LIN transceiver *MTC-30600*

1.0 Key Features

LIN-Bus Transceiver
- LIN compliant to specification revision 1.2
- I²T-100 High Voltage Technology
- Bus voltage ±80V
- Transmission rate up to 20kBaud
- SO8 Package

Protection
- Thermal shutdown
- Indefinite short-circuit protection to supply and ground
- Transients on VBAT (80V)

Power saving
- Operating voltage = 4.5 to 5.5V
- Power down supply current <50µA

EMI compatibility
- Integrated filter and hysteresis for receiver

EMC compatibility
- Integrated slope control for transmitter
- Slope control dependant from V_{bat} to enable maximum capacitive-load

General Description

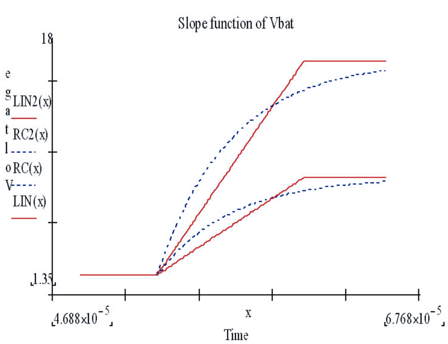
The single-wire transceiver MTC-30600 is a monolithic integrated circuit in a SO-8 package. It works as an interface between the protocol controller and the physical bus.

The MTC-30600 is especially suitable to drive the bus line in LIN systems in automotive and industrial applications. Further it can be used in standard ISO9141 systems.

In order to reduce the current consumption the MTC-30600 offers a stand-by mode. A wake-up caused by a message on the bus sets the RxD output low and pulls the INH-output high until the device is switched to normal operation mode.

The transceiver is implemented in I²T-100 technology enabling both high voltage analogue circuitry and digital functionality to co-exist on the same chip.

The MTC-30600 provides an ultra-safe solution to today's automotive In-Vehicle Networking requirements by providing unlimited short circuit protection in the event of a fault condition.



