Power Good

The Power Good PG pin informs e.g. the microcontroller in case the output voltage has fallen below the lower threshold $V_{Q,pgt-d}$ of typ. 3.65 V. Connecting the regulator to a battery voltage at first the power good signal remains LOW. When the output voltage has reached the higher threshold $V_{Q,pgt-i}$ the power good output remains still LOW for the power good delay time t_{rd}. Afterwards the power good output turns HIGH. The delay time can be set by the user with an external capacitor at pin D according to the requirements of the application.

The Power Good circuitry supervises the output voltage. In case V_Q falls below the lower Power Good switching threshold $V_{Q,pgt-d}$ the PG output is set LOW after the Power Good reaction time. The Power Good LOW signal is generated down to an output voltage V_Q to 1 V. A LOW signal at the Power Good pin informs that the battery was lost and memory is no longer valid.

The feature should be used in combination with a microcontroller with internal reset.

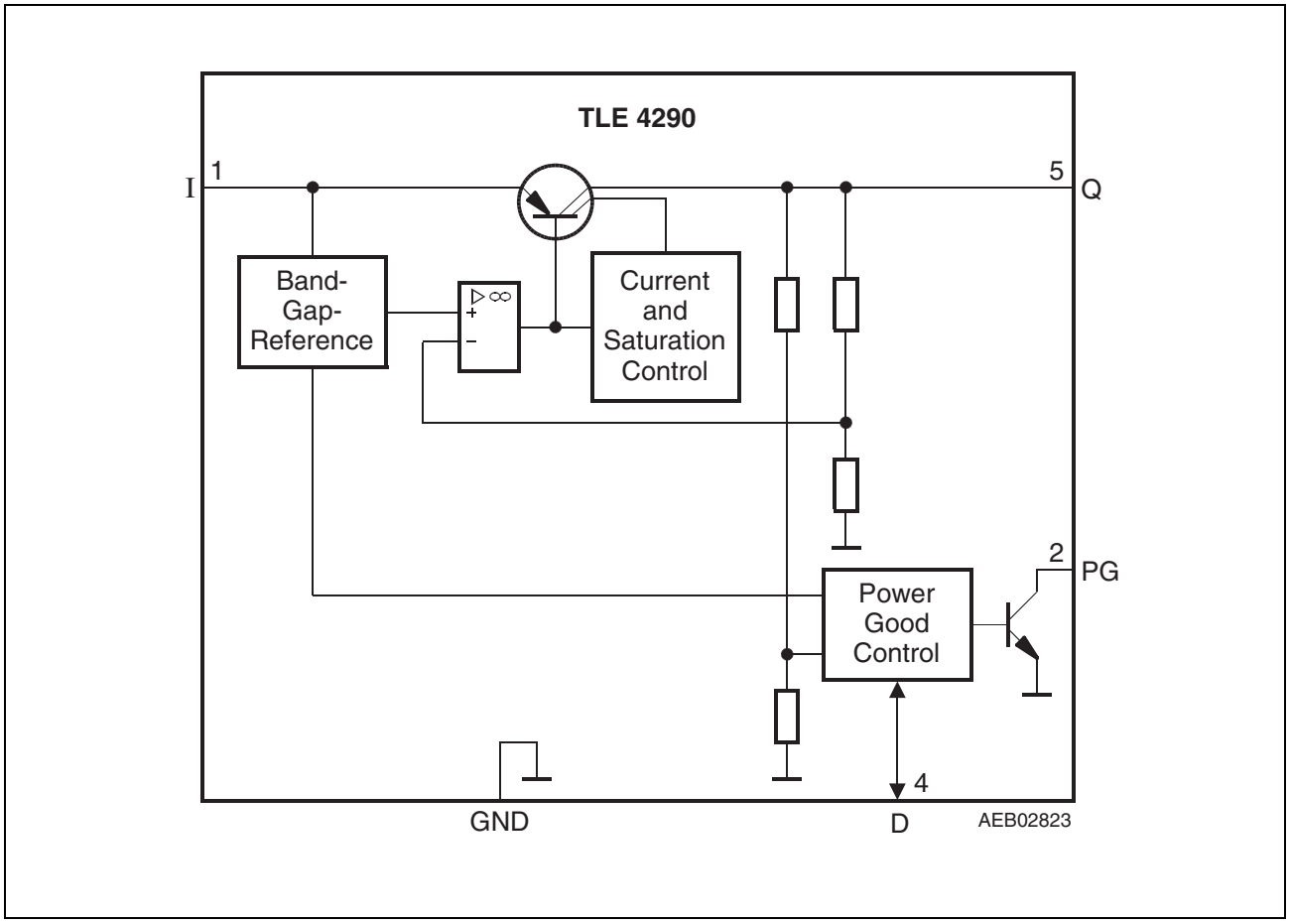

Figure 1 Block Diagram

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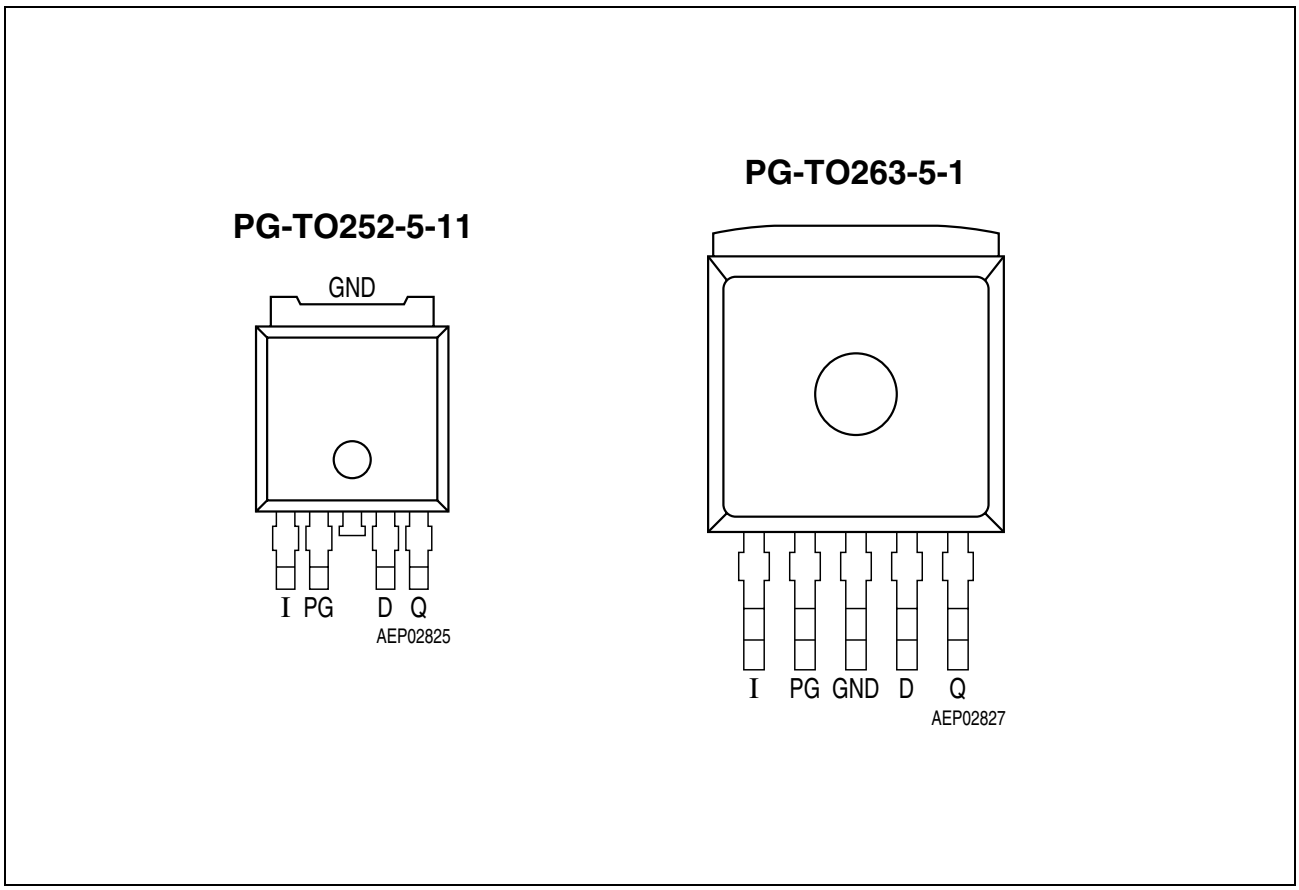

Figure 2 Pin Configuration (top view)

Table 1 Pin Definitions and Functions

Pin No.	Symbol	Function
1	I	**Input;** block to ground directly at the IC with a ceramic capacitor.
2	PG	**Power Good;** open collector output. Add a pull-up resistor of > 5 kΩ to pin Q.
3	GND	**Ground;** Pin 3 internally connected to heatsink.
4	D	**Delay;** connect a capacitor to GND for setting power good delay time.
5	Q	**Output;** block to ground with a capacitor, $C \geq 22$ µF ESR < 5 Ω at 10 kHz.

