

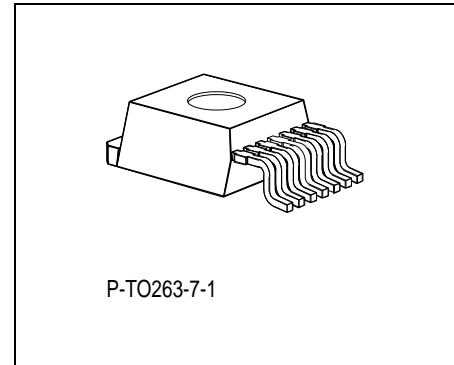
Adjustable LED Driver

TLE 4242 G

Target Data

Features

- Adjustable constant current up to 500mA ($\pm 5\%$)
- Wide input voltage range up to 42V
- Low drop voltage
- Open load detection
- Overtemperature protection
- Short circuit proof
- Reverse polarity proof
- Wide temperature range : $- 40^{\circ}\text{C}$ to 150°C



Type	Ordering Code	Package
TLE 4242 G		P-TO-263-7-1 (SMD)

Functional Description

The TLE 4242 G is an integrated adjustable constant current source driving loads up to 500 mA. The output current level can be adjusted via an external resistor. The IC is designed to supply high power LEDs (eg. Osram Dragon LA W57B) under the severe conditions of automotive applications resulting in constant brightness and extended LED lifetime. It is provided in the surface mounted P-TO-263-7-1 package. Protection circuits prevent damage to the device in case of overload, short circuit, reverse polarity and overheat. The connected LEDs are protected against reverse polarity as well as excess voltages up to 45 V.

The integrated PWM input of the TLE 4242 G permits LED brightness regulation by pulse width modulation. Due to the high input impedance of the PWM input the LED driver can be operated as a protected high side switch.

