iC-WKN

15 V CW LASER DIODE DRIVER

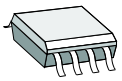
FEATURES

- CW operation up to 300 mA from 2.4 to 15 V supply voltage
- Rapid soft start after power-on typical within 70 µs
- Optimised for N-type laser diodes
- Simple output power adjustment via an external resistor (APC)
- Power control loop accuracy better than 1.5 % 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
- 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 (N/P/M configurations)
- Modulation via the feedback inputs is possible
- Wide monitor current range from 2.5 µA to 6.25 mA
- Pin compatible to iC-WK and iC-WKL (SO8 package)

APPLICATIONS

- Blue laser diodes
- LD modules

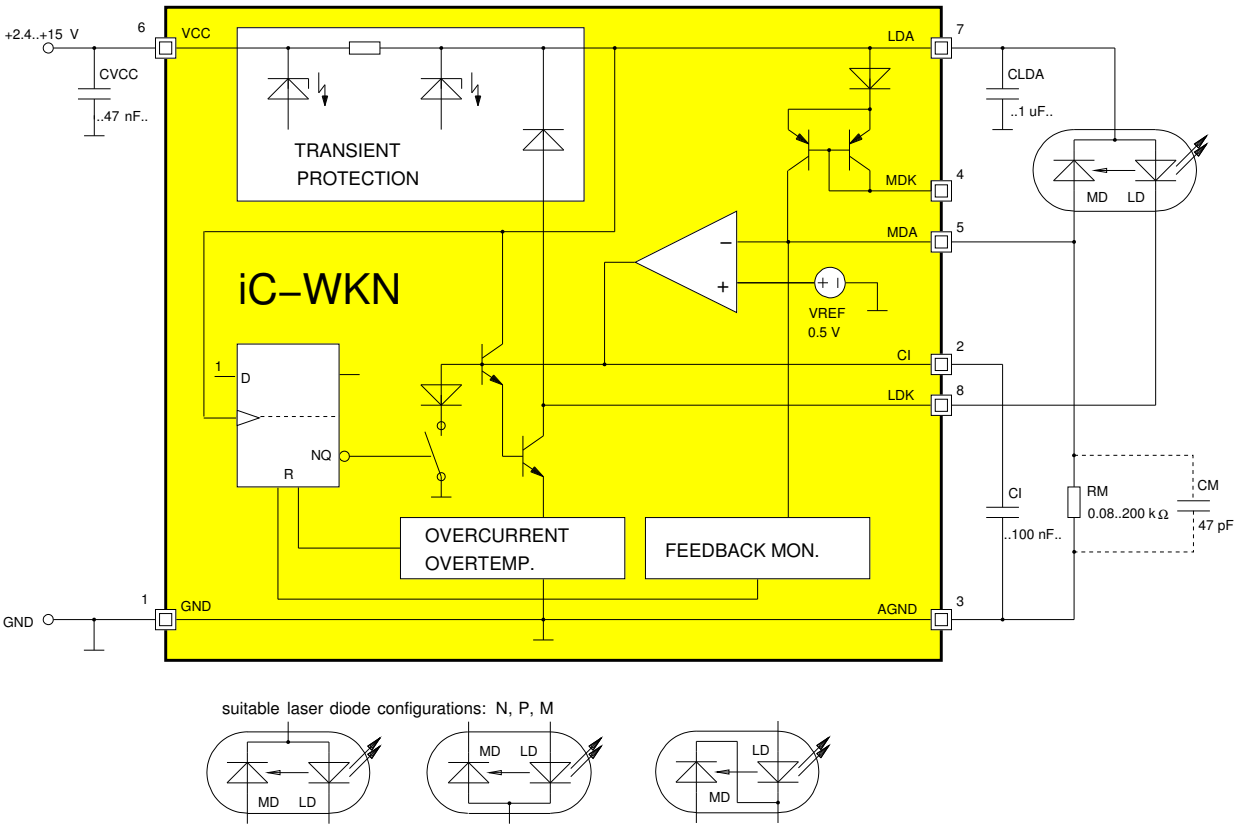
PACKAGES



SO8tp

DFN10
4 mm x 4 mm
(on request)

BLOCK DIAGRAM



DESCRIPTION

iC-WKN is a driver for laser diodes in continuous wave operation with laser currents of up to 300 mA, which requires only four external components. The wide power supply range of up to 15 V allows for operation of blue laser diodes.

