	EDP	DP	PF	PS	SA	Data Field							
Bit	3	1	1	8	8	8	8	8	8	8	8	8	8	8
Definition	0x03	0	0	0x3C	0x56 (Destination Address)	0xF4 (Source Address)	Follow the definition in Table 7.							

Table 6 Data Field Contents of Charger Protocol Version

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	CAN Type	1 byte	BYTE	CANType	Charger CAN type, CAN2.0 communication is adopted for current version.
2	Protocol Version Number	3 byte	BYTE [3]	ProtocolVersionType	Protocol version number supported by the charger, the current version stipulated in this part is V2.0.0, if the vehicle negotiation result is “Continue Negotiation”, but there is no other version supported for the charger, it will continue to send the current version number.
3	Reserved	1 byte	BYTE	ReservedType	The receiver does not judge the value
4	Reserved	1 byte	BYTE	ReservedType	The receiver does not judge the value
5	Reserved	1 byte	BYTE	ReservedType	The receiver does not judge the value
6	Check Code	1 byte	BYTE	CheckcodeType	Message Check Code, cumulative sum from byte 1 to byte 7

Table 7 Data Field Contents of Vehicle Negotiation Results

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	CAN Type	1 byte	BYTE	CANType	Vehicle CAN type, CAN2.0 communication is adopted for current version.
2	Negotiation Results	1 byte	BYTE	VersionResultType	Vehicle version negotiation results, including “Continue Negotiation”, “Negotiation Succeeded”, “Negotiation Failed”.
3	Negotiation Version Number	3 byte	BYTE [3]	ProtocolVersionType	Desired or Agreed Version Number of the Vehicle. If the vehicle negotiation result is “Negotiation Succeeded”, the value is the version number agreed by both sides; If the vehicle negotiation result is “Continue Negotiation”, the value is the desired version number of the vehicle; If the vehicle negotiation result is “Negotiation Failed”, the value is 0xFFFFFF;
4	Reserved	1 byte	BYTE	ReservedType	The receiver does not judge the value.
5	Reserved	1 byte	BYTE	ReservedType	The receiver does not judge the value
6	Check Code	1 byte	BYTE	CheckcodeType	Message Check Code, cumulative sum from byte 1 to byte 7

7.3 Message Interaction Process

After the physical connection is completed, the charger starts to send the message “Charger Protocol Version” after closing S1. The charger first sends the highest protocol version number it supports, and the vehicle receives and checks the version number it supports and returns the version negotiation results. In case of “Continue Negotiation”, both sides continue to negotiate with the lower protocol version number; in case of “Negotiation Succeeded”, both sides exchange information according to the agreed version of the communication protocol; in case of “Negotiation Failed”, both sides exit the communication process.

For complete state transition process, see Table 8 and Table 9.

Table 8 Charger State Transition Table

Charger		Triggering condition					
		T1 Timer Enabled	**Received "Negotiation Succeeded"**	**Received "Negotiation Failed"**	**Received "Continue Negotiation"**	**T2 Timer Enabled**	**Received Invalid Frame**
Status	S0 (Original State)	Sent CvList (Ns), enter S1	-	-	-	-	-
	S1 (In Negotiation)	Sent CvList (Ns)	Turn off T1, T2, enter S2	Turn off T1, T2, enter S3	Adjust Ns pointing in accordance with "Desired Version Number" message of vehicle (if supported, Ns points to this version number; or else, it points to former lower version; Ns remains unchanged if it is the first one), keep S1	Enter S3, turn off T1, T2	-
	S2 (Negotiation Succeeded, enter function negotiation)	-	Enter function negotiation	Enter S3	Send successfully negotiated version	-	-
	S3 (Negotiation Failed, terminate the process)	-	-	-	-	-	-

Note 1: T1 is the charger transmission timer. When S1 is closed, turn on T1 timer with the cycle of 50ms

Note 2: T2 is the version-negotiated timeout timer. When S1 is closed, turn on T2 timer with the default value of 5s

Note 3: CVList: Charger-supported Protocol Version Queue, with version number ranking from the smallest to the largest, Ns refers to the counter and initial value points to the highest version number

Note 4: .- means the charger does nothing

Note 5: Invalid frame is all messages not listed in the table, including other messages excluding version negotiation message or version contents that do not satisfy the interaction principle.

Table 9 Vehicle State Transition Table

Vehicle		Triggering condition					
		Received CvList			**Received "Function Negotiation Message"**	**T2 Timer Enabled**	**Received Invalid Frame**
		With the same version number	**With the lower version number**	**No lower version number**			
Status	S1 (In Negotiation)	Send "Negotiation Succeeded", enter S2	Send "Continue Negotiation", with the version number nearest to the lower version number	Send "Negotiation Failed", enter S3	-	Send "Negotiation Failed", terminate the process	-
	S2 (Negotiation Succeeded)	Send "Negotiation Succeeded"	Send "Continue Negotiation", with the version number nearest to the lower version number, enter S1	Send "Negotiation Failed", enter S3	Enter Function Negotiation	Send "Negotiation Failed", terminate the process	-
	S3 (Negotiation Failed)	Send "Negotiation Failed"	Send "Negotiation Failed"	Send "Negotiation Failed"	Send "Negotiation Failed"	Send "Negotiation Failed", terminate the process	-

Note 1: T2 is the version-negotiated timeout timer. When S1 is closed, turn on T2 timer with the default value of 5s

Note 2: CVList: Charger-supported Protocol Version Queue, with version number ranking from the smallest to the largest, Ns refers to the counter and initial value points to the highest version number
Note 3: .- means the charger does nothing
Note 4: Invalid frame is the messages not listed in all state tables, such as other messages excluding version negotiation message or version contents that do not satisfy the interaction principle.

Figure 1 gives the message interaction process of version negotiation.

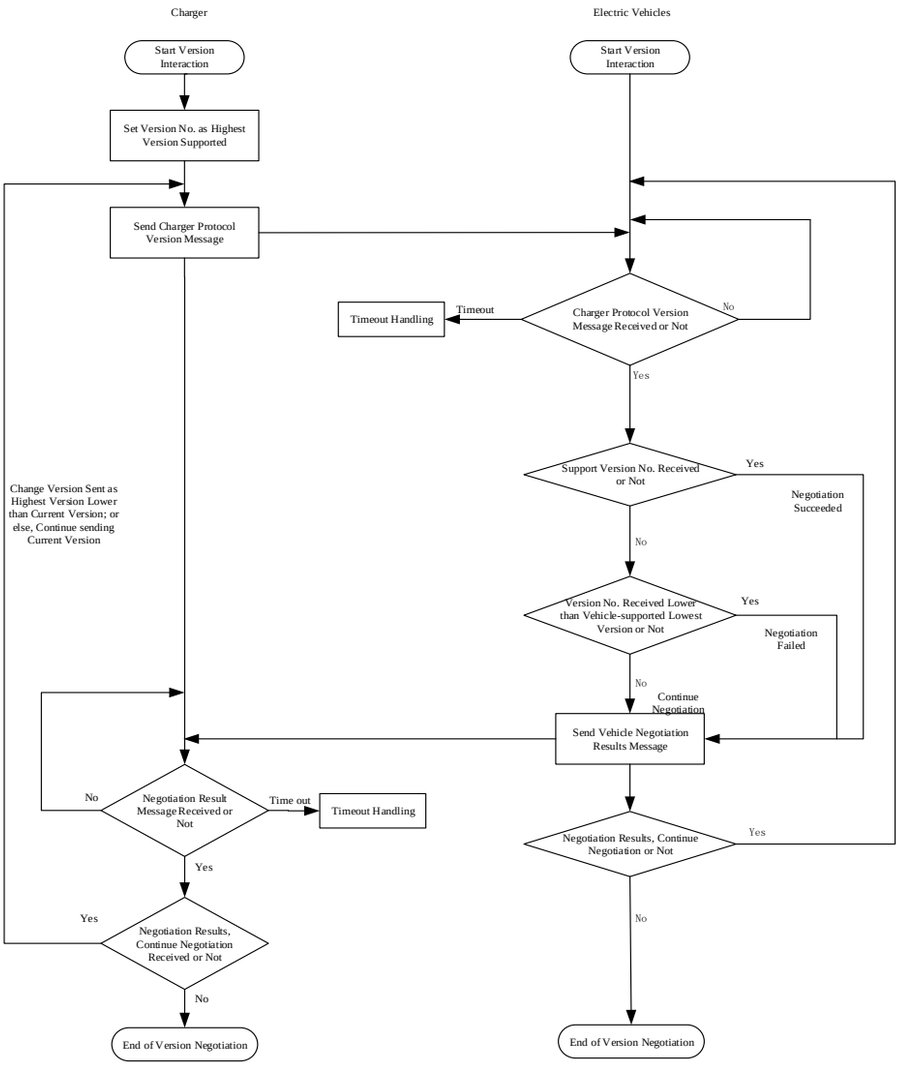

Figure 1 Version Negotiation Message Interaction

8 Transmission Layer

8.1 Message Type

8.1.1 Classification

The transmission layer is responsible for data transmission and flow control, such as flow control, grouping number and sequence check, etc.. The message types specified in this part include long messages, reliable short messages and unreliable short messages. Long messages, and reliable short message provide reliable transmission services for upper-level application, while unreliable short messages are oriented to the transmission service of simply unreliable messages.

8.1.2 Long Message

The sending of long messages (LM) shall follow the multi-message frame transmission mode specified in 8.2, and the message frame format is defined as shown in Table 10.

Table 10 Message Frame Format of Long Messages

Protocol Data Unit	P	EDP	DP	PF	PS	SA	Data Field							
Bit	3	1	1	8	8	8	8	8	8	8	8	8	8	8
Definition	0x06	0	0	0x01	Destination Address	Source Address	Frame SN: 0	Total Number of Frames	Total Number of Bytes		0xFF	0xFF	0xFF	0xFF
							Frame SN: >0	Parameter group of application layer, when the last frame is less than 8 bytes, fill in 0xFF						

Note 1: For the convenience of description, LM (0) is usually used to represent the long message frame with frame SN of 0; LM (n) represents the message frame of long messages with the frame SN of n (n>0).

Note 2: Total Number of Frames is the number of all frames transmitted including LM (0) and parameter group of application layer.

Note 3: Total number of bytes refers to the length of parameter group of application layer for long messages, excluding frame SN and 0xFF filled in for last frame less than 8 bytes

Control frame of long messages is used for error control and flow control, consisting of three types:

– Long Message Acknowledge LM_ACK

– Long Message Negative Acknowledge LM_NACK

– Long Message End of Acknowledge LM_EndACK

Including, LM_ACK and LM_EndACK refer to acknowledge response of the receiver to the sender, LM_NACK refers to the negative acknowledge of the receiver or sender to the opposite. The control frame format of long messages is shown in Table 11.

Table 11 Control Frame Format of Long Messages

Protocol Data Unit	P	EDP	DP	PF	PS	SA	Data Field							
Bit	3	1	1	8	8	8	8	8	8	8	8	8	8	8
Definition	3	0	0	0x04	Destination Address	Source Address	LM_ACK: 1	SN of start frame to be received	Total number of frame to be received	0xFF	0xFF	0xFF	0xFF	0xFF
							LM_NACK: 2	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF
							LM_EndACK: 3	Total number of frame received	Received Total Number of Bytes		0xFF	0xFF	0xFF	0xFF

Note 1: For the convenience of description, LM_ACK (n,k) is usually used to represent the control frame of long message acknowledge with SN of start frame to be received of n and the number of total frames to be received of k.

8.1.3 Reliable Short Messages

Reliable short messages (SM_RM) require the acknowledge from the receiver. The number of retransmission times for a reliable short message are limited to 3, namely the total number for sending times is 4. If the sender still fails to receive the acknowledge after sending it 4 times, the sender shall abandon further attempt and the time interval of retransmission is 100ms-250ms. The

message frame format for reliable short messages is shown in Table 12, and the acknowledge (control frame) format is defined in Table 13.

Table 12 Message Frame Format of Reliable Short Messages

Protocol Data Unit	P	EDP	DP	PF	PS	SA	Data Field							
Bit	3	1	1	8	8	8	8	8	8	8	8	8	8	8
Definition	0x04	0	0	0x02	Destination Address	Source Address	Follow the definition of application layer, fill in 0xFF for the frame less than 8 bytes.							

Table 13 Control Frame Format of Reliable Short Messages

Protocol Data Unit	P	EDP	DP	PF	PS	SA	Data Field							
Bit	3	1	1	8	8	8	8	8	8	8	8	8	8	8
Definition	0x03	0	0	0x04	Destination Address	Source Address	0	1	0xFF	0xFF	0xFF	0xFF	0xFF	0xFF

8.1.4 Unreliable Short Messages

Unreliable short messages (SM_URM) do not require acknowledge from the receiver. The messages sent circularly in upper-level application are generally unreliable short messages. The message frame format is shown in Table 14.

Table 14 Message Frame Definition of Unreliable Short Messages

Protocol Data Unit	P	DP	DP	PF	PS	SA	Data Field							
Bit	3	1	1	8	8	8	8	8	8	8	8	8	8	8
Definition	0x06	0	0	0x03	Destination Address	Source Address	Follow the definition of application layer, fill in 0xFF for the frame less than 8 bytes.							

8.2 Multi-message Frame Transmission Mode

8.2.1 Principle

The transmission control of long messages includes two main functions: sub-packaging & regrouping and connection management.

8.2.2 Sub-packaging & Regrouping

When the data field length of a long message is greater than 8 bytes, the sender shall split it into several smaller data frames and then transmit them one by one. After receiving all data frames, the receiver shall regroup them into the original message.

(1) Data Frame

In order to ensure each data frame can be recognized and regrouped, the first byte of data field of message frame is defined as the SN of data frame ranging from 1 to 255, therefore, the maximum length of data is 1785 bytes. The data frame SN of 0 indicates that the sender requests to establish a virtual connection for long message transmission.

(2) SN

The SN is allocated to data frame upon disassembly and assembly, after receiving the data, the receiver uses the SN to regroup the data frame back to the original message. Data frames are sent from the data frame numbered 1 in numbered increment order.

(3) Data Disassembly

Data disassembly is used for messages with data field larger than 8 bytes. The time interval LMS_T1 between data frames of message sent shall be less than 10ms (to be discussed). The receiver shall confirm that these data frames have the same parameter identification.

Each data frame (except the last one) is loaded with 7 bytes of the original data. The 8 bytes of data field for the last data frame include: SN of data frame and parameter data with at least one-byte. All unused bytes are set to “FF”.

(4) Data Regrouping

After the data frames are successively received, the receiver will regroup then into long messages in sequential order.

8.2.3 Connection Management

Connection management stipulates the establishment, use and closure of virtual connection between nodes during long message transmission. A virtual connection refers to the temporary connection between two nodes during the communication process for the purpose of sending a long message.

(1) Principle

- Before each long message is sent, both the sender and the receiver need to reset the counter used to record the frame SN; for the sender, the counter is used to record the frame SN of the next message to be sent; for the receiver, the counter is used to record the frame SN of the next message to be received.
- The sender sends a data frame with the frame SN of 0 to start the connection, and the receiver acknowledges the connection.
- After the connection is established, the sender sends the data frame in accordance with the acknowledge of the receiver, and waits for the acknowledge from the receiver after sending.
- Establishing two or more connections at the same time is not supported for both sender and receiver.
- After connection timeout of the same type occurs for three times consecutively, the message “Send Failed” shall be returned to the application layer.
- Only point-to-point transmission of long messages is supported.

(2) Connection Establishment

When the sender requests a long message, the frame SN is 0, containing the total number of frames and total number of bytes of the long message.

After receiving a long message with frame SN of 0, the receiver can receive or refuse to establish the connection. If the receiver selects to receive, send long message acknowledge LM_ACK, which includes SN of start frame to be received by the receiver and total number of frame to be received. After establishing the connection, the receiver shall start to receive from the data frame with SN of 1.

If the sender has received the LM ACK, the connection is established.

If the receiver is short of resources or storage space, the connection can be refused. At this time, negative acknowledge LM_NACK shall be sent, and the connection is failed.

