TJA1083

FlexRay node transceiver

Rev. 1 — 10 October 2012 | Product data sheet

1. General description

The TJA1083 FlexRay node transceiver is compliant with the FlexRay Electrical Physical Layer specification V3.0.1 (see Ref. 1). In order to meet JASPAR the equirements, it implements the 'Increased voltage amplitude transmitter' functional class. It is primarily intended for communication systems operating at between 2.5 Mbit/s and 10 Mbit/s, and provides an advanced interface between the protocol controller and the physical bus in a FlexRay network. The TJA1083 offers an optimized solution for Electronic Control Unit (ECU) applications that do not need enhanced power management and are typically switched by the ignition or activated by a dedicated wake-up line.

The TJA1083 provides a differential transmit capability to the network and a differential receive capability to the FlexRay controller. It offers excellent ElectroMagnetic Compatibility (EMC) performance as well as high ElectroStatic Discharge (ESD) protection.

The TJA1083 actively monitors system performance using dedicated error and status information (readable by any microcontroller), as well as internal voltage and temperature monitoring.

2. Features and benefits

2.1 Optimized for time triggered communication systems

- Compliant with Electrical Physical Layer specification V3.0.1
- Meets JASPAR requirements as described in the 'Bus driver increased voltage amplitude transmitter' functional class
- Automotive product qualification in accordance with AEC-Q100
- Data transfer rates from 2.5 Mbit/s to 10 Mbit/s
- Supports 60 ns minimum bit time at 400 mV differential input voltage
- Very low ElectroMagnetic Emission (EME) to support unshielded cable
- Differential receiver with high common-mode range for excellent ElectroMagnetic Immunity (EMI)
- Auto I/O level adaptation to host controller supply voltage V_{IO}
- Can be used in 14 V, 24 V and 48 V powered systems
- Instant transmitter shut-down interface (BGE pin)

2.2 Low-power management

- Very low current consumption in Standby mode
- Remote wake-up via a wake-up pattern or dedicated FlexRay data frames on the bus lines

2.3 Diagnosis and robustness

- Enhanced supply voltage monitoring for V_{CC} and V_{IO}
- Two error diagnosis modes:
  - Status register readout via the Serial Peripheral Interface (SPI)
  - Simple error indication via pin ERRN
- Overtemperature detection
- Short-circuit detection on bus lines
- Power-on flag
- Clamping diagnosis for pins TXEN and BGE
- Bus pins protected against ±6 kV ESD pulses according to IEC61000-4-2 and ±8 kV according to HBM
- Bus pins protected against transients in automotive environment (according to ISO 7637 class C)
- Bus pins short-circuit proof to battery voltage (14 V, 24 V and 48 V) and ground
- Maximum differential voltage between pins BP or BM and any other pin of ±60 V
- Bus lines remain passive when the transceiver is not powered
- No reverse currents from the digital input pins to V_{IO} or V_{CC} when the transceiver is not powered

2.4 Functional classes according to FlexRay Electrical Physical Layer specification V3.0.1

- Bus driver - increased voltage amplitude transmitter
- Bus driver - bus guardian control interface
- Bus driver - logic level adaptation
- Bus driver - remote wake-up

3. Ordering information

Table 1. Ordering information

Type number	Package		
	Name	Description	Version
TJA1083TT	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1

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4. Block diagram

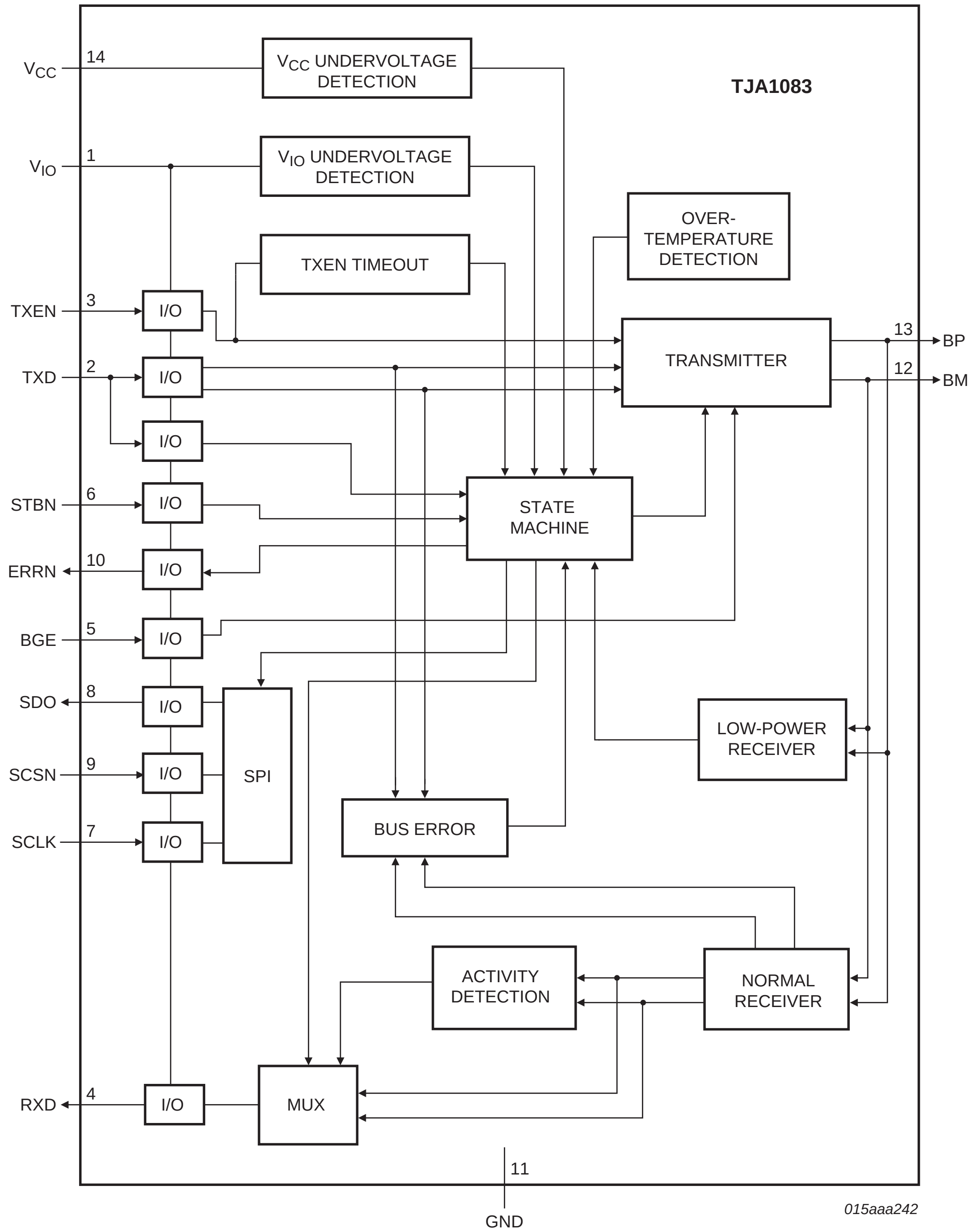

Fig 1. Block diagram

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5. Pinning information

5.1 Pinning

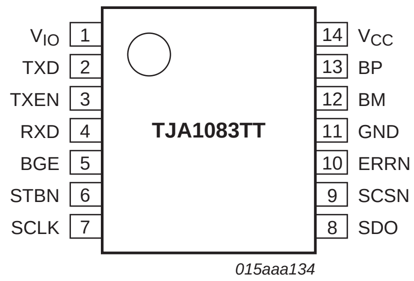

Fig 2. Pin configuration

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Type	Description
V_{IO}	1	P	supply voltage for V_{IO} voltage level adaptation
TXD	2	I	transmit data input; internal pull-down
TXEN	3	I	transmitter enable input; when HIGH transmitter disabled; internal pull-up
RXD	4	O	receive data output
BGE	5	I	bus guardian enable input; when LOW transmitter disabled; internal pull-down
STBN	6	I	mode control input; transceiver in Normal mode when HIGH; internal pull-down
SCLK	7	I	SPI clock signal; internal pull-up
SDO	8	O	SPI data output
SCSN	9	I	SPI chip select input; internal pull-up/pull-down
ERRN	10	O	error diagnosis output and wake-up indication
GND	11	P	ground
BM	12	I/O	bus line minus
BP	13	I/O	bus line plus
V_{CC}	14	P	supply voltage (+5 V)

6. Functional description

6.1 Power modes

The TJA1083 features three power modes: Normal, Standby and Power-off. Normal and Standby modes can be selected via the STBN input (HIGH for Normal mode) once the transceiver has been powered up. See Table 3 for a detailed description of pin signaling in the three power modes.

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Table 3. Pin signaling in the different power modes

Mode	STBN	UV at V_{IO}	UV at V_{CC}	ERRN LOW	ERRN HIGH	RXD LOW	RXD HIGH	SDO	Biasing BP, BM	UV-det	Trans-mitter	Low-power receiver
Normal	HIGH	no	no	error flag set	error flag reset	bus DATA_0	bus DATA_1 or idle	high-impedance (in simple error indication mode) or enabled (in SPI mode)	V_{CC} / 2	enabled	enabled	enabled[1]
Standby	LOW	no	no	wake flag set	wake flag reset	wake flag set	wake flag reset		GND		disabled	enabled[2]
	LOW	no	yes[3]	wake flag set[4]	wake flag reset[4]	wake flag set[4]	wake flag reset[4]					disabled
	HIGH	no	yes[3]	error flag set	error flag reset	wake flag set[4]	wake flag reset[4]					
	X	yes[5]	no	LOW		LOW		high-impedance				enabled[2]
	X	yes[5]	yes[3]	LOW		LOW						disabled
Power-off	X	X[5]	yes	high-impedance		HIGH			GND[6]	disabled		disabled

[1] The wake flag is set if a valid wake-up event is detected while switching to Standby mode.

[2] The wake flag is set if a valid wake-up event is detected.

[3] $V_{uvd(VCC)} > V_{CC} > V_{th(det)POR}$.

[4] Pins ERRN and RXD reflect the state of the wake flag prior to the V_{CC} undervoltage event.

[5] The internal signals at pins STBN, BGE and TXD are set LOW; the internal signals at pins TXEN, SCLK and SCSN are set HIGH.

[6] Except when V_{CC} = 0; in this case BP and BM are floating.

6.1.1 Normal mode

In Normal mode, the transceiver transmits and receives data via the bus lines BP and BM. The transmitter and the normal receiver are enabled, along with the undervoltage detection function. The timing diagram for Normal mode is illustrated in Figure 3.

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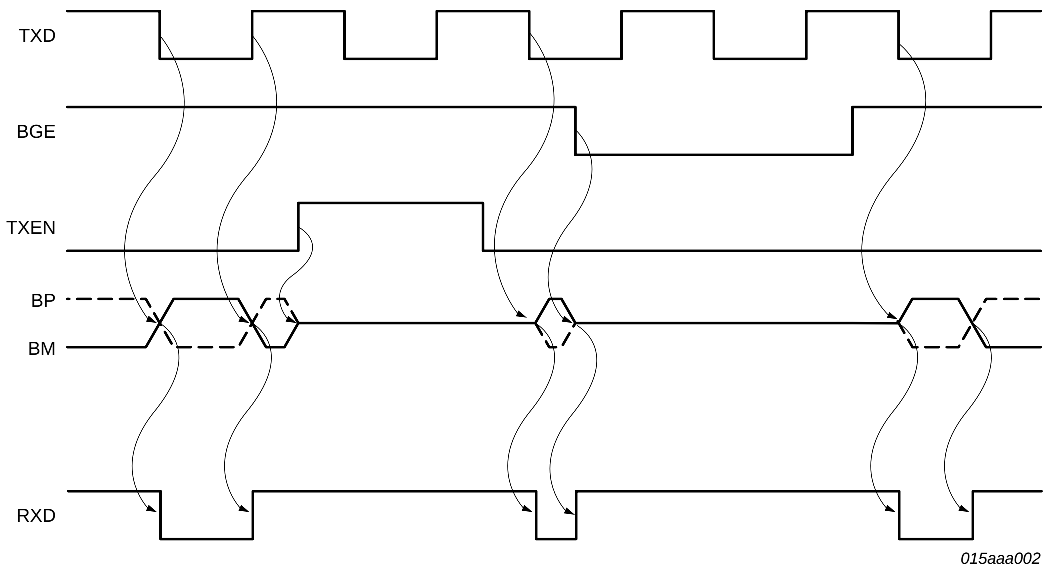

Fig 3. Timing diagram for Normal mode

Table 4 describes the behavior of the transmitter in Normal mode, when the temperature flag (TEMP HIGH) is not set and with no time-out on pin TXEN. Transmitter behavior is illustrated in Figure 13.

