

# NCV7420

## LIN Transceiver with 3.3 V or 5 V Voltage Regulator

### General Description

The NCV7420 is a fully featured local interconnect network (LIN) transceiver designed to interface between a LIN protocol controller and the physical bus. The transceiver is implemented in I3T technology enabling both high-voltage analog circuitry and digital functionality to co-exist on the same chip.

The NCV7420 LIN device is a member of the in-vehicle networking (IVN) transceiver family of ON Semiconductor that integrates a LIN v2.0 physical transceiver and either a 3.3 V or a 5 V voltage regulator. It is designed to work in harsh automotive environment and is submitted to the TS16949 qualification flow.

The LIN bus is designed to communicate low rate data from control devices such as door locks, mirrors, car seats, and sunroofs at the lowest possible cost. The bus is designed to eliminate as much wiring as possible and is implemented using a single wire in each node. Each node has a slave MCU-state machine that recognizes and translates the instructions specific to that function. The main attraction of the LIN bus is that all the functions are not time critical and usually relate to passenger comfort.

### KEY FEATURES

#### LIN-Bus Transceiver

- LIN compliant to specification revision 2.0 (backward compatible to version 1.3) and J2602
- I3T high voltage technology
- Bus voltage  $\pm 45$  V
- Transmission rate up to 20 kBaud
- SOIC 14 Green package
- This is a Pb-Free Device\*

#### Protection

- Thermal shutdown
- Indefinite short-circuit protection on pins LIN and WAKE towards supply and ground
- Load dump protection (45 V)
- Bus pins protected against transients in an automotive environment
- ESD protection level for LIN, INH, WAKE and Vbb up to  $\pm 8$  kV

#### EMI Compatibility

- Integrated slope control

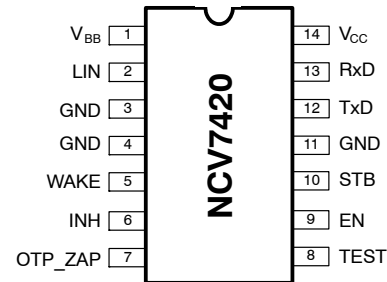
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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### PIN CONFIGURATION



SOIC 14  
D SUFFIX  
CASE 751AP

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 14 of this data sheet.

#### Voltage Regulator

- Output voltage 5 V / ~50 mA or 3.3 V / ~50 mA
- Wake-up input
- Enable inputs for stand-by and sleep mode
- INH output for auxiliary purposes (switching of an external pull-up or resistive divider towards battery, control of an external voltage regulator etc.)

#### Modes

- Normal mode: LIN communication in either low (up to 10 kBaud) or normal slope
- Sleep mode: V<sub>CC</sub> is switched “off” and no communication on LIN bus
- Stand-by mode: V<sub>CC</sub> is switched “on” but there is no communication on LIN bus
- Wake-up bringing the component from sleep mode into standby mode is possible either by LIN command or digital input signal on WAKE pin. Wake-up from LIN bus can also be detected and flagged when the chip is already in standby mode.

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**Table 1. KEY TECHNICAL CHARACTERISTICS – 3.3 V version**

Symbol	Parameter	Min.	Typ.	Max.	Unit
Vbb	Nominal battery operating voltage	5	12	26	V
Vbb	Load dump protection (Note 1)			45	V
Ibb_SLP	Supply current in sleep mode			20	μA
Vcc_out (Note 5)	Regulated Vcc output, Vcc load 1 mA–30 mA	3.23	3.30	3.37	V
	Regulated Vcc output, Vcc load 0 mA–50 mA	3.19	3.30	3.41	V
Iout_max	Maximum continuous Vcc output current (Note 2)	30			mA
	Maximum Vcc output current, thermal shutdown can occur (Note 2)	50			mA
V_wake	Operating DC voltage on WAKE pin	0		Vbb	V
	Maximum rating voltage on WAKE pin	–45		45	V
Tj	Junction thermal shutdown temperature	165		195	°C
Tamb	Operating ambient temperature	–40		+105	°C
Vesd	Electrostatic discharge voltage (LIN, WAKE, VBB) System HBM (Note 3)	–8		+8	kV
	Electrostatic discharge voltage (LIN, INH, WAKE, VBB) HBM (Note 4)	–4		+4	kV
	Electrostatic discharge voltage (other pins) HBM (Note 4)	–2		+2	kV

**Table 2. KEY TECHNICAL CHARACTERISTICS – 5 V version**

Symbol	Parameter	Min.	Typ.	Max.	Unit
Vbb	Nominal battery operating voltage	6	12	26	V
Vbb	Load dump protection (Note 1)			45	V
Ibb_SLP	Supply current in sleep mode			20	μA
Vcc_out (Note 5)	Regulated Vcc output, Vcc load 1 mA–30 mA	4.9	5.0	5.1	V
	Regulated Vcc output, Vcc load 0 mA–50 mA	4.83	5.0	5.17	V
Iout_max	Maximum continuous Vcc output current (Note 2)	30			mA
	Maximum Vcc output current, thermal shutdown can occur (Note 2)	50			mA
V_wake	Operating DC voltage on WAKE pin	0		Vbb	V
	Maximum rating voltage on WAKE pin	–45		45	V
Tj	Junction thermal shutdown temperature	165		195	°C
Tamb	Operating ambient temperature	–40		+105	°C
Vesd	Electrostatic discharge voltage (LIN, WAKE, VBB) System HBM (Note 3)	–8		+8	kV
	Electrostatic discharge voltage (LIN, INH, WAKE, VBB) HBM (Note 4)	–4		+4	kV
	Electrostatic discharge voltage (other pins) HBM (Note 4)	–2		+2	kV

1. The applied transients shall be in accordance with ISO 7637 part 1, test pulse 5. The device complies with functional class C; class A can be reached depending on the application and external components.
2. Current limitation is set above 50 mA but thermal shutdown can occur for currents above 30 mA
3. Equivalent to discharging a 150 pF capacitor through a 330 Ω resistor conform to IEC Standard 1000–4–2. LIN bus filter 220 pF, Vbb blocking capacitor 100 nF, 3k3/10n R/C network on WAKE.
4. Equivalent to discharging a 100 pF capacitor through a 1.5 kΩ resistor conform to MIL STD 883 method 3015.7.
5. Vcc voltage must be properly stabilized by external capacitors: capacitor of min. 80 nF with ESR<10 mΩ in parallel with a capacitor of min. 8 μF, ESR<1Ω.

