IRS9100C Data Sheet

Real3 Laser diode driver

IRS9100C
Laser Driver

Features

- Driver for fast switching laser diodes or LEDs
- Laser (typ. VCSEL) current up to 6 A
- Fast rise and fall times < 0.8 ns
- Low switch on-resistance < 60 mΩ
- Build-in fail safe function for
  - LVDS input monitoring
  - Thermal shut-down
  - Low supply voltage
- Supply voltage : VDD = 2.5 - 3.7 V
- TSNP-10-4 package (1.1 x 1.5 x 0.37 mm (X/Y/Z))
- RoHS compliant

Attention: ***The driver IRS9100C does not provide any measures to support laser safety or general safety functions. For laser class definition and safety measures the user need to take care in the design and documentation of the end device.***

Potential applications

High current and fast switching Illumination driver for VCSELs or LEDs within:

- indirect Time-of-Flight cameras
- LDS systems

within the following main applications

- Mobile devices (e.g. smart phones, AR/VR headsets)
- Robotics
- Smart home cameras and security cameras

Ordering Information

Base part number	Package type	Standard pack form	Quantity
IRS9100C	TSNP-10-4	Tape and Reel	6000

Product validation

Qualified for applications listed above based on the test conditions in the relevant tests of JEDEC20/22.

Description

The IRS9100C is a low cost small footprint laser diode driver IC for indirect Time-of-Flight (ToF) image sensors enabling fast switching and high efficient conversion from electrical to optical power. The laser driver is designed to be perfectly aligned with the REAL3™ iToF image sensor family but can be also used for LDS (laser distance sensor) systems using dToF sensors.

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1 Block diagram reference

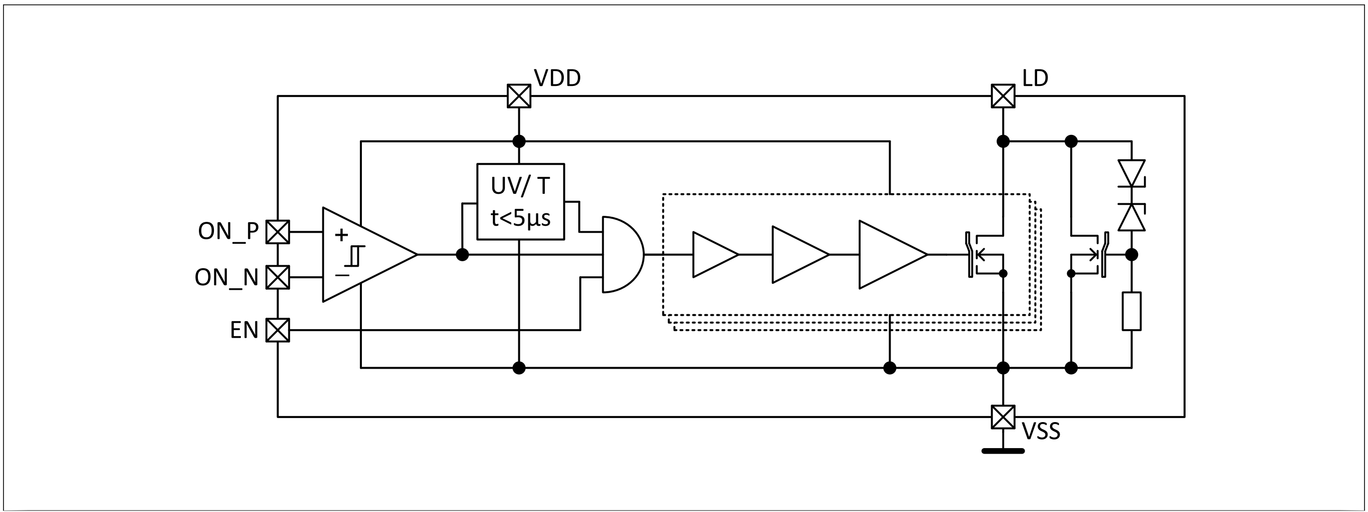

Figure 1 **IRS9100C Block diagram**

In the block diagram above the main functional units of the IRS9100C are summarized. The main functional units are:

- LVDS interface
- Voltage , LVDS timing and temperature monitor
- Low side NMOS with gate driver
- High voltage protection clamp for LD input

Application Circuit

The IRS9100C enables a very low Bill of Material (BoM) and small footprint solution for laser and LED illumination systems.

