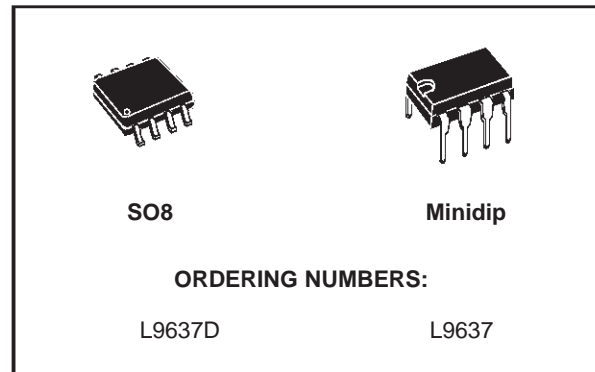


## ISO 9141 INTERFACE

- OPERATING POWER SUPPLY VOLTAGE RANGE  $4.5V \leq V_S \leq 36V$  (40V FOR TRANSIENTS)
- REVERSE SUPPLY (BATTERY) PROTECTED DOWN TO  $V_S \geq -24V$
- STANDBY MODE WITH VERY LOW CURRENT CONSUMPTION  $I_{SSB} 1\mu A @ V_{CC} 0.5V$
- LOW QUIESCENT CURRENT IN OFF CONDITION  $I_{SOFF} = 120\mu A$
- 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  $-24V \leq V_K \leq V_S$
- K OUTPUT CURRENT LIMITATION, TYP  $I_K = 60mA$
- DEFINED OFF OUTPUT STATUS IN UNDERVOLTAGE CONDITION AND  $V_S$  OR GND INTERRUPTION
- CONTROLLED OUTPUT SLOPE FOR LOW EMI
- HIGH INPUT IMPEDANCE FOR OPEN  $V_S$  OR GND CONNECTION

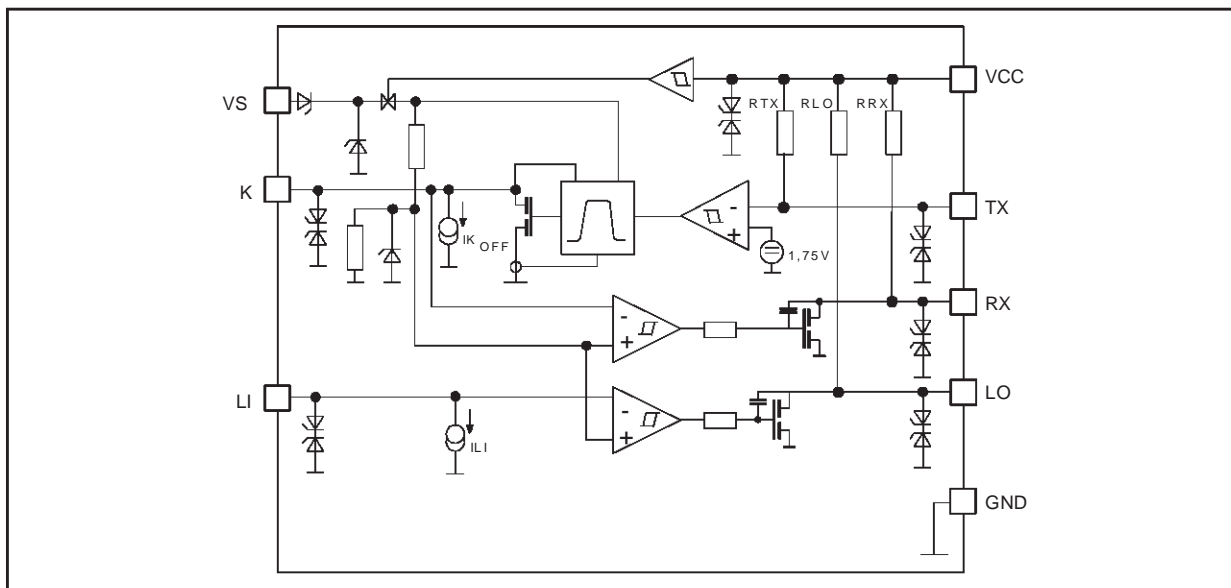


- DEFINED OUTPUT ON STATUS OF LO OR RX FOR OPEN LI OR K INPUTS
- DEFINED K OUTPUT OFF FOR TX INPUT OPEN
- INTEGRATED PULL UP RESISTORS FOR TX, RX AND LO
- EMI ROBUSTNESS OPTIMIZED

