

# iC-LQNP

## PULSE AND AC LIGHT SENSOR



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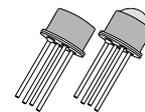
### FEATURES

- ◆ Fast response amplifier with on-chip photodiode
- ◆ High interference immunity due to monolithic design
- ◆ Active photodiode area of ca. 1 mm<sup>2</sup>
- ◆ Suitable for visible light and near infra-red
- ◆ Integrated band-pass filter with 140 kHz center frequency
- ◆ Maximum gain obtained for pulse light of 1.4 μs and upwards
- ◆ High LF and DC (ambient) light suppression
- ◆ Transfer characteristics irrespective of ambient light level
- ◆ Soft signal and noise limiter with excess ambient light
- ◆ Fast recovery from flashes
- ◆ Complementary analog current source outputs, transimpedance can be set by external resistor
- ◆ Single 5 to 12 V supply, low power consumption also with bright ambient light

### APPLICATIONS

- ◆ Receiver for through beam and reflection light barriers with background suppression (sunlight) e.g. for presence detection in power operated gates, doors and windows etc.

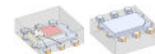
### PACKAGES



TO18-4F/L

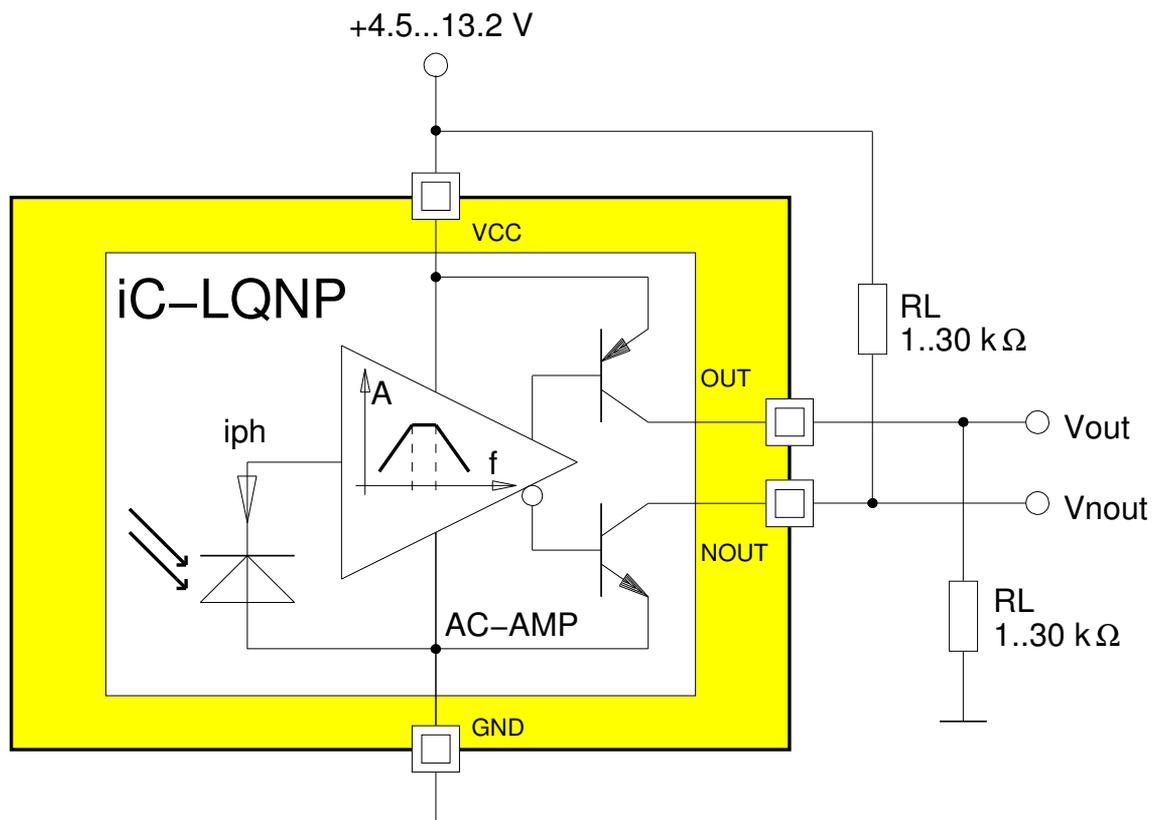


oBGA LQ1C



cDFN6-3x3

### BLOCK DIAGRAM



# iC-LQNP

## PULSE AND AC LIGHT SENSOR



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### DESCRIPTION

iC-LQNP is a sensor for pulse and alternating light with a monolithically integrated photodiode. The device supersedes conventional photoreceivers, such as those in light barriers, for example.