Table 4. Transmitter operation in Normal mode

BGE	TXEN	TXD	Bus state	Transmitter
L	X	X	idle	transmitter is disabled
X	H	X	idle	transmitter is disabled
H	L	H	DATA_1	transmitter is enabled; the bus lines are actively driven; BP is driven HIGH and BM is driven LOW
H	L	L	DATA_0	transmitter is enabled; the bus lines are actively driven; BP is driven LOW and BM is driven HIGH

The transmitter is activated during the first LOW level on pin TXD while pin BGE is HIGH and pin TXEN is LOW.

In Normal mode, the normal receiver output is connected directly to pin RXD (see Table 5). Receiver behavior is illustrated in Figure 14.

Table 5. Behavior of normal receiver in Normal mode

Bus state	RXD
DATA_0	L
DATA_1	H
idle	H

When V_{IO} and V_{CC} are within their operating ranges, pin ERRN indicates the status of the error flag. See Section 6.8 for a detailed description of error signaling in Normal mode.

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6.1.1.1 Bus activity and idle detection

In Normal mode, bus activity and bus idle are detected as follows:

- Bus activity is detected when the absolute differential voltage on the bus lines is higher than $|V_{i(dif)det(act)}|$ for $t_{det(act)(bus)}$:
  - If the differential voltage on the bus lines is lower than $V_{IL(dif)}$ after bus activity has been detected, pin RXD switches LOW.
  - If the differential voltage on the bus lines is higher than $V_{IH(dif)}$ after bus activity has been detected, pin RXD remains HIGH.
- Bus idle is detected when the absolute differential voltage on the bus lines is lower than $|V_{i(dif)det(act)}|$ for $t_{det(idle)(bus)}$. This results in pin RXD being switched HIGH or staying HIGH.

6.1.2 Standby mode

Standby mode is a low-power mode featuring very low current consumption. In Standby mode, the transceiver is unable to transmit or receive data since both the transmitter and the normal receiver are switched off. The low-power receiver is activated to monitor the bus for wake-up activity, provided an undervoltage has not been detected on pin V_{CC}.

The low-power receiver is deactivated if an undervoltage is detected on pin V_{CC} - with the result that the wake flag is not set if a wake-up pattern or dedicated data frame is received.

Pins ERRN and RXD indicate the status of the wake flag when V_{IO} and V_{CC} are within their operating ranges. See Table 3 for a description of pins ERRN and RXD when an undervoltage is detected on pin V_{IO} or pin V_{CC}.

The status register cannot be read via the SPI interface if an undervoltage is detected on pin V_{IO}.

The BGE input has no effect in Standby mode.

6.1.3 Power-off mode

The transmitter and the two receivers (normal and low-power) are deactivated in Power-off mode. As a result, the wake flag is not set if a wake-up pattern or dedicated data frame is received. If the voltage at V_{CC} rises above $V_{th(rec)POR}$, the transceiver switches to Standby mode and the digital section is reset. If V_{CC} subsequently drops below $V_{th(det)POR}$, the transceiver reverts to Power-off mode (see Section 6.2).

The status register cannot be read via the SPI interface in Power-off mode.

6.1.4 State transitions

Figure 4 shows the TJA1083 state transition diagram. The timing diagram for the ERRN indication signal during transitions between Normal and Standby modes, when the error flag is set and the wake flag is not set, is illustrated in Figure 5 and described in Table 6.

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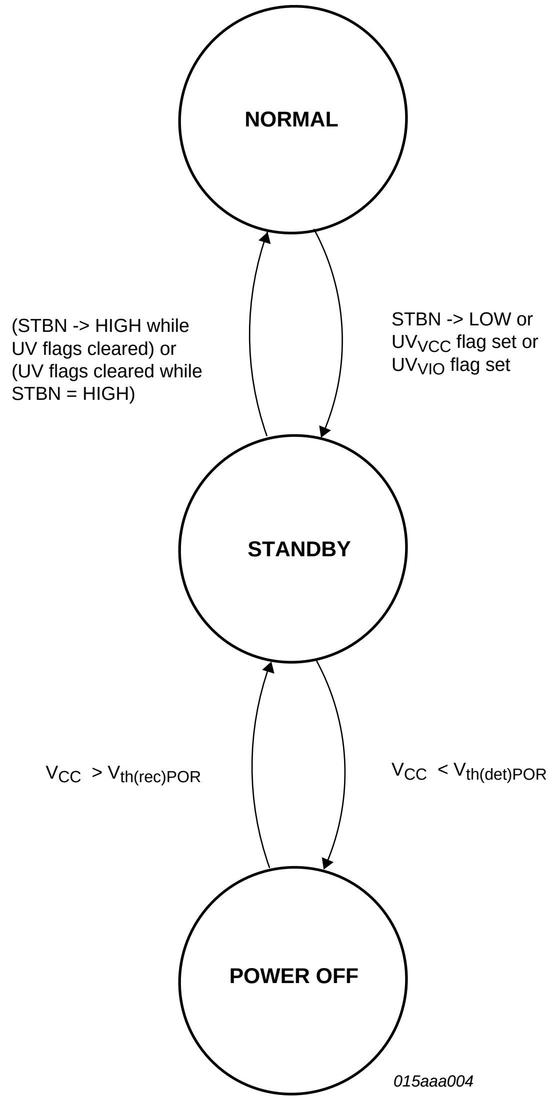

Fig 4. State transitions diagram

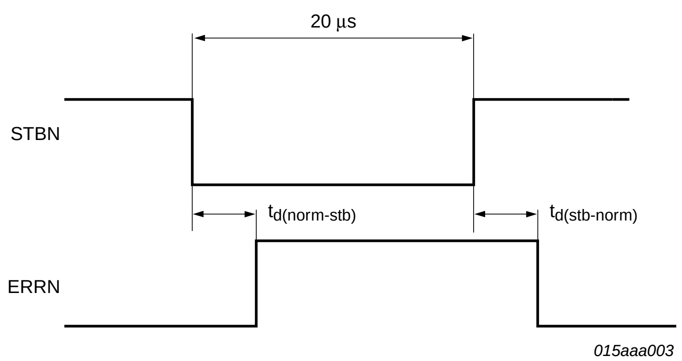

Fig 5. State transitions timing (error flag set)

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Table 6. State transitions

→ indicates the action that initiates a transaction; 1 → and 2 → are the consequences of a transaction.

Transition	UVV_{IO} flag[1]	UVV_{CC} flag[1]	wake flag[1]	PWON flag[1]	STBN	VCC level
Normal to Standby	cleared	cleared	cleared	cleared	→ L	$V_{CC} > V_{uvd(VCC)}$
	→ set	cleared	cleared	cleared	H	$V_{CC} > V_{uvd(VCC)}$
	cleared	→ set	cleared	cleared	H	$V_{uvd(VCC)} > V_{CC} > V_{th(det)POR}$
Standby to Normal	cleared	cleared	1 → cleared	2 → cleared	→ H	$V_{CC} > V_{uvd(VCC)}$
	→ cleared	cleared	1 → cleared	2 → cleared	H	$V_{CC} > V_{uvd(VCC)}$
	cleared	→ cleared	1 → cleared	2 → cleared	H	$V_{uvd(VCC)} > V_{CC} > V_{th(det)POR}$
Standby to Power-off	X	set	X	X	X	→ $V_{CC} < V_{th(det)POR}$
Power-off to Standby	X	set	X	1 → set	X	→ $V_{CC} > V_{th(rec)POR}$

[1] See Table 7 for set and reset conditions of all flags.

6.2 Power-up and power-down behavior

6.2.1 Power-up

The TJA1083 has two supply pins: V_{CC} (+5 V) and V_{IO} (for the voltage level adaptation). The ramp up of the different power supplies can vary, depending on the state or value of a number of signals and parameters. The power-up behavior of the TJA1083 is not affected by the sequence in which power is supplied to these pins or by the voltage ramp up.

As an example, Figure 6 shows one possible power supply ramp-up scenario. The digital section of the TJA1083 is supplied by V_{CC}. The voltage on pin V_{CC} ramps up before the voltage on pin V_{IO}. As long as the voltage on V_{CC} remains below the power-on reset recovery threshold, $V_{th(rec)POR}$, the internal state machine is inactive and the transceiver is totally passive, remaining in Power-off mode. As soon as the voltage rises above the $V_{th(rec)POR}$ threshold, the internal state machine starts running, setting the PWON flag and switching the TJA1083 to Standby mode. This initializes the V_{CC} and V_{IO} under-voltage flags to the set state (since both V_{CC} and V_{IO} are actually in undervoltage state just after power-on).

Once both V_{IO} and V_{CC} have reached their operating ranges, the under-voltage flags are reset. The operating mode is then determined by the level on STBN (the TJA1083 switches to Normal mode if STBN is HIGH and remains in Standby mode if STBN is LOW), provided V_{IO} and V_{CC} are above their respective undervoltage recovery levels ($V_{uvr(VIO)}$ and $V_{uvr(VCC)}$).

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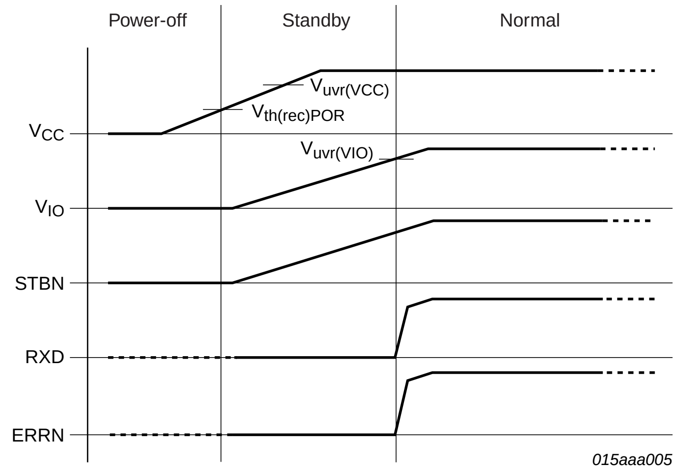

Fig 6. Power-up behavior (example)

6.2.2 Power-down

The behavior of the TJA1083 during power-down is illustrated in Figure 7.

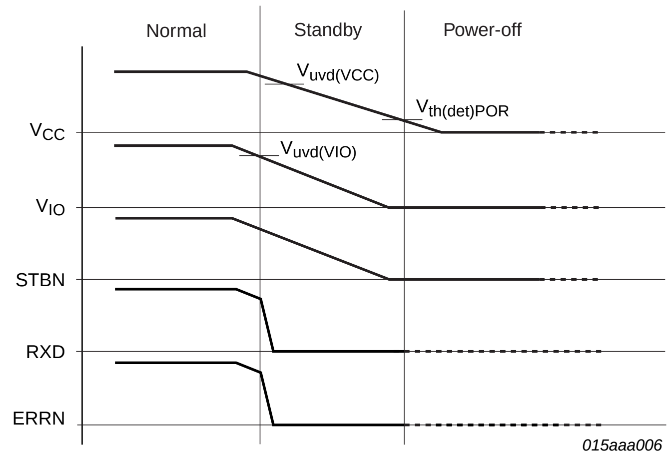

Fig 7. Power-down behavior (example)

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6.3 Remote wake-up

6.3.1 Bus wake-up via wake-up pattern

A valid remote wake-up event occurs when a wake-up pattern is received. A wake-up pattern consists of at least two consecutive wake-up symbols. A wake-up symbol comprises a DATA_0 phase lasting longer than $t_{det(wake)DATA\_0}$ followed by an idle phase lasting longer than $t_{det(wake)idle}$, provided both wake-up symbols occur within a time span of $t_{det(wake)tot}$ (see Figure 8). The transceiver also wakes up if DATA_1 phases are substituted for the idle phases.

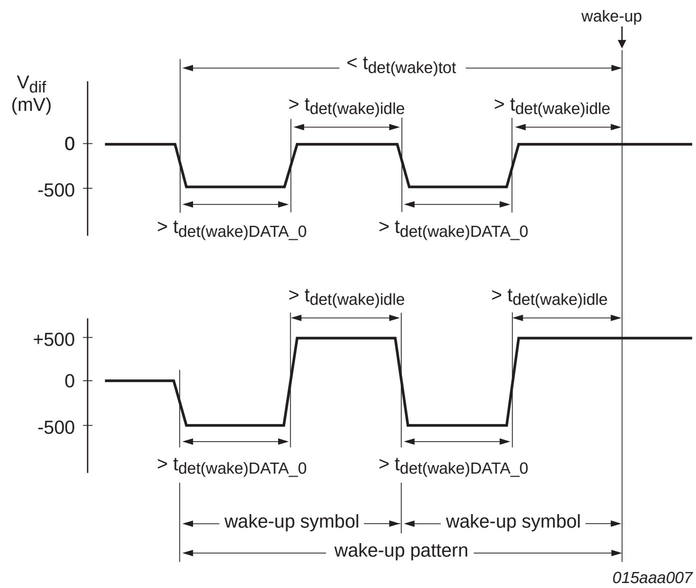

Fig 8. Bus wake-up timing

See Ref. 1 for more details of the wake-up mechanism.

