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北京新能源汽车股份有限公司

MCU 诊断规范

—C33DB—Z03

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1. 术语

DTC	故障诊断码
BS	Block size
STmin	Minimum Separation Time
C	有条件的
M	强制性执行
U	用户选用
TBD	待定义
SID	服务标识符
DID	数据标识符
NRC	负响应码
UDS	统一的诊断服务
Server	服务器
Client	客户端
ECU	电控单元

2. 参考文献

NO.	参考文档	题目
[1]	ISO11898-1: 2003	Road vehicles - Controller area network (CAN) Part 1:Data link layer and physical signaling
[2]	ISO11898-2: 2003	Road vehicles - Controller area network (CAN) Part 2: High-speed medium access unit
[3]	ISO11898-5: 2007	Road vehicles - Controller area network (CAN) Part 5: High-speed medium access unit with low-power mode
[4]	ISO15765-2: 2004	Road Vehicle - Diagnostic on CAN Part 2: Networking Layer Services
[5]	ISO15765-3: 2004	Road Vehicle - Diagnostic on CAN Part 3: Application Layer Services
[6]	ISO14229-1: 2006	Road Vehicle - Diagnostic Systems Diagnostic Services Specification
[7]	ISO15031-6: 2005	Road vehicles - Communication between vehicle and external equipment for emission-related diagnostic Part 6: Diagnostic trouble code definitions

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3. 网络拓扑

参考《C33DB-Z03 整车网络拓扑结构》

4. 诊断接口

参考《C33DB-Z03 整车网络拓扑结构》

5. 需求

5.1 诊断协议

5.1.1. 物理层

物理层应满足ISO11898-2要求及北京新能源汽车股份有限公司企业标准《新能源汽车高速CAN 网络节点级电子控制单元（ ECU）技术要求》(Q/BMEV 02.124-2014)要求。

5.1.2. 数据链路层

数据链路层应满足 ISO11898-1 要求。

所有诊断请求和应答帧的数据长度应为 8 字节，否则电控单元将忽略该诊断帧。当诊断响应长度不足 8 字节时，空余的字节应用 0xAA 填充。

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5.1.3. 网络层

网络层应满足 ISO15765-2 要求和下述要求：

5.1.3.1. 寻址方式

可以支持物理寻址和功能寻址。

诊断消息 ID 描述见下表：

控制器名称	简称	物理寻址诊断请求 ID(Hex)	诊断响应 ID(Hex)	功能寻址诊断请求 ID(Hex)	实施网段
驱动电机控制器	MCU	0x7E0	0x7E8	0x7DF	EVBUS

D 列表

5.1.3.2. 网络层时间参数

Parameter	Value	Unit
BS	8	-
STmin	20	ms

Parameter	Timeout	Performance Requirement	Unit
N_As/N_Ar	70	n/a	ms
N_Br	n/a	<70	ms
N_Bs	150	n/a	ms
N_Cs	n/a	<70	ms
N_Cr	150	n/a	ms

Tab 2. 网络层时间参数需求

5.1.4. 应用层时间参数

Parameter	Min	Max	Timeout	Unit
P2server	0	50	n/a	ms
P2client	n/a	n/a	150	ms
P2*server	0	2000	n/a	ms
P2* client	n/a	n/a	5000	ms
P3client_phys2	P2server	n/a	n/a	ms
P3client_func	P2server_max	n/a	n/a	ms

Parameter	Min	Nominal	Timeout	Unit
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S3server	n/a	n/a	5000	ms
S3client	0	2000	4000	ms

Tab 3. 应用层时间参数需求

Diagnostic Services (ISO14229-1)

Services shall be implemented according to ISO14229-1. Additional details are specified in this section.

5.1.5. Supported Diagnostic Services

The overview of ECU supported diagnostic services is described in the following table.

Table 5 Supported diagnostic services of ECU

Diagnostic Services List		Session			Security Access	Addressing	
SID (Hex)	Service Name	Default	Extended	Programming		Physical Address	Function Address
10	DiagnosticSessionControl	√	√	√		√	√
11	EcuReset	√	√	√		√	√
27	SecurityAccess		√	√		√	
28	CommunicationControl		√			√	√
3E	TesterPresent	√	√	√		√	√
85	ControlDTCSetting		√			√	√
22	ReadDataByIdentifier	√	√	√		√	
2E	WriteDataByIdentifier		√	√	√1 √3	√	
2F	InputOutputControlByIdentifier		√		√1	√	
14	ClearDiagnosticInformation	√	√			√	
19	ReadDTCInformation	√	√			√	
31	RoutineControl		√	√	√1 √3	√	
34	RequestDownload			√	√3	√	
36	TransferData			√	√3	√	
37	RequestTransferExit			√	√3	√	

说明：访问权限 √1 表示需要扩展安全级权限，√3 表示需要编程安全级权限。

The services need to support suppressPositiveResponseBit (SPRS) are showed in following

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table.

Tab 4. Services supported SPRS bit

Diagnostic Services List		Support SPRS bit
SID (Hex)	Service Name	
10	DiagnosticSessionControl	√
11	EcuReset	√
27	SecurityAccess	
28	CommunicationControl	√
3E	TesterPresent	√
85	ControlDTCSetting	√
22	ReadDataByIdentifier	
2E	WriteDataByIdentifier	
14	ClearDiagnosticInformation	
19	ReadDTCInformation	
2F	InputOutputContorlByIdentifier	
31	RoutineControl	
34	RequestDownload	
36	TransferData	
37	RequestTransferExit	

The negativeResponseCodes (NRC) used by ECU are defined as follows:

Tab 5. Negative Response Codes

NRC(Hex)	Description
11H	serviceNotSupported
12H	subFunctionNotSupported
13H	incorrectMessageLengthOrInvalidFormat
22H	conditionsNotCorrect
24H	requestSequenceError
36H	exceededNumberOfAttempts
31H	requestOutOfRange
33H	securityAccessDenied
37H	requiredTimeDelayNotExpired
35H	InvalidKey
72H	generalProgrammingFailure
78H	responsePending

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NRC(Hex)	Description
7FH	serviceNotSupportedInActiveSession
92H/93H	VoltageTooHigh / voltageTooLow
7EH	subFunctionNotSupportedInActiveSession

If two or more NRCs are reasonable, the ECU could send the negative response message according to the following priority rules:

- The 7Fh NRC have the highest priority;
- For others, the NRC follows ISO14229 standard.

5.1.6. DiagnosticSessionControl (10H)

This service is used by the client to enable different diagnostic sessions in the server(s). A diagnostic session enables a specific set of diagnostic services in the server(s).

5.1.6.1. Message Format

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	10
#2	Sub-function = [DefaultSession ProgrammingSession ExtendedDiagnosticSession]	M	01 02 03

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	50
#2	Sub-Function=[DefaultSession ProgrammingSession ExtendedDiagnosticSession]	M	01 02 03
	P2server[]=[
#3	byte#1	M	00-FF
#4	byte#2]	M	00-FF
	P2*server[]=[
#5	byte#1	M	00-FF
#6	byte#2]	M	00-FF

Timing P2server value is provided in 1ms resolution.

Timing P2*server value is provided in 10ms resolution.

Negative Response:

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Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	10
#3	NegativeResponseCode	M	NRC

Sub-function Parameter Definition

HEX	Description	Cvt
01	DefaultSession This diagnostic session enables the default diagnostic session in the server(s) and does not support any diagnostic application timeout handling provisions. (e.g. no TesterPresent service is necessary to keep the session active).	M
02	ProgrammingSession This diagnostic session enables all diagnostic services required to supported the memory programming of a server.	M
03	ExtendedDiagnosticSession This diagnostic session can e.g. be used to enable all diagnostic services required to support the adjustment of functions like “Idle Speed, CO Value, etc.” in the server’s memory. It can also be used to enable diagnostic services, which are not specifically tied to the adjustment of functions.	M

Negative Response Codes (NRC)

NRC(Hex)	Description	Cvt
11	The service identifier in the request message is not supported.	M
12	The sub-function parameter in the request message is not supported.	M
13	The length of the message is wrong.	M
22	The ECU current conditions do not allow the change of diagnostic Session.	M

5.1.6.2. Implementation Rules

This service is used by the diagnostic tool to enable different types of diagnostic sessions in a server. In order to execute a diagnostic service the appropriate session has to be started first. There shall be only one diagnostic session active at a time.

Normal/Default Session (01h) shall be enabled automatically by the ECU if no diagnostic session has been requested at power up.

The ECU shall return to Normal/Default Session (01h) after timeout of Extended Diagnostic Session.

The ECU shall be capable of providing all diagnostic functionality defined for the default diagnostic session under normal operating conditions.

The ECU shall first send a DiagnosticSessionControl Positive Response (50h xx) message before the new session becomes active in the ECU.

A DiagnosticSessionControl Positive Response (50h xx) message shall be returned by an ECU if the diagnostic tool requests a session that is already running. If the ECU has already received the

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same request message previously and performed the requested operation, the ECU shall continue to perform the current operation (i.e. it is not a change of the session).

