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Final

P12_0132-1_017_S12ZVL_L22_Report00
Date of Approval: 2014-Aug-06

Test Report

Device Under Test

Object Family	MC9S12ZVL
Manufacturer	Freescale Semiconductor
Type	LIN Transceiver
Sample marking	PC912Z VL32MLF 0N22G CTCTKY1412A

Customer

Order No.	P12_0132a
Name	Freescale Semiconductor México
Address	Periférico Sur 8110 Col. El Mante, Tlaquepaque, Jal. 45609 Mexico

Number of Pages	48
Test Period	from ww31/2014 until ww32/2014
Test Method / Test Requirement	LIN Conformance Test Specification
Performed Tests and References	1 LIN OSI Layer 1 – Physical Layer For LIN devices with Rx and Tx access For the LIN Physical Layer Specification Revision 2.2 (Dec. 31th, 2010) LIN OSI Layer1 Physical Layer for LIN Specification 2.2 Version 2.2
Conformance Test Results	The Test Results refer to the delivered device.
1 LIN OSI Layer 1 for Revision 2.2	**Pass**

For detailed information see chapter Test List at the following pages.

Approved by

L. Kukla, Project Manager

Test performed by

J. Eversmeier, Project Engineer

Table of Content

Revision History

Old revision	New revision	Amendment Description	Editor
–	00	Final version	LK

1 Device Under Test (detailed)

General	
Date of Sample Arrival	21.07.2014
Manufacturer	Freescale Semiconductor
Sample Marking	PC912Z VL32MLF 0N22G CTCTKY1412A
Test performed with DUT no.	#1 (S/N: AX142705005)

Device Specification	
Name	MC9S12ZVL
Version	LIN Transceiver
Design step	-
HW-Version	-
SW-Version	-

Documentation	
Hardware manual	-
User manual / datasheet	MC9S12ZVL_Rev.01.00.pdf

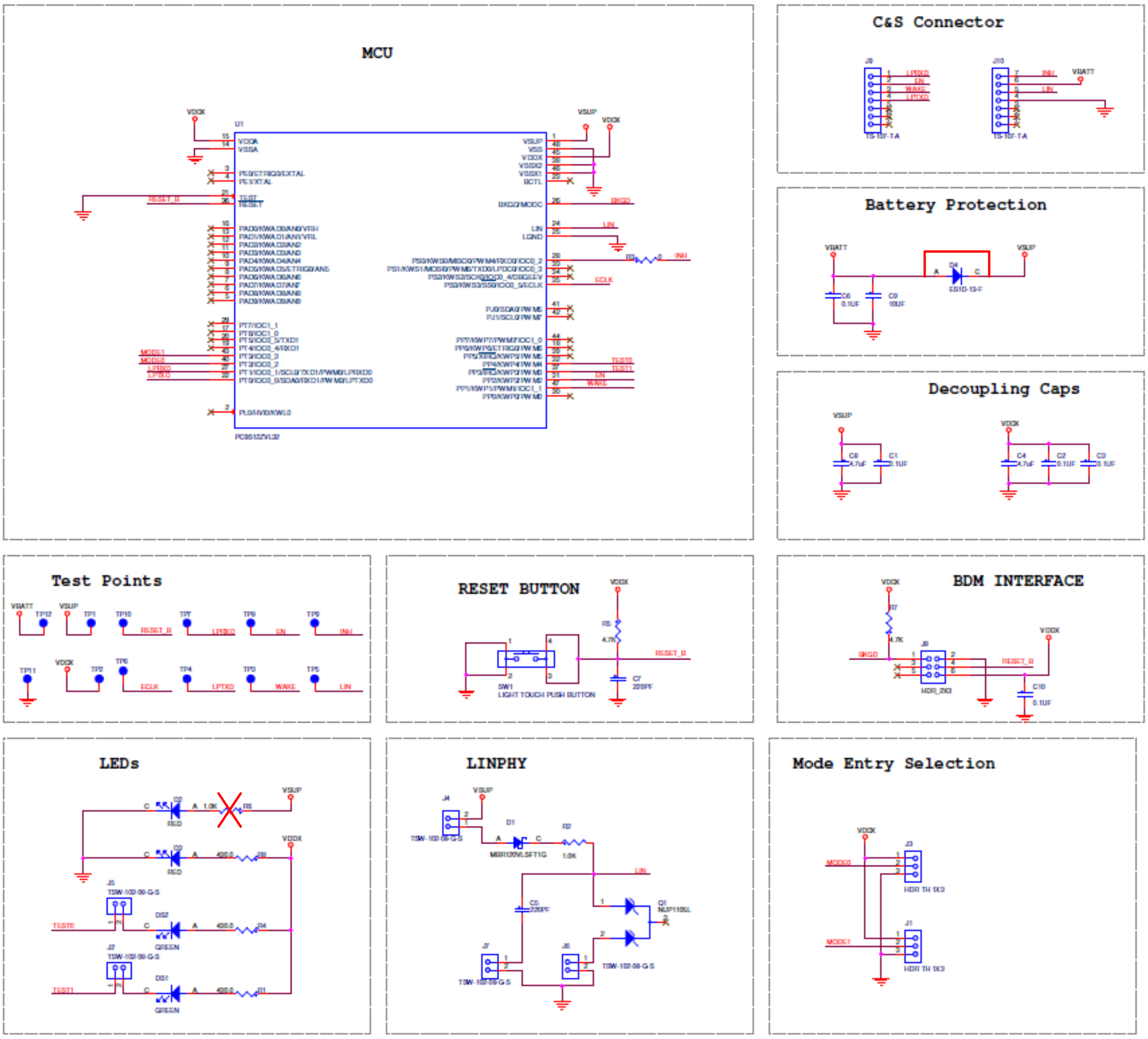
Device Classification	
According to	C

Software Specification	
IDE	-
Compiler	-
Device	-

Supplement	
Node Capability File	-
Connection plan	P12_0132-1_008_S12ZVL_L22_Connection_Plan00.pdf

2 Setup for Device Under Test

D4 is bypassed and R6 is removed to support V_{SUP}


MCU
C&S Connector
Battery Protection
Decoupling Caps
Test Points
RESET BUTTON
BDM INTERFACE
LEDs
LINPHY
Mode Entry Selection

3 Test Equipment

The following test equipment and test system have been used.

No.	Component	Manufacturer	Version / Type	ID
C&S Hardware				
LIN 2.2				
1	LIN-Power switch Board	C&S	Rev 2.1	CSHW_000037
2	LIN-Stimulation Board	C&S	Rev 2.2	CSHW_000096
3	LIN-GND-shift Board	C&S	Rev 1.3	CSHW_000075
4	LIN-IUT Board	C&S	Rev 2.1	CSHW_000071
5	LIN-Adapter Board	C&S	Rev 2.2	CSHW_000097
6	LIN-Adapter Board	C&S	Rev 2.2	CSHW_000073
7	LIN-Adapter Board	C&S	Rev 1.1	CSHW_000040
8	LIN-Adapter Board	C&S	Rev 1.1	CSHW_000099
9	LIN Stimuli Board	C&S	Rev.1.2	CSHW_000010
10	LIN IUT Board	C&S	Rev 2.1	CSHW_000193
LIN ext.Duty Cycle Test				
11	Duty Cycle Board	C&S	Rev 1.0	CSHW_000212
Test System Hardware				
12	Power Supply	Hameg	HM 8142	700034
13	Power Supply	Hameg	HM 8142	700044
14	Power Supply	Hameg	HM 8142	700045
15	Power Supply	Hameg	HM 8142	700017
16	Oscilloscope	Agilent	54622D	700035
17	Oscilloscope	Agilent	MSO8104A	700090
18	Function/ Waveform generator	Hewlett Packard	33120A	700007
19	Function/ Waveform generator	Hewlett Packard	33120A	700043
20	Function/ Waveform generator	Agilent	33220A	700068
21	Data Acquisition /Switch Unit	Agilent	34970A	700056
22	Data Acquisition /Switch Unit	Agilent	34970A	700015
23	20-Channel-Multiplexer Module (2/4 Wire)	Agilent	34901A	700091
24	20-Channel-Multiplexer Module (2/4 Wire)	Agilent	34901A	700059
25	20-Channel Actuator Module	Agilent	34903A	500060
Software				
26	LIN_PL_Supervisor	C&S	1.0.5.0, Build 5	

4 Technical Correspondence

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5 Test List

5.1 Dynamic Tests

Following test case numeration relates on the corresponding test specification.

No.	Description	Result	Comment
2.1	**Operating Voltage Range**		
2.1.1	Voltage Ramp V_{SUP} = [7V…18V], 0.1V/s [up]	Pass	RX shows the 10kHz Signal, The maximum deviation is less or equal than 10%
2.1.2	Voltage Ramp V_{SUP} = [18V…7V], 0.1V/s [down]	Pass	RX shows the 10kHz Signal, The maximum deviation is less or equal 10%
2.2	**Threshold Voltages**		
2.2.1	**IUT as Receiver: V_{SUP} @ V_{BUS_DOM} (down)**		
2.2.1.1	V_{SUP} = 7V Signal Range [18V…4.2V] Expected RX Signal recessive	Pass	RX is recessive.
	V_{SUP} = 7V Signal Range [2.8V…-1.05V] Expected RX Signal dominant	Pass	RX is dominant.
2.2.1.2	V_{SUP} = 13V Signal Range [18V…7.8V] Expected RX Signal recessive	Pass	RX is recessive.
	V_{SUP} = 13V Signal Range [5.2V…-2.1V] Expected RX Signal dominant	Pass	RX is dominant.
2.2.1.3	V_{SUP} = 18V Signal Range [20.7V…10.8V] Expected RX Signal recessive	Pass	RX is recessive.
	V_{SUP} = 18V Signal Range [7.2V…-2.7V] Expected RX Signal dominant	Pass	RX is dominant.
2.2.2	**IUT as Receiver: V_{SUP} @ V_{BUS_REC} (up)**		
2.2.2.1	V_{SUP} = 7V Signal Range [-1.05V…2.8V] Expected RX Signal dominant	Pass	RX is dominant.
	V_{SUP} = 7V Signal Range [4.2V…18V] Expected RX Signal recessive	Pass	RX is recessive.
2.2.2.2	V_{SUP} = 13V Signal Range [-2.1V…5.2V] Expected RX Signal dominant	Pass	RX is dominant.
	V_{SUP} = 13V Signal Range [7.8V…18V] Expected RX Signal recessive	Pass	RX is recessive.

No.	Description	Result	Comment
2.2.2.3	V_{SUP} = 18V Signal Range [-2.7V…7.2V] Expected RX Signal dominant	Pass	RX is dominant.
	V_{SUP} = 18V Signal Range [10.8V…20.7V] Expected RX Signal recessive	Pass	RX is recessive.
2.2.3	**IUT as Receiver: V_{SUP} @ V_{BUS}**		
2.2.3.1	V_{SUP} = 7V Signal Range [-1.05V…8.05V] up [8.05V…-1.05V] down	Pass	V_{BUS_CNT} is in range of [0.475…0.525]*V_{SUP}, V_{HYS} is less than 0.175* V_{SUP}.
2.2.3.2	V_{SUP} = 14V Signal Range [-2.1V…16.1V] up [16.1V…-2.1V] down	Pass	V_{BUS_CNT} is in range of [0.475…0.525]*V_{SUP}, V_{HYS} is less than 0.175* V_{SUP}.
2.2.3.3	V_{SUP} = 18V Signal Range [-2.7V…20.7V] up [20.7V…-2.7V] down	Pass	V_{BUS_CNT} is in range of [0.475…0.525]*V_{SUP}, V_{HYS} is less than 0.175* V_{SUP}.
2.3	**Variation of $V_{SUP\_NON\_OP} \in$ [- 0.3V ... 7.0V]; [18V … 40V]**		
2.3.1	Master ECU V_{BAT} = [-0.3V…8V], [18V…40V] 60 kΩ + diode to V_{LIN} = 18 V	Not applicable	IUT as Transceiver
2.3.2	Slave ECU V_{BAT} = [-0.3V…8V], [18V…40V] 1.1kΩ + diode to V_{LIN} = 18 V	Not applicable	IUT as Transceiver
2.3.3	Transceiver V_{SUP} = [-0.3V…7V], [18V…40V]1.1 kΩ + diode to V_{LIN} = 18 V	Pass	No dominant state occurs, the IUT is not destroyed, the recessive voltage afterwards is less or equal +/-5%
2.4	**I_{BUS} Under Several Conditions**		
2.4.1	I_{BUS_LIM} @ Dominant State (Driver On); V_{IUT} = 18V	Pass	LIN shows the rectangular signal, the dominant state bus level is lower than th_dom=4.518V for Transceiver
2.4.2	$I_{BUS\_PAS\_dom}$: IUT in Recessive State : V_{IUT} = 12V; V_{BUS} = 0V	Pass	The maximum voltage drop is higher than -500mV.
2.4.3	$I_{BUS\_PAS\_rec}$: IUT in Recessive State : V_{SUP} = 7V with Variation of $V_{BUS} \in$ [8V ... 18V]	Pass	The maximum voltage drop is less or equal than 20mV.

No.	Description	Result	Comment
2.5	**Slope Control**		
2.5.1	**Measuring the Duty Cycle @ 10.4 kBit/sec – IUT as Transmitter**		
2.5.1.1.1	V_{SUP} = 7V Bus Load = 1nF, 1kΩ V_{PS2}=6.0V	Pass	The measured duty cycle D3 is greater or equal than 0.417.
2.5.1.1.2	V_{SUP} = 7V Bus Load = 1nF, 1kΩ V_{PS2}=6.6V	Pass	The measured duty cycle D3 is greater or equal than 0.417.
2.5.1.2.1	V_{SUP} = 7V Bus Load = 6.8nF, 660Ω V_{PS2}=6.0V	Pass	The measured duty cycle D3 is greater or equal than 0.417.
2.5.1.2.2	V_{SUP} = 7V Bus Load = 6.8nF, 660Ω V_{PS2}=6.6V	Pass	The measured duty cycle D3 is greater or equal than 0.417.
2.5.1.3.1	V_{SUP} = 7V Bus Load = 10nF, 500Ω V_{PS2}=6.0V	Pass	The measured duty cycle D3 is greater or equal than 0.417.
2.5.1.3.2	V_{SUP} = 7V Bus Load = 10nF, 500Ω V_{PS2}=6.6V	Pass	The measured duty cycle D3 is greater or equal than 0.417.
2.5.1.4.1	V_{SUP} = 7.6V Bus Load = 1nF, 1kΩ V_{PS2}=6.6V	Pass	The measured duty cycle D3 is greater or equal than 0.417, the measured duty cycle D4 is less or equal than 0.590.
2.5.1.4.2	V_{SUP} = 7.6V Bus Load = 1nF, 1kΩ V_{PS2}=7.2V	Pass	The measured duty cycle D3 is greater or equal than 0.417, the measured duty cycle D4 is less or equal than 0.590.
2.5.1.5.1	V_{SUP} = 7.6V Bus Load = 6.8nF, 660Ω V_{PS2}=6.6V	Pass	The measured duty cycle D3 is greater or equal than 0.417, the measured duty cycle D4 is less or equal than 0.590.
2.5.1.5.2	V_{SUP} = 7.6V Bus Load = 6.8nF, 660Ω V_{PS2}=7.2V	Pass	The measured duty cycle D3 is greater or equal than 0.417, the measured duty cycle D4 is less or equal than 0.590.