### DESCRIPTION

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

### BLOCK DIAGRAM

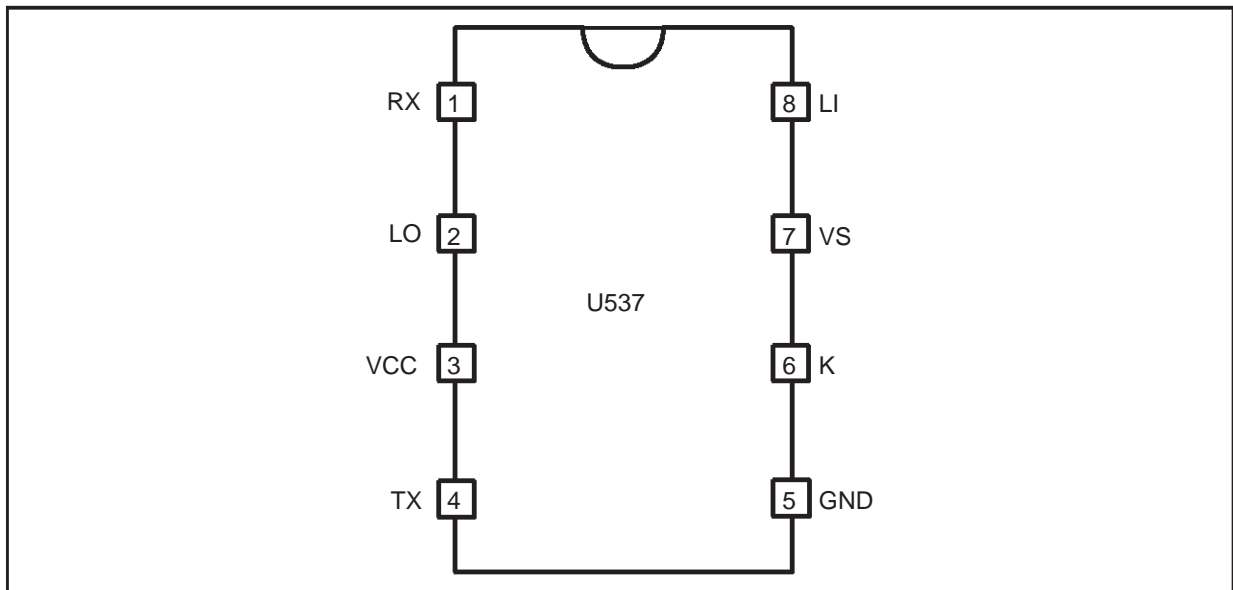


**ABSOLUTE MAXIMUM RATINGS** (No damage or latch)

Symbol	Parameter	Value	Unit
V <sub>S</sub>	Supply Voltage	-24 to +36	V
	ISO transients t = 400ms	-24 to +40	V
V <sub>CC</sub>	Stabilized Voltage	-0.3 to +7	V
ΔV <sub>S</sub> /dt	Supply Voltage transient	-10 to +10	V/μs
V <sub>LI, K</sub>	Pin Voltage	-24 to V <sub>S</sub>	V
V <sub>LO, RX, TX</sub>	Pin Voltage	-24 to V <sub>CC</sub>	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.

**PIN CONNECTION** (Top view)



**THERMAL DATA**

Symbol	Parameter	Min.	Typ.	Max.	Unit
T <sub>JSDon</sub>	Temperature K shutdown switch on threshold	160		200	°C
T <sub>JSDoff</sub>	Temperature K shutdown switch off threshold	150		200	°C
R <sub>th j-amb</sub>	Thermal steady state junction to ambient resistance for <b>SO8</b>	130	155	180	°C/W
	Thermal steady state junction to ambient resistance for <b>Minidip</b>	80	100	120	°C/W

**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

**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.)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$V_S$	Supply Voltage		4.5		36	V
$V_{CC}$	Stabilized Voltage		3		7	V
$T_j$	Junction temperature		-40		150	°C
$I_{CC}$	Supply $V_{CC}$ Current	$V_{CC} \leq 5.5V$ ; $V_{LI}, V_{TX} = 0V$		1.4	2.3	mA
		$V_K \geq V_{Khigh}$ ; $V_{LI} \geq V_{LIhigh}$ $V_{TX} = V_{CC}$ @ $V_{CC} \leq 5.5V$	-5	<1	5	$\mu A$
$I_{SON}$	Supply $V_S$ Current	$V_S \leq 16V$ ; $V_{LI}, V_{TX} = 0V$		1.2	3	mA
$I_{SOFF}$		$V_K \geq V_{Khigh}$ ; $V_{LI} \geq V_{LIhigh}$ $V_{TX} \geq V_{TXhigh}$ @ $V_S \leq 12V$		120	220	$\mu A$
$I_{SSB}$		$V_{CC} \leq 0.5V$ @ $V_S \leq 12V$		<1		$\mu A$
$V_{Klow}$	Input Voltage Low state	RX output status LOW $4.5V \leq V_S \leq 18V$	-24		$0.45V_S$	V
		RX output status LOW $18V < V_S$	-24		8	V
$V_{Khigh}$	Input Voltage High state	RX output status HIGH $4.5V \leq V_S \leq 18V$	$0.55V_S$		$V_S$	V
		RX output status HIGH $18V < V_S$	12		$V_S$	V
$V_{Khys}$	Input Threshold Hysteresis	$V_{Khigh} - V_{Klow}$		$0.025V_S$	0.8	V
$I_{Koff}$	Input Current	@ $V_{TX} \geq V_{TXhigh}$ $V_K \leq V_S$ $V_S, V_{CC} \geq 0$ or $V_S, V_{CC} = open$	-5	4	25	$\mu A$
$R_{KON}$	Output ON Impedance	@ $V_S \geq 6.5V$ $V_{TX} \leq V_{TXlow}$ $I_K \geq 7mA$ 1)		10	30	$\Omega$
$I_{KSC}$	Short Circuit Current		30	60	100	mA
$V_{TXlow}$	Input voltage LOW state		-24		1	V
$V_{TXhigh}$	Input voltage HIGH state		2.5		$V_{CC}$	V
$R_{RXON}$ $R_{LOON}$	Output ON Impedance	$V_K \leq V_{Klow}$ ; $V_{LI} \leq V_{LIlow}$ $V_S \geq 6.5V$ $I_{RX, LO} \geq 1mA$ 1)		40	90	$\Omega$
$I_{RXSC}$ $I_{LOSC}$	Output Short Circuit Current		9	20	35	mA
$V_{RXH}$ $V_{LOH}$	Output Voltage HIGH state	$10M\Omega \leq R_{LRX}$ $10M\Omega \leq R_{LLO}$	$V_{CC} - 0.25$	$V_{CC} - 0.1$	$V_{CC}$	V
$R_{LO}$ $R_{RX}$	Output pull-up resistance	Output status = (HIGH) $-0.15V \leq V_{LO} \leq V_{CC} + 0.15V$ $-0.15V \leq V_{RX} \leq V_{CC} + 0.15V$	5	10	20	K $\Omega$
$R_{TX}$	Input pull up resistance	$-0.15V \leq V_{TX} \leq V_{CC} + 0.15V$	10	20	40	K $\Omega$
$V_{LIlow}$	Input voltage LOW state	LO output status LOW $4.5V \leq V_S \leq 18V$	-24		$0.45V_S$	V
		LO output status LOW $18V < V_S$	-24		8	V
$V_{Lhigh}$	Input voltage HIGH state	LO output status HIGH $4.5V \leq V_S \leq 18V$	$0.55V_S$		$V_S$	V
		LO output status HIGH $18V < V_S$	12		$V_S$	V
$V_{LIhys}$	Input threshold hysteresis	$V_{LIhigh} - V_{LIlow}$		$0.025V_S$	0.8	V
$I_{LI}$	Input current	$V_{LI} \leq V_S$ $V_S, V_{CC} \geq 0$ or $V_S, V_{CC} = open$	-5	4	25	$\mu A$

