iC-LQNP
PULSE AND AC LIGHT SENSOR

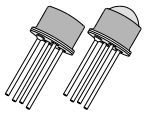
FEATURES

- Fast response amplifier with on-chip photodiode
- High interference immunity due to monolithic design
- Active photodiode area of ca. 1 mm^2
- 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

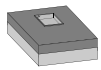
APPLICATIONS

- 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.

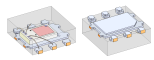
PACKAGES



TO18-4F/L

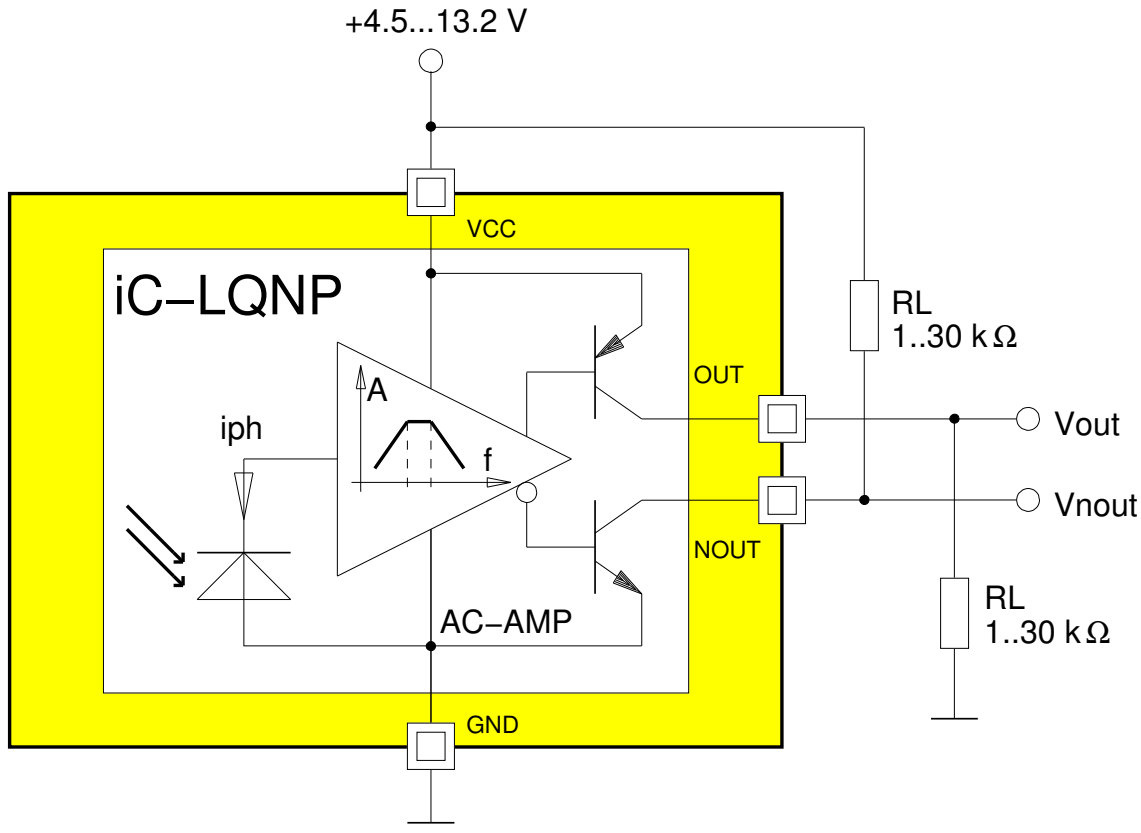


oBGA LQ1C



cDFN6-3x3

BLOCK DIAGRAM



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.

