ISO / DIS 14230 Road Vehicles - Diagnostic Systems

Keyword Protocol 2000

Part 3: Implementation

Status: Draft International Standard

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Introduction

This International Standard has been established in order to define common requirements for the implementation of diagnostic services for diagnostic systems

To achieve this, the standard is based on the Open System Interconnection (O.S.I.) Basic Reference Model in accordance with ISO 7498 which structures communication systems into seven layers. When mapped on this model, the services used by a diagnostic tester and an Electronic Control Unit (ECU) are broken into:

- Diagnostic services (layer 7),
- Communication services (layers 1 to 6)

See figure 1 below.

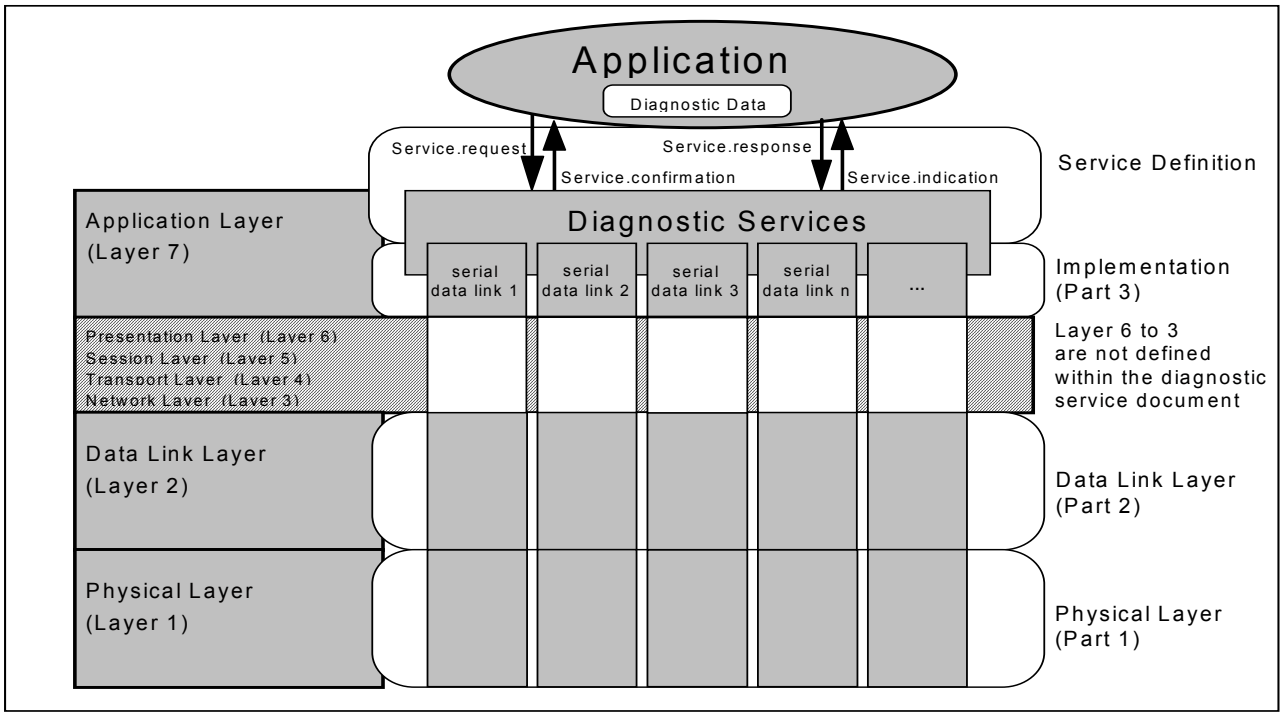


Figure 1 - Mapping of the Diagnostic Services and Keyword Protocol 2000 on the O.S.I. Model

1 - Scope

This International Standard specifies the requirements for the Keyword Protocol 2000 data link on which one or several on-vehicle Electronic Control Units are connected to an off-board tester in order to perform diagnostic functions.

It consists of three parts:

- Part 1: Physical Layer
- Part 2: Data Link Layer, Error Handling
- Part 3: Implementation of Diagnostic Services

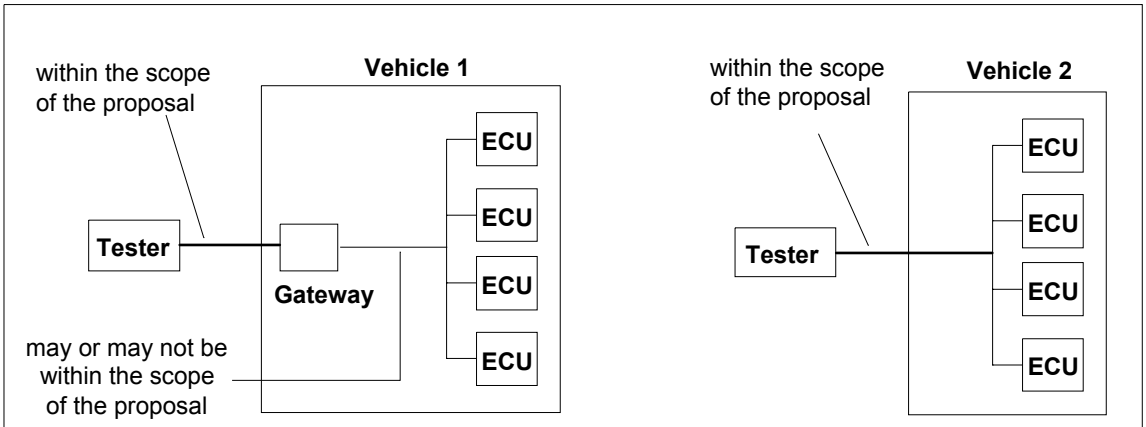
Part 3 specifies the requirements of the implementation of the Diagnostic Services specified in the ***ISO 14229***, including:

- byte encoding and hexadecimal values for the service identifiers,
- byte encoding for the parameters of the diagnostic service requests and responses,
- hexadecimal values for the standard parameters.

The vehicle environment to which this standard applies may consist of:

- a single tester that may be temporarily connected to the on-vehicle diagnostic data link and
- several on-vehicle Electronic Control Units connected directly or indirectly.

See figure 2 below.



In vehicle 1, the ECUs are connected by an internal data link and indirectly connected to the diagnostic data link through a gateway. This document applies to the diagnostic communications over the diagnostic data link; the diagnostic communications over the internal data link may conform to this document or to another protocol.

In vehicle 2, the ECUs are directly connected to the diagnostic data link.

Figure 2 - Vehicle diagnostic architecture

2 - Normative reference

The following standards contain provisions which, through reference in this text, constitute provisions of this document. All standards are subject to revision, and parties to agreement based on this document are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of ISO maintain registers of currently valid International Standards.

ISO 7498-1:1984	Information processing systems - Open systems interconnection - Basic reference model.
ISO TR 8509:1987	Information processing systems - Open systems interconnection - Conventions of services.
ISO 4092:1988/Cor.1:1991	Road vehicles - Testers for motor vehicles - Vocabulary Technical Corrigendum 1.
ISO 9141-2	CARB Requirements for Interchange of Digital Information
ISO 14229	Road Vehicles - Diagnostic Systems - Diagnostic Services Specification
ISO 14230-1:1996	Road Vehicles - Diagnostic systems - Keyword Protocol 2000 - Part 1: Physical Layer
ISO 14230-2:1996	Road Vehicles - Diagnostic systems - Keyword Protocol 2000 - Part 2: Data Link Layer
ISO 14230-4:1996	Road Vehicles - Diagnostic systems - Keyword Protocol 2000 - Part 4: Requirements For Emission Related Systems
SAE J1587	Joint SAE/TMC Electronic Data Interchange Between Microcomputer Systems in Heavy-Duty Vehicle Applications
SAE J1930	E/E Systems Diagnostic Terms, Definitions, Abbreviations & Acronyms
SAE J1962	Diagnostic Connector
SAE J1978	OBD II Scan Tool
SAE J1979	E/E Diagnostic Test Modes
SAE J2012	Diagnostic Trouble Code Definitions
SAE J2186	E/E Diagnostic Data Link Security
SAE J2190	Enhanced Diagnostic Test Modes

3 - Definitions and abbreviations

3.1 - Terms defined in other standards

3.1.1 - ISO definitions

This document makes use of terms defined in the ***ISO 14229 Diagnostic Services Specification*** document.

3.1.2 - SAE definitions

This document makes use of terms defined in the SAE J1930 E/E Systems Diagnostic Terms, Definitions, Abbreviations & Acronyms document.

3.2 - Terms defined by this document

3.2.1 - Service Identifier value convention table

The following chart indicates the different ranges of service identifier values, which are defined in SAE J1979, Keyword Protocol 2000 or by the vehicle manufacturer.

Service Identifier Hex Value	Service type (bit 6)	Where defined
00 - 0F	Request	SAE J1979
10 - 1F 20 - 2F 30 - 3E	Request (bit 6 = 0)	KWP 2000 Part 3
3F	Not Applicable	reserved
40 - 4F	Response	SAE J1979
50 - 5F 60 - 6F 70 - 7E	Positive Response to Services ($10 - $3E) (bit 6 = 1)	KWP 2000 Part 3
7F	Negative Response	
80	Request 'ESC' - Code	
81 - 8F	Request (bit 6 = 0)	KWP 2000 Part 2
90 - 9F	Request (bit 6 = 0)	reserved for future exp. as needed
A0 - BF	Request (bit 6 = 0)	defined by vehicle manufacturer
C0	Positive Resp. 'ESC' - Code	KWP 2000 Part 3
C1 - CF	Positive Response (bit 6 = 1)	KWP 2000 Part 2
D0 - DF	Positive Response (bit 6 = 1)	reserved for future exp. as needed
E0 - FF	Positive Response (bit 6 = 1)	defined by vehicle manufacturer

Table 3.2.1 - Service Identifier value convention table (SAE J1979, KWP 2000)

KWP 2000 Part 3 = ISO 14230 Keyword Protocol 2000 Part 3: Implementation
KWP 2000 Part 2 = ISO 14230 Keyword Protocol 2000 Part 2: Data Link Layer

Service identifier values "$00 - $0F" and "$40 - $4F" are reserved to be defined in SAE J1979 which currently only includes functionally addressed services. Usage of shaded service identifier values is defined in this document.
There is a one-to-one correspondence between request messages and positive response messages, with "bit 6" of the service identifier hex value indicating the service type.

4 - Conventions

This document is guided by the conventions discussed in the O.S.I. Service Conventions (ISO/TR 8509) as they apply to the diagnostic services. These conventions define the interactions between the service user and the service provider. Information is passed between the service user and the service provider by service primitives, which may convey parameters.

4.1 - Service description convention

This section defines the layout used to describe the diagnostic services. It includes:

- Parameter Definition
- Message Data Bytes
- Message Description
- Message Flow Example

4.1.1 - Parameter definition

This section defines the use and the values of parameters used by the service.

4.1.2 - Message data bytes

The definition of each message includes a table which lists the parameters of its primitives: request/indication ("Req/Ind"), response/confirmation ("Rsp/Cnf") for positive or negative result. All have the same structure. The first table (refer to section 4.1.2.1) describes the request message, the second table (refer to section 4.1.2.2) the positive response message and the third table (refer to section 4.1.2.3) the negative response message. Thus, only a positive or a negative response message may be used; both are listed in separate tables because the list of parameters differ between positive and negative response messages.

4.1.2.1 - Request message

The following table shows a general service table structure and its syntax.

Type	Parameter Name	*)	Hex Value	Mnemonic
Header Bytes	**Format Byte** **Target Byte** **Source Byte** **Length Byte**	**M** **C1)** **C1)** **C2)**	**xx** **xx** **xx** **xx**	**FMT** **TGT** **SRC** **LEN**
<ServiceId>	**<Service Name> Request Service Identifier**	**M**	**xx**	**SN**
<Parameter Type> : <Parameter Type>	<List of parameters> = [<Parameter Name> : <Parameter Name>]	C3)	xx=[xx : xx]	**PN**
CS	**Checksum Byte**	**M**	**xx**	**CS**

Table 4.1.2.1 - Request message

***) Cvt. = Convention; This column specifies the convention of each type used in a message.**

C1) Condition 1: The header bytes "Target" and "Source" depend on the content of the "Format Byte" which is specified in the ISO 14230 (KWP 2000 Part 2: Data Link Layer) document. Both either exist or don't exist in the header of each message.

C2) Condition 2: The header byte "Length" depends on the content of the "Format Byte" which is specified in the ISO 14230 (KWP 2000 Part 2: Data Link Layer) document.

C3) Condition 3: These parameters may be either mandatory (M) or user optional (U), depending on the individual message.

The content of the shaded areas of each message table is defined in the document ISO 14230 (KWP 2000 Part 2: Data Link Layer).

Table content description:

- Under the <**Service Name> Request Message** are listed the parameters specific to the service request/indication.

- Under the <**Service Name> Positive Response Message** are listed the parameters specific to the service response/confirmation in case the requested service was successful.

- Under the <**Service Name> Negative Response Message** are listed the parameters specific to the service response/confirmation in case the requested service has failed or could not be completed in time.

- For a given primitive, the presence of each parameter is described by one of the following values:

  M: mandatory;

  U: user option; the parameter may or may not be supplied, depending on dynamic usage by the user;

  C: conditional; the presence of the parameter depends upon other parameters within the service;

  S: mandatory (unless specified otherwise) selection of a parameter from a parameter list;

4.1.2.2 - Positive response message

A positive response message shall be sent by the server if it is able to completely perform the requested actions.

Type	Parameter Name	*)	Hex Value	Mnemonic
Header Bytes	**Format Byte** **Target Byte** **Source Byte** **Length Byte**	**M** **C1)** **C1)** **C2)**	**xx** **xx** **xx** **xx**	**FMT** **TGT** **SRC** **LEN**
<ServiceId>	**<Service Name> Positive Response Service Identifier**	**M**	**xx**	**SNPR**
<Parameter Type> : <Parameter Type>	<List of parameters> = [<Parameter Name> : <Parameter Name>]	C3)	xx=[xx : xx]	**PN**
CS	**Checksum Byte**	**M**	**xx**	**CS**

Table 4.1.2.2 - Positive response message

4.1.2.3 - Negative response message

A negative response message shall be sent by the server if it is not able to completely perform the requested actions.

Type	Parameter Name	*)	Hex Value	Mnemonic
Header Bytes	**Format Byte** **Target Byte** **Source Byte** **Length Byte**	**M** **C1)** **C1)** **C2)**	**xx** **xx** **xx** **xx**	**FMT** **TGT** **SRC** **LEN**
<ServiceId>	**negativeResponse Service Identifier**	**M**	**xx**	**NACK**
<ServiceId>	**<Service Name> Request Service Identifier**	**M**	xx	**SN**
<Parameter Type>	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**
CS	**Checksum Byte**	**M**	**xx**	**CS**

Table 4.1.2.3 - Negative response message

4.1.3 - Message description

This section provides a description of the actions performed by the client and the server which are specific to the KWP 2000 data link.
The response condition is service specific and defined separately for each service.

4.1.4 - Message flow examples

This section provides message flow descriptions presented in a table format. Time relates to the table in a ***top to bottom*** sequence.

The table consists of three columns:

- column 1: includes the relevant inter-message timing which is specified in the document ISO 14230 (KWP 2000 Part 2: Data Link Layer). The message shall be started within the relevant inter message timing.

- column 2: includes all requests send by the client to the server

- column 3: includes all responses send by the server to the client

- The reading entry of the message flow table always starts with the first item in the time column "P3" (1st column) followed by a request message of the client (2nd column) The next entry is the timing parameter "P2" (1st column) for the server to send the positive or negative response message (3rd column).

For simplification all messages are described without any identifiers and/or data values. Details of messages are always specified in the section: **Message data bytes.**

time	client (Tester)	server (ECU)
P3	<Service Name> Request[...]	
P2		<Service Name> PositiveResponse[...]

Table 4.1.4 - Message flow example of physical addressed service

Note: Above message flow example is not documented for each service. Only services, which call for more detailed message flow description shall have their own message flow section.

4.2 - Functional unit table

The intention of specifying functional unit tables is to group similar Keyword Protocol 2000 services into a functional unit. The definition of each functional unit includes a table which lists its services.

Functional Unit	Description
Diagnostic Management	This functional unit includes Keyword Protocol 2000 services which are used to realise diagnostic management functions between the client (tester) and the server (ECU).
Data Transmission	This functional unit includes Keyword Protocol 2000 services which are used to realise data transmission functions between the client (tester) and the server (ECU).
Stored Data Transmission	This functional unit includes Keyword Protocol 2000 services which are used to realise stored data transmission functions between the client (tester) and the server (ECU).
Input / Output Control	This functional unit includes Keyword Protocol 2000 services which are used to realise input / output control functions between the client (tester) and the server (ECU).
Remote Activation of Routine	This functional unit includes Keyword Protocol 2000 services which are used to realise remote activation of routine functions between the client (tester) and the server (ECU).
Upload / Download	This functional unit includes Keyword Protocol 2000 services which are used to realise upload / download functions between the client (tester) and the server (ECU).

Table 4.2 - Keyword Protocol 2000 functional units

4.3 - Service Identifier value summary table

The left column of the following table lists all services of the Diagnostic Services Specification, the middle column assigns the KWP 2000 Implementation "Request Hex Value" and the right column assigns the KWP 2000 Implementation "Positive Response Hex Value". The positive response service identifier values are built from the request service identifier values by setting "bit 6 = 1".

Diagnostic Service Name	KWP 2000 Implementation	
	Request Hex Value	Response Hex Value
startDiagnosticSession	10	50
ecuReset	11	51
readFreezeFrameData	12	52
readDiagnosticTroubleCodes	13	53
clearDiagnosticInformation	14	54
readStatusOfDiagnosticTroubleCodes	17	57
readDiagnosticTroubleCodesByStatus	18	58
readEcuIdentification	1A	5A
stopDiagnosticSession	20	60
readDataByLocalIdentifier	21	61
readDataByCommonIdentifier	22	62
readMemoryByAddress	23	63
setDataRates	26	66
securityAccess	27	67
DynamicallyDefineLocalIdentifier	2C	6C
writeDataByCommonIdentifier	2E	6E
inputOutputControlByCommonIdentifier	2F	6F
inputOutputControlByLocalIdentifier	30	70
startRoutineByLocalIdentifier	31	71
stopRoutineByLocalIdentifier	32	72
requestRoutineResultsByLocalIdentifier	33	73
requestDownload	34	74
requestUpload	35	75
transferData	36	76
requestTransferExit	37	77
startRoutineByAddress	38	78
stopRoutineByAddress	39	79
requestRoutineResultsByAddress	3A	7A
writeDataByLocalIdentifier	3B	7B
writeMemoryByAddress	3D	7D
testerPresent	3E	7E
escCode (Not part of Diagnostic Services Specification; KWP 2000 only)	80	C0

Table 4.3 - Service Identifier value summary table

4.4 - Response Code value summary table

The following table lists and assigns hex values for all response codes used in KWP 2000.
The definition of each response code is described in the ***ISO 14229 Diagnostic Services*** Specification document.