**ELECTRICAL CHARACTERISTIC** (continued)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$C_{KI, LO, RX}$	Internal output capacities				20	pF
$f_{LI-LO}$ $f_{K-RX}$ $f_{TX-K}$	Transmission Frequency	$9V < V_S < 16V$ (external loads) $R_{KO} = 510\Omega$ , $C_K \leq 1.3nF$ in active mode see Fig. 3	50	100		kHz
$t_{rLI-LO}$ $t_{rK-RX}$ $t_{rTX-K}$	Rise Time	for the definition of $t_r$ , $t_f$ see Fig.1.		2	6	$\mu s$
$t_{fLI-LO}$ $t_{fK-RX}$ $t_{fTX-K}$	Fall Time	$9V < V_S < 16V$ (external loads) $R_{KO} = 510\Omega$ , $C_K \leq 1.3nF$		2	6	$\mu s$
$t_{OFF, LI-LO}$ $t_{OFF, K-RX}$ $t_{OFF, TX-K}$	Switch OFF time	for the definition of $t_{on}$ , $t_{OFF}$ see Fig.1.		4	17	$\mu s$
$t_{ON, LI-LO}$ $t_{ON, K-RX}$ $t_{ON, TX-K}$	Switch ON time	$9V < V_S < 16V$ (external loads) $R_{KO} = 510\Omega$ , $C_K \leq 1.3nF$ (inactive mode see Fig. 3)		4	17	$\mu s$

1) For output currents lower than this value a series protection diode can become active. See also Fig. 4 and 5.

