

## 10-Channel LED Driver PR4010

The PR4010 is a 10 channel constant current driver with serial interface for LED display applications. The LED current is programmable via an external resistor. It can be used for single lines of LED, as well as for matrix displays. The device is available in a 20-pin SSOP package.

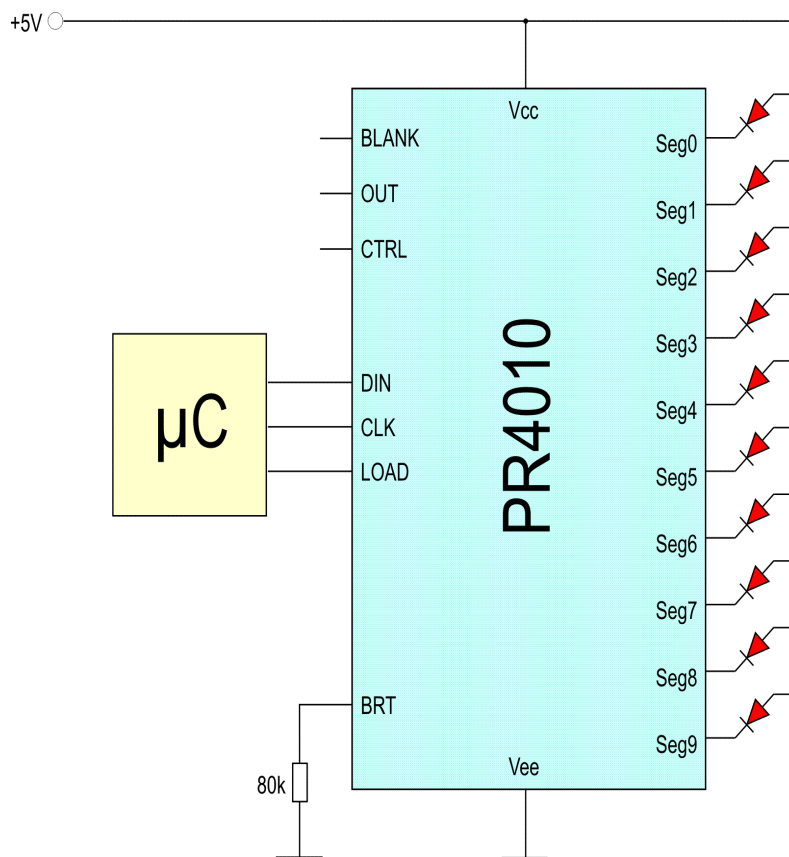
### Features

- 10 constant current sink channels
- Supply voltage 5V
- Serial interface, shift register with latch
- External brightness control
- Current output with max. sink current of 10mA
- Cascadable

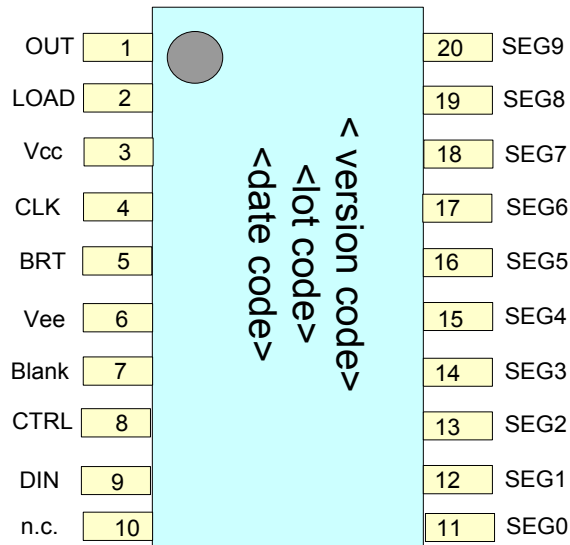
### Applications

- LED status displays
- Bargraph displays
- Indicator signs
- Instrument displays
- LED matrix text displays

### Typical Application



## Pin Configurations



Package SSOP-20

Topside marking:  
version code "PR4010" or "PR4001"