No.	Description	Result	Comment
2.5.1.6.1	V_{SUP} = 7.6V Bus Load = 10nF, 500Ω V_{PS2}=6.6V	Pass	The measured duty cycle D3 is greater or equal than 0.417, the measured duty cycle D4 is less or equal than 0.590.
2.5.1.6.2	V_{SUP} = 7.6V Bus Load = 10nF, 500Ω V_{PS2}=7.2V	Pass	The measured duty cycle D3 is greater or equal than 0.417, the measured duty cycle D4 is less or equal than 0.590.
2.5.1.7.1	V_{SUP} = 18V Bus Load = 1nF, 1kΩ V_{PS2}=17.0V	Pass	The measured duty cycle D3 is greater or equal than 0.417, the measured duty cycle D4 is less or equal than 0.590.
2.5.1.7.2	V_{SUP} = 18V Bus Load = 1nF, 1kΩ V_{PS2}=17.6V	Pass	The measured duty cycle D3 is greater or equal than 0.417, the measured duty cycle D4 is less or equal than 0.590.
2.5.1.8.1	V_{SUP} = 18V Bus Load = 6.8nF, 660Ω V_{PS2}=17.0V	Pass	The measured duty cycle D3 is greater or equal than 0.417, the measured duty cycle D4 is less or equal than 0.590.
2.5.1.8.2	V_{SUP} = 18V Bus Load = 6.8nF, 660Ω V_{PS2}=17.6V	Pass	The measured duty cycle D3 is greater or equal than 0.417, the measured duty cycle D4 is less or equal than 0.590.
2.5.1.9.1	V_{SUP} = 18V Bus Load = 10nF, 500Ω V_{PS2}=17.0V	Pass	The measured duty cycle D3 is greater or equal than 0.417, the measured duty cycle D4 is less or equal than 0.590.
2.5.1.9.2	V_{SUP} = 18V Bus Load = 10nF, 500Ω V_{PS2}=17.6V	Pass	The measured duty cycle D3 is greater or equal than 0.417, the measured duty cycle D4 is less or equal than 0.590.

No.	Description			Result	Comment
2.5.2	**Measuring the Duty Cycle @ 20.0 kBit/sec – IUT as Transmitter**				
2.5.2.1.1	V_{SUP} = 7V	Bus Load = 1nF, 1kΩ	V_{PS2}=6.0V	Pass	The measured duty cycle D1 is greater or equal than 0.396.
2.5.2.1.2	V_{SUP} = 7V	Bus Load = 1nF, 1kΩ	V_{PS2}=6.6V	Pass	The measured duty cycle D1 is greater or equal than 0.396.
2.5.2.2.1	V_{SUP} = 7V	Bus Load = 6.8nF, 660Ω	V_{PS2}=6.0V	Pass	The measured duty cycle D1 is greater or equal than 0.396.
2.5.2.2.2	V_{SUP} = 7V	Bus Load = 6.8nF, 660Ω	V_{PS2}=6.6V	Pass	The measured duty cycle D1 is greater or equal than 0.396.
2.5.2.3.1	V_{SUP} = 7V	Bus Load = 10nF, 500Ω	V_{PS2}=6.0V	Pass	The measured duty cycle D1 is greater or equal than 0.396.
2.5.2.3.2	V_{SUP} = 7V	Bus Load = 10nF, 500Ω	V_{PS2}=6.6V	Pass	The measured duty cycle D1 is greater or equal than 0.396.
2.5.2.4.1	V_{SUP} = 7.6V	Bus Load = 1nF, 1kΩ	V_{PS2}=6.6V	Pass	The measured duty cycle D1 must be greater or equal than 0.396, the measured duty cycle D2 is less or equal 0.581.
2.5.2.4.2	V_{SUP} = 7.6V	Bus Load = 1nF, 1kΩ	V_{PS2}=7.2V	Pass	The measured duty cycle D1 must be greater or equal than 0.396, the measured duty cycle D2 is less or equal 0.581.
2.5.2.5.1	V_{SUP} = 7.6V	Bus Load = 6.8nF, 660Ω	V_{PS2}=6.6V	Pass	The measured duty cycle D1 must be greater or equal than 0.396, the measured duty cycle D2 is less or equal 0.581.
2.5.2.5.2	V_{SUP} = 7.6V	Bus Load = 6.8nF, 660Ω	V_{PS2}=7.2V	Pass	The measured duty cycle D1 must be greater or equal than 0.396, the measured duty cycle D2 is less or equal 0.581.

No.	Description			Result	Comment
2.5.2.6.1	V_{SUP} = 7.6V	Bus Load = 10nF, 500Ω	V_{PS2}=6.6V	Pass	The measured duty cycle D1 must be greater or equal than 0.396, the measured duty cycle D2 is less or equal 0.581.
2.5.2.6.2	V_{SUP} = 7.6V	Bus Load = 10nF, 500Ω	V_{PS2}=7.2V	Pass	The measured duty cycle D1 must be greater or equal than 0.396, the measured duty cycle D2 is less or equal 0.581.
2.5.2.7.1	V_{SUP} = 18V	Bus Load = 1nF, 1kΩ	V_{PS2}=17.0V	Pass	The measured duty cycle D1 must be greater or equal than 0.396, the measured duty cycle D2 is less or equal 0.581.
2.5.2.7.2	V_{SUP} = 18V	Bus Load = 1nF, 1kΩ	V_{PS2}=17.6V	Pass	The measured duty cycle D1 must be greater or equal than 0.396, the measured duty cycle D2 is less or equal 0.581.
2.5.2.8.1	V_{SUP} = 18V	Bus Load = 6.8nF, 660Ω	V_{PS2}=17.0V	Pass	The measured duty cycle D1 must be greater or equal than 0.396, the measured duty cycle D2 is less or equal 0.581.
2.5.2.8.2	V_{SUP} = 18V	Bus Load = 6.8nF, 660Ω	V_{PS2}=17.6V	Pass	The measured duty cycle D1 must be greater or equal than 0.396, the measured duty cycle D2 is less or equal 0.581.
2.5.2.9.1	V_{SUP} = 18V	Bus Load = 10nF, 500Ω	V_{PS2}=17.0V	Pass	The measured duty cycle D1 must be greater or equal than 0.396, the measured duty cycle D2 is less or equal 0.581.
2.5.2.9.2	V_{SUP} = 18V	Bus Load = 10nF, 500Ω	V_{PS2}=17.6V	Pass	The measured duty cycle D1 must be greater or equal than 0.396, the measured duty cycle D2 is less or equal 0.581.

No.	Description	Result	Comment
2.6	**Propagation Delay**		
2.6.1	**Propagation Delay of the Receiver**		
2.6.1.1	V_{SUP} = 7V RX Load = 20pF	Pass	t_{rx_pd} is less than 6µs, t_{rx_sym} is in range +/- 2µs.
2.6.1.2	V_{SUP} = 14V RX Load = 20pF	Pass	t_{rx_pd} is less than 6µs, t_{rx_sym} is in range +/- 2µs.
2.6.1.3	V_{SUP} = 18V RX Load = 20pF	Pass	t_{rx_pd} is less than 6µs, t_{rx_sym} is in range +/- 2µs.
2.7	**GND / VBAT Shift Test – Dynamic**		
2.7.1	GND Shift Test – Dynamic – IUT as Transceiver (Master)	Pass	The duty cycle of RX is in range D1 – 2µs ... D2 + 2µs.
2.7.2	GND Shift Test – Dynamic – IUT as Transceiver (Slave)	Pass	The duty cycle of RX is in range D1 – 2µs ... D2 + 2µs.
2.7.3	VBAT Shift Test – Dynamic – IUT as Transceiver (Master)	Pass	The duty cycle of RX is in range D1 – 2µs ... D2 + 2µs.
2.7.4	VBAT Shift Test – Dynamic – IUT as Transceiver (Slave)	Pass	The duty cycle of RX is in range D1 – 2µs ... D2 + 2µs.
2.8	**Failure**		
2.8.1	Loss of Battery	Pass	No parasitic current path is formed between the bus line and the DUT.
2.8.2	Loss of GND	Pass	No parasitic current path is formed between the bus line and the DUT.
2.9	**Verifying internal capacitance and dynamic interference – IUT as Slave**		
2.9.1	Normal power supply	Pass	C_{SLAVE} is less or equal than 250pF: $T_{INT} \leq T_{REF}$ The IUT does not interfere with the dynamic stimulus

No.	Description	Result	Comment
2.9.2	IUT loss of GND	Pass	C_{SLAVE} is less or equal than 250pF: $T_{INT} \leq T_{REF}$ The IUT does not interfere with the dynamic stimulus
2.9.2	IUT loss of V_{SUP}	Pass	C_{SLAVE} is less or equal than 250pF: $T_{INT} \leq T_{REF}$ The IUT does not interfere with the dynamic stimulus

5.2 Static Tests

The motivation of static test cases is to check the availability and the boundaries in the data sheet of the IUT. For all integrated circuits every related parameter in Table 3 must be part of the data sheet and fulfil the specified boundaries in terms of physical worst case condition. Data sheet parameter names may deviate from the names in Table 3, but in this case a cross-reference list (data sheet versus Table 3) shall be provided for this test. Parameter conditions may deviate from the conditions in Table 3, if the data sheet conditions are according to the physical worst case context in Table 3 at least. If one parameter does not pass this test, the result of the whole conformance test is failed.

Reference LIN Physical Layer Spec Revision 2.2 December 31, 2010, section Line Driver/Receiver, 6.5.4 ELECTRICAL DC PA-RAMETERS, table 6.6 to 6.11

Notes to the following table:

name of parameter and values in LIN specification ← *cross reference* → *cross reference of parameters*

values in data sheet

result of static test

no.	reference	parameter	min	max	unit	comment / condition	valid for…	cross reference and data sheet values				ref.	result
1.	Param 9	V_{BAT}	8.0	18.0	V	ECU operating voltage	all devices with integrated reverse polarity diode	V_{BAT} =	V_{XX}	MIN	MAX	Table 4.1	pass/fail/ comment

Data sheet used:
MC9S12ZVL_Rev.01.00.pdf

No.	reference	parameter	min	max	unit	comment / condition	valid for…	cross reference and data sheet values				ref.	Result
1.	Param 9	V_{BAT}	8.0	18.0	V	ECU operating voltage	all devices with integrated reverse polarity diode	V_{BAT} =	-	MIN -	MAX -	-	n/a no diode
2.	Param 10	V_{SUP}	7.0	18.0	V	Supply voltage range	all devices without integrated reverse polarity diode	V_{SUP}=	V_{LINSUP}	MIN 5V	MAX 18V	Table A-26.1	Pass
3.	Param 11	$V_{SUP\_NON\_OP}$	-0.3	40.0	V	voltage range within which the device is not destroyed	all devices	$V_{SUP\_NON\_OP}$=	V_{SUP}	MIN -0.3V	MAX 42V	Table A-3.1	Pass
4.	Param 12	I_{BUS_LIM}	40	200	mA	Current Limitation for Driver dominant state driver on $V_{BUS} = V_{BAT\_max}$	all devices with integrated LIN transmitter	I_{BUS_LIM}=	I_{LIN_LIM}	MIN 40mA	MAX 200mA	Table A-26.2	Pass
								Conditions					
								V_{BUS} =	$V_{LIN} = V_{LINSUP\_LIN\_MAX}$				

No.	reference	parameter	min	max	unit	comment / condition	valid for…	cross reference and data sheet values	ref.	result
5.	Param 13	$I_{BUS\_PAS\_dom}$	-1		mA	Input Leakage Current at the Receiver incl. Slave Pull-Up Resistor as specified in Table 6.7 driver off V_{BUS} = 0V V_{BAT}= 12V	all devices with integrated slave pull-up resistor	$I_{BUS\_PAS\_dom}$= $I_{LIN\_PAS\_dom}$: MIN -1mA, MAX - Conditions driver state: driver off V_{BUS} = V_{LIN} = 0V V_{BAT} = V_{LINSUP} = 12V	Table A-26.3	Pass
6.	Param 14	$I_{BUS\_PAS\_rec}$		20	µA	driver off 8V<V_{BAT}<18V 8V<V_{BUS}<18V V_{BUS} > V_{BAT}	all devices	$I_{BUS\_PAS\_rec}$ = $I_{LIN\_PAS\_rec}$: MIN -, MAX 20µA Conditions driver state: driver off 8V<V_{BAT}<18V: V<V_{LINSUP}<18V 8V<V_{BUS}<18V: 5V<V_{LIN}<18V V_{BUS} > V_{BAT}: V_{LIN} > V_{LINSUP}	Table A-26.4	Pass
7.	Param 15	$I_{BUS\_NO\_GND}$	-1	1	mA	Control unit disconnected from ground GND_{Device} = V_{SUP} 0V<V_{BUS}<18V V_{BAT} = 12V Loss of local ground must not affect communication in the residual network.	all devices	$I_{BUS\_NO\_GND}$= $I_{LIN\_NO\_GND}$: MIN -1mA, MAX 1mA Conditions GND_{Device} = V_{SUP}: GND_{Device} = V_{LINSUP} V_{BUS}: 0V<V_{LIN}<18V V_{BAT}: V_{LINSUP} = 12V	Table A-26.5	Pass

No.	reference	parameter	min	max	unit	comment / condition	valid for…	cross reference and data sheet values	ref.	result
8.	Param 16	$I_{BUS\_NO\_BAT}$		100	µA	V_{BAT} disconnected V_{SUP_Device} = GND $0<V_{BUS}<18V$ Node has to sustain the current that can flow under this condition. Bus must remain operational under this condition.	all devices	$I_{BUS\_NO\_BAT}$ | $I_{LIN\_NO\_BAT}$ | MIN: - | MAX: 30µA **Conditions** V_{BAT} = disconnected | battery disconnected V_{SUP_Device} = GND | V_{LINSUP} = GND_{Device} V_{BUS} | $0<V_{LIN}<18V$	Table A-26.6	Pass
9.	Param 17	V_{BUSdom}		0.4	V_{SUP}	receiver dominant state	all devices with integrated LIN receiver	V_{BUSdom} = | V_{LINdom} | MIN: - | MAX: 0.4 V_{LINSUP}	Table A-26.7	Pass
10.	Param 18	V_{BUSrec}	0.6		V_{SUP}	receiver recessive state	all devices with integrated LIN receiver	V_{BUSrec} = | V_{LINrec} | MIN: 0.6 V_{LINSUP} | MAX: -	Table A-26.8	Pass
11.	Param 19	V_{BUS_CNT}	0.475	0.525	V_{SUP}	$V_{BUS\_CNT} = (V_{th\_dom}+V_{th\_rec})/2$	all devices with integrated LIN receiver	V_{BUS_CNT}= | V_{LIN_CNT} | MIN: 0.475 V_{LINSUP} | MAX: 0.525 V_{LINSUP} **Condition** $V_{BUS\_CNT} = (V_{th\_dom}+V_{th\_rec})/2$ | $V_{LIN\_CNT} =(V_{th\_dom}+ V_{th\_rec})/2$	Table A-26.9	Pass
12.	Param 20	V_{HYS}		0.175	V_{SUP}	$V_{HYS} = V_{th\_rec}-V_{th\_dom}$	all devices with integrated LIN receiver	V_{HYS} = | V_{HYS} | MIN: - | MAX: 0.175 V_{LINSUP} **Conditions** $V_{HYS} = V_{th\_rec}-V_{th\_dom}$ | $V_{HYS} = V_{th\_rec} -V_{th\_dom}$	Table A-26.10	Pass