**Figure 1:** Input to Output Timings and Output Pulse Shape.

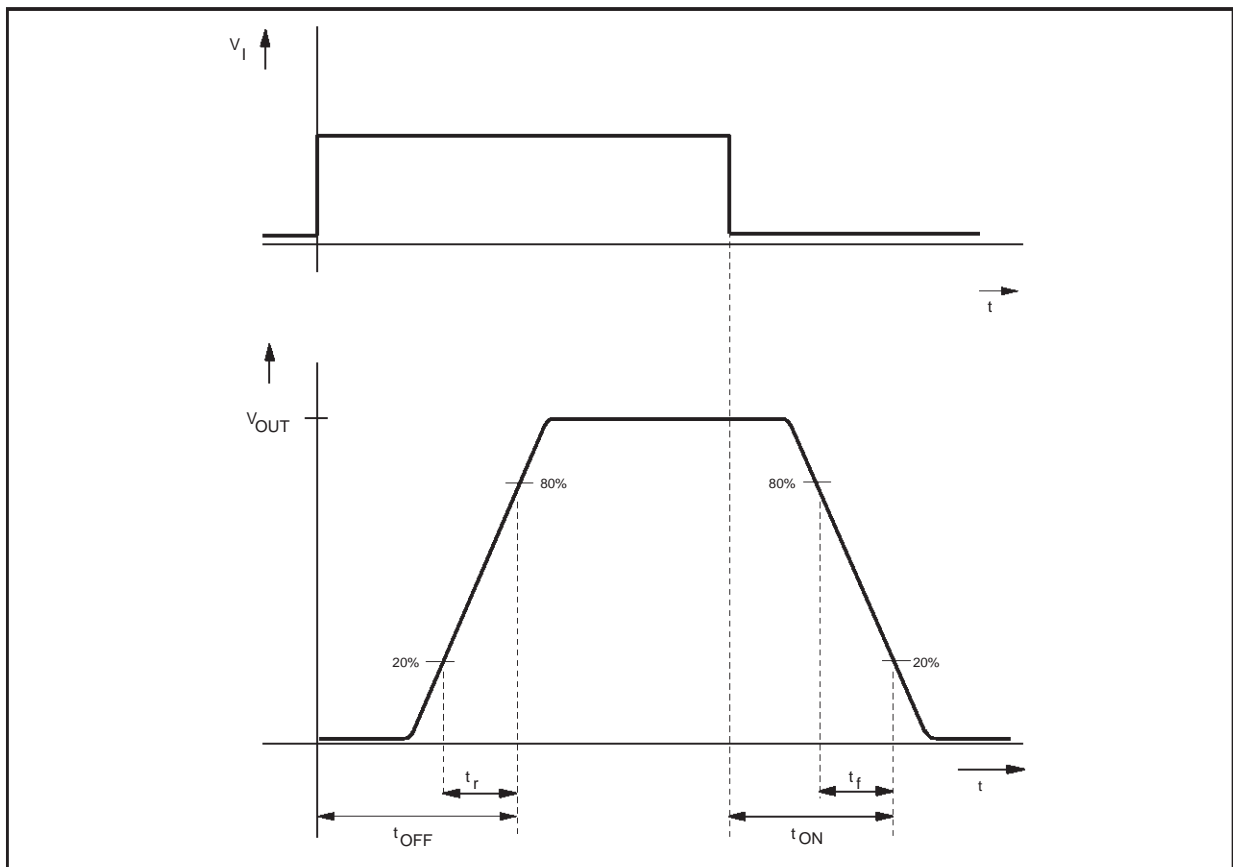
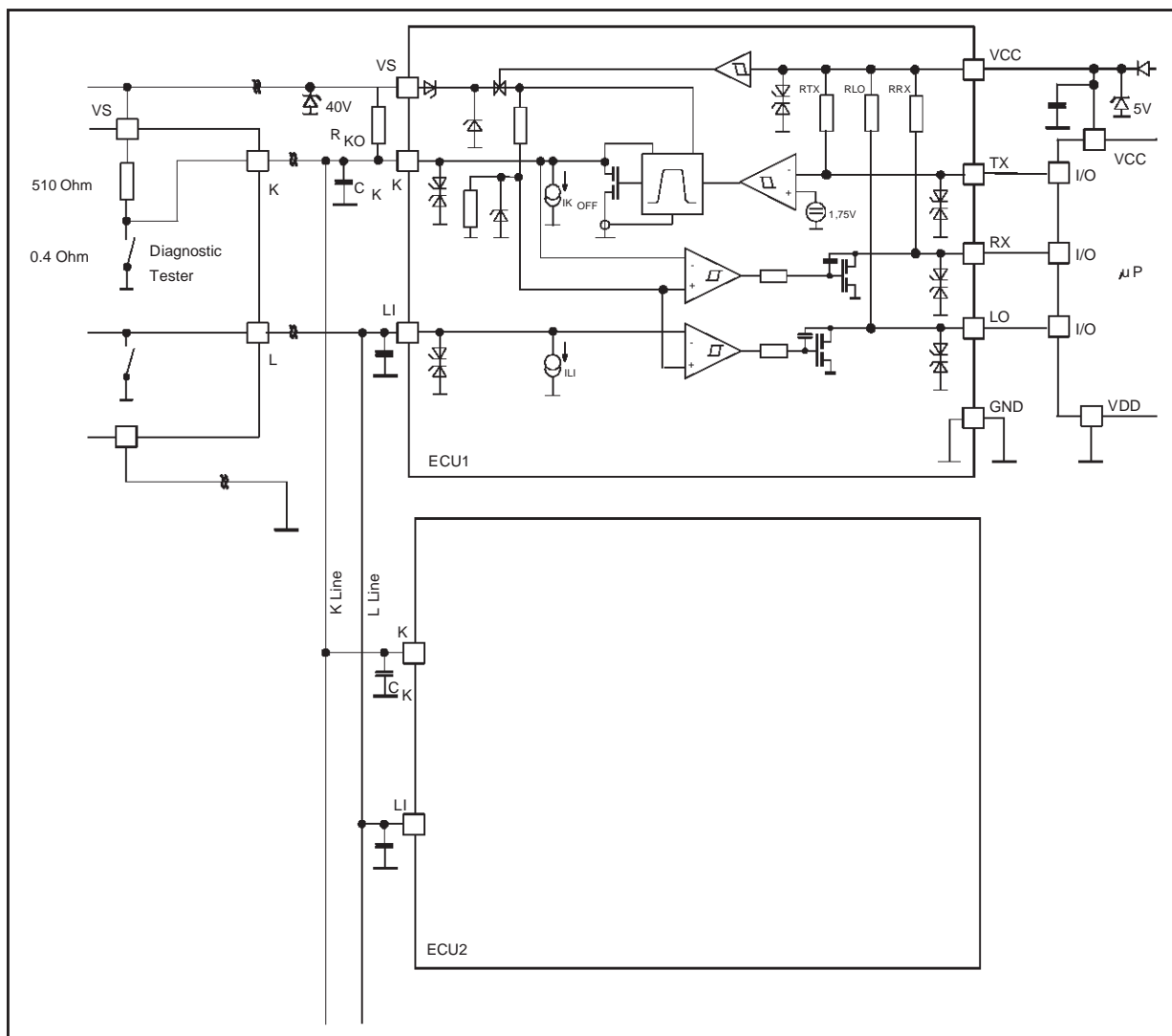


Figure 2: ISO Application Circuit



### 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  $V_{Bat}$  related diagnosis bus. It also includes a separate comparator L which is also able to be linked to the  $V_{Bat}$  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  $R_{KO} \leq 5K\Omega$  to achieve clear output ON conditions.

All  $V_{Bat}$  bus defined inputs LI and K have supply voltage dependent thresholds together with suf-