Hex Value	Response Code
10	generalReject
11	serviceNotSupported
12	subFunctionNotSupported-invalidFormat
21	busy-RepeatRequest
22	conditionsNotCorrect or requestSequenceError
23	routineNotComplete
31	requestOutOfRange
33	securityAccessDenied
35	invalidKey
36	exceedNumberOfAttempts
37	requiredTimeDelayNotExpired
40	downloadNotAccepted
41	improperDownloadType
42	can'tDownloadToSpecifiedAddress
43	can'tDownloadNumberOfBytesRequested
50	uploadNotAccepted
51	improperUploadType
52	can'tUploadFromSpecifiedAddress
53	can'tUploadNumberOfBytesRequested
71	transferSuspended
72	transferAborted
74	illegalAddressInBlockTransfer
75	illegalByteCountInBlockTransfer
76	illegalBlockTransferType
77	blockTransferDataChecksumError
78	reqCorrectlyRcvd-RspPending (requestCorrectlyReceived-ResponsePending)
79	incorrectByteCountDuringBlockTransfer
80 - FF	manufacturerSpecificCodes

Table 4.4 - Response Code value summary table

4.5 - Response code handling

The figure below specifies the server behaviour on a client request message. This figure shows the logic as specified in the description of the response codes and to be implemented in the server and client as appropriate.

Note: The use of (a) negative response message(s) by the server shall be in case the server can not respond with a positive response message on a client (tester) request message. In such case the server shall send one of the response codes listed below as specified in figure 3.

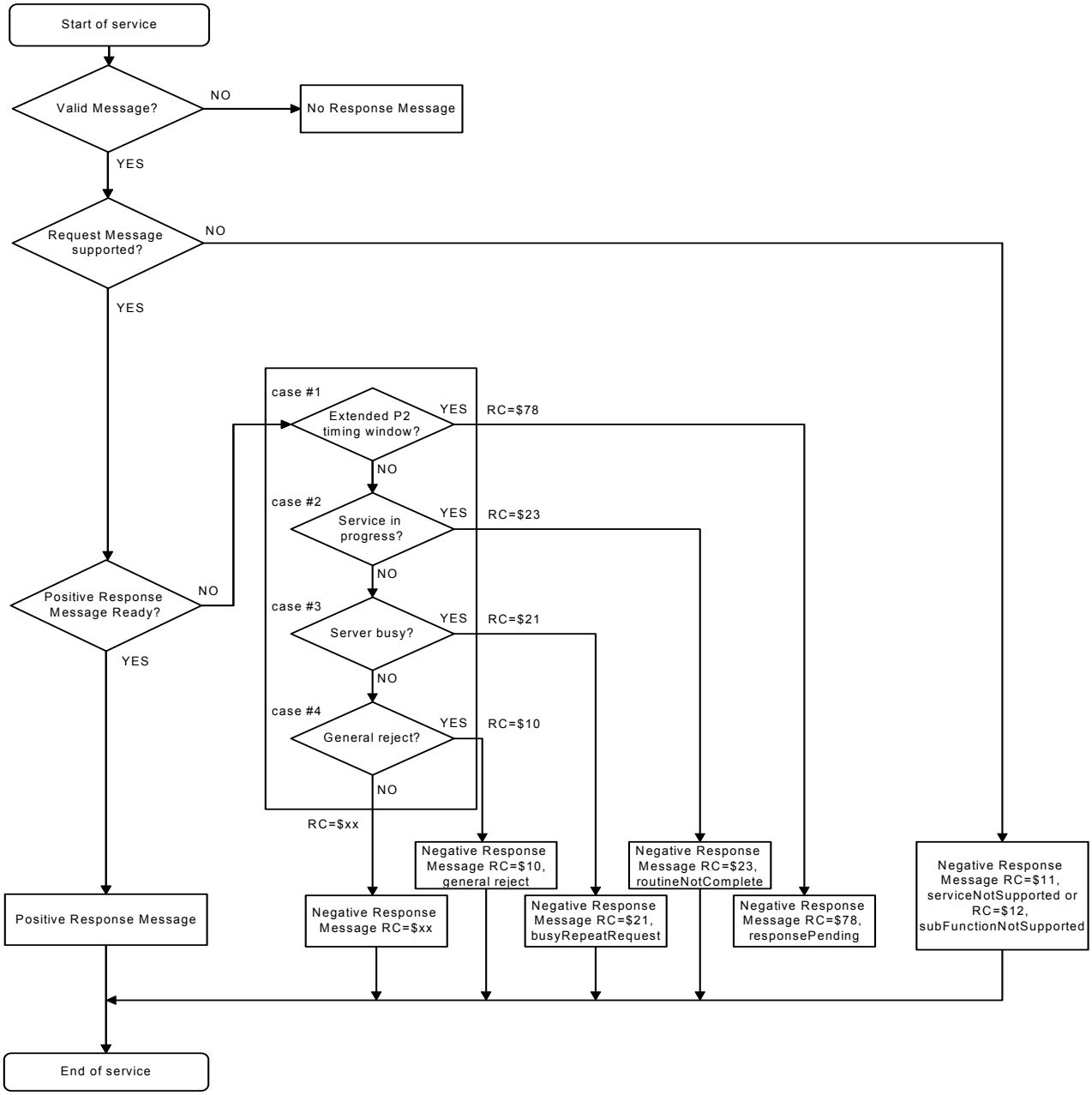


Figure 3 - Server positive and negative response message behaviour

5 - General implementation rules

5.1 - Parameter definitions

The following rules in regard to parameter definitions shall apply:

- The subsequent sections (from section 6. to the end of the document except for the last section) define the services of each functional unit. In these sections, the service structure makes reference to parameters, in order to describe the allowable values for such parameters. The parameters of general purpose are defined in the ***Diagnostic Services Specification*** document. Parameters which are specific to a functional unit are described in the corresponding section.
- This document lists and defines response codes and values. Negative response codes are specified in section 4.4. Other response codes may be reserved either for future definition by this document or for the system designer's specific use.
- This document specifies the parameters which shall be used within each KWP 2000 service.
- The sequence of parameters within a service shall not be changed during an implementation.
- This document specifies the parameter memoryAddress based on a three (3) byte address (High Byte, Middle Byte and Low Byte). Additional bytes of specifying the memoryAddress (e.g. memory type identifier, larger address range) may be implemented and is the responsibility of the vehicle manufacturer. This applies to all services which use the memoryAddress parameter.

5.2 - Functional and physical addressed service requests

Two (2) different addressing methods are specified in KWP 2000 to send a service request to a server(s).

- ***Functional*** addressing with a three byte header is used by the client if it doesn't know the physical address of the server that shall respond to a service request or if more than one (1) server can respond to the request.
- ***Functional*** addressing with a one byte header is not possible.
- ***Physical*** addressing with a three byte header shall always be a dedicated message to one server. The header of the service request message indicates (target address) which server shall respond to the service request message.
- ***Physical*** addressing with a one byte header is possible.
- Only those server(s) which are initialised and in a diagnostic session which support the service request message shall send a response message.
- ***Functional*** and ***Physical*** addressing methods are specified in detail in the document ***ISO 14230 KWP 2000 Part 2: Data Link Layer***.
- The data link shall always be initialised prior to sending any of the KWP 2000 services.

5.3 - Message flow examples of physical/functional addressed services

5.3.1 - Physical addressed services

5.3.1.1 - Physical addressed service with positive/negative response message

The table below shows a typical service request followed by a positive response message and a service request followed by a negative response message.

time	client (Tester)	server (ECU)
P3	<Service Name> Request[...]	
P2		<Service Name> PositiveResponse[...]
P3	<Service Name> Request[...]	
P2		<Service Name> NegativeResponse[RC]
P3	<Service Name> Request[...]	
P2		<Service Name> PositiveResponse[...]

Table 5.3.1.1 - Message flow example of physical addressed service

5.3.1.2 - Physical addressed service with periodic transmissions

The table below shows a message flow which describes a physical addressed service request with multiple positive response messages.

time	client (Tester)	server (ECU)
P3	<readDataByLocalIdentifier> Request[RLI,TXM]	
P2		<readDataByLocalIdentifier > PositiveResponse#1[RLI, ...]
P2		:
P2		<readDataByLocalIdentifier > PositiveResponse#k[RLI, ...]
P3*	<readDataByCommonIdentifier> Req.[RCI,TXM]	
P2		<readDataByCommonIdentifier> PosResp#1[RCI, ...]
P2		:
P2		<readDataByCommonIdentifier> PosResp#k[RCI, ...]
P3*	<readMemoryByAddress> Request[MA,MS,TXM]	
P2		<readMemoryByAddress> PosResp#1[RECVAL]
P2		:
P2		<readMemoryByAddress> PosResp#1[RECVAL]
P3*	<Any Other Service Name> Request[...]	
P2		< Any Other Service Name > PositiveResponse[...]
P3	<readDataByLocalIdentifier> Request[RLI]	
P2		<readDataByLocalIdentifier > PositiveResponse[RLI, ...]

Table 5.3.1.2 - Message flow example of physical addressed service with periodic transmissions

P3* **: The values of the "*P3**" timing parameters shall be less than the value of "P2min" in order to allow the client (tester) to send a new request message.**

Above message flow describes a physical addressed service request readDataByLocal/Common-Identifier or readMemoryByAddress with the periodic transmission mode enabled. The request message is followed by multiple positive response messages from the physically addressed server. The periodically transmitted response messages are terminated by the client with any request message not including the optional transmissionMode parameter. This request message shall be send to the server within the **"P3*"** timing window.

5.3.1.3 - Physical addressed service and negative response message(s) with "routineNotComplete" and "busy-RepeatRequest"

The table below shows a message flow which describes a physical addressed service request followed by a negative response message with the response code set to "routineNotComplete".

time	client (Tester)	server (ECU)
P3	<Service Name> Request [...]	**{ server has started routine! }**
P2		<Service Name> NegativeResponse[routineNotComplete]
P3	<Service Name> Request[...]	
P2		<Service Name> NegativeResponse[busy-RepeatRequest]
	:	**:**
P3	<Service Name> Request[...]	
P2		<Service Name> NegativeResponse[busy-RepeatRequest]
P3	<Service Name> Request[...]	**{ server has completed routine! }**
P2		<Service Name> PositiveResponse[...]
		OR
P2		<Service Name> NegativeResponse[RC != busy-RepeatRequest]

Table 5.3.1.3 - Physical addressing and negative response with "routineNotComplete" and "busy-RepeatRequest"

Above message flow example is based on a request message from the client which cause the server to respond with a negative response message including the negative response code "routineNotComplete".
This response code indicates that the request message was properly received by the server and the routine/task/function (initiated by the request message) is in process, but not yet completed. If the client repeats or sends another request message the server shall "not reinitiate the task" (in case of the same request message) if the initial task has not been completed. The server shall send another negative response message with the response code "busy-RepeatRequest". The negative response message shall be sent on each request message as long as the server has not yet completed the initial routine/task/function. If the server has finished the routine/task/function it shall respond with either a positive response message or a negative response message with a response code not equal to "busy-RepeatRequest".
The communication timing is not affected!

Applications which may require above message flow are:

- clearDiagnosticInformation,
- execution of routines
- securityAccess

5.3.1.4 - Implementation example of "Server can not sent a positive response within required timing"

5.3.1.4.1 - Example of physical addressed service and negative response message with "reqCorrectlyRcvd-RspPending within Normal or Extended Timing"

The table below shows a message flow which describes a physical addressed service request followed by a negative response message with the response code set to "requestCorrectlyReceived-ResponsePending".

time	client (Tester)	server (ECU)
P3	<Service Name> Request[...]	
P2		<Service Name> NegRsp#1[reqCorrectlyRcvd-RspPending]
		:
P2*		<Service Name> NegRsp#n[reqCorrectlyRcvd-RspPending]
P2*		<Service Name> PositiveResponse[...]
P3	<Service Name> Request[...]	
P2		<Service Name> PositiveResponse[...]

Table 5.3.1.4.1 - Example of physical addressing and negative response with "reqCorrectlyRcvd-RspPending"

P2* **: P2min to P3max (refer to section 4.4.1 in ISO 14230 KWP 2000 Part 2: Data Link Layer Specification)**

Above message flow example is based on a request message from the client which cause the server to respond with one or multiple negative response message including the negative response code "requestCorrectlyReceived-ResponsePending".
This response code indicates that the request message was received correctly, and that any parameters in the request message were valid, but the action to be performed may not be completed yet. This response code can be used to indicate that the request message was properly received and does not need to be retransmitted, but the server is not yet ready to receive another request.
The negative response message may be sent once or multiple times within a service if required by the server!
During the period of (a) negative response message(s) the testerPresent service shall be disabled in the client!
This response code shall only be used in a negative response message if the server will not be able to receive further request messages from the client within the P3 timing window. This may be the case if the server does data processing or executes a routine which does not allow any attention to serial communication.

Note: The communication timing method is specified in section "4.4.1 Timing exceptions" in the ISO 14230 Keyword Protocol 2000 Part 2: Data Link Layer Specification!

Applications which may require above message flow are:

- clearDiagnosticInformation
- execution of routines
- transferData request messages including up to 255 data bytes
- Flash EEPROM or EEPROM memory programming

5.3.1.4.2 - Implementation of "Server can not sent a positive response within Default Timing"

The table below shows a message flow which describes a physical addressed service request followed by a positive response message sent with previously modified timing.

time	client (Tester)	server (ECU)
P3	startDiagnosticSession.Request[...]	
P2		startDiagnosticSession.PosRsp[...]
P3	accessTimingParameter.Request[readLimits]	
P2		accessTimingParameter.PosRsp[readLimits, P2-P4]
P3	accessTimingParameter.Request[setValues, P2-P4]	
P2	{ e.g. P2max = $F2 (18850 ms) }	accessTimingParameter.PosRsp[setValues]
	{ Modified Timing is active! }	**{ Modified Timing is active! }**
P3	<Service Name> Request[...]	
P2		<Service Name> PositiveResponse[...]
P3	<stopDiagnosticSession> Request[]	
P2	***OR***	<stopDiagnosticSession> PositiveResponse[]
P3	<startDiagnosticSession> Request[...]	***OR***
P2		<startDiagnosticSession> PositiveResponse[...]
	{ Default Timing is active! }	**{ Default Timing is active! }**
P3	<Service Name> Request[...]	
P2		<Service Name> PositiveResponse[...]

Table 5.3.1.4.2 - Physical addressing and modified timing with accessTimingParameter service

P3, P2 **: New timing parameter values are active!**

Above message flow example describes the method of modifying the timing parameter values in the server and the client by using the accessTimingParameter service as specified in the ISO 14230 Keyword Protocol 2000 Part 2: Data Link Layer Specification.
This method shall be used in case a server does not support a negative response message with the response code ($78) "requestCorrectlyReceived-ResponsePending".

5.3.2 - Functional addressed services

5.3.2.1 - Functional addressed service with positive/negative response message

The table below shows a message flow example which describes a functional addressed service request followed by response messages of multiple servers (ECU#1, ECU#2 ... ECU#n-1, ECU#n).

time	client (Tester)	server (ECU)
P3	<Service Name> Request[...]	
P2		<Service Name> PositiveResponse[...] {ECU#1}
P2		<Service Name> NegativeResponse[...] {ECU#2}
:		**:**
P2		<Service Name> PositiveResponse[...] {ECU#n-1}
P2		<Service Name> PositiveResponse[...] {ECU#n}
P3	<Service Name> Other Request[...]	
P2		<Service Name> Other PositiveResponse[...] {ECU}

Table 5.3.2.1 - Message flow example of functional addressed service

Above message flow example is based on a functional request message send by the client. An unknown number of servers has been initialised previously (e.g. fast initialisation by wake up pattern) which send positive and negative response messages.

5.3.2.2 - Functional addressed service and negative response message(s) with "routineNotComplete" and "busy-RepeatRequest"

The table below shows a message flow which describes a functional addressed service request followed by a negative response message with the response code set to "routineNotComplete" from one server. All other servers send positive response messages.

time	client (Tester)	server (ECU)
P3	<Service Name> Request[...] { Functional }	**{ server has started routine! }**
P2		<Service Name> NegRsp[routineNotComplete] {ECU#1}
P2		<Service Name> PositiveResponse[...] {ECU#2}
P2		<Service Name> PositiveResponse[...] {ECU#3}
P3	<Service Name> Request[...] { Functional }	
P2		<Service Name> NegRsp[busy-RepeatRequest] {ECU#1}
P2		<Service Name> PositiveResponse[...] {ECU#2}
P2		<Service Name> PositiveResponse[...] {ECU#3}
P3	<Service Name> Request[...] { Functional }	**{ server has completed routine! }**
P2		<Service Name> PositiveResponse[...] {ECU#1}
P2		<Service Name> PositiveResponse[...] {ECU#2}
P2		<Service Name> PositiveResponse[...] {ECU#3}

Table 5.3.2.2 - Functional addressing and negative response with "busy-RepeatRequest"

Above message flow example is based on a functional request message from the client which cause one server (ECU#1) to respond with a negative response message including the negative response code "routineNotComplete". The other servers (ECU#2, ECU#3) send a positive response message.
The response code indicates that the request message was properly received by the server and the routine/task/function (initiated by the request message) is in process, but not yet completed. If the client repeats or sends another functional request message the server shall "not reinitiate the task" (in case of the same request message) if the initial task has not been completed. The server shall send another negative response message with the response code "busy-RepeatRequest". The negative response message shall be sent on each functional request message as long as the server has not yet completed the initial routine/task/function. If the server (ECU#1) has finished the routine/task/function it shall respond with either a positive response message or a negative response message with a response code not equal to "busy-RepeatRequest". The communication timing is not affected!

Applications which may require above message flow are:

- clearDiagnosticInformation,
- execution of routines
- securityAccess

5.3.2.3 - Implementation example of functional addressed service and negative response message with "requestCorrectlyReceived-ResponsePending"

The table below shows a message flow example which describes a functional addressed request message followed by a negative response message with the response code set to "requestCorrectlyReceived-ResponsePending" from one server (ECU#1) and positive response messages from the other servers (ECU#2, ECU#3).

time	client (Tester)	server (ECU)
P3	<Service Name> Req[...] { Functional }	
P2		<Service Name> NegRsp#1[reqCorrectlyRcvd-RspPendg] {ECU#1}
P2*		<Service Name> PositiveResponse[...] {ECU#2}
P2*		<Service Name> PositiveResponse[...] {ECU#3}
P2*		<Service Name> NegRsp#2[reqCorrectlyRcvd-RspPendg] {ECU#1}
P2*		:
P2*		<Service Name> NegRsp#n[reqCorrectlyRcvd-RspPendg] {ECU#1}
P2*		<Service Name> PositiveResponse[...] {ECU#1}
P3	<Service Name> Req[...] { Functional }	
P2		<Service Name> PositiveResponse[...] {ECU#1}
P2		<Service Name> PositiveResponse[...] {ECU#2}
P2		<Service Name> PositiveResponse[...] {ECU#3}

Table 5.3.2.3 - Example of functional addressing and negative response with "reqCorrectlyRcvd-RspPending"

P2* **: P2min to P3max (refer to section 4.4.1 in ISO 14230 KWP 2000 Part 2: Data Link Layer Specification)**

Above message flow example is based on a request message from the client which cause the server to respond with one or multiple negative response message including the negative response code "requestCorrectlyReceived-ResponsePending". This response code indicates that the request message was received correctly, and that any parameters in the request message were valid, but the action to be performed may not be completed yet. This response code can be used to indicate that the request message was properly received and does not need to be retransmitted, but the server is not yet ready to receive another request. The negative response message may be sent once or multiple times within a service if required by the server! During the period of (a) negative response message(s) the testerPresent service shall be disabled in the client!
This response code shall only be used in a negative response message if the server will not be able to receive further request messages from the client within the P3 timing window. This may be the case if the server does data processing or executes a routine which does not allow any attention to serial communication.