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

The regulator is adapted to the laser diode 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: 2.5 µA to 6.25 mA). The capacitor at CI determines the control time constants and start-up time.

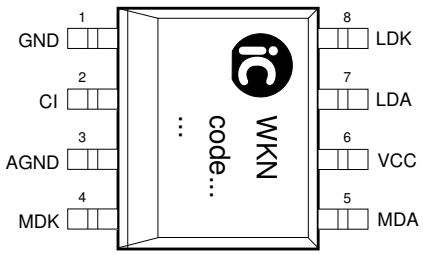
A second monitor input, pin MDK, allows the driver to be used for other types of laser diode configuration; alternatively, it can be used as an analog modulation input (DC to a few kHz).

In the event of failure, such as overcurrent in the laser path due to a lack of feedback, for example, a quick power lockout is activated. The shutdown persists 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.

iC-WKN offers additional protection by means of spike detection at pin MDA. Should spikes or oscillation occur at pin MDA the power lockout is activated after a certain time-out.

PACKAGES SO8tp, DFN10 4 mm x 4 mm to JEDEC standard

PIN CONFIGURATION SO8tp
(top view)

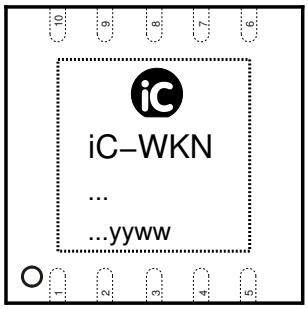


PIN FUNCTIONS

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...+15 V Supply Voltage
7	LDA	Laser Supply (LD Anode)
8	LDK	Driver Output (LD Cathode)

The *Thermal Pad* is to be connected to a Ground Plane on the PCB. Do not short-circuit pins AGND and GND, for this may deteriorate the precision of the regulator and interfere with the soft-start!

PIN CONFIGURATION DFN10 4 mm x 4 mm
(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	n.c.	
6	MDA	APC Setup, Monitor Input 1 (MD Anode)
7	n.c.	
8	VCC	+2.4...+15 V Supply Voltage
9	LDA	Laser Supply (LD Anode)
10	LDK	Driver Output (LD Cathode)

The *Thermal Pad* is to be connected to a Ground Plane on the PCB. Do not short-circuit pins AGND and GND, for this may deteriorate the precision of the regulator and interfere with the soft-start!

ABSOLUTE MAXIMUM RATINGS

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

Item-No.	Symbol	Parameter	Conditions	Fig.	Min.	Max.	Unit
G001	VCC	Voltage at VCC			-6	16	V
G002	I(VCC)	Current in VCC			-10	900	mA
G003	I(CI)	Current in CI			-10	10	mA
G004	I(LDA)	Current in LDA			-900	10	mA
G005	I(LDK)	Current in LDK			-10	900	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
G009	I(GND)	Current in GND			-900	10	mA
G010	Vd()	ESD Susceptibility at all pins	MIL-STD-883, Method 3015, HBM 100 pF discharged through 1.5 kΩ			2	kV
G011	Tj	Operating Junction Temperature			-40	150	°C
G012	Tj	Storage Temperature Range			-40	150	°C

THERMAL DATA

Operating Conditions: VCC = 2.4...15 V

Item-No.	Symbol	Parameter	Conditions	Fig.	Min.	Typ.	Max.	Unit
T01	Ta	Operating Ambient Temperature Range			-40		85	°C
T02	Rthja	Thermal Resistance Chip/Ambient	soldered to PCB; no additional cooling areas therm. pad soldered to approx. 2 cm² cooling area			 30	170 50	k/W 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 CHARACTERISTIC