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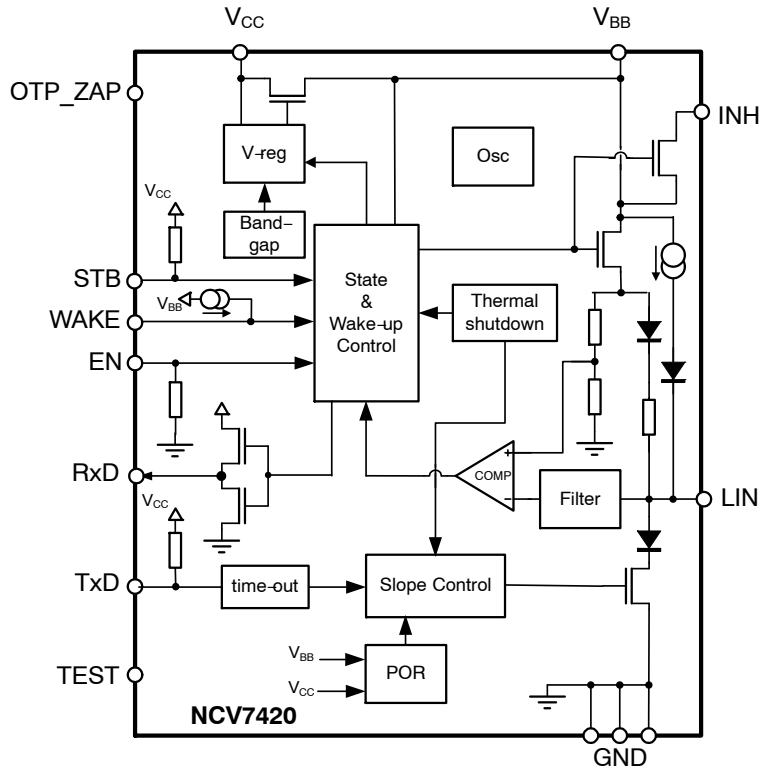


Figure 1. Block Diagram

## Typical Application

### Application Schematic

The EMC immunity of the Master-mode device can be further enhanced by adding a capacitor between the LIN output and ground. The optimum value of this capacitor is determined by the length and capacitance of the LIN bus, the

number and capacitance of Slave devices, the pull-up resistance of all devices (Master & Slave), and the required time constant of the system, respectively.

Vcc voltage must be properly stabilized by external capacitors: capacitor of min. 80 nF (ESR < 10 mΩ) in parallel with a capacitor of min. 8 μF (ESR < 1 Ω).

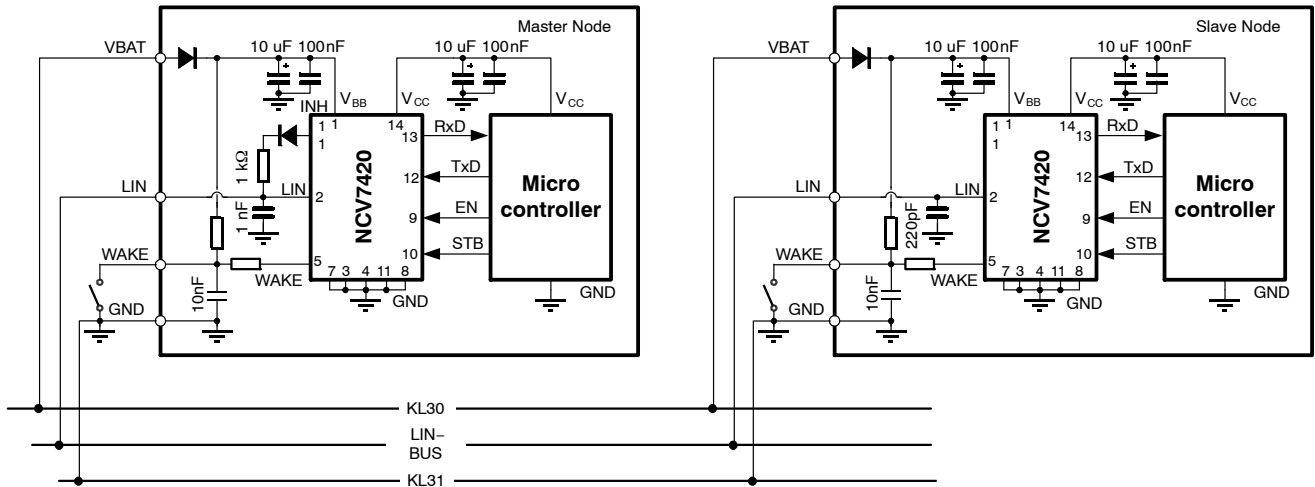


Figure 2. Typical Application Diagram

**Table 3. PIN DESCRIPTION**

Pin	Name	Description
1	VBB	Battery supply input
2	LIN	LIN bus output/input
3	GND	Ground
4	GND	Ground
5	WAKE	High voltage digital input pin to switch the part from sleep- to standby mode
6	INH	Inhibit output
7	OTP_ZAP	Supply for programming of trimming bits at factory testing, should be grounded in the application
8	TEST	Digital input for factory testing, should be grounded in the application
9	EN	Enable input, transceiver in normal operation mode when high
10	STB	Standby mode control input
11	GND	Ground
12	TxD	Transmit data input, low in dominant state
13	RxD	Receive data output; low in dominant state; push-pull output
14	Vcc	Supply voltage (output)

**Overall Functional Description**

LIN is a serial communication protocol that efficiently supports the control of mechatronic nodes in distributed automotive applications. The domain is class-A multiplex buses with a single master node and a set of slave nodes.

NCV7420 is designed as a master or slave node for the LIN communication interface with an integrated 3.3 V or 5 V voltage regulator having a current capability up to 50 mA for supplying any external components (microcontroller).

NCV7420 contains the LIN transmitter, LIN receiver, voltage regulator, power-on-reset (POR) circuits and thermal shutdown (TSD). The LIN transmitter is optimised for the maximum specified transmission speed of 20 kBaud

with EMC performance due to reduced slew rate of the LIN output.

