iC-WK

2.4V CW LASER DIODE DRIVER

target specification

FEATURES

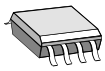
- CW operation up to 60mA from 2.4..6V supply voltage
- Rapid soft start after power-on
- Simple power adjustment via the external resistor
- Control loop accuracy better than 1% with changes in temperature, supply voltage and load current
- Integrated reverse polarity protection for the iC and laser diode
- Strong suppression of transients with very small external capacitors
- Integrated flyback path protects against transients
- Permanent shutdown with excessive temperature and overcurrent (i.e. if the laser diode is damaged or the feedback current path fails)
- Two feedback inputs permit all current LD types to be used (M/P/N configurations)
- Modulation via the feedback inputs is possible
- Wide monitor current range from 10µA to 2.5mA
- Extended temperature range available as an option

APPLICATIONS

- Battery-powered LD modules
- LD Pointers

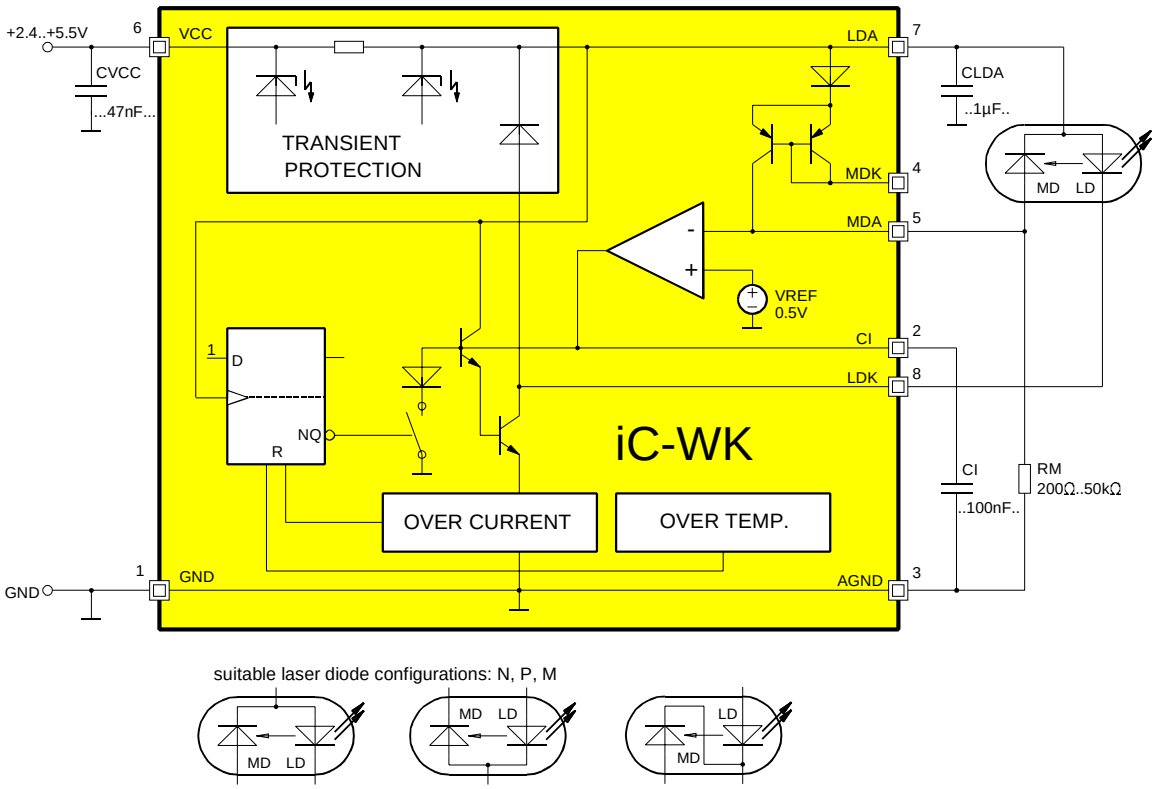
PACKAGES

(MSOP8)



SO8

BLOCK DIAGRAM



DESCRIPTION

The iC-WK device is a driver for laser diodes in continuous wave operation which requires only four external components. The broad power supply range of 2.4V to 6V and the integrated reverse battery protection allow for battery operation with a minimum of two cells. A reversed battery connection destroys neither the iC nor the laser diode.

The iC includes integrated circuitry protecting against destruction by ESD, excessive temperature and overcurrent and a soft start which regulates the power and protects the laser diode when the power supply is switched on. The iC also filters the laser diode power supply for transients.

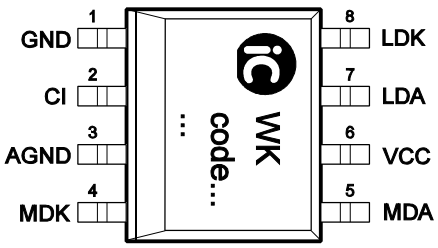
The power supply is regulated and adapted for the laser diode used by an external resistor at MDA. The monitor current acts as a reference and is regulated independent of the influence of temperature and supply voltage (range: 10µA to 2.5mA). The capacitor at CI determines the recovery time constants and start-up time.

A second monitor input, pin MDK, allows the driver to be used for other types of laser diode configuration; alternatively, it can be used as an analog modulation input (DC to a few kHz).

