

UDS Unified Diagnostic Services - ISO 14229

softing

UDS and OBD Positioning in the ISO/OSI Layer Model

International Standard Organization's Open System Interconnect 7 Layer Communication Model

| Layer | Description | Standards for UDS | Standards for OBD |
|-------|------------------------|-----------------------------|-------------------|
| "8" | Diagnostic Application | User | ISO 15031-5 |
| 7 | Application Layer | ISO 14229-1 ISO 15765-3 | ISO 15031-5 |
| 6 | Presentation Layer | Not applicable | Not applicable |
| 5 | Session Layer | ISO 15765-3 | Not applicable |
| 4 | Transport layer | ISO 15765-2 | Not applicable |
| 3 | Network Layer | ISO 15765-2 | ISO 15765-4 |
| 2 | Data Link Layer | ISO 11898-1 | ISO 15765-4 |
| 1 | Physical Layer | ISO 11898-2* ISO 11898-3 | ISO 15765-4 |

*)

The bus physics used is to be selected by the user
Therefore, several standards for different physical layer for e.g. High-Speed- (ISO 11898-2) or Fault-Tolerant-CAN (ISO 11898-3) can be used

Diagnostic Messages - Structures and Types

Request without Sub-Function or Positive Response

Requests with Sub-Function Byte

UUDT-Responses

Negative Responses

The Sub-Function Byte of UDS

Services without Sub-Function-Byte: \$14, \$23, \$24, \$2A, \$2E, \$2F, \$34, \$35, \$36, \$37, \$3D, \$84

Services with Sub-Function Byte: \$10, \$11, \$19, \$27, \$28, \$2C, \$31, \$3E, \$83, \$85, \$87

Services with Sub-Function Byte and Storage State Parameter : \$86

Bit 7: suppressPosRspMsgIndicationBit

Bit 6 to 0: sub-function parameter value

Remark:

Periodic Message Types of UDS

Responses in a CAN data field according to ISO 15765-3

Unacknowledged Segmented Data Transfer (USDT)

Unacknowledged Unsegmented Data Transfer (UUDT)

Responses can be of two different formats/types:

Type 1: with Response Service Identifier

Type 2: without Response Service Identifier

The type is respected by the Service \$2A Read Data by Periodic Identifier

Service Overview

| Functional Unit | SID | Available in Default Session | Available for RoE | Has Sub-Function | Service Name | Mnemonic |
|---|------|------------------------------|-------------------|------------------|------------------------------------|----------|
| Diagnostic and Communication Management | \$10 | ✓ | | ✓ | Diagnostic Session Control | DSC |
| | \$11 | ✓ | | ✓ | ECU Reset | ER |
| | \$27 | | | ✓ | Security Access | SA |
| | \$28 | | | ✓ | Communication Control | CC |
| | \$3E | | | ✓ | Tester Present | TP |
| | \$83 | | | ✓ | Access Timing Parameter | ATP |
| | \$84 | | | ✓ | Secured Data Transmission | SDT |
| | \$85 | | | ✓ | Control DTC Setting | CDTCS |
| Data Transmission | \$86 | ✓ | | ✓ | Response On Event | ROE |
| | \$87 | | | ✓ | Link Control | LC |
| | \$22 | ✓ | | | Read Data By Identifier | RDBI |
| | \$23 | ✓ | | | Read Memory By Address | RMBA |
| | \$24 | ✓ | | | Read Scaling Data By Identifier | RSDBI |
| | \$2A | | ✓ | | Read Data By Periodic Identifier | RDBPI |
| | \$2C | ✓ | | ✓ | Dynamically Define Data Identifier | DDDI |
| | \$2E | ✓ | | | Write Data By Identifier | WDBI |
| Stored Data Transmission | \$3D | ✓ | | | Write Memory By Address | WMBA |
| | \$14 | ✓ | | | Clear Diagnostic Information | CDTCI |
| Input Output Control | \$19 | ✓ | ✓ | ✓ | Read DTC Information | RDTCI |
| Remote Activation of Routine | \$2F | | ✓ | | Input Output Control By Identifier | IOCBi |
| Upload Download | \$31 | ✓ | ✓ | ✓ | Routine Control | RC |
| | \$34 | | | | Request Download | RD |
| | \$35 | | | | Request Upload | RU |
| | \$36 | | | | Transfer Data | TD |
| | \$37 | | | | Request Transfer Exit | RTE |

Simple/Polling Diagnostic Services

These services consist of one request and one response (max.) for physical addressing, or a group of responses for functional addressing

Three Potential Polling Communication Flows when using the Sub-Function Byte

1. Positive Response

2. Negative Response

3. Response suppressed

Erroneous Communication with Sub-Function Byte

Suppression requested (Bit 7 of Byte 2 is set to "1", but response is sent by the ECU)

Common Response Codes

| Hex | Mnemonic | Description |
|-------|----------|---|
| 10 | GR | General reject |
| 11 | SNS | Service not supported |
| 12 | SFNS | Sub-Function not supported |
| 13 | IMLOIF | Incorrect message length or invalid format |
| 14 | RTL | Response too long |
| 21 | BRR | Busy repeat request |
| 22 | CNC | Conditions not correct |
| 24 | RSE | Request sequence error |
| 25 | NRFSC | No response from sub-net component |
| 26 | FPEORA | Failure prevents execution of requested action |
| 31 | ROOR | Request out of range |
| 33 | SAD | Security access denied |
| 35 | IK | Invalid key |
| 36 | ENOA | Exceeded number of attempts |
| 37 | RTDNE | Required time delay not expired |
| 38-4F | RBEDLSD | Reserved by Extended Data Link Security Document |
| 70 | UDNA | Upload/Download not accepted |
| 71 | TDS | Transfer data suspended |
| 72 | GPF | General programming failure |
| 73 | WBSC | Wrong Block Sequence Counter |
| 78 | RCRRP | Request correctly received, but response is pending |
| 7E | SFNSIAS | Sub-Function not supported in active session |
| 7F | SNSIAS | Service not supported in active session |