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Table 2 Absolute Maximum Ratings

Parameter	Symbol	Limit Values		Unit	Test Condition
		Min.	Max.		
Input I					
Voltage	V_I	-42	45	V	–
Current	I_I	–	–	–	Internally limited
Output Q					
Voltage	V_Q	-1.0	16	V	–
Current	I_Q	–	–	–	Internally limited
Power Good Output PG					
Voltage	V_{PG}	-0.3	25	V	–
Current	I_{PG}	-5	5	mA	–
Delay D					
Voltage	V_D	-0.3	7	V	–
Current	I_D	-2	2	mA	–
Temperature					
Junction temperature	T_j	-40	150	°C	–
Storage temperature	T_{stg}	-50	150	°C	–

Note: Stresses above those listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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Table 3 Operating Range

Parameter	Symbol	Limit Values		Unit	Remarks
		Min.	Max.		
Input voltage	V_I	5.5	42	V	–
Junction temperature	T_j	-40	150	°C	–
Thermal Resistance					
Junction case	$R_{thj\text{-}c}$	–	4	K/W	–
Junction ambient	$R_{thj\text{-}a}$	–	53	K/W	TO263[1)]
Junction ambient	$R_{thj\text{-}a}$	–	78	K/W	TO252[1)]

1) Worst case, regarding peak temperature; zero airflow; mounted on a PCB FR4, 80 × 80 × 1.5 mm^3, heat sink area 300 mm^2

Note: In the operating range, the functions given in the circuit description are fulfilled.

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Table 4 Characteristics

V_I = 13.5 V; -40 °C < T_j < 150 °C (unless otherwise specified)

Parameter	Symbol	Limit Values			Unit	Measuring Condition
		Min.	Typ.	Max.		
Output						
Output voltage	V_Q	4.9	5.0	5.1	V	5 mA < I_Q < 400 mA; 6 V < V_I < 28 V
Output voltage	V_Q	4.9	5.0	5.1	V	5 mA < I_Q < 200 mA; 6 V < V_I < 40 V
Output current limitation	I_Q	450	700	–	mA	1)
Current consumption; $I_q = I_I - I_Q$	I_q	–	200	230	µA	I_Q = 1 mA; T_j = 25 °C
Current consumption; $I_q = I_I - I_Q$	I_q	–	200	255	µA	I_Q = 1 mA; $T_j \leq$ 85 °C
Current consumption; $I_q = I_I - I_Q$	I_q	–	5	12	mA	I_Q = 250 mA
Current consumption; $I_q = I_I - I_Q$	I_q	–	12	25	mA	I_Q = 400 mA
Drop voltage	V_{dr}	–	250	500	mV	I_Q = 300 mA $V_{dr} = V_I - V_Q$ 1)
Load regulation	$\Delta V_{Q,lo}$	-30	15	30	mV	V_I = 6 V; I_Q = 5 mA to 400 mA
Line regulation	$\Delta V_{Q,li}$	-15	5	15	mV	V_I = 8 V to 32 V; I_Q = 5 mA
Power supply ripple rejection	$PSRR$	–	60	–	dB	f_r = 100 Hz; V_r = 0.5 Vpp
Temperature output voltage drift	dV_Q/dT	–	0.5	–	mV/K	–
Output Capacitor	C_Q	22	–	–	µF	ESR < 5 Ω in the operation range
Power Good Output PG and Delay Timing D						
Power Good switching threshold	$V_{Q,pgt-i}$	4.45	4.65	4.80	V	V_Q increasing
Power Good switching threshold	$V_{Q,pgt-d}$	3.50	3.65	3.80	V	V_Q decreasing

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Table 4 Characteristics (cont'd)

V_I = 13.5 V; -40 °C < T_j < 150 °C (unless otherwise specified)

Parameter	Symbol	Limit Values			Unit	Measuring Condition
		Min.	Typ.	Max.		
Power Good output low voltage	V_{PGL}	–	0.2	0.4	V	$R_{PG} \geq 5\ k\Omega$; $V_Q > 1$ V
Power Good output leakage current	I_{PGH}	–	0	2	µA	$V_{PG} > 4.5$ V
Power Good charging current	$I_{D,c}$	3	6	9	µA	$V_D = 1$ V
Upper timing threshold	V_{DU}	1.5	1.8	2.2	V	–
Lower timing threshold	V_{DL}	0.60	0.85	1.10	V	–
Power Good delay time	t_{rd}	10	16	22	ms	$C_D = 47$ nF
Power Good reaction time	t_{rr}	0.2	0.5	2.0	µs	$C_D = 47$ nF

1) Measured when the output voltage V_Q has dropped 100 mV from the nominal value obtained at V_I = 13.5 V.

Note: The listed characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specify mean values expected over the production spread. If not otherwise specified, typical characteristics apply at T_a = 25 °C and the given supply voltage.