(3) Data Transmission

The sender starts data transmission after receiving LM_ACK. The receiver is responsible for adjusting the data flow control between nodes; if the receiver needs to suspend the data flow, use LM_ACK to set total number of frame to be received as 1 and the SN of start frame to be received as the SN of last frame received, the sender sends this contents of frame repeatedly (i.e. receive the last frame message of last group repeatedly), and the receiver does nothing after receiving the message.

If the receiver decides to terminate the transmission, LM_NACK shall be sent, and after the sender receives LM_NACK, the transmission of long message is terminated.

(4) Connection Closed

With no transmission error, after all data frames have been received, the receiver will send message end of acknowledge LM_EndACK and notify the sender of connection closed.

During the process of long message transmission, the sender or receiver may terminate the connection by using LM_NACK at any time. For example, if the receiver has no resources available to process the message, it can abandon the connection by sending LM_NACK. When LM_NACK is received, all transmitted data frames will be abandoned.

Any transmission failure on either side (such as 3 consecutive connection timeout of the same type) may cause a connection to close. Connection closed on long message includes:

1) Under the following circumstances for the sender, it is considered the connection is closed:

a. Complete data transfer of the entire long message and receive LM_EndACK;

b. Send LM_NACK;

c. Receive LM_NACK;

2) Under the following circumstances for the receiver, it is considered the connection is closed:

a. Send LM_EndACK after completing data transfer of the entire long message;

b. Send LM_NACK (such as the sender wishes to stop communication in advance, timeout, etc.);

c. Receive LM_NACK;

(5) Connection Timeout

– After the receiver receives a data frame, if it fails to receive the next data frame within LMS_T2, it is considered as timeout. After timeout, LM_ACK is sent to notify the sender of resending, after three times of timeout, LM_NACK will be sent to abandon the connection.

– After the receiver sends LM_ACK, if it fails to receive the data frame with correct frame SN within LMS_T2, it is considered as timeout. After timeout, LM_ACK is

sent to notify the sender of resending, after three times of timeout, LM_NACK will be sent to abandon the connection.

- After the sender sends the message frame with frame SN of 0, if it fails to receive the acknowledge from the receiver within LMS_T2, it is considered as timeout; After timeout, the message frame with frame SN of 0 will be resent; after three times of timeout, LM_NACK will be sent to abandon the connection; (to be discussed)
- After the sender sends all frames that need to be transmitted this time, if it fails to receive the acknowledge from the receiver within T2 (LM_ACK or LM_EndACK message), it is considered as timeout; After timeout, the last frame will be resent; after three times of timeout, LM_NACK will be sent to abandon the connection; (to be discussed);
- If the transmission time of the entire long message since the sender sends the data frame with the frame SN of 0 is larger than LMS_T3, it is considered as timeout; after timeout, LM_NACK will be sent to abandon the connection.

LMS_T2= 100ms (to be discussed)

LMS_T3= 10000ms (to be discussed)

For complete state transition process of long message sending, see Table 15 and Table 16.

Table 15 Charger State Transition Table

Sender		Triggering condition										
					Transmitting cycle LMS_T1 timing enabled			Receiving message timeout LMS_T2 timing enabled		Data transmission timeout LMS_T3 timing enabled	Suspend transmission	Invalid message
		LM_ACK (n,k)	LM_NACK	LM_EndACK	Current sending frame is neither the last frame of message requested by the receiver nor the last frame of long message send_cnt<k-1 and n+send_cnt<lm_tfra-1	Current sending frame is the last frame of message requested by the receiver and the transmission of long message has not been completed send_cnt≥k-1 and n+send_cnt<lm_tfra-1	Current sending frame is the last frame of long message or the transmission has been completed n+send_cnt≥lm_tfra-1	The number of timeout is less than 3	The number of timeout is not less than 3			
State	**Connection establishment S0**	Send LM(n) according to the acknowledge, reset err_cnt, set send_cnt as 1, turn on LMS_T1, turn off LMS_T2 and enter S1	Enter S4	-	-	-	-	err_cnt plus 1, send LM (0), enter S0, turn on LMS_T2	Send LM_NACK, enter S4	Send LM_NACK, enter S4	Send LM_NACK, enter S4	-
	Data Transmission S1	Save k, Send LM(n) according to the acknowledge, reset err_cnt, set send_cnt as 1, turn on LMS_T1, turn off LMS_T2 and enter S1	Enter S4	-	Send LM (n+send_cnt), send_cnt plus 1, turn on LMS_T1 and enter S1	Send LM (n+k), send_cnt plus 1, turn off LMS_T1, turn on LMS_T2 and enter S2	Send LM (lm_tfral), send_cnt plus 1, turn off LMS_T1, turn on LMS_T2 and enter S3	-	-	Send LM_NACK, enter S4	Send LM_NACK, enter S4	-
	Wait for acknowledge S2	Adjust package SN for sending LM as n according to the acknowledge, reset err_cnt, set send_cnt as 1, turn on LMS_T1, turn off LMS_T2 and enter S1	Enter S4	-	-	-	-	err_cnt plus 1, send LM (n+k-1), enter S2, turn on LMS_T2	Send LM_NACK, enter S4	Send LM_NACK, enter S4	Send LM_NACK, enter S4	-
	Wait for end of acknowledge S3	Adjust package SN for sending LM as n according to the acknowledge, reset err_cnt, set send_cnt as 1, turn on LMS_T1, turn off LMS_T2 and enter S1	Enter S4	Enter S4	-	-	-	err_cnt plus 1, send LM (lm_tfra-1), enter S3, turn on LMS_T2	Send LM_NACK, enter S4	-	-	-
	Connection closed S4	-	-	-	-	-	-	-	-	-	-	-

Note 1: err_cnt receiving timeout counts
Note 2: send_cnt sending frame counts
Note 3: LMS_T1: message sending interval per frame, start counting after the message is sent;
Note 4: LMS_T2: receiving message timeout timer;
Note 5: LMS_T3: total timer for long message transmission, turn on after sending the first frame of message.
Note 6: lm_tfra: total number of frames for sending long message.
Note 7: Connection closed, reset all counters (err_cnt, send_cnt), turn off all timers (LMS_T1, LMS_T2, LMS_T3)

Table 16 Vehicle State Transition Table

Vehicle		Triggering condition											
		LM (0)	LM (n)						LM_NACK	Receiving message timeout LMS_T2 timing enabled	Suspend receiving	Data transmission timeout LMS_T3 timing enabled	Suspend transmission	Invalid message
			Long messages have been received recv_tfra≥lm_tfra	Frame numbers received are discontinuous, receive repeated messages n<recv_no+1	Frame numbers received are discontinuous, messages are missed n>recv_no+1 and recv_tfra<lm_tfra	Receive the last frame of long message n=recv_no+1 and recv_tfra+1=lm_tfra	Receive the last frame of request n=recv_no+1 and recv_num≥k and recv_tfra+1<lm_tfra	Not all received n=recv_no+1 and recv_num<k and recv_tfra+1<lm_tfra						
State	Idle S0	Save lm_tfra, send LM_ACK(1,k), turn on LMS_T2, LMS_T3, reset recv_no, reset recv_num, set recv_tfra as 1 and enter S1	-	-	-	-	-	-	-	-	-	-	-	-
	Receive data S1	Send LM_ACK(1,k), turn on LMS_T2, reset recv_no, reset recv_num, set recv_tfra as 1 and enter S1	Set recv_tfra as lm_tfra, send LM_EndACK and enter S2	-	Send LM_ACK(recv_no+1,k), turn on LMS_T2, reset recv_num and enter S1	Set recv_tfra as lm_tfra, send LM_EndACK and enter S2	Set recv_no as n, send LM_ACK(n+1, k), reset recv_num, recv_tfra plus 1, turn on LMS_T2 and enter S1	Set recv_no as n, recv_num plus 1, recv_tfra plus 1, turn on LMS_T2 and enter S1	Enter S2	Send LM_ACK(recv_no+1,k), reset LMS_T2 and enter S1	Send LM_ACK(recv_no,1), reset T2 and enter S1	Send LM_NACK and enter S2	Send LM_NACK and enter S2	-
	Connection closed S2	Save lm_tfra, send LM_ACK(1,k), turn on LMS_T2, LMS_T3, reset recv_no, reset recv_num, set recv_tfra as 1 and enter S1	Set recv_tfra as lm_tfra, send LM_EndACK and enter S2	-	-	-	-	-	-	-	-	-	-	-

Note 1: err_cnt receiving timeout counts;
Note 2: recv_no receiving data package frame number;
Note 3: recv_num frame number of valid data frame received by request currently;
Note 4: recv_tfra frame number of total valid data received by connection currently;
Note 5: LMS_T2: receiving message timeout timer;
Note 6: LMS_T3: timer for long message transmission;
Note 7: lm_tfra: total number of frames for sending long message;
Note 8: K represents the frame number of data frame to be received (take the smaller value between receiving number and the number of remaining sending frame)
Note 9: Connection closed, reset all counters (recv_no, recv_num), turn off all timers (LMS_T2, LMS_T3).

Figure 2 gives the interaction process of long message.

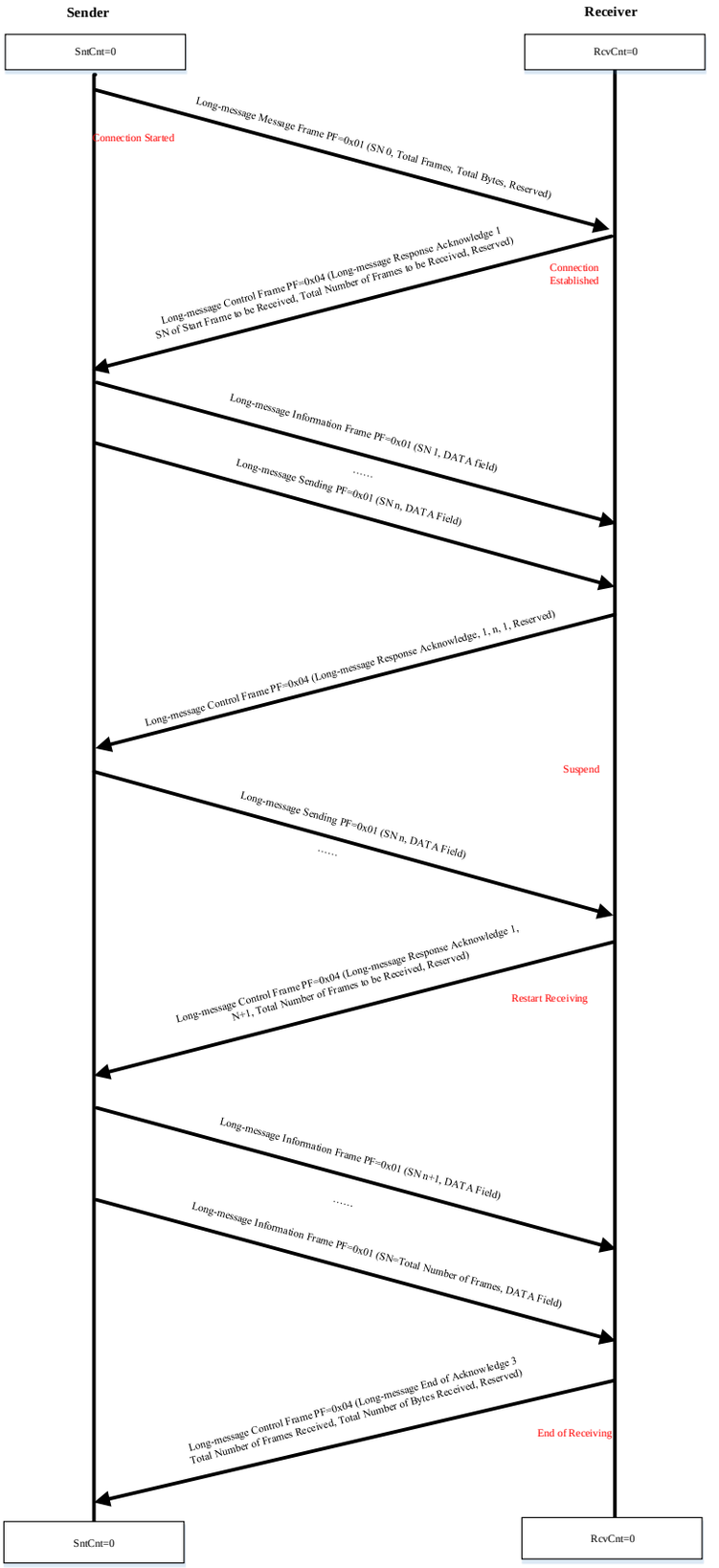

Figure 2 Interaction Process of Long Message

9 Application Layer

9.1 Overview

9.1.1 Adopt PGI to number the parameter group, and identify message contents for each node according to PGI.

9.1.2 Unless specifically requested, both sides shall send messages according to actual data.

9.1.3 The receiver receives the parameter value exceeding message range or not specified in the standard. Unless otherwise specified, ignore the message. (To be discussed: exit the communication or ignore current data).

9.1.4 When the parameter value received by the receiver is “Reserved” value or “Invalid” value, the current data will not be processed.

9.1.5 The data types transmitted in this part are defined in Table 17, and the network byte order in little-endian mode shall be used to transfer digital message.

Table 17 Data Types

Data Type	Description and Requirements
BYTE	Unsigned single-byte integer (byte, 8-digit)
WORD	Unsigned double-byte integer (word, 16-digit)
DWORD	Unsigned four-byte integer (dword, 32-digit)
BYTE[n]	n byte
STRING	ASCII character code, if there is no data, set 0 as the terminator, the coding symbol is shown in 5.1 of GB/T1988; for Chinese characters, adopt the location area code with 2 bytes for each character, the coding symbol is shown in Chapter 6 of GB/T18030.

9.2 Charging Communication Process

The charging communication process specified in this part is composed of multiple function modules in sequence, and the function codes (FC) corresponding to each function module are shown in Table 18. A complete charging communication process includes all required function modules with no or several optional function modules, as shown in Figure 3.

In addition to function negotiation and parameter configuration, other function modules can be reloaded to achieve different applications, and different applications of function module can be distinguished by function description code (FDC). In this part, each override function module can support up to 8 FDCs.

During the process of charging communication, to guarantee the synchronization of message interaction, if there is no special requirements, the function modules other than function negotiation and parameter configuration shall first conduct phase acknowledge in accordance with the requirements stipulated in Appendix B.2 before information interaction so as to guarantee the consistency of communication information on FC and FDC.

Table 18 Function Modules Forming Charging Communication Process

Name of Function Module	Function Code (FC)	Description	Type of Function Module	Overridable or not
Function Negotiation	0x10	Interaction and acknowledge of related functions realized by this charging	Required	No
Parameter Configuration	0x20	Interaction of Basic Charging Parameters	Required	No
Authentication	0x30	Vehicle and/or Charger Identity Interaction and Acknowledge	Optional	Yes

Scheduling	0x40	Start the interaction and acknowledge of the time point of power supply mode or precharge function module	Optional	Yes
Self-check of Charging System	0x50	Realize the insulation detection, short-circuit detection and welding detection of the charger (including discharge)	Required	Yes
Power Supply Mode	0x60	The charger completes the power supply functions such as heating the battery pack in constant voltage mode in case the battery pack is not connected	Optional	Yes
Precharge and Energy Transmission	0x70	It includes precharge and energy transmission. The former is relevant operations performed by the charger before energy transmission to avoid the shock to the battery pack, and the latter refers to the whole process from starting to ending the charging and/or discharging.	Required	Yes
End of charging	0x80	Relevant operations performed after the completion of energy transmission, such as interaction of charging process statistics and other related information	Optional	Yes

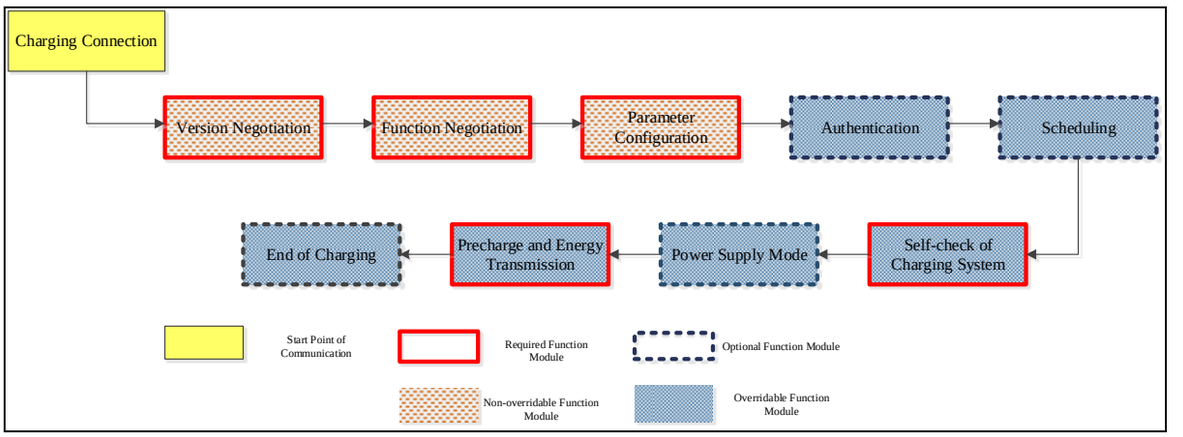

Figure 3 Function Module Classification

9.3 Function Negotiation

9.3.1 General Description

The function module of function negotiation is not overridable, the principle of function negotiation, message definition and information interaction process remain unchanged and there is only one application example. Both sides confirm the functions realized in the charging process through function negotiation and conduct message interaction according to FDC of each FC agreed upon. The overall description of function negotiation function module is shown in Table 19.

