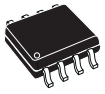
L9637D

ISO 9141 INTERFACE

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



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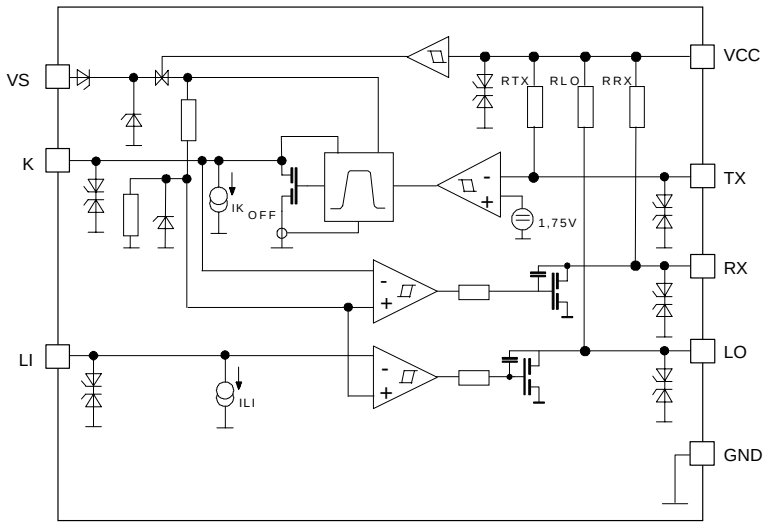
ORDERING NUMBER: L9637D

- 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 L9637D is a monolithic integrated circuit containing standard ISO 9141 compatible interface functions.

BLOCK DIAGRAM

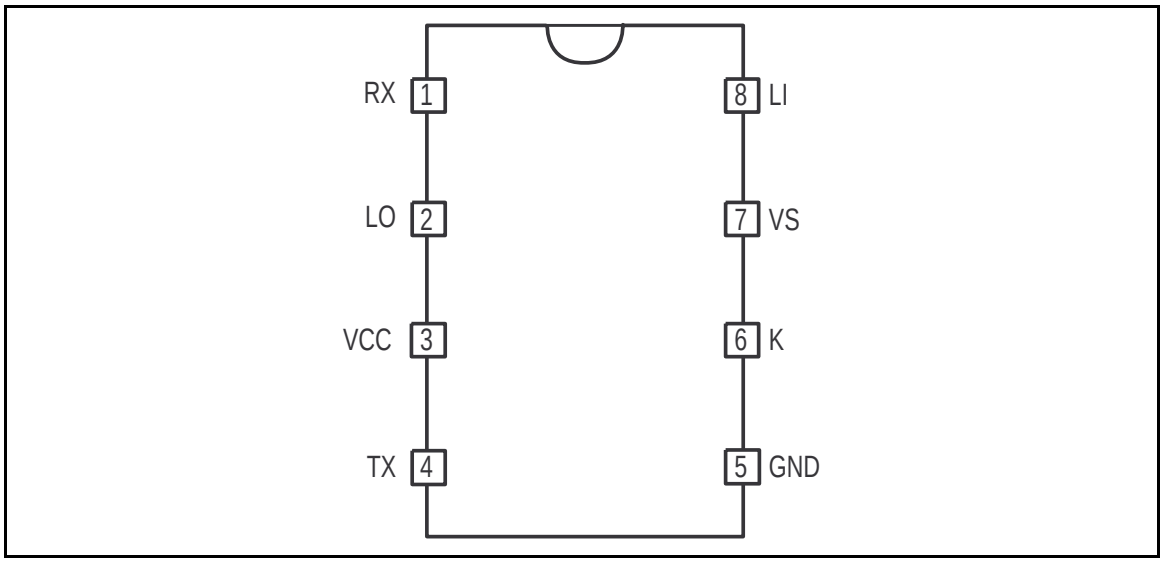


ABSOLUTE MAXIMUM RATINGS (No damage or latch)

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

PIN CONNECTION (Top view)