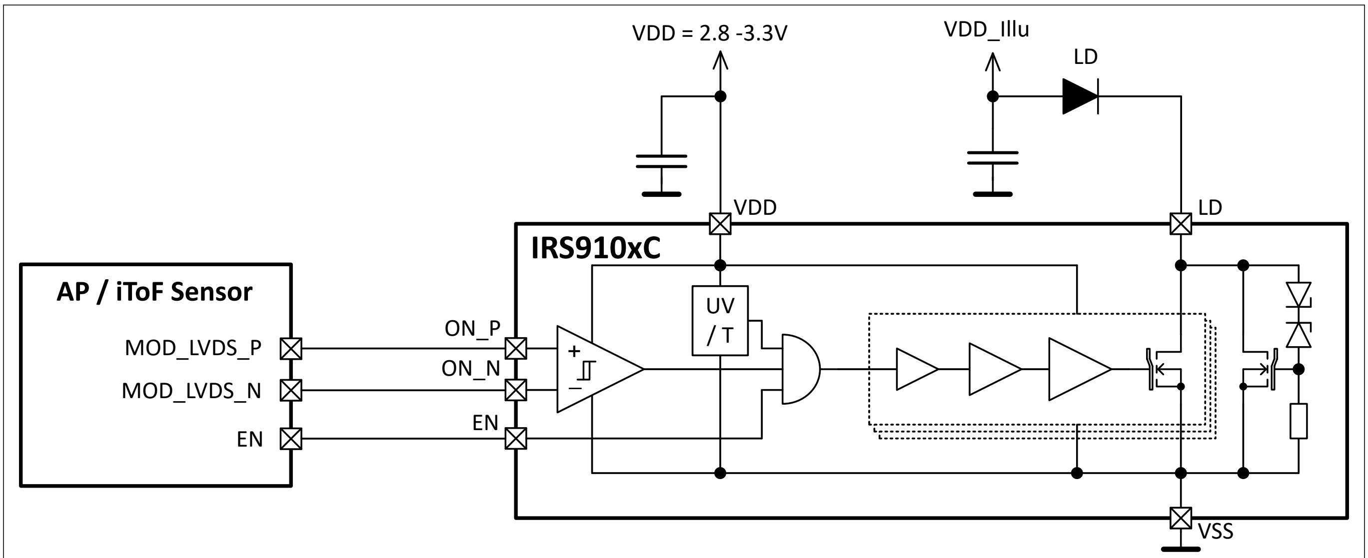

Figure 2 **IRS9100C Application Circuitry**

2 Pin configuration

The figure below shows the pin-out of the IRS9100C on top view.

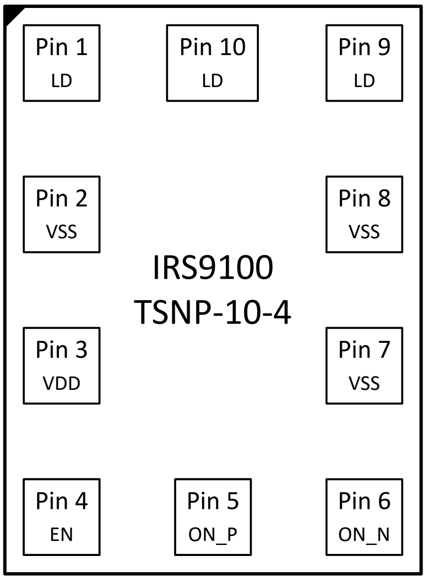

Figure 3 Pin-out

Pin No.	Symbol	I/O	Pin type	Equivalent circuit	Description
1	LD	-	Analog input		Connected to laser diode cathode
2	VSS	-	Ground		Analog power ground
3	VDD	-	Power		Analog power supply
4	EN	I	Digital input		Driver enable L: LD disabled H: LD enabled
5	ON_P	I	LVDS positive		Modulation signal input
6	ON_N	I	LVDS negative		Modulation signal input
7	VSS	-	Ground		Analog power ground
8	VSS	-	Ground		Analog power ground
9	LD	-	Analog input		Connected to laser diode cathode
10	LD	-	Analog input		Connected to laser diode cathode

3 Functional description

The IRS9100C laser driver together with the passive components and the laser diode provides the functionality to transfer an input data signal which is typically provided as LVDS (Low Voltage Differential Signal)into a well shaped and timing stable optical signal.

