



## Light-Curtain Device with 2-Wire Bus Interface

### General Description

The epc10x chip set is a general purpose CMOS integrated circuit for light-curtain applications. epc100 is used on the receiver side (Rx) whereas epc 101 is on the emitter side (Tx). Up to 1023 devices may be connected to two respectively four wires in parallel. Each device can be individually addressed by an epc100 chip which acts as the interface between a microcontroller and the 2-wire bus. It manages the bus traffic between the microcontroller and the individual Rx and Tx elements. Programmable fuses i.e. for the address, sensitivity, LED light pulse width, etc. allow the device to be parametrized in the final system (OTP memory).

Each chip can be put into 'standby mode' or 'operating mode' to reduce power consumption. During 'standby mode', power consumption is reduced and the photo diode is shorted.

Refer to the separate Data Sheet of the epc100 receiver chip and to the Reference Manual epc10x for implementation, usage and configuration information.

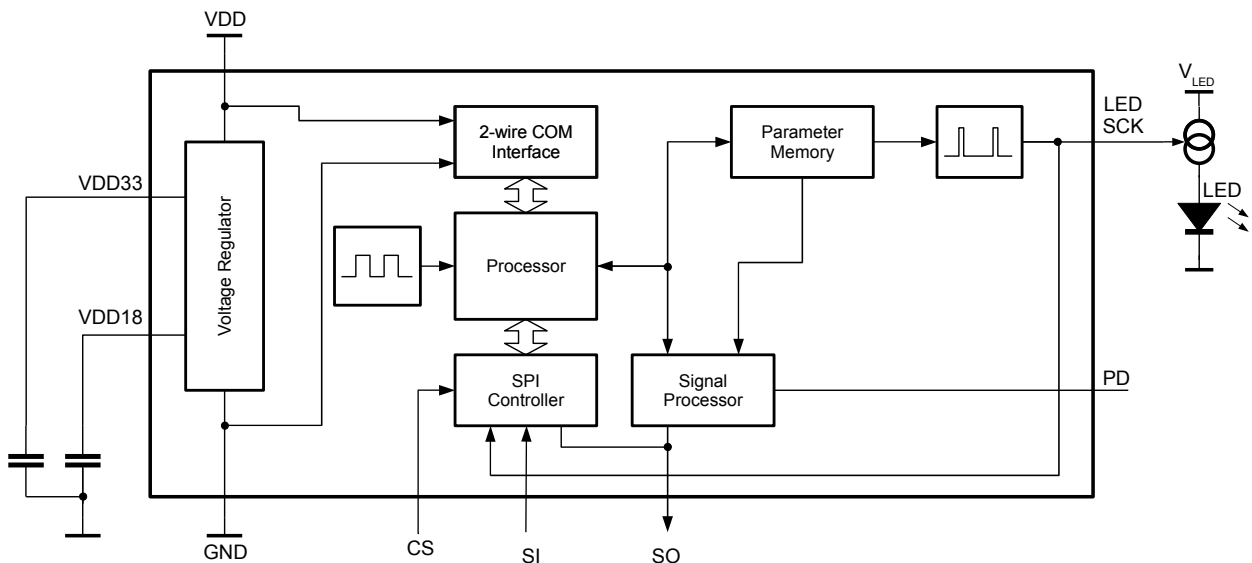
### Feature

- Light pulse transmitter
- Universal LED controller
- Scan period down to 30  $\mu$ s
- integrated clock generator
- CSP10 package with very small footprint and standard QFN16 package available

### Applications

- Light barriers ranging from millimeters to tens of meters
- Light curtains
- Smoke detectors
- Liquid detectors

### Functional Block Diagram



Absolute Maximum Ratings (Notes 1, 2)		Recommended Operating Conditions			
Voltage to any pin except $V_{DD}$	-0.3V to $V_{DD}+0.3$ V	<b>Min.</b>	<b>Max.</b>	<b>Units</b>	
Supply Voltage on 2-wire bus $V_{DD}$	-0.3V to +8.0V	Operating Voltage on 2-wire bus $V_{DD}$	4.5	5.5	V
Programming Voltage on 2-wire bus $V_{DD}$	-0.3V to +8.0V	Programming Voltage on $V_{DD}$	7.0	8.0	V
Input current at any pin except LED	-6mA to +6 mA				
Power consumption with maximum load	125mW				
Storage Temperature Range ( $T_s$ )	-55°C to +155°C	Operating Temperature ( $T_o$ )	-40°	+85	°C
Lead Temperature solder, 4 sec. ( $T_L$ )	+260°C	Relative Humidity (non-condensing)	+5	+95	%

**Note 1:** Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Recommended operating conditions indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see Electrical Characteristics.

