

UDS on CAN&CANFD 通用诊断要求

SOR-Appendix T11

Revision history/修改历史

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		2.1.1	修改表格中 OSI 层的描述	
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		2.1.3	新增章节	
		2.1.5.1	新增章节	
		2.1.5.3	更改章节中的参数定义	
		2.1.6.2	新增章节	
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		2.1.8	新增章节	
		2.1.9	新增章节	
		3	更新诊断数据 Diagnostic Data 中的所有参数定义及格式说明	
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		1.3	新增规范性引用文件 ISO14229-2-2013、ISO 15765-2-2016、ISO 15031-3_2004、ISO 15031-6_2015、ISO 13400-2_2012	
		1.4	删除术语及缩写 ACK、CMC、EMC、ESD、SJW、以及解释	
			替换“测试仪”为“外部诊断工具”	
		2.5	新增网络层需求	
		2.5.1	新增诊断消息标识符的相关描述	
		2.5.4	重新编制表格-诊断消息格式	
		2.6	新增会话层需求	
		2.9	细化安全访问章节需求	
		2.9.2	增加安全访问流程描述	

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		2.9.3	删除: c)上电/复位前最后一次安全访问尝试失败, 增加延时计时器的描述	
		2.10	新增故障管理章节需求	
		3.2	在诊断会话控制 (0x10) 服务章节新增服务端诊断会话状态图	
		3.3	删除 0x11 02 子功能, 新增 0x11 03 子功能	
		3.5.1	修改 DTCFormatIdentifier 为 SAE_J2012-DA_DTCFormat_00	
		3.6	修改 0x22 服务对多个 DID 同时请求的定义	
		3.14	删除 76 服务肯定响应信息 TransferResponseParameterRecord	
		4.1	追加参数 dataIdentifier (DID)的应用场景说明	
		All	重新调整文档章节排布, 更新了文档的部分内容描述	
2022/03/05	N/A	4.1	诊断物流数据表中新增 DID: 0xF103 应用诊断数据库版本号, 0xF104 PBL 诊断数据库版本号, 0xF105 SBL 诊断数据库版本号, 0xF17F 软件校验和值。修改 DID: 0xF190 不可 2E 服务写入。	夏利平
2022/03/10	N/A	2.12.3	将“延时计数器存储在非易失存储器内”修改为“失败计数器存储在非易失存储器内”	夏利平
		2.14.6	细化故障扩展信息的需求内容	
2022/04/06	N/A	3.17.1	删除 85 服务的消息格式中的 group ID	夏利平
		4.1	F18A 长度改为 10 个字符长度	
2022/07/18	N/A	2.10.5	更新本地快照的描述信息和开发需求	杜春红
2022/07/25	N/A	2.6.1	删除 S3client	杜春红
		2.7.1	删除 P2client、P2*client、P3client_phys、P3client_func 参数 表 9 中增加标称值, 增加 P2server、P2*server 的标称值	杜春红
		2.10.6	增加故障扩展信息的部分内容, 比如: 计数器的大小, 以及计数器值的维持值	杜春红
2022/7/26	N/A	2.5.4	修改表 5 的内容和注释信息	杜春红

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2022/10/26	2.1	2.4	对 CAN 节点的 DLC 进行了独立描述 对 CANFD 的 DLC 及 CAN_DL 进行了补充说明	夏利平
		2.7.1	补充对 P2*Server 时序参数的说明	
		2.9	明确使用 AES 系列算法作为安全算法	
		2.9.1	明确安全访问等级中 seed/key 为十六进制格式	
		2.10.2	增加 ECU 上下电操作循环定义	
		2.10.7	新增故障优先级	
		2.11	新增诊断通信条件	
		3.1	31 服务支持功能寻址及默认会话	
		3.4.2	在 groupofdte 表中增加某个特定 DTC（可选）	
		3.5.1.3	0x19 0x04 服务的肯定响应，增加字节 6 的说明	
		3.6	22 服务需支持同时 10 组 DID 的请求，且按请求顺序响应支持的 DID	
		3.6.1	关于客户端超过了一次允许请求的最大数据标识符数的描述从 NRC\$31 中删除，在 NRC\$13 中添加	
		3.8.2	“安全访问类型”参数定义表中删除 levelxx 的描述	
		3.12.1	新增 RoutineStatusRecor[] 中 routineStatus#1 的定义，如下： 0x00 = Routine Completed 0x01 = Routine Aborted 0x02 = Routine Executing	
		3.17.1	85 服务删除 NRC\$31	
		4.1	对软件刷写过程中数值保持不变的 DID 进行了补充说明 F18A 未使用字节，需尾部补空白	
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1 简介

1.1 文档简述

本标准旨在指导和规范 UDS on CAN&CANFD 通用诊断设计工作。

This standard is intended to guide and standardize the design of universal diagnostics for UDS on CAN&CANFD.

1.2 适用范围

本标准规定了小米汽车项目上连接在 CAN/CANFD 网络上的 CAN 接口 ECU 的通用统一诊断服务的实现需求。OBD 要求的法规（排放相关）诊断不包括在本标准中。具有法规诊断功能的 ECU 可以通过附加规范补充本要求的诊断部分。任何和本技术标准不一致的偏差需要获得小米汽车基础技术工程师的认可。

This standard specifies generic UDS on CAN&CANFD implementation requirements for the CAN-interfaced ECU which is connected on CAN/CANFD network on Xiaomi vehicle project. Legislated (Emission-Related) diagnostics required by OBD is not covered by this standard. ECUs with legislative diagnostics may complement the diagnostic part of this requirement with additional specifications. Any deviation inconsistent with this technical standard shall be approved by the basic technical engineer of Xiaomi Automobile.

1.3 规范性引用文件

下列引用文档对于本文档的应用是必不可少的。标注日期的引用文件，仅标注日期的版本适用。未标注日期的引用文件，其最新版本（包括所有的修正项）适用于本标准。

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[1]ISO11898-1-2015: Data link layer and physical signaling, 2015

[2]ISO11898-2-2016: High-speed medium access unit, 2016

[3]SAE J2284-4-2016 High Speed CAN(HSC) for Vehicle Applications at 500kbps with CAN FD Data at 2Mbps

[4]ISO14229-1-2013 ROAD VEHICLES — UNIFIED DIAGNOSTIC SERVICES (UDS) — PART 1: SPECIFICATION AND REQUIREMENTS

[5]ISO14229-2-2013 Road vehicles— Unified diagnostic services (UDS) —Part 2: Session layer services.

[6]ISO14229-3-2012 ROAD VEHICLES — UNIFIED DIAGNOSTIC SERVICES (UDS) — PART 3: UNIFIED DIAGNOSTIC SERVICES ON CAN IMPLEMENTATION (UDSONCAN)

[7] ISO 15765-2-2016: Road vehicles – Diagnostic communication over Controller Area Network (DoCAN) —Part 2: Transport protocol and network layer services

[8] ISO 15765-4-2021: Road vehicles–Diagnostic communication over Controller Area Network (DoCAN) —Part 4: Requirements for emissions-related systems

[9] ISO 15031-3_2004: Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics —Part 3_Diagnostic connector and related electrical circuits, specification and use

[10] ISO 15031-6_2015:Road vehicles -- Communication between vehicle and external equipment for emissions-related diagnostics -- Part 6_ Diagnostic trouble code definitions

[11]ISO 13400-2_2012: Road vehicles — Diagnostic communication over Internet Protocol(DoIP) —Part 2:Transport protocol and network layer services

1.4 术语及缩写的解释

Abbr.缩略语	Description 描述
BS	Block Size 块大小
CAN	Controller Area Network 控制器局域网
CAN_H	CAN High CAN 高
CAN_L	CAN Low CAN 低
CF	Consecutive Frame 连续帧
Cvt	Convention 约定值

DID	Data Identifier 数据标识符
DLC	Data Length code 数据长度代码
DTC	Diagnostic Trouble Code 诊断故障代码
ECU	Electronic Control Unit 电子控制单元
FC	Flow Control 流控帧
FF	First Frame 首帧
FF_DL	First Frame Data Length 首帧数据长度
LSB	Least Significant Byte 最低有效字节
MSB	Most Significant Byte 最高有效字节
N_Ar	Network Layer Timing Parameter Ar 网络层时序参数 Ar
N_As	Network Layer Timing Parameter As 网络层时序参数 As
N_Bs	Network Layer Timing Parameter Bs 网络层时序参数 Bs
N_Br	Network Layer Timing Parameter Br 网络层时序参数 Br
N_Cs	Network Layer Timing Parameter Cs 网络层时序参数 Cs
N_Cr	Network Layer Timing Parameter Cr 网络层时序参数 Cr
OBD	On-Board Diagnostics 车载诊断
PCI	Protocol Control Information 协议控制单元
Private ECU	An ECU not addressable from a client/tester point of view 不可被客户端/外部诊断工具角度寻址的控制器
Public ECU	An ECU addressable from a client/tester point of view 可被客户端/外部诊断工具角度寻址的控制器
SF	SingleFrame 单帧
SN	Sequence Number 序列号
STmin	Separation Time Minimum 最小间隔时间
UDS	Unified Diagnostic Services 统一诊断服务
Client/Tester	Client/External Diagnostic Tool 客户端/外部诊断工具
Server	Electronical Control Unit Node 电子控制单元节点
N/A	Not Applicable 不适用
M	Mandatory 强制的
C	Conditional 有条件的

O	Optional 可选的
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2 诊断需求 Diagnostic Requirements

2.1 概述 Overview

统一诊断服务 (UDS) 应遵循 ISO 14229 中规定的要求, 该标准基于将通信系统分为七层的开放系统互连 (OSI) 基本参考模型。 诊断规范对应于 OSI 层如下:

The unified diagnostic service (UDS) shall follow the requirements stated in ISO 14229 which is based on the Open Systems Interconnection (OSI) Basic Reference Model structuring the communication systems into seven layers. The diagnostic specifications correspond to the OSI layers as follows:

表 1 — 适用于 OSI 层的诊断规范 Table 1 — Diagnostic specifications applicable to the OSI layers

适用性 Applicability	OSI 七层 OSI seven layer	增强型诊断服务 Enhanced diagnostics services
7 层适用于 ISO/IEC 7498-1 和 ISO/IEC 10731 中的约定 Seven layer according to ISO/IEC 7498-1 and ISO/IEC 10731	Application (layer 7)	ISO 14229-1, ISO 14229-3 UDSonCAN
	Presentation (layer 6)	
	Session (layer 5)	ISO 14229-2
	Transport (layer 4)	ISO 15765-2
	Network (layer 3)	
	Data Link (layer 2)	ISO 11898-1, ISO 11898-2, ISO 11898-5
	Physical (layer 1)	

2.2 诊断连接器 Diagnostic Connector

诊断接口将使用 ISO 15031-3 中定义的 16 针通用连接器。诊断连接器提供了实现车辆访问车载通信网络系统的物理方式。表 2 和图 1 显示了车辆连接器和外部测试设备的触点标示:

The diagnostic interface will use the 16-pin common connector defined in ISO 15031-3. The diagnostic connector provides a physical way for the vehicle to access the in-vehicle communication network system. Table 2 and Figure 1 show the contact designations of the vehicle connector and external test equipment.

表 2 — 诊断连接器引脚定义 Table 2 — Diagnostic Connector PIN

编号 Pin	描述 Description
1	预留 reserved
2	预留 reserved
3	以太网 RX+ (兼容 100BaseTx) Ethernet RX+ (100BaseTx compatible)
4	底盘地 Chassis ground
5	信号地 Signal ground
6	诊断 CAN-H Diag CAN-H
7	SAE 保留 SAE reserved
8	以太网激活线 Ethernet Active
9	预留 reserved
10	预留 reserved
11	以太网 RX- (兼容 100BaseTx) Ethernet RX-(100BaseTx compatible)
12	以太网 TX+ (兼容 100BaseTx) Ethernet TX+(100BaseTx compatible)
13	以太网 TX- (兼容 100BaseTx) Ethernet TX-(100BaseTx compatible)
14	诊断 CAN-L Diag CAN-L
15	预留 reserved
16	电池电压 Battery voltage

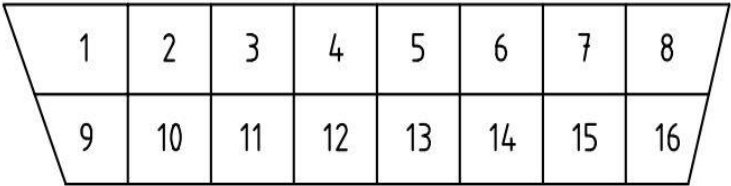


图 1 — 诊断连接器引脚 Figure1 — Diagnostic connector PIN

2.3 私有控制器 Private ECUs

连接到私有 CAN 网络的子节点，例如将 ECU 连接到其外部传感器或执行器的网络，而不使用公共 CAN 总线，不应要求遵守本规范。子节点将向位于公共 CAN 网络上的主节点报告诊断信息。因此网络的主节点必须遵守此规范。诊断会话期间,主节点必须能够接收正常的车辆运行 CAN 消息。

Sub-nodes connected to a private CAN network, such as connecting an ECU to its external sensor or actuator network without using one of the public CAN buses, should not be required to comply with this specification. The sub-nodes reports the diagnostic information to the master node on the public CAN network. Therefore, the master node of the network must comply with this specification. The master node must be able to receive normal vehicle operation CAN messages during the diagnostic session.

2.4 数据链路层 Data Link Layer

所有 CAN 节点的诊断请求和响应帧的 DLC 应始终设置为 8，否则应忽略该帧。当诊断响应帧长度小于 8 字节时，CAN DLC 应设置为 8，未使用的字节应使用 0xAA 进行填充。

所有 CANFD 节点都应接收和发送 CANFD 格式的帧并忽略传统 CAN 帧。如果诊断请求是 CANFD 帧，那么诊断响应也应该是 CANFD 帧。DLC 值会对应一个 CAN_DL 值，它是 CAN 帧数据/有效载荷的物理长度。接收的 CANFD 帧 CAN_DL 值为 8、12、16、20、24、32、48 和 64。如果诊断响应的长度小于 8 字节，则 CAN_DL 值应设置为 8。对于超过 8 个字节的诊断响应帧，CAN_DL 值应按下表设置。未使用的字节应使用 0xAA 进行填充。

The CAN DLC of diagnostic request and response frame shall always set to 8, otherwise the frame shall be ignored. When the diagnostic response frame length is less than 8 bytes, CAN DLC shall be set to 8 and unused bytes to be filled with 0xAA.

All CANFD nodes shall receive and transmit CANFD format diagnostic frames and ignore classical CAN frames. If diagnostic request is CANFD frame, then diagnostic response shall also be CANFD frame. DLC value results in a CAN_DL value, which is the physical length of a CAN frame data/payload. The accepted CAN FD data length (CAN_DL) is 8, 12, 16, 20, 24, 32, 48 and 64. If the length of diagnostic response is less than 8 bytes, then CAN FD data length (CAN_DL) shall be set to 8. For the diagnostic

response frames with more than 8 bytes, CAN FD data length (CAN_DL) shall be set according to the following table. The unused bytes shall be filled with 0xAA.

表3 — CANFD DL设置规则 Table 3 — CANFD DL setting rule

CAN FD data length (CAN_DL)							
8	12	16	20	24	32	48	64
DL<8	8<=DL<=10	11<=DL<=14	15<=DL<=18	19<=DL<=22	23<=DL<=30	31<=DL<=46	47<=DL<=62

2.5 网络层 Network layer

诊断网络层主要用于网络节点之间数据交换。例如，从控制器到控制器，或外部测试设备和控制器之间。如果要传输的数据不适合单个 CAN/CANFD 帧，则提供一种分割方法。

Diagnostic network layer is mainly used for data exchange between network nodes. e.g. from ECU to ECU, or between external test equipment and an ECU. If the data to be transferred does not fit into a single CAN/CANFD frame, a segmentation method is provided.

2.5.1 诊断消息寻址 Diagnostic Message Addressing

诊断消息标识符是必需的，以便将诊断消息与正常通信消息分开。请求消息中的诊断消息 ID 还决定该消息使用的寻址类型，是物理寻址(针对单个服务端)还是功能寻址(针对一个或多个服务端)。

Diagnostic message Identifiers are required in order to separate diagnostic messages from normal communication messages. The diagnostic message ID in a request message also determines the type of addressing used for that message, either physically addressed (targeted to a single server) or functionally addressed (targeted to one or multiple servers).

- 物理寻址(1 对 1 通信) 支持所有类型的网络层消息。
- Physical addressing (1 to 1 communication) shall be supported for all types of network layer messages.
- 功能寻址(1 到 n 通信)应只支持单帧通信。
- Functional addressing (1 to n communication) shall only be supported for SingleFrame communication.

正常的车辆网络配置为一个多级网络，如下图整车网络拓扑中所述，不同网络上同时具有公共和私有 ECU。

本章定义了对任一网络上所有公共 ECU 的诊断消息寻址的要求。

The normal vehicle network configuration will be a multi-level network, as described in the vehicle network topology in the following figure, with both public and private ECUs on different networks. This chapter defines the requirements for addressing diagnostic messages for all public ECUs on any network.

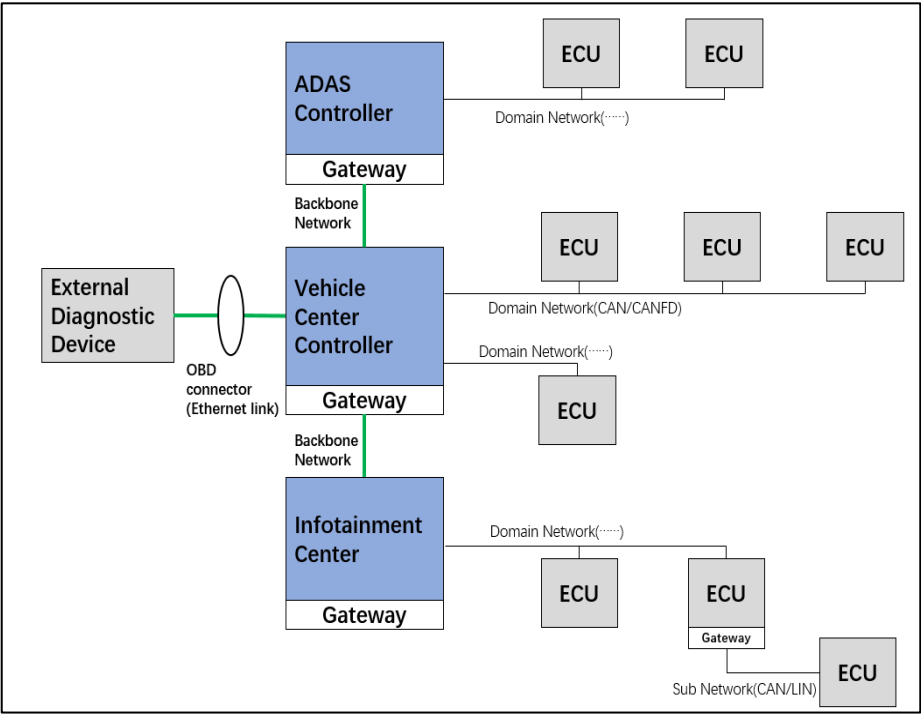


图 2 — 整车拓扑原型示例 Figure 2 — Example of the vehicle network topology

为了让外部诊断工具能够向车辆网络上的公共 ECU 发送特定的请求，每个公共 ECU 都需要有自己唯一的地址。这个地址将取决于 ECU 位于哪个网络以及网络属于哪个域。

To make it possible for the tester to send a specific request to a public ECU on the vehicle network, each public ECU needs to have its own unique address. The address will be dependent on which network the ECU is located on and which domain the network belongs to.

逻辑地址范围 0x1000–0x7FFF（车辆制造商特定）在道路车辆–互联网协议诊断通信（DoIP）–第 2 部分：网络和传输层要求和服务中定义，其中小米汽车使用范围 0x1000–0x7FFF，用作公共控制器的地址。

The logical Center ID 0x1000 – 0x7FFF (Vehicle manufacturer specific) defined in Road-vehicles–Diagnostic Communication over Internet Protocol (DoIP)–Part 2: Network and Transport Layer

Requirements and Services, where Xiaomi uses the range 0x1000 to 0x7FFF, is used as addresses for the public ECUs.

逻辑地址范围 0x0E80–0x0EFF（外部车辆制造/售后增强型诊断测试设备）在道路车辆–互联网协议诊断通信 (DoIP)–第 2 部分：网络和传输层要求和服务中定义用于外部诊断工具。其中小米汽车使用 0x0E80 用作外部诊断仪的地址。

The logical Center ID 0x0E80–0x0EFF (External vehicle manufacture / aftersales enhanced diagnostic test equipment) defined in Road vehicles–Diagnostic Communication over Internet Protocol (DoIP)–Part 2: Network and Transport Layer Requirements and Services, is used for the external diagnostic tester. Where Xiaomi uses the 0x0E80, is used as addresses for the enhanced diagnostic test equipment.

2.5.2 诊断逻辑地址格式 Diagnostic logical address format

用于诊断请求（目标地址）和响应（源地址）的寻址格式分为四个部分，其中使用了中央网关地址、域地址、网段地址和控制器地址的组合，见下表。

The format for diagnostic request (target address) and response (source address) is divided into four parts, which use a combination of Center ID, Domain ID, Network ID and ECU ID, as shown in the table below.

表4 — 寻址格式 Table 4 — Addressing format

车内控制器逻辑地址(2 byte) In-vehicle logical ECU address(2 byte)															
bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
中央网关地址 Center ID				域地址 Domain ID				网段地址 Network ID				控制器地址 ECU ID			

每个 ECU 均应支持物理寻址和功能寻址。每个 ECU 应有一个车辆唯一的物理逻辑地址，具体定义请参见信号矩阵。

Both physical and functional addressing shall be supported by each ECU. Each ECU should have a unique physical logical address, please refer to the signal matrix for specific definitions.

