

LED Driver PR4103

High Power LED Buck Converter

The PR4103 is a LED buck driver for driving one or several high power LEDs in series. The supply voltage can be up to 20 V, with an output current of more than 1 A using an external n-channel MOSFET switching transistor. The SOT23 package allows mounting on small-sized boards.

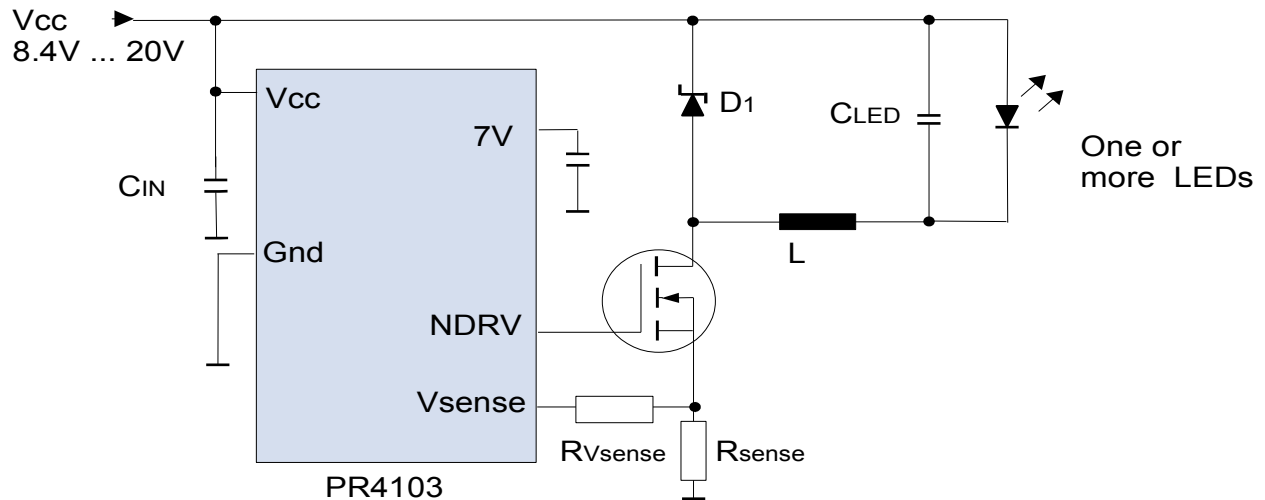
FEATURES

- Adjustable output current of 1 A and more
- Supply voltage up to 20 V
- Under voltage lockout

APPLICATIONS

- Halogen lamp or filament
- bulb replacement by LEDs
- General illumination
- Warning lights
- Automotive lighting
- LCD backlighting
- Indicator signs

CIRCUIT DIAGRAM



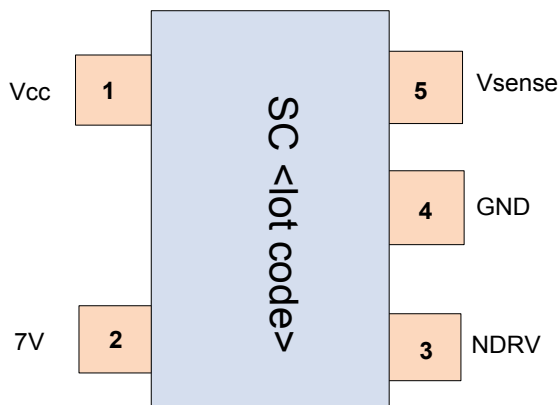
ABSOLUTE MAXIMUM RATINGS

Parameter	Min	Max	Units
VCC, VDI (no damage)	-0.3	23	[V]
All other pins		14	[V]
Operating Chip Temperature Range (over temperature protection)	-20	125	[°C]
Storage Temperature Range	-55	150	[°C]
Electrostatic Discharge (ESD) Protection	2		[kV]

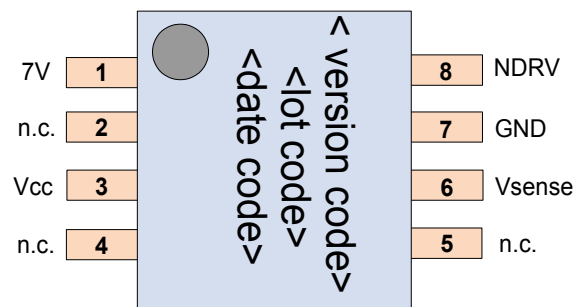
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IC PINs

PIN CONFIGURATIONS



PR4103A: Package SOT23-5
Topside marking: "SC" with lot code



PR4103B: Package SOP8
Topside marking: "PR4103"
"SC10"+version code

PIN DESCRIPTIONS

PIN No. PR4103A	PIN No. PR4103B	PIN Name	PIN Function Description
1	3	Vcc	Supply voltage
2	1	7 V	Internal 7 V linear regulator output. Connect a capacitor of 3.3 μ F to GND. Voltage is not for external use.
3	8	NDRV	Gate connection for an external n-channel MOSFET.
4	7	GND	Ground
5	6	Vsense	Feedback for controlling the output current. Connect this pin to the series resistor R_{Vsense} and the sense resistor R_{Sense} . The external MOSFET is switched off when the voltage at this pin is higher than V_{sense} .