Changes in the photocurrent are amplified whereas the photocurrents caused by background light are electronically suppressed with over 60 dB (at 100 Hz).

The integrated amplifier forms a band-pass characteristic without using any external components. The high pass filter suppresses ambient light and low frequency alternating light and the low pass filter reduces high frequency noise.

For visible light or near infrared the highest sensitivity for alternating light signals is reached at approximately 140 kHz; for pulse light this is reached at 1.4  $\mu$ s and upwards.

The transimpedance can be selected within a range of approximately 1 to 10 M $\Omega$  via the external load resistor.

iC-LQNP is available as a 4-lead TO18 metal can package with a glass lens or flat window. Customised COB versions are also possible.

# iC-LQNP

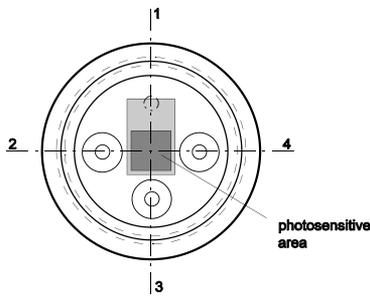
## PULSE AND AC LIGHT SENSOR



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### PACKAGING INFORMATION TO18-4F/L, cDFN6, oBGA LQ1C

#### PIN CONFIGURATION TO18-4F/L

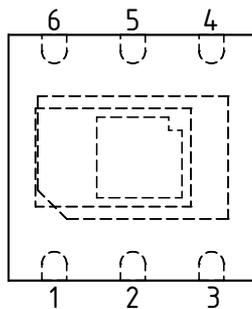


#### PIN FUNCTIONS

##### No. Name Function

- 1 GND Ground
- 2 OUT High-Side Current Output
- 3 VCC +4.5 to +13.2 V Supply Voltage
- 4 NOUT Low-Side Current Output

#### PIN CONFIGURATION cDFN6 3 mm x 3 mm

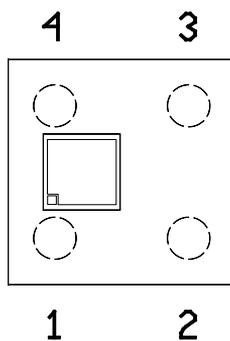


#### PIN FUNCTIONS

##### No. Name Function

- 1 GND Ground
- 2 OUT High-Side Current Output
- 3 n.c.
- 4 n.c.
- 5 NOUT Low-Side Current Output
- 6 VCC +4.5 to +13.2 V Supply Voltage