可以通过功能逻辑地址向整车中的所有（公共）ECU 发送请求。功能寻址(1 到 n 通信)应只支持单帧传输。

It shall be possible via a functional logical address, to send a request to all (public) ECUs in the complete vehicle. Functional addressing (1 to n communication) shall only be supported for SingleFrame transmission

小米汽车使用 0x7FFF，用作功能逻辑地址。

Xiaomi uses the 0x7FFF, is used as functional logical address for the vehicle.

2.5.3 CAN/CANFD 节点诊断地址格式 Diagnostic address format of CAN/CANFD node

CAN/CANFD 节点 ECU 只支持常规寻址方式，采用 11 位 CAN 标识符。每个 CAN/CANFD ECU 应支持总共三个 USDT CAN 诊断 ID：

—物理寻址的请求（或 ECU 诊断接收 ID）。

—物理和功能寻址响应（或 ECU 诊断传输 ID）。ECU 诊断传输 ID 始终等于 ECU 诊断接收 ID 的值减去 0x100。ECU 使用的物理请求及响应 CAN 标识符定义请参见信号矩阵。

—对所有域中所有 ECU 的功能寻址请求。（小米汽车使用 0x7FF 作为 CAN/CANFD ECU 的功能寻址请求地址）

CAN/CANFD ECU only supports normal addressing mode and uses 11-bit CAN identifier. Each CAN/CANFD ECU should support a total of three USDT CAN diagnostic IDs:

—Physical addressing request (or ECU Diagnostic Reception ID).

—Physical and functional addressing response or (ECU Diagnostic Transmission ID). The ECU diagnostic Transmission ID is always equal to the value of the ECU diagnostic Reception ID minus 0x100. Please refer to the signal matrix for the definition of the physical request and response CAN identifier used by the ECU.

—Functional addressing requests for all ECUs in all domains. (Xiaomi uses 0x7FF as the functional addressing request address of CAN/CANFD ECU)

从逻辑地址（ECU 地址）到 11 位 CAN ID 的转换。示例：如果逻辑地址（即 TA 和 SA）为 0x1234（中央网关地址=0x1，域地址=0x2，网段地址=0x3 和 控制器地址=0x4），则应使用 CAN ID 0x734。

Conversion from logical address (ECU address) to 11-bit CAN ID. Example: If the logical address (ie TA and SA) is 0x1234 (Center ID=0x1, Domain ID=0x2, Network ID=0x3 and ECU ID=0x4), CAN ID 0x734 should be used.

2.5.4 消息格式 Message format

表 5 — 诊断消息格式 Table 5 — Diagnostic message format

Message Type	Byte1		Byte2	Byte3	Byte4-6	Byte7-8	Byte9-64
	Bits 7-4	Bits 3-0					
SingleFrame (CAN_DL<=8)	0000b	SF_DL	Data				/
SingleFrame 1 (CAN_DL>8)	0000b	0000b	SF_DL	Data			
FirstFrame 2 (FF_DL<=4095)	0001b	FF_DL		Data			
FirstFrame 3 (FF_DL>4095)	0001b	0000b	00000000b	FF_DL		Data	
ConsecutiveFrame 4	0010b	SN	Data				
FlowControlFrame 5	0011b	FS	BS	STmin	/	/	/
1. 消息与 CAN_DL > 8 将使用转义序列，其中字节#1 的较低部分被设置为 0(无效长度)。这向网络层表明 SF_DL 的值是根据帧中的下一个字节(字节#2)确定的。因为 CAN_DL 被定义为大于 8，所以这个定义只对 CAN FD 类型帧有效。							
2. 在多帧传输中，如果实际 FF_DL <= 4095，则第一帧以传统 PCI 格式发送。							
3、在多帧传输中，如果实际 FF_DL>4095，则使用新的 PCI 格式发送第一帧，即原 FF_DL 置 0，用 byte3-6 表示 FF_DL。							
4、SequenceNumber (SN)应该编码在 N_PCI 字节 1 的低半字节。SN 取值范围为 0 ~ 15。							
5、FS (FlowStatus)参数表示发送网络实体是否可以继续消息传输。							
1. Messages with CAN_DL > 8 shall use an escape sequence where the lower nibble of Byte #1 is set to 0 (invalid length).This signifies to the network layer that the value of SF_DL is determined based on the next byte in the frame (Byte #2). As CAN_DL is defined to be greater than 8, this definition is only valid for CAN FD type frames.							
2. In multi-frame transmission, if the actual FF_DL <= 4095, then the first frame is sent in the traditional PCI format.							
3. In multi-frame transmission, if the actual FF_DL > 4095, the new PCI format is used to send the first frame, i.e., the original FF_DL is set to 0 and the byte3-6 is used to represent FF_DL.							
4. The SequenceNumber (SN) shall be encoded in the lower nibble bits of N_PCI byte 1. The SN shall be set to a value within the range of 0 to 15.							
5. The parameter FlowStatus (FS) indicates whether the sending network entity can proceed with the message transmission.							

2.5.5 时序参数 Timing parameter

表 6 — 流控帧参数值 Table 6 — Flow control parameter value

参数名称 Parameter	默认值 Default Value	单位 Unit
BS	0	-
STmin_TESTER	0	ms
STmin_ECU	10 - Application software 0 - Boot software	ms

表 7 — 网络层时序参数值 Table 7 — Network layer timing parameter value

参数名称 Parameter	超时值 Timeout	性能要求 Performance Requirement	单位 Unit
N_As/N_Ar	75	NA	ms
N_Bs	150	NA	ms
N_Br	NA	< 75	ms
N-Cs	NA	< 75	ms
N-Cr	150	NA	ms

2.6 会话层 Session layer

2.6.1 时序参数 Timing parameter

表 8 — 会话层时序参数值 Table 8 — Session layer timing parameter value

参数名称 Parameter	最小值 Min	最大值 Max	类型 Type	单位 Unit
S3server	NA	5000	Timer reload value	ms

2.7 应用层 Application layer

2.7.1 时序参数 Timing parameter

表 9— 应用层时序参数值 Table 9— Application layer timing parameter value

参数名称 Parameter	最小值 Min	标称值 Typical	最大值 Max	类型 Type	单位 Unit
P2server	0	/	50	Performance requirement	ms
P2*server	0 ^{Note1}	/	2000	Performance requirement	ms
P4server	P2server	P2server_Max	15000	Performance requirement	ms

Note1: 对于最终响应，所有会话中 P2 * Server 的最短时间为 0ms。

在增强的响应时间期间，连续否定消息（NRC78）的传输之间的时间应固定为 2000ms。

Note1: For a final response the minimum time for P2*Server in all sessions is 0ms.

During the enhanced response timing, the time between the transmission of consecutive negative messages (each with negative response code 0x78) shall be 2000ms.

2.7.2 具有物理和功能寻址的多个并发请求消息 Multiple concurrent request messages with physical and functional addressing

一个通用的诊断服务在服务端一般只有一个诊断协议实例，一个诊断协议实例一次只能处理一个请求。规则是任何接收到的消息（无论是物理或功能寻址）都占用此资源，直到请求消息被处理（发送最终响应或应用程序调用无响应）。

A common server implementation has only one diagnostic protocol instance available in the server. One diagnostic protocol instance can only handle one request at a time. The rule is that any received message (regardless of addressing mode physical or functional) occupies this resource until the request message is processed (with final response sent or application call without response).

只有两种例外情况需要单独处理：

- 客户端使用保持活动逻辑来保持先前启用的会话在一个或多个服务端上保持活动状态。Keep-Alive-Logic 被定义为具有 SPRMIB=true 的功能寻址的有效 TesterPresent 消息，并且必须由旁路逻辑处理。服务端负责确保此特定消息不会“阻塞”服务端的应用程序层，并且可以处理紧随其后的寻址消息。

- 如果服务端支持一个或多个法定诊断请求，并且在非法定服务（例如，增强型诊断）处于活动状态时收到这些请求之一，则应中止当前活动服务，启动默认会话，并启动和处理法定诊断请求。如果编程会话处于活动状态，则此要求不适用。

There are only two exceptions which have to be treated separately:

- The keep-alive logic is used by a client to keep a previously enabled session active in one or multiple servers. Keep-Alive-Logic is defined as the functionally addressed valid TesterPresent message with SPRMIB=true and has to be processed by bypass logic. It is up to the server to make sure that this

specific message cannot "block" the server's application layer and that an immediately following addressed message can be processed.

– If a server supports one or more legislated diagnostic requests and one of these requests is received while a non-legislated service (e.g., enhanced diagnostics) is active, then the active service shall be aborted, the default session shall be started and the legislated diagnostic service shall be processed. This requirement does not apply if the programming session is active.

2.8 诊断网关 Diagnostic Gateway

具备诊断网关功能的 ECU 应根据诊断及刷写网关规范[Diagnostic And Bootloader Gateway Specification]进行网关软件的实施。

The ECU with diagnostic gateway function should implement the gateway software according to the Diagnostic and Bootloader Gateway Specification [Diagnostic And Bootloader Gateway Specification].

对于连接了多个私有 ECU 的公共 ECU 主节点，需要负责根据 LIN 矩阵中定义的从机状态报告位在其故障存储空间中记录 LIN 从机故障状态。车辆上电后 LIN 通讯稳定后，可以通过对公共 ECU 主节点发送 ReadDTCInformation (0x19) 和 ClearDiagnosticInformation(0x14)服务读取和清除记录在公共 ECU 主节点故障存储器中的 LIN 从机节点的 DTC。

For a public ECU master node connected to multiple private ECUs, it is responsible for recording the LIN slave failure status in its failure storage space according to the slave state reporting bits defined in the LIN matrix. After the vehicle is powered on, after the LIN communication is stable, the DTC of the LIN slave node recorded in the public ECU master fault memory can be read and cleared by sending the ReadDTCInformation (0x19) and ClearDiagnosticInformation (0x14) services to the public ECU master.

LIN 从机节点数据和自检应能够通过诊断服务由外部测试工具获取或触发。若公共 ECU 主节点没有在 P2server 时间内获取到从机节点的数据，应由公共 ECU 主节点向外部测试工具返回否定响应(0x78)。

LIN Slave data and self-checks should be able to be acquired or triggered by external test tools through diagnostic services. If the public ECU master does not obtain the data of the slave node within

the P2server time, the public ECU maste should return a pending negative (0x78) response to the external test tool.

2.9 安全访问 Security Access

为了能够访问由于保密、排放或安全原因而受限的数据或诊断服务，ECU 应根据需要支持安全访问算法。ECU 可根据系统需求支持一个或多个不同的安全访问级别，有关安全范围级别的定义参见 2.9.1 章节。

In order to be able to access data or diagnostic services that are restricted due to security, emissions, or safety reasons, the ECU should support secure access algorithms as needed. ECU can support one or more different security access levels according to system requirements. For the definition of security access level, please refer to chapter 2.9.1.

小米汽车采用 AES 系列算法作为主体安全算法，并使用密钥管理。小米汽车将在定点后释放独立的安全算法规范文件给供应商。供应商应根据规范实施合理的种子及密钥的生成算法，并确保与安全访问算法有关的所有信息都严格控制。未经小米诊断工程师认可，供应商不应执行零件诊断规范内未定义的安全算法等级。

Xiaomi selects the AES series algorithm as the main security algorithm and uses key management. Xiaomi will release an independent security algorithm specification file to the supplier after sourcing. The supplier shall implement a reasonable seed and key generation algorithm in accordance with the specification, and ensure that all information related to the security access algorithm is strictly controlled. Without the approval of the diagnostic engineer, the supplier shall not implement the securiy algorithm level that is not defined in the ECU diagnostic special specification.

2.9.1 安全访问等级 Security Access Levels

为安全操作定义了几种不同的安全访问级别。不同级别的安全访问定义了不同类型的访问权限，具体取决于外部测试工具使用的功能。

Several different security access levels are defined for secured operations. Different levels of security access define different types of access permissions, depending on the functions used by the external testing tool.

表 10 — 安全访问等级 Table 10 — Security Access Levels

安全访问等级 Security Access Level		描述 Description	备注 Comment
Seed(hex)	Key(hex)		
01	02	用于软件下载 Used for software download	具备下载功能的 ECU 均需执行。 All ECUs with download function need to be implemented.
03	04	用于整车模式切换 Used for CarMode transition	仅指定 ECU 需执行。 Only specified ECU needs to be implemented.
05	06	用于通用诊断服务 Used for Basic diagnostic services	具备诊断功能的 ECU 均需执行。 All ECUs with diagnostic functions need to be implemented.
07	08	用于防盗功能 Used for IMMO function	具备防盗功能的 ECU 均需执行。 All ECUs with anti-theft function need to be implemented.
09	0A	用于信息安全 Used for Security logs	具备信息安全功能的 ECU 均需执行。 All ECUs with Cyber security functions need to be implemented.
5F	60	用于车载起爆装置的报废激活 Used for end of life activation of on-board pyrotechnic devices	仅指定 ECU 需执行。 Only specified ECU needs to be implemented.
61-69	62-6A	用于在 ECU 供应商侧执行特殊功能 Used for the purposes of performing special functions in the ECU supplier side	ECU 供应商开发环境中执行特殊功能的目的。 The implementation of special functions in the development environment of the ECU supplier.

2.9.2 安全访问流程 Security Access Procedure

当外部测试工具从 ECU 请求所需的安全访问类型的安全种子时，就会启动安全访问流程。当外部测试工具提供的安全密钥与 ECU 计算出的安全密钥相匹配时，ECU 的安全访问权限被授予。

The security access procedure is started when the tester requests a security seed from the ECU for the required type of security access. Security access to the ECU is granted when the security key provided by the tester matches the security key calculated by the ECU.

在所有需要安全访问的 ECU 上都应实现如下图“安全访问流程”所示的安全访问流程。

The security access process flow shown in Figure below “Security Access Procedure” shall be implemented in all ECUs that require secure access.

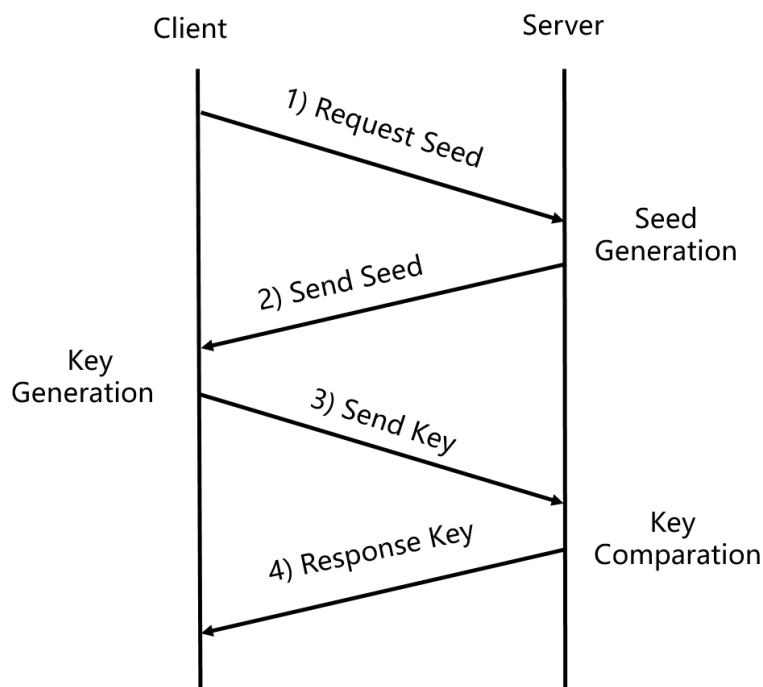


图 3 — 安全访问流程图 Figure 3 — Security Access Procedure

安全访问流程如下所示:

- 1) 客户要求的 “种子”
- 2) 服务器发送 “种子”
- 3) 客户端发送 “密钥” (适用于收到的种子)
- 4) 服务器响应 “Key” 是有效的, 并且它会自动解锁

The secure access process is as follows:

- 1) Client requests the “Seed”
- 2) Server sends the “Seed”
- 3) Client sends the “Key” (appropriate for the Seed received)
- 4) Server responds that the “Key” was valid and that it will unlock itself

在任何时刻, 只有一个安全级别是激活的。例如, 如果与 requestSeed 0x03 相关联的安全级别是激活的, 并且测试者请求成功地解锁了与 requestSeed 0x01 相关联的安全级别, 那么只有与 requestSeed 0x01 相关联

的安全级别支持的安全功能在那个时候应该被解锁。任何先前被与 requestSeed 0x03 相关的安全级别解锁的附加安全功能将不再是活动的。安全级别编号是任意的，并不意味着级别之间有任何关系。

Only one security level shall be active at any instant of time. For example, if the security level associated with requestSeed 0x03 is active and a tester request is successful in unlocking the security level associated with requestSeed 0x01, then only the secured functionality supported by the security level associated with requestSeed 0x01 shall be unlocked at that time. Any additional secured functionality that was previously unlocked by the security level associated with requestSeed 0x03 shall no longer be active. The security levels numbering is arbitrary and does not imply any relationship between the levels.

客户端应通过发送安全访问服务“请求种子”消息请求服务端“解锁”。服务端应通过使用安全访问服务“请求种子”肯定响应消息发送“种子”来响应。种子是密钥计算算法的输入参数。客户端使用它来计算相应的密钥值。

The client shall request the server to “unlock” by sending the service SecurityAccess- ‘RequestSeed’ message. The server shall respond by sending a “seed” using the service SecurityAccess ‘requestSeed’ positive response message. The seed is the input parameter for the key calculation algorithm. It is used by the client to calculate the corresponding key value.

客户端应通过使用适当的安全访问服务“发送密钥”请求消息将计算出的“密钥”发送到服务端来请求密钥比对。服务端应将此“密钥”与内部存储/计算的密钥进行比较。如果这两个数字匹配，则服务端应解锁客户端对特定服务/数据的访问，并通过安全访问服务“发送密钥”肯定响应消息来进行指示。如果这两个数字不匹配，则应将其视为错误访问尝试。无效的密钥要求客户端从安全访问“请求种子”消息重新开始。

The client shall then respond by returning a "key" number back to the server using the appropriate service SecurityAccess ‘sendKey’ request message. 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’ positive response message. If the two numbers do not match, this shall be considered a false access attempt. An invalid key requires the client to start over from the beginning with a SecurityAccess 'requestSeed' message

2.9.3 延迟时间控制 Delay time control

电控单元在以下情况时应激活延时机制，启动延时计时器。失败计数器存储在非易失存储器内。

- a)连续 2 次安全访问尝试失败;
- b)连续 3 次“请求种子”尝试。

The ECU shall activate the delay mechanism and activate the delay timer. . Failure counter should be stored in non-volatile memory in the following situations.

- a) Two (2) false access attempts has been reached;
- b) Three(3) consecutive "Request Seed" attempts.

如果延时计时小于 10 s 时收到安全访问-请求种子服务的请求报文，电控单元应反馈相应的否定响应报文。一旦使用有效密钥成功解锁电控单元，失败计数器将重置为零 (0)，延时机制应停止。

If the time delay time is less than 10s, the ECU shall response a corresponding negative response to a SecurityAccess “requestSeed” message. Once the ECU is successfully unlocked with a valid key, the failure counter will be reset to zero (0) and the delay mechanism should stop.

如果外部测试工具请求种子，它必须将相应的密钥发送到 ECU。这个顺序是强制性的。如果外部测试工具发送连续的“请求种子”，则请求被接受并返回相同的种子，但安全访问失败计数器从第二个“请求种子”开始递增 1。当诊断会话发生切换或会话超时发生时，当前 send-key 序列结束。

If the external test tool requests a seed, it must send the corresponding key to the ECU. This order is mandatory. If the external test tool sends a continuous "request seed", the request is accepted and the same seed is returned, but the security access failure counter is incremented by 1 from the second "request seed". When the diagnostic session is transited (whether from non-defaultSession to defaultSession or non-defaultSession to non-defaultSession) or the session timeout occurs, the current send-key sequence ends.

如果外部测试工具发送无效密钥，请求被拒绝，支持的否定响应代码“InvalidKey”，序列将被重置（任何当前种子变为无效）并且安全访问失败计数器增加 1。

If the external test tool sends an invalid key, the request is rejected, and the negative response code "InvalidKey" is supported, the sequence will be reset (any current seed becomes invalid) and the security access failure counter is increased by 1.

当 SecurityAccess 失败计数器达到 2 (即 2 次错误访问尝试或 3 次连续“请求种子”尝试) 时, 服务端应等待 10 秒, 然后再接受另一个服务 SecurityAccess “请求种子” 消息。在此期间任何服务 SecurityAccess “requestSeed” 消息都将被拒绝, 并使用支持的否定响应代码

“requiredTimeDelayNotExpired” 。当 10 秒等待过去后, SecurityAccess 失败计数器应减 1, 并允许进行一次新的尝试。如果尝试失败 (由于无效的密钥或连续的“请求种子” 尝试), SecurityAccess 失败计数器应再次增加, 服务端应在接受另一个服务 SecurityAccess “requestSeed” 消息之前等待 10 秒。

When the SecurityAccess failure counter reaches 2 (that is, 2 wrong access attempts or 3 consecutive "request seed" attempts), the server should wait 10 seconds before accepting another service SecurityAccess "request seed" message. Any service SecurityAccess "requestSeed" message during this period will be rejected with a supported negative response code

“requiredTimeDelayNotExpired” . After 10 seconds have elapsed, the SecurityAccess failure counter should be decremented by 1, and a new attempt should be allowed. If the attempt fails (due to invalid keys or continuous "request seed" attempts), the SecurityAccess failure counter should be incremented again and the server should wait 10 seconds before accepting another service SecurityAccess "requestSeed" message.