6.3.2 Bus wake-up via dedicated FlexRay data frame

The TJA1083 wake flag is set when a dedicated data frame emulating a valid wake-up pattern, as shown in Figure 9, is received.

The DATA_0 and DATA_1 phases of the emulated wake-up symbol are interrupted by the Byte Start Sequence (BSS) preceding each byte in the data frame. With a data rate of 10 Mbit/s, the interruption has a maximum duration of 130 ns and does not prevent the transceiver from recognizing the wake-up pattern in the payload.

For longer interruptions at lower data rates (5 Mbit/s and 2.5 Mbit/s), the wake-up pattern should be used (see Section 6.3.1).

The wake flag is not set if an invalid wake-up pattern is received. See Ref. 1 for more details on invalid wake-up patterns.

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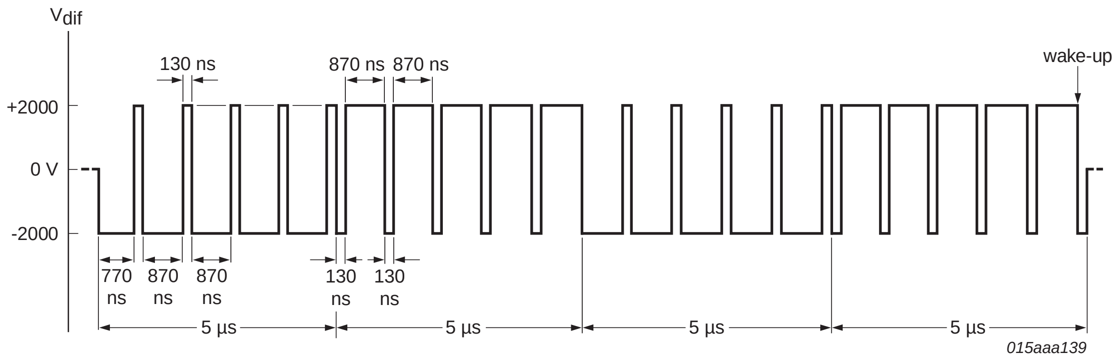

The duration of each interruption is 130 ns.

The transition time from DATA_0 to DATA_1 and vice versa is about 20 ns.

The TJA1083 wake-up flag is set on receipt of the following frame payload:

0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0x00, 0x00, 0x00, 0x00, 0x00,
0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0x00, 0x00, 0x00, 0x00, 0x00,
0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0x00, 0x00, 0x00, 0x00, 0x00,
0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF

Fig 9. Minimum bus pattern for bus wake-up via dedicated FlexRay data frame

6.4 Bus error detection

The TJA1083 detects the following bus errors during transmission:

- Short-circuit BP to BM at the ECU connector or on the bus
- Short-circuit BP to GND at the ECU connector or on the bus
- Short-circuit BM to GND at the ECU connector or on the bus
- Short-circuit BP to V_{CC} at the ECU connector or on the bus
- Short-circuit BM to V_{CC} at the ECU connector or on the bus

The bus error flag is not set when a wake-up pattern or a FlexRay Collision Avoidance Symbol (CAS) is being transmitted or received.

6.5 Fail silent behavior

Three mechanisms guarantee the 'fail silent' behavior of the TJA1083:

- The TXEN clamped flag is set if pin TXEN goes LOW for longer than $t_{detCL(TXEN)}$ in Normal mode; the transmitter is disabled.
- The BGE clamped flag is set if pin BGE goes HIGH for longer than $t_{detCL(BGE)}$ in Normal mode; no action is taken.
- If a loss-of-ground occurs at the transceiver, resulting in the TJA1083 switching to Power-off mode, no current flows out of the digital input pins (TXD, TXEN, BGE, STBN, SCLK, SCSN); see Table 3 for details of the behavior of the bus pins.

6.6 TJA1083 flags

The TJA1083 has 11 status/error flags. These are described in Table 7.

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Table 7. TJA1083 flags and set/reset conditions

Flag name	Flag type	Flag description	Set condition	Reset condition[1]	Consequence of flag set
bus wake	status flag	indicates if a wake-up event has occurred	wake-up event on bus in Standby mode[2]	transition to Normal mode	RXD → LOW; ERRN → LOW [3]
Normal mode	status flag	indicates if the transceiver is in Normal mode	entering Normal mode	leaving Normal mode	-
transmitter enabled	status flag	indicates the transmitter status	transmitter enabled[4]	transmitter disabled	-
BGE clamped	status flag	indicates if pin BGE is clamped	BGE HIGH for longer than $t_{detCL(BGE)}$[5]	BGE LOW[5]	-
PWON	status flag	indicates when the digital section is initialized	$V_{CC} > V_{th(rec)POR}$	transition to Normal mode	-
bus error	error flag	indicates if a bus error has been detected	bus error detected[5]	no bus error detected or positive edge on TXEN[5]	ERRN → LOW [6]
TEMP HIGH	error flag	indicates if the max. junction temperature has been reached	$T_{vj} > T_{j(dis)(high)}$[5]	TXEN = HIGH while $T_{vj} < T_{j(dis)(high)}$[5]	ERRN → LOW [6]; transmitter disabled
TXEN clamped	error flag	indicates if pin TXEN is clamped	TXEN LOW for longer than $t_{detCL(TXEN)}$[5]	TXEN = HIGH[5]	ERRN → LOW [6]; transmitter disabled
UVV_{CC}	error flag	indicates if there is an undervoltage at pin V_{CC}	$V_{CC} < V_{uvd(VCC)}$ for longer than $t_{det(uv)(VCC)}$	$V_{CC} > V_{uvr(VCC)}$ for longer than $t_{rec(uv)(VCC)}$	ERRN → LOW [6]; entering Standby mode
UVV_{IO}	error flag	indicates if there is an undervoltage at pin V_{IO}	$V_{IO} < V_{uvd(VIO)}$ for longer than $t_{det(uv)(VIO)}$	$V_{IO} > V_{uvr(VIO)}$ for longer than $t_{rec(uv)(VIO)}$	ERRN → LOW [6]; entering Standby mode
SPI error	error flag	indicates if an SPI error has occurred	SPI error detected[8]	falling edge on SCSN	ERRN → LOW [7]; SDO goes to a high impedance state

[1] All flags, except for the PWON flag, are reset after a power-on reset.

[2] If an undervoltage has not been detected on pin V_{CC}.

[3] If STBN = LOW.

[4] If BGE = HIGH, the Normal mode flag is set, the TEMP HIGH flag is not set and the TXEN clamped flag is not set.

[5] Flag can only be set or reset in Normal mode or on leaving Normal mode.

[6] If STBN = HIGH.

[7] If STBN = HIGH in SPI mode

[8] The SPI error flag is set when:

a) more than 16 falling edges occur on pin SCLK while pin SCSN = LOW

b) less than 16 falling edges occur on pin SCLK while pin SCSN = LOW.

6.7 TJA1083 status register

The TJA1083 contains a 16-bit status register, of which bits S0 to S4 reflect the state of the status flags, bits S5 to S10 reflect the state of the error flags and bit S15 is a parity bit. All flags can be individually read out on pin SDO via a 16-bit SPI interface when the transceiver is configured in SPI mode. The status register bits are described in Table 8.

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Table 8. TJA1083 status register

Status bit	Flag name	Set condition	Reset condition
S0	bus wake	bus wake flag set	bus wake flag cleared
S1	Normal mode	Normal mode flag set	Normal mode flag cleared
S2	transmitter enabled	transmitter enabled flag set	transmitter enabled flag cleared
S3	BGE clamped	BGE clamped flag set	BGE clamped flag cleared
S4	PWON	PWON flag set	PWON flag cleared and successful readout[1]
S5	bus error	bus error flag set	bus error flag cleared and successful readout[1]
S6	TEMP HIGH	TEMP HIGH flag set	TEMP HIGH flag cleared and successful readout[1]
S7	TXEN clamped	TXEN clamped flag set	TXEN clamped flag cleared and successful readout[1]
S8	UVV_{CC}	UVV_{CC} flag set	UVV_{CC} flag cleared and successful readout[1]
S9	UVV_{IO}	UVV_{IO} flag set	UVV_{IO} flag cleared and successful readout[1]
S10	SPI error	SPI error flag set	SPI error flag cleared and successful readout[1]
S11	reserved	always LOW	
S12	reserved	always HIGH	
S13	reserved	always LOW	
S14	reserved	always HIGH	
S15	parity bit	odd parity of status bits	even parity of status bits

[1] Also cleared during Power-off.

6.8 Error signaling

The TJA1083 provides two modes for error indication:

- Simple error indication mode
- SPI mode (default mode)

SPI mode is active on power-up.

To switch to simple error indication mode, SCSN must be held LOW (connected to GND) and SCLK held HIGH (connected to V_{IO}) for longer than $t_{det(L)(SCLK)}$ (provided a V_{IO} undervoltage has not occurred). When the TJA1083 is in simple error indication mode, a rising edge on SCSN initiates a transition to SPI mode (again provided a V_{IO} undervoltage has not occurred); see Figure 10.

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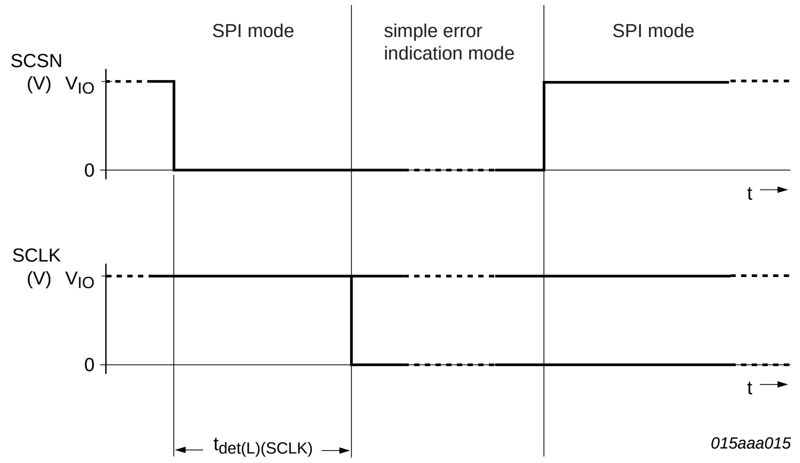

Fig 10. Timing diagram for configuration of error indication mode

If a V_{IO} undervoltage condition is detected, it is not possible to switch between SPI mode and simple error indication mode.

6.8.1 SPI mode

The error flag information in the status register is latched in SPI mode. This means that the status bit is reset once the status register has been completely read (provided the corresponding error flag has been reset). If an error condition is detected in Normal mode, pin ERRN goes LOW (provided one of the error bits, S5 to S10, is set). Pin ERRN goes HIGH again once all the error bits have been reset.

6.8.2 Simple error indication mode

If an error condition is detected in Normal mode, pin ERRN goes LOW once the relevant error flag has been set. Pin ERRN stays stable for at least $t_{ERRNL(min)}$ and goes HIGH again when all error conditions have been cleared and all flags have been reset. Error flags are not latched. It is not possible to read-out the status bits in this mode.

6.9 SPI interface

The TJA1083 includes a 16-bit SPI interface to enable a host to read the status register when the transceiver is in SPI mode (see Section 6.8).

While pin SCSN is HIGH, the SDO output is in a high-impedance state. To begin a status register readout, the host must force pin SCSN LOW. This action causes the SDO pin to output a LOW level by default. The data on pin SDO is then shifted out on the rising edge of the clock signal on pin SCLK.

The status bits shifted out on pin SDO are active HIGH. The status bits are refreshed and pin SDO returned to a high-impedance state once the status register has been read successfully (after exactly 16 clock cycles) and SCSN has been forced HIGH again. Clock signals on SCLK are ignored while SCSN is HIGH. The timing diagram for the SPI readout is illustrated in Figure 11.

The SLCK period ranges from 500 ns to 100 μs (10 kbit/s to 2 Mbit/s).

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If SCSN remains LOW for longer than 16 clock cycles, it is recognized as an SPI error. When this happens, the SPI error flag is set and pin SDO goes to a high-impedance state until the next falling edge on pin SCSN.

An SPI error is also assumed if fewer than 16 clock cycles are received while SCSN is LOW. If this happens, the SPI error flag is set.

All status bits are refreshed once the status register has been successfully read.

When the transceiver is in simple error indication mode the SDO output is in a high-impedance state and pin SCSN is in pull-down mode. In SPI mode pin SCSN is in pull-up mode.

SPI readout is not possible when the transceiver has detected an undervoltage on V_{IO}.