#### PIN CONFIGURATION oBGA LQ1C



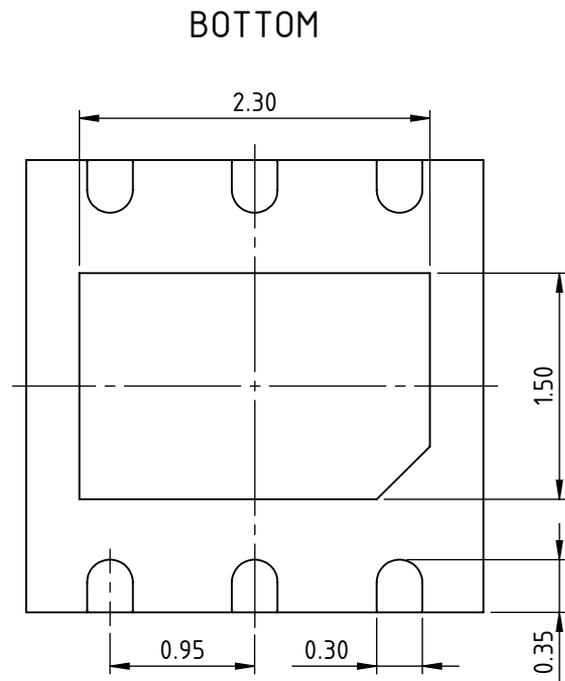
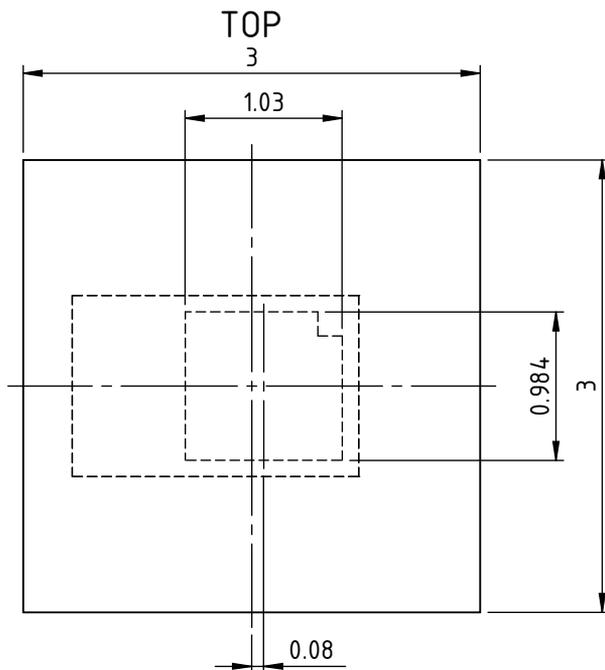
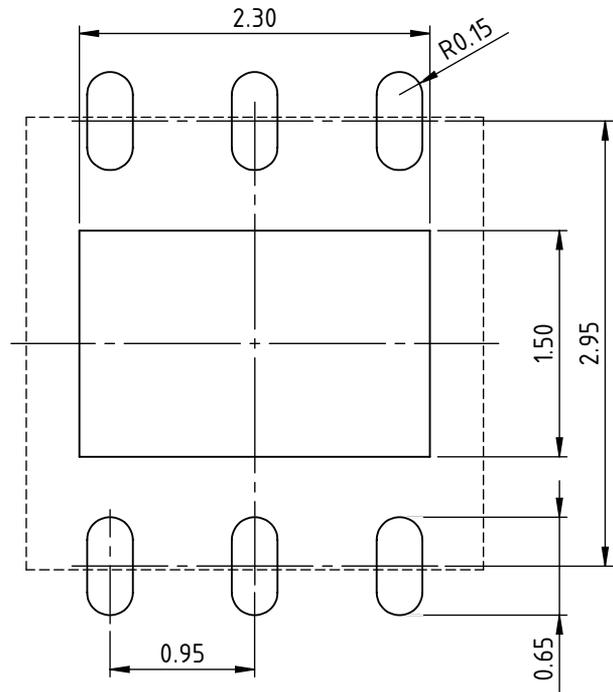
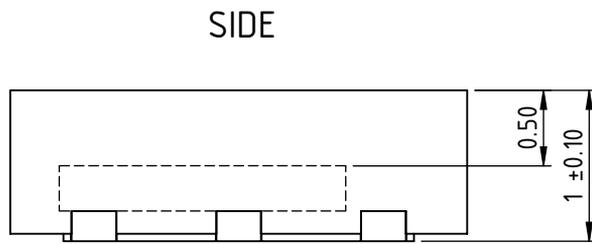
#### PIN FUNCTIONS

##### No. Name Function

- 1 GND Ground
- 2 VCC +4.5 to +13.2 V Supply Voltage
- 3 OUT High-Side Current Output
- 4 GND Ground

**PACKAGE DIMENSIONS cDFN6-3x3**

**RECOMMENDED PCB-FOOTPRINT**



All dimensions given in mm. Tolerances of form and position according to JEDEC MO-229.  
Positional tolerance of sensor pattern:  $\pm 0.10\text{mm}$  /  $\pm 1^\circ$  (with respect to backside pad).

