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Road vehicles — Diagnostic systems — Keyword Protocol 2000 —

Part 3:
Application layer

Véhicules routiers — Systèmes de diagnostic — Protocole «Keyword 2000» —

Partie 3: Couche application

Reference numbe
ISO 14230-3:199 (E)

Contents

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Foreword

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

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 14230-1 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, subcommittee SC 3, *Electrical and electronic equipment*.

ISO 14230 consists of the following parts, under the general title *Road vehicles — Diagnostic systems — Keyword Protocol 2000*:

— *Part 1: Physical layer*

— *Part 2: Data link layer*

— *Part 3: Application layer*

— *Part 4: Requirements for emissions-related systems*

Annex A of this part of ISO 14230 is for information only.

Introduction

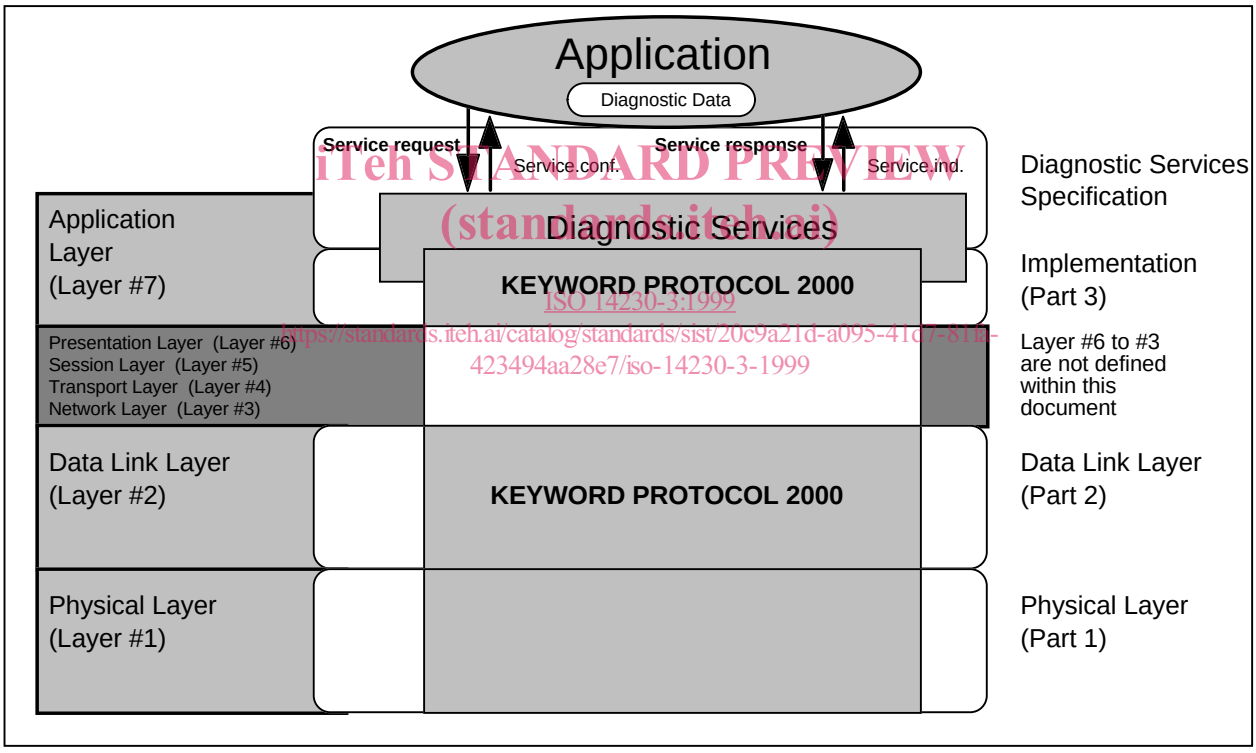
ISO 14230 has been established in order to define common requirements for diagnostic systems implemented on a serial data link.

To achieve this, it is based on the Open Systems Interconnection (OSI) 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.



Example of serial data links: KWP2000, VAN, CAN, J1850, etc.

Figure 1 — Mapping of Diagnostic Services and Keyword Protocol 2000 on OSI Model

Road vehicles — Diagnostic systems — Keyword Protocol 2000 —

Part 3:
Application layer

1 Scope

This part of ISO 14230 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.

This part of ISO 14230 specifies the requirements of the implementation of the Diagnostic Services specified in 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 part of ISO 14230 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).