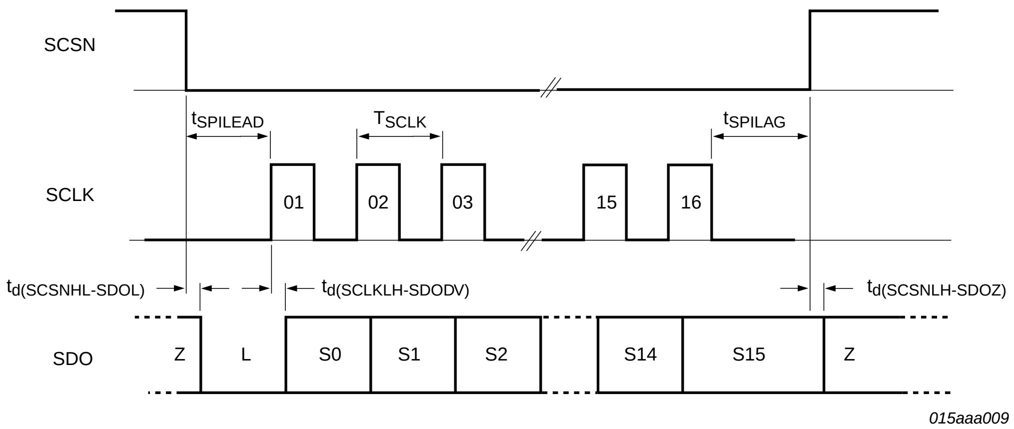

Fig 11. SPI readout timing diagram

7. Limiting values

Table 9. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). All voltages are referenced to GND.

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage	no time limit	–0.3	+5.5	V
V_{IO}	supply voltage on pin V_{IO}	no time limit	–0.3	+5.5	V
V_{ERRN}	voltage on pin ERRN	no time limit	–0.3	V_{IO} + 0.3	V
V_{RXD}	voltage on pin RXD	no time limit	–0.3	V_{IO} + 0.3	V
V_{SDO}	voltage on pin SDO	no time limit	–0.3	V_{IO} + 0.3	V
V_{TXEN}	voltage on pin TXEN	no time limit	–0.3	+5.5	V
V_{TXD}	voltage on pin TXD	no time limit	–0.3	+5.5	V
V_{STBN}	voltage on pin STBN	no time limit	–0.3	+5.5	V
V_{SCSN}	voltage on pin SCSN	no time limit	–0.3	+5.5	V
V_{SCLK}	voltage on pin SCLK	no time limit	–0.3	+5.5	V
V_{BGE}	voltage on pin BGE	no time limit	–0.3	+5.5	V
V_{BP}	voltage on pin BP	no time limit (with respect to pins BM and GND)	–60	+60	V

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Table 9. Limiting values *...continued*

In accordance with the Absolute Maximum Rating System (IEC 60134). All voltages are referenced to GND.

Symbol	Parameter	Conditions		Min	Max	Unit
V_{BM}	voltage on pin BM	no time limit (with respect to pins BP and GND)		−60	+60	V
$I_{I(ERRN)}$	input current on pin ERRN	no time limit; V_{IO} = 0 V		−10	10	mA
$I_{I(RXD)}$	input current on pin RXD	no time limit; V_{IO} = 0 V		−10	10	mA
$I_{I(SDO)}$	input current on pin SDO	no time limit; V_{IO} = 0 V		−10	10	mA
V_{trt}	transient voltage	on pins BM and BP	[1]	−100	-	V
			[2]	-	75	V
			[3]	−150	-	V
			[4]	-	100	V
T_{stg}	storage temperature			−55	+150	°C
T_{vj}	virtual junction temperature		[5]	−40	+150	°C
T_{amb}	ambient temperature			−40	+125	°C
V_{ESD}	electrostatic discharge voltage	IEC61000-4-2 on pins BP and BM to ground	[6]	−6.0	+6.0	kV
		HBM on pins BP and BM to ground	[7]	−8.0	+8.0	kV
		HBM on any other pin	[7]	−4.0	+4.0	kV
		MM on all pins	[8]	−200	+200	V
		CDM on all pins	[9]	−1000	+1000	V

[1] According to ISO7637, test pulse 1, class C; verified by an external test house.

[2] According to ISO7637, test pulse 2a, class C; verified by an external test house.

[3] According to ISO7637, test pulse 3a, class C; verified by an external test house.

[4] According to ISO7637, test pulse 3b, class C; verified by an external test house.

[5] In accordance with IEC 60747-1. An alternative definition of T_{vj} is: $T_{vj} = T_{amb} + P \times R_{th(j-a)}$, where $R_{th(j-a)}$ is a fixed value used in the calculation of T_{vj}. The rating for T_{vj} limits the allowable combinations of power dissipation (P) and ambient temperature (T_{amb}).

[6] IEC61000-4-2: C = 150 pF; R = 330 Ω; verified by an external test house; the test results were equal to or better than ±6 kV (unaided).

[7] HBM: C = 100 pF; R = 1.5 kΩ.

[8] MM: C = 200 pF; L = 0.75 μH; R = 10 Ω.

[9] CDM: R = 1 Ω.

8. Thermal characteristics

Table 10. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	130	K/W

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9. Static characteristics

Table 11. Static characteristics

All parameters are guaranteed for V_{CC} = 4.45 V to 5.25 V; V_{IO} = 2.55 V to 5.25 V; T_{vj} = −40 °C to +150 °C; R_{bus} = 40 Ω to 55 Ω and C_{bus} = 100 pF unless otherwise specified. All voltages are defined with respect to ground; positive currents flow into the IC.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Pin V_{CC}						
I_{CC}	supply current	Standby mode with no undervoltage; $T_{vj} \leq 85$ °C	-	20	30	μA
		Standby mode with no undervoltage; $T_{vj} \leq 150$ °C	-	20	40	μA
		Power-off mode; $T_{vj} \leq 85$ °C	-	-	30	μA
		Power-off mode; $T_{vj} \leq 150$ °C	-	-	40	μA
		Normal mode; V_{BGE} = 0 V or $V_{TXEN} = V_{IO}$	-	11	22	mA
		Normal mode; $V_{BGE} = V_{IO}$; V_{TXEN} = 0 V	-	40	60	mA
		Normal mode; $V_{BGE} = V_{IO}$; V_{TXEN} = 0; V; R_{bus} > 10 MΩ	-	25	40	mA
$V_{uvd(VCC)}$	undervoltage detection voltage on pin V_{CC}		4.45	-	4.729	V
$V_{uvr(VCC)}$	undervoltage recovery voltage on pin V_{CC}		4.47	-	4.749	V
$V_{uvhys(VCC)}$	undervoltage hysteresis voltage on pin V_{CC}		20	-	290	mV
$V_{th(det)POR}$	power-on reset detection threshold voltage		3.75	-	4.15	V
$V_{th(rec)POR}$	power-on reset recovery threshold voltage		3.85	-	4.25	V
$V_{hys(POR)}$	power-on reset hysteresis voltage		100	-	500	mV
Pin V_{IO}						
I_{IO}	supply current on pin V_{IO}	Normal mode; $V_{TXEN} = V_{IO}$; $V_{BGE} = V_{IO}$; R_{RXD} > 10 MΩ	-	-	1000	μA
		Normal mode; V_{TXEN} = 0 V; $V_{BGE} = V_{IO}$; R_{RXD} > 10 MΩ	-	-	1000	μA
		Standby mode with no undervoltage	-	2.2	7	μA
		Power-off mode; V_{IO} = 5 V	-	3	7	μA
$V_{uvd(VIO)}$	undervoltage detection voltage on pin V_{IO}		2.55	-	2.774	V
$V_{uvr(VIO)}$	undervoltage recovery voltage on pin V_{IO}		2.575	-	2.799	V
$V_{uvhys(VIO)}$	undervoltage hysteresis voltage on pin V_{IO}		25	-	240	mV
Pin SCSN						
V_{IH}	HIGH-level input voltage		$0.7V_{IO}$	-	5.5	V

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Table 11. Static characteristics *…continued*

All parameters are guaranteed for V_{CC} = 4.45 V to 5.25 V; V_{IO} = 2.55 V to 5.25 V; T_{vj} = –40 °C to +150 °C; R_{bus} = 40 Ω to 55 Ω and C_{bus} = 100 pF unless otherwise specified. All voltages are defined with respect to ground; positive currents flow into the IC.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IL}	LOW-level input voltage		–0.3	-	$0.3V_{IO}$	V
I_{IH}	HIGH-level input current	Simple error indication mode; $V_{SCSN} = 0.7V_{IO}$	3	-	15	µA
I_{IL}	LOW-level input current	SPI mode; $V_{SCSN} = 0.3V_{IO}$	–15	-	–3	µA
I_r	reverse current	Power-off mode; to V_{CC}/V_{IO}; V_{SCSN} = 5 V; $V_{CC} = V_{IO}$ = 0 V	–5	0	+5	µA
Pin SCLK						
V_{IH}	HIGH-level input voltage		$0.7V_{IO}$	-	5.5	V
V_{IL}	LOW-level input voltage		–0.3	-	$0.3V_{IO}$	V
I_{IH}	HIGH-level input current	$V_{SCLK} = V_{IO}$	–1	0	+1	µA
I_{IL}	LOW-level input current	$V_{SCLK} = 0.3V_{IO}$	–15	-	–3	µA
I_r	reverse current	Power-off mode; to V_{CC}/V_{IO}; V_{SCLK} = 5 V; $V_{CC} = V_{IO}$ = 0 V	–5	0	+5	µA
Pin STBN						
V_{IH}	HIGH-level input voltage		$0.7V_{IO}$	-	5.5	V
V_{IL}	LOW-level input voltage		–0.3	-	$0.3V_{IO}$	V
I_{IH}	HIGH-level input current	$V_{STBN} = 0.7V_{IO}$	3	-	15	µA
I_{IL}	LOW-level input current	V_{STBN} = 0 V	–1	0	+1	µA
I_r	reverse current	Power-off mode; to V_{CC}/V_{IO}; V_{STBN} = 5 V; $V_{CC} = V_{IO}$ = 0 V	–5	0	+5	µA
Pin TXEN						
V_{IH}	HIGH-level input voltage		$0.7V_{IO}$	-	5.5	V
V_{IL}	LOW-level input voltage		–0.3	-	$0.3V_{IO}$	V
I_{IH}	HIGH-level input current	$V_{TXEN} = V_{IO}$	–1	0	+1	µA
I_{IL}	LOW-level input current	$V_{TXEN} = 0.3V_{IO}$	–300	-	–50	µA
I_r	reverse current	Power-off mode; to V_{CC}/V_{IO}; V_{TXEN} = 5 V; $V_{CC} = V_{IO}$ = 0 V	–5	0	+5	µA
Pin BGE						
V_{IH}	HIGH-level input voltage		$0.7V_{IO}$	-	5.5	V
V_{IL}	LOW-level input voltage		–0.3	-	$0.3V_{IO}$	V
I_{IH}	HIGH-level input current	$V_{BGE} = 0.6V_{IO}$	3	-	15	µA
I_{IL}	LOW-level input current	V_{BGE} = 0 V	–1	0	+1	µA
I_r	reverse current	Power-off mode; to V_{CC}/V_{IO}; V_{BGE} = 5 V; $V_{CC} = V_{IO}$ = 0 V	–5	0	+5	µA
Pin TXD						
V_{IH}	HIGH-level input voltage	Normal mode	$0.6V_{IO}$	-	5.5	V
V_{IL}	LOW-level input voltage	Normal mode	–0.3	-	$0.4V_{IO}$	V
I_{IH}	HIGH-level input current	$V_{TXD} = 0.6V_{IO}$	3	-	15	µA
I_{IL}	LOW-level input current	V_{TXD} = 0 V	–1	0	+1	µA

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Table 11. Static characteristics *…continued*

All parameters are guaranteed for V_{CC} = 4.45 V to 5.25 V; V_{IO} = 2.55 V to 5.25 V; T_{vj} = −40 °C to +150 °C; R_{bus} = 40 Ω to 55 Ω and C_{bus} = 100 pF unless otherwise specified. All voltages are defined with respect to ground; positive currents flow into the IC.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_r	reverse current	Power-off mode; to V_{CC}/V_{IO}; V_{TXD} = 5 V; V_{CC} = V_{IO} = 0 V		−5	0	+5	µA
C_i	input capacitance	with respect to all other pins at ground; V_{TXD} = 100 mV; f = 5 MHz	[1]	-	-	10	pF
Pin RXD							
V_{OH}	HIGH-level output voltage	$I_{OH(RXD)}$ = −1.5 mA		V_{IO} − 0.4	-	V_{IO}	V
V_{OL}	LOW-level output voltage	$I_{OL(RXD)}$ = 1.5 mA		-	-	0.4	V
I_{OH}	HIGH-level output current	V_{RXD} = V_{IO} − 0.4 V; V_{IO} = V_{CC}		−15	-	−1.5	mA
I_{OL}	LOW-level output current	V_{RXD} = 0.4 V		1.5	-	15	mA
V_O	output voltage	when undervoltage on V_{IO}; R_L = 100 kΩ to GND		-	-	500	mV
		Power-off mode; R_L = 100 kΩ to V_{IO}		V_{IO} − 500	-	V_{IO}	mV
Pin ERRN							
V_{OH}	HIGH-level output voltage	$I_{OH(ERRN)}$ = −100 µA		V_{IO} − 0.4	-	V_{IO}	V
V_{OL}	LOW-level output voltage	$I_{OL(ERRN)}$ = 200 µA		-	-	0.4	V
I_{OH}	HIGH-level output current	V_{ERRN} = V_{IO} − 0.4 V; V_{IO} = V_{CC}		−1500	-	−100	µA
I_{OL}	LOW-level output current	V_{ERRN} = 0.4 V		200	-	1700	µA
I_L	leakage current	Power-off mode; $V_{ERRN} \leq V_{IO}$		−5	-	+5	µA
V_O	output voltage	when undervoltage on V_{IO}; R_L = 100 kΩ to GND		-	-	500	mV
		Power-off mode; R_L = 100 kΩ to GND		-	-	500	mV
Pin SDO							
V_{OH}	HIGH-level output voltage	$I_{OH(SDO)}$ = −0.5 mA		V_{IO} − 0.4	-	V_{IO}	V
V_{OL}	LOW-level output voltage	$I_{OL(SDO)}$ = 0.8 mA		-	-	0.4	V
I_{OH}	HIGH-level output current	V_{SDO} = V_{IO} − 0.4 V		−8	−3	−0.5	mA
I_{OL}	LOW-level output current	V_{SDO} = 0.4 V		0.8	3	9	mA
I_L	leakage current	high-impedance state; 0 V < V_{SDO} < V_{IO}		−5	-	+5	µA