Circuit Description

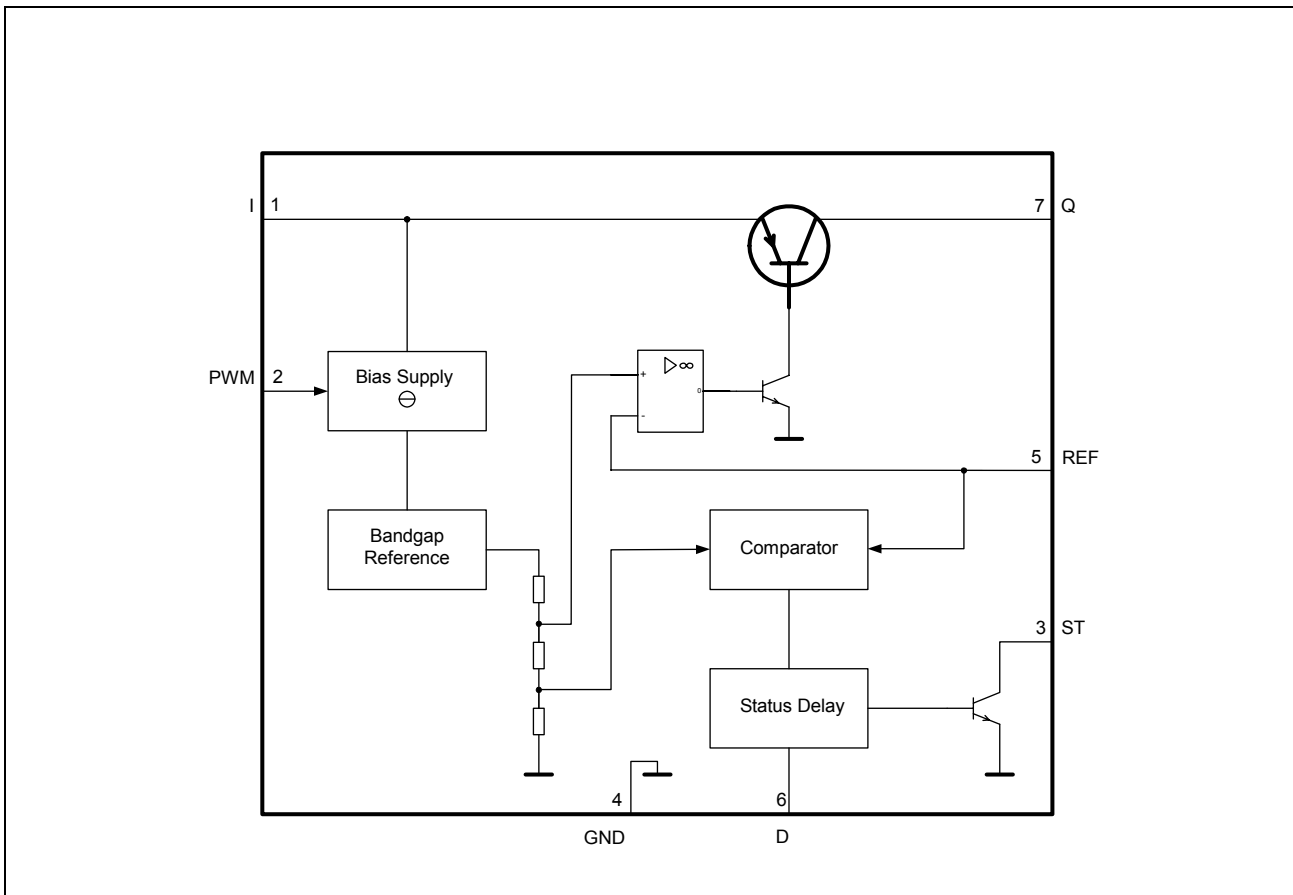


Figure 1 Block Diagram

An external shunt resistor in the ground path of the connected LEDs is used to sense the LED current. A regulation loop holds the voltage drop at the shunt resistor on a constant level of typ. 180 mV. Selecting the shunt resistance permits to adjust the appropriate constant current level. The typ. output current calculates

$$I_{Q, \text{typ}} = \frac{V_{\text{REF}}}{R_{\text{REF}}}$$

where V_{REF} is the reference voltage with a typical level of 180 mV (see Fig. page 10) . The equation applies in a range of $0.39 \Omega \leq R_{\text{REF}} \leq 1.8 \Omega$.

The output current is shown as a function of the reference resistance on page 10. With the PWM input the LED brightness can be regulated via duty cycle. Also PWM=L sets the TLE 4242 in sleep mode resulting in a very low current consumption of $\ll 1\mu\text{A}$ typ. Due to the high impedance of the PWM input (see Fig. I_{PWM} versus V_{PWM} on page 12) the PWM pin can thus also be used as an enable input.