THERMAL DATA

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_{JSDon} T_{JSDoff}	Temperature K shutdown switch on threshold Temperature K shutdown switch off threshold	160 150		200 200	°C °C
$R_{th\ j\text{-}amb}$	Thermal steady state junction to ambient resistance	130	155	180	°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	$V_{CC} \leq 5.5V$; VLI,VTX = 0V		1.4	2.3	mA
		$VK \geq VK_{high}$; $VLI \geq VLI_{high}$ $VTX = V_{CC}$ @ $V_{CC} \leq 5.5V$	-5	<1	5	µA
IS_{ON}	Supply VS Current	$V_S \leq 16V$; VLI, VTX = 0V		1.2	3	mA
IS_{OFF}		$VK \geq VK_{high}$; $VLI \geq VLI_{high}$ $VTX \geq VTX_{high}$ @ $V_S \leq 12V$		120	220	µA
IS_{SB}		$V_{CC} \leq 0.5V$ @ $V_S \leq 12V$		<1		µA
VK_{low}	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
VK_{high}	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
VK_{hys}	Input Threshold Hysteresis	VK_{high} - VK_{low}		0.025 V_S	0.8	V
IK_{off}	Input Current	@ $VTX \geq VTX_{high}$ $VK \leq V_S$ V_S, $V_{CC} \geq 0$ or V_S, V_{CC} = open	-5	4	25	µA
RK_{ON}	Output ON Impedance	@ $V_S \geq 6.5V$ $VTX \leq VTX_{low}$ $I_K \geq 7mA$ 1)		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	$VK \leq VK_{low}$; $VLI \leq VLI_{low}$ $V_S \geq 6.5V$ $I_{RX, LO} \geq 1mA$ 1)		40	90	Ω
IRX_{SC} ILO_{SC}	Output Short Circuit Current		9	20	35	mA
VRX_H VLO_H	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
RLO RRX	Output pull-up resistance	Output status = (HIGH) $-0.15V \leq VLO \leq V_{CC} + 0.15V$ $-0.15V \leq VRX \leq V_{CC} + 0.15V$	5	10	20	KΩ
RTX	Input pull up resistance	$-0.15V \leq VTX \leq V_{CC} + 0.15V$	10	20	40	KΩ
VLI_{low}	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
VL_{high}	Input voltage HIGH state	LO output status HIGH $4.5V \leq V_S \leq 18V$	$0.55V_S$		VS	V
		LO output status HIGH $18V < V_S$	12		VS	V
VLI_{hys}	Input threshold hysteresis	VLI_{high} - VLI_{low}		$0.025V_S$	0.8	V
ILI	Input current	$VLI \leq V_S$ V_S, $V_{CC} \geq 0$ or V_S, V_{CC} = open	-5	4	25	µA

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} = 510Ω, C_K ≤ 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 tr, t_f see Fig.1. 9V < V_S < 16V (external loads) R_{KO} = 510Ω, C_K ≤ 1.3nF		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 Fig.1. 9V < V_S < 16V (external loads) R_{KO} = 510Ω, C_K ≤ 1.3nF (inactive mode see Fig. 3)		4	17	µs
$t_{ON,LI-LO}$ $t_{ON,K-RX}$ $t_{ON,TX-K}$	Switch ON time			4	17	µs

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.

