

1. Features and Benefits

- Motor driver
 - Driver for DC/BLDC/Stepper motor
 - $R_{on} = 3\Omega$ typ. for 1 half-bridge + shunt
 - 2x NFET for each half-bridge
 - on-chip charge-pump for top-NFETs
 - V_{ds} protection for all NFETs
- Microcontroller:
 - MLX16-FX, application CPU
 - MLX4, communication CPU
 - 2x watch-dog
 - +50 input interrupt controller
 - Common purpose timer
- Memories split per CPU
 - MLX16-FX memories:
 - 32 kByte Flash with ECC
 - 8 kByte ROM
 - 2 kByte RAM
 - 512 Byte EEPROM
 - MLX4 memories:
 - 6 kByte ROM
 - 512 Byte RAM
- Pin-compatible drivers in SO8 and QFN24
 - MLX81330 < 0.5A
 - MLX81332 < 1A
- **Automotive AEC-Q100 qualified**
- Periphery
 - Configurable RC-clock 12..32 MHz
 - 4x general purpose IO's, digital, analog, 1x high-voltage input, SPI, I2C-slave
 - 5x 16-bit motor PWM timers
 - 2x 16-bit timers
 - 10-bit ADC with < 6 μs conversion time with multiple channels and different ADC references
 - Differential current sense amplifier
 - Temperature sensor, over-temperature detection
 - Over-current detection, over-voltage and under-voltage protection
- Voltage regulators
 - Internal voltage regulators, directly powered from 12V battery supply
 - Operating voltage $V_s = 5.5V$ to 20V
 - Operation down to 3.5V with reduced analog characteristics, down to 3V without losing register content, down to 1.5V with intact RAM memory
 - Low standby current consumption of typ 25 μA (max 50 μA) in sleep mode
 - Wake-up possible via LIN, external pins or internal wake-up timer
- Bus interface
 - LIN 2.x/SAE J2602 and ISO17987-4 compliant LIN slave

2. Application Examples

- Small Stepper/BLDC flap or valve, < 0.5A_{pk} per phase
- Small DC flap/valve, or single-coil fan/pump, < 0.7A_{pk}

3. Ordering Information

Order Code	Temp. Range	Package	Delivery	Remark
MLX81330 K LW-BMC-102-RE	-40 - 125 °C	QFN24_WF 4x4	Reel	DC/BLDC/Stepper with 4x IO
MLX81330 KDC-BMC-002-RE	-40 - 125 °C	SO8-ep	Reel	BLDC with 1x IO, auto-address
MLX81330 KDC-BMC-102-RE	-40 - 125 °C	SO8-ep	Reel	Stepper, auto-address
MLX81330 KDC-BMC-202-RE	-40 - 125 °C	SO8-ep	Reel	Stepper with 1x IO
MLX81330 KDC-BMC-302-RE	-40 - 125 °C	SO8-ep	Reel	DC motor with 3x IO

Table 1 – Ordering information

4. Family Concept

	MLX81330	MLX81332	MLX81334**
MCU Memory	32 KB Flash + 14 KB ROM	32 KB Flash + 16 KB ROM	64 KB Flash + 16 KB ROM
MCU EEPROM	64x 8 Byte	64x 8 Byte	64x 8 Byte
MCU RAM	2.5 KB	2.5 KB	4.5 KB
Driver	4x Driver on-chip typ. 3Ω Halfbridge	4x Driver on-chip typ. 0.8Ω Halfbridge	4x Driver on-chip typ. 0.8Ω Halfbridge
IO pins (analog, digital)	3x LV + 1x HV/LV	7x LV + 1x HV/LV	7x LV + 1x HV/LV
Motor current sense	Low side, On-chip	Low side, On-chip	Low side, On-chip
Sensor interface (3V/5V supply)	analog, pwm, spi, sent, I ² C	analog, pwm, spi, sent, I ² C, uart	analog, pwm, spi, sent, I ² C, uart
Sensorless support (hw + sw)	Yes	Yes	Yes
LIN auto-address support (AA)	Yes	Yes	Yes
Maximum IC Temperature (with validated mission profile)	T _j = 175°C	T _j = 175°C	T _j = 175°C
Package	QFN24, 4x4 SO8-ep	QFN24, 4x4 SO8-ep	QFN32, 5x5 ** roadmap

Table 2 – Family Overview

5. Revision history

Version	Date	Description of changes
1.0	10/11/2020	Initial MLX81330 product abstract

Table 3 – Revision history

6. Contents

1. Features and Benefits.....	1
2. Application Examples.....	1
3. Ordering Information	2
4. Family Concept.....	2
5. Revision history	2
6. Contents.....	3
7. IC Block diagram.....	4
8. Technical description.....	5
8.1. Package data QFN24.....	5
8.2. Package data SO8-ep	6
8.3. Package Pin-out	7
8.4. Package Marking.....	11
9. Typical application schematic.....	12
10. Electrical characteristics	14
10.1. Absolute maximum ratings	14
10.2. Operating range	15
10.3. Electrical specifications	16
10.3.1. Current consumption	16
10.3.2. Supply system	16
10.3.3. Clock generation	18
10.3.4. Motor driver module	19
10.3.5. VSM supply sensor.....	20
10.3.6. Over-temperature detection	20
10.3.7. ADC.....	21
10.3.8. IO	22
10.3.9. LIN.....	23
11. Disclaimer.....	26