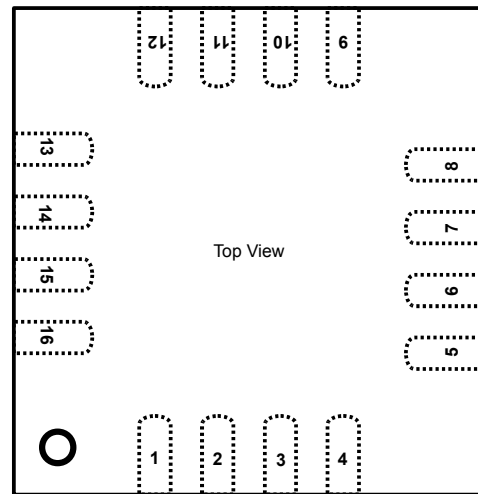
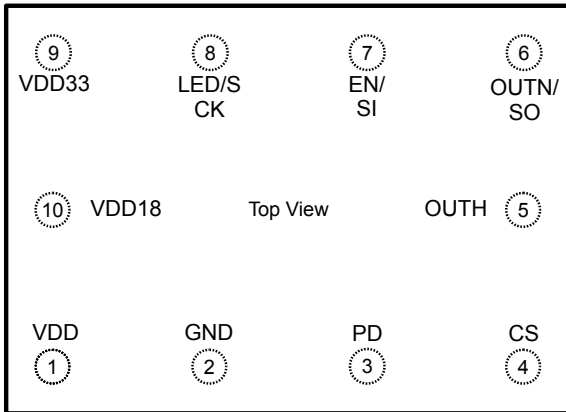
**Note 2:** This device is a highly sensitive CMOS ac current amplifier with an ESD rating of JEDEC HBM class 0 (<250V). Handling and assembly of this device should only be done at ESD protected workstations.

### Electrical Characteristics

$V_{DD} = 5.0$  V,  $-40^\circ\text{C} < T_A < +85^\circ\text{C}$ , if not otherwise specified

Symbol	Parameter	Conditions/Comments	Values			Units
			Min.	Typ.	Max.	
$V_{PP}$	Ripple on supply voltage, peak to peak	2-wire interface $V_{det}$				
		50mV			25	mV
		100mV			50	mV
		200mV			100	mV
$I_{DD\_IDLE}$	Current consumption	in idle mode			1.4	mA
$I_{DD\_OP}$	Current consumption	in operation mode $I_{PD} = 0$ mA			2	mA
$V_{det}$	Detection level for 2-wire interface		80		120	mV
$I_{MOD}$	Modulation current for 2-wire interface		6.4		9.8	mA
$T_{pulse}$	LED pulse length	configurable	1		8	µs
$f_{clk}$	Reference clock	Internal oscillator		1		MHz
$df_{clk}$	Temperature drift of the oscillator			7		%
$V_{PUP}$	Power-up Threshold Voltage	The voltage at $V_{DD33}$ when the device starts up	2.4		3	V
$V_{IH}$	High level input voltage		$0.7 * V_{DD}$		$V_{DD}$	V
$V_{IL}$	Low level input voltage		GND		$0.3 * V_{DD}$	V
$I_{LEAKD}$	Input leakage current				10	µA
$V_{OH}$	Output high voltage	@ 4mA sink except pin SCK/LED	$V_{DD}-0.5$			V
$V_{OL}$	Output low voltage	@ 4mA source			0.5	V
$I_{SCK/LED}$	Source current	@ PIN SCK / LED	0.7		1.3	V
$V_{Hst}$	Schmitt Trigger Hysteresis		0.1			V
$R_{PU}$	Pull-Up Resistor		30		200	kΩ

### Connection Diagrams



10-Pin Chip Scale Package (CSP)