2.10 故障管理 Fault Management

2.10.1 故障检测 Fault Detection

故障检测被定义为 ECU 识别影响 ECU 或任何相关外围组件(传感器、执行器、开关和接线)或系统性能的故障条件的能力。此外, 所有网络错误的情况都应被监视。因此, 检测到的故障至少包含 ECU 级故障和系统级故障。

Fault detection is defined as the ECU's ability to identify fault conditions that affect the ECU or any related peripheral components (sensors, actuators, switches, and wiring) or system performance. In addition, all network error situations should be monitored. Therefore, detected faults include at least ECU level faults and system level faults.

如果 ECU 的某些功能因为一个故障而受损, 则需要存储 DTC 以覆盖故障的根本原因, 其他因根本原因引起的故障则暂停。例如, 当总线关闭时, 控制器应挂起失去通讯故障。

If some function of the ECU is compromised by a failure, the DTC needs to be stored to cover the root cause of the failure, and other faults are compromised by root cause shall be suspended. For example, when the bus is off, the ECU should hang up to lose communication failure.

故障检测过程分为几个部分，定义 ECU 应该在什么时候监控系统中的故障，以及如何检测到故障。

The fault detection process is divided into several parts, defining when the ECU should monitor faults in the system and how they should be detected.

故障检测使用以下术语:

Fault detection uses the following terms:

TRC (Test Run Criteria): 描述 DTC 运行循环的启停条件。

Test Run Criteria(TRC): This section describes the start and stop criteria for the DTC operation cycle.

故障检测标准: 该值被认为是故障发生时的错误触发值。需要列出的信息如下:

- 1、测试失败阈值:
- 2、测试通过阈值:
- 3、测试失败禁止
- 4、增加步长
- 5、步长递减
- 6、检测样品不合格标准
- 7、检测样品通过标准

Fault Detection Criteria: This section describes the error trigger value when the value is considered faulty. The following information needs to be listed:

- 1、test failed threshold:
- 2、test passed threshold:
- 3、test failed inhibit
- 4、increment step size
- 5、decrement step size
- 6、test sample failed criteria

7、test sample passed criteria

客户故障现象:介绍发生故障时, 客户或维护人员可能遇到的现象

Customer Fault Symptom: This section describes the symptoms that may be presented to customers and/or maintenance personnel when a failure occurs.

故障原因:介绍所有可能导致 DTC 被设置的故障原因。

Fault Cause: This section describes all possible fault causes that may set this DTC.

ECU 故障处理措施:介绍控制模块在发生故障时的处理措施。

Fault Measures in ECU: This section describes the measures taken by the control module when the fault is active.

2.10.2 操作循环定义 Operation Cycle Definition

操作循环定义监视器运行的开始和结束条件。在一个操作循环中, 可能已经完成了几个监视循环(不管它们的测试结果如何)。ECU 可以支持多个操作循环。

An operation cycle defines the start and end conditions for monitors to run. During an operation cycle several monitoring cycles may have completed (regardless of their test results). An ECU may support several operation cycles.

小米汽车推荐使用以下三种操作循环, 如果有任何偏离, 需要与小米诊断工程师进行确认。

- 1、车辆上下电循环-电源模式从 "Awake" 或 "OFF" 切换成 "ACC" 或 "Run" ;
- 2、驾驶循环-PTReady 从 "Not Active" 切换成 "Active";
- 3、ECU 上下电循环, 具体策略由 ECU 团队在诊断数据表中进行明确。

XiaoMi recommends using the following three operation cycles. If there is any deviation, please confirm with XiaoMi diagnostic engineers.

- 1、The vehicle power on or off cycle: "Power Mode " changes from "Awake" or "OFF" to "ACC" or "Run";
- 2、Driving cycle: "PT Ready " changes from "Not Active" to "Active";
- 3、ECU power ON-OFF cycle, and the specific strategy is specified by the ECU team in the Diagnostic database.

2.10.3 诊断故障代码 DTC

使用常用的字母和数值来表示车载诊断系统检测的故障。Xiaomi 规范中诊断故障代码采用 3 个字节。诊断故障代码高字节和诊断故障代码低字节提供诊断故障代码的编码，编码规则应该符合 ISO 15031-6 的要求。诊断故障代码失效类型(FTB)字节提供失效类型信息（例如：“B1234 11”）。

Common letters and values are used to indicate faults detected by on-board diagnostic systems
The Xiaomi specification uses a 3-byte diagnostic trouble codes. The DTC high byte and diagnostic trouble low byte provide the DTC code which should comply with ISO 15031-6, and the DTC failure type byte (FTB) provides the failure type information (e.g. "B1234 11").

ISO 15031-6 规定了电气/电子诊断的系统、代码类别、十六进制值和特定部分。

ISO 15031-6 specifies systems, code categories, hexadecimal values, and particular sections of electrical/electronic systems diagnostic.

表 11— ISO15031 故障码分类 Table 11— ISO15031 DTC categories

System	Code categories	Hex value	Appendix
Body	B0xxx – B3xxx	8XXX ₁₆ – BXXX ₁₆	B
Chassis	C0xxx – C3xxx	4XXX ₁₆ – 7xxx ₁₆	C
Powertrain	P0xxx – P3xxx	0XXX ₁₆ – 3XXX ₁₆	P
Generic/Network and vehicle integration	U0xxx – U3xxx	CXXX ₁₆ – FXXX ₁₆	U

DTC 由一个字母数字标识符和 3 个数字代码组成。这个字母数字标识符为 “B0” 、 “B1” 、 “B2” 、 “B3” 、 “C0” 、 “C1” 、 “C2” 、 “C3” 、 “P0” 、 “P1” 、 “P2” 、 “P3” 、 “U0” 、 “U1” 、 “U2” 、 “U3” ，对应车身、底盘、动力和网络四大类。

The recommended DTCs consist of a three digit hexadecimal code preceded by an alphanumeric designator. The alphanumeric designators are “B0” , “B1” , “B2” , “B3” , “C0” , “C1” , “C2” , “C3” , “P0” , “P1” , “P2” , “P3” , “U0” , “U1” , “U2” , “U3” , corresponding to four sets of body, four sets of chassis, four sets of powertrain, and four sets of network and vehicle integration trouble codes.

2.10.3.1 诊断故障代码格式 DTC format

以 DTC B123411 为例，DTC 的格式如下表所示：

The following table is an example for DTC B123411 format.

表 12 — DTC 格式 Table 12 — DTC Format

DTC High Byte				DTC Middle Byte				DTC Low Byte			
0x9		0x2		0x3		0x4		0x1		0x1	
1	0	0	1	0	0	1	1	0	1	0	0
B	1	2		3		4		1		1	

使用 DTC 格式标识符 0x00 作为数据总线值 0x923411 的 3 字节 DTC 将作为制造商控制的车身代码 B1234-11 显示给技术人员。

A 3-byte DTC using DTC Format Identifier 0x00 as a data bus value 0x923411 would be displayed to technicians as the manufacturer controlled body code B1234–11.

2.10.4 故障状态 DTC Status

故障内存管理 DTC 以及 DTC 的状态信息。DTC 状态信息可以帮助我们了解 DTC 的状态，如活动、等待、DTC 就绪指示器和警告指示器请求状态。

The fault memory manages DTCs including its status information. The DTC status information help us to know about the state of the DTC such as active, pending, DTC readiness indicator, and the warning indicator request state.

表 13 — DTC 状态位分配 Table 13 — DTC Status Bit Assignments

Bit	Description	Cvt
0	测试失败 该位用来指示最近进行的测试的结果。逻辑上的“1”表明最后一次测试失败，这意味着该失败已经完全成熟。如果最近执行的测试的结果返回一个“通过”的结果，意味着所有不成熟的条件都已满足，则重置为逻辑“0”。 状态定义： ‘0’ = DTC 测试的最新结果表明没有检测到故障。 ‘1’ = DTC 测试的最新结果，表示成熟的失败结果。 TestFailed 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. Reset	M

	to logical '0' if the result of the most recently performed test returns a “pass” result meaning that all de-mature criteria have been fulfilled. Bit state definition: '0' = most recent result from DTC test indicated no failure detected. '1' = most recent result from DTC test indicated a matured failing result.	
1	本次操作循环测试失败 该位用于指示一个诊断测试在当前的操作循环中测试的结果。当启动一个新的操作循环时，或者在调用 ClearDiagnosticInformation 之后，将其重置为逻辑 “0” 。 如果这个位被设置为逻辑 “1” ，它将保持 “1” ，直到一个新的操作循环开始。 状态定义: '0' = testFailed:在当前操作循环中，或者在当前操作循环中对 ClearDiagnosticInformation 进行了调用之后，没有报告结果。 '1' = testFailed:在当前操作循环中报告了至少一次结果。 TestFailedThisOperationCycle This bit shall indicate whether or not a diagnostic test has reported a testFailed result at any time during the current operation cycle. Reset to logical '0' when a new operation cycle is initiated or after a call to ClearDiagnosticInformation. If this bit is set to logical '1', it shall remain a '1' until a new operation cycle is started. Bit state definition: '0' = testFailed: result has not been reported during the current operation cycle or after a call was made to ClearDiagnosticInformation during the current operation cycle. '1' = testFailed: result was reported at least once during the current operation cycle.	M
2	未确认的诊断故障代码 该位用来指示是否一个诊断测试在当前或者上一个操作循环中报出一个测试失败的结果。如果测试完成该位才会被更新。设置 “未确认的诊断故障代码” 这一位和设置 “本次操作循环测试失败” 这一位的条件相同。不同之处是 “本次操作循环测试失败” 这意味会在当前操作循环结束时被清除，而 “未确认的诊断故障代码” 这位不会清除，直到操作循环结束前该测试通过并且没有再失败过。 状态定义: '0' =在测试完成并且没有检测到故障的操作循环之后，或者在对 ClearDiagnosticInformation 服务的调用之后，该位应该设置为 0。	M

	'1' =如果在当前运行循环内检测到故障，该位应设置为 1 并锁存。 PendingDTC This bit shall indicate whether or not a diagnostic test has reported a testFailed 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 pendingDTC bit and the TestFailedThisOperationCycle bit are the same. The difference is that the testFailedThisOperationCycle is cleared at the beginning of each operation cycle and the pendingDTC bit is not cleared until an operation cycle has completed where the test has passed at least once and never failed. Bit state definition: '0' = This bit shall be set to 0 after completing an operation cycle during which the test completed and a malfunction was not detected or upon a call to the ClearDiagnosticInformation service. '1' = This bit shall be set to 1 and latched if a malfunction is detected during the current operation cycle.	
3	已确认的诊断故障代码 该位用来表示故障是否被检测到足够次数，以保证 DTC 被存储在长期存储器中。一个已确认的 DTC 并不总是表明在请求时出现了故障。(testFailed 可用于确定在请求时是否存在故障)。在调用 ClearDiagnosticInformation 之后，或者在满足老化阈值之后(例:100 IGN ON 到 OFF 循环，没有检测到其他故障)，将其重置为逻辑 "0" 。此外，由于故障存储导致 DTC 溢出后，此位可重置。 状态定义： '0' = DTC 从上次调用 ClearDiagnosticInformation 之后，或者在满足了 DTC 的老化条件之后(或者 DTC 由于故障内存溢出而被擦除)，从未被确认过。 '1' = DTC 从 cleardiagnosticinformation 的最后一次调用以来至少确认了一次，并且老化标准还没有被满足。 ConfirmedDTC This bit shall indicate whether a malfunction was detected enough times to warrant that the DTC is desired to be stored in long-term memory.A confirmedDTC does not always indicate that the malfunction is present at the time of the request. (testFailed can be used to determine if a malfunction is present at the time of the request).Reset to logical '0' after	M

	a call to ClearDiagnosticInformation or after aging threshold has been satisfied (e.g. 100 IGN ON to OFF cycles without another detected malfunction). Furthermore this bit is reset when the fault record associated with this DTC is overwritten by a newer DTC based upon vehicle manufacturer specific fault memory overflow requirements. Bit state definition '0' = DTC has never been confirmed since the last call to ClearDiagnosticInformation or after the aging criteria have been satisfied for the DTC (or DTC has been erased due to fault memory overflow). '1' = DTC confirmed at least once since the last call to ClearDiagnosticInformation and aging criteria have not yet been satisfied.	
4	自上次清除后测试未完成 该位用来指示自从上一个清除诊断信息服务完成后，DTC 测试是否已经运行并完成。1 表明 DTC 测试尚未完成。如果测试运行并通过，或者测试运行并失败(例如 testFailedThisOperationCycle = '1')，则该位应设置为'0'(并锁存)。 状态定义： '0' = DTC 测试自上次清除诊断信息以来至少返回了一次通过或失败的测试结果。 '1' = 自上次清除诊断信息以来，DTC 测试一直没有运行到完成。 TestNotCompletedSinceLastClear This bit shall indicate whether a DTC test has ever run and completed since the last time a call was made to ClearDiagnosticInformation. One ('1') shall indicate that the DTC test has not run to completion. If the test runs and passes or if the test runs and fails (e.g. testFailedThisOperationCycle = '1') then the bit shall be set to a '0'(and latched). Bit state definition '0' = DTC test has returned either a passed or failed test result at least one time since the last time diagnostic information was cleared. '1' = DTC test has not run to completion since the last time diagnostic information was cleared.	M
5	自上次清除后测试失败	M

	该位指示自从上次清除诊断信息服务后，是否一个 DTC 测试报出一个失败的结果。“0” 将用来指示该测试还没有运行或者改测试已经运行并且通过。如果测试运行并且失败，那么该位将会保留“1”。在清除诊断信息服务后，该位置“0”。 状态定义： '0' = DTC 测试自上次清除诊断信息以来没有表示失败的结果。 '1' = DTC 测试从上次清除诊断信息以来至少返回一次失败的结果。 TestFailedSinceLastClear This bit shall indicate whether a DTC test has completed with a failed result since the last time a call was made to ClearDiagnosticInformation.Zero ('0') shall indicate that the test has not run or that the DTC test ran and passed. If the test runs and fails then the bit shall remain latched at a '1'. Bit state definition '0' = DTC test has not indicated a failed result since the last time diagnostic information was cleared. '1' = DTC test returned a failed result at least once since the last time diagnostic information was cleared.	
6	本次操作循环测试未完成 该位用于指示在当前的操作循环中是否一个 DTC 测试运行且完成(或者在最后一次调用 ClearDiagnosticInformation 之后，在当前操作循环中完成)。“1”表示这个 DTC 测试在当前的操作循环中没有完成。如果这个测试运行且通过或者失败，则该位会置“0”，直到一个新的操作循环开始。清除诊断信息服务后，该位置“0”。 状态定义： '0' = DTC 测试在当前驱动循环(或自当前操作循环中最后一次诊断信息被清除以来)中返回了一个 passed 或 testFailedThisOperationCycle = '1'的结果。 '1' = DTC 测试还没有运行完此操作循环(或自上次诊断信息被清除此操作循环以来)。 TestNotCompletedThisOperationCycle This bit shall indicate whether a DTC test has ever run and completed during the current operation cycle (or completed during the current operation cycle after the last time a call was made to ClearDiagnosticInformation).	M

	A logical '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. Bit state definition '0' = DTC test has returned either a passed or testFailedThisOperationCycle = '1' result during the current drive cycle (or since the last time diagnostic information was cleared during the current operation cycle). '1' = DTC test has not run to completion this operation cycle (or since the last time diagnostic information was cleared this operation cycle).	
7	请求点亮警告指示灯 该位应报告与特定 DTC 相关的任何警告指示器的状态。警告输出可能包括指示灯、显示文本信息。如果一个特定的 DTC 不存在警告指示器，该状态将默认为逻辑 "0" 状态。如果一个特定的 DTC 存在警告指示器，需要列明警告指示器开启条件和关闭条件。如果给定的 DTC 的警告指示器是亮的，则 confirmedDTC 也应设置为 "1" 。 状态定义： '0' = 服务器没有请求激活警告指示器 '1' = 服务器正在请求激活警告指示器 warningIndicatorRequested 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 particular DTC, this status shall default to a logic '0' state. If the warning indicator is on for a given DTC, "Warning Indicator on condition" and "Warning Indicator off condition" need to be listed. If the warning indicator is on for a given DTC, then confirmedDTC shall also be set to '1' Bit state definition '0' = Server is not requesting warningIndicator to be active '1' = Server is requesting warningIndicator to be active	U

2.10.5 故障快照信息 DTC Snapshot Information

DTC 快照(有时称为冻结帧)是与 DTC 相关的特定数据记录, 存储在服务器的内存中。DTC 快照记录可能包含多个数据参数, 可用于在故障发生时重建车辆状况(例如 B+, RPM、时间戳)。DTC 特定的数据参数旨在简化技术人员的故障处理过程。按使用范围分为全局快照和本地快照。

DTC Snapshots(sometimes referred to as freeze frames) are specific data records associated with a DTC, that are stored in the server's memory. The DTC Snapshot record may contain multiple data-parameters that can be used to reconstruct the vehicle conditions (e.g. B+, RPM, time-stamp) at the time of the failure occurrence. The DTC specific data-parameters are intended to ease the fault isolation process by the technician. According to the using scope, there are global snapshot and local snapshot.

全局 DTC 快照数据由分布在车辆网络上并由所有 ECU 接收的数据组成。

Global DTC snapshot data consists of data that is distributed across the vehicle networks and received by all ECUs.

本地 DTC 快照数据是为每个 ECU 单独定义的, 可以包括只有特定 ECU 知道的数据。对于发生的原因确定, 清晰的 DTC, 可以不做个性化冻结帧。

Local DTC snapshot data is defined individually for each ECU and can include data that is only known to the particular ECU. For DTCs where the cause of the occurrence is clear, the local snapshot can be omitted.

一个服务端应该支持为一个 DTC 存储多个快照记录, 以跟踪 DTC 每次发生时出现的条件。故障内存应尽可能大, 必须能够存储至少 20 个 DTC 及其快照记录数据。每个 DTC 必须存储至少一个快照记录。

A server should support the storage of multiple DTC Snapshot records for a single DTC to track conditions present at each occurrence of the DTC. The fault memory implementation should be as large as possible and must store at least 20 DTCs with their snapshot record data. Every DTC has to store at least one snapshot record.

第一个快照记录包含关于第一次发生的信息。该快照为必选项。

The first snapshot record contains information about the first occurrence. This snapshot is mandatory.

第二个(可选)快照记录包含最后一个出现。

The second (optional) snapshot record contains the last occurrence.

快照记录信息应该在客户端成功的 ClearDiagnosticInformation 请求后被清除。当存储 DTC 和快照数据的内存溢出时(存储 DTC 和快照数据的内存空间在服务器中被完全占用)，根据 DTC 优先级删除 DTC 快照数据。

DTCSnapshot record identification information shall be cleared upon a successful ClearDiagnosticInformation request from the client. Delete DTC snapshot data based on the DTC priority for the deletion of stored DTCs and DTCSnapshot data in case of a memory overflow (memory space for stored DTCs and DTCSnapshot data completely occupied in the server).

服务端应在单个响应消息中报告一个 DTCSnapshot 记录，除非客户端将 DTCSnapshotRecordNumber 设置为 0xFF，因为这将导致服务端响应为单个响应消息中为客户端定义的 DTCMaskRecord 存储的所有 DTCSnapshot 记录。 DTCAndStatusRecord 仅包含在响应消息中一次。如果客户端在其请求中将参数 DTCSnapshotRecordNumber 使用了 0xFF，则服务端应按数字升序报告为特定 DTC 捕获的所有 DTCSnapshot 记录。

The server shall report one DTCSnapshot record in a single response message, except the client has set the DTCSnapshotRecordNumber to 0xFF, because this shall cause the server to respond with all DTCSnapshot records stored for the client defined DTCMaskRecord in a single response message. The DTCAndStatusRecord is only included one time in the response message.If the client has used 0xFF for the parameter DTCSnapshotRecordNumber in its request, the server shall report all DTCSnapshot records captured for the particular DTC in numeric ascending order.

2.10.6 故障扩展信息 DTC Extended Information

扩展数据信息由与 DTC 关联的扩展状态信息组成。扩展数据信息包含 DTC 参数值，这些值在请求时已被识别。扩展数据信息的一个典型用法是存储与 DTC 关联的动态数据，如故障发生计数器、故障待处理计数器、老化计数器。

Retrieve DTCExtendedData associated with a client defined DTC and status mask combination out of the DTC memory or the DTC mirror memory. DTCExtendedData consists of extended status information associated with a DTC. DTCExtendedData contains DTC parameter values, which have been identified at the time of the request. A typical use of DTCExtendedData is to store dynamic data

associated with the DTC such as fault occurrence counter, fault pending counter, aged counter and ageing counter.

计数器为一个字节。如果发生任何会导致计数器超过 0xFF 的计数操作，则计数值应保持在 0xFF。

The counter shall be implemented as one byte. If any count operation occurs which would cause a counter to roll over past 0xFF then the count value shall instead be maintained at 0xFF.

