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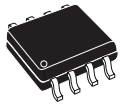
L9637

Monolithic bus driver with ISO 9141 interface

Features

- Operating power supply voltage range $4.5\ V \le V_S \le 36\ V$ (40 V for transients)
- Reverse supply (battery) protected down to $V_S \ge -24\ V$
- Standby mode with very low current consumption $IS_{SB} \le 1\ mA$ @ $V_{CC} \le 0.5\ V$
- Low quiescent current in off condition $IS_{OFF} = 120\ \mu A$
- TTL compatible TX input
- Bidirectional K-I/O pin with supply voltage dependent input threshold
- Overtemperature shut down function Selective to K-I/O pin
- Wide input and output voltage range $-24\ V \le V_K \le V_S$
- K output current limitation, typ. $I_K = 60\ mA$
- Defined OFF output status in undervoltage condition and V_S or GND interruption
- Controlled output slope for low EMI



SO8

- High input impedance for open V_S or GND connection
- Defined output ON status of LO or RX for open LI or K inputs
- Defined K output OFF for TX input open
- Integrated pull up resistors for TX, RX and LO
- EMI robustness optimized

Description

The L9637 is a monolithic integrated circuit containing standard ISO 9141 compatible interface functions.

Table 1. Device summary

Order code	Package	Packing
L9637D	SO8	Tube
L9637D013TR	SO8	Tape and reel
E-L9637D(1)	SO8	Tube
E-L9637D013TR(1)	SO8	Tape and reel

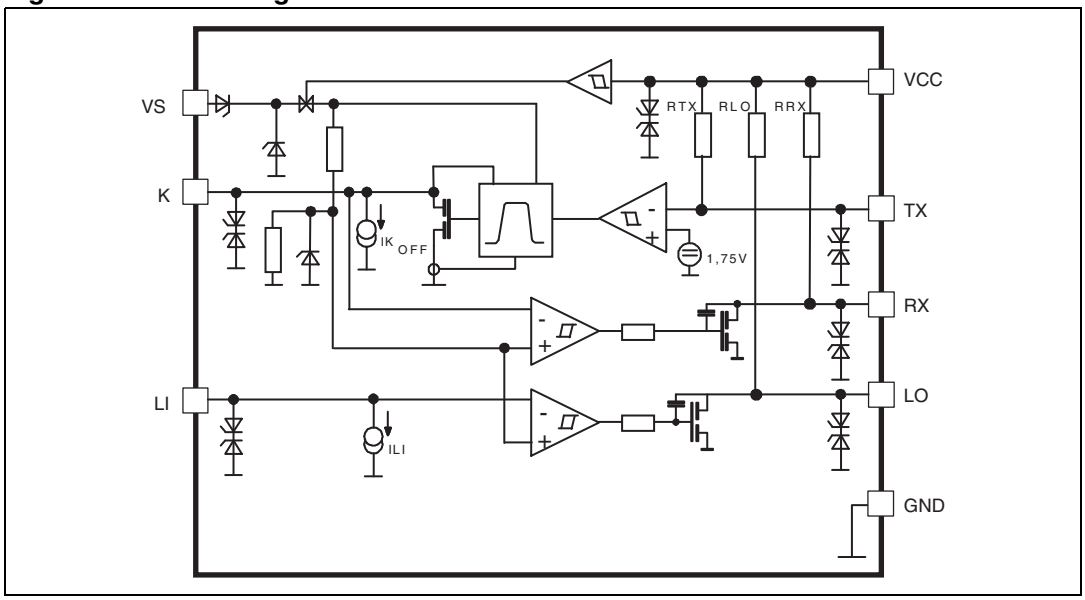
1. Device in ECOPACK® package (see *Section 4: Package information on page 13*).

Contents

1 Block diagram and pin description

1.1 Block diagram

Figure 1. Block diagram



1.2 Pin description

Figure 2. Pin connection (top view)

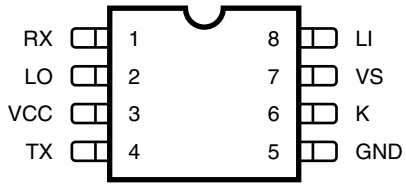


Table 2. Pin description

N.	Name	Function
1	RX	Output for K as input
2	LO	Output L comparator
3	VCC	Stabilized voltage supply
4	TX	Input for K as output
5	GND	Common GND
6	K	Bidirectional I/O
7	VS	Supply voltage
8	LI	Input L comparator

2 Electrical specification

2.1 Absolute maximum ratings

Table 3. Absolute maximum ratings (No damage or latch)

Symbol	Parameter	Value	Unit
V_S	Supply voltage ISO transients t = 400 ms	-24 to +36 -24 to +40	V
V_{CC}	Stabilized voltage	-0.3 to +7	V
$\Delta V_S/d_t$	Supply voltage transient	-10 to +10	V/µs
$V_{LI, K}$	Pin voltage	-24 to V_S	V
$V_{LO, RX, TX}$		-24 to V_{CC}	V

Note: Max. ESD voltages are ±2kV with human body model C = 100pF, R = 1.5k corresponds to maximum energy dissipation 0.2mJ according to MIL883C.

