

Adjustable Current LITIX[™] Linear

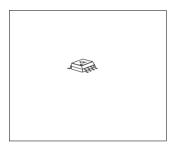
TLE4241GM



Features

- Adjustable constant output current
- Wide input voltage range
- Low drop voltage
- Open load detection
- Overtemperature protection
- Short circuit proof
- Reverse polarity proof
- Wide temperature range: -40 °C < T_i < 150 °C
- Very small SMD-Package
- Green Product (RoHS compliant)
- AEC Qualified

Functional Description



The **TLE4241GM** is an integrated adjustable constant current source. It provides an output current adjustable via different means (SET, PWM, reference resistor) which is kept nearly independent from load and supply voltage changes. The IC is designed to supply LEDs under the severe conditions of automotive applications resulting in constant brightness and extended LED lifetime. It is provided in the very small P-DSO-8-9 (Micro 8) package. Protection circuits prevent damage to the device in case of overload, short circuit, reverse polarity and overtemperature. The connected LEDs are protected against reverse polarity as well as excess voltages up to 45 V. A status output allows handling of open load and short circuit at the main output.

A PWM input offers the possibility to adjust the LED brightness by pulse width modulation.

With an implemented high/low current switch the output current level can be reduced e.g. for brake/tail light application.

The implemented features such as adjustable output current, the high/low current switch and the provided PWM input make the device well suited for a broad range of LED and other applications.

Туре	Package
TLE4241GM	P-DSO-8-9

Data Sheet



Circuit Description

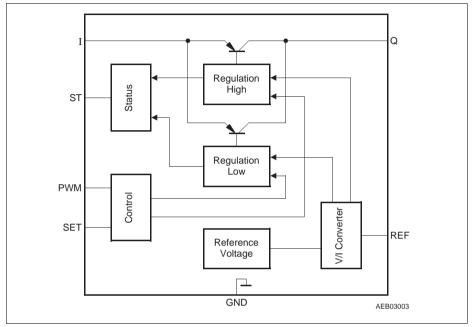


Figure 1 Block Diagram

An internal reference voltage of typ. 1.20 V supplies the REF pin which is connected to GND via an external resistor. In the SET = H mode the reference current flowing on the REF pin is mirrored with an amplification to form the desired output current. The typ. output current in the SET = H mode calculates:

$$I_{Q, typ}/mA = \frac{1.20}{R_{REF}/k\Omega} \times 487 + 0.1$$
 (1)

The output current is shown as a function of the reference resistance on **Page 10** for the high as well as for the low current mode.

With the PWM input the LED brightness can be regulated via duty cycle. Also PWM = L sets the TLE4241 in sleep mode resulting in a very low current consumption of << 1 μ A typ. Due to the high impedance of the PWM input (see timing diagram I_{PWM} versus V_{PWM} on **Page 12**) the PWM pin can thus also be used as an Enable input.



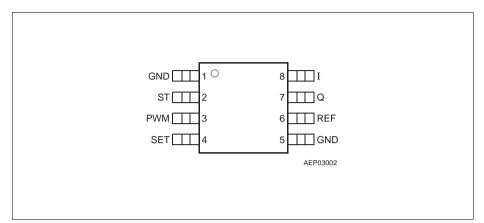


	Figure 2	Pin Configuration (top view)
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Table 1	Pin Defii	Pin Definitions and Functions					
Pin No.	Symbol	bol Function					
1	GND	Ground; internally connected to pin 5					
2	ST	Status Output; open collector output, connect to external pull-up resistor (10 k Ω or higher)					
3	PWM	Pulse Width Modulation Input; if not needed connect to V_1					
4	SET	High/Low Current Input; choice of current level					
5	GND	Ground; internally connected to pin 1					
6	REF	Reference Input; connect to GND via an external resistor to adjust the output current					
7	Q	Output					
8	I	Input ; block to GND directly at the IC with a 100 nF ceramic capacitor					

