
**Road vehicles — Unified diagnostic
services (UDS) —**

**Part 1:
Application layer**

*Véhicules routiers — Services de diagnostic unifiés (SDU) —
Partie 1: Couches application*



COPYRIGHT PROTECTED DOCUMENT

© ISO 2020

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org
Published in Switzerland

[This is a preview. Click here to purchase the full publication.](#)

Contents	Page
Foreword.....	ix
Introduction.....	x
1 Scope	1
2 Normative references	1
3 Terms and definitions.....	2
4 Symbols and abbreviated terms.....	5
5 Conventions	5
6 Document overview	6
7 Application layer services	7
7.1 General	7
7.2 Format description of application layer services	9
7.3 Format description of service primitives	9
7.3.1 General definition.....	9
7.3.2 Service request and service indication primitives.....	10
7.3.3 Service response and service confirm primitives.....	11
7.3.4 Service request-confirm and service response-confirm primitives	11
7.4 Service data unit specification.....	12
7.4.1 Mandatory parameters.....	12
7.4.2 Vehicle system requirements.....	14
7.4.3 Optional parameters - A_AE, application layer remote address.....	15
8 Application layer protocol.....	15
8.1 General definition.....	15
8.2 A_PDU, application protocol data unit	16
8.3 A_PCI, application protocol control information	16
8.4 SI, service identifier	17
8.5 A_NR_SI, Negative response service identifier	17
8.6 Negative response/confirmation service primitive.....	18
8.7 Server response implementation rules.....	18
8.7.1 General definitions.....	18
8.7.2 General server response behaviour	19
8.7.3 Request message with SubFunction parameter and server response behaviour.....	21
8.7.4 Request message without SubFunction parameter and server response behaviour	25
8.7.5 Pseudo code example of server response behaviour	27
8.7.6 Multiple concurrent request messages with physical and functional addressing.....	29
9 Service description conventions	29
9.1 Service description	29
9.2 Request message.....	30
9.2.1 Request message definition.....	30
9.2.2 Request message SubFunction parameter \$Level (LEV_) definition	31
9.2.3 Request message data-parameter definition	33
9.3 Positive response message.....	33
9.3.1 Positive response message definition.....	33
9.3.2 Positive	34

9.4	Supported negative response codes (NRC_)	34
9.5	Message flow examples	35
10	Diagnostic and communication management functional unit	36
10.1	Overview	36
10.2	DiagnosticSessionControl (10 ₁₆) service	36
10.2.1	Service description	36
10.2.2	Request message	40
10.2.3	Positive response message	41
10.2.4	Supported negative response codes (NRC_)	42
10.2.5	Message flow example(s) DiagnosticSessionControl – Start programmingSession	43
10.3	ECUReset (11 ₁₆) service	43
10.3.1	Service description	43
10.3.2	Request message	44
10.3.3	Positive response message	45
10.3.4	Supported negative response codes (NRC_)	46
10.3.5	Message flow example ECUReset	47
10.4	SecurityAccess (27 ₁₆) service	47
10.4.1	Service description	47
10.4.2	Request message	49
10.4.3	Positive response message	51
10.4.4	Supported negative response codes (NRC_)	51
10.4.5	Message flow example(s) SecurityAccess	52
10.5	CommunicationControl (28 ₁₆) service	54
10.5.1	Service description	54
10.5.2	Request message	54
10.5.3	Positive response message	56
10.5.4	Supported negative response codes (NRC_)	56
10.5.5	Message flow example CommunicationControl (disable transmission of network management messages)	57
10.5.6	Message flow example CommunicationControl (switch a remote network into the diagnostic-only scheduling mode where the node with address 000A ₁₆ is connected to)	57
10.5.7	Message flow example CommunicationControl (switch to application scheduling mode with enhanced address information, the node 000A ₁₆ , which is connected to a sub-network, is addressed)	58
10.6	Authentication (29 ₁₆) service	59
10.6.1	Service overview	59
10.6.2	Authentication with PKI Certificate Exchange (APCE)	60
10.6.3	Authentication with Challenge-Response (ACR)	65
10.6.4	Common requirements	69
10.6.5	Request message	71
10.6.6	Positive response message	78
10.6.7	Supported negative response codes (NRC_)	85
10.6.8	Message flow example(s) Authentication	86
10.7	TesterPresent (3E ₁₆) service	108
10.7.1	Service description	108
10.7.2	Request message	108
10.7.3	Positive response message	108
10.7.4	Supported negative response codes (NRC_)	109
10.7.5	Message flow example(s) TesterPresent	109
10.8	ControlDTCSetting (85 ₁₆) service	110
10.8.1	Service description	110
10.8.2	Request message	111