Table 19 General Description of Function Negotiation

Serial No.	Item	Description Information
1	Phase Name	Function Negotiation
2	Target	The vehicle identifies FC and corresponding FDC of the charger and decides the charging function through negotiation.
3	Description	After successful version negotiation, all override function modules and their respective FDC can be negotiated between the charger and the vehicle. The charger will send all supported FCs and corresponding FDCs to the vehicle, and the vehicle will select its supported FC and corresponding unique FDC and return it to the charger. Both sides should conduct follow-up information interaction with FC and FDC negotiated successfully.
4	Precondition	Version Negotiation Succeeded
5	Requirements	– FC and FDC sent by the charger shall include all necessary function modules. The charger can support multiple FDCs under one FC and send all FCs and FDCs to the vehicle at one time. – It is up to the vehicle to determine the outcomes of function negotiation. In general, if both sides

		support the same FDC on certain FC, the negotiation is successful on this FC; if both sides do not have a mutually supported FDC on a certain FC, the negotiation on this FC is failed. – The result of negotiation on the same FC can have one FDC at most, which is selected by the vehicle according to its own strategy
6	End Condition	Negotiation succeeded: In the negotiation results returned by the vehicle, both the charger and the vehicle have the same FDC in all required function modules, and both sides take this as the negotiation results to enter the information interaction of the next function module; Negotiation failed: In the negotiation results returned by the vehicle, either the charger or the vehicle does not have the same FDC in one of the required function module at least, and the negotiation is failed. Exit for Timeout: If both sides fail to complete the function negotiation within the specified time, it will exit the communication process. Note: FDC negotiation results of override function module should not be used as the evaluation basis for the success of function negotiation.

9.3.2 Message Definition

The function modules of function negotiation include “Charger Support Function”, “Negotiation Acknowledge Results of Vehicle Functions”, as shown in Table 20, the definitions of message parameter group shall comply with the requirements stipulated in Table 21 and 22.

Table 20 Function Negotiation Module Message

Message Description	Message Type	Source Address - Destination Address
“Charger Support Function” Message	Long Messages	Charger - Vehicle
“Negotiation Acknowledge Results of Vehicle Functions” Message	Reliable Short Messages	Vehicle - Charger

Table 21 Data Format and Contents of “Charger Support Function” Message

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2-9	Support of Function Description Code	8 byte	BYTE [8]	FDCSupportType	Whether the authentication function module supports the 1st-8th FDC
10-17	Support of Function Description Code	8 byte	BYTE [8]	FDCSupportType	Whether the scheduling function module supports the 1st-8th FDC
18-25	Support of Function Description Code	8 byte	BYTE [8]	FDCSupportType	Whether the function module of charging system self-check supports the 1st-8th FDC
26-33	Support of Function Description Code	8 byte	BYTE [8]	FDCSupportType	Whether the function module of power supply mode supports the 1st-8th FDC
34-41	Support of Function Description Code	8 byte	BYTE [8]	FDCSupportType	Whether the function module of scheduling and energy transmission supports the 1st-8th FDC
42-49	Support of Function Description Code	8 byte	BYTE [8]	FDCSupportType	Whether the end of charging function module supports the 1st-8th FDC

Table 22 Data Format and Contents of "Acknowledge Results of Vehicle Functions Negotiation" Message

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Negotiation Results of Function Description Code	1 byte	BYTE	FDCNegoResultType	FDC of authentication function module supported by the vehicle; if all FDCs are not supported by the vehicle, fill in 0;
3	Negotiation Results of Function Description Code	1 byte	BYTE	FDCNegoResultType	FDC of scheduling function module supported by the vehicle; if all FDCs are not supported by the vehicle, fill in 0
4	Negotiation Results of Function Description Code	1 byte	BYTE	FDCNegoResultType	FDC of the function module of charging self-check supported by the vehicle; if all FDCs are not supported by the vehicle, fill in 0
5	Negotiation Results of Function Description Code	1 byte	BYTE	FDCNegoResultType	FDC of the function module of power supply mode supported by the vehicle; if all FDCs are not supported by the vehicle, fill in 0
6	Negotiation Results of Function Description Code	1 byte	BYTE	FDCNegoResultType	FDC of function module of precharge and energy transmission supported by the vehicle; if all FDCs are not supported by the vehicle, fill in 0
7	Negotiation Results of Function Description Code	1 byte	BYTE	FDCNegoResultType	FDC of the end charging function module supported by the vehicle; if all FDCs are not supported by the vehicle, fill in 0

9.3.3 Message Interaction Process

The charger and vehicle will enter function negotiation after version negotiation is successful, the charger will send the message of "Charger Support Function", and the vehicle will return the message of "Negotiation Acknowledge Results of Vehicle Functions" based on the application scenario and the priority. Complete state transition process is shown in Table 23 and Table 24.

Table 23 Charger State Transition Table

Charger		Triggering condition						
		Received "Vehicle Negotiation Results" message			Received "Vehicle Support Function" Message		T2 Timer Enabled	Received invalid message
		Negotiation Succeeded	Continue Negotiation	Negotiation Failed	Required Function Module Negotiation Succeeded	Part of Required Function Module Negotiation Not Succeeded		
Status	S0 (initialization)	Enter S1	Return to version negotiation (negotiation)	Enter S3, turn off T2	-	-	-	-
	S1 (In Negotiation)	Send "Charger Support Function" Message	Return to version negotiation (negotiation)	Enter S3, turn off T2	Enter S2, turn off T2	Enter S3, turn off T2	Enter S3	-
	S2 (Negotiation succeeded, enter parameter configuration)	-	-	-	-	-	-	-
	S3 (Negotiation failed, send "Suspend message_function negotiation failed")	-	-	-	-	-	-	-
Note 1: T2 refers to function negotiation timeout timer at the charger side; when "Vehicle (Version) Negotiation Succeeded" message is received, turn on T2 with the default value of 5s Note 2: .- means the charger does nothing Note 3: Invalid frame is the messages not listed in all state tables, such as other messages excluding function negotiation message or version contents that do not satisfy the interaction principle								

Table 24 Vehicle State Transition Table

Vehicle		Triggering condition				
		Received "Charger Support Function" Message	Received "Suspend message_function negotiation failed" message)	Received "Charger Charging Parameters" message	T2 Timer Enabled	Received Invalid Frame
Status	S1 (In Negotiation)	Send "Vehicle Support Function" message, enter S2	-	Enter parameter configuration, turn off T2	Enter S3	-
	S2 (Negotiation succeeded, enter parameter configuration)	-	Enter S3, turn off T2	Enter parameter configuration, turn off T2	Enter S3	-
	S3 (Negotiation failed, exit communication)	-	-	-	-	-
Note 1: T2 refers to function negotiation timeout timer at the vehicle side; after successfully sending "Vehicle (Version) Negotiation Succeeded" message by the vehicle, turn on T2 with the default value of 5s Note 2: .- means the charger does nothing Note 3: Invalid frame is the messages not listed in all state tables, such as other messages excluding function negotiation message or version contents that do not satisfy the interaction principle						

Figure 4 gives the message interaction process of function negotiation module.

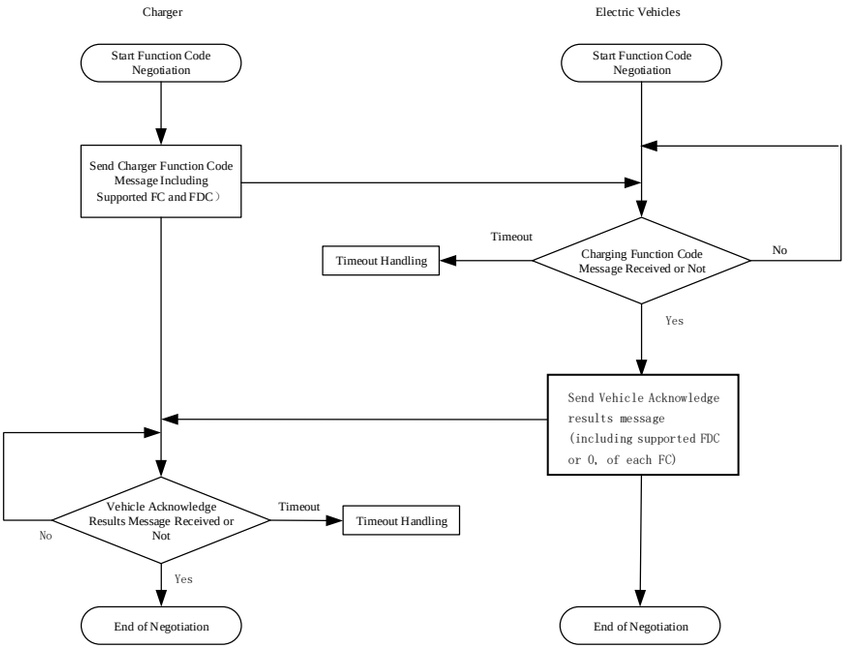

Figure 4 Interaction Process of Function Negotiation

9.4 Parameter Configuration

9.4.1 General Description

The function module of function configuration is not overridable, the principle of parameter matching, message definition and information interaction process remain unchanged and there is only one application example. Both sides confirm whether the basic parameters of charging are matched through parameter configuration. Specific description on function module of parameter configuration is shown in Table 25.

Table 25 Overall Description of Parameter Configuration

Serial No.	Item	Description Information
1	Phase Name	Parameter Configuration Phase
2	Target	Vehicle and charger exchange basic charging parameters.
3	Description	After function negotiation is successful, the charger and the vehicle interact with basic parameters of charging for parameter matching.
4	Precondition	Function Negotiation Succeeded
5	Requirements	Parameters (definitions) sent by the charger and the vehicle shall satisfy the definitions stipulated in Chapter XX of GB/T18487.1
6	End Condition	Matching of charging parameters succeeded: Charging parameters are matched, entering the information interaction of the next function module; Matching of charging parameters failed: Under one of the following circumstances, the matching is failed – The current voltage of the complete vehicle charging system is lower than the minimum output voltage of the charger; – The current voltage of the complete vehicle charging system is higher than the maximum output voltage of the charger. Exit for Timeout: If both sides fail to complete the parameter configuration within the specified time, it will exit the communication process.

9.4.2 Message Definition

The function modules of parameter configuration include “Charger Charging Function” and “Vehicle Charging Parameters” messages, as shown in Table 26, the definitions of message parameter group shall comply with the requirements stipulated in Table 27 and 28.

Table 26 “Function Modules of Parameter Configuration” Message

Message Description	Message Type	Source Address - Destination Address
“Charger Charging Parameters” message	Long Messages	Charger - Vehicle
“Vehicle Charging Parameters” message	Long Messages	Vehicle - Charger

Table 27 Data Format and Contents of Charger Charging Parameters

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Voltage	2 bytes	WORD	VoltageType	For Maximum Charging Output Voltage of Charger (V), see the requirements stipulated in Chapter XX of GB/T18487.1
3	Voltage	2 bytes	WORD	VoltageType	For Minimum Charging Output Voltage of Charger (V), see the requirements stipulated in Chapter XX of GB/T18487.1
4	Current	2 bytes	WORD	CurrentType	For Maximum Charging Output Current of Charger (A), see the requirements stipulated in Chapter XX of GB/T18487.1
5	Current	2 bytes	WORD	CurrentType	For Minimum Charging Output Current of Charger (A), see the requirements stipulated in Chapter XX of GB/T18487.1

Table 28 Data Format and Contents of Vehicle Charging Parameters

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Current	2 bytes	WORD	CurrentType	For Maximum Allowable Total Charging Current, see the requirements stipulated in Chapter XX of GB/T18487.1
3	Voltage	2 bytes	WORD	VoltageType	For Maximum Allowable Total Charging Voltage, see the requirements stipulated in Chapter XX of GB/T18487.1
4	Capacity	2 bytes	WORD	CapacityType	The maximum allowable total input energy of the vehicle is determined by the vehicle; if vehicle expects charger to take it as the cutoff threshold, vehicle sends the actual data; or else, the vehicle will send 0xFFFF
5	State of Charge	2 bytes	WORD	SOCType	Current State of Charge for Power Battery of Complete Vehicle
6	Voltage	2 bytes	WORD	VoltageType	Current Voltage of Complete Vehicle Charging System

9.4.3 Message Interaction Process

After the function negotiation between the charger and the vehicle is successful, the charger starts to send “Charger Charging Parameters” message, the vehicle will return “Vehicle Charging Parameters” message after receiving the message. Complete state transition process is shown in Table 29 and Table 30.

Table 29 Charger State Transition Table

Charger	Triggering condition				
	Received “Vehicle Function” message and acknowledge negotiation succeeded	Received “Vehicle Charging Parameters” message		T2 Timer Enabled	Received Invalid Frame
		Charging parameters matching succeeded	Charging parameters		

				matching failed		
Status	**S0 (initialization)**	Enter S1	-	-	-	-
	S1 (In Negotiation)	Send “Charger Charging Parameters” message	Enter S2, turn off T2	Enter S3, turn off T2	Enter S3	-
	S2 (parameters matched, enter the next function module according to “function negotiation”)	-	-	-	-	-
	S3 (Parameters mismatched, send Suspend Message_Parameters Matching Failed message, terminate the process)	-	-	-	-	-
Note 1: T2 refers to function negotiation timeout timer at the charger side; after receiving “Vehicle Function” message and acknowledging “Negotiation Succeeded”, turn on T2 with the default value of 5s Note 2: .- means the charger does nothing Note 3: c. Invalid frame is the messages not listed in all state tables, such as other messages excluding function negotiation message or version contents that do not satisfy the interaction principle						

Table 30 Vehicle State Transition Table

Vehicle		**Triggering condition**				
		Received “Charger Charging Parameters” message	**Received Suspend Message_Charging Parameters Matching Failed message**	**Received Next Function Module message**	**T2 Timer Enabled**	**Received Invalid Frame**
Status	**S1**	Send “Vehicle Charging Parameters” message, enter acknowledge phase	Response suspended, exit the communication	-	Exit the communication after timeout	-
Note 1: T2 refers to function negotiation timeout timer at the vehicle side; after sending “Vehicle Function” message and acknowledging “Function Negotiation Succeeded”, turn on T2 with the default value of 5s; Note 2: .- means the charger does nothing Note 3: Invalid frame is the messages not listed in all state tables, such as other messages excluding function negotiation message or version contents that do not satisfy the interaction principle.						

Figure 5 gives the message interaction process of the function module of parameter configuration.