Note: The communication timing method is specified in section "4.4.1 Timing exceptions" in the ISO 14230 Keyword Protocol 2000 Part 2: Data Link Layer Specification!

Applications which may require above message flow are:

- clearDiagnosticInformation
- execution of routines
- transferData request messages including up to 255 data bytes
- Flash EEPROM or EEPROM memory programming

6 - Diagnostic Management functional unit

The services provided by this functional unit are described in table 6:

Service name	Description
startDiagnosticSession	The client requests to start a diagnostic session with a server(s).
stopDiagnosticSession	The client requests to stop the current diagnostic session.
securityAccess	The client requests to unlock a secured server.
testerPresent	The client indicates to the server(s) that it is still present.
ecuReset	The client forces the server(s) to perform a reset.
readEcuIdentification	The client requests identification data from the server(s).

Table 6 - Diagnostic Management functional unit

6.1 - StartDiagnosticSession service

6.1.1 - Parameter definition

- The parameter ***diagnosticMode*** is used by the startDiagnosticSession service to select the specific behaviour of the server(s). No values are defined in this document.

Hex	Description
00 - 7F	**reservedByDocument** This range of values is reserved by this document for future definition.
80 - FF	**manufacturerSpecific** This range of values is reserved for vehicle manufacturer specific use.

Table 6.1.1 - Definition of diagnosticMode Values

6.1.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**startDiagnosticSession Request Service Id**	**M**	**10**	**SDS**
2	diagnosticMode=[reservedByDocument, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**DIAGMODE**

Table 6.1.2.1 - StartDiagnosticSession Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**startDiagnosticSession Positive Response Service Id**	**S**	**50**	**SDSPR**
2	diagnosticMode=[reservedByDocument, manufacturerSpecific]	U	xx=[00-7F, 80-FF]	**DIAGMODE**

Table 6.1.2.2 - StartDiagnosticSession Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**startDiagnosticSession Request Service Id**	**S**	**10**	**SDS**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 6.1.2.3 - StartDiagnosticSession Negative Response Message

6.1.3 - Message description

Above specified messages are used to enable different diagnostic modes in the server. Possible diagnostic modes are not defined in this document.
A diagnostic session shall only be started if communication has been established between the client and the server. For more detail how to start communication refer to the document ***ISO 14230 (KWP 2000 Part 2: Data Link Layer)***.

- If no diagnostic session has been requested by the client after startCommunication a default session shall be automatically enabled in the server. The default session shall support at least the following services:

  "stopCommunication service" ***ISO 14230 (KWP 2000 Part 2: Data Link Layer)***
  "testerPresent service" ***ISO 14230 (KWP 2000 Part 3: Implementation)***

- The default timing parameters in the server shall be active while the default session is running.

- If a diagnostic session has been requested by the client which is already running the server shall send a positive response message.

- Whenever a new diagnostic session is requested by the client, the server shall first send a startDiagnosticSession positive response message before the new session becomes active in the server. If the server sends a negative response message with the startDiagnosticSession request service identifier the current session shall continue. There shall be only one session active at a time. A diagnostic session enables a specific set of KWP 2000 services which shall be defined by the vehicle manufacturer. A session can enable vehicle manufacturer specific services which are not part of this document.

6.1.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1 and Functional Addressed Service in section 5.3.2.1.

6.2 - StopDiagnosticSession service

6.2.1 Parameter Definition

This service shall not use any parameter definition.

6.2.2 - Message Data Bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**stopDiagnosticSession Request Service Id**	**M**	**20**	**SPDS**

Table 6.2.2.1 - StopDiagnosticSession Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**stopDiagnosticSession Positive Response Service Id**	**S**	**60**	**SPDSPR**

Table 6.2.2.2 - StopDiagnosticSession Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**stopDiagnosticSession Request Service Id**	**S**	**20**	**SPDS**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 6.2.2.3 - StopDiagnosticSession Negative Response Message

6.2.3 - Message description

Above specified messages are used to disable the current diagnostic mode in the server.
The following implementation rules shall be followed:

- A diagnostic session shall only be stopped if communication has been established between the client and the server and a diagnostic session is running.

- If no diagnostic session is running the default session is active (see startDiagnosticSession). The default session cannot be disabled by a stopDiagnosticSession service.

- If the server has sent a stopDiagnosticSession positive response message the default timing parameters in the server shall be valid while the default session is running.

- If the server has sent a stopDiagnosticSession positive response message it shall have stopped the current diagnostic session, that is, perform the necessary action to return to a state in which it is able to restore its normal operating conditions. Restoring the normal operating conditions of the server may include the reset of all the actuators controlled if they have been activated by the client during the diagnostic session being stopped and resuming all normal algorithms of the server.

- If the server has sent a stopDiagnosticSession positive response message it shall have re-locked the server if it was unlocked by the client during the diagnostic session.

- If a stopDiagnosticSession has been requested by the client and the default session is already running the server shall send a positive response message and immediately reset all timing parameters.

- The client shall send a stopDiagnosticSession request message before disabling communication via a stopCommunication service but only if a startDiagnosticSession request message has been sent previously.

- If the server sends a negative response message with the stopDiagnosticSession request service identifier the active session shall be continued.

- A stopDiagnosticSession service shall also be used to disable vehicle manufacturer specific diagnostic sessions.

6.2.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1 and Functional Addressed Service in section 5.3.2.1.

6.3 - SecurityAccess service

6.3.1 - Parameter definition

- The parameter ***accessMode*** is used in the securityAccess service. It indicates to the server the step in progress for this service, the level of security the client wants to access and the format of seed and key. Values are defined in the table below for requestSeed and sendKey.

Hex	Description
01	**requestSeed** RequestSeed with the level of security defined by the vehicle manufacturer.
02	**sendKey** SendKey with the level of security defined by the vehicle manufacturer.
03, 05, 07 - 7F	**requestSeed** RequestSeed with different levels of security defined by the vehicle manufacturer.
04, 06, 08 - 80	**sendKey** SendKey with different levels of security defined by the vehicle manufacturer.
81 - FF	**manufacturerSpecific** This range of values is reserved for vehicle manufacturer specific use.

Table 6.3.1.1 - Definition of accessMode values

- The values of the parameter ***seed*** are not defined in this document except for the value "$00 00" which indicates to the client that the server is not locked.

- The values of the parameter ***key*** are not defined in this document.

- The parameter ***securityAccessStatus*** may be used to receive the status of the server security system. The value is defined in the table below.

Hex	Description
34	**securityAccessAllowed**

Table 6.3.1.2 - Definition of securityAccessStatus value

6.3.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**securityAccess Request#1 Service Id**	**M**	**27**	**SA#1**
2	accessMode=[requestSeed: shall be an odd number greater than $01 if additional levels of security are supported, ($01 default), manufacturerSpecific]	M	xx=[01, 03, : 7F, 81-FF]	**ACCMODE**

Table 6.3.2.1 - securityAccess Request#1 Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**securityAccess Positive Response#1 Service Id**	**S**	**67**	**SA#1PR**
2	accessMode=[requestSeed: shall be an odd number greater than $01 if additional levels of security are supported, ($01 default), manufacturerSpecific]	M	xx=[01, 03, : 7F, 81-FF]	**ACCMODE**
3 : n	seed#1 : seed#m	C : C	xx : xx	**SEED**
n+1	securityAccessStatus=[securityAccessAllowed]	U	34	**SACCSTAT**

Table 6.3.2.2 - securityAccess Positive Response#1 Message

C = condition: accessMode must be set to "requestSeed".

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse#1 Service Id**	**S**	**7F**	**NACK**
2	**securityAccess Request Service Id**	**S**	**27**	**SA**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 6.3.2.3 - SecurityAccess Negative Response#1 Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**securityAccess Request#2 Service Id**	**M**	**27**	**SA#2**
2	accessMode=[sendKey: shall be an even number one greater than accessMode in request#1 if additional levels of security are supported, ($02 default) manufacturerSpecific]	M	xx=[02, 04, : 80, 82-FE]	**ACCMODE**
3 : n	key#1 : key#m	C : C	xx : xx	**KEY**

Table 6.3.2.4 - SecurityAccess Request#2 Message

C = condition: accessMode must be set to "SendKey".

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**securityAccess Positive Response#2 Service Id**	**S**	**67**	**SA#2PR**
2	accessMode=[sendKey: shall be an even number one greater than AccessMode in request#1 if additional levels of security are supported, ($02 default) manufacturerSpecific]	M	xx=[02, 04, : 80, 82-FE]	**ACCMODE**
3	securityAccessStatus=[securityAccessAllowed]	U	34	**SACCSTAT**

Table 6.3.2.5 - SecurityAccess Positive Response#2 Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse#2 Service Id**	**S**	**7F**	**NACK**
2	**securityAccess Request Service Id**	**S**	**27**	**SA**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 6.3.2.6 - SecurityAccess Negative Response#2 Message

6.3.3 - Message description

This mode is intended to be used to implement the data link security measures defined in SAE J2186 (E/E Data Link Security).

- The client shall request the server to "unlock" itself by sending the service securityAccess request#1. The server shall respond by sending a "seed" using the service securityAccess positive response#1. The client shall respond by returning a "key" number back to the server using the service securityAccess request#2. The server shall compare this "key" to one internally stored.

If the two numbers match, then the server shall enable ("unlock") the client's access to specific KWP 2000 services and indicate that with the service securityAccess positive response#2. If upon two (2) attempts of a service securityAccess request#2 by the client, where the two keys do not match, then the server shall insert a ten (10) second time delay before allowing further attempts.

- The ten (10) second time delay shall also be required before the server responds to a service securityAccess request#1 from the client after server power-on.

- If a device supports security, but is already unlocked when a securityAccess request#1 is received, that server shall respond with a securityAccess positive response#1 service with a seed of "$00 00". A client shall use this method to determine if a server is locked by checking for a non-zero seed.

- The security system shall not prevent normal diagnostic or vehicle communications between the client and the servers. Proper "unlocking" of the server is a prerequisite to the client's ability to perform some of the more critical functions such as reading specific memory locations within the server, downloading information to specific locations, or downloading routines for execution by the controller. In other words, the only access to the server permitted while in a "locked" mode is through the server specific software. This permits the server specific software to protect itself from unauthorised intrusion.

- Servers that provide security shall support reject messages if a secure mode is requested while the server is locked.

- Some servers could support multiple levels of security, either for different functions controlled by the server, or to allow different capabilities to be exercised. These additional levels of security can be accessed by using the service securityAccess requests#1 and #2 with an accessMode value greater than the default value. The second data byte of the "requestSeed" shall always be an odd number, and the second data byte of the service to "sendKey" shall be the next even number.

6.3.4 - Message flow example

time	client (Tester)	server (ECU)
P3	securityAccess.Request#1[...]	
P2		securityAccess.PositiveResponse#1[...]
P3	securityAccess.Request#2[...]	
P2		securityAccess.PositiveResponse#2[...]

Table 6.3.4.1 - Message flow example of securityAccess services

Note: In case of a securityAccess negative response#1 it is the vehicle manufacturer's responsibility to decide how to proceed.

6.4 - TesterPresent service

6.4.1 - Parameter definition

- The parameter ***responseRequired*** is used in the testerPresent request message. It indicates to the server whether a response message is required or not. Values for this parameter are defined in the table below:

Hex	Description
01	**yes** The server shall send a response on the request message.
02	**no** The server shall not send a response on the request message.
03 - 7F	**reservedByDocument** This range of values is reserved by this document for future definition.
80 - FF	**vehicle manufacturerSpecific** This range of values is reserved for vehicle manufacturer specific use.

Table 6.4.1 - Definition of responseRequired values

6.4.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**testerPresent Request Service Id**	**M**	**3E**	**TP**
2	responseRequired=[Yes, No]	U	xx=[01, 02]	**RSPREQ**

Table 6.4.2.1 - testerPresent Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**testerPresent Positive Response Service Id**	**S**	**7E**	**TPPR**

Table 6.4.2.2 - testerPresent Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**testerPresent Request Service Id**	**M**	**3E**	**TP**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 6.4.2.3 - testerPresent Negative Response Message

6.4.3 - Message description

This service shall be used to indicate to a server the client is present. This service is required in the absence of other KWP 2000 services to prevent servers from automatically returning to normal operation and stop communication.

The following rules shall be followed:

- The presence of this service shall assure to keep communication active between client and server.

- The presence of this service shall indicate that the system should remain in a diagnostic mode of operation.

- If the user optional parameter responseRequired is not included in the testerPresent request message the server shall send a testerPresent positive response.

6.4.4 - Message flow example

time	client (Tester)	server (ECU)
P3 P2	testerPresent.Request[Yes]	 testerPresent.PositiveResponse[]
P3 P2 P3 P2	testerPresent.Request[No] testerPresent.Request[No]	 { no response from server } { no response from server }
P3 P2	testerPresent.Request[]	 testerPresent.PositiveResponse[]

Table 6.4.4 - Message flow example of testerPresent services

6.5 - EcuReset service

6.5.1 - Parameter definition

- The parameter ***resetMode*** is used by the ecuReset request message to describe how the server has to perform the reset. Values are defined in the table below:

Hex	Description
01	**powerOn** This value identifies the powerOn resetMode which shall be a simulated powerOn reset which most ECUs perform after ignition OFF/ON cycle. When the ECU performs the reset the client (tester) shall be prepared to re-establish communication.
02	**powerOnWhileMaintainingCommunication** This value identifies the powerOn resetMode which shall be a simulated powerOn reset which most ECUs perform after ignition OFF/ON cycle. When the ECU performs the reset the server (ECU) shall maintain the communication with the client (tester).
03 - 7F	**reservedByDocument** This range of values is reserved by this document for future definition.
80 - FF	**manufacturerSpecific** This range of values is reserved for vehicle manufacturer specific use.

Table 6.5.1.1 - Definition of resetMode values

- The parameter ***resetStatus*** is used by the ecuReset positive response message to provide information about the status of the reset(s). Format and length of this parameter are vehicle manufacturer specific.

Hex	Description
xx ... xx	**resetStatus** This parameter shall report resetStatus information. It is the vehicle manufacturer's responsibility to define the type and format of the data value(s).

Table 6.5.1.2 - Definition of resetStatus value

6.5.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ecuReset Request Service Id**	**M**	**11**	**ECURST**
2	resetMode=[powerOn, powerOnWhileMaintainingCommunication, reservedByDocument, manufacturerSpecific]	U	xx=[01, 02, 03 - 7F, 80 - FF]	**RSTOPT**

Table 6.5.2.1 - ecuReset Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ecuReset Positive Response Service Id**	**S**	**51**	**ECURSTPR**
2 : n	resetStatus#1 : resetStatus#m	U : U	xx : xx	**RSTSTAT**

Table 6.5.2.2 - ecuReset Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**ecuReset Request Service Id**	**M**	**11**	**ECURST**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 6.5.2.3 - ecuReset Negative Response Message

6.5.3 - Message description

This service requests the server to effectively perform an ECU reset based on the content of the resetMode parameter value. It is the vehicle manufacturer's responsibility to define whether the positive response message shall be sent before or after the resetMode is executed.

A possible implementation would be to report the number of resets performed by the server(s) after the last full power down / power up cycle (key off/on).

6.5.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1 and Functional Addressed Service in section 5.3.2.1.

6.6 - ReadEcuIdentification service

6.6.1 - Parameter definition

- The parameter ***identificationOption*** is used by the readEcuIdentification request message to describe the kind of identification data requested by the client. Values are defined in the table below:

Hex	Description
00 - 7F	**reservedByDocument** This range of values is reserved by this document for future definition.
80 - FF	**manufacturerSpecific** This range of values is reserved for vehicle manufacturer specific use.

Table 6.6.1 - Definition of identificationOption values

- The parameter ***identificationRecordValue*** is used by the readEcuIdentification positive response message to provide the identification data to the client. The content of the identification record is not defined in this document and is vehicle manufacturer specific.

6.6.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**readEcuIdentification Request Service Id**	**M**	**1A**	**RECUID**
2	identificationOption=[reservedByDocument, manufacturerSpecific]	U	xx=[00 - 7F, 80 - FF]	**IDOPT**

Table 6.6.2.1 - readEcuIdentification Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**readEcuIdentification Positive Response Service Id**	**S**	**5A**	**RECUIDPR**
2	identificationRecordValue=[ECUIdentificationParameter#1 : ECUIdentificationParameter#m]	M	xx=[xx : xx]	**IDRECVAL**

Table 6.6.2.2 - ReadEcuIdentification Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**readEcuIdentification Request Service Id**	**M**	**1A**	**RECUID**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 6.6.2.3 - ReadEcuIdentification Negative Response Message

6.6.3 - Message description

The readECUIdentification request message requests identification data from the server. The type of identifcation data requested by the client shall be identified by the identifcationOption parameter. The server sends an identification data record included in the readEcuIdentification positive response message. The format and definition of the identification data record shall be vehicle manufacturer specific and is not part of this document.

6.6.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1 and Functional Addressed Service in section 5.3.2.1.

7 - Data Transmission functional unit

The services provided by this functional unit are described in table 7:

Service name	Description
ReadDataByLocalIdentifier	The client requests the transmission of the current value of a record with access by recordLocalIdentifier.
ReadDataByCommonIdentfier	The client requests the transmission of the current value of a record with access by recordCommonIdentifier.
ReadMemoryByAddress	The client requests the transmission of a memory area.
DynamicallyDefineLocalIdentifier	The client requests to dynamically define local identifiers that may subsequently be accessed by recordLocalIdentifier.
WriteDataByLocalIdentifier	The client requests to write a record accessed by recordLocal-Identifier.
WriteDataByCommonIdentifier	The client requests to write a record accessed by recordCommon-Identifier.
WriteMemoryByAddress	The client requests to overwrite a memory area.
SetDataRates	The client changes the data rates for periodic transmissions.

Table 7 - Data Transmission functional unit

7.1 - ReadDataByLocalIdentifier service

7.1.1 - Parameter definition

- The parameter ***recordLocalIdentifier*** in the readDataByLocalIdentifier request message identifies a server specific local data record. This parameter shall be available in the server's memory. The recordLocalIdentifier value shall either exist in fixed memory or temporarily stored in RAM if defined dynamically by the service dynamicallyDefineLocalIdentifier.

