JH-ACU-8A

Diagnostic Communication Specification

For KWP2000

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北京万得嘉瑞汽车技术有限公司

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1. Introduction

This standard specifies the requirements for setting up the interchange of digital informati on between JH-ACU-8A ACU (airbag control unit) of the vehicle and the diagnostic test er.

The contents to be not defined in this specification refer to the Appendix A.

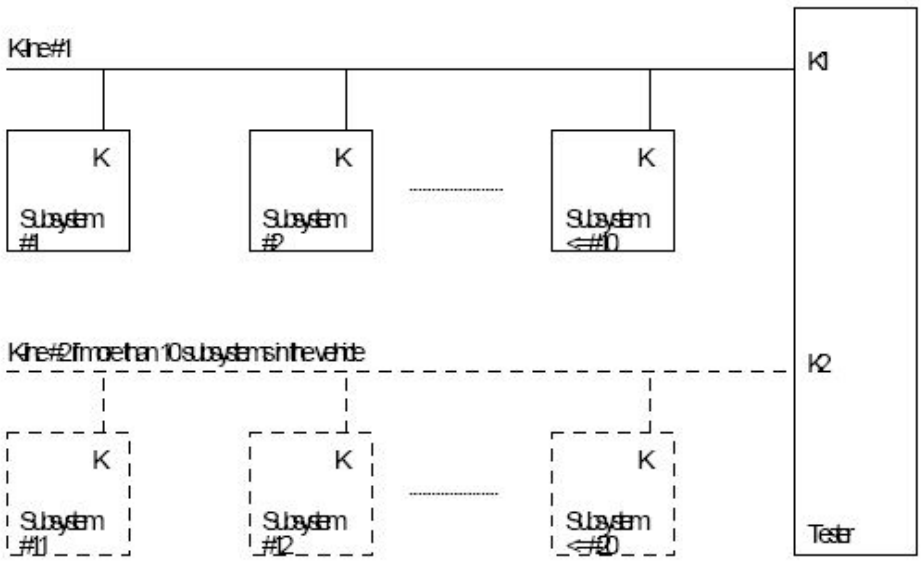
2. Serial Diagnostic Communication Link

Scope

This chapter describes the technical requirements with reference to on-board workshop diagnostics for the ACU (Airbag Control Unit) subsystem. The main purpose of on board diagnostic is to determine failures in the electronic system or its periphery in a simple, reliable and effective way.

General Configuration

Communication between the ACU and the tester takes place on a serial data link which shall be implemented as a half-duplex Universal Asynchronous Receiver/Transmitter (UART) bus. The ACU shall support a one wire communication connection to the diagnostic tester in accordance with ISO 9141-2, with line K only and without line L (see diagram below). Line K is a bidirectional data line used to convey request messages from the diagnostic tester to the ACU and response messages from the ACU to the diagnostic tester.



Subsystem – Tester Configuration

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Signal Specification

Coding type

NRZ (non return zero)

Transmission rate (Initialization & Subsequent communication)

10.4kbps ± 1.7% (ECU)
10.4kbps ± 1% (diagnostic tester)

Bit transmission

LSB first
1 start bit - logic '0' for one bit duration
8 data bits - the LSB being sent first
1 stop bit - logic '1' for one bit duration

Normal state

Logic '1'

Signal voltage level

A logic "0" is equivalent to a voltage level on the K-Line of less than 20% VBATT for transmitter, 30% for receiver.

A logic "1" is equivalent to a voltage level on the K-Line greater than 80% VBATT for transmitter, 70% for receiver.

In addition, the slope times shall be less than 10% of the bit time. The slope times are defined as the time taken for the voltage to change from 20% to 80%, and from 80% to 20%, for transmitters. Voltage levels between 30% and 70% of VBATT may be detected as either logic "1" or logic "0". Since Non-Return-to-Zero (NRZ) coding is used, the bit time is defined as half of the time between the 50% levels of successive rising or falling edges of alternating "1" and "0" bits. The following figure illustrates the worst case on the signal levels.

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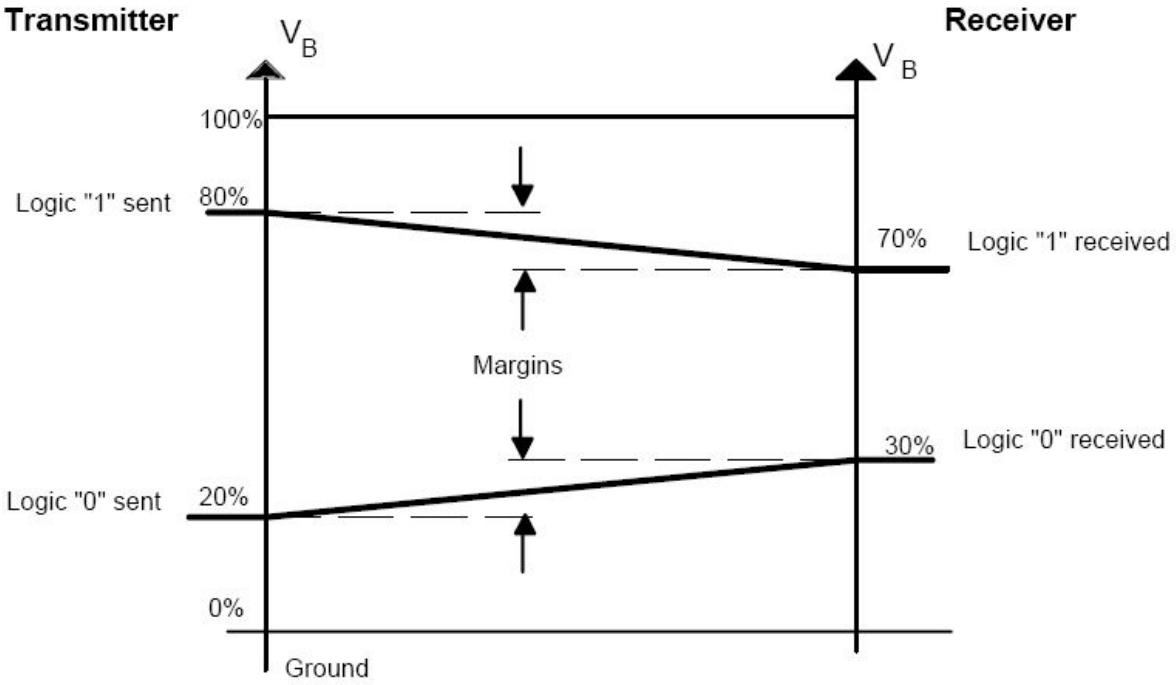