The junction temperature is monitored via a thermal shutdown circuit that switches the LIN transmitter and voltage regulator off when temperature exceeds the TSD trigger level.

NCV7420 has four operating states (normal mode, low slope mode, stand-by mode, and sleep mode) that are determined by the input signals EN, WAKE, STB, and TxD.

**Operating States**

NCV7420 provides four operating states, two modes for normal operation with communication, one stand-by without communication and one low power mode with very low current consumption. See Figure 3.

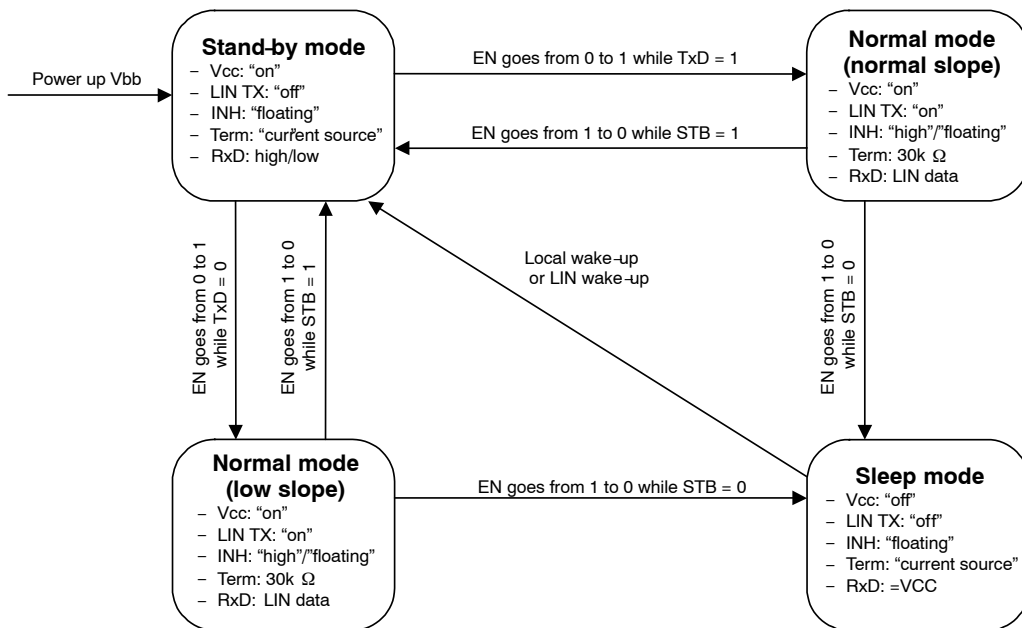


Figure 3. State Diagram

Table 4. MODE SELECTION

Mode	Vcc	RxD	INH	LIN	30 kΩ on LIN	Note
Normal – Slope	ON	Low = Dominant State High = Recessive State	High if STB=High during state transition; Floating otherwise	Normal Slope	ON	(Note 6)
Normal – Low Slope	ON	Low = Dominant State High = Recessive State	High if STB=High during state transition; Floating otherwise	Low Slope	ON	(Note 7)
Stand-by	ON	Low after LIN wakeup, high otherwise	Floating	OFF	OFF	(Note 8)
Sleep	OFF	Clamped to Vcc	Floating	OFF	OFF	

- The normal slope mode is entered when pin EN goes HIGH while TxD is in HIGH state during EN transition.
- The low slope mode is entered when pin EN goes HIGH while TxD is in LOW state during EN transition. LIN transmitter gets on only after TxD returns to high after the state transition.
- The stand-by mode is entered automatically after power-up.

**Normal Slope Mode**

In normal slope mode the transceiver can transmit and receive data via LIN bus with speed up to 20 kBaud. The transmit data stream of the LIN protocol is present on the TxD pin and converted by the transmitter into a LIN bus signal with controlled slew rate to minimize EMC emission. The receiver consists of the comparator that has a threshold with hysteresis in respect to the supply voltage and an input filter to remove bus noise. The LIN output is pulled HIGH via an internal 30 kΩ pull-up resistor. For master applications it is needed to put an external 1 kΩ resistor with a serial diode between LIN and Vbb (or INH). See Figure 2. The mode selection is done by EN=HIGH when TxD pin is HIGH. If STB pin is high during the standby-to-normal slope mode transition, INH pin is pulled high. Otherwise, it stays floating.

**Low Slope Mode**

In low slope mode the slew rate of the signal on the LIN bus is reduced (rising and falling edges of the LIN bus signal

are longer). This further reduces the EMC emission. As a consequence the maximum speed on the LIN bus is reduced up to 10 kBaud. This mode is suited for applications where the communication speed is not critical. The mode selection is done by EN=HIGH when TxD pin is LOW. In order not to transmit immediately a dominant state on the bus (because TxD=LOW), the LIN transmitter is enabled only after TxD returns to HIGH. If STB pin is high during the standby-to-low slope mode transition, INH pin is pulled high. Otherwise, it stays floating.

**Stand-by Mode**

The stand-by mode is always entered after power-up of the NCV7420. It can also be entered from normal mode when the EN pin is low and the stand-by pin is high. From sleep mode it can be entered after a local wake-up or LIN wakeup. In stand-by mode the Vcc voltage regulator for supplying external components (e.g. a microcontroller) stays active. Also the LIN receiver stays active to be able to detect a remote wake-up via bus. The LIN transmitter is

disabled and the slave internal termination resistor of 30 kΩ between LIN and Vbb is disconnected in order to minimize current consumption. Only a pull-up current source between Vbb and LIN is active.

**Sleep Mode**

The Sleep Mode provides extreme low current consumption. This mode is entered when both EN and STB pins are LOW coming from normal mode. The internal termination resistor of 30 kΩ between LIN and Vbb is disconnected and also the Vcc regulator is switched off to minimize current consumption.

**Wake-up**

NCV7420 has two possibilities to wake-up from sleep or stand-by mode (see Figure 3):

- Local wake-up: enables the transition from sleep mode to stand-by mode
- Remote wake-up via LIN: enables the transition from sleep- to stand-by mode and can be also detected when already in standby mode.

A local wake-up is **only** detected in sleep mode if a transition from LOW to HIGH or from HIGH to LOW is seen on the wake pin.