In the event of failure, such as overcurrent in the laser path with a lack of feedback, for example, a quick power lockout is activated. The shutdown continues until power is reapplied, permitting a restart. The strain on power packs and batteries is relieved and the laser class is retained even in the event of a disturbance.

PACKAGES SO8, MSOP8 to JEDEC Standard

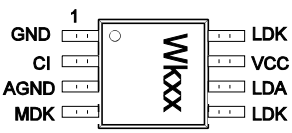
PIN CONFIGURATION SO8
(top view)



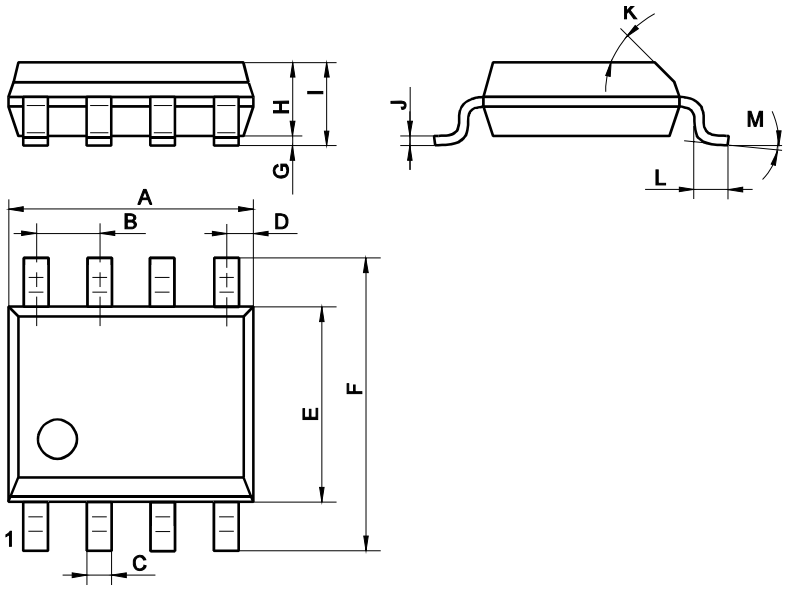
PIN FUNCTIONS

No.	Name	Function
1	GND	Ground
2	CI	Capacitance for Power Control
3	AGND	Reference Ground for CI, RM
4	MDK	Monitor Input 2 (MD Cathode, modulation)
5	MDA	APC Setup, Monitor Input 1 (MD Anode)
6	VCC	+2.4 .. +6V Supply Voltage
7	LDA	Laser Supply (LD Anode)
8	LDK	Driver Output (LD Cathode)

PIN CONFIGURATION MSOP8 (3mm)

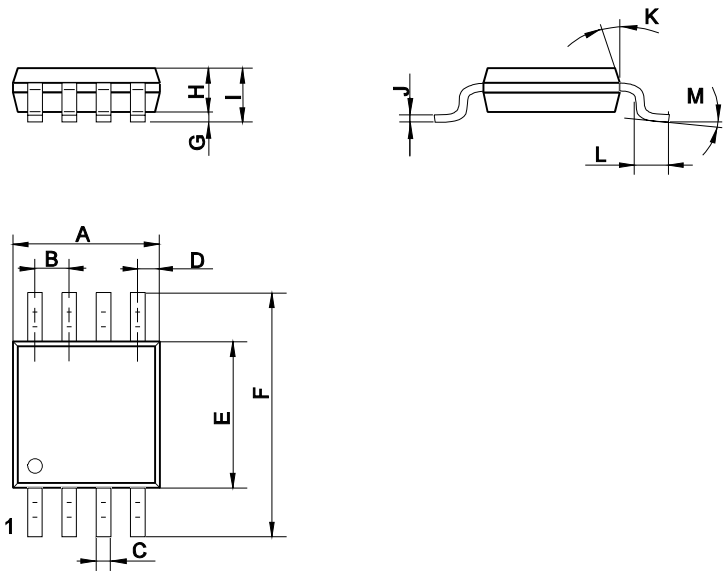


PACKAGE DIMENSIONS SOP8 (in mm)



	Min.	Max.
A	4.8	4.98
B	1.27 BSC	
C	0.35	0.49
D	0.53 REF	
E	3.81	3.99
F	5.8	6.2
G	0.1	0.25
H	1.1	1.65
I	1.35	1.75
J	0.19	0.25
K	45 DEG	
L	0.41	1.27
M	0 DEG	8 DEG

PACKAGE DIMENSIONS MSOP8 (in mm)



	Min.	Max.
A	2.9	3.1
B	0.65 BSC	
C	0.33	
D	0.525	
E	2.9	3.1
F	4.75	5.05
G	0.05	0.15
H	0.78	0.94
I		1.1
J	0.1	
K	9 DEG	15 DEG
L	0.4	0.7
M	0 DEG	6 DEG