No.	reference	parameter	min	max	unit	comment / condition	valid for…	cross reference and data sheet values				ref.	result
13.	Param 27	D1	0.396			$T_{HRec(max)} = 0.744 \times V_{SUP}$; $T_{HDom(max)} = 0.581 \times V_{SUP}$; V_{SUP} = 7.0V...18V; t_{Bit} = 50µs; D1 = $t_{Bus\_rec(min)} / (2 \times t_{Bit})$	all devices with integrated LIN transmitter D1 valid for 20kBaud	D1=	D1	MIN	MAX	Table A-27.7	Pass
										0.396	-		
								Conditions					
								$T_{HRec(max)}$ =	$T_{HRec(max)} = 0.744 \times V_{LINSUP}$				
								$T_{HDom(max)}$ =	$T_{HDom(max)} = 0.581 \times V_{LINSUP}$				
								V_{SUP} =	V_{LINSUP} = 7.0V...18V				
								t_{Bit} =	t_{Bit} = 50us				
								D1 = $t_{Bus\_rec(min)} / (2 \times t_{Bit})$	D1 = $t_{Bus\_rec(min)} / (2 \times t_{Bit})$				
14.	Param 28	D2		0.581		$T_{HRec(min)} = 0.422 \times V_{SUP}$; $T_{HDom(min)} = 0.284 \times V_{SUP}$; V_{SUP} = 7.6V...18V; t_{Bit} = 50µs; D2 = $t_{Bus\_rec(max)} / (2 \times t_{Bit})$	all devices with integrated LIN transmitter D2 valid for 20kBaud	D2=	D2	MIN	MAX	Table A-27.8	Pass
										-	0.581		
								Conditions					
								$T_{HRec(min)}$=	$T_{HRec(min)} = 0.422 \times V_{LINSUP}$				
								$T_{HDom(min)}$ =	$T_{HDom(min)} = 0.284 \times V_{LINSUP}$				
								V_{SUP} =	V_{LINSUP} = 7.6V...18V				
								t_{Bit} =	t_{Bit} = 50us				
								D2 = $t_{Bus\_rec(max)} / (2 \times t_{Bit})$	D2 = $t_{Bus\_rec(max)} / (2 \times t_{Bit})$				

No.	reference	parameter	min	max	unit	comment / condition	valid for…	cross reference and data sheet values	ref.	result
15.	Param 29	D3	0.417			$T_{HRec(max)}$ = 0.778 x V_{SUP}; $T_{HDom(max)}$ = 0.616 x V_{SUP}; V_{SUP} = 7.0V...18V; t_{Bit} = 96µs; D3 = $t_{Bus\_rec(min)}$ / (2 x t_{Bit})	all devices with integrated LIN transmitter D3 valid for 10.4 kBaud	D3= D3 MIN: 0.417, MAX: - Conditions $T_{HRec(max)}$ = $T_{HRec(max)}$ = 0.778 x V_{LINSUP} $T_{HDom(max)}$ = $T_{HDom(max)}$ = 0.616 x V_{LINSUP} V_{SUP} = V_{LINSUP} = 7.0V...18V t_{Bit} = t_{Bit} = 96us D3 = $t_{Bus\_rec(min)}$ / (2 x t_{Bit}) D3 = $t_{Bus\_rec(min)}$ / (2 x t_{Bit})	Table A-27.11	Pass
16.	Param 30	D4		0.590		$T_{HRec(min)}$ = 0.389 x V_{SUP}; $T_{HDom(min)}$ = 0.251 x V_{SUP}; V_{SUP} = 7.6V...18V; t_{Bit} = 96µs; D4 = $t_{Bus\_rec(max)}$ / (2 x t_{Bit})	all devices with integrated LIN transmitter D4 valid for 10.4 kBaud	D4= D4 MIN: -, MAX: 0.590 Conditions $T_{HRec(min)}$ = $T_{HRec(min)}$ = 0.389 x V_{LINSUP} $T_{HDom(min)}$ = $T_{HDom(min)}$ = 0.251 x V_{LINSUP} V_{SUP} = V_{LINSUP} = 7.6V...18V t_{Bit} = t_{Bit} = 96us D4 = $t_{Bus\_rec(max)}$ / (2 x t_{Bit}) D4 = $t_{Bus\_rec(max)}$ / (2 x t_{Bit})	Table A-27.12	Pass
17.	Param 31	t_{rx_pd}		6	µs	propagation delay of receiver	all devices with integrated LIN receiver	t_{rx_pd} = t_{rx_pd} MIN: -, MAX: 6µs	Table A-27.3	Pass
18.	Param 32	t_{rx_sym}	-2	2	µs	symmetry of receiver propagation delay rising edge w.r.t. falling edge	all devices with integrated LIN receiver	t_{rx_sym}= t_{rx_sym} MIN: -2µs, MAX: 2µs	Table A-27.4	Pass

No.	reference	parameter	min	max	unit	comment / condition	valid for…	cross reference and data sheet values				ref.	result
19.	Param 26	R_{SLAVE}	20	60	kΩ		all devices with integrated slave pull-up resistor	R_{SLAVE}=	R_{slave}	MIN 27kΩ	MAX 40kΩ	Table A-26.13	Pass
20.	Param 25	R_{MASTER}	900	1100	Ω	The serial diode is mandatory. Only for valid for Transceiver with integrated Master pull up resistor	all devices with integrated master pull-up resistor	R_{MASTER} =	-	-		-	n/a No Master Device
21.	Param 37	C_{SLAVE}		250	pF	Capacitance of slave node	all LIN slave devices	C_{SLAVE}=	C_{slave}	250pF		Table A-26.11	Pass
22.	LIN 2.2 Specification Chapter 6.5.7	LIN device states changes	-	-	-	All LIN device state changes on conditional events (e.g. temperature shut-down) shall be specified in the LIN device data sheet.	all devices	Automatic transmitter shutdown in case of an over-current or TxD-dominant timeout				Chapter 1.4.8	Pass
23.		LIN transceiver input capacitance	-	-	-	A maximum LIN transceiver input capacitance shall be specified in the LIN device data sheet. Please consider the data sheet limits (e.g. voltage, temperature). The value should be as low as possible.	all devices			C_{LIN} Max 45pF		Table A-26.12	Pass

:

6 Test Protocol Dynamic Tests

Following test case numeration and cross references relates on the corresponding test specification.

TC 2.1 Operating Voltage Range

This test shall ensure the correct operation in the valid supply voltage ranges, by correct reception of dominant bits. The IUT is therefore supplied with an increasing / decreasing voltage ramp.

TC 2.1.1 Voltage Ramp [7.0V…18V], 0.1V/s [up]

Comment	Test Result
The RX pin of the IUT shows the 10kHz signal with a maximum deviation of 10% (time, voltage) is allowed.	Pass

TC 2.1.2 Voltage Ramp [18V…7.0V], 0.1V/s [down]

Comment	Test Result
The RX pin of the IUT shows the 10kHz signal with a maximum deviation of 10% (time, voltage) is allowed.	Pass

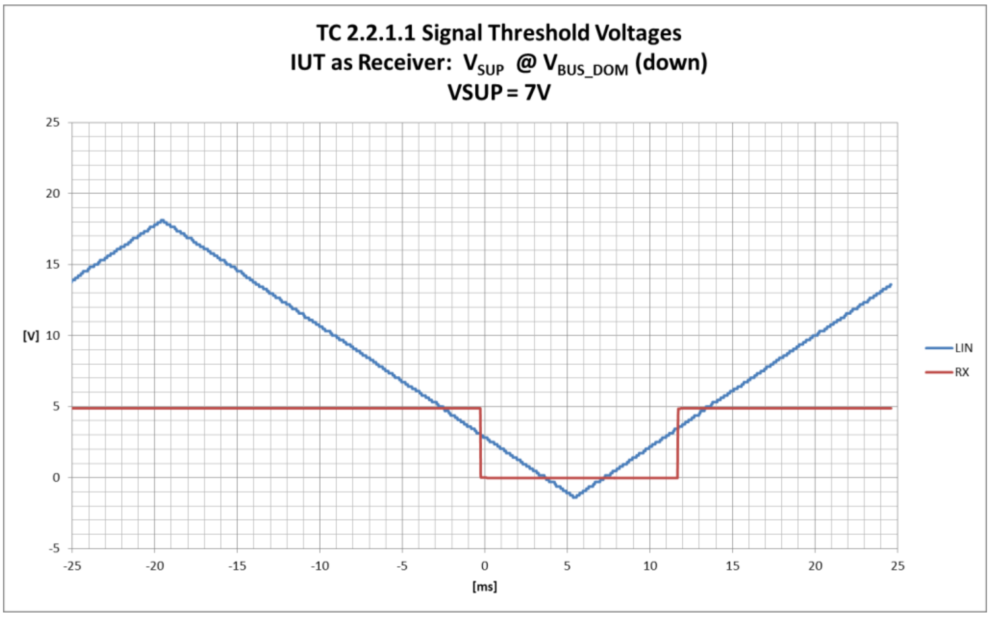
TC 2.2 Threshold Voltages

This group of tests checks whether the receiver threshold voltage of the IUT are implemented correctly within the entire specified operating supply voltage range. The LIN Bus voltage is driven with a voltage ramp checking the entire dominant and recessive signal area with respect to the applied supply voltage. In TC 2.2.1 and 2.2.2 the signal has to stay continuously on recessive or dominant level depending on the test case. In TC 2.2.3 the RX output transition is detected.

TC 2.2.1 IUT as Receiver: V_{SUP} @ V_{BUS_DOM} (down)

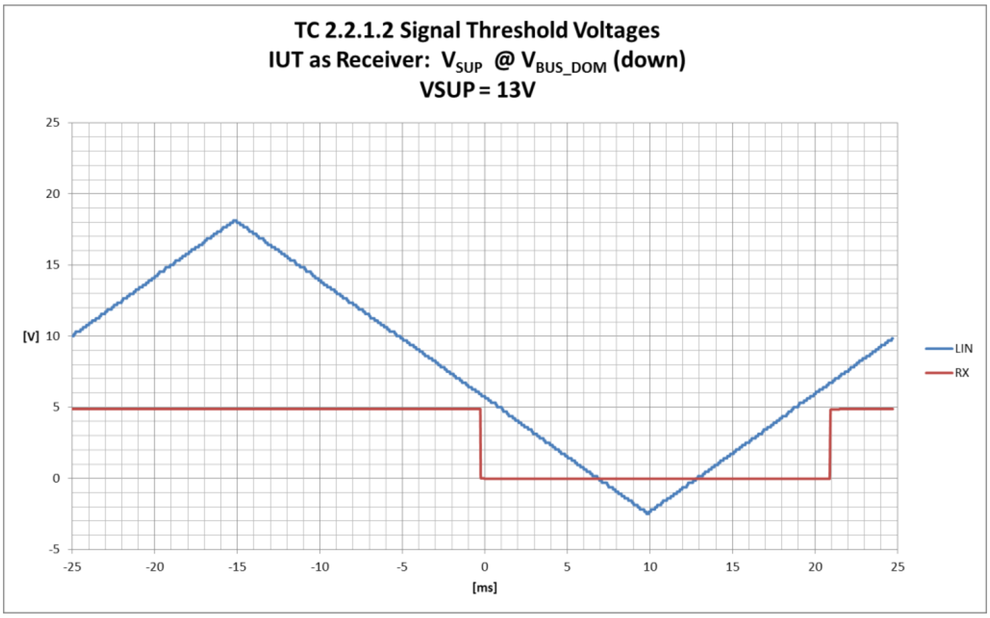
TC 2.2.1.1 V_{SUP} = 7V Signal Range [18V…4.2V], Expected RX Signal recessive

V_{SUP} = 7V Signal Range [2.8V…-1.05V], Expected RX Signal dominant

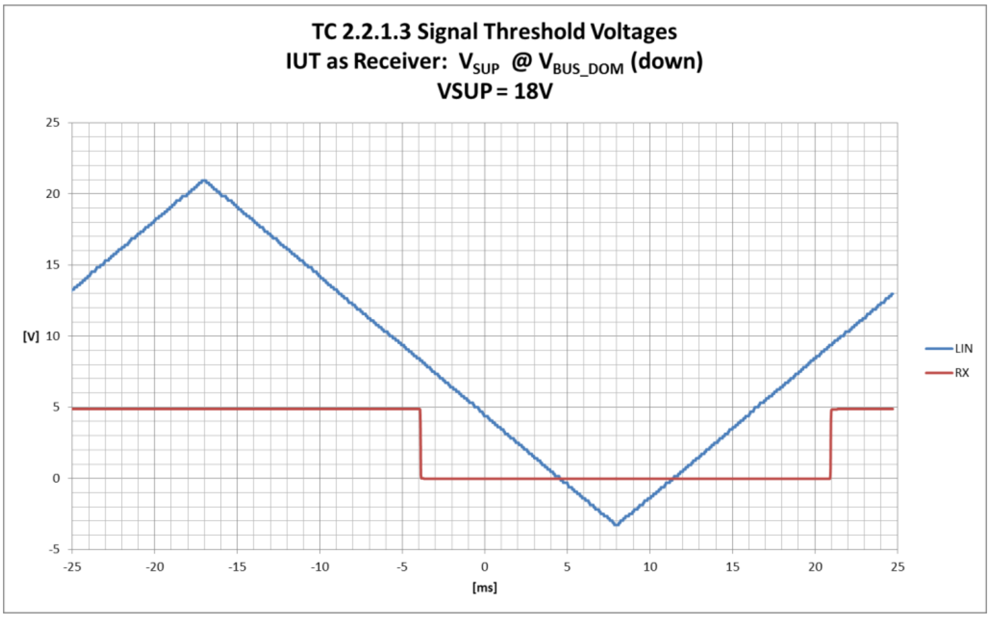


TC 2.2.1.2 V_{SUP} = 13V, Signal Range [18V…7.8V], Expected RX Signal recessive

V_{SUP} = 13V, Signal Range [5.2 V…-2.1V], Expected RX Signal dominant



TC 2.2.1.3 V_{SUP} = 18V, Signal Range [20.7 V…10.8V], Expected RX Signal recessive
V_{SUP} = 18V, Signal Range [7.2 V…-2.7V], Expected RX Signal dominant