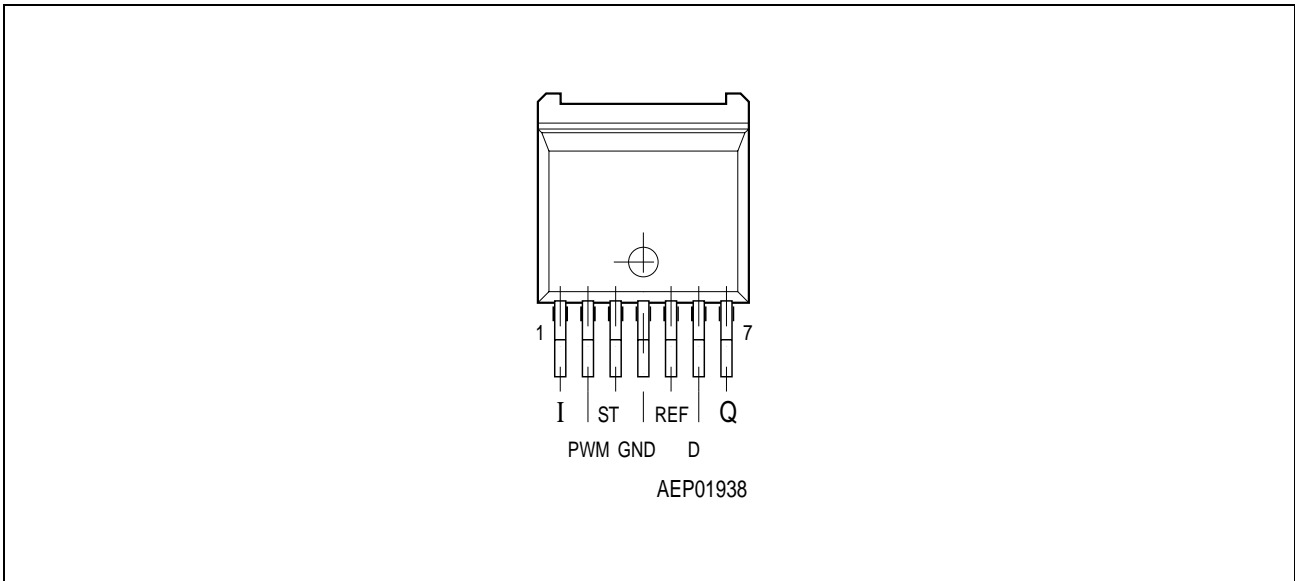


Figure 2 Pin Configuration (top view)

Pin Definitions and Functions

Pin No.	Symbol	Function
1	I	Input ; block to GND directly at the IC with a 100 nF ceramic capacitor.
2	PWM	Pulse Width Modulation Input ; if not needed connect to I
3	ST	Status Output ; open collector output, connect to external pull up resistor ($R_{pull\ up} \geq 4.7\ k\Omega$).
4	GND	Ground.
5	REF	Reference Input ; connect to shunt resistor.
6	D	Status Delay ; connect to GND via an optional capacitor to set status reaction delay. Leave open if no ST delay is needed.
7	Q	Output