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Table 11. Static characteristics *...continued*

All parameters are guaranteed for V_{CC} = 4.45 V to 5.25 V; V_{IO} = 2.55 V to 5.25 V; T_{vj} = –40 °C to +150 °C; R_{bus} = 40 Ω to 55 Ω and C_{bus} = 100 pF unless otherwise specified. All voltages are defined with respect to ground; positive currents flow into the IC.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_O	output voltage	when undervoltage on V_{IO}; V_{CC} > 4.75 V; R_L = 100 kΩ to GND		–500	-	+500	mV
		Power-off mode; R_L = 100 kΩ to GND		-	-	500	mV
Pins BP and BM							
$V_{o(idle)(BP)}$	idle output voltage on pin BP	Normal mode; V_{TXEN} = V_{IO}		$0.4V_{CC}$	$0.5V_{CC}$	$0.6V_{CC}$	V
		Standby mode with no undervoltage on pin V_{CC}		–0.1	0	+0.1	V
$V_{o(idle)(BM)}$	idle output voltage on pin BM	Normal mode; V_{TXEN} = V_{IO}		$0.4V_{CC}$	$0.5V_{CC}$	$0.6V_{CC}$	V
		Standby mode with no undervoltage on pin V_{CC}		–0.1	0	+0.1	V
$I_{o(idle)BP}$	idle output current on pin BP	Normal and Standby modes with no undervoltage; –60 V ≤ V_{BP} ≤ +60 V		–7.5	-	+7.5	mA
$I_{o(idle)BM}$	idle output current on pin BM	Normal and Standby modes with no undervoltage; –60 V ≤ V_{BM} ≤ +60 V		–7.5	-	+7.5	mA
$V_{o(idle)(dif)}$	differential idle output voltage	Normal mode		–25	0	+25	mV
$V_{OH(dif)}$	differential HIGH-level output voltage	4.75 V ≤ V_{CC} ≤ 5.25 V		900	-	2000	mV
		4.45 V ≤ V_{CC} ≤ 5.25 V		700	-	2000	mV
$V_{OL(dif)}$	differential LOW-level output voltage	4.75 V ≤ V_{CC} ≤ 5.25 V		–2000	-	–900	mV
		4.45 V ≤ V_{CC} ≤ 5.25 V		–2000		–700	mV
$V_{IH(dif)}$	differential HIGH-level input voltage	Normal mode; –10 V ≤ V_{cm} ≤ +15 V	[2]	150	225	300	mV
$V_{IL(dif)}$	differential LOW-level input voltage	Normal mode; –10 V ≤ V_{cm} ≤ +15 V	[2]	–300	–225	–150	mV
		Standby mode with no undervoltage on pin V_{CC}; –10 V ≤ V_{cm} ≤ +15 V	[2]	–400	–225	–100	mV
$\|\Delta V_{i(dif)(H-L)}\|$	differential input volt. diff. betw. HIGH- and LOW-levels (abs. value)	V_{cm} = 2.5 V	[2]	-	-	30	mV
$\|V_{i(dif)det(act)}\|$	activity detection differential input voltage (absolute value)			150	225	300	mV
$\|I_{O(sc)}\|$	short-circuit output current (absolute value)	on pin BP; –5 V ≤ V_{BP} ≤ +60 V; R_{sc} ≤ 1 Ω; t_{sc} ≥ 1500 μs	[4][6]	-	-	72	mA
		on pin BP; –5 V ≤ V_{BP} ≤ +27 V; R_{sc} ≤ 1 Ω; t_{sc} ≥ 1500 μs	[4][6]	-	-	60	mA
		on pin BM; –5 V ≤ V_{BM} ≤ +60 V; R_{sc} ≤ 1 Ω; t_{sc} ≥ 1500 μs	[4][6]	-	-	72	mA
		on pin BM; –5 V ≤ V_{BM} ≤ +27 V; R_{sc} ≤ 1 Ω; t_{sc} ≥ 1500 μs	[4][6]	-	-	60	mA
		on pins BP and BM; V_{BP} = V_{BM}; R_{sc} ≤ 1 Ω; t_{sc} ≥ 1500 μs	[5][6]	-	-	60	mA
$R_{i(BP)}$	input resistance on pin BP	R_{bus} = ∞ Ω		10	20	40	kΩ

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Table 11. Static characteristics *...continued*

All parameters are guaranteed for V_{CC} = 4.45 V to 5.25 V; V_{IO} = 2.55 V to 5.25 V; T_{vj} = −40 °C to +150 °C; R_{bus} = 40 Ω to 55 Ω and C_{bus} = 100 pF unless otherwise specified. All voltages are defined with respect to ground; positive currents flow into the IC.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{i(BM)}$	input resistance on pin BM	R_{bus} = ∞ Ω		10	20	40	kΩ
$R_{i(dif)(BP-BM)}$	differential input resistance between pin BP and pin BM	R_{bus} = ∞ Ω		20	40	80	kΩ
$I_{LI(BP)}$	input leakage current on pin BP	Power-off mode; V_{CC} = V_{IO} = 0 V; 0 V ≤ V_{BP} ≤ 5 V		−5	0	+5	μA
		loss of ground; V_{BP} = V_{BM} = 0 V; all other pins connected to 16 V via 0 Ω	[1]	−1600	-	+1600	μA
$I_{LI(BM)}$	input leakage current on pin BM	Power-off mode; V_{CC} = V_{IO} = 0 V; 0 V ≤ V_{BM} ≤ 5 V		−5	0	+5	μA
		loss of ground; V_{BP} = V_{BM} = 0 V; all other pins connected to 16 V via 0 Ω	[1]	−1600	-	+1600	μA
$V_{cm(bus)(DATA\_0)}$	DATA_0 bus common-mode voltage	Normal mode		$0.4V_{CC}$	$0.5V_{CC}$	$0.65V_{CC}$	V
$V_{cm(bus)(DATA\_1)}$	DATA_1 bus common-mode voltage	Normal mode		$0.4V_{CC}$	$0.5V_{CC}$	$0.65V_{CC}$	V
$\Delta V_{cm(bus)}$	bus common-mode voltage difference	Normal mode; DATA_1 − DATA_0		−25	0	+25	mV
$C_{i(BP)}$	input capacitance on pin BP	with respect to all other pins at ground; V_{BP} = 100 mV; f = 5 MHz	[1]	-	-	15	pF
$C_{i(BM)}$	input capacitance on pin BM	with respect to all other pins at ground; V_{BM} = 100 mV; f = 5 MHz	[1]	-	-	15	pF
$C_{i(dif)(BP-BM)}$	differential input capacitance between pin BP and pin BM	with respect to all other pins at ground; V_{BP} = 100 mV; V_{BM} = 100 mV; f = 5 MHz	[1]	-	-	5	pF
$Z_{o(eq)TX}$	transmitter equivalent output impedance	Normal mode; C_{bus} = 100 pF; R_{bus} = 40 Ω or 100 Ω	[3]	10	-	600	Ω
Temperature protection							
$T_{j(dis)(high)}$	high disable junction temperature			180	-	200	°C

[1] Guaranteed by design.

[2] V_{cm} is the BP/BM common mode voltage.

[3] $Z_{o(TX)(eq)} = 50\ \Omega \times (V_{bus(100)} - V_{bus(40)})/(2.5 \times V_{bus(40)} - V_{bus(100)})$, where:
$V_{bus(100)}$ = the differential output voltage on a load of 100 Ω and 100 pF in parallel.
$V_{bus(40)}$ = the differential output voltage on a load of 40 Ω and100 pF in parallel, when driving a DATA_1.

[4] R_{sc} is the short-circuit resistance; voltage difference between bus pins BP and BM is 60 V max.

[5] R_{sc} is the short-circuit resistance between BP and BM.

[6] t_{sc} is the minimum duration of the short-circuit

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10. Dynamic characteristics

Table 12. Dynamic characteristics

All parameters are guaranteed for V_{CC} = 4.45 V to 5.25 V; V_{IO} = 2.55 V to 5.25 V; T_{vj} = –40 °C to +150 °C; R_{bus} = 40 Ω and C_{bus} = 100 pF unless otherwise specified. All voltages are defined with respect to ground; positive currents flow into the IC.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Pins BP and BM							
$t_{d(TXD-bus)}$	delay time from TXD to bus	Normal mode	[1][2]				
		DATA_0		-	-	60	ns
		DATA_1		-	-	60	ns
$\Delta t_{d(TXD-bus)}$	delay time difference from TXD to bus	Normal mode; between DATA_0 and DATA_1; Normal mode	[1][2]	–4	-	+4	ns
$t_{d(bus-RXD)}$	delay time from bus to RXD	Normal mode; C_{RXD} = 25 pF; V_{cm} = 2.5 V	[3][4]				
		DATA_0		-	-	75	ns
		DATA_1		-	-	75	ns
$\Delta t_{d(bus-RXD)}$	delay time difference from bus to RXD	between DATA_0 and DATA_1; Normal mode; C_{RXD} = 25 pF; V_{cm} = 2.5 V	[3][4]	–5	-	5	ns
$t_{d(TXEN-busidle)}$	delay time from TXEN to bus idle	Normal mode; V_{TXD} = 0 V	[5]	-	-	75	ns
$t_{d(TXEN-busact)}$	delay time from TXEN to bus active	Normal mode; V_{TXD} = 0 V	[5]	-	-	75	ns
$\lvert\Delta t_{d(TXEN-bus)}\rvert$	delay time difference from TXEN to bus (absolute value)	Normal mode; between TXEN to bus active and TXEN to bus idle; V_{TXD} = 0 V	[6][5]			50	ns
$t_{d(BGE-busidle)}$	delay time from BGE to bus idle	Normal mode; V_{TXD} = 0 V	[5]	-	-	75	ns
$t_{d(BGE-busact)}$	delay time from BGE to bus active	Normal mode; V_{TXD} = 0 V	[5]	-	-	75	ns
$t_{r(dif)(bus)}$	bus differential rise time	DATA_0 to DATA_1; 20 % to 80 %	[5]	6	-	18.75	ns
$t_{f(dif)(bus)}$	bus differential fall time	DATA_1 to DATA_0; 80 % to 20 %	[5]	6	-	18.75	ns
$\Delta t_{(r-f)(dif)}$	difference between differential rise and fall time	on bus; 80 % to 20 %	[5]	–3	-	3	ns
$t_{f(bus)(idle-act)}$	bus fall time from idle to active	bus idle to DATA_0; –30 mV > V_{dif} > –300 mV	[5][7]	-	-	30	ns
$t_{f(bus)(act-idle)}$	bus fall time from active to idle	DATA_1 to bus idle; 300 mV > V_{dif} > 30 mV	[5][7]	-	-	30	ns
$t_{r(bus)(act-idle)}$	bus rise time from active to idle	DATA_0 to bus idle; –300 mV < V_{dif} < –30 mV	[5][7]	-	-	30	ns
Wake-up detection							
$t_{det(wake)DATA\_0}$	DATA_0 wake-up detection time	Standby mode with no undervoltage on pin V_{CC}; –10 V ≤ V_{cm} ≤ +15 V	[3][8]	1	-	4	µs
$t_{det(wake)idle}$	idle wake-up detection time	Standby mode with no undervoltage on pin V_{CC}; –10 V ≤ V_{cm} ≤ +15 V	[3][8]	1	-	4	µs

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Table 12. Dynamic characteristics *...continued*