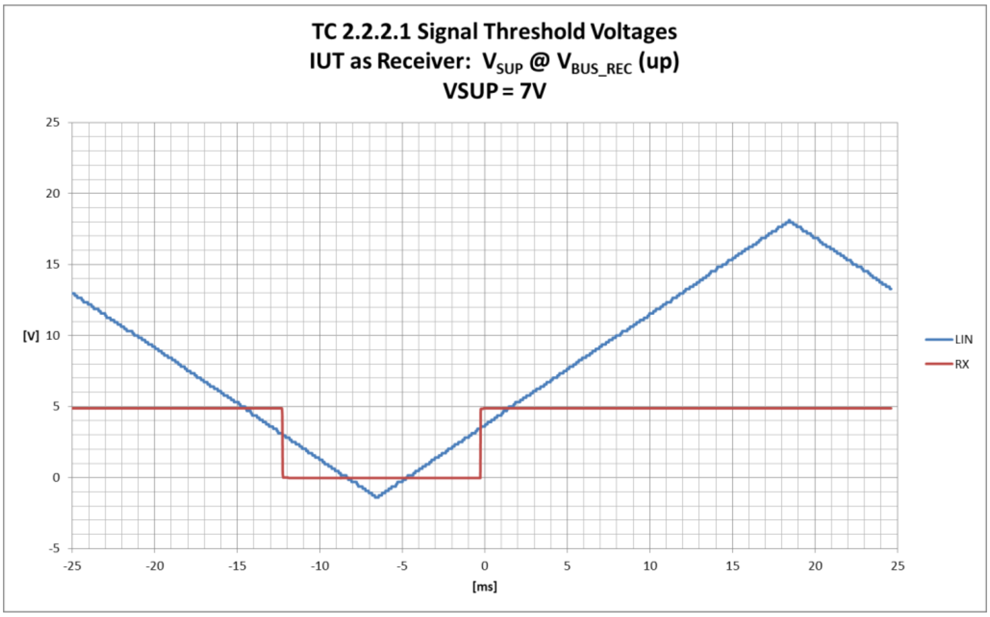


# test	V_{SUP}	Signal Range	Expected RX Signal	Measured RX Signal
2.2.1.1	7V	[18V…4.2V]	recessive	recessive
		[2.8V…-1.05V]	dominant	dominant
2.2.1.2	13V	[18V…7.8V]	recessive	recessive
		[5.2…-2.1V]	dominant	dominant
2.2.1.3	18V	[20.7V…10.8V]	recessive	recessive
		[7.2V…-2.7V]	dominant	dominant

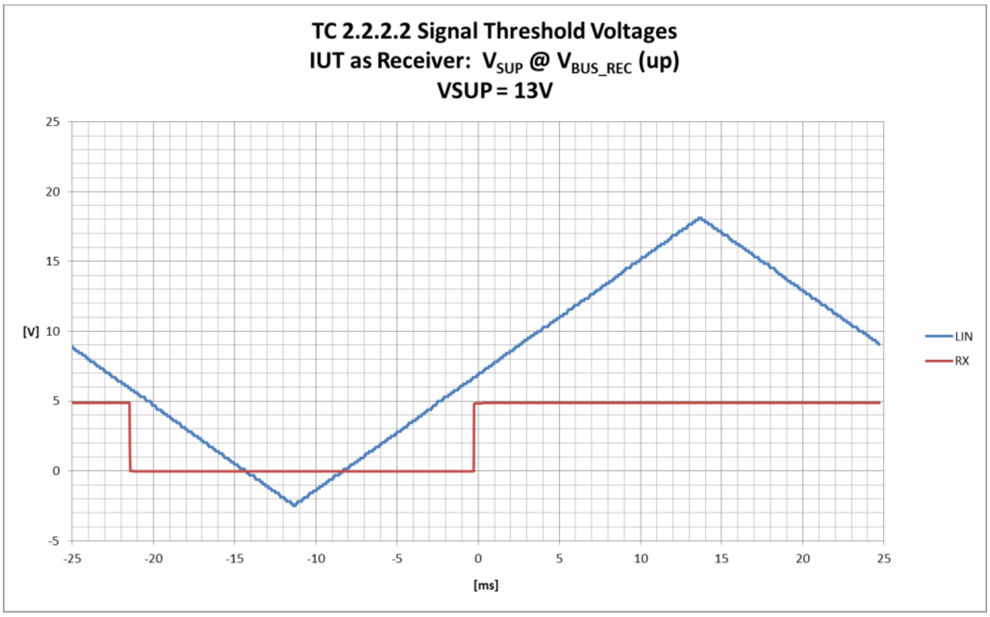
Comment	Test Result
The IUT must generate a dominant or recessive value on RX as defined.	Pass

TC 2.2.2 IUT as Receiver: V_{SUP} @ V_{BUS_REC} (up)

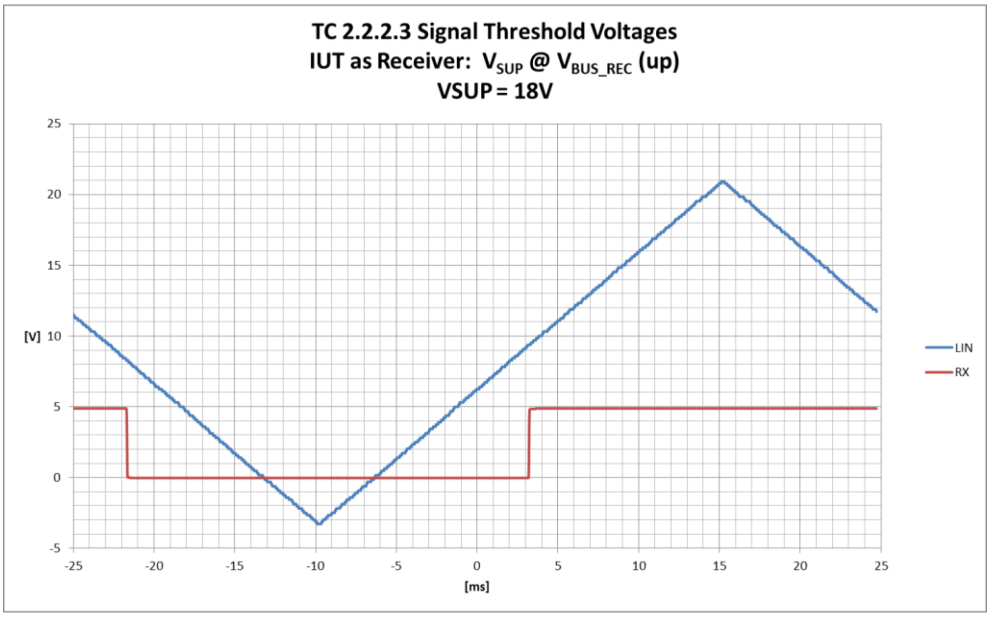
TC 2.2.2.1 V_{SUP} = 7V, Signal Range [-1.05V…2.8V], Expected RX Signal dominant
V_{SUP} = 7V, Signal Range [4.2V…18V], Expected RX Signal recessive



TC 2.2.2.2 V_{SUP} = 13V, Signal Range [-2.1V…5.2V], Expected RX Signal dominant
V_{SUP} = 13V, Signal Range [7.8V…18V], Expected RX Signal recessive



TC 2.2.2.3 V_{SUP} = 18V, Signal Range [-2.7V…7.2V], Expected RX Signal dominant
V_{SUP} = 18V, Signal Range [10.8V…20.7V], Expected RX Signal recessive



# test	V_{SUP}	Signal Range	Expected RX Signal	Measured RX Signal
2.2.2.1	7V	[-1.05V…2.8V]	dominant	dominant
		[4.2V…18V]	recessive	recessive
2.2.2.2	13V	[-2.1V…5.2V]	dominant	dominant
		[7.8…18V]	recessive	recessive
2.2.2.3	18V	[-2.7V…7.2V]	dominant	dominant
		[10.8V…20.7V]	recessive	recessive

Comment	Test Result
The IUT must generate a dominant or recessive value on RX as defined.	Pass

TC 2.2.3 IUT as Receiver: VSUP @ V_{BUS}

This test shall verify the symmetry of the receiver thresholds. For this purpose a voltage ramp on V_{BUS} shows the required threshold values.

TC 2.2.3.1 V_{SUP} = 7V, Signal Range [-1.05V…8.05V] up [8.05V…-1.05V] down

Vsup	7V
V_th_dom	3.250 V
V_th_rec	3.687 V
V_hys	0.438 V
V_bus_cnt	3.468 V

Comment	Test Result
The RX output transition must meet the following conditions: VBUS_CNT = (Vth_dom+Vth_rec)/2 in range of [0.475…0.525]*VSUP VHYS = Vth_rec – Vth_dom must be less than 0.175*VSUP	Pass

TC 2.2.3.2 V_{SUP} = 14V, Signal Range [-2.1V…16.1V] up [16.1V…-2.1V] down

Vsup	14V
V_th_dom	6.505 V
V_th_rec	7.318 V
V_hys	0.813 V
V_bus_cnt	6.911 V

Comment	Test Result
The RX output transition must meet the following conditions: VBUS_CNT = (Vth_dom+Vth_rec)/2 in range of [0.475…0.525]*VSUP VHYS = Vth_rec – Vth_dom must be less than 0.175*VSUP	Pass

TC 2.2.3.3 V_{SUP} = 18V, Signal Range [-2.7V…20.7V] up [20.7V…-2.7V] down

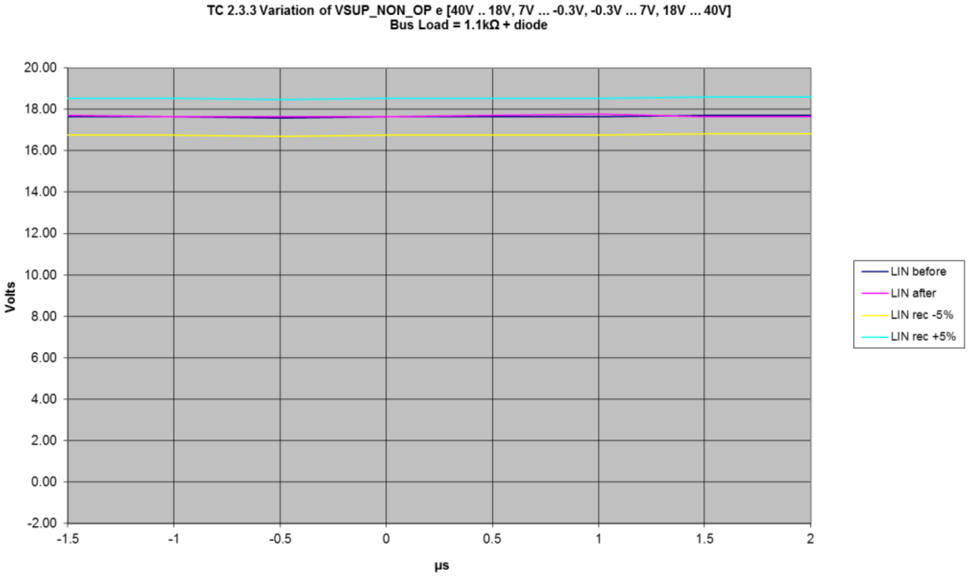
Vsup	18V
V_th_dom	8.375 V
V_th_rec	9.438 V
V_hys	1.063 V
V_bus_cnt	8.906 V

Comment	Test Result
The RX output transition must meet the following conditions: VBUS_CNT = (Vth_dom+Vth_rec)/2 in range of [0.475…0.525]*VSUP VHYS = Vth_rec – Vth_dom must be less than 0.175*VSUP	Pass

TC 2.3 Variation of $V_{SUP\_NON\_OP} \in$ [- 0.3V...7V], [18V…40V]

Within this test it should be checked, whether the IUT influences the bus during under and over voltage conditions.

TC 2.3.3 IUT as Transceiver 1.1kΩ + diode to V_{LIN} = 18 V

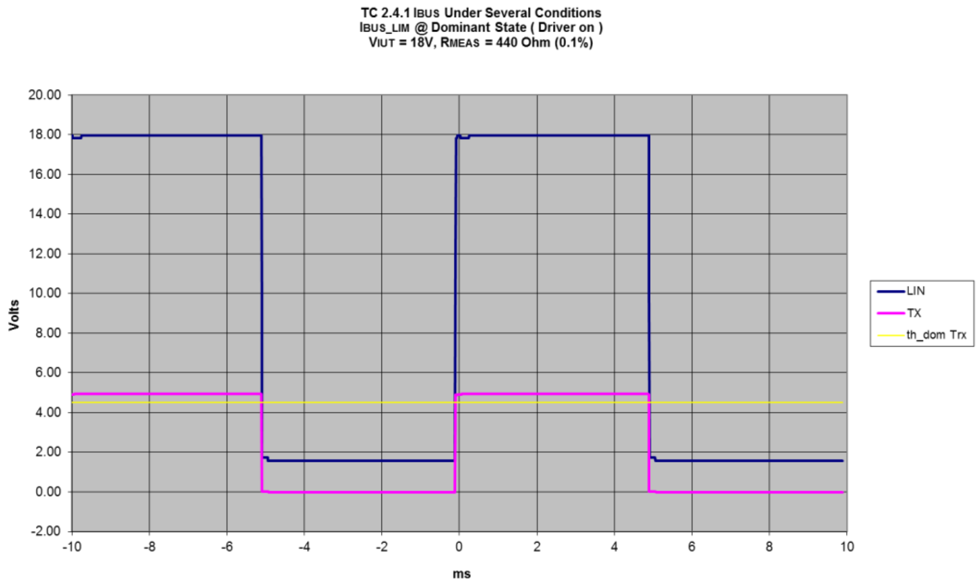


Comment	Test Result
No dominant state on LIN shall occur. The IUT must not be destroyed during the test. The afterwards recessive voltage shall have a maximum deviation of +/-5% from the before recessive voltage.	Pass

TC 2.4 I_{BUS} Under Several Conditions

TC 2.4.1 I_{BUS_LIM} @ Dominant State (Driver On)

This test checks the drive capability of the output stage. A LIN driver has to pull the LIN bus below a certain voltage according to the LIN standard. The current limitation is measured indirectly.