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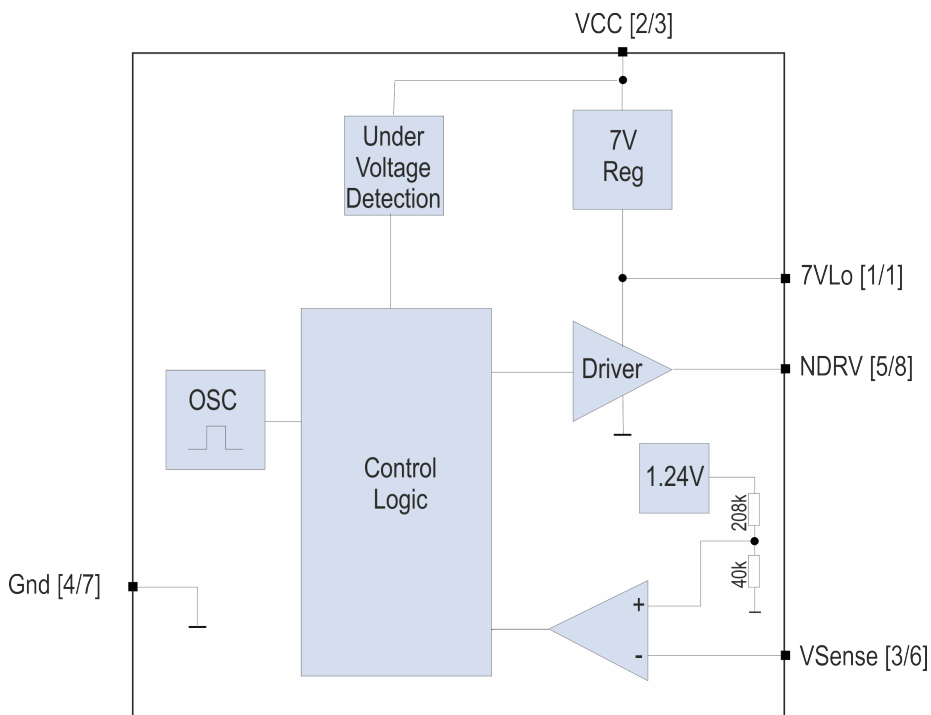
Characteristics

ELECTRICAL CHARACTERISTICS

V_{CC} = 12 VDC, T_a = 25°C, L = 470 µH (unless otherwise noted)

Symbol	Parameter	Min	Typ	Max	Units
V _{CC}	Supply voltage			21	[V]
VDI	Undervoltage detection	Start-up		9.0	[V]
		Shut-off	8.0	8.4	[V]
I _{suppON}	Supply current		3.0		[mA]
V _{NDRV}	Gate output voltage HIGH	5.0	5.8		[V]
I _{OUTsource}	Output source current at NDRV			50	[mA]
I _{OUTsink}	Output sink current at NDRV			20	[mA]
f _{OP}	Operating frequency		130		[kHz]
V _{SENSE}	Threshold voltage at R _{SENSE}		200		[mV]