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Application Information

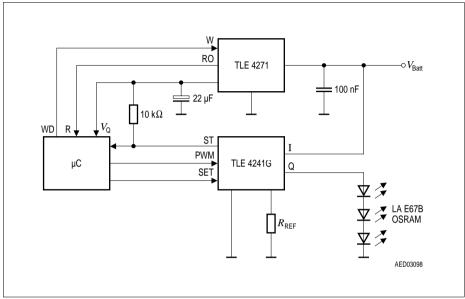


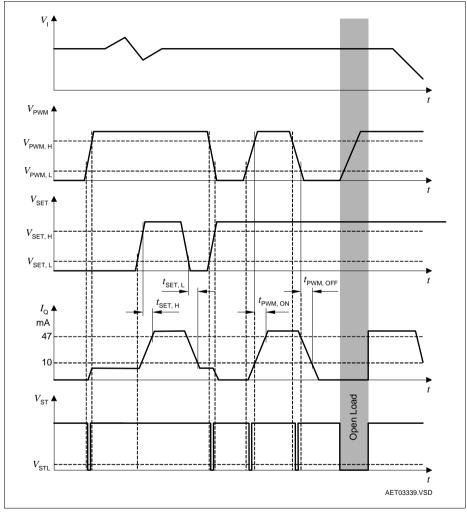
Figure 3 Application Circuit

Figure 3 shows a typical application with the TLE4241GM LITIXTM Linear. 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 slightly negative temperature coefficient of the TLE4241GM output current protects the LEDs against over-temperature stress if the IC is placed nearby the LEDs.

The voltage drop ($V_{\rm I} - V_{\rm Q}$) across the TLE4241GM is monitored in order to detect an open load condition indicated at the status output pin ST. In case of open load, the voltage drop will decrease below the lower status switching threshold $V_{\rm dr,L}$. Hence, the status output ST will be driven low. In normal operation, the voltage drop is above the upper status threshold $V_{\rm dr,H}$, thus the open collector output ST is in high-ohmic state (see also section Status Output at the Electrical Characteristics).

The function of ST, SET and PWM as well as their timings are shown in Figure 4.







Function and Timing Diagram

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Table 2 Absolute Maximum Ratings

-40 °C < *T*_i < 150 °C

Parameter	Symbol	Limit	Values	Unit	Remarks
		Min.	Max.		
Input	I	1			
Voltage	$V_{\rm I}$	-42	45	V	-
Current	I	-	-	mA	internally limited
Output	L				
Voltage	V_{Q}	-1	40	V	-
Current	IQ	-	-	mA	internally limited
Status Output			1		
Voltage	$V_{\rm ST}$	-0.3	40	V	-
Current	I _{ST}	- 5	5	mA	internally limited
Reference Input					
Voltage	V_{REF}	-0.3	7	V	-
Current	I _{REF}	-2	2	mA	-
Pulse Width Modulation In					
Voltage	V_{PWM}	-40	40	V	-
Current	-	-1	1	mA	-
High/Low Current Input					
Voltage	V_{SET}	-40	40	V	-
Current	I _{SET}	-1	1	mA	-
Temperatures	I	4			
Junction temperature	T	-40	150	°C	-
Storage temperature	T _{stg}	-50	150	°C	-
Thermal Resistances		1		1	
Junction ambient	$R_{ m thja}$	-	105	K/W	1)

1) Worst case regarding peak temperature; mounted on PCB 80 \times 80 \times 1.5 mm³, 35 μm Cu, 300 mm² heat sink area.

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



Table 3Operating Range

Parameter	Symbol	Limi	t Values	Unit	Remarks
		Min.	Max.	1	
Input voltage	$V_{\rm I}$	4	45	V	-
Status output voltage	$V_{\rm ST}$	-	16	V	-
SET voltage	V_{SET}	0	40	V	-
PWM voltage	V_{PWM}	0	40	V	-
Junction temperature	Tj	-40	150	°C	-
Reference Resistor	R _{REF}	7	100	kΩ	SET = H
		4.7	18	kΩ	SET = L



Table 4 Electrical Characteristics

9 V $\leq V_{\rm I} \leq$ 16 V; $R_{\rm REF}$ = 10 kΩ; $V_{\rm PWM} \geq V_{\rm PWM,H}$; -40 °C < $T_{\rm J}$ < 150 °C; all voltages with respect to ground; positive current defined flowing into pin; unless otherwise specified