10.8.3	Positive response message.....	112
10.8.4	Supported negative response codes (NRC_).....	112
10.8.5	Message flow example(s) ControlDTCSetting	113
10.9	ResponseOnEvent (86 ₁₆) service	114
10.9.1	Service description	114
10.9.2	Request message.....	121
10.9.3	Positive response message.....	127
10.9.4	Supported negative response codes (NRC_).....	130
10.9.5	Message flow example(s) ResponseOnEvent.....	131
10.10	LinkControl (87 ₁₆) service.....	146
10.10.1	Service description	146
10.10.2	Request message	147
10.10.3	Positive response message	149
10.10.4	Supported negative response codes (NRC_)	149
10.10.5	Message flow example(s) LinkControl	150
11	Data transmission functional unit.....	152
11.1	Overview	152
11.2	ReadDataByIdentifier (22 ₁₆) service.....	153
11.2.1	Service description	153
11.2.2	Request message.....	153
11.2.3	Positive response message.....	154
11.2.4	Supported negative response codes (NRC_).....	155
11.2.5	Message flow example ReadDataByIdentifier.....	157
11.3	ReadMemoryByAddress (23 ₁₆) service	159
11.3.1	Service description	159
11.3.2	Request message.....	159
11.3.3	Positive response message.....	161
11.3.4	Supported negative response codes (NRC_).....	161
11.3.5	Message flow example ReadMemoryByAddress.....	163
11.4	ReadScalingDataByIdentifier (24 ₁₆) service.....	166
11.4.1	Service description	166
11.4.2	Request message.....	166
11.4.3	Positive response message.....	166
11.4.4	Supported negative response codes (NRC_).....	167
11.4.5	Message flow example ReadScalingDataByIdentifier	169
11.5	ReadDataByPeriodicIdentifier (2A ₁₆) service.....	172
11.5.1	Service description	172
11.5.2	Request message.....	176
11.5.3	Positive response message.....	176
11.5.4	Supported negative response codes (NRC_).....	177
11.5.5	Message flow example ReadDataByPeriodicIdentifier.....	180
11.6	DynamicallyDefineDataIdentifier (2C ₁₆) service	191
11.6.1	Service description	191
11.6.2	Request message.....	192
11.6.3	Positive response message.....	195
11.6.4	Supported negative response codes (NRC_).....	196
11.6.5	Message flow examples DynamicallyDefineDataIdentifier.....	197
11.7	WriteDataByIdentifier (2E ₁₆) service.....	212
11.7.1	Service description	212
11.7.2	Request message.....	212
11.7.3	Positive response message.....	213
11.7.4	Supported negative response codes (NRC_).....	214
11.7.5	Message	215