BLOCK DIAGRAM



[... / ...]: Pin numbers for PR4103A / PR4103B

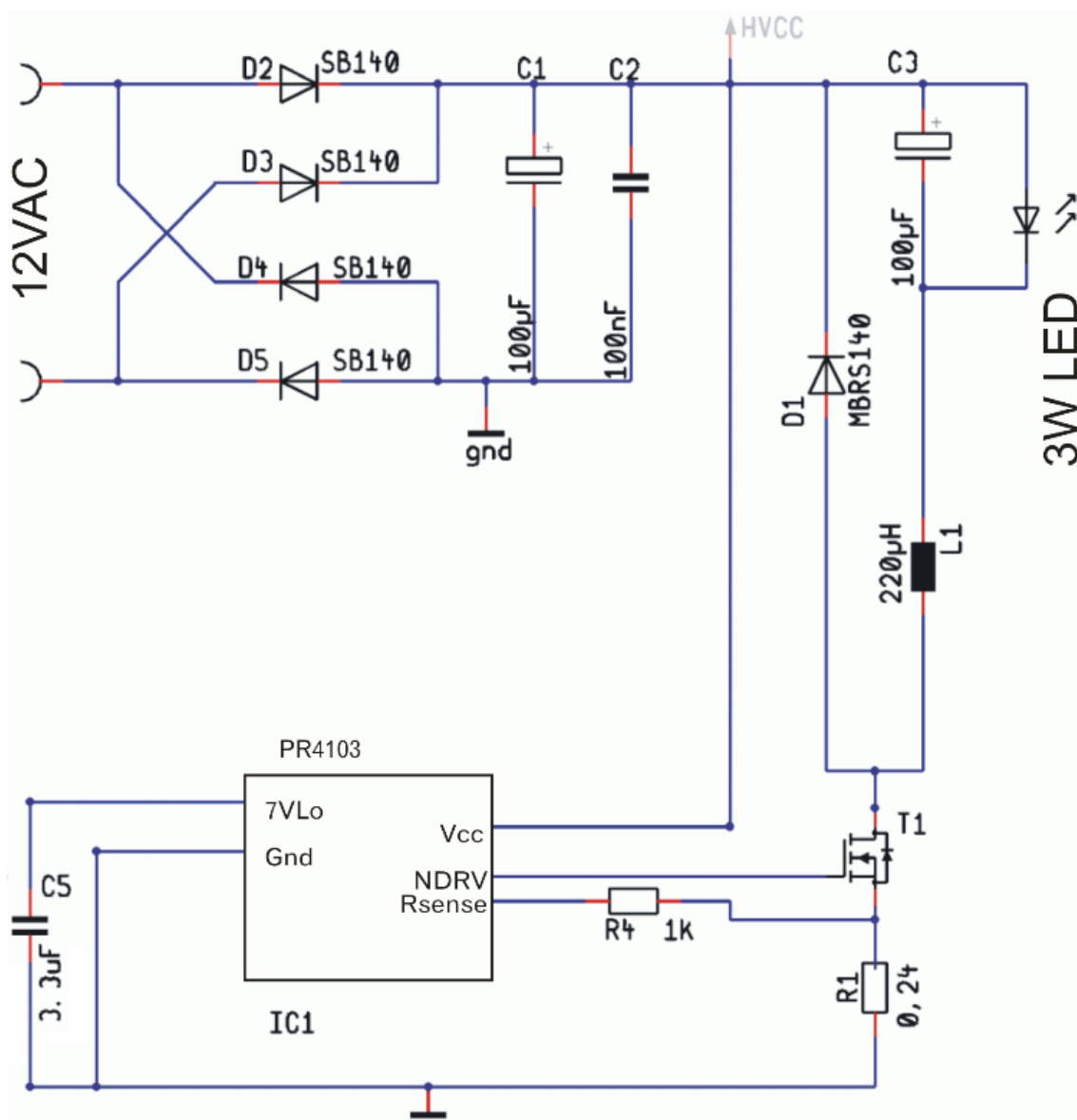
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Application Notes

TYPICAL APPLICATION WITH A 12 VAC POWER SUPPLY FOR A MINIMUM BOARD SIZE

The following circuit drives one LED from a 12 VAC supply. This circuit uses the PR4103A in SOT23 package and is optimized for a low number of small-sized external components to have a small PCB. LED and driver are supplied from the full-wave rectified and smoothed voltage. Ripples on the supply should be small enough to avoid a period in which the voltage becomes lower than the LED forward voltage, or below the undervoltage shut-off .

With $R_{SENSE} = 0.24 \Omega$, as utilized in the diagram, the LED current is approx. 850 mA. For varied target currents see the following section "Selection of R_{SENSE} ".



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Application Notes

SELECTION OF THE INPUT CAPACITOR C_{in}

The input capacitor is necessary in case of AC supply voltages to smooth the supply voltage. A value between 100 μF and 4700 μF for normal AC and of 470 μF up to 10000 μF for phase-cut supply voltages is recommended. In parallel a 100 nF capacitor should be placed close to the IC supply pins. Step-down regulators draw current from the input supply in pulses with very fast rise and fall times. The input capacitor is also required to reduce the resulting voltage ripple at the PR4103 input and to force this switching current into a tight local loop, minimizing EMI. The input capacitor must have a low impedance at the switching frequency to do this effectively, and it should have an adequate ripple current rating.

SELECTION OF THE EXTERNAL MOSFET

The n-channel MOSFET must have a gate threshold voltage of less than 3.8 V and a low ON resistance. To improve the behaviour of the module, long lines between the IC and the transistor should be avoided.

SELECTION OF THE EXTERNAL DIODE

A Schottky diode with fast recovery is needed to reduce the voltage drop. The diode must be able to carry the LED current flowing during the OFF time of the driver. The reverse voltage of the diode should be higher than the input voltage.