7. IC Block diagram

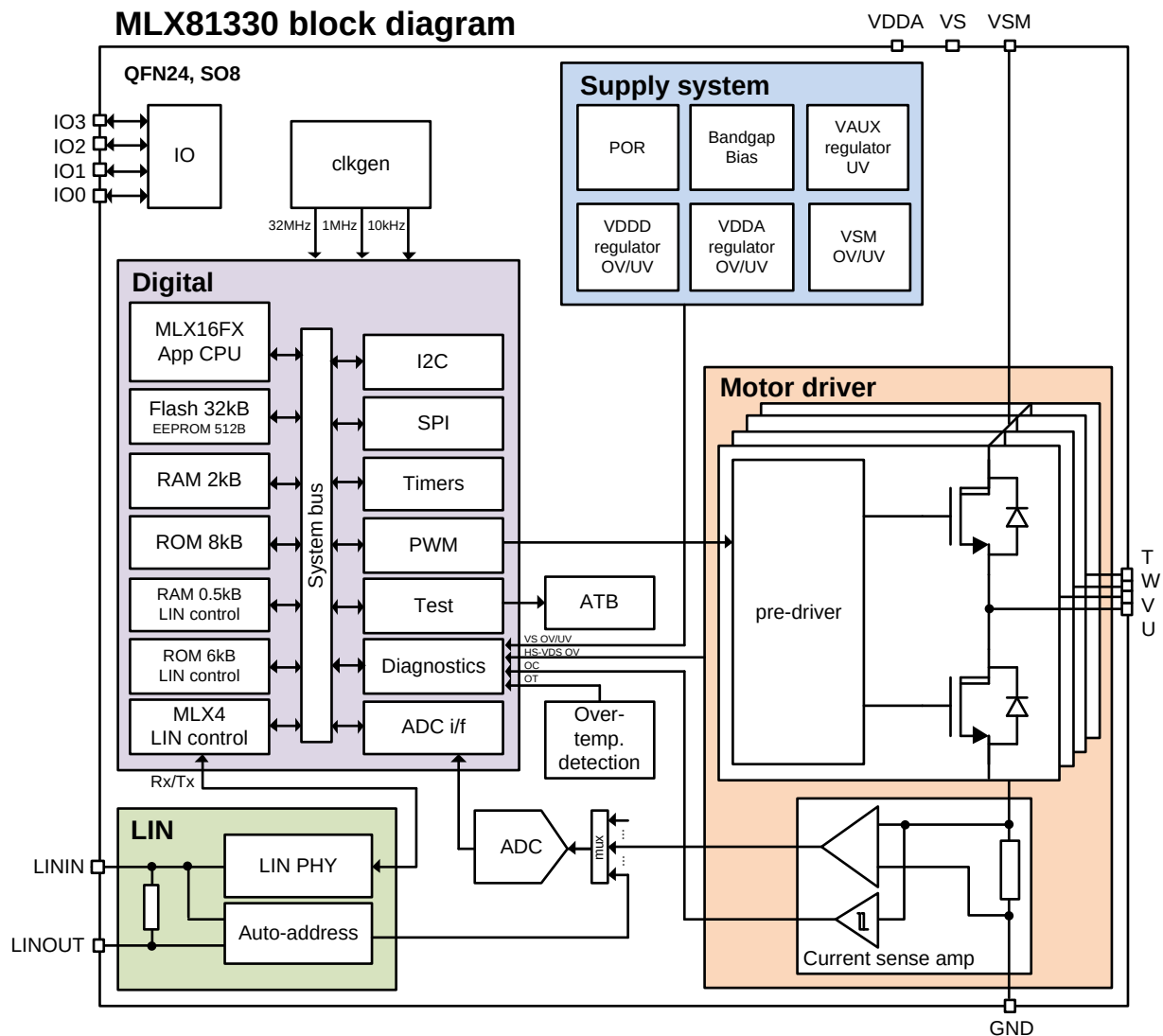


Figure 1 – IC Block diagram

8. Technical description

8.1. Package data QFN24

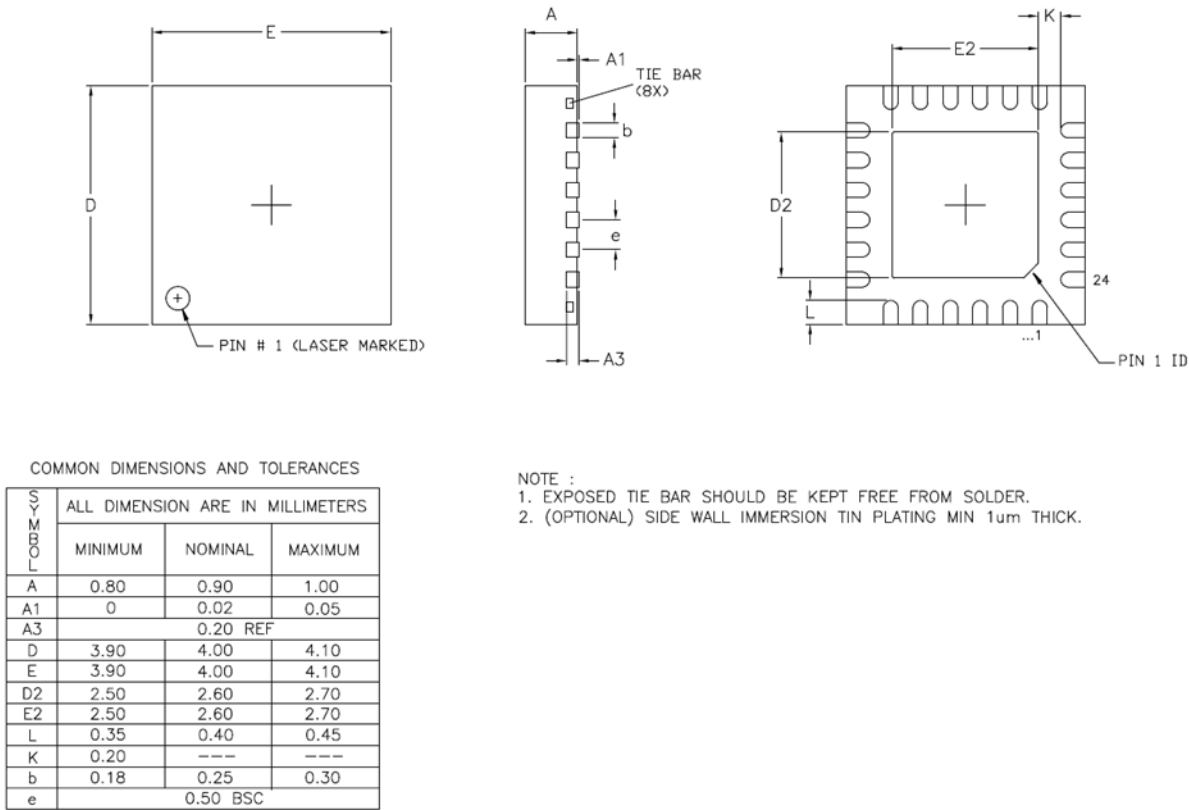
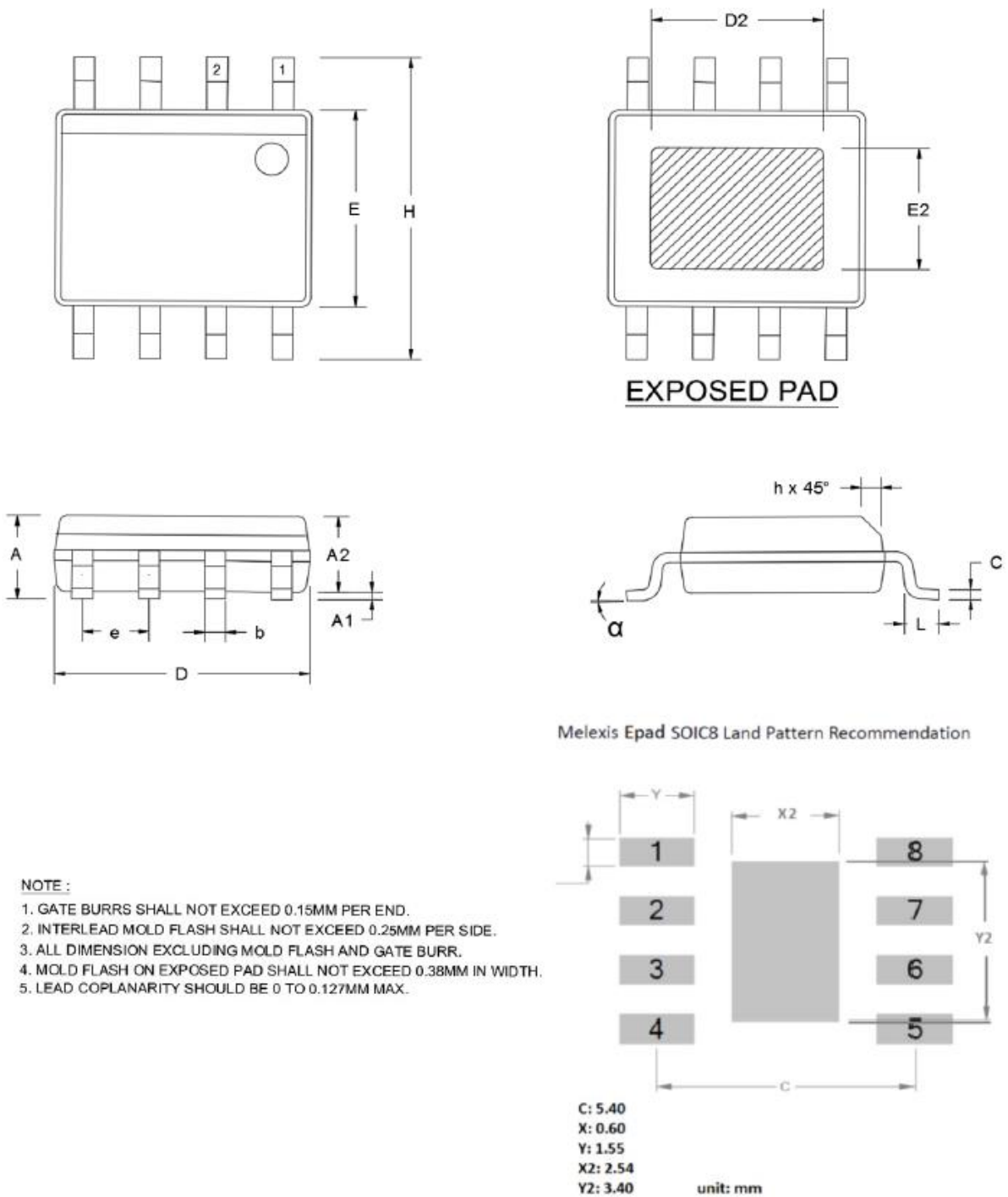