11.8	WriteMemoryByAddress (3D ₁₆) service	216
11.8.1	Service description	216
11.8.2	Request message	217
11.8.3	Positive response message	218
11.8.4	Supported negative response codes (NRC_)	219
11.8.5	Message flow example WriteMemoryByAddress	221
12	Stored data transmission functional unit	223
12.1	Overview	223
12.2	ClearDiagnosticInformation (14 ₁₆) service	223
12.2.1	Service description	223
12.2.2	Request message	224
12.2.3	Positive response message	225
12.2.4	Supported negative response codes (NRC_)	225
12.2.5	Message flow example ClearDiagnosticInformation	226
12.3	ReadDTCInformation (19 ₁₆) service	227
12.3.1	Service description	227
12.3.2	Request message	238
12.3.3	Positive response message	249
12.3.4	Supported negative response codes (NRC_)	263
12.3.5	Message flow examples – ReadDTCInformation	264
13	InputOutput control functional unit	297
13.1	Overview	297
13.2	InputOutputControlByIdentifier (2F ₁₆) service	297
13.2.1	Service description	297
13.2.2	Request message	298
13.2.3	Positive response message	299
13.2.4	Supported negative response codes (NRC_)	300
13.2.5	Message flow example(s) InputOutputControlByIdentifier	301
14	Routine functional unit	310
14.1	Overview	310
14.2	RoutineControl (31 ₁₆) service	311
14.2.1	Service description	311
14.2.2	Request message	312
14.2.3	Positive response message	314
14.2.4	Supported negative response codes (NRC_)	315
14.2.5	Message flow example(s) RoutineControl	317
15	Upload download functional unit	321
15.1	Overview	321
15.2	RequestDownload (34 ₁₆) service	321
15.2.1	Service description	321
15.2.2	Request message	322
15.2.3	Positive response message	323
15.2.4	Supported negative response codes (NRC_)	324
15.2.5	Message flow example(s) RequestDownload	325
15.3	RequestUpload (35 ₁₆) service	325
15.3.1	Service description	325
15.3.2	Request message	326
15.3.3	Positive response message	327
15.3.4	Supported negative response codes (NRC_)	328
15.3.5	Message flow example(s) RequestUpload	329
15.4	TransferData (36 ₁₆) service	330
15.4.1	Service description	330

15.4.2	Request message.....	330
15.4.3	Positive response message.....	331
15.4.4	Supported negative response codes (NRC_).....	332
15.4.5	Message flow example(s) TransferData.....	334
15.5	RequestTransferExit (37 ₁₆) service	334
15.5.1	Service description	334
15.5.2	Request message.....	335
15.5.3	Positive response message.....	335
15.5.4	Supported negative response codes (NRC_).....	336
15.5.5	Message flow example(s) for downloading/uploading data	337
15.6	RequestFileTransfer (38 ₁₆) service	344
15.6.1	Service description	344
15.6.2	Request message.....	344
15.6.3	Positive response message.....	346
15.6.4	Supported negative response codes (NRC_).....	348
15.6.5	Message flow example(s) RequestFileTransfer.....	350
16	Security sub-layer definition	353
16.1	General	353
16.1.1	Purpose	353
16.1.2	Security sub-layer description.....	353
16.1.3	Security sub-layer access.....	354
16.1.4	General server response behaviour	356
16.2	SecuredDataTransmission (84 ₁₆) service.....	358
16.2.1	Service description	358
16.2.2	Request message.....	358
16.2.3	Positive response message for successful internal message.....	360
16.2.4	Supported negative response codes (NRC_).....	362
16.2.5	Message flow example SecuredDataTransmission	363
17	Non-volatile server memory programming process	366
17.1	General information	366
17.2	Detailed programming sequence.....	370
17.2.1	Programming phase #1 — Download of application software and/or application data	370
17.3	Server reprogramming requirements	379
17.3.1	Requirements for servers to support programming.....	379
17.3.2	Software, data identification and fingerprints	382
17.3.3	Server routine access	383
17.4	Non-volatile server memory programming message flow examples.....	383
17.4.1	General information	383
17.4.2	Programming phase #1 — Pre-Programming step	383
17.4.3	Programming phase #1 — Programming step.....	384
17.4.4	Programming phase #1 — Post-Programming step	389
Annex A	(normative) Global parameter definitions	390
Annex B	(normative) Diagnostic and communication management functional unit data-parameter definitions.....	400
Annex C	(normative) Data transmission functional unit data-parameter definitions.....	405
Annex D	(normative) Stored data transmission functional unit data-parameter definitions....	422
Annex E	(normative) Input output control functional unit data-parameter definitions.....	444
Annex F	(normative) Routine functional unit data-parameter definitions.....	445

Annex G (normative) Upload and download functional unit data-parameter	447
Annex H (informative) Examples for addressAndLengthFormatIdentifier parameter values...	448
Annex I (normative) Security access state chart.....	450
Annex J (informative) Recommended implementation for multiple client environments.....	458
Bibliography.....	464

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

This third edition cancels and replaces the second edition (ISO 14229-1:2013), which has been technically revised. The main changes compared to the previous edition are as follows:

- new diagnostic service for Authentication has been introduced to address cyber security topics;
- new clause "Security sub-layer definition";
- some unused SubFunction of ReadDTCInformation service are deleted, e.g. Mirror Memory;
- the ReadDataByPeriodicIdentifier is updated; and
- several clarifications and corrections are implemented.