2.2 Thermal data

Table 4. Thermal data

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_{JSDon}	Temperature K shutdown switch on threshold	160	-	200	°C
T_{JSDoff}	Temperature K shutdown switch off threshold	150	-	200	°C
$R_{th\ j\text{-}amb}$	Thermal steady state junction to ambient resistance	130	155	180	°C/W

2.3 Electrical characteristics

The electrical characteristics are valid within the below defined operating conditions, unless otherwise specified. The function is guaranteed by design until T_{JSDon} temperature shutdown switch-on-threshold.

Table 5. Electrical characteristics

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
V_S	Supply voltage	-	4.5	-	36	V
V_{CC}	Stabilized voltage	see note (1)	3	5	7	V
T_j	Junction temperature	-	-40	-	150	°C
I_{CC}	Supply V_{CC} current	$V_{CC} \leq 5.5$ V; VLI,VTX = 0 V	-	1.4	2.3	mA
		VK ≥ VK_{high}; VLI ≥ VLI_{high} VTX = V_{CC} @ $V_{CC} \leq 5.5$ V	-5	<1	5	µA

Table 5. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
IS_{ON}	Supply V_S current	$V_S \leq 16$ V; VLI, VTX = 0 V	-	1.2	3	mA
IS_{OFF}		VK ≥ VK_{high}; VLI ≥ VLI_{high} VTX ≥ VTX_{high} @ $V_S \leq 12$ V	-	120	220	µA
IS_{SB}		$V_{CC} \leq 0.5$ V @ $V_S \leq 12$ V	-	<1	-	µA
VK_{low}	Input voltage low state	RX output status LOW 4.5 V ≤ $V_S \leq 18$ V	-24	-	$0.45V_S$	V
		RX output status LOW 18 V < V_S	-24	-	8	V
VK_{high}	Input voltage high state	RX output status HIGH 4.5 V ≤ $V_S \leq 18$ V	$0.55V_S$	-	V_S	V
		RX output status HIGH 18 V < V_S	12	-	V_S	V
V_{Khys}	Input threshold hysteresis	VK_{high} - VK_{low}	-	0.025 V_S	0.8	V
I_{Koff}	Input current	@ VTX ≥ VTX_{high} VK ≤ V_S; V_S, $V_{CC} \geq 0$ or V_S, V_{CC} = open	-5	4	25	µA
RK_{ON}	Output ON impedance	@ $V_S \geq 6.5$ V VTX ≤ VTX_{low} $I_K \geq 7$ mA (2)	-	10	30	Ω
IK_{SC}	Short circuit current		30	60	100	mA
VTX_{low}	Input voltage LOW state		-24	-	1	V
VTX_{high}	Input voltage HIGH state		2.5	-	V_{CC}	V
RRX_{ON} RLO_{ON}	Output ON impedance	VK ≤ VK_{low}; VLI ≤ VLI_{low} $V_S \geq 6.5$ V $I_{RX, LO} \geq 1$ mA	-	40	90	Ω
IRX_{SC} ILO_{SC}	Output short circuit current		9	20	35	mA
VRX_H VLO_H	Output voltage HIGH state	10MΩ ≤ R_{LRX} 10MΩ ≤ R_{LLO}	V_{CC}- 0.25	V_{CC}- 0.1	V_{CC}-	V
RLO RRX	Output pull-up resistance	Output status = (HIGH) -0.15 V ≤ VLO ≤ V_{CC} + 0.15 V -0.15 V ≤ VRX ≤ V_{CC} + 0.15 V	5	10	20	kΩ
RTX	Input pull up resistance	-0.15 V ≤ VTX ≤ V_{CC} + 0.15 V	10	20	40	kΩ
VLI_{low}	Input voltage LOW state	LO output status LOW 4.5 V ≤ $V_S \leq 18$ V LO output status LOW 18 V < V_S	-24 -24	-	$0.45V_S$ 8	V

Table 5. Electrical characteristics (continued)