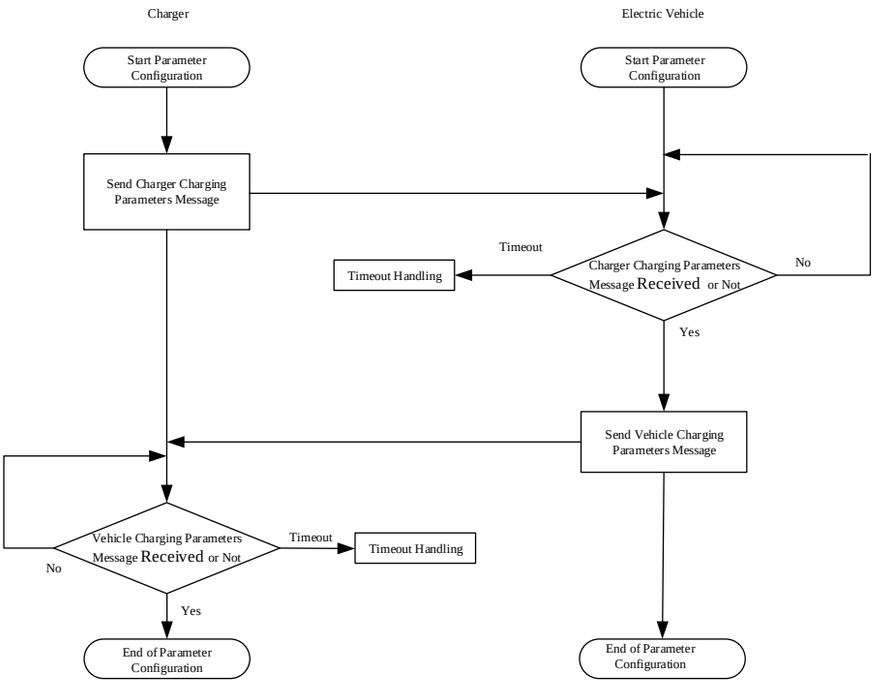

Figure 5 Interaction Process of Parameter Configuration

9.5 Self-check of Charging System

9.5.1 General Description

Self-check function module of charging system is not only a required function module, but also a override function module.

This part stipulates the default self-check process of charging system during the process of basic charging (FDC corresponding to self-check function module of charging system is 1). In this process, the charger shall complete the self-check process such as insulation detection (including discharge), short-circuit detection and welding detection in accordance with the requirements stipulated in Chapter XX of GB/T18487.1. Specific description on self-check function module of charging system is shown in Table 31.

Table 31 Overall Description of Charging System Self-check (FDC=1)

Serial No.	Item	Description Information
1	Phase Name	Self-check Phase of Charging System
2	Target	The charger should complete such functions as insulation detection (including discharge), short-circuit detection and welding detection, etc.
3	Description	In the process of basic charging, after parameter configuration is successful, the charger should complete insulation detection, short-circuit detection, welding detection and other preparation before charging after confirming the electronic vehicle lock is locked.
4	Precondition	Parameter Configuration Succeeded
5	Requirements	The charger shall confirm the electronic lock is locked before starting insulation detection. Insulation detection, short-circuit detection and welding detection shall comply with the requirements stipulated in Chapter XX of GB/T18487.1.
6	End Condition	Self-check Succeeded: The self-check of charger system is successful and enter precharge and energy transmission phase. Self-check Failed: Under one of the following circumstances, both sides exit the charging process – The electronic vehicle lock fails to be locked within the specified time; – Insulation detection of the charger failed;

		– Short-circuit detection of the charger failed; – Welding detection of the charger failed; Exit for Timeout: If the charger fails to complete the system self-check within the specified time, it will exit the communication process.

9.5.2 Message Definition

The self-check function modules of charging system (FDC=1) include “Charger Self-check Information” and “Vehicle Self-check Information” messages, as shown in Table 32, the definitions of message parameter group shall comply with the requirements stipulated in Table 33 and 34.

Table 32 Self-check Function Module of Charging System (FDC=1) message

Message Description	Message Type	Source Address - Destination Address
Charger Self-check Information	Unreliable Short Messages	Charger - Vehicle
Vehicle Self-check Information	Unreliable Short Messages	Vehicle - Charger

Table 33 Charger Self-check Information message

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Welding Detection State	1 byte	BYTE	CheckType	Welding detection state information, including In Detection, Passed, Failed
3	Short-circuit Detection State	1 byte	BYTE	CheckType	Short-circuit detection state information, including In Detection, Passed, Failed
4	Insulation Detection State	1 byte	BYTE	CheckType	Insulation detection state information, including In Detection, Passed, Failed

Table 34 Vehicle Self-check Information message

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	State of electronic lock	1 byte	BYTE	LockType	Lock State Information of Electronic Vehicle Lock, including Locked and Unlocked

9.5.3 Message Interaction Process

For complete state transition process of Self-check Function Module of Charging System (FDC=1), see Table 35 and Table 36.

Table 35 Charger State Transition Table

Charger		Triggering condition								
		Received "Vehicle Acknowledge Results" message for this module	Received "Vehicle Self-check Information"		T3 Enabled	Self-check succeeded	Self-check failed	T2 Timer Enabled	Received "Vehicle Suspension" message	An exception on charger occurs
			Locked of electronic lock	Unlocked of electronic lock						
Status	S0 (initialization)	Send "Charger Self-check Information" and enter S1	-	-	-	-	-	-	-	-
	S1 (Wait for Lockup of electronic lock)	-	Send "Charger Self-check Information" and enter S2	-	Send "Charger Self-check Information" and enter S2	-	-	Enter S4, turn off T2	Enter S4, turn off T2	Enter S4, turn off T2
	S2 (Self-check of Charging System)	-	-	Enter S4, turn off T2	Send "Charger Self-check Information" and enter S2	Send "Charger Self-check Information" and enter S3	Send "Charger Self-check Information" and enter S4	Enter S4, turn off T2	Enter S4, turn off T2	Enter S4, turn off T2
	S3 (Self-check of Charging System succeeded, enter the next function module)	-	-	-	-	-	-	-	-	Enter S4, turn off T2
	S4 (Self-check of Charging System failed, send Suspend message, exit the communication)	-	-	-	-	-	-	-	-	-

Note 1: T2 refers to timeout timer of system self-check at the charger side; after receiving "Vehicle Acknowledge Results" message of self-check, turn on T2 with the default value of 5s;
Note 2: T3 refers to the cycle during which the charger sends the self-check information message, turn on T3 after sending the message.
Note 3: .- means the charger does nothing

Table 36 Vehicle State Transition Table

Vehicle		Triggering condition						
		Received "Charger Self-check Information" message with message contents having no failed detection and at least one item being in detection	**Received "Charger Self-check Information" message, all self-check items have been passed the detection**	**Received "Charger Self-check Information" message with at least one self-check detection of message contents failed**	**Received Next Function Module message**	**T2 Enabled**	**Received "Charger Suspension" message**	**An exception on vehicle occurs**
Status	**S1 (In Negotiation)**	Lock up the electronic lock, and send "Vehicle Self-check Information" message	Enter S2, turn off T2	Enter S3, turn off T2	Enter the Next Function Module, turn off T2	Enter S3	Enter S3, turn off T2	Enter S3, turn off T2
	S2 (Self-check is completed, enter the Next Function Module)	-	-	-	-	-	-	Enter S3, turn off T2
	s3 (Self-check is failed, send bst and exit the communication)	-	-	-	-	-	-	-
Note 1: T2 refers to timeout timer of self-check function module at the vehicle side; after sending "Vehicle Acknowledge Results" after successful self-check, turn on T2 with default value of 5s; Note 2: .- means the vehicle does nothing Note 3: Invalid frame is the messages not listed in all state tables, such as other messages excluding self-check information message or version contents that do not satisfy the interaction principle.								

Table 6 gives the message interaction process of Self-check Function Module of Charging System (FDC=1).

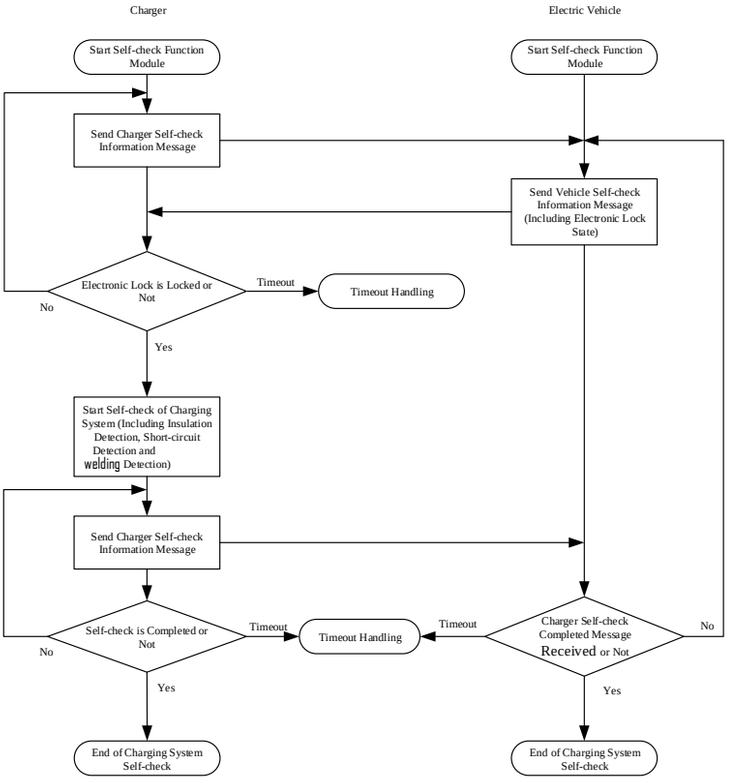

Figure 6 Interaction Process of Charging System Self-check

9.6 Precharge and Energy Transmission

9.6.1 General Description

Precharge and Energy Transmission function module is a required function module, but also override function module.

This part stipulates the default Precharge and Energy Transmission process (FDC corresponding to the function module of precharge and energy transmission is 1) during the process of basic charging. In this process, the charger shall complete the precharge and enter energy transmission phase in accordance with the requirements stipulated in Chapter XX of GB/T18487.1. Specific description of precharge and energy transmission function module is shown in Table 37.

Table **37Overall Description of Function Module of Precharge and Energy Transmission(FDC=1)**

Serial No.	Item	Description Information
1	Phase Name	Precharge and Energy Transmission Phase
2	Target	The charger output should be subject to the charging demands of the vehicle, and both sides can actively suspend the charging.
3	Description	During the process of basic charging, the charger should complete the precharge to enter energy transmission phase in accordance with Chapter XX of GB/T18487.1 after the system self-check is successful; During the process of energy transmission, the charger sends dynamic output capacity and the vehicle can adjust the charging demands accordingly to complete the charging process.
4	Precondition	Self-check of Charging System succeeded
5	Requirements	– During the charging process, if the output capacity of the charger is increased, firstly send new output capacity value, then increase the output current; if the output capacity of the charger is

		decreased, directly reduce the output current (simultaneously sending new output capacity) – During the charging process, the vehicle can adjust the charging demands according to the charging limitation sent by the charger in the parameter configuration function module or to the dynamic output capacity of the charger in this function module. When the vehicle or the charger needs to temporarily stop charging, it can notify the other side through "Suspend Message" message with the suspension time less than 250s.
6	End Condition	— Charging Suspension: The charger or the vehicle suspends or temporarily stop charging.
1	Phase Name	Precharge and Energy Transmission Phase

9.6.2 Message Definition

The function modules of precharge and energy transmission (FDC=1) include the message of "Charger Ready State", "Vehicle Ready State", "Vehicle Charging Demand", "Basic Information of Vehicle Charging" and "Dynamic Output Capacity of Charger", as shown in Table 38. In the whole phase of precharge and energy transmission, send messages with the interval of 250ms periodically, the definitions of parameter group of parameters shall comply with the requirements stipulated in Table 39 to Table 45.

Table 38 Function Module of Precharge and Energy Transmission(FDC=1) message

Message Description	Message Type	Source Address - Destination Address
Charger Ready State	Unreliable Short Messages	Charger - Vehicle
Vehicle Ready State	Unreliable Short Messages	Vehicle - Charger
Vehicle Charging Demands	Unreliable Short Messages	Vehicle - Charger
Basic Information of Vehicle Charging	Unreliable Short Messages	Vehicle - Charger
Charger Dynamic Output Capacity	Unreliable Short Messages	Charger - Vehicle

Table 39 Contents of Charger Ready State

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Charger Ready State	1 byte	BYTE	ReadyType	Charger Ready State, including Not-ready and Ready

Table 40 Contents of Vehicle Ready State

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Vehicle Ready State	1 byte	BYTE	ReadyType	Vehicle Ready State, including Not-ready and Ready

Table 41 Contents of Vehicle Charging Demands

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Voltage	2 bytes	WORD	VoltageType	Complete Vehicle Charging Voltage Demands (V)
3	Current	2 bytes	WORD	CurrentType	Complete Vehicle Charging Current Demands (A)
4	Charging mode	1 byte	BYTE	ChargeModeType	Charging mode desired by the vehicle, including "Constant Current" and "Constant Voltage"

Table 42 Basic Information Contents of Vehicle Charging

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	State of Charge	2 bytes	BYTE	SOCType	Current State of Charge
3	Time (Minute)	2 bytes	BYTE	MTime1Type	Remaining estimate time, minute in unit

Table 43 Charger Dynamic Output Capacity message

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Current	2 bytes	WORD	CurrentType	Current Maximum Output Current of Charger (A)
3	Reasons for Output Capacity Change	1 byte	BYTE	ReasonType	Reasons for Current Output Capacity Change of Charger

9.6.3 Message Interaction Process

For complete state transition process of Function Module of Precharge and Energy Transmission (FDC=1), see Table 46 and Table 47.

Table 46 Charger State Transition Table

Charger		Triggering condition											
		Received "Vehicle Acknowledge Results" message for this module	Received "Vehicle Ready State"			T3 Enabled	Precharge completed	Output Capacity Change	Received "Vehicle Charging Demands" and "Basic Information of Vehicle Charging"	Received "Vehicle Suspension" message	T4 Enabled	Received Invalid Frame	An exception of Charger Occurs
			Vehicle Not Ready	Vehicle Ready	T2 Enabled								
State	S0 (initialization)	Send the non-ready message of "Charger Ready State", enter S1	-	-	-	-	-	-	-	-	-	-	-
	S1 (Wait for vehicle ready)	-	-	Enter S2	Turn off T2, enter S6	Send the non-ready message of "Charger Ready State", enter S1	-	-	-	Send "Suspend Charger Charging" message , enter the Next Function Module, turn off T2 and T3	Turn off T3, enter S6	-	Enter S6
	S2 (Charger Precharge)	-	Enter S1	Enter S2	Turn off T2, enter S6	Send the non-ready message of "Charger Ready State", enter S2	Enter S3	-	-	Send "Suspend Charger Charging" message , enter the Next Function Module, turn off T2 and T3	Turn off T3, enter S6	-	Enter S6
	S3 (Charger Ready)	-	Enter S1	Enter S3	Turn off T2, enter S6	Send the ready message of "Charger Ready State", enter S3	-	Turn off T2, adjust output according to demands, enter S4	-	Send "Suspend Charger Charging" message , enter the Next Function Module, turn off T2 and T3	Turn off T3, enter S6	-	Enter S6
	S4 (Electric Energy Output)	-	-	-	-	-	-	Adjust output according to demands, enter S4	Send "Charger Dynamic Output Capacity", enter S4	Send "Suspend Charger Charging" message , enter the Next Function	Turn off T3, enter S6	-	Enter S6

										Module, turn off T3			
	S5 (Charging Suspension)	-	-	-	-	-	-	Send “Suspend Charger Charging” message	-	Send “Suspend Charger Charging” message , enter the Next Function Module, turn off T3	Turn off T3, enter S6	-	Enter S6
	S6 (Communication is ended, send suspension message)	-	-	-	-	-	-	-	-	-	-	-	-
Note 1: T2 refers to timeout timer of the charger waiting for vehicle ready state; after receiving “Vehicle Acknowledge Results” of precharge and energy transmission, turn on T2 with the default value of 30s; Note 2: T3 refers to the cycle time of the charger sending ready message with the default value of 100ms, turn on T3 again after sending the message; Note 3: T4 refers to timeout timer of receiving vehicle message, after sending the charger ready message, turn on T4 with the default value of 5s; Note 4: .- means the charger does nothing Note 5: Invalid frame is the messages not listed in all state tables, such as other messages excluding precharge and energy transmission or version contents that do not satisfy the interaction principle												