Figure 2 - Signal voltage levels, Worst case

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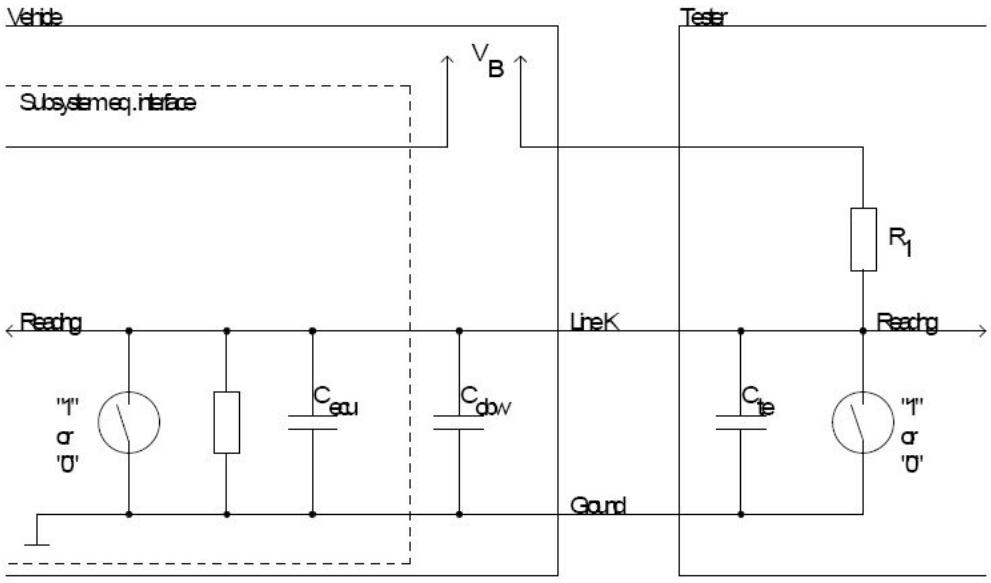
Electrical Specification

General

The following electrical specification is taken directly from ISO 9141-2 (i.e. there are no additional electrical requirements in this document other than those in ISO 9141-2.)

The electrical specification shall apply:

- over a working temperature range of 0ˆC and +50ˆC
- to a nominal 12 V system for which the serial communication shall operate correctly within the normal operating voltage range of the ACU. V_{BATT} is defined as battery voltage.



Communication Schematics

ACU Interface

At logic "1", or in receiving state, the ACU will look like a resistance to ground of at least 50 kΩ. At logic "0" the ACU will have an equivalent sink resistance not more than 110 Ω between K-line and Ground.

When the serial communication is not in operation and the ACU is connected to the tester, the K-line shall not be at logic "0".

Maximum allowed capacitance C_{ACU} between line K and ground is 500 pF.

The serial communication input/output circuitry of the ACU shall withstand transients and overvoltage present on the K-line via the tester source resistance, limited to -1 V to +40 V.

The serial communication input/output circuitry of the ACU shall withstand permanent short-circuit (also during communication) on K-line to battery voltage V_{BATT} and to Ground.

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Tester Interface

The K-line shall be connected to V_{BATT} via nominal 510 Ω, R1, internally in the tester.

Transmission state:

- At logic "1", without any ACU's coupled to the K-line, the tester shall have an equivalent voltage source greater than 90% of V_{BATT} sourced from the vehicle positive voltage VBATT, and an equivalent resistance R1 of 510 Ω ‰5%.
- At logic "0", the tester shall have an equivalent voltage of less than 10% of VBATT, at a maximum sink current of 2A.

Receiving state:

- The equivalent resistance of the line K of the tester shall be 510 Ω ‰5%.

The total capacitance of the diagnostic tester, its cable and connector, C_{Te}, shall not exceed 2nF. The tester shall expect a resistance of 5 KΩ or higher to ground when connected to the vehicle.

Wiring

The capacitance C_{OBW} of the serial communication line built into the vehicle shall not exceed 2 nF, when measured without any ACU connected. Battery voltage and ground shall also be made available to the diagnostic tester, but need not come directly from an ACU.

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3. Data Link Layer

Message structure

Message format

Header (4 Bytes)				Data bytes (Max. 255 Bytes)				Checksum
Fmt	Tgt	Src	Len	SID	Data1	Data2	…….	CS

Header with address information, with additional length byte

Fmt: Format Byte
Tgt: Target Address Byte
Src: Source Address Byte
Len: Length Byte Information of Data bytes

Format byte

The format byte contains 6 bit length information and 2 bit address mode information.

A1	A0	L5	L4	L3	L2	L1	L0

A1	A0	Mode
1	0	Physical addressing with address information

L5 ~ L0	Remark
0	Length information bit is not used

Target and Source address byte

Request	Header				Data bytes	Checksum
	Fmt	ACh	F1h	Length		CS
Response	Header				Data bytes	Checksum
	Fmt	F1h	ACh	Length		CS

ACU supports F0hex ~ FDhex as Tester Address. (Normally, Tester Address is F1hex)
Default ACU Address is AChex and Format byte is 80hex.

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Length byte

				Length				
Fmt	Tgt	Src	Length	SID	Data	…	…	CS
4 Bytes				Max 255 bytes				1 byte

The ACU expects a 4 Byte Header, only for the Start Communication a 3 Byte Header is accepted.

The ACU response is always with a 4 Byte Header, i.e. with a length byte.

Data Bytes

The data field may contain up to 255 bytes of information. The first byte of the data field is the Service Identification Byte. It may be followed by parameters and data depending on the selected service.

Checksum Byte

Fmt	Tgt	Src	Length	SID	Data	…	…	CS
4 bytes				Max 255 bytes				1 byte
Checksum calculation								

The checksum byte (CS) inserted at the end of the message block is defined as the simple 8-bit sum series of all bytes in the message, excluding the checksum.

If the message is **<1> <2> <3> ... <N> , <CS>**

Then, **<CS> = <1> + <2> + <3> + … + <N>**

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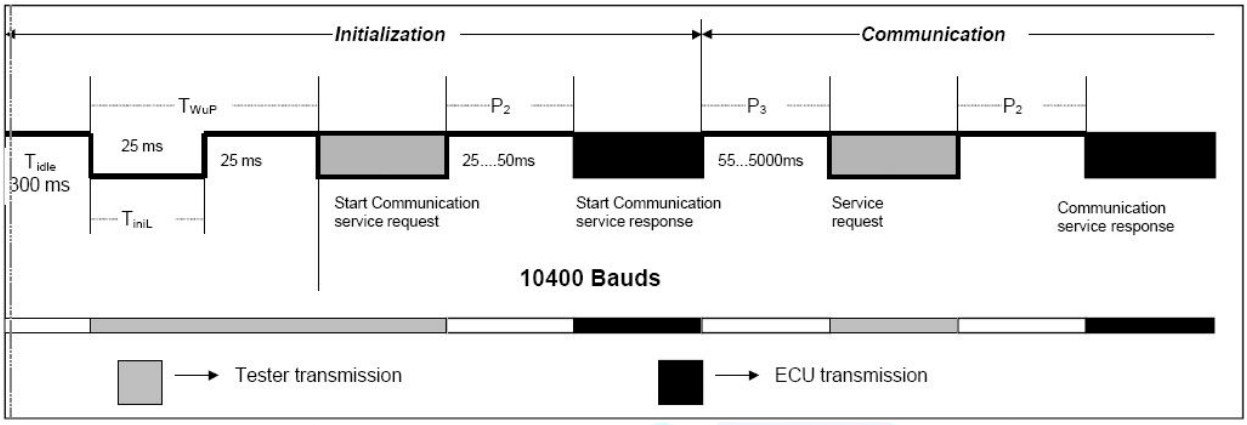
Fast Initialization

The tester shall send a Wake-up Pattern (WuP) on "K-Line", the pattern begins after an idle time on "K-line" with a low time of TiniL. The tester transmits the first bit of the Start Communication service after a time of tWuP following the first falling edge.