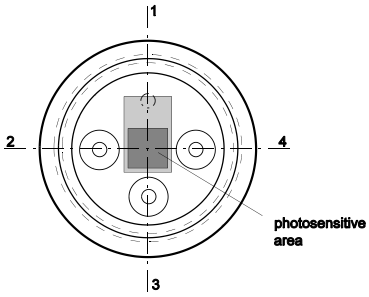
For visible light or near infrared the highest sensitivity for alternating light signals is reached at approximately 140 kHz; for pulse light this is reached at 1.4 µs and upwards.

The transimpedance can be selected within a range of approximately 1 to 10 MΩ 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.

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

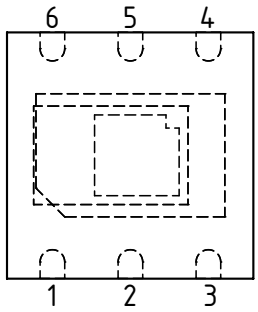
PIN CONFIGURATION TO18-4F/L



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

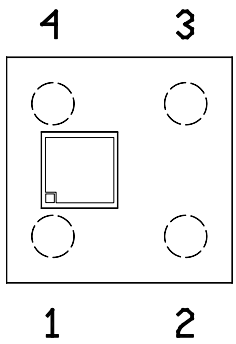
PIN CONFIGURATION cDFN6 3 mm x 3 mm



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

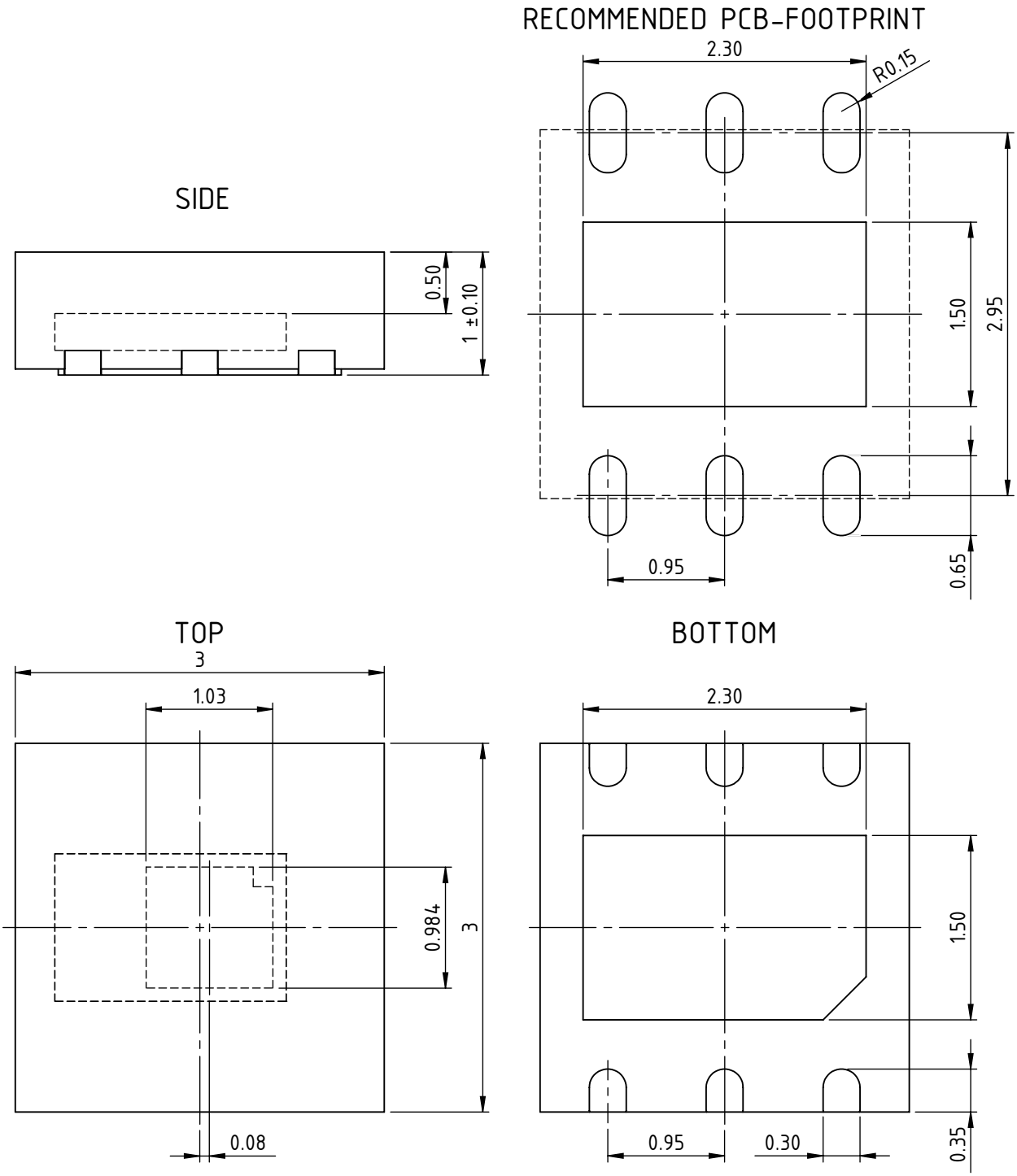
PIN CONFIGURATION oBGA LQ1C



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



All dimensions given in mm. Tolerances of form and position according to JEDEC MO-229.
Positional tolerance of sensor pattern: ±0.10mm / ±1° (with respect to backside pad).

drb_cdfn6-3x3-1_lqn_pack_1, 20:1

ABSOLUTE MAXIMUM RATINGS

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

Item No.	Symbol	Parameter	Conditions	Min.	Max.	Unit
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
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 Customer Information #7 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.

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
Total Device							
