



Automobiles - Clock Extension Peripheral
Interface (CXPI)
-Part 5: Protocol Conformance Test specification
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TABLE OF CONTENTS

INTRODUCTION	1
1 SCOPE	1
2 REFERENCES	1
3 TERMS AND DEFINITIONS	1
4 SYMBOLS AND ABBREVIATED TERMS	1
4.1 Symbols	1
4.2 Abbreviated Terms	2
5 DATA LINK LAYER TEST SPECIFICATION	3
5.1 General	3
5.2 Test Conditions	3
5.3 Mandatory Requirements for IUT as Master	3
5.4 Mandatory Requirements for IUT as Slave	3
5.5 Test Description Method	4
5.6 Test System Requirements	4
5.7 Test System	4
5.8 Test Setup	5
5.8.1 Configuration of IUT and Test System	5
5.8.2 Propagation Delay from PID Field	7
5.8.3 Bit Rate	7
5.9 Essential Test Cases before Test Start	7
5.9.1 General	7
5.9.2 [DLL-CT 001] 'Error Bit' Response Function Check	7
5.10 Timing Parameter	8
5.10.1 [DLL-CT 002] IBS Length	8
5.10.2 [DLL-CT 003] IFS Length	8
5.10.3 [DLL-CT 004] Maximum Length of the Frame	9
5.11 Normal Frame Transmission/Reception Test	9
5.11.1 [DLL-CT 005] Response to PID Field	9
5.11.2 [DLL-CT 006] Transmission of PID Field	10
5.11.3 [DLL-CT 007] Transmission of the PTYPE Field	10
5.11.4 [DLL-CT 008] Response Function to PTYPE Field	11
5.11.5 [DLL-CT 009] Behavior for Unknown PID Field Reception	11
5.11.6 [DLL-CT 010] DLC and Data Verification 1 of Normal Frame	12
5.11.7 [DLL-CT 011] DLC and Data Verification 2 of Normal Frame, In case of DLC with '1101b' and '1110b'	12
5.11.8 [DLL-CT 012] DLC, Extended DLC and Data Verification of Long Frame	13
5.11.9 [DLL-CT 013] CT (Counter) Function of Normal Frame	13
5.11.10 [DLL-CT 014] Given CRC of Normal Frame	14
5.11.11 [DLL-CT 015] Given CRC of Long Frame	14
5.11.12 [DLL-CT 016] Unused Data Field	15
5.11.13 [DLL-CT 017] Completion of Transmission Frame	15
5.11.14 [DLL-CT 018] Completion of Reception Frame	16
5.11.15 [DLL-CT 019] Data Consistency Judgment of Received Frame	16
5.12 Detection of Clock Existence	17
5.12.1 [DLL-CT 020] Detection of Clock Existence	17
5.13 Bus Access Management	17
5.13.1 [DLL-CT 021] Frame Transmission in Method 1: Event Trigger Method	17
5.13.2 [DLL-CT 022] Frame Transmission in Method 2: Polling Method	18
5.13.3 [DLL-CT 023] Frame Reception Starting Condition 1	18
5.13.4 [DLL-CT 024] Frame Reception Starting Condition 2	19
5.13.5 [DLL-CT 025] Frame Reception Starting Condition 3	19
5.13.6 [DLL-CT 026] Arbitration Function 1 (Stop the Transmission by the Arbitration)	20
5.13.7 [DLL-CT 027] Arbitration Function 2 (Arbitration by Using Carrier Sense)	20
5.13.8 [DLL-CT 028] Arbitration Function 3 (Switch the IUT Operation Mode into Receiver by Losing Arbitration)	21
5.14 Error Detection Test	22
5.14.1 [DLL-CT 029] Bit Error	22
5.14.2 [DLL-CT 030] CRC Error	23
5.14.3 [DLL-CT 031] Parity Error of the PID Field	24
5.14.4 [DLL-CT 032] Parity Error of the PTYPE Field	25
5.14.5 [DLL-CT 033] Physical Bus Error 1 (In Case of Only the Clock Existing on the Bus)	25