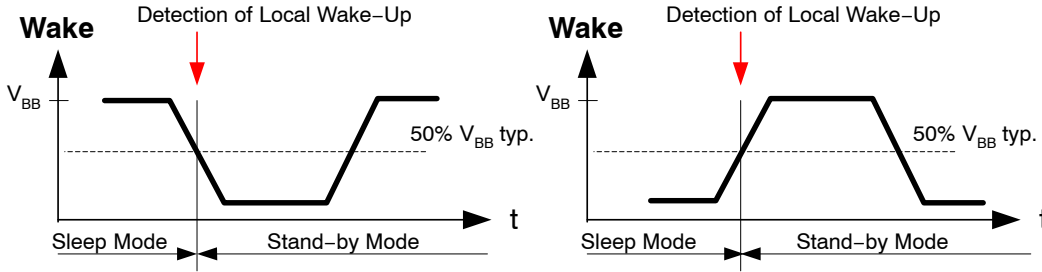


Figure 4. Local Wake-up Signal

A remote wake-up is **only** detected if a combination of (1) a falling edge at the LIN pin (transition from recessive to dominant) is followed by (2) a dominant level maintained

for a time period > t<sub>WAKE</sub> and (3) again a rising edge at pin LIN (transition from dominant to recessive) happens.

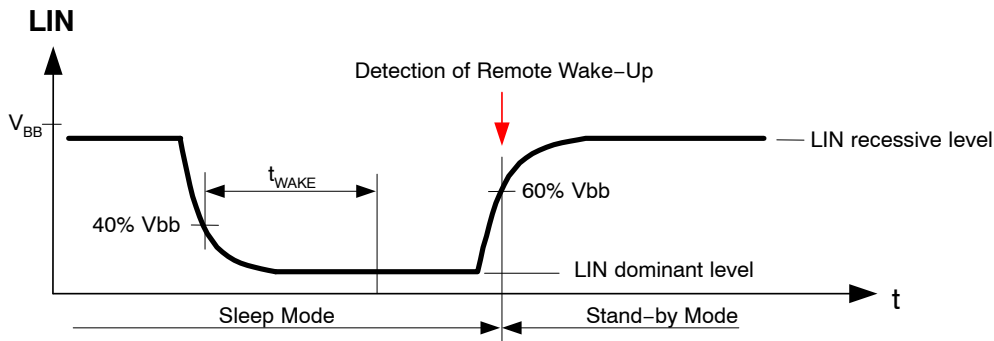


Figure 5. Remote Wake-up Behavior

The wake-up source is distinguished by pin RxD in the stand-by mode:

- RxD remains HIGH after power-up or local wake-up.

- RxD is kept LOW until normal mode is entered after a remote wake-up (LIN).

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## Electrical Characteristics

### Definitions

All voltages are referenced to GND (Pin 13). Positive currents flow into the IC.

**Table 5. ABSOLUTE MAXIMUM RATINGS – 3.3 V and 5 V versions**

Symbol	Parameter	Min.	Max.	Unit
Vbb	Battery voltage on pin Vbb (Note 9)	-0.3	+45	V
Vcc	DC voltage on pin Vcc	0	+7	V
I_Vcc	Current delivered by the Vcc regulator	50		mA
V_LIN	LIN bus voltage (Note 10)	-45	+45	V
V_INH	DC voltage on inhibit pin	-0.3	Vbb + 0.3	V
V_WAKE	DC voltage on WAKE pin	-45	45	V
V_Dig_in	DC input voltage on pins TxD, RxD, EN, STB	-0.3	Vcc + 0.3	V
Tjunc	Maximum junction temperature	-40	+165	°C
Vesd	Electrostatic discharge voltage (pins LIN, WAKE and Vbb) system HBM (Note 11)	-8	+8	kV
	Electrostatic discharge voltage (pins LIN, INH, WAKE and Vbb) HBM (Note 12)	-4	+4	kV
	Electrostatic discharge voltage (other pins) HBM (Note 12)	-2.0	+2.0	kV
	Electrostatic discharge voltage; charge device model (Note 13)	-250	+250	V

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

9. The applied transients shall be in accordance with ISO 7637 part 1, test pulses 1, 2, 3a, 3b, and 5. The device complies with functional class C; class A can be reached depending on the application and external components.

10. The applied transients shall be in accordance with ISO 7637 part 1, test pulses 1, 2, 3a, and 3b. The device complies with functional class C; class A can be reached depending on the application and external components.

11. Equivalent to discharging a 150 pF capacitor through a 330  $\Omega$  resistor conform to IEC Standard 1000-4-2. LIN bus filter 220 pF, Vbb blocking capacitor 100 nF, 3k3/10n R/C network on WAKE.

12. Equivalent to discharging a 100 pF capacitor through a 1.5 k $\Omega$  resistor conform to MIL STD 883 method 3015.7.

13. Conform to EOS/ESD-DS5.3 (socket mode).

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**DC Characteristics – 3.3 V version** ( $V_{BB} = 5\text{ V to }26\text{ V}$ ;  $T_{junc} = -40^{\circ}\text{C to }+150^{\circ}\text{C}$ ; unless otherwise specified.)

**Table 6. DC CHARACTERISTICS SUPPLY – Pins VBB and VCC**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I <sub>bb_ON</sub>	Supply current	Normal mode; LIN recessive			1	mA
I <sub>bb_STB</sub>	Supply current	Stand-by mode, V <sub>bb</sub> = 5 – 18 V			60	μA
I <sub>bb_SLP</sub>	Supply current	Sleep mode, V <sub>bb</sub> = 5 – 18 V			20	μA
V <sub>cc_out</sub>	Regulator output voltage	V <sub>cc</sub> load 1 mA – 30 mA	3.23	3.30	3.37	V
	Regulator output voltage	V <sub>cc</sub> load 0 mA – 50 mA	3.19	3.30	3.41	V
I <sub>out_max_cont</sub>	Maximum output current	V <sub>bb</sub> = 16 V; T <sub>amb</sub> = 105°C			30	mA
I <sub>out_max_conta</sub>	Maximum output current	V <sub>bb</sub> = 26 V; limited lifetime			30	mA
I <sub>out_max_abs</sub>	Absolute maximum output current	Thermal shutdown can occur			50	mA
I <sub>out_lim</sub>	Over-current limitation		50		150	mA