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### ABSOLUTE MAXIMUM RATINGS

Beyond these values damage may occur; device operation is not guaranteed.

Item No.	Symbol	Parameter	Conditions	Min.   Max.		Unit
				Min.	Max.	
G001	VCC	Supply Voltage		0	15	V
G002	I()	Output Current		-4	4	mA
G003	Vd()	ESD susceptibility at all pins	HBM, 100 pF discharged through 1.5 kΩ		1.5	kV
G004	Tj	Junction Temperature		-40	150	°C
G005	Ts	Storage Temperature	see package specifications			

### THERMAL DATA

Operating Conditions: VCC = 4.5...13.2 V

Item No.	Symbol	Parameter	Conditions	Min.   Typ.   Max.			Unit
				Min.	Typ.	Max.	
T01	Ta	Operating Ambient Temperature Range	cDFN6 for other packages, see relevant package specifications	0		70	°C
T02	Tpk	Peak Temperature cDFN6	tpk < 10 s, convection reflow MSL6, TOL (max. floor life 8 h at 30 °C and 60% RH)  See <a href="#">Customer Information #7</a> for detailed information.			245	°C

All voltages are referenced to ground unless otherwise stated.

All currents flowing into the device pins are positive; all currents flowing out of the device pins are negative.

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### ELECTRICAL CHARACTERISTICS

Operating Conditions: VCC = 4.5...13.2 V, RL = 10 kΩ, CL = 20 pF, λ = 875 nm, Tj = -25...125 °C, if not otherwise stated.

Item No.	Symbol	Parameter	Conditions				Unit
				Min.	Typ.	Max.	
<b>Total Device</b>							
001	VCC	Permissible Supply Voltage		4.5		13.2	V
002	I(VCC)	Supply Current	E(PD) = 0 E(PD) <sub>ac</sub> = 0, E(PD) <sub>pk</sub> = 0, E(PD) <sub>cw</sub> = 30 mW/cm <sup>2</sup> , no load	0.4	0.8	1.4 2	mA mA
003	Vs(OUT)	Output Saturation Voltage at OUT	I() = -1 mA, Vs(OUT) = VCC - V(OUT)			0.5	V
004	Vs(NOUT)	Output Saturation Voltage at NOUT	I() = 1 mA			0.5	V
005	I()	Permissible Output Current in NOUT, OUT	I(NOUT) I(OUT)	0 -2		2 0	mA mA
006	I0()	Output Bias Current in OUT	E(PD) = 0 E(PD) = 0, VCC = 5 V, Tj = 27 °C	-235	-145	-105	μA μA
007	I0()	Output Bias Current in NOUT	E(PD) = 0 E(PD) = 0, VCC = 5 V, Tj = 27 °C	105	145	235	μA μA
008	Vc(j)hi	Output Clamp Voltage hi	Vc(j)hi = V(OUT) - VCC, VCC = 0V, I() = 4 mA	0.25	0.5	1.4	V
009	Vc(j)lo	Output Clamp Voltage lo	I() = -4 mA	-1.4	-0.5	-0.25	V
<b>Photodiode</b>							
101	Aph()	Radiant Sensitive Area		1			mm <sup>2</sup>
102	S(λ)max	Spectral Sensitivity			0.5		A/W
103	λ <sub>ar</sub>	Spectral Application Range	Se(λ <sub>ar</sub> ) = 0.1 × S(λ)max	500		1050	nm
<b>Photocurrent Amplifier</b>							
201	E()cw	Permissible DC Irradiance	λ <sub>LED</sub> für S(λ)max, iC-LQNP Chip			30	mW/ cm <sup>2</sup>
202	Ev()cw	Ambient Light Susceptibility	standard illuminant A, T = 2856 K; TO18-4F  TO18-4L		50  7		mW/ cm <sup>2</sup> mW/ cm <sup>2</sup>
203	Ev()cw	Ambient Light Susceptibility	standard illuminant A, T = 2856 K; TO18-4F TO18-4L		70 10		klx klx
204	E()pk	Permissible Peak Irradiance	I((N)OUT)  increases or remains constant as E()pk increases; chip, TO18-4F  TO18-4L			100  15	mW/ cm <sup>2</sup> mW/ cm <sup>2</sup>
205	Gpk	Pulse Light Amplification 875 nm	VCC = 5 V, E(PD)pk = 35 μW/cm <sup>2</sup> , tr = tf = 0.1 μs, twpk = 1.4 μs; chip, TO18-4F TO18-4L	100 700	220 1540	350 2500	A/W A/W
206	Gpk	Pulse Light Amplification 850 nm	see 205; chip, TO18-4F TO18-4L		250 1800		A/W A/W
207	Δt()	Output Current Delay	see 205,  I((N)OUT) : 0 → 50% peak value			1.5	μs
208	trec	Recovery Time	see 205, settled better 10% to initial quiescent point			15	μs
209	trec	Power Flash Recovery Time	E(PD)pk = 35 mW/cm <sup>2</sup> , twpk = 100 μs			60	μs
210	Gac	AC Light Amplification	f = fc, E(PD) <sub>ac</sub> = 35 μW/cm <sup>2</sup> ; Chip, TO18-4F TO18-4L		400 2800		A/W A/W
211	fc	Bandpass Center Frequency	RL = 1 kΩ, CL = 20 pF RL = 10 kΩ, CL = 20 pF		140 120		kHz kHz
212	fhc	Upper Cut-off Frequency (-3 dB)	RL = 1 kΩ, CL = 20 pF RL = 10 kΩ, CL = 20 pF		400 360		kHz kHz