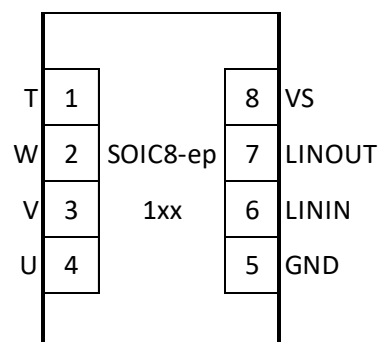
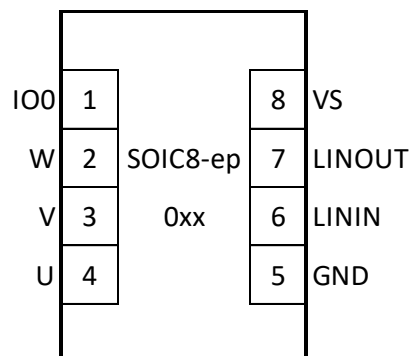
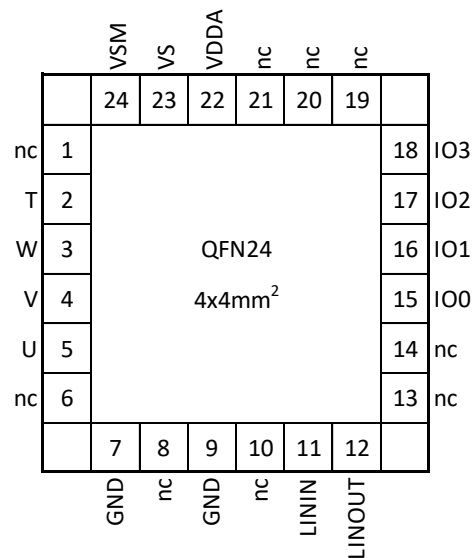
Figure 2 – Package data QFN24

8.2. Package data SO8-ep



	A	A1	A2	D	E	H	L	b	c	e	h	α	D2	E2
MIN	1.37	0.00	1.24	4.80	3.81	5.80	0.41	0.35	0.19	1.27	0.25	0.00	3.05	2.16
TYP										BSC			3.30	2.54
MAX	1.73	0.15	1.57	4.98	3.99	6.20	1.27	0.49	0.25		0.50	8.00	3.55	2.79

Figure 3 – Package Drawing SOIC8 with exposed pad



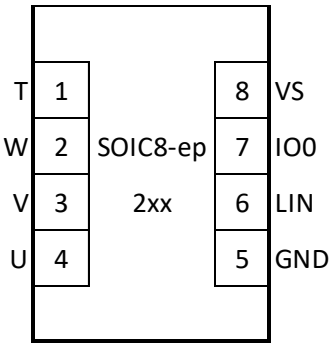


Figure 7 – Pin-out diagram SO8-ep, -2xx variant (Stepper motor, 1x IO)

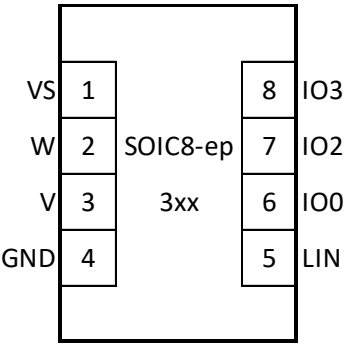


Figure 8 – Pin-out diagram SO8-ep, -3xx variant (DC motor, 3x IO)

#	Pin name	Description	
QFN24, 4x4mm		All pins accessible	
1	nc		
2	T	T-phase	
3	W	W-phase	
4	V	V-phase	
5	U	U-phase	
6	nc		
7	GND	Ground	
8	nc		
9	GND	Ground	
10	nc		
11	LIN-IN	LIN input	
12	LIN-OUT	LIN output (for auto-addressing)	

#	Pin name	Description	
13	nc		
14	nc		
15	IO0	LVIO + HVI (high-voltage input)	
16	IO1	LVIO	
17	IO2	LVIO	
18	IO3	LVIO	
19	nc		
20	nc		
21	nc		
22	VDDA	3.3V analog supply voltage	
23	VS	Supply voltage for MCU	
24	VSM	Supply voltage for motor driver	

Table 4 – Pin-out description for QFN24

SO8-ep		8-pins accessible	-0xx variant (BLDC, auto-address, 1x IO)
1	IO0	LVIO + HVI (high-voltage input)	
2	W	W-phase	
3	V	V-phase	
4	U	U-phase	
5	GND	Ground	
6	LIN-in	LIN input	
7	LIN-out	LIN output (for auto-addressing)	
8	VS	Supply voltage (MCU + Driver)	