Table 47 Vehicle State Transition Table

Vehicle		**Triggering condition**										
		Received “Charger Ready State”			**Battery Insert Succeeded**	**Received “Charger Dynamic Output Capacity” message**	**Received “Charger Suspension” message**	**T4 Enabled**	**T5 Enabled**	**T3 Enabled**	**Received Invalid Frame**	**Vehicle Exception**
		Charger Not-ready	**Charger Ready**	**T2 Enabled**								
State	**S1 (Vehicle Not-ready)**	Battery involved, send “Vehicle Ready State” as Not-ready, enter S1	Send Vehicle Not-ready of “Vehicle Ready State” , enter S1	Turn off T2, enter S5	Enter S2	-	Send “Suspend Vehicle Charging” message , enter the Next Function Module, turn off T2 and T3	-	-	Turn off T3, enter S5	-	Enter S5
	S2 (Vehicle Ready)	Send Vehicle Ready of “Vehicle Ready State” , enter S2	Send “Vehicle Charging Demands” and “Basic Information of Vehicle Charging”, enter S3, turn off T2	Turn off T2, enter S5	-	-	Send “Suspend Vehicle Charging” message , enter the Next Function Module, turn off T2 and T3	-	-	Turn off T3, enter S5	-	Enter S5
	S3 (In Charging)	-	-	-	-	Adjust charging	Send “Suspend Vehicle Charging”	Adjust chargin	Send “Basic	-	-	Enter S5

						demands according to actual situations, enter S3	message , enter the Next Function Module, turn off T2 and T3	g demands according to actual situations, send “Vehicle Charging Demands”, enter S3	Information of Vehicle Charging ” according to actual situations, enter S3			
	S4 (Charging Suspension)	-	-	-	-	-	Send “Suspend Vehicle Charging” message , enter the Next Function Module, turn off T2 and T3	Send “Suspend Vehicle Charging” message	-	-	-	Enter S5
	S5 (Communication is ended, exit the communication)	-	-	-	-	-	-	-	-	-	-	-

Note 1: T2 refers to timeout timer of the vehicle waiting for charger ready state; after sending “Vehicle Acknowledge Results” of precharge and energy transmission, turn on T2 with the default value of 30s;

Note 2: T3 refers to timeout timer of receiving charger message, after sending the message, turn on T3 with the default value of 5s;

Note 3: T4 refers to the sending cycle of “Vehicle Charging Demands”, turn on T4 after sending the message; T5 refers to the sending cycle of “Basic Information of Vehicle Charging”, turn on T4 after sending the message;

Note 4: .- means the vehicle does nothing

Note 5: Invalid frame is the messages not listed in all state tables, such as other messages excluding precharge and energy transmission or version contents that do not satisfy the interaction principle.

Table 7 gives the message interaction process of Function Module of Precharge and Energy Transmission (FDC=1).

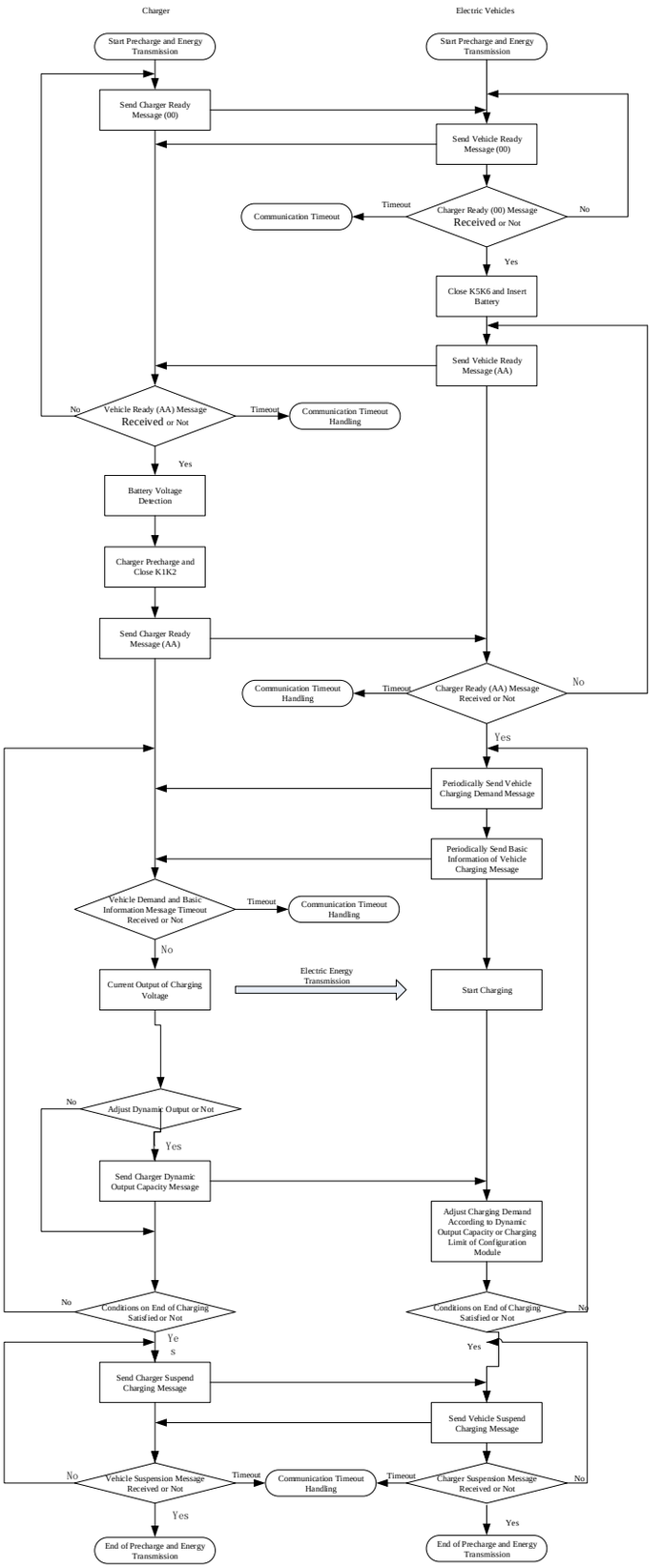

Figure 7 Interaction Process of Precharge and Energy Transmission

9.7 End of Charging

9.7.1 General Description

As the last process of communication interaction, the function module of end of charging is a required function module, but also a override function module.

This part stipulates the optional end of charging process during basic charging process (FDC corresponding to end of charging function module is 1). In this process, the charger completed the energy transmission and implements data interaction of charging statistics. Specific description on end of charging function module is shown in Table 48.

Table 48 Overall Description of Function Module of End of Charging (FDC=1)

Serial No.	Item	Description Information
1	Phase Name	End of charging
2	Target	The vehicle and the charger have completed the charging and clearing process.
3	Description	The vehicle and the charger complete the interaction of statistical data of charging after charging completed.
4	Precondition	End of charging
5	Requirements	/
6	End Condition	/

9.7.2 Message Definition

The function module of end of charging (FDC=1) include “Charger Statistics”, “Vehicle Statistics” message, as shown in Table 49, the definitions of message parameter group shall comply with the requirements stipulated in Table 50 and 51.

Table 49 Function Negotiation Module Message

Message Description	Message Type	Source Address - Destination Address
Charger Statistics message	Long Messages	Charger - Vehicle
Vehicle Statistics message	Long Messages	Vehicle - Charger

Table 50 Vehicle Statistics message

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	State of Charge	2 bytes	BYTE	SOCType	State of Charge upon Vehicle Suspension

Table 51 Charger Statistics message

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Capacity	2 bytes	BYTE	CapacityType	Total Charging Capacity of Charger for this Charging

9.7.3 Message Interaction Process

For complete state transition process of Function Module of End of Charging (FDC=1), see Table 52 and Table 53.

Table 52 Charger State Transition Table

Charger		Triggering condition				
		Received "Vehicle Acknowledge Results" message for this module	**Received "Vehicle Statistics" message**	**T3 Enabled**	**T2 Enabled**	**Received Invalid Frame**
Status	**S0 (initialization)**	Sending "Charger Statistics" message, enter S1	-	-	-	-
	S1 (Wait for Vehicle Statistics message)	-	Enter S2, turn off T3	Sending "Charger Statistics" message, enter S1	Enter S2, turn off T2	-
	S2 (Exit the communication)	-	-	-	Enter S2, turn off T2	-

Note 1: T2 refers to timeout timer of end of charging phase at the charger side; after receiving "Vehicle Acknowledge Results" of this phase, turn on T2 with the default value of 5s;

Note 2: T3 refers to the cycle during which the charger sends the charger statistics message, turn on T3 after sending the message.

Note 3: .- means the charger does nothing

Note 4: Invalid frame is the messages not listed in all state tables, such as other messages excluding statistics message or version contents that do not satisfy the interaction principle.

Table 53 Vehicle State Transition Table

Vehicle		Triggering condition			
		Received "Charger Statistics" message	**T2 Enabled**	**Received "Charger Version" message**	**Received Invalid Frame**
Status	**S1 (Wait for charger Statistics message)**	Sending "Vehicle Statistics" message, enter S1	Enter S3	Initiate a new communication interaction	-
	S2 (Exit the communication)	-	-	-	-

Note 1: T2 refers to timeout timer of end of charging phase at the vehicle side; after sending "Vehicle Acknowledge Results" of this phase, turn on T2 with the default value of 5s;

Note 2: .- means the vehicle does nothing

Note 3: Invalid frame is the messages not listed in all state tables, such as other messages excluding statistics message or version contents that do not satisfy the interaction principle.

Table 8 gives the message interaction process of Function Module of End of Charging (FDC=1).

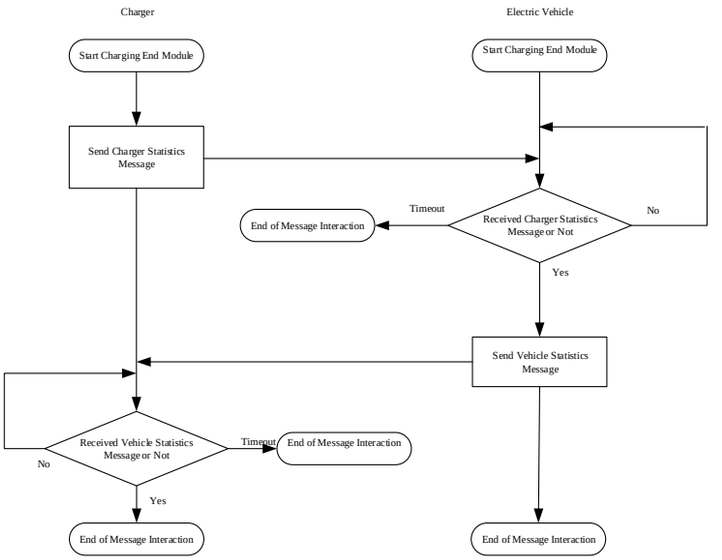

Figure 8 Interaction Process of End of Charging

10 Timeout

10.1 Overview

The message timeout is defined as two kinds: One is the message timeout defined at the bottom level; the other is the function module timeout defined at the application layer.

10.2 Bottom-level Message

For the message marked as “Long Message” in the application layer, the message timeout at the bottom level shall conform to the provisions stipulated in 8.2.3; For “Reliable Short Message”, the message timeout at the bottom level and retransmission time shall meet the requirements in 8.1.3; For “Unreliable Short Message”, circular sending shall be conducted at intervals defined by the application layer.

10.3 Application-layer Function Module Timeout

In order to ensure the synchronization of high-performance communication and state transitions, each function module shall define the function interaction timeout FunctionModule_Timeout (Timeout state transitions are shown in Figure 9). For override function modules, timeout shall be defined separately for each FDC.

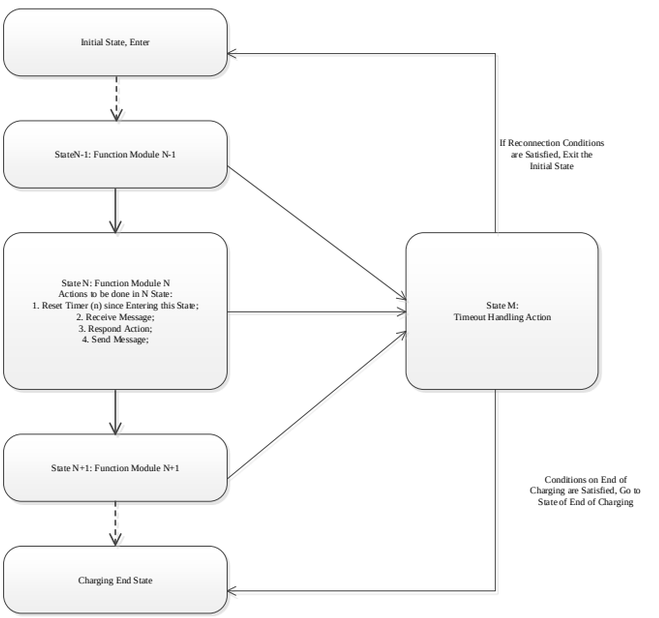

Figure 9 Diagram for Timeout State Transition of Function Module

The timeout definitions on function modules of version negotiation, function negotiation and parameter negotiation are shown in Table 54. The information initiator of function modules can be reloaded (SECC for this part). If there is no special regulation, the starting time for timing is "Vehicle Acknowledge Results" message of phase acknowledge on receiving successful vehicles. If no message is sent/received within FunctionModule_Timeout indicating the success/failure of the current function module negotiation or the end of information interaction, SECC enters timeout processing and exits the communication process; The information responder of the function module can be reloaded (EVCC for this part). If there is no special regulation, the starting time for timing is "Vehicle Acknowledge Results" message of phase acknowledge on sending successfully (that is, the vehicle has received “SM_ACK” acknowledge information). If the function of the current function module is not completed within the time of

FunctionModule_Timeout, EVCC enters timeout processing and exits the communication process.

Table 54 Function Module Timeout

Function Module	Function Description Code	Timeout Time (s)	Starting Point of Timing	
			Charger	Vehicle
Version Negotiation	/	5	S1 closed	S1 closed is detected
Function Negotiation	/	5	Received “Vehicle Version Negotiation Results” message and negotiation succeeded	Sending “Vehicle Version Negotiation Results” message successfully and negotiation succeeded
Parameter Configuration	/	60	Received “Vehicle Function Negotiation Results” message and negotiation succeeded	Sending “Vehicle Function Negotiation Results” message successfully and negotiation succeeded
Self-check of Charging System	FDC=1	20	Received “Vehicle Acknowledge Results” message and phase acknowledge succeeded	Sending “Vehicle Acknowledge Results” message successfully and phase acknowledge succeeded
End of charging	FDC=1	5	Received “Vehicle Acknowledge Results” message and phase acknowledge succeeded	Sending “Vehicle Acknowledge Results” message successfully and phase acknowledge succeeded

Appendix A
(Informative Appendix)
Parameter Type Table

Parameter types stipulated in this part are shown in Table A.1.

