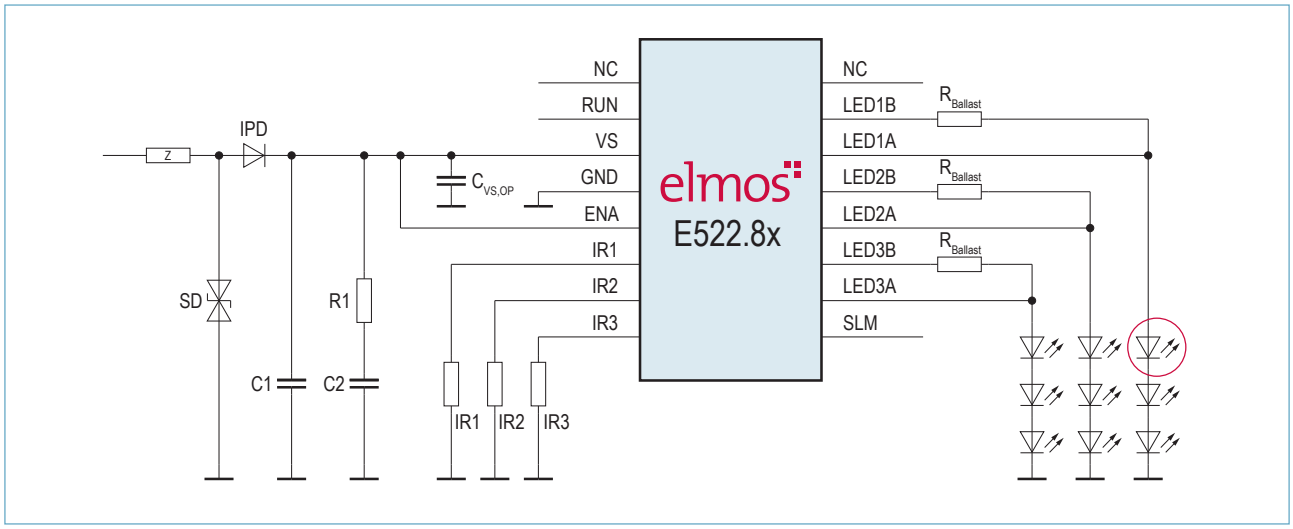
1 Purpose

Detection of a short circuit of one LED in a string.



2 Application description / problem

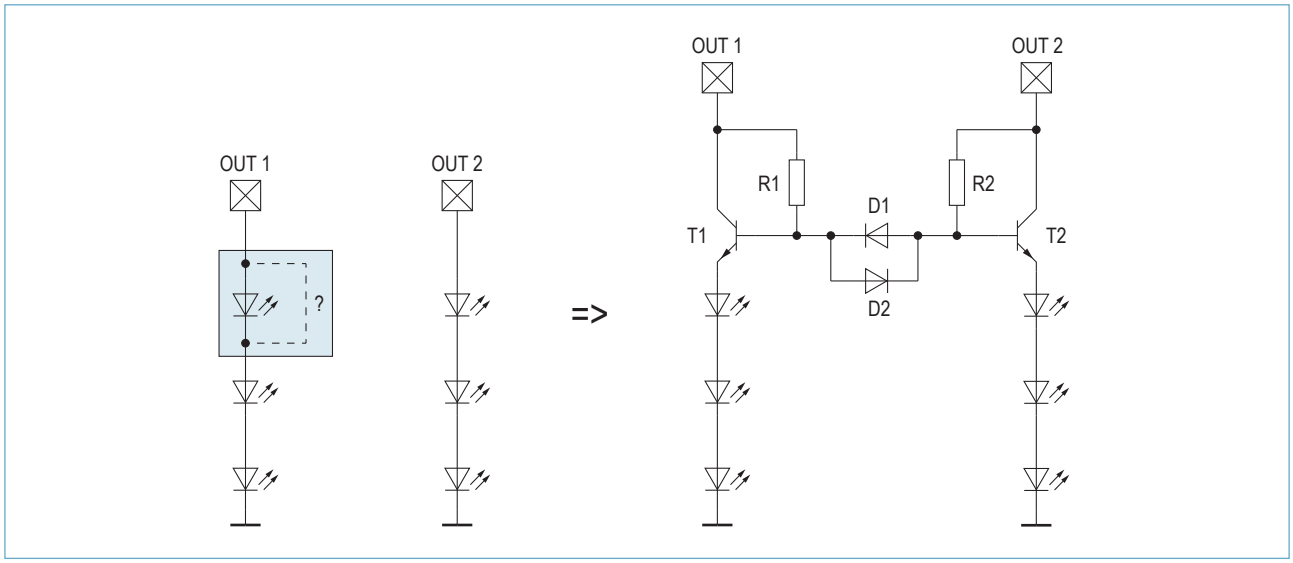
In some application it is necessary to detect a short-circuit-failure of one LED in a string using a LED driver. Especially in applications for rear light the need of such a failure detection increases. Typical IC already provide a detection of short-circuit to ground or an open failure. It will be shown using minimum two strings it is possible with just a few external components to detect a single LED short-circuit within one string.