Table 5 – Pin-out description for SO8-ep, -0xx variant

SO8-ep		8-pins accessible	-1xx variant (Stepper, auto-address)
1	T	T-phase	
2	W	W-phase	
3	V	V-phase	
4	U	U-phase	
5	GND	Ground	
6	LIN-in	LIN input	
7	LIN-out	LIN output (for auto-addressing)	
8	VS	Supply voltage (MCU + Driver)	

Table 6 – Pin-out description for SO8-ep, -1xx variant

SO8-ep		8-pins accessible	-2xx variant (DC/BLDC/Stepper, 1x IO)
1	T	T-phase	
2	W	W-phase	
3	V	V-phase	
4	U	U-phase	
5	GND	Ground	
6	LIN	LIN input	
7	IO0	LVIO + HVI (high-voltage input)	
8	VS	Supply voltage (MCU + Driver)	

Table 7 – Pin-out description for SO8-ep, -2xx variant

SO8-ep		8-pins accessible	-3xx variant (DC motor, 3x IO)
1	VS	Supply voltage (MCU + Driver)	
2	W	W + T-phase	2 drivers bonded in parallel
3	V	U + V-phase	2 drivers bonded in parallel
4	GND	Ground	
5	LIN	LIN input	
6	IO0	LVIO + HVI (high-voltage input)	
7	IO1	LVIO	
8	IO2	LVIO	

Table 8 – Pin-out description for SO8-ep, -3xx variant

8.4. Package Marking

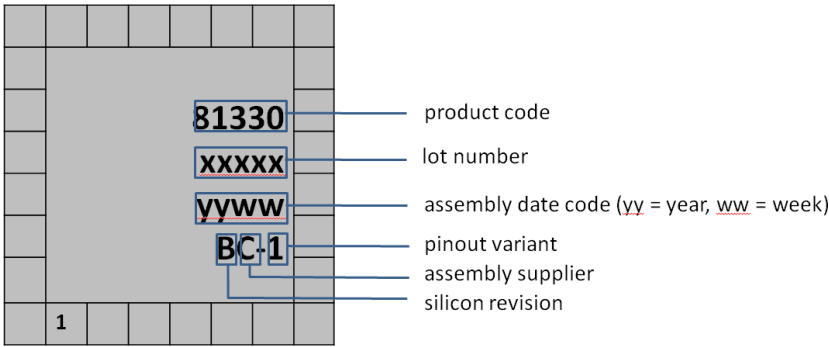


Figure 9 – Package Marking QFN24

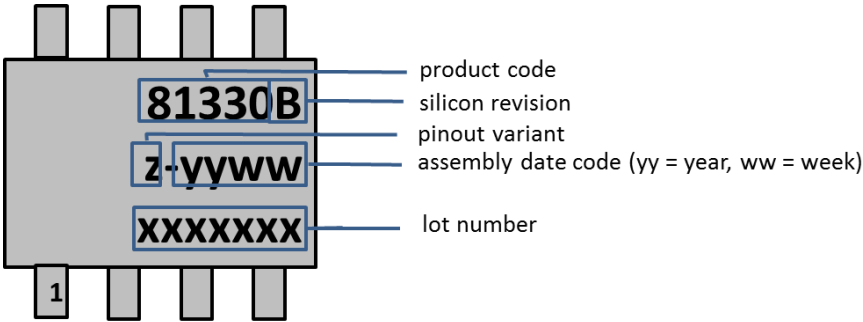


Figure 10 – Package Marking SOIC8-EP

9. Typical application schematic

In the following schematic examples, external components are indicated that may be needed to protect the IC against EMC / ESD pulses. Depending on ECU conditioned power, overvoltage and reverse polarity discretes may not be needed. Capacitor discretes or capacitor values will depend on specific OEM ESD/EMC requirements.