Table A.1 Parameter Type Table

Parameter Name	Parameter Type	Definition
Identification Code of Parameter Group	PIDType	See Table A.2
CAN Type	CANType	CAN2.0: 0; CAN FD: 1; CANXL: 2
Protocol Version Number	ProtocolVersionType	Major version number: BYTE1; Minor version number: BYTE2; Temporary version number: BYTE3
Reserved	ReservedType	0xFF in default
Check Code	CheckcodeType	Data Resolution: 1/digit; 0 offset; data range: 0-255;
Negotiation Results	VersionResultType	Continue Negotiation: 0; Negotiation Succeeded: 1; Negotiation Failed: 2
Function Code	FCType	See Table A.3
Function Description Code	FDCType	See Table A.3
Support of Function Description Code	FDCSupportType	BYTE1: Support of 1st FDC; Support: Non-0; Nonsupport: 0 BYTE2: Support of 2nd FDC; Support: Non-0; Nonsupport: 0 BYTE3: Support of 3rd FDC; Support: Non-0; Nonsupport: 0 BYTE4: Support of 4th FDC; Support: Non-0; Nonsupport: 0 BYTE5: Support of 5th FDC; Support: Non-0; Nonsupport: 0 BYTE6: Support of 6th FDC; Support: Non-0; Nonsupport: 0 BYTE7: Support of 7th FDC; Support: Non-0; Nonsupport: 0 BYTE8: Support of 8th FDC; Support: Non-0; Nonsupport: 0 Note: For FDC allocation, see specific description of FDC, fill 0 for undefined byte of FDC (unsupported)
Negotiation Results of Function Description	FDCNegoResultType	Data Resolution: 1/digit; 0 offset; data range: 0-8;
Welding Detection State	CheckType	In detection: 0; Detection Passed: 1; Detection failed: 2
State of electronic lock	LockType	Unlocked: 0; Locked: 1
Charger Ready State	ReadyType	Not-ready: 0; Ready: 1
Voltage	VoltageType	Data Resolution: 0.1V/digit; 0V offset; data range: 0-6553.5V
Current	CurrentType	Data Resolution: 0.1A/digit; 0A offset; data range: 0-6553.5A
State of Charge	SOCType	Data resolution: 0.1%/bit, 0% offset; data range: 0-100%
Capacity	CapacityType	Data Resolution: 0.1 kWh/digit; 0 kWh offset; data range: 0-1000 kWh
Charging mode	ChargeModeType	Constant Current: 1; Constant Voltage: 2
Time (Minute)	MTime1Type	Data resolution: 1 min/bit, 0 min offset; data range: 0-600 min
Time (Minute)	MTime2Type	Data resolution: 1 min/bit, 0 min offset; data range: 0-1440 min
Reasons for Output Capacity Change	ReasonType	Power Grid: 1; Charger: 2; Others: 3
Suspension Type	EndCodeType	See Table A.4
Suspension Reason	EndReasionType	See Table A.4
Phase Request	PhaseType	Function Code: BYTE1, Function Description Code: BYTE2
Phase Acknowledge	PhaseACKType	Acknowledged (consistent phase): 1; Disacknowledged (inconsistent phase): 0
Code Scanning/Card Swiping State of Charger	CAuthenStatusType	Start/Proceed: 0x00; Completed: 0xAA
Code Scanning/Card Swiping State of Vehicle	VAuthenStatusType	Continue Waiting: 0x00; Refuse to Wait: 0xDD
Authentication Results	AuthenResultType	Authentication Succeeded: 0x00; Authentication Failed: 0x01
Vehicle Identification	VINType	VIN is composed of Byte1 to Byte 17 as reference

Number		
Output power of charger	PowerType	Data resolution: 0.1 kW/bit, 0 kW offset; data range: 0-1000 kW.
Percentage of Output Power	PowerProType	Data resolution: 0.1%/bit, 0% offset; data range: 0-100%
Scheduling Acknowledged	ScheACKType	Acknowledge succeeded: 0xAA; Acknowledge failed: 0xFF
Scheduling Negotiation Results	ScheNegotype	Negotiation succeeded: 0xAA; Negotiation failed: 0xFF
Support immediate charging	SupportChargerType	Not support immediate charging: <0x00>; Support immediate charging: 0xAA; Sending after acknowledge of success: 0xFF

Table A.2 Identification Code of Parameter Group

Function Module	Contents of Parameter Group	Type of Parameter Group	Message Code	Parameter Group Identification (PGI)
Function Negotiation	Support Function Code of Charger	Information	B1	0x11
	“Negotiation Acknowledge Results of Vehicle Functions” Message	Information	B2	0x12
Parameter Negotiation	“Charger Charging Parameters” message	Information	C1	0x21
	“Vehicle Charging Parameters” message	Information	C2	0x22
Authentication	“Charger Authentication Parameters” message (FDC=1)	Information	D1	0x31
	“Vehicle Authentication Waiting” message (FDC=1)	Information	D2	0x32
	Authentication Results (FDC=1)	Information	D3	0x33
	“Vehicle Authentication Parameters” message (FDC=2)	Information	D4	0x34
	Authentication Results (FDC=2)	Information	D5	0x35
Scheduling	“Charger DC Scheduling Charging Information” message (FDC=1)	Information	E1	0x41
	“Charger DC Scheduling Charging Acknowledge” message (FDC=1)	Information	E2	0x42
	“Vehicle DC Scheduling Charging Information” message (FDC=1)	Information	E3	0x43
	“Vehicle DC Scheduling Charging Negotiation” message (FDC=1)	Information	E4	0x44
Self-check of Charging System	“Charger Self-check Information” message (FDC=1)	Information	F1	0x51
	“Vehicle Self-check Information” message (FDC=1)	Information	F2	0x52
Precharge and Energy Transmission	“Charger Ready State” message (FDC=1)	Information	H1	0x71
	“Vehicle Ready State” message (FDC=1)	Information	H2	0x72
	“Vehicle Charging Demands” message (FDC=1)	Information	H3	0x73
	“Basic Information of Vehicle Charging” message (FDC=1)	Information	H4	0x74
	“Charger Dynamic Output Capacity” message (FDC=1)	Information	H5	0x75
End of charging	“Charger Statistics” message (FDC=1)	Information	I1	0x81
	“Vehicle Statistics” message (FDC=1)	Information	I2	0x82
Phase Acknowledge	Information of Function Code and Function Description Code	Information	X1	0x01
	Vehicle Acknowledge Results	Information	X2	0x02
“Suspension” message	“Charger Suspension” message	Control	X3	0x03
	“Vehicle Suspension” message	Control	X4	0x04

Table A.3 Allocation Table of Function Codes (FC)

Function Module	Function Code (FC)
Function Negotiation	0x10
Parameter Configuration	0x20
Authentication	0x30
Scheduling	0x40

Self-check of Charging System	0x50
Power Supply Mode	0x60
Precharge and Energy Transmission	0x70
End of charging	0x80

Table A.4 Allocation Table of Suspension Message

Object	Suspension Type (Code)	Suspension Reason (Code)
Charger	Suspend Charging (0x01)	Normal Suspension of Charger Charging (0x01)
		Error Suspension of Charger Charging (0x02)
		Fault Suspension of Charger Charging (0x03)
		Active Suspension of Vehicle (0x04)
	Information Interaction Timeout of Function Module (0x02)	Timeout of Function Negotiation (0x01)
		Time out of Parameter Configuration (0x01)
		Authentication Timeout (0x03)
		Scheduling Timeout (0x04)
		Self-check Timeout of Charging System (0x05)
		Timeout of Power Supply Mode (0x06)
		Timeout of Precharge and Energy Transmission (0x07)
		Timeout of End of charging (0x08)
	Function Module Execution Failed (0x03)	Function Negotiation Execution Failed, such as function negotiation failed (0x01)
		Parameters Configuration Failed, such as charging parameters mismatched (0x02)
		Authentication Execution Failed (0x03)
		Scheduling Execution Failed (0x04)
		Self-check of Charging System Failed, such as failure in self-check, insulation detection, short-circuit detection, etc. (0x05)
		Power Supply Mode Execution Failed (0x06)
		Precharge and Energy Transmission Failed, such as precharge failed (0x07)
		End of Charging Execution Failed (0x08)
	Others (0x04)	Customization
Vehicle	Suspend Charging (0x01)	Normal Suspension of Vehicle Charging (0x01)
		Error Suspension of Vehicle Charging (0x02)
		Fault Suspension of Vehicle Charging (0x03)
		Active Suspension of Charger (0x04)
	Information Interaction Timeout of Function Module (0x02)	Timeout of Function Negotiation (0x01)
		Time out of Parameter Configuration (0x01)
		Authentication Timeout (0x03)
		Scheduling Timeout (0x04)
		Self-check Timeout of Charging System (0x05)
		Timeout of Power Supply Mode (0x06)
		Timeout of Precharge and Energy Transmission (0x07)
		Timeout of End of charging (0x08)
	Function Module Execution Failed (0x03)	Function Negotiation Execution Failed, such as function negotiation failed (0x01)
		Parameters Configuration Failed, such as charging parameters mismatched (0x02)
		Authentication Execution Failed (0x03)
		Scheduling Execution Failed (0x04)
		Self-check of Charging System Failed, such as lockup of electronic lock failed (0x05）
		Power Supply Mode Execution Failed (0x06)
		Precharge and Energy Transmission Failed, such as precharge failed (0x07)
		End of Charging Execution Failed (0x08)
	Others (0x04)	Customization

Appendix B
(Informative Appendix)
Phase Acknowledge Message

Before entering FDC information interaction of override function module (that is, after the information interaction of function module of parameter configuration is completed), the charger and the vehicle should first confirm the consistency of the current FC and FDC. The charger sends the current FC and FDC, after confirming the consistency of the vehicle, the charger will realize FDC of each function module.

The phase acknowledge process is the basis for information interaction and synchronization between the charger and the vehicle, and the message definitions and information interaction process are fixed and unchanged. The format and contents of message data of phase acknowledge process are shown in Table B1., Table B.2 and Table B.3.

Table B.1 Phase Acknowledge Message

Message Description	Information Type	Source Address - Destination Address
Information of Function Code and Function Description Code	Reliable Short Messages	Charger - Vehicle
Vehicle Acknowledge Results	Reliable Short Messages	Vehicle - Charger

Table B.2 Information of Function Code and Function Description Code message

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Phase Information	2 bytes	WORD	PhaseType	FC and FDC about to enter function module

Table B.3 Vehicle Acknowledge Results message

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Phase Acknowledge	1 byte	BYTE	PhaseACKType	Vehicle Acknowledge Information

The complete state transition of phase acknowledge is shown in Table B.1 and Table B.2.

Table B.1 Charger State Transition Table

Charger		Triggering condition				
		initialization	Received “Vehicle Acknowledge Results”		T2 Enabled	Received Invalid Frame
			Vehicle Acknowledge Succeeded	Vehicle Acknowledge Failed		
Status	S0 (initialization)	Sending “Current Function Module and Function Description Code”, enter S1	-	-	-	-
	S1 (Wait for acknowledge)	-	Enter S2, turn off T2	Enter S3, turn off T2	Enter S3, turn off T2	-

	S2 (Acknowledge succeeded, enter current function module)	-	-	-	-	-
	S3 (Exit the communication)	-	-	-	-	-

Note:
a. T2 refers to timeout timer of acknowledge phase at the charger side, after sending “Current Function Module and Function Description Code” of this phase, turn on T2 with the default value of 5s;
b. -: means the charger does nothing
c. Invalid frame is the messages not listed in all state tables, such as other messages excluding phase acknowledge message or version contents that do not satisfy the interaction principle.

Table B.2 Vehicle State Transition Table

Vehicle		**Triggering condition**				
		Received “Charger Function Acknowledge” message			**T2 Enabled**	**Received Invalid Frame**
		Do not support FC or FDC sent by the charger	**FC or FDC Inconsistent**	**FDC and FC Consistent**		
Status	**S1 (Wait for acknowledge)**	Sending “Vehicle Acknowledge Results”, acknowledge failed, enter S3	Relocate FC or FDC, if succeeded, send successful acknowledge of “Vehicle Acknowledge Results” and enter S2; or else, send failed acknowledge of “Vehicle Acknowledge Results” and enter S3	Sending “Vehicle Acknowledge Results”, acknowledge succeeded , enter S2	Enter S3, turn off T2	-
	S2 (Acknowledge succeeded, enter current function module)	-	-	-	-	-
	S3 (Exit the communication)	-	-	-	-	-

Note 1: T2 refers to timeout timer of phase acknowledge at the vehicle side; after sending the message of last phase, turn on T2 with the default value of 5s;
Note 2: .- means the vehicle does nothing
Note 3: Invalid frame is the messages not listed in all state tables, such as other messages excluding phase acknowledge message or version contents that do not satisfy the interaction principle.

Appendix C
(Informative Appendix)
Suspended Message

In the process of FDC execution, there may be execution failure (such as unsuccessful negotiation, parameters mismatch, etc.), and it is necessary to exit the entire communication or current function modules, the suspended message stipulated in this appendix provides a unified interface to exit communication or function module, with its message definitions and information interaction process remaining unchanged. The formate and contents of the message and data of phase acknowledge process are shown in Table C.1, Table C.2 and Table C.3.

Table C.1 Phase Acknowledge Message

Message Description	Information Type	Source Address - Destination Address
“Charger Suspension” message	Reliable Short Messages	Charger - Vehicle
“Vehicle Suspension” message	Reliable Short Messages	Vehicle - Charger

Table C.2 “Charger Suspension” message

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Charger Suspension Type	1 byte	BYTE	EndCodeType	See Table A.4
3	Charger Suspension Reason	1 byte	BYTE	EndReasionType	See Table A.4

Table C.3 “Vehicle Suspension” message

Serial No.	Parameter Contents	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Vehicle Suspension Type	1 byte	BYTE	EndCodeType	See Table A.4
3	Vehicle Suspension Reason	1 byte	BYTE	EndReasionType	See Table A.4

Appendix D
(Informative Appendix)
Realization of Charging Application Scenario

The information interaction in the charging process is composed of several function modules in sequence. By reloading different instances of override function modules, different charging functions and scenarios can be realized.

Figure D.1 defines the information interaction process of a typical basic charging application scenario, in which the shaded part is the module with which basic charging is realized.

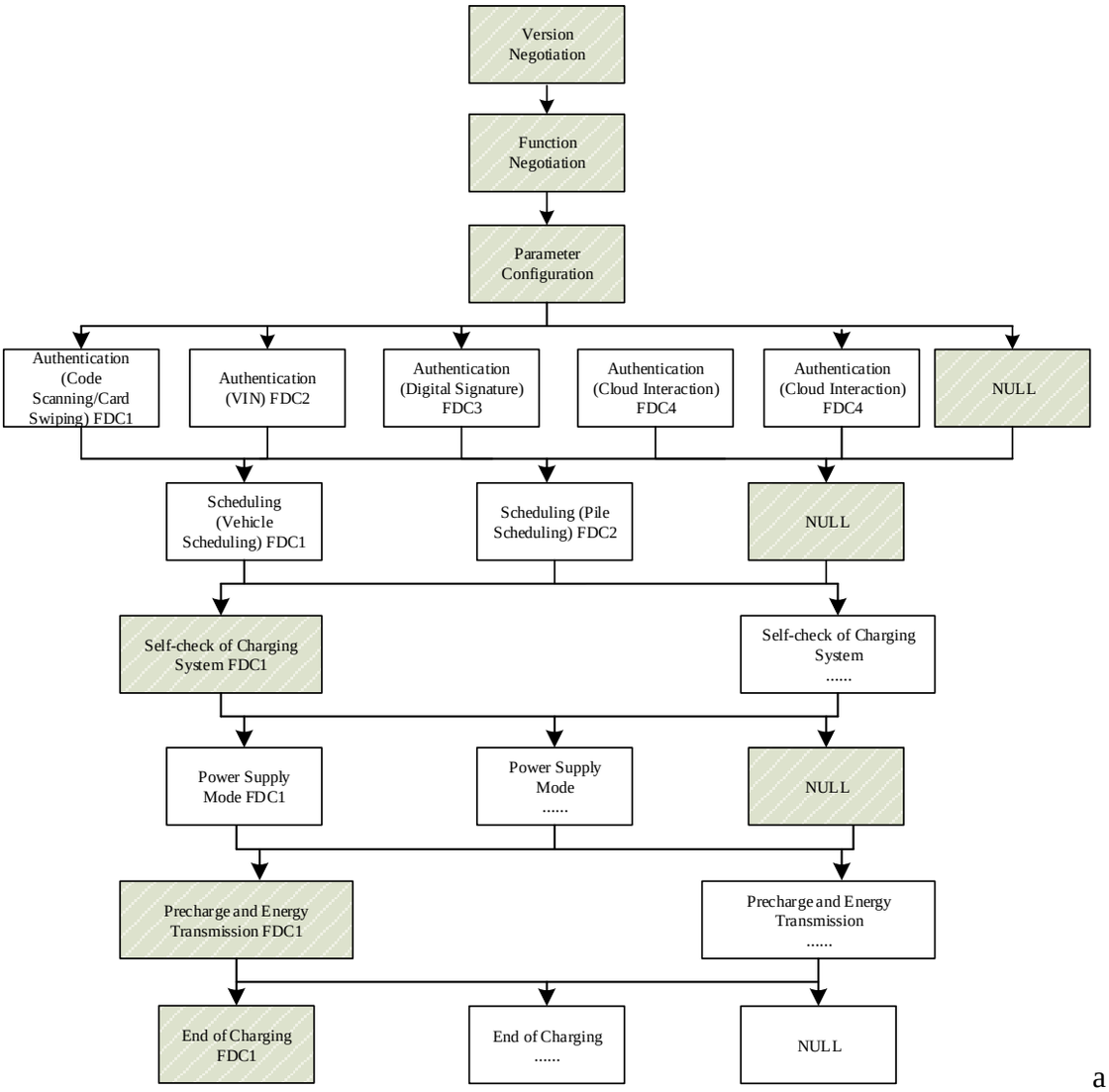

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Figure D.1 Realization of Charging Application Scenario

Appendix E
(Informative Appendix)
Authentication Function Module

E.1 Brief introduction

The authentication function module (FC=0x30) is an optional function module, but also a override function module. The Appendix stipulates the interaction process of authentication function module, in which the charger shall be able to complete the identity authentication between vehicle piles.