5.14.6	[DLL-CT 034] Physical Bus Error 2 (In Case of the Bus Fixed)	26
5.14.7	[DLL-CT 035] Physical Bus Error 3 (In Case of Detection under the Standby Mode)	27
5.14.8	[DLL-CT 036] Data Length Error of Normal Frame	28
5.14.9	[DLL-CT 037] Data Length Error of Long Frame	29
5.14.10	[DLL-CT 038] Ignorance of Data Length Error (No Support of Long Frame)	30
5.14.11	[DLL-CT 039] Counter Error	30
5.14.12	[DLL-CT 040] Recovery from Counter Error	32
5.14.13	[DLL-CT 041] Framing Error in the Reception Node	33
5.14.14	[DLL-CT 042] Framing Error in the Transmission Node	33
5.15	Failure Management	34
5.15.1	[DLL-CT 043] Transmission Prohibition 1	34
5.15.2	[DLL-CT 044] Transmission Prohibition 2	34
5.15.3	[DLL-CT 045] Recovery from Transmission Prohibition by Wakeup or Reset, IUT as Master	35
5.15.4	[DLL-CT 046] Recovery from Transmission Prohibition by Wakeup, IUT as Slave	35
5.15.5	[DLL-CT 047] Recovery from Transmission Prohibition by Normal Reception	35
5.16	Wakeup/ Sleep Process	37
5.16.1	[DLL-CT 048] "Sleep.ind" Verification	37
5.16.2	[DLL-CT 049] Sleep Frame Transmission	37
5.16.3	[DLL-CT 050] Abort Sleep Frame Transmission by Losing Arbitration	38
5.16.4	[DLL-CT 051] Abort Sleep Frame Transmission by Transmission Error	39
5.17	Sleep Frame Reception	40
5.17.1	[DLL-CT 052] Sleep Frame Reception Test 1	40
5.17.2	[DLL-CT 053] Sleep Frame Reception Test 2	40
5.18	Wakeup pulse Reception	41
5.18.1	[DLL-CT 054] Wakeup Pulse Reception 1, IUT as Master	41
5.18.2	[DLL-CT 055] Wakeup Pulse Reception 2, IUT as Slave	42
5.18.3	[DLL-CT 056] Wakeup by Clock Detection	43
5.19	Wakeup Pulse Transmission	44
5.19.1	[DLL-CT 057] Wakeup Pulse Transmission	44
5.19.2	[DLL-CT 058] Wakeup Pulse Retransmission	44
5.20	Wakeup.ind Value Verification	45
5.20.1	[DLL-CT 059] Wakeup.ind Value Verification 1, IUT as Slave	45
5.20.2	[DLL-CT 060] Wakeup.ind Value Verification 2, IUT as Slave	45
5.20.3	[DLL-CT 061] Wakeup.ind Value Verification, IUT as Master	46
5.21	Multi Master Clock System	46
5.21.1	[DLL-CT 062] Clock Supply of Secondary Clock Master	46
5.21.2	[DLL-CT 063] Clock Supply Stop of Secondary Clock Master 1 (Reception Error Continues for 1 Second or More)	46
5.21.3	[DLL-CT 064] Clock Supply Stop of Secondary Clock Master 2 (Reception Error is 50% or More)	47
5.21.4	[DLL-CT 065] Clock Supply Recovery of Master Node	48
6	PHYSICAL LAYER TEST SPECIFICATION	49
6.1	Definition of Communication Cycle	49
6.1.1	IUT as Master	49
6.1.2	IUT as Slave	49
6.2	Test System Description Method	50
6.3	Requirements to Measurement System	51
6.3.1	Data Generator	51
6.3.2	Other Requirements	53
6.4	Operational Conditions - Calibration	53
6.4.1	Initial Configuration	53
6.4.2	[EPL-CT 001] Clock Supply	54
6.4.3	[EPL-CT 002] Operating Voltage Range	55
6.5	Threshold	56
6.5.1	[EPL-CT-003] Threshold Voltage Test 1	56
6.5.2	[EPL-CT 004] Threshold Voltage Test 2	57
6.5.3	[EPL-CT 005] Threshold Duty Cycle Test	59
6.6	Current Characteristics for Each Bus State	61
6.6.1	[EPL-CT 006] Drive Current Test	61
6.6.2	[EPL-CT 007] Input Leakage Test	62
6.6.3	[EPL-CT 008] Reverse Leakage Current Test	63
6.7	Slope Control	64
6.7.1	[EPL-CT 009] Measuring the Duty Cycle 1	64

6.7.2	[EPL-CT 010] Measuring the Duty Cycle 2	66
6.8	GND / V_{BAT} Shift Test	68
6.8.1	[EPL-CT 011] GND Shift Test	69
6.8.2	[EPL-CT 012] V_{BAT} Shift Test	70
6.9	Test for Failure.....	71
6.9.1	[EPL-CT 013] Loss of Battery Test (V_{BAT})	71
6.9.2	[EPL-CT 014] Loss of GND Test.....	72
6.10	Internal Static Capacity.....	73
6.10.1	[EPL-CT 015] Internal Static Capacity Test	73
6.11	Internal Resistance Value Measurement during the Operation.....	75
6.11.1	[EPL-CT 016] Measuring Internal Resistor 1	76
6.11.2	[EPL-CT 017] Measuring Internal Resistor 2	76
6.12	Measurement Test for Transceiver with Internal R_{master} or Transceiver with Variable R_{master}	77
6.12.1	[EPL-CT 018] Input Leakage Test (Measurement Test for Transceiver with Internal R_{master})	77
6.12.2	[EPL-CT 019] Measuring the Duty Cycle, IUT as Slave is Connected to Transceiver with Variable R_{master}	78
6.12.3	[EPL-CT 020] Measuring Internal Resistor, IUT as Master Has Transceiver with Variable R_{master}	80

FOREWORD

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There are following part in the **JASO D 015**.

JASO D 015-1 Part1 : General Information and Use Cases Definition

JASO D 015-2 Part2 : Transport Protocol and Network Layer Services

JASO D 015-3 Part3 : Protocol Specification

JASO D 015-4 Part4 : Unified diagnostic services on Clock extension peripheral interface (UDSonCXPI)

JASO D 015-5 Part5 : Protocol Conformance Test Specification

Automobiles - Clock Extension Peripheral Interface (CXPI)

-Part5: Protocol Conformance Test specification

INTRODUCTION

The objective of this standard “Clock Extension Peripheral Interface” (abbreviation: CXPI) communication protocol is to define a specification which enables the arbitration without destructing even if the protocol sends the PWM (Pulse Width Modulation) waveform which is superimposed the data and clock on communication bus and also multiple peripherals send the UART (Universal Asynchronous Receiver Transmitter) at the same time.

1 SCOPE

The standard defines CXPI communication protocol conformance test for Automobiles - CXPI communication protocol for mainly HMI (Human Machine Interface) of road vehicles electric system.

2 REFERENCES

The following standards contain sections which, through reference in this text, constitute sections of this standard. For dated references, it shall apply the version but not the revised version (including the supplemental version). For the undated references, the latest edition of the normative document referred to applies (including the supplemental version).

JIS X 0001: 1994	Glossary of terms used in information processing - Fundamental terms
JIS X 0005: 2002	Glossary of terms used in information processing (Representation of data)
JIS X 0009: 1997	Glossary of terms used in information processing (Data communication)
JIS X 0025: 1994	Glossary of terms used in information processing (Local area networks)
JIS X 0026: 1995	Glossary of terms used in information processing (Open Systems Interconnection)
JASO D 015-3: 2015,	Road vehicles - Clock Extension Peripheral Interface (CXPI) -Part3: Protocol specification

3 TERMS AND DEFINITIONS

For the purposes of this standard, the following terms and definitions, other than those given in **JIS X 0001**, **JIS X 0005**, **JIS X 0009**, **JIS X 0025** and **JIS X 0026** apply.