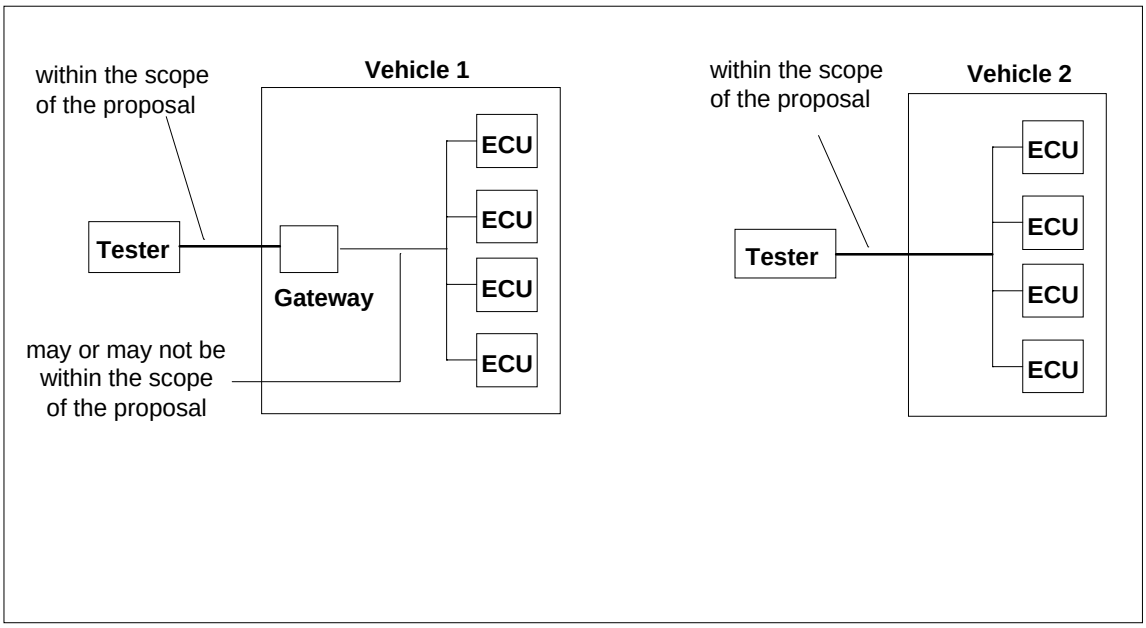


Figure 2 — Vehicle diagnostic architecture

2 Normative references

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 14229:—[1)] , *Road vehicles — Diagnostic systems — Diagnostic services specification.*

ISO 14230-2:— [1)], *Road vehicles — Diagnostic systems — Keyword Protocol 2000 — Part 2 : Data link layer.*

SAE J 1930: 1995, *Electrical/electronic systems diagnostic — Terms, definitions, abbreviations and acronyms.*

SAE J 1979: 1997, *E/E diagnostic test modes— Terms, definitions, abbreviations and acronyms.*

3 Definitions

For the purposes of this part of ISO 14230, the definitions given in ISO 14229 and SAE J 1930 apply.

4 Conventions

4.1 General

4.1.1 This part of ISO 14230 is guided by the OSI service conventions (CVT; see ISO 8509) to the extent that they are applicable to the diagnostic services. These conventions define the interactions between the service use and the service provider by the supplier through service primitives which themselves may convey parameters.

4.1.2 Table 1 indicates the different ranges of service identifier values, which are defined in SAE J 1979, ISO 14230 or by the vehicle manufacturer.

Table 1 — Service Identifier value convention table

Service Identifier Hex Value	Service type[1)] (bit 6)	Where defined
00 - 0F	Request	SAE J 1979
10 - 1F 20 - 2F 30 - 3E	Request (bit 6 = 0)	ISO 14230-3
3F	Not applicable	reserved
40 - 4F	Response	SAE J1979
50 - 5F 60 - 6F 70 - 7E	Positive Response to Services ($10 - $3E) (bit 6 = 1)	ISO 14230-3
7F	Negative Response	
80	Request 'ESC' - Code	
81 - 8F	Request (bit 6 = 0)	ISO 14230-2
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	ISO 14230-3
C1 - CF	Positive Response (bit 6 = 1)	ISO 14230-2
D0 - DF	Positive Response (bit 6 = 1)	reserved for future exp. as needed
E0 - FF	Positive Response (bit 6 = 1)	defined by vehicle manufacturer

1) 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.

1) To be published.