16 Pin QFN Package

10-Pin CSP	16-Pin QFN	PIN Name	Type	Description
1	9	V <sub>DD</sub>	Power supply	Positive power supply for regulator and positive terminal of the 2-wire interface.
2	7	GND	Power supply	Negative power supply pin.
3	6	PD	Analog Input	Photo diode input.
4	4	CS	Digital Input	SPI Interface: Chip Select. Active low, with pull up
5	2	AOUT OUTH	Analog Out Digital Out	Amplified and filtered signal of the photo diode (push-pull) or light reserve output (open drain) with 50 % threshold voltage above the threshold of the OUT output.
6	1	SO	Digital Output	SPI Interface: Serial out
7	15	SI	Digital Output	SPI Interface: Serial input
8	14	SCK	Digital In / Out	SPI Interface: Shift Clock
9	12	V <sub>DD33</sub>	Power supply Decoupling	Positive power supply for analog and digital circuitry. If the the device is supplied by V <sub>DD33</sub> , a power supply filter capacitor is connected to this pin. This is not a supply pin for external components → for test purpose only!
10	10	V <sub>DD18</sub>	Analog Out	1.8 V regulator output → This is not a supply pin for external components. For test purpose only!
n/a	3	NC		Not connected. Connect this pin with VSS.
n/a	5	NC		Not connected. Connect this pin with VSS.
n/a	8	NC		Not connected. Connect this pin with VSS.
n/a	11	NC		Not connected. Connect this pin with VSS.
n/a	13	NC		Not connected. Connect this pin with VSS.
n/a	16	NC		Not connected. Connect this pin with VSS.

## Overview Functional Description

### Light Curtain – Transmitter

Figure 1 shows a typical schematic circuit of a light curtain emitter edge. A microcontroller manages the transmitters in the edge via an interface chip (epc100) to the 2-wire power and communication bus. Since the LEDs draw a very high peak current when enabled, huge noise on the 2-wire bus would interfere with the communication protocol on the bus. Thus, the LEDs are connected to a separate 2-wire power bus.

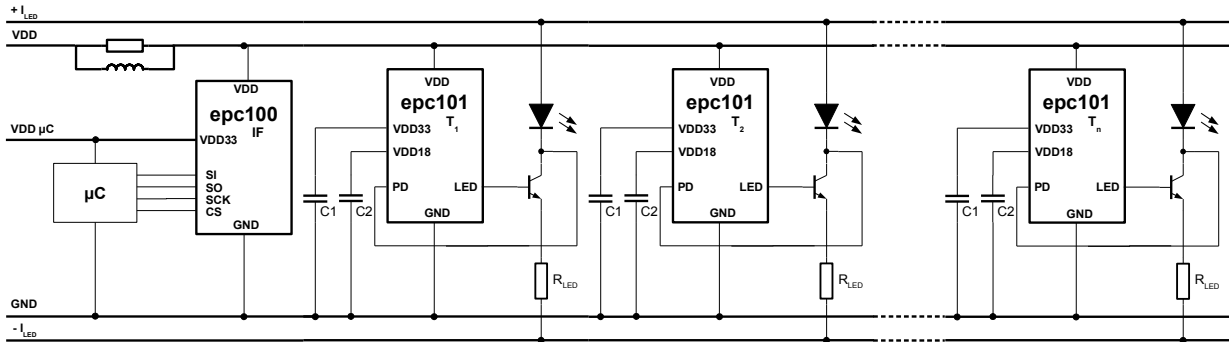


Figure 1: Light curtain transmitter with up to 300mA pulse current through the LED

The feedback LED voltage to the PD input is to allocate the physical location of the transmitter node to the unique chip ID during production. In this mode the LED is used as a receiver. For configuration please refer to the Reference Manual epc10x.

In Figure 1, the LED current is defined by a common current source. The resistor  $R_{LED}$ , which is typically 2.2 Ohms, is not needed in non-safety applications. If this resistor is inserted, a failure mode will be detected if more than one LED is active due to a short circuit or a failure in the epc101. It is also possible to have a common voltage supply and to control the LED current by a series resistor.

In order to allow a stable operation of the transmitter nodes, two voltage supply decoupling capacitors are needed: C1 should be of 100nF and C2 4.7nF, both ceramic types.