Comment	Test Result
LIN has to show the rectangular signal. The dominant state bus level has to be lower than th_dom= 4.518V for transceiver.	Pass

TC 2.4.2 $I_{BUS\_PAS\_dom}$: IUT in Recessive State: V_{BUS} = 0V

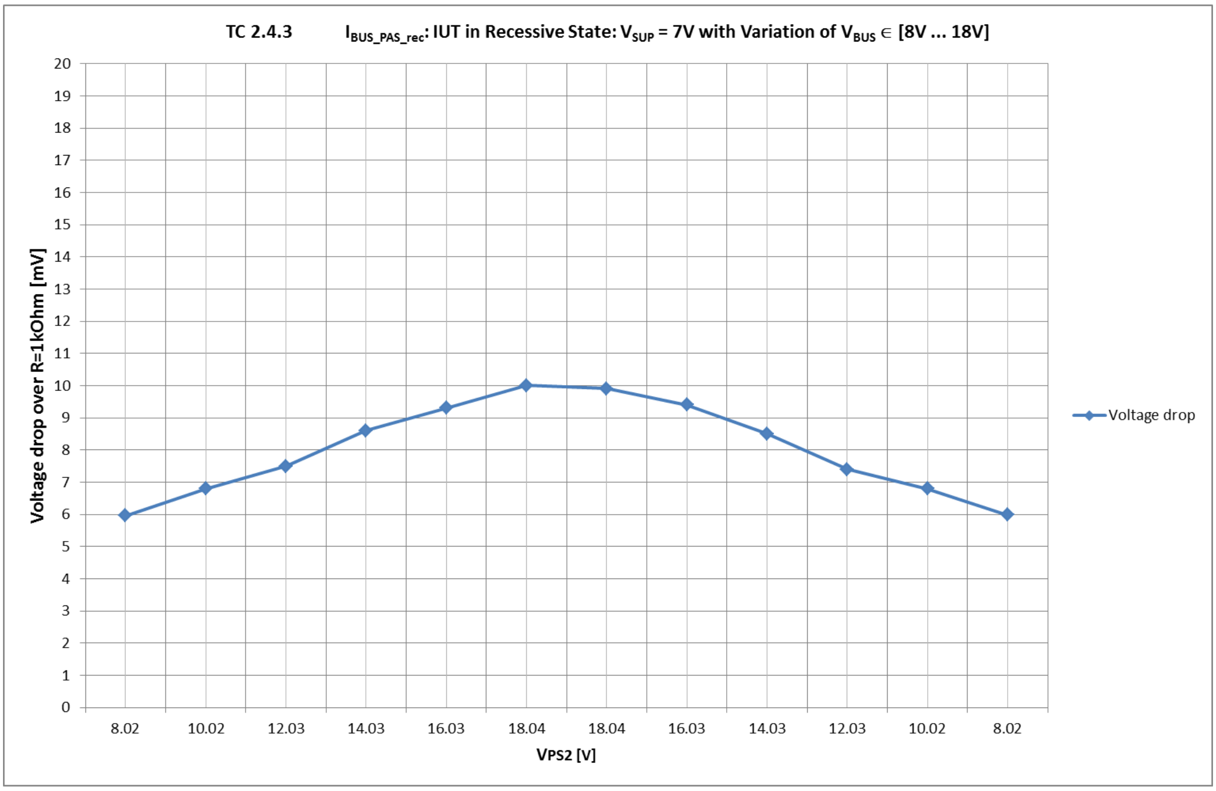
This test case is intended to test the input leakage current $I_{BUS\_PAS\_dom}$ into a node during dominant state of the LIN bus.

measured Voltage	-157 mV

Comment	Test Result
The maximum value of voltage drop shall be higher than -500mV.	Pass

TC 2.4.3 $I_{BUS\_PAS\_rec}$: IUT in Recessive State: V_{SUP} = 7V with Variation of V_{BUS} ∈ [8V ... 18V]

This test case is checking, whether there is a diode implementation within the termination path of the IUT. The reverse currents should be limited to $I_{BUS\_PAS\_rec}$ (Max) from the LIN wire into the IUT even if V_{BUS} is higher than the IUT's supply voltage V_{IUT}.

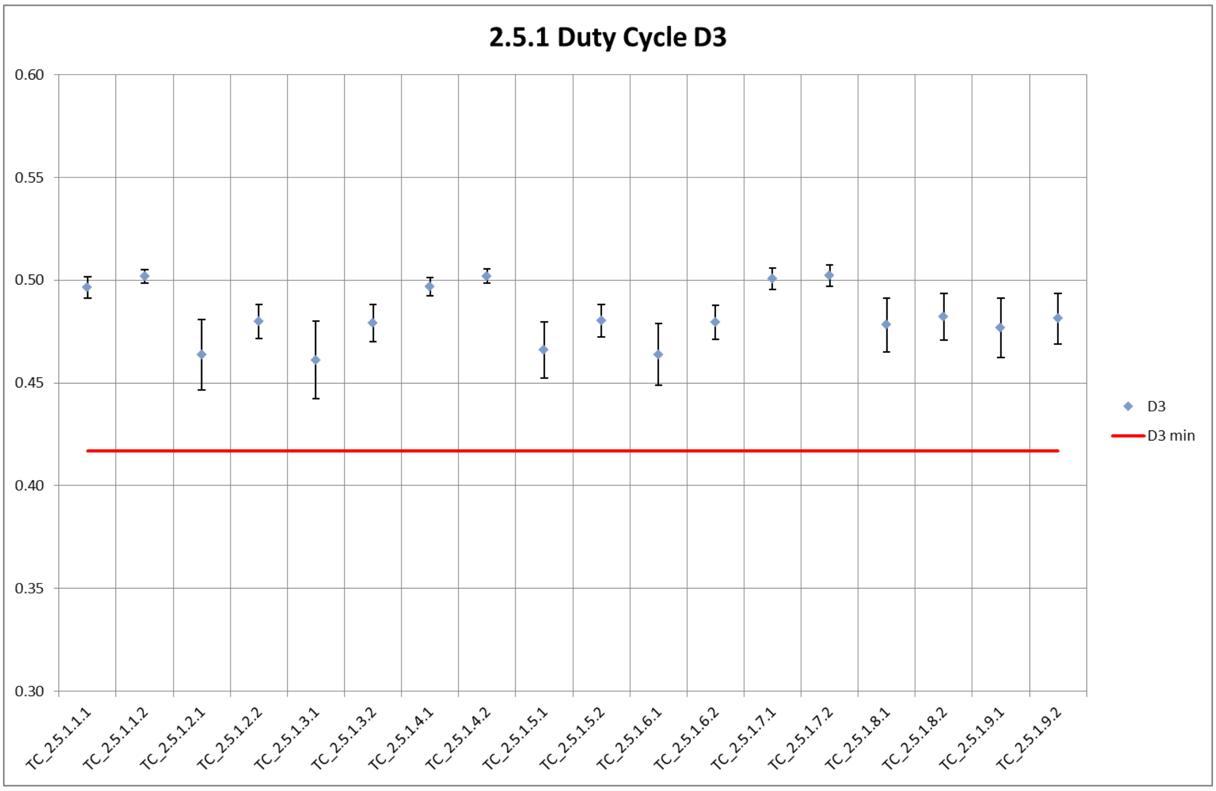


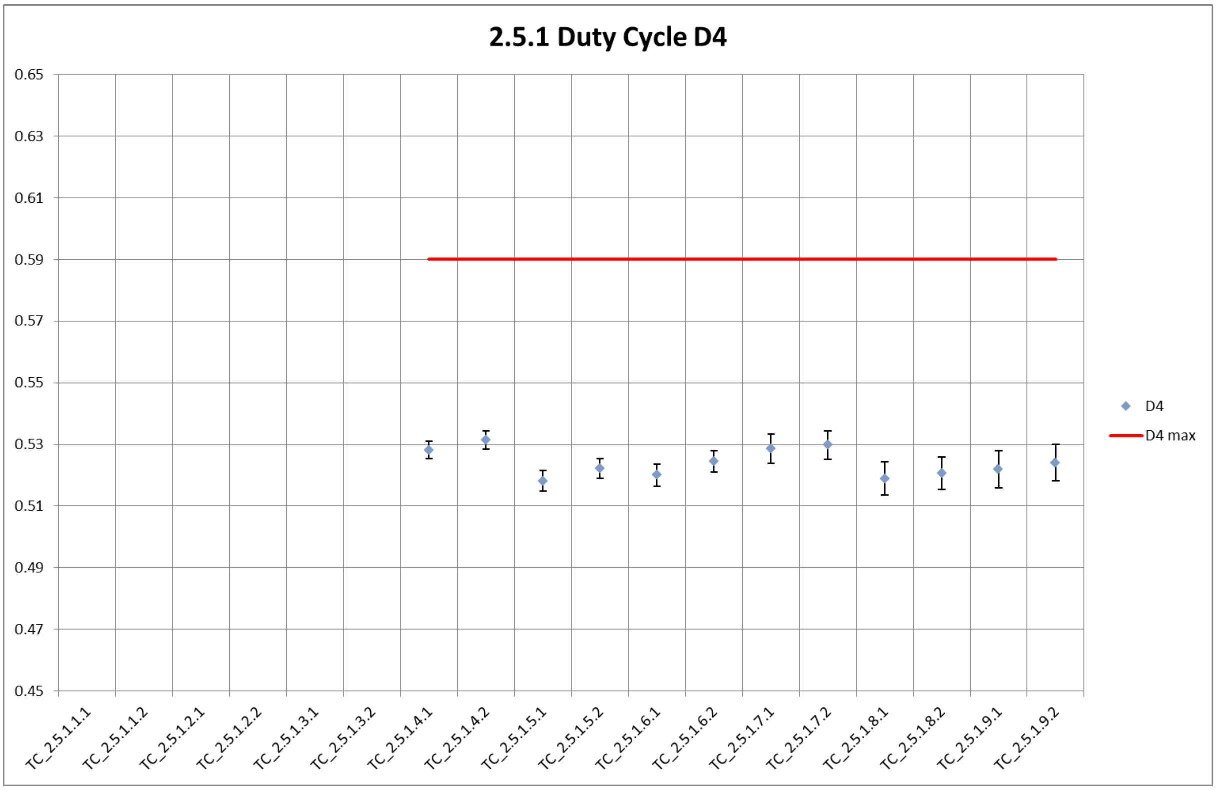
Comment	Test Result
The maximum value of voltage drop shall be less or equal 20mV.	Pass

TC 2.5 Slope Control

Sense of this test is checking the slope control function of the driver stage.

TC 2.5.1 Measuring the Duty Cycle @ 10.4 kBit/sec – IUT as Transmitter





Test case #	V_{SUP} / V_{BAT} (PS 1)	V_{PS2} (PS 2)	Bus loads (C; R)	Duty cycle		Result
				D3 ±U*	D4 ±U*	
2.5.1.1.1	7.0V / 8.0V	6.0V	1nF (1%); 1kΩ (0.1%)	0.497 ±0.005	–	Pass
2.5.1.1.2	7.0V / 8.0V	6.6V	1nF (1%); 1kΩ (0.1%)	0.502 ±0.003	–	Pass
2.5.1.2.1	7.0V / 8.0V	6.0V	6.8nF (1%); 660 Ω (0.1%)	0.464 ±0.017	–	Pass
2.5.1.2.2	7.0V / 8.0V	6.6V	6.8nF (1%); 660 Ω (0.1%)	0.480 ±0.008	–	Pass
2.5.1.3.1	7.0V / 8.0V	6.0V	10nF (1%); 500 Ω (0.1%)	0.461 ±0.019	–	Pass
2.5.1.3.2	7.0V / 8.0V	6.6V	10nF (1%); 500 Ω (0.1%)	0.479 ±0.009	–	Pass
2.5.1.4.1	7.6V / 8.6V	6.6V	1nF (1%); 1kΩ (0.1%)	0.497 ±0.004	0.528 ±0.003	Pass
2.5.1.4.2	7.6V / 8.6V	7.2V	1nF (1%); 1kΩ (0.1%)	0.502 ±0.003	0.531 ±0.003	Pass
2.5.1.5.1	7.6V / 8.6V	6.6V	6.8nF (1%); 660 Ω (0.1%)	0.466 ±0.014	0.518 ±0.003	Pass
2.5.1.5.2	7.6V / 8.6V	7.2V	6.8nF (1%); 660 Ω (0.1%)	0.480 ±0.008	0.522 ±0.003	Pass
2.5.1.6.1	7.6V / 8.6V	6.6V	10nF (1%); 500 Ω (0.1%)	0.464 ±0.015	0.520 ±0.004	Pass
2.5.1.6.2	7.6V / 8.6V	7.2V	10nF (1%); 500 Ω (0.1%)	0.480 ±0.008	0.524 ±0.003	Pass
2.5.1.7.1	18V / 18.6V	17.0V	1nF (1%); 1kΩ (0.1%)	0.501 ±0.005	0.529 ±0.005	Pass
2.5.1.7.2	18V / 18.6V	17.6V	1nF (1%); 1kΩ (0.1%)	0.502 ±0.005	0.530 ±0.005	Pass
2.5.1.8.1	18V / 18.6V	17.0V	6.8nF (1%); 660 Ω (0.1%)	0.478 ±0.013	0.519 ±0.005	Pass
2.5.1.8.2	18V / 18.6V	17.6V	6.8nF (1%); 660 Ω (0.1%)	0.482 ±0.011	0.521 ±0.005	Pass
2.5.1.9.1	18V / 18.6V	17.0V	10nF (1%); 500 Ω (0.1%)	0.477 ±0.014	0.522 ±0.006	Pass
2.5.1.9.2	18V / 18.6V	17.6V	10nF (1%); 500 Ω (0.1%)	0.481 ±0.012	0.524 ±0.006	Pass

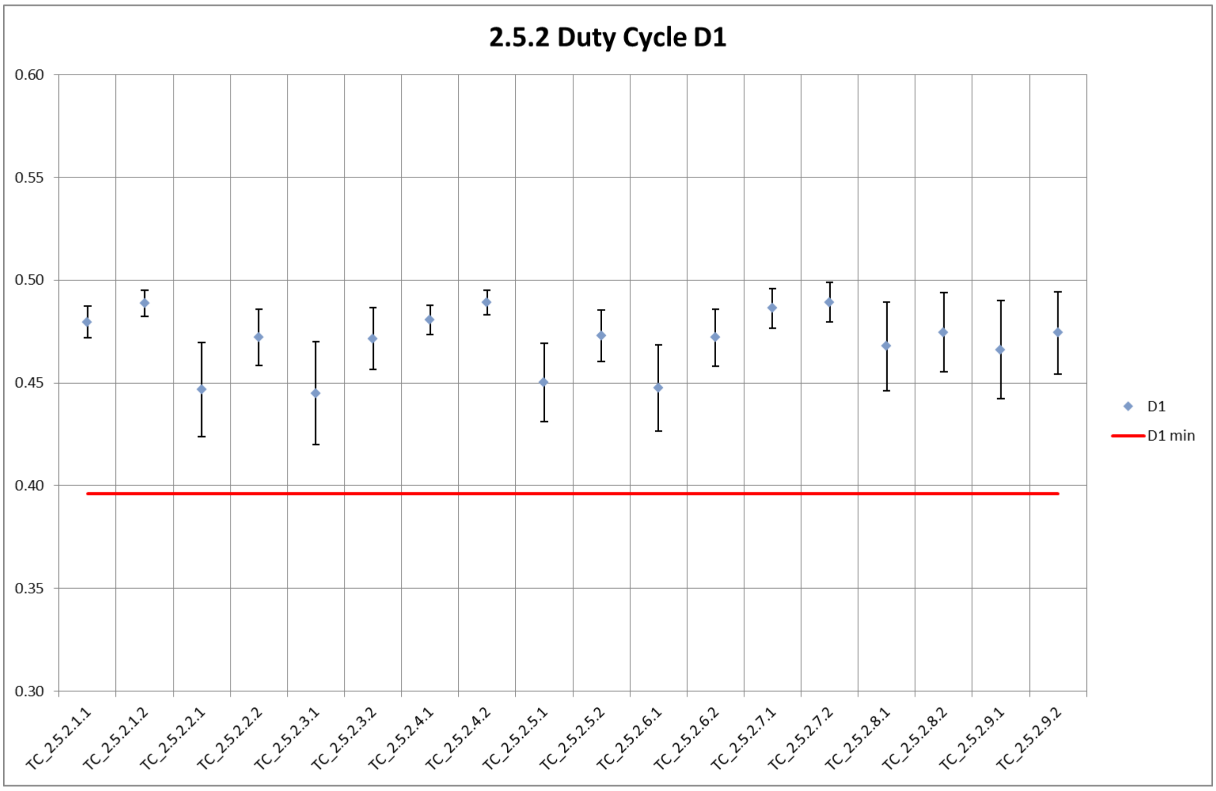
*The measurement uncertainty analysis based on the type B evaluation according to the “Guide to the Expression of Uncertainty in Measurement” (European Committee for Standardization, ENV 13005, 1999).