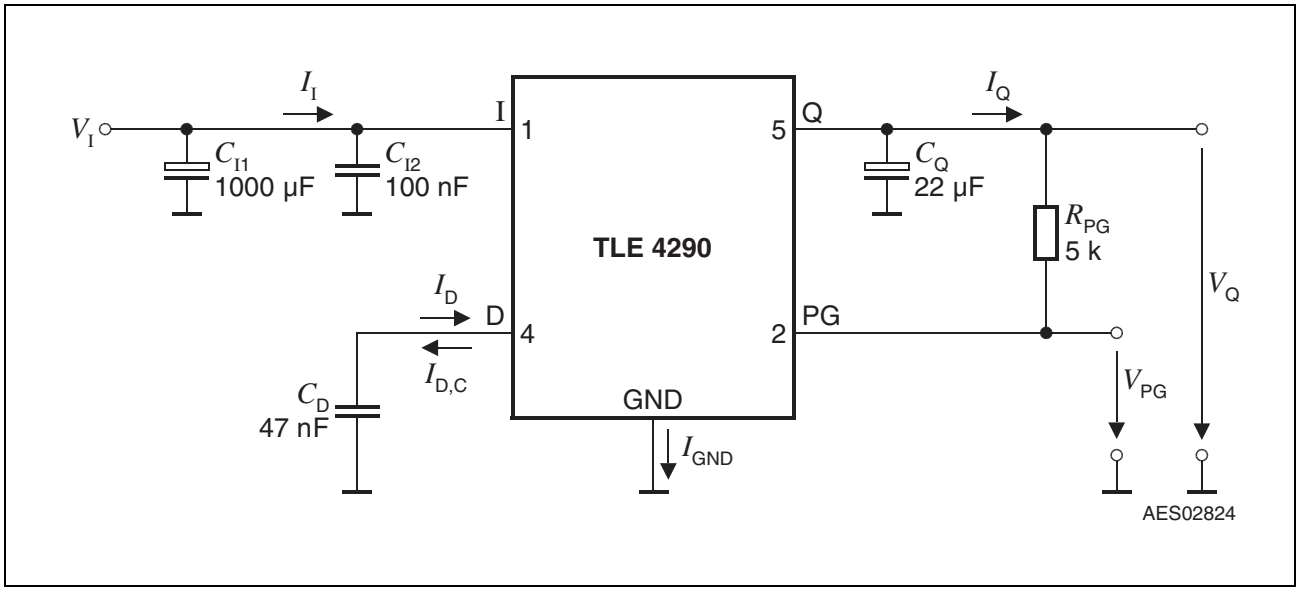

Figure 3 Test Circuit

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Application Information

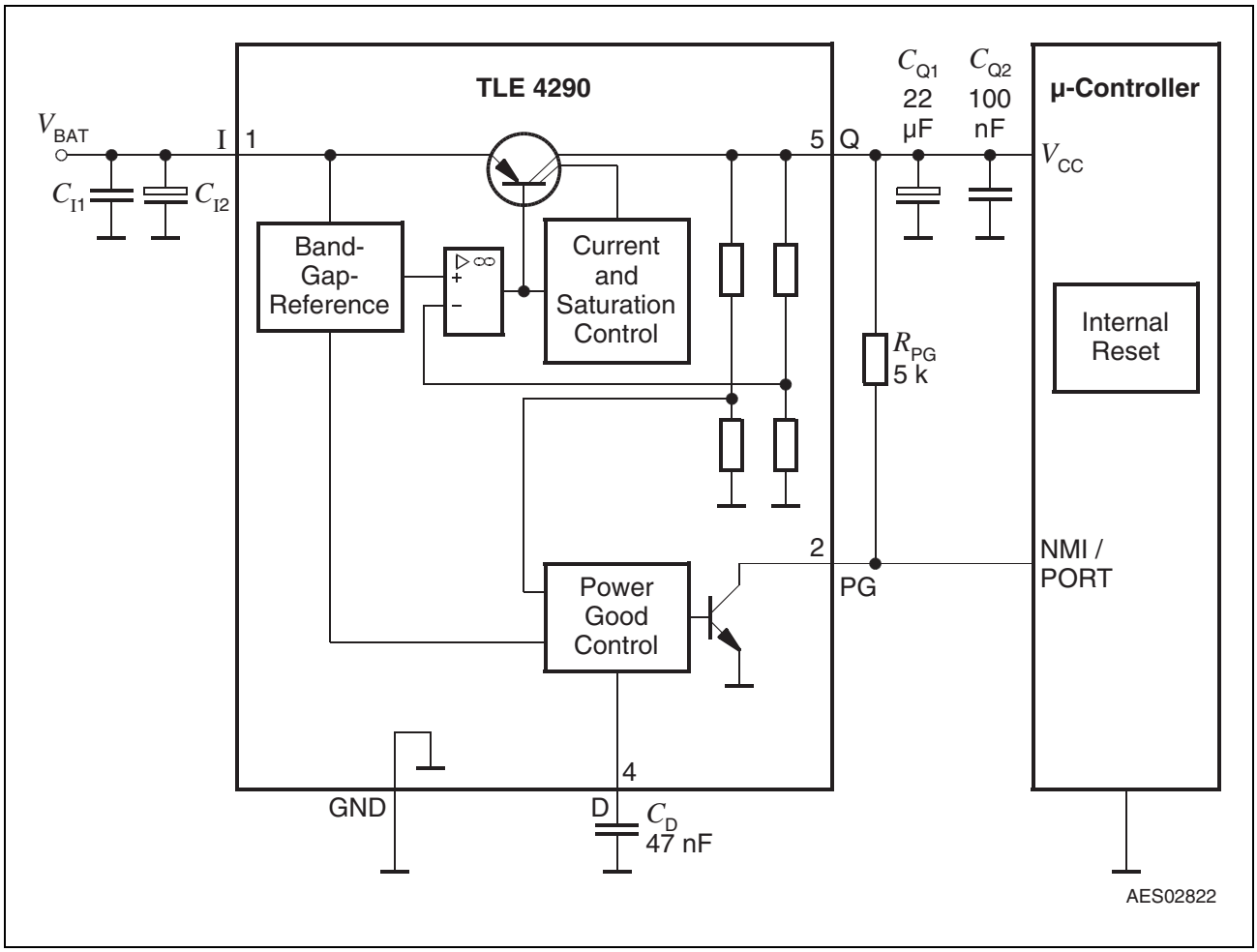

Figure 4 Application Diagram

Input, Output

An input capacitor is necessary for damping line influences. A resistor of approx. 1 Ω in series with C_I, can damp the LC of the input inductivity and the input capacitor.

The TLE 4290 requires an output capacitor of at least 22 µF with an ESR below 5 Ω for stability.

Power Good

The Power Good pin informs e.g. the micro-controller in case the output voltage has fallen below a threshold of typ. 3.65 V. When the battery voltage is supplied the Power Good signal indicates a loss of memory due to missing power. After the Memory Good switching threshold is reached the Power Good output remains low for the Power Good delay time. This time can be set by the user with an external capacitor at pin D according to the requirements of the application, e.g. the time until the microcontroller is initialized and ready to receive any information.

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The power good circuit supervises the output voltage. In case V_Q falls below the Power Good switching threshold the Power Good output PG is set LOW after the power good reaction time. The power good LOW signal is generated down to an output voltage V_Q to 1 V. A LOW signal at the power good pin informs that the battery was lost and memory is no longer valid.

The feature should only be used in combination to a microcontroller with internal reset.

For the power good delay time after the output voltage of the regulator is above the reset threshold, the reset signal is set High again. The reset delay time is defined by the reset delay capacitor C_D at pin D.

The Power Good delay time is defined by the charging time of an external delay capacitor C_D.

$$C_D = (t_{rd} \times I_{D,c}) / \Delta V \quad (1)$$

With:

- C_D = Power Good delay capacitor
- t_{rd} = Power Good delay time
- $\Delta V = V_{DU}$, typical 1.8 V
- $I_{D,c}$ = Charge current typical 6 µA