For long range applications, a LED current of up to 1A is needed. Such a high pulse current can be achieved by using a darlington stage according to Figure 2. Resistor  $R_{LED}$  is typically 2.7 Ohms, resistor R approx. 1 kOhm. Possible transistors are for T1 BC846B and for T2 BC807-40.

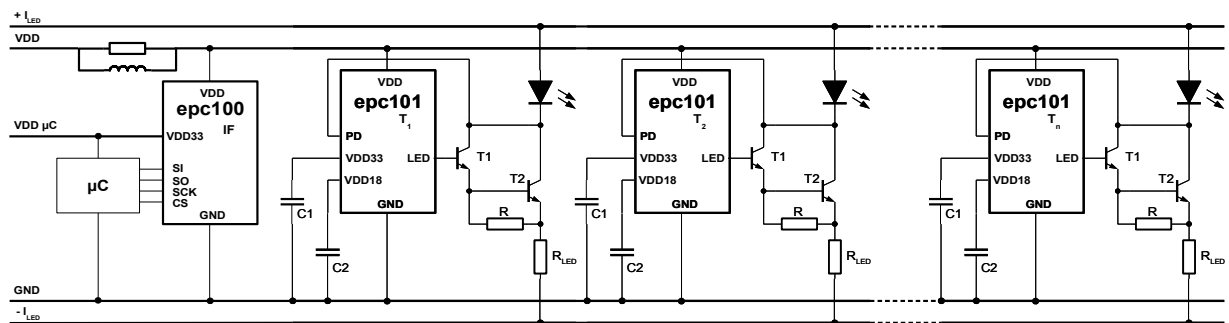
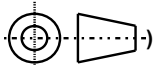
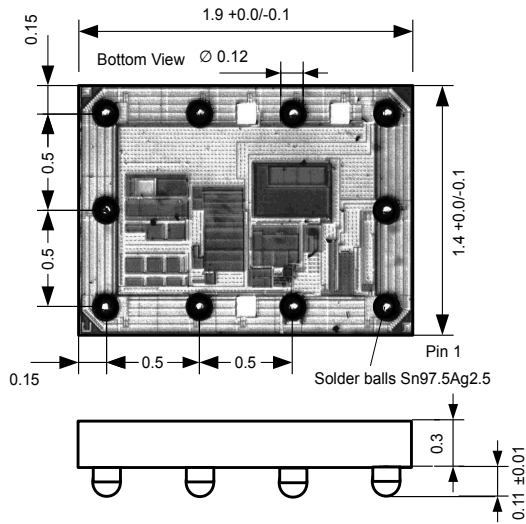


Figure 2: Light curtain transmitter with more than 300mA pulse current through the LED

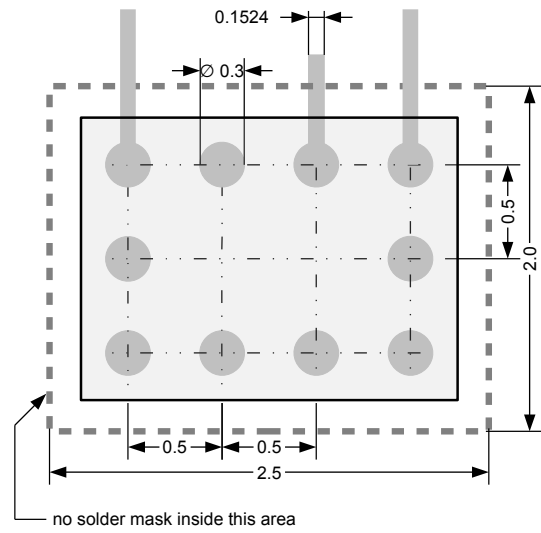
Layout Information (all measures in mm, )