3 Condition

This external circuit is intended for LED strings with comparable string voltages.

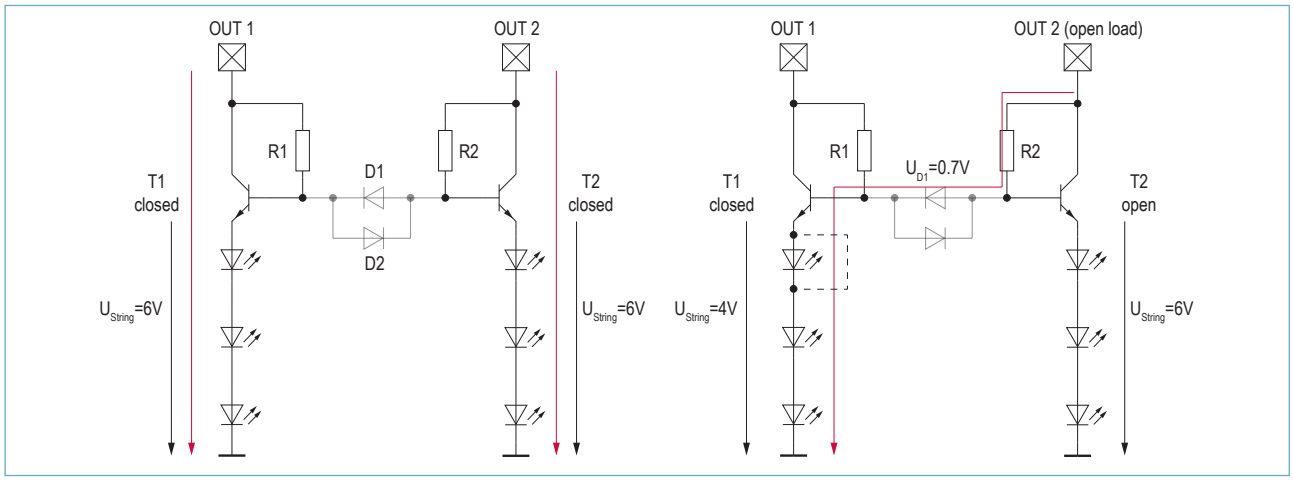
4 Solution

With just a few components the IC can detect a single short-circuit at each string. Between the output of the LED driver and the LED string there is an electrical switch, a bipolar transistor.



