iC-HV
VCSEL ARRAY DRIVER

preliminary

iC-Haus

## FEATURES

♦ Triple VCSEL switch from CW up to 200 MHz
♦ Chip-on-chip assembly of the VCSEL array onto the iC-HV
♦ CW operation with up to 1 A per switch
♦ Pulsed operation with up to 3 A per switch
♦ Inputs can be paralleled for full 3 A CW and 9 A pulsed current
♦ Spike-free switching of the VCSEL current
♦ TTL or LVDS switching inputs
♦ Operates as three switched, voltage-controlled current sinks
♦ Simple current control at pins CIx
♦ CIx voltage < 3 V for full CW current
♦ Wide supply voltage range from 3 to 5.5 V
♦ Temperature measurement
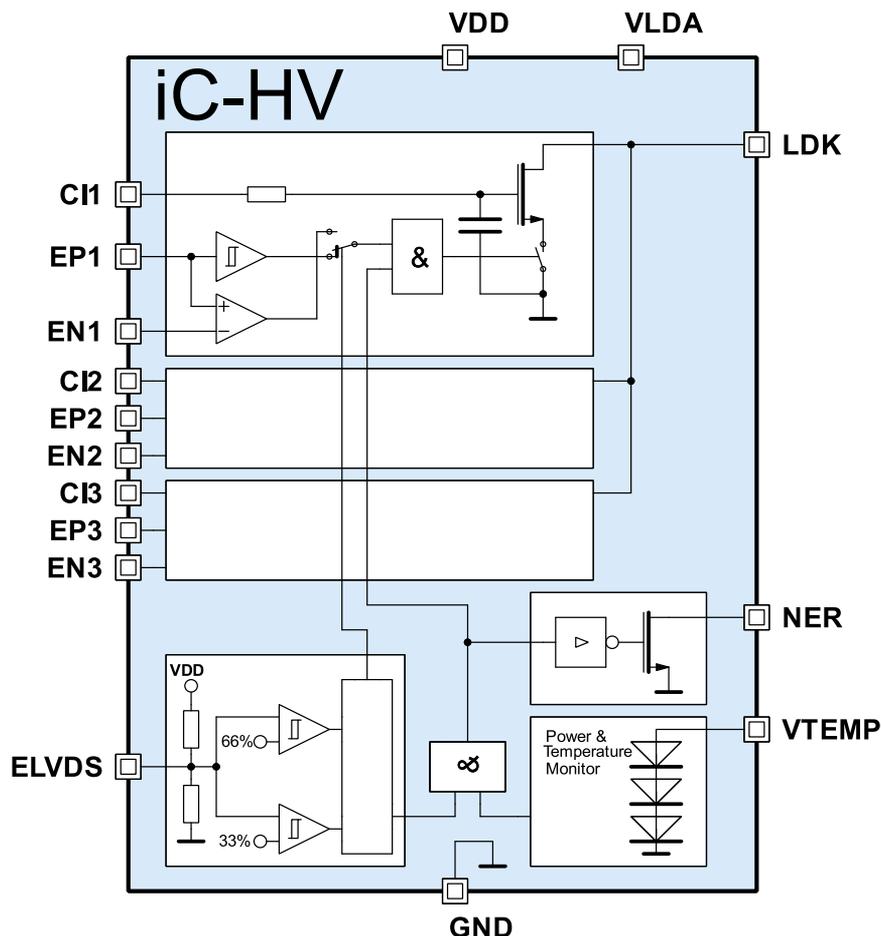♦ Open drain error output
♦ Thermal shutdown

APPLICATIONS

♦ Laser illumination
♦ TOF camera lighting
♦ LIDAR lighting
♦ Camera lighting
♦ Gesture recognition

CHIP
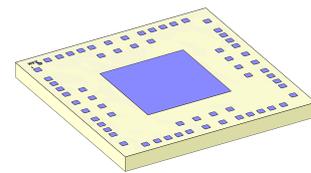
3.2 mm x 3.2 mm

BLOCK DIAGRAM

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DESCRIPTION

The triple laser switch iC-HV enables the spike-free switching of VCSEL arrays with well-defined currents at frequencies ranging from DC to 200 MHz.