Timing

During normal operation the following timing parameters are relevant:

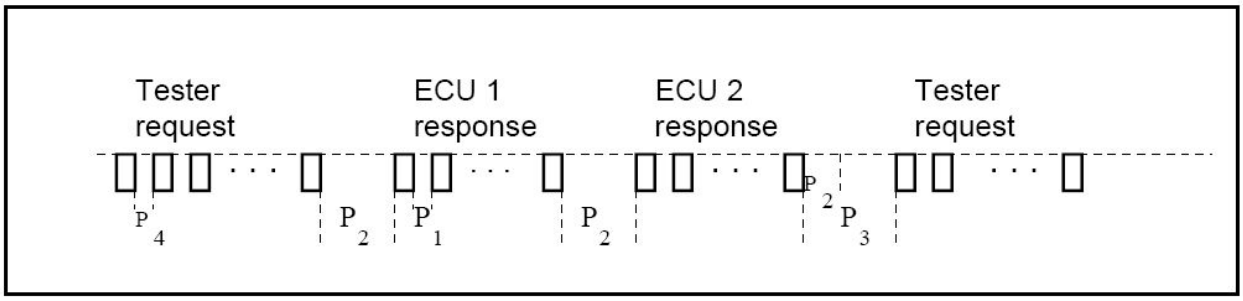


Figure 4 - Message flow, timing

Timing parameters definition

Value	Description
P1	Inter byte time for ECU response
P2	Time between tester request and ECU response or two ECU responses
P3	Time between end of ECU responses and start of new tester request
P4	Inter byte time for tester request
TWuP	High low sequence of the Wake-up-Pattern
TiniL	Low sequence of the Wake-up-Pattern
Tidle	Idle time

Timing parameter set

Timing Parameter	Minimum values [ms]			Maximum values [ms]		
	Lower limit	Default	Resolution	Default	Upper limit	Resolution
P1	0	0	--	20	20	--
P2	0	25	0.5	50	50	25
P3	0	55	0.5	5000	5000	250
P4	0	5	0.5	20	20	--
Twup	40	50	--	50	51	--
TiniL	24	25	--	25	26	--
Tidle	--	300	--	--	--	--

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Error Handling

Start Communication service

If the tester detects an error during the "Start Communication Service" either by timing or by the bit stream, then the tester will wait for a period of Tidle before beginning the process again (starting with the wake up pattern). If an ACU detects an error in the sequence from the tester then it shall be immediately prepared to recognize another "Start Communication Service". Both tester and ACU are required to recognize failure to comply with maximum timing values. Minimum timing value transgressions need not be detected but are likely to cause bit stream errors.

JH-ACU-8A ACU detected Tester transmission error

JH-ACU-8A checks each message by its checksum and number of bytes received before P2max elapses. If either is in error then JH-ACU-8A send no response and will internally ignore the whole message. When JH-ACU-8A detects other errors in the format or content of messages, but which satisfy the checksum and length requirements, in order that the tester be aware that there is not a simple communications problem, JH-ACU-8A will respond with the appropriate negative response.

JH-ACU-8A ACU detected error in ACU response

JH-ACU-8A can not detect a difference between what it transmitted and what was detected on the "K-Line".

4. Communication Services

Implemented KWP2000 Diagnostic Service

Diagnostic Service Name	Request Value	Positive Response	Negative Response	Remarks
Start Communication	81h	C1h	NO	
Stop Communication	82h	C2h	7Fh	
Tester Present	3Eh	7Eh	7Fh	
Read ACU Identification	1Ah	5Ah	7Fh	
Read Diagnostic Trouble Codes	18h	58h	7Fh	
Clear Diagnostic Information	14h	54h	7Fh	
Read Data by Local Identifier[1]	21h	61h	7Fh	

Start Communication Service

Request Message

Byte	Hex Value	Parameter Name
#1	**81h**	Start Communication Request Service Id

Positive Response

Byte	Hex Value	Parameter Name
#1	**C1h**	Start Communication Positive Response Service Id
#2	**31h**	Key byte #1
#3	**30h**	Key byte #2

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[1] This service is separated to detail services by request service identifier 2.

Stop Communication Service

Request Message

Byte	Hex Value	Parameter Name
#1	**82h**	Stop Communication Request Service Id

Positive Response

Byte	Hex Value	Parameter Name
#1	**C2h**	Stop Communication Positive Response Service Id

After transmitting the positive response the ACU will reset itself.

Negative Response

Byte	Hex Value	Parameter Name
#1	**7Fh**	negative Response Service Id
#2	**82h**	Stop Communication Request Service Id
#3	**xxh**	Response Code[2]

Tester Present service

The Tester Present service shall be used to indicate to ACU the tester is present. This service is required in the absence of other KWP 2000 services to prevent ACU from automatically returning to normal operation and stop communication.

Request Message

Data Byte	Hex Value	Parameter Name
#1	**3Eh**	Tester Present Request Service Id

Positive Response

Data Byte	Hex Value	Parameter Name

[2] Refer the response codes to following Appendix B.

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#1	**7Eh**	Tester Present Positive Response Service Id

Negative Response

Data Byte	Hex Value	Parameter Name
#1	**7Fh**	Negative Response Service Id
#2	**3Eh**	Tester Present Request Service Id
#3	**xxh**	Response Code

Read ACU Identification service

Request Message

This Command allows the diagnostic tester to read out the ACU identification.

Data Byte	Hex Value	Parameter Name
#1	**1Ah**	Read ACU Identification Request Service Id
#2	**80h**	Identification Option

Positive Response

The ACU responds by transmitting a message containing the following information: ACU Serial No. and manufacturing information which includes the label version (ASCII) and ML FB(ASCII), parameter version.

Data Byte	Hex Value	Parameter Name
#1	**5Ah**	Read ACU Identification Positive Response Service ID
#2 : #5	**xxh** **:** **xxh**	ACU Serial No. (BCD, 4bytes)
#6 : #10	**xxh** **:** **xxh**	Manufacturing Information (Label version 2bytes(ASCII), MLFB 3bytes(ASCII))
#11 : #12	**xxh** **:** **xxh**	Parameter version (BCD,2bytes)

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Negative Response

Data Byte	Hex Value	Parameter Name
#1	**7Fh**	Negative Response Service ID
#2	**1Ah**	Read ACU Identification Request Service ID
#3	**xxh**	Response Code

Read Diagnostic Trouble Codes[3] Service

Request Message

This command allows the diagnostic tester to read out the fault codes and status of faults. The tester initiates the request by transmitting the following message.

Data Byte	Hex Value	Hex Value
#1	**18h**	Read Diagnostic Trouble Codes Request Service ID
#2	**00h**	Status of DTC = [Active Fault
	01h	Historic Fault]
#3	**80h**	Body Group (High byte)
#4	**00h**	Body Group (Low byte)

Positive Response

The fault codes from the ACU will be taken and sent in fault recognized order. According to the number of fault codes that can be stored in the ACU up to a maximum of 16 fault codes are transmitted to the tester. If DTC(Crash record or Internal Fault was entered, the fault memory can't be cleared by Diagnostic Service any more.

Data Byte	Hex Value	Parameter Name
#1	**58h**	Read Diagnostic Trouble Codes Positive Response Service ID
#2	**xxh**	Number of DTC
#3	**xxh**	DTC#1 (High byte)
#4	**xxh**	DTC#1 (Low byte)

[3] Refer the diagnostic trouble codes to following Appendix C.