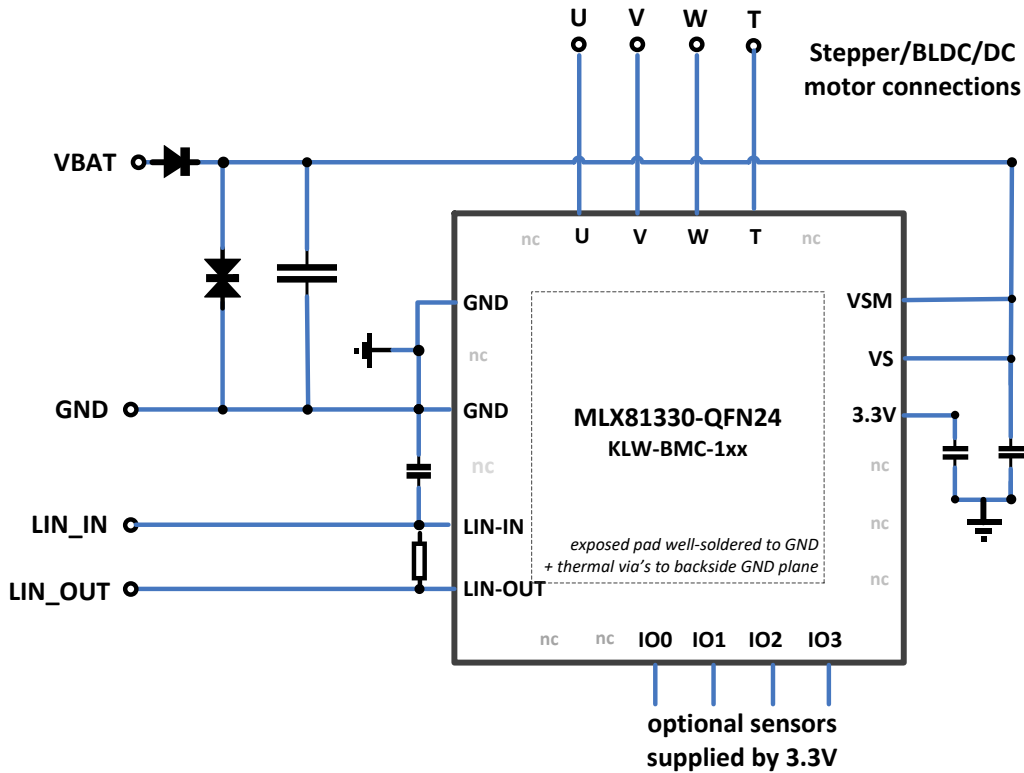


Figure 11 – Typical stepper/BLDC/DC motor schematic with MLX81330 in QFN24

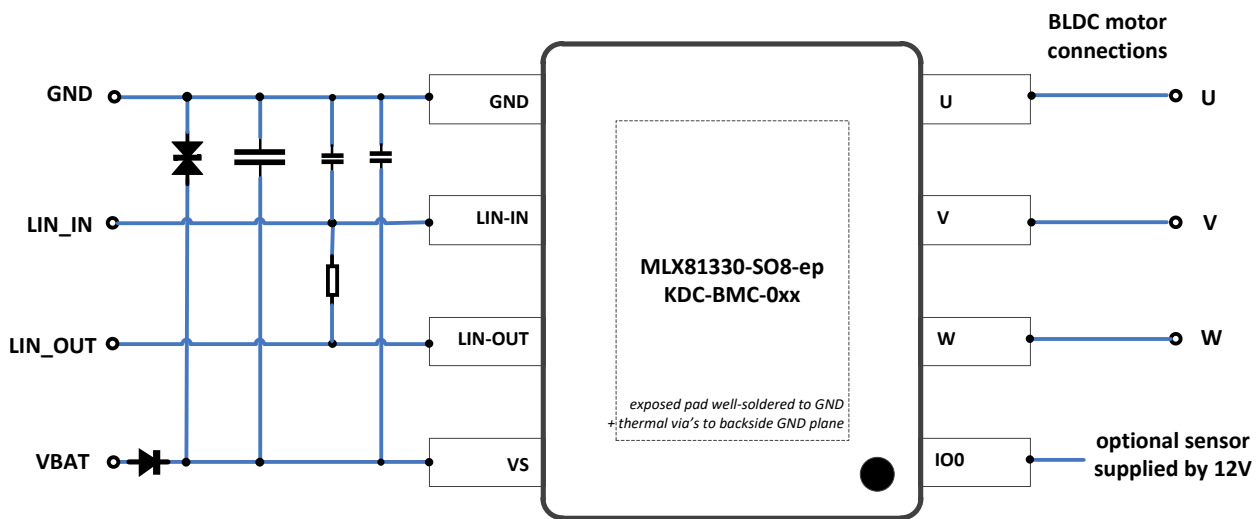


Figure 12 – Typical BLDC motor schematic with MLX81330 in SO8-ep, -0xx variant

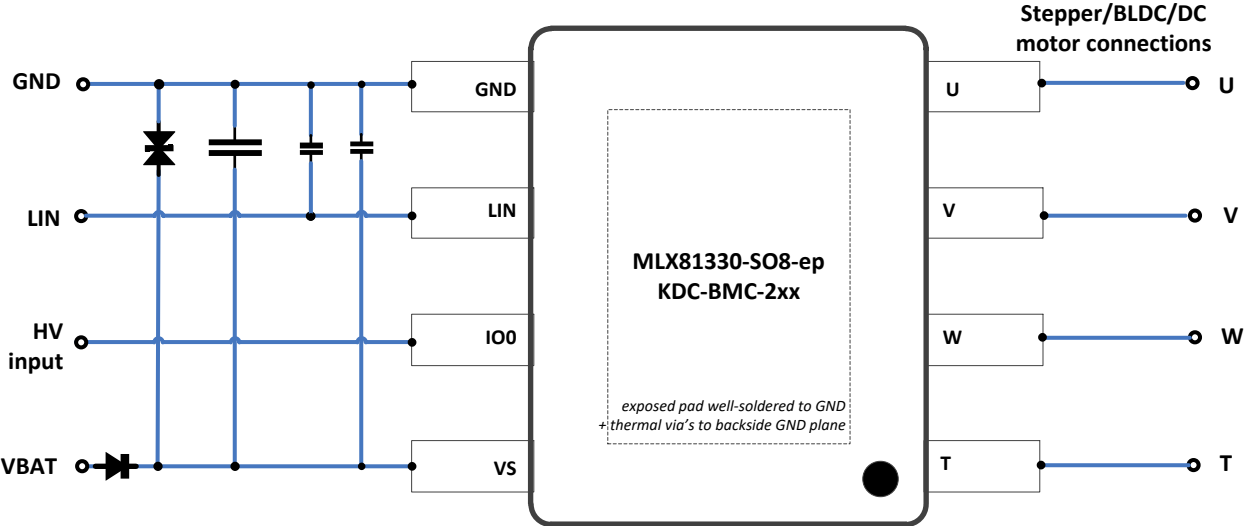


Figure 13 – Typical stepper/BLDC/DC motor schematic with MLX81330 in SO8-ep, -2xx variant

10. Electrical characteristics

10.1. Absolute maximum ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Supply voltage	VS, VSM	-0.3		28	V	
Supply voltage	VS, VSM	-0.3		40	V	t < 500ms
Supply voltage transient	VS.tr1	-100			V	ISO 7637-2 pulse 1 [1]
Supply voltage transient	VS.tr2			75	V	ISO 7637-2 pulse 2 [1]
Supply voltage transient	VS.tr3	-150		100	V	ISO 7637-2 pulses 3a, 3b [1]
Output voltage	VDDA	-0.3		3.6	V	
LIN bus voltage	VLIN	-40			V	Referenced to VS
LIN bus voltage	VLIN			40	V	Referenced to GND
LIN bus voltage transient	VLIN.tr1	-30			V	ISO 7637-3 DCC slow – [2]
LIN bus voltage transient	VLIN.tr2			30	V	ISO 7637-3 DCC slow + [2]
LIN bus voltage transient	VLIN.tr3	-150		100	V	ISO 7637-2 pulses 3a, 3b [2]
Analog HV voltage	VAN_HV	-0.3		VS+0.3	V	IO0 (HV input mode) U, V, W, T
Analog LV voltage	VAN_LV	-0.3		VDDA+0.3	V	IO0, IO1, IO2, IO3
Digital input voltage	VIN_DIG	-0.3		VDDA+0.3	V	IO0, IO1, IO2, IO3
Digital output voltage	VOUT_DIG	-0.3		VDDA+0.3	V	IO0, IO1, IO2, IO3
ESD HBM capability	ESD_HBM	-2		2	kV	All pins except LININ, LINOUT
ESD HBM capability	ESD_HBM_LIN	-6		6	kV	Pins LININ, LINOUT
ESD CDM capability	ESD_CDM	-500		500	V	All pins
Junction temperature	TJ	-55		175	°C	

Table 9 – Absolute maximum ratings

[1] ISO 7637 test pulses are applied to VS via a reverse polarity diode and blocking capacitor.

[2] ISO 7637 test pulses are applied to LIN via a coupling capacitance of 1nF.

10.2. Operating range

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Supply voltage	VS	6.5	12	20	V	Driver full performance
Supply voltage	VS	5.5		6.5	V	Driver reduced performance [1]
Supply voltage	VS	4		20	V	Analog full performance
Supply voltage	VS	3.5		4	V	Analog reduced performance [2]
Supply voltage	VS	3		20	V	Digital functional
Supply voltage	VS	1.5		20	V	SRAM content valid
Junction temperature	TJ	-40		150	°C	Limited time at Tj=175 °C [3]

Table 10 – Operating range

[1] Motor driver is functional at reduced performance (higher bridge resistance, reduced accuracy of current sense amplifier)

[2] 3.3V regulator is functional at reduced performance (lower current capability)

[3] Extended temperature range with Tj=175 °C is only allowed for a limited time, customer's mission profile has to be agreed by Melexis as an obligatory part of the Part Submission Warrant (PSW).