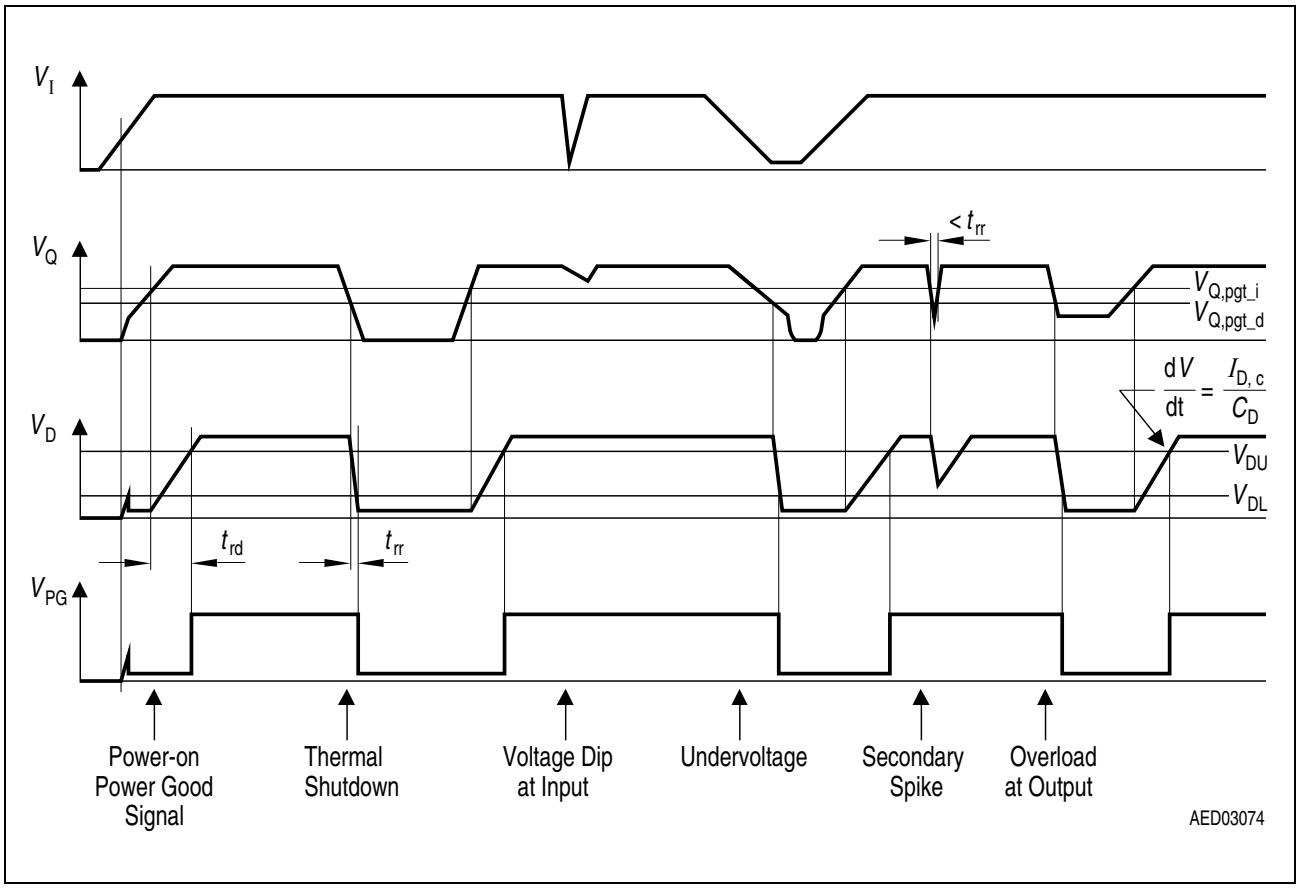

Figure 5 Power Good Timing

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The power good reaction time t_{rr} is the time it takes the voltage regulator to set power good output PG LOW after the output voltage has dropped below the power good switching threshold. It is typically 0.5 µs for delay capacitor of 47 nF. For other values for C_D the reaction time can be estimated using the following equation:

$$t_{rr} = 10\ \text{ns/nF} \times C_D \quad (2)$$

The Power Good output is an open collector output. It requires externally a pull-up resistor of at least 5 kΩ to Q.

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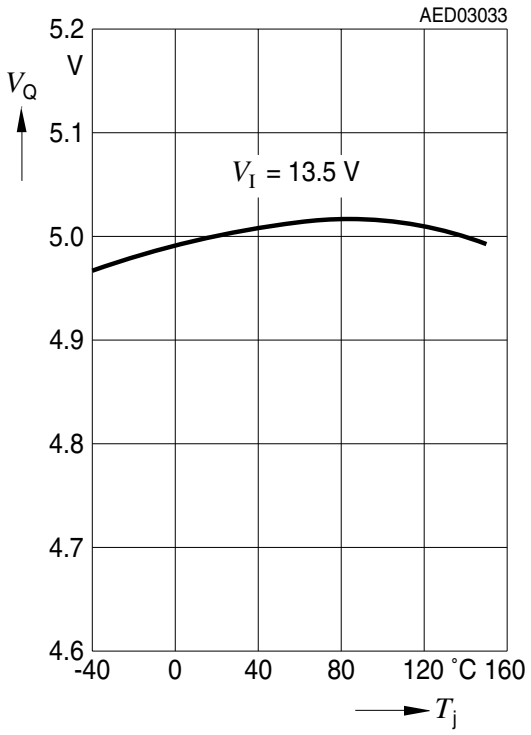
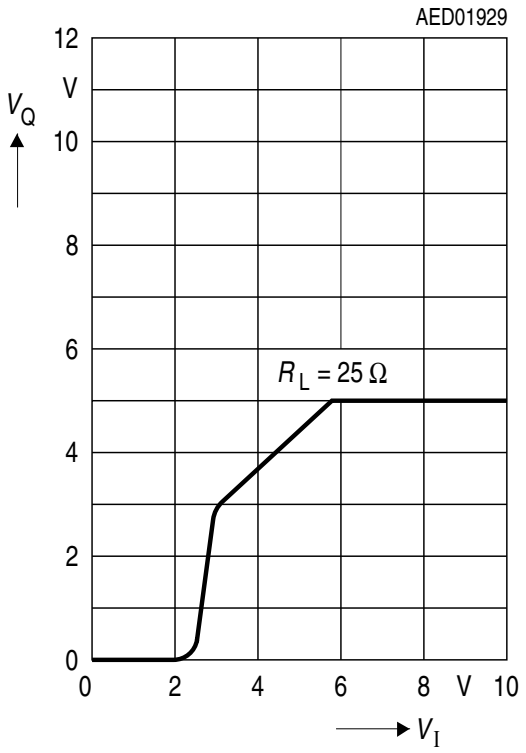
Typical Performance Characteristics