## Pin Description

Pin No	Pin Name	Pin Function Description
1	OUT	Output of SEG9 shift register flipflop, for cascading several PR4010
2	Load	Serial interface: load signal (data latched from shift register to output flipflop)
3	Vcc	Positive supply voltage
4	CLK	Serial Interface: clock signal
5	BRT	Output current setting
6	Vee	Negative supply voltage
7	Blank	Pulled to HIGH: sets the output current to zero; LOW or open: normal operation
8	CTRL	Open or pulled to HIGH: no function; LOW: inverts DIN signal
9	DIN	Serial interface: data input
10	n.c.	Not connected
11	SEG0	Segment 0 output
12	SEG1	Segment 1 output
13	SEG2	Segment 2 output
14	SEG3	Segment 3 output
15	SEG4	Segment 4 output
16	SEG5	Segment 5 output
17	SEG6	Segment 6 output
18	SEG7	Segment 7 output
19	SEG8	Segment 8 output
20	SEG9	Segment 9 output

## Absolute Maximum Ratings

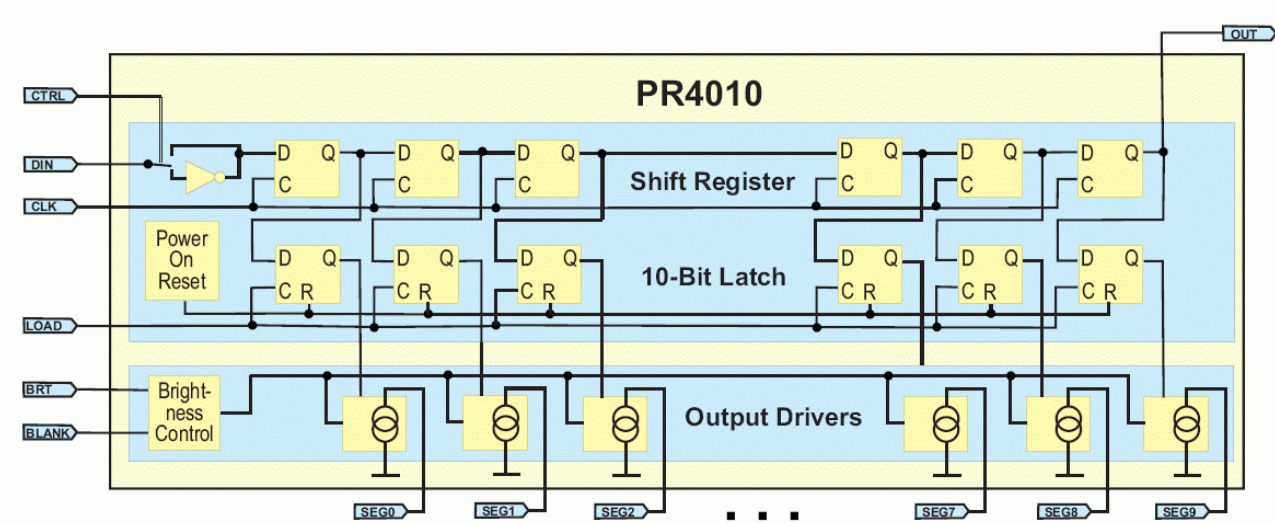
Parameter	Min	Max	Units
Maximum voltage at all pins (except BRT)	-0.3	10	V
Maximum sink current through pins Seg0..Seg9		10	mA
Operating junction temperature range	-20	125	°C
Storage temperature range	-55	150	°C
Electrostatic discharge (ESD) protection	2		kV

## Electrical Characteristics

V<sub>CC</sub>=5 VDC, T<sub>a</sub> = 25°C (unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V <sub>CC</sub>	Supply voltage range	I <sub>LEDmax</sub> = 5mA I <sub>LEDmax</sub> = 10mA	3.3 4.7		5.5 5.5	V
I <sub>CC</sub>	IC supply current	all outputs off all outputs on	0.5	1.0 n/a	2.0	mA
I <sub>LED</sub>	Current through pins Seg0..Seg9	V <sub>CC</sub> =5V, V <sub>out</sub> =0.8V R <sub>Brt</sub> =80 kOhm		5		mA
I <sub>LED</sub>	Current through pins Seg0..Seg9	V <sub>CC</sub> =5V, V <sub>out</sub> =0.6V R <sub>Brt</sub> =182 kOhm		2.5		mA
I <sub>LED</sub>	Current through pins Seg0..Seg9	V <sub>CC</sub> =5V, V <sub>out</sub> =0.3V R <sub>Brt</sub> =424 kOhm		1		mA
Δ I <sub>LED</sub>	LED current matching	I <sub>LED</sub> =2.5mA	-5		+5	%
V <sub>POR</sub>	Power on reset voltage			1.7		V
V <sub>IH</sub> V <sub>IL</sub> R <sub>PullUp</sub>	Logic input voltage High Logic input voltage Low Internal pull-up resistor from V <sub>CC</sub>	DIN, CLK, LOAD, CTRL	2.2		1.4	V V kΩ
V <sub>IH</sub> V <sub>IL</sub> R <sub>PullUp</sub>	Logic input voltage High Logic input voltage Low Internal pull-up resistor from V <sub>CC</sub>	BLANK	2.2	none	1.4	V V kΩ
I <sub>L</sub>	Sink current Low	OUT			0.5	mA
V <sub>BRT</sub>	Reference voltage at BRT		1.17	1.20	1.23	V
R <sub>BRT</sub>	Range of external resistance at BRT pin		50		1000	kΩ
Θ <sub>JA</sub>	Thermal resistance junction-ambient	SSOP-20 package, no air convection		160		°C/W