4 SYMBOLS AND ABBREVIATED TERMS**4.1 Symbols**

$T_{\text{clock stop m}}$	Time that the master node stops to transmit the clock after master node receives the sleep frame
T_{sleep}	Time that each Slave node transits to Sleep mode after the node receives the sleep frame
$T_{\text{wakeup_m}}$	Minimum time that master node starts the transmission of any PID field or PTYPE field first for the wakeup sequence
$T_{\text{wakeup_schedule_m}}$	Maximum time until master node starts the transmission of any PID field or PTYPE field first for the wakeup sequence
$T_{\text{clock start m}}$	Time that the master node transmits the clock on the CXPI bus at the latest
$T_{\text{wakeup_recovery_s}}$	Time that slave node starts the transmission of the second wakeup pulse after transmits the first wakeup pulse
$T_{\text{check clock}}$	Judgment time for the Clock existence
$T_{\text{tx wakeup}}$	Time that the transceiver node transmits the dominant voltage of the Wakeup pulse
$T_{\text{tx wakeup space}}$	Interval time between two of dominant level of transmitting wakeup pulse
C_{COMMON}	capacitance in the communication line
C_{BUS}	total bus capacitance
C_{REF}	reference capacitance

C_{SLAVE}	capacitance of slave node
I_{BUS}	current into the IUT bus line
I_{BUS_LIM}	current limitation for driver dominant state driver on V_{BUS}
$I_{BUS_NO_BAT}$	current at IUT bus line when V_{BAT} is disconnected
$I_{BUS_NO_GND}$	current at IUT bus line when V_{GND_IUT} is disconnected
$I_{BUS_PAS_dom}$	current at IUT bus line when driver off (passive) at dominant CXPI-bus-level ($V_{BUS} = 0\text{ V}$ and $V_{BAT} = 12\text{ V}$)
$I_{BUS_PAS_rec}$	current at IUT bus line when driver off (passive) at recessive CXPI-bus-level ($8\text{ V} < V_{BAT} < 18\text{ V}$; $8\text{ V} < V_{BUS} < 18\text{ V}$; $V_{BUS} \geq V_{BAT}$)
R_{COMMON}	resistor in the communication line
R_{BUS}	total bus-resistor including all slave node resistors and master node resistors $R_{BUS} = R_{Master} \parallel R_{Slave1} \parallel R_{Slave2} \parallel \dots \parallel R_{SlaveN}$
R_{REF}	reference resistor
R_{master}	master node resistor
R_{MEAS}	measurement resistor
R_{slave}	slave node resistor
T_{bit}	Nominal bit time
ΔT_{bit}	delta of basic bit times
TH_{dom}	dominant threshold of the received node
T_{tx_dif}	difference of the dominant time between logical value “1” and logical value “0”
$T_{tx_0_hi}$	time that the received node detects the recessive voltage
$T_{tx_0_lo_dom}$	dominant time of logical value “0”
$T_{tx_0_lo_rec}$	dominant time of logical value “0”
$T_{tx_1_lo_dom}$	dominant time of logical value “1”
$T_{tx_1_lo_rec}$	dominant time of logical value “1”
V_{BAT}	voltage across the IUT supply connectors
$V_{BATTERY}$	voltage across the vehicle battery connectors
V_{BS_TS}	battery shift test voltage
V_{BUS}	Voltage of communication bus
V_{BUS_CNT}	center recessive threshold voltage of the received node
V_{BUS_dom}	dominant voltage of the received node
V_{BUS_rec}	recessive voltage of the received node
V_{GND_TS}	ground shift test voltage
V_{GND_IUT}	voltage on the local IUT ground connector with respect to vehicle battery ground connector
V_{HYS}	hysteresis voltage between the recessive threshold voltage and the dominant threshold voltage of the received node
V_{IUT}	voltage at IUT supply pins
$V_{PS1/2}$	voltage at remote power supply no.1/no.2
V_{Shift_BAT}	battery shift voltage
V_{Shift_GND}	GND shift voltage
V_{SUP}	voltage at transceiver node supply pins
V_{th_dom}	measured vale that the dominant threshold voltage of the received node
V_{th_rec}	measured vale that the recessive threshold voltage of the received node

4.2 Abbreviated Terms

BUS	BUS pin on the IUT
CRC	Cyclic Redundancy Check
CXP	Clock eXtension Peripheral Interface
DLC	Data Length Code
GND	GrouND

IBS	Inter Byte Space
ID	IDentifier
IFS	Inter Frame Space
IUT	Implementation Under Test
PID	Protected ID
PTYPE	Protected TYPE
PWM	Pulse Width Modulation

5 DATA LINK LAYER TEST SPECIFICATION

5.1 General

This test specification is not able to cover all contingencies. Due to the fact of the missing vehicle environment, it is possible that the IUT's behavior differs.

5.2 Test Conditions

The tests have to be done at room temperature in a range of 15 to 35 °C.

5.3 Mandatory Requirements for IUT as Master

IUT shall retain the communication schedule by any means, and execute it.

IUT shall be able to transmit/ receive the response corresponding with the PID field.

The occurrence of the error described in **JASO D 015-3:5.4.12** "Error bit" shall notify to the other nodes.

IUT shall be initialized in the test case respectively.

5.4 Mandatory Requirements for IUT as Slave

IUT shall be able to transmit/ receive the response corresponding with the PID field.

The occurrence of the error defined in **JASO D 015-3:5.4.12** "Error bit" shall be able to notify to the outside.

IUT shall initialize for the test case respectively.

5.5 Test Description Method

In the description of each test case, which IUT type (master node / slave node) is applicable is defined. Each test case is configured by the **Table 1**.

Table 1 - Test Description Method

State	Description
Set up	- Define the IUT as master node or slave node - Define setup or using the test frame for the IUT and the Test System - Define the bit rate for the each test case
Initialization	- In case that no initialization procedure is specified, describe "The predefined initialization", and follow the procedure below. - Set the IUT status at the beginning of test as follows; - Master node: Transmitting the Requests (PID field) according to the periodic transmit schedule - Slave node: Responding to the Requests - If the IUT is supported for Wakeup/ Sleep, it shall be sleep prohibition. - An initialization of the IUT shall be performed before each test case. In the initializing procedure the IUT shall be reset so that the transmission/reception frames ID shall be configured and the error counter value is reset (to "0").
Test	- Define the test method of IUT. - If there are one or more test steps in this item, the test steps shall execute in order of description.
Judgment criteria	- Define the expected behavior of IUT when the test step is executed. It shall be criteria of test.
Reference	- Reference of requirements defined in the protocol specification or this standard.