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
VL_{high}	Input voltage HIGH state	LO output status HIGH 4.5 V ≤ V_S ≤ 18 V LO output status HIGH 18 V < V_S	0.55V_S 12	-	V_S	V
VLI_{hys}	Input threshold hysteresis	VLI_{high} - VLI_{low}	-	0.025V_S	0.8	V
ILI	Input current	VLI ≤ V_S V_S, V_{CC} ≥ 0 or V_S, V_{CC} = open	-5	4	25	µA
$C_{Ki,LO,RX}$	Internal output capacities		-	-	20	pF
f_{LI-LO} f_{K-RX} f_{TX-k}	Transmission frequency	9 V < V_S < 16 V (external loads) R_{KO} = 510 Ω, C_K ≤ 1.3 nF in active mode see *Figure 5*	-	-	50	kHz
t_{rLI-LO} t_{rK-RX} t_{rTX-K}	Rise time	for the definition of t_r, t_f see *Figure 3* 9 V < V_S < 16 V (external loads) R_{KO} = 510 Ω, CK ≤ 1.3 nF	-	2	6	µs
t_{fLI-LO} t_{fK-RX} t_{fTX-K}	Fall time		-	2	6	µs
$t_{OFF,LI-LO}$ $t_{OFF,K-RX}$ $t_{OFF,TX-K}$	Switch OFF time	for the definition of ton, t_{OFF} see *Figure 3*. 9 V < V_S < 16 V (external loads) R_{KO} = 510 Ω, C_K ≤ 1.3 nF (inactive mode see *Figure 5*)	-	4	17	µs
$t_{ON,LI-LO}$ $t_{ON,K-RX}$ $t_{ON,TX-K}$	Switch ON time		-	4	17	µs

1. Specs are tested at 5V only. Compliance on Vcc full range is guaranteed by design.
2. For output currents lower than this value a series protection diode can become active. See also *Figure 8* and *9*.