The ECU shall remain in its current diagnostic session if it is not able to switch into the requested diagnostic session.

The TesterPresent (3Eh) service shall be used to keep the non-default diagnostic sessions active by retriggering S3server. Also any other service request shall retrigger S3server.

A functional TesterPresent (3Eh) request without response may be sent at any time, even regardless of any other service in progress.

When receiving or transmitting any diagnostic messages, including 3Eh service, the S3server timer will reset.

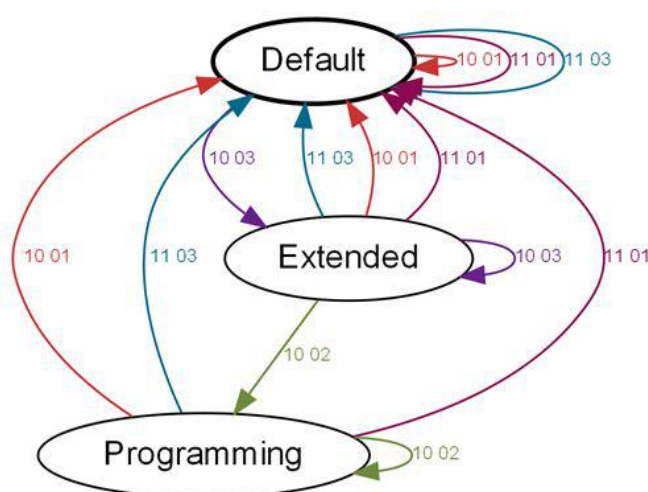


Fig 1. Session transition diagram

5.1.7. ECUReset (11H)

This service requests the server to effectively perform an ECU reset based on the content of the ResetType parameter value (suppressPosRspMsgIndicationBit (bit 7) not shown).

5.1.7.1. Message Format

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	11
#2	Sub-Function= [ResetType: HardReset SoftReset]	M	01 03

Positive Response:

Positive Response:						
Byte	Name				Cvt	Value
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#1	PositiveResponseServiceIdentifier	M	51
#2	Sub-Function=[ResetType: HardReset SoftReset]	M	01 03

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	11
#3	NegativeResponseCode	M	NRC

Sub-function Parameter Definition

Option (Hex)	Description	Cvt
01	HardReset This value identifies a “hard reset” condition which simulates the power-on / start-up sequence typically performed after a server has been previously disconnected from its power supply (i.e. battery).	U
03	SoftReset This value identifies a “soft reset” condition, which causes the server to immediately restart the application program if applicable. The performed action is implementation specific and not defined by the standard. A typical action is to restart the application without reinitializing of previously learned configuration data, adaptive factors and other long-term adjustments.	U

Negative Response Codes (NRC)

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M
12	Sub-function parameter in the request message is not supported.	M
13	The length of the message is wrong	M
22	The criteria for the ECUReset request are not met.	M

5.1.7.2. Implementation Rules

The positive response shall be sent before performing the ECU reset.

The execution of reset will take <TBD> ms, which means the ECU can't respond to any new request sent within this time.

5.1.8. CommunicationControl (28H)

The service is used to “switch on/off” the transmission and/or the reception of certain messages of (a) server(s).

5.1.8.1. Message Format**Request:**

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Byte	Name	Cvt	Value (hex)
#1	RequestServiceIdentifier	M	28
#2	Sub-Function = [<div> EnableRxAndTx EnableRxAndDisableTx DisableRxAndEnableTx DisableRxAndTx] </div>	M	00 01 02 03
#3	CommunicationType= [<div> NormalCommunicationMessages NetworkManagementCommunicationMessages NetworkManagementCommunicationMessages AndNormalCommunicationMessages] </div>	M	01 02 03

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	68
#2	Sub-Function = [<div> EnableRxAndTx EnableRxAndDisableTx DisableRxAndEnableTx DisableRxAndTx] </div>	M	00 01 02 03

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	28
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC)

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M
12	Sub-function parameter in the request message is not supported.	M
13	The length of the message is wrong	M
22	The operating conditions of the server are not met to perform the required action.	M
31	None of the requested CommunicationType values are supported by the device.	M

Sub-function Parameter Definition:

Option(hex)	Description	Cvt
00	EnableRxAndTx This value indicates that the reception and transmission of messages shall be enabled for the specified CommunicationType.	M
01	EnableRxAndDisableTx This value indicates that the reception of messages shall be enabled and the transmis-sion shall be disabled for the specified communicationType.	U
02	DisableRxAndEnableTx This value indicates that the reception of messages shall be disabled and the trans-mission shall be enabled for the specified communicationType.	U

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03	DisableRxAndTx This value indicates that the reception and transmission of messages shall be disabled for the specified CommunicationType.	M
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Data Parameter Definition:

Option(hex)	Description	Cvt
01	NormalCommunicationMessages This value references all application-related communication (inter-application signal exchange between multiple in-vehicle servers).	M
02	NetworkManagementCommunicationMessages This value references all network management related communication.	U
03	NetworkManagementCommunicationMessagesAndNormalCommunicationMessages This value references all network management and application-related communication	U

5.1.8.2. Implementation Rules

There are no special general implementation rules for this service.

5.1.9. SecurityAccess (27H)

The purpose of this service is to provide a means to access data and/or diagnostic services, which have restricted access for security or safety reasons. Diagnostic services for downloading/uploading routines or data into a server and reading specific memory locations from a server are situations where security access may be required. Improper routines or data downloaded into a server could potentially damage the electronics or other vehicle components or risk the vehicle's compliance to safety, or security standards. The security concept uses a seed and key relationship.

The client shall request the server to unlock by sending the service SecurityAccess-RequestSeed message. The server shall respond by sending a seed. The seed is the input parameter for the key calculation algorithm. It is used by the client to calculate the corresponding key value.

In a second step, the client shall request the key comparison by sending the calculated key to the server using the appropriate service SecurityAccess-SendKey. The server shall compare this key to one internally stored/calculated. If the two numbers match, then the server shall enable (unlock) the client's access to specific services/data and indicate that with the service SecurityAccess-SendKey. If the two numbers do not match, this shall be considered as a false access attempt. If access is rejected for any other reason, it shall not be considered as a false access attempt. An invalid key requires the client to start over from the beginning with a SecurityAccess-RequestSeed message.

If a server supports security, but is already unlocked when a SecurityAccess-RequestSeed

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message is received, that server shall respond with a SecurityAccess-RequestSeed positive response message service with a seed value equal to zero (0). The client shall use this method to determine if a server is locked by checking for a non-zero seed.

The Seed-Key algorithm for SecurityAccess (Mandatory) :

$\text{Key} = (((\text{seed} \gg 4) \text{ XOR } \text{seed}) \ll 3) \text{ XOR } \text{seed})$ 。

The Security Seed is 4 Bytes random numbers.

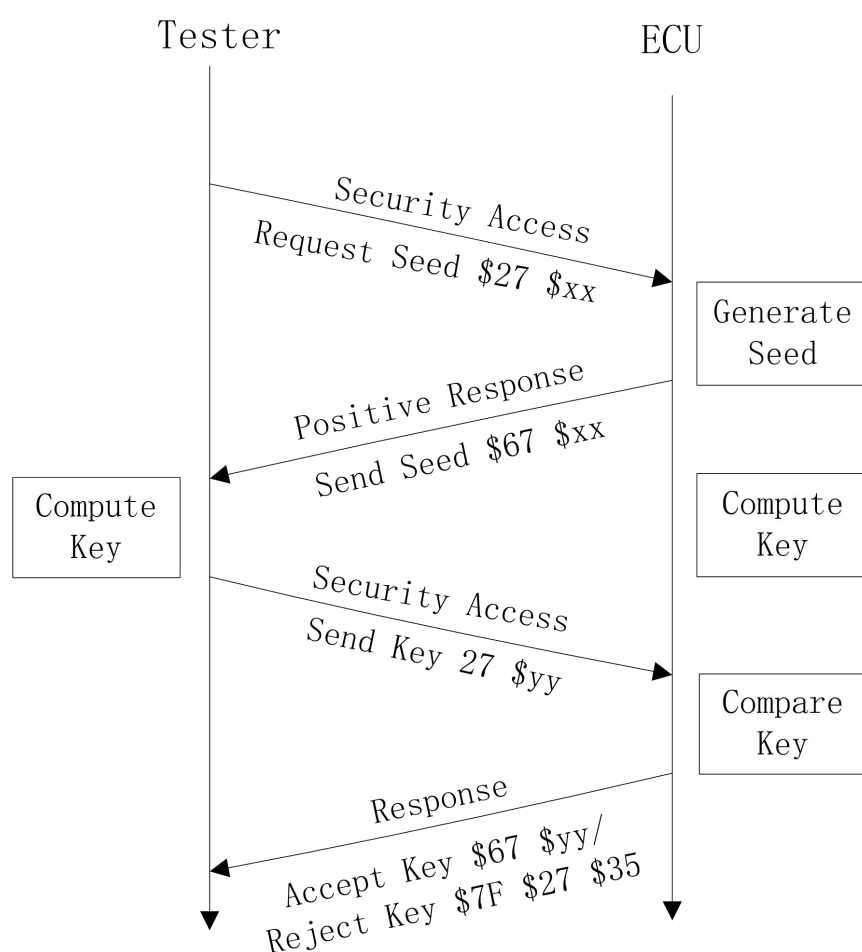


Fig 2. Security Access procedure

5.1.9.1. Message Format

5.1.9.1.1. Request Seed

This service requests a seed from the server. Based on this seed, the client is able to calculate

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the corresponding key to be sent for unlocking the server.