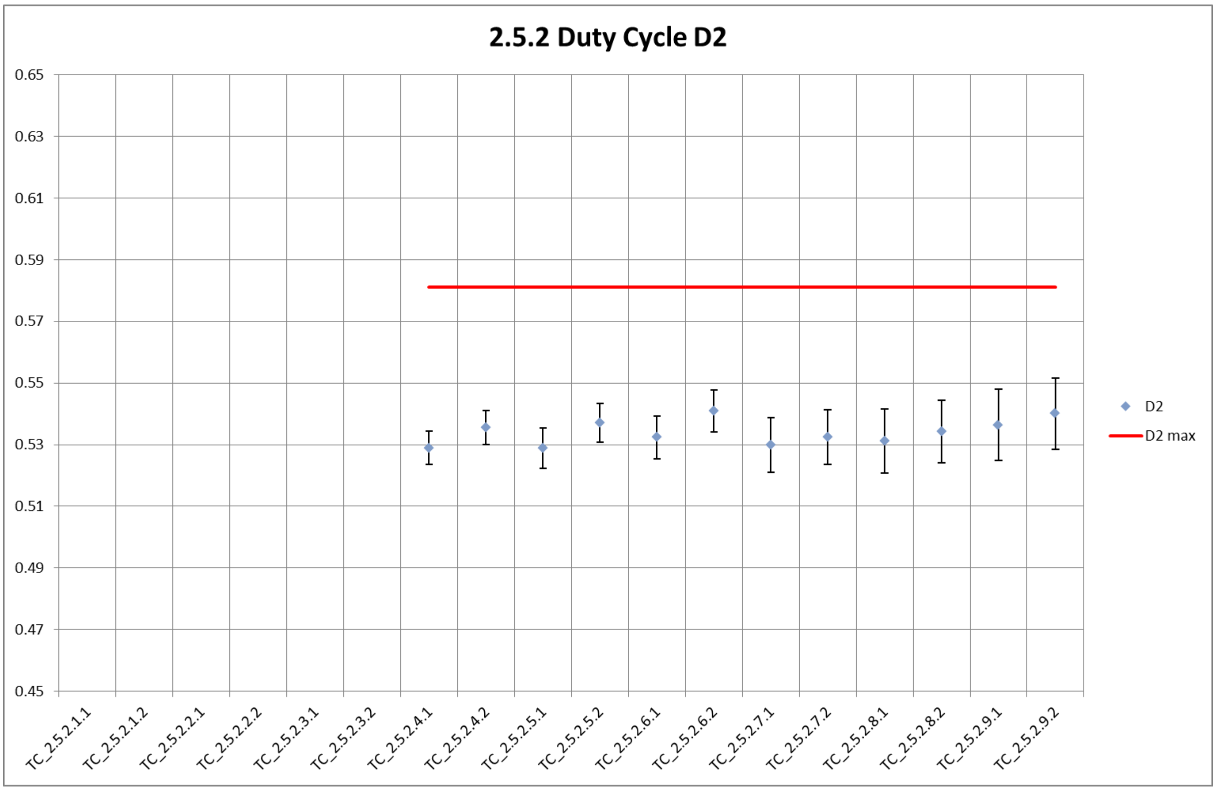
The steps involved are as follows:

1. Evaluation of the relationship between input quantities xi and the output quantity $y = f(x_1, x_2, \ldots, x_n)$
2. Identification of the standard uncertainty $u(x_i)$ for each input estimate x_i
3. Identification of the combined standard uncertainty $u_c(x_i)$ for the output quantity y
4. Calculation of the expanded uncertainty $U = k \cdot u_c(x_i)$, with coverage factor k=2. The coverage probability is approximately 95%.

Comment	Test Result
The measured duty cycle D3 must be greater or equal than 0.417 for V_{SUP} = [7.0V... 18V], the measured duty cycle D4 must also be less or equal than 0.590 for V_{SUP} = [7.6V... 18V].	Pass

TC 2.5.2 Measuring the Duty Cycle @ 20 kBit/sec – IUT as Transmitter





Test case #	V_{SUP} / V_{BAT} (PS 1)	V_{PS2} (PS 2)	Bus loads (C; R)	Duty cycle		Result
				D1±U*	D2±U*	
2.5.2.1.1	7.0V / 8.0V	6.0V	1nF (1%); 1kΩ (0.1%)	0.480 ±0.008	–	Pass
2.5.2.1.2	7.0V / 8.0V	6.6V	1nF (1%); 1kΩ (0.1%)	0.489 ±0.006	–	Pass
2.5.2.2.1	7.0V / 8.0V	6.0V	6.8nF (1%); 660 Ω (0.1%)	0.447 ±0.023	–	Pass
2.5.2.2.2	7.0V / 8.0V	6.6V	6.8nF (1%); 660 Ω (0.1%)	0.472 ±0.014	–	Pass
2.5.2.3.1	7.0V / 8.0V	6.0V	10nF (1%); 500 Ω (0.1%)	0.445 ±0.025	–	Pass
2.5.2.3.2	7.0V / 8.0V	6.6V	10nF (1%); 500 Ω (0.1%)	0.472 ±0.015	–	Pass
2.5.2.4.1	7.6V / 8.6V	6.6V	1nF (1%); 1kΩ (0.1%)	0.481 ±0.007	0.529 ±0.005	Pass
2.5.2.4.2	7.6V / 8.6V	7.2V	1nF (1%); 1kΩ (0.1%)	0.489 ±0.006	0.535 ±0.006	Pass
2.5.2.5.1	7.6V / 8.6V	6.6V	6.8nF (1%); 660 Ω (0.1%)	0.450 ±0.019	0.529 ±0.007	Pass
2.5.2.5.2	7.6V / 8.6V	7.2V	6.8nF (1%); 660 Ω (0.1%)	0.473 ±0.012	0.537 ±0.006	Pass
2.5.2.6.1	7.6V / 8.6V	6.6V	10nF (1%); 500 Ω (0.1%)	0.447 ±0.021	0.532 ±0.007	Pass
2.5.2.6.2	7.6V / 8.6V	7.2V	10nF (1%); 500 Ω (0.1%)	0.472 ±0.014	0.541 ±0.007	Pass
2.5.2.7.1	18V / 18.6V	17.0V	1nF (1%); 1kΩ (0.1%)	0.486 ±0.010	0.530 ±0.009	Pass
2.5.2.7.2	18V / 18.6V	17.6V	1nF (1%); 1kΩ (0.1%)	0.489 ±0.010	0.532 ±0.009	Pass
2.5.2.8.1	18V / 18.6V	17.0V	6.8nF (1%); 660 Ω (0.1%)	0.468 ±0.022	0.531 ±0.010	Pass
2.5.2.8.2	18V / 18.6V	17.6V	6.8nF (1%); 660 Ω (0.1%)	0.475 ±0.019	0.534 ±0.010	Pass
2.5.2.9.1	18V / 18.6V	17.0V	10nF (1%); 500 Ω (0.1%)	0.466 ±0.024	0.536 ±0.012	Pass
2.5.2.9.2	18V / 18.6V	17.6V	10nF (1%); 500 Ω (0.1%)	0.474 ±0.020	0.540 ±0.012	Pass

*The measurement uncertainty analysis based on the type B evaluation according to the “Guide to the Expression of Uncertainty in Measurement” (European Committee for Standardization, ENV 13005, 1999).

The steps involved are as follows:

1. Evaluation of the relationship between input quantities xi and the output quantity y = f(x_1, x_2, …, x_n)
2. Identification of the standard uncertainty u(x_i) for each input estimate x_i
3. Identification of the combined standard uncertainty u_c (x_i) for the output quantity y
4. Calculation of the expanded uncertainty U = k·u_c (x_i), with coverage factor k=2. The coverage probability is approximately 95%.

Comment	Test Result
The measured duty cycle D1 must be greater or equal than 0.396 for V_{SUP} = [7.0V – 18V], the measured duty cycle D2 must be less or equal than 0.581 for V_{SUP} = [7.6V – 18V].	Pass

TC 2.6 Propagation Delay

TC 2.6.1 Propagation Delay of the Receiver

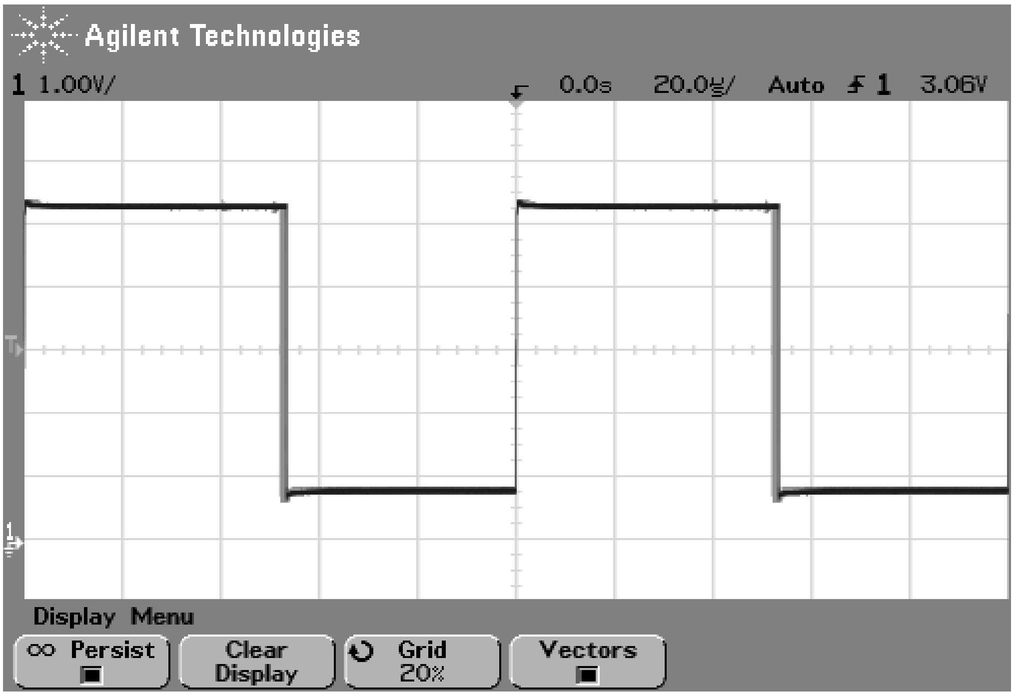
The following test checks the receiver internal delay and its symmetry.

TC	V_{SUP}	RX Load	t_{rx_pdf}	t_{rx_pdr}	t_{rx_pd}	t_{rx_sym}
2.6.1.1	7V	20pF	2.920 µs	2.940 µs	2.940 µs	-0.020 µs
2.6.1.2	14V	20pF	2.860 µs	2.885 µs	2.885 µs	-0.025 µs
2.6.1.3	18V	20pF	2.865 µs	2.875 µs	2.875 µs	-0.010 µs

Comment	Test Result
The measured time t_{rx_pd} is less than 6µs, the symmetry t_{rx_sym} is in range of ± 2µs	Pass

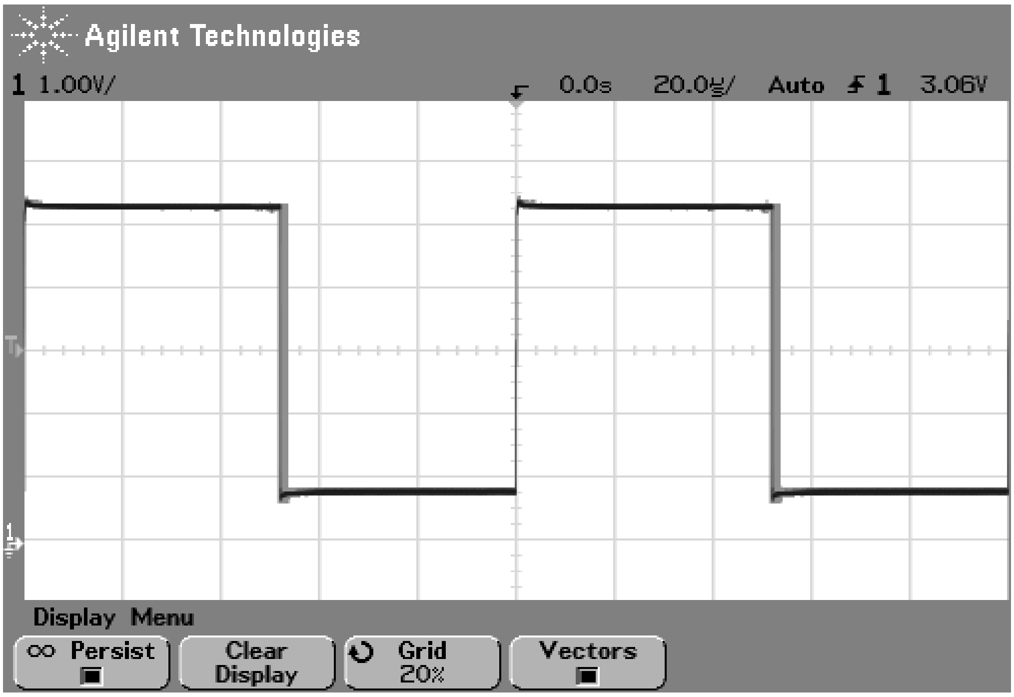
TC 2.7 GND/V_{BAT} Shift Test – Dynamic

TC 2.7.1 GND Shift Test – Dynamic - IUT as Transceiver (Master)