**Table 7. DC CHARACTERISTICS LIN TRANSMITTER – Pin LIN**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V <sub>Lin_dom_LoSup</sub>	LIN dominant output voltage	TXD = low; V <sub>bb</sub> = 7.3 V			1.2	V
V <sub>Lin_dom_HiSup</sub>	LIN dominant output voltage	TXD = low; V <sub>bb</sub> = 18 V			2.0	V
V <sub>Lin_rec</sub>	LIN recessive output voltage	TXD = highH; I <sub>lin</sub> = 0 mA	V <sub>bb</sub> – V <sub>γ</sub> (Note 14)			V
I <sub>LIN_lim</sub>	Short circuit current limitation	V <sub>Lin</sub> = V <sub>bb_max</sub>	40		200	mA
R <sub>slave</sub>	Internal pull-up resistance		20	33	47	kΩ
I <sub>LIN_off_dom</sub>	LIN output current bus in dominant state	Driver off; V <sub>bb</sub> = 12 V	–1			mA
I <sub>LIN_off_rec</sub>	LIN output current bus in recessive state	Driver off; V <sub>bb</sub> = 12 V			20	μA
I <sub>LIN_no_GND</sub>	Communication not affected	V <sub>bb</sub> = GND = 12 V; 0 < V <sub>Lin</sub> < 18 V	–1		1	mA
I <sub>LIN_no_Vbb</sub>	LIN bus remains operational	V <sub>bb</sub> = GND = 0 V; 0 < V <sub>Lin</sub> < 18 V			100	μA

**Table 8. DC CHARACTERISTICS LIN RECEIVER – Pin LIN**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V <sub>rec_dom</sub>	Receiver threshold	LIN bus recessive → dominant	0.4		0.6	V <sub>bb</sub>
V <sub>rec_rec</sub>	Receiver threshold	LIN bus dominant → recessive	0.4		0.6	V <sub>bb</sub>
V <sub>rec_cnt</sub>	Receiver centre voltage	(V <sub>bus_dom</sub> + V <sub>bus_rec</sub> ) / 2	0.475		0.525	V <sub>bb</sub>
V <sub>rec_hys</sub>	Receiver hysteresis		0.05		0.175	V <sub>bb</sub>

**Table 9. DC CHARACTERISTICS I/Os**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>Pin WAKE</b>						
V <sub>wake_th</sub>	Threshold voltage		0.35		0.65	V <sub>bb</sub>

14. V<sub>γ</sub> is the forward diode voltage. Typically (over the complete temperature) V<sub>γ</sub> = 1 V.

15. By one of the trimming bits, following reconfiguration can be done during chip-level testing in order to fit the NCV7420\_3 into different interface: pins TxD and EN will have typ. 10 kΩ pull-down resistor to ground and pin WAKE will have typ. 10 μA pull-up current source.



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**DC Characteristics – 3.3 V version** ( $V_{BB} = 5\text{ V to }26\text{ V}$ ;  $T_{junc} = -40^{\circ}\text{C to }+150^{\circ}\text{C}$ ; unless otherwise specified.)

**Table 9. DC CHARACTERISTICS I/Os**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>Pin WAKE</b>						
I_leak	Input leakage current (Note 15)	Vwake = 0 V; Vbb = 18 V	-1	-0.5	1	μA
T_wake_min	Debounce time	Sleep mode; rising and falling edge	8		54	μs
<b>Pins TxD and STB</b>						
Vil	Low level input voltage				0.8	V
Vih	High level input voltage		2.0			V
Rpu	Pull-up resistance to Vcc (Note 15)		50		200	kΩ
<b>Pin INH</b>						
Delta_VH	High level voltage drop	IINH = 15 mA		0.35	0.75	V
I_leak	Leakage current	Sleep mode; VINH = 0 V	-1		1	μA
<b>Pin EN</b>						
Vil	Low level input voltage				0.8	V
Vih	High level input voltage		2.0			V
Rpd	Pull-down resistance to ground (Note 15)		50		200	kΩ
<b>Pin RxD</b>						
Vol	Low level output voltage	Isink = 2 mA			0.65	V
Voh	High level output voltage	Isource = -2 mA	Vcc - 0.65 V			V

**Table 10. DC CHARACTERISTICS**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>POR</b>						
PORH_Vbb	POR high level Vbb comparator				4.75	V
PORL_Vbb	POR low level Vbb comparator		3			V
POR_Vbb_sl	Maximum slope on Vbb to guarantee POR				50	V/ms
PORH_Vcc	POR high level Vcc comparator				3	V
PORL_Vcc	POR low level Vcc comparator		2			V
POR_Vcc_hyst	Hysteresis of POR level Vcc comparator		100			mV
<b>TSD</b>						
Tj	Junction temperature	For shutdown	165		195	°C
Tj_hyst	Thermal shutdown hysteresis		9		18	°C

14.  $V_f$  is the forward diode voltage. Typically (over the complete temperature)  $V_f = 1\text{ V}$ .

15. By one of the trimming bits, following reconfiguration can be done during chip-level testing in order to fit the NCV7420\_3 into different interface: pins TxD and EN will have typ. 10 kΩ pull-down resistor to ground and pin WAKE will have typ. 10 μA pull-up current source.

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**DC Characteristics – 5 V version** – ( $V_{BB} = 6\text{ V to }26\text{ V}$ ;  $T_{junc} = -40^{\circ}\text{C to }+150^{\circ}\text{C}$ ; unless otherwise specified.)