001	VCC	Permissible Supply Voltage		4.5		13.2	V
002	I(VCC)	Supply Current	E(PD) = 0 E(PD)ac = 0, E(PD)pk = 0, E(PD)cw = 30 mW/cm², 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()hi	Output Clamp Voltage hi	Vc()hi = V(OUT) − VCC, VCC = 0V, I() = 4 mA	0.25	0.5	1.4	V
009	Vc()lo	Output Clamp Voltage lo	I() = -4 mA	-1.4	-0.5	-0.25	V
Photodiode							
101	Aph()	Radiant Sensitive Area			1		mm²
102	S(λ)max	Spectral Sensitivity			0.5		A/W
103	λ_{ar}	Spectral Application Range	Se(λ_{ar}) = 0.1 × S(λ)max	500		1050	nm
Photocurrent Amplifier							
201	E()cw	Permissible DC Irradiance	λ_{LED} für S(λ)max, iC-LQNP Chip			30	mW/cm²
202	Ev()cw	Ambient Light Susceptibility	standard illuminant A, T = 2856 K; TO18-4F TO18-4L		 50 7		 mW/cm² mW/cm²
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/cm² mW/cm²
205	Gpk	Pulse Light Amplification 875 nm	VCC = 5 V, E(PD)pk = 35 µW/cm², 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/cm², twpk = 100 µs			60	µs
210	Gac	AC Light Amplification	f = fc, E(PD)ac = 35 µW/cm²; 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

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	flc	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 / (fhc - flc); 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	Vn()	Output Noise Voltage (RMS)	VCC = 5 V, E(PD) = 0 VCC = 5 V, Ev(PD)dc 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