根据下表，ECU 支持的所有 DTC 都应支持 DTC 操作循环计数器和 DTC 故障检测计数器：

DTC operation cycle counters & DTC fault detection counters shall be supported for all DTCs supported by the ECU according to the table below:

记录号 Record Number	名称 Name	定义 Definition	支持 Support
0x01	DTC 操作循环计数器#1 (OCC1) DTC operation cycle counter#1 (OCC1)	自上次 DTC failed 以来的操作循环计数器表示自 DTC 故障检测计数器达到最大值+127(自 DTC 信息被清除)以来的操作循环数。应包括所有操作循环，包括那些测试未完成的操作循环。 如果计数器可用并已启动，则应在引用的操作循环结束时递增。 如果内部错误计数器达到 DemDebounceCounter-FailedThreshold，该操作循环计数器应初始化为零。 The counter Cycles since last failed is representing the number of operation cycles since the DTC fault detection counter last reached its maximum value +127 (since DTC information was last cleared). All operation	M

		cycles, including those during which the test was not completed shall be included. In case the counter is available and started, it shall be incremented at the end of the referenced operation cycle. If internal debounce counter reach DemDebounceCounter-FailedThreshold, the counter shall initialized to zero.	
0x03	DTC 操作循环计数器#3 (OCC3) DTC operation cycle counter#3 (OCC3)	自第一次 DTC failed 以来的操作循环计数器表示自 DTC 故障检测计数器第一次达到其最大值 +127 (自上次清除 DTC 信息) 以来的操作循环数。 应包括所有操作循环, 包含那些未完成故障测试的操作循环。 如果计数器可用并已启动, 则应在引用的操作循环结束时递增。 The counter Cycles since first failed is representing the number of operation cycles since the DTC fault detection counter first reached its maximum value of +127 (since DTC information was last cleared). All operation cycles, including those in which the test has not been completed shall be included. In case the counter is available and started, it shall be incremented at the end of the referenced operation cycle.	M

0x04	DTC 操作循环计数器#4 (OCC4) DTC operation cycle counter#4 (OCC4)	DTC failed 操作循环计数器表示 DTC 故障检测计数器达到最大值+127（自上次清除 DTC 信息以来）的操作循环数。 如果计数器可用并已启动，则在 UDS 状态位 1 设置为 1 的情况下，它应在引用的操作循环（请参阅 DemOperationCycleRef）结束时递增。 The counter Failed cycles is representing the number of operation cycles during which the DTC fault detection counter reached its maximum value of +127 (since DTC information was last cleared). In case the counter is available and started, it shall be incremented at the end of the referenced operation cycle (refer to DemOperationCycleRef) in case the UDS status bit 1 is set to 1.	M
0x10	DTC 故障检测计数 10 (FDC10) DTC fault Detection counter 10 (FDC10)	1. 在新的操作循环开始时，计数值应为 0。 2. 当故障检测因不满足故障检测条件而停止时，计数值应在相同操作循环内保持不变。 3. 当前错误计数器值为负数时，如果一个测试的单个测试样本返回失败结果，新的错误计数器应以 0 为基础进行累加。 4. 当前错误计数器值为正数时，如果一个测试的单个测试样本返回通过结果，新的错误计数器应以 0 为基础进行递减。 5. 每次 DTC 故障检测并产生测试失败或通过结果时，计数值应更新（增加或减少）。如果连续	M

		测试失败结果的数量超过 127 达到 testFailedLimit +127 (从开始值 0) 或如果连续测试通过结果的数量超过 128 达到 testPassedLimit -128 (从开始 值 0), 计数值应保持+127 或-128, 并无法更新 (增加或减少)。 有关 DTC 状态位的详细信息, 请参阅 DTC 状态位部分。 存储的计数器应根据 UDS 服务中指定的诊断服务的请求进行报告, 并报告为 1 字节有符号数字, 范围为 -128 到 + 127。 1. At the start of a new operation cycle the count value shall be 0. 2. The count value shall be maintained between test runs within one and same operation cycle (also when the test run is blocked due to the test run criteria is not satisfied). 3. If a single test sample of a test returns a fail result, when the current value of the counter is negative, the new count value resulting from the fail result shall be set as if the current count value had been 0 . 4. If a single test sample of a test returns a pass result, when the current value of the counter is positive, the new count value	
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		resulting from the pass result shall be set as if the current count value had been 0 (a test sample represents the pass result shall always causes fault detection counter to decrement below 0). 5. The count value shall be updated (increased or decreased) each time the DTC test runs and produce a test sample failed or passed result. If the number of consecutive test sample failed results is more than 127 to reach the testFailedLimit +127 (from the start value 0) or if the number of consecutive test sample passed results is more than 128 to reach the testPassedLimit -128 (from the start value 0), the count value cannot be updated (increased or decreased) each time the DTC test runs and produce a test sample failed or passed result. Refer to section DTC status bits for details of the DTC status bits. The stored counter shall be reported on request of the diagnostic services specified in [Data_1] UDS Services and be reported as 1 byte signed numeric with a range of -128 to + 127.	
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2.10.7 故障优先级 DTC Priority

一般来说，ECU 设计用于在非易失性存储器中同时存储每个支持的 DTC 的大量 DTC 状态信息。因此，需要一种优先级排序。

对于每个 DTC，必须定义相应的优先级。ECU 供应商必须根据下表为每个 DTC 提供初始和适当的优先级。小米确认每个 DTC 的优先级。

如果在出现新故障诊断码时，电子控制单元（ECU）的故障诊断码（DTC）状态信息存储器已满，则系统必须决定是忽略最新的故障诊断代码，还是从故障记忆中删除任何其他故障诊断码，以获得存储最新故障诊断代码的可用空间。

故障优先级定义为基于重要性级别的 DTC 排序。故障优先级用于确定在所有数据记录已满的情况下，哪些故障条目可以从存储器中删除。故障优先级 1 定义为无法从存储器中推送的故障，优先级 1 DTC 的总数不得超过故障存储器的最大值。故障优先级 2...n 被定义为可通过相同或更高优先级的故障从存储器中删除的故障（例如，优先级 2 的 DTC 应删除优先级 3 的 DTC）。

定义此故障诊断码优先级的值（1-255）。应采用以下优先级：

In general, ECU is designed to store a large amount of DTC status information of each supported DTC in nonvolatile memory at the same time. Therefore, a prioritization is required.

For each DTC, the corresponding priority must be defined. ECU supplier must provide initial and appropriate priority for each DTC according to Table below. XIAOMI confirms the priority of each DTC. If the diagnostic trouble code (DTC) status information memory of the electronic control unit (ECU) is full when a new diagnostic trouble code occurs, the system must decide whether to ignore the latest diagnostic trouble code or delete any other diagnostic trouble code from the fault memory to obtain the available space for storing the latest diagnostic trouble code.

Fault priority is defined as DTC ranking based on importance level. Fault priority is used to determine which fault entries can be deleted from the memory when all data records are full. Fault priority 1 is defined as the fault that cannot be pushed from the memory. The total number of priority 1 DTC shall not exceed the maximum value of the fault memory. Fault priority 2... n is defined as faults that can be deleted from the memory by faults of the same or higher priority (for example, DTC of priority 2 shall delete DTC of priority 3).

Value (1-255) defining the priority of this DTC. The following priority should be applied:

DTC 优先级定义 DTC priority		
Level	Action	Criterion Description
Level 1	故障发生需要立即检查车辆 The failure requires an immediate check of the vehicle.	满足以下条件之一： 1) 法规要求（如被动安全、功能安全）要求的故障警告指示； 2) 关键系统（动力、功能安全、驱动、转向、制动、关键网络通讯故障、绝缘、安全保护、热管理）功能完全丧失，影响行车安全或人身安全。 One of the following conditions is met: 1) Fault Warning indicator required by regulations (e.g. passive safety, functional safety); 2) The key system (functional safety, drive, steering,

		braking, key network communication failure, insulation, safety protection, thermal management) function is completely lost, affecting the driving safety or personal safety.
Level 2	故障发生需要在安全的情况下直接缓慢行驶到附近维修站检修车辆 The failure requires a check of the vehicle by driving slowly to the nearby maintenance station directly under a safe condition.	满足下列所有条件： 1) 关键系统（动力、功能安全、驱动、转向、制动、关键网络通信故障、热管理）的功能受限或性能下降； 2) 当前故障不影响行车安全或人身安全，但继续行车会导致故障范围扩大，可能导致自身或其他系统出现新的 I 级故障。 All of the following conditions must be met: 1) Function limitation or performance degradation of key systems (power, functional safety, drive, steering, braking, key network communication failure, thermal management); 2) The current fault does not affect the driving safety or personal safety, but continues to drive will result in the scope of failure expands and may cause new level I fault of itself or other systems.
Level 3	故障发生需要在方便时尽快开车到附近的维修站检修车辆 The failure requires a check of the vehicle by driving to the nearby maintenance station as soon as possible when convenient.	必须满足以下所有条件： 1) 关键系统（动力、功能安全、驱动、转向、制动、关键网络通信故障、热管理）的功能受限或性能下降； 2) 当前故障不会影响行车安全或人身安全，不会扩大或限制连续行车的故障范围（如系统内），不会导致自身或其他系统出现新的 I 级故障。 All of the following conditions must be met: 1) Function limitation or performance degradation of key svstems (power, functional safety, drive, steering, braking, key network communication failure,thermal management); 2) The current fault will not affect the driving safety or personal safety, and the failure range of continuous driving will not be expanded or Limited (such as within the system), which will not cause new level I fault of itself or other systems.
Level 4	故障发生仅需要维修 The failure requests maintainance only.	非关键系统（便利、舒适、娱乐）功能丧失，能被驾驶员清晰感知，当前故障不会影响行车安全或人身安全。 The non critical system (convenience, comfort and entertainment) functions lost with driver clearly perception and the current failure willll not affect the driving safety or personal safety.

Level 5	按实际需要维护 Maintenance as actual required.	驾驶员感知差异的非关键系统（便利性、舒适性、娱乐性）功能有限或性能下降，当前故障不会影响行车安全或人身安全。 Non critical systems (convenience, comfort, entertainment) with driver perception differences have limited functions or performance degradation and the current failure will not affect the driving safety or personal safety.
Level 6 – 255	Undefined	Undefined

2.11 诊断通信条件 Diagnostic Communication Condition

当 ECU 被唤醒，且发出第一帧报文后，ECU 需要具备接收和响应诊断请求的能力。

当 ECU 接收到诊断复位(0x11)服务后，ECU 需要在 1000ms 内具备接收和响应诊断请求的能力。

When the ECU is awakened, and the ECU sends the first frame message, the ECU needs to have the ability to receive and respond to diagnostic requests.

When the ECU receives the diagnostic reset (0x11) service, the ECU needs to be able to receive and respond to diagnostic requests within 1000ms.

3 诊断服务 Diagnostic Services

3.1 所需诊断服务概述 Required Diagnostic Services Overview

下表显示了所有需要在小米汽车配备的 ECU 中实现的 UDS 诊断服务。

The following table shows all of the UDS diagnostic services which are required to be implemented in ECUs equipped in Xiaomi Vehicles.

表 14 — 支持的 UDS 服务 Table 14 — Supported UDS Service List

诊断服务 Diagnostic Services	默认会话 Default Session	编程会话 Programming Session	扩展诊断会话 Extended Diagnostic Session	安全系统诊断会话 SaftySystem Diagnostic Session	安全访问需求 Security Access required	寻址类型 Addressing type
0x10-Diagnostic SessionControl	M	M	M	O	No	Physical & Functional
0x11-ECUReset	M	M	M	O	No	Physical & Functional
0x14-ClearDiagnostic Information	M	N/A	M	O	No	Physical & Functional
0x19-ReadDTC Information	M	N/A	M	O	No	Physical & Functional
0x22-ReadDataBy Identifier	M	M	M	O	No	Physical & Functional
0x23-ReadMemoryByAddress	N/A	N/A	O	O	Yes	Physical
0x27-SecurityAccess	N/A	M	M	O	No	Physical
0x28-Communication Control	N/A	N/A	M	O	No	Physical & Functional
0x2E-WriteDataBy Identifier	N/A	M	M	O	Yes	Physical
0x2F-InputOutputControlByIdentifier	N/A	N/A	O	O	Yes	Physical
0x31-RoutineControl	M	M	M	O	Yes	Physical & Functional
0x34-Request Download	N/A	M	N/A	N/A	Yes	Physical
0x36-TransferData	N/A	M	N/A	N/A	Yes	Physical

0x37-RequestTransferExit	N/A	M	N/A	N/A	Yes	Physical
0x3E-TesterPresent	M	M	M	O	No	Physical & Functional
0x85-ControlDTC Setting	N/A	N/A	M	O	No	Physical & Functional

Note1: 对于任何给定服务的服务器支持的所有子功能参数值（即子功能结构的第 6-0 位），都应支持 肯定响应抑制位(suppressPosRspMsgIndicationBit) 值 “0” 和 “1” 。

Note1: suppressPosRspMsgIndicationBit values of both '0' and '1' shall be supported for all sub-function parameter values (i.e., bits 6-0 of the sub-function structure) supported by the server for any given service.

3.2 诊断会话控制 (0x10) 服务 DiagnosticSessionControl (0x10)

诊断会话控制服务用于在服务端中启用不同的诊断会话。

The DiagnosticSessionControl service is used by the client to enable different diagnostic sessions in the server(s).

诊断会话在服务端中启用一组特定的诊断服务和/或功能。该服务提供了这样的功能，服务端可以报告数据链路层特定的参数值(例如定时参数值)对启用的诊断会话有效。

A diagnostic session enables a specific set of diagnostic services and/or functionality in the server(s). This service provides the capability that the server(s) can report data link layer specific parameter values valid for the enabled diagnostic session (e.g. timing parameter values).

一个服务端上，始终只有一个活动的诊断会话。服务端在上电时将始终启动默认诊断会话。如果没有启动其他诊断会话，则默认诊断会话将在服务端上电时运行

There shall always be exactly one diagnostic session active in a server. A server shall always start the default diagnostic session when powered up. If no other diagnostic session is started, then the default diagnostic session shall be running as long as the server is powered.

进入编程会话的前提条件规则如下：

- a) 车速不超过 3km/h;
- b) 系统不执行内部关键操作;
- c) 其他需要小米汽车同意的限制条件。

当不满足这些条件中的至少一项时，ECU 应返回 NRC 0x22。 如果无法获得有效车速，则该场景视为车速满足前提条件。

The precondition rules to implement the programming session of the service are as follow:

- a) Vehicle speed is not over 3km/h;
- b) No critical operations is performed by the system;
- c) Other limiting conditions need to be agreed by Xiaomi.

When at least one of these conditions is not met, the ECU shall return NRC 0x22. If the valid vehicle speed cannot be obtained, this scene shall be regarded as the vehicle speed having fulfilled the precondition.

图 4 概述了诊断会话转换，以及服务器在转换到另一个会话时应该做什么。

Figure 4 provides an overview about the diagnostic session transition and what the server shall do when it transitions to another session.

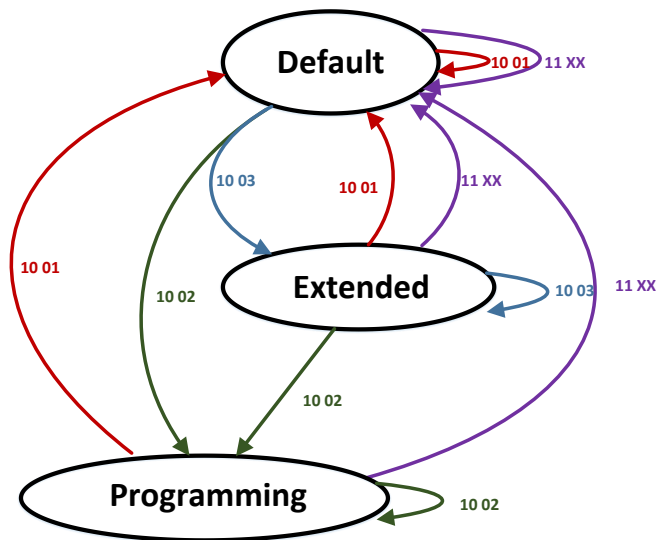


图 4 — 服务端诊断会话状态图 Figure 4 — Server diagnostic session state diagram

3.2.1 消息格式 Message Format

请求消息定义：Request message definition:

A_Data Byte	Parameter Name	Cvt	Value (hex)
#1	DiagnosticSessionControl Request SID	M	10
#2	Sub-Function = [DiagnosticSessionType]	M	00 – FF

肯定响应消息：Positive Response message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	50
#2	Sub-Function = [DiagnosticSessionType]	M	00 – FF
#3	P2server [] = [P2CAN_Server_max High byte	M	00-FF
#4	P2CAN_Server_max Low byte]	M	00-FF
#5	P2*server[] = [P2*CAN_Server_max High byte	M	00-FF
#6	P2*CAN_Server_max Low byte]	M	00-FF

作为会话参数记录报告的定时参数应遵循下表中定义的缩放格式。

The timing parameters reported as Session Parameter Record shall follow the scaling format

defined in Table below.

Parameter	Description	Number of Bytes	Resolution (ms/bit)	Min Value (ms)	Max Value (ms)
P2CAN_Server_max	服务端对激活的诊断会话默认支持的 P2 Server_max 计时。 Default P2 Server_max timing supported by the server for the activated diagnostic session.	2	1	0	65535
P2*CAN_Server_max	服务端对激活的诊断会话支持的增强 (NRC 0x78) P2 Server_max 计时。	2	10	0	655350

	Enhanced (NRC 0x78) P2 Server_max supported by the server for the activated diagnostic session.				
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否定响应消息：Negative Response message:

Byte	Name	Cvt	Value (hex)
#1	Negative Response Service Identifier	M	7F
#2	OriginalRequestServiceIdentifier	M	10
#3	NegativeResponseCode	M	(see below)

支持的否定响应码：Supported Negative Response Codes:

NRC (hex)	Description
12	不支持该子功能 如果不支持该子功能参数，则应发送此否定响应码。 subFunctionNotSupported This NRC shall be sent if the sub-function parameter is not supported.
13	不正确的消息长度或无效格式 如果消息长度错误，则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.
22	条件不正确 如果不满足诊断会话控制请求的标准，则应返回此否定响应码。所有的条件均应提供给小米汽车。 conditionsNotCorrect This NRC shall be returned if the criteria are not met or request sequence error for the request DiagnosticSessionControl. All the criteria shall be provided to Xiaomi.

3.2.2 参数选项 Parameter Options

[诊断会话类型]参数指定应启动哪个会话。有关会话跳转的详细定义，请参考 Ref.4。

The DiagnosticSessionType parameter specifies which session shall be started. For the detailed definition of the session switching, please refer to Ref. 4.

Option (hex)	Description 描述
01	默认会话 - 需要肯定响应 Default Session – Positive response required
02	编程会话 - 需要肯定响应 Programming Session – Positive response required
03	扩展诊断会话 - 需要肯定响应 Extended Diagnostic Session – Positive response required
04	安全系统诊断会话- 需要肯定响应 SafetySystemSession – Positive response required

3.3 ECU 复位 (0x11) 服务 ECUReset(0x11)

客户端使用 ECU 复位服务来请求服务端重置。

The ECUReset service is used by the client to request a server reset

该服务请求服务端根据嵌入在 ECUReset 请求消息中的 resetType 参数值的内容有效地执行服务端重置。

ECUReset 正响应消息(如果需要)应该在服务端执行重置之前发送。服务端重置成功后，服务端将激活默认会话。

This service requests the server to effectively perform a server reset based on the content of the resetType parameter value embedded in the ECUReset request message. The ECUReset positive response message (if required) shall be sent before the reset is executed in the server(s). After a successful server reset the server shall activate the defaultSession.

进入 ECU 复位 (0x11) 服务的前提条件规则如下：

- a) 车速不超过 3km/h;
- b) 系统不执行内部关键操作;
- c) 其他需要小米汽车同意的限制条件。

当至少这些条件之一不满足时，ECU 应返回 NRC 0x22。 如果无法获得有效车速，则该场景视为车速满足前提条件。

The precondition rules to implement the ECUReset(0x11) service are as follow:

- a) Vehicle speed is not over 3km/h;
- b) No critical operations are performed by the system;

- c) Other limiting conditions need to be agreed by Xiaomi.

When at least one of these conditions is not met, the ECU shall return NRC 0x22. If the valid vehicle speed cannot be obtained, this scene shall be regarded as the vehicle speed having fulfilled the pre-conditions.

3.3.1 消息格式 Message Format

请求消息定义: Request message definition:

Byte	Name	Cvt	Value (hex)
#1	ECUReset Request SID	M	11
#2	Sub-Function = [ResetType]	M	00-FF

肯定响应消息: Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	51
#2	Sub-Function = [ResetType]	M	00-FF

否定响应消息: Negative Response Message:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	11
#3	NegativeResponseCode	M	(see below)

支持的否定响应码: Supported Negative Response Codes:

NRC (hex)	Description
12	不支持该子功能 如果不支持该子功能参数, 则应发送此否定响应码。 subFunctionNotSupported This NRC shall be sent if the sub-function parameter is not supported.
13	不正确的消息长度或无效格式

	如果消息长度错误，则应发送此否定响应码。incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.
22	条件不正确 如果未满足请求 EcuReset 的条件，则应返回此否定响应码。所有的条件均应提供给小米汽车。 conditionsNotCorrect This NRC shall be returned if the criteria for the ECUReset request is not met. All the criteria shall be provided to Xiaomi.
7F	活动会话不支持服务 Service not supported in active session

3.3.2 参数选项 Parameter Options

ECU 复位请求消息使用子功能参数“复位类型”来描述服务端必须如何执行重置。

The ResetType parameter specifies which kind of reset shall be performed.

Option(hex)	Description	Cvt
01	硬重启 该值规定了“硬复位”条件，该条件模拟通常在服务端先前已与其电源（即电池）断开之后执行的通电/启动流程。执行的操作由具体实施情况而定，本规范未定义。这可能导致易失性存储器和非易失性存储器位置被重新初始化为预定值。 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). The performed action is implementation specific and not defined by the standard. It might result in the re-initialization of both volatile memory and non-volatile memory locations to predetermined values.	M
03	软重启 这个值标识一个“软重启”条件，如果可用，它会导致服务器立即重启应用程序。执行的操作是特定实现的，不是由标准定义的。一个典型的操作是重新启动应用程序，而不重新初始化以前学到的配置数据、自适应因素和其他长期调整。 softReset	U

	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.	
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3.4 清除诊断信息 (0x14) 服务 ClearDiagnosticInformation (0x14)Service

客户端使用清除诊断信息服务来清除服务端内存中的诊断信息。

The ClearDiagnosticInformation service is used by the client to clear diagnostic information in one or multiple servers' memory.