Parameter	Symbol	Limit Values			Unit	Test Condition
		Min.	Тур.	Max.		
Current consumption off mode	$I_{\rm qOFF}$	-	0.1	4	μA	PWM = L, $T_{\rm J}$ < 85 °C $V_{\rm I} \le$ 13.5 V
Current consumption	I _{qL}	-	4	7	mA	SET = L; $V_{\rm Q}$ = 6 V
Current consumption	I_{qH}	-	5	7	mA	SET = H; V_Q = 6 V
Current consumption open load	$I_{\rm qL,O}$	-	-	8	mA	SET = L; V_{Q} open
Current consumption open load	$I_{\rm qH,O}$	-	-	8	mA	SET = H; V_{Q} open
Output					4	
Output current	IQ	7	8.4	9.5	mA	SET = L, V_Q = 6 V
		-	8.6	-	mA	SET = L, V_Q = 4 V
Output current	I _Q	50	58.5	65	mA	SET = H, $V_{\rm Q}$ = 6 V
		-	60.0	-	mA	SET = H, V_Q = 4 V
Current Ratio	$I_{\rm QH}/I_{\rm QL}$	6	7	8	-	-
Output current limit	I _{Qmax}	-	83	-	mA	SET = L; R_{REF} = 0 Ω
Output current limit	I _{Qmax}	-	83	-	mA	SET = H; R_{REF} = 0 Ω
Drop voltage	V_{dr}	-	0.2	0.5	V	SET = L; $I_{\rm Q}$ = 80% of $I_{\rm Q,nom,L}$
Drop voltage	V_{dr}	-	0.3	0.5	V	SET = H; I_Q = 80% of $I_{Q,nom,H}$
PWM Input						
PWM high level	$V_{\rm PWM,H}$	2.0	-	-	V	-
PWM low level	$V_{PWM,L}$	-	-	0.5	V	-
PWM input current high level	I _{PWM,H}	-	220	500	μΑ	V _{PWM} = 5.0 V
PWM input current low level	$I_{\rm PWM,L}$	-10	-	10	μA	$V_{\rm PWM}$ = 0.0 V
Turn on delay time	t _{PWM,ON}	0	5	30	μS	20%/80% <i>I</i> _Q , see Figure 4



Table 4 Electrical Characteristics (cont'd)

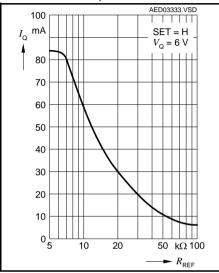
9 V $\leq V_{\rm I} \leq$ 16 V; $R_{\rm REF}$ = 10 kΩ; $V_{\rm PWM} \geq V_{\rm PWM,H}$; -40 °C < $T_{\rm j}$ < 150 °C; all voltages with respect to ground; positive current defined flowing into pin; unless otherwise specified

Parameter	Symbol	Limit Values			Unit	Test Condition	
		Min.	Тур.	Max.			
Turn off delay time	t _{PWM,OFF}	0	10	30	μS	20%/80% <i>I</i> _Q , see Figure 4	
SET Input							
SET high level	$V_{\rm SET,H}$	2.0	-	-	V	-	
SET low level	$V_{\rm SET,L}$	-	-	0.5	V	-	
SET input current high level	$I_{\rm SET,H}$	-	220	500	μA	$V_{\rm SET}$ = 5.0 V	
SET input current low level	$I_{\rm SET,L}$	-10	-	10	μA	$V_{\rm SET}$ = 0.0 V	
Delay time L -> H	t _{SET,H}	-	-	30	μS	20%/80% <i>I</i> _Q , see Figure 4	
Delay time H -> L	t _{SET,L}	-	-	30	μS	20%/80% <i>I</i> _Q , see Figure 4	
Status Output	L						
Lower status switching threshold	$V_{\rm dr,L}$	0.15	-	-	V	$(V_1 - V_Q)$ decreasing SET = L	
		0.15	-	-	V	$(V_1 - V_Q)$ decreasing SET = H	
Upper status switching threshold	$V_{\rm dr,H}$	-	-	0.7	V	$(V_1 - V_Q)$ increasing SET = L	
		-	-	0.7	V	$(V_1 - V_Q)$ increasing SET = H	
Status low voltage	V _{STL}	-	-	0.4	V	$(V_{\rm I} - V_{\rm Q}) < V_{\rm dr,L}$ $I_{\rm ST}$ = 1.0 mA	
Leakage current	I _{STLK}	-	-	10	μΑ	$(V_1 - V_Q) > V_{dr,H}$ $V_{ST} = 5.0 \text{ V}$	
	1	1	1	1	1	-	