**CSP-10 Package**

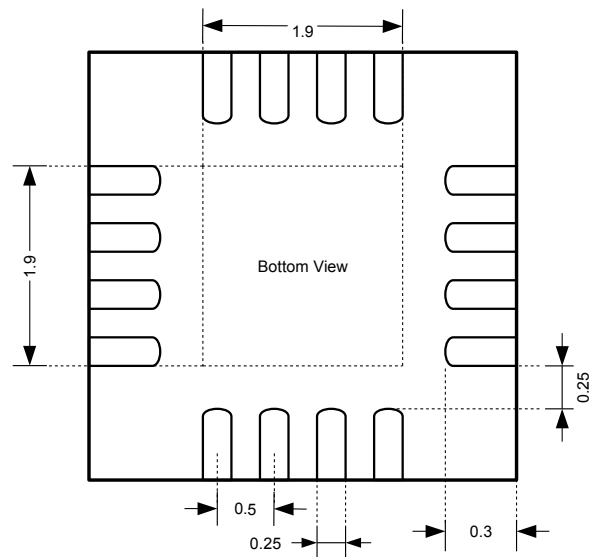
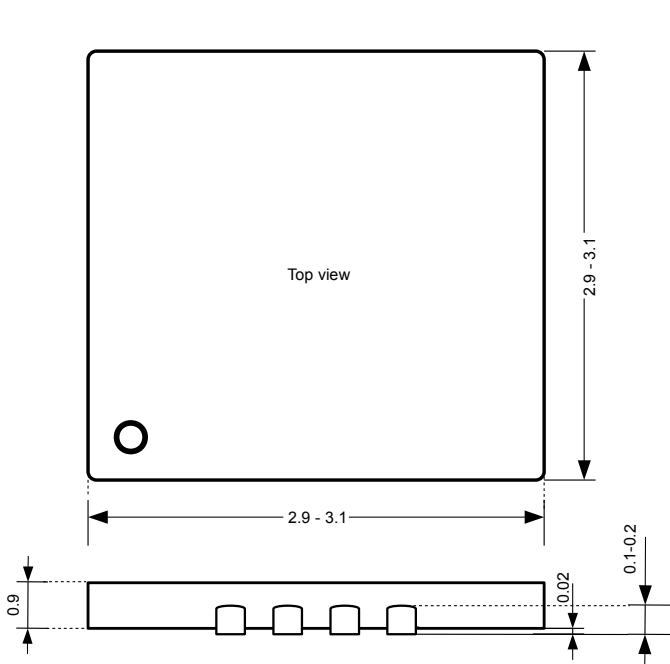
**Mechanical Dimensions**



**Layout Recommendations**



**QFN-16 Package**



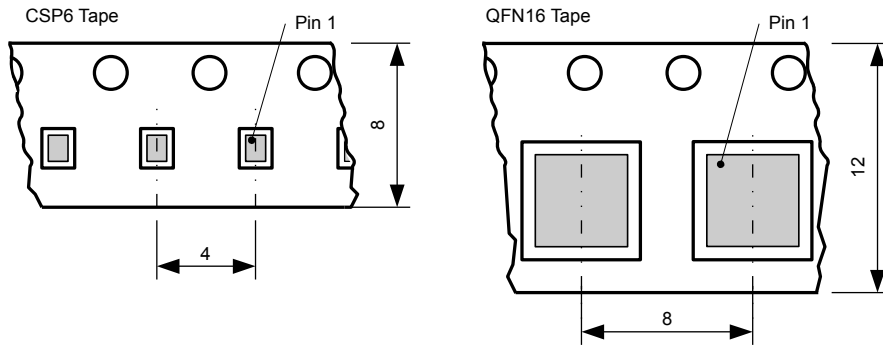
### Reflow Solder Profile

For infrared or conventional soldering the solder profile has to follow the recommendations of IPC/JEDEC J-STD-020C (min. revision C) for Pb-free assembly for both types of packages. The peak soldering temperature ( $T_L$ ) should not exceed +260°C for a maximum of 4 sec.

### Packaging Information (all measures in mm)

#### Tape & Reel Information

The devices are mounted on embossed tape for automatic placement systems. The tape is wound on 178 mm (7 inch) or 330 mm (13 inch) reels and individually packaged for shipment. General tape-and-reel specification data are available in a separate data sheet and indicate the tape sizes for various package types. Further tape-and-reel specifications can be found in the Electronic Industries Association (EIA) standard 481-1, 481-2, 481-3.



epc does not guarantee that there are no empty cavities.  
Thus, the pick-and-place machine should do check the presence of a chip during picking.

### Order Information

Part Number	Package	RoHS compliance	Packaging Method
epc100-CSP10	CSP10	Yes	Reel
epc100-QFN16	QFN16	Yes	Reel
epc101-CSP10	CSP10	Yes	Reel
epc101-QFN16	QFN16	Yes	Reel

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