# iC-LQNP

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### ELECTRICAL CHARACTERISTICS

Operating Conditions: VCC = 4.5...13.2 V, RL = 10 kΩ, CL = 20 pF, λ = 875 nm, Tj = -25...125 °C, if not otherwise stated.

Item No.	Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
213	f <sub>lc</sub>	Lower Cut-off Frequency (-3 dB)	RL = 1 kΩ, CL = 20 pF RL = 10 kΩ, CL = 20 pF		40 35		kHz kHz
214	Q	Filter Q-Factor	Q = fc / (f <sub>hc</sub> - f <sub>lc</sub> ); RL = 1 kΩ, CL = 20 pF RL = 10 kΩ, CL = 20 pF		0.65 0.65		
215	G100	LF Suppression	f = 100 Hz		60		dB
216	V <sub>n</sub> ( )	Output Noise Voltage (RMS)	VCC = 5 V, E(PD) = 0 VCC = 5 V, E <sub>v</sub> (PD) <sub>dc</sub> ca. 15.000 lx, standard illuminant A, T = 2856 K, chip		7 20		mV mV
217	ton(VCC)	Power-On Setup Time	Tj = -25...70 °C			450	μs

### CHARACTERISTICS: Diagrams

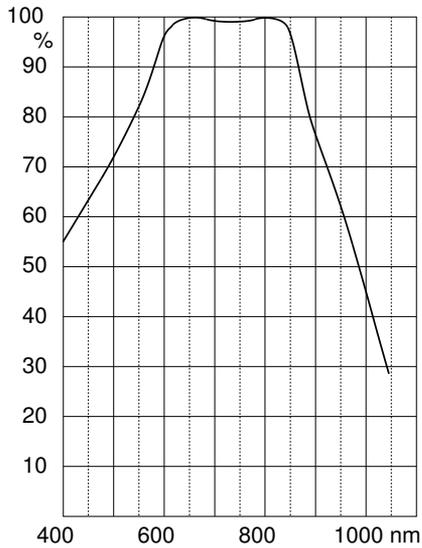


Figure 1: Typical relative spectral sensitivity

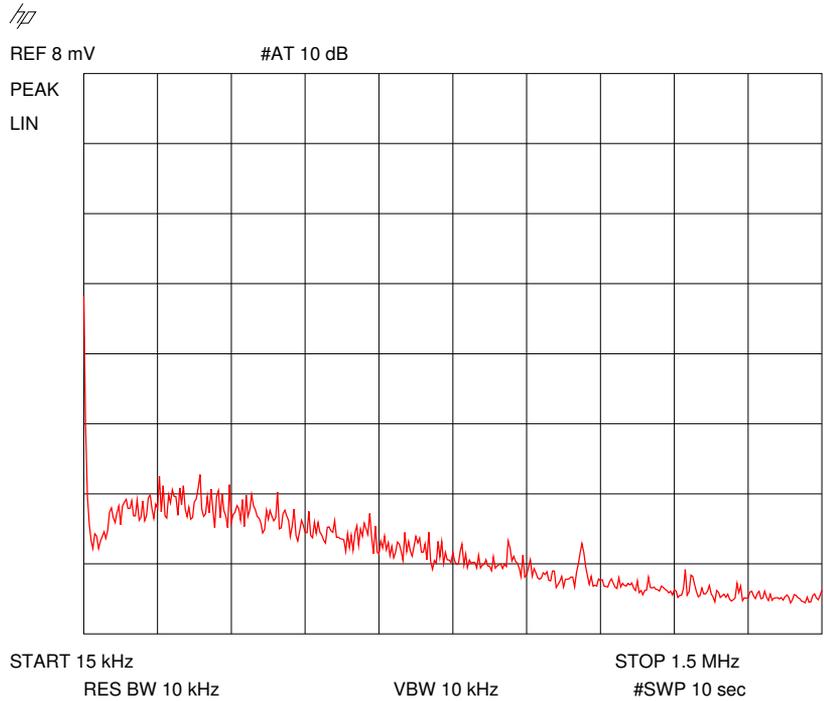


Figure 2: Output voltage noise [mV/ $\sqrt{10\text{ kHz}}$ ] to 10 k $\Omega$ /20 pF load with  $E_v(\text{dc}) < 500\text{ lx}$