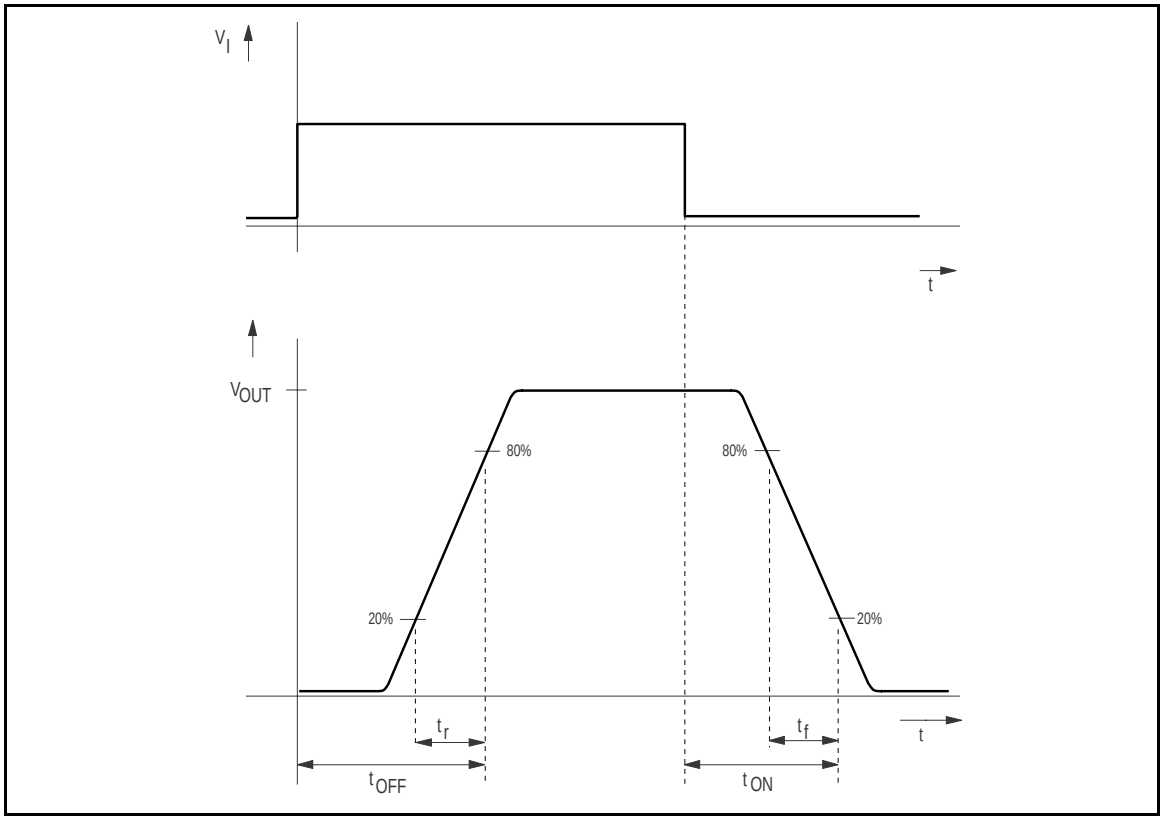