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	27
#2	SecurityAccessType = RequestSeed	M	01, 03, 11

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	67
#2	SecurityAccessType = RequestSeed	M	01, 03, 11
	SecuritySeed [] = [M	
#3	seed#1 (high byte)	M	00-FF

#6	seed#m (low byte)]	M	00-FF

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	27
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC)

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M
12	Sub-function parameter in the request message is not supported.	M
13	The length of the message is wrong.	M
22	The criteria for the SecurityAccess request are not met.	M
37	requiredTimeDelayNotExpired	M

5.1.9.1.2. Send Key

This service sends a key calculated by the client to the server. The server shall compare this key to one internally stored/calculated. If the two numbers match, then the server shall enable (“unlock”) the client’s access to specific services/data.

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	27
#2	SecurityAccessType = SendKey	M	02, 04, 12
	SecurityKey [] = [M	
#3	key#1 (high byte)	M	00-FF

#6	key#m (low byte)]	U	00-FF

Positive Response:

Byte	Name	Cvt	Value
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#1	PositiveResponseServiceIdentifier	M	67
#2	SecurityAccessType = SendKey	M	02, 04, 12

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	27
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC)

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M
12	Sub-function parameter in the request message is not supported.	M
13	The length of the message is wrong.	M
22	The criteria for the SecurityAccess request are not met.	M
24	requestSequenceError The “sendKey” sub-function is received without first receiving a “requestSeed” request message.	M
35	invalidKey	M
36	exceededNumberOfAttempts Send if the delay timer is active due to exceeding the maximum number of allowed false access attempts.	M

Sub-function Parameter Definition

HEX	Description	Cvt
01	requestSeed (level 1)	M
02	sendKey (level 1)	M
03	requestSeed (level 2)	U
04	sendKey (level 2)	U
11	requestSeed (level 3 flash)	M
12	sendKey (level 3 flash)	M

5.1.9.2. Implementation Rules

After PowerOn/Reset the ECU is in locked state. The security access failure counter is set to 0.

The ECU shall wait 10 s before accepting the first RequestSeed message after EcuReset/PowerOn.

After the third failure attempt the ECU shall wait 10s before accepting the next “Request Seed” message. A flag is stored in the EEPROM of the ECU. On every PowerOn/Reset, the ECU checks for this flag, then waits again 10s before accepting the next “Request Seed” message (It is allowed to implement the Security Access requirement without based on the Flag)

Any SecurityAccess request during this time will be rejected with the negative response code “Required time delay not expired” (37h).

If the tester requests a seed, it has to send the corresponding key to the ECU. This sequence is mandatory. If the tester sends a consecutive “Request Seed”, the request is accepted and the same

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seed is returned, but the security access failure counter is incremented.

If the tester sends an invalid key, the request is rejected with negative response code “InvalidKey”, the sequence shall be reset (any current seed becomes invalid) and the security access failure counter is incremented.

When the security counter reaches the value of 3 (i.e. 3 failed tries), the ECU shall wait 10s before accepting another “Request Seed” message. Any such request during this time will be rejected with the negative response code “Required time delay not expired” (37h). When the 10s wait time is elapsed the security access failure counter is decremented by one and another try is allowed. When during this try the security access failure counter is incremented again (due to an invalid key), the ECU shall wait again 10s before accepting another “Request Seed” message. When this try is valid, the security access failure counter will be changed to 0.

BJEV uses four states (three different levels): Locked, Unlocked (Level 1), Unlocked (Level 2) and Unlocked (Flash). The ECU could support some of them according to the requirement.

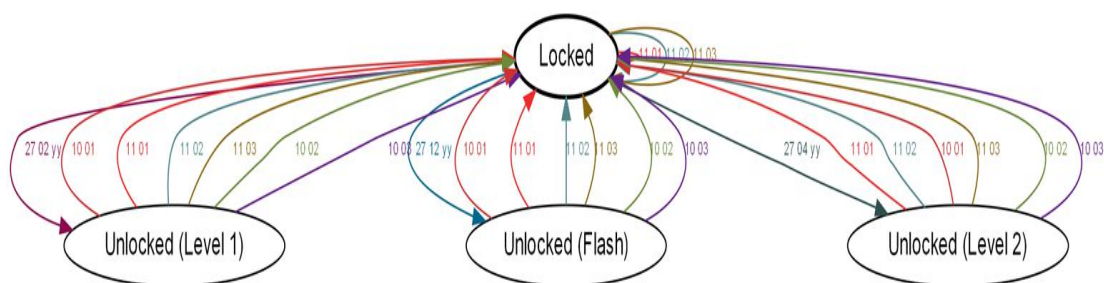
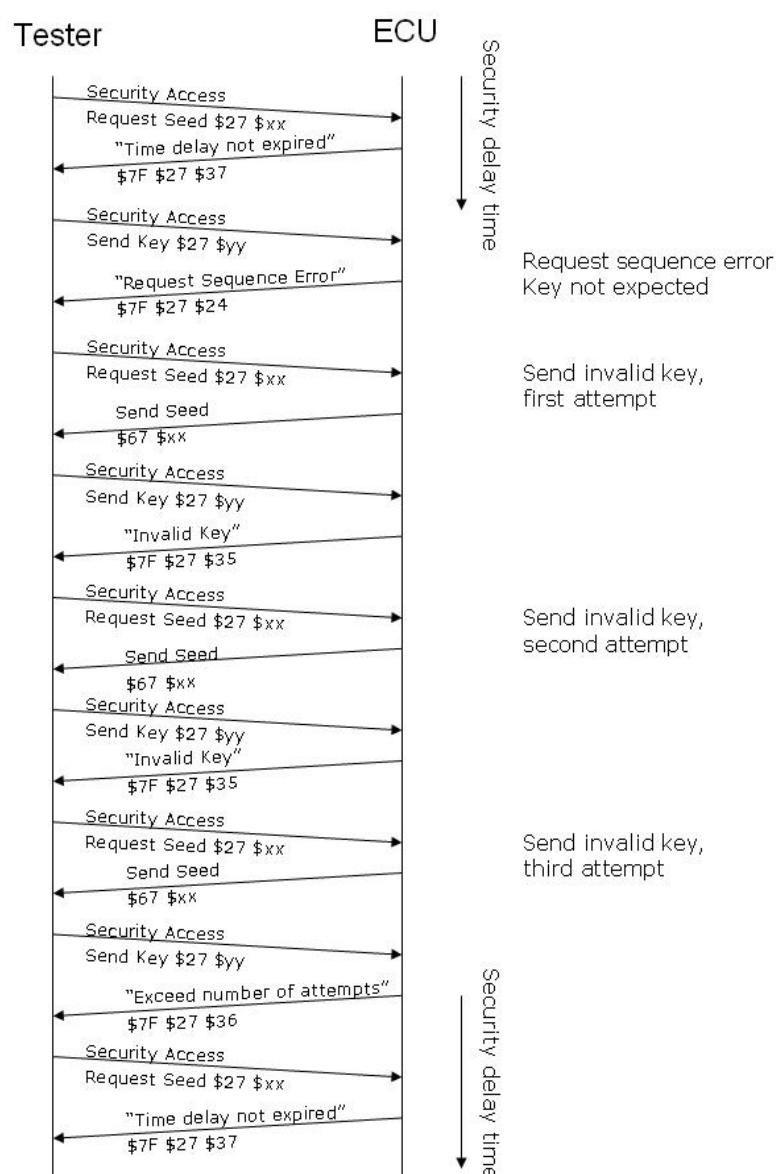


Fig 3. SecurityAccess

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5.1.10. TesterPresent (3EH)

This service shall be used to indicate to a server that the client is present. This service is required in the absence of other UDS services to prevent servers from automatically returning to normal operation and stop communication.

5.1.10.1. Message Format

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	3E
#2	zeroSubFunction	M	00

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	7E
#2	zeroSubFunction	M	00

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	3E
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC):

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M
12	Sub-function parameter in the request message is not supported.	M
13	The length of the message is wrong.	M

Sub-function Parameter Definition

HEX	Description	Cvt
00	ZeroSubFunction This parameter value is used to indicate that no sub-function value beside the suppressPosRspMsgIndicationBit is supported by this service.	M

5.1.10.2. Implementation Rules

There are no special general implementation rules for this service.

5.1.11. ControlDTCSetting(85H)

This service is used to enable and disable the setting of Diagnostic Trouble Codes, DTCs, in the

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ECU(s).