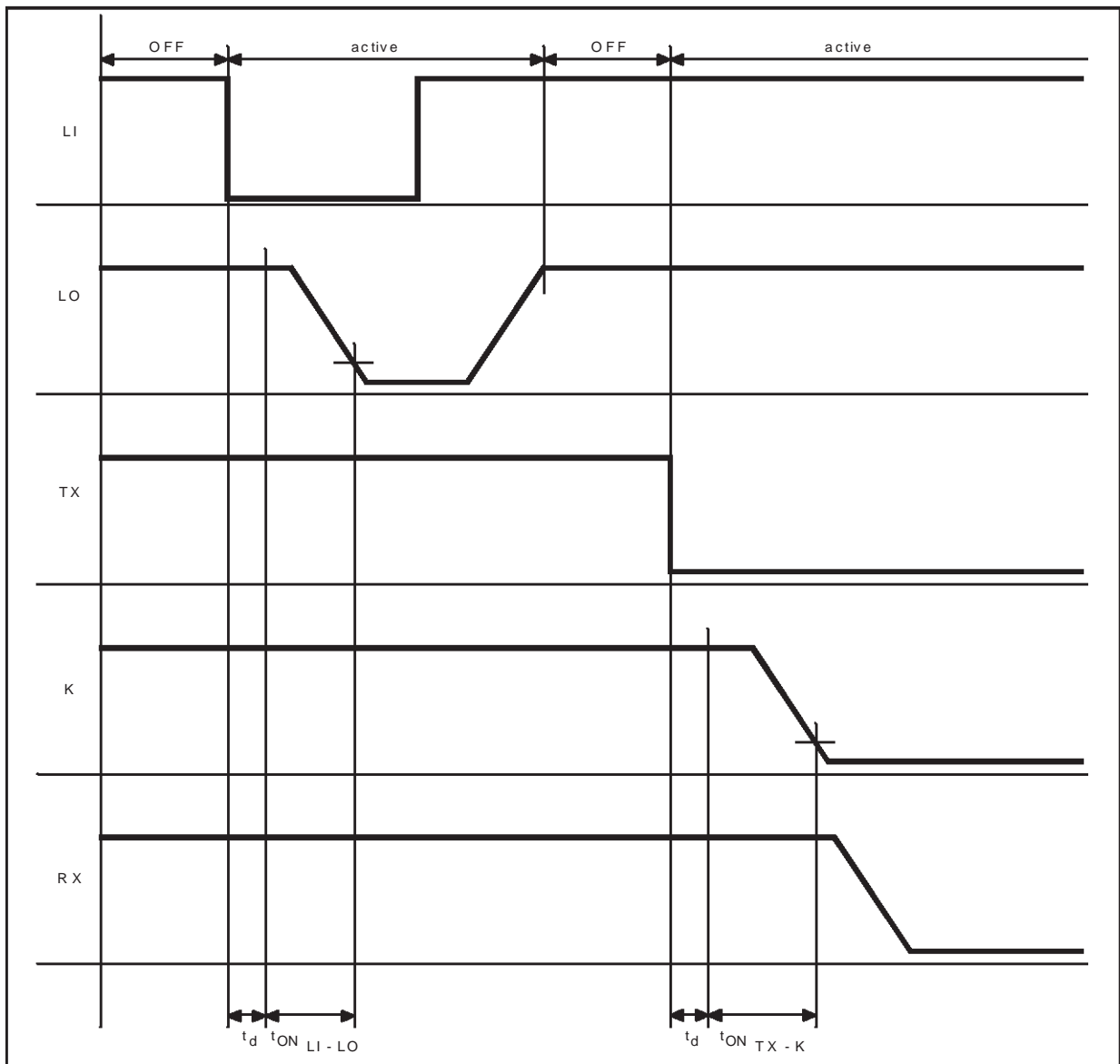
ficient hysteresis to suppress line spikes. These pins are protected against overvoltages, shorts to GND and  $V_S$  and can also be driven beyond  $V_S$  and GND. These features are also given for TX, RX and LI only taking into account the behaviour of the internal pull up resistances. The thermal shut down function switches OFF the K output if the chip temperature increases above the thermal shut down threshold. To reactivate K again the chip temperature must decrease below the K switch ON temp. To achieve no fault for  $V_S$  under-voltage 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.  $\pm 0.2\text{mJ}$ . All these features together with a high possible baud rate  $>50\text{Kbaud}$ , 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  $I_{\text{off typ}} \leq 120\mu\text{A}$ , and a real standby function with zero power consumption  $I_{\text{SB typ}} \leq 1\mu\text{A}$  during system depowering  $V_{\text{CC}} \leq 0.5\text{V}$  make this device high efficient for automotive bus system.

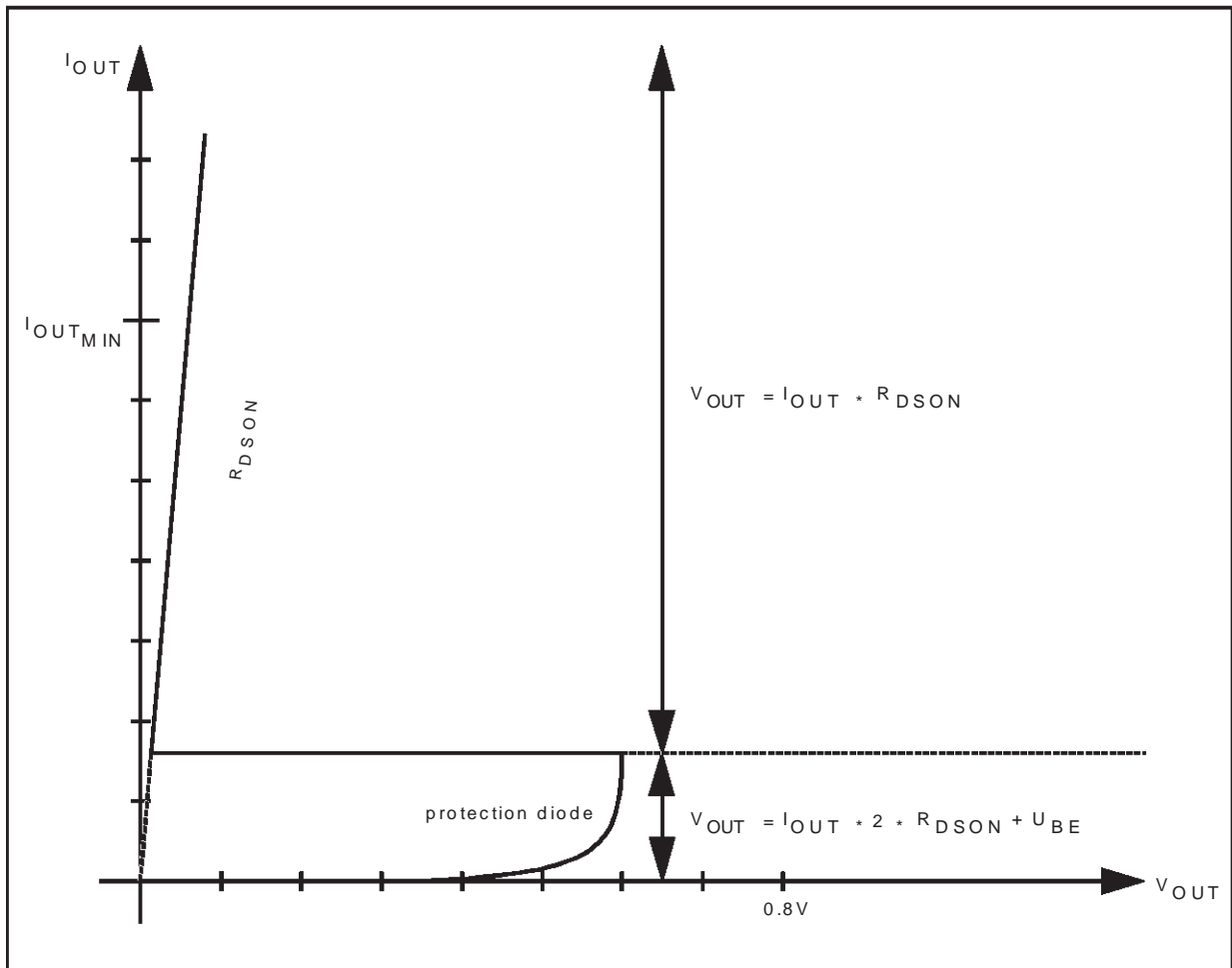
After wake up of the system from OFF or SB condition the first output signal will have an additional delay time  $t_{\text{d typ}} \leq 5\mu\text{s}$  see also Fig. 3.