Ordering Information
Part N°: MTC-30600-I
Package: SO8
Temp. Range: -40°C…125°C

2.0 Typical application Schematic

2.1 Application schematic

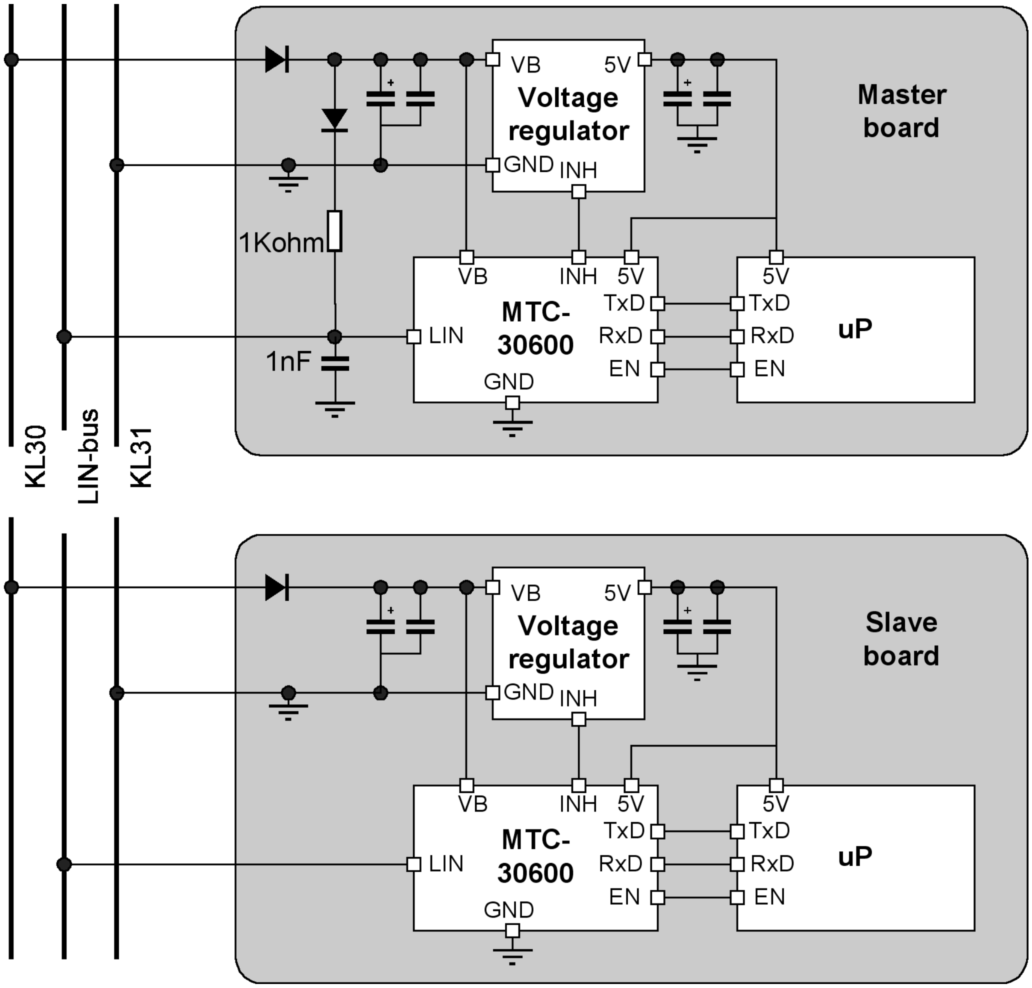


Fig.1: **Typical application diagram with master and slave module**

2.2 Pin description

2.2.1 Pin out (Top view)

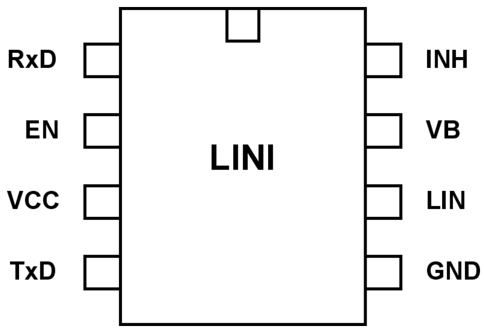
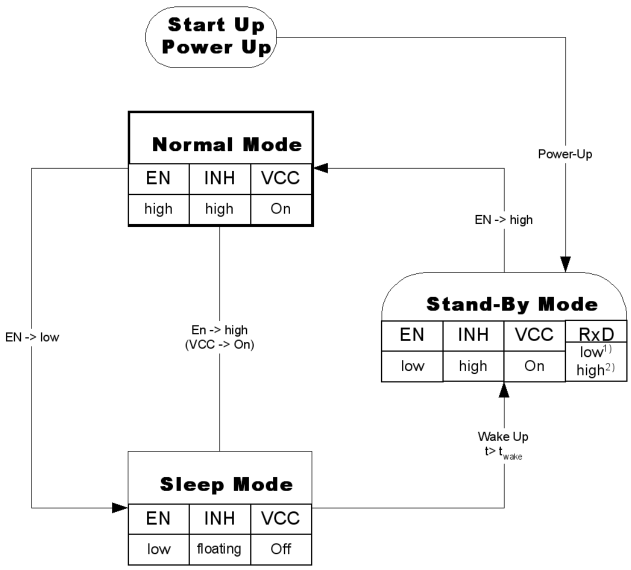


Fig.2: **Pin configuration (viewed from above)**

2.2.2 Pin description

Pin No	*Symbol*	*Function*
1	RxD	Receive data output; LOW in dominant state
2	EN	Enable input; transceiver in normal operation mode when HIGH; Internal 10 KΩ pull up
3	VCC	5V supply input
4	TxD	Transmit data input; LOW in dominant state; Internal 40 KΩ pull up
5	GND	Ground
6	LIN	Bus output/input; LOW in dominant state; Internal 30 KΩ pull up
7	VB	Battery supply input;
8	INH	Inhibit output; to control a voltage regulator, becomes HIGH when wake-up via LIN bus occurs

2.3 Application Information



1) after wake-up via bus
2) after start up

Fig.3: **State Diagram**

For fail safe reasons the MTC-30600 already has an internal pull up resistor of 30kΩ implemented. To achieve the required timings for the dominant to recessive transition of the bus signal an additional external termination resistor of 1kΩ is required. It is recommended to place this resistor in the master node. To avoid reverse currents from the bus line into the battery supply line in case of an unpowered node, it is recommended to place a diode in series to the external pull up. For small systems (low bus capacitance) the EMC performance of the system is supported by an additional capacitor of at least 1nF in the master node (see figure 1, Typical application diagram).

A capacitor of 10µF at the supply voltage input VB buffers the input voltage. In combination with the required reverse polarity diode this prevents the device from detecting power down conditions in case of negative transients on the supply line.