ABSOLUTE MAXIMUM RATINGS

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

Item	Symbol	Parameter	Conditions	Fig.	Min.	Max.	Unit
G001	VCC	Voltage at VCC			-6	6	V
G002	I(VCC)	Current in VCC			-70	70	mA
G003	I(CI)	Current in CI			-10	10	mA
G004	I(LDA)	Current in LDA			-70	70	mA
G005	I(LDK)	Current in LDK			-70	70	mA
G006	I(MDA)	Current in MDA			-10	10	mA
G007	I(MDK)	Current in MDK			-10	10	mA
G008	I(AGMD)	Current in AGND			-10	10	mA
E001	Vd()	ESD Susceptibility at all pins	MIL-STD-883, Method 3015, HBM 100pF discharged through 1.5kΩ			2	kV
TG1	Tj	Operating Junction Temperature			-40	150	°C
TG2	Tj	Storage Temperature Range			-40	150	°C

THERMAL DATA

Operating Conditions: VCC= 2.4..5.5V

Item	Symbol	Parameter	Conditions	Fig.	Min.	Typ.	Max.	Unit
T1	Ta	Operating Ambient Temperature Range (extended range on request)			-25		85	°C
T2	Rthja	Thermal Resistance Chip / Ambient	SO8 package, soldered on PCB, no additional cooling areas				140	K/W

All voltages are referenced to ground unless otherwise noted.
All currents into the device pins are positive; all currents out of the device pins are negative.

ELECTRICAL CHARACTERISTICS

Operating Conditions: VCC= 2.4..5.5V, RM= 200Ω..50kΩ, Tj= -40..125°C unless otherwise noted

Item	Symbol	Parameter	Conditions	Tj °C	Fig.	Min.	Typ.	Max.	Unit
Total Device									
001	VCC	Permissible Supply Voltage				2.4		5.5	V
002	I(LDK)	Permissible Laser Drive Current	power control range			5		60	mA
003	Idc(VCC)	Supply Current without load path	closed control loop, I(MDK)= 0, RM= 200Ω, I(LDK)= 60mA					5.5	mA
004	Ioff(VCC)	Supply Current on Reset					2.4	5	mA
005	Ir(VCC)	Reverse Supply Current	RM= 50kΩ			-6	-3		mA
006	ton()	Turn-on Delay	VCC: 0V→5V to 95% I(LDK); I(LDK)= 60mA, CI= 47nF I(LDK)= 60mA, CI= 100nF					 70 150	 µs µs
E001	Vc()hi	Clamp Voltage hi at VCC, LDA, MDK	I()= 10mA, other pins open			6		9	V
E002	Vc()hi	Clamp Voltage hi at LDK	V()< VCC+1V; I()= 10mA, other pins open			6		9	V
E003	Vc()hi	Clamp Voltage hi at MDA	I()= 10mA, other pins open			1.4		4	V
E004	Vc()hi	Clamp Voltage hi at CI	I()= 10mA, other pins open			1.1		3.5	V
E005	Vc()lo	Clamp Voltage lo at VCC, LDA, MDK, MDA, CI	I()= -10mA, other pins open			-9			V
Reference and Monitor Inputs MDA, MDK, AGND									
101	V(MDA)	Reference Voltage at MDA	closed control loop, V(LDK) >Vs(LDK)			480	500	530	mV
102	dV(MDA)	Reference Voltage Temperature Drift at MDA	see 101;					120	µV/°C
103	Ierr(MDA)	Input Current in MDA	closed control loop, I(MDK)= 0, I(LDK)= 20..60mA			-300		300	nA
104	dI(MDA)	Input Current Temperature Drift in MDA	see 103;			-2		2	nA/°C
105	APCerr	Control Error	RM= 10kΩ, Tj= 0..70°C RM= 10kΩ, Tj= -25..85°C					0.3 1	% %
106	dI(RM)	Supply Voltage Suppression	V(VCC): 2.4V→5.5V, I(LDK)= 60mA			-1		1	%
107	Rgnd()	Resistor AGND-GND						3	Ω
301	Vf(MDK)	Voltage at MDK	Vf()= V(LDA) -V(MDK); I(MDK)= 1µA..1mA			0.55		2	V
302	CR()	Current Ratio I(MDA) / I(MDK)	I(MDK)= 10µA..1mA			0.98		1.02	
303	TC()	Current Ratio Temperature Coefficient I(MDA) / I(MDK)				-0.005		+0.005	%/°C
Laser Drive LDA, LDK									
201	Vs(LDK)	Saturation Voltage at LDK	I(LDK)= 40mA I(LDK)= 60mA					300 400	mV mV
202	dI(LD)	Load Balancing Error	I(LD)= 20mA, I(LDK): 20mA→60mA			-1		1	%
203	It(LDK)	Overcurrent Threshold in LDK				60	130	300	mA
204	toff()	Overcurrent Reset Delay	lack of feedback: I(RM)= 0 to I(LDK)= It(LDK); I(LDK)= 20mA, CI= 47nF I(LDK)= 20mA, CI= 100nF I(LDK)= 60mA, CI= 47nF I(LDK)= 60mA, CI= 100nF					 85 170 60 130	 µs µs µs µs

ELECTRICAL CHARACTERISTICS

Operating Conditions: VCC= 2.4..5.5V, RM= 200Ω..50kΩ, Tj= -40..125°C unless otherwise noted

Item	Symbol	Parameter	Conditions	Tj °C	Fig.	Min.	Typ.	Max.	Unit
Laser Drive LDA, LDK (continued)									
205	Vf()	Diode Forward Voltage LDK-LDA	I(LDK)< 60mA					1.1	V
206	Rvcc()	Transient Protection Resistor	VCC vs. LDA					3	Ω
Control Release Flip-Flop									
401	VCCen	Set Threshold for Enable Flip-Flop		-40 27 125		1.2 1.0 0.6		1.9 1.7 1.2	V V V
402	Toff	Overtemperature Shutdown				125		150	°C

DESCRIPTION OF FUNCTIONS

Turn-on behavior

After switching on the supply voltage the output stage remains disabled until the internal enabling flip-flop is set by a sufficiently high voltage at LDA.