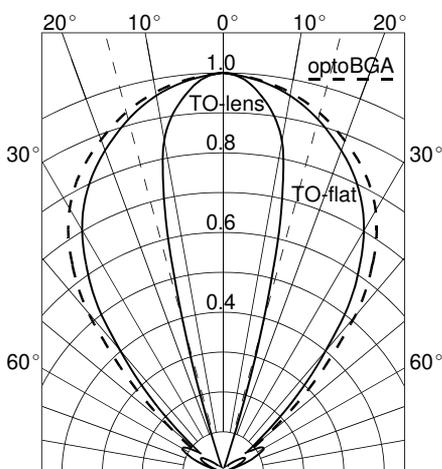


Figure 3: Typical directional characteristics for TO18 and optoBGA™ packages

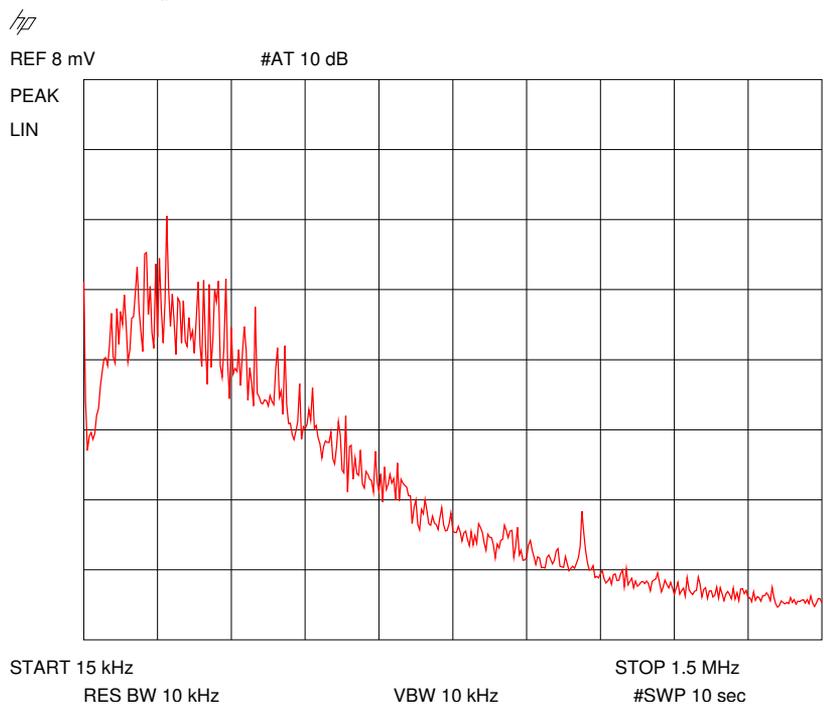


Figure 4: Output voltage noise [mV/ $\sqrt{10\text{ kHz}}$ ] to 10 k $\Omega$ /20 pF load with  $E_v(\text{dc})$  ca. 15.000 lx (standard illuminant A, T = 2856 K)

## APPLICATION HINTS

### Example Output Signals

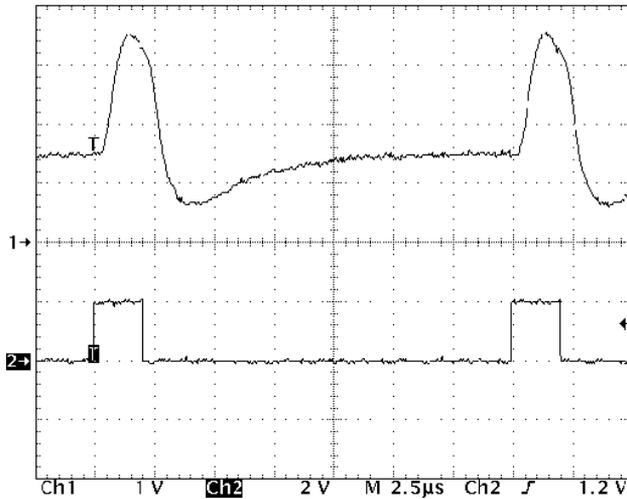