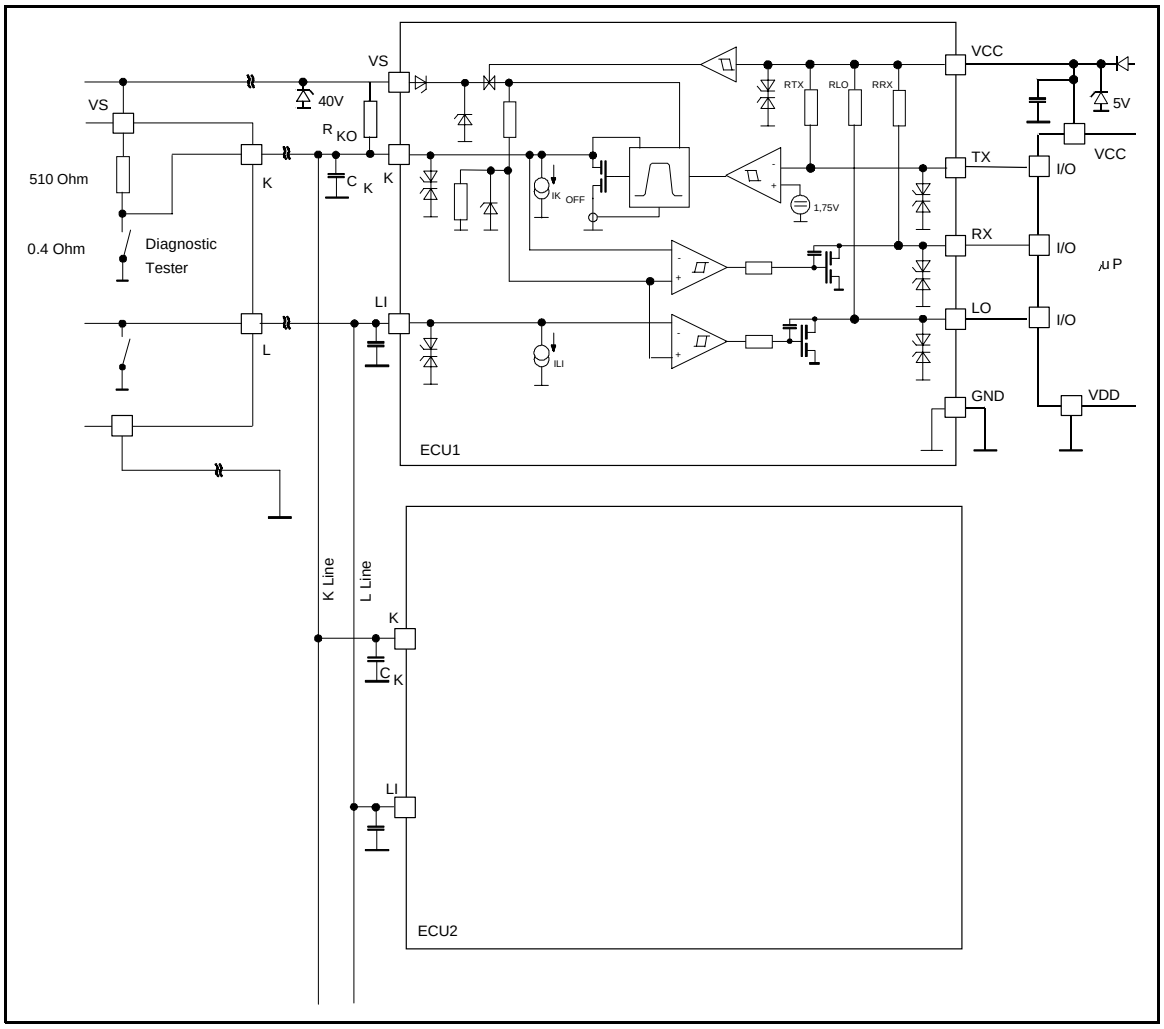