A quick soft start occurs during phase I; the control capacitor CI is loaded at an accelerated rate until the output stage supplies current at LDK. An open-circuit voltage at pin MDA is used to verify the external resistance.

Phase 2, the initialization process, begins when current starts to flow at LDK. This phase ends when the laser reaches its threshold current and the monitor current produced raises the potential at resistor RM.

The transition to CW operation (phase 3) is gradual and primarily influenced by the CI and RM components. CI is correctly dimensioned when the voltage overshoot at MDA is at a minimum.

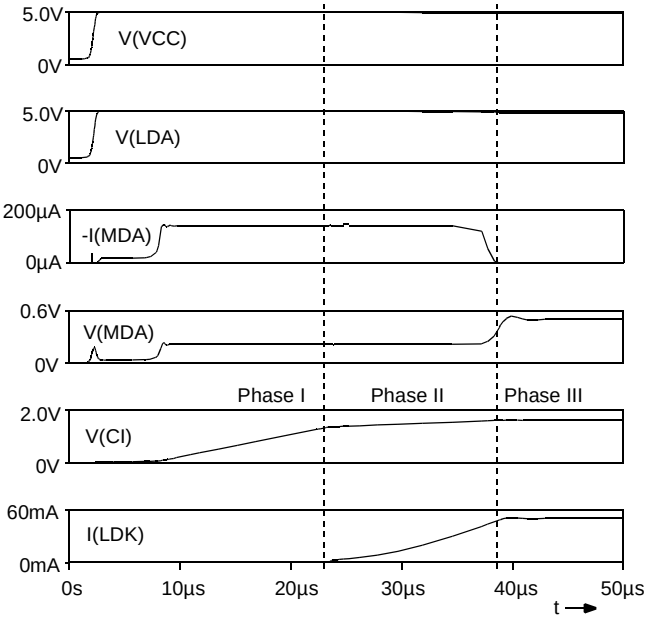


Fig. 1: Turn-on behaviour

Turn-off behavior

iC-WK functions without a fixed undervoltage lockout, thus the laser diode forward voltage is the prime factor determining the lowest possible supply voltage.

If the voltage drops below this, the output stage is forcibly saturated and the laser current falls. In this instance iC-WK simultaneously discharges control capacitor CI so that no excessive laser diode currents occur when the supply voltage again rises.

Disruptions in operation

The power control is shut down with excessive driver temperature or when the laser current reaches the overcurrent shutdown threshold, for example when the feedback is interrupted. If the monitor diode or the preset resistor RM fail the device is shutdown in less than 0.25ms, provided that the supply voltage applied is high enough.

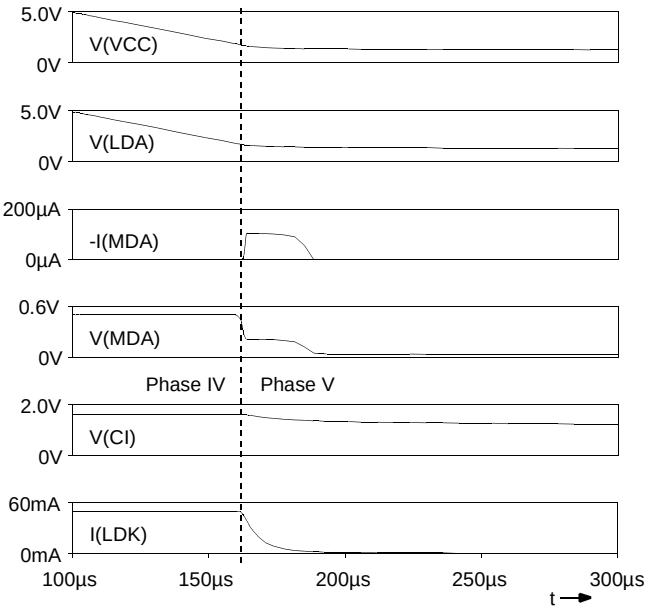


Fig. 2: Turn-off behaviour

APPLICATIONS INFORMATION

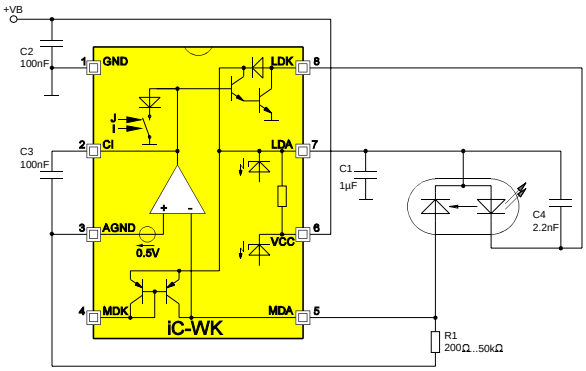


Fig. 3: circuit for N-type laser diodes (cathode MD to anode LD)