当清除诊断信息服务被完全处理后，服务端应发送一个肯定响应。即使没有存储 DTC，服务端也应发送肯定响应。如果服务端支持内存中 DTC 状态信息的多个副本（例如，RAM 中的一个副本和 EEPROM 中的一个副本），则服务端应清除读取 DTC 信息状态报告服务使用的副本。根据适当的备份策略（例如在电源锁存阶段）更新其他副本，如长期存储器中的备份副本。

The server shall send a positive response when the ClearDiagnosticInformation service is completely processed. The server shall send a positive response even if no DTCs are stored. If a server supports multiple copies of DTC status information in memory (e.g. one copy in RAM and one copy in EEPROM), the server shall clear the copy used by the ReadDTCInformation status reporting service. Additional copies, e.g. backup copies in long-term memory, are updated according to the appropriate backup strategy (e.g. in the power-latch phase).

对于动力总成系统，进入该服务的前提条件规则如下：

- a) 车速不超过 3km/h；
- b) 系统不执行内部关键操作；
- c) 其他需要小米汽车同意的限制条件。

当不满足这些条件中的至少一项时，ECU 应返回 NRC 0x22。如果无法获得有效车速，则该场景视为车速满足前提条件。

For powertrain systems, the pre-conditions rules to implement the service are as follow:

- a) Vehicle speed is not over 3km/h;

- b) No critical operations is performed by the system;
- c) Other limiting conditions need to be agreed by Xiaomi.

When at least one of these conditions is not met, the ECU shall return NRC 0x22. If the valid vehicle speed cannot be obtained, this scene shall be regarded as the vehicle speed having fulfilled the pre-conditions.

3.4.1 消息格式 Message Format

请求消息定义：Request message definition:

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

肯定响应消息：Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	54

否定响应消息：Negative Response Message:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	14
#3	NegativeResponseCode	M	(see below)

支持的否定响应码：Supported Negative Response Codes:

NRC (hex)	Description
13	不正确的消息长度或无效格式 如果消息长度错误，则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.

22	条件不正确 如果服务端内部条件阻止清除存储在服务端中的 DTC 相关信息，则应返回此否定响应码。所有的条件均应提供给小米汽车。 conditionsNotCorrect This NRC shall be used if internal conditions within the server prevent the clearing of DTC related information stored in the server. All the conditions shall be provided to Xiaomi.
31	请求超出范围 如果不支持指定的 groupOfDTC 参数，则应返回此否定响应码。 requestOutOfRange This NRC shall be returned if the specified groupOfDTC parameter is not supported.
72	一般编程失败 如果服务端在写入内存位置时检测到错误，则应返回此否定响应码。generalProgrammingFailure This NRC shall be returned if the server detects an error when writing to a memory location.

3.4.2 参数选项 Parameter Options

groupOfDTC 参数定义如下：

The groupOfDTC parameter is defined as follows:

Option (hex)	Description	Cvt
FFFFFF	All Groups (all DTCs)	M
xxxxxx Note1	某个特定 DTC	U
Note1: 诊断工具可只清除一个特定的 DTC 组也可清除一个特定的 DTC 。 Note1: With the parameter groupOfDTC, the diagnostic tool is also possible to clear only a specific group of DTCs or a specific DTC.		

3.5 读写 DTC 信息 (0x19) 服务 ReadDTCInformation (0x19)Service

该服务允许客户端从车辆内的任一服务端或服务端组读取服务端驻留诊断故障代码（DTC）信息的状态。

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.

本文中档中定义了以下服务：

The following services is defined in this document:

Service (hex)	Description	Implementation
19 01	客户端可以检索与客户端定义的 DTC 状态掩码匹配的 DTC 数量。 The client can retrieve the number of DTCs matching a client defined DTC status mask.	M
19 02	客户端可以检索与客户端定义的 DTC 状态掩码匹配的所有 DTC 和相应状态的列表。 The client can retrieve the list of all DTCs and corresponding statuses which matches a client defined DTC status mask.	M
19 04	客户端可以检索客户端定义的 DTC 编号和 DTCSnapshotRecordNumber (所有记录的 [FF]) 的 DTCSnapshot 记录数据。 The client can retrieve the DTCSnapshot record data for a client defined DTC number and a DTCSnapshotRecordNumber ([FF] for all records).	M
19 06	客户端可以检索与客户端定义的 DTC 编号和 DTCExtendedDatarecord 编号 (所有记录的 [FF]) 相关联的 DTCExtendedData 记录。 The client can retrieve the DTCExtendedData records associated with a client defined DTC number and DTCExtendedDatarecord number ([FF] for all records).	M
19 0A	此参数指定服务端应向客户端发送服务端内支持的所有 DTC 和相应状态的列表。 This parameter specifies that the server shall transmit to the client a list of all DTCs and corresponding statuses supported within the server.	M

3.5.1 消息格式 Message Format

3.5.1.1 ReadDTCInformation – ReportNumberOfDTCByStatusMask (0x19 0x01)

请求消息定义：Request message definition:

Byte	Name	Cvt	Byte Value (hex)
#1	RequestServiceIdentifier	M	19
#2	Sub-Function = [ReportNumberOfDTCByStatusMask]	M	01

#3	DTCStatusMask	M	00-FF
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肯定响应消息: Positive Response Message:

Byte	Name	Cvt	Byte Value (hex)
#1	PositiveResponseServiceIdentifier	M	59
#2	ReportType = [ReportNumberOfDTCByStatusMask]	M	01
#3	DTCStatusAvailabilityMask	M	01-FF
#4	DTCFormatIdentifier = [SAE_J2012-DA_DTCFormat_00]	M	00
#5	DTCCount[] = [DTCCountHighByte	M	00-FF
#6	DTCCountLowByte]	M	00-FF

否定响应消息: Negative Response Message:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	19
#3	NegativeResponseCode	M	(see below)

支持的否定响应码: Supported Negative Response Codes:

NRC (hex)	Description
12	不支持该子功能 如果不支持该子功能参数, 则应发送此否定响应码。 subFunctionNotSupported This NRC shall be sent if the sub-function parameter is not supported.
13	不正确的消息长度或无效格式 如果消息长度错误, 则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.
31	请求超出范围 如果出现以下情况, 则应返回此否定响应码:

	1. 客户端指定了服务端无法识别的 DTCMaskRecord / DTCSeverityMaskRecord。 2. 客户端指定了无效的 DTCSnapshotRecordNumber /DTCExtendedDataRecordNumber。 requestOutOfRange This code is returned if: 1. The client specified a DTCMaskRecord / DTCSeverityMaskRecord that was not recognized by the server. 2. The client specified an invalid DTCSnapshotRecordNumber /DTCExtendedDataRecordNumber.
--	--

3.5.1.2 ReadDTCInformation – ReportDTCByStatusMask (0x19 0x02)

请求消息定义：Request message definition:

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

肯定响应消息：Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	59
#2	ReportType = [ReportDTCByStatusMask]	M	02
#3	DTCStatusAvailabilityMask	M	01-FF
#4	DTCAndStatusRecord [] = [DTCHighByte#1 DTCMiddleByte#1 DTCLowByte#1 statusOfDTC#1 DTCHighByte#2 DTCMiddleByte#2 DTCLowByte#2 statusOfDTC#2	C1	00-FF
#5		C1	00-FF
#6		C1	00-FF
#7		C1	00-FF
#8		C2	00-FF
#9		C2	00-FF
#10		C2	00-FF
#11		C2	00-FF
:	:	:	:

#n-3	DTCHighByte#m	C2	00-FF
#n-2	DTCMiddleByte#m	C2	00-FF
#n-1	DTCLowByte#m	C2	00-FF
#n	statusOfDTC#m]	C2	00-FF

否定响应消息：Negative Response Message:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	19
#3	NegativeResponseCode	M	(see below)

支持的否定响应码：Supported Negative Response Codes:

NRC (hex)	Description
12	不支持该子功能 如果不支持该子功能参数，则应发送此否定响应码。 subFunctionNotSupported This NRC shall be sent if the sub-function parameter is not supported.
13	不正确的消息长度或无效格式 如果消息长度错误，则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.
31	请求超出范围 如果出现以下情况，则应返回此否定响应码： 1. 客户端指定了服务端无法识别的 DTCMaskRecord / DTCSeverityMaskRecord。 2. 客户端指定了无效的 DTCSnapshotRecordNumber /DTCExtendedDataRecordNumber。 requestOutOfRange This code is returned if:

	1. The client specified a DTCMaskRecord / DTCSeverityMaskRecord that was not recognized by the server. 2. The client specified an invalid DTCSnapshotRecordNumber /DTCExtendedDataRecordNumber.
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3.5.1.3 ReadDTCInformation – ReportDTCSnapshotRecordsByDTCNumber (0x19 0x04)

请求消息定义：Request message definition:

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

肯定响应消息：Positive Response Message:

Byte	Parameter Name	Cvt	Value(hex)
#1	PositiveResponseServiceIdentifier	M	59
#2	ReportType = [ReportDTCSnapshotRecordByDTCNumber]	M	04
#3	DTCAndStatusRecord [] = [DTCHighByte	M	00-FF
#4	DTCMiddleByte	M	00-FF
#5	DTCLowByte	M	00-FF
#6	StausOfDTC]	M	00-FF
#7	DTCSnapshotRecordNumber #1	C1	00-FE
#8	DTCSnapshotRecordNumberOfIdentifiers #1	C1	00-FF
#9	DTCSnapshotRecord[] #1 = [DataIdentifier#1 byte #1 (MSB)	C1	00-FF
#10	DataIdentifier#1 byte #2 (LSB)	C1	00-FF

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#11	SnapshotData#1 byte #1	C1	00-FF
...	...	...	...
#11+(p-1)	SnapshotData#1 byte #p	C1	00-FF
...	...	...	...
#r-(m-1)-2	DataIdentifier#w byte #1 (MSB)	C2	00-FF
#r-(m-1)-1	DataIdentifier#w byte #2 (LSB)	C2	00-FF
#r-(m-1)	SnapshotData#w byte #1	C2	00-FF
...	...	...	...
#r	SnapshotData#w byte #m]	C2	00-FF
...	...	...	...
#t	DTCSnapshotRecordNumber #x	C3	00-FE
#t+1	DTCSnapshotRecordNumberOfIdentifiers #x	C3	00-FF
#t+2	DTCSnapshotRecord[] #x = [DataIdentifier#1 byte #1 (MSB)	C3	00-FF
#t+3	DataIdentifier#1 byte #2 (LSB)	C3	00-FF
#t+4	SnapshotData#1 byte #1	C3	00-FF
...	...	...	...
#t+4+(p-1)	SnapshotData#1 byte #p	C3	00- FF
...	...	...	...
#n-(u-1)-2	DataIdentifier#w byte #1 (MSB)	C4	00- FF
#n-(u-1)-1	DataIdentifier#w byte #2 (LSB)	C4	00- FF
#n-(u-1)	SnapshotData#w byte #1	C4	00-FF
...	...	...	...
#n	SnapshotData#w byte #u]	C4	00-FF

C1: DTCSnapshotRecordNumber 和 DTCSnapshotRecord 参数中的第一个 dataIdentifier/snapshotData 组合只有在至少有一个 DTCSnapshot 记录可被报告时才存在 (DTCSnapshotRecordNumber 在请求中不等于 FF hex 或只有一个记录可供报告, 如果 DTCSnapshotRecordNumber 设置为请求中的 0xFF)。

C2/C4: 单个 DTCSnapshotRecord 中允许存在多个 dataIdentifier/snapshotData 组合。例如对于单个 dataIdentifier 仅引用数据的组成部分的情况就是这种情况。当 dataIdentifier 引用一个数据块时, 可以使用单个 dataIdentifier/snapshotData 组合。

C3: DTCSnapshotRecordNumber 和 DTCSnapshotRecord 参数中的第一个 dataIdentifier/snapshotData 组合仅在请求报告所有记录（请求中的 DTCSnapshotRecordNumber 设置为 0xFF）并且有多个记录可报告时才存在。

DTCSnapshotRecordNumberOfIdentifiers 显示紧随其后的 DTCSnapshotRecord 中的 dataIdentifier 数。

C1: The DTCSnapshotRecordNumber and the first dataIdentifier/snapshotData combination in the DTCSnapshotRecord parameter is only present if at least one DTCSnapshot record is available to be reported (DTCSnapshotRecordNumber unequal to FF hex in the request or only one record is available to be reported if DTCSnapshotRecordNumber is set to FF hex in the request).

C2/C4 There are multiple dataIdentifier/snapshotData combinations allowed to be present in a single DTCSnapshotRecord. This can e.g. be the case for the situation where a single dataIdentifier only references an integral part of data. When the dataIdentifier references a block of data then a single dataIdentifier/snapshotData combination can be used.

C3: The DTCSnapshotRecordNumber and the first dataIdentifier/snapshotData combination in the DTCSnapshotRecord parameter is only present if all records are requested to be reported (DTCSnapshotRecordNumber set to FF hex in the request) and more than one record is available to be reported.

DTCSnapshotRecordNumberOfIdentifiers shows the number of dataIdentifiers in the immediately following DTCSnapshotRecord.

否定响应消息: Negative Response Message:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	19
#3	NegativeResponseCode	M	(see below)

支持的否定响应码: Supported Negative Response Codes:

NRC (hex)	Description
12	不支持该子功能 如果不支持该子功能参数，则应发送此否定响应码。 subFunctionNotSupported This NRC shall be sent if the sub-function parameter is not supported.
13	不正确的消息长度或无效格式 如果消息长度错误，则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat

	This NRC shall be sent if the length of the message is wrong.
31	请求超出范围 如果出现以下情况，则应返回此否定响应码： 1. 客户端指定了服务端无法识别的 DTCMaskRecord / DTCSeverityMaskRecord。 2. 客户端指定了无效的 DTCSnapshotRecordNumber /DTCExtendedDataRecordNumber。 requestOutOfRange This code is returned if: 1. The client specified a DTCMaskRecord / DTCSeverityMaskRecord that was not recognized by the server. 2. The client specified an invalid DTCSnapshotRecordNumber /DTCExtendedDataRecordNumber.

3.5.1.4 ReadDTCInformation – ReportDTCExtendedDataRecordsByDTCNumber (0x19 0x06)

请求消息定义：Request message definition:

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

肯定响应消息：Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	59
#2	ReportType = [ReportDTCExtendedDataRecordByDTCNumber]	M	06
#3	DTCAndStatusRecord[] = [DTCHighByte	M	00-FF
#4	DTCMiddleByte	M	00-FF
#5	DTCLowByte	M	00-FF

#6	statusOfDTC]	M	00-FF
#7	DTCExtendedDataRecordNumber #1	C1	01-EF
#8	DTCExtendedDataRecord[] #1 = [ExtendedData #1 byte #1	C1	00-FF
:	:	C1	00-FF
#8+(p-1)	ExtendedData #1 byte #p]	C1	00-FF
:	:	:	:
#t	DTCExtendedDataRecordNumber #x	C2	01-EF
#t+1	DTCExtendedDataRecord[] #x = [ExtendedData #x byte #1	C2	00-FF
:	:	C2	00-FF
#t+1+(q-1)	ExtendedData #x byte #q]	C2	00-FF

C1: DTCExtendedDataRecord 参数中的 DTCExtendedDataRecordNumber 和 extendedData 只有在至少有一个 DTCExtendedDataRecord 可以上报时才会出现（请求中 DTCExtendedDataRecordNumber 不等于 0xFF 或者如果请求中的 DTCExtendedDataRecordNumber 设置为 0xFF 则只能上报一条记录）。

C2: DTCExtendedDataRecord 参数中的 DTCExtendedDataRecordNumber 和 extendedData 仅在请求上报所有记录（请求中的 DTCExtendedDataRecordNumber 设置为 0xFF）并且有多个记录可上报时才存在。

C1: The DTCExtendedDataRecordNumber and the extendedData in the DTCExtendedDataRecord parameter are only present if at least one DTCExtendedDataRecord is available to be reported

(DTCExtendedDataRecordNumber unequal to FF hex in the request or only one record is available to be reported if DTCExtendedDataRecordNumber is set to FF hex in the request).

C2: The DTCExtendedDataRecordNumber and the extendedData in the DTCExtendedDataRecord parameter are only present if all records are requested to be reported (DTCExtendedDataRecordNumber set to FF hex in the request) and more than one record is available to be reported.

否定响应消息: Negative Response Message:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	19
#3	NegativeResponseCode	M	(see below)

支持的否定响应码: Supported Negative Response Codes:

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NRC (hex)	Description
12	不支持该子功能 如果不支持该子功能参数，则应发送此否定响应码。 subFunctionNotSupported This NRC shall be sent if the sub-function parameter is not supported.
13	不正确的消息长度或无效格式 如果消息长度错误，则应发送此否定响应码。incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.
31	请求超出范围 如果出现以下情况，则应返回此否定响应码： 1. 客户端指定了服务端无法识别的 DTCMaskRecord / DTCSeverityMaskRecord。 2. 客户端指定了无效的 DTCSnapshotRecordNumber /DTCExtendedDataRecordNumber。 requestOutOfRange This NRC shall be sent if: 1. The client specified a DTCMaskRecord / DTCSeverityMaskRecord that was not recognized by the server. 2. The client specified an invalid DTCSnapshotRecordNumber /DTCExtendedDataRecordNumber.

3.5.1.5 ReadDTCInformation – ReportSupportedDTCs (0x19 0x0A)

请求消息定义：Request message definition:

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

肯定响应消息：Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	59
#2	ReportType = [ReportSupportedDTCs]	M	0A
#3	DTCStatusAvailabilityMask	M	01-FF

	DTCAndStatusRecord [] = [		
#4	DTCHighByte#1	C1	00-FF
#5	DTCMiddleByte#1	C1	00-FF
#6	DTCLowByte#1	C1	00-FF
#7	statusOfDTC#1	C1	00-FF
#8	DTCHighByte#2	C2	00-FF
#9	DTCMiddleByte#2	C2	00-FF
#10	DTCLowByte#2	C2	00-FF
#11	statusOfDTC#2	C2	00-FF
:	:	:	:
#n-3	DTCHighByte#m	C2	00-FF
#n-2	DTCMiddleByte#m	C2	00-FF
#n-1	DTCLowByte#m	C2	00-FF
#n	statusOfDTC#m]	C2	00-FF

C1: This parameter is only present if DTC information is available to be reported.

C2: This parameter is only present if more than one DTC is to be reported.

否定响应消息: Negative Response Message:

Byte	Name	Cvt	Value
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	19
#3	NegativeResponseCode	M	(see below)

支持的否定响应码: Supported Negative Response Codes:

NRC (hex)	Description
12	不支持该子功能 如果不支持该子功能参数, 则应发送此否定响应码。 subFunctionNotSupported This NRC shall be sent if the sub-function parameter is not supported.
13	不正确的消息长度或无效格式 如果消息长度错误, 则应发送此否定响应码。incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.

31	请求超出范围 如果出现以下情况，则应返回此否定响应码： 1. 客户端指定了服务端无法识别的 DTCMaskRecord / DTCSeverityMaskRecord。 2. 客户端指定了无效的 DTCSnapshotRecordNumber /DTCExtendedDataRecordNumber。 requestOutOfRange This NRC shall be sent if: 1. The client specified a DTCMaskRecord / DTCSeverityMaskRecord that was not recognized by the server. 2. The client specified an invalid DTCSnapshotRecordNumber /DTCExtendedDataRecordNumber.
----	--

3.5.2 参数选项 Parameter Options

该服务使用子功能参数来选择一种 DTC 报告类型，定义如下：

The sub-function parameters are used by this service to select one of the DTC report types as defined as follows:

Option(hex)	Description	Cvt.
01	此参数指定服务端应向客户端发送与客户端定义的状态掩码匹配 的 DTC 数量。 reportNumberOfDTCByStatusMask This parameter specifies that the server shall transmit to the client the number of DTC' s matching a client defined status mask.	M
02	此参数指定服务端应向客户端发送与客户端定义的状态掩码匹配 的 DTC 和相应状态的列表。 reportDTCByStatusMask This parameter specifies that the server shall transmit to the client a list of DTC' s and corresponding statuses matching a client defined status mask.	M
04	此参数指定服务端应向客户端发送与客户端定义的 DTC 号和 DTCSnapshot 记录号（所有记录的 0xFF，所有 OBD 记录的 0xFE）相关联的 DTCSnapshot 记录。 reportDTCSnapshotRecordByDTCNumber	U

	This parameter specifies that the server shall transmit to the client the DTCSnapshot record(s) associated with a client defined DTC number and DTCSnapshot record number (FF hex for all records, FE hex for all OBD records).	
06	此参数指定服务端应向客户端发送与客户端定义的 DTC 号和 DTCExtendedData 记录号相关的 DTCExtendedData 记录（所有记录的 0xFF，所有 OBD 记录的 0xFE）。 reportDTCExtendedDataRecordByDTCNumber This parameter specifies that the server shall transmit to the client the DTCExtendedData record(s) associated with a client defined DTC number and DTCExtendedData record number (FF hex for all records, FE hex for all OBD records).	M
0A	此参数指定服务端应向客户端发送服务端内支持的所有 DTC 和相应状态的列表。 reportSupportedDTC This parameter specifies that the server shall transmit to the client a list of all DTC' s and corresponding statuses supported within the server.	M

3.6 通过标识符读取数据 (0x22) 服务 ReadDataByIdentifier (0x22) Service

“通过标识符读取数据”服务允许客户端向服务端请求由一个或多个数据标识符标识的数据记录值。

The ReadDataByIdentifier service allows the client to request data record values from the server identified by one or more dataIdentifiers.