Figure 3. Input to output timings and output pulse shape

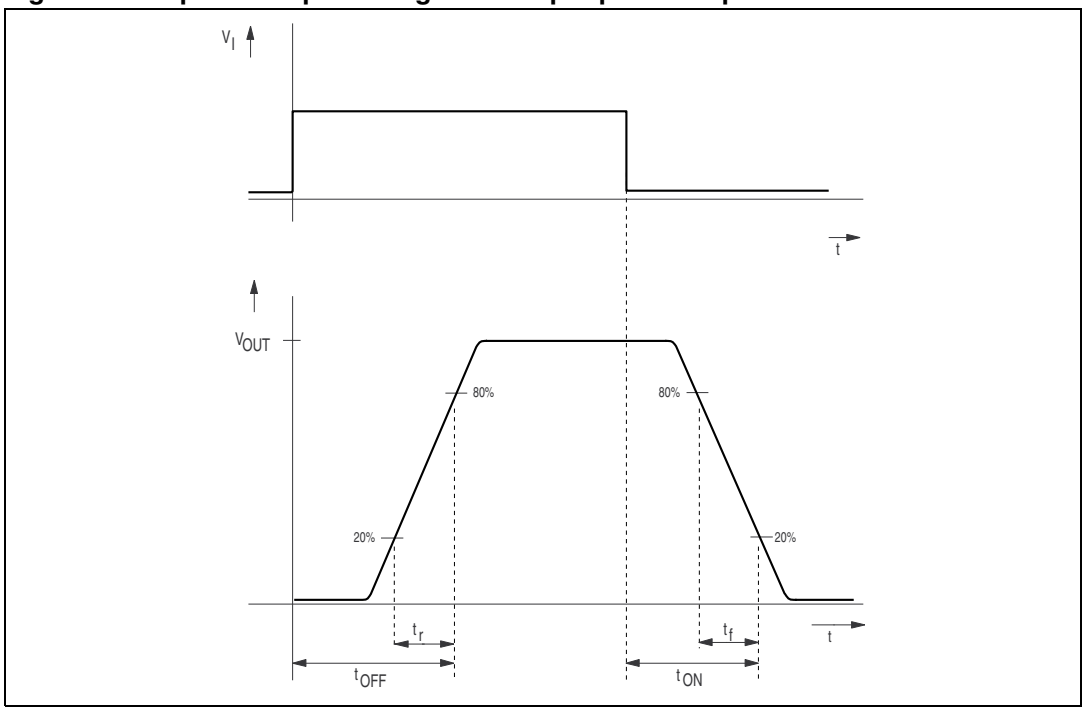
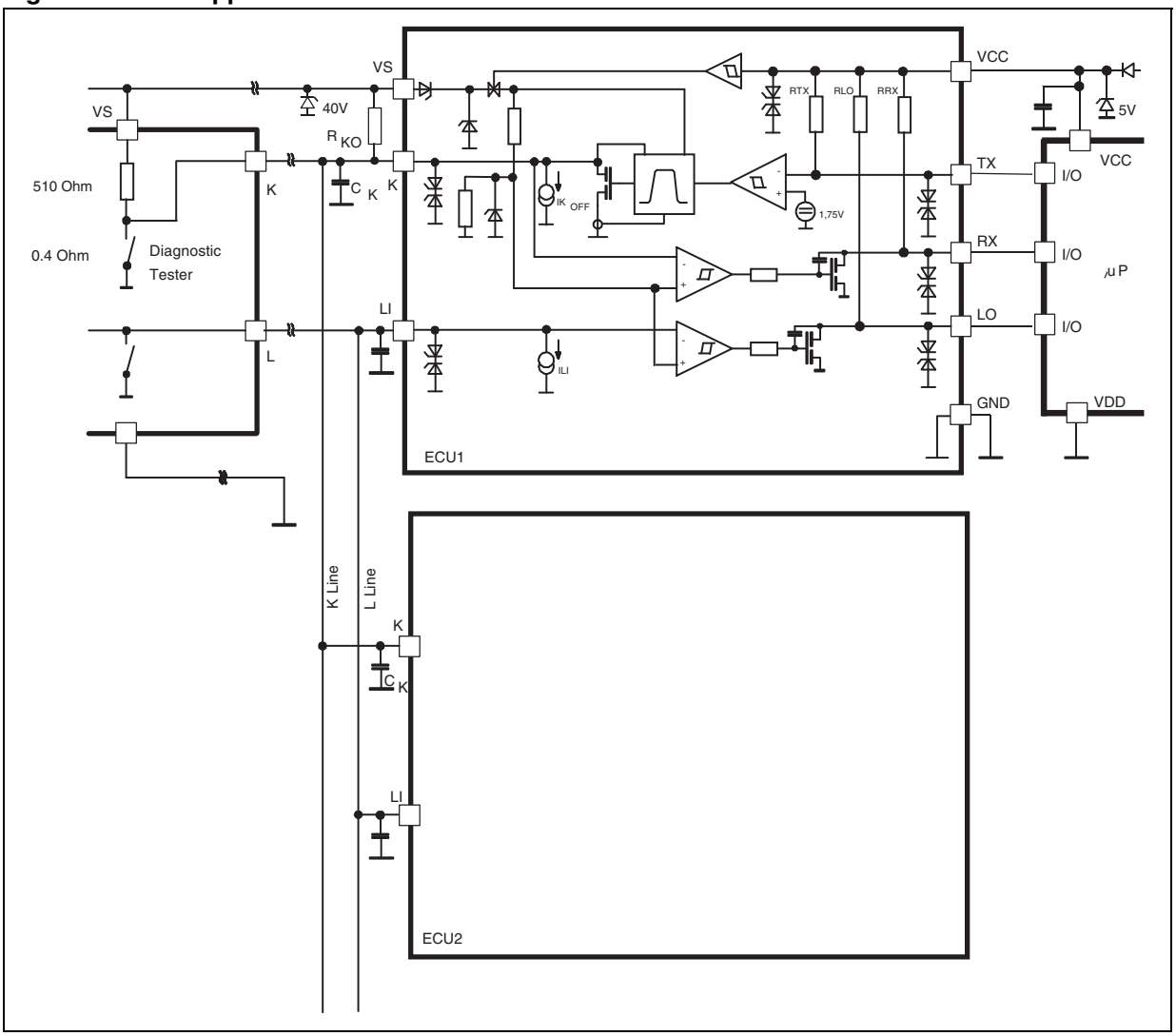


Figure 4. ISO application circuit



3 Functional description

The L9637 is a monolithic bus driver designed to provide bidirectional serial communication in automotive diagnostic applications according to the specification "Diagnostic Systems ISO9141".

The device provides a bidirectional link, called K, to the $V_{Ba}t$ related diagnosis bus. It also includes a separate comparator L which is also able to be linked to the $V_{Ba}t$ bus. The input TX and output RX of K are related to V_{CC} with her integrated pull up resistances. Also the L comparator output LO has a pull up resistance connected to V_{CC}.

The maximum external pull up resistance at K related to V_S should not be higher than $R_{KO} \leq 5\ k\Omega$ to achieve clear output ON conditions.