In order to reduce the current consumption the MTC-30600 offers a sleep operation mode. This mode is selected by switching the enable input EN low (see figure 3, state diagram). In the sleep mode a voltage regulator can be controlled via the INH output in order to minimize the current consumption of the whole application. A wake-up caused by a message on the communication bus automatically enables the voltage regulator by switching the INH output high. In parallel, the wake-up is indicated by setting the RxD output low. When entering the normal mode this wake-up flag is reset and the RxD output is released to transmit the bus data. In case the voltage regulator control input is not connected to INH output or the microcontroller is active respectively, the MTC-30600 can be set in normal operation mode without a wake-up via the communication bus.

3.0 Electrical Characteristics

3.1 Absolute maximum ratings

Note: Maximum ratings are absolute ratings; exceeding any one of these values may cause irreversible damage to the integrated circuit.

Parameter	Symbol	Limit Values min	max	Unit	Remarks
Voltages					
Supply voltage	V_{CC}	-0.3	7	V	
Battery supply voltage	V_B	-0.3	40	V	
Bus input voltage	V_{bus}	-40	40	V	
INH voltage	V_{inh}	-0.3	VB+0.3	V	
Logic voltages at EN, TxD, RxD	V_I	-0.3	VCC+0.3	V	0 V < VCC < 5.5 V
Electrostatic discharge voltage at VB, Bus	V_{ESD}	-4	4	kV	human body model (100 pF via 1.5kΩ)
Electrostatic discharge voltage	V_{ESD}	-2	2	kV	human body model (100 pF via 1.5kΩ)
Temperatures					
Junction temperature	T_j	-40	150	°C	

3.2 Operating Range

Parameter	Symbol	Limit Values min	max	Unit	Remarks
Voltages					
Supply voltage	V_{CC}	4.5	5.5	V	
Battery supply voltage	V_B	8	18	V	
Junction temperature	T_j	-40	150	°C	
Thermal Shutdown (junction temperature)					
Thermal Shutdown temp	T_{jSD}	150	170	190	°C
Thermal shutdown hyst.	Δ_T	–	10	–	K
Thermal resistances					
Junction ambient	R_{thj-a}	–	185	K/W	–

3.3 Electrical Characteristics

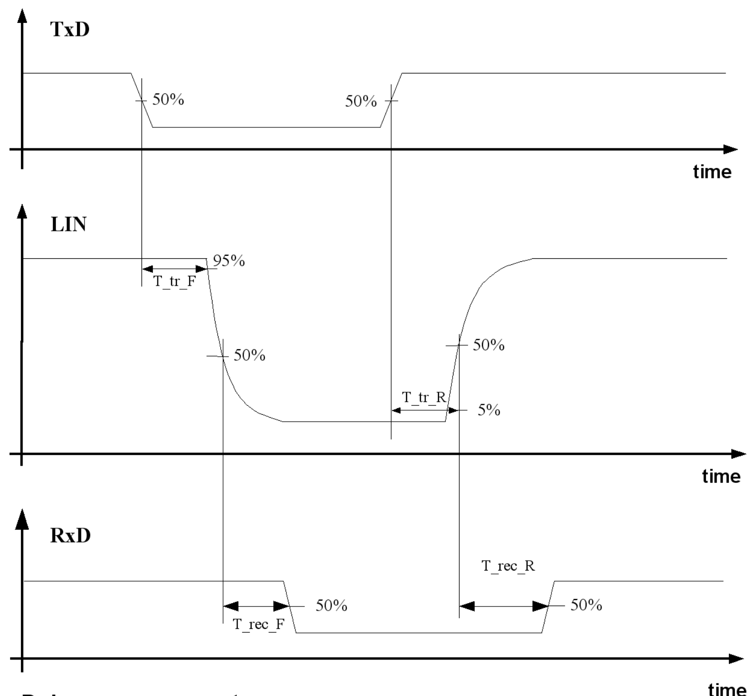
4.5 V < V_{CC} <5.5 V; 8.0 V < V_B <18 V; R_L =500Ω … 1 kΩ; V_{EN} > V_{EN},on ; -40 °C < T j<125 °C; all voltages with respect to ground; positive current flowing into pin; unless otherwise specified.