A list of all parts in the ISO 14229 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO 14229 has been established in order to define common requirements for diagnostic systems, whatever the serial data link is.

To achieve this, ISO 14229 is based on the Open Systems Interconnection (OSI) Basic Reference Model in accordance with ISO/IEC 7498-1 and ISO/IEC 10731, which structures communication systems into seven layers. When mapped on this model, the services used by a diagnostic tester (client) and an Electronic Control Unit (ECU, server) are broken into the following layers in accordance with Table 1:

- Application layer (layer 7), unified diagnostic services specified in this document, ISO 14229-3 UDSonCAN, ISO 14229-4 UDSonFR, ISO 14229-5 UDSonIP, ISO 14229-6 UDSonK-Line, ISO 14229-7 UDSonLIN, ISO 14229-8¹ UDSonCXPI, further standards and ISO 27145-3 VOBD.
- Presentation layer (layer 6), vehicle manufacturer specific, ISO 27145-2 VOBD.
- Session layer services (layer 5) specified in ISO 14229-2.
- Transport layer services (layer 4), specified in ISO 15765-2 DoCAN, ISO 10681-2 Communication on FlexRay, ISO 13400-2 DoIP, ISO 17987-2 LIN, ISO 20794-3² CXPI, ISO 27145-4 VOBD.
- Network layer services (layer 3), specified in ISO 15765-2 DoCAN, ISO 10681-2 Communication on FlexRay, ISO 13400-2 DoIP, ISO 17987-2 LIN, ISO 20794-3 CXPI, ISO 27145-4 VOBD.
- Data link layer (layer 2), specified in ISO 11898-1, ISO 11898-2, ISO 17458-2, ISO 13400-3, IEEE 802.3, ISO 14230-2, ISO 17987-3 LIN, ISO 20794-4³ CXPI, and further standards, ISO 27145-4 VOBD.
- Physical layer (layer 1), specified in ISO 11898-1, ISO 11898-2, ISO 17458-4, ISO 13400-3, IEEE 802.3, ISO 14230-1, ISO 17987-4 LIN, ISO 20794-4 CXPI, and further standards, ISO 27145-4 VOBD.

NOTE The diagnostic services in this document are implemented in various applications, e.g. road vehicles – tachograph systems, road vehicles – interchange of digital information on electrical connections between towing and towed vehicles, road vehicles – diagnostic systems, etc. Future modifications to this document will provide long-term backward compatibility with the implementation standards as described above.

¹ Under preparation. Stage at the time of publication: ISO/FDIS 14229-8:2020.

² Under preparation. Stage at the time of publication: ISO/FDIS 20794-3:2020.

³ Under preparation. Stage at the time of publication: ISO/FDIS 20794-4:2020.

Table 1 — Example of diagnostic/programming specifications applicable to the OSI layers

OSI seven layer ^a	Enhanced diagnostics services							VOBD
Application (layer 7)	ISO 14229-1, ISO 14229-3 UDSONCAN, ISO 14229-4 UDSONFR, ISO 14229-5 UDSONIP, ISO 14229-6 UDSONK-Line, ISO 14229-7 UDSONLIN, ISO 14229-8 UDSONCXPI, further standards							ISO 27145-3
Presentation (layer 6)	vehicle manufacturer specific							ISO 27145-2
Session (layer 5)	ISO 14229-2							
Transport (layer 4)	ISO 15765-2	ISO 10681-2	ISO 13400-2	Not applicable	ISO 17987-2	ISO 20794-3	further standards	ISO 27145-4
Network (layer 3)							further standards	
Data link (layer 2)	ISO 11898-1,	ISO 17458-2	ISO 13400-3,	ISO 14230-2	ISO 17987-3	ISO 20794-4	further standards	
Physical (layer 1)	ISO 11898-2	ISO 17458-4	IEEE 802.3	ISO 14230-1	ISO 17987-4		further standards	
^a Seven layers according to ISO/IEC 7498-1 and ISO/IEC 10731.								