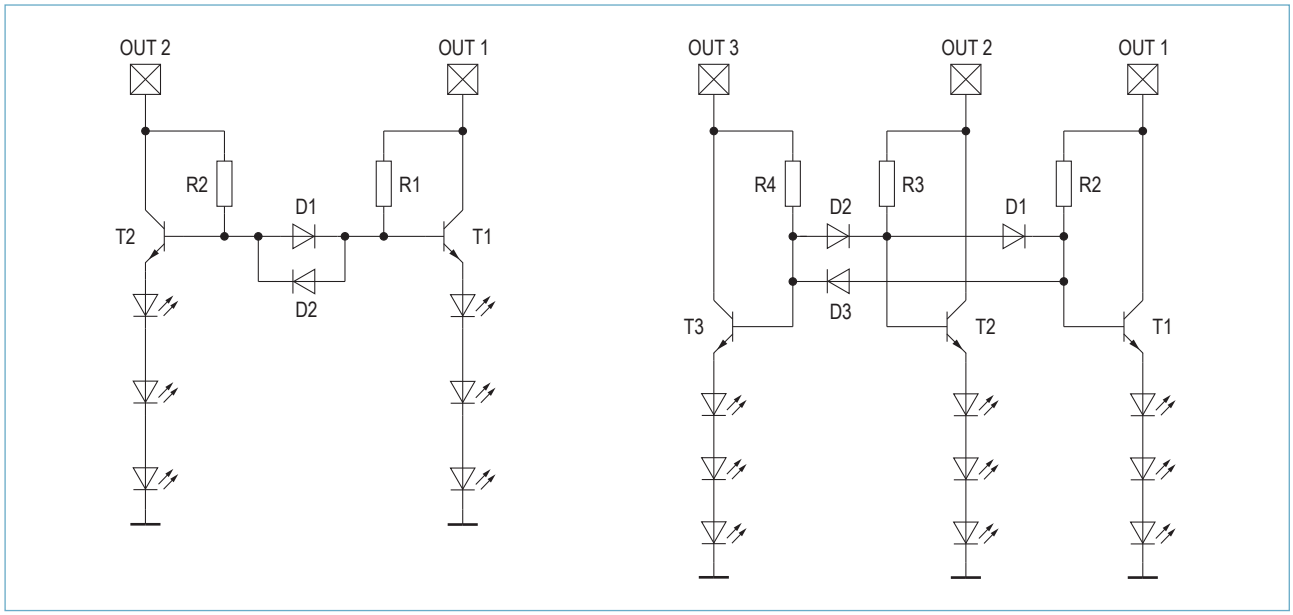
Note: patent pending

When there is no failure the switches are closed and the provided current flows through the LEDs. In case of a short circuit the corresponding diode between the strings get conductive and the current flows through the diode into the opposite string with the shorted LED. The dimension of the diode determines the threshold to detect the short-circuit.



This concept is based on the potential differences between these two strings. In normal operation the potential is nearly the same and both transistors are closed. In failure condition the potentials get different: The string voltage of the shorted string decreases and therefore the corresponding diode gets conductive. The diode drop is the reason that the Base-Emitter voltage goes below the threshold to close the transistor T2 and the IC detects an open-failure at Out 2.

The exemplary circuit are shown below.