服务端通过肯定响应消息发送数据记录值。客户端请求消息包含一个或多个两字节的数据标识符值，用于标识服务端维护的数据记录。服务端需支持最大 10 组数据标识符的同时请求，且按请求顺序响应所有支持的数据记录值，本次请求中不支持的数据标识符需要丢弃，支持的数据标识符需要响应。服务端的编程模式下不需要支持多组数据标识符同时请求的需求。任何偏离请与小米诊断工程师进行确认。数据记录的格式和定义由供应商和小米汽车在特定 ECU 诊断需求中定义。

The server sends data record values via the positive response message. The client request message contains one or more two-byte dataIdentifier values that identify data record(s) maintained by the server. The server needs to support the simultaneous request of up to 10 sets of data identifiers, and respond to all supported data record values in the order of request, unsupported data identifiers need to be discarded, and supported data identifiers need to be responded. In the programming mode of the server, there is no need to support the requirement of multiple sets of data identifiers being

requested at the same time. Any deviation should be confirmed with Xiaomi Diagnostic Engineer . The format and definition of the RecordValues is defined by Specific ECU Diagnostic Requirement with supplier and Xiaomi.

3.6.1 消息格式 Message Format

请求消息定义：Request message definition:

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

肯定响应消息：Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	62
#2	DataIdentifier [] #1 = [byte#1 (MSB)	M	00-FF
#3	byte#2]	M	00-FF
#4	DataRecord[] #1 = [data#1	M	00-FF
:	:	:	:
#(k-1)+4	data#k]	U	00-FF
:	:	:	:
#n-(o-1)-2	DataIdentifier [] #m = [byte#1 (MSB)	U	00-FF
#n-(o-1)-1	byte#2]	U	00-FF

#n-(o-1)	DataRecord[] #m = [	U	00-FF
:	:	:	:
#n	data#o]	U	00-FF

否定响应消息: Negative Response Message:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	22
#3	NegativeResponseCode	M	(see below)

支持的否定响应码: Supported Negative Response Codes:

NRC (hex)	Description
13	不正确的消息长度或无效格式 如果请求消息的长度无效或客户端超过了一次允许请求的最大数据标识符数，则应发送此 NRC incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the request message is invalid or the client exceeded the maximum number of dataIdentifiers allowed to be requested at a time.
14	响应过长 如果响应消息的总长度超过底层传输协议的限制(例如，当单个请求中请求多个 DID 时)，则应发送此否定响应码。 responseTooLong This NRC shall be sent if the total length of the response message exceeds the limit of the underlying transport protocol (e.g., when multiple DIDs are requested in a single request).
22	条件不正确 如果不满足服务端的操作条件以执行所需的操作，则应返回此否定响应码。所有的条件均应提供给小米汽车。 conditionsNotCorrect This NRC shall be sent if the operating conditions of the server are not met to perform the required action. All the conditions shall be provided to Xiaomi.
31	请求超出范围

	如果设备不支持请求的数据标识的值，则应返回此否定响应码。 requestOutOfRange This NRC shall be sent if none of the requested data identifier values are supported by the device.
--	---

3.6.2 参数选项 Parameter Options

更多详细信息，请参阅 ECU 特定的诊断需求。

See ECU specific diagnostic requirement for more details.

3.7 通过地址读取内存 (0x23) 服务 ReadMemoryByAddress (0x23) Service

通过地址读取内存服务允许客户端通过提供的读取起始地址和内存大小来请求服务端的内存数据。

The ReadMemoryByAddress service allows the client to request memory data from the server via a provided starting address and to specify the size of memory to be read.

通过地址读取内存请求消息用于向服务端请求由参数内存地址和内存大小标识的内存数据。用于内存地址和内存大小参数的字节数由地址和长度格式标识符(低半字节和高半字节)定义。

The ReadMemoryByAddress request message is used to request memory data from the server identified by the parameter memoryAddress and memorySize. The number of bytes used for the memoryAddress and MemorySize parameter is defined by addressAndLengthFormatIdentifier (low and high nibble).

3.7.1 消息格式 Message Format

请求消息定义：Request message definition:

Byte	Name	Cvt	Value (hex)
#1	ReadMemoryByAddress Request Service Id	M	23
#2	addressAndLengthFormatIdentifier	M	24
#3	memoryAddress[] = [	M	00-FF
:	:	:	:

#(m-1)+3	byte#m]	C1	00-FF
#n-(k-1)	memorySize[] = [byte#1 (MSB)	M	00-FF
:	:	:	:
#n	byte#k]	C2	00-FF

C1: C1 参数的存在取决于 addressAndLengthFormatIdentifier 的地址长度信息参数。

C2: C2 参数的存在取决于 addressAndLengthFormatIdentifier 的内存大小长度信息参数。

C1: The presence of the C1 parameter depends on address length information parameter of the addressAndLengthFormatIdentifier.

C2: The presence of the C2 parameter depends on the memory size length information of the addressAndLengthFormatIdentifier.

肯定响应消息: Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	63
#2	DataRecord [] = [data#1	M	00-FF
:	:	:	:
#n	data#m]	M	00-FF

否定响应消息: Negative Response Message:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	23
#3	NegativeResponseCode	M	(see below)

支持的否定响应码: Supported Negative Response Codes:

NRC (hex)	Description
13	不正确的消息长度或无效格式

	如果消息长度错误，则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.
22	条件不正确 如果不满足服务端的操作条件，则应返回此否定响应码。所有的条件均应提供给小米汽车。 conditionsNotCorrect This NRC shall be sent if the operating conditions of the server are not met to perform the required action. All the conditions shall be provided to Xiaomi.
31	请求超出范围 如果出现以下情况，则应返回此否定响应码： 1) 区间[0xMA, (0xMA + 0xMS - 0x1)]内的任一内存地址无效； 2) 区间[0xMA, (0xMA + 0xMS - 0x1)]内的任一内存地址受限； 3) 请求消息中的 memorySize 参数值大于服务端支持的最大值； 4) 指定的 addressAndLengthFormatIdentifier 无效。 requestOutOfRange This NRC shall be sent if 1) any memory address within the interval [\$MA, (\$MA + \$MS - \$1)] is invalid; 2) any memory address within the interval [\$MA, (\$MA + \$MS - \$1)] is restricted; 3) the memorySize parameter value in the request message is greater than the maximum value supported by the server; 4) the specified addressAndLengthFormatIdentifier is not valid.
33	安全访问被拒绝 如区间[0xMA, (0xMA + 0xMS - 0x1)]内任一内存地址加密且服务端被锁定，则应返回此否定响应码。 SecurityAccessDenied

	This code shall be sent if any memory address within the interval [\$MA, (\$MA + \$MS-\$1)] is secure and the server is locked.
7F	活动会话不支持服务 Service not supported in active session

3.7.2 参数选项 Parameter Options

定义 Definition
地址和长度格式标识符 该参数是单字节值，每个半字节单独编码： 位 7 - 4:内存大小参数的长度(字节数)； 位 3 - 0:内存地址参数的长度(字节数)。 addressAndLengthFormatIdentifier This parameter is a one-byte value with each nibble encoded separately: bit 7 - 4: length (number of bytes) of the memorySize parameter; bit 3 - 0: length (number of bytes) of the memoryAddress parameter.
内存地址 参数内存地址是服务端内存中检索数据的起始地址。该地址使用的字节数由地址和长度标识符的低半字节(位 3 - 0)定义。内存地址参数中的字节#m 始终是服务端引用的地址中最低有效字节。地址中的最高有效字节可以用作内存标识符。使用内存标识符的一个示例是具有 16 位寻址和内存地址重叠的双处理器服务端(当给定的地址对任何一个处理器都有效，但产生不同的物理内存设备或使用内部和外部闪存时)。在这种情况下，内存地址参数中其它未使用的字节可以指定为用于选择所需内存设备的内存标识符。此功能的使用应由系统供应商定义。 memoryAddress The parameter memoryAddress is the starting address of server memory from which data is to be retrieved. The number of bytes used for this address is defined by the low nibble (bit 3 - 0) of the addressFormatIdentifier. Byte#m in the memoryAddress parameter is always the least significant byte of the address being referenced in the server. The most significant byte of the address can be used as a memoryIdentifier. An example of the use of a memoryIdentifier would be a dual processor server with 16-bit addressing and memory address overlap (when a given address is valid for either processor but yields a different physical memory device or internal and external flash is used). In this case, an otherwise unused byte within the

memoryAddress parameter can be specified as a memoryIdentifier used to select the desired memory device. Usage of this functionality shall be as defined by system supplier.

内存大小

通过地址读取内存请求消息中的参数内存大小指从服务端内存中的内存地址指定的地址开始读取的字节数。该大小使用的字节数由地址和长度信息的高半字节(位 7 - 4)定义。

memorySize

The parameter memorySize in the ReadMemoryByAddress request message specifies the number of bytes to be read starting at the address specified by memoryAddress in the server's memory. The number of bytes used for this size is defined by the high nibble (bit 7 - 4) of the addressFormatIdentifier.

3.8 安全访问 (0x27) 服务 SecurityAccess (0x27) Service

此服务的目的是提供访问数据和/或诊断服务的手段，这些数据 and/或诊断服务由于保密、排放或安全的原因而受到限制。用于将例程或数据下载或上传到服务端以及从服务端读取特定内存位置的诊断服务，可能需要在安全访问的情况下进行。下载到服务端的非正常例程或数据可能会损坏电子设备或其他车辆零件，或者影响车辆排放、保密或安全标准的符合性。安全概念利用了种子和密钥之间的关系。

The purpose of this service is to provide means to access data and/or diagnostic services, which have restricted access for security, emissions, 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 emission, safety, or security standards. The security concept uses a seed and key relationship.

3.8.1 消息格式 Message Format

3.8.1.1 请求种子 Request Seed

此服务从服务端请求种子。基于这个种子，客户端能够计算出相应的密钥，用于解锁服务端。

This service requests a seed from the server. Based on this seed, the client is able to calculate the corresponding key to be sent for unlocking the server.

请求消息定义：Request message definition:

Byte	Name	Cvt	Value (hex)
#1	RequestServiceIdentifier	M	27
#2	SecurityAccessType = RequestSeed	M	01, 03, 05, 07 , 09, 5F,61-69

肯定响应消息：Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	67
#2	SecurityAccessType = RequestSeed	M	01, 03, 05, 07 , 09, 5F,61-69
#3	SecuritySeed [] = [	M	00-FF
:	:	:	:
#n	seed#m (low byte)]	M	00-FF

否定响应消息：Negative Response Message:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	27
#3	NegativeResponseCode	M	(see below)

支持的否定响应码：Supported Negative Response Codes:

NRC (hex)	Description
12	不支持该子功能 如果不支持该子功能参数，则应发送此否定响应码。 subFunctionNotSupported This NRC shall be sent if the sub-function parameter is not supported.
13	不正确的消息长度或无效格式 如果消息长度错误，则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.

22	条件不正确 如果不满足请求安全访问的条件，则应返回此否定响应码。所有的条件均应提供给小米汽车。 conditionsNotCorrect This code shall be returned if the criteria for the request SecurityAccess are not met. All the conditions shall be provided to Xiaomi.
37	要求的时间延迟未失效 如果请求在延迟计时器处于活动状态时发送，则应返回此否定响应码。 requiredTimeDelayNotExpired Send if the delay timer is active and a request is transmitted.
7F	活动会话不支持服务 Service not supported in active session

3.8.1.2 发送密钥 Send Key

该服务将客户端计算的密钥发送到服务端。 服务端应将此密钥与内部存储/计算的密钥进行比较。 如果两个数字匹配，则服务端应启用（“解锁”）客户端对特定服务/数据的访问。

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.

请求消息定义：Request message definition:

Byte	Name	Cvt	Value (hex)
#1	RequestServiceIdentifier	M	27
#2	SecurityAccessType = SendKey	M	02,04,06,08 ,0A,62-6A
#3	SecurityKey [] = [	M	00-FF
:	:	:	:
#n	key#m (low byte)]	U	00-FF

肯定响应消息：Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	67

#2	SecurityAccessType = SendKey	M	02,04,06,08 ,0A,62-6A
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Negative Response Message: 否定响应消息:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	27
#3	NegativeResponseCode	M	(see below)

支持的否定响应码: Supported Negative Response Codes:

NRC (hex)	Description
12	不支持该子功能 如果不支持该子功能参数, 则应发送此否定响应码。 subFunctionNotSupported This NRC shall be sent if the sub-function parameter is not supported.
13	不正确的消息长度或无效格式 如果消息长度错误, 则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.
22	条件不正确 如果不满足请求安全访问的条件, 则应返回此否定响应码。所有的条件均应提供给小米汽车。 conditionsNotCorrect This code shall be returned if the criteria for the request SecurityAccess are not met. All the conditions shall be provided to Xiaomi.
24	请求顺序错误 如果在没有收到“请求种子”请求消息的情况下接收到“发送密钥”子功能, 则应发送此否定响应码。 requestSequenceError Send if the ‘sendKey’ sub-function is received without first receiving a ‘requestSeed’ request message.
35	无效密钥

	如果接收到“发送密钥”子功能值，并且该密钥的值与服务端的内部存储/计算密钥不匹配，则发送此否定响应码。 invalidKey Send if an expected 'sendKey' sub-function value is received and the value of the key does not match the server's internally stored/calculated key.
36	超出尝试次数 如果延迟计时器由于超出允许的错误的访问尝试的最大次数而处于活动状态，则发送此否定响应码。 exceededNumberOfAttempts Send if the delay timer is active due to exceeding the maximum number of allowed false access attempts.
7F	活动会话不支持服务 Service not supported in active session

3.8.2 参数选项 Parameter Options

“安全访问类型”参数定义如下：The SecurityAccessType is defined as follows:

Option(hex)	Description
01	请求种子达到安全级别：解锁 - 用于软件下载 requestSeed to reach security level: Unlocked –Used for software download
02	发送密钥达到安全级别：解锁 - 用于软件下载 sendKey to reach security level: Unlocked –Used for software download
03	请求种子达到安全级别：解锁 - 用于整车模式切换 requestSeed to reach security level: Unlocked –Used for CarMode transition
04	发送密钥达到安全级别：解锁 - 用于整车模式切换 sendKey to reach security level: Unlocked –Used for CarMode transition
05	请求种子达到安全级别：解锁 - 用于通用诊断服务 requestSeed to reach security level: Unlocked –Used for Basic diagnostic services
06	发送密钥达到安全级别：解锁 - 用于通用诊断服务 sendKey to reach security level: Unlocked –Used for Basic diagnostic services

07	请求种子达到安全级别：解锁 - 用于防盗功能 requestSeed to reach security level: Unlocked –Used for IMMO function
08	发送密钥达到安全级别：解锁 - 用于防盗功能 sendKey to reach security level: Unlocked –Used for IMMO function
09	请求种子达到安全级别：解锁 - 用于信息安全 requestSeed to reach security level: Unlocked –Used for Security logs
0A	发送密钥达到安全级别：解锁 - 用于信息安全 sendKey to reach security level: Unlocked –Used for Security logs
5F	请求种子达到安全级别：解锁 - 用于车载起爆装置的报废激活 requestSeed to reach security level: Unlocked –Used for end of life activation of on-board pyrotechnic devices
60	发送密钥达到安全级别：解锁 - 用于车载起爆装置的报废激活 sendKey to reach security level: Unlocked –Used for end of life activation of on-board pyrotechnic devices
61-69	请求种子达到安全级别：解锁 -用于在 ECU 供应商侧执行特殊功能 requestSeed to reach security level: Unlocked –Used for the purposes of performing special functions in the ECU supplier side
62-6A	发送密钥达到安全级别：解锁 -用于在 ECU 供应商侧执行特殊功能 sendKey to reach security level: Unlocked –Used for the purposes of performing special functions in the ECU supplier side

3.9 通信控制 (0x28) 服务 CommunicationControl (0x28) Service

该服务的目的是开启/关闭服务端（例如应用程序通信消息或网络管理消息）的某些消息的传输和/或接收。

对于连接到多个通道（例如，网关）的 ECU，此服务将影响所有通道，而不仅仅是接收诊断请求的通道。对于网关 ECU，诊断消息的正常路由不受此服务的影响。

The purpose of this service is to switch on/off the transmission and/or the reception of certain messages of servers (e.g. application communication messages or network management messages). For the ECU that connects to multiple channels (e.g. Gateway), this service will affect all channels but not

only the one that received the diagnostic request. For the gateway ECU, the normal routing of diagnostic messages is not affected by this service.

进入该服务的前提条件规则如下：

- a) 车速不超过 3km/h；
- b) 系统不执行内部关键操作；
- c) 其他需要小米汽车同意的限制条件。

当不满足这些条件中的至少一项时，ECU 应返回 NRC 0x22。 如果无法获得有效车速，则该场景视为车速满足前提条件。

The precondition rules to implement the service are as follow:

- a) Vehicle speed is not over 3km/h;
- b) No critical operations is performed by the system;
- c) Other limiting conditions need to be agreed by Xiaomi.

When at least one of these conditions is not met, the ECU shall return NRC 0x22. If the valid vehicle speed cannot be obtained, this scene shall be regarded as the vehicle speed having fulfilled the pre-condition.

3.9.1 消息格式 Message Format

请求消息定义：Request message definition:

Byte	Name	Cvt	Value (hex)
#1	RequestServiceIdentifier	M	28
#2	Sub-Function = [ControlType]	M	00-7F
#3	CommunicationType	M	01, 02, 03

肯定响应消息：Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	68
#2	Sub-Function = [ControlType]	M	00-7F

否定响应消息: Negative Response Message:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	28
#3	NegativeResponseCode	M	(see below)

支持的否定响应码: Supported Negative Response Codes:

NRC (hex)	Description
12	不支持该子功能 如果不支持该子功能参数, 则应发送此否定响应码。 subFunctionNotSupported This NRC shall be sent if the sub-function parameter is not supported.
13	不正确的消息长度或无效格式 如果消息长度错误, 则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.
22	条件不正确 当服务端处于无法禁用/启用请求的通信类型的临界正常模式活动时, 则应返回此否定响应码。 所有的条件均应提供给小米汽车。 conditionsNotCorrect Used when the server is in a critical normal mode activity and therefore cannot disable/enable the requested communication type. All the conditions shall be provided to Xiaomi.
31	请求超出范围 如果服务端在通信类型参数中检测到错误, 则应返回此否定响应码。requestOutOfRange The server shall use this response code, if it detects an error in the communicationType parameter.
7F	活动会话不支持服务 Service not supported in active session

3.9.2 参数选项 Parameter Options

控制类型：ControlType:

Option (hex)	Description	Cvt.
00	启用 Rx 和 Tx 此值指示对于指定的通信类型，应启用消息的接收和传输。 enableRxAndTx This value indicates that the reception and transmission of messages shall be enabled for the specified communicationType.	M
01	启用 Rx 和禁用 Tx 此值指示对于指定的通信类型，应启用消息的接收并禁用传输。 enableRxAndDisableTx This value indicates that the reception of messages shall be enabled and the transmission shall be disabled for the specified communicationType.	M
02	禁用 Rx 并启用 Tx 此值指示对于指定的通信类型，应启用消息的传输并禁用接收。 disableRxAndEnableTx This value indicates that the reception of messages shall be disabled and the transmission shall be enabled for the specified communicationType.	U
03	禁用 Rx 和 Tx 此值指示对于指定的通信类型，应禁用消息的接收和传输。 disableRxAndTx This value indicates that the reception and transmission of messages shall be disabled for the specified communicationType.	U

通信类型：CommunicationType:

Option (hex)	Description	implementation
01	正常通信消息 该值引用所有与应用程序相关的通信（多个车载服务端之间的应用程序间信号交换）。 normalCommunicationMessages	M

	This value references all application-related communication (inter-application signal exchange between multiple in-vehicle servers).	
02	网络管理通信消息 该值引用所有与网络管理相关的通信。 networkManagementCommunicationMessages This value references all network management related communication.	M
03	网络管理通信消息和正常通信消息 此值引用所有网络管理和与应用程序相关的通信。 networkManagementCommunicationMessages and normalCommunicationMessages This value references all network management and application-related communication.	M

3.10 通过标识符写入数据 (0x2E) 服务 WriteDataByIdentifier (0x2E) Service

客户端使用通过标识符写入数据 (0x2E) 服务将记录数据值写入服务端。数据记录由数据标识符标识。此服务的可能用例是：

- 清除非易失性内存
- 重置学习值
- 设置选项内容

服务端可能会限制或禁止对某些数据标识符值的写访问。

The WriteDataByIdentifier service is used by the client to write record data values to a server. The data record is identified by a DataIdentifier. Possible use-cases for this service are:

- Clear non-volatile memory
- Reset learned values
- Set option content

The server may restrict or prohibit write access to certain dataIdentifier values.