All V_{Bat} bus defined inputs LI and K have supply voltage dependent thresholds together with sufficient hysteresis to suppress line spikes. These pins are protected against overvoltages, shorts to GND and V_S and can also be driven beyond V_S and GND.

These features are also given for TX, RX and LI only taking into account the behavior of the internal pull up resistances. The thermal shut down function switches OFF the K output if the chip temperature increases above the thermal shut down threshold. To reactivate K again the temperature must decrease below the K switch ON temp. To achieve no fault for V_S undervoltage conditions the outputs will be switched OFF and stay at high impedance.

The device is also protected against reverse battery condition. During lack of V_S or GND all pins shows high impedance characteristic. To realize a lack of the V_S related bus line LI and K the outputs LO and RX shows defined ON status.

Suppressing all 4 classes of "Schaffner" signals all pins can be load with short energy pulses of max. ±0.2 mJ. All these features together with a high possible baud rate >50Kbaud, controlled output slopes for low EMI, a wide power supply voltage range and a very small quiescent current during OFF (TX LI K=High) condition $IS_{off\ typ} \leq 120\ \mu A$, and a real standby function with zero power consumption $IS_{SB\ typ} \leq 1\ \mu A$ during system de powering $V_{CC} \leq 0.5$ V make this device high efficient for automotive bus system.

After wake up of the system from OFF or SB condition the first output signal will have an additional delay time $td_{typ} \leq 5\ \mu s$ see also *Figure 5*.

The typical output voltage behavior for the K, LO, RX outputs as a function of the output current is shown in *Figure 6*. *Figure 7* shows a waveform of the output signal when the low level changes from $R_{ON} * I_{OUT}$ to $I_{OUT} * 2 * R_{ON} + U_{BE}$ state. This variation occurs due to too low output current or after a negative transient forced to the output or to the supply voltage line.