4.1.3 The table content consists of the following:

— 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.

4.1.4 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.

4.2 Service description convention

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

— Parameter Definition;

— Message Data Bytes;

— Message Description;

— Message Flow Example.

4.2.1 Parameter definition

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

4.2.2 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. Table 2 describes the request message, table 3 the positive response message and table 4 the negative response message.

A positive response message shall be given by the server if it can carry out all the operations requested. It shall otherwise give a negative response.

The response messages are listed in separate tables because the list of parameters differs between positive and negative response messages.

Table 2 — Request message

Type	Parameter Name	CVT[1)]	Hex Value	Mnemonic
Header Bytes[2)]	Format Byte Target Byte Source Byte Length Byte	M C[3)] C[3)] C[4)]	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>]	C[5)]	xx=[xx : xx]	PN
CS[2)]	Checksum Byte	M	xx	CS

1) See 4.1.4

2) Defined in ISO 14230-2.

3) The header bytes "Target" and "Source" depend on the content of the "Format Byte" which is specified in ISO 14230-2 (KWP 2000 Part 2: Data Link Layer) document. Both either exist or do not exist in the header of each message.

4): The header byte "Length" depends on the content of the "Format Byte" which is specified in ISO DIS 14230-2.

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

Table 3 — Positive response message

Type	Parameter Name	CVT[1)]	Hex Value	Mnemonic
Header Bytes[2)]	Format Byte Target Byte Source Byte Length Byte	M C[3)] C[3)] C[4)]	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>]	C[5]	xx=[xx : xx]	PN
CS[2)]	Checksum Byte	M	xx	CS

1) See 4.1.4

2) Defined in ISO 14230-2.

3) The header bytes "Target" and "Source" depend on the content of the "Format Byte" which is specified in ISO 14230-2 (KWP 2000 Part 2: Data Link Layer) document. Both either exist or do not exist in the header of each message.

4): The header byte "Length" depends on the content of the "Format Byte" which is specified in ISO DIS 14230-2.

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

Table 4 — Negative response message

Type	Parameter Name	CVT[1]	Hex Value	Mnemonic
Header Bytes[2]	Format Byte Target Byte Source Byte Length Byte	M C[3] C[3]) C[4]	xx xx xx xx	FMT TGT SRC LEN
<ServiceId>	Ne ativeResponse 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[2]	Checksum Byte	M	xx	CS

1) See 4.1.4
2) Defined in ISO 14230-2.
3) The header bytes "Target" and "Source" depend on the content of the "Format Byte" which is specified in ISO 14230-2 (KWP 2000 Part 2: Data Link Layer) document. Both either exist or do not exist in the header of each message.

4): The header byte "Length" depends on the content of the "Format Byte" which is specified in ISO DIS 14230-2..

4.2.3 Message description

This section"Message description" provides a description of the actions performed by the client and the server which are specific to the KWP 2000 Protocol (see ISO 14230-2).

The response condition is service specific and defined separately for each service.

4.2.4 Message flow examples

This section provides message flow descriptions presented in a table format (see table 5). The table consists of three columns:

— column 1: includes the relevant inter-message timing which is specified in the document ISO/DIS 14230-2. 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.

Sending of a message shall start during the period of time between appropriate messages.

Time relates to the table in a top to bottom sequence. 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.

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

Table 5 — Message flow example of physical addressed service

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

4.3 Functional unit table

The intention of specifying functional unit tables is to group similar Keyword Protocol (KWP) 200 services into a functional unit. The definition of each functional unit includes a table such as table 6 which lists its services.

Table 6 — Keyword Protocol 2000 functional units

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).

4.4 Service Identifier value summary table

The left column of table 7 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".

4.5 Response Code value summary table

Table 8 lists and assigns hex values for all response codes used in KWP 2000. The definition of each response code is described in ISO 14229.

Table 7 — Service Identifier value summary table

Diagnostic Service Name	KWP 200 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[1)]	80	C0

1) Does not form part of diagnostic services specification but only of KWP Protocol 2000.

Table 8 —Response Code value summary table

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
79	IncorrectByteCountDuringBlockTransfer
80 - FF	ManufacturerSpecificCodes
1) RequestCorrectlyReceived-ResponsePending	

4.6 Response handling

Figure 3 specifies the server behaviour on a client request message. It shows the logic as specified in the description of the response codes and to be implemented in the server and client as appropriate.

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 as specified in figure 3.