All parameters are guaranteed for V_{CC} = 4.45 V to 5.25 V; V_{IO} = 2.55 V to 5.25 V; T_{vj} = −40 °C to +150 °C; R_{bus} = 40 Ω and C_{bus} = 100 pF unless otherwise specified. All voltages are defined with respect to ground; positive currents flow into the IC.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$t_{det(wake)tot}$	total wake-up detection time	Standby mode with no undervoltage on pin V_{CC}; −10 V ≤ V_{cm} ≤ +15 V	[3][8]	50	-	115	μs
$t_{sup(int)wake}$	wake-up interruption suppression time	Standby mode with no undervoltage on pin V_{CC}; −10 V ≤ V_{cm} ≤ +15 V	[3][9]	130	-	1000	ns
$t_{d(wake-ERRN)}$	delay time from wake-up to ERRN	Standby mode		-	-	100	μs
$t_{d(wake-RXD)}$	delay time from wake-up to RXD	Standby mode		-	-	100	μs
Undervoltage							
$t_{det(uv)(VCC)}$	undervoltage detection time on pin V_{CC}	0 V ≤ V_{IO} ≤ 5.5 V; V_{CC} = 4.35 V		2	-	100	μs
$t_{rec(uv)(VCC)}$	undervoltage recovery time on pin V_{CC}	0 V ≤ V_{IO} ≤ 5.5 V; V_{CC} = 4.85 V		2	-	100	μs
$t_{det(uv)(VIO)}$	undervoltage detection time on pin V_{IO}	$V_{th(det)POR}$ < V_{CC} < 5.5 V; V_{IO} = 2.45 V		5	-	100	μs
$t_{rec(uv)(VIO)}$	undervoltage recovery time on pin V_{IO}	$V_{th(det)POR}$ < V_{CC} < 5.5 V; V_{IO} = 2.9 V		5	-	100	μs
Activity detection							
$t_{det(act)(bus)}$	activity detection time on bus pins	Normal mode; V_{cm} = 2.5 V; V_{dif}: 0 mV → 400 mV	[3][7]	100	-	250	ns
$t_{det(idle)(bus)}$	idle detection time on bus pins	Normal mode; V_{cm} = 2.5 V; V_{dif}: 400 mV → 0 mV	[3][7]	100	-	200	ns
$\|\Delta t_{det(act-idle)}\|$	active to idle detection time difference (absolute value)	Normal mode; on bus pins; V_{cm} = 2.5 V	[3]	-	-	150	ns
ERRN signaling							
$t_{det(L)(SCLK)}$	LOW-level detection time on pin SCLK	Normal or Standby mode with no undervoltage on pin V_{IO}		95	-	310	μs
$t_{ERRNL(min)}$	minimum ERRN LOW time	simple error indication mode; Normal or Standby mode		2	-	10	μs
$t_{d(errdet-ERRNL)}$	delay time from error detection to ERRN LOW	all modes		-	-	100	μs
SPI							
$t_{d(SCSNHL-SDOL)}$	SCSN falling edge to SDO LOW-level delay time	$V_{uvd(VIO)}$ < V_{IO} < 5.5 V; 4.45 V < V_{CC} < 5.5 V; C_{SDO} = 50 pF	[10]	-	-	250	ns
$t_{d(SCLKLH-SDODV)}$	SCLK rising edge to SDO data valid delay time	$V_{uvd(VIO)}$ < V_{IO} < 5.5 V; 4.45 V < V_{CC} < 5.5 V; C_{SDO} = 50 pF	[10]	-	-	200	ns
$t_{d(SCSNLH-SDOZ)}$	SCSN rising edge to SDO three-state delay time	$V_{uvd(VIO)}$ < V_{IO} < 5.5 V; 4.45 V < V_{CC} < 5.5 V; C_{SDO} = 50 pF	[10]	-	-	500	ns
T_{SCLK}	SCLK period	$V_{uvd(VIO)}$ < V_{IO} < 5.5 V; 4.45 V < V_{CC} < 5.5 V; C_{SDO} = 50 pF	[10]	0.5	-	100	μs

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Table 12. Dynamic characteristics *...continued*

All parameters are guaranteed for V_{CC} = 4.45 V to 5.25 V; V_{IO} = 2.55 V to 5.25 V; T_{vj} = −40 °C to +150 °C; R_{bus} = 40 Ω and C_{bus} = 100 pF unless otherwise specified. All voltages are defined with respect to ground; positive currents flow into the IC.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$t_{SPILEAD}$	SPI enable lead time	$V_{uvd(VIO)} < V_{IO} < 5.5$ V; 4.45 V < V_{CC} < 5.5 V; C_{SDO} = 50 pF	[10]	250	-	-	ns
t_{SPILAG}	SPI enable lag time	$V_{uvd(VIO)} < V_{IO} < 5.5$ V; 4.45 V < V_{CC} < 5.5 V; C_{SDO} = 50 pF	[10]	250	-	-	ns
RXD							
t_r	rise time	20 % to 80 %; C_{RXD} = 15 pF	[6]	-	-	9	ns
		20 % to 80 %; C_{RXD} = 25 pF	[6]	-	-	10.75	ns
t_f	fall time	80 % to 20 %; C_{RXD} = 15 pF	[6]	-	-	9	ns
		80 % to 20 %; C_{RXD} = 25 pF	[6]	-	-	10.75	ns
$\Delta t_{(r-f)}$	difference between rise and fall time	C_{RXD} = 15 pF	[6]	-	-	5	ns
		C_{RXD} = 25 pF	[6]	-	-	5	ns
		C_{RXD} = 10 pF; simulated	[6][11]	-	-	5	ns
$t_{(r+f)}$	sum of rise and fall time	C_{RXD} = 15 pF	[6]	-	-	13	ns
		C_{RXD} = 25 pF	[6]	-	-	16.5	ns
		C_{RXD} = 10 pF; simulated	[6][11]	-	-	16.5	ns
Bus error flag							
$t_{d(norm-stb)}$	normal mode to standby delay time	bus error flag set		3	-	10	μs
$t_{d(stb-norm)}$	standby to normal mode delay time	bus error flag set		3	-	10	μs
Miscellaneous							
$t_{detCL(TXEN)}$	TXEN clamp detection time			650	-	2600	μs
$t_{detCL(BGE)}$	BGE clamp detection time			650	-	2600	μs
$t_{d(TXENH-RXDH)}$	delay time from TXEN HIGH to RXD HIGH	idle loop delay; Normal mode; TXD = LOW; V_{cm} = 2.5 V; C_{RXD} = 25 pF	[3]	-	-	300	ns

[1] Sum of TXD rise and fall times (20 % to 80 %); $t_{r(TXD)} + t_{f(TXD)}$ = max. 9 ns.

[2] See Figure 13.

[3] V_{cm} is the BP/BM common mode voltage.

[4] See Figure 14.

[5] See Figure 13.

[6] Guaranteed by design.

[7] $V_{dif} = V_{BP} - V_{BM}$.

[8] See Figure 8.

[9] See Figure 9.

[10] See Figure 11.

[11] Load at end of 50 Ω microstrip with a propagation delay of 1 ns; 20 % to 80 % and 80 % to 20 %.

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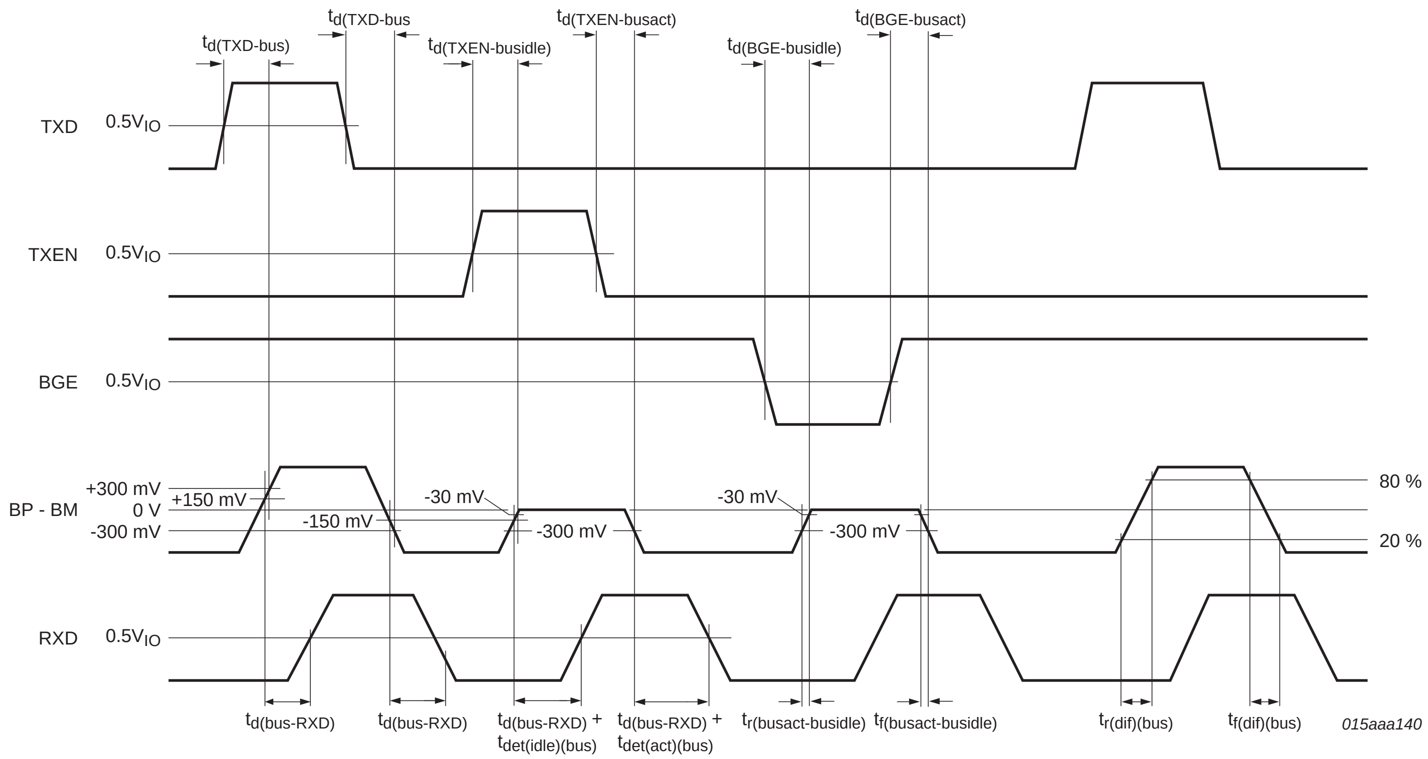

Fig 12. Detailed timing diagram

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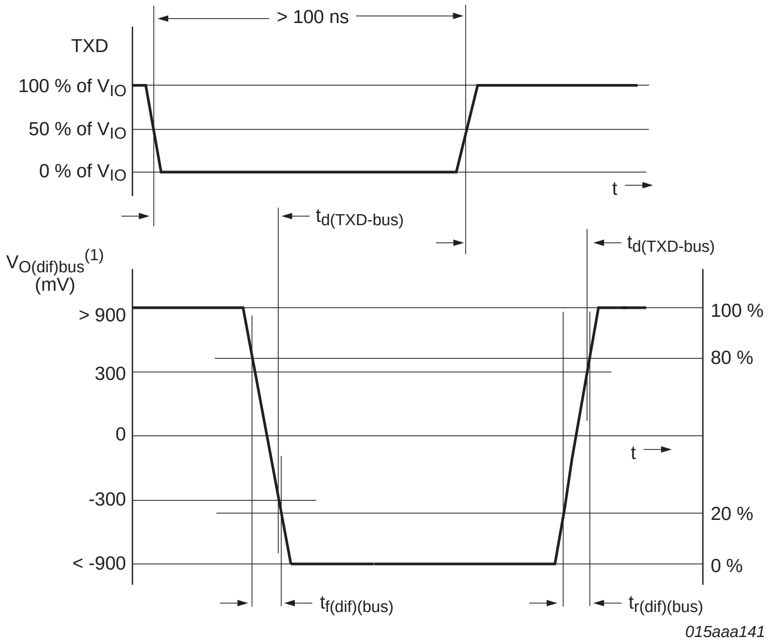

(1) $V_{O(dif)bus}$ is the transmitter test signal.