10.3. Electrical specifications

10.3.1. Current consumption

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Normal working current	INOM		10	15	mA	
Sleep mode current	ISLEEP		25	50	μA	VS=13V
Stop mode current	ISTOP		250	500	μA	
Holding current	IHOLD		5	7	mA	

Table 11 – Electrical specifications : current consumption

10.3.2. Supply system

10.3.2.1. VDDA 3.3V regulator (5V option, external C: 0 ... 220nF)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
3.3V analog supply voltage (default)	VDDA	3.2	3.3	3.4	V	Bandgap and VDDA regulator trimmed
3.3V current capability	IVDDA	15			mA	VS >= 4V
3.3V external current capability	IVDDA_EXT	0		10	mA	VS >= 4V
3.3V under-voltage detection threshold	VTH_UV_VDDA	2.75	2.85	2.95	V	VDDA ramping down
3.3V under-voltage detection hysteresis	VHY_UV_VDDA	0.1	0.15		V	

5V option (SWITCH_VDDA_TO_5V=1)

5V analog supply voltage (option)	VDDA	4.85	5	5.15	V	Bandgap and VDDA regulator trimmed
5V current capability	IVDDA	15			mA	VS >= 5.5V
5V external current capability	IVDDA_EXT	0		10	mA	VS >= 5.5V
5V under-voltage detection threshold	VTH_UV_VDDA	3.95	4.1	4.25	V	VDDA ramping down
5V under-voltage detection hysteresis	VHY_UV_VDDA	0.1	0.15		V	

Table 12 – Electrical specifications : VDDA regulator

10.3.2.2. VDDD 1.8V regulator

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
1.8V digital supply voltage	VDDD	1.8	1.875	1.95	V	Bandgap and VDDD regulator trimmed
1.8V current capability	IVDDD	15			mA	No external sensor allowed

Table 13 – Electrical specifications : VDDD regulator

10.3.2.3. VS under-voltage and over-voltage detection

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
VS under-voltage detection threshold	VTH_UV_VS	3.5	4	4.5	V	PRUV_VS=0
VS under-voltage detection threshold	VTH_UV_VS	4.5	5	5.5	V	PRUV_VS=1
VS under-voltage detection threshold	VTH_UV_VS	5.5	6	6.5	V	PRUV_VS=2
VS under-voltage detection threshold	VTH_UV_VS	6.5	7	7.5	V	PRUV_VS=3
VS under-voltage detection threshold	VTH_UV_VS	7.5	8	8.5	V	PRUV_VS=4
VS under-voltage detection threshold	VTH_UV_VS	8.5	9	9.5	V	PRUV_VS=5
VS under-voltage detection hysteresis	VHY_UV_VS	0.1	0.5	1	V	
VS over-voltage detection threshold	VTH_OV_VS	20	22	24	V	PROV_VS=0
VS over-voltage detection threshold	VTH_OV_VS	22	24	26	V	PROV_VS=1
VS over-voltage detection threshold	VTH_OV_VS	38	40	42	V	PROV_VS=2
VS over-voltage detection hysteresis	VHY_OV_VS	1	2	3	V	

Table 14 – Electrical specifications : VS over- and under-voltage detection

10.3.2.4. Wake-up circuit

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Wake-up filter time IO pins	TFILT_WU_IO	15		80	μs	
Wake-up filter time LIN pin	TFILT_WU_LIN	28		125	μs	
Wake-up time internal timer	TWU_INT		n/a			WUI=00 (no wake-up)
Wake-up time internal timer	TWU_INT		4096 / FOSC_10K			WUI=01 (~0.4 s)
Wake-up time internal timer	TWU_INT		8192 / FOSC_10K			WUI=10 (~0.8 s)
Wake-up time internal timer	TWU_INT		16384 / FOSC_10K			WUI=11 (~1.6 s)

Table 15 – Electrical specifications : wake-up circuit

10.3.2.5. Bandgap

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Bandgap voltage	VBG	1.15	1.185	1.22	V	Trimmed
Bandgap voltage temperature coeff.	TC_VBG			180	ppm/K	

Table 16 – Electrical specifications : bandgap

10.3.3. Clock generation

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Frequency 1MHz oscillator	FOSC_1M	-5%	1	+5%	MHz	Trimmed
Frequency 32MHz oscillator	FOSC_32M	-5%	32	+5%	MHz	Trimmed
Frequency 10kHz oscillator	FOSC_10K	5	10	20	kHz	
Timing accuracy	TIMING_ACC	-1.5%		1.5%	%	Timing accuracy after sw correction using EEPROM calibration values

Table 17 – Electrical specifications : clock generation

10.3.4. Motor driver module

10.3.4.1. Charge pump clock

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Charge pump clock frequency	FOSC_CP	53	60	67	MHz	Trimmed
Charge pump clock frequency	FOSC_CP	74	82	90	MHz	Trimmed (default)

Table 18 – Electrical specifications : driver clock

10.3.4.2. Output stage

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Half-bridge phase current	IHB			0.4	Apk	During normal operation
Half-bridge phase current	IHB			0.3	Arms	During normal operation
Half-bridge resistance	RHB		3	6	Ω	TopFET + BottomFet + Shunt
Duty cycle range of PWM output	DC_OUT	5		95	%	For switching PWM (0% or 100% can be set as well)
Duty cycle of PWM output	DC_OUT	4		6	%	PWM duty cycle setting = 5%
Duty cycle of PWM output	DC_OUT	94		96	%	PWM duty cycle setting = 95%
FET over-current detection threshold	ITH_DS_HS	0.7	1	1.3	A	

Table 19 – Electrical specifications : output stage

10.3.4.3. Current sense amplifier

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Sense resistor	RCS		0.2	0.4	Ω	
Input range	ICS	-1		1	A	Current sensing range
Input range	ICS			2	A	High-end range extension for over-current detection
Over-current detection threshold	ITH_OC	-1		2	A	Adjustable through 8bit DAC

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Over-current detection threshold accuracy	ITH_OC	-10		10	%	OCD threshold = 1A
Gain	GCS	0.76	0.8	0.84	V/A	Trimmed and calibrated
Offset	VCSO	1.215	1.25	1.285	V	Trimmed and calibrated

Table 20 – Electrical specifications : current sense amplifier

10.3.5. VSM supply sensor

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Voltage range for ADC measurement				28	V	Measurement of VSM/21
VSM filter cut-off frequency				4	kHz	

Table 21 – Electrical specifications : VSM supply sensor

10.3.6. Over-temperature detection

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
OTD threshold	TTH_OT	175	185	195	°C	Temperature ramping up
OTD threshold	TTH_OT	150	160	170	°C	Temperature ramping down
OTD hysteresis	THY_OT	10	25		°C	