Application Information

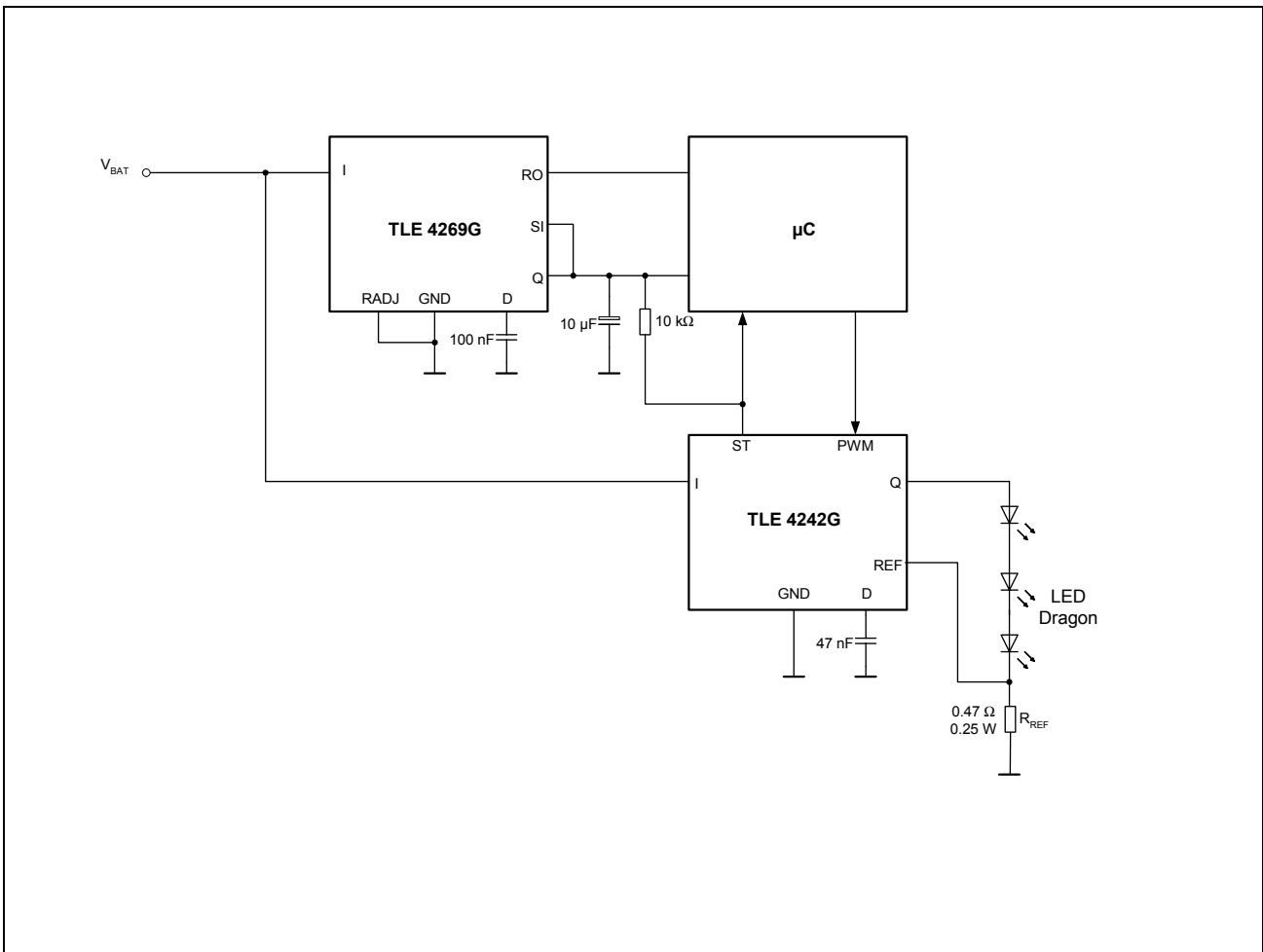


Figure 3 Application Circuit

Fig. 3 shows a typical application with the TLE 4242 G LED driver. The 3 LEDs are driven with an adequate supply current adjusted by the resistor R_{REF} . Thus brightness variations due to forward voltage spread of the LEDs are prevented. The luminosity spread arising from the LED production process can be compensated via software by an appropriate duty cycle applied to the PWM pin. Hence selection of the LEDs to forward voltage as well as to luminosity classes can be spared. The minimum supply voltage calculates as the sum of the LED forward voltages, the TLE 4242 G drop voltage (max. 0.7 V at a LED current of 300 mA) and the max. voltage drop at the shunt resistor R_{REF} of max 187 mV.

The status output of the LED driver (ST) detects an open load condition enabling to supervise correct LED function. A LED failure is detected if the voltage drop at the shunt resistor R_{REF} falls below typ. 25 mV. In this case the status output pin ST is set low after a delay time adjustable via an optional capacitor connected to the pin D.

The functionality of the ST and PWM as well as their timings are shown in Fig. 4. The Status delay can be adjusted via the capacitor connected to the timing Pin D. The delay time scales in linear way with the capacitance C_D :