The typical output voltage behaviour for the K, LO, RX outputs as a function of the output current is shown in Fig.4. Fig.5 shows a waveform of the output signal when the low level changes from  $R_{\text{ON}} * I_{\text{OUT}}$  to  $I_{\text{OUT}} * 2 * R_{\text{ON}} + U_{\text{BE}}$  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 3: Typical timing for mode transitions.



**Figure 4:** Output Characteristics at K, LO, RX.



**Figure 5:** Output Signal Shape Related to Output Current.

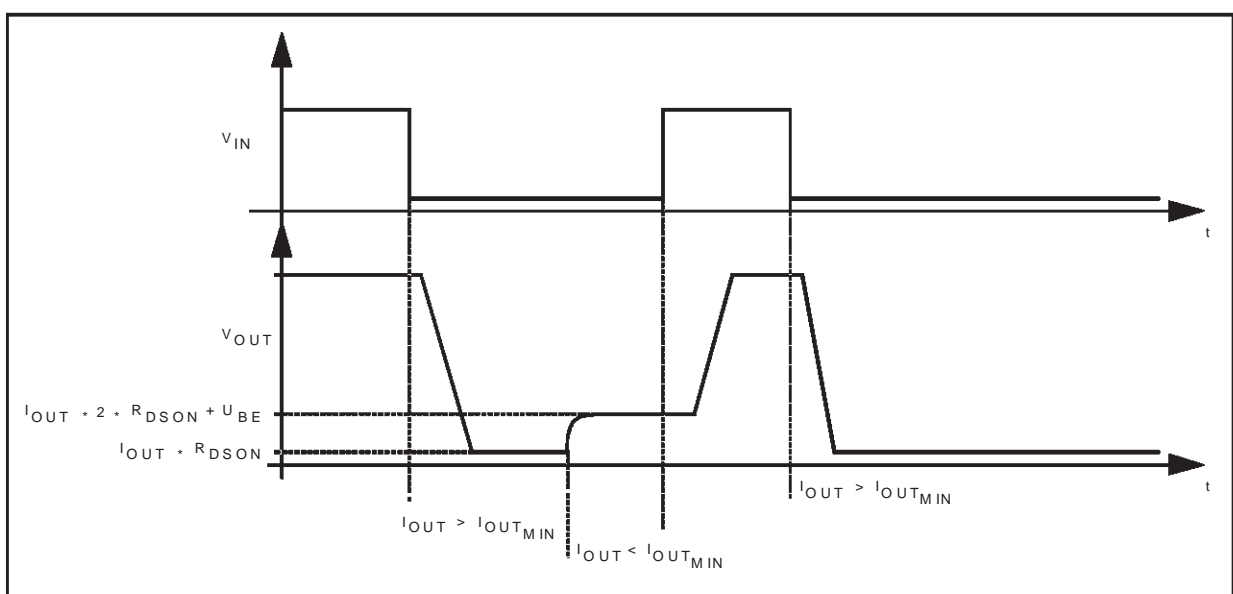


Figure 6: EMS Performance (ISO 9141 BUS system).