- The parameter ***transmissionMode*** in the readDataByLocalIdentifier request message indicates how the server shall transmit the data record. Values are defined in the table below:

Hex	Description
01	**single** The server transmits the positive response message only once independent of the value specified by the parameter maximumNumberOfResponsesToSend.
02	**slow** The server transmits the positive response message periodically/repeatedly at the slowRate. The value of the slowRate is always predefined in the server and can be set by the client with the setDataRates service. This parameter specifies the value of the period at which the server transmits the record value upon the next readDataByLocalIdentifier/GlobalIdentifier and readMemoryByAddress request message with the transmissionMode parameter set to ***slow***. The repetition rate specified by the transmissionMode parameter ***slow*** is vehicle manufacturer specific.
03	**medium** The server transmits the positive response message periodically/repeatedly at the mediumRate. The value of the mediumRate is always predefined in the server and can be set by the client with the setDataRates service. This parameter specifies the value of the period at which the server transmits the record value upon the next readDataByLocalIdentifier/ CommonIdentifier and readMemoryByAddress request message with the transmissionMode parameter set to ***medium***. The repetition rate specifed by the transmissionMode parameter ***medium*** is vehicle manufacturer specific.
04	**fast** The server transmits the positive response message periodically/repeatedly at the fastRate. The value of the fastRate is always predefined in the server and can be set by the client with the setDataRates service. This parameter specifies the value of the period at which the server transmits the record value upon the next readDataByLocalIdentifier/GlobalIdentifier and readMemoryByAddress request message with the transmissionMode parameter set to ***fast***. The repetition rate specifed by the transmissionMode parameter ***fast*** is vehicle manufacturer specific and means as fast as possible.
05	**stop** The server stops transmitting positive response messages send periodically/repeatedly.

Table 7.1.1.1 - Definition of transmissionMode values

- The parameter ***maximumNumberOfResponsesToSend*** in the readDataByLocalIdentifier request message shall be used to indicate the number of positive response messages to be sent by the server upon the request message.

Hex	Description
00	**inValid** This value shall not be used by this parameter.
01 - FF	**numberOfResponsesToSend** This range of values shall be used to specify the number of responses the server shall send.

Table 7.1.1.2 - Definition of maximumNumberOfResponsesToSend values

- The parameter ***recordValue*** is used by the readDataByLocalIdentifier positive response message to provide the data record identified by the recordLocalIdentifier to the client. The content of the data record is not defined in this document and is vehicle manufacturer specific.

7.1.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**readDataByLocalIdentifier Request Service Id**	**M**	**21**	**RDBLID**
2	recordLocalIdentifier	M	xx	**RLOCID**
3	transmissionMode=[single, slow, medium, fast, stop]	U	xx=[01, 02, 03, 04, 05]	**TXM**
4	maximumNumberOfResponsesToSend	U/C1	xx	**MNORTS**

Table 7.1.2.1 - readDataByLocalIdentifier Request Message

C1 = condition: transmissionMode parameter must be present

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**readDataByLocalIdentifier Positive Response Service Id**	**S**	**61**	**RDBLIDPR**
2	recordLocalIdentifier	M	xx	**RLOCID**
3 : n	recordValue#1 : recordValue#m	M : M	xx : xx	**RECVAL**

Table 7.1.2.2 - readDataByLocalIdentifier Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**readDataByLocalIdentifier Request Service Id**	**M**	**21**	**RDBLID**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 7.1.2.3 - readDataByLocalIdentifier Negative Response Message

7.1.3 - Message description

The readDataByLocalIdentifier request message requests data record values from the server identified by a recordLocalIdentifier. The server sends data record values via the readDataByLocalIdentifier positive response message. The format and definition of the recordValues shall be vehicle manufacturer specific. RecordValues shall include analogue input and output signals, digital input and output signals, internal data and system status information if supported by the ECU.

If the server sends messages periodically and the client wants to stop the repeated positive response messages by a readDataByLocalIdentifier request message it shall send the request message after the P1 timing has expired and before the P2min timing becomes active. Refer to the message flow diagram and the ISO 14230 (KWP 2000 Part 2: Data Link Layer) document for more detail.

In addition, the user optional/conditional maximumNumberOfResponsesToSend parameter indicates to the server how many repetitions of positive response messages are requested by the client. The timing is not affected by this parameter.

7.1.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1 and Physical Addressed Service with transmissionMode parameter in section 5.3.1.2.

The following message flow is an example of Physical Addressed Service with transmissionMode (TXM) and maximumNumberOfResponsesToSend (MAXNOFRSPTOSEND) parameter present.

time	client (Tester)	server (ECU)
P3	readDataByLocalId.Request[	
	TXM=slow...fast, MAXNOFRSPTOSEND=03]	
P2*		readDataByLocalId.PositiveResponse#1[...]
P2*		readDataByLocalId.PositiveResponse#2[...]
P2*		readDataByLocalId.PositiveResponse#3[...]
P3	{ next request service }	
P2		{ next response service }

Table 7.1.4 - Message flow example of readDataByLocalIdentifier services with transmissionMode and maximumNumberOfResponsesToSend present

P2*: The P2 timing parameter may have been set previously by the parameters of the SetDataRates request message.

7.2 - ReadDataByCommonIdentifier service

7.2.1 - Parameter definition

- The parameter ***recordCommonIdentifier*** in the readDataByCommonIdentifier service identifies a data record which is supported by multiple servers.

- The parameter ***transmissionMode*** is defined in section 7.1.1.

- The parameter ***maximumNumberOfResponsesToSend*** is defined in section 7.1.1.

- The parameter ***recordValue*** is defined in section 7.1.1.

7.2.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**readDataByCommonIdentifier Request Service Id**	**M**	**22**	**RDBCID**
2	recordCommonIdentifier (High Byte)	M	xx	**RCIDHB**
3	recordCommonIdentifier (Low Byte)	M	xx	**RCIDLB**
4	transmissionMode=[single, slow, medium, fast, stop]	U	xx=[01, 02, 03, 04, 05]	**TXM**
5	maximumNumberOfResponsesToSend	U/C1	xx	**MNORTS**

Table 7.2.2.1 - readDataByCommonIdentifier Request Message

C1 = condition: transmissionMode parameter must be present

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**readDataByCommonIdentifier Positive Response Service Id**	**S**	**62**	**RDBCIDPR**
2	recordCommonIdentifier (High Byte)	M	xx	**RCIDHB**
3	recordCommonIdentifier (Low Byte)	M	xx	**RCIDLB**
4 : n	recordValue#1 : recordValue#m	M : M	xx : xx	**RECVAL**

Table 7.2.2.2 - readDataByCommonIdentifier Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**readDataByCommonIdentifier Request Service Id**	**M**	**22**	**RDBCID**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 7.2.2.3 - readDataByCommonIdentifier Negative Response Message

7.2.3 - Message description

The readDataByCommonIdentifier request message requests data record values from the server(s) identified by a common recordCommonIdentifier. The server(s) send data record values via the readDataByCommonIdentifier positive response message. The format and definition of the recordValues shall be vehicle manufacturer specific. RecordValues shall include analogue input and output signals, digital input and output signals, internal data and system status information if supported by the ECU(s).

If the server sends messages periodically and the client wants to stop the repeated positive response messages by a readDataByCommonIdentifier request message it shall send the request after the P1 timing has expired and before the P2min timing becomes active. Refer to the message flow diagram and the ISO 14230 (KWP 2000 Part 2: Data Link Layer) document for more detail.

In addition, the user optional/conditional maximumNumberOfResponsesToSend parameter indicates to the server how many repetitions of positive response messages are requested by the client. The timing is not affected by this parameter.

7.2.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1 or 5.3.1.2 and Functional Addressed Service in section 5.3.2.1.

7.3 - ReadMemoryByAddress service

7.3.1 - Parameter definition

- The parameter ***memoryAddress*** in the readMemoryByAddress request message identifies the start address in the server's memory. If the server supports "16 bit" wide address range the high byte of the memoryAddress shall be used as a memoryIdentifier if required.

- The parameter ***memorySize*** specifies the number of bytes to be read starting at a specified memory address in the server's memory.

- The parameter ***transmissionMode*** is defined in section 7.1.1.

- The parameter ***maximumNumberOfResposesToSend*** is defined in section 7.1.1.

- The parameter ***recordValue*** is defined in section 7.1.1.

7.3.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**readMemoryByAddress Request**	**M**	**23**	**RMBA**
2	memoryAddress (High Byte)	M	xx	**MEMAHB**
3	memoryAddress (Middle Byte)	M	xx	**MEMAMB**
4	memoryAddress (Low Byte)	M	xx	**MEMALB**
5	memorySize	M	xx	**MEMSIZE**
6	transmissionMode=[single, slow, medium, fast, stop]	U	xx=[01, 02, 03, 04, 05]	**TXM**
7	maximumNumberOfResponsesToSend	U/C1	xx	**MNORTS**

Table 7.3.2.1 - ReadMemoryByAddress Request Message

C1 = condition: transmissionMode parameter must be present

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**readMemoryByAddress Positive Response**	**S**	**63**	**RMBAPR**
2 : n	recordValue#1 : recordValue#m	M : M	xx : xx	**RECVAL**
n+1	memoryAddress (High Byte)	U	xx	**MEMAHB**
n+2	memoryAddress (Middle Byte)	U	xx	**MEMAMB**
n+3	memoryAddress (Low Byte)	U	xx	**MEMALB**

Table 7.3.2.2 - ReadMemoryByAddress Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**readMemoryByAddressRequest Service Id**	**M**	**23**	**RMBA**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 7.3.2.3 - ReadMemoryByAddress Negative Response Message

7.3.3 - Message description

The readMemoryByAddress request message requests memory data from the server identified by the parameters memoryAddress and memorySize.

The server sends data record values via the readMemoryByAddress positive response message. The format and definition of the recordValues shall be vehicle manufacturer specific. RecordValues shall include analogue input and output signals, digital input and output signals, internal data and system status information if supported by the ECU.

If the server sends positive response messages periodically and the client wants to stop the repeated messages by a readMemoryByAddress request message it shall send the request after the P1 timing has expired and before the P2min timing becomes active. Refer to the message flow diagram and the ISO 14230 (KWP 2000 Part 2: Data Link Layer) document for more detail.
In addition, the user optional/conditional maximumNumberOfResponsesToSend parameter indicates to the server how many repetitions of positive response messages are requested by the client. The timing is not affected by this parameter.

7.3.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1 or 5.3.1.2.

7.4 - DynamicallyDefineLocalIdentifier service

7.4.1 - Parameter definition

- The parameter ***dynamicallyDefinedLocalIdentifier*** in the dynamicallyDefineLocalIdentifier request message identifies a data record which has been defined by the client in the request service.

- The parameter ***definitionMode*** in the dynamicallyDefineLocalIdentifier request message specifies the method of how the data record is defined. Values are defined in the table below:

Hex	Description
01	**defineByLocalIdentifier**
02	**defineByCommonIdentifier**
03	**defineByMemoryAddress**
04	**clearDynamicallyDefinedLocalIdentifier**
05 - 7F	**reservedByDocument** This range of values is reserved by this document for future definition.
80 - FF	**manufacturerSpecific** This range of values is reserved for vehicle manufacturer specific use.

Table 7.4.1 - Definition of definitionMode values

- The parameter ***positionInDynamicallyDefinedLocalIdentifier*** in the dynamically-DefineLocalIdentifier request message identifies the position of the data in the readDataByLocalIdentifier positive response message.

- The parameter ***recordLocalIdentifier*** is defined in section 7.1.1.

- The parameter ***recordCommonIdentifier*** is defined in section 7.1.2.

- The parameter ***memorySize*** in the dynamicallyDefineLocalIdentifier request message identifies the number of bytes of data identified by the recordLocal/CommonIdentifier.

- The parameter ***memoryAddress*** in the dynamicallyDefineLocalIdentifier request message identifies the start address of a data record in the server's memory. If the server supports "16 bit" wide address range the high byte of the memoryAddress shall be used as a memoryIdentifier if required.

- The parameter ***positionInRecordLocalIdentifier*** in the dynamicallyDefineLocalIdentifier request message identifies the position in the data record identified by the recordLocalIdentifier in the server's memory.

- The parameter ***positionInRecordCommonIdentifier*** in the dynamicallyDefineLocalIdentifier request message identifies the position in the data record identified by the recordCommonIdentifier in the server's memory.

7.4.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**dynamicallyDefineLocalIdentifier Request Service Id**	**M**	**2C**	**DLIDDY**
2	dynamicallyDefinedLocalIdentifier	M	xx	**DDLOCID**
3	definitionMode=[defineByLocalIdentifier]#1	M	01	**DEFMODE**
4	positionInDynamicallyDefinedLocalIdentifier#1	M	xx	**PIDYDLID**
5	memorySize#1	M	xx	**MEMSIZE**
6	recordLocalIdentifier#1	M	xx	**RLOCID**
7	positionInRecordLocalIdentifier#1	M	xx	**PIRLOCID**
8	definitionMode=[defineByLocalIdentifier]#2	M	01	**DEFMODE**
9	positionInDynamicallyDefinedLocalIdentifier#2	M	xx	**PIDYDLID**
10	memorySize#2	M	xx	**MEMSIZE**
11	recordLocalIdentifier#2	M	xx	**RLOCID**
12	positionInRecordLocalIdentifier#2	M	xx	**PIRLOCID**
:	:	:	:	**:**
n-4	definitionMode=[defineByLocalIdentifier]#m	M	01	**DEFMODE**
n-3	positionInDynamicallyDefinedLocalIdentifier#m	M	xx	**PIDYDLID**
n-2	memorySize#m	M	xx	**MEMSIZE**
n-1	recordLocalIdentifier#m	M	xx	**RLOCID**
n	positionInRecordLocalIdentifier#m	M	xx	**PIRLOCID**

Table 7.4.2.1.1 - DynamicallyDefineLocalIdentifier Request Message definitionMode=defineByLocalIdentifier

This message is used by the client to dynamically define a local identifier in the request message. If the definitionMode parameter is set to defineByLocalIdentifier the following procedure shall be followed:

- The parameter positionInDynamicallyDefinedLocalIdentifier shall specifiy the position in the record referenced by the parameter dynamicallyDefinedLocalIdentifier. The record specified may be a "1 byte" parameter (e.g. Engine Coolant Temperature Sensor) or a multiple byte record representing many parameters (e.g. analogue and discrete inputs).

- The parameter memorySize shall specify the number of data bytes referenced by the parameter recordLocalIdentifier.

- The parameter positionInRecordLocalIdentifier shall specifiy the starting position in the record stored in the server's memory.

- The request may consist of multiple definitions.

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**dynamicallyDefineLocalIdentifier Request Service Id**	**M**	**2C**	**DLIDDY**
2	dynamicallyDefinedLocalIdentifier	M	xx	**DDLOCID**
3	definitionMode=[defineByCommonIdentifier]#1	M	02	**DEFMODE**
4	positionInDynamicallyDefinedLocalIdentifier#1	M	xx	**PIDYDLID**
5	memorySize#1	M	xx	**MEMSIZE**
6	recordCommonIdentifier#1 (High Byte)	M	xx	**RCIDHB**
7	recordCommonIdentifier#1 (Low Byte)	M	xx	**RCIDLB**
8	positionInRecordCommonIdentifier#1	M	xx	**PIRLOCID**
9	definitionMode=[defineByCommonIdentifier]#2	M	02	**DEFMODE**
10	positionInDynamicallyDefinedLocalIdentifier#2	M	xx	**PIDYDLID**
11	memorySize#2	M	xx	**MEMSIZE**
12	recordCommonIdentifier#2 (High Byte)	M	xx	**RCIDHB**
13	recordCommonIdentifier#2 (Low Byte)	M	xx	**RCIDLB**
14	positionInRecordCommonIdentifier#2	M	xx	**PIRLOCID**
:	:	:	:	**:**
n-5	definitionMode=[defineByCommonIdentifier]#m	M	02	**DEFMODE**
n-4	positionInDynamicallyDefinedLocalIdentifier#m	M	xx	**PIDYDLID**
n-3	memorySize#m	M	xx	**MEMSIZE**
n-2	recordCommonIdentifier#m (High Byte)	M	xx	**RCIDHB**
n-1	recordCommonIdentifier#m (Low Byte)	M	xx	**RCIDLB**
n	positionInRecordCommonIdentifier#m	M	xx	**PIRLOCID**

Table 7.4.2.1.2 - DynamicallyDefineLocalIdentifier Request Message definitionMode=defineByCommonIdentifier

This message is used by the client to dynamically define a local identifier in the request message. If the definitionMode parameter is set to defineByCommonIdentifier the following procedure shall be followed:

- The parameter positionInDynamicallyDefinedLocalIdentifier shall specifiy the position in the record referenced by the parameter dynamicallyDefinedLocalIdentifier. The record specified may be a "1 byte" parameter (e.g. Engine Coolant Temperature Sensor) or a multiple byte record representing many parameters (e.g. analogue and discrete inputs).

- The parameter memorySize shall specify the number of data bytes referenced by the parameter recordCommonIdentifier.

- The parameter positionInRecordCommonIdentifier shall specifiy the starting position in the record stored in the server's memory.

- The request may consist of multiple definitions.

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**dynamicallyDefineLocalIdentifier Request Service Id**	**M**	**2C**	**DLIDDY**
2	dynamicallyDefinedLocalIdentifier	M	xx	**DDLOCID**
3	definitionMode=[defineByMemoryAddress]#1	M	03	**DEFMODE**
4	positionInDynamicallyDefinedLocalIdentifier#1	M	xx	**PIDYDLID**
5	memorySize#1	M	xx	**MEMSIZE**
6	memoryAddress#1 (High Byte)	M	xx	**MEMAHB**
7	memoryAddress#1 (Middle Byte)	M	xx	**MEMAMB**
8	memoryAddress#1 (Low Byte)	M	xx	**MEMALB**
9	definitionMode=[defineByMemoryAddress]#2	M	03	**DEFMODE**
10	positionInDynamicallyDefinedLocalIdentifier#2	M	xx	**PIDYDLID**
11	memorySize#2	M	xx	**MEMSIZE**
12	memoryAddress#2 (High Byte)	M	xx	**MEMAHB**
13	memoryAddress#2 (Middle Byte)	M	xx	**MEMAMB**
14	memoryAddress#2 (Low Byte)	M	xx	**MEMALB**
:	:	:	:	**:**
n-5	definitionMode=[defineByMemoryAddress]#m	M	03	**DEFMODE**
n-4	positionInDynamicallyDefinedLocalIdentifier#m	M	xx	**PIDYDLID**
n-3	memorySize#m	M	xx	**MEMSIZE**
n-2	memoryAddress#m (High Byte)	M	xx	**MEMAHB**
n-1	memoryAddress#m (Middle Byte)	M	xx	**MEMAMB**
n	memoryAddress#m (Low Byte)	M	xx	**MEMALB**

Table 7.4.2.1.3 - DynamicallyDefineLocalIdentifier Request Message definitionMode=defineByMemoryAddress

This message is used by the client to dynamically define a local identifier in the request message. If the definitionMode parameter is set to defineByMemoryAddress the following procedure shall be followed:

- The parameter positionInDynamicallyDefinedLocalIdentifier shall specifiy the position in the record referenced by the parameter dynamicallyDefinedLocalIdentifier.

- The record specified may be a "1 byte" parameter (e.g. Engine Coolant Temperature Sensor) or a multiple byte record representing many parameters (e.g. analogue and discrete inputs).