Figure 5: Output signal for 2  $\mu$ s pulse light.  
Transmitter: LED 875 nm with  $t_r = t_f = 0.1 \mu$ s;  
 $V_{CC} = 5$  V,  $R_L = 10$  k $\Omega$ ,  $C_L = 20$  pF;  
Chan 1: V(OUT), 1 V/DIV vertically,  
Chan 2: I(LED), 20 mA/DIV vertically

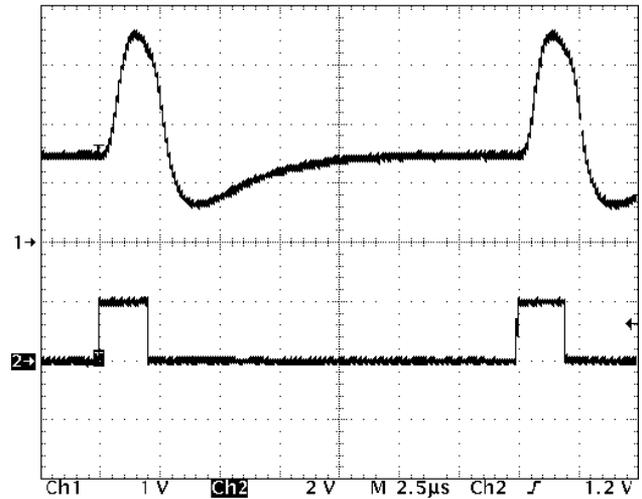


Figure 6: Output signal for 2  $\mu$ s pulse light with noise  
(accumulated over 256 samples)