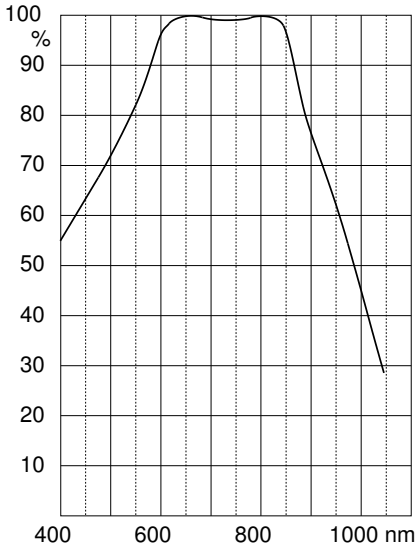


Figure 1: Typical relative spectral sensitivity

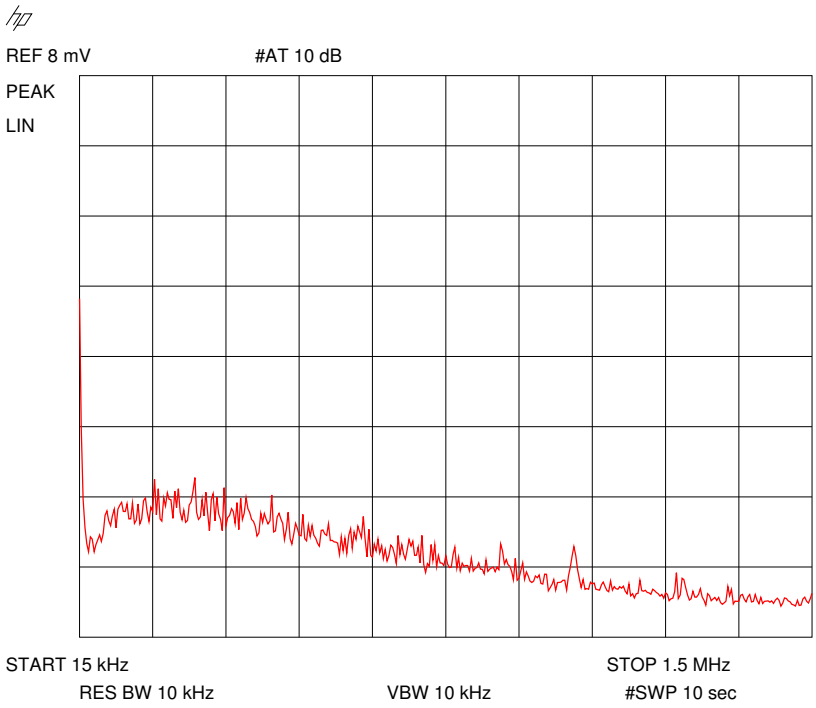


Figure 2: Output voltage noise [mV/$\sqrt{}$10 kHz] to 10 kΩ/20 pF load with Ev()dc < 500 lx