The VCSEL current is determined by the voltages at pins CIx.

Three fast switches are controlled independently via TTL/LVDS inputs.

The VCSEL array can thus simply be turned on and off or switched between different current levels, defined by the voltages at CIx.

Each switch can be operated up to 1 A CW and 3 A pulsed current, depending on the frequency, duty cycle, and heat dissipation. The switches can be paralleled for up to 3 A CW and 9 A pulsed current.

A 1.4 mm x 1.4 mm pad (pin LDK) allows the VCSEL array to be mounted directly onto the iC-HV, yielding the shortest possible VCSEL-current track-length for maximum switching speed.

The integrated thermal shutdown feature protects the iC-HV from damage by excessive temperature.

ABSOLUTE MAXIMUM RATINGS

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

Item No.	Symbol	Parameter	Conditions	Min.	Max.	Unit
G001	VDD	Voltage at VDD		-0.3	6	V
G002	I(VDD)	Current in VDD		-10	750	mA
G003	VLDA	Voltage at VLDA		-0.3	6	V
G004	I(VLDA)	Current in VLDA	DC current	-10	3600	mA
G005	V()	Voltage at CI1...3, EP1...3, EN1...3, ELVDS, NER, VTEMP		-0.3	6	V
G006	I()	Current in CI1...3, EP1...3, EN1...3, ELVDS, VTEMP		-10	10	mA
G007	I(NER)	Current in NER		-10	20	mA
G008	Vd()	ESD Susceptibility at all pins	HBM 100 pF discharged through 1.5 kΩ		2	kV
G009	Tj	Operating Junction Temperature		-40	125	°C
G010	Ts	Storage Temperature Range		-40	150	°C

THERMAL DATA

Item No.	Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
T01	Ta	Operating Ambient Temperature Range		-25		85	°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: VDD = 3.0...5.5 V, Tj = -40...125 °C unless otherwise stated