The ControlDTCSetting request message can be used to stop the setting of diagnostic trouble codes in an individual server or a group of servers. If the server being addressed is not able to stop the setting of diagnostic trouble codes, it shall respond with a ControlDTCSetting negative response message indicating the reason for the reject.

5.1.11.1.Message Format

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	85
#2	DTCSettingType = [On Off]	M	01 02

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	C5
#2	DTCSettingType [On Off]	M	01 02

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	85
#3	NegativeResponseCode	M	NRC

Sub-function Parameter Definition

HEX	Description	Cvt
01	On The server(s) shall resume the setting of diagnostic trouble codes according to normal operating conditions	M
02	Off The server(s) shall stop the setting of diagnostic trouble codes.	M

Negative Response Codes(NRC)

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M
12	Sub-function parameter in the request message is not supported.	M
13	The length of the message is wrong	M
22	The operating conditions of the server are not met to perform the required action.	U

5.1.11.2.Implementation Rules

The setting of DTCs in the ECU shall be switched off directly after the request

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ControlDTCSetting with setting mode 2 (switch off) is received (Option: Suppress positive response message indication bit is set) or after successful transmission of the positive response (Option: Suppress positive response message indication bit is not set).

The setting of DTCs in the ECU shall be switched on again, when one of the following events occurs:

The request ControlDTCSetting with setting mode 1 (switch on) is received (Option: Suppress positive response message indication bit is set) or after successful transmission of the positive response (Option: Suppress positive response message indication bit is not set).

The ECU power supply voltage is down (reset or ECU power down event).

The diagnostic session changes from Extended Diagnostic Session to Default Session.

The services ReadDTCInformation - ReportDTCByStatusMask, ReadDTCInformation - ReportSupportedDTC and ClearDiagnosticInformation shall not be affected by this service.

5.1.12. ReadDataByIdentifier (22H)

The request message requests data record values from the server by one or more dataIdentifier(s).

When receiving a ReadDataByIdentifier request, the server will access the data elements of the records specified by the dataIdentifier parameter(s) and transmit their value in ReadDataByIdentifier positive response containing the associated dataRecord parameter(s).

5.1.12.1. Message Format

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	22
	DataIdentifier[] #1 = [
#2	byte#1 (MSB)	M	00-FF
#3	byte#2]	M	00-FF
...
	DataIdentifier[] #m = [
#n-1	byte#1 (MSB)	U	00-FF
#n	byte#2]	U	00-FF

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	62
	DataIdentifier[] #1 = [
#2	byte#1 (MSB)	M	00-FF

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#3	byte#2]	M	00-FF
	DataRecord[] #1 = [
#4	data#1	M	00-FF
...
#{k-1)+4	data#k]	U	00-FF
...
	DataIdentifier[] #m = [
#n-(o-1)-2	byte#1 (MSB)	U	00-FF
#n-(o-1)-1	byte#2]	U	00-FF
	DataRecord[] #m = [
#n-(o-1)	data#1	U	00-FF

#n	data#o]	U	00-FF

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	22
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC)

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M
13	The length of the message is wrong.	M
22	The operating conditions of the server are not met to perform the required action.	U
31	None of the requested dataIdentifier values are supported by the device.	M

Data Parameter Definition:

For dataIdentifier supported by the ECU, please refer to appendix B.

5.1.12.2. Implementation Rules

The maximum number of dataIdentifiers to be read within a single request is limited to 1.

5.1.13. WriteDataByIdentifier (2EH)

The WriteDataByIdentifier service is used by the client to write a dataRecord to a server. The data is identified by a dataIdentifier.

5.1.13.1. Message Format

Request:

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Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	2E
	DataIdentifier[] #1 = [
#2	byte#1 (MSB)	M	00-FF
#3	byte#2]	M	00-FF
	DataRecord [] = [
#4	data#1	U	00-FF
...
#m+3	data#m]	U	00-FF

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	6E
	DataIdentifier[] #1 = [
#2	byte#1 (MSB)	M	00-FF
#3	byte#2]	M	00-FF

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	2E
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC)

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	
13	The length of the message is wrong.	M
22	1. The operating conditions of the ECU are such that it can't perform the required action (e.g., the data for a DataIdentifier is stored in EEPROM and an EEPROM failure has occurred). 2. The ECU internal conditions do not allow the writing of any DataIdentifier/ IdentificationOption. 1) The system is currently in initialization. 2) The system is currently in InputOutputControlByIdentifier service active stage. 3) The system is currently busy at modifying memory. 4) The vehicle is moving.	U
31	1. The dataIdentifier in the request message is not supported in the server or the dataIdentifier is supported for read only purpose (via ReadDataByIdentifier service). 2. Any data transmitted in the request message after the dataIdentifier is invalid (if applicable to the node).	M
33	The dataIdentifier, which reference a specific address, is secured and the server is not in an unlocked state.	M
72	The server detects an error when writing to a memory location.	M

Data Parameter Definition:

For dataIdentifier supported by the ECU, please refer to appendix B.

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5.1.13.2. Implementation Rules

It is the system supplier's responsibility that the server conditions are met when performing any action request by this service, including but not limited to the following:

- 1) The high and low voltage current fault does not exist in the system.

Please specify other rules in your module.

5.1.14. InputOutputControlByIdentifier (2FH)

This service is used by the tester to substitute a value for an input signal, internal ECU function and/or control an output of an electronic system referenced by an inputOutputDataIdentifier .

5.1.14.1. Message Format

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	2F
	DataIdentifier[] #1 = [
#2	byte#1 (MSB)	M	00-FF
#3	byte#2]	M	00-FF
	ControlOptionRecord#1[] = [
#4	ControlState#1/InputOutputControlParameter	M/U	00-FF
...
#4+(m-1)	ControlState #m]	C	00-FF
	ControlEnableMaskRecord#1[] = [
#4+m	ControlMask #1	C	00-FF
...
#4+m+(r-1)	ControlMask #r]	C	00-FF

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	6F
	DataIdentifier[] #1 = [
#2	byte#1 (MSB)	M	00-FF
#3	byte#2]	M	00-FF
	ControlStatusRecord#1[] = [
#4	ControlState#1/InputOutputControlParameter	C	00-FF
...
#4+(m-1)	ControlState #m]	C	00-FF

Negative Response:

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Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	2F
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC)

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M
13	The length of the message is wrong.	M
22	ConditionsNotCorrect	M
24	The “returnControlToECU” sub-function is received without first receiving a “ShortTermAdjustment” request message.	M
31	1. The server does not support the requested dataIdentifier. 2. The user optional inputOutputControlParameter contains invalid data. 3. One or multiple of the controlState are invalid.	M
33	The corresponding security is not yet granted to perform the required service.	M

Data Parameter Definition

Option (Hex)	Description	
00	returnControlToECU This parameter specifies that the ECU shall take control of the value of dataIdentifier.	CVT
01	ResetToDefault The value shall indicate to the server that it is requested to reset the input signal, in-ternal parameter or output signal referenced by the inputOutputLocalIdentifier to its default state. Number of controlState bytes in request: 0 Number of controlState bytes in pos. response: depends on the dataIdentifier	M
02	FreezeCurrentState This value shall indicate to the server that it is requested to freeze the current state of the input signal, internal parameter or output signal referenced by the inputOutputLocalIdentifier. Number of controlState bytes in request: 0 Number of controlState bytes in pos. response: depends on the dataIdentifier	M
03	ShortTermAdjustment This parameter specifies that the ECU shall set the value of dataIdentifier to request value of the controlStateParamter. If the diagnostic communication with the tester is broken, the control shall be given back to the ECU.	M

5.1.14.2. Implementation Rule

It is the system supplier’s responsibility that the server conditions are met when performing any action request by this service, including but not limited to the following:

- 1) The high and low voltage current fault does not exist in the system.

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2) The controlled system, including the actuator, has no fault.

Please specify other rules in your module.

5.1.15. ClearDiagnosticInformation (14H)

This service is used by the client to clear diagnostic information in the server's memory.

5.1.15.1. Message Format

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	14
	GroupOfDTC []=[
#2	groupOfDTCHighByte	M	00-FF
#3	groupOfDTCMiddleByte	M	00-FF
#4	groupOfDTCLowByte]	M	00-FF

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	54

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	14
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC)

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M
13	The length of the message is wrong	M
22	The ECU internal conditions do not allow deletion of the diagnostic information stored in the node. These are: 1) The vehicle is moving. 2) The system is currently in initialization or shutdown process. 3) The system is currently in I/O Control. 4) The system is in the process of changing some Memory content.	M
31	Wrong groupOfDTC values in request.	M

Data Parameter Definition:

Option (Hex)	Description
FFFFFF	All Groups (all DTC's)
xxxxxx	A particular DTC

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5.1.15.2. Implementation Rule

The implementation of clearing diagnostic information will take the time of <TBD> seconds.

The DTCs stored in RAM and non-volatile memory shall be cleared before the positive response is sent.