$$t_{STHL,typ} = \frac{C_D}{47nF} \times 10ms$$

$$t_{STLH,typ} = \frac{C_D}{47nF} \times 10\mu s$$

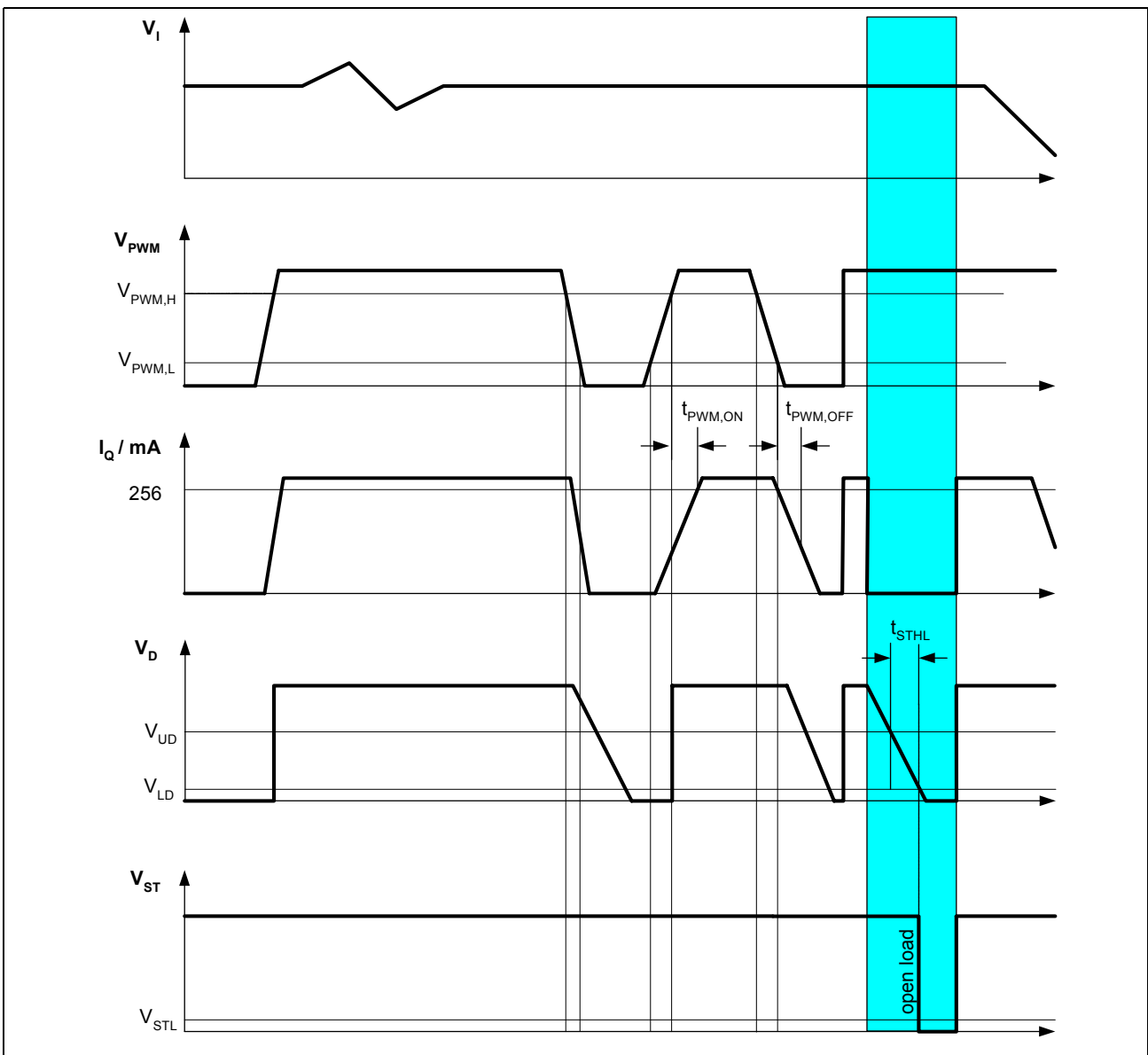


Figure 4 Function and Timing Diagram

Absolute Maximum Ratings
 $-40\text{ °C} < T_j < 150\text{ °C}$

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		

Input

Voltage	V_I	- 42	45	V	-
Current	I_I	-	-	mA	internally limited

Output

Voltage	V_Q	- 1	40	V	-
Current	I_Q	-	-	mA	internally limited

Status Output

Voltage	V_{ST}	- 0.3	40	V	-
Current	I_{ST}	- 5	5	mA	-

Status Delay

Voltage	V_D	- 0.3	7	V	-
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Reference Input

Voltage	V_{REF}	-1	16	V	-
Current	I_{REF}	- 2	2	mA	-

Pulse Width Modulation Input

Voltage	V_{PWM}	- 40	40	V	-
Current	-	- 1	1	mA	-

Temperatures

Junction temperature	T_j	- 40	150	°C	-
Storage temperature	T_{stg}	- 50	150	°C	-

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		

Thermal Resistances

Junction ambient	R_{thja}	–	78	K/W	¹⁾ Footprint only
		–	52	K/W	300mm ² heat sink area
		–	39	K/W	600mm ² heat sink area
Junction case	R_{thjc}	–	3	K/W	

¹⁾ Worst case regarding peak temperature; mounted on PCB FR4, 80 × 80 × 1.5 mm³, 35 μm Cu

Note: Maximum ratings are absolute ratings; exceeding any one of these values may cause irreversible damage to the integrated circuit

Operating Range

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		
Input voltage	V_I	4.5	42	V	–
Status output voltage	V_{ST}	–	16	V	–
Status Delay capacitance	C_D	0	2.2	μF	–
PWM voltage	V_{PWM}	0	40	V	–
Junction temperature	T_j	– 40	150	°C	–
Reference Resistor	R_{REF}	0	1.8	Ω	–

Electrical Characteristics

$V_I = 13.5 \text{ V}$; $R_{REF} = 0.47 \text{ } \Omega$; $V_{PWM} \geq V_{PWM,H}$; $-40 \text{ } ^\circ\text{C} < T_j < 150 \text{ } ^\circ\text{C}$; all voltages with respect to ground; positive current defined flowing into pin; unless otherwise specified