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#5	**xxh**	Status of DTC#1
#6	**Xxh**	Number of fault detection#1[4]
#7~8	**Xxh**	Fault lasting time#1[5]
: :	**:** **:**	
#6n-5	**xxh**	DTC#n (High byte)
#6n-4	**xxh**	DTC#n (Low byte)
#6n-3	**xxh**	Status of DTC#n
6n-2	**Xxh**	Number of fault detection#n
#6n-1~6n	**xxxxh**	Fault lasting time#n

Negative Response

Data Byte	Hex Value	Parameter Name
#1	**7Fh**	Negative Response Service ID
#2	**18h**	Read Diagnostic Trouble Codes Request Service ID
#3	**xxh**	Response Code

Clear Diagnostic Information Service

Request Message

This command allows the diagnostic tester to clear the fault memory in the ACU. The ACU responds by transmitting either a Positive or a Negative response message back to the diagnostic tester. If the ACU cannot clear its fault memory (in case of an internal fault or if a crash is recorded) a Negative Response code $10 „General Reject… will be transmitted. The message Positive Response will be transmitted immediately after the fault memory was cleared

Data Byte	Hex Value	Parameter Name
#1	**14h**	Clear Diagnostic Information Request Service ID
#2	**80h**	Body Group (High byte)
#3	**00h**	Body Group (Low byte)

[4] Number of fault detection: 0 ~ 255 times

[5] Fault lasting time: resolution of 5 minutes, Max 5460 hours.

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Positive Response

Data Byte	Hex Value	Parameter Name
#1	**54h**	Clear Diagnostic Information Positive Response Service ID
#2	**80h**	Body Group (High byte)
#3	**00h**	Body Group (Low byte)

Negative Response

Data Byte	Hex Value	Parameter Name
#1	**7Fh**	Negative Response Service ID
#2	**14h**	Clear Diagnostic Information Request Service ID
#3	**xxh**	Response Code

Read Data by Local Identifier Service

Request Message

The ACU should send all data of record Value specified in this specification via the read Data by Local Identifier positive response message. The information includes the crash information and Real time data, Deployment data, Crash pulse data. If the crash information and deployment data is not recorded, a Negative Response code $10 „General Reject… will be transmitted.

Data Byte	Hex Value	Parameter Name
#1	**21h**	Read Data by Local Identifier Request Service ID
#2	**xxh**	Record Local Identifier

Overview of Record Local Identifier

Record Local Identifier	Hex Value
Designated data	**08h**
Front Deployment data #1	**D0h**[6]
Front Deployment data #2	**D1h**[7]
Front Deployment data #3	**D2h**[8]

[6] The second front crash record data
[7] The last front crash record data
[8] The first front crash record data

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Driver-side Deployment data	**D3h**
Driver-side Near Deployment data	**D4h**
Passenger-side Deployment data	**D5h**
Passenger-side Near Deployment data	**D6h**
Driver-rear side Deployment data	**D7h**
Driver-rear side Near Deployment data	**D8h**
Passenger-rear side Deployment data	**D9h**
Passenger-rear side Near Deployment data	**DAh**

Positive Response

Data Byte	Hex Value	Parameter Name
#1	**61h**	Read Data by Local Identifier Positive Response Service ID
#2	**xxh**	Record Local Identifier
#3	**Xxh**	Record value #1
:	**:**	:
#n	**xxh**	Record value #m

Record Value (08h) – Designated data

Byte	Bit#	Description	Record Value
#1	---	Battery Voltage	((value*0.0192)*59/12+ 0.7) V
#2	---	Energy reserve Voltage for DAB	(Value*0.0192*8) V 00h: Not supported
#3	---	Energy reserve Voltage for PAB	
#4	---	Energy reserve Voltage for DRPT	
#5	---	Energy reserve Voltage for PRPT	
#6	---	Energy reserve Voltage for DSAB	
#7	---	Energy reserve Voltage for PSAB	
#8	---	Energy reserve Voltage for DCAB	
#9	---	Energy reserve Voltage for PCAB	
#10	---	Energy reserve Voltage for Rear DSAB	
#11	---	Energy reserve Voltage for Rear PSAB	
#12	---	VAS voltage	(Value*0.0129*5.4) V
#13	---	DAB resistance	(Value*10/255) ohm 00h: Not supported
#14	---	PAB resistance	
#15	---	Retractor DPT resistance	

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#16	---	Retractor PPT resistance	
#17	---	DSAB resistance	
#18	---	PSAB resistance	
#19	---	DCAB resistance	
#20	---	PCAB resistance	
#21	---	Rear DSAB resistance	
#22	---	Rear PSAB resistance	
#23	1,0	Driver Buckle Switch Status	00 = Unbuckled/ enabled 01 = Buckled/disabled 10 = Failure 11 = Not supported
	3,2	Passenger Buckle Switch Status	
	5,4	Passenger Airbag disable switch Status	

Record Value (D0h) – Front Deployment Data #1

Byte	Bit#	Description	Record Value
#1~#80	---	X sensor acceleration value[9]	1ms filtered data , if value>=128, value = value - 256;
#1~20	--	TBD	0x00
#1~#80	---	Y sensor acceleration value[10]	1ms filtered data,if value>=128, value = value - 256;
#1~20	--	TBD	0x00
#201	1,0	Driver airbag status	00 = no fire / 01 = fire 11 = not supported
	3,2	Passenger airbag status	
	5,4	Driver Pretensioner status	
	7,6	Passenger Pretensioner status	
#202	2,1,0	Driver pretensioner fired times	Xxh (if near crash, not used)
	5,4,3	Passenger pretensioner fired times	
#203	1,0	Driver Seat buckle status	00 = unbuckled / 01 = buckled 10 = fault / 11 = not supported (if near crash, not used)
	3,2	Passenger Seat buckle status	
	4	Warning lamp status at the time of crash	1 = off / 0 = on (if near crash, not used)
	5	Crash output	0 = not sent / 1 = sent

[9] Acceleration value is total 80ms(10ms before algorithm start and 70ms after algorithm start)
If TTF of the airbag is bigger than 70, the time window for recorded acceleration value shall be shifted.
[10] Acceleration value is total 80ms(10ms before algorithm start and 70ms after algorithm start)
If TTF of the airbag is bigger than 70, the time window for recorded acceleration value shall be shifted.