Figure 5. Typical timing for mode transitions

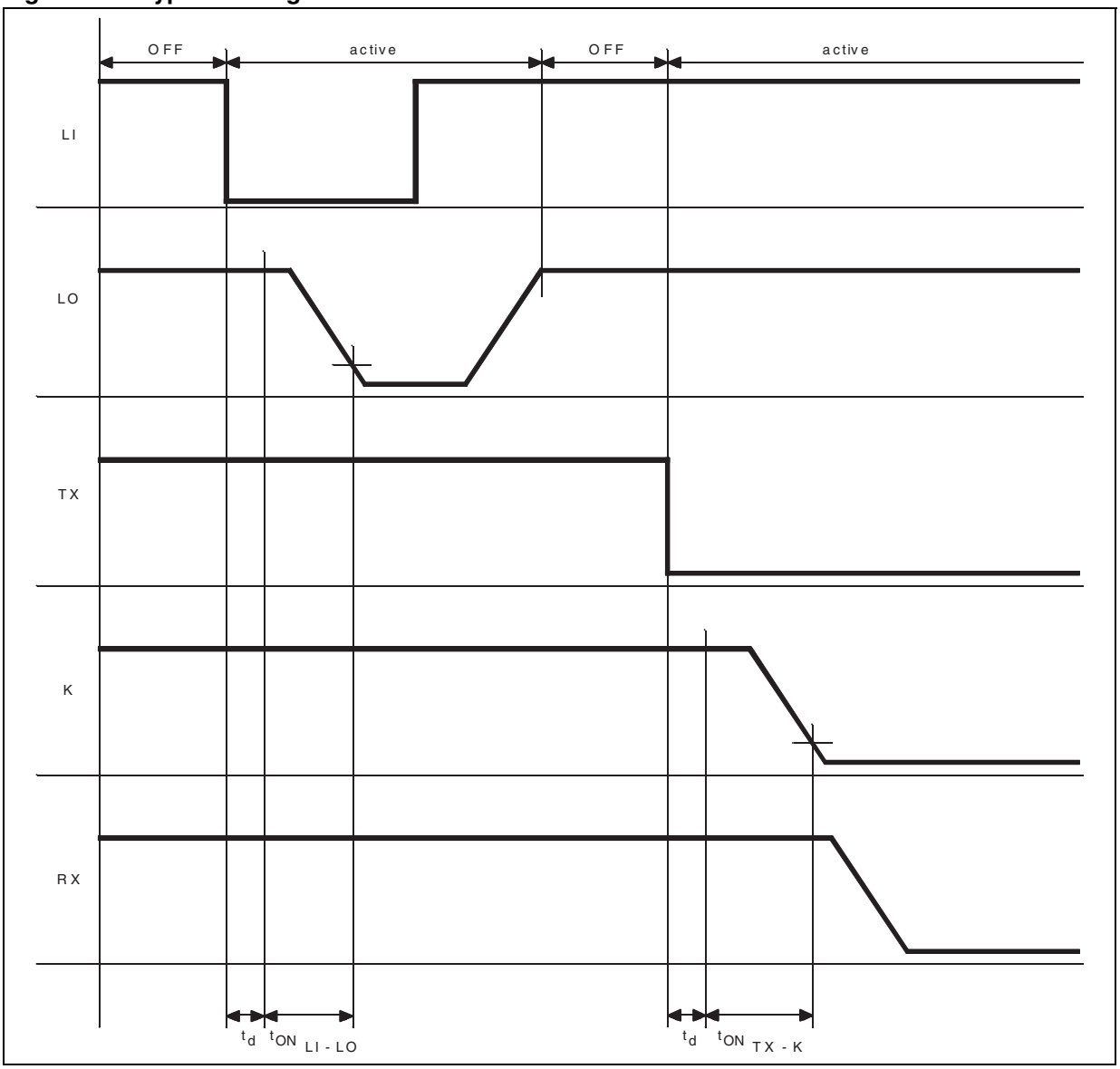


Figure 6. Output characteristics at K, LO, RX

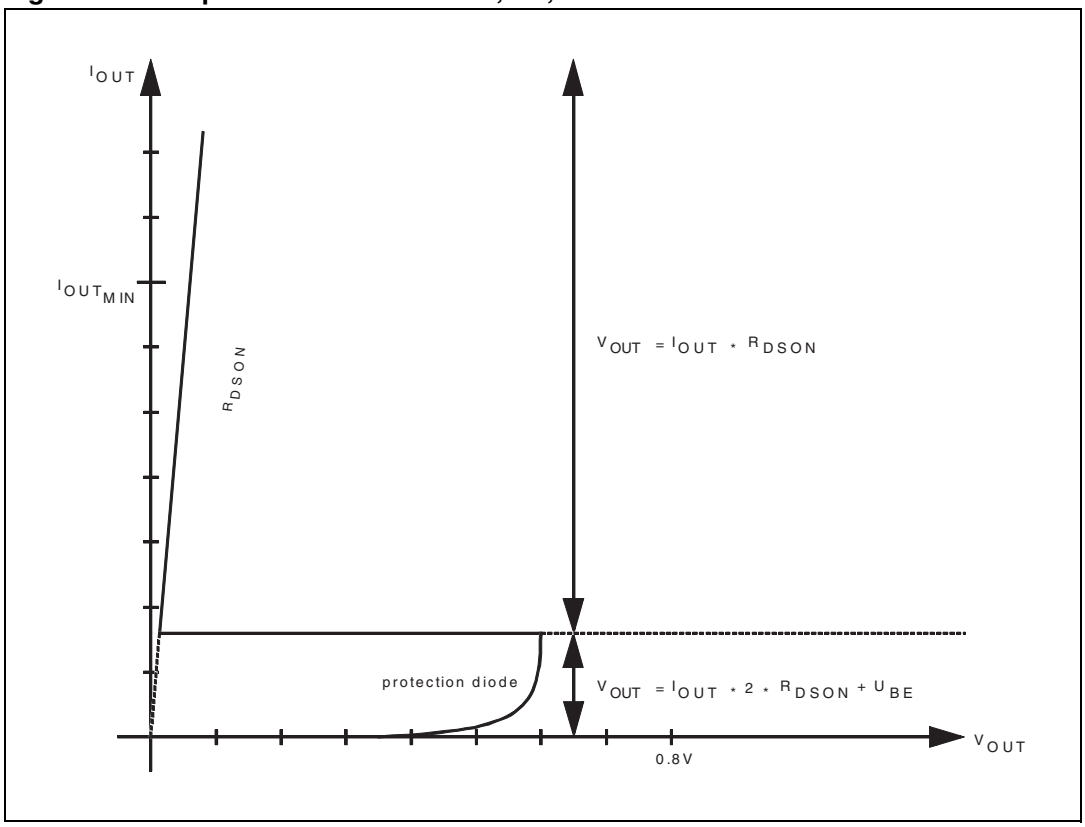