5.6 Test System Requirements

The Test System shall ensure the precision of the bit time of the master node given by the CXPI specification.

5.7 Test System

The details for the Test System are not described in this standard. The Test System is implemented by the method that can execute the test steps described in each test. At that time, the Test System which is implemented shall be independent from other tests and shall have repeatability, and not rely on the operator's ability.

5.8 Test Setup

5.8.1 Configuration of IUT and Test System

Before executing the test, some settings have to be done concerning:

- PID field including the frame ID of periodical transmission
- The response corresponding to the frame ID shall be transmitted by a master node and a slave node
- In case of event trigger method, the PID field of event frame shall be transmitted by a slave node
- In case of polling method, the PTYPE field shall be transmitted by a master node
- In case of polling method, the event frame shall be transmitted as the PID field following the PTYPE field by a master node or a slave node
- Delay time after the transmission of PID field by a master node.
- Bit rate which has to be used for the test case

In the **Table 2** below, several standard frames used by the IUT and the Test System are predefined. In each test case description, the frame setting is specified mostly in 'Description' column of the table. The configuration described there must be suitable configuration for the each test case.

If there is no reference to the **Table 2**, the settings are described in the test case specification itself.

- If the IUT is not able to support for the given frame ID, it is possible to replace the given frame ID with the frame ID that the IUT can handle.
- For the delay after the transmission of PID field by the master node see the Section 5.8.2.

All frames used shall be selected so that they should be valid for device specification. If the specification does not specify the direction (transmission or reception) of frame transfer, IUT shall have both transmission and reception ability in principle.

Table 2 - Configuration of test frames used by IUT and Test System

Test Frame	Requirements for the Test Frame
TST_FRAME_1_Tx	Any transmission frame transmitted by the IUT (including event frame of event trigger method: method 1 or polling method: method 2) Event frame is chosen corresponding to method 1 or method 2, as follows. TST_FRAME_1_Tx (method 1) TST_FRAME_1_Tx (method 2)
TST_FRAME_1_Rx	Any reception frame received by the IUT (including all types of frames other than the sleep frame)
TST_FRAME_2	Data length of 12 bytes method 1: event frame (event trigger method)
TST_FRAME_3	Data length of 12 bytes method 2 event frame (polling method)
TST_FRAME_4	Read response error bit
TST_FRAME_5	Sleep frame
TST_FRAME_6_Tx	Any transmission long frame transmitted by the IUT (including event frame of method 1 or method 2) Event frame is chosen corresponding to method 1 or method 2, as follows. TST_FRAME_6_Tx (method 1) TST_FRAME_6_Tx (method 2)
TST_FRAME_6_Rx	Any reception long frame received by the IUT (including event frame of method 1 or method 2)
TST_FRAME_7	Data length of 255 bytes event long frame of method 1: event trigger method
TST_FRAME_8	Data length of 255 bytes event long frame of method 2: polling method
TST_FRAME_UNKOWN	Frames with all possible PIDs excluding assigned frame IDs that are not defined for reception / transmission for IUT with a correct parity bit. Number of data bytes of this frame shall be 12, Data1 to Data12 shall be filled with 0x00, 0x01, 0x02, 0x03, 0x04, 0x05, 0x06, 0x07, 0x08, 0x09, 0x0A and 0x0B in this order.
TST_FRAME_INVALID_PID	Frames with a PID excluding assigned frame ID with an incorrect parity bit. Number of data bytes of this frame shall be 12. Data1 to Data12 shall be filled with 0x00, 0x01, 0x02, 0x03, 0x04, 0x05, 0x06, 0x07, 0x08, 0x09, 0x0A and 0x0B in this order.

5.8.2 Propagation Delay from PID Field

If not otherwise specified the delay between the PID field and frame information shall comply with **JASO D 015-3:5.4.3.3.2** “IBS”.

5.8.3 Bit Rate

The default bit rate is set to the highest bit rate that is specified by the specification of the IUT. If not otherwise specified the bit rate as shown in “Default” is set.

5.9 Essential Test Cases before Test Start

5.9.1 General

The following tests shall be executed and meet the criteria, before executing further tests defined after section 5.10 of this standard.

5.9.2 [DLL-CT 001] “Error Bit” Response Function Check

This test method is described in **Table 3**.

Table 3 - Test System: “Error Bit” Response Function Check

State	Description	
Setup	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Rx, TST_FRAME_4
	Bit Rate	Default
Initialization	TST_FRAME_4 shall be transmitted twice by the Test System to ensure that the error bit is cleared.	
Test	The Test System transmits TST_FRAME_1_Rx with inverted CRC. TST_FRAME_4 shall be transmitted twice by the IUT.	
Judgment criteria	The IUT shall transmit the error bit = “TRUE” by the first transmission of TST_FRAME_4. The IUT shall transmit the error bit = “FALSE” by the second transmission of TST_FRAME_4.	
Reference	JASO D 015-3:5.4.12 “Error Notification”	

5.10 Timing Parameter

5.10.1 [DLL-CT 002] IBS Length

This test verifies if the length of IBS complies with the CXPI specification.

This test method is described in **Table 4**.

Table 4 - Test System: IBS Length

State	Description	
Setup	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx
	Bit Rate	Default
Initialization	Default	
Test	TST_FRAME_1_Tx shall be transmitted by the IUT.	
Judgment criteria	IBS within the frame transmitted by IUT shall be less than or equal to 9 bits in length.	
Reference	JASO D 015-3:5.4.3.3.2 “Inter-Byte-Space (IBS)”	

5.10.2 [DLL-CT 003] IFS Length

This test verifies if the length of IFS complies with the CXPI specification.

This test is applicable only **to** IUTs which support PID field transmission.

This test method is described in **Table 5**.