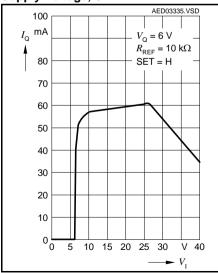


Typical Performance Characteristics

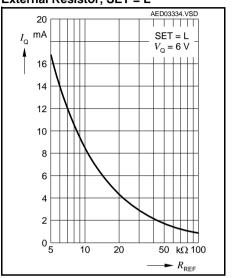
Output Current versus External Resistor, SET = H



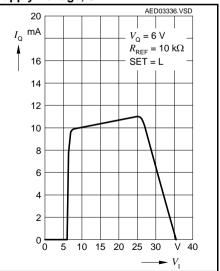
Output Current versus Supply Voltage, SET = H



Output Current versus External Resistor, SET = L

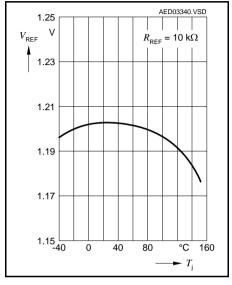


Output Current versus Supply Voltage, SET = L





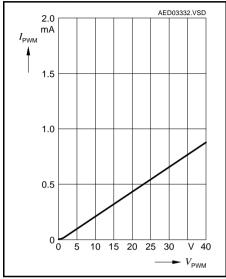
Reference Voltage versus Junction Temperature



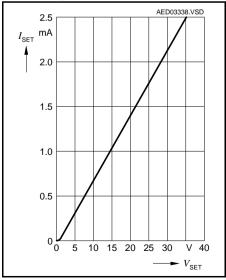
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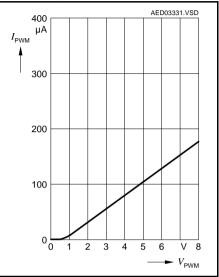
PWM Pin Input Current versus PWM Voltage



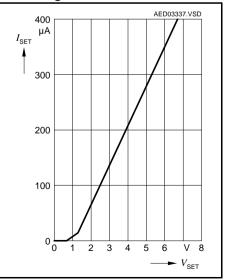
SET Pin Input Current versus SET Voltage



PWM Pin Input Current versus PWM Voltage



SET Pin Input Current versus SET Voltage





Package Outlines

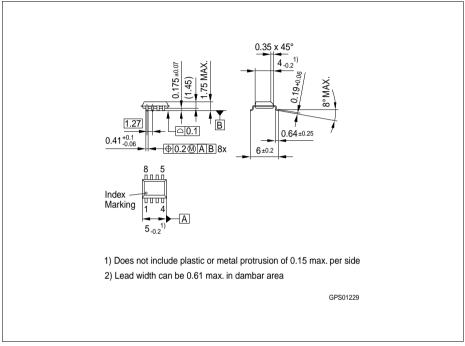


Figure 5 P-DSO-8-9 (Plastic Dual Small Outline)

Green Product (RoHS compliant)

To meet the world-wide customer requirements for environmentally friendly products and to be compliant with government regulations the device is available as a green product. Green products are RoHS-Compliant (i.e Pb-free finish on leads and suitable for Pb-free soldering according to IPC/JEDEC J-STD-020).

You can find all of our packages, sorts of packing and others in our Infineon Internet Page "Products": http://www.infineon.com/products.

SMD = Surface Mounted Device

Data Sheet

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Dimensions in mm





Revision History

Version	Date	Changes
Rev. 1.2	2004-04-13	Page 4, 9: Improved indication and explanation of the open load detection function.
Rev. 1.3	2007-03-19	Initial version of RoHS-compliant derivate of TLE4241GM Page 1: AEC certified statement added Page 1 and Page 13: RoHS compliance statement and Green product feature added Page 1 and Page 13: Package changed to RoHS compliant version Legal Disclaimer updated
Rev. 1.4	2015-07-09	Electrical Characteristics updated Page 8

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