- The parameter memorySize shall specify the number of data bytes starting at the specified memoryAddress in the server's memory.

- The request may consist of multiple definitions.

Note: The parameter positionInRecordLocal/CommonIdentifier is not used in the request message if definitionMode is set to defineByMemoryAddress.

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**dynamicallyDefineLocalIdentifier Request Service Id**	**M**	**2C**	**DLIDDY**
2	dynamicallyDefinedLocalIdentifier	M	xx	**DDLOCID**
3	definitionMode=[clearDynamicallyDefinedLocalIdentifier]	M	04	**DEFMODE**

Table 7.4.2.1.4 - DynamicallyDefineLocalIdentifier Request Message definitionMode=clearDynamicallyDefinedLocalIdentifier

This service is used by the client to clear a dynamicallyDefinedLocalIdentifier. The definitionMode parameter is set to clearDynamicallyDefinedLocalIdentifier. This request message shall free up the server's memory which is used to create a dynamicallyDefinedLocalIdentifier data record.

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**dynamicallyDefineLocalIdentifier Positive Response SId**	**M**	**6C**	**DLIDDYPR**
2	dynamicallyDefinedLocalIdentifier	M	xx	**DDLOCID**

Table 7.4.2.2 - DynamicallyDefineLocalIdentifier Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**dynamicallyDefineLocalIdentifierRequest Service Id**	**M**	**2C**	**DLIDDY**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 7.4.2.3 - DynamicallyDefineLocalIdentifier Negative Response Message

7.4.3 - Message description

The server shall send a positive response message after it has erased the dynamically defined local Identifier record.

This service is used by the client to clear the data record in the server's memory by sending a dynamicallyDefineLocalIdentifier request message including the parameter dynamicallyDefined-LocalIdentifier to be cleared and the parameter definitionMode set to clearDynamicallyDefined-LocalIdentifier.

7.4.4 - Message flow examples

The following message flow example shows a dynamicallyDefineLocalIdentifier service which consists of a single request and positive response message to define the parameters referenced by the dynamicallyDefinedLocalIdentifier. The dynamically defined data record is then read by a readDataByLocalidentifier service.

time	client (Tester)	server (ECU)
P3	dynamicallyDefineLocalId.Request[...]	
P2		dynamicallyDefineLocalId.PositiveResponse[...]
P3	readDataByLocalId.Request[...]	
P2		readDataByLocalId.PositiveResponse[...]

Table 7.4.4.1 - Message flow example of single dynamicallyDefineLocalIdentifier service followed by a readDataByLocalIdentifier service

The following message flow example shows a dynamicallyDefineLocalIdentifier service which consists of multiple requests and positive response messages to define the parameters referenced by the dynamicallyDefinedLocalIdentifier. The dynamically defined data record is then read by a readDataByLocalidentifier service.

time	client (Tester)	server (ECU)
P3	dynamicallyDefineLocalId.Request#1[...]	
P2		dynamicallyDefineLocalId.PositiveResponse#1[...]
P3	dynamicallyDefineLocalId.Request#2[...]	
P2		dynamicallyDefineLocalId.PositiveResponse#2[...]
:	:	:
P3	dynamicallyDefineLocalId.Request#n[...]	
P2		dynamicallyDefineLocalId.PositiveResponse#2[...]
P3	readDataByLocalId.Request[...]	
P2		readDataByLocalId.PositiveResponse[...]

Table 7.4.4.2 - Message flow example of multiple dynamicallyDefineLocalIdentifier services followed by a readDataByLocalIdentifier service

The DynamicallyDefineLocalIdentifier service shall only be used with physical addressing.

7.5 - WriteDataByLocalIdentifier service

7.5.1 - Parameter definition

- The parameter ***recordLocalIdentifier*** is defined in section 7.1.1.
- The parameter ***recordValue*** is defined in section 7.1.1.

7.5.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**writeDataByLocalIdentifier Request Service Id**	**M**	**3B**	**WDBLID**
2	recordLocalIdentifier	M	xx	**RECLID**
3 : n	recordValue#1 : recordValue#m	M : M	xx : xx	**RECVAL**

Table 7.5.2.1 - WriteDataByLocalIdentifier Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**writeDataByLocalIdentifier Positive Response Service Id**	**S**	**7B**	**WDBLIDPR**
2	recordLocalIdentifier	M	xx	**RECLID**

Table 7.5.2.2 - WriteDataByLocalIdentifier Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**writeDataByLocalIdentifier Request Service Id**	**M**	**3B**	**WDBLID**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 7.5.2.3 - WriteDataByLocalIdentifier Negative Response Message

7.5.3 - Message description

The writeDataByLocalIdentifier service is used by the client to write recordValues (data values) to a server. The data are identified by a recordLocalIdentifier. It is the vehicle manufacturer's responsibility that the server conditions are met when performing this service.

Possible uses for this service are:

- Clear non-volatile memory
- Reset learned values
- Set option content
- Set Vehicle Identification Number (VIN)
- Change calibration values

7.5.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1.

7.6 - WriteDataByCommonIdentifier service

7.6.1 - Parameter definition

- The parameter ***recordCommonIdentifier*** is defined in section 7.2.1.
- The parameter ***recordValue*** is defined in section 7.1.1.

7.6.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**writeDataByCommonIdentifier Request Service Id**	**M**	**2E**	**WDBCID**
2	recordCommonIdentifier (High Byte)	M	xx	**RECCIDHB**
3	recordCommonIdentifier (Low Byte)	M	xx	**RECCIDLB**
4 : n	recordValue#1 : recordValue#m	M : M	xx : xx	**RECVAL**

Table 7.6.2.1 - WriteDataByCommonIdentifier Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**writeDataByCommonIdentifier Positive Response SId**	**S**	**6E**	**WDBCIDPR**
2	recordCommonIdentifier (High Byte)	M	xx	**RECCIDHB**
3	recordCommonIdentifier (Low Byte)	M	xx	**RECCIDLB**

Table 7.6.2.2 - WriteDataByCommonIdentifier Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**writeDataByCommonIdentifier Request Service Id**	**M**	**2E**	**WDBCID**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 7.6.2.3 - WriteDataByCommonIdentifier Negative Response Message

7.6.3 - Message description

The writeDataByCommonIdentifier service is used by the client to write recordValues (data values) to multiple servers with a single request message. The data are identified by a recordCommonIdentifier. It is the vehicle manufacturer's responsibility that the server's conditions are met when performing this service.

Possible uses for this service are:

- Clear non-volatile memory
- Reset learned values
- Set option content
- Set Vehicle Identification Number (VIN)

7.6.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1 and Functional Addressed Service in section 5.3.2.1.

7.7 - WriteMemoryByAddress service

7.7.1 - Parameter definition

- The parameter ***memoryAddress*** is defined in section 7.3.1.
- The parameter ***memorySize*** is defined in section 7.3.1.
- The parameter ***recordValue*** is defined in section 7.1.1.

7.7.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**writeMemoryByAddress Request Service Id**	**M**	**3D**	**WMBA**
2	memoryAddress (High Byte)	M	xx	**MEMAHB**
3	memoryAddress (Middle Byte)	M	xx	**MEMAMB**
4	memoryAddress (Low Byte)	M	xx	**MEMALB**
5	memorySize	M	xx	**MEMSIZE**
6 : n	recordValue#1 : recordValue#m	M : M	xx : xx	**RECVAL**

Table 7.7.2.1 - WriteMemoryByAddress Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**writeMemoryByAddress Positive Response**	**S**	**7D**	**WMBAPR**
2	memoryAddress (High Byte)	U	xx	**MEMAHB**
3	memoryAddress (Middle Byte)	U	xx	**MEMAMB**
4	memoryAddress (Low Byte)	U	xx	**MEMALB**

Table 7.7.2.2 - WriteMemoryByAddress Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**writeMemoryByAddress Negative Response**	**S**	**7F**	**NACK**
2	**writeMemoryByAddress Request Service Id**	**M**	**3D**	**WMBA**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 7.7.2.3 - WriteMemoryByAddress Negative Response Message

7.7.3 - Message description

The writeMemoryByAddress service is used by the client to write recordValues (data values) to a server. The data are identified by the server's memoryAddress and memorySize.
It is the vehicle manufacturer's responsibility that the server conditions are met when performing this service.

Possible uses for this service are:

- Clear non-volatile memory
- Reset learned values
- Set option content
- Set Vehicle Identification Number (VIN)
- Change calibration values

7.7.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1.

7.8 - SetDataRates service

7.8.1 - Parameter definition

- The parameters ***slowRate, mediumRate*** and ***fastRate*** shall be used to specifiy the transmission speed of positive response messages to be sent by the server if the appropriate request message has specified the transmissionMode parameter to one of the above rates. The following table lists possible values to be assigned to ***slowRate, mediumRate*** and ***fastRate***.

Hex	Description
00	This value shall cause the server to send positive response messages as fast as possible based on the vehicle manufacturer's definition of slowRate, mediumRate and fastRate.
01 - FE	This range of values shall be used by the vehicle manufacturer to specify/change the default rates of the parameters slowRate, mediumRate and fastRate. It is the vehicle manufacturer's responsibility to define these values and their corresponding transmission rates of the parameters slowRate, mediumRate and fastRate.
FF	This value shall not change the current rate of positive response messages send by the server.

Table 7.8.1 - Definition of slowRate, mediumRate and fastRate values

7.8.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**SetDataRates Request Service Id**	**M**	**26**	**SDR**
2	slowRate	M	xx	**SLRATE**
3	mediumRate	M	xx	**MDRATE**
4	fastRate	M	xx	**FTRATE**

Table 7.8.2.1 - SetDataRates Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**SetDataRates Positive Response**	**S**	**66**	**SDRPR**

Table 7.8.2.2 - SetDataRates Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**SetDataRates Request Service Id**	**M**	**26**	**SDR**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 7.8.2.3 - SetDataRates Negative Response Message

7.8.3 - Message description

The setDataRates service is used by the client to overwrite the default timing of periodic transmissions used by the server. This message only affects those services which make use of the parameter transmissionMode in the readDataByLocalIdentifier, readDataByCommonIdentifier and readMemoryByAddress request messages. It is the vehicle manufacturer's responsibility to specify values and their corresponding periodic transmission rates.

Regardless of which rate is modified in the request, all rates shall have values as defined in the table 7.8.1.

7.8.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1.

8 - Stored Data Transmission functional unit

The services provided by this functional unit are described in table 8:

Service name	Description
ReadDiagnosticTroubleCodes	The client requests from the server the transmission of both, number of DTC and values of the diagnostic trouble codes.
ReadDiagnosticTroubleCodesBy-Status	The client requests from the server the transmission of both, number of DTC and values of the diagnostic trouble codes depending on their status.
ReadStatusOfDiagnosticTrouble-Codes	The client requests from the server the transmission of the number of DTC, values and status of the diagnostic trouble codes.
ReadFreezeFrameData	The client requests from the server the transmission of the value of a record stored in a freeze frame.
ClearDiagnosticInformation	The client requests from the server to clear all or a group of the diagnostic information stored.

Table 8 - Stored Data Transmission functional unit

8.1 - ReadDiagnosticTroubleCodes service

8.1.1 - Parameter definition

- The parameter ***groupOfDTC*** is used by the ReadDTC, ReadDTCByStatus and ReadStatusOfDTC services to select to which functional group of DTC or to which specific DTC access is requested. Format and length of this parameter are vehicle manufacturer specific.

Note: Standardised DTCs and DTCs formats are specified in SAE J2012 for passenger cars and in SAE J1587 and SAE J1939 for heavy duty vehicles.

- The parameter ***numberOfDTC*** is used by the ReadNumberOfDTC positive response to indicate how many DTCs of the group specified in the request have been stored by the client(s). A specific standard value is noDTCStored.

Hex	Description
00	**noDTCStored** This value indicates to the server that the client(s) doesn't (don't) have any DTC stored.
01-FF	**numberOfDTCStored** This range of values indicate to the server that the client(s) has (have) stored DTC(s).

Table 8.1.1.2 - Definition of numberOfDTC values

- The parameter ***listOfDTC*** is used by the server to report DTC(s) stored by the client(s).

Note: Standardised DTCs and DTCs formats are specified in SAE J2012 for passenger cars and in SAE J1587 and SAE J1939 for heavy duty vehicles.

8.1.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**readDiagnosticTroubleCodes Request Service Id**	**M**	**13**	**RDDTC**
2 : n	groupOfDTC#1 : groupOfDTC#m	U : U	xx : xx	**GODTC**

Table 8.1.2.1 - ReadDiagnosticTroubleCodes Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**readDiagnosticTroubleCodes Positive Resp. Service Id**	**M**	**53**	**RDDTCPR**
2	numberOfDTC	M	xx	**#DTC**
3 : : : : : : n	listOfDTC=[DTC#1 : DTC#1 : : DTC#m : DTC#m]	C	xx : xx : : xx : xx	**LSTOFDTC**

Table 8.1.2.2 - ReadDiagnosticTroubleCodes Positive Response Message

C = condition: listOfDTC is only present if numberOfDTC is > "$00".

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**readDiagnosticTroubleCodes Request Service Id**	**M**	**13**	**RDDTC**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 8.1.2.3 - ReadDiagnosticTroubleCodes Negative Response Message

8.1.3 - Message description

The readDiagnosticTroubleCodes service is used by the client to read diagnostic trouble codes from the server's memory. If the user optional parameter groupOfDTC is present in the request message then the server(s) shall only report DTC(s) based on the functional group selected by the client.

If the server(s) doesn't (don't) have any DTC stored it (they) shall set the parameter numberOfDTCStored to "$00". This causes the server(s) not to include DTC(s) in the parameter listOfDTC in the positive response message.

8.1.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1 and Functional Addressed Service in section 5.3.2.1.

8.2 - ReadDiagnosticTroubleCodesByStatus service

8.2.1 - Parameter definition

- The parameter ***statusOfDTC*** is used by ReadDiagnosticTroubleCodesByStatus and ReadStatusOfDiagnosticTroubleCodes service to inform the client about the status of each DTC stored in the server's memory. Format and length of this parameter are vehicle manufacturer specific.

Note: Standardised DTCs and DTCs formats are specified in SAE J2012 for passenger cars and in SAE J1587 and SAE J1939 for heavy duty vehicles.

- The parameter ***groupOfDTC*** is defined in section 8.1.1.

- The parameter ***numberOfDTC*** is defined in section 8.1.1.

- The parameter ***listOfDTCAndStatus*** is used by the server to report DTC(s) and their associated status.

8.2.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ReadDiagnosticTroubleCodesByStatus Request SId**	**M**	**18**	**RDDTCS**
2	statusOfDTC#1	M	xx	**STATDTC**
:	:	:	:	
n	statusOfDTC#m	U	xx	
n+1	groupOfDTC#1	U	xx	**GODTC**
:	:	:	:	
n+m	groupOfDTC#m	U	xx	

Table 8.2.2.1 - ReadDiagnosticTroubleCodesByStatus Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ReadDiagnosticTroubleCodesByStatus Pos. Response SId**	**M**	**58**	**RDDTCSPR**
2	numberOfDTC	M	xx	**#DTC**
	listOfDTCAndStatus=[	C		**LSTDTCST**
3	DTC#1		xx	
:	:		:	
:	DTC#1		xx	
:	statusOfDTC#1		xx	
:	:		:	
:	statusOfDTC#1		xx	
:	:		:	
:	:		:	
:	DTC#m		xx	
:	:		:	
:	DTC#m		xx	
:	statusOfDTC#m		xx	
:	:		:	
n	statusOfDTC#m		xx	
	]			

Table 8.2.2.2 - ReadDiagnosticTroubleCodesByStatus Positive Response Message

C = condition: listOfDTCAndStatus is only present if numberOfDTC is > "$00".

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**ReadDiagnosticTroubleCodesByStatus Request SId**	**M**	**18**	**RDDTC**
3	responseCode=[	M	xx=[	**RC**
	KWP2000ResponseCode,		00-7F,	
	manufacturerSpecific		80-FF	
	]		]	

Table 8.2.2.3 - ReadDiagnosticTroubleCodesByStatus Negative Response Message

8.2.3 - Message description

The readDiagnosticTroubleCodesByStatus service is used by the client to read diagnostic trouble codes by status from the server's memory. If the user optional parameter groupOfDTC is present in the request message then the server(s) shall only report DTC(s) with status information based on the functional group selected by the client.

If the server(s) doesn't (don't) have any DTC with status information stored it (they) shall set the parameter numberOfDTCStored to "$00". This causes the server(s) not to include DTC(s) and status information in the parameter listOfDTC in the positive response message.

8.2.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1 and Functional Addressed Service in section 5.3.2.1.

8.3 - ReadStatusOfDiagnosticTroubleCodes service

8.3.1 - Parameter definition

- The parameter ***groupOfDTC*** is defined in section 8.1.1.
- The parameter ***numberOfDTC*** is defined in section 8.1.1.
- The parameter ***listOfDTCAndStatus*** is defined in section 8.2.1.

8.3.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ReadStatusOfDiagnosticTroubleCodes Request SId**	**M**	**17**	**RDSDTC**
2 : n	groupOfDTC#1 : groupOfDTC#m	U : U	xx : xx	**GODTC**

Table 8.3.2.1 - ReadStatusOfDiagnosticTroubleCodes Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**ReadStatusOfDiagnosticTroubleCodes Pos. Resp. SId**	**M**	**57**	**RDSDTCPR**
2	numberOfDTC	M	xx	**#DTC**
	listOfDTCAndStatus=[	C		**LSTDTCST**
3 : : : : : : : : : : : : : n	DTC#1 : DTC#1 statusOfDTC#1 : statusOfDTC#1 : : DTC#m : DTC#m statusOfDTC#m : statusOfDTC#m]		xx : xx xx : xx : : xx : xx xx : xx	

Table 8.3.2.2 - ReadStatusOfDiagnosticTroubleCodes Positive Response Message

C = condition: listOfDTCAndStatus is only present if numberOfDTC is > "$00".

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**ReadStatusOfDiagnosticTroubleCodes Request SId**	**M**	**17**	**RDDTC**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 8.3.2.3 - ReadStatusOfDiagnosticTroubleCodes Negative Response Message

8.3.3 - Message description

The readStatusOfDiagnosticTroubleCodes service is used by the client to read diagnostic trouble codes with their associated status from the server's memory. If the user optional parameter groupOfDTC is present in the request message then the server(s) shall only report DTC(s) with status information based on the functional group selected by the client.

If the server(s) doesn't (don't) have any DTC with status information stored it (they) shall set the parameter numberOfDTCStored to "$00". This causes the server(s) not to include DTC(s) and status information in the parameter listOfDTC in the positive response message.

8.3.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1 and Functional Addressed Service in section 5.3.2.1.

8.4 - ReadFreezeFrameData service

8.4.1 - Parameter definition

- The parameter ***freezeFrameNumber*** is used by the client to identify the freeze frame to be read from the server's memory.

- The parameter ***recordAccessMethodIdentifier*** is used by the client to define the access method which shall be used in the recordIdentification parameter to access a specific freeze frame data record within the freezeFrameData.