Figure 7. Output signal shape related to output current

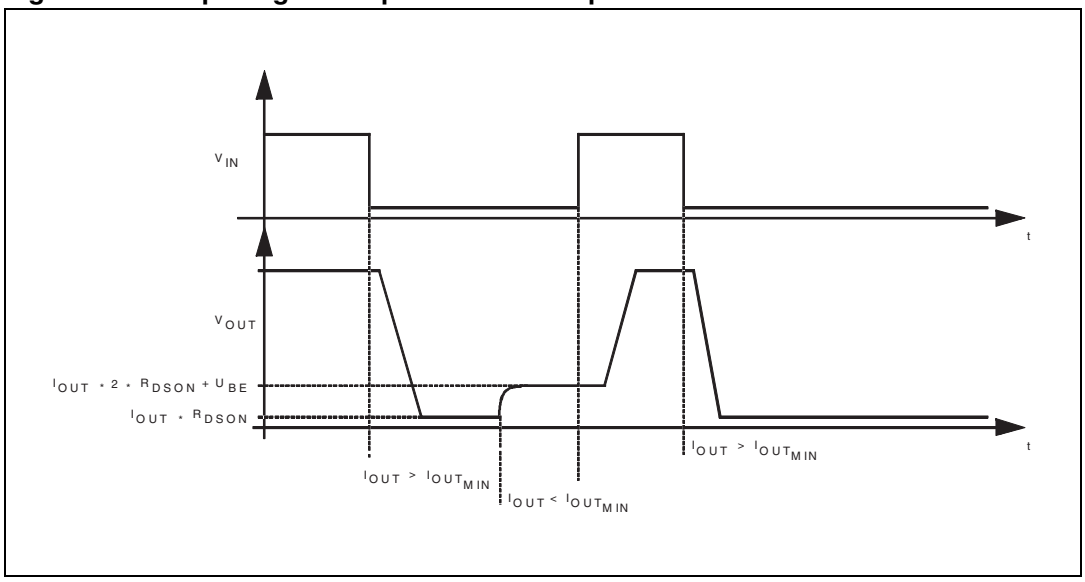


Figure 8. EMS performance (ISO 9141 bus system)

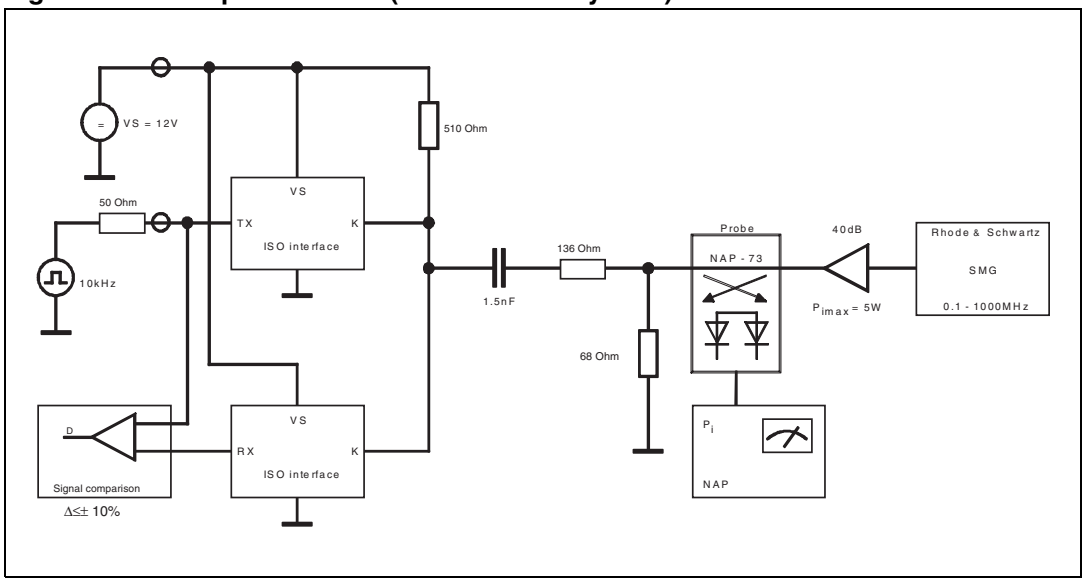
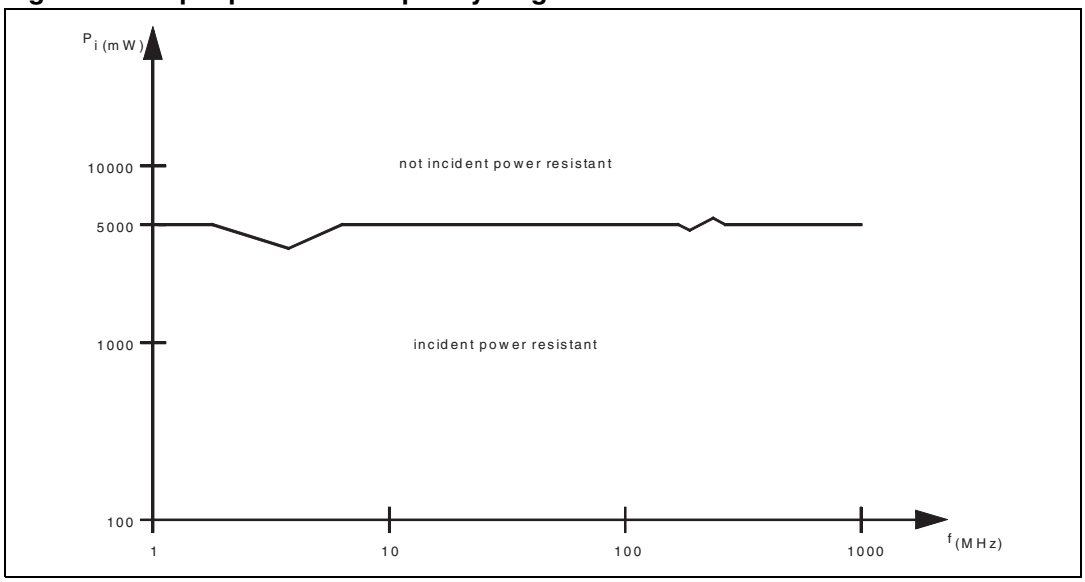