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Current consumption off mode	I_{qOFF}	–	0.1	2	μA	$\text{PWM} = \text{L}, T_j < 85^\circ\text{C}$
Current consumption	I_{qL}	–	12	22	mA	$V_Q = 6.6 \text{ V}$

Output

Output current	I_Q	364	383	402	mA	$V_Q - V_{REF}^{1)} = 6.6 \text{ V}$
		171	180	189	mA	$V_Q - V_{REF} = 6.6 \text{ V}$; $R_{REF} = 1.0 \text{ } \Omega$
		438	461	484	mA	$V_Q - V_{REF} = 6.6 \text{ V}$; $R_{REF} = 0.39 \text{ } \Omega$
		345	383	420	mA	$5.4 \text{ V} \leq V_Q - V_{REF} \leq 7.8 \text{ V}$; $9 \text{ V} \leq V_I \leq 16 \text{ V}$
Output current limit	I_{Qmax}	–	600	–	mA	$R_{REF} = 0 \text{ } \Omega$
Drop voltage	V_{dr}	–	0.35	0.7	V	$I_Q = 300 \text{ mA}$

PWM Input

PWM high level	$V_{PWM,H}$	2.6	–	–	V	–
PWM low level	$V_{PWM,L}$	–	–	0.7	V	–
PWM input current high level	$I_{PWM,H}$	–	220	500	μA	$V_{PWM} = 5.0 \text{ V}$
PWM input current low level	$I_{PWM,L}$	– 1	–	1	μA	$V_{PWM} = 0.0 \text{ V}$
Turn on delay time	$t_{PWM,ON}$	0	15	40	μs	30%/70% I_Q , see Fig. 4
Turn off delay time	$t_{PWM,OFF}$	0	15	40	μs	30%/70% I_Q , see Fig. 4

Electrical Characteristics (cont'd)

$V_I = 13.5 \text{ V}$; $R_{REF} = 0.47 \text{ } \Omega$; $V_{PWM} \geq V_{PWM,H}$; $-40 \text{ } ^\circ\text{C} < T_j < 150 \text{ } ^\circ\text{C}$; all voltages with respect to ground; positive current defined flowing into pin; unless otherwise specified

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		

Reference

Reference Voltage	V_{REF}	173	180	187	mV	-
Reference Input Current	I_{REF}	-1	0.1	1	μA	$V_{REF} = 180 \text{ mV}$

Status Output

Lower status switching threshold	V_{IQL}	15	25	-	mV	ST = L
Upper status switching threshold	V_{IQH}	-	30	40	mV	ST = H
Status low voltage	V_{STL}	-	-	0.4	V	$I_{ST} = 1.5 \text{ mA}$
Leakage current	I_{STLK}	-	-	5	μA	$V_{ST} = 5.0 \text{ V}$

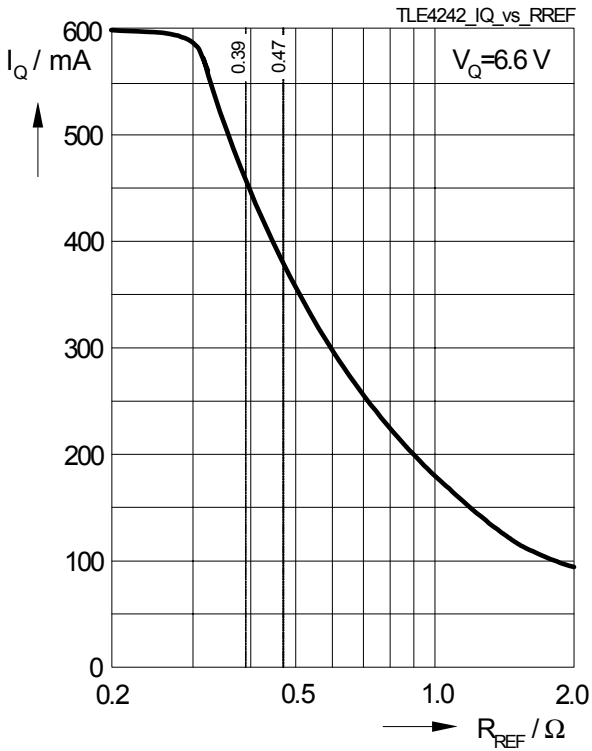
Status Delay

Status reaction delay	t_{STHL}	6	10	14	ms	$C_D = 47 \text{ nF}$, ST H→L
Status release delay	t_{STLH}	-	10	20	μs	$C_D = 47 \text{ nF}$, ST L→H