With the parameter groupOfDTC it is also possible to clear only a specific group of DTCs or a specific DTC.

A subsequent call to read out the fault memory shall not retrieve any DTC which has been set before the last execution of ClearDiagnosticInformation.

Even if no DTC was stored, the ECU shall return with a positive response.

There shall be no sequence dependency to any other service. Even if the fault memory was not read, it may be cleared.

A DTC can just be cleared by tester with service 14h.

5.1.16. ReadDTCInformation (19H)

This service allows a client to read the status of server-resident Diagnostic Trouble Code (DTC) information from any server, or group of servers within a vehicle.

5.1.16.1. Message Format

5.1.16.1.1. ReadDTCInformation-ReportNumberOfDTCByStatusMask(0x19 0x01)

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	19
	Sub-Function=	M	
#2	ReportNumberOfDTCByStatusMask		01
#3	DTCStatusMask	M	00-FF

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	59
	Sub-Function=	M	
#2	ReportNumberOfDTCByStatusMask		01
#3	DTCStatusAvailabilityMask	M	01-FF
	DTCFormatIdentifier =		
#4	ISO15031-6DTCFormat	M	00
	DTCCount[]=[
#5	DTCCountHighByte	M	00-FF

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#6	DTCCountLowByte]	M	00-FF
----	------------------	---	-------

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	19
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC):

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M
12	Sub-function parameter in the request message is not supported.	M
13	The length of the message is wrong	M
31	requestOutOfRange	M

5.1.16.1.2. ReadDTCInformation- ReportDTCByStatusMask (0x19 0x02)

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	19
	Sub-Function=	M	
#2	ReportDTCByStatusMask		02
#3	DTCStatusMask	M	00-FF

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	59
	Sub-Function=	M	
#2	ReportDTCByStatusMask		02
#3	DTCStatusAvailabilityMask	M	01-FF
	DTCAndStatusRecord[] =[
#4	DTCHighByte#1	C	00-FF
...	DTCMiddleByte#1		00-FF
	DTCLowByte#1		00-FF
	statusOfDTC#1		00-FF
	DTCHighByte#2		00-FF
	DTCMiddleByte #2		00-FF
	DTCLowByte#2		00-FF
	statusOfDTC#2		00-FF
		00-FF
	DTCHighByte#m		00-FF
	DTCMiddleByte#m		00-FF
	DTCLowByte#m		00-FF
#N	statusOfDTC#m]		00-FF

Negative Response:

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Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	19
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC):

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M
12	Sub-function parameter in the request message is not supported.	M
13	The length of the message is wrong	M
31	requestOutOfRange	M

5.1.16.1.3. ReadDTCInformation- reportDTCSnapshotIdentification (0x19 0x03)

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	19
	Sub-Function=	M	
#2	reportDTCSnapshotIdentification		03

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	59
	Sub-Function=	M	
#2	reportDTCSnapshotIdentification		03
	DTCRecord[] =[C	
#3	DTCHighByte#1		00-FF
#4	DTCMiddleByte#1		00-FF
#5	DTCLowByte#1]		00-FF
#6	DTCSnapshotRecordNumber #1		00-FF
	...		
	DTCRecord[] #m=[C	
#n-3	DTCHighByte#m		00-FF
#n-2	DTCMiddleByte#m		00-FF
#n-1	DTCLowByte#m]		00-FF
#n	DTCSnapshotRecordNumber #m		00-FF

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	19
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC):

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M

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12	Sub-function parameter in the request message is not supported.	M
13	The length of the message is wrong	M
31	requestOutOfRange	M

5.1.16.1.4. ReadDTCInformation-reportDTCSnapshotRecordByDTCNumber (0x19 0x04)

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	19
	Sub-Function=	M	
#2	ReportDTCSnapshotRecordByDTCNumber		04
	DTCMaskRecord []=[
#3	DTCHighByte	M	00-FF
#4	DTCMiddleByte	M	00-FF
#5	DTCLowByte]	M	00-FF
#6	DTCSnapshotRecordNumber	M	00-FF

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	59
	Sub-Function=	M	
#2	ReportDTCSnapshotRecordByDTCNumber		04
	DTCAndStatusRecord[] =[
#3	DTCHighByte		00-FF
#4	DTCMiddleByte		00-FF
#5	DTCLowByte		00-FF
#6	statusOfDTC]		00-FF
#7	DTCSnapshotRecordNumber#1		00-FE
#8	DTCSnapshotRecordNumberOfIdentifiers #1		00-FF
	DTCSnapshotRecord[] #1 = [
#9	dataIdentifier#1 byte (MSB)	C	00-FF
#10	dataIdentifier#1 byte (LSB)		00-FF
#11	snapshotData#1 byte #1		00-FF
...
#11+(p-1)	snapshotData#1 byte #p		00-FF
...
#11+(p-1) +(p+2)*(w-2)+1	dataIdentifier#w byte (MSB)		00-FF
#11+(p-1) +(p+2)*(w-2)+2	dataIdentifier#w byte (LSB)		00-FF
#11+(p-1) +(p+2)*(w-2)+3	snapshotData#w byte #1		00-FF

#11+(p-1)	snapshotData#wbyte #p]		...

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$+(p+2)*(w-2)$ $+3+(p-1)$			
..	...		
#t	DTCSnapshotRecordNumber#x		00-FE
#t+1	DTCSnapshotRecordNumberOfIdentifiers#x		00-FF
	DTCSnapshotRecord[]#x= [
# t+2	dataIdentifier#1 byte (MSB)		00-FF
# t+3	dataIdentifier#1 byte (LSB)		00-FF
# t+4	snapshotData#1 byte #1		00-FF
...
# t+4+(p-1)	snapshotData#1 byte #p		00-FF
...
# t+4+(p-1) $+(p+2)*(w-2)+1$	dataIdentifier#w byte (MSB)		00-FF
# t+4+(p-1) $+(p+2)*(w-2)+2$	dataIdentifier#w byte (LSB)		00-FF
# t+4+(p-1) $+(p+2)*(w-2)+3$	snapshotData#w byte #1		00-FF

# t+4+(p-1) $+(p+2)*(w-2)+3$ $+(p-1)$	snapshotData#w byte #p]		...

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	19
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC):

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M
12	Sub-function parameter in the request message is not supported.	M
13	The length of the message is wrong	M
31	requestOutOfRange	M

5.1.16.1.5. ReadDTCInformation- reportDTCExtendedDataRecordByDTCNumber (0x19 0x06)

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	19
	Sub-Function=	M	
#2	ReportDTCExtendedDataRecordByDTCNumber		06
	DTCMaskRecord []=[
#3	DTCHighByte	M	00-FF
#4	DTCMiddleByte	M	00-FF

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#5	DTCLowByte]	M	00-FF
#6	DTCExtendedDataRecordNumber	M	00-FF

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	59
	Sub-Function=	M	
#2	ReportDTCExtendedDataRecordByDTCNumber		06
	DTCAndStatusRecord[] = [C	
#3	DTCHighByte		00-FF
#4	DTCMiddleByte		00-FF
#5	DTCLowByte		00-FF
#6	statusOfDTC]		00-FF
#7	DTCExtendedDataRecordNumber#1		00-EF
	DTCExtendedDataRecord[] #1 = [
#8	ExtendedData #1 byte #1		00-FF
...	...		00-FF
#8+(p-1)	ExtendedData #1 byte #p]		00-FF
...	...		00-FF
#t	DTCExtendedDataRecordNumber #x		00-EF
	DTCExtendedDataRecord[] #x = [00-FF
#t+1	ExtendedData #x byte #1		00-FF
...	...		00-FF
#t+1+(q-1)	ExtendedData #x byte #q]		00-FF

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	19
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC):

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M
12	Sub-function parameter in the request message is not supported.	M
13	The length of the message is wrong	M
31	requestOutOfRange	M

5.1.16.1.6. ReadDTCInformation- ReportSupportedDTC (0x19 0x0A)

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	19
	Sub-Function=	M	
#2	ReportSupportedDTC		0A

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Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	59
	Sub-Function=	M	
#2	ReportSupportedDTC		0A
#3	DTCStatusAvailabilityMask	M	01-FF
	DTCAndStatusRecord[] = [
#4	DTCHighByte #1	M	00
#5	DTCMiddleByte #1		
#6	DTCLowByte #1	M	00-FF
#7	statusOfDTC #1	M	00-FF
...	...		
#7+4*(m-2)+1	DTCHighByte #m	M	00-FF
#7+4*(m-2)+2	DTCMiddleByte #m	M	00-FF
#7+4*(m-2)+3	DTCLowByte #m	M	00-FF
#7+4*(m-2)+4	statusOfDTC #m]	M	00-FF

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	19
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC):

NRC (Hex)	Conditions	Cvt
11	The service identifier in the request message is not supported.	M
12	Sub-function parameter in the request message is not supported.	M
13	The length of the message is wrong	M
31	requestOutOfRange	M

5.1.16.2. Data Parameter Definition

The following data parameters are defined for this service.