Hex	Description
00	**requestAllData** This value indicates to the server(s) that the client requests all freeze frame data stored within the server's memory.
01	**requestByLocalIdentifier** This value indicates to the server(s) that the client requests freeze frame data identified by a local identifier.
02	**requestByCommonIdentifier** This value indicates to the server(s) that the client requests freeze frame data identified by a common identifier.
03	**requestByMemoryAddress** This value indicates to the server(s) that the client requests freeze frame data identified by a memory address. If the server supports "16 bit" wide address range the high byte of the memoryAddress shall be used as a memoryIdentifier if required.
04	**requestByDTC** This value indicates to the server(s) that the client requests freeze frame data identified by a DTC.
05 - 7F	**reservedByDocument** This range of values is reserved by this document for future definition.
80 - FF	**manufacturerSpecific** This range of values is reserved for vehicle manufacturer specific use.

Table 8.4.1.1 - Definition of recordAccessMethodIdentifier values

- The parameter ***recordIdentification*** is used by the client to identify the record within the freeze frame referenced by the parameter freezeFrameNumber.

Hex	Description
00	**allData** This value identifies the entire record which includes all data of a single freeze frame.
00 - FF	**localIdentifier** This range of values identifies a record which includes the data within a freeze frame referenced by a localIdentifier.
00 - FF 00 - FF	**commonIdentifier (High Byte)** **commonIdentifier (low Byte)** This range of values identifies a record which includes the data within a freeze frame referenced by a commonIdentifier.
00 - FF 00 - FF 00 - FF	**memoryAddress (High Byte)** **memoryAddress (Middle Byte)** **memoryAddress (Low Byte)** This range of values identifies a record which includes the data within a freeze frame referenced by a memoryAddress.
00 - FF : 00 - FF	**DTC (Diagnostic Trouble Code)** This range of values identifies a record which includes the data within a freeze frame referenced by a DTC.

Table 8.4.1.2 - Definition of recordIdentification values

- The parameter ***freezeFrameData*** is used by the readFreezeFrameData positive response message and consists of the data identified by the parameters freezeFrameNumber and, if present, recordIdentification.

8.4.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**readFreezeFrameData Request Service Id**	**M**	**12**	**RDFFD**
2	freezeFrameNumber	M	xx	**FRZFR#**
3	recordAccessMethodIdentifier=[1)	U	xx=[	**RECAMID**
	requestAllData		00	
	requestByLocalIdentifier		01	
	requestByCommonIdentifier		02	
	requestByMemoryAddress		03	
	requestByDTC		04	
	reservedByDocument		05 - 7F	
	manufacturerSpecific		80 - FF	
	]		]	
4	recordIdentification=[1)		xx=[	**RECID**
	allData	U/C1	00	
	localIdentifier	U/C2	xx	
	commonIdentifier (High Byte)	U/C3	xx	
	memoryAddress (High Byte)	U/C4	xx	
	DTC	U/C5	xx	
	reservedByDocument	U/C6	xx	
	manufacturerSpecific	U/C7	xx	
5	commonIdentifier (Low Byte)	U/C3	xx	
	memoryAddress (Middle Byte)	U/C4	xx	
	DTC	U/C5	xx	
6	memoryAddress (Low Byte)	U/C4	xx	
	DTC	U/C5	xx	
:	:		:	
n	DTC	U/C5	xx	
	]		]	

Table 8.4.2.1 - ReadFreezeFrameData Request Message

1) Parameters of the request shall only be present together
C1 = condition: recordAccessMethodIdentifier = requestAllData
C2 = condition: recordAccessMethodIdentifier = requestByLocalIdentifier
C3 = condition: recordAccessMethodIdentifier = requestByCommonIdentifier
C4 = condition: recordAccessMethodIdentifier = requestByMemoryAddress
C5 = condition: recordAccessMethodIdentifier = requestByDTC
C6 = condition: recordAccessMethodIdentifier = reservedByDocument
C7 = condition: recordAccessMethodIdentifier = manufacturerSpecific

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**readFreezeFrameData Positive Response Service Id**	**S**	**52**	**RDFFDPR**
2	freezeFrameNumber	M	xx	**FRZFR#**
3 : k-2	freezeFrameData : freezeFrameData	M	xx : xx	**FRZFRD**
k-1	recordAccessMethodIdentifier=[1) requestAllData requestByLocalIdentifier requestByCommonIdentifier requestByMemoryAddress requestByDTC reservedByDocument manufacturerSpecific]	U	xx=[00 01 02 03 04 05 - 7F 80 - FF]	**RECAMID**
k	recordIdentification=[1) allData localIdentifier commonIdentifier (High Byte) memoryAddress (High Byte) DTC reservedByDocument manufacturerSpecific	 U/C1 U/C2 U/C3 U/C4 U/C5 U/C6 U/C7	xx=[00 xx xx xx xx xx xx	**RECID**
k+1	commonIdentifier (Low Byte) memoryAddress (Middle Byte) DTC	U/C3 U/C4 U/C5	xx xx xx	
k+2 : n	memoryAddress (Low Byte) DTC : DTC]	U/C4 U/C5 U/C5	xx xx : xx]	

Table 8.4.2.2 - ReadFreezeFrameData Positive Response Message

1) Parameter shall be present if present in the request and parameters of the request shall only be repeated together
C1 = condition: recordAccessMethodIdentifier = requestAllData
C2 = condition: recordAccessMethodIdentifier = requestByLocalIdentifier
C3 = condition: recordAccessMethodIdentifier = requestByCommonIdentifier
C4 = condition: recordAccessMethodIdentifier = requestByMemoryAddress
C5 = condition: recordAccessMethodIdentifier = requestByDTC
C6 = condition: recordAccessMethodIdentifier = reservedByDocument
C7 = condition: recordAccessMethodIdentifier = manufacturerSpecific

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**readFreezeFrameData Request Service Id**	**M**	**12**	**RDFFD**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 8.4.2.3 - ReadFreezeFrameData Negative Response Message

8.4.3 - Message description

The readFreezeFrameData service is used by the client to read freezeFrameData stored in the server's memory. The parameter freezeFrameNumber identifies the respective freeze frame if one or multiple freeze frames are stored in the server's memory.

The user optional recordAccessMethodIdentifier in the request message identifies the access method used by the client to request freezeFrameData from the server's memory. In addition, the user optional parameter recordIdentifier shall always be used in conjunction with the recordAccessMethodIdentifier. The content, type and size of this parameter depends on the value of the recordAccessMethodIdentifier (refer to table 8.4.2.1).
The server shall send a positive response message including the freezeFrameNumber, freezeFrameData and the user optional/conditional parameters recordAccessMethodIdentifier and recordIdentifier, if both were present in the request.

Example: Data content and data format of the freezeFrameData shall be specified by the vehicle manufacturer. Typical uses for this mode are to report data stored upon detection of a system malfunction. Multiple frames of data may be stored before and/or after the malfunction has been detected.

8.4.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1 and Functional Addressed Service in section 5.3.2.1.

8.5 - ClearDiagnosticInformation service

8.5.1 - Parameter definition

- The parameter ***groupOfDiagnosticInformation*** is used by the ClearDiagnosticInformation service to select to which functional group of DTC or which specific DTC is selected. Format and length of this parameter are vehicle manufacturer specific.

Note: Standardised DTCs and DTCs formats are specified in SAE J2012 for passenger cars and in SAE J1587 and SAE J1939 for heavy duty vehicles.

8.5.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**clearDiagnosticInformation Request Service Id**	**M**	**14**	**CLRDTC**
2	groupOfDiagnosticInformation#1	U	xx	**GODIN**
:	:	:	:	
n	groupOfDiagnosticInformation#m	U	xx	

Table 8.5.2.1 - ClearDiagnosticInformation Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**clearDiagnosticInformation Positive Response SId**	**S**	**54**	**CLRDTCPR**
2 : n	groupOfDiagnosticInformation#1 : groupOfDiagnosticInformation#m	U/C : U/C	xx : xx	**GODIN**

Table 8.5.2.2 - ClearDiagnosticInformation Positive Response Message

C = condition: parameter shall be present if present in the request

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**clearDiagnosticInformation Request Service Id**	**M**	**14**	**CLRDTC**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 8.5.2.3 - ClearDiagnosticInformation Negative Response Message

8.5.3 - Message description

The clearDiagnosticInformation service is used by the client to clear diagnostic information in the server's memory. If the user optional parameter groupOfDiagnosticInformation is present in the request message then the server(s) shall clear all diagnostic information based on the functional group selected by the client. If a specific DTC shall be cleared the client shall send the groupOfDiagnosticInformation parameter including the DTC to clear.

If the server(s) doesn't (don't) have any DTC and/or diagnostic information stored the server(s) shall send a positive response message after an appropriate request message has been received.

8.5.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1 and Functional Addressed Service in section 5.3.2.1.

9 - InputOutput Control functional unit

The services provided by this functional unit are described in table 9:

Service name	Description
InputOutputControlByLocalIdentifier	The client requests the control of an input/output specific to the server.
InputOutputControlByCommonIdentifier	The client requests the control of a common input/output.

Table 9 - InputOutput Control functional unit

9.1 - InputOutputControlByLocalIdentifier service

9.1.1 - Parameter definition

- The parameter ***inputOutputLocalIdentifier*** in the inputOutputControlByLocalIdentifier request service identifies an ECU local input signal, internal parameter or output signal.

- The parameter ***controlOption*** is used by the InputOutputControlByLocal/Common-Identifier request service to describe how the server has to control its inputs or outputs. It may consist of multiple bytes which include specific control information to manipulate the input or output signal identified by the inputOutputLocal/CommonIdentifier.

- The parameter ***controlStatus*** is used by the InputOutputControlByLocal/CommonIdentifier positive response service to give to the client information about the status (e.g. feedback) of the requested control and other related information.

9.1.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30**	**IOCBLID**
2	inputOutputLocalIdentifier	M	xx	**IOLID**
3	controlOption#1	U	xx	**CRTLOPT**
:	:	:	:	
n	controlOption#m	U	xx	

Table 9.1.2.1 - InputOutputControlByLocalIdentifier Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**inputOutputControlByLocalIdentifier Positive Response SId**	**S**	**70**	**IOCBLIDPR**
2	inputOutputLocalIdentifier	M	xx	**IOLID**
3	controlStatus#1	U	xx	**CRTLSTAT**
:	:	:	:	
n	controlStatus#m	U	xx	

Table 9.1.2.2 - InputOutputControlByLocalIdentifier Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**inputOutputControlByLocalIdentifier Request SId**	**M**	**30**	**IOCBLID**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 9.1.2.3 - InputOutputControlByLocalIdentifier Negative Response Message

9.1.3 - Message description

The InputOutputControlByLocalIdentifier 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 an inputOutputLocalIdentifier 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 message was successfully executed. It is user optional if the positive response message shall include controlStatus information which possibly is available during or after the control execution.

The controlOption parameter can be implemented as a single ON/OFF parameter or as a more complex sequence of control parameters including a number of cycles, a duration, etc. if required.

9.1.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1.

9.2 - InputOutputControlByCommonIdentifier service

9.2.1 - Parameter definition

- The parameter ***inputOutputCommonIdentifier*** in the inputOutputControlByCommonIdentifier request service identifies an input or output common to the ECU(s).

- The parameter ***controlOption*** is defined in section 9.1.1.

- The parameter ***controlStatus*** is defined in section 9.1.1.

9.2.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**inputOutputControlByCommonIdentifier Request SId**	**M**	**2F**	**IOCBCID**
2	inputOutputCommonIdentifier (High Byte)	M	xx	**IOCIDHB**
3	inputOutputCommonIdentifier (Low Byte)	M	xx	**IOCIDLB**
4 : n	controlOption#1 : controlOption#m	U : U	xx : xx	**CRTLOPT**

Table 9.2.2.1 - InputOutputControlByCommonIdentifier Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**inputOutputControlByCommonIdentifier Positive Resp. SId**	**S**	**6F**	**IOCBCIDPR**
2	inputOutputCommonIdentifier (High Byte)	M	xx	**IOCIDHB**
3	inputOutputCommonIdentifier (Low Byte)	M	xx	**IOCIDLB**
4 : n	controlStatus#1 : controlStatus#m	U : U	xx : xx	**CRTLSTAT**

Table 9.2.2.2 - InputOutputControlByCommonIdentifier Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**inputOutputControlByCommonIdentifier Request SId**	**M**	**2F**	**IOCBCID**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 9.2.2.3 - InputOutputControlByCommonIdentifier Negative Response Message

9.2.3 - Message description

The InputOutputControlByCommonIdentifier service is used by the client to substitute a value for an input signal, internal ECU function and/or an control output (actuator) of electronic systems referenced by an inputOutputCommonIdentifier 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(s) shall send a positive response message if the request message was successfully executed. It is user optional if the positive response message shall include controlStatus information which possibly is available during or after the control execution.

The controlOption parameter can be implemented as a single ON/OFF parameter or as a more complex sequence of control parameters including a number of cycles, a duration, etc.

9.2.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1 and Functional Addressed Service in section 5.3.2.1.

10 - Remote Activation Of Routine functional unit

The services provided by this functional unit are described in table 10:

Service name	Description
StartRoutineByLocalIdentifier	The client requests to start a routine in the ECU of the server.
StartRoutineByAddress	The client requests to start a routine in the ECU of the server.
StopRoutineByLocalIdentifier	The client requests to stop a routine in the ECU of the server.
StopRoutineByAddress	The client requests to stop a routine in the ECU of the server.
RequestRoutineResultsByLocalIdentifier	The client requests the results of a routine by the Routine Local Identifier.
RequestRoutineResultsByAddress	The client requests the results of a routine by the Routine Address.

Table 10 - Remote Activation Of Routine functional unit

10.1 - StartRoutineByLocalIdentifier service

10.1.1 - Parameter definition

- The parameter ***routineLocalIdentifier*** in the start/stopRoutineByLocalIdentifier and requestRoutineResultsByLocalIdentifier request message identifies a server local routine.

- The parameter ***routineEntryOption*** is used by the startRoutineByLocalIdentifier and startRoutineByAddress request message to specify the start conditions of the routine.

- The parameter ***routineEntryStatus*** is used by the startRoutineByLocalIdentifier and startRoutineByAddress positive response message to give to the client additional information about the status of the server following the start of the routine.

10.1.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**startRoutineByLocalIdentifier Request Service Id**	**M**	**31**	**SRBLID**
2	routineLocalIdentifier	M	xx	**RLOCID**
3	routineEntryOption#1	U	xx	**RENTOPT**
:	:	:	:	
n	routineEntryOption#m	U	xx	

Table 10.1.2.1 - StartRoutineByLocalIdentifier Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**startRoutineByLocalIdentifier Positive Response SId**	**S**	**71**	**SRBLIDPR**
2	routineLocalIdentifier	M	xx	**RLOCID**
3 : n	routineEntryStatus#1 : routineEntryStatus#m	U : U	xx : xx	**RENTSTAT**

Table 10.1.2.2 - StartRoutineByLocalIdentifier Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**startRoutineByLocalIdentifier Request Service Id**	**M**	**31**	**SRBLID**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 10.1.2.3 - StartRoutineByLocalIdentifier Negative Response Message

10.1.3 - Message description

This startRoutineByLocalIdentifier service is used by the client to start a routine in the server's memory.

The routine in the server shall be started after the positive response message has been sent. The routine shall be stopped until a stopRoutineByLocalIdentifier service is issued.

The routines could either be tests that run instead of normal operating code or could be routines that are enabled and executed with the normal operating code running. In particular in the first case, it might be necessary to switch the server in a specific diagnostic mode using the startDiagnosticSession service or to unlock the server using the securityAccess service prior to using the startRoutineByLocalIdentifier service.

The parameter routineEntryOption is user optional and shall be of any type and length defined within KWP 2000.

Examples of routineEntryOptions are: timeToRun, startUpVariables, etc.

10.1.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1.
A complete message flow example is shown in section 10.5.4.

10.2 - StartRoutineByAddress service

10.2.1 - Parameter definition

- The parameter ***routineAddress*** in the start/stopRoutineByAddress and requestRoutine-ResultsByAddress request message identifies a server local routine.

- The parameter ***routineEntryOption*** is defined in section 10.1.1.

- The parameter ***routineEntryStatus*** is defined in section 10.1.1.

10.2.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**startRoutineByAddress Request Service Id**	**M**	**38**	**STRBAD**
2	routineAddress (High Byte)	M	xx	**MEMAHB**
3	routineAddress (Middle Byte)	M	xx	**MEMAMB**
4	routineAddress (Low Byte)	M	xx	**MEMALB**
5 : n	routineEntryOption#1 : routineEntryOption#m	U : U	xx : xx	**RENTOPT**

Table 10.2.2.1 - StartRoutineByAddress Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**startRoutineByAddress Positive Response Service Id**	**S**	**78**	**STRBADPR**
2	routineAddress (High Byte)	M	xx	**MEMAHB**
3	routineAddress (Middle Byte)	M	xx	**MEMAMB**
4	routineAddress (Low Byte)	M	xx	**MEMALB**
5 : n	routineEntryStatus#1 : routineEntryStatus#m	U : U	xx : xx	**RENTSTAT**

Table 10.2.2.2 - StartRoutineByAddress Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**startRoutineByAddress Request Service Id**	**M**	**38**	**STRBAD**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 10.2.2.3 - StartRoutineByAddress Negative Response Message

10.2.3 - Message description

The startRoutineByAddress service is used by the client to start a routine in the server's memory. The routine in the server shall be started after the positive response message has been sent. The routine shall be stopped until a stopRoutineByAddress service is received.

The routines could either be tests that run instead of normal operating code or could be routines that are enabled and executed with the normal operating code running. In particular in the first case, it might be necessary to switch the server in a specific diagnostic mode using the startDiagnosticSession service or to unlock the server using the securityAccess service prior to using the startRoutineByAddress service.

The parameter routineEntryOption is user optional and shall be of any type and length defined within KWP 2000.

Examples of routineEntryOptions are: timeToRun, startUpVariables, etc.

10.2.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1.
A complete message flow example is shown in section 10.6.4.

10.3 - StopRoutineByLocalIdentifier service

10.3.1 - Parameter definition

- The parameter ***routineLocalIdentifier*** is defined in section 10.1.1.

- The parameter ***routineExitOption*** is used by the stopRoutineByLocalIdentifier and stopRoutineByAddress request message to specify the stop conditions of the routine.

- The parameter ***routineExitStatus*** is used by the stopRoutineByLocalIdentifier and stopRoutineByAddress positive response message to provide additional information to the client about the status of the server after the routine has been stopped. Values are defined in the table below:

Hex	Description
00-60	**reservedByDocument** This range of values is reserved by this document (refer to section 4.4 Response Codes).
61	**normalExitWithResultsAvailable**
62	**normalExitWithoutResultsAvailable**
63	**abnormalExitWithResultsAvailable**
64	**abnormalExitWithoutResultsAvailable**
65 - 7F	**reservedByDocument** This range of values is reserved by this document (refer to section 4.4 Response Codes).
80 - FF	**manufacturerSpecificCodes** This range of values is reserved for vehicle manufacturer specific use.