E.2 Code Scanning/Card Swiping (FDC=1)

E.2.1 General Description

Specific description for code scanning/card swiping (FDC=1) authentication function module is shown in Table E.1.

Table E.1 Overall Description of Authentication Function Module (FDC=1)

Serial No.	Item	Description Information
1	Phase Name	Authentication Phase
2	Target	The charger has completed the identity authentication between piles.
3	Description	In the basic charging process, after the successful parameter configuration, if identity authentication between piles is successful, start the charger; or else, end this communication process.
4	Precondition	Parameter Configuration Succeeded
5	Requirements	The vehicle should wait for the results of code scanning/card swiping within the time required by the charging pile.
6	End Condition	Authentication succeeded: The equipment/vehicle sends Authentication Results message (authentication succeeded) to the vehicle/equipment, enter follow-up phase; Authentication failed: The equipment/vehicle sends Authentication Results message (authentication failed) to the vehicle/equipment, end this communication; Exit for Timeout: If both sides fail to complete authentication within the specified time, the vehicle or charger will send “Suspend Charging” message, and exit the communication process.

E.2.2 Message Classification

Code scanning/card swiping shall include “Charger Authentication Parameters” message, “Vehicle Authentication Waiting” message and “Authentication Results” message, as shown in Table E.2. The definitions of message parameter group shall comply with the requirements stipulated in Table E.3, Table E.4 and Table E.5.

Table E.2 Code Scanning/Card Swiping message

Message Description	Message Type	Source Address - Destination Address
“Charger Authentication Parameters” message	Unreliable Short Messages	Charger - Vehicle
“Vehicle Authentication Waiting” message	Unreliable Short Messages	Vehicle - Charger
Authentication Results	Reliable Short Messages	Charger - Vehicle

Table E.3 Format of “Charger Authentication Parameters” message

Serial No.	Parameter Definition	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2

Serial No.	Parameter Definition	Length	Data Type	Parameter Type	Description and Requirements
2	Code Scanning/Card Swiping State of Charger	1 byte	BYTE	CAuthenStatusType	Current Code Scanning/Card Swiping State of Charger
3	Time (Minute)	1 byte	BYTE	MTime1Type	Authentication Waiting Time

Table E.4 Formate of "Vehicle Authentication Waiting" message

Serial No.	Parameter Definition	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Code Scanning/Card Swiping State of Vehicle	1 byte	BYTE	VAuthenStatusType	Current Code Scanning/Card Swiping State of Vehicle

Table E.5 Formate of "Authentication Results" message

Serial No.	Parameter Definition	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Authentication Results	1 byte	BYTE	AuthenResultType	Identity Authentication Results

E.2.3 Message Interaction Process

For complete state transition process of Code Scanning/Card Swiping (FDC=1), see Table E.6 and Table E.7.

Table E.6 Charger State Transition Table

Charger		Triggering condition						
		Received "Vehicle Acknowledge Results" message for this module	Received "Vehicle Authentication Waiting" message		Authentication completed	T3 Enabled	T2 Timer Enabled	Received "Vehicle Suspension" message
			Continue Waiting	Refuse to wait				
State	S0 (initialization)	Sending "Charger Authentication Parameters" message (0x00=Start/Continue), enter S1	-	-	-	-	-	-
	S1 (Wait for Code Scanning/Card Swiping)	-	Sending "Charger Authentication Parameters" message (0x00=Start/Continue), enter S2	Enter S4, turn off T2	Sending "Charger Authentication Parameters" message (0xAA=Complete), enter S2	Enter S3, turn off T2	Enter S3, turn off T2	Enter S3, turn off T2

	S2 (Complete Authentication, enter the next function module)	-	-	-	Sending “Authentication Results”, if the authentication is successful, enter the next function module; or else, enter S3	-	-	Enter S3, turn off T2
	S3 (Authentication Failed, send suspend charging, exit the communication)	-	-	-	-	-	-	-
Note 1: T2 refers the authentication timeout timer at the charger side, after receiving “Vehicle Authentication Waiting” message, turn on T2; Note 2: T3 refers to the cycle during which the charger sends the charger authentication parameter message, turn on T3 after sending the message. Note 3: .- means the charger does nothing								

Table E.7 Vehicle State Transition Table

Vehicle		Triggering condition					
		Received "Charger Authentication Parameters" message (0x00=Start/Continue)	**Wait for Code Scanning/Card Swiping**	**Received "Authentication Results" message**	**T3 Enabled**	**T2 Enabled**	**Received "Charger Suspension" message**
Status	**S1 (In Negotiation)**	If waiting is consented, send "Vehicle Authentication Waiting" message (0x00=Continue Waiting); if waiting is refused, send "Vehicle Authentication Waiting" message (0xDD=Refuse to Wait), enter S3	-	-	-	Enter S3	Enter S3, turn off T2
	S1 (Wait for Code Scanning/Card Swiping)	-	Sending "Vehicle Authentication Waiting" message (0x00=Continue Waiting)	-	Enter S3	Enter S3	Enter S3, turn off T2
	S3 (send bst and exit the communication)	-	-	-	-	-	-
Note 1: T2 refers the authentication timeout timer at the charger side, after receiving "Vehicle Authentication Waiting" message, turn on T2; Note 2: T3 refers to the cycle during which the vehicle sends the vehicle authentication waiting message, turn on T3 after sending the message; Note 31: .- means the vehicle does nothing.							

Table E.1 gives the message interaction process of Function Module of Code Scanning/Card Swiping (FDC=1).

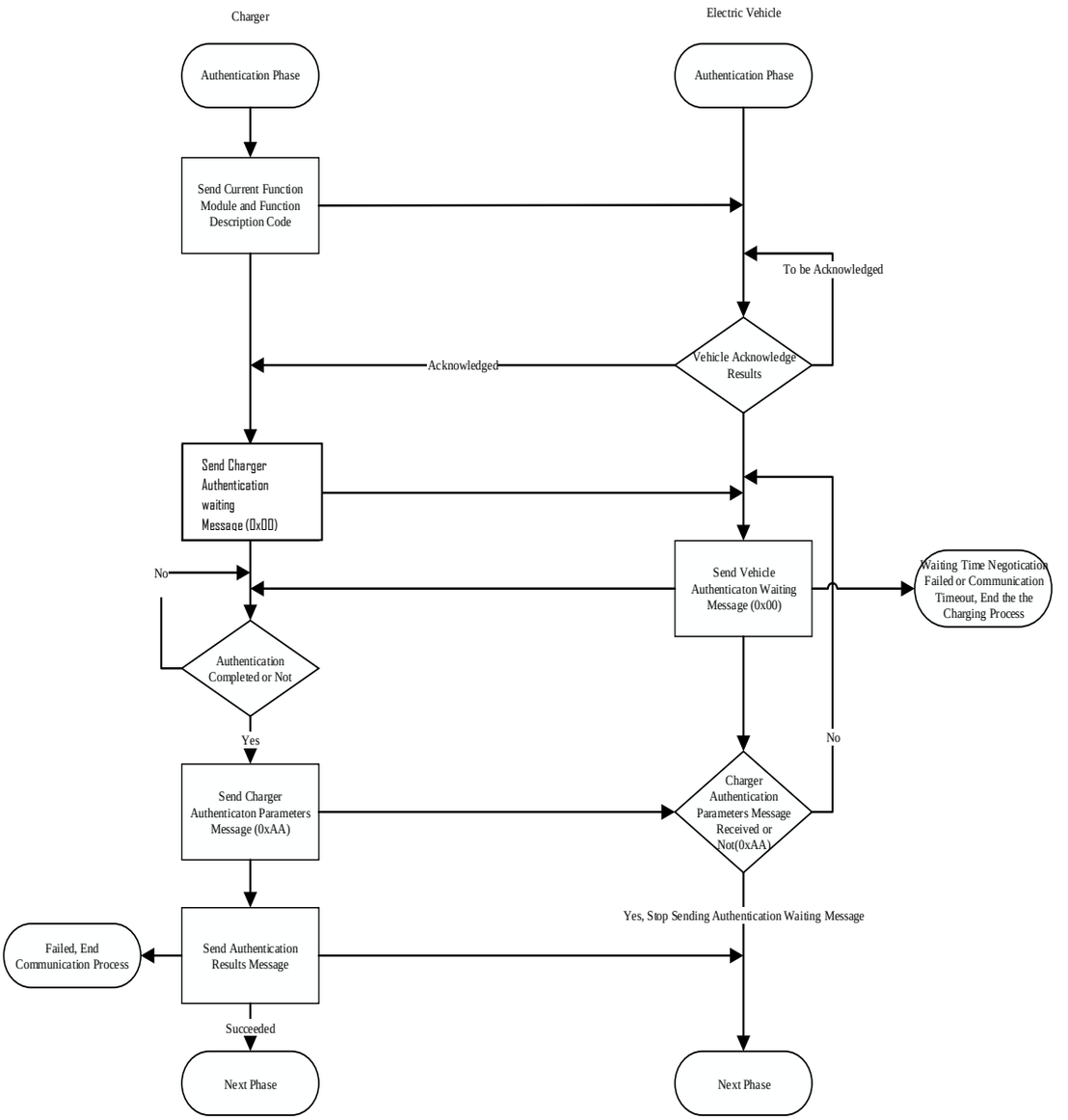

Figure E.1 Interaction Process of Code Scanning/Card Swiping

E.3 VIN Authentication (FDC=2)

E.3.1 General Description

Specific description for VIN Authentication (FDC=2) function module is shown in Table E.8.

Table E.8 Overall Description of Authentication Function Module (FC=0x30)

Serial No.	Item	Description Information
1	Phase Name	Authentication Phase
2	Target	The charger has completed the identity authentication between charger and vehicle.
3	Description	In the basic charging process, after the successful parameter configuration, if identity authentication between charger and vehicle is successful, start the charger; or else, end this communication process.
4	Precondition	Parameter Configuration Succeeded.
5	Requirements	The vehicle sends VIN code to the charger.
6	End Condition	Authentication succeeded: The equipment/vehicle sends Authentication Results message

		(authentication succeeded) to the vehicle/equipment, enter follow-up phase; Authentication failed: The equipment/vehicle sends Authentication Results message (authentication failed) to the vehicle/equipment, end this communication; Exit for Timeout: If both sides fail to complete authentication within the specified time, the vehicle or charger will send “Suspend Charging” message, and exit the communication process.

E.3.2 Message Classification

VIN authentication shall include “Vehicle Authentication Parameters” message, “Authentication Results” message, as shown in Table E.9. The definitions of message parameter group shall comply with the requirements stipulated in Table E.10 and Table E.11.

Table E.9 VIN Authentication message

Message Description	Message Type	Source Address - Destination Address
“Vehicle Authentication Parameters” message	Long Messages	Vehicle - Charger
Authentication Results	Reliable Short Messages	Charger - Vehicle

Table E.10 Formate of “Vehicle Authentication Parameters” message

Serial No.	Parameter Definition	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See A.2
2	Vehicle Identification Number(VIN)	17 byte	BYTE [17]	VINType	

Table E.11 Formate of “Authentication Results” message

Serial No.	Parameter Definition	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See A.2
2	Authentication Results	1 byte	BYTE	AuthenResultType	Identity Authentication Results

E.3.3 Message Interaction Process

For complete state transition process of VIN Authentication Function Module (FDC=2), see Table E.12 and Table E.13.

Table E.12 Charger State Transition Table

Charger		Triggering condition				
		Received “Vehicle Acknowledge Results” message for this module	Received “Vehicle Authentication Parameters” message	Authentication completed	T2 Timer Enabled	Received “Vehicle Suspension” message
State	S0 (initialization)	-	-	-	-	-
	S2 (Complete Authentication, enter the next function module)	-	-	Sending “Authentication Results”, if the authentication is successful, enter the next function module; or else, enter S3	Enter S3, turn off T2	Enter S3, turn off T2
	S3 (Authentication Failed, send suspend charging,	-		-	-	-

	exit the communication)					
Note 1: T2 refers the authentication timeout timer at the charger side, after receiving “Vehicle Authentication Parameters” message, turn on T2 with the default value of 5s; Note 2: .- means the charger does nothing						

Table E.13 Vehicle State Transition Table

Vehicle		**Triggering condition**					
		Sending “Vehicle Authentication Parameters” message	**Received “Authentication Results” message, authentication succeeded**	**Received “Authentication Results” message, authentication failed**	**Received Next Function Module message**	**T2 Enabled**	**Received “Charger Suspension” message**
Status	**S1 (In Negotiation)**	-	Enter S2, turn off T2	Enter S3, turn off T2	Enter the Next Function Module, turn off T2	Enter S3	Enter S3, turn off T2
	S2 (Authentication is completed, enter the Next Function Module)	-	-	-	-	-	-
	S3 (Authentication Failed, send bst, exit the communication)	-	-	-	-	-	-
Note 1: T2 refers to timeout timer of self-check function module at the vehicle side; after sending “Vehicle Acknowledge Parameter” message, turn on T2 with default value of 5s; Note 1: .- means the vehicle does nothing							

Table E.2 gives the message interaction process of VIN Authentication Function Module (FDC=2).

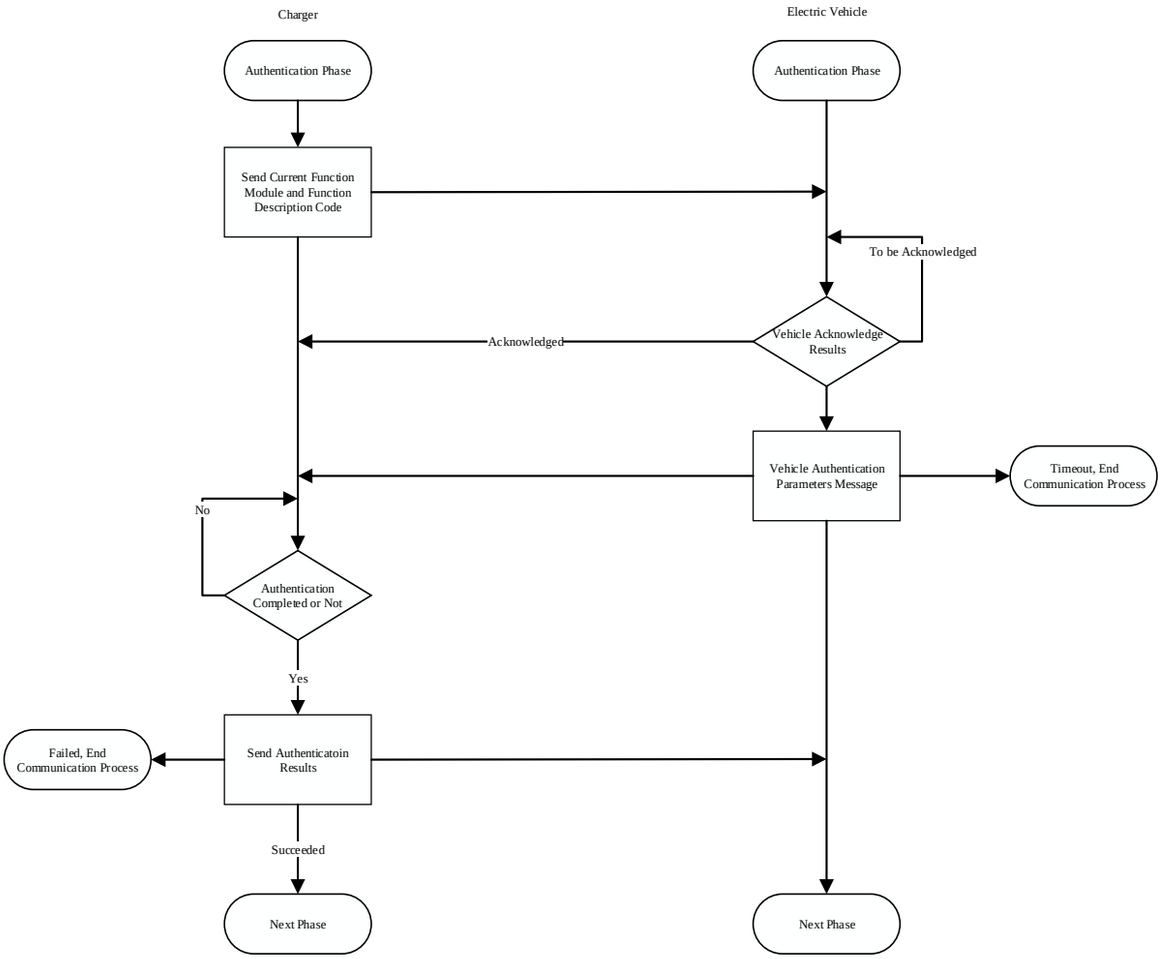

Figure E.2 Interaction Process of VIN Authentication

Appendix F
(Informative Appendix)
Scheduling Function Module

F.1 Brief introduction

The function module of DC Scheduling Charging (FC=0x40) is an optional function module. The Appendix stipulates the interaction process of DC scheduling charging function module, in which the charger and the vehicle shall be able to complete DC scheduling charging function.