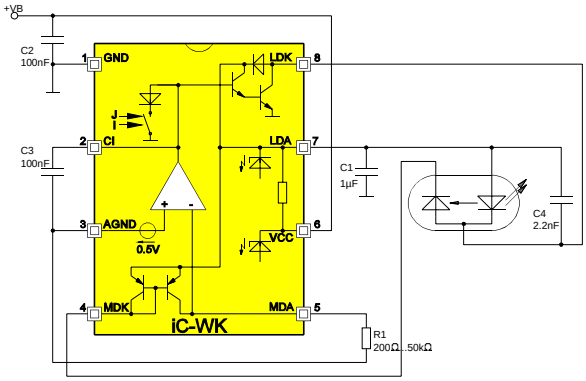


Fig. 4: circuit for P-type laser diodes (anode MD to cathode LD)

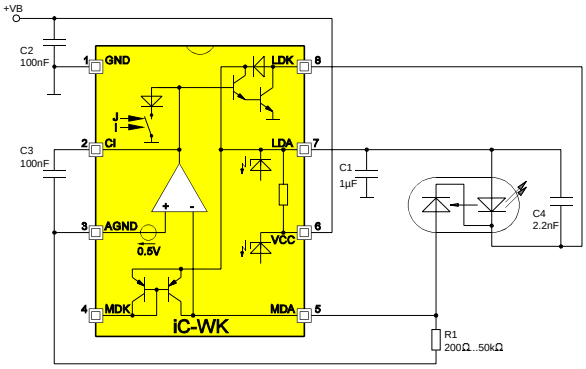


Fig. 5: circuit for M-type laser diodes (common cathode for LD and MD)

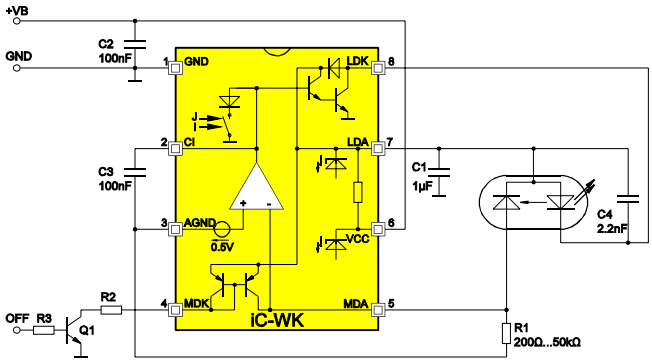


Fig. 6: using the second monitor input as a switching input (N-type lasers)

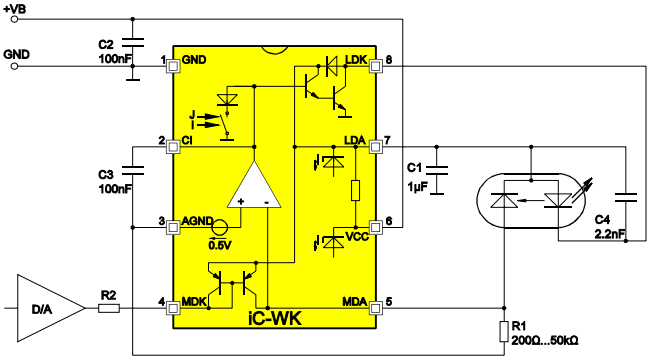


Fig. 7: using the second monitor input for modulation (N-type lasers)

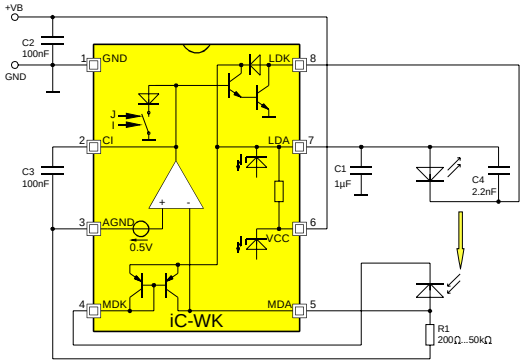


Fig. 8: using both monitor inputs to amplify the current (N-type lasers)