Table 5 - Test System: IFS Length

State	Description	
Setup	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx
	Bit Rate	Default
Initialization	Default	
Test	The IUT shall be set the internal condition to transmit TST_FRAME_1_Tx or TST_FRAME_1_Tx (method1) during any type of frame is being transmitted.	
Judgment criteria	IFS shall be greater than or equal to 20 bits in length.	
Reference	JASO D 015-3:5.4.3.3.1 “Inter-Frame-Space (IFS)”	

5.10.3 [DLL-CT 004] Maximum Length of the Frame

This test verifies if the maximum length of frame complies with the CXPI specification.

This test method is described in **Table 6**.

Table 6 - Test System: Maximum Length of the Frame

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx, TST_FRAME_6_Tx
	Bit Rate	Default
Initialization	Default	
Test	The Test System transmits each TST_FRAME_1_Tx and TST_FRAME_6_Tx ^{a)} .	
Judgment criteria	Maximum value of frame length shall be less than or equal to the maximum number of bits in each frame defined in JASO D 015-3:5.4.3.1 “Frame Configuration”.	
Reference	JASO D 015-3:5.4.3.1 “Frame Configuration”	
NOTE ^{a)} TST_FRAME_6_Tx is only applicable to IUTs which support long frame.		

5.11 Normal Frame Transmission/Reception Test**5.11.1 [DLL-CT 005] Response to PID Field**

This test verifies if IUT responds to PID field with the proper frame format.

This test method is described in **Table 7**.

Table 7 - Test System: Response to PID Field

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx
	Bit Rate	Default
Initialization	Default	
Test	The IUT transmits TST_FRAME_1_Tx. The Test System transmits PID field of TST_FRAME_1_Tx to make the IUT transmit TST_FRAME_1_Tx.	
Judgment criteria	The IUT shall transmit the frame corresponding to the PID field after it receives the PID field. The frame structure of TST_FRAME_1_Tx shall comply with JASO D 015-3:5.4.3.1.1 “Normal frame”.	
Reference	JASO D 015-3:5.4.3.1.1 “Normal Frame” JASO D 015-3:5.4.3.1.1.4 “PID Field” JASO D 015-3:5.4.5.1 “Method 1: Event Trigger Method” JASO D 015-3:5.4.5.2 “Method 2: Polling Method”	

5.11.2 [DLL-CT 006] Transmission of PID Field

This test verifies if the PID field transmitted by IUT complies with the CXPI specification.

This test is applicable only to IUTs which support PID field transmission.

This test method is described in **Table 8**.

Table 8 - Test System: Transmission of PID Field

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx
	Bit Rate	Default
Initialization	Default	
Test	The IUT transmits PID field of TST_FRAME_1_Tx.	
Judgment criteria	The format of PID field transmitted by the IUT shall comply with JASO D 015-3:5.4.3.1.1.4 "PID Field".	
Reference	JASO D 015-3:5.4.3.1.1.4 "PID Field" JASO D 015-3:5.4.5.1 "Method 1: Event Trigger Method" JASO D 015-3:5.4.5.2 "Method 2: Polling Method"	

5.11.3 [DLL-CT 007] Transmission of the PTYP Field

This test verifies if the PTYP field transmitted by IUT complies with the CXPI specification.

This test is applicable only to IUTs which support PTYP field transmission.

This test method is described in **Table 9**.

Table 9 - Test System: Transmission of the PTYP Field

State	Description	
Set up	IUT type	Master
	Configuration	-
	Bit Rate	Default
Initialization	Default	
Test	The IUT turns the power on and sets up the condition where the PTYP field is ready to transmit.	
Judgment criteria	The format of PTYP field transmitted by the IUT shall comply with JASO D 015-3:5.4.3.1.1.3 "PTYP Field".	
Reference	JASO D 015-3:5.4.3.1.1.3 "PTYP Field Method 2: Polling Method" JASO D 015-3:5.4.5.2 "Method 2: Polling Method"	

5.11.4 [DLL-CT 008] Response Function to PTYPE Field

In case of polling method, this test verifies if the IUT as slave node transmits the frame responding to PTYPE field.

This test is applicable only to IUTs which support response to a PTYPE field.

This test method is described in **Table 10**.

Table 10 - Test System: Response Function to PTYPE Field

State	Description	
Set up	IUT type	Slave
	Configuration	TST_FRAME_1_Tx (method 2), TST_FRAME_4
	Bit Rate	Default
Initialization	Default	
Test	The IUT shall be set the internal condition to transmit TST_FRAME_1_Tx (method 2) and the Test System as Master node transmits PTYPE field of TST_FRAME_1_Tx (method 2). Then the Test System requires the IUT to transmit TST_FRAME_4. After IUT sends TST_FRAME_1_Tx (method 2). The Test System as master node retransmits PTYPE field requesting the TST_FRAME_1_Tx (method 2) after the transmission conditions of TST_FRAME_1_Tx (method 2) of the IUT is cleared.	
Judgment criteria	The IUT shall transmit PID field of TST_FRAME_1_Tx (method 2), frame information, Data and CRC after the Test System transmits PTYPE field. During the transmission of PID field of TST_FRAME_1_Tx (method 2), frame information, Data and CRC, there shall not be an error. The IUT shall transmit TST_FRAME_4 with the error bit = "FALSE". After clearing the transmission condition of TST_FRAME_1_Tx (method 2), IUT shall not respond to the PTYPE field of TST_FRAME_1_Tx (method 2).	
Reference	JASO D 015-3:5.4.5 2 "Method 2: Polling Method"	

5.11.5 [DLL-CT 009] Behavior for Unknown PID Field Reception

This test verifies the behavior of the IUT when an unknown PID field appears on the communication bus.

This test method is described in **Table 11**.

Table 11 - Test System: Behavior for Unknown PID Field Reception

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_UNKNOWN
	Bit Rate	Default
Initialization	Default	
Test	The Test System transmits TST_FRAME_UNKNOWN.	
Judgment criteria	The IUT shall not respond to the PID field of TST_FRAME_UNKNOWN ignoring an unknown PID field of frame.	
Reference	JASO D 015-3:5.4.3.1.1.4 "PID field" JASO D 015-3:5.4.5.1 "Methoe 1: Event Trigger Method"	

5.11.6 [DLL-CT 010] DLC and Data Verification 1 of Normal Frame

This test verifies if the DLC field for the normal frame complies with the CXPI specification.