Output Voltage V_Q versus Temperature T_j



Output Voltage V_Q versus Input Voltage V_I



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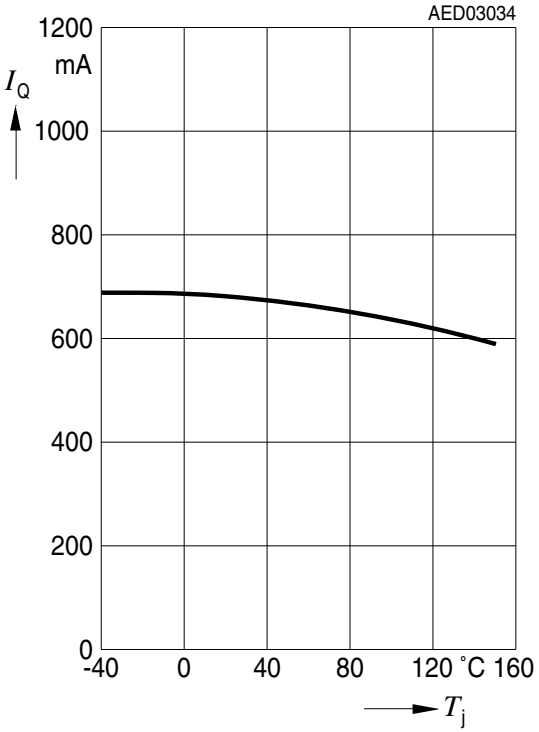
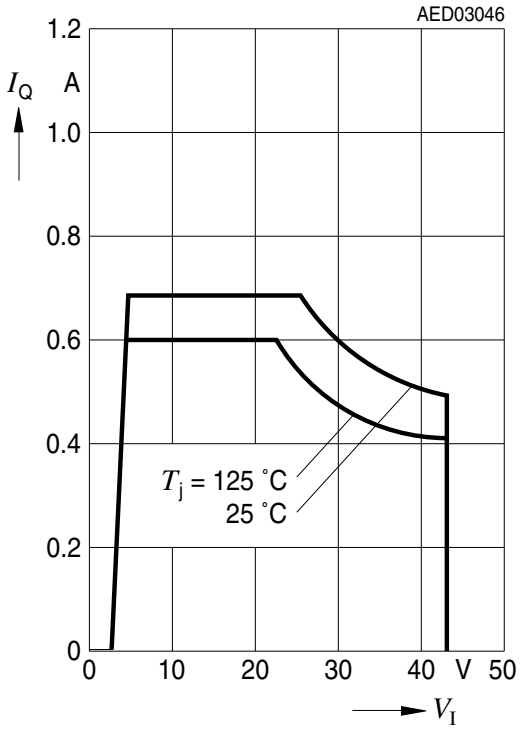
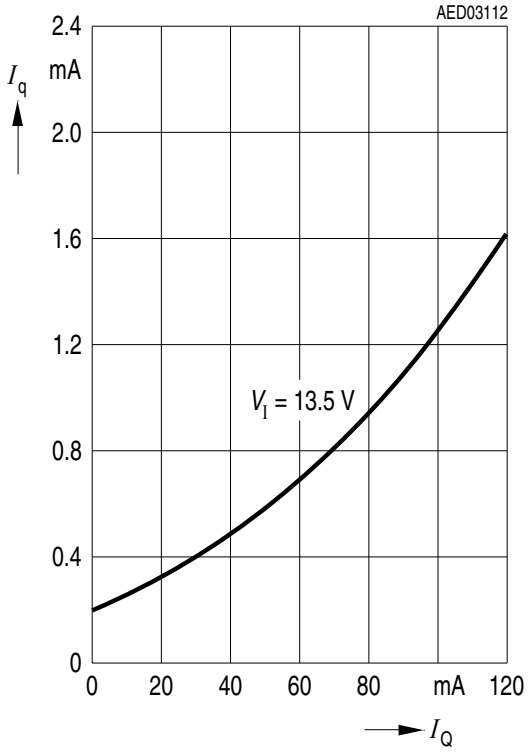
Output Current I_Q versus Temperature T_j