## Block Diagram



## Functional Description

The PR4010 is a 10-channel LED driver with serial interface, controllable current sinks and common output current control.

**Power-on reset:** As long as the supply voltage is below  $V_{POR}$ , all latches are set to '0', and the output drivers are off.

**DIN, CLK, LOAD:** The serial interface consists of 10 positive-edge-triggered D-type flipflops and input signals DIN (data bits), CLK (clock) and LOAD (transfer data from shift register to latch)

**BRT:** The reference current for the output drivers is set by a resistor between BRT and  $V_{EE}$ . BRT is held on reference voltage  $V_{BRT}$ .

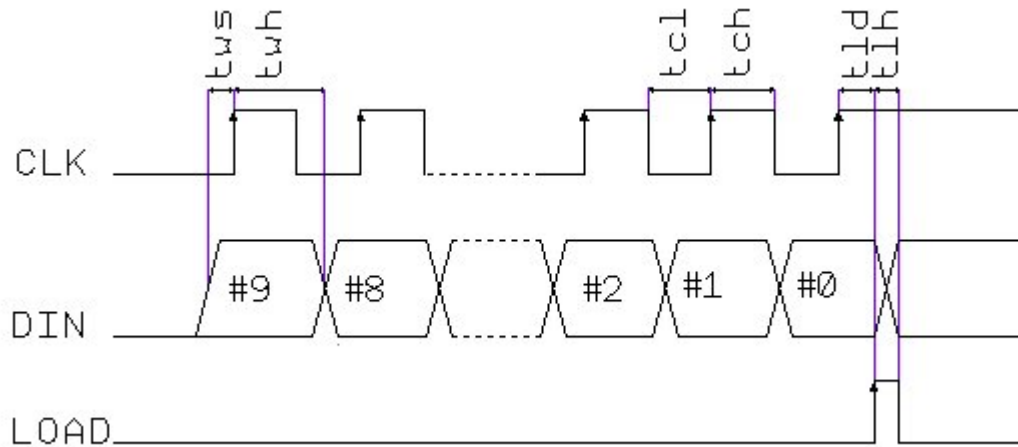
**BLANK:** If BLANK is set to '1', all output drivers will be set to zero output current. This will not affect the logic state of shift register or latch. It can be used e.g. for blinking or PWM brightness control. This input does not have an internal pull-up resistor. It can be open or pulled to LOW for normal operation.

**OUT:** The logic output OUT assumes the logic state of the output of the SEG9 flipflop. By connecting OUT with DIN of another IC, several PR4010 can be chained.

**CTRL:** The CTRL signal can invert the logic polarity of the DIN signal, to provide compatibility to certain applications. If CTRL is open or 'HIGH', the signal is processed in the normal way; if CTRL is 'LOW', the DIN signal is internally inverted. In the latter case also the OUT signal is inverted against the DIN data at the respective bit position, so if several PR4010 are cascaded, only the CTRL input of the first IC in the chain should be activated to avoid a double inversion.

## Communication

Typical sequence of the signal to control all 10 segments is shown in the following diagram.



The DIN signal is read at each positive edge of the CLK signal.