Item No.	Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Total Device (x = 1...3)							
001	VDD	Permissible Supply Voltage		3		5.5	V
002	I(VDD)	Supply Current in VDD	CW operation			25	mA
003	I(VDD)	Supply Current in VDD	pulsed operation, f(EPx,ENx) = 200 MHz, all switches			700	mA
004	VLDA	Permissible Voltage at VLDA		-0.3		5.5	V
005	V(NER)	Permissible Voltage at NER		-0.3		5.5	V
006	Vc(CIx)hi	Clamp Voltage hi at CIx	Vc(CIx) = V(CIx) − VDD; I(CI) = 10 mA, other pins open	0.3		1.6	V
007	Vc()hi	Clamp Voltage hi at EPx, ENx, ELVDS	Vc() = V() − VDD; I() = 1 mA, other pins open	0.8		3	V
008	Vc()lo	Clamp Voltage lo at VDD, VLDA, CIx, EPx, ENx, ELVDS, NER, VTEMP	I() = -10 mA, other pins open	-1.6		-0.3	V
Current Control LDK, CI1...3 (x = 1...3)							
101	Icw(LDK)	Permissible CW Current in LDK (per switch)				1000	mA
102	Vs(LDK)	Saturation Voltage at LDK	I(LDK) = 900 mA, V(CIx) = V(CIx)@I(LDK) = 1000 mA			1.5	V
103	I0(LDKx)	Leakage Current in LDK	EPx = lo, V(LDK), V(VLDA) = 5.5 V			600	µA
104	tr()	LDK Current Rise Time	Iop(LDK) = 1000 mA, I(LDK): 10% → 90% Iop, V(ELVDS) = 0 V or VDD			1	ns
105	tf()	LDKx Current Fall Time	Iop(LDK) = 1000 mA, I(LDK): 90% → 10% Iop, V(ELVDS) = 0 V or VDD			1	ns
106	tp()	Propagation Delay V(EPx) → I(LDK)	V(ELVDS) = 0 V or VDD, Differential LVDS Rise and Fall Time < 0.5 ns	3	5	14	ns
107	CR()	Current Matching all switches		0.9		1.1	
108	V(CIx)	Permissible Voltage at CIx		-0.3		VDD	V
109	Vt(CIx)	Threshold Voltage at CIx	I(LDKx) < 5 mA	0.4		1.2	V
110	V(CIx)	Operating Voltage at CIx	I(LDK) = 1000 mA, V(LDK) > 1.8 V		2	2.9	V
111	Ipd(CIx)	Pull-Down Current at CIx	V(CIx) = 0.5...5.5 V	1	2.5	5	µA
112	C(CIx)	Capacity at CIx	V(CIx) = 2 V	270	350	460	pF
113	tskc()	Switch to Switch Skew				160*	ps
Input EP1...3, EN1...3 (x = 1...3)							
201	Vt(TTL)hi	Input Threshold Voltage hi	V(ELVDS) < 20% VDD, TTL			2	V
202	Vt(TTL)lo	Input Threshold Voltage lo	V(ELVDS) < 20% VDD, TTL	0.8			V
203	Vhys(TTL)	Hysteresis	Vhys() = Vt()hi − Vt()lo; V(ELVDS) < 20% VDD, TTL	50			mV
204	R(EPx)	Pull-Down Resistor	V(ELVDS) < 20% VDD, TTL	100	162	220	kΩ
205	R(ENx)	Pull-Down Resistor	V(ELVDS) < 20% VDD, TTL	170	282	390	kΩ
206	V(EPx)	Voltage at EPx	V(ELVDS) > 80% VDD, LVDS, EPx, ENx open	31	33	35	%VDD
207	V(ENx)	Voltage at ENx	V(ELVDS) > 80% VDD, LVDS, EPx, ENx open	40	42	44	%VDD
208	Ri(EPx)	Resistor at ENx	V(ELVDS) > 80% VDD, LVDS, EPx, ENx open	75	109	155	kΩ
209	Ri(ENx)	Resistor at ENx	V(ELVDS) > 80% VDD, LVDS, EPx, ENx open	80	119	170	kΩ
210	Vdiff	Differential Voltage	Vdiff = |V(EPx) − V(ENx)|; V(ELVDS) > 80% VDD, LVDS	200			mV
211	V()	Input Voltage Range	V(ELVDS) > 80% VDD, LVDS	-0.2		VDD + 0.2	V
Input ELVDS							
301	V(ELVDS)	Voltage at ELVDS	ELVDS open	48	50	52	%VDD
302	Ri(ELVDS)			35	50	70	kΩ

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* Projected values by simulation

ELECTRICAL CHARACTERISTICS

Operating Conditions: VDD = 3.0...5.5 V, Tj = -40...125 °C unless otherwise stated

Item No.	Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
303	Vt(ELVDS)	Threshold Voltage TTL to Error		26	33	40	%VDD
304	Vt(ELVDS)	Threshold Voltage Error to LVDS		59	66	73	%VDD
305	Vhys()	Hysteresis		10	25	100	mV
Ouput NER							
401	Vsat(NER)	Saturation Voltage at NER	ELVDS open, I(NER) = 2 mA			0.6	V
402	I(NER)	Current in NER	ELVDS open, V(NER) > 0.6 V	3	9	20	mA
Temperature Measurement and Overtemperature							
501	VTEMP	Voltage at VTEMP	Tj = 27 °C	1.96	2.09	2.22	V
502	TC()	Temperature Coefficient		-6.46	-5.8	-4.94[†]	mV/°C
503	I(VTEMP)	Pull-Up Current	V(VTEMP) = 0 V	-200	-100	-40	µA
504	Toff	Overtemperature Shutdown	rising temperature	130		170	°C
505	Ton	Overtemperature Release	falling temperature	120		160	°C
506	Thys	Hysteresis	Toff − Ton	5			°C
Power On							
601	VON	Power-On Voltage VDD	rising voltage			2.9	V
602	VOFF	Power-Down Voltage VDD	falling voltage	1.5			V
603	Vhys	Hysteresis		50		500	mV