**Table 11. DC CHARACTERISTICS SUPPLY – Pins VBB and VCC**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I <sub>bb_ON</sub>	Supply current	Normal mode; LIN recessive			1	mA
I <sub>bb_STB</sub>	Supply current	Stand-by mode, V <sub>bb</sub> = 6 – 18 V			60	μA
I <sub>bb_SLP</sub>	Supply current	Sleep mode, V <sub>bb</sub> = 6 – 18 V			20	μA
V <sub>cc_out</sub>	Regulator output voltage	V <sub>cc</sub> load 1 mA – 30 mA	4.9	5.0	5.1	V
	Regulator output voltage	V <sub>cc</sub> load 0 mA – 50 mA	4.83	5.0	5.17	V
I <sub>out_max_cont</sub>	Maximum output current	V <sub>bb</sub> = 16 V; T <sub>amb</sub> = 105°C			30	mA
I <sub>out_max_conta</sub>	Maximum output current	V <sub>bb</sub> = 26 V; limited lifetime			30	mA
I <sub>out_max_abs</sub>	Absolute maximum output current	Thermal shutdown can occur			50	mA
I <sub>out_lim</sub>	Over-current limitation		50		150	mA

**Table 12. DC CHARACTERISTICS LIN TRANSMITTER – Pin LIN**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V <sub>Lin_dom_LoSup</sub>	LIN dominant output voltage	TXD = low; V <sub>bb</sub> = 7.3 V			1.2	V
V <sub>Lin_dom_HiSup</sub>	LIN dominant output voltage	TXD = low; V <sub>bb</sub> = 18 V			2.0	V
V <sub>Lin_rec</sub>	LIN recessive output voltage	TXD = highH; I <sub>lin</sub> = 0 mA	V <sub>bb</sub> – V <sub>γ</sub> (Note 16)			V
I <sub>LIN_lim</sub>	Short circuit current limitation	V <sub>Lin</sub> = V <sub>bb_max</sub>	40		200	mA
R <sub>slave</sub>	Internal pull-up resistance		20	33	47	kΩ
I <sub>LIN_off_dom</sub>	LIN output current bus in dominant state	Driver off; V <sub>bb</sub> = 12 V	-1			mA
I <sub>LIN_off_rec</sub>	LIN output current bus in recessive state	Driver off; V <sub>bb</sub> = 12 V			20	μA
I <sub>LIN_no_GND</sub>	Communication not affected	V <sub>bb</sub> = GND = 12 V; 0 < V <sub>Lin</sub> < 18 V	-1		1	mA
I <sub>LIN_no_Vbb</sub>	LIN bus remains operational	V <sub>bb</sub> = GND = 0 V; 0 < V <sub>Lin</sub> < 18 V			100	μA

**Table 13. DC CHARACTERISTICS LIN RECEIVER – Pin LIN**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V <sub>rec_dom</sub>	Receiver threshold	LIN bus recessive → dominant	0.4		0.6	V <sub>bb</sub>
V <sub>rec_rec</sub>	Receiver threshold	LIN bus dominant → recessive	0.4		0.6	V <sub>bb</sub>
V <sub>rec_cnt</sub>	Receiver center voltage	(V <sub>bus_dom</sub> + V <sub>bus_rec</sub> ) / 2	0.475		0.525	V <sub>bb</sub>
V <sub>rec_hys</sub>	Receiver hysteresis		0.05		0.175	V <sub>bb</sub>

**Table 14. DC CHARACTERISTICS I/OS**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
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**Pin WAKE**

V <sub>wake_th</sub>	Threshold voltage		0.35		0.65	V <sub>bb</sub>
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16. V<sub>γ</sub> is the forward diode voltage. Typically (over the complete temperature) V<sub>γ</sub> = 1 V.

17. By one of the trimming bits, following reconfiguration can be done during chip-level testing in order to fit the NCV7420\_5 into different interface: pins TxD and EN will have typ. 10 kΩ pull-down resistor to ground and pin WAKE will have typ. 10 μA pull-up current source.

# NCV7420

**DC Characteristics – 5 V version** – ( $V_{BB} = 6\text{ V to }26\text{ V}$ ;  $T_{junc} = -40^{\circ}\text{C to }+150^{\circ}\text{C}$ ; unless otherwise specified.)

**Table 14. DC CHARACTERISTICS I/OS**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>Pin WAKE</b>						
I_leak	Input leakage current (Note 17)	Vwake = 0 V; Vbb = 18 V	-1	-0.5	1	μA
T_wake_min	Debounce time	Sleep mode; rising and falling edge	8		54	μs
<b>Pins TxD and STB</b>						
Vil	Low level input voltage				0.8	V
Vih	High level input voltage		2.0			V
Rpu	Pull-up resistance to Vcc (Note 17)		50		200	kΩ
<b>Pin INH</b>						
Delta_VH	High level voltage drop	IINH = 15 mA		0.35	0.75	V
I_leak	Leakage current	Sleep mode; VINH = 0 V	-1		1	μA
<b>Pin EN</b>						
Vil	Low level input voltage				0.8	V
Vih	High level input voltage		2.0			V
Rpd	Pull-down resistance to ground (Note 17)		50		200	kΩ
<b>Pin RxD</b>						
Vol	Low level output voltage	Isink = 2 mA			0.65	V
Voh	High level output voltage	Isource = -2 mA	Vcc - 0.65 V			V

**Table 15. DC CHARACTERISTICS**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>POR</b>						
PORH_Vbb	POR high level Vbb comparator				4.75	V
PORL_Vbb	POR low level Vbb comparator		3			V
POR_Vbb_sl	Maximum slope on Vbb to guarantee POR				50	V/ms
PORH_Vcc	POR high level Vcc comparator				4.5	V
PORL_Vcc	POR low level Vcc comparator		3			V
POR_Vcc_hyst	Hysteresis of POR level Vcc comparator		100			mV
<b>TSD</b>						
Tj	Junction temperature	For shutdown	165		195	°C
Tj_hyst	Thermal shutdown hysteresis		9		18	°C

16.  $V_f$  is the forward diode voltage. Typically (over the complete temperature)  $V_f = 1\text{ V}$ .

17. By one of the trimming bits, following reconfiguration can be done during chip-level testing in order to fit the NCV7420\_5 into different interface: pins TxD and EN will have typ. 10 kΩ pull-down resistor to ground and pin WAKE will have typ. 10 μA pull-up current source.

# NCV7420

**AC Characteristics – 3.3 V and 5 V versions** – ( $V_{BB} = 7\text{ V to }18\text{ V}$ ;  $T_{junc} = -40^{\circ}\text{C to }+150^{\circ}\text{C}$ ; unless otherwise specified.)