Parameter	Description
DTCStatusMask	The DTCStatusMask contains 8 DTC status bits. This byte is used in the request message to allow an external test tool to request DTC information for the DTCs whose status matches the DTC Status Mask. A DTC's status matches the DTC Status Mask if any one of the DTC's actual status bits is set to "1" and the corresponding status bit in the DTCStatusMask is also set to "1". (i.e., if the DTC Status Mask is bit-wise logically ANDed with the DTC's actual status and the result is non-zero, then a match has occurred). If the external test tool specifies a status mask that contains bits that the ECU does not support, then the ECU shall process the DTC information using only the bits that it does support.

The ECU supported DTC statuses are described in the following table.

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Bit Field	Bit Field Description	Cvt
0	<p>test failed 0x00 – false 0x01 – true</p> <p>This bit shall indicate the result of the most recently performed test. A logical ‘1’ shall indicate that the last test failed meaning that the failure is completely matured (Active). A logical ‘0’ shall indicate that the result of the most recently performed test returns a “pass” result. Reset to 0 after a call of Clear Diagnostic Information.</p>	M
1	<p>Test failed this operation cycle 0x00 – false 0x01 – true</p> <p>This bit shall indicate that a diagnostic test has reported a Test Failed result at any time during the current operation cycle. Reset to 0 when a new operation cycle is initiated or after a call to Clear Diagnostic Information. Once this bit is set to 1, it shall remain a 1 until a new operation cycle is started.</p>	M
2	<p>pending DTC 0x00 – false 0x01 – true</p> <p>This bit shall indicate whether or not a diagnostic test has reported a Test Failed result at any time during the current or last completed operation cycle. The status shall only be updated if the test runs and completes. The criteria to set the Pending DTC bit and the Test Failed This Operation Cycle bit are the same. The difference is that the Test Failed This Operation Cycle is cleared at the end of the current operation cycle and the Pending DTC bit is not cleared until an operation cycle has completed where the test has passed at least once and never failed. Reset to 0 after a call of ClearDiagnosticInformation.</p>	N/A
3	<p>confirmed DTC 0x00 – false 0x01 – true</p> <p>This bit shall indicate whether a malfunction was detected enough times to warrant that the DTC is stored in long-term memory (Pending DTC has been set = ‘1’ one or more times for emission relevant electronic control units). This information can be used by the external test tool to request additional diagnostic information such as Extended Data Records or Snapshot Records. A Confirmed DTC does not indicate that the malfunction is present at the time of the request (Pending DTC or Test Failed can be used to determine if a malfunction is present at the time of the request.). Reset to logical ‘0’ after a call to Clear Diagnostic Information or after self-healing criteria has been satisfied or after discarding this DTC due to Fault Memory overflow.</p>	M
4	<p>Test not complete since last clear 0x00 – false 0x01 – true</p> <p>This bit shall indicate whether a DTC test has run to completion since the last time a call was made to Clear Diagnostic Information. One (1) shall indicate that the DTC test has not run to completion. If the test runs and passes or fails (Test Failed This Operation Cycle = 1) then the bit shall be set to a Zero (0) and latched. Reset to One (1) after a call to Clear Diagnostic Information.</p>	N/A

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5	Test failed since last clear 0x00 – false 0x01 – true This bit shall indicate whether a DTC test has ever returned a Test Failed = 1 result since the last time a call was made to Clear Diagnostic Information (latched Test Failed This Operation Cycle =1).Zero (0) shall indicate that the test has not run or that the DTC test ran and passed (but never failed). If the test runs and fails then the bit shall remain latched at a 1. Reset to Zero(0) after a call to Clear Diagnostic Information. In contradiction to the Confirmed DTC this bit is not reset by self-healing criteria or when it was overwritten due to an overflow of the fault memory.	M
6	Test not complete this operation cycle 0x00 – false 0x01 – true This bit shall indicate whether a DTC test has ever run and completed during the current operation cycle. One (1) shall indicate that the DTC test has not run to completion during the current operation cycle. If the test runs and passes or fails then the bit shall be set (and latched) to 0 until a new operation cycle is started. Reset to 1 after a call to Clear Diagnostic Information.	N/A
7	Warning indicator requested Warning indicator requested 0x00 – false 0x01 – true This bit shall report the status of any warning indicators associated with a particular DTC. Warning outputs may consist of indicator lamp(s), displayed text information, etc. If no warning indicators exist for a given system or particular DTC, this status shall default to a logic”0” state.The bit is set to 1 when the performed test results ‘failed’.Reset to a logical ‘0’ after a call to Clear Diagnostic Information.	C

冻结帧具体信息参见附录 A。

5.1.17. RoutineControl (31H)

This service is used by the client to start/stop a routine and request routine results in the server's memory. The routine is identified by a 2-byte RoutineIdentifier.

5.1.17.1. Message Format

Request:

Byte	Name	Cvt	Value(hex)
#1	RequestServiceIdentifier	M	31
#2	RoutineControlType	M	00-FF
	RoutineIdentifier [] = [

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#3	byte#1 (MSB)	M	00-FF
#4	byte#2 (LSB)]	M	00-FF
	RoutineControlOptionRecord [] = [..	...
#5	routineControlOption#1	C/U	00-FF
...
#n	routineControlOption#m]	C/U	00-FF
C: This parameter is user optional to be present for sub-function parameter startRoutine and stopRoutine.			

Positive Response:

Byte	Name	Cvt	Value
#1	PositiveResponseServiceIdentifier	M	71
#2	RoutineControlType	M	00-7F
	RoutineIdentifier [] = [
#3	byte#1 (MSB)	M	00-FF
#4	byte#2(LSB)]	M	00-FF
...	RoutineStatusRecord [] = [..	...
#5	routineStatus#1	U	00-FF
...
#n	routineStatus#m]	U	00-FF

Negative Response:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	RequestServiceIdentifier	M	31
#3	NegativeResponseCode	M	NRC

Negative Response Codes(NRC):

NRC (Hex)	Conditions
11	The service identifier in the request message is not supported.
12	The sub-function parameter in the request message is not supported.
13	The length of the message is wrong.
22	The criteria for the request RoutineControl are not met.
24	This code shall be returned if the “stopRoutine” or “requestRoutineResults” Sub-function is received without first receiving a “startRoutine” for the requested routineIdentifier.
31	This code shall be returned if: 1) the server does not support the requested routineIdentifier; 2) the user optional Routine Control Option Record contains invalid data for the requested routineIdentifier.
33	The corresponding security is not yet granted to perform the required service.

Sub-function Parameter Definition:

Option (Hex)	Description	Cvt
01	StartRoutine This parameter specifies that the server shall start the routine specified by the routineIdentifier.	M

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02	StopRoutine This parameter specifies that the server shall stop the routine specified by the routineIdentifier.	M
03	RequestRoutineResults This parameter specifies that the server shall return result values of the routine specified by the routineIdentifier.	M

Data Parameter Definition:

RoutineIdentifier (Hex)	Description
0203	CheckPreprogramConditon This value shall be used to check the server's preprogram condition before reprogramming the ECU.
FF00	eraseMemory This value shall be used to start the server's memory erase routine.
FF01	checkProgrammingDependencies This value shall be used to check the server's memory programming dependencies.
0202	CheckDataIntegrity This value shall be used to check the server's memory data integrity, it is recommended to use CRC32 algorithms.

5.1.17.2. Implementation Rule

It is the system supplier's responsibility that the server conditions are met when performing any action request by this service.

Please specify other rules in your module.

5.1.18. RequestDownload(34H)

参见北汽新能源 Bootloader 刷新规范。

5.1.19. TransferData (36H)

参见北汽新能源 Bootloader 刷新规范。

5.1.20. RequestTransferExit (37H)

参见北汽新能源 Bootloader 刷新规范。

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6. 故障定义

序号	故障名称	故障码 DTC	备注
1	MCU IGBT 驱动电路过流故障（A 相）	P116016	
	MCU IGBT 驱动电路过流故障（B 相）	P116116	
	MCU IGBT 驱动电路过流故障（C 相）	P116216	
2	MCU 相电流过流故障	P113519	
3	电机超速故障	P0A4400	
4	MCU 直流母线过压故障	P114017	
5	MCU 直流母线欠压故障	P114016	
6	MCU IGBT 过温故障（A 相）	P117098	
	MCU IGBT 过温故障（B 相）	P117198	
	MCU IGBT 过温故障（C 相）	P117298	
7	MCU 过温故障	P117F98	不支持
8	电机过温故障	P0A2F98	
9	电机三相电流校验故障	P112164	
10	MCU 相电流采样回路故障（A 相）	P118A12	
	MCU 相电流采样回路故障（B 相）	P118B12	
	MCU 相电流采样回路故障（C 相）	P118C12	
11	MCU 位置信号检测回路故障	P0A3F00	
12	MCU IGBT 温度检测回路故障（A 相）	P11801C	
	MCU IGBT 温度检测回路故障（B 相）	P11811C	
	MCU IGBT 温度检测回路故障（C 相）	P11821C	
13	MCU 温度检测回路故障	P11881C	不支持
14	电机温度检测回路故障	P0A001C	
15	MCU 直流母线电压采样回路故障	P11841C	
16	MCU 直流母线电流采样回路故障	P0A5101	不支持
17	MCU 反馈转矩与转矩命令校验错误故障	P113064	不支持
18	转矩命令超限故障	U040186	
19	与 VCU 通讯丢失故障	U010087	
20	电机系统高压暴露故障	P0A0A94	
21	MCU 低压电源过压故障	U300317	
22	MCU 低压电源欠压故障	U300316	