Figure 9. Input power vs. frequency diagram



4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*.

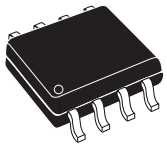
ECOPACK® is an ST trademark.

Figure 10. SO8 mechanical data and package dimensions

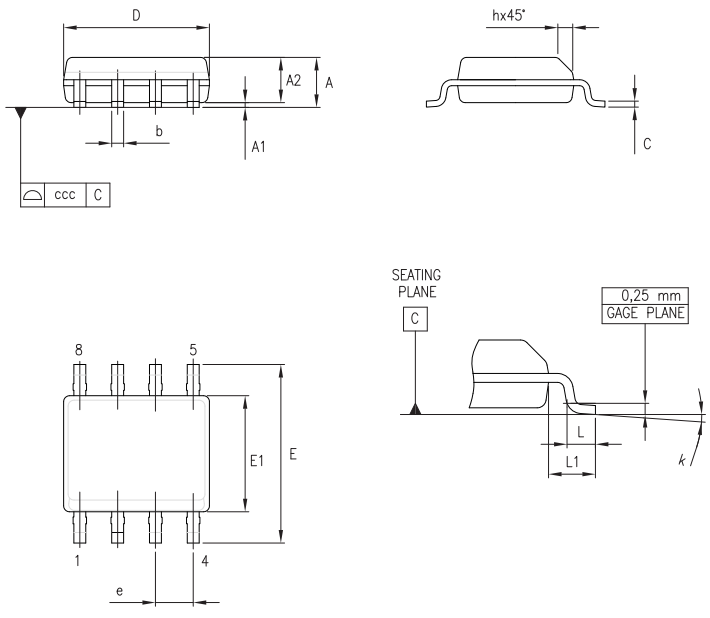
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.750			0.0689
A1	0.100		0.250	0.0039		0.0098
A2	1.250			0.0492		
b	0.280		0.480	0.0110		0.0189
c	0.170		0.230	0.0067		0.0091
D (1)	4.800	4.900	5.000	0.1890	0.1929	0.1969
E	5.800	6.000	6.200	0.2283	0.2362	0.2441
E1(2)	3.800	3.900	4.000	0.1496	0.1535	0.1575
e		1.270			0.0500	
h	0.250		0.500	0.0098		0.0197
L	0.400		1.270	0.0157		0.0500
L1		1.040			0.0409	
k	0°		8°	0°		8°
ccc			0.100			0.0039

Notes: 1. Dimensions D does not include mold flash, protrusions or gate burrs. Mold flash, potrusions or gate burrs shall not exceed 0.15mm in total (both side).
2. Dimension "E1" does not include interlead flash or protrusions. Interlead flash or protrusions shall not exceed 0.25mm per side.

OUTLINE AND MECHANICAL DATA



SO-8



5 Revision history

Table 6. Document revision history

Date	Revision	Changes
24-Jan-2002	5	Initial release.
07-Nov-2008	6	Document reformatted. Added *Table 1: Device summary on page 1*. Updated *Section 4: Package information on page 13*.
15-Jun-2009	7	Updated the values of “stabilized voltage” and “transmission frequency” parameters on *Table 5: Electrical characteristics*.
20-Sep-2013	8	Updated disclaimer.

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