F.2 Vehicle-defined Scheduling Start Time (FDC=1)

F.2.1 General Description

Specific description for DC scheduling charging function module of vehicle-defined scheduling start time (FDC=1) is shown in Table F.1.

Table F.1 Overall Description of DC Scheduling Charging Function Module (FDC=1)

Serial No.	Item	Description Information
1	Phase Name	DC Scheduling Charging
2	Target	The charger and the vehicle should complete DC Scheduling Charging
3	Description	The charger sends its output power and the percentage of the available output power for 24 consecutive hours in the maximum output power. The vehicle sends its desired starting time of charging and desired departure time. The charger is required to perform DC scheduling charging accordingly.
4	Precondition	Charging parameter configuration succeeded and authentication (if any) succeeded
5	Requirements	After the charging parameter configuration and authentication (if any) is successful, the charger and the vehicle should conduct message communication of DC scheduling charging function and carry out corresponding operations, with its process including: – The charger sends its output power and the percentage of the available output power for 24 consecutive hours in the maximum output power; – The vehicle sends its desired starting time of charging and desired departure time; – The charger performs acknowledgement for DC scheduling charging; – The vehicle conducts DC scheduling charging negotiation; – If negotiation is successful, the vehicle completes and ends this function module; the charger cuts off S1 and wait for the scheduling start time; when the start time is arrived, close S1, the charger completes and ends this function module; – If negotiation is failed but it supports immediate charging, the vehicle and the charger complete and end this function module (enter the next module); – If negotiation is failed but it does not support immediate charging, the vehicle and the charger send “Suspend Charging” message, and exit this charging process;
6	End Condition	DC Scheduling Charging Succeeded: If vehicle negotiation is successful, the vehicle completes and ends this function module; the charger cuts off S1 and wait for the scheduling start time; when the start time is arrived, close S1, the charger completes and ends this function module; DC Scheduling Charging Failed: – If vehicle negotiation is failed but it supports immediate charging, the vehicle and the charger complete and end this function module (enter the next module); – If vehicle negotiation is failed but it does not support immediate charging, the vehicle and the charger send “Suspend Charging” message, and exit this charging process; – In the DC scheduling charging function module, if the vehicle or the charger is abnormal or any failure occurs, the vehicle or the charger will send “Suspend Charging” message and exit this charging process; DC Scheduling Charging Timeout: If the charger or the vehicle fails to complete DC scheduling charging acknowledge or DC scheduling charging negotiation, the charger and the vehicle will send “Suspend Charging” message and exit this charging process.

F.2.2 Message Classification

Vehicle-defined Scheduling Start Time (FDC=1) includes “Charger DC Scheduling Charging Information” message, “Charger DC Scheduling Charging Acknowledge” message, “Vehicle DC Scheduling Charging Information” message and “Vehicle DC Scheduling Charging Negotiation” message, as shown in Table F.2. The definitions of message parameter group shall comply with the requirements stipulated in Table F.3, Table F.4, Table F.5 and Table F.6.

Table F.2 Vehicle-defined Scheduling Start Time message

Message Description	Message Type	Source Address - Destination Address
“Charger DC Scheduling Charging Information” message	Long Messages	Charger - Vehicle
“Charger DC Scheduling Charging Acknowledge” message	Reliable Short Messages	Charger - Vehicle
“Vehicle DC Scheduling Charging Information” message	Reliable Short Messages	Vehicle - Charger
“Vehicle DC Scheduling Charging Negotiation” message	Reliable Short Messages	Vehicle - Charger

Table F.3 “Charger DC Scheduling Charging Information” message

Serial No.	Parameter Definition	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Output power of charger	2 bytes	BYTE [2]	PowerType	The charger gives its maximum output power with data resolution of 0.1kW/bit (Unit: kW)
3	Percentage of Charger Output Power	48 byte	BYTE	PowerProType	Starting from the hour time of the current message interaction, give the percentage of the available output power for the following 24 consecutive hours in the maximum output power for every 30 minutes, with a total of 48 time periods (Unit: %). For example: If the interaction time is 18:12, send the power percentage at 18:00, 18:30, 19:00. … to 17:30 with total 48 periods

Table F.4 “Charger DC Scheduling Charging Acknowledge” message

Serial No.	Parameter Definition	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Charger DC Scheduling Charging Acknowledge	1 byte	BYTE	ScheACKType	Charger DC Scheduling Charging Acknowledge
3	Support immediate charging	1 byte	BYTE	SupportChargerType	<0x00>: Not support immediate charging; <0xAA>: Support immediate charging; <0xFF>: Sending after acknowledge of success

Table F.5 “Vehicle DC Scheduling Charging Information” message

Serial No.	Parameter Definition	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Time (Minute)	2 bytes	BYTE	MTime2Type	Vehicle-desired charging start time, that is how long it is expected to start charging, with data range of 0-1440 (Unit: minutes).

Serial No.	Parameter Definition	Length	Data Type	Parameter Type	Description and Requirements
3	Time (Minute)	2 bytes	BYTE	MTime2Type	Optional, Vehicle-desired departure time, that is how long it is expected to departure, with data range of 0-1440 (Unit: minutes). (Note: The charger can use the desired departure time of the vehicle to generate the optimal charging plan)

Table F.6 "Vehicle DC Scheduling Charging Negotiation" message

Serial No.	Parameter Definition	Length	Data Type	Parameter Type	Description and Requirements
1	Identification of Parameter Group	1 byte	BYTE	PIDType	See Table A.2
2	Scheduling Negotiation Results	1 byte	BYTE	ScheNegotype	Charger DC Scheduling Charging Negotiation Results
3	Enter immediate charging	1 byte	BYTE	SupportChargerType	<0x00>: Not conduct immediate charging; <0xAA>: Conduct immediate charging; <0xFF>: Sending after acknowledge of success

F.2.3 Message Interaction Process

The complete state transition process of vehicle-defined scheduling start time (FDC=1) is shown in Table F.7 and Table F.8.

Table F.7 Charger State Transition Table

Charger		Triggering condition										
		Received "Vehicle Acknowledge Results" message for this module	Received "Vehicle DC Scheduling Charging Information, Desired Charging Time and Departure Time"			Received "Vehicle DC Scheduling Charging Negotiation Results"			Received "Suspend Vehicle Charging Information "	T1a Timer Enabled	=T2 Timer (DC Scheduling Time) Enabled	The charger determines that it needs to send a suspend message
			Desired Charging Time and Departure Time are satisfied for the charger	Desired Charging Time and Departure Time are dissatisfied for the charger, immediate charging is supported	Desired Charging Time and Departure Time are dissatisfied for the charger, immediate charging is not supported	Vehicle DC Scheduling Charging Negotiation Results, succeeded	Vehicle DC Scheduling Charging Negotiation Results, failed, continue immediate charging	Vehicle DC Scheduling Charging Negotiation Results, failed, stop immediate charging				
Status	S0 (initialization)	Sending "Charger DC Scheduling Charging Information, Maximum Output Power and Percentage", enter S1	-	-	-	-	-	-	Enter S4, turn off T1	Enter S4, turn off T1	-	Enter S4, turn off T1
	S1 (Wait for Vehicle DC Scheduling Charging Information)	-	Sending "Charger DC Scheduling Charging Acknowledge, Succeeded", enter S2	Sending "Charger DC Scheduling Charging Acknowledge, Failed, Support Immediate Charging", enter S2	Sending "Charger DC Scheduling Charging Acknowledge, Failed, Do not support Immediate Charging", enter S2	-	-	-	Enter S4, turn off T1	Enter S4, turn off T1	-	Enter S4, turn off T1
	S2 (Wait for Vehicle DC Scheduling Charging Negotiation Results)	-	-	-	-	Disconnect S1, enter S3, turn off T1, turn on T2 timer	Turn off T1, enter the next module	Enter S4, turn off T1	Enter S4, turn off T1	Enter S4, turn off T1	-	Enter S4, turn off T1
	S3 (DC Scheduling Charging Negotiation succeeded, wait for scheduling charging time)	-	-	-	-	-	-	-	Enter S4, close S1 and turn off T2	-	Close S1,turn off T2 and enter the next module	Enter S4, close S1 and turn off T2
	S4 (Send "Suspend Charging", end the communication)	-	-	-	-	-	-	-	-	-	-	-

Note 1: T1 refers to the timeout timer of DC Scheduling Charging at the charger side, after entering S0 state, turn on T1 with default value of 10s;
Note 2: T2 refers to the countdown timer of charger DC scheduling charging, after negotiation is successful and S1 is disconnected, turn on T2;
Note 3: .- means the charger does nothing.

Table F.8 Vehicle State Transition Table

Vehicle		Triggering condition								
		Received "Charger DC Scheduling Charging Information"	Received "Charger DC Scheduling Charging Acknowledge Results"			Received "Charger Suspend Charging Information"	Detected Charger Disconnected S1	T1a Timer Enabled	Detected Charger Closed S1	The vehicle determines it needs to send "Suspend Charging" message at present
			Charger DC Scheduling Charging Acknowledge Results, succeeded	Charger DC Scheduling Charging Acknowledge Results, failed; both the charger and the vehicle support Immediate Charging after negotiation failed	Vehicle DC Scheduling Charging Acknowledge Results, failed; at least one of the charger and the vehicle doesn't support Immediate Charging after negotiation failed					
Status	S1 (Generate Vehicle DC Scheduling Charging Information)	Calculate the scheduling charging time, send vehicle DC scheduling charging time to the charger, including desired charging time and departure time, and enter S2	-	-	-	Enter S5, turn off T1	-	Enter S5, turn off T1	-	Enter S5, turn off T1
	S2 (Wait for Charger DC Scheduling Charging Acknowledge Information)	-	Send Vehicle DC Scheduling Charging Negotiation Results, succeeded, enter S3	Send Vehicle DC Scheduling Charging Negotiation Results, failed, continue immediate charging, enter the next module, turn off T1	Send Vehicle DC Scheduling Charging Negotiation Results, failed, not continue immediate charging, enter S5, turn off T1	Enter S5, turn off T1	-	Enter S5, turn off T1	-	Enter S5, turn off T1
	S3 (DC Scheduling Charging Negotiation succeeded, wait for scheduling charging timer of charging pile)	-	-	-	-	Enter S5, turn off T1	Enter S4, turn off T1	Enter S5, turn off T1	-	Enter S5, turn off T1
	S4 (DC Scheduling Charging Timer Started, wait for scheduling charging time)	-	-	-	-	-	-	-	Enter the next module	Enter S5
	S5 (Send "Suspend Charging", end the communication)	-	-	-	-	-	-	-	-	-

Note 1: T1 refers to the timeout timer of DC Scheduling Charging at the vehicle side, after entering S1 state, turn on T1 with default value of 10s;
Note 2: .- means the charger does nothing.

Figure F.1 gives the message interaction process of Function Module of Vehicle-defined Scheduling Start Time (FDC=1).

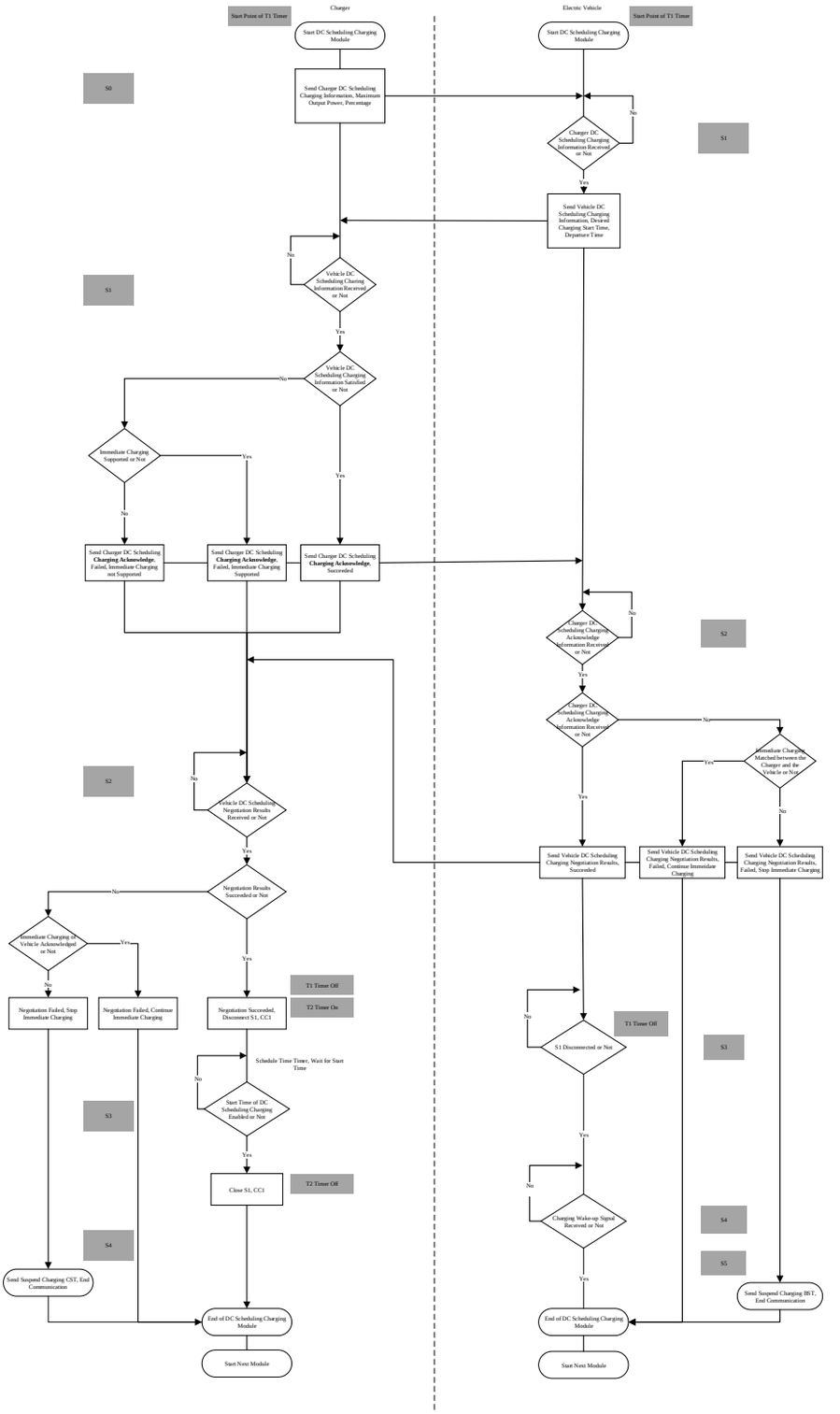

Figure F.1 Interaction Process of Function Module of Vehicle-defined Scheduling Start Time