Table 22 – Electrical specifications : over-temperature detection

10.3.7. ADC

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Reference voltage	VREFADC		VDDA		V	
Reference voltage	VREFADC	2.45	2.5	2.55	V	Trimmed and calibrated
Reference voltage	VREFADC	1.47	1.5	1.53	V	Trimmed and calibrated
Reference voltage	VREFADC	0.735	0.75	0.765	V	Trimmed and calibrated
Resolution			10		bit	
Conversion time	TCONV			6	μs	
DNL		-1		1	LSB	
INL		-3		3	LSB	
ADC LV channel (with 1/1.36 divider) accuracy		-45		45	mV	0V – 3.3V input
ADC HV channel (with 1/21 divider) accuracy		-0.30		0.30	V	<5V input, calibrated acc. calibration document
ADC HV channel (with 1/21 divider) accuracy		-0.60		0.60	V	<20V input, calibrated acc. calibration document
ADC VSMF channel (with 1/21 divider) accuracy		-0.20		0.20	V	<5V input, calibrated acc. calibration document
ADC VSMF channel (with 1/21 divider) accuracy		-0.30		0.30	V	<20V input, calibrated acc. calibration document
ADC temperature channel accuracy		-10		10	°C	Calibrated acc. calibration document
ADC channel selection		0		25		See datasheet

Table 23 – Electrical specifications : ADC

10.3.8. IO

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Input threshold level L → H				2.4	V	
Input threshold level H → L		1			V	
Input hysteresis		0.1			V	
Output voltage L, IO1...3				0.4	V	ILOAD = 2mA
Output voltage L, IO0				0.5	V	ILOAD = 2mA
Output voltage H, IO1...3		VDDA - 0.4V			V	ILOAD = 2mA
Output voltage H, IO0		VDDA - 0.5V			V	ILOAD = 2mA, VS > 5.5V
Input voltage range for high-voltage ADC measurement		0		28	V	IO0 Measurement of IO0/21
Input voltage range for low-voltage ADC measurement		0		VDDA	V	IO0...3 Measurement of IOx/1.36
I2C SDA hold time (vs SCL)		0	35	70	ns	IO0 pin, SDAFILT_IO=00, setting for Fast-mode Plus
I2C SDA hold time (vs SCL)		180	260	340	ns	IO0 pin, SDAFILT_IO=01
I2C SDA hold time (vs SCL)		240	330	420	ns	IO0 pin, SDAFILT_IO=10
I2C SDA hold time (vs SCL)		360	500	640	ns	IO0 pin, SDAFILT_IO=11, setting for Standard-mode and Fast-mode

Table 24 – Electrical specifications : IO

10.3.9. LIN

10.3.9.1. LIN transceiver- static

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Transmitter internal capacitance [1]	CLIN		30	40	pF	Response on 14V pulse via 1K
Bus short circuit current	IBUS_LIM	40	100	200	mA	V _{LIN} = V _S = 27V, V _{TxD} = 0V
Pull up resistance bus, untrimmed	RSLAVE	20	35	60	kΩ	V _{DISTERM} = 0
Pull up current bus, sleep mode	ISLAVE_SLEEP	-50	-20	-5	μA	V _{LIN} = 0V, V _{SBY} = V _{AUX} , V _{EN} = 0
Dominant input leakage current including pull up resistor	IBUS_PAS_dom	-600			μA	V _{LIN} = 0V, V _S = 12V, V _{TxD} = V _{DDD} , V _{DISTERM} = 0 V _{EN} = V _{DDD} , V _{SBY} = 0
Recessive input leakage current	IBUS_PAS_rec		0.25	1	μA	V _{EN} = V _{DDD} , V _{SBY} = 0, V _{TxD} = V _{DDD} , V _{LIN} > V _S
Bus reverse current loss of battery [2]	IBUS_NO_BAT		0.25	1	μA	V _S = 0V, 0V < V _{LIN} < 27V
Bus current during loss of ground [2]	IBUS_NO_GND	-100		1	μA	V _S = V _{GND} = 12V, 0 < V _{LIN} < 27V
Transmitter dominant output voltage [2]	VoIBUS	0		0.2×V _S	V	R _{load} = 500Ω
Transmitter recessive output voltage [2]	VohBUS	0.8×V _S		1×V _S	V	V _{EN} = V _{DDD} , V _{SBY} = 0, V _{TxD} = V _{DDD} or sleep mode
Receiver dominant voltage	VBUSdom			0.4×V _S	V	
Receiver recessive voltage	VBUSrec	0.6×V _S			V	
Center point of receiver threshold	VBUS_CNT	0.475×V _S	0.5×V _S	0.525×V _S	V	V _{BUS_cnt} =(V _{th_dom} +V _{th_rec})/2
Receiver hysteresis	VHYS			0.175×V _S	V	V _{HYS} =(V _{th_rec} –V _{th_dom})

Table 25 – Electrical specifications : LIN transceiver – static

[1] No production test, guaranteed by design and qualification

[2] In accordance to SAE J2602

10.3.9.2. LIN transceiver – dynamic

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Propagation delay receiver [1]	trx_pdf			6	μs	CRxD =25pF falling edge
Propagation delay receiver [1]	trx_pdr			6	μs	CRxD =25pF rising edge
Propagation delay receiver symmetry	trx_sym	-2		2	μs	Calculate trx_pdf - trx_pdr
Receiver debounce time [2]	trx_deb	0.5		4	μs	LIN rising & falling edge
LIN duty cycle 1 [2] [3] [5]	D1	0.396				20kbps operation, normal mode Vs = 7 to 18V
LIN duty cycle 2 [2] [3] [5]	D2			0.581		20kbps operation, normal mode Vs = 7 to 18V
LIN duty cycle 3 [2] [3] [5]	D3	0.417				10.4kbps operation, low speed mode Vs = 7 to 18V
LIN duty cycle 4 [2] [3] [5]	D4			0.590		10.4kbps operation, low speed mode Vs = 7 to 18V
tREC(MAX) – tDOM(MIN) [4] [5]	Δt3			15.9	μs	10.4kbps operation, low speed mode
tDOM(MAX) – tREC(MIN) [4] [5]	Δt4			17.28	μs	10.4kbps operation, low speed mode
Slew rate on pin LIN normal mode, untrimmed			1.7		V/ μs	dV/dt between duty cycle measurement points, Vs=12V
Slew rate on pin LIN low speed mode, untrimmed			0.85		V/ μs	dV/dt between duty cycle measurement points, Vs=12V
TxD dominant timeout [6]	ttxd_to		15		ms	Normal mode, vTxD = 0V

Table 26 – Electrical specifications : LIN transceiver – dynamic

[1] This parameter is tested by applying a square wave signal to the LIN. The minimum slew rate for the LIN rising and falling edges is 50V/μs

[2] See Figure 14

[3] Standard loads for duty cycle measurements are 1KΩ/1nF, 660Ω/6.8nF, 500Ω/10nF, internal master termination disabled

[4] In accordance to SAE J2602, see Figure 15

[5] For supply voltage ranges $V_s=5.5...7V$ and $V_s=18...27V$ parametric deviations are possible (target specification is w/o deviations & $ppK>2.0$)