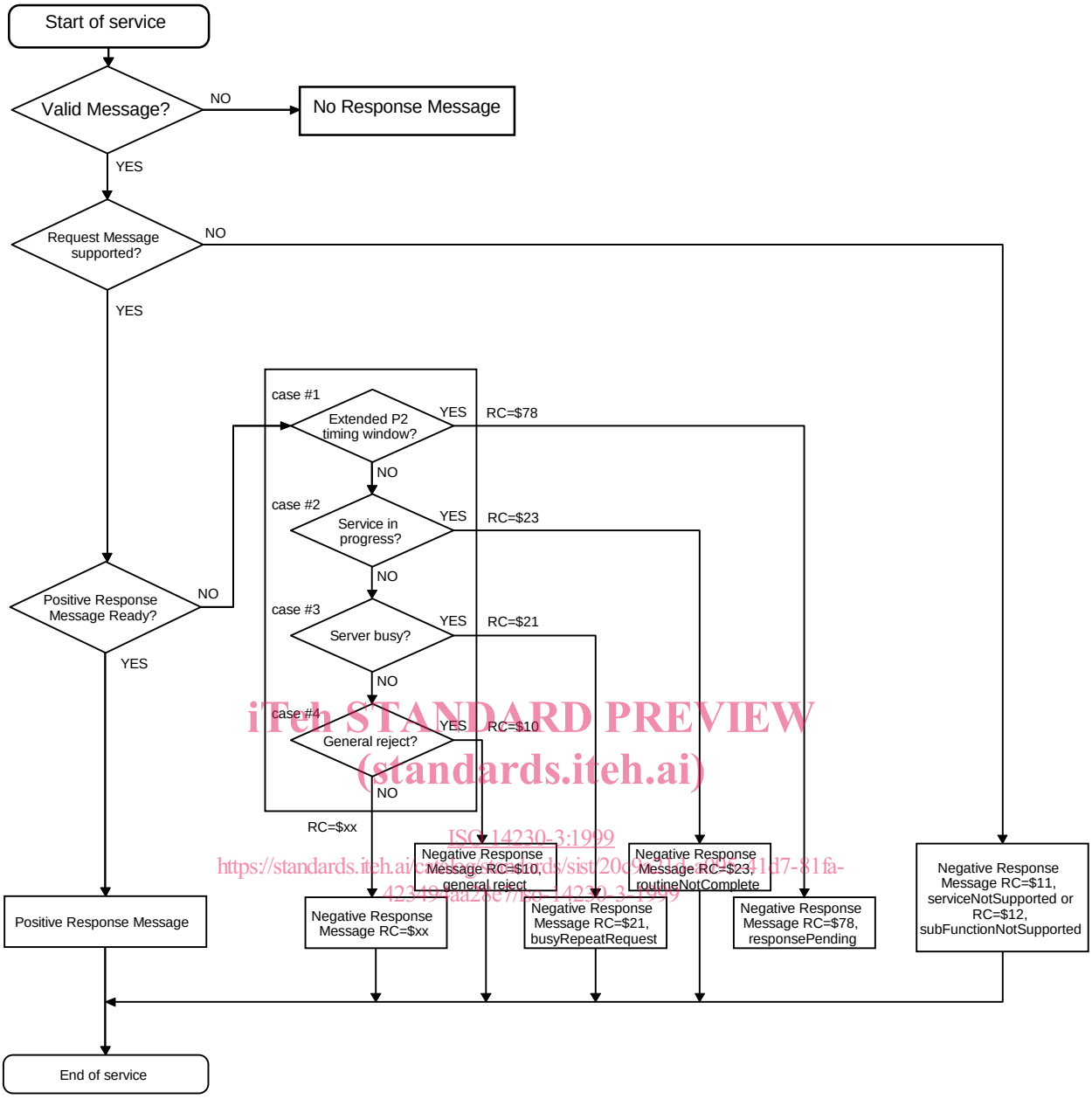


Figure 3 — Server positive and negative response message behaviour

5 General implementation rules

5.1 Parameter definitions

The following rules in regard to parameter definitions shall apply:

— clauses 6 to 12 define the services of each functional unit. In these clauses, 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 ISO 14229. Parameters which are specific to a functional unit are described in the corresponding clause;

— this part of ISO 14230 lists and defines response codes and values. Negative response codes are specified in 4.4. Other response codes may be reserved either for future definition by this part of ISO 14230 or for the system designer's specific use;

— this part of ISO 14230 specifies the parameters which shall be used within each KWP 2000 service;