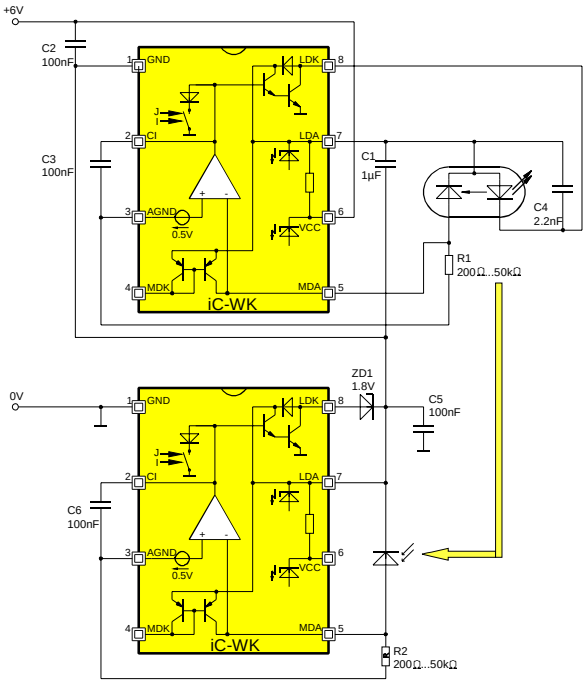


Fig. 9: safety circuit with a second iC-WK monitoring the optical output power

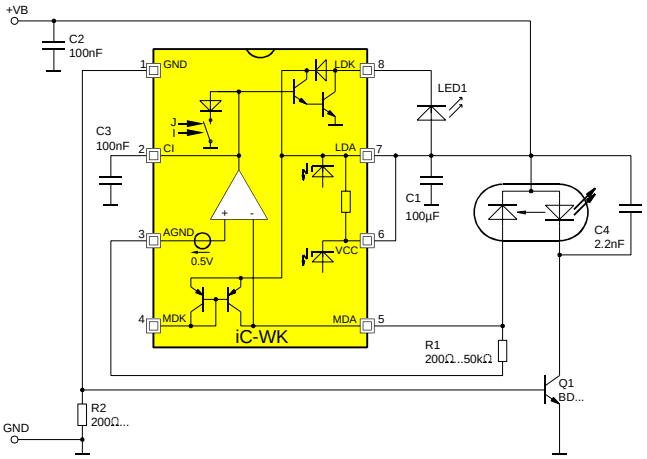


Fig. 10: circuitry for higher laser diode currents (60mA..4A) using an external power transistor

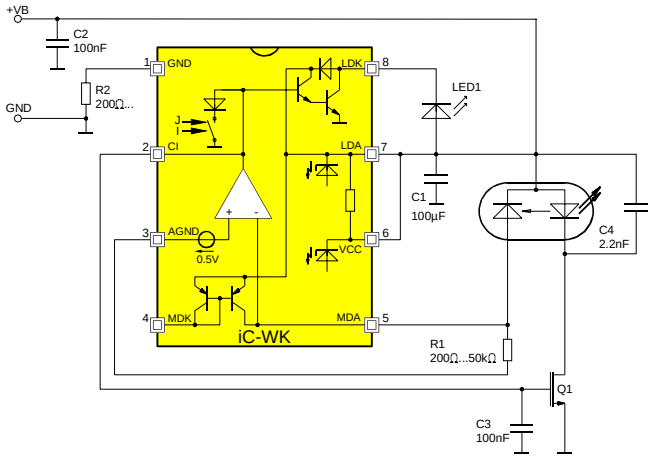


Fig. 11: circuitry for higher laser diode currents (60mA..4A) using an external power MOSFET

Dimensions for external components

Component	Range	Comments
C1	100nF..1µF	filter capacitor for the laser diode supply
C2	(0)..100µF	optional, may be omitted if C1 offers sufficient filtering
C3	22nF..220nF ca. 100nF	selection depends on laser diode operated example: I(LDK) / I(MD)= 35mA / 0.25mA
C4	1nF..10nF	optional, additional ESD protection capacitor
R1	200Ω..50kΩ ca. 2kΩ	selection depends on laser diode operated example: R1= V(MDA) / I(MD)= 0.5V / 0.25mA = 2kΩ

DEMO BOARD

iC-WK comes with two Demo Boards (6.25mm x 20mm) for test purposes. The following figures show the circuitry and the top and bottom of the test boards (layout are on a scale of 4:1).