Operating Conditions: VCC = 2.4...15 V, RM = 80 Ω...200 kΩ, Tj = -40...125 °C unless otherwise noted

Item-No.	Symbol	Parameter	Conditions	Tj °C	Fig.	Min.	Typ.	Max.	Unit
Total Device									
001	VCC	Permissible Supply Voltage				2.4		15	V
002	I(LDK)m	Permissible Laser Drive Current	power control range			10		300	mA
003	Idc(VCC)	Supply Current without load path	closed control loop, I(MDK) = 0, I(LDK) = 290 mA				10	20	mA
004	Ioff(VCC)	Supply Current on Reset					2.4	5	mA
005	Ir(VCC)	Reverse Supply Current	RM = 50 kΩ, VCC = -6 V			-6	-3		mA
006	ton()	Turn-on Delay	VCC: 0 → 5 V to 95 % I(LDK), I(LDK) = I(LDK)m; CI = 47 nF CI = 100 nF					 70 150	 µs µs
007	Vc()hi	Clamp Voltage hi at VCC, LDA	I()= 10 mA, other pins open			16		24	V
008	Vc()hi	Clamp Voltage hi at LDK	V() < VCC + 1 V; I() = 10 mA, other pins open			16		24	V
009	Vc()hi	Clamp Voltage hi at MDK vs. LDA	I() = 10 mA, other pins open			8		11	V
010	Vc()hi	Clamp Voltage hi at MDA, CI	I() = 10 mA, other pins open			1.1		4	V
011	Vc()lo	Clamp Voltage lo at VCC, LDA, MDK, MDA, CI	I() = -10 mA, 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	520	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) = 10...290 mA			-100		100	nA
104	dI(MDA)	Input Current Temperature Drift in MDA	see 103			-1		1	nA/°C
105	APCerr	Control Error	RM = 10 kΩ, Tj = 0...80 °C RM = 10 kΩ, Tj = -40...125 °C					0.3 1	% %
106	dI(RM)	Supply Voltage Suppression	V(VCC): 2.4 → 15 V, I(LDK) = 290 mA			-1.5		1.5	%
107	Rgnd()	Resistor AGND-GND						3	Ω
108	Vf(MDK)	Voltage at MDK	Vf() = V(LDA) - V(MDK), I(MDK) = 1 µA...1 mA			0.46		2	V
109	CR()	Current Ratio I(MDA) / I(MDK)	I(MDK) = 1 µA...1 mA I(MDK) = 1..6 mA			0.98 0.95		1.02 1.05	
110	TC()	Current Ratio Temperature Coefficient I(MDA) / I(MDK)	I(MDK) = 1 µA...1 mA I(MDK) = 1...6 mA			-0.005 -0.025		0.005 0.025	%/°C %/°C
Laser Driver LDA, LDK									
201	Vs(LDK)	Saturation Voltage at LDK	I(LDK) = 40 mA I(LDK) = 290 mA					350 700	mV mV
202	dI(LD)	Load Balancing Error	I(LD) = 20 mA, I(LDK): 20 mA → 290 mA			-1.5		1.5	%
203	It(LDK)	Overcurrent Threshold in LDK	V(LDK) = 2...5.5 V			300		700	mA
204	It(LDK)m	Maximum Overcurrent Threshold in LDK						1.2	A
205	toff()	Overcurrent Reset Delay	lack of feedback: I(MD) = 0 to I(LDK) = It(LDK); CI = 47 nF CI = 100 nF					 85 170	 µs µs
206	Vf()	Flyback Diode Forward Voltage LDK-LDA	I(LDK) < 290 mA					1.3	V
207	Rvcc()	Transient Protection Resistor	VCC to LDA					1.3	Ω
208	Vt(MDA)	Shutdown Threshold at MDA	t > 1 µs			0.7		2	V

ELECTRICAL CHARACTERISTIC

Operating Conditions: VCC = 2.4...15 V, RM = 80 Ω...200 kΩ, Tj = -40...125 °C unless otherwise noted

Item-No.	Symbol	Parameter	Conditions	Tj °C	Fig.	Min.	Typ.	Max.	Unit
Control Release Flip-Flop									
401	VCCen	Set Threshold for Enable Flip-Flop		 -40 27 125		0.6 1.2 1.0 0.6		1.9 1.9 1.7 1.2	V V V V
402	Toff	Overtemperature Shutdown				140		165	°C

SAFETY PRECAUTIONS

Laser light can damage the human eye and the eyes of animals. Do not look at any laser light directly or through any optical lens. When handling a laser diode, do not look directly at the light generated by it. Wear appropriate safety glasses to prevent light from entering the eye even by reflection.