Within indirect ToF sensor system one of the major challenge is to generate an optical signal which is fulfilling the following constraints:

- High power conversion efficiency
- Laser diode forward currents up to 6 A
- Predictable temperature behavior
- Fast and stable rise and fall times < 0.8 ns
- Stable delay over life time
- Low EMC emissions

The above challenges are addressed within the IRS9100C where ever possible (efficiency of VCSEL can not be influenced).

Operation Modes

The laser driver does have three major operation modes:

Operation Mode	EN pin	LVDS Signal
Power Down	Low	Don't care
Idle	High	static low LVDS signal
Active	High	LVDS signal > 100 kHz

Safety Functions

The IRS9100C has the following safety mechanism to protect the laser and the driver itself and turn off the current through the laser:

- Static high input signal on LVDS interface. Input high signals > 5 µs will be suppressed to make sure the laser is not turned on due to any malfunction of the image sensor or application.
- Low voltage detection on VDD < 2.2 V (typ)
- Temperature protection of the driver > 155 °C (typ)

4 Electrical characteristics and parameters

This chapter will give the main performance parameters , the absolute maximum ratings, all necessary interface parameters and the allowed operating conditions of the IRS9100C

4.1 Absolute Maximum Ratings

Table 1 Absolute Maximum Ratings

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Supply	VDD	-0.3		4	V	
Load (Laserdiode)	LD	-0.3		5.5	V	Static
Load (Laserdiode) - dynamic	LD	-0.3		14	V	max. clamping voltage of short transients
Enable	EN	-0.3		VDD+0.3	V	
Switch ON pos.	ON_P	-0.3		VDD+0.3	V	
Switch ON neg.	ON_N	-0.3		VDD+0.3	V	
Ground / Substrate Potential	VSS		0		V	
ESD Resistivity HBM (all Pins)	V_{HBM}	-2		+2	kV	
ESD Resistivity CDM (all Pins)	V_{CDM}	-500		+500	V	
RoHS compliant	RoHS	Yes				

4.2 Operation Conditions

Table 2 Operation Conditions

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Supply Range active	VDD_{active}	2.52	3.3	3.7	V	static during active mode
Supply Range idle/transient	VDD_{trans}	2.52	3.3	4.0	V	overshoot and idle mode
Ambient Temperature	T_A	-40		85	°C	
Junction Temperature	T_j	-40		105	°C	
Modulation Frequency	f_{MOD}	10	100	150	MHz	25% DC
Load Current - average	$I_{ld,av}$			0.75	A	
Supply Blocking Capacitance	C_{VDD}	100			nF	
Load Current	I_{ld}			6	A	

4.3 Current Consumption

Table 3 Electrical characteristics

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Current consumption idle	$I_{VDD,idle}$			4	mA	EN=1, no modulation
Current consumption active	$I_{VDD,active}$		2	2.7	mA/MHz	EN=1
Current consumption power down	$I_{VDD,pd\ 25°C}$			1	μA	EN=0, Temp=25°C, VDD=3.3V
Current consumption power down hot	$I_{VDD,pd\ 85°C}$			15	μA	EN=0, Temp=85°C, VDD=3.3V

4.4 Electrical characteristics

Table 4 Electrical characteristics

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
ON resistance (LD to VSS)	R_{ON}		40	60	mΩ	V_{DS} = 300 mV
OFF current (LD to VSS)	I_{OFF}			100	nA	V_{LD} =5 V, Temp=25 °C
OFF current (LD to VSS) hot	$I_{OFF,hot}$			500	nA	V_{LD} = 5 V, Temp = 85 °C
DC Clamping Voltage LD Pin	V_{clamp}	5.5	8	14	V	I_{LD} =10mA
Clamping Resistance (differential Ron)	R_{clamp}	3	6.5	9	Ω	I_{clmp} = 10->20 mA
Thermal Shut-Down	T_{SD}	140	155	170	°C	
Thermal Shut-Down Release	$T_{SD,rel}$	125	140	155		
Under-voltage Threshold	V_{UV}	2	2.2	2.4	V	

Table 5 Timings

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Rise and Fall time	t_{rise} , t_{fall}			0.8	ns	[Standard Load]
Propagation Delay	t_{prop}			5	ns	[Standard Load]
Propagation Delay Delta Variation: Rising vs. Falling	dt_{prop}			200	ps	[Standard Load]
Propagation Delay Variation with Supply	dt_{prop} /dV_{VDD}		350		ps/V	[Standard Load]
Propagation Delay: Temperature Coefficient	tc_{tprop}		3.5		ps/K	
Ramp Up Time	t_{ramp}			25	μs	EN=VDD, VDD=0->3.3 V within 1 us

(table continues...)