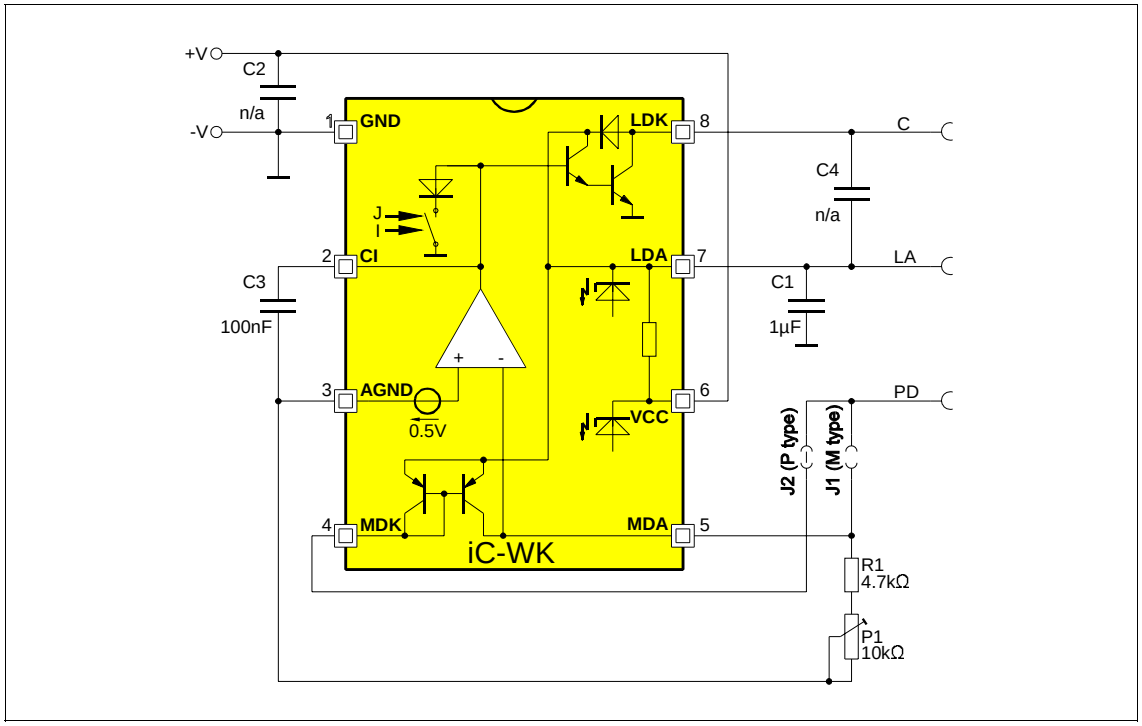


Fig. 12: schematic diagram of demo board WK1D for P-/M-type laser diodes

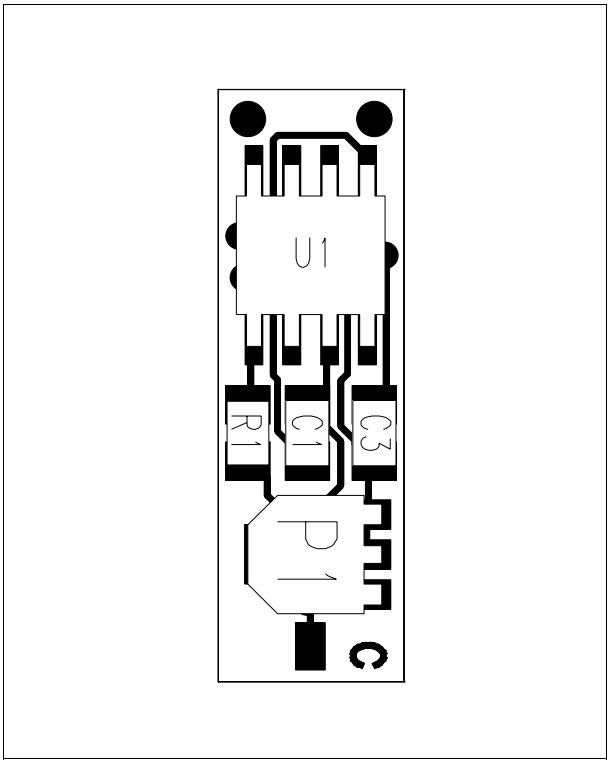


Fig. 13: demo board WK1D (top side)

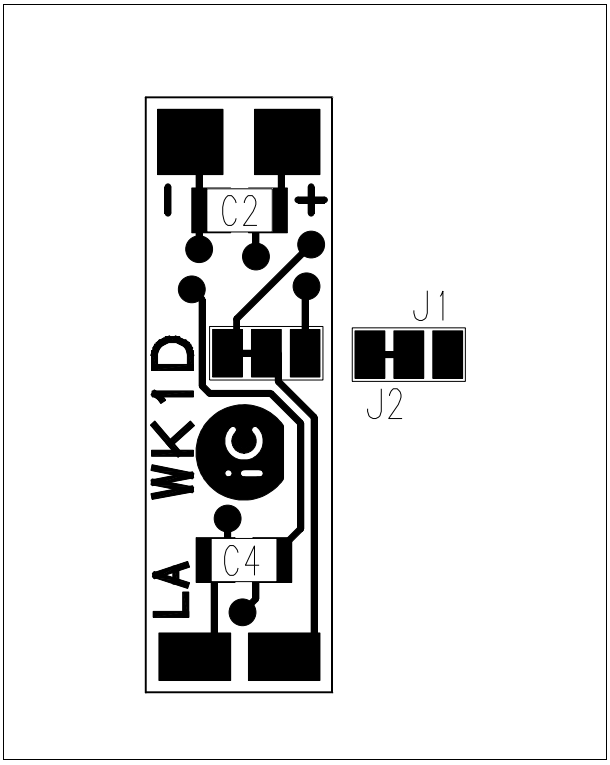


Fig. 14: demo board WK1D (bottom side)