Table 10.3.1 - Definition of routineExitStatus values

10.3.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**stopRoutineByLocalIdentifier Request Service Id**	**M**	**32**	**SPRBLID**
2	routineLocalIdentifier	M	xx	**RLOCID**
3 : n	routineExitOption#1 : routineExitOption#m	U : U	xx : xx	**REXITOPT**

Table 10.3.2.1 - StopRoutineByLocalIdentifier Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**stopRoutineByLocalIdentifier Positive Response**	**S**	**72**	**SPRBLIDPR**
2	routineLocalIdentifier	M	xx	**RLOCID**
3 : n	routineExitStatus#1 : routineExitStatus#m	U : U	xx : xx	**REXITSTAT**

Table 10.3.2.2 - StopRoutineByLocalIdentifier Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**stopRoutineByLocalIdentifier Request Service Id**	**M**	**32**	**SPRBLID**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 10.3.2.3 - StopRoutineByLocalIdentifier Negative Response Message

10.3.3 - Message description

The stopRoutineByLocalIdentifier service is used by the client to stop a routine in the server's memory referenced by a routineLocalIdentifier. The routine in the server shall be stopped after the positive response message has been sent.

The parameter routineExitOption is user optional and shall be of any type and length defined within KWP 2000.

Examples of routineExitOption are: timeToExpireBeforeRoutineStops, variables, etc.
The parameter routineExitStatus is user optional and shall be of any type and length defined within KWP 2000.

Examples of routineExitStatus are: totalRunTime, results generated by the routine before stopped, etc.

10.3.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1.
A complete message flow example is shown in section 10.5.4.

10.4 - StopRoutineByAddress service

10.4.1 - Parameter definition

- The parameter ***routineAddress*** is defined in section 10.2.1.
- The parameter ***routineExitOption*** is defined in section 10.3.1.
- The parameter ***routineExitStatus*** is defined in section 10.3.1.

10.4.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**stopRoutineByAddress Request Service Id**	**M**	**39**	**SPRBAD**
2	routineAddress (High Byte)	M	xx	**MEMAHB**
3	routineAddress (Middle Byte)	M	xx	**MEMAMB**
4	routineAddress (Low Byte)	M	xx	**MEMALB**
5 : n	routineExitOption#1 : routineExitOption#m	U : U	xx : xx	**REXITOPT**

Table 10.4.2.1 - StopRoutineByAddress Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**stopRoutineByAddress Positive Response Service Id**	**S**	**79**	**SPRBADPR**
2	routineAddress (High Byte)	M	xx	**MEMAHB**
3	routineAddress (Middle Byte)	M	xx	**MEMAMB**
4	routineAddress (Low Byte)	M	xx	**MEMALB**
5 : n	routineExitStatus#1 : routineExitStatus#m	U : U	xx : xx	**REXITSTAT**

Table 10.4.2.2 - StopRoutineByAddress Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**stopRoutineByAddress Request Service Id**	**M**	**39**	**SPRBAD**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 10.4.2.3 - StopRoutineByAddress Negative Response Message

10.4.3 - Message description

The stopRoutineByAddress service is used by the client to stop a routine in the server's memory referenced by a memoryAddress. The routine in the server shall be stopped after the positive response message has been sent.

The parameter routineExitOption is user optional and shall be of any type and length defined within KWP 2000.

Examples of routineExitOption are: timeToExpireBeforeRoutineStops, variables, etc.
The parameter routineExitStatus is user optional and shall be of any type and length defined within KWP 2000.

Examples of routineExitStatus are: totalRunTime, results generated by the routine before stopped, etc.

10.4.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1.
A complete message flow example is shown in section 10.6.4.

10.5 - RequestRoutineResultsByLocalIdentifier service

10.5.1 - Parameter definition

- The parameter ***routineLocalIdentifier*** is defined in section 10.1.1.

- The parameter ***routineResults*** is used by the requestRoutineResultsByLocalIdentifier and requestRoutineResultsByAddress positive response message to provide the results (exit status information) of the routine which has been stopped previously in the server.

10.5.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**requestRoutineResultsByLocalIdentifier Request SId**	**M**	**33**	**RRRBLID**
2	routineLocalIdentifier	M	xx	**RLOCID**

Table 10.5.2.1 - RequestRoutineResultsByLocalIdentifier Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**requestRoutineResultsByLocalIdentifier Pos. Resp. SId**	**S**	**73**	**RRRBLIDPR**
2	routineLocalIdentifier	M	xx	**RLOCID**
3 : n	routineResults#1 : routineResults#m	U : U	xx : xx	**RRESULT**

Table 10.5.2.2 - RequestRoutineResultsByLocalIdentifier Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**requestRoutineResultsByLocalIdentifier Request SId**	**M**	**33**	**RRRBLID**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 10.5.2.3 - RequestRoutineResultsByLocalIdentifier Negative Response Message

10.5.3 - Message description

The requestRoutineResultsByLocalIdentifier service is used by the client to request results (e.g. exit status information) referenced by a routineLocalIdentifier and generated by the routine which was executed in the server's memory.

The parameter routineResults is user optional and shall be of any type and length defined within KWP 2000. Based on the routineResults which may have been received in the stopRoutineByLocalidentifier or stopRoutineByAddress positive response message (routineResults = normal/abnormalExitWithResults) the requestRoutineResultsByLocalIdentifier service shall be used.

Example of routineResults: data collected by the ECU which could not be transmitted during routine execution because of ECU performance limitations.

10.5.4 - Message flow example

time	client (Tester)	server (ECU)
P3 P2	startRoutineByLocalId.Request[...]	 startRoutineByLocalId.PositiveResponse[...]
P3 P2	stopRoutineByLocalId.Request[...]	 stopRoutineByLocalId.PositiveResponse[...]
P3 P2	requestRoutineResultsByLocalId.Request[...]	 requestRoutineResultsByLocalId.PositiveResponse[...]

Table 10.5.4 - Message flow example of start/stopRoutineByLocalIdentifier service followed by a requestRoutineResultsByLocalIdentifier service

The requestRoutineResultsByLocalIdentifier service shall only be used with physical addressing.

10.6 - RequestRoutineResultsByAddress service

10.6.1 - Parameter definition

- The parameter ***routineAddress*** is defined in section 10.2.1.
- The parameter ***routineResults*** is defined in section 10.5.1.

10.6.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**requestRoutineResultsByAddress Request Service Id**	**M**	**3A**	**RRRBAD**
2	routineAddress (High Byte)	M	xx	**MEMAHB**
3	routineAddress (Middle Byte)	M	xx	**MEMAMB**
4	routineAddress (Low Byte)	M	xx	**MEMALB**

Table 10.6.2.1 - RequestRoutineResultsByAddress Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**requestRoutineResultsByAddress Positive Response SId**	**S**	**7A**	**RRRBAD**
2	routineAddress (High Byte)	M	xx	**MEMAHB**
3	routineAddress (Middle Byte)	M	xx	**MEMAMB**
4	routineAddress (Low Byte)	M	xx	**MEMALB**
5 : n	routineResults#1 : routineResults#m	U : U	xx : xx	**RRESULT**

Table 10.6.2.2 - RequestRoutineResultsByAddress Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**Negative ResponseService Id**	**S**	**7F**	**NACK**
2	**requestRoutineResultsByAddress Request Service Id**	**M**	**3A**	**RRRBAD**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 10.6.2.3 - RequestRoutineResultsByAddress Negative Response Message

10.6.3 - Message description

The requestRoutineResultsByAddress service is used by the client to request results referenced by a memoryAddress and generated by the routine which was executed in the server's memory.

The parameter routineResults is user optional and shall be of any type and length defined within KWP 2000. Based on the routineResults which may have been received in the stopRoutineByLocalIdentifier or stopRoutineByAddress positive response message (routineResults = normal/abnormalExitWithResults) the requestRoutineResultsByAddress service shall be used.

Example of routineResults: data collected by the ECU which could not be transmitted during routine execution because of ECU performance limitations.

10.6.4 - Message flow example

See message flow example of Physical Addressed Service in section 10.5.4.

Note: Above mentioned message flow example uses a localIdentifier instead of a memoryAddress.

11 - Upload Download functional unit

The services provided by this functional unit are described in table 11:

Service name	Description
RequestDownload	The client requests the negotiation of a data transfer from the client to the server.
RequestUpload	The client requests the negotiation of a data transfer from the server to the client.
TransferData	The client transmits data to the server (download) or requests data from the server (upload).
RequestTransferExit	The client requests the termination of a data transfer.

Table 11 - Upload Download functional unit

11.1 - RequestDownload service

11.1.1 - Parameter definition

- The parameter ***transferRequestParameter*** is used by all request messages of the Upload Download functional unit and shall include all the information necessary for the request messages. Format and length for this parameter is vehicle manufacturer specific.

- The parameter ***transferResponseParameter*** in the requestDownload positive response message defines the status of the server if it is ready to receive data. One value is defined in the table below. Format and length of additional parameters are vehicle manufacturer specific.

Hex	Description
00-43	**reservedByDocument** This range of values is reserved by this document (refer to section 4.4 Response Codes).
44	**readyForDownload**
45-7F	**reservedByDocument** This range of values is reserved by this document (refer to section 4.4 Response Codes).
80 - FF	**manufacturerSpecificCodes** This range of values is reserved for vehicle manufacturer specific use.

Table 11.1.1 - Definition of transferResponseParameter value

11.1.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**requestDownload Request Service Id**	**M**	**34**	**REQDWN**
2	transferRequestParameter#1	U	xx	**TRNFREQP**
:	:	:	:	
n	transferRequestParameter#m	U	xx	

Table 11.1.2.1 - RequestDownload Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**requestDownload Positive Response Service Id**	**M**	**74**	**REQDWNPR**
2 : n	transferResponseParameter#1 : transferResponseParameter#m	U : U	xx : xx	**TRNFRSPP**

Table 11.1.2.2 - RequestDownload Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**requestDownload Request Service Id**	**M**	**34**	**REQDWN**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 11.1.2.3 - RequestDownload Negative Response Message

11.1.3 - Message description

The requestDownload service is used by the client to initiate a data transfer from the client to the server (download). After the server has received the requestDownload request message the ECU shall take all necessary actions to receive data before it sends a positive response message.

The parameters transferRequestParameter and transferResponseParameter are user optional and shall be of any type and length defined within KWP 2000.

Example of transferRequestParameter: initialisation value(s) for data download.
Example of transferResponseParameter: maximum number of bytes per transferData message.

11.1.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1.
A complete message flow example is shown in section 11.4.4.

11.2 - RequestUpload service

11.2.1 - Parameter definition

- The parameter ***transferRequestParameter*** is defined in section 11.1.1.

- The parameter ***transferResponseParameter*** in the requestUpload positive response message defines the status of the server if it is ready to transmit data. One value is defined in the table below. Format and length of additional parameters are vehicle manufacturer specific.

Hex	Description
00-53	**reservedByDocument** This range of values is reserved by this document (refer to section 4.4 Response Codes).
54	**readyForUpload**
55-7F	**reservedByDocument** This range of values is reserved by this document (refer to section 4.4 Response Codes).
80 - FF	**manufacturerSpecificCodes** This range of values is reserved for vehicle manufacturer specific use.

Table 11.2.1 - Definition of transferResponseParameter value

11.2.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**requestUpload Request Service Id**	**M**	**35**	**REQUP**
2 : n	transferRequestParameter#1 : transferRequestParameter#m	U : U	xx : xx	**TRNFREQP**

Table 11.2.2.1 - RequestUpload Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**requestUpload Positive Response Service Id**	**M**	**75**	**REQUPPR**
2 : n	transferResponseParameter#1 : transferResponseParameter#m	U : U	xx : xx	**TRNFRSPP**

Table 11.2.2.2 - RequestUpload Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**requestUpload Request Service Id**	**M**	**35**	**REQUP**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 11.2.2.3 - RequestUpload Negative Response Message

11.2.3 - Message description

The requestUpload service is used by the client to initiate a data transfer from the server to the client (upload). After the server has received the requestUpload request message the ECU shall take all necessary actions to send data before it sends a positive response message.

The parameters transferRequestParameter and transferResponseParameter are user optional and shall be of any type and length defined within KWP 2000.

Example of transferRequestParameter: initialisation value(s) for data upload.
Example of transferResponseParameter: maximum number of bytes per transferData message.

11.2.4 - Message flow example

See message flow example of Physical Addressed Service in section 5.3.1.1.
A complete message flow example is shown in section 11.4.4.

11.3 - TransferData service

11.3.1 - Parameter definition

- The parameter ***transferRequestParameter*** in the transferData request message shall contain parameter(s) which are required by the server to support the transfer of data. Format and length of this parameter(s) are vehicle manufacturer specific. In addition, this document specifies one value which is described in the table below:

Hex	Description
00-72	**reservedByDocument** This range of values is reserved by this document (refer to section 4.4 Response Codes).
73	**blockTransferComplete/NextBlock**
74-7F	**reservedByDocument** This range of values is reserved by this document (refer to section 4.4 Response Codes).
80 - FF	**manufacturerSpecificCodes** This range of values is reserved for vehicle manufacturer specific use.

Table 11.3.1 - Definition of transferRequestParameter value

- The parameter ***transferResponseParameter*** in the transferData positive response message shall contain parameter(s) which are required by the client to support the transfer of data. Format and length of this parameter(s) are vehicle manufacturer specific. In addition, this document specifies one value which is described in the table below:

Hex	Description
00-72	**reservedByDocument** This range of values is reserved by this document (refer to section 4.4 Response Codes).
73	**blockTransferComplete/NextBlock**
74-7F	**reservedByDocument** This range of values is reserved by this document (refer to section 4.4 Response Codes).
80 - FF	**manufacturerSpecificCodes** This range of values is reserved for vehicle manufacturer specific use.

Table 11.3.2 - Definition of transferResponseParameter value

11.3.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**transferData Request Service Id**	**M**	**36**	**TRNDAT**
2	transferRequestParameter#1	U	xx	**TRNOPT**
:	:	:	:	
n	transferRequestParameter#m	U	xx	

Table 11.3.2.1 - TransferData Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**transferData Positive Response Service Id**	**M**	**76**	**TRNDATPR**
2 : n	transferResponseParameter#1 : transferResponseParameter#m	U : U	xx : xx	**TRNFRSPP**

Table 11.3.2.2 - TransferData Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**transferData Request Service Id**	**M**	**36**	**TRNDAT**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 11.3.2.3 - TransferData Negative Response Message

11.3.3 - Message description

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). The data transfer direction is defined by the preceding requestDownload or requestUpload service.

If the client initiated a requestDownload the data to be downloaded is included in the parameter(s) transferRequestParameter in the transferData request message(s). The server may include the blockTransferComplete/NextBlock parameter as an transferResponseParameter in the transferData positive response message.

If the client initiated a requestUpload the data to be uploaded is included in the parameter(s) transferResponseParameter in the transferData positive response message(s). The client may include the blockTransferComplete/NextBlock parameter as an transferRequestParameter in the transferData request message.

The user optional parameters transferRequestParameter and transferResponseParameter in the transferData request and positive response messages shall be of any type and length defined within KWP 2000.

Example of transferRequestParameter and transferResponseParameter:

- For a download, the parameter transferRequestParameter could include the data to be transferred and the parameter transferResponseParameter a checksum computed by the server.
- For an upload, the parameter transferRequestParameter parameter could include the address and number of bytes to retrieve data and the parameter transferResponseParameter the uploaded data.

The transferData service shall only be terminated by the requestTransferExit service.

11.3.4 - Message flow example

time	client (Tester)	server (ECU)
P3	transferData.Request#1[...]	
P2		transferData.PositiveResponse#1[...]
P3	transferData.Request#2[...]	
P2		transferData.PositiveResponse#2[...]
:	:	:
P3	transferData.Request#n[...]	
P2		transferData.PositiveResponse#n[...]

Table 11.3.4 - Message flow example of transferData Service

The TransferData service shall only be used with physical addressing.

11.4 - RequestTransferExit service

11.4.1 - Parameter definition

- The parameter ***transferRequestParameter*** is defined in section 11.1.1.

- The parameter ***transferResponseParameter*** in the requestTransferExit positive response message defines the status of the server's data transfer exit status. Format and length of additional parameters are vehicle manufacturer specific.

11.4.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**requestTransferExit Request Service Id**	**M**	**37**	**RTRNEX**
2	transferRequestParameter#1	U	xx	**TRNFREQP**
:	:	:	:	
n	transferRequestParameter#m	U	xx	

Table 11.4.2.1 - RequestTransferExit Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**requestTransferExit Positive Response Service Id**	**M**	**77**	**RTRNEXPR**
2	transferResponseParameter#1	U	xx	**TRNFRSPP**
:	:	:	:	
n	transferResponseParameter#m	U	xx	

Table 11.4.2.2 - RequestTransferExit Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**requestTransferExit Request Service Id**	**M**	**37**	**RTRNEX**
3	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 11.4.2.3 - RequestTransferExit Negative Response Message

11.4.3 - Message description

This service is used by the client to terminate a data transfer between client and server. The user optional parameters transferRequestParameter and transferResponseParameter in the requestTransferExit request and positive response message shall be of any type and length defined within KWP 2000.

Example of transferRequestParameter: checksum request of entire data transferred.
Example of transferResponseParameter: checksum of entire data transferred.

11.4.4 - Message flow example

time	client (Tester)	server (ECU)
P3	requestUpload.Request[...]	
P2		requestUpload.PositiveResponse[...]
P3	transferData.Request#1[...]	
P2		transferData.PositiveResponse#1[...]
P3	transferData.Request#2[...]	
P2		transferData.PositiveResponse#2[...]
:	:	:
P3	transferData.Request#n[...]	
P2		transferData.PositiveResponse#n[...]
P3	requestTransferExit.Request[...]	
P2		requestTransferExit.PositiveResponse[...]

Table 11.4.4 - Message flow example of requestUpload, multiple transferData services followed by a requestTransferExit service

The requestTransferExit service shall only be used with physical addressing.

12 - Keyword Protocol 2000 extended service

12.1 - EscapeCode service

12.1.1 - Parameter definition

- The parameter ***manufacturerSpecific Service Identifier*** is defined as an extension of the service identifiers specified in the document ISO 14230. The range of values is specified in the table below:

Hex	Description
00 - FF	**manufacturerSpecific** This range of values is reserved for vehicle manufacturer specific use.

Table 12.1.1 - Definition of manufacturerSpecific Service Identifier

- The parameter ***recordValue*** is defined in section 7.1.1.

12.1.2 - Message data bytes

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**escapeCode Request Service Id**	**M**	**80**	**ESCODE**
2	manufacturerSpecific Service Id	M	xx	**MFSPSID**
3 : n	recordValue#1 : recordValue#m	U : U	xx : xx	**DATAVAL**

Table 12.1.2.1 - EscapeCode Request Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**escapeCode Positive Response Service Id**	**M**	**C0**	**ESCODEPR**
2	manufacturerSpecific Service Id	M	xx	**MFSPSID**
3 : n	recordValue#1 : recordValue#m	U : U	xx : xx	**DATAVAL**

Table 12.1.2.2 - EscapeCode Positive Response Message

Data Byte	Parameter Name	Cvt	Hex Value	Mnemonic
1	**negativeResponse Service Id**	**S**	**7F**	**NACK**
2	**escapeCode Request Service Id**	**M**	**80**	**ESCODE**
3	manufacturerSpecific Service Id	M	xx	**MFSPSID**
4	responseCode=[KWP2000ResponseCode, manufacturerSpecific]	M	xx=[00-7F, 80-FF]	**RC**

Table 12.1.2.3 - EscapeCode Negative Response Message

12.1.3 - Message description

The escapeCode service is used by the client if none of the services specified in the document ISO 14230 can provide the function required by the vehicle manufacturer.