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			(if near crash, not used)
	6	Crash recording completion status	0 = not completed 1 = completed (if near crash, not used)
#204	1,0	Driver airbag loop condition	00 = good 01 = fault 11 = not supported (if near crash, not used)
	3,2	Passenger airbag loop condition	
	5,4	Driver pretensioner loop condition	
	7,6	Passenger pretensioner loop condition	
#205	1,0	PADS status at the time of crash	00 = off / 01 = on / 10 = defect 11 = not supported (if near crash, not used)
	3,2	PADI status at the time of crash	
#206	---	Continuous on/off time of warning lamp	0 ~ FFF0 with a resolution of 5 min. (max. 5460 hours or 227.5 days) (if near crash, not used)
#207			
#208	---	Continuously ignition cycle count when warning lamp is on	00 ~ FF (if near crash, not used)
#209	---	Safing Sensor Close Time	xxh
#210	---	Driver airbag Firing Current time	xxh (Resolution : 25us)
#211	---	Passenger airbag Firing Current time	xxh (Resolution : 25us)
#212	---	Driver Pretetion Firing Current time	Xxh (Resolution : 25us)
#213	---	Passenger Pretetion Firing Current time	Xxh (Resolution : 25us)
#214	---	Operation Counter High byte	Xxh
#215	---	Operation Counter Mid byte	Xxh
#216	---	Operation Counter Low byte	Xxh
#217~#218	---	Operation Counter	Xxxxh (Resolution: 100ms)
#219	---	ACU Ignition Times High byte	xxh
#220	---	ACU Ignition Times Mid byte	xxh
#221	---	ACU Ignition Times Low byte	xxh
#222	---	DAB Time to fire	Algorithm enable to firing command
#223	---	PAB Time to fire	
#224	---	Pretensioner Time to fire	

Record Value (D1h) – Front Deployment Data #2

Byte	Bit#	Description	Record Value

#1~#80	---	X sensor acceleration value[11]	1ms filtered data,if value>=128, value = value - 256;
#1~20	--	TBD	0x00
#1~#80	---	Y sensor acceleration value[12]	1ms filtered data,if value>=128, value = value - 256;
#1~20	--	TBD	0x00
#201	1,0	Driver airbag status	00 = no fire / 01 = fire 11 = not supported
	3,2	Passenger airbag status	
	5,4	Driver Pretensioner status	
	7,6	Passenger Pretensioner status	
#202	2,1,0	Driver pretensioner fired times	Xxh (if near crash, not used)
	5,4,3	Passenger pretensioner fired times	
#203	1,0	Driver Seat buckle status	00 = unbuckled / 01 = buckled 10 = fault / 11 = not supported (if near crash, not used)
	3,2	Passenger Seat buckle status	
	4	Warning lamp status at the time of crash	1 = off / 0 = on (if near crash, not used)
	5	Crash output	0 = not sent / 1 = sent (if near crash, not used)
	6	Crash recording completion status	0 = not completed 1 = completed (if near crash, not used)
#204	1,0	Driver airbag loop condition	00 = good 01 = fault 11 = not supported (if near crash, not used)
	3,2	Passenger airbag loop condition	
	5,4	Driver pretensioner loop condition	
	7,6	Passenger pretensioner loop condition	
#205	1,0	PADS status at the time of crash	00 = off / 01 = on / 10 = defect 11 = not supported (if near crash, not used)
	3,2	PADI status at the time of crash	
#206	---	Continuous on/off time of warning lamp	0 ~ FFF0 with a resolution of 5 min. (max. 5460 hours or 227.5 days)
#207			

[11] Acceleration value is total 200ms(10ms before algorithm start and 70ms after algorithm start)
If TTF of the airbag is bigger than 70, the time window for recorded acceleration value shall be shifted.
[12] Acceleration value is total 10ms(20ms before algorithm start and 70ms after algorithm start)
If TTF of the airbag is bigger than 70, the time window for recorded acceleration value shall be shifted.

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			(if near crash, not used)
#208	---	Continuously ignition cycle count when warning lamp is on	00 ~ FF (if near crash, not used)
#209	---	Safing Sensor Close Time	xxh
#210	---	Driver airbag Firing Current time	xxh (Resolution : 25us)
#211	---	Passenger airbag Firing Current time	xxh (Resolution : 25us)
#212	---	Driver Pretetion Firing Current time	Xxh (Resolution : 25us)
#213	---	Passenger Pretetion Firing Current time	Xxh (Resolution : 25us)
#214	---	Operation Counter High byte	Xxh
#215	---	Operation Counter Mid byte	Xxh
#216	---	Operation Counter Low byte	Xxh
#217~#218	---	Operation Counter	Xxxxh (Resolution: 100ms)
#219	---	ACU Ignition Times High byte	xxh
#220	---	ACU Ignition Times Mid byte	xxh
#221	---	ACU Ignition Times Low byte	xxh
#222	---	DAB Time to fire	Algorithm enable to firing com mand
#223	---	PAB Time to fire	
#224	---	Pretensioner Time to fire	

Record Value (D2h) – Front Deployment Data #3

Byte	Bit#	Description	Record Value
#1~#80	---	X sensor acceleration value[13]	1ms filtered data,if value>=128, value = value - 256;
#1~20	--	TBD	0x00
#1~#80	---	Y sensor acceleration value[14]	1ms filtered data,if value>=128, value = value - 256;
#1~20	--	TBD	0x00
#201	1,0	Driver airbag status	00 = no fire / 01 = fire 11 = not supported
	3,2	Passenger airbag status	
	5,4	Driver Pretensioner status	
	7,6	Passenger Pretensioner status	
#202	2,1,0	Driver pretensioner fired times	Xxh (if near crash, not used)
	5,4,3	Passenger pretensioner fired times	

[13] Acceleration value is total 80ms(10ms before algorithm start and70ms after algorithm start)
If TTF of the airbag is bigger than 70, the time window for recorded acceleration value shall be shifted.
[14] Acceleration value is total 80ms(10ms before algorithm start and 70ms after algorithm start)
If TTF of the airbag is bigger than 70, the time window for recorded acceleration value shall be shifted.

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#203	1,0	Driver Seat buckle status	00 = unbuckled / 01 = buckled 10 = fault / 11 = not supported (if near crash, not used)
	3,2	Passenger Seat buckle status	
	4	Warning lamp status at the time of crash	1 = off /0 = on (if near crash, not used)
	5	Crash output	0 = not sent / 1 = sent (if near crash, not used)
	6	Crash recording completion status	0 = not completed 1 = completed (if near crash, not used)
#204	1,0	Driver airbag loop condition	00 = good 01 = fault 11 = not supported (if near crash, not used)
	3,2	Passenger airbag loop condition	
	5,4	Driver pretensioner loop condition	
	7,6	Passenger pretensioner loop condition	
#205	1,0	PADS status at the time of crash	00 = off / 01 = on / 10 = defect 11 = not supported (if near crash, not used)
	3,2	PADI status at the time of crash	
#206	---	Continuous on/off time of warning lamp	0 ~ FFF0 with a resolution of 5 min. (max. 5460 hours or 227.5 days) (if near crash, not used)
#207			
#208	---	Continuously ignition cycle count when warning lamp is on	00 ~ FF (if near crash, not used)
#209	---	Safing Sensor Close Time	Xxh
#210	---	Driver airbag Firing Current time	Xxh (Resolution : 25us)
#211	---	Passenger airbag Firing Current time	Xxh (Resolution : 25us)
#212	---	Driver Pretetion Firing Current time	Xxh (Resolution : 25us)
#213	---	Passenger Pretetion Firing Current time	Xxh (Resolution : 25us)
#214	---	Operation Counter High byte	Xxh
#215	---	Operation Counter Mid byte	Xxh
#216	---	Operation Counter Low byte	Xxh
#217~#218	---	Operation Counter	Xxxxh (Resolution: 100ms)
#219	---	ACU Ignition Times High byte	xxh
#220	---	ACU Ignition Times Mid byte	xxh
#221	---	ACU Ignition Times Low byte	xxh
#222	---	DAB Time to fire	Algorithm enable to firing com