[6] Parameter in relation to internal signal TxD

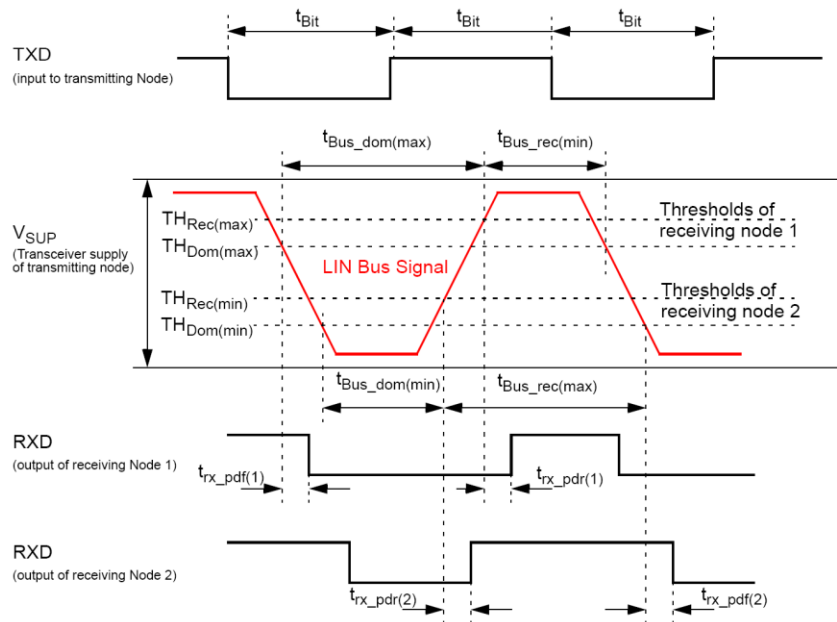


Figure 14 – LIN timing diagram (reference LIN2.1 specification)

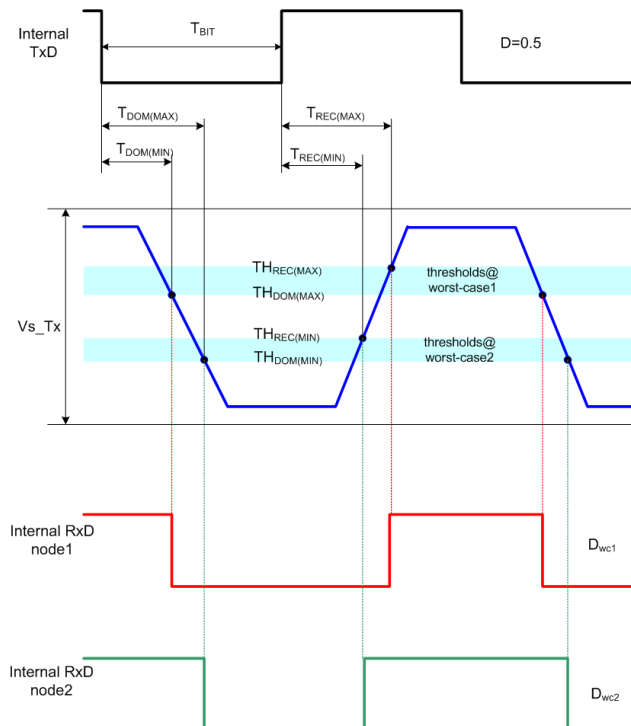


Figure 15 – LIN timing diagram, relation between propagation delay and duty cycle (reference SAE J2602 specification)

11. Disclaimer

The content of this document is believed to be correct and accurate. However, the content of this document is furnished "as is" for informational use only and no representation, nor warranty is provided by Melexis about its accuracy, nor about the results of its implementation. Melexis assumes no responsibility or liability for any errors or inaccuracies that may appear in this document. Customer will follow the practices contained in this document under its sole responsibility. This documentation is in fact provided without warranty, term, or condition of any kind, either implied or expressed, including but not limited to warranties of merchantability, satisfactory quality, non-infringement, and fitness for purpose. Melexis, its employees and agents and its affiliates' and their employees and agents will not be responsible for any loss, however arising, from the use of, or reliance on this document. Notwithstanding the foregoing, contractual obligations expressly undertaken in writing by Melexis prevail over this disclaimer.

This document is subject to change without notice, and should not be construed as a commitment by Melexis. Therefore, before placing orders or prior to designing the product into a system, users or any third party should obtain the latest version of the relevant information.

Users or any third party must determine the suitability of the product described in this document for its application, including the level of reliability required and determine whether it is fit for a particular purpose.

This document as well as the product here described may be subject to export control regulations. Be aware that export might require a prior authorization from competent authorities. The product is not designed, authorized or warranted to be suitable in applications requiring extended temperature range and/or unusual environmental requirements. High reliability applications, such as medical life-support or life-sustaining equipment or avionics application are specifically excluded by Melexis. The product may not be used for the following applications subject to export control regulations: the development, production, processing, operation, maintenance, storage, recognition or proliferation of:

- 1. chemical, biological or nuclear weapons, or for the development, production, maintenance or storage of missiles for such weapons;*
- 2. civil firearms, including spare parts or ammunition for such arms;*
- 3. defense related products, or other material for military use or for law enforcement;*
- 4. any applications that, alone or in combination with other goods, substances or organisms could cause serious harm to persons or goods and that can be used as a means of violence in an armed conflict or any similar violent situation.*

No license nor any other right or interest is granted to any of Melexis' or third party's intellectual property rights.

If this document is marked "restricted" or with similar words, or if in any case the content of this document is to be reasonably understood as being confidential, the recipient of this document shall not communicate, nor disclose to any third party, any part of the document without Melexis' express written consent. The recipient shall take all necessary measures to apply and preserve the confidential character of the document. In particular, the recipient shall (i) hold document in confidence with at least the same degree of care by which it maintains the confidentiality of its own proprietary and confidential information, but no less than reasonable care; (ii) restrict the disclosure of the document solely to its employees for the purpose for which this document was received, on a strictly need to know basis and providing that such persons to whom the document is disclosed are bound by confidentiality terms substantially similar to those in this disclaimer; (iii) use the document only in connection with the purpose for which this document was received, and reproduce document only to the extent necessary for such purposes; (iv) not use the document for commercial purposes or to the detriment of Melexis or its customers. The confidentiality obligations set forth in this disclaimer will have indefinite duration and in any case they will be effective for no less than 10 years from the receipt of this document.

This disclaimer will be governed by and construed in accordance with Belgian law and any disputes relating to this disclaimer will be subject to the exclusive jurisdiction of the courts of Brussels, Belgium.

The invalidity or ineffectiveness of any of the provisions of this disclaimer does not affect the validity or effectiveness of the other provisions. The previous versions of this document are repealed.

Melexis © - No part of this document may be reproduced without the prior written consent of Melexis. (2020)

IATF 16949 and ISO 14001 Certified