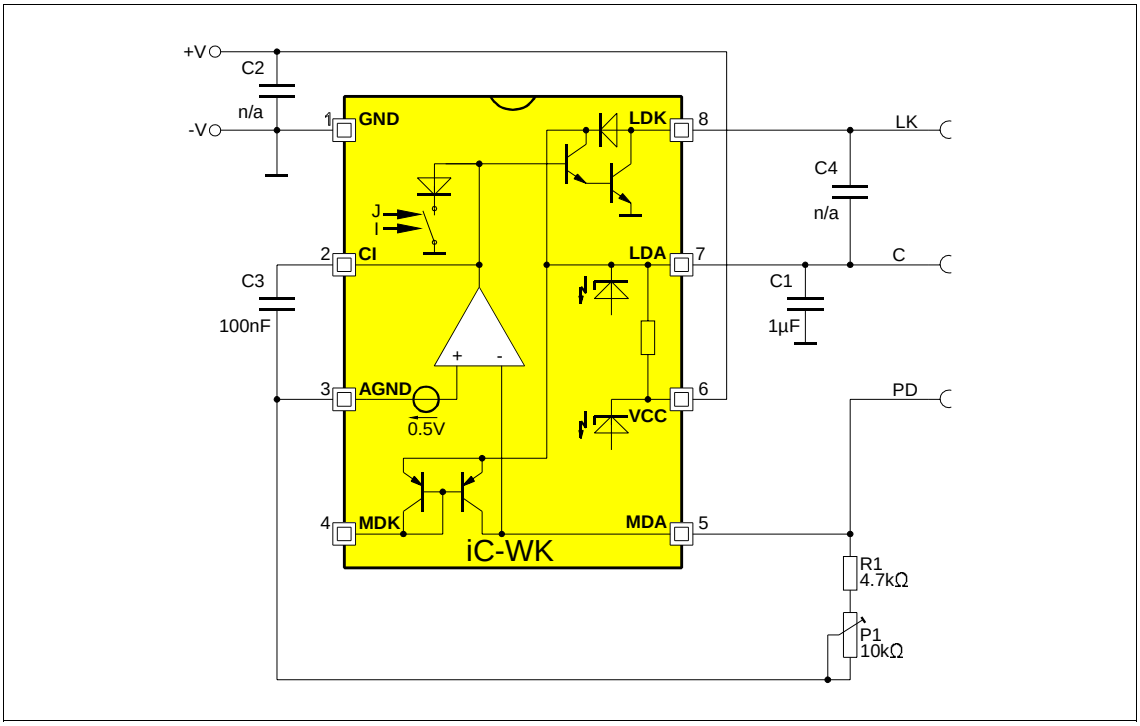


Fig. 15: schematic diagram of demo board WK2D for N-type laser diodes

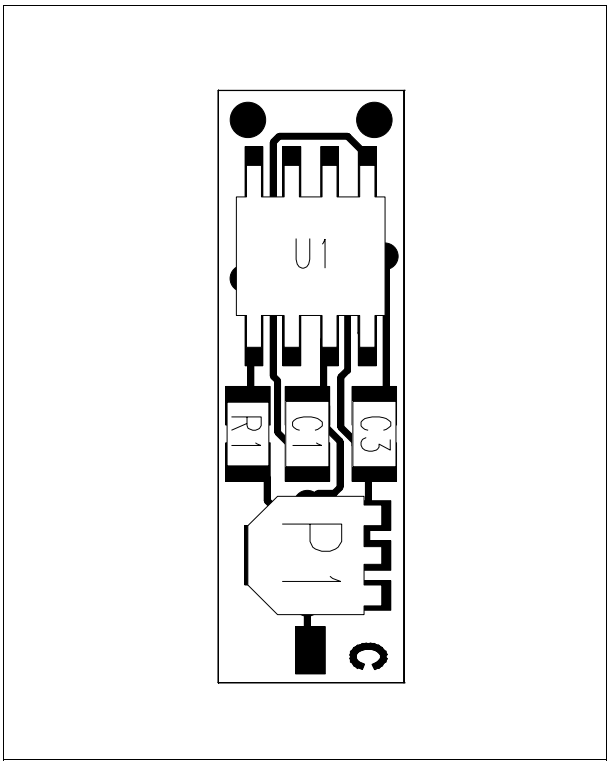


Fig. 16: demo board WK2D (top side)

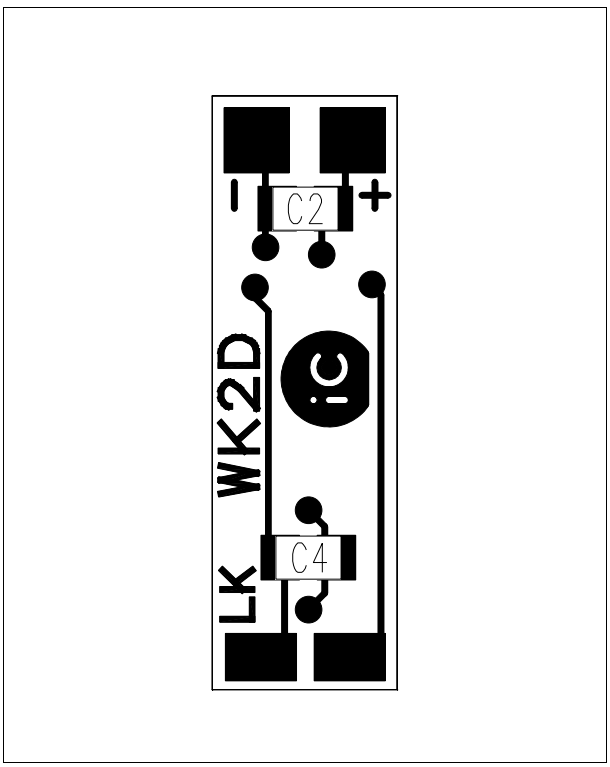


Fig. 17: demo board WK2D (bottom side)

ORDERING INFORMATION

Type	Package	Order designation
iC-WK	SO8 MSOP8	iC-WK SO8 iC-WK MSOP8
WK demo board for P-/M-type lasers WK demo board for N-type lasers		WK1D DEMO WK2D DEMO

For information about prices, terms of delivery, other packaging options etc., please contact:

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