3.10.1 消息格式 Message Format

请求消息定义：Request message definition:

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

肯定响应消息：Positive Response Message:

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

否定响应消息：Negative Response Message:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	2E
#3	NegativeResponseCode	M	(see below)

支持的否定响应码：Supported Negative Response Codes:

NRC (hex)	Description
13	不正确的消息长度或无效格式 如果消息长度错误，则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.
22	条件不正确

	如果不满足服务端的操作条件以执行所需的操作，则应返回此否定响应码。所有的条件均应提供给小米汽车。 conditionsNotCorrect This response code shall be sent if the operating conditions of the server are not met to perform the required action. All the conditions shall be provided to Xiaomi.
31	请求超出范围 如果出现以下情况，则应返回此否定响应码： 1. 服务端不支持请求消息中的数据标识符或数据标识符支持只读属性（通过标识符读取数据服务）； 2. 数据标识符之后的请求消息中传输的任何数据都是无效的（如果适用于节点）。 requestOutOfRange This response code shall be sent if 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).
33	安全访问被拒绝 如果引用特定地址的数据标识符是安全的并且服务端未处于解锁状态，则应返回此否定响应码。 securityAccessDenied This code shall be sent if the dataIdentifier, which reference a specific address, is secured and the server is not in an unlocked state.
72	一般编程失败 如果服务端在写入内存位置时检测到错误，则应返回此否定响应码。 generalProgrammingFailure This return code shall be sent if the server detects an error when writing to a memory location.
7F	活动会话不支持服务 Service not supported in active session

3.10.2 参数选项 Parameter Options

更多详细信息，请参阅 ECU 特定的诊断需求。

See ECU specific diagnostic requirement for more details.

3.11 通过标识符控制输入输出 (0x2F) 服务 InputOutputControlByIdentifier (0x2F)Service

客户端使用通过数据标识符控制输入输出服务为输入信号，内部服务端功能提供替代值，和/或强制控制电气系统中的输出（执行器）值。用户可选的控制选项参数应包括服务端输入信号、内部功能和/或输出信号所需的所有信息。如果请求控件成功启动或达到其期望状态，服务器将发送一个肯定的响应消息。

The InputOutputControlByIdentifier service is used by the client to substitute a value for an input signal, internal ECU function and/or control an output (actuator) of an electronic system referenced by a DataIdentifier of the server. The user optional ControlOption parameter shall include all information required by the server' s input signal, internal function and/or output signal. The server shall send a positive response message if the request control was successfully started or has reached its desired state.

3.11.1 消息格式 Message Format

请求消息定义：Request message definition:

Byte	Name	Cvt	Value (hex)
#1	RequestServiceIdentifier	M	2F
#2	DataIdentifier#1[] = [byte#1 (MSB)	M	00-FF
#3	byte#2 (LSB)]	M	00-FF
#4	ControlOptionRecord#1[] = [	M1/ U1:	00-FF
:	:	:	:
#4+(m-1)	constrolState#m]	C1	00-FF
#4+m	ControlEnableMaskRecord#1[] = [	C2	00-FF
:	controlMask#1	:	:
#4+m+(r-1)	controlMask#r]	C2	00-FF

M1/U1 强制: ControlState#1 可用作输入输出控制参数或附加控制状态。
C1: 此参数的存在取决于 dataIdentifier#1 和 controlOptionRecord#1 的输入输出控制参数 (如果 controlOptionRecord #1 的 controlState#1 用作输入输出控制参数)。
C2: 此参数的存在取决于 dataIdentifier#1。
M1/U1 Mandatory: ControlState#1 can be used as either an Input Output Control Parameter or as an additional controlState.
C1: The presence of this parameter depends on the dataIdentifier#1 and the input Output ControlParameter of controlOptionRecord#1 (if controlState#1 of control Option Record#1 is used as an inputOutputControlParameter).
C2: The presence of this parameter depends on the dataIdentifier#1.

肯定响应消息: Postive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	6F
#2	DataIdentifier#1 = [	M	00-FF
#3	byte#1 (MSB) byte#2 (LSB)]	M	00-FF
#4	ControlStatusRecord#1[] = [	C1	00-FF
:	:	:	:
#4+(m-1)	controlState#m]	C2	00-FF
C1: 这个参数的存在取决于它在请求消息中的使用。 ControlState#1 用作 InputOutputControlParameter 或附加的 controlState。 如果它被用作 InputOutputControlParameter, 那么它应该出现在响应消息中, 并且应该是请求消息中给出的 InputOutputControlParameter 值的回显。 C2: 此参数的存在取决于 dataIdentifier 和输入输出控制参数 (如果 controlState#1 用作 inputOutputControlParameter)。 C1: The presence of this parameter depends on its usage in the request message. ControlState#1 is either used as an InputOutputControlParameter or as an additional controlState. If it is used as an InputOutputControlParameter then it shall be present in the response message and shall be the echo of the InputOutputControlParameter value given in the request message.			

C2: The presence of this parameter depends on the dataIdentifier and the input Output ControlParameter (if controlState#1 is used as an inputOutputControlParameter).

否定响应消息: Negative Response Message:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	2F
#3	NegativeResponseCode	M	(see below)

支持的否定响应码: Supported Negative Response Codes:

NRC (hex)	Description
13	不正确的消息长度或无效格式 如果消息长度错误, 则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.
22	条件不正确 如果不满足请求输入输出控制的条件, 则应返回此否定响应码。所有的条件均应提供给小米汽车。 conditionsNotCorrect This code shall be returned if the criteria for the request InputOutputControl are not met. All the conditions shall be provided to Xiaomi.
31	请求超出范围 如果出现以下情况, 则应返回此否定响应码: 1.设备不支持请求的数据标识符值; 2.输入输出控制参数中的值无效 (见输入输出控制参数定义); 3.控制选项记录中的一个或多个可用控制状态值无效。 requestOutOfRange This code shall be returned if: 1. the requested dataIdentifier value is not supported by the device, 2. the dataIdentifier uses the controlState#1 parameter as an inputOutputControlParameter and the value contained in this parameter is invalid (see definition of inputOutputControlParameter),

	3. one or multiple of the applicable controlStates of the controlOptionRecord record are invalid.
33	安全访问被拒绝 如果客户端发送带有有效安全数据标识符的请求并且服务端的安全功能当前处于活动状态，则应返回此否定响应码。 securityAccessDenied This code shall be returned if a client sends a request with a valid secure dataIdentifier and the server' s security feature is currently active.
7F	活动会话不支持服务 Service not supported in active session

3.11.2 参数选项 Parameter Options

Option (hex)	Description	Cvt
00	返回控制权到 ECU 该值应向服务端表明客户端不再控制由输入输出局部标识符引用的输入信号、内部参数或输出信号。 请求消息中的控制状态字节数：0 肯定响应消息中控制状态字节数：取决于数据标识符 returnControlToECU This value shall indicate to the server that the client does no longer have control about 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
01	重置为默认 该值应指示服务端请求将输入输出局部标识符引用的输入信号、内部参数或输出信号重置为其默认状态。 请求消息中的控制状态字节数：0	C

	肯定响应消息中控制状态字节数：取决于数据标识符 resetToDefault This value shall indicate to the server that it is requested to reset the input signal, internal 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	
02	冻结当前状态 该值应指示服务端请求冻结输入输出局部标识符引用的输入信号、内部参数或输出信号的当前状态。 请求消息中的控制状态字节数：0 肯定响应消息中控制状态字节数：取决于数据标识符 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	U
03	短期调整 该值应向服务端表明，它被请求将 RAM 中输入输出局部标识符引用的输入信号、内部参数或输出信号调整为包含在控制选项参数中的值。（例如，将怠速空气控制阀设置为特定的步数，将阀门的脉冲宽度设置为特定值/占空比）。 请求消息中的控制状态字节数：取决于数据标识符 肯定响应消息中控制状态字节数：取决于数据标识符 shortTermAdjustment	M

	This value shall indicate to the server that it is requested to adjust the input signal, internal parameter or output signal referenced by the inputOutputLocalIdentifier in RAM to the value(s) included in the controlOption parameter(s). (e.g. set Idle Air Control Valve to a specific step number, set pulse width of valve to a specific value/duty cycle). Number of controlState bytes in request: depends on the dataIdentifier Number of controlState bytes in pos. response: depends on the dataIdentifier	
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3.12 例程控制 (0x31) 服务 RoutineControl (0x31) Service

客户端使用此服务来启动/停止例程并请求服务端内存中的例程结果。 该例程由一个 2 字节的例程标识符标识。

The RoutineControl 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.

3.12.1 消息格式 Message Format

请求消息定义：Request message definition:

Byte	Name	Cvt	Value (hex)
#1	RequestServiceIdentifier	M	31
#2	Sub-Function = [RoutineControlType]	M	00-FF
#3	RoutineIdentifier [] = [byte#1 (MSB)	M	00-FF
#4	byte#2]	M	00-FF
#5	RoutineControlOptionRecord [] = [routineControlOption#1	C/U	00-FF
:	:	:	:

#n	routineControlOption#m]	C/U	00-FF
C: 用户可以在子功能为启动例程和停止例程时使用该参数。 C: This parameter is user optional to be present for sub-function parameter startRoutine and stopRoutine.			

肯定响应消息: Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	71
#2	RoutineControlType	M	00-7F
#3	RoutineIdentifier [] = [byte#1 (MSB) byte#2]	M	00-FF
#4		M	00-FF
#5	RoutineStatusRecord [] = [routineStatus#1 : : : routineStatus#m]	M1 注	00-FF
:		:	:
#n		U	00-FF

注：所有支持的子功能，对例程控制服务请求的肯定响应都应具有数据参数 RoutineStatusRecord。
RoutineStatus#1 用于指示 routineControl 的执行结果，其定义参照下表。

Note:

The positive response on the service routineControl request, regardless of sub-function, shall have the data parameter RoutineStatusRecord.

RoutineStatus#1 is used to indicate the execution result of routineControl, and its definition refers to the following table.

例程状态定义 Routine status definition:

Hex	名称/Name	定义/Definition
0x00	Routine Completed	该例程完成了所有请求的功能 (成功与否)。通过服务routineControl读取的例程结果 (如果有) 是有效的。 The routine completed all requested functionality (successfully or not).The routine results (if any), readable via service routineControl is valid.
0x01	Routine Aborted	由于以下任意原因, 例程在完成所有请求的功能之前中止: 1. 未满足开启例程条件, 未开始例程。 2. 出现退出例程的条件, 例程已中止。 3. 例程已被 stopRoutine 请求中止。 The routine aborted before completion of all requested functionality due to any of the following reasons: 1. The routine has not started due to the entry conditions are not fulfilled. 2. The routine has been aborted due to any of the exit conditions have

		occurred. 3. The routine has been aborted by a stopRoutine request.
0x02	Routine Executing	该例程正在执行中，尚未完成。 The routine is under execution and not yet completed.

否定响应消息：Negative Response Message:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	31
#3	NegativeResponseCode	M	(see below)

支持的否定响应码：Supported Negative Response Codes:

NRC (hex)	Description
12	不支持该子功能 如果不支持该子功能参数，则应发送此否定响应码。 subFunctionNotSupported This NRC shall be sent if the sub-function parameter is not supported.
13	不正确的消息长度或无效格式 如果消息长度错误，则应发送此否定响应码。incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.
22	条件不正确 如果不满足例程控制的条件，则应返回此否定响应码。所有的条件均应提供给小米汽车。 conditionsNotCorrect This NRC shall be returned if the criteria for the request RoutineControl are not met. All the conditions shall be provided to Xiaomi.
24	请求顺序错误 如果在没有收到“启动例程”请求消息的情况下接收到“停止例程”或“请求例程结果”子功能，则应返回此否定响应码。 requestSequenceError

	This NRC shall be returned if the 'stopRoutine' or 'requestRoutineResults' sub-function is received without first receiving a 'startRoutine' for the requested routineIdentifier.
31	请求超出范围 如果出现以下情况，则应返回此否定响应码： 1.服务端不支持请求的例程标识符， 2.被请求例程标识符的用户可选例程控制选项记录包含无效数据。 requestOutOfRange This NRC shall be returned if: 1. The server does not support the requested routineIdentifier, 2. The user optional routineControlOptionRecord contains invalid data for the requested routineIdentifier.
33	安全访问被拒绝 如果客户端发送具有有效安全例程标识符的请求并且服务端的安全功能当前处于活动状态时，则应返回此否定响应码。 securityAccessDenied This NRC shall be sent if a client sends a request with a valid secure routineIdentifier and the server' s security feature is currently active.
72	一般编程失败 如果服务端在写入内存位置时检测到错误，则应返回此否定响应码。举例当例程擦除或编程永久存储设备（例如闪存）中的某个存储位置并且对该存储位置的访问失败时。 generalProgrammingFailure This NRC shall be returned if the server detects an error when performing a routine, which accesses server internal memory. An example is when the routine erases or programmes a certain memory location in the permanent memory device (e.g. Flash Memory) and the access to that memory location fails.
7F	活动会话不支持服务 Service not supported in active session

3.12.2 参数选项 Parameter Options

Optio (hex)	Description
01	启动例程 该参数定义了服务端应启动例程标识符定义的例程。 startRoutine This parameter specifies that the server shall start the routine specified by the routineIdentifier.
02	停止例程 该参数定义了服务端应停止例程标识符定义的例程。 stopRoutine This parameter specifies that the server shall stop the routine specified by the routineIdentifier.
03	请求例程结果 该参数定义了服务端应返回例程标识符定义的例程结果值。 requestRoutineResults This parameter specifies that the server shall return result values of the routine specified by the routineIdentifier.

3.12.3 例程标识符 Routine Identifier

推荐以下例程标识符，并应在该网络的节点中实现。

The following routines are commended and should be implemented in the nodes of this network.

Routine Identifier	Description	Cvt
0202- Check Memory	使用签名检查下载块的正确性。 Check for correctness of a downloaded block using signature.	M
0205- Check Programming Dependencies	检查所有下载的软件部分的完整性和依赖性。 Check complete and dependencies of all downloaded software part.	M

FF00- Erase Memory	例行控制诊断请求启动重新编程序列的擦除存储器步骤。 The Routine Control Diagnostic Request initiates the Erase Memory step of the reprogramming sequence.	M
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3.13 请求下载 (0x34) 服务 RequestDownload (0x34) Service

客户端使用“请求下载”服务启动从客户端到服务端的数据传输(下载)。

The RequestDownload service is used by the client to initiate a data transfer from the client to the server (download).

在服务端收到“请求下载”请求消息后，服务端应在发送肯定响应消息之前采取所有必要的操作来接收数据。

After the server has received the requestDownload request message the server shall take all necessary actions to receive data before it sends a positive response message.

3.13.1 消息格式 Message Format

请求消息定义：Request message definition:

Byte	Name	Cvt	Value (hex)
#1	RequestServiceIdentifier	M	34
#2	DataFormatIdentifier	M	00-FF
#3	addressAndLengthFormatIdentifier	M	44
#4	MemoryAddress [] = [	M	00-FF
	byte#1 (MSB)		
.	.		
.	.		
#(n-1)+4	byte#n (LSB)]	C1	00-FF
# n+4	MemorySize [] = [	M	00-FF
	byte#1 (MSB)		

.	.	.	00-FF
.	.	.	00-FF
# n+4+(k-1)	byte#k (LSB)]	C2	00-FF
C1:该参数的存在取决于地址和长度格式标识符中的地址长度信息参数。 C2:该参数的存在取决于地址和长度格式标识符中的内存大小信息参数。 C1: The presence of the MemoryAddress parameter depends on the address length information parameter of the addressAndLengthFormatIdentifier. C2: The presence of the MemorySize parameter depends on the memory size length information of the addressAndLengthFormatIdentifier.			

肯定响应消息: Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	74
#2	LengthFormatIdentifier	M	00-F0
#3	MaxNumberOfBlockLength [	M	00-FF
:	:	:	:
#n	byte#m]	M	00-FF

否定响应消息: Negative Response Message:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	34
#3	NegativeResponseCode	M	(see below)

支持的否定响应码: Supported Negative Response Codes:

NRC (hex)	Description
13	不正确的消息长度或无效格式

	如果消息长度错误，则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.
22	条件不正确 如果服务端在接收软件或校准模块的下载过程中收到对此服务的请求，则应返回此否定响应码。在下载模块期间服务端和客户端之间的数据大小不匹配，则可能会发生这种情况。所有的条件均应提供给小米汽车。 conditionsNotCorrect This NRC shall be returned if a server receives a request for this service while in the process of receiving a download of a software or calibration module. This could occur if there is a data size mismatch between the server and the client during the download of a module. All the conditions shall be provided to Xiaomi.
31	请求超出范围 如果出现以下情况，则应返回此否定响应码： 1. 指定的数据格式标识符无效。 2. 指定的地址和长度格式标识符无效。 3. 指定的内存地址/内存大小无效。 requestOutOfRange This NRC shall be returnedif: 1. The specified dataFormatIdentifier is not valid. 2. The specified addressAndLengthFormatIdentifier is not valid. 3. The specified memoryAddress/memorySize is not valid.
33	安全访问被拒绝

	如果服务端是安全的（对于支持安全访问服务的服务端），当收到此服务的请求时，则应返回此否定响应码。 securityAccessDenied This NRC shall be returned if the server is secure (for server' s that support the SecurityAccess service) when a request for this service has been received.
70	上传下载不被接受 由于某些故障条件，无法完成下载到服务端内存的尝试时，则应返回此否定响应码。 uploadDownloadNotAccepted This NRC indicates that an attempt to download to a server's memory cannot be accomplished due to some fault conditions.
7F	活动会话不支持服务 Service not supported in active session

3.13.2 参数选项 Parameter Options

地址和长度格式标识符是一个字节值，每个半字节单独编码。数据格式标识符由两个半字节组成，左边半字节包含压缩方法，右边半字节包含加密方法。 如果不应应用压缩或加密，则相应的参数应设置为 0x00。

The addressAndLengthFormatIdentifier is a one-byte value with each nibble coded separately. The DataFormatIdentifier consists of two nibbles, the left one containing the compression method, the right one containing the encryption method. If no compression or encryption applies, the corresponding parameter shall be set to 0x00.

如果ECU的内存大小不超过4G字节，则内存地址参数长度为4个字节，内存大小参数长度为4Bytes，地址和长度格式标识符的值为0x44。 否则，内存地址参数长度应为 8个字节，内存大小参数长度应为 8个字节，地址和长度格式标识符的值应为 0x88。

If the memory size of the ECU doesn' t exceed 4GBytes, the MemoryAddress parameter' length shall be 4Bytes and the MemorySize parameter length shall be 4Bytes, and the value of the addressAndLengthFormatIdentifier should be 0x44. Otherwise, the MemoryAddress parameter length

shall be 8Bytes and the MemorySize parameter length shall be 8Bytes, and the value of the addressAndLengthFormatIdentifier should be 0x88.

3.14 传输数据 (0x36) 服务 TransferData (0x36) Service

客户端使用传输数据服务将数据从客户端传输到服务端（下载）或从服务端传输到客户端（上传）。

The TransferData service is used by the client to transfer data either from the client to the server (download) or from the server to the client (upload).

数据传输方向由前面的请求下载 (0x34) 或请求上传 (0x35) 服务定义。 本文档中的数据传输方向固定为仅下载。

The data transfer direction is defined by the preceding RequestDownload or RequestUpload service. The data transfer direction within this document is fixed to download only.

传输数据 (0x36) 服务请求包括一个块序列计数器以允许在多个传输数据请求的序列期间传输数据 (0x36) 服务失败的情况下改进错误处理。当接收到请求下载 (0x34) 请求消息时，服务端的块序列计数器应初始化为— (1)。 这意味着在请求下载 (0x34) 服务请求消息之后的第一个传输数据 (0x36) 服务请求消息以一 (1) 的块序列计数器开始。

The TransferData service request includes a blockSequenceCounter to allow for improved error handling in case a TransferData service fails during a sequence of multiple TransferData requests. The blockSequenceCounter of the server shall be initialized to one (1) when receiving a RequestDownload (0x34) request message. This means that the first TransferData (0x36) request message following the RequestDownload (0x34) request message starts with a blockSequenceCounter of one (1).

3.14.1 消息格式 Message Format

请求消息定义：Request message definition:

Byte	Name	Cvt	Value (hex)
#1	RequestServiceIdentifier	M	36
#2	BlockSequenceCounter	M	00-FF

#3	TransferRequestParameterRecord [] = [		
:	transferRequestParameter#1	C	00-FF
:	:	:	:
#n	transferRequestParameter#m]	U	00-FF

C = 有条件的：如果正在进行下载，则此参数是必需的。

C = Conditional: this parameter is mandatory if a download is in progress.