			mand
#223	---	PAB Time to fire	
#224	---	Pretensioner Time to fire	

Record Value (D3h) – Driver side Deployment data

Byte	Bit#	Description	Record value
#1~#100	---	Driver Side Impact g value	0.5ms filtered data
#101	1,0	Driver Side airbag status	00 = no fire 01 = fire 11 = not supported
	3,2	Driver curtain airbag status	
	5,4	Driver Rear side airbag status	
#102	1,0	Driver Seat buckle status	00 = unbuckled / 01 = buckled 10 = fault / 11 = not supported
	3,2	Passenger Seat buckle status	
	4	Warning lamp status at the time of crash	1= off / 0 = on
	5	Crash output	0 = not sent / 1 = sent
	6	Crash recording completion status	0 = not completed 1 = completed
#103 #104	---	Continuous on/off time of warning lamp	0 ~ FFF0 with a resolution of 5 min. (max. 5460 hours or 227.5 days)
#105	1,0	Driver Side airbag loop condition	00 = good 01 = fault 11 = not supported
	3,2	Driver curtain airbag loop condition	
	5,4	Driver Rear side airbag loop condition	
#106	1,0	PADS status at the time of crash	00 = off / 01 = on / 10 = defect 11 = not supported
	3,2	PADI status at the time of crash	
#107	1,0	Driver front SIS loop condition	00 = good / 01 = fault 11 = not supported
	3,2	Passenger front SIS loop condition	
	5,4	Driver rear SIS loop condition	
	7,6	Passenger rear SIS loop condition	
#108	---	Continuously ignition cycle count when warning lamp is on	00 ~ FF
#109	---	TBD	Xxh
#110	---	Driver Side airbag Firing Current time	Xxh (Resolution : 25us)
#111	---	Driver Curtain airbag Firing Current time	Xxh (Resolution : 25us)
#112	---	Rear Driver Side airbag Firing Current time	Xxh (Resolution : 25us)
#113	---	Operation Counter High byte	Xxh

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#114	---	Operation Counter Mid byte	Xxh
#115	---	Operation Counter Low byte	Xxh
#116~7	---	Operation Counter	Xxxxh (Resolution: 100ms)
#118	---	ACU Ignition Times High byte	Xxh
#119	---	ACU Ignition Times Mid byte	Xxh
#120	---	ACU Ignition Timers Low byte	Xxh
#121	---	Driver side airbag time to Fire	

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Record Value (D4h) – Driver side Near Deployment data

Byte	Bit#	Description	Record value
#1~#100	---	Driver Side Impact g value	0.5ms filtered data
#101	1,0	Driver Side airbag status	00 = no fire 01 = fire 11 = not supported
	3,2	Driver curtain airbag status	
	5,4	Driver Rear side airbag status	
#102	1,0	Driver Seat buckle status	Not used
	3,2	Passenger Seat buckle status	
	4	Warning lamp status at the time of crash	Not used
	5	Crash output	Not used
	6	Crash recording completion status	Not used
#103	---	Continuous on/off time of warning lamp	Not used
#104			
#105	1,0	Driver Side airbag loop condition	Not used
	3,2	Driver curtain airbag loop condition	
	5,4	Driver Rear side airbag loop condition	
#106	1,0	PADS status at the time of crash	Not used
	3,2	PADI status at the time of crash	
#107	1,0	Driver front SIS loop condition	Not used
	3,2	Passenger front SIS loop condition	
	5,4	Driver rear SIS loop condition	
	7,6	Passenger rear SIS loop condition	
#108	---	Continuously ignition cycle count when warning lamp is on	Not used
#109	---	TBD	Xxh
#110	---	Driver Side airbag Firing Current time	Xxh (Resolution : 25us)
#111	---	Driver Curtain airbag Firing Current time	Xxh (Resolution : 25us)

#112	---	Rear Driver Side airbag Firing Current time	Xxh (Resolution : 25us)
#113	---	Operation Counter High byte	Xxh
#114	---	Operation Counter Mid byte	Xxh
#115	---	Operation Counter Low byte	Xxh
#116~7	---	Operation Counter	Xxxxh (Resolution: 100ms)
#118	---	ACU Ignition Times High byte	Xxh
#119	---	ACU Ignition Times Mid byte	Xxh
#120	---	ACU Ignition Timers Low byte	Xxh

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Record Value (D5h) – Passenger side Deployment data

Byte	Bit#	Description	Record value
#1~#100	---	Passenger Side Impact g value	0.5ms filtered data
#101	1,0	Passenger Side airbag status	00 = no fire 01 = fire 11 = not supported
	3,2	Passenger curtain airbag status	
	5,4	Passenger Rear side airbag status	
#102	1,0	Driver Seat buckle status	00 = unbuckled / 01 = buckled 10 = fault / 11 = not supported
	3,2	Passenger Seat buckle status	
	4	Warning lamp status at the time of crash	1 = off / 0 = on
	5	Crash output	0 = not sent / 1 = sent
	6	Crash recording completion status	0 = not completed 1 = completed
#103	---	Continuous on/off time of warning lamp	0 ~ FFF0 with a resolution of 5 min. (max. 5460 hours or 227.5 days)
#104			
#105	1,0	Passenger Side airbag loop condition	00 = good 01 = fault 11 = not supported
	3,2	Passenger curtain airbag loop condition	
	5,4	Passenger Rear side airbag loop condition	
#106	1,0	PADS status at the time of crash	00 = off / 01 = on / 10 = defect 11 = not supported
	3,2	PADI status at the time of crash	
#107	1,0	Driver front SIS loop condition	00 = good / 01 = fault 11 = not supported
	3,2	Passenger front SIS loop condition	
	5,4	Driver rear SIS loop condition	
	7,6	Passenger rear SIS loop condition	
#108	---	Continuously ignition cycle count when warning lamp is on	00 ~ FF

#109	---	TBD	Xxh
#110	---	Passenger Side airbag Firing Current time	Xxh (Resolution : 25us)
#111	---	Passenger Curtain airbag Firing Current time	Xxh (Resolution : 25us)
#112	---	RearPassenger Side airbag Firing Current time	Xxh (Resolution : 25us)
#113	---	Operation Counter High byte	Xxh
#114	---	Operation Counter Mid byte	Xxh
#115	---	Operation Counter Low byte	Xxh
#116~7	---	Operation Counter	Xxxxh (Resolution: 100ms)
#118	---	ACU Ignition Times High byte	Xxh
#119	---	ACU Ignition Times Mid byte	Xxh
#120	---	ACU Ignition Timers Low byte	Xxh
#121	---	Passenger side airbag time to Fire	

Record Value (D6h) – Passenger side Near Deployment data

Byte	Bit#	Description	Record value
#1~#100	---	Passenger Side Impact g value	0.5ms filtered data
#101	1,0	Passenger Side airbag status	00 = no fire 01 = fire 11 = not supported
	3,2	Passenger curtain airbag status	
	5,4	Passenger Rear side airbag status	
#102	1,0	Driver Seat buckle status	Not used
	3,2	Passenger Seat buckle status	
	4	Warning lamp status at the time of crash	Not used
	5	Crash output	Not used
	6	Crash recording completion status	Not used
#103	---	Continuous on/off time of warning lamp	Not used
#104			
#105	1,0	Passenger Side airbag loop condition	Not used
	3,2	Passenger curtain airbag loop condition	
	5,4	Passenger Rear side airbag loop condition	
#106	1,0	PADS status at the time of crash	Not used
	3,2	PADI status at the time of crash	
#107	1,0	Driver front SIS loop condition	Not used
	3,2	Passenger front SIS loop condition	
	5,4	Driver rear SIS loop condition	