1kΩ/1nF

Duty Cycle in range of 52.1% – 53.6%

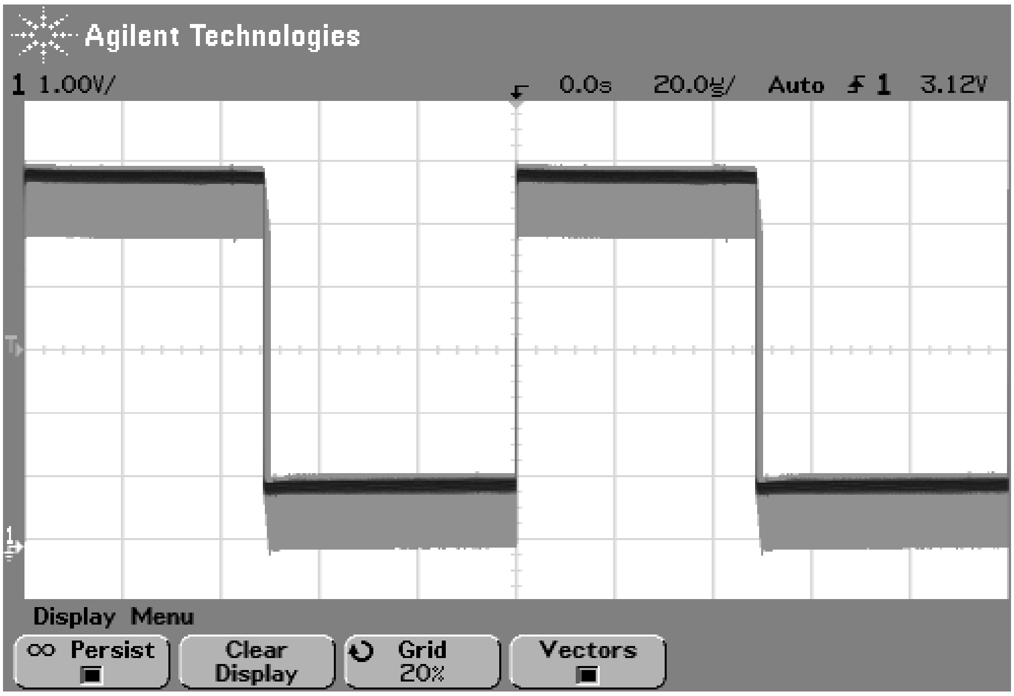


500Ω/10nF

Duty Cycle in range of 51.7% – 53.6%

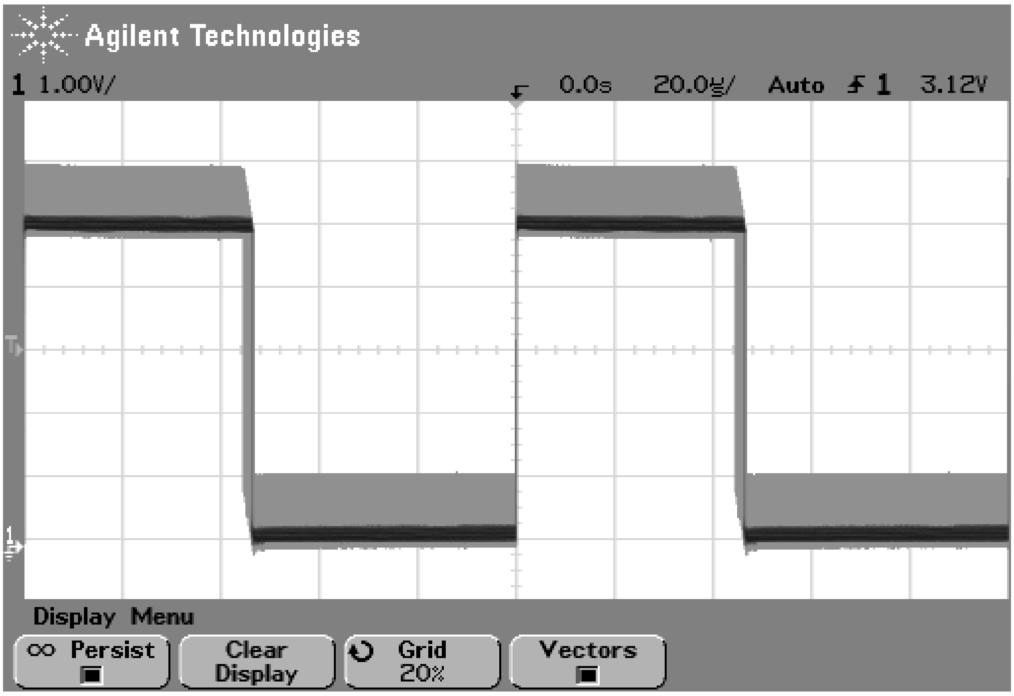
Comment	Test Result
The receive duty cycle measured at RxD2 must be in the range of 0.376 … 0.601.	Pass

TC 2.7.2 GND Shift Test – Dynamic - IUT as Transceiver (Slave)



1kΩ/1nF

Duty Cycle in range of 48.6% – 50.0%

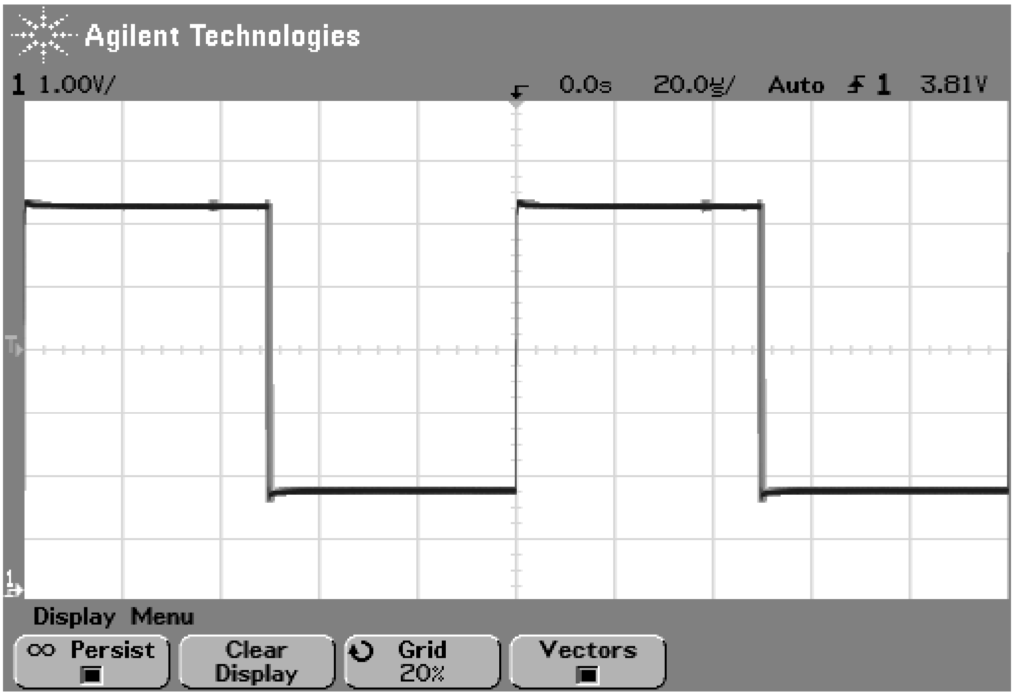


500Ω/10nF

Duty Cycle in range of 44.5% – 46.8%

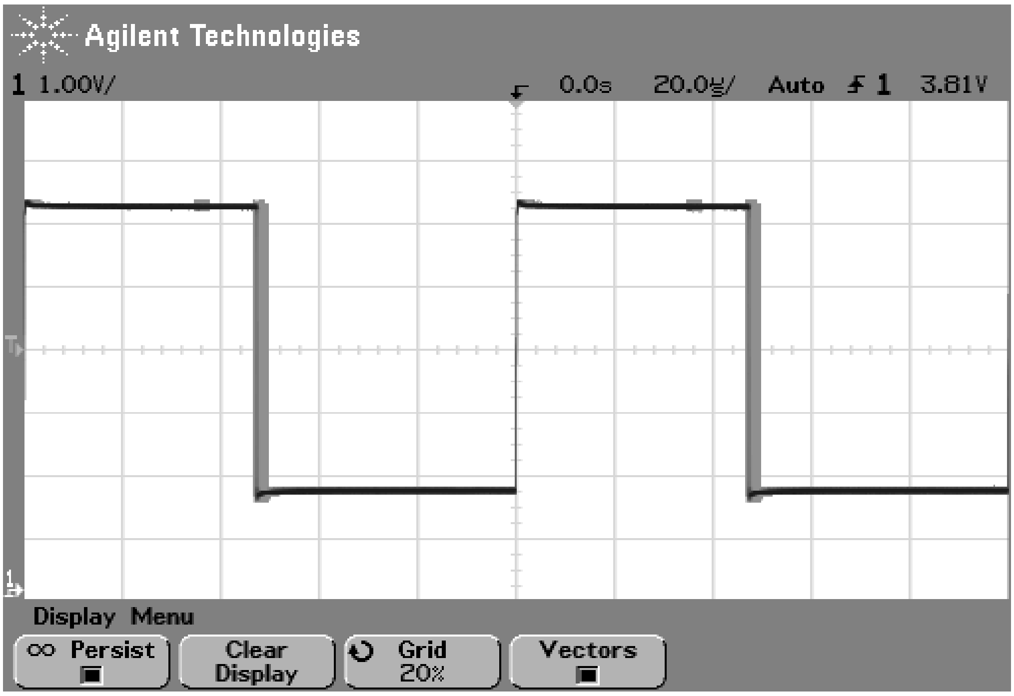
Comment	Test Result
The receive duty cycle measured at RxD2 must be in the range of 0.376 … 0.601.	Pass

TC 2.7.3 V_{BAT} Shift Test – Dynamic - IUT as Transceiver (Master)



1kΩ/1nF

Duty Cycle in range of 49.2% – 50.4%

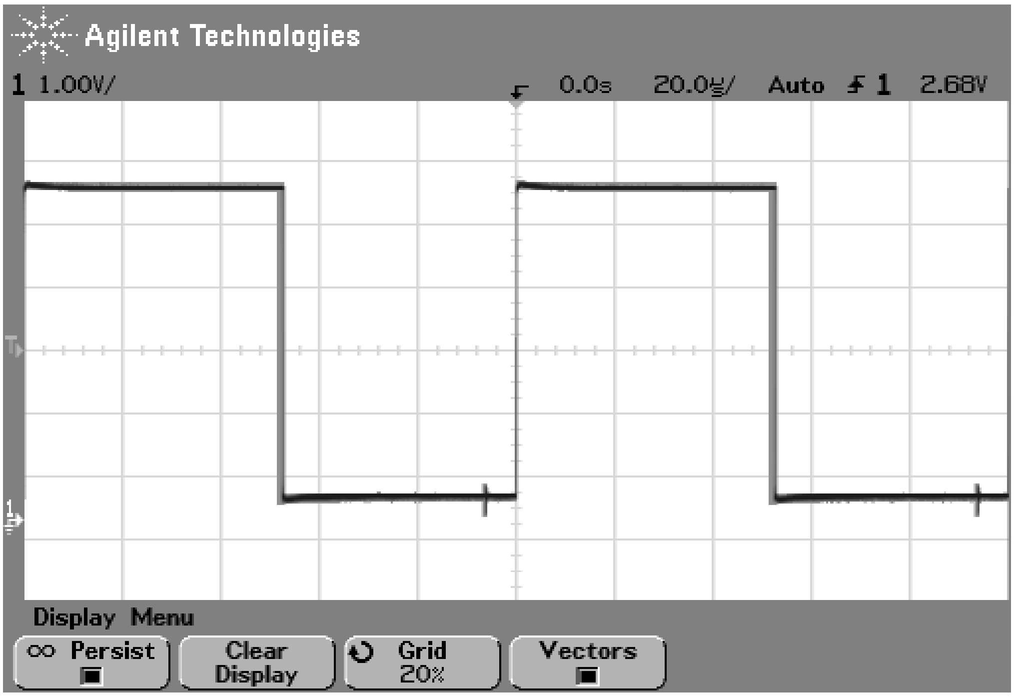


500Ω/10nF

Duty Cycle in range of 46.7% – 49.6%

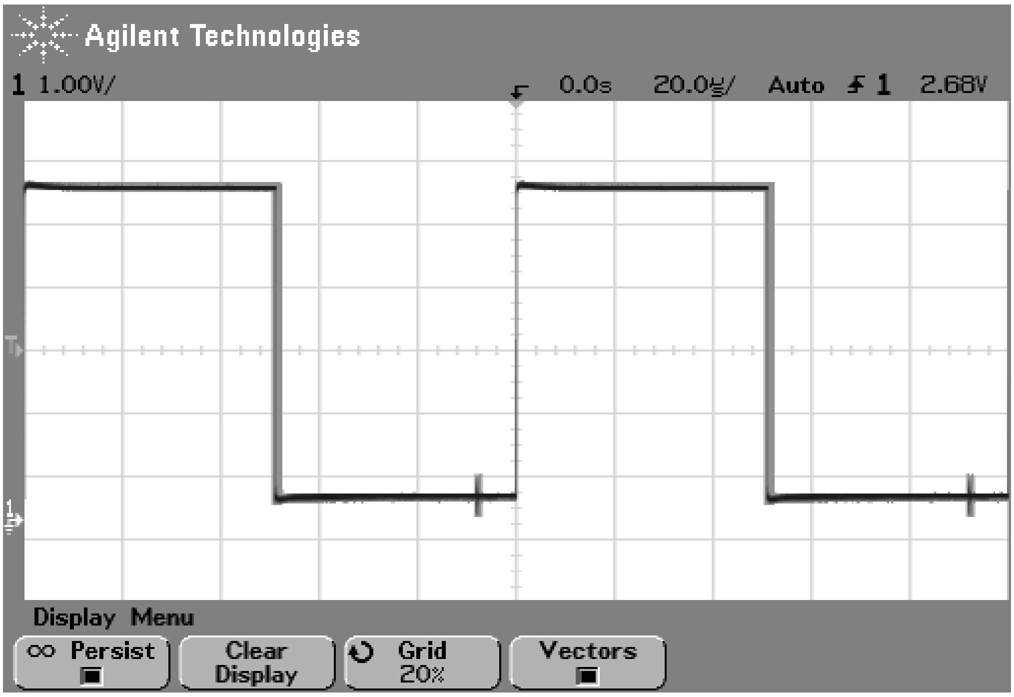
Comment	Test Result
The receive duty cycle measured at RxD2 must be in the range of 0.376 … 0.601.	Pass

TC 2.7.4 V_{BAT} Shift Test – Dynamic - IUT as Transceiver (Slave)