This test method is described in **Table 12**.

Table 12 - Test System: DLC and Data Verification 1 of Normal Frame

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx
	Bit Rate	Default
Initialization	Default	
Test	The IUT transmits TST_FRAME_1_Tx changing the DLC with all possible data length values.	
Judgment criteria	Structure of frame information shall comply with JASO D 015-3:5.4.3.1.1.5 "Frame information". The correlation between DLC value and data length (size of Data bytes) shall comply with JASO D 015-3:5.4.3.1.1.5 a "Data Length Code (DLC)".	
Reference	JASO D 015-3:5.4.3.1.1.5 "Frame information" JASO D 015-3:5.4.3.1.1.5 a "Data Length Code (DLC)"	

5.11.7 [DLL-CT 011] DLC and Data Verification 2 of Normal Frame, In case of DLC with '1101b' and '1110b'

This test verifies if the DLC field for the normal frame complies with the CXPI specification.

This test method is described in **Table 13**.

Table 13 - Test System: DLC and Data Verification 2 of Normal Frame, In case of DLC with '1101b' and '1110b'

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_2, TST_FRAME_3, TST_FRAME_4,
	Bit Rate	Default
Initialization	TST_FRAME_4 shall be transmitted twice by the Test System to ensure that the error bit is cleared.	
Test	The Test System shall transmit TST_FRAME_2 and TST_FRAME_3 changing the DLC value as shown in Table 14 . The Test System requires the IUT to transmit TST_FRAME_4.	
Judgment criteria	IUT shall receive TST_FRAME_2 and TST_FRAME_3 as 12 data bytes regardless of DLC value. The IUT shall transmit TST_FRAME_4 with the error bit = "FALSE".	
Reference	JASO D 015-3:5.4.3.1.1.5 a "Data Length Code (DLC)"	

Table 14 - Test cases: DLC and Data Verification 2 of Normal Frame, In case of DLC with '1101b' and '1110b'

Test case	Value of DLC
#1	1101b
#2	1110b

5.11.8 [DLL-CT 012] DLC, Extended DLC and Data Verification of Long Frame

This test verifies if the extended DLC field of the long frame complies with the CXPI specification.

This test is applicable only to IUTs which support long frame.

This test method is described in **Table 15**.

Table 15 - Test System: DLC, Extended DLC and Data Verification of Long Frame

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_6_Tx
	Bit Rate	Default
Initialization	Default	
Test	The IUT transmits TST_FRAME_6_Tx changing the Extended DLC with all possible data length values.	
Judgment criteria	TST_FRAME_6_Tx shall comply with JASO D 015-3:5.4.3.1.3 “Long Frame (OP)”. The DLC value shall be filled with ‘1111b’. The Extension DLC value shall meet the data length size.	
Reference	JASO D 015-3:5.4.3.1.1.5 a) “Data Length Code (DLC)” JASO D 015-3:5.4.3.1.3 “Long Frame (OP)”	

5.11.9 [DLL-CT 013] CT (Counter) Function of Normal Frame

This test verifies if the CT field complies with the CXPI specification.

This test is applicable only to frames which is capable of the CT function.

This test method is described in **Table 16**.

Table 16 - Test System: CT (Counter) Function of Normal Frame

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx
	Bit Rate	Default
Initialization	Default	
Test	The IUT transmits TST_FRAME_1_Tx consecutively.	
Judgment criteria	The CT value of TST_FRAME_1_Tx shall be incremented as the value defined in JASO D 015-3:5.4.3.1.1.5 c) “Counter (CT) (OP)”.	
Reference	JASO D 015-3:5.4.3.1.1.5 c) “Counter (CT) (OP)”	

5.11.10 [DLL-CT 014] Given CRC of Normal Frame

This test verifies if the CRC field for the normal frame complies with the CXPI specification.

This test method is described in **Table 17**.

Table 17 - Test System: Given CRC of Normal Frame

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx
	Bit Rate	Default
Initialization	Default	
Test	The IUT transmits TST_FRAME_1_Tx changing the Extended DLC with all possible data length values.	
Judgment criteria	It shall be given CRC described in JASO D 015-3:5.4.3.1.1.7 “Cyclic Redundancy Check (CRC)”.	
Reference	JASO D 015-3:5.4.3.1.1.7 “Cyclic Redundancy Check (CRC)”	

5.11.11 [DLL-CT 015] Given CRC of Long Frame

This test verifies if the CRC field for the long frame complies with the CXPI specification.

This test is applicable only to IUTs which support long frame.

This test method is described in **Table 18**.

Table 18 - Test System: Given CRC of Long Frame

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_6_Tx
	Bit Rate	Default
Initialization	Default	
Test	The IUT transmits TST_FRAME_6_Tx changing the Extended DLC with all possible data length values.	
Judgment criteria	It shall be given CRC described in JASO D 015-3:5.4.3.1.3.1 “Long Frame (OP)”.	
Reference	JASO D 015-3:5.4.3.1.3.1 “Method 1: Event Trigger Method” JASO D 015-3:5.4.3.1.3.2 “Method 2: Polling Method”	

5.11.12 [DLL-CT 016] Unused Data Field

This test verifies if the unused Data field complies with the CXPI specification.

This test method is described in **Table 19**.

Table 19-Test System: Unused Data Field

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx, TST_FRAME_6_Tx
	Bit Rate	Default
Initialization	Default	
Test	The IUT transmits Data field of TST_FRAME_1_Tx and TST_FRAME_6_Tx including unused data bits.	
Judgment criteria	All of unused data bits shall be “1”.	
Reference	JASO D 015-3:5.4.3.4 “Unused part”	

5.11.13 [DLL-CT 017] Completion of Transmission Frame

This test verifies if the completion of transmission frame complies with the CXPI specification.

This test method is described in **Table 20**.