Figure 2: ISO Application Circuit



FUNCTIONAL DESCRIPTION

The L9637D 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 sufficent 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 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.

Supressing all 4 classes of "Schaffner" signals all pins can be load with short energy pulses of max. ±0.2mJ. 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 depowering $V_{CC} \leq 0.5V$ 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 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 $R_{ON} * I_{OUT}$ 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 3: Typical timing for mode transitions.

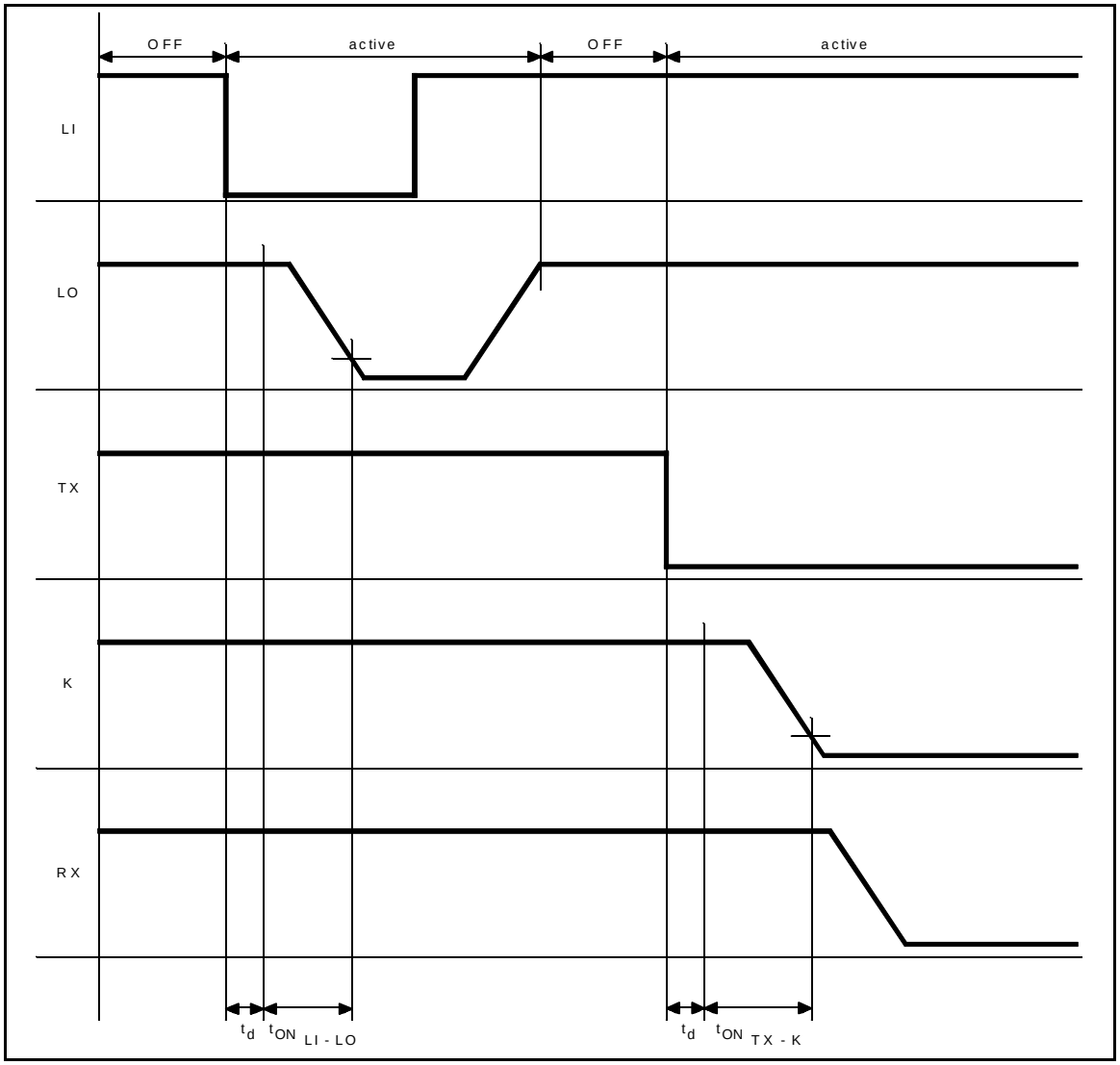


Figure 4: Output Characteristics at K, LO, RX.