1kΩ/1nF

Duty Cycle in range of 51.5% – 52.9%



500Ω/10nF

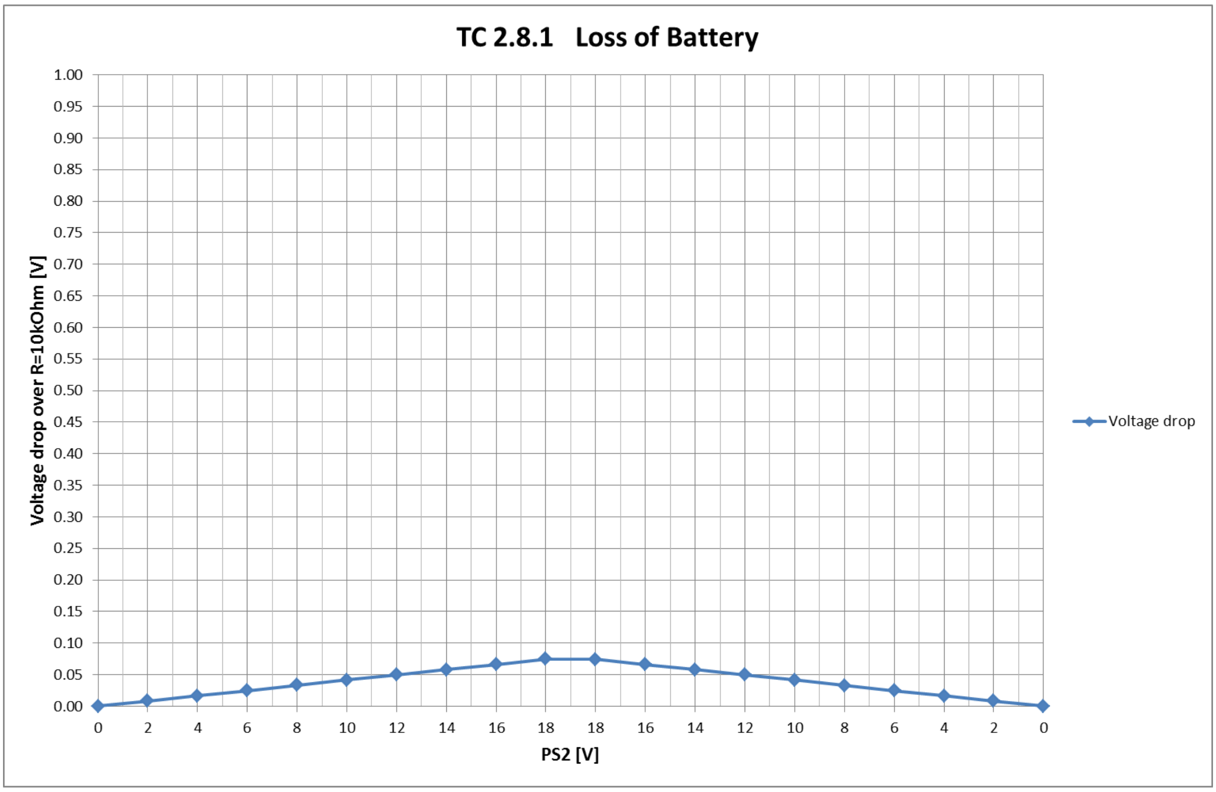
Duty Cycle in range of 50.5% – 52.3%

Comment	Test Result
The receive duty cycle measured at RxD2 must be in the range of 0.376 … 0.601.	Pass

TC 2.8 Failure

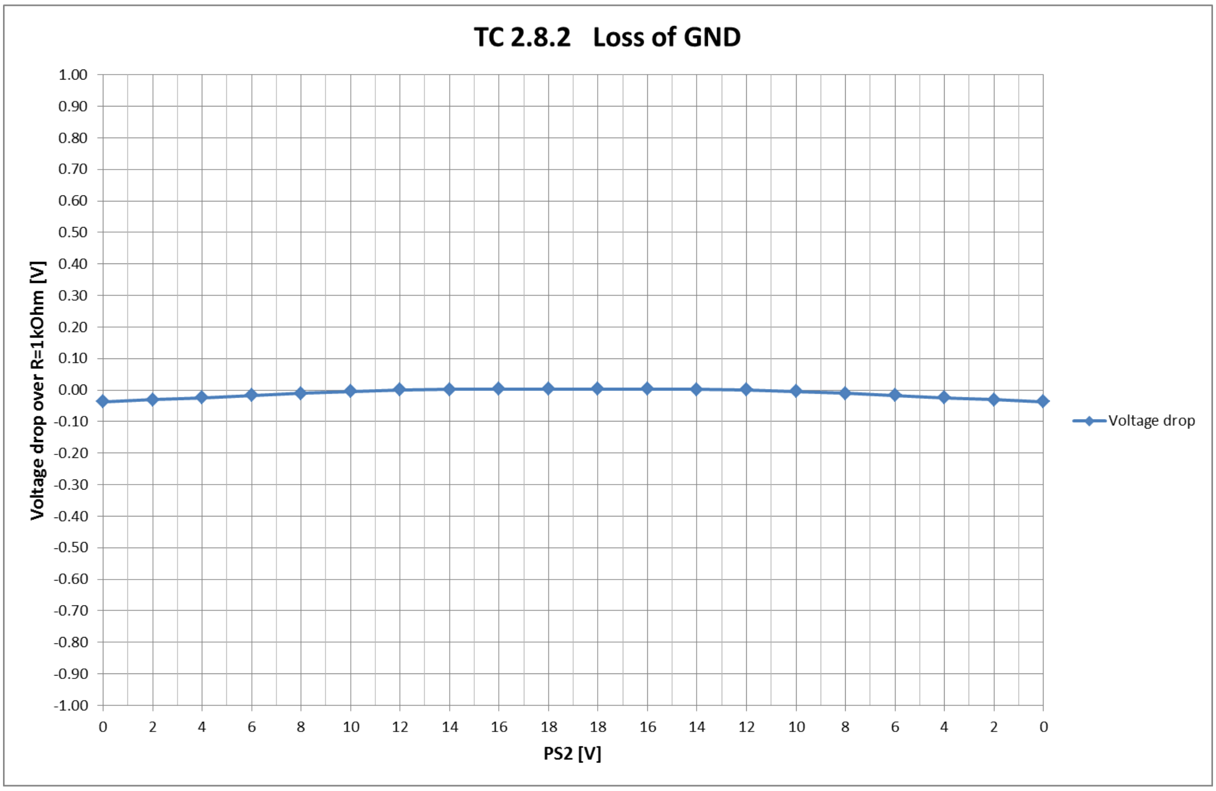
Purpose of this test is to check, whether some parasitic reverse currents are flowing into the IUT.

TC 2.8.1 Loss of Battery



Comment	Test Result
I_{BUS} must be less than 100µA, means 1V voltage drop over R=10kOhm. After reconnecting battery line, IUT must restart after failure recovery.	Pass

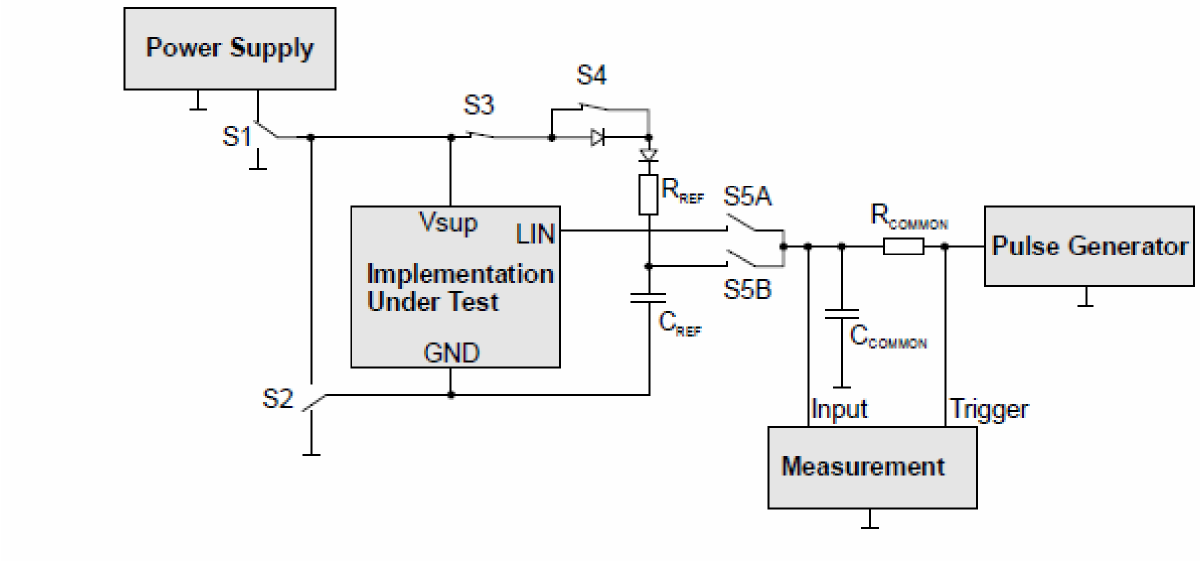
TC 2.8.2 Loss of GND



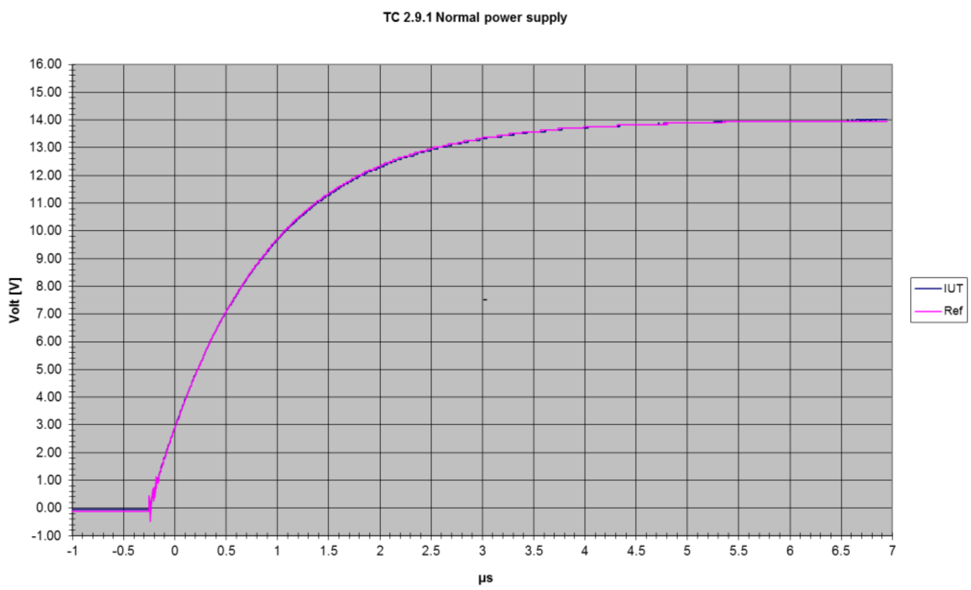
Comment	Test Result
I_{BUS} must be included in ± 1mA, means 1V voltage drop over R=1kOhm.	Pass

TC 2.9 Verifying internal capacitance and dynamic interference – IUT as Slave

Test Configuration:



TC 2.9.1 Normal power supply

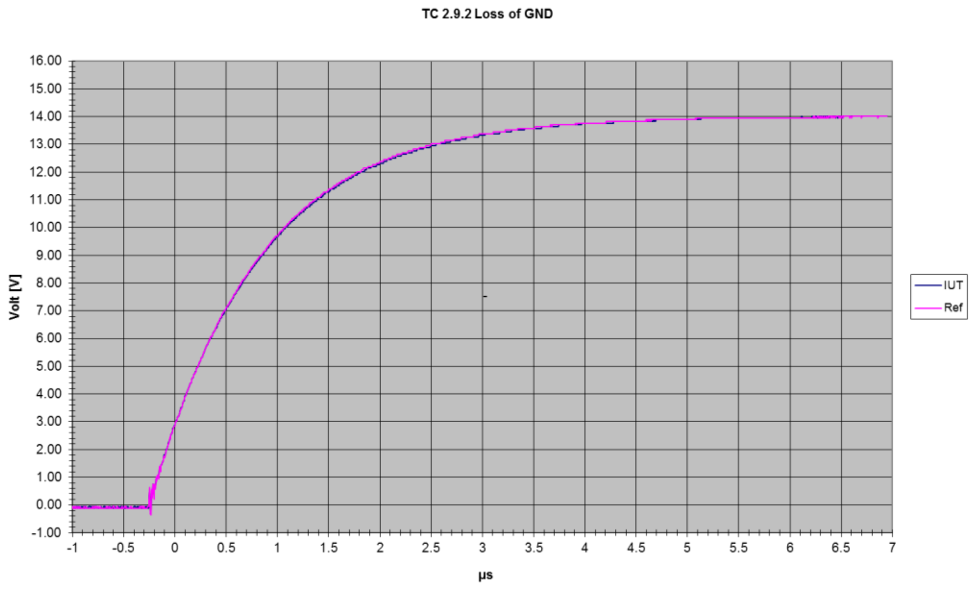


T_{INT}	T_{REF}
1.055 µs*)	1.050 µs

*) T_{INT} is within the tolerance of ±5%.

Comment	Test Result
C_{SLAVE} must be less or equal than 250pF: $T_{INT} \leq T_{REF}$ The IUT must not interfere with the dynamic stimulus.	Pass

TC 2.9.2 IUT loss of GND

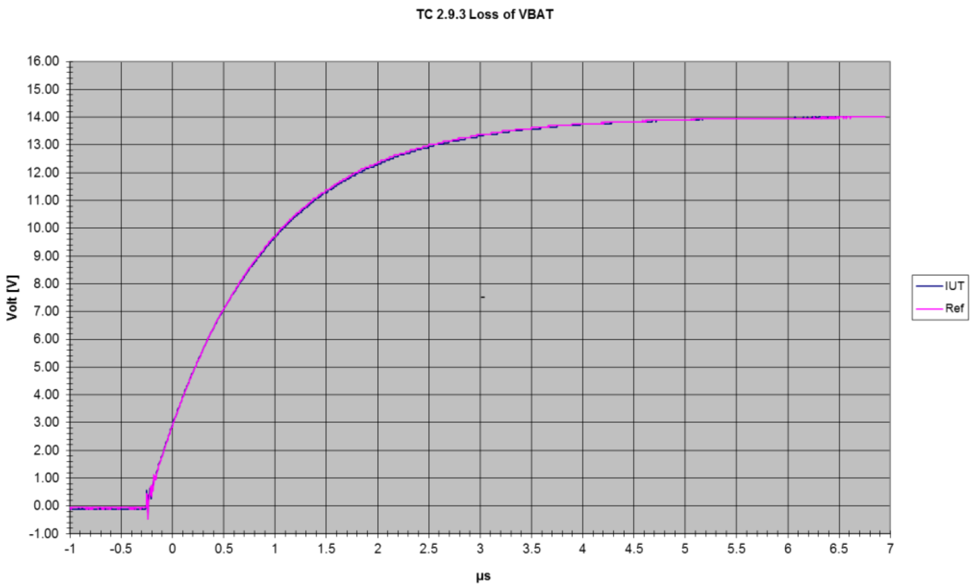


T_{INT}	T_{REF}
1.060 µs*)	1.055 µs

*) T_{INT} is within the tolerance of ±5%.

Comment	Test Result
C_{SLAVE} must be less or equal than 250pF: $T_{INT} \leq T_{REF}$ The IUT must not interfere with the dynamic stimulus.	Pass

TC 2.9.3 IUT loss of V_{SUP}



T_{INT}	T_{REF}
1.065 µs*)	1.055 µs

*) T_{INT} is within the tolerance of ±5%.

Comment	Test Result
C_{SLAVE} must be less or equal than 250pF: $T_{INT} \leq T_{REF}$ The IUT must not interfere with the dynamic stimulus.	Pass