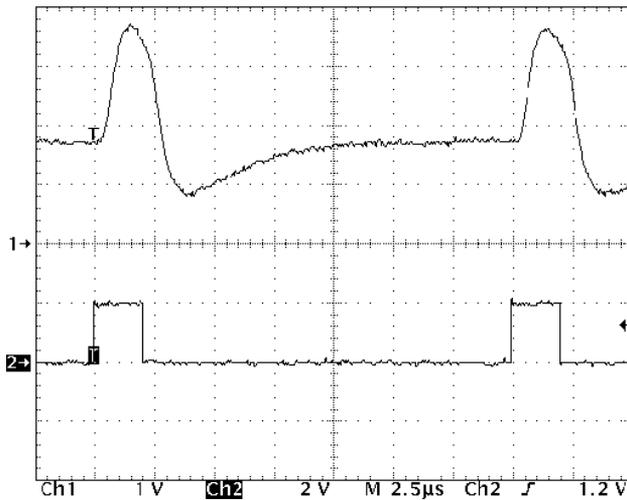


Figure 7: Output signal for 2  $\mu$ s pulse light, superimposed by ambient light of approx. 15000 Lux

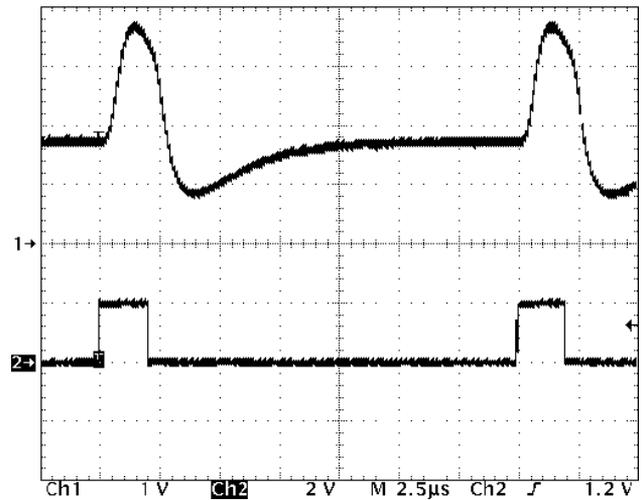


Figure 8: As in Fig. 7, accumulated for visibility over 256 samples. Despite of bright ambient light condition noise remains low level.

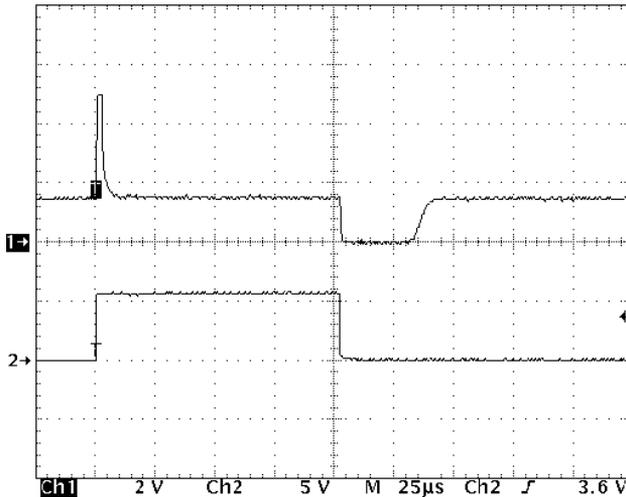


Figure 9: Recovery after 100 µs power pulse; back to ready-to-receive state after approx. 35 µs;  
Chan 1: V(OUT), 2 V/DIV vertically

### REVISION HISTORY

Rel.	Rel. Date*	Chapter	Modification	Page
C1	2016-05-20	PACKAGING INFORMATION	Package Dimensions for cDFN6-3x3 added	4
		THERMAL DATA	Operating Ambient Temperatur for cDFN6-3x3 reduced to 0 to 70 °C	5

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\* Release Date format: YYYY-MM-DD

**ORDERING INFORMATION**

Type	Package	Order Designation
iC-LQNP	TO18-4L	iC-LQNP TO18-4L
iC-LQNP	TO18-4F	iC-LQNP TO18-4F
iC-LQNP	cDFN6	iC-LQNP cDFN6
iC-LQNP	oBGA LQ1C	iC-LQ oBGA LQ1C
iC-LQNP	-	iC-LQNP chip

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