Fig 13. Transmitter timing diagram

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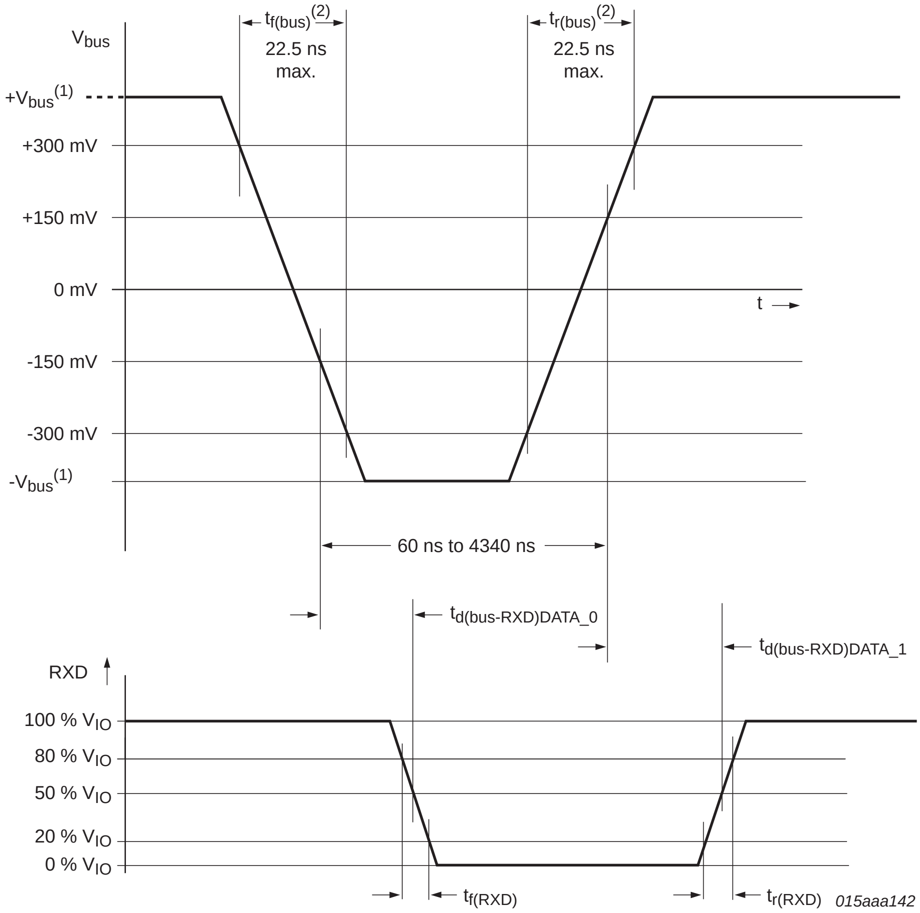

(1) $|V_{bus}|$ = 400 mV (min) to 3000 mV (max).

(2) $t_{r(bus)}$ and $t_{f(bus)}$ are defined for V_{bus} between −300 mV and +300 mV; $t_{r(bus)} = t_{f(bus)}$ = 22.5 ns for $|V_{bus}|$ = 400 mV to 800 V; value will be lower for $|V_{bus}|$ > 800 mV.

Fig 14. Normal receiver timing diagram

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11. Test information

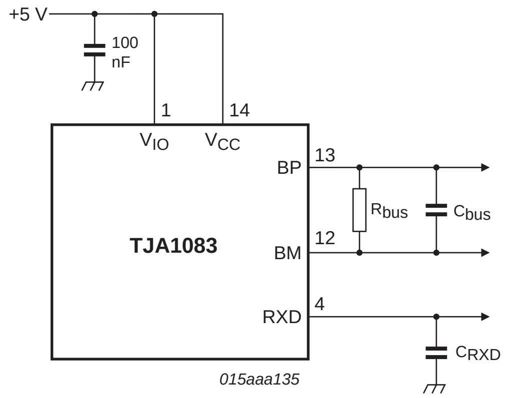
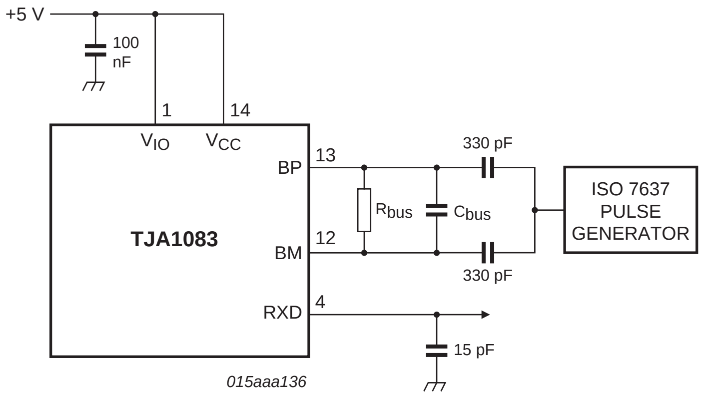


Fig 15. Test circuit for measuring dynamic characteristics



The waveforms of the applied transients are in accordance with ISO 7637, test pulses 1, 2a, 3a and 3b.

Test conditions:

Normal mode: bus idle

Normal mode: bus active; TXD at 5 MHz and TXEN at 1 kHz

Fig 16. Test circuit for measuring automotive transients

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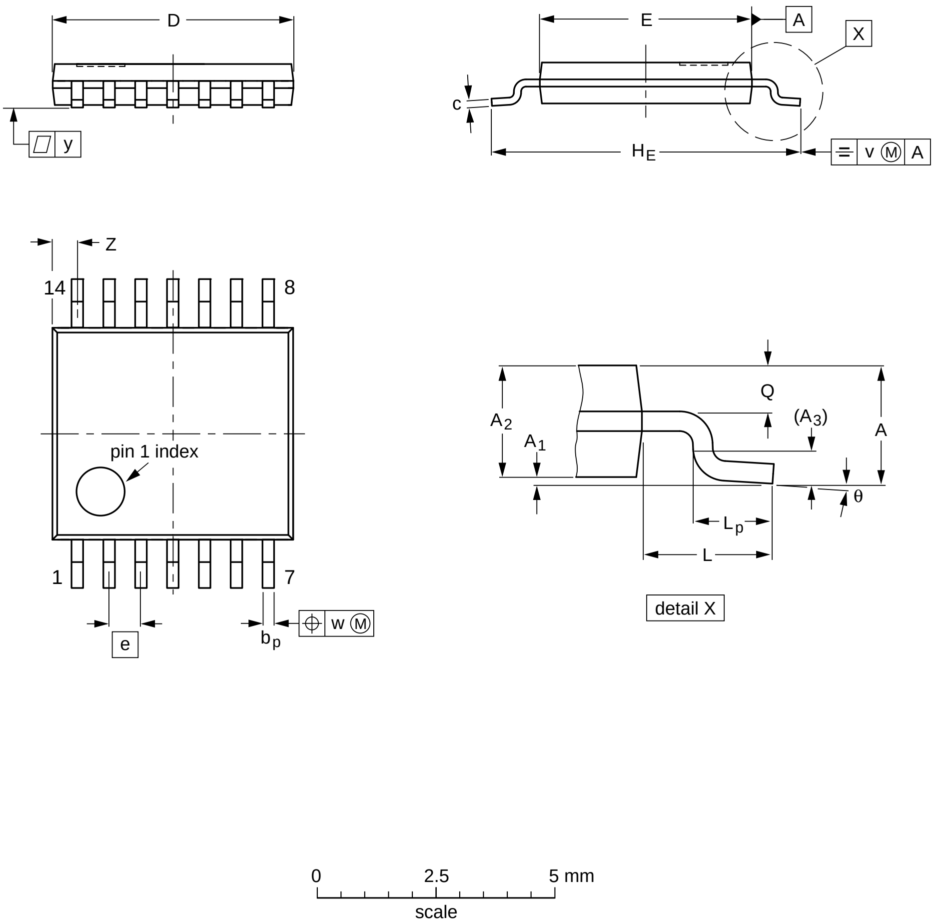
12. Package outline

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm **SOT402-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (2)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.72 0.38	8° 0°

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT402-1		MO-153				~~99-12-27~~ 03-02-18

Fig 17. Package outline SOT402-1 (TSSOP14)

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13. Soldering of SMD packages

This text provides a very brief insight into a complex technology. A more in-depth account of soldering ICs can be found in Application Note *AN10365 “Surface mount reflow soldering description”*.

13.1 Introduction to soldering

Soldering is one of the most common methods through which packages are attached to Printed Circuit Boards (PCBs), to form electrical circuits. The soldered joint provides both the mechanical and the electrical connection. There is no single soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and Surface Mount Devices (SMDs) are mixed on one printed wiring board; however, it is not suitable for fine pitch SMDs. Reflow soldering is ideal for the small pitches and high densities that come with increased miniaturization.

13.2 Wave and reflow soldering

Wave soldering is a joining technology in which the joints are made by solder coming from a standing wave of liquid solder. The wave soldering process is suitable for the following:

- Through-hole components
- Leaded or leadless SMDs, which are glued to the surface of the printed circuit board

Not all SMDs can be wave soldered. Packages with solder balls, and some leadless packages which have solder lands underneath the body, cannot be wave soldered. Also, leaded SMDs with leads having a pitch smaller than ~0.6 mm cannot be wave soldered, due to an increased probability of bridging.

The reflow soldering process involves applying solder paste to a board, followed by component placement and exposure to a temperature profile. Leaded packages, packages with solder balls, and leadless packages are all reflow solderable.

Key characteristics in both wave and reflow soldering are:

- Board specifications, including the board finish, solder masks and vias
- Package footprints, including solder thieves and orientation
- The moisture sensitivity level of the packages
- Package placement
- Inspection and repair
- Lead-free soldering versus SnPb soldering

13.3 Wave soldering

Key characteristics in wave soldering are:

- Process issues, such as application of adhesive and flux, clinching of leads, board transport, the solder wave parameters, and the time during which components are exposed to the wave
- Solder bath specifications, including temperature and impurities

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13.4 Reflow soldering

Key characteristics in reflow soldering are:

- Lead-free versus SnPb soldering; note that a lead-free reflow process usually leads to higher minimum peak temperatures (see Figure 18) than a SnPb process, thus reducing the process window
- Solder paste printing issues including smearing, release, and adjusting the process window for a mix of large and small components on one board
- Reflow temperature profile; this profile includes preheat, reflow (in which the board is heated to the peak temperature) and cooling down. It is imperative that the peak temperature is high enough for the solder to make reliable solder joints (a solder paste characteristic). In addition, the peak temperature must be low enough that the packages and/or boards are not damaged. The peak temperature of the package depends on package thickness and volume and is classified in accordance with Table 13 and 14

Table 13. SnPb eutectic process (from J-STD-020C)

Package thickness (mm)	Package reflow temperature (°C)	
	Volume (mm³)	
	< 350	≥ 350
< 2.5	235	220
≥ 2.5	220	220

Table 14. Lead-free process (from J-STD-020C)

Package thickness (mm)	Package reflow temperature (°C)		
	Volume (mm³)		
	< 350	350 to 2000	> 2000
< 1.6	260	260	260
1.6 to 2.5	260	250	245
> 2.5	250	245	245

Moisture sensitivity precautions, as indicated on the packing, must be respected at all times.

Studies have shown that small packages reach higher temperatures during reflow soldering, see Figure 18.

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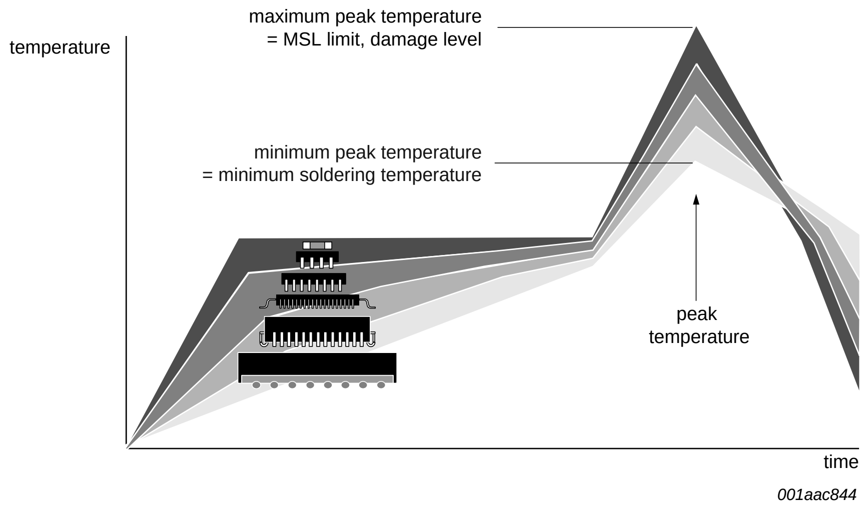

MSL: Moisture Sensitivity Level

Fig 18. Temperature profiles for large and small components

For further information on temperature profiles, refer to Application Note *AN10365 "Surface mount reflow soldering description"*.

14. Appendix

14.1 Differences between TJA1082 and TJA1083

The main differences between the TJA1083 and the TJA1082 are:

- The TJA1083 is EPL V3.0.1 compliant whereas the TJA1082 is EPL V2.1 Rev. B compliant
- The TJA1083 is JASPAR compliant (minimum transmitter output voltage of 900 mV)
- The TJA1083 has a higher pulse immunity (ISO7637)
- The TJA1083 has improved EMC behavior
- The bus load conditions for the static and dynamic characteristics are different in EPL V3.0.1 compared to EPL V2.1 Rev. B: 40 Ω to 55 Ω for the static characteristics instead of 40 Ω and 40 Ω for the dynamic characteristics instead of 45 Ω.