Parameter	Symbol	Limit Values min	typ	max	Unit	Remarks
Current Consumption						
Current consumption	I_{CC}		250	500	µA	recessive state; V TxD = V_{CC}
Current consumption	I_{VB}		100	200	µA	recessive state; V TxD = V_{CC}
Current consumption	I_{CC}		400	700	µA	dominant state; V TxD = 0 V
Current consumption	I_{VB}		1.0	1.5	mA	dominant state; V TxD = 0 V
Current consumption	I_{VB}		20	50	µA	sleep-mode
Receiver Output (pin RxD)						
HIGH level output	V RD,H	0.8 x V_{CC}		V_{CC}	V	I RD = 0.7mA ,
LOW level output	V RD,L	0		0.2 x V_{CC}	V	I RD = 0.7mA ,
Bus receiver (pin LIN)						
Receiver threshold voltage, recessive to dominant edge	V bus,rd	0.4 x VB	0.48 x VB		V	-8 V < V bus < Vbus,dom
Receiver threshold voltage,dominant to recessive edge	V bus,dr		0.52 x VB	0.6 x VB	V	V bus,rec < V bus <20 V
Receiver hysteresis	V bus,hys	0.02 x VB	0.04 x VB	0.2 x VB	mV	V bus,hys =V bus,rec - Vbus,dom
wake-up threshold voltage	V wake	0.40 x VB		0.60 x VB	V	
Transmission Input (pin TxD)						
HIGH level input voltage	V TD,	H 0.7 x V CC			V	recessive state
LOW level input voltage	V TD,L			0.3 x V CC	V	dominant state
Pull-up resistor to VCC	R TD,pu	24		60	KΩ	
Bus transmitter (pin LIN)						
Bus recessive output voltage	V bus,rec	0.9 x VB		VB	V	V TxD = V CC
Bus dominant output voltage	V bus,dom	0		0.15 x VB	V	V TxD = 0 V;
Bus dominant output voltage	V bus,volt			1.4	V	V TxD = 0 V; I bus = 40mA
Bus short circuit current	I bus,sc	40	85	130	mA	V bus,short = 13.5 V
Leakage current	I bus,lk	-400	-200		µA	V CC =0V, VB =0V, V bus = -8 V
			5	20	µA	V CC =0V, VB =0V, V bus = 20 V
Bus pull up resistance	R bus	20	30	47	kΩ	
Enable input (pin EN)						
HIGH level input voltage	V EN,on	0.7 x Vcc			V	normal mode
LOW level input voltage	V EN,off			0.3 x Vcc	V	low power mode
Pull-down resistor to GND		6		15	KΩ	
Inhibit output (pin INH)						
HIGH level drop voltage V INH = VB -V INH	V INH		0.5	1.0	V	.I INH = - 0.15 mA
Leakage current	I INH,lk	- 5.0		5.0	µA	sleep mode V INH = 0 V

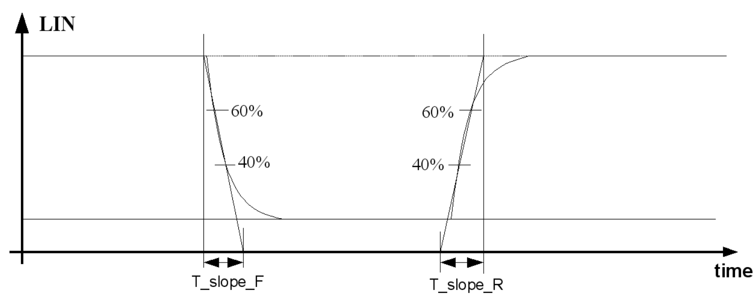
3.3 Electrical Characteristics (cont'd)

4.5 V < V_{CC} <5.5 V; 8.0 V < V_B <18 V; R_L =500Ω … 1 kΩ; V_{EN} > V_{EN},on ; -40 °C < T j<125 °C; all voltages with respect to ground; positive current flowing into pin; unless otherwise specified.
Load for driver definitions = 500Ω … 1kΩ (between transceivers supply and LIN
Load for slope definitions (typical loads) = (L1) 1nF 1kΩ / (L2) 6.8nF 600Ω / (L3) 10nF 500Ω