Table 20 - Test System: Completion of Transmission-Frame

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx, TST_FRAME_4 TST_FRAME_UNKNOWN
	Bit Rate	Default
Initialization	TST_FRAME_4 shall be transmitted twice by the Test System to ensure that the error bit is cleared.	
Test	The Test System transmits TST_FRAME_1_Tx. The Test System transmits the PID field of TST_FRAME_UNKNOWN after recognizing IFS of specified bit length shown in Table 21 (from the end of transmitting the CRC of TST_FRAME_1_Tx). The Test System requires the IUT to transmit TST_FRAME_4.	
Judgment criteria	The error bit shall be transmitted with a value described in Table 21 .	
Reference	JASO D 015-3:5.4.5 “Completion of Frame”	

Table 21-Test cases: Completion of Transmission Frame

Test case	IFS	Judgment criteria
#1	11 bits	The IUT shall transmit TST_FRAME_4 with the error bit = “FALSE”.
#2	9 bits	The IUT shall transmit TST_FRAME_4 with the error bit = “TRUE”.

5.11.14 [DLL-CT 018] Completion of Reception Frame

This test verifies if the completion of reception frame complies with the CXPI specification.

This test method is described in **Table 22**.

Table 22 - Test System: Completion of Reception Frame

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Rx, TST_FRAME_4 TST_FRAME_UNKNOWN
	Bit Rate	Default
Initialization	TST_FRAME_4 shall be transmitted twice by the Test System to ensure that the error bit is cleared.	
Test	The Test System transmits TST_FRAME_1_Rx. The Test System transmits the PID field of TST_FRAME_UNKNOWN after elapsing the IFS time shown in Table 23 (from the end of transmitting the CRC of TST_FRAME_1_Rx). The Test System requires the IUT to transmit TST_FRAME_4.	
Judgment criteria	This test shall meet the judgment criteria described in Table 23 .	
Reference	JASO D 015-3:5.4.5 "Completion of Frame"	

Table 23 - Test cases: Completion of Reception Frame

Test case	IFS	Judgment criteria
#1	11 bits	IUT shall receive the same data with the transmitted data by the Test System. The IUT shall transmit TST_FRAME_4 with the error bit = "FALSE".
#2	9 bits	The IUT shall discard the received frame. The IUT shall transmit TST_FRAME_4 with the error bit = "TRUE".

5.11.15 [DLL-CT 019] Data Consistency Judgment of Received Frame

This test verifies if the function for the judgment of received frame complies with the CXPI specification.

This test method is described in **Table 24**.

Table 24 - Test System: Data Consistency Judgment of Received Frame

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Rx, TST_FRAME_UNKOWN, TST_FRAME_4
	Bit Rate	Default
Initialization	TST_FRAME_4 shall be transmitted twice by the Test System to ensure that the error bit is cleared.	
Test	The Test System transmits to the IUT TST_FRAME_1_Rx, TST_FRAME_UNKOWN, TST_FRAME_4, TST_FRAME_UNKOWN with inverted CRC and TST_FRAME_4 in this order.	
Judgment criteria	The IUT shall receive TST_FRAME_1_Rx. The IUT shall not receive the TST_FRAME_UNKOWN. The IUT shall transmit TST_FRAME_4 with the error bit = "FALSE" for both cases.	
Reference	JASO D 015-3:5.4.6 Judgment of Received Frame	

5.12 Detection of Clock Existence

5.12.1 [DLL-CT 020] Detection of Clock Existence

This test verifies the detection function of clock existence.

This test method is described in **Table 25**.

Table 25 - Test System: Detection of Clock Existence

State	Description	
Set up	IUT type	Slave
	Configuration	TST_FRAME_1_Tx
	Bit Rate	Default
Initialization	The IUT shall be in the power-off state.	
Test	The IUT turns the power on, and then the Test System starts transmitting the clock in a waveform as specified in Table 26 after the elapse time when the IUT is ready for transmit and receive. 50 ms after starting the transmission of the clock by the Test System, the IUT shall transmit the PID field of TST_FRAME_1_Tx.	
Judgment criteria	The IUT shall detect the clock existence. The IUT shall transmit the Response field of TST_FRAME_1_Tx or the PID field of TST_FRAME_1_Tx.	
Reference	JASO D 015-3:5.4.7 "Detection of Clock Existence"	

Table 26 - Test cases: Detection of Clock Existence

Test case	Requirements for the clock waveform	Inclination ratio
#1	$T_{tx_1_lo_dom} = 0.11 T_{bit}$	<5V/μs
#2	$T_{tx_1_lo_rec} = 0.45 T_{bit}$	

5.13 Bus Access Management

5.13.1 [DLL-CT 021] Frame Transmission in Method 1: Event Trigger Method

This test verifies if the timing parameters for the method 1: Event trigger method comply with the CXPI specification.

This test method is described in **Table 27**.

Table 27 - Test System: Frame Transmission in Method 1: Event Trigger Method

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx, TST_FRAME_6_Tx
	Bit Rate	Default
Initialization	The IUT shall be set the internal condition to transmit TST_FRAME_1_Tx (method1), TST_FRAME_6_Tx (method1).	
Test	The IUT transmits TST_FRAME_1_Tx, TST_FRAME_6_Tx consecutively in minimum interval period conducted by the Test System.	
Judgment criteria	The IUT shall start the transmission in idle state after IFS elapsed.	
Reference	JASO D 015-3:5.4.8.1.1 "Method 1: Event Trigger Method"	

5.13.2 [DLL-CT 022] Frame Transmission in Method 2: Polling Method

This test verifies if the timing parameters for the method 2: Polling method comply with the CXPI specification.
This test method is described in **Table 28**.

Table 28 - Test System: Frame Transmission in Method 2: Polling Method

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx
	Bit Rate	Default
Initialization	The IUT shall form the transmission condition of TST_FRAME_1_Tx (method 2).	
Test	The IUT transmits TST_FRAME_1_Tx consecutively in minimum interval period conducted by the Test System.	
Judgment criteria	In case that IUT is Master: The IUT shall start the transmission of the PID field or PTYPPE field in idle state after IFS elapsed. In case that IUT is Slave: The IUT shall not respond other than the PID field or PTYPPE field which its Response is not associated.	
Reference	JASO D 015-3:5.4.8.1.2 "Method 2: Polling Method"	

5.13.3 [DLL-CT 023] Frame Reception Starting Condition 1

This test verifies if the starting condition of frame reception complies with the CXPI specification.
This test method is described in **Table 29**.