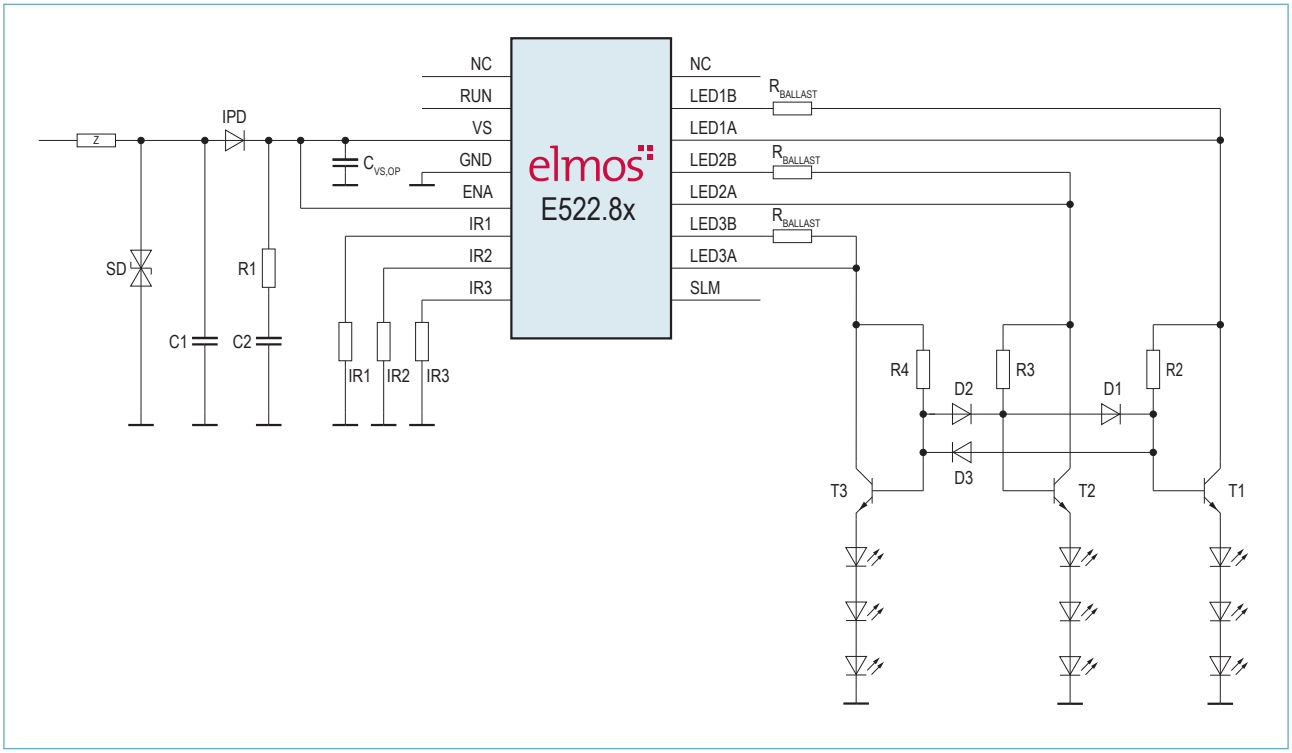
This external circuit delivers a workaround to detect a short-circuit across one LED over the open failure detection on the adjacent LED string. To use this the following conditions have to be taken into consideration:

- short circuit in String 1 →open detection in Output2 and Output3
- short circuit in String 2 →open detection in Output3 and Output1
- short circuit in String 3 →open detection in Output1 and Output2

This conditions are the reason why the use of the Failure Feedback Mode is not recommended.
This external circuit just can be used in Single Lamp Mode. Therefore leave the SLM Pin open.

Note: patent pending

In the picture below this concept is shown for the E522.80 with three independent LED-Driver.



Components	Description
Z	Network resistance
SD	Suppressor diode (bidirectional like SMAJ28CA or SMAJ30CA)
IPD	Reverse polarity diode
R1	1.5Ω => optional IC independent damping element
C1	10-100nF
C2	2.2µF => optional IC independent damping element
$C_{VS,OP}$	220-330nF
IR1-3	Dependent on Application between 9.53-30kΩ
$R_{Ballast}$	Dependent on Application
R2-R4	1kΩ, package size 0603,sufficiently low impedance to drive the base of the high-beta NPN, on the other sufficiently high impedance to allow the open-detection at a neighboring channel
T1-T3	=> NXP 2PC4081S/R, ideally Version S, but also Version R is possible, depending on power dissipation BC817-25 or BC817-40 for higher gain
D1-D3	=> Copackaged as BAS40V-7/40V/Dual Independent/ AEC-Q101/IF=200mA => Non copackaged as BAS40/40V/Single/AEC-Q101/ IF=200mA

If higher tolerances between the two adjacent LED strings are needed, an alternate diode with larger V_f has to be taken into consideration.

Note: patent pending

Usage Restrictions

Elmos Semiconductor AG provide the E522.80-87 Demonstration Board simply and solely for IC evaluation purposes in laboratory. The Kit or any part of the Kit must not be used for other purposes or within non laboratory environments. Especially the use or the integration in production systems, appliances or other installations is prohibited.

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Elmos Semiconductor AG – Headquarters
Heinrich-Hertz-Str. 1 | 44227 Dortmund | Germany
Phone +49 (0) 231-75 49-100 | Fax +49 (0) 231-75 49-159
sales-germany@elmos.com | www.elmos.com

Note: patent pending