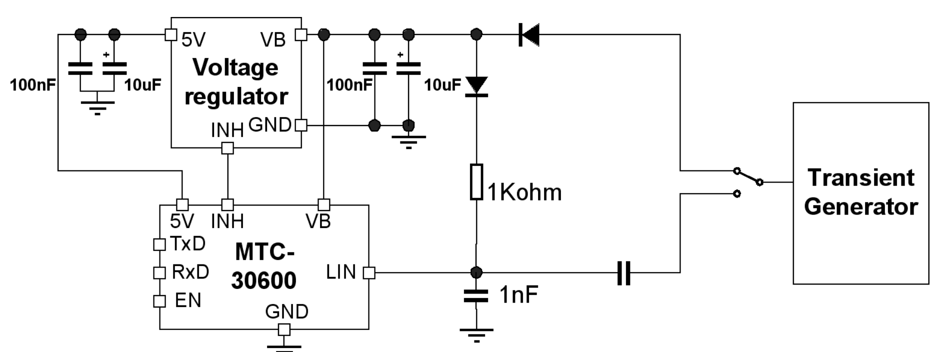
Parameter	Symbol	Limit Values			Unit	Remarks
		min	typ	max		
Dynamic Transceiver Characteristics						
Slope time falling edge	t _slope_F	2.6		22,5	µs	See Fig 4
Slope time rising edge	t _slope_R	2.6		22,5	µs	See Fig 4
Slope time symmetry	t _slope _Sym	-4		4	µs	T_slope_Sym =t_slope_F –t_slope_R
Propagation delay TxD LOW to bus	T_tr_F		1	4	µs	See Fig 4
Propagation delay TxD HIGH to bus	T_tr_R		1	4	µs	See Fig 4
Propagation delay bus dominant to RxD LOW	T_rec_F		2	4	µs	See Fig 4 , Rxd <20pF
Propagation delay bus recessive to RxD HIGH	T_rec_R		2	4	µs	See Fig 4 , Rxd <20pF
Receiver delay symmetry	t sym, Rec	-2		2	µs	t sym,Rec = T_rec_F –T_rec_R
Transmitter delay symmetry	t sym,Tr	-2		2	µs	t sym,Tr = T_tr_F – T_tr_R
Wake-up delay time	t wake	30	100	200	µs	



Delay-measurement



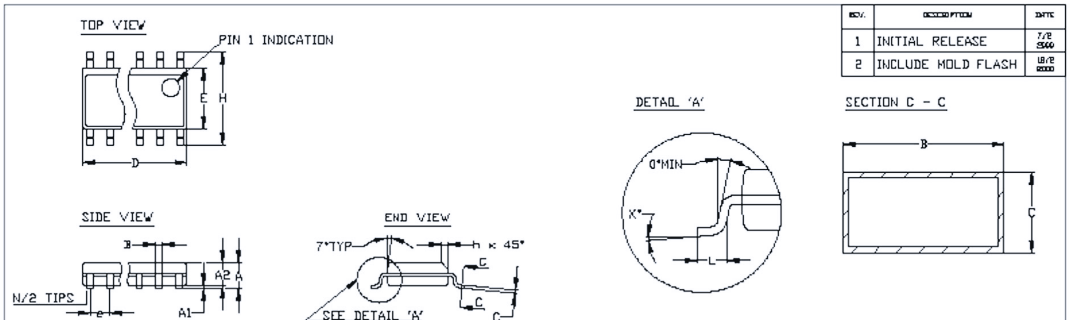
Slope-measurement



Load for driver definitions = 500Ω … 1kΩ (between transceivers supply and LIN
Load for slope definitions (typical loads) = (L1) 1nF 1kΩ / (L2) 6.8nF 600Ω / (L3) 10nF 500Ω

Fig.4: **Transmitter-parameters**

4.0 Package Outlines



NOTE: Mold flash or protusions shall not exceed 0.006 Inches on D per side

SYMBOL	INCHES			NOTE	NOTE VARI-ATIONS	1			2	ALCATEL PACKAGE NR.	ALCATEL PACKAGE CODE
							D		N		
	MIN	NOM	MAX			MIN	NOM	MAX			
A	0,061	0,064	0,068		AA	0,189	0,194	0,196	8	87_0031	SO8,SO8Q
A1	0,004	0,006	0,010		AB	0,337	0,342	0,344	14	87_0032	SO14,SO14Q
A2	0,055	0,058	0,061		AC	0,386	0,391	0,393	16	87_0033	SO16A,SO16Q
B	0,0138	0,0160	0,0200								
C	0,0075	0,0080	0,0098								
D		SEE VARIATIONS		1							
E	0,150	0,155	0,157								
e		0,050 BSC									
H	0,230	0,236	0,244								
h	0,010	0,013	0,016								
L	0,016	0,025	0,035								
N		SEE VARIATIONS		2							
X	0	5	8								

Sorts of Packing

Package outlines for tubes, trays etc. are contained in our Data Book “Package Information”.
SMD = Surface Mounted Device
Dimensions in mm

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