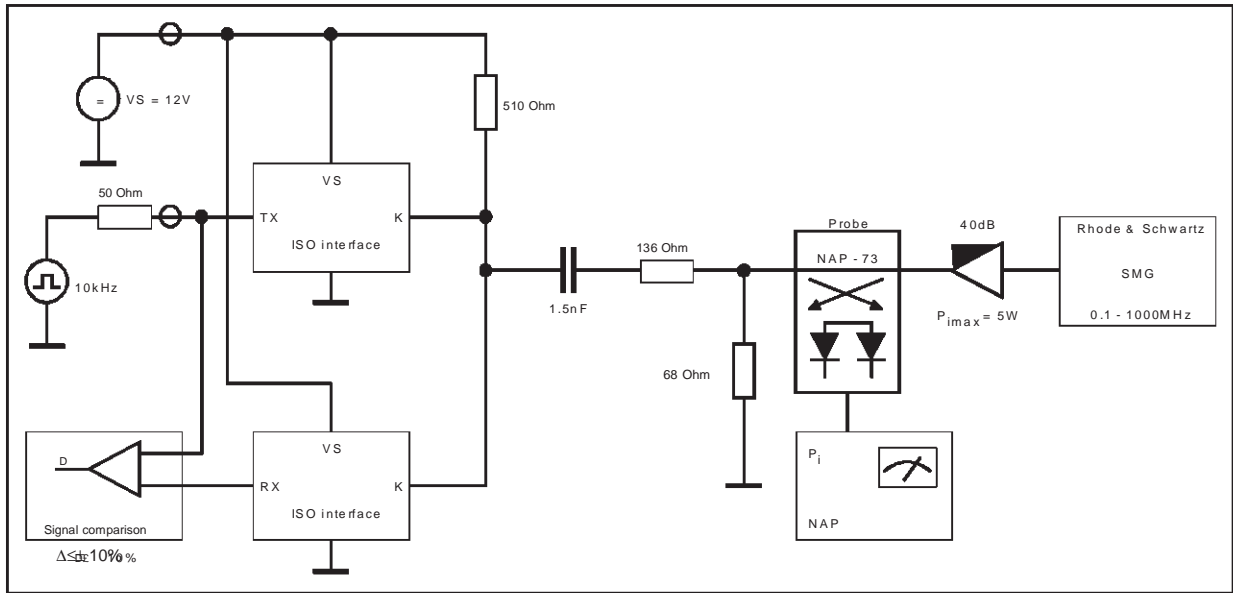
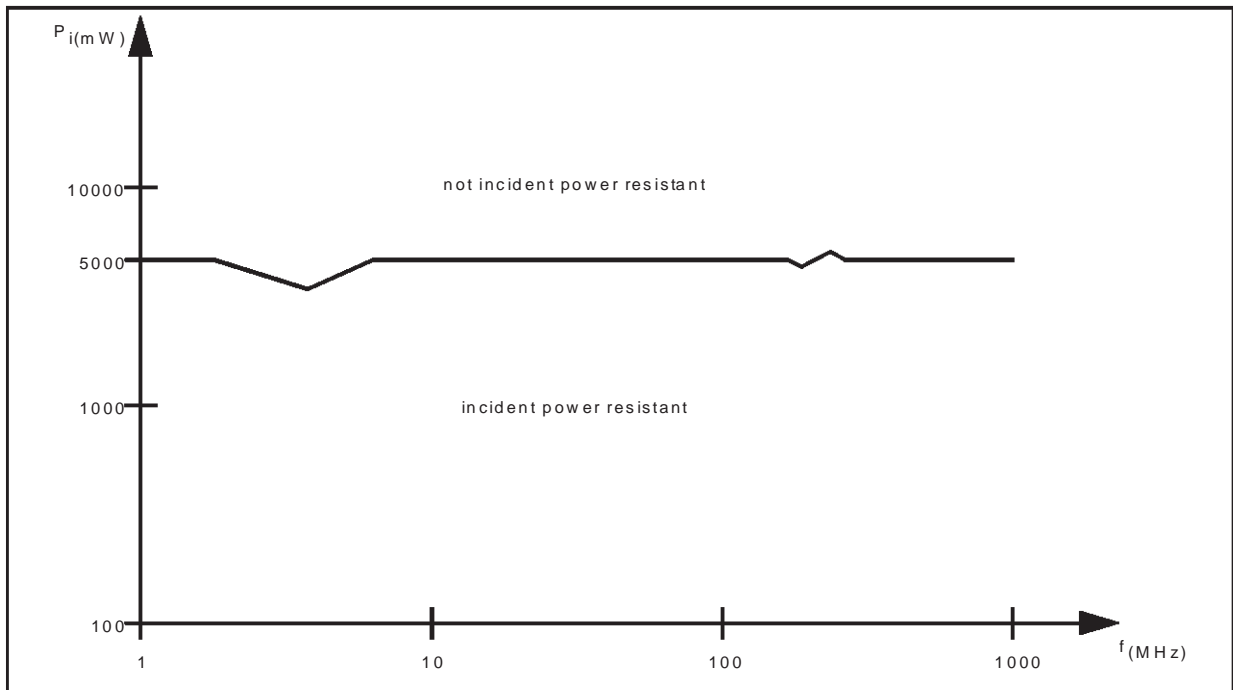


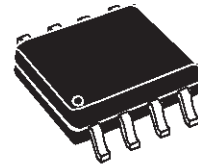
Figure 7.





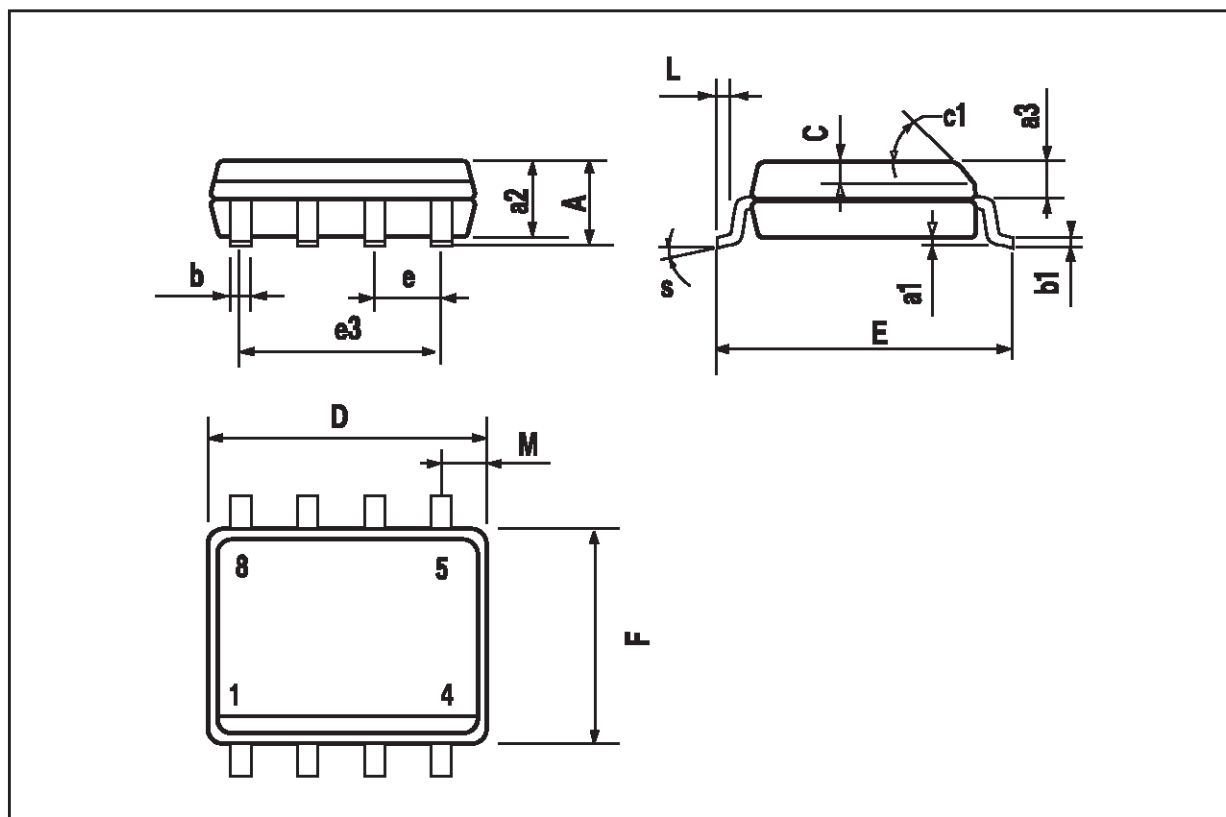
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.026		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.020
c1	45° (typ.)					
D (1)	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F (1)	3.8		4.0	0.15		0.157
L	0.4		1.27	0.016		0.050
M			0.6			0.024
S	8° (max.)					