OPERATION WITH INSUFFICIENT VOLTAGES

In operation with several LEDs in series, it is possible that the supply voltage is higher than the undervoltage detection threshold, but insufficient to drive the programmed LED current because of the LED forward voltage. Then the desired LED current can obviously not be reached. In this case the MOSFET is permanently switched through, allowing the maximum LED current possible, but always less than the current setpoint. The PWM control

SELECTION OF INDUCTOR AND C_{LED}

Selection of the inductor value depends a lot on the supply voltage, the number of connected LEDs, but also on the allowed current ripple and the desired efficiency. For a smaller LED current higher values above 660 μH should be used. In case that a minimized board size is desired inductor values around 100 μH may be selected but efficiency and LED current ripple are not optimized in this case. The saturation current of the inductors must be higher than the LED peak current. A low DC resistance of the coil avoids additional loss of efficiency.

A capacitor value of C_{LED} between 22 μF and 1000 μF in parallel to the LED is recommended to reduce the LED current ripple and avoid exceeding the LED current rating.

does not work in this mode. When the supply rises, the converter will resume normal operation.

SELECTION OF R_{VSENSE} AND R_{SENSE}

The input V_{SENSE} needs a series resistor $R_{VSENSE} = 1 \text{ k}\Omega$ while the LED current is defined by the selection of R_{SENSE} . The nominal value of the current sense resistor can be calculated with the following formula:

$$R_{SENSE} = \frac{V_{SENSE}}{I_{LED}}$$

The value of V_{SENSE} can be found in the „Electrical Characteristics“.

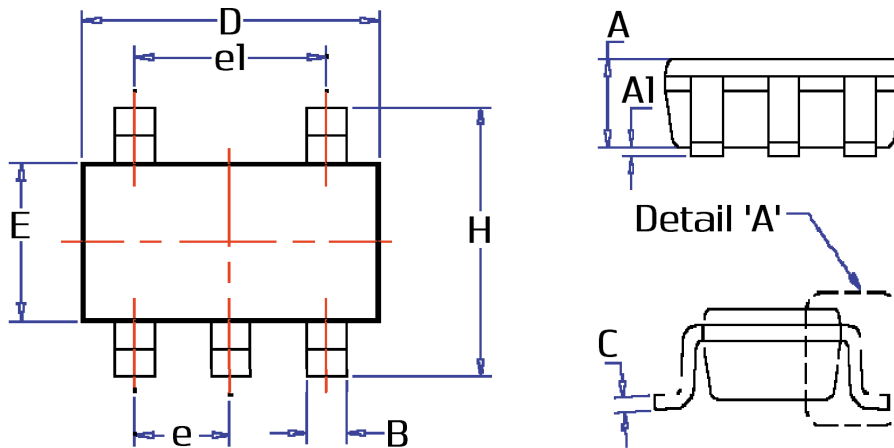
For example: With an LED current of 1 A and $V_{SENSE} = 200 \text{ mV}$, R_{SENSE} has a value of 200 m Ω . The following table gives some resistor values.

LED Current	R_{SENSE}
350 mA	0.571 Ω
700 mA	0.286 Ω
1000 mA	0.200 Ω

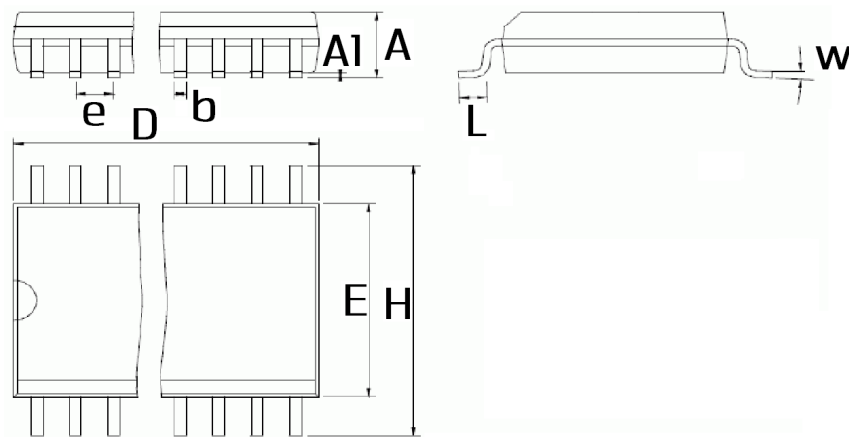
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Available Packages

SOT23-5 (PR4103A)



S08L PACKAGE (PR4103B)



Package		D	E	H	A	A1	A2	e	e1	B / b	L	w
SOT23-5 PR4103A	Nom.	2.90	1.60	2.80	1.10	0.05	0.80	0.95	1.90	0.40	0.20	
	Max.	3.10	1.80	3.00	1.30	0.10			2.10	0.50		
SOP 08L PR4103B	Nom.	4.90	3.90	6.00	1.75	0.15		1.27		0.41	0.72	4°
	Max.											

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Delivery in die form upon request.
All parts delivered comply with RoHS. Finish is pure tin.



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