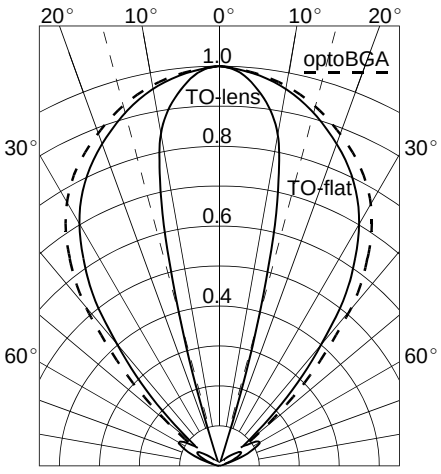


Figure 3: Typical directional characteristics for TO18 and opto-BGA™ packages

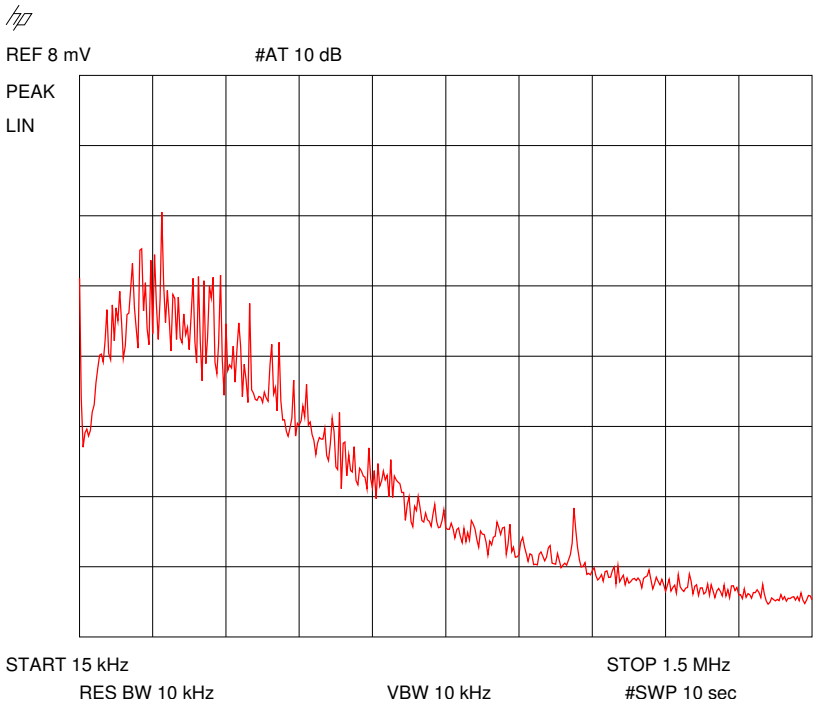


Figure 4: Output voltage noise [mV/$\sqrt{}$10 kHz] to 10 kΩ/20 pF load with Ev()dc ca. 15.000 lx (standard illuminant A, T = 2856 K)

APPLICATION HINTS

Example Output Signals

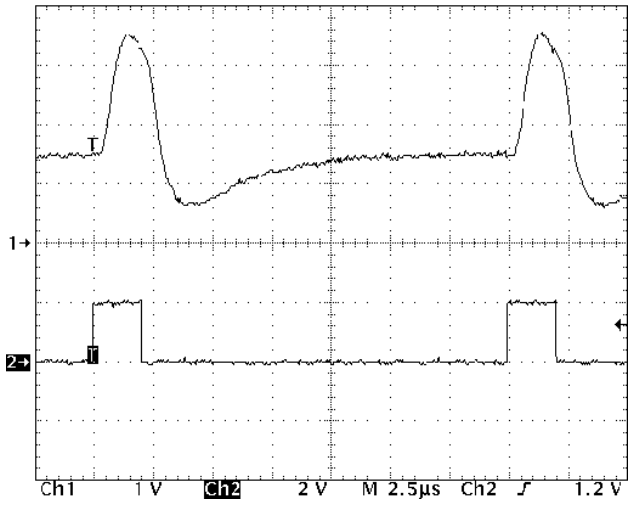


Figure 5: Output signal for 2 µs pulse light.
Transmitter: LED 875 nm with tr = tf = 0.1 µs;
VCC = 5 V, RL = 10 kΩ, CL = 20 pF;
Chan 1: V(OUT), 1 V/DIV vertically,
Chan 2: I(LED), 20 mA/DIV vertically

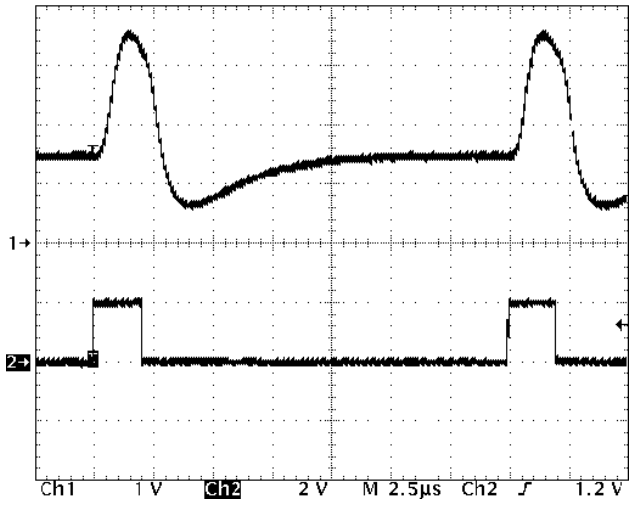


Figure 6: Output signal for 2 µs pulse light with noise (accumulated over 256 samples)