Signal timing is represented in following table:

Symbol	Parameter	Min	Typ	Max	Units
$t_{cl}$	'Clock' signal low level hold time	0.5		-	$\mu\text{s}$
$t_{ch}$	'Clock' signal high level hold time	0.5		-	$\mu\text{s}$
$t_{ws}$	'Write bit' setup time (time between DIN is valid and CLK positive edge)	0.2		$t_{cl}-0.2$	$\mu\text{s}$
$t_{wh}$	'Write bit' hold time (time during which DIN is valid and unchanged)	$t_{ch}+0.2$		$t_{ch}+t_{cl}-0.2$	$\mu\text{s}$
$t_{ld}$	'Load' signal delay (time between CLK positive edge for last bit to be transmitted and LOAD positive edge)	0.5		-	$\mu\text{s}$
$t_{lh}$	'Load' signal hold time	0.5		-	$\mu\text{s}$

## Application Notes

### Calculation of maximum ambient temperature

$V_{CC}$ : supply voltage for IC and LEDs  
 $I_{CC}$ : IC supply current (see Electrical Characteristics)  
 $V_{FLED}$ : LED forward voltage at the respective current  
 $I_{LED}$ : LED current per channel  
 $n_{LED}$ : number of LEDs switched on simultaneously  
 $P_{total}$ : total power dissipation in IC

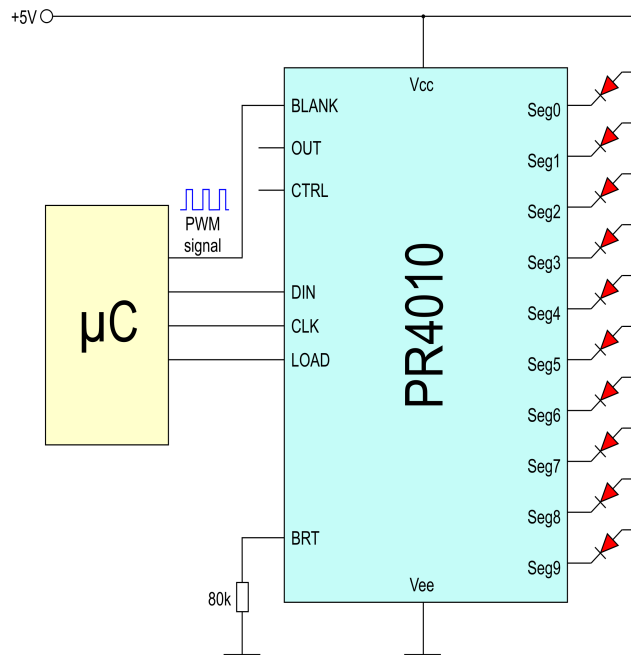
$$P_{total} = (V_{CC} - V_{FLED}) \cdot n_{LED} \cdot I_{LED} + V_{CC} \cdot I_{CC}$$

$T_A$ : ambient temperature  
 $T_{Jmax}$ : maximum junction temperature (see Absolute Maximum Ratings)  
 $\Theta_{JA}$ : thermal resistance of package (see Electrical Characteristics)  
 $T_{Amax}$ : maximum ambient temperature