Table 29 - Test System: Frame Reception Starting Condition 1

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Rx, TST_FRAME_4
	Bit Rate	Default
Initialization	TST_FRAME_4 shall be transmitted twice by the Test System to ensure that the error bit is cleared.	
Test	The Test System transmits TST_FRAME_1_Rx consecutively. During this transmission, the next frame transmission shall start after inserting 11 bits interval of IFS from the completion of the previous frame. The Test System requires the IUT to transmit TST_FRAME_4.	
Judgment criteria	The IUT shall receive TST_FRAME_1_Rx without an error. The IUT shall transmit TST_FRAME_4 with the error bit = "FALSE".	
Reference	JASO D 015-3:5.4.3.3.1 "Inter-Frame-Space (IFS)"	

5.13.4 [DLL-CT 024] Frame Reception Starting Condition 2

This test verifies if the starting condition of frame reception complies with the CXPI specification.
This test method is described in **Table 30**.

Table 30 - Test System: Frame Reception Starting Condition 2

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Rx, TST_FRAME_4
	Bit Rate	Default
Initialization	TST_FRAME_4 shall be transmitted twice by the Test System to ensure that the error bit is cleared.	
Test	The Test System transmits the two consecutive frames of TST_FRAME_1_Rx by the 9 bits interval of IFS. The Test System requires the IUT to transmit TST_FRAME_4.	
Judgment criteria	Consecutive two frames of TST_FRAME_1_Rx shall not be received. The IUT shall transmit TST_FRAME_4 with the error bit = "TRUE".	
Reference	JASO D 015-3:5.4.3.3.1 "Inter-Frame-Space (IFS)"	

5.13.5 [DLL-CT 025] Frame Reception Starting Condition 3

This test verifies if the starting condition of frame reception complies with the CXPI specification.
This test method is described in **Table 31**.

Table 31 - Test System: Frame Reception Starting Condition 3

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Rx, TST_FRAME_4
	Bit Rate	Default
Initialization	The IUT shall be in the power-off state.	
Test	The Test System transmits the consecutive frames of TST_FRAME_1_Rx by the 10 bits interval of IFS. If the IUT is master node, the Test System shall prepare to transmit TST_FRAME_1_Rx by the 10 bits interval of IFS immediately after it receives clock waveform. At this transmission, the CRC error shall have been implemented in TST_FRAME_1_Rx. Then the IUT is powered. After completing the power-on and initializing process of the IUT, transmitting at least one TST_FRAME_1_Rx, the Test System transmits the PID field of TST_FRAME_4 by the 20 bits interval of IFS.	
Judgment criteria	The IUT shall transmit TST_FRAME_4 with the error bit = "FALSE".	
Reference	JASO D 015-3:5.4.3.3.1 "Inter-Frame-Space (IFS)"	

5.13.6 [DLL-CT 026] Arbitration Function 1 (Stop the Transmission by the Arbitration)

This test verifies if the function of arbitration for bit collisions complies with the CXPI specification.
This test method is described in **Table 32**.

Table 32 - Test System: Arbitration Function 1 (Stop the Transmission by the Arbitration)

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx, TST_FRAME_4
	Bit Rate	Default
Initialization	TST_FRAME_4 shall be transmitted twice by the Test System to ensure that the error bit is cleared.	
Test	The Test System causes the collision between any recessive bit and dominant bit of the PID field of TST_FRAME_1_Tx excluding the parity bit. The Test System requires the IUT to transmit TST_FRAME_4.	
Judgment criteria	The IUT shall stop the transmission after dominant bit collision. The IUT shall transmit TST_FRAME_4 with the error bit = "FALSE".	
Reference	JASO D 015-3:5.4.8.2 "Arbitration"	

5.13.7 [DLL-CT 027] Arbitration Function 2 (Arbitration by Using Carrier Sense)

This test verifies if the arbitration function of PTYPE or PID field complies with the CXPI specification.
This test method is described in **Table 33**.

Table 33 - Test System: Arbitration Function 2 (Arbitration by Using Carrier Sense)

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx, TST_FRAME_UNKNOMN
	Bit Rate	Default
Initialization	Default	
Test	During the Test System transmits TST_FRAME_UNKNOWN by the 18 bits interval of IFS consecutively, the IUT is set the internal condition to be ready for transmitting TST_FRAME_1_Tx.	
Judgment criteria	The IUT shall keep preventing from transmitting the PID field. TST_FRAME_UNKOWN shall not be corrupted.	
Reference	JASO D 015-3:5.4.8.2 "Arbitration"	

5.13.8 [DLL-CT 028] Arbitration Function 3 (Switch the IUT Operation Mode into Receiver by Losing Arbitration)

This test verifies if the IUT as receiver complies with the CXPI specification after losing arbitration.

This test method is described in **Table 34**.

Table 34 - Test System: Arbitration Function 3 (Switch the IUT Operation Mode into Receiver by Losing Arbitration)

State	Description	
Set up	IUT type	Master, Slave
	Configuration	TST_FRAME_1_Tx, TST_FRAME_1_Rx, TST_FRAME_4
	Bit Rate	Default
Initialization	TST_FRAME_4 shall be transmitted twice by the Test System to ensure that the error bit is cleared.	
Test	The Test System transmits TST_FRAME_1_Rx with the PID field which has higher priority than the PID field of TST_FRAME_1_Tx that shall be transmitted by the IUT at the same time. The Test System requires the IUT to transmit TST_FRAME_4.	
Judgment criteria	The IUT shall transmit TST_FRAME_4 with the error bit = "FALSE". The IUT shall receive the same data that the Test System transmits.	
Reference	JASO D 015-3:5.4.8.2 "Arbitration"	