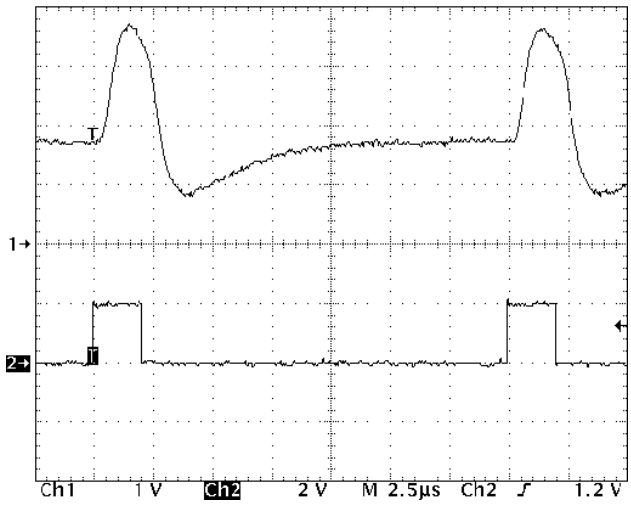


Figure 7: Output signal for 2 µs pulse light, superimposed by ambient light of approx. 15000 Lux

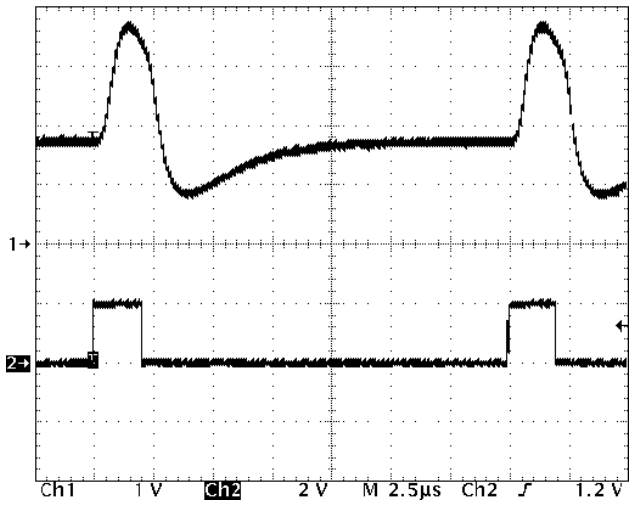


Figure 8: As in Fig. 7, accumulated for visibility over 256 samples. Despite of bright ambient light condition noise remains low level.

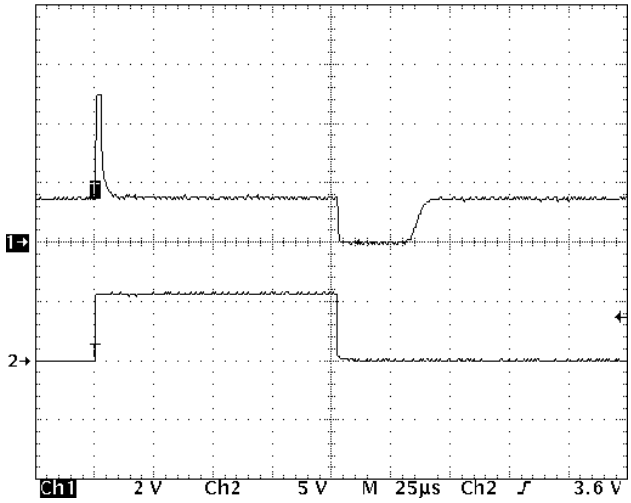


Figure 9: Recovery after 100 µs power pulse; back to ready-to-receive state after approx. 35 µs; Chan 1: V(OUT), 2 V/DIV vertically

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

* 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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