$$T_{Amax} = T_{Jmax} - \Theta_{JA} \cdot P_{total}$$

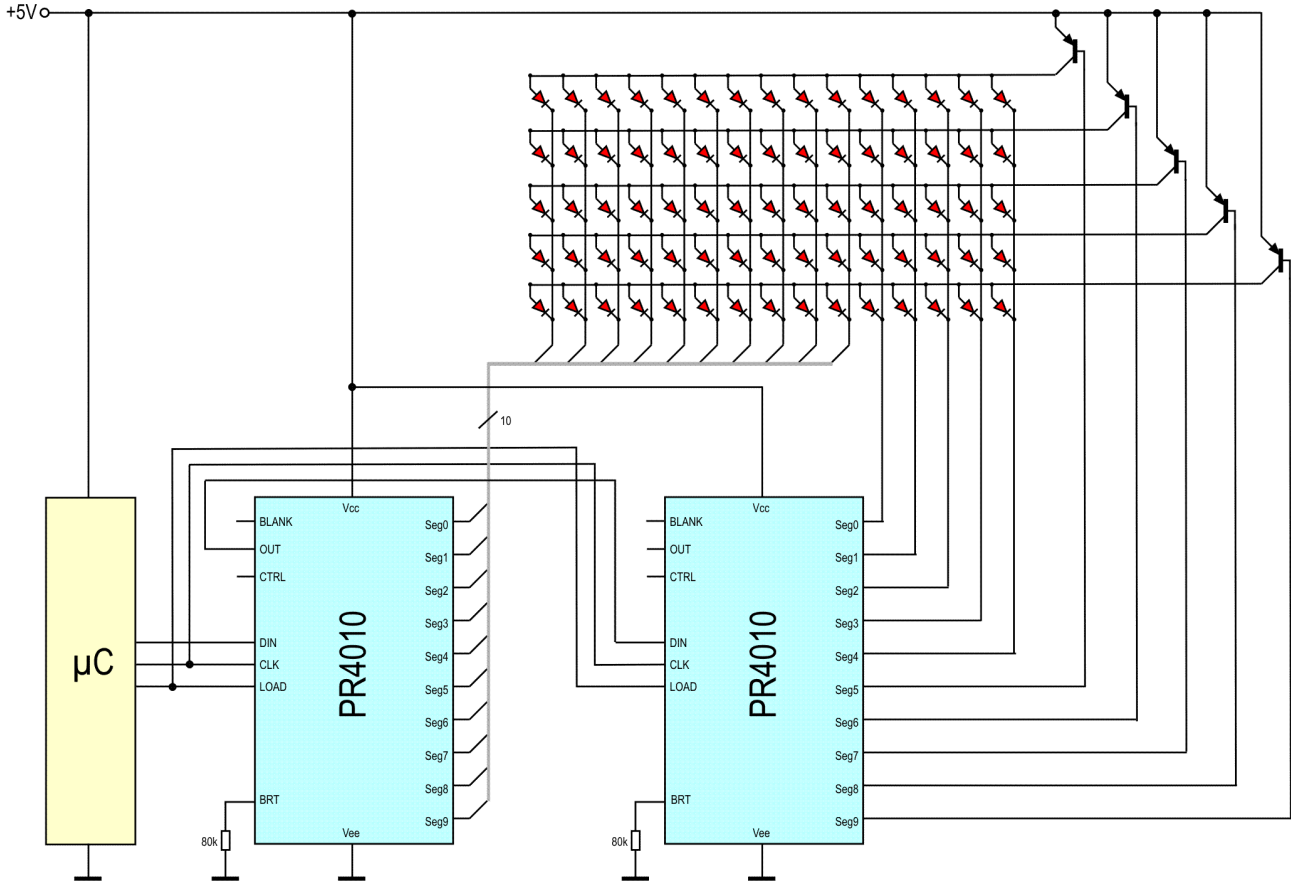
### Brightness control with PWM signal

Besides the control of the output current via the BRT signal, it is also possible to control the brightness with the BLANK input.



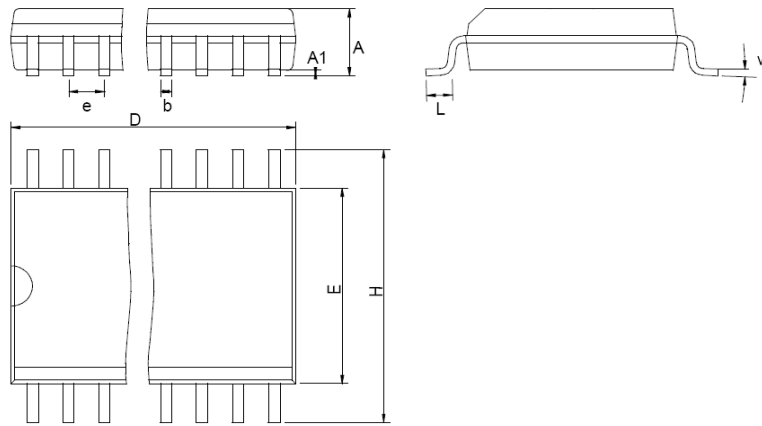
## Operation with dot matrix displays

With a small number of external components, PR4010 can be used to drive dot matrix displays.



In this example, five outputs are used to select one line via an external PNP transistor. Two PR4010 are cascaded to provide a total of 20 drivers. When multiplexing the control signals more than 75 LEDs in the display matrix can be operated.

## Available Package



**SSOP20 package**

		<i>D</i>	<i>E</i>	<i>H</i>	<i>A</i>	<i>A1</i>	<i>e</i>	<i>b</i>	<i>L</i>	<i>Copl.</i>	<i>w</i>
SSOP 20	nom. max.	8.65	3.90	6.00	1.75	0.15	0.635	0.26	0.72	0.10	4°

All parts comply with RoHS. Finish is pure tin.



**Pb-free**



**pure tin**

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