All values not described are reserved for future definition

Specific conditions driven Response Codes

| Hex | Mnemonic | Description |
|-----|----------|-----------------------------------|
| 81 | RPMTHT | rpm too high |
| 82 | RPMTLT | rpm too low |
| 83 | EIR | Engine is running |
| 84 | EINR | Engine is not running |
| 85 | ERTTL | Engine run-time too low |
| 86 | TEMPHT | Temperature too high |
| 87 | TEMPTL | Temperature too low |
| 88 | VSTH | Vehicle speed too high |
| 89 | VSTL | Vehicle speed too low |
| 8A | TPTH | Throttle/Pedal too high |
| 8B | TPTL | Throttle/Pedal too low |
| 8C | TRNIN | Transmission range not in neutral |
| 8D | TRNIG | Transmission range not in gear |
| 8F | BSNC | Brake switch(es) not closed |
| 90 | SLNIP | Shifter lever not in park |
| 91 | TCCL | Torque converter clutch locked |
| 92 | VTH | Voltage too high |
| 93 | VTL | Voltage too low |

All values not described are reserved for future definition

Error Memory Functions

1) Erase Error Memory (\$14 Clear Diagnostic Information)

Parameter 1: Service ID = \$14

Parameter 2: Diagnostic Trouble Code (DTC) with three byte length

2) Sub-Functions for Service \$19 Read DTC Information

| Hex | Description |
|-----|---|
| 01 | Report number of DTC by Status Mask |
| 02 | Report DTC by Status Mask |
| 03 | Report DTC Snapshot Identification |
| 04 | Report DTC Snapshot Record by DTC number |
| 05 | Report DTC Snapshot Record by Record number |
| 06 | Report DTC Extended Data Record by DTC number |
| 07 | Report number of DTC by Severity Mask Record |
| 08 | Report DTC by Severity Mask Record |
| 09 | Report Severity Information of DTC |
| 0A | Report Supported DTC |
| 0B | Report First Test Failed DTC |
| 0C | Report First Confirmed DTC |
| 0D | Report Most Recent Test Failed DTC |
| 0E | Report Most Recent Confirmed DTC |
| 0F | Report Mirror Memory DTC by Status Mask |
| 10 | Report Mirror Memory DTC Extended Data Record by DTC number |
| 11 | Report number of Mirror Memory DTC by Status Mask |
| 12 | Report number of Emissions Related OBD DTC by Status Mask |
| 13 | Report Emissions Related OBD DTC by Status Mask |
| 14 | Report DTC Fault Detection Counter |
| 15 | Report DTC with Permanent Status |

Periodic Service Execution (Service \$2A)

For one Request follows one initial Response. After that, periodically more responses will follow. The sending can be stopped by using a simple diagnostic service

Service parameter "Transmission Mode"

The frequency of the data transmission can be configured using the the Transmission Mode. The UDS-Standard defines abstract values as:

Slow = \$01

Medium = \$02

Fast = \$03

Stop sending = \$04

The real values in Hertz for each frequency need to be defined between OEM and ECU supplier

Generic Periodic Communication Flow

1. Setup Periodic Transmission

2. Getting Periodic Responses

3. Stop Transmission

Type 1 Communication Flow

Type 2 Communication Flow

Response on Event – RoE (Service \$86)

For one or two setup and start Requests one or two initial Responses are given, followed by 0 to n event-driven Responses depending on the number of occurrences of tracked events. The distance between several events is non-deterministic.

The RoE mechanism can be activated in any Session, including the Default-Session

It does not need Tester Present messages to stay active

Generic Event-Driven Communication Flow

Example: DTC Status Change Communication Flow

Pre-defined values for parameter Event Type (6 Bits)

UDS Response Handling

Specifics

All services, which have a parameter "Sub-Function", support the "Response-Suppression-Handling"

All services to read data do not support this feature

A service, which uses the suppressPosRspMsgIndicationBit of the Sub-Function Byte only, must set the other bits of the Sub-Function Byte to 0, to support the transmission of the Bit 7

SuppressPositiveResponseMsgIndicationBit = TRUE

⇒ Suppression of the positive response

⇒ All negative responses are send nevertheless

For functional requests, some specific negative responses are always to be suppressed, independent of the value of the Suppress Positive Response Message Indication Bit:

Service not supported (NRC \$11)

Subfunction not supported (NRC \$12)

"Respond-to"-Services

ReadDataByIdentifier (\$22)

ReadDTCInformation (\$19)

RoutineControl (\$31)

InputOutputControlByIdentifier (\$2F)

Session Handling

PowerOn of the ECU

Request other Session ⇒ Reset Event-Logic

Tester

Default Session

Timeout

Non-Default Session

Request Default Session ⇒ Complete Reset

Request Default Session ⇒ Reset Event-Logic

Request same or other Session ⇒ Reset Event-Logic

⇒ Enable Security

⇒ Stop Periodic Transmission

⇒ Reset Communication State

⇒ Reset Measurements and Settings

Standardized values of Parameter „Diagnostic Session Type“

\$01 Default Session

\$02 Programming Session

\$03 Extended Diagnostic Session

\$04 Safety System Diagnostic Session