**Table 16. AC CHARACTERISTICS LIN TRANSMITTER – Pin LIN**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
D1	Duty Cycle 1 = $t_{BUS\_REC(min)} / (2 \times T_{Bit})$	$TH_{REC(min)} = 0.284 \times V_{bb}$ $TH_{DOM(min)} = 0.422 \times V_{bb}$ $T_{BIT} = 50\ \mu\text{s}$	0.396			
D2	Duty Cycle 2 = $t_{BUS\_REC(max)} / (2 \times T_{Bit})$	$TH_{REC(max)} = 0.744 \times V_{bb}$ $TH_{DOM(max)} = 0.581 \times V_{bb}$ $T_{BIT} = 50\ \mu\text{s}$			0.581	
T_fall_norm	LIN falling edge	Normal slope mode; $V_{bb} = 12\text{ V}$ ; L1, L2 (Note 18)			22.5	$\mu\text{s}$
T_rise_norm	LIN rising edge	Normal slope mode; $V_{bb} = 12\text{ V}$ ; L1, L2 (Note 18)			22.5	$\mu\text{s}$
T_sym_norm	LIN slope symmetry	Normal slope mode; $V_{bb} = 12\text{ V}$ ; L1, L2 (Note 18)	-4		4	$\mu\text{s}$
T_fall_norm	LIN falling edge	Normal slope mode; $V_{bb} = 12\text{ V}$ ; L3 (Note 18)			27	$\mu\text{s}$
T_rise_norm	LIN rising edge	Normal slope mode; $V_{bb} = 12\text{ V}$ ; L3 (Note 18)			27	$\mu\text{s}$
T_sym_norm	LIN slope symmetry	Normal slope mode; $V_{bb} = 12\text{ V}$ ; L3 (Note 18)	-5		5	$\mu\text{s}$
T_fall_low	LIN falling edge	Low slope mode (Note 19); $V_{bb} = 12\text{ V}$ ; L3 (Note 18)			62	$\mu\text{s}$
T_rise_low	LIN rising edge	Low slope mode (Note 19); $V_{bb} = 12\text{ V}$ ; L3 (Note 18)			62	$\mu\text{s}$
T_wake	Dominant time-out for wake-up via LIN bus		30		150	$\mu\text{s}$
T_dom	TxD dominant time-out	TxD = low	6		20	ms

18. The AC parameters are specified for following RC loads on the LIN bus: L1 = 1 k $\Omega$  / 1 nF; L2 = 660  $\Omega$  / 6.8 nF; L3 = 500  $\Omega$  / 10 nF.

19. Low slope mode is not compliant to the LIN 1.3 or LIN 2.0 standard.

# NCV7420

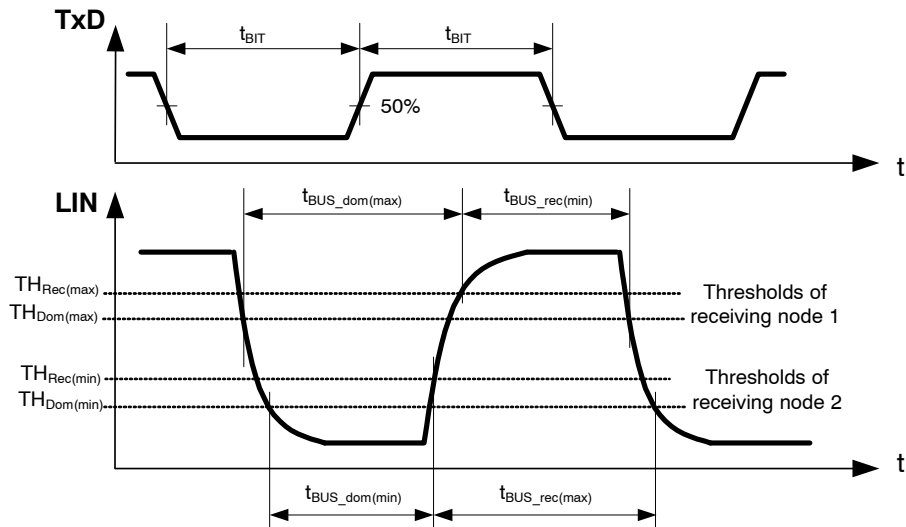


Figure 6. LIN Transmitter Duty Cycle

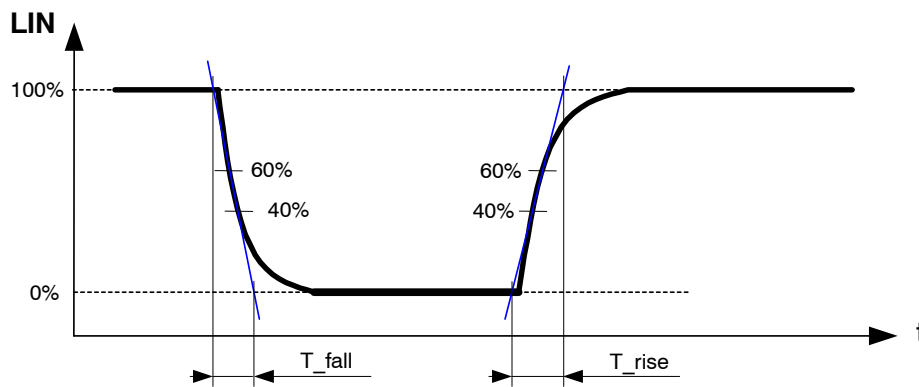


Figure 7. LIN Transmitter Rising and Falling Times

Table 17. AC CHARACTERISTICS LIN RECEIVER

Symbol Pin LIN	Parameter	Conditions	Min.	Typ.	Max.	Unit
Trec_prop_down	Propagation delay of receiver falling edge		0.1		6	$\mu$ s
Trec_prop_up	Propagation delay of receiver rising edge		0.1		6	$\mu$ s
Trec_sym	Propagation delay symmetry	Trec_prop_down – Trec_prop_up	-2		2	$\mu$ s