FUNCTION DESCRIPTION

Turn-on behaviour

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

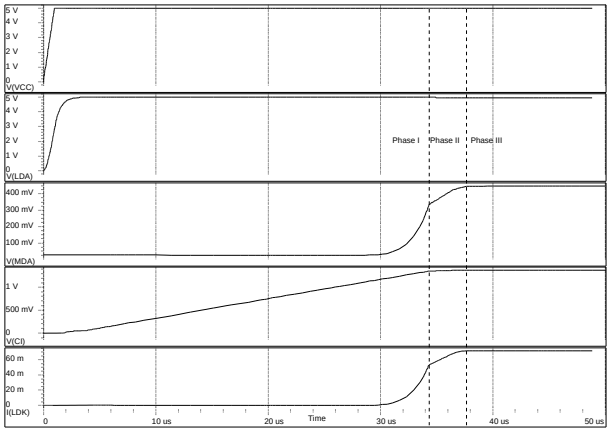


Figure 1: Turn-on behaviour

A quick soft-start follows during phase I; the control capacitor CI is charged at an accelerated rate until the voltage at pin MDA reaches 1/3 of its nominal value.

With $V(MDA) > 1/3V(MDA)_{nom}$ phase II starts, the controlled start-up. The transition to CW operation (phase III) is gradual and primarily determined by the values of CI and RM. CI is properly dimensioned when the voltage overshoot at MDA is at a minimum.

Turn-off behaviour

iC-WKN works 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 value, the output driver is forcibly saturated and the laser current decreases. iC-WKN simultaneously discharges the control capacitor CI so that no excessive laser diode currents occur when the supply voltage rises again.

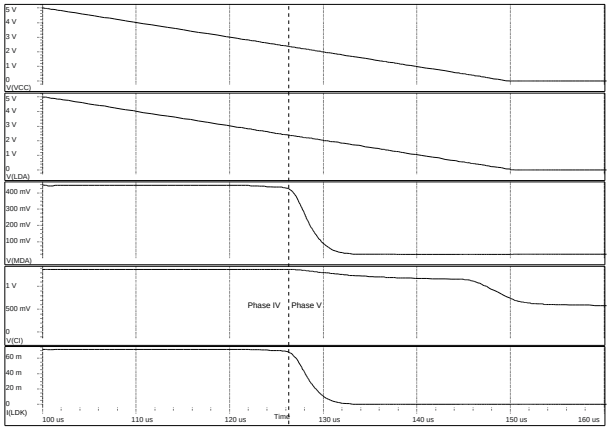


Figure 2: Turn-off behaviour

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 bias resistor RM fail, the device is shut down in less than 250 µs, provided that the supply voltage applied is high enough. When modulating the laser current via pin MDK, excessive voltage occurring at pin MDA also may cause a shutdown.

APPLICATION NOTES

Setting the output power

The output power is simply set by RM = V(MDA) / I(MD); with V(MDA) = Item-No. 101 and I(MD) = monitor current of the laser diode at the desired operating point. RM should be combined from a fixed resistor (max. output power) and a trimmer (calibration).

Further application notes on the iC-WK family (iC-WK, iC-WKL, iC-WKN) and the data sheet of the demo board are available as separate documents.

ORDERING INFORMATION

Type	Package	Order Designation
iC-WKN	SO8tp DFN10 4 mm x 4 mm	iC-WKN SO8 iC-WKN DFN10
Demo Board		WKN4D DEMO

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

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