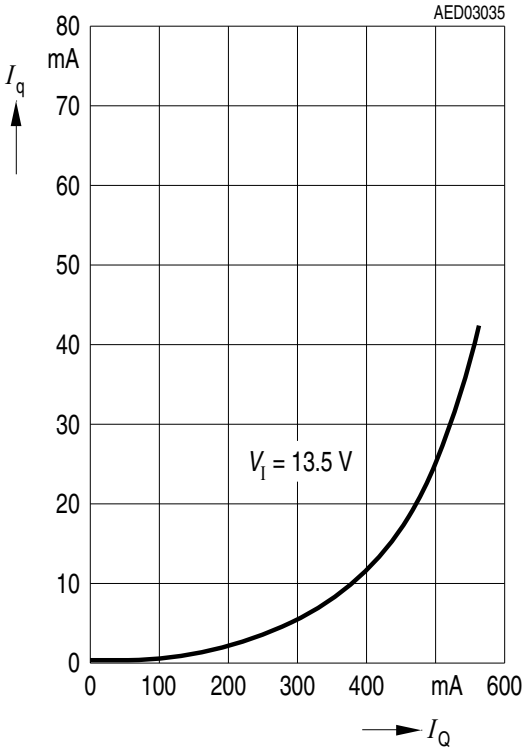
Output Current I_Q versus Input Voltage V_I



Current Consumption I_q versus Output Current I_Q; T_j = 25 °C



Current Consumption I_q versus Output Current I_Q



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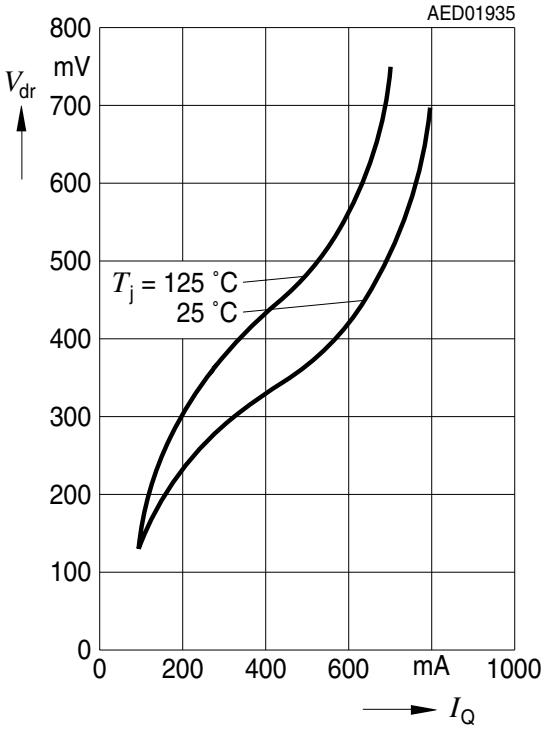
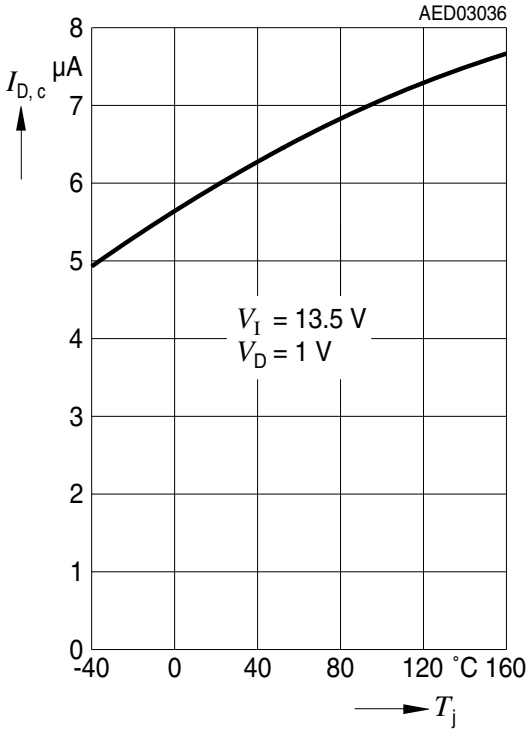