# NCV7420

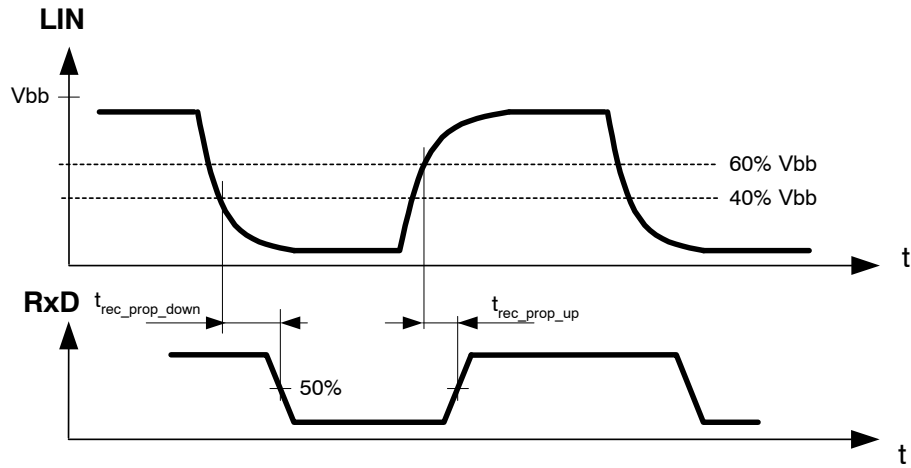


Figure 8. LIN Receiver Timing

## ORDERING INFORMATION

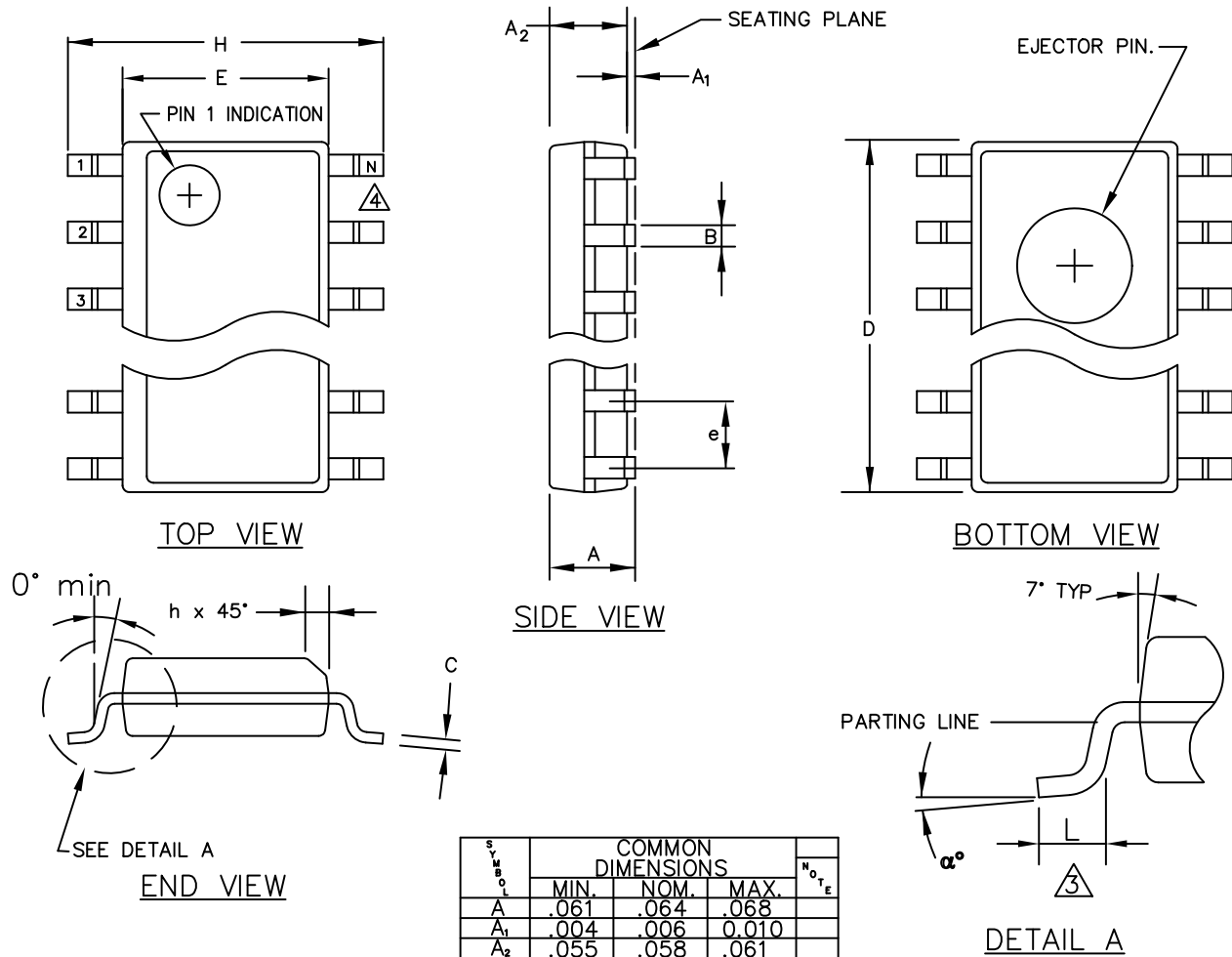
Part Number	Description	Package	Container		Temperature Range
			Shipping <sup>†</sup>	Qty.	
NCV7420D23G	LIN Transceiver + 3.3 V Vreg.	SOIC 150 14 GREEN (JEDEC MS-012)	Tube/Rail	55	-40°C to 105°C
NCV7420D23R2G	LIN Transceiver + 3.3 V Vreg.	SOIC 150 14 GREEN (JEDEC MS-012)	Tape & Reel	3000	-40°C to 105°C
NCV7420D25G	LIN Transceiver + 5 V Vreg.	SOIC 150 14 GREEN (JEDEC MS-012)	Tube/Rail	55	-40°C to 105°C
NCV7420D25R2G	LIN Transceiver + 5 V Vreg.	SOIC 150 14 GREEN (JEDEC MS-012)	Tape & Reel	3000	-40°C to 105°C

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# NCV7420

## PACKAGE DIMENSIONS

SOIC 14  
CASE 751AP-01  
ISSUE A



SYMBOL	COMMON DIMENSIONS			NOTE
	MIN.	NOM.	MAX.	
A	.061	.064	.068	
A <sub>1</sub>	.004	.006	0.010	
A <sub>2</sub>	.055	.058	.061	
B	.0138	.016	.020	
C	.0075	.008	.0098	
D	SEE VARIATIONS			1
E	.150	.155	.157	
e	.050 BSC			
H	.230	.236	.244	
h	.010	.013	.016	
L	.016	.025	.035	
N	SEE VARIATIONS			2
$\alpha^\circ$	0°	5°	8°	

VARIATIONS				
	1			2
	D			N
NOTE	MIN.	NOM.	MAX.	
AA	.189	.194	.196	8
AB	.337	.342	.344	14
AC	.386	.391	.393	16

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