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14.2 Implementation of EPL 3.0.1 requirements in the TJA1083

Table 15. EPL 3.0.1 implementation in TJA1083

EPL 3.0.1				TJA1083			
	Min	Max	Unit	Symbol	Min	Max	Unit
dBDRxAsym	-	5	ns	$\lvert\Delta t_{d(bus-RXD)}\rvert$	0	5	ns
dBDRx10	-	75	ns	$t_{d(bus-RXD)}$	-	75	ns
dBDRx01	-	75	ns	$t_{d(bus-RXD)}$	-	75	ns
dBDRxai	50	275	ns	$t_{det(idle)(bus)} + t_{d(bus-RXD)}$	100	275	ns
dBDRxia	100	325	ns	$t_{det(act)(bus)} + t_{d(bus-RXD)}$	100	325	ns
dBDTxAsym	-	4	ns	$\lvert\Delta t_{d(TXD-bus)}\rvert$	0	4	ns
dBDTx10	-	75	ns	$t_{d(TXD-bus)}$	-	60	ns
dBDTx01	-	75	ns	$t_{d(TXD-bus)}$	-	60	ns
dBDTxai	-	75	ns	$t_{d(TXEN-busidle)}$	-	75	ns
dBDTxia	-	75	ns	$t_{d(TXEN-busact)}$	-	75	ns
dBusTxai	-	30	ns	$t_{r(bus)(act-idle)}$	-	30	ns
dBusTxia	-	30	ns	$t_{f(bus)(idle-act)}$	-	30	ns
dBusTx01	6	18.75	ns	$t_{r(dif)(bus)}$	6	18.75	ns
dBusTx10	6	18.75	ns	$t_{f(dif)(bus)}$	6	18.75	ns
$uBDTx_{active}$	600	2000	mV	$V_{OH(dif)}$	900	2000	mV
$uBDTx_{idle}$	0	30	mV	$\lvert V_{o(idle)(dif)}\rvert$	0	25	mV
$uV_{DIG-OUT-HIGH}$	80	100	%	$V_{OH(RXD)}$	$V_{IO} - 0.4$	V_{IO}	V
				$V_{OH(ERRN)}$	$V_{IO} - 0.4$	V_{IO}	V
$uV_{DIG-OUT-LOW}$	-	20	%	$V_{OL(RXD)}$	-	0.4	V
				$V_{OL(ERRN)}$	-	0.4	V
$uV_{DIG-IN-HIGH}$	-	70	%	$V_{IH(TXEN)}$	$0.7V_{IO}$	5.5	V
				$V_{IH(STBN)}$	$0.7V_{IO}$	5.5	V
				$V_{IH(BGE)}$	$0.7V_{IO}$	5.5	V
$uV_{DIG-IN-LOW}$	30	-	%	$V_{IL(TXEN)}$	−0.3	$+0.3V_{IO}$	V
				$V_{IL(STBN)}$	−0.3	$+0.3V_{IO}$	V
				$V_{IL(BGE)}$	−0.3	$+0.3V_{IO}$	V
uData0	−300	−150	mV	$V_{IL(dif)}$	−300	−150	mV
uData1	150	300	mV	$V_{IH(dif)}$	150	300	mV
uData1-|uData0|	−30	30	mV	$\lvert\Delta V_{i(dif)(H-L)}\rvert$	-	30	mV
dBDActivityDetection	100	250	ns	$t_{det(act)(bus)}$	100	250	ns
dBDIdleDetection	50	200	ns	$t_{det(idle)(bus)}$	100	200	ns
R_{CM1}, R_{CM2}	10	40	kΩ	$R_{i(BP)}$, $R_{i(BM)}$	10	40	kΩ
uCM	−10	15	V	V_{cm} [1]	−10	+15	V
$iBM_{GNDShortMax}$	-	60	mA	$\lvert I_{O(sc)(BM)}\rvert$	-	60	mA
$iBP_{GNDShortMax}$	-	60	mA	$\lvert I_{O(sc)(BP)}\rvert$	-	60	mA
$iBM_{BAT48ShortMax}$	-	72	mA	$\lvert I_{O(sc)(BM)}\rvert$	-	72	mA
$iBP_{BAT48ShortMax}$	-	72	mA	$\lvert I_{O(sc)(BP)}\rvert$	-	72	mA
$iBM_{BAT27ShortMax}$	-	60	mA	$\lvert I_{O(sc)(BM)}\rvert$	-	60	mA

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Table 15. EPL 3.0.1 implementation in TJA1083

EPL 3.0.1				TJA1083			
	Min	Max	Unit	Symbol	Min	Max	Unit
$iBP_{BAT27ShortMax}$	-	60	mA	$\|I_{O(sc)(BP)}\|$	-	60	mA
uBias, non low-power modes	1800	3200	mV	$V_{o(idle)(BP)}$, $V_{o(idle)(BM)}$[2]	1800	3150	mV
uBias, low-power modes	-200	200	mV	$V_{o(idle)(BP)}$, $V_{o(idle)(BM)}$[3]	–0.1	+0.1	V
$dWU_{0Detect}$	1	4	µs	$t_{det(wake)DATA\_0}$	1	4	µs
$dWU_{IdleDetect}$	1	4	µs	$t_{det(wake)idle}$	1	4	µs
$dWU_{Timeout}$	48	140	µs	$t_{det(wake)tot}$	50	115	µs
$uBDUVV_{CC}$	4	-	V	$V_{uvd(VCC)}$	4.45	4.729	V
$dBDUVV_{CC}$	-	1000	ms	$t_{det(uv)(VCC)}$	2	100	µs
iBP_{Leak}	-	25	µA	$I_{LI(BP)}$	-5	+5	µA
iBM_{Leak}	-	25	µA	$I_{LI(BM)}$	-5	+5	µA
Functional class ‘bus driver logic level adaptation’				implemented; see Section 2.4			
Functional class ‘bus driver - bus guardian interface’				implemented; see Section 2.4			
Device qualification according to AEC-Q100 (Rev. F)				see Section 2.1			
T_{AMB_Class1}	–40	125	°C	T_{amb}	–40	+125	°C
dBDTxDM	–50	50	ns	$\Delta t_{d(TXEN-bus)}$	–50	50	ns
$iBM_{-5VshortMax}$	-	60	mA	$\|I_{O(sc)(BM)}\|$	-	60	mA
$iBP_{-5VshortMax}$	-	60	mA	$\|I_{O(sc)(BP)}\|$	-	60	mA
$iBM_{BPShortMax}$	-	60	mA	$\|I_{O(sc)(BM)}\|$	-	60	mA
$iBP_{BMShortMax}$	-	60	mA	$\|I_{O(sc)(BP)}\|$	-	60	mA
$iBM_{BAT60ShortMax}$	-	90	mA	$\|I_{O(sc)(BM)}\|$	-	72	mA
$iBP_{BAT60ShortMax}$	-	90	mA	$\|I_{O(sc)(BP)}\|$	-	72	mA
uUV_{IO}	2	-	V	$V_{uvd(VIO)}$	2.55	2.774	V
$dBDUVV_{IO}$	-	1000	ms	$t_{det(uv)(VIO)}$	5	100	µs
$dBDWakeupReaction_{remote}$	-	100	µs	$t_{d(wake-ERRN)}$, $t_{d(wake-RXD)}$	-	100	µs
dBDTxActiveMax	650	2600	µs	$t_{detCL(TXEN)}$	650	2600	µs
dBDModeChange	100	100	µs	$t_{d(norm-stb)}$, $t_{d(stb-norm)}$	3	10	µs
$dBDERRN_{Stable}$	1	10	µs	$t_{ERRN(min)}$	2	10	µs
$dReactionTime_{ERRN}$	-	100	µs	$t_{d(errdet-ERRNL)}$	-	100	µs
uData0_LP	–400	–100	mV	$V_{IL(dif)}$	–400	–100	mV
$dWU_{Interrupt}$	0.13	1	µs	$t_{sup(int)wake}$	130	1000	ns
uBDLogic_1	-	60	%	$V_{IH(TXD)}$	$0.6V_{IO}$	5.5	V
uBDLogic_0	40	-	%	$V_{IL(TXD)}$	–0.3	$0.4V_{IO}$	V
$dBDRV_{CC}$	-	10	ms	$t_{rec(uv)(VCC)}$	2	100	µs
$dBDRV_{IO}$	-	10	ms	$t_{rec(uv)(VIO)}$	5	100	µs
$iBP_{LeakGND}$	-	1600	µA	$I_{LI(BP)}$	–1600	1600	µA
$iBM_{LeakGND}$	-	1600	µA	$I_{LI(BM)}$	–1600	1600	µA
Functional class ‘bus driver remote wakeup’				implemented; see Section 2.4			

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Table 15. EPL 3.0.1 implementation in TJA1083

EPL 3.0.1				TJA1083			
	Min	Max	Unit	Symbol	Min	Max	Unit
Functional class 'bus driver increased voltage amplitude transmitter'				implemented; see Section 2.4			
$uESD_{Ext}$	6	-	kV	$\lvert V_{ESD} \rvert$: HBM on pins BP and BM to GND	-	8	kV
$uESD_{Int}$	2	-	kV	$\lvert V_{ESD} \rvert$: HBM on any other pin	-	4	kV
$uESD_{IEC}$	6	-	kV	$\lvert V_{ESD} \rvert$: IEC61000-4-2 on pins BP and BM to GND	-	8	kV
$dBDRxD_{R15} + dBDRxD_{F15}$	-	13	ns	$\Sigma t_{(r+f)}$ (pin RXD; 15 pF load)	-	13	ns
$\lvert dBDRxD_{R15} - dBDRxD_{F15} \rvert$	-	5	ns	$\lvert \Delta t_{(r-f)} \rvert$ (pin RXD; 15 pF load)	-	5	ns
C_BDTxD	-	10	pF	$C_{i(TXD)}$	-	10	pF
dBDTxRxai	-	325	ns	$t_{d(TXENH-RXDH)}$	-	300	ns
$uV_{DIG-OUT-UV}$	-	500	mV	$V_{O(UVVIO)RXD}$	-	500	mV
				$V_{O(UVVIO)ERRN}$	-	500	mV
				$V_{O(UVVIO)SDO}$	-	500	mV
$uV_{DIG-OUT-OFF}$	product specific			$V_{OL(RXD)}$ [4]	$V_{IO} - 500$	V_{IO}	mV
				$V_{OL(ERRN)}$ [4]	-	500	mV
				$V_{OL(SDO)}$ [4]	-	500	mV
$R_{BDTransmitter}$	product specific			$Z_{o(TX)(eq)}$	10	600	Ω
RxD signal sum of rise and fall time at TP4_CC	-	16.5	ns	$\Sigma t_{(r+f)}$ (pin RXD; 10 pF load; simulated)	-	16.5	ns
$dBDRxD_{R25} + dBDRxD_{F25}$	-	16.5	ns	$\Sigma t_{(r+f)}$ (pin RXD; 25 pF load)	-	16.5	ns
$\lvert dBDRxD_{R25} - dBDRxD_{F25} \rvert$	-	5	ns	$\lvert \Delta t_{(r-f)} \rvert$ (pin RXD; 25 pF load)	-	5	ns
dBusTxDif	-	3	ns	$\lvert \Delta t_{(r-f)(dif)} \rvert$	-	3	ns
RxD signal difference of rise and fall time at TP4_CC	-	5	ns	$\lvert \Delta t_{(r-f)} \rvert$ (pin RXD; 10 pF load; simulated)	-	5	ns

[1] V_{cm} is the BP/BM common mode voltage, $(V_{BP} + V_{BM}) / 2$, and is specified in conditions column of parameters $V_{IH(dif)}$ and $V_{IL(dif)}$ for pins BP and BM; see Table 11. V_{cm} is tested on a receiving bus driver with a transmitting bus driver that has a ground offset voltage in the range −12.5 V to +12.5 V and transmits a 50/50 pattern.

[2] Min. value: $V_{o(idle)(BP)} = V_{o(idle)(BM)} = 0.4V_{CC} = 0.4 \times 4.5$ V = 1800 mV; max value: $V_{o(idle)(BP)} = V_{o(idle)(BM)} = 0.6V_{CC} = 0.6 \times 5.25$ V = 3150 mV; the nominal voltage is 2500 mV.

[3] The normal voltage is 0 mV.

[4] Power-off mode.

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15. Abbreviations

Table 16. Abbreviations

Abbreviation	Description
CDM	Charged Device Model
ECU	Electronic Control Unit
EMC	ElectroMagnetic Compatibility
EME	ElectroMagnetic Emission
EMI	ElectroMagnetic Immunity
ESD	ElectroStatic Discharge
HBM	Human Body Model
JASPAR	Japan Automotive Software Platform Architecture
MM	Machine Model
PWON	Power-on

16. References

[1] **EPL —** FlexRay Communications System Electrical Physical Layer Specification Version 3.0.1 (expected to be released by the end of 2009)

[2] **AN —** Application hint AN10365 - Surface mount reflow soldering description

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17. Revision history

Table 17. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
TJA1083 v.1	20121010	Product data sheet	-	-

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18.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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Date of release: 10 October 2012
Document identifier: TJA1083