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	7,6	Passenger rear SIS loop condition	
#108	---	Continuously ignition cycle count when warning lamp is on	Not used
#109	---	TBD	Xxh
#110	---	Passenger Side airbag Firing Current time	Xxh (Resolution : 25us)
#111	---	Passenger Curtain airbag Firing Current time	Xxh (Resolution : 25us)
#112	---	RearPassenger Side airbag Firing Current tim e	Xxh (Resolution : 25us)
#113	---	Operation Counter High byte	Xxh
#114	---	Operation Counter Mid byte	Xxh
#115	---	Operation Counter Low byte	Xxh
#116~7	---	Operation Counter	Xxxxh (Resolution: 100ms)
#118	---	ACU Ignition Times High byte	Xxh
#119	---	ACU Ignition Times Mid byte	Xxh
#120	---	ACU Ignition Timers Low byte	Xxh

Record Value (D7h) – Driver-rear side Deployment data

Byte	Bit#	Description	Record value
#1~#100	---	Driver-rear Side Impact g value	0.5ms filtered data
#101	1,0	Driver Side airbag status	00 = no fire 01 = fire 11 = not supported
	3,2	Driver curtain airbag status	
	5,4	Driver Rear side airbag status	
#102	1,0	Driver Seat buckle status	00 = unbuckled / 01 = buckled 10 = fault / 11 = not supporte d
	3,2	Passenger Seat buckle status	
	4	Warning lamp status at the time of crash	1= off / 0 = on
	5	Crash output	0 = not sent / 1 = sent
	6	Crash recording completion status	0 = not completed 1 = completed
#103	---	Continuous on/off time of warning lamp	0 ~ FFF0 with a resolution of 5 min. (max. 5460 hours or 227.5 days)
#104			
#105	1,0	Driver Side airbag loop condition	00 = good 01 = fault 11 = not supported
	3,2	Driver curtain airbag loop condition	
	5,4	Driver Rear side airbag loop condition	
#106	1,0	PADS status at the time of crash	00 = off / 01 = on / 10 = defect

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	3,2	PADI status at the time of crash	11 = not supported
#107	1,0	Driver front SIS loop condition	00 = good / 01 = fault 11 = not supported
	3,2	Passenger front SIS loop condition	
	5,4	Driver rear SIS loop condition	
	7,6	Passenger rear SIS loop condition	
#108	---	Continuously ignition cycle count when warning lamp is on	00 ~ FF
#109	---	TBD	Xxh
#110	---	Driver Side airbag Firing Current time	Xxh (Resolution : 25us)
#111	---	Driver Curtain airbag Firing Current time	Xxh (Resolution : 25us)
#112	---	Rear Driver Side airbag Firing Current time	Xxh (Resolution : 25us)
#113	---	Operation Counter High byte	Xxh
#114	---	Operation Counter Mid byte	Xxh
#115	---	Operation Counter Low byte	Xxh
#116~7	---	Operation Counter	Xxxxh (Resolution: 100ms)
#118	---	ACU Ignition Times High byte	Xxh
#119	---	ACU Ignition Times Mid byte	Xxh
#120	---	ACU Ignition Timers Low byte	Xxh
#121	---	Driver-rear side airbag time to Fire	

Record Value (D8h) – Driver-rear side Near Deployment data

Byte	Bit#	Description	Record value
#1~#100	---	Driver-rear Side Impact g value	0.5ms filtered data
#101	1,0	Driver Side airbag status	00 = no fire 01 = fire 11 = not supported
	3,2	Driver curtain airbag status	
	5,4	Driver Rear side airbag status	
#102	1,0	Driver Seat buckle status	Not used
	3,2	Passenger Seat buckle status	
	4	Warning lamp status at the time of crash	Not used
	5	Crash output	Not used
	6	Crash recording completion status	Not used
#103	---	Continuous on/off time of warning lamp	Not used
#104			
#105	1,0	Driver Side airbag loop condition	Not used
	3,2	Driver curtain airbag loop condition	

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	5,4	Driver Rear side airbag loop condition	
#106	1,0	PADS status at the time of crash	Not used
	3,2	PADI status at the time of crash	
#107	1,0	Driver front SIS loop condition	Not used
	3,2	Passenger front SIS loop condition	
	5,4	Driver rear SIS loop condition	
	7,6	Passenger rear SIS loop condition	
#108	---	Continuously ignition cycle count when warning lamp is on	Not used
#109	---	TBD	Xxh
#110	---	Driver Side airbag Firing Current time	Xxh (Resolution : 25us)
#111	---	Driver Curtain airbag Firing Current time	Xxh (Resolution : 25us)
#112	---	Rear Driver Side airbag Firing Current time	Xxh (Resolution : 25us)
#113	---	Operation Counter High byte	Xxh
#114	---	Operation Counter Mid byte	Xxh
#115	---	Operation Counter Low byte	Xxh
#116~7	---	Operation Counter	Xxxxh (Resolution: 100ms)
#118	---	ACU Ignition Times High byte	Xxh
#119	---	ACU Ignition Times Mid byte	Xxh
#120	---	ACU Ignition Timers Low byte	Xxh

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Record Value (D9h) – Passenger-rear side Deployment data

Byte	Bit#	Description	Record value
#1~#100	---	Passenger-rear Side Impact g value	0.5ms filtered data
#101	1,0	Passenger Side airbag status	00 = no fire 01 = fire 11 = not supported
	3,2	Passenger curtain airbag status	
	5,4	Passenger Rear side airbag status	
#102	1,0	Driver Seat buckle status	00 = unbuckled / 01 = buckled 10 = fault / 11 = not supported
	3,2	Passenger Seat buckle status	
	4	Warning lamp status at the time of crash	1 = off / 0 = on
	5	Crash output	0 = not sent / 1 = sent
	6	Crash recording completion status	0 = not completed 1 = completed

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#103	---	Continuous on/off time of warning lamp	0 ~ FFF0 with a resolution of 5 min. (max. 5460 hours or 227.5 days)
#104			
#105	1,0	Passenger Side airbag loop condition	00 = good 01 = fault 11 = not supported
	3,2	Passenger curtain airbag loop condition	
	5,4	Passenger Rear side airbag loop condition	
#106	1,0	PADS status at the time of crash	00 = off / 01 = on / 10 = defect 11 = not supported
	3,2	PADI status at the time of crash	
#107	1,0	Driver front SIS loop condition	00 = good / 01 = fault 11 = not supported
	3,2	Passenger front SIS loop condition	
	5,4	Driver rear SIS loop condition	
	7,6	Passenger rear SIS loop condition	
#108	---	Continuously ignition cycle count when warning lamp is on	00 ~ FF
#109	---	TBD	Xxh
#110	---	Passenger Side airbag Firing Current time	Xxh (Resolution : 25us)
#111	---	Passenger Curtain airbag Firing Current time	Xxh (Resolution : 25us)
#112	---	RearPassenger Side airbag Firing Current tim e	Xxh (Resolution : 25us)
#113	---	Operation Counter High byte	Xxh
#114	---	Operation Counter Mid byte	Xxh
#115	---	Operation Counter Low byte	Xxh
#116~7	---	Operation Counter	Xxxxh (Resolution: 100ms)
#118	---	ACU Ignition Times High byte	Xxh
#119	---	ACU Ignition Times Mid byte	Xxh
#120	---	ACU Ignition Timers Low byte	Xxh
#121	---	Passenger-rear side airbag time to Fire	