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23	MCU 电源模块故障	P11A01C	不支持
24	MCU 相电流传感器零漂故障（A 相）	P118A28	
	MCU 相电流传感器零漂故障（B 相）	P118B28	
	MCU 相电流传感器零漂故障（C 相）	P118C28	
25	MCU 直流母线电流传感器零漂故障	P118D28	不支持
26	MCU RAM 故障	P060444	不支持
27	MCU ROM 故障	P060545	不支持
28	MCU EEPROM 故障	P062F46	

具体参见北汽新能源 C33DB-Z03 项目电机系统故障定义。

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[illegible]

19	U010087	是	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	01	
20	P0A0A94	是	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	01	
21	U300317	是	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	01	
22	U300316	是	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	01	
23	P11A01C	是	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	01	不支持
24	P118A28	否																										
	P118B28																											
	P118C28																											
25	P118D28	否																										不支持
26	P060444	否																										不支持
27	P060545	否																										不支持
28	P062F46	否																										

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附录 B: 参数定义

B.1 版本信息参数列表:

编号	名称	DID(Hex)	Read	Write	备注
1	VIN	F190	√	√	
2	零件号	F187	√		
3	应用软件指纹	F184	√	√	
4	供应商代码	F18A	√		
5	ECU 硬件版本号	F191	√		
6	ECU 软件版本号	F195	√		
7	Bootloader 软件版本号	F183	√		
8	电机编码（只适用 MCU）	02FF	√	√ 1	

B.2 数据流参数列表:

编号	名称	DID(Hex)	Read	Write	备注
1	驱动电机工作模式命令	0202	√		
2	整车行驶状态命令	0212	√		
3	驱动电机控制器工作状态	0203	√		
4	整车 State 状态	0213	√		
5	直流母线电压	0200	√		
6	直流母线电流	0201	√		
7	驱动电机目标转矩命令	0204	√		
8	驱动电机目标转速命令	0206	√		
9	驱动电机当前转矩	0205	√		
10	驱动电机当前转速	0207	√		
11	MCU IGBT 温度（A 相）	0214	√		
12	MCU IGBT 温度（B 相）	0215	√		
13	MCU IGBT 温度（C 相）	0216	√		
14	MCU 温度	0208	√		
15	驱动电机温度	0209	√		
16	Id 给定值	020C	√		
17	Id 反馈值	020E	√		
18	Iq 给定值	020D	√		
19	Iq 反馈值	020F	√		
20	Ud	020A	√		
21	Uq	020B	√		
22	转子位置电角度	0217	√		

23	转子位置初始角度	0218	√		
24	MCU 低压电源电压	0210	√		

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B.3 版本信息参数定义

DID	信号/变量名称	访问权限			数据宽度/ 字节	描述	分辨率	偏移量	最小值	最大值
		22	2e	2f						
F190	VIN	√0	√1	☒	17	VIN	字符#1: “L” 字符#2: “N” 字符#3: “B” 字符#4: “S” 字符#5: “C” 字符#6: “B” 字符#7: “3” 字符#8: “F” 字符#9: “x”（随机） 字符#10: “E” 字符#11: “D” 字符#12-字符#17: Serial Number “000001-999999”			
F187	零件号	√0	☒	☒	9	零件号	字符#1-字符#9: Serial Number”E00103063” 参见 Q-BJEV 01.6-2012 产品零部件号和图样号编制及要求			
F183	Bootloader 软件版本号	√0	☒	☒	10	Bootloader 软件版本号	参见《北京新能源汽车股份有限公司整车各零部件电控单元基于 UDS 协议的 Bootloader 刷新规范_V4.0__20151231》			
F184	应用软件指纹	√0	√3	☒	9	应用软件指纹	字符#1: 年（BCD 编码） 字符#2: 月（BCD 编码） 字符#3: 日（BCD 编码） 字符#4: 诊断仪串号（0-FF） 字符#5: 诊断仪串号（0-FF） 字符#6: 诊断仪串号（0-FF） 字符#7 诊断仪串号（0-FF） 字符#8 诊断仪串号（0-FF） 字符#9 诊断仪串号（0-FF）			
F18A	供应商代码	√0	☒	☒	10	供应商代码	字符#1-字符#10: A755e01782 深圳市麦格米特驱动技术有限公司			

F191	ECU 硬件版本号	√0	☒	☒	9	ECU 硬件版本号	字符#1-字符#9：Serial Number”E10000001” 参见 Q-BJEV 01.12-2012 控制器版本和刷新管理规定	
F195	ECU 软件版本号	√0	☒	☒	9	ECU 软件版本号	字符#1-字符#9：Serial Number”E10000051” 参见 Q-BJEV 01.12-2012 控制器版本和刷新管理规定	
F199	编程日期	√0	√3	☒	3	编程日期	字符#1：年（BCD 编码） 字符#2：月（BCD 编码） 字符#3：日（BCD 编码）	
02FF	电机编码	√0	☒	√1	30	电机编码	Byte0-Byte9	字符#1~#10： 供应商编码 举例：北汽大洋电机科技有限公司 A010E00656
							Byte10-Byte14	字符#11~#15： 生产日期 举例：G0422
							Byte15-Byte19	字符#6~#20： 流水号 举例：1179
							Byte20	字符#21： 平台号 举例：D
							Byte21-Byte9	字符#22~#30： 零部件号 举例：E00095795

说明：访问权限√0表示不需要安全级权限，√1表示需要扩展安全级权限，√3表示需要编程安全级权限，☒表示不支持相应服务。

B.4 数据流参数定义

DID	信号/变量名称	单位	访问权限			数据宽度/位	描述	分辨率	偏移量	最小值	最大值
			22	2e	2f						
0202	驱动电机工作模式命令	N/A	√ 0	☒	☒	Byte 0					
						0	MCU 使能命令	0-使能关（Disable） 1-使能（Enable）			
						1-3	驱动电机工作模式命令	0-待机模式 1-转矩模式 2-转速模式 3~7-保留（Reserved）			
						4-5	驱动电机转矩、转速指令方向命令				

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								0-保留（Reserved） 1-正指令 2-负指令 3-保留（Reserved）
						6-7	保留	0~3-保留（Reserved）
0212	整车行驶状态命令	N/A	√0	☒	☒	Byte 0		
						0-1	保留	0~3-保留（Reserved）
						2-4	档位信号	0-Void 1-P档 2-N档 3-R档 4-D档 5-E档 6~7-保留（Reserved）
						5	制动信号	0-未踩制动踏板 1-已踩制动踏板
						6	保留	0~1-保留（Reserved）
						7	防溜坡功能使能命令	0~1-保留（Reserved）
						Byte 0		
0203	驱动电机控制器工作状态	N/A	√0	☒	☒	0	MCU 初始化状态	0-初始化未完成 1-初始化已完成
						1-2	驱动电机当前状态	0-待机状态 1-电动状态 2-发电状态 3-保留（Reserved）

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						3-5	驱动电机当前工作模式	0-待机模式 1-转矩模式 2-转速模式 3~7-保留（Reserved）
						6-7	驱动电机当前旋转方向	0-待机状态 1-正转（前进） 2-反转（倒车） 3-保留（Reserved）
						Byte 1		
						0	驱动电机控制器高压检测完成标志	0-未完成 1-已完成
						1	EEPROM 写数据完成标志位	0-未完成 1-已完成
						2	驱动电机控制器高压放电完成标志位	0-未完成 1-已完成
						3	驱动电机控制器低压下电请求标志位	0-未完成 1-已完成
						4	驱动电机系统降功率请求标志位	0-全功率运行 1-降功率运行
						5	驱动电机控制器关闭使能请求标志位	0-不关使能 1-关使能