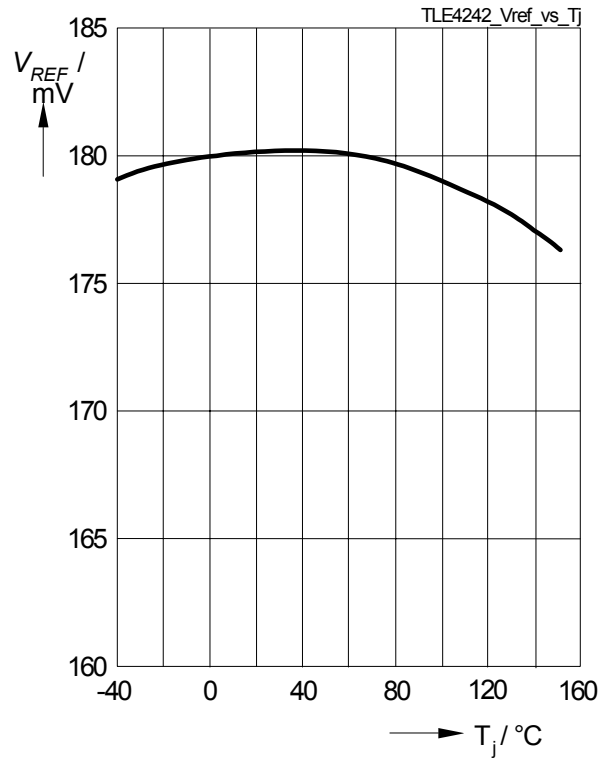
¹⁾ $V_Q - V_{REF}$ equals the forward voltage sum of the connected LEDs, see Fig.3