Record Value (DAh) – Passenger-rear side Near Deployment data

Byte	Bit#	Description	Record value
#1~#100	---	Passenger-rear Side Impact g value	0.5ms filtered data
#101	1,0	Passenger Side airbag status	00 = no fire 01 = fire 11 = not supported
	3,2	Passenger curtain airbag status	
	5,4	Passenger Rear side airbag status	
#102	1,0	Driver Seat buckle status	Not used
	3,2	Passenger Seat buckle status	

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	4	Warning lamp status at the time of crash	Not used
	5	Crash output	Not used
	6	Crash recording completion status	Not used
#103	---	Continuous on/off time of warning lamp	Not used
#104			
#105	1,0	Passenger Side airbag loop condition	Not used
	3,2	Passenger curtain airbag loop condition	
	5,4	Passenger Rear side airbag loop condition	
#106	1,0	PADS status at the time of crash	Not used
	3,2	PADI status at the time of crash	
#107	1,0	Driver front SIS loop condition	Not used
	3,2	Passenger front SIS loop condition	
	5,4	Driver rear SIS loop condition	
	7,6	Passenger rear SIS loop condition	
#108	---	Continuously ignition cycle count when warning lamp is on	Not used
#109	---	TBD	Xxh
#110	---	Passenger Side airbag Firing Current time	Xxh (Resolution : 25us)
#111	---	Passenger Curtain airbag Firing Current time	Xxh (Resolution : 25us)
#112	---	RearPassenger Side airbag Firing Current time	Xxh (Resolution : 25us)
#113	---	Operation Counter High byte	Xxh
#114	---	Operation Counter Mid byte	Xxh
#115	---	Operation Counter Low byte	Xxh
#116~7	---	Operation Counter	Xxxxh (Resolution: 100ms)
#118	---	ACU Ignition Times High byte	Xxh
#119	---	ACU Ignition Times Mid byte	Xxh
#120	---	ACU Ignition Timers Low byte	Xxh

Negative Response

Data Byte	Hex Value	Parameter Name
#1	**7Fh**	Negative Response Service ID
#2	**21h**	Read Data by Local Identifier Request Service ID
#3	**xxh**	Response Code

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Appendix A

- Normative Reference -

ISO 9141-2	Road vehicle-Diagnostic systems-Requirements for interchange of digital information
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 14230-3:1996	Road Vehicles - Diagnostic systems - Keyword Protocol 2000- Part 3: Implementation
ISO 14230-4:1996	Road Vehicles - Diagnostic systems - Keyword Protocol 2000- Part 4: Requirements for Emission Related Systems
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

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Appendix B

- Communication fault response codes -

Hex Value	Response Code
10h	General Reject
11h	Service Not Supported
12h	subFunction Not Supported-invalid Format
21h	busy-Repeat Request
22h	Conditions Not Correct or request Sequence Error
23h	Routine Not Complete
78h	Request Correctly Received-Response Pending

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Appendix C

- Diagnostic Fault Codes -

8101	Battery voltage high
8102	Battery voltage low
8201	Driver airbag resistance too High
8202	Driver airbag resistance too Low
8203	Driver airbag resistance circuit short to Ground
8204	Driver airbag resistance circuit short to Battery
8211	Passenger airbag resistance too High
8212	Passenger airbag resistance too Low
8213	Passenger airbag resistance circuit short to Ground
8214	Passenger airbag resistance circuit short to Battery
8221	Pretensioner front-Driver resistance too High
8222	Pretensioner front-Driver resistance too Low
8223	Pretensioner front-Driver resistance circuit short to Ground
8224	Pretensioner front-Driver resistance circuit short to Battery
8226	Pretensioner front-Passenger resistance too High
8227	Pretensioner front-Passenger resistance too Low
8228	Pretensioner front-Passenger resistance circuit short to Ground
8229	Pretensioner front-Passenger resistance circuit short to Battery
8241	Driver side airbag resistance too High
8242	Driver side airbag resistance too Low
8243	Driver side airbag resistance circuit short to Ground
8244	Driver side airbag resistance circuit short to Battery
8246	Passenger side airbag resistance too High
8247	Passenger side airbag resistance too Low
8248	Passenger side airbag resistance circuit short to Ground
8249	Passenger side airbag resistance circuit short to Battery
8251	Driver curtain airbag resistance too High
8252	Driver curtain airbag resistance too Low
8253	Driver curtain airbag resistance circuit short to Ground
8254	Driver curtain airbag resistance circuit short to Battery
8256	Passenger curtain airbag resistance too High
8257	Passenger curtain airbag resistance too Low

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8258	Passenger curtain airbag resistance circuit short to Ground
8259	Passenger curtain airbag resistance circuit short to Battery
8261	Driver Rear side airbag resistance too High
8262	Driver Rear side airbag resistance too Low
8263	Driver Rear side airbag resistance circuit short to Ground
8264	Driver Rear side airbag resistance circuit short to Battery
8266	Passenger Rear side airbag resistance too High
8267	Passenger Rear side airbag resistance too Low
8268	Passenger Rear side resistance circuit short to Ground
8269	Passenger Rear side airbag resistance circuit short to Battery
8301	Warning lamp Fault – Short to GND
8302	Warning lamp Fault – Short to Battery
8305	Passenger airbag off warning lamp short to Ground
8306	Passenger airbag off warning lamp short to Battery
8400	SIS front-Driver defect
8401	SIS front-Driver circuit short to Ground
8402	SIS front-Driver circuit short to Battery
8403	SIS front-Passenger defect
8404	SIS front-Passenger circuit short to Ground
8405	SIS front-Passenger circuit short to Battery
8406	SIS front-Driver communication error
8407	SIS front-Passenger communication error
8408	SIS rear-Driver communication error
8409	SIS rear-Passenger communication error
8410	SIS front-Driver option mismatch
8411	SIS front-Passenger option mismatch
8412	SIS rear-Driver option mismatch
8413	SIS rear-Passenger option mismatch
8414	SIS rear-Driver defect
8415	SIS rear-Passenger defect
8416	SIS rear-Driver circuit short to Ground
8417	SIS rear-Driver circuit short to Battery
8418	SIS rear-Passenger circuit short to Ground
8419	SIS rear-Passenger circuit short to Battery
8610	Internal fault – Replace ECU
8611	Crash recorded in frontal airbag only(Frontal – Replace ACU)
8612	Crash recorded in Driver side airbag (Replace ACU)

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8613	Crash recorded in Passenger side airbag (Replace ACU)
8614	Crash recorded in Belt pretensioner only
8615	Belt pretensioner 6 times deployment
8616	Crash Output Short to Ground
8617	Crash Output Short to Battery
8710	Buckle Switch Driver open or short to Battery
8711	Buckle Switch Driver short or short to Ground
8712	Buckle Switch Passenger open or short to Battery
8713	Buckle Switch Passenger short or short to Ground
8714	Buckle Switch Driver defect
8715	Buckle Switch Passenger defect
8725	Passenger airbag deactivation switch open or short to Battery
8726	Passenger airbag deactivation switch short or short to Ground
8727	Passenger airbag deactivation switch defect
8750	Vehicle Option Fault
8801	Wachdog Continuous fault

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