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						6-7	保留	0~3-Void			
0213	整车 State 状态	N/A	√0	☒	☒	16	整车状态机编码	1	0	0	65534
0200	直流母线电压	V	√0	☒	☒	16	直流母线电压实际值	0.02	0	0	1310
0201	直流母线电流	A	√0	☒	☒	16	直流母线电流实际值	0.04	-1310	-1310	1310
0204	驱动电机目标转矩命令	Nm	√0	☒	☒	16	MCU 接收到的转矩指令	0.04	-1310	-1310	1310
0206	驱动电机目标转速命令	rpm	√0	☒	☒	16	MCU 接收到的转速指令	0.6	-19660	-19660	19660
0205	驱动电机当前转矩	Nm	√0	☒	☒	16	电机当前转矩实际值	0.04	-1310	-1310	1310
0207	驱动电机当前转速	rpm	√0	☒	☒	16	电机当前转速实际值	0.6	-19660	-19660	19660
0214	MCU IGBT 温度（A 相）	℃	√0	☒	☒	8	A 相 IGBT 模块当前内部温度	1	-48	-48	206
0215	MCU IGBT 温度（B 相）	℃	√0	☒	☒	8	B 相 IGBT 模块当前内部温度	1	-48	-48	206
0216	MCU IGBT 温度（C 相）	℃	√0	☒	☒	8	C 相 IGBT 模块当前内部温度	1	-48	-48	206
0208	MCU 温度	℃	√0	☒	☒	8	MCU 当前散热底板温度	1	-48	-48	206
0209	驱动电机温度	℃	√0	☒	☒	8	驱动电机当前温度	1	-48	-48	206
020C	Id 给定值	A	√0	☒	☒	16	D 轴电流给定值	0.04	-1310	-1310	1310
020E	Id 反馈值	A	√0	☒	☒	16	D 轴电流反馈值	0.04	-1310	-1310	1310
020D	Iq 给定值	A	√0	☒	☒	16	Q 轴电流给定值	0.04	-1310	-1310	1310
020F	Iq 反馈值	A	√0	☒	☒	16	Q 轴电流反馈值	0.04	-1310	-1310	1310
020A	Ud	V	√0	☒	☒	16	D 轴电压	0.04	-1310	-1310	1310
020B	Uq	V	√0	☒	☒	16	Q 轴电压	0.04	-1310	-1310	1310
0217	转子位置电角度	°	√0	☒	☒	8	转子位置电角度	1.5	0	0	382
0218	转子位置初始角度	°	√0	☒	☒	8	转子位置初始角度	1.5	0	0	382
0210	MCU 低压电源电压	V	√0	☒	☒	8	MCU 低压供电电源电压	0.12	0	0	30

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附录 C
(规范性附录)
应用 ISO15031-5 标准的读取 VIN 信息的诊断规范

1. 适用范围

本附录仅适用于北汽新能源动力系统部及自主开发的电机控制系统

2. 开发要求

为尽可能兼容车管所读取 VIN 的相关设备，因此需在原有 ISO14229-1 协议基础上增加 ISO15031-5 部分功能

3. 术语

M	强制性执行
C	有条件的
N. A	不适用
U	用户选用
SID	服务标识符
Server	服务器
Tester	客户端/诊断仪
ECU	电控单元

引用文件

ISO15031-5: 2006 Road vehicles - Communication between vehicle and external equipment for emissions-related diagnostics – Part 5: Emissions-related diagnostic services

4. 诊断需求

诊断消息 ID

控制器名称	简称	物理寻址	诊断响应	功能寻址	实施网段
电机控制器	MCU	0x7E0	0x7E8	0x7DF	<i>EVBUS</i>

服务列表

服务标识	描述	Cvt
0x01	Request current powertrain diagnostic data	M
0x02	Request powertrain freeze frame data	U
0x03	Request emission-related diagnostic trouble code	M
0x04	Clear/reset emission-related diagnostic information	M
0x05	Request oxygen sensor monitoring test results	N.A
0x06	Request on-board monitoring test results for specific monitored systems	U
0x07	Request emission-related diagnostic trouble codes detected during current or last completed driving cycle	M

0x08	Request control of on-board system, test or component	U
0x09	Request vehicle information	M
0x0A	Request emission-related permanent diagnostic trouble code	U

响应规则

4.1.1. 不支持请求服务标识符

不发送响应

4.1.2. 支持请求服务标识符，其参数（PID，MID，TID 等）

支持全部参数：发送肯定响应

支持部分参数：发送对应参数的肯定响应

不支持任何参数：不发送响应

条件	响应规则
服务0x01不支持	所有支持该0x01服务的ECU应该响应0x01，ID 0x00的服务，若服务0x01不支持，则不允许响应
服务0x01支持，不支持请求PID	不响应
服务0x01支持，支持请求PID	在P2时间内给出响应，不允许否定响应码为0x78的否定响应
服务0x02不支持	不响应
服务0x02支持，支持请求PID，无存储冻结帧	不响应，除非ECU支持PID 是0x00，0x20...
服务0x02支持，不支持请求PID，无存储冻结帧	不响应
服务0x02支持，支持请求PID，有存储冻结帧	P2 时间内给出响应
服务0x02支持，不支持请求PID，有存储冻结帧	不响应
服务0x03，0x07不支持	不响应
服务0x03，0x07支持，但无DTC存储	肯定响应，标识无DTC
服务0x03，0x07支持，DTC存储	肯定响应，包括DTC
服务0x04不支持	不响应
服务0x04支持，但条件不正确	否定响应（0x7F，0x04，0x22）
服务0x04支持，但条件正确	肯定响应或否定响应（0x7F，0x04，0x78）
服务0x06不支持	不响应
服务0x06支持，支持请求TID，无存储的数据	肯定响应，测试值，最大最小值设置为0x00
服务0x06支持，不支持请求TID，无存储的数据	不响应

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服务0x06支持，支持请求TID，有存储的数据	P2时间内给出响应
服务0x06支持，不支持请求TID，有存储数据	不响应
服务0x08不支持	不响应
服务0x08支持，支持请求TID，条件不正确	否定响应（0x7F，0x08，0x22）
服务0x08支持，不支持请求TID	不响应
服务0x09不支持	不响应
服务0x09支持，支持请求InfoType，数据可用（VIN， CVN， CALID）	P2时间内给出响应
服务0x09支持，支持请求InfoType，数据无法获取（ CVN），条件正确	否定响应（0x7F，0x09，0x78，直到肯定响应可以发送
服务0x09支持，支持请求InfoType，数据无法获取（ CVN），条件不正确	否定响应（0x7F，0x09，0x22）
服务0x09支持，不支持请求InfoType	不响应

强制要求

4.1.3. 诊断请求

MCU必须支持功能寻址的诊断请求

4.1.4. 服务及 PID 要求

MCU必须支持服务标识符0x01的PID=\$00的诊断请求，及服务标识符0x09的PID=\$00和PID=\$02的诊断请求

5. 示例

支持请求服务及参数

发送/接收	CANID	DLC		服务	PID	参数				
Tester	7DF	8	2	1	0	0	0	0	0	0
MCU	7E8	8	6	41	0	BE	1F	A8	13	0
Tester	7DF	8	2	1	1	0	0	0	0	0
MCU	7E8	8	6	41	1	0	7	E1	0	0
Tester	7DF	8	2	1	0	0	0	0	0	0
MCU	7E8	8	6	41	0	BE	1F	A8	13	0
Tester	7DF	8	1	3	0	0	0	0	0	0
MCU	7E8	8	2	43	0	0	0	0	0	0
Tester	7DF	8	2	1	0	0	0	0	0	0
MCU	7E8	8	6	41	0	BE	1F	A8	13	0
Tester	7DF	8	1	7	0	0	0	0	0	0
MCU	7E8	8	2	47	0	0	0	0	0	0
Tester	7DF	8	2	1	0	0	0	0	0	0
MCU	7E8	8	6	41	0	BE	1F	A8	13	0
Tester	7DF	8	2	1	20	0	0	0	0	0
MCU	7E8	8	6	41	20	90	5	80	11	0
Tester	7DF	8	2	1	40	0	0	0	0	0
MCU	7E8	8	6	41	40	FA	DC	80	0	0

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Tester	7DF	8	2	1	1	0	0	0	0	0
MCU	7E8	8	6	41	1	0	7	E1	0	0
Tester	7DF	8	2	1	0	0	0	0	0	0
MCU	7E8	8	6	41	0	BE	1F	A8	13	0
Tester	7DF	8	2	9	0	0	0	0	0	0
MCU	7E8	8	6	49	0	55	40	0	0	0
Tester	7DF	8	2	9	2	0	0	0	0	0
MCU	7E8	8	10	14	49	2	1	4C	47	42
Tester	7E0	8	30	0	5	0	0	0	0	0
MCU	7E8	8	21	48	35	32	45	30	33	46
MCU	7E8	8	22	59	33	34	35	35	34	39
Tester	7DF	8	2	9	4	0	0	0	0	0
MCU	7E8	8	10	13	49	4	1	31	34	46
Tester	7E0	8	30	0	5	0	0	0	0	0
MCU	7E8	8	21	50	34	41	0	0	0	0
MCU	7E8	8	22	0	0	0	0	0	0	0
Tester	7DF	8	2	9	6	0	0	0	0	0
MCU	7E8	8	7	49	6	1	0A	2F	E8	C9

不支持请求服务及参数

发送/接收	CANID	DLC		服务	PID	参数				
Tester	7DF	8	3	5	xx	xx	0	0	0	0
MCU	7E8	不响应								

注：附录 A 与正文进行“分隔符下一页”设置，纸张大小设置 A3，纸张方向设置横向，在下表格属性设置“在各页顶端以标题形式重复出现”，各分系统应根据各自故障库对应冻结帧信息按照以下示例列表进行设计。

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