## OUTLINE AND MECHANICAL DATA



**SO8**

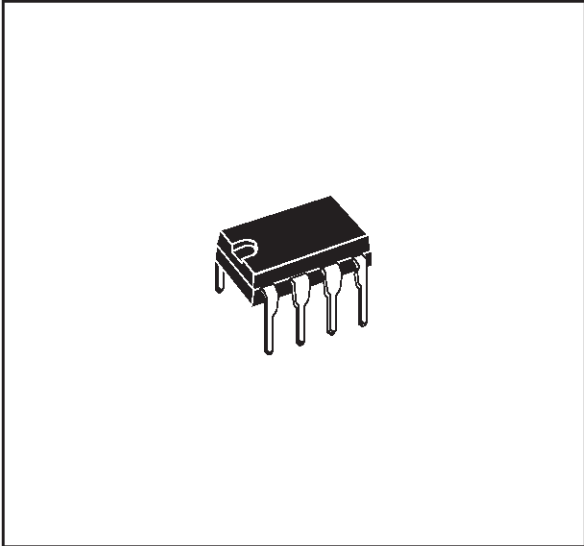
(1) D and F do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm (.006inch).



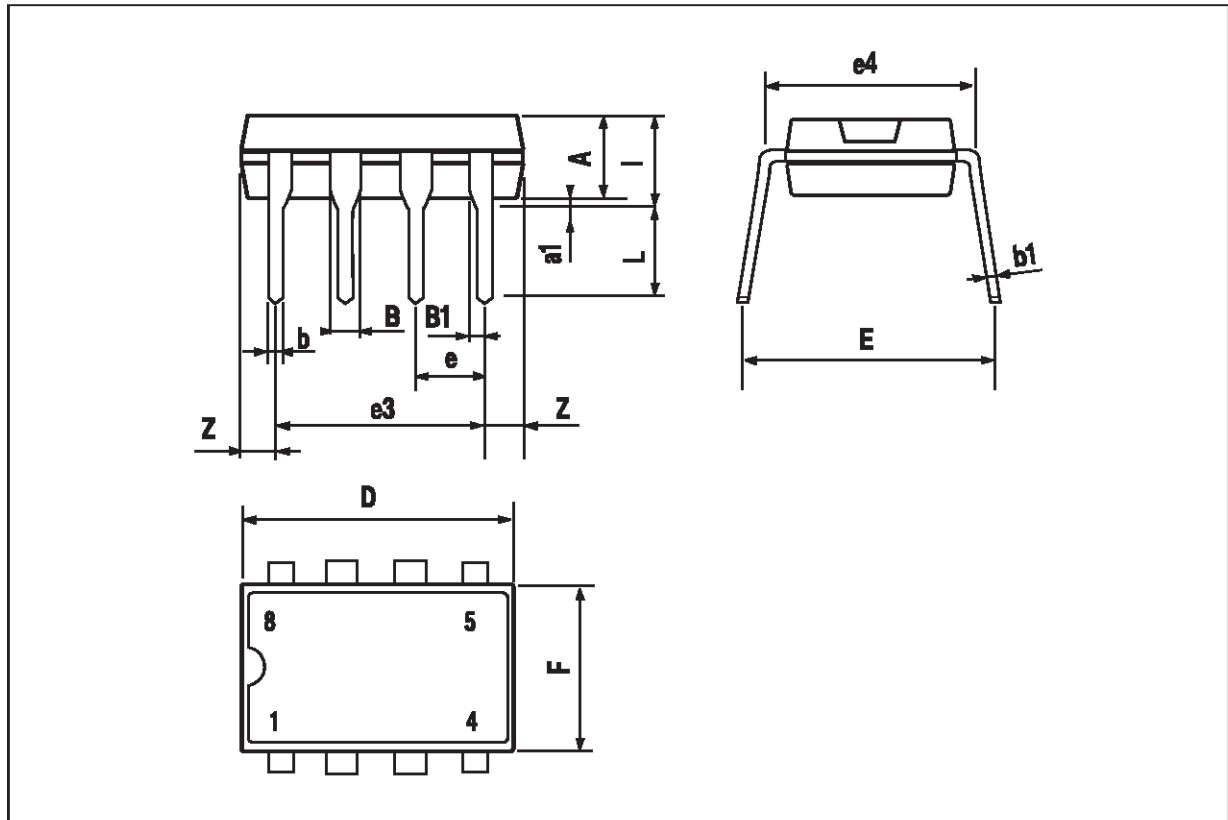
# L9637

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0.260
I			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

## OUTLINE AND MECHANICAL DATA



**Minidip**



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