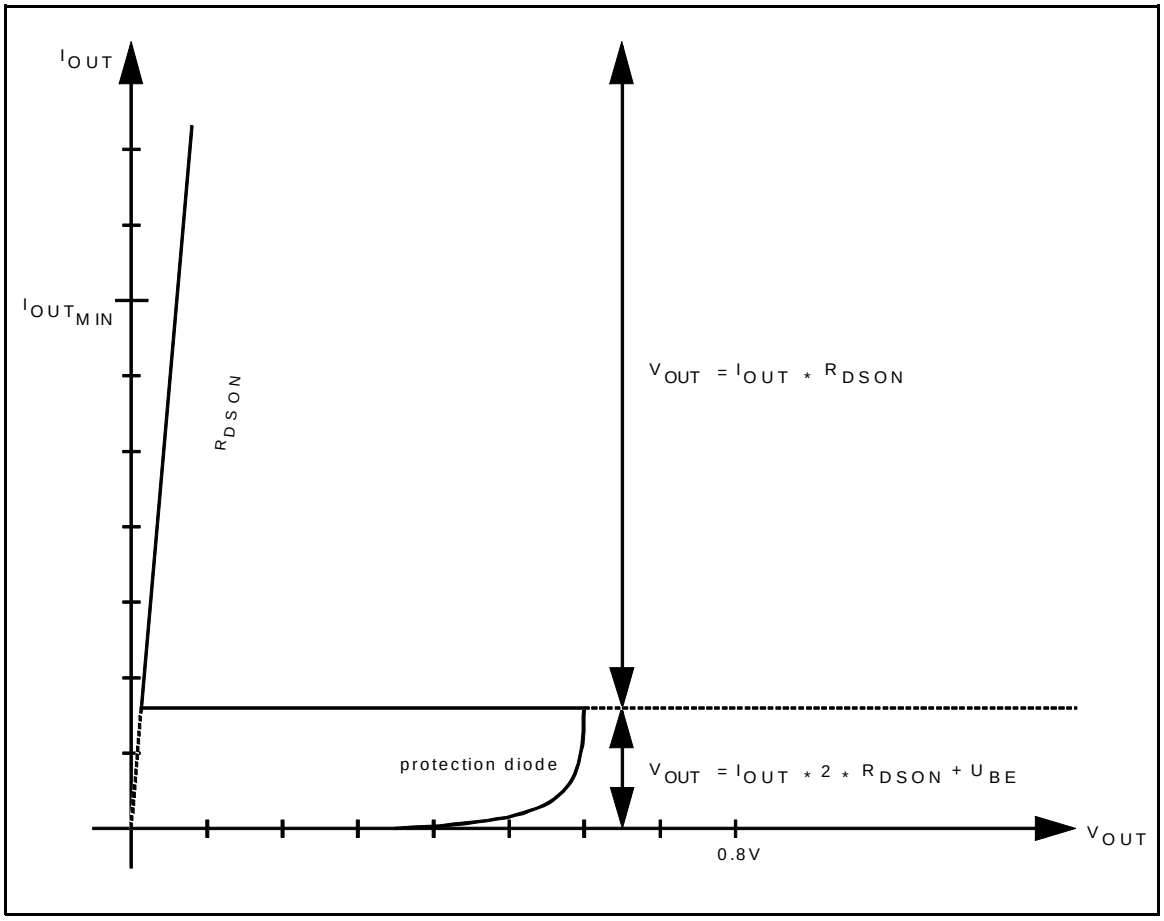


Figure 5: Output Signal Shape Related to Output Current.

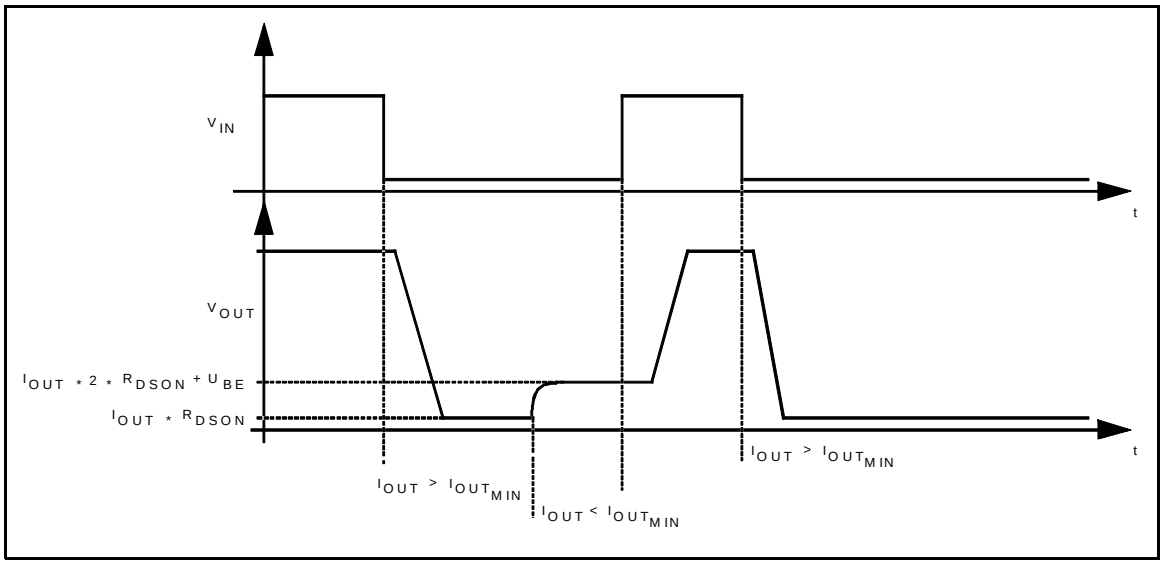


Figure 6: EMS Performance (ISO 9141 BUS system).