Table 5 (continued) Timings

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Start Up Time	t_{EN}			5	µs	
Shut Off Time	$t_{EN,off}$			2	µs	EN=1->0
ON time limitation (safety time-out)		2.5	3.75	5	µs	

Note: [Standard Load] = 0.55 Ω

Table 6 LVDS Input

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Input differential threshold	V_{idth}	-100		100	mV	
Input differential hysteresis	V_{hyst}	25			mV	
Differential input resistance	R_{in}	90	111	132	Ohm	R_{in} is integrated in the pad
LVDS common mode pull down resistance	$R_{LVDS,pd}$	640	800	960	kΩ	

Table 7 EN Input

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
EN threshold rising	V_{TH_rise}	0.9		1.2	V	
EN threshold falling	V_{TH_fall}	0.8		1.1	V	
EN Pull Down current	$I_{PD,EN}$	-30%	3	+30%	µA	V_{EN} =0.8 V
En Pull Down resistor	$R_{PD,EN}$		300		kΩ	

5 Package dimensions

The TSNP-10-4 Package is a chip scale package with the dimension given in the drawing below.

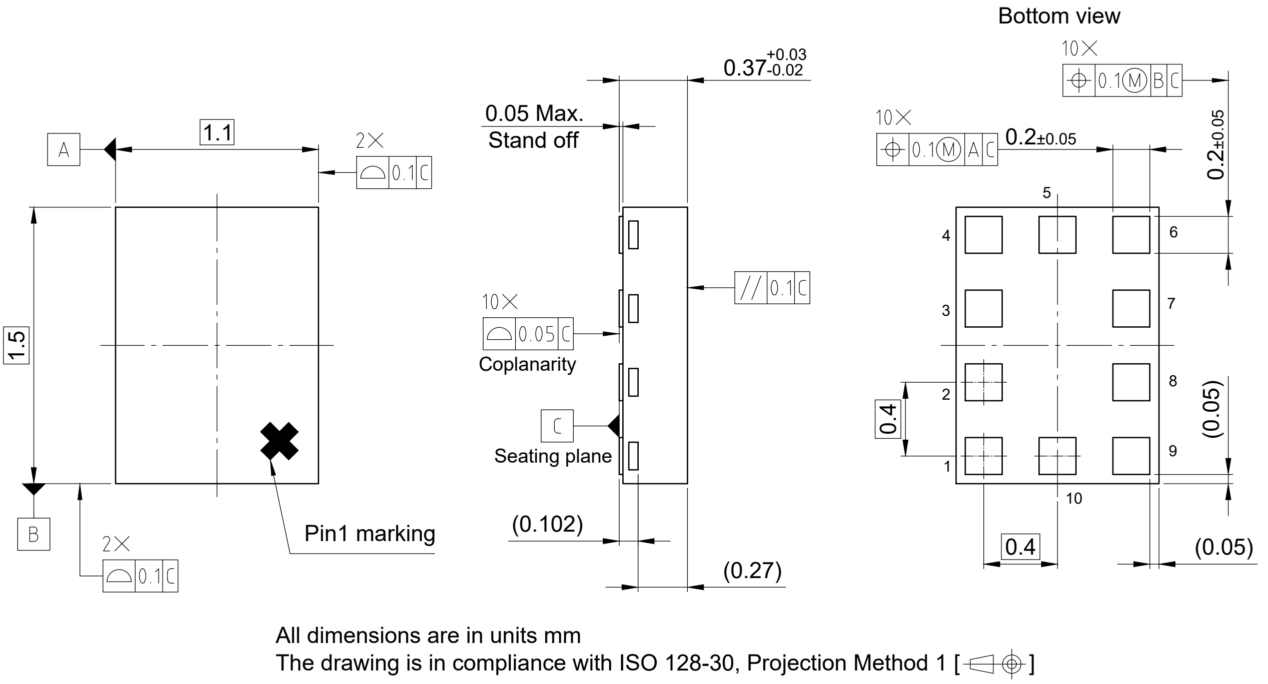

Figure 4 **Package dimensions**

Revision history

Document version	Date of release	Description of changes
0.1	2019-09-16	• initial version
1.0	2020-08-07	• Package changed, package drawing refined
1.1	2020-08-14	• Re-released after bugfix to also contain product validation section
1.2	2020-09-02	• Electrical Characteristics: Start-up time (tEN),Shut-Off time(tEN,off) and Rclamp
1.3	2023-05-10	• additional applications

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