肯定响应消息：Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	76
#2	BlockSequenceCounter	M	00-FF

否定响应消息：Negative Response Message:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	36
#3	NegativeResponseCode	M	(see below)

支持的否定响应码：Supported Negative Response Codes:

NRC (hex)	Description
13	不正确的消息长度或无效格式 如果消息长度错误（例如，消息长度不符合请求下载（0x34）服务的肯定响应中返回最大块长度参数的要求），则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong. (e.g., message length does not meet requirements of maxNumberOfBlockLength parameter returned in the positive response to requestDownload).
24	请求顺序错误

	如果出现以下情况，则应返回此否定响应码： 1. 如果在收到对该服务的请求时请求下载（0x34）服务或请求上传（0x35）服务未处于活动状态。 2. 如果请求下载（0x34）服务或请求上传（0x35）服务是活动的，但服务端已经收到了由活动请求下载（0x34）服务或请求上传（0x35）服务中的内存大小参数确定的所有数据。 注：服务端应接受重复的传输数据请求消息，其块序列计数器等于包含在前一个传输数据请求消息中的一个。 requestSequenceError The server shall use this response code 1. If the RequestDownload or RequestUpload service is not active when a request for this service is received. 2. If the RequestDownload or RequestUpload service is active, but the server has already received all data as determined by the memorySize parameter in the active RequestDownlod or RequestUpload service. NOTE The repetition of a TransferData request message with a blockSequenceCounter equal to the one included in the previous TransferData request message shall be accepted by the server.
31	请求超出范围 如果传输请求参数记录包含附加控制参数（例如附加地址信息）并且该控制信息无效，则应返回此否定响应码。 requestOutOfRange This NRC shall be returned if the transferRequestParameterRecord contains additional control parameters (e.g. additional address information) and this control information is invalid.
71	传输数据暂停 如果出现以下情况，则应返回此否定响应码： 1. 数据传输操作因某些故障而停止。

	2. 下载模块长度不满足请求下载（0x34）服务的请求消息中发送的内存大小参数的要求。 transferDataSuspended This NRC shall be returned if 1. The response code indicates that a data transfer operation was halted due to some fault. 2. The download module length does not meet the requirements of the memorySize parameter sent in the request message of the requestDownload service.
72	一般编程失败 如果服务端在下载数据期间擦除或编程永久存储设备（例如闪存）中的存储位置时检测到错误，则应返回此否定响应码。 generalProgrammingFailure This NRC shall be returned if the server detects an error when erasing or programming a memory location in the permanent memory device (e.g. Flash Memory) during the download of data.
73	错误的块序列计数器 如果服务端在块序列计数器的序列中检测到错误，则应返回此否定响应码。 注：服务端应接受重复的传输数据请求消息，其块序列计数器等于包含在前一个 传输数据请求消息中的一个。 wrongBlockSequenceCounter This NRC shall be returned if the server detects an error in the sequence of the blockSequenceCounter. NOTE The repetition of a TransferData request message with a blockSequenceCounter equal to the one included in the previous TransferData request message shall be accepted by the server.
7F	活动会话不支持服务 Service not supported in active session
92-93	电压太高 / 电压太低

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	77

否定响应消息: Negative Response Message:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	37
#3	NegativeResponseCode	M	(See below)

支持的否定响应码: Supported Negative Response Codes:

NRC (hex)	Description
13	不正确的消息长度或无效格式 如果消息长度错误, 则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.
24	请求顺序错误 如果出现以下情况, 则应返回此否定响应码: 1. 收到此服务的请求时, 编程过程未完成。 2. 请求下载 (0x34) 或请求上传 (0x35) 服务未激活。 requestSequenceError This NRC shall be sent if: 1. The programming process is not completed when a request for this service is received. 2. The RequestDownload or RequestUpload service is not active.
7F	活动会话不支持服务 Service not supported in active session

3.15.2 参数选项 Parameter Options

此服务没有参数。

There are no parameters for this service.

3.16 通信保持 (0x3E) 服务 TesterPresent (0x3E) Service

此服务用于指示服务端(或多个服务端)客户端仍连接到车辆，之前已激活的某些诊断服务和/或通信仍处于激活状态。在没有其他 UDS 服务的情况下需要此服务，以防止服务端自动返回到默认诊断会话。

This service is used to indicate to a server (or servers) that a client is still connected to the vehicle and that certain diagnostic services and/or communication that have been previously activated are to remain active. This service is required in the absence of other UDS services to prevent servers from automatically returning to default diagnostic session.

3.16.1 消息格式 Message Format

请求消息定义：Request message definition:

Byte	Name	Cvt	Value (hex)
#1	RequestServiceIdentifier	M	3E
#2	Sub-Function = [ZeroSubFunction]	M	00

肯定响应消息：Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	7E
#2	ZeroSubFunction	M	00

否定响应消息：Negative Response Message:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F

#2	OriginalRequestServiceIdentifier	M	3E
#3	NegativeResponseCode	M	(see below)

支持的否定响应码：Supported Negative Response Codes:

NRC (hex)	Description
12	不支持该子功能 如果不支持该子功能参数，则应发送此否定响应码。 subFunctionNotSupported This NRC shall be sent if the sub-function parameter is not supported.
13	不正确的消息长度或无效格式 如果消息长度错误，则应发送此否定响应码。 incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.

3.16.2 参数选项 Parameter Options

Option (hex)	Description
00	零子功能 该参数值用于指示该服务不支持肯定响应抑制位之外的子功能值。 zeroSubFunction This parameter value is used to indicate that no sub-function value beside the suppressPosRspMsgIndicationBit is supported by this service.

3.17 控制诊断故障码(DTC)设置 (0x85) 服务 ControlDTCSetting (0x85) Service

客户端通过ControlDTCSetting服务应使用停止或恢复服务端中DTC状态位的更新。DTC状态位报告在对ReadDTCInformation的某些子功能的正响应的statusOfDTC参数中。

The ControlDTCSetting service shall be used by a client to stop or resume the updating of DTC status

bits in the server(s). DTC status bits are reported in the statusOfDTC parameter of the positive response to certain subfunctions of ReadDTCInformation.

控制DTC设置请求消息可用于停止更新单个服务端或一组服务端中DTC状态位。如果被寻址的服务端不能停止DTC 状态位的更新，则应给出控制DTC设置否定响应消息表明否定的原因。

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 rejection.

一旦控制DTC设置请求被执行且子功能设置为“on”或发生会话层超时（服务端转换到默认会话），DTC状态位信息的更新将继续。

The update of the DTC status bit information shall continue once a ControlDTCSetting request is performed with sub-function set to “on” or a session layer timeout occurs (server transitions to defaultSession).

进入该服务的前提条件规则如下：

- a) 车速不超过3km/h;
- b) 系统不执行内部关键操作;
- c) 其他需要小米汽车同意的限制条件。

当不满足这些条件中的至少一项时，ECU 应返回 NRC 0x22。 如果无法获得有效车速，则该场景视为车速满足前提条件。

The precondition rules to implement the service are as follow:

- a) Vehicle speed is not over 3km/h;
- b) No critical operations is performed by the system;
- c) Other limiting conditions need to be agreed by Xiaomi.

When at least one of these conditions is not met, the ECU shall return NRC 0x22. If the valid vehicle speed cannot be obtained, this scene shall be regarded as the vehicle speed having fulfilled the precondition.

3.17.1 消息格式 Message Format

请求消息定义：Request message definition:

Byte	Name	Cvt	Value (hex)
#1	RequestServiceIdentifier	M	85
#2	Sub-Function = [DTCSettingType]	M	00-7F

肯定响应消息：Positive Response Message:

Byte	Name	Cvt	Value (hex)
#1	PositiveResponseServiceIdentifier	M	C5
#2	DTCSettingType	M	00-7F

否定响应消息：Negative Response Message:

Byte	Name	Cvt	Value (hex)
#1	NegativeResponseServiceIdentifier	M	7F
#2	OriginalRequestServiceIdentifier	M	85
#3	NegativeResponseCode	M	(see below)

支持的否定响应码：Supported Negative Response Codes:

NRC (hex)	Description
12	不支持该子功能 如果不支持该子功能参数，则应发送此否定响应码 subFunctionNotSupported This NRC shall be sent if the sub-function parameter is not supported..
13	不正确的消息长度或无效格式 如果消息长度错误，则应发送此否定响应码。incorrectMessageLengthOrInvalidFormat This NRC shall be sent if the length of the message is wrong.
22	条件不正确

	当服务端处于关键的正常模式活动并因此无法执行请求的 DTC控制功能时，则应返回此否定响应码。所有的条件均应提供给小米汽车。 conditionsNotCorrect Used when the server is in a critical normal mode activity and therefore cannot perform the requested DTC control functionality. All the conditions shall be provided to Xiaomi.
7F	活动会话不支持服务 Service not supported in active session

3.17.2 参数选项 Parameter Options

Option (hex)	Description
01	开启 根据正常的操作条件，服务端应恢复更新诊断故障码的状态位。 on The server(s) shall resume the updating of diagnostic trouble code status bits according to normal operating conditions.
02	关闭 服务端应停止更新诊断故障码的状态位。 off The server(s) shall stop the updating of diagnostic trouble code status bits.

4 诊断数据 Diagnostic Data

4.1 DID 参数定义 DID parameter definitions

参数dataIdentifier (DID)在逻辑上表示一个对象(例如, 进风口门位置)或对象集合。这个参数在服务器的内存中是可用的。通常, DID能够用于许多诊断服务请求, 包括0x22 (readDataByIdentifier)、0x2E (writeDataByIdentifier)和0x2F(inputOutputControlByIdentifier)。 dataIdentifier也用于各种诊断服务响应(例如, 对服务0x19子函数readDTCSnapshotRecordByDTCNumber的肯定响应)。重要:无论dataIdentifier用于哪个服务, 它都应该在给定的ECU上一致地表示相同的東西(例如, 给定的对象具有给定的大小/含义/等)。

The parameter dataIdentifier (DID) logically represents an object (e.g., Air Inlet Door Position) or collection of objects. This parameter shall be available in the server's memory. In general, a DID is capable of being utilized in many diagnostic service requests including 0x22 (readDataByIdentifier), 0x2E (writeDataByIdentifier), and 0x2F(inputOutputControlByIdentifier). A dataIdentifier is also used in various diagnostic service responses (e.g.,positive response to service 0x19 subfunction readDTCSnapshotRecordByDTCNumber).IMPORTANT — Regardless of which service a dataIdentifier is used with, it shall consistently represent the same thing (i.e., a given object with a given size / meaning / etc.) on a given ECU.

ECU和车辆的识别信息应在ECU内的数据记录中定义, 如下表所示。

Information for identification of the ECU and the vehicle shall be defined in data records within the ECU, according to below table.

表 15— 诊断物流数据 Table 15— Diagnostic logistics data

Data record			Encode Format	Read access		Session	
Identifier	Name	Description		Read	Write	Other session	Programming session
0xF100	Private ECU(s) Delivery Assembly Part Number	该值将用于读取ECU主节点下的所有私有ECU的零件号集。 它应在交付到装配厂或服务站时识别完整的私有控制器。控制器首次交付后, 该编号不得更改或更新。记录数据的第一个数据字节应为所报告的私有控制器的个数。在私有控	1Byte,BCD+(1 3*N)Byte,ASCII	Yes	N/A	Yes	N/A

		制器的个数之后报私有节点的零件号。数据的格式定义如下： 字节 0 私有ECU的个数（例如 2） 字节 1-13 私有ECU#1的零件号（例如 P123456789001） 字节 14-26 私有ECU#2的零件号（例如 P223456789001） This value shall be used to reference the complete set of Private ECU(s) Delivery Assembly Part Number. The Part Number(s) shall identify the complete Private ECU at the point of delivery to the assembly plant or the service bay. The number shall not be altered or updated after initial delivery of the ECU. The first data byte of the record data shall be the TotalNumbrOfPrivateECUs that are reported. Following the TotalNumbrOfPrivateECUs the Part Numbers are reported. The format of the data structure shall be defined as below: Byte 0 TotalNumbrOfPrivateECUs (e.g. 2) Byte 1-13 Private ECU#1 Delivery Assembly Part Number (e.g. P123456789001) Byte 14-26 Private ECU#2 Delivery Assembly Part Number (e.g. P223456789001)					
0xF101	Private ECU(s) Serial Number	该值将用于读取ECU主节点下的所有私有ECU的序列号集。每个私有ECU均有唯一的序列号，由供应商提供。记录数据的第一个数据字节应为所报告的私有ECU的个数。在私有ECU的个数之后报私有节点的序列号。数据的格式定义如下： 字节 0 私有ECU的个数（例如 2） 字节 1-8 私有ECU#1的序列号（例如 2021103011223344）	1Byte,BCD+(8*N)Byte,BCD	Yes	N/A	Yes	N/A

		字节 9-16 私有ECU#2的序列号（例如 2021103012345678） This value shall be used to reference the complete set of Private ECU(s) Serial Number Number. A supplier unique Serial number per Private ECU.The first data byte of the record data shall be the TotalNumbrOfPrivateECUs that are reported. Following the TotalNumbrOfPrivateECUs the Serial Numbers are reported. The format of the data structure shall be defined as below: Byte 0 TotalNumbrOfPrivateECUs (e.g. 2) Byte 1-8 Private ECU#1 Serial Number (e.g. 2021103011223344) Byte 9-16 Private ECU#2 Serial Number (e.g. 2021103012345678)					
0xF102	SBL软件版本号 secondaryBootSoftwareVersionNumber	该值将用于读取SBL软件的版本号。 This value shall be used to reference the Secondary Bootloader software version number.	13 Byte, ASCII	Yes	N/A	N/A	Yes (Only Secondary Boot support)
0xF103	应用诊断数据库版本号 ApplicationDiagnosticDatabasePartNumber	该值将用于读取应用诊断数据库的版本号。 This value shall be used to reference the Application Diagnostic Database Part Number.	13 Byte, ASCII	Yes	N/A	Yes	N/A
0xF104	PBL诊断数据库版本号 PrimaryBootloaderDiagnosticDatabasePartNumber	该值将用于读取PBL诊断数据库的版本号，该编号在软件刷写过程中保持不变。This value shall be used to reference the Primary Bootloader Diagnostic Database Part Number, this number remains unchanged during the flashing process.	13 Byte, ASCII	Yes	N/A	Yes	Yes
0xF105	SBL诊断数据库版本号 SecondaryBootloaderDiagnosticDatabasePartNumber	该值将用于读取SBL诊断数据库的版本号。 This value shall be used to reference the Secondary Bootloader Diagnostic Database Part Number.	13 Byte, ASCII	Yes	N/A	N/A	Yes (Only Secondary Boot support)

0xF180	PBL软件版本号 PrimaryBootSoftwareVersionNumber	该值将用于读取PBL软件的版本号，该编号在软件刷写过程中保持不变。 This value shall be used to reference the Primary Bootloader software version number, this number remains unchanged during the flashing process.	13 Byte, ASCII	Yes	N/A	Yes	Yes
0xF186	诊断会话模式 ActiveDiagnosticSession	该值应用于读取目标控制器中的活动诊断会话。 数据格式定义如下： 0x01 – 默认诊断会话 0x02 – 编程会话 0x03 – 扩展诊断会话 0x04 – 安全系统诊断会话 This value shall be used to report the active diagnostic session in the server. The format of the data structure shall be defined as below: 0x01 – Default Diagnostic Session 0x02 – Programming Session 0x03 – Extended Diagnostic Session 0x04 – Safety System Diagnostic Session	1Byte, Hex	Yes	N/A	Yes	Yes
0xF18A	系统供应商代码 systemSupplierIdentifier	该值应用于读取系统供应商名称和地址信息。 控制器必须在末尾用“空格字符”(0x20)填充未使用的字节。此编号在刷写过程中保持不变。(小米汽车将向供应商提供该代码。) This value shall be used to reference the system supplier name and address information. The ECU must pad unused bytes with a 'space character' (0x20) at the end.This number remains unchanged during the flashing process. (XiaoMi will provide the code to the supplier.)	10Byte, ASCII	Yes	N/A	Yes	Yes
0xF18B	ECU制造日期 ECUManufacturingDate	该值应用于读取 ECU（服务端）制造日期。这是供应商侧ECU的制造日期。这个编号在	4Byte, BCD	Yes	N/A	Yes	N/A

		软件刷写过程中保持不变。数据的格式定义如下： 字节 0-1 年（例如 2021） 字节 2 月（例如 10） 字节 3 天（例如 30） This value shall be used to reference the ECU (server) manufacturing date. This is the manufacturing date of ECU at the supplier' s side.This number remains unchanged during the flashing process.The format of the data structure shall be defined as below: Byte 0-1 Year (e.g. 2021) Byte 2 Month (e.g. 10) Byte 3 Day (e.g. 30)					
0xF18C	ECU序列号 ECUSerialNumber	该值应用于读取 ECU（服务端）序列号。每个 ECU 的序列号都是唯一的，该编号在软件刷写过程中保持不变。数据的格式定义如下： 字节 0-1 年（例如 2021） 字节 2 月（例如 10） 字节 3 天（例如 30） 字节 4-7 序列号（例如 12345678） This value shall be used to reference the ECU (server) serial number. A supplier unique ECU serial number per ECU, This number remains unchanged during the flashing process. The format of the data structure shall be defined as below: Byte 0-1 Year (e.g. 2021) Byte 2 Month (e.g. 10) Byte 3 Day (e.g. 30) Byte 4-7 SerialNumber (e.g. 12345678)	8Byte, BCD	Yes	N/A	Yes	Yes
0xF18E	总成供货号 AssemblyPartNumber	该值应用于读取车辆制造商的总成供货号，该编号在软件刷写过程中保持不变。 This value shall be used to reference the Assembly Part Number.This number	13 Byte, ASCII	Yes	N/A	Yes	N/A

		remains unchanged during the flashing process.					
0xF190	车辆识别码 VINDataIdentifier	该值将用于读取VIN码。VIN码与ECU特定功能关联的ECU需要实现该DID，其余ECU不需要实现。该编号在软件刷写过程中保持不变。 This value shall be used to reference the VIN number.The ECU which VIN code is associated with a specific function needs to implement the DID, and the other ECUs do not need to implement it. This number remains unchanged during the flashing process.	17Byte, ASCII	Yes	N/A	Yes	Yes
0xF193	系统供应商ECU硬件版本号 systemSupplierECUHardwareVersionNumber	该值将用于读取系统供应商的硬件版本号。该编号在软件刷写过程中保持不变。 This value shall be used to reference the system supplier hardware version number. This number remains unchanged during the flashing process.	13Byte, ASCII	Yes	N/A	Yes	Yes
0xF198	修理厂代码或诊断仪序列号 repairShopCodeOrTesterSerialNumberDataIdentifier	该值将用于读取修理厂代码或诊断仪（客户端）序列号（例如，指示最近使用的客户端重新编程服务端内存）。诊断设备必须用“空格字符”（0x20）填充未使用的字节。 This value shall be used to reference the repair shop code or tester (client) serial number (e.g., to indicate the most recent service client used re-program server memory). The diagnostic equipment must pad unused bytes with a 'space character' (0x20).	13Byte, ASCII	Yes	Yes	Yes (Only read)	Yes
0xF199	编程日期 programmingDate	该值将用于读取控制器最近一次编程的日期。数据的格式定义如下： 字节 0-1 年（例如 2021） 字节 2 月（例如 10） 字节 3 天（例如 30） This value shall be used to reference the date when the server was last programmed. The format of the data structure shall be defined as below: Byte 0-1 Year (e.g. 2021)	4Byte, BCD	Yes	Yes	Yes (Only read)	Yes

		Byte 2 Month (e.g. 10) Byte 3 Day (e.g. 30)					
0xF19D	ECU安装日期 ECUInstallationDate	该值将用于读取服务端(ECU)安装在车辆中的日期。数据的格式定义如下: 字节 0-1 年 (例如 2021) 字节 2 月 (例如 10) 字节 3 天 (例如 30) This value shall be used to reference the date when the server (ECU) was installed in the vehicle. The format of the data structure shall be defined as below: Byte 0-1 Year (e.g. 2021) Byte 2 Month (e.g. 10) Byte 3 Day (e.g. 30)	4Byte, BCD	Yes	Yes	Yes	N/A
0xF1A0	ECU软件版本号 ECU Software Part Numbers	该值将用于读取 ECU 软件的完整零件号集。零件号仅允许用于可单独下载到 ECU 的软件层级。记录数据的第一个数据字节应为所报告的软件层级数。在软件层级数之后报告ECU软件零件号, 除了在编程会话中。数据的格式定义如下: 字节 0 软件层级数 (例如 2) 字节 1-13 ECU软件#1的零件号 (例如 S123456789001) 字节 14-26 ECU软件#2的零件号 (例如 S223456789001) This value shall be used to reference the complete set of part numbers for the ECU software. The Part Number(s) is only allowed to be used for item(s) that can be separately downloaded to the ECU. The first data byte of the record data shall be the TotalNumbrOfECUSWPartNumbr that are reported. Following the TotalNumbrOfECUSWPartNumbr the ECU Software Part Numbers are reported, except in programming	1Byte,BCD+(13*N)Byte,ASCII	Yes	N/A	Yes	N/A

		session. The format of the data structure shall be defined as below: Byte 0 TotalNumbrOfECUSWPartNumbr (e.g. 2) Byte 1-13 ECU Software #1 Part Number (e.g. S123456789001) Byte 14-26 ECU Software #2 Part Number (e.g. S223456789001)					
0xF17F	软件校验和值 SoftwareChecksumValue	该值将用于读取软件校验和值，用于验证 ECU 软件的完整性。 每次上电或 ECU 复位后，应尽快完成校验和值计算^{注1}，计算校验和值的最长时间为 120[s]。ECU 内部存储的校验和值应始终为最新的计算结果。 外部诊断工具请求校验和值时，ECU 应正确响应存储的校验和值。否则只有在校验和值正在计算中且没有存储的校验和值时，ECU 才会响应 NRC 0x78。校验和值计算方法应遵循 CRC32 算法（参见 软件下载规范 6.3 CRC32）。 数据的格式定义如下： 字节 0-3 PBL 软件计算的校验和值 字节 4-7 除 PBL 软件外的所有软件计算的校验和值^{注2} 注1：该校验和值的计算不应干扰正常的诊断功能。 注2：校验和值计算的软件范围需要排除在正常功能范围内允许发生变化的一些数据，例如：客户数据、自学习数据、配置数据等。特殊要求需经小米基础技术团队认可。 A Software ChecksumValue DID is used to verify the integrity of the ECU software. The checksum value calculation shall be completed as soon as possible after each power on or ECU reset, the maximum time for calculating checksum value is 120[s]. The stored checksum value shall always covered with the latest calculate result.	8Byte, HEX	Yes	N/A	Yes	N/A

		When checksum value is requested by clients, the ECU shall respond with the stored value correctly, otherwise the ECU shall respond with NRC 0x78 only when the checksum value calculation is processing and without stored value. Checksum value calculation method shall follow the CRC32 algorithm (refer to Flash Programming Specification 6.3 CRC32). The format of the data structure shall be defined as below: Bytes 0-3 Checksum calculated for PBL software Bytes 4-7 Checksum calculated for all software excluded PBL software ^{Note2} Note1: The calculation for this checksum value shall not disturb normal diagnostic function. Note2: The software shall also be exclude which data will allow changes in normal function scope, e.g. customer data, self-learning data, configuration data etc. Special reasonable requirement need to be approved by Xiaomi Base technology team.					
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