12.1.4 - Message flow example

time	client (Tester)	server (ECU)
P3	escapeCode.Request[...]	
P2		escapeCode.PositiveResponse[...]
P3	escapeCode.Request[...]	
P2		escapeCode.NegativeResponse[...]
P3	escapeCode.Request[...]	
P2		escapeCode.PositiveResponse[...]

Table 12.1.4 - Message flow example of escapeCode service

See also message flow examples of Physical Addressed Service on section 5.3.1.1 and Functional Addressed Service in section 5.3.2.1.

13 - Application examples

This section aims at showing with a real example how the Keyword Protocol 2000 services defined in this document can be used to build diagnostic applications for a tester and one or multiple on-vehicle ECUs.

13.1 - Description of the on-vehicle ECUs

Description of On-Vehicle Configuration
Two ECUs connected: Engine Control Module & Transmission Control Module • Multi Point Connection

Table 13.1.1 - On-vehicle configuration

List of communication functions supported by both ECUs
• Fast Initialisation • Arbitration

Table 13.1.2 - ECU supported functions

ECM features
• Re-programmable (Flash EPROM) • Requires security login with Seed & Key

Table 13.1.3 - ECM features

ECU supported services	ECM	TCM	Security Required
startCommunication	YES	YES	NO
stopCommunication	YES	YES	NO
accessTimingParameter (TPI: read, set)	YES	YES	NO
testerPresent	YES	YES	NO
startDiagnosticSession(RepairShop)	YES	YES	NO
stopDiagnosticSession	YES	YES	NO
readECUIdentification	YES	YES	NO
readDiagnosticTroubleCodes	YES	YES	NO
clearDiagnosticInformation	YES	YES	NO
readDataByLocalIdentifer	YES	YES	NO
dynamicallyDefineLocalIdentifier	YES	YES	NO
securityAccess	YES	NO	NO
startDiagnosticSession(Programming)	YES	NO	YES
requestDownload	YES	NO	YES
transferData	YES	NO	YES
startRoutineByLocalIdentifier	YES	NO	YES
requestTransferExit	YES	NO	YES

Table 13.1.4 - ECU supported services

13.2 - Functional initialisation and functional addressed communication

- Both ECUs shall be initialised with the fast initialisation wake up pattern and startCommunication request service.
- A repair shop diagnostic session is started in both ECUs with a functional startDiagnosticSession request service.
- The client sends a functional readECUIdentification request service to retrieve all identification data of each ECU.
- A functional readDiagnosticTroubleCodes request is used by the client to read the DTC's from the ECUs.

time	client (Tester)	server (ECU)
	Fast Initialisation startComm.Req[] {TGT=$FE; Functional Init. }	
P2		startComm.PosRsp[KB1,KB2] {ECM}
P2		startComm.PosRsp[KB1,KB2] {TCM} **{ Normal Timing is enabled by the key bytes of the ECM and TCM! }**
P3	startDiagSess.Req[normalDiagSess] {TGT=$FE}	
P2		startDiagSess.PosRsp[] {ECM}
P2		startDiagSess.PosRsp[] {TCM}
P3	readECUId.Req[identificationOption] {TGT=$FE}	
P2		readECUId.PosRsp[identificationRecordValues] {TCM}
P2		readECUId.PosRsp[identificationRecordValues] {ECM}
P3	readDTC.Req[GroupOfDTC] {TGT=$FE}	
P2		readDTC.PosRsp[#DTC,DTC#1,DTC#2] {ECM}
P2		readDTC.PosRsp[#DTC,DTC#3] {TCM}

Table 13.2 - Message flow of functional initialisation and communication

13.3 - Single and multiple response messages and termination of communication

- The client reads specific data records identified by a recordLocalIdentifier from each ECU individually by sending physical addressed readDataByLocalIdentifier requests.
- Five data records, identified by another recordLocalIdentifier, are requested from the ECM with the readDataByLocalIdentifier with the transmission mode parameter set to "fast" and maximum number of responses to send set to "5".
- After above tests are finished the tester clears all diagnostic information by sending a functional clearDiagnosticInformation request service.
- Then the diagnostic session of the TCM is finished.
- The communication with the TCM is stopped by a functional stopCommunication request service.

time	client (Tester)	server (ECU)
P3	readDataByLocId.Req[RecLocId=10] {TGT=ECM}	
P2		readDataByLocId.PosRsp[10,recordValues] {ECM}
P3	readDataByLocId.Req[RecLocId=03] {TGT=TCM}	
P2		readDataByLocId.PosRsp[03,recordValues] {TCM}
P3	readDataByLocId.Req[RecLocId=01,TXM=fast, MAXNORTS=5] {TGT=ECM}	
P2		readDataByLocId.PosRsp[01,recordValues] {ECM}
P2		readDataByLocId.PosRsp[01,recordValues] {ECM}
P2		readDataByLocId.PosRsp[01,recordValues] {ECM}
P2		readDataByLocId.PosRsp[01,recordValues] {ECM}
P2		readDataByLocId.PosRsp[01,recordValues] {ECM}
P3	clearDiagInfo.Req[GroupOfDTC] {TGT=$FE}	
P2		clearDiagnosticInformation.PosRsp[] {ECM}
P2		clearDiagnosticInformation.PosRsp[] {TCM}
P3	stopDiagnosticSession.Req[] {TGT=TCM}	
P2		stopDiagnosticSession.PosRsp[] {TCM}
P3	stopCommunication.Req[] {TGT=TCM}	
P2		stopCommunication.PosRsp[] {TCM}

Table 13.3 - Message flow of single and multiple response messages

13.4 - SecurityAccess, data transfer and modification of timing parameters

Now the tester starts preparing for reprogramming the ECM's memory by utilising the following services:

- The tester sends a securityAccess request with the accessMode set to requestForSeed to the ECM. The ECM responds with the parameter Seed.

- The tester manipulates the Seed into a Key value and sends it to the ECM with the securityAccess request with the accessMode set to sendKey. The ECM denies the request by sending a negative response with the responseCode set to securityAccessDenied (tester has sent the wrong key). The ECM starts a ten (10) second timer which shall be expired before the next securityAccess is allowed.

- Now it is the client's responsibility to keep the communication alive. Therefore the tester must continuously send testerPresent messages to the ECM with the parameter responseRequired set to YES. The number of testerPresent services required depends on the timing parameter P3max. The tester stops sending testerPresent requests as soon as the 10 second timer has expired. A new request is sent to the server.

time	client (Tester)	server (ECU)
P3	securityAcc.Req[RequestSeed] {TGT=ECM}	
P2		securityAcc.PosRsp[ResponseWithSeed,Seed] {ECM}
P3	securityAcc.Req[SendKey] {TGT=ECM}	{ tester has sent the wrong key }
P2		securityAcc.NegRsp[SecurityAccessDenied] {ECM}
		{ 10 second timer starts! }
P3	testerPresent.Req#1[Yes] {TGT=ECM}	
P2		testerPresent.PosRsp#1[] {ECM}
P3	testerPresent.Req#2[Yes] {TGT=ECM}	
P2		testerPresent.PosRsp#2[] {ECM}
:	:	:
P3	testerPresent.Req#n[Yes] {TGT=ECM}	
P2		testerPresent.PosRsp#n[] {ECM}
		{ 10 second timer expired! }

Table 13.4.1 - Message flow of securityAccess

- The tester repeats the entire login procedure. It finally received a positive response with the parameter securityAccessAllowed. Now the ECM is ready to execute diagnostic sessions which require a security login.

- The tester starts a programming session in the ECM which enables a new set of services which were not available in the repairShop diagnostic mode.
- To speed up the upcoming data transfer the tester changes the timing parameters based on the ECMs communication capabilities. Therefore it sends the accessTimingParameter request service with the timingParameterIndex set to readLimits. The ECM responses with the internally stored timing parameters "P2 - P4" used for fast data transfer and memory re-programming.

- The tester sends another accessTimingParameter request service with the timingParameterIndex set to setLimits. The timing becomes active with the next request of the tester.

time	client (Tester)	server (ECU)
P3	securityAccess.Req[RequestSeed] {TGT=ECM}	
P2		securityAccess.PosRsp[ResponseWithSeed,Seed] {ECM}
P3	securityAccess.Req[SendKey] {TGT=ECM}	
P2		securityAccess.PosRsp[SendKey,SecurityAccessAllwd] {ECM}
P3	startDiagSession.Req[ProgSession] {TGT=ECM}	
P2		startDiagSession.PosRsp[] {ECM}
P3	accessTimingPara.Req[readLimits] {TGT=ECM}	
P2		accessTimingPara.PosRsp[readLimits,P2-P4] {ECM}
		{ ECM sends fast programming P2...P4 timing values! }
P3	accessTimingPara.Req[setPara,P2 - P4]	
P2	{TGT=ECM}	accessTimingPara.PosRsp[setPara] {ECM}
		{ Fast programming timing P2...P4 is enabled! }

Table 13.4.2 - Message flow of securityAccess, startDiagnosticSession and accessTimingParameter

- The tester sends a requestDownload request with an transferRequestParameter parameters (e.g. memory start address, memory size, etc.). The positive response message of the ECM indicates to the tester that the ECM has accepted the request and is ready for receiving download data.

- The transferData service is used to download a software routine from the tester to the ECM.

- The tester now sends the startRoutineByLocalIdentifier request message to start the routine which has been downloaded before. This routine re-organises the RAM of the ECM in order to free up additional memory space to store further downloaded data.

- The tester uses multiple transferData services to download all FLASH EEPROM data to be re-programmed.

- When finished the tester terminates the data transfer by sending a requestTransferExit request message.

- Now the tester stops the current diagnostic session.

- Finally, the communication is terminated by the stopCommunication service.

time	client (Tester)	server (ECU)
P3 P2	requestDownload.Req[TRNFREQP] {TGT=ECM}	 requestDownload.PosRsp[TRNFRSPP] {ECM}
P3 P2	transferData.Req[TRNFREQP,...] {TGT=ECM}	 transferData.PosRsp[TRNFRSPP] {ECM}
P3 P2	startRoutineByLocId.Req[RLOCID,RENTOPT...] {TGT=ECM}	 startRoutineByLocId.PosRsp[RLOCID,RENTSTAT] {ECM}
P3 P2 P3 P2 : P3 P2	transferData.Req[TRNFREQP,...] {TGT=ECM} transferData.Req[TRNFREQP,...] {TGT=ECM} : transferData.Req[TRNFREQP,...] {TGT=ECM}	 transferData.PosRsp[TRNFRSPP] {ECM} transferData.PosRsp[TRNFRSPP] {ECM} : transferData.PosRsp[TRNFRSPP] {ECM}
P3 P2	requestTransferExit.Req[TRNFREQP] {TGT=ECM}	 requestTransferExit.PosRsp[TRNFRSPP] {ECM}
P3 P2	stopDiagnosticSession.Req[] {TGT=$FE}	 stopDiagnosticSession.PosRsp[] {ECM}
P3 P2	stopCommunication.Req[] {TGT=$FE}	 stopCommunication.PosRsp[] {ECM}

Table 13.4.3 - Message flow of transferData and stopCommunication

13.5 - ReadDataByLocalIdentifier service with dynamicallyDefine-LocalIdentifier

13.5.1 - Tester display parameter selection

While diagnosing an ECM (engine control module) the service technician gets a large list of parameters displayed on the tester screen. The technician selects the following four parameters out of the list which are of interest to him:

- Throttle Position Sensor
- Idle Air Control
- Engine Coolant Temperature Sensor
- Engine Speed

The technician selects these parameters to be displayed in the following order:

Display Position	Parameter Description
1	Engine Coolant Temperature Sensor
2	Engine Speed
3	Throttle Position Sensor
4	Idle Air Control

Table 13.5.1 - Parameter order in tester display

13.5.2 - ECM parameter definition

Within the ECM these parameters are stored as follows:

Parameter Description	Definition Mode	Location in ECM	Memory Size
Engine Coolant Temperature Sensor	defineByLocalIdentifier = $01	position $07 in record identified by recordLocalIdentifier $3A	2 bytes
Engine Speed	defineByCommonIdentifier = $02	position $03 in record identified by recordCommonIdentifier $B754	1 byte
Throttle Position Sensor	defineByMemoryAddress = $03	start address $01DE05	3 bytes
Idle Air Control	defineByLocalIdentifier = $01	position $02 in record identified by recordLocalIdentifier $D2	1 byte

Table 13.5.2 - Parameter definition and source in ECM

Within KWP 2000 the dynamicallyDefineLocalIdentifier service is used to assign a localIdentifier to these four parameters which are afterwards read by the readDataByLocalIdentifier service.
The tester defines the value "$25" for this localIdentifier which identifies a new record consisting of the four parameters selected by the service technician.

There are several possibilities for the tester to define this new record by using the dynamicallyDefineLocalIdentifier service. Two examples are shown:

13.5.3 - Definition by a single request message

The tester uses only one dynamicallyDefineLocalIdentifier request message to define the entire record. This message has the following content:

Data Byte	Parameter Name	Hex Value	Mnemonic
1	**dynamicallyDefineLocalIdentifier Request Service Id**	**2C**	**DLIDDY**
2	dynamicallyDefinedLocalIdentifier	25	**DDLOCID**
3	definitionMode=[defineByLocalIdentifier]	01	**DEFMODE**
4	positionInDynamicallyDefinedLocalIdentifier	03	**PIDYDLID**
5	memorySize	02	**MEMSIZE**
6	recordLocalIdentifier	3A	**RLOCID**
7	positionInRecordLocalIdentifier	07	**PIRLOCID**
8	definitionMode=[defineByCommonIdentifier]	02	**DEFMODE**
9	positionInDynamicallyDefinedLocalIdentifier	01	**PIDYDLID**
10	memorySize	01	**MEMSIZE**
11	recordCommonIdentifier (High Byte)	B7	**RCIDHB**
12	recordCommonIdentifier (Low Byte)	54	**RCIDLB**
13	positionInRecordCommonIdentifier	03	**PIRLOCID**
14	definitionMode=[defineByMemoryAddress]	03	**DEFMODE**
15	positionInDynamicallyDefinedLocalIdentifier	02	**PIDYDLID**
16	memorySize	02	**MEMSIZE**
17	memoryAddress (High Byte)	01	**MEMAHB**
18	memoryAddress (Middle Byte)	DE	**MEMAMB**
19	memoryAddress (Low Byte)	05	**MEMALB**
20	definitionMode=[defineByLocalIdentifier]	01	**DEFMODE**
21	positionInDynamicallyDefinedLocalIdentifier	04	**PIDYDLID**
22	memorySize	01	**MEMSIZE**
23	recordLocalIdentifier	D2	**RLOCID**
24	positionInRecordLocalIdentifier	02	**PIRLOCID**

Table 13.5.3 - dynamicallyDefineLocalIdentifier request message#1

13.5.4 - Definition by multiple request messages

The tester for example uses three (3) dynamicallyDefineLocalIdentifier request messages to define the record. The messages have the following content:

Data Byte	Parameter Name	Hex Value	Mnemonic
1	**dynamicallyDefineLocalIdentifier Request Service Id**	**2C**	**DLIDDY**
2	dynamicallyDefinedLocalIdentifier	25	**DDLOCID**
3	definitionMode=[defineByLocalIdentifier]	01	**DEFMODE**
4	positionInDynamicallyDefinedLocalIdentifier	03	**PIDYDLID**
5	memorySize	02	**MEMSIZE**
6	recordLocalIdentifier	3A	**RLOCID**
7	positionInRecordLocalIdentifier	07	**PIRLOCID**
8	definitionMode=[defineByLocalIdentifier]	01	**DEFMODE**
9	positionInDynamicallyDefinedLocalIdentifier	04	**PIDYDLID**
10	memorySize	01	**MEMSIZE**
11	recordLocalIdentifier	D2	**RLOCID**
12	positionInRecordLocalIdentifier	02	**PIRLOCID**

Table 13.5.4.1 - dynamicallyDefineLocalIdentifier request message#1

Data Byte	Parameter Name	Hex Value	Mnemonic
1	**dynamicallyDefineLocalIdentifier Request Service Id**	**2C**	**DLIDDY**
2	dynamicallyDefinedLocalIdentifier	25	**DDLOCID**
3	definitionMode=[defineByCommonIdentifier]	02	**DEFMODE**
4	positionInDynamicallyDefinedLocalIdentifier	01	**PIDYDLID**
5	memorySize	01	**MEMSIZE**
6	recordCommonIdentifier (High Byte)	B7	**RCIDHB**
7	recordCommonIdentifier (Low Byte)	54	**RCIDLB**
8	positionInRecordCommonIdentifier	03	**PIRLOCID**

Table 13.5.4.2 - dynamicallyDefineLocalIdentifier request message#2

Data Byte	Parameter Name	Hex Value	Mnemonic
1	**dynamicallyDefineLocalIdentifier Request Service Id**	**2C**	**DLIDDY**
2	dynamicallyDefinedLocalIdentifier	25	**DDLOCID**
3	definitionMode=[defineByMemoryAddress]	03	**DEFMODE**
4	positionInDynamicallyDefinedLocalIdentifier	02	**PIDYDLID**
5	memorySize	02	**MEMSIZE**
6	memoryAddress (High Byte)	01	**MEMAHB**
7	memoryAddress (Middle Byte)	DE	**MEMAMB**
8	memoryAddress (Low Byte)	05	**MEMALB**

Table 13.5.4.3 - dynamicallyDefineLocalIdentifier request message#3

13.5.5 - Reading the data record

After defining the new record referenced by the dynamicallyDefinedLocalIdentifier "$25" the tester sends the readDataByLocalIdentifier request message to read the values of the four parameters. The values shall only be updated on the tester display upon request by the service technician. Therefore the tester sets the parameter transmissionMode to "single".

Data Byte	Parameter Name	Hex Value	Mnemonic
1	**readDataByLocalIdentifier Request Service Id**	**21**	**RDBLID**
2	recordLocalIdentifier	25	**RLOCID**
3	transmissionMode=[single]	01	**TXM**

Table 13.5.5.1 - readDataByLocalIdentifier request message

After receiving the readDataByLoacalIdentifier request message the ECM sends the readDataByLocalIdentifier positive response message with the following content:

Data Byte	Parameter Name	Hex Value	Mnemonic
1	**readDataByLocalIdentifier Positive Response Service Id**	**61**	**RDBLIDPR**
2	recordLocalIdentifier	25	**RLOCID**
3	Engine Speed (High Byte)	xx	**RECVAL**
4	Engine Speed (Low Byte)	xx	**RECVAL**
5	Throttle Position Sensor (High Byte)	xx	**RECVAL**
6	Throttle Position Sensor (Low Byte)	xx	**RECVAL**
7	Engine Coolant Temperature Sensor	xx	**RECVAL**
8	Idle Air Control	xx	**RECVAL**

Table 13.5.5.2 - readDataByLocalIdentifier response message