Typical Performance Characteristics

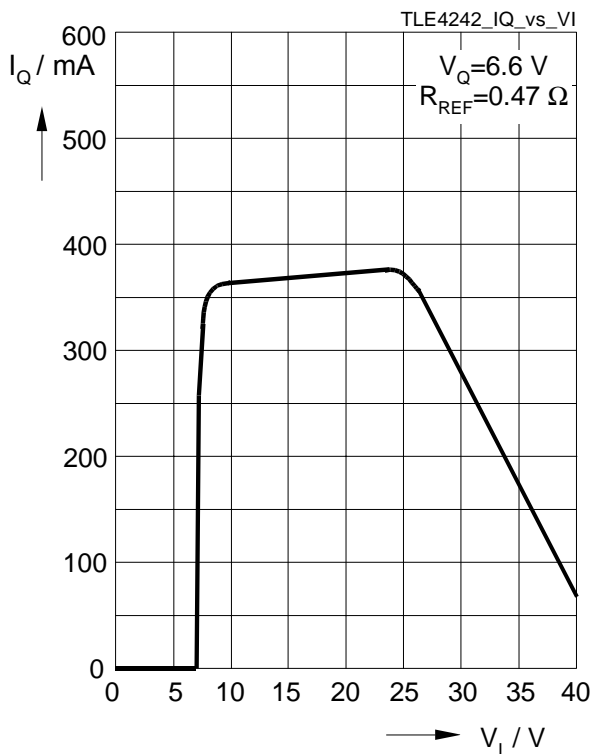
Output Current versus External Resistor



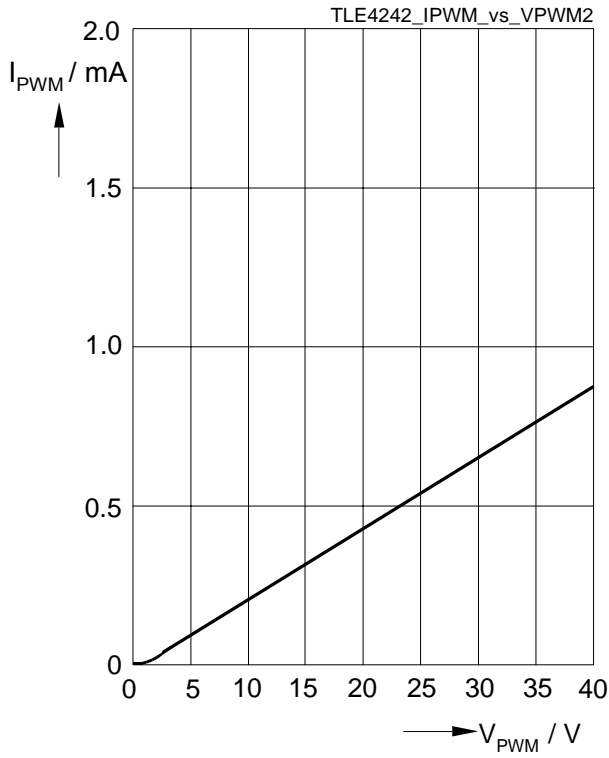
Reference Voltage versus Junction Temperature



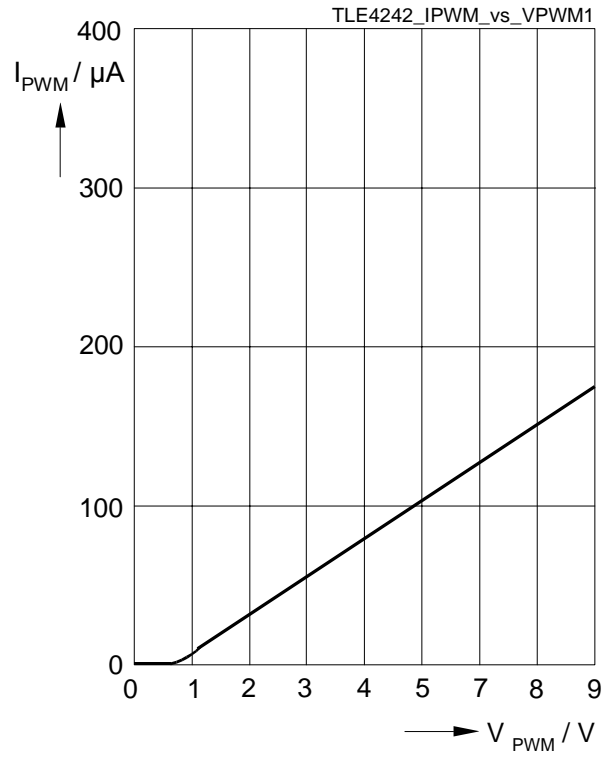
Output Current versus Supply Voltage



PWM Pin Input Current versus PWM Voltage



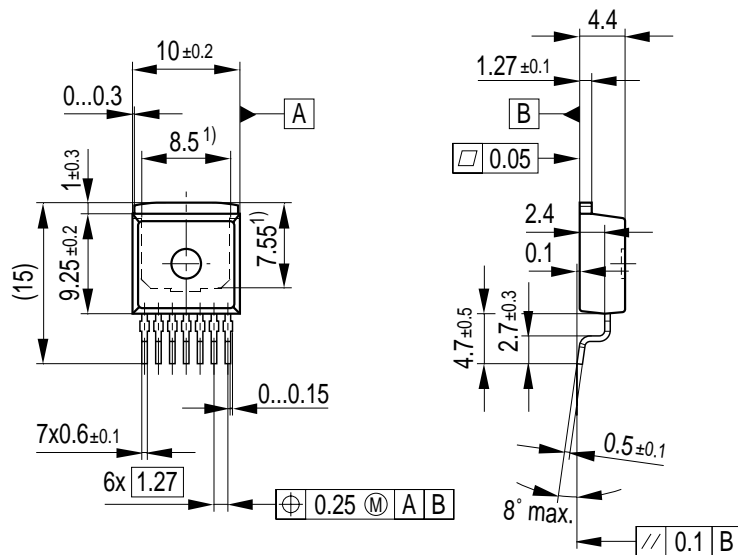
PWM Pin Input Current versus PWM Voltage



Package Outlines

P-TO-263-7-1

(Plastic Transistor Single Outline Package)



- 1) Typical
Metal surface min. X=7.25, Y=6.9
All metal surfaces tin plated, except area of cut.

Sorts of Packing

Package outlines for tubes, trays etc. are contained in our Data Book "Package Information".

SMD = Surface Mounted Device

Dimensions in mm

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