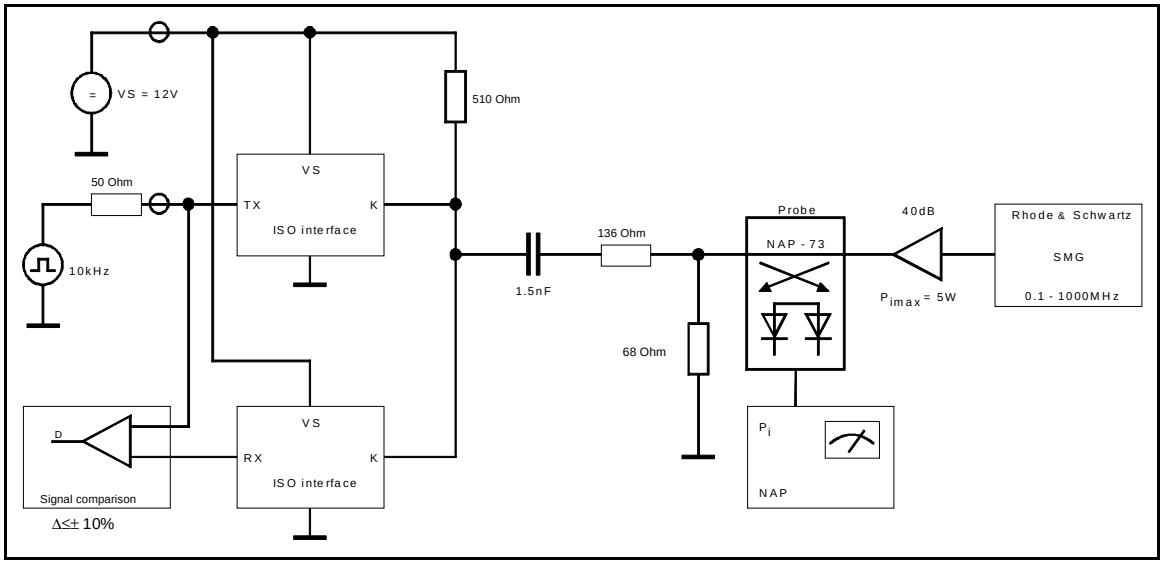
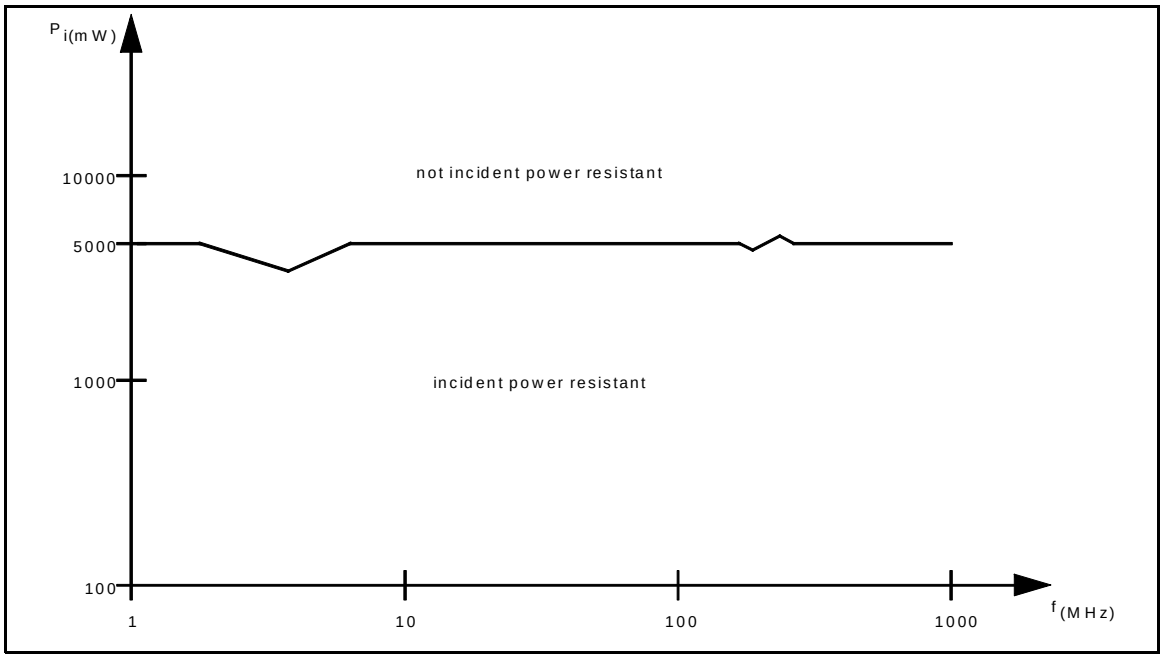


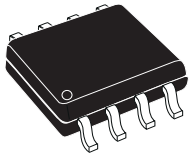
Figure 7.



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.)					

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

OUTLINE AND MECHANICAL DATA



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