[†] Projected values by simulation

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CONFIGURATION INPUT ELVDS

Pin ELVDS selects between TTL or LVDS mode. The unconnected pin ELVDS is an error condition signaled at pin NER with the VCSEL current disabled.

Pin ELVDS connected to GND selects the TTL mode. Pin ELVDS connected to VDD selects the LVDS mode.

DIGITAL INPUTS EP1...3 EN1...3

EP1...3 and EN1..3 are the digital switching inputs. With pin ELVDS set to *TTL mode*, each pin EPx enables the current sink at the respective switch. The ENx pins are unused. With pin ELVDS set to *LVDS mode*, the EPx pins are the positive and the ENx pins are the negative LVDS inputs. EP1 and EN1 control switch 1, EP2 and

EN2 control switch 2 and EP3 and EN3 control switch 3. For correct LVDS operation 100 Ω terminating resistors between the respective EPx and ENx pins, very close to the inputs, are required. Input pins from unused switches have to be connected to GND (TTL operation) resp. EPx to GND and ENx to VDD (LVDS operation).

ANALOG CURRENT CONTROL VOLTAGE INPUTS CI1...3

The voltage at pins CI1...3 sets the current.

PULSED OPERATION

The current for pulsed operation may be higher than for CW operation. Therefore the RMS current of the pulse train has to be considered.

With $I_{CW_{max}}$ from Electrical Characteristics No. 101 and pulses < 10 µs. So for a single switch operated with a 50% duty cycle, the max. VCSEL current becomes

$$I_{pulse_{max}} = I_{CW_{max}} \cdot \sqrt{\frac{repetition\ time(T)}{pulse\ time(t)}} \qquad (1)$$

$$I_{pulse_{max}} = 1000\,mA \cdot \sqrt{2} = 1414\,mA$$

ERROR OUTPUT NER

The open drain pin NER is a low-active error output. Signalled errors are ELVDS open or at 50% VDD, VDD undervoltage and thermal shutdown.

TEMPERATURE MEASUREMENT VTEMP

Pin VTEMP shows the voltage of three stacked diodes and can be used to measure the chip temperature.

THERMAL SHUTDOWN

iC-HV is protected by an integrated thermal shutdown feature. When the shutdown temperature is reached all switches are turned off. Falling temperature after this shutdown will unconditionally enable all channels again. Necessary precaution to prevent damage of the laser may be to also disable any external control circuits for the laser output power or current control during thermal shutdown. The error signal at pin NER can be used to e.g. disable the control circuit.

REVISION HISTORY

Rel.	Rel. Date‡	Chapter	Modification	Page
A1	2017-08-15		Initial release	

‡ Release Date format: YYYY-MM-DD

ORDERING INFORMATION

Type	Package	Order Designation
iC-HV	dice	on request

Please send your purchase orders to our order handling team:

Fax: +49 (0) 61 35 - 92 92 - 692
E-Mail: dispo@ichaus.com

For technical support, information about prices and terms of delivery please contact:

iC-Haus GmbH **Tel.: +49 (0) 61 35 - 92 92 - 0**
Am Kuemmerling 18 **Fax: +49 (0) 61 35 - 92 92 - 192**
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GERMANY   **E-Mail: sales@ichaus.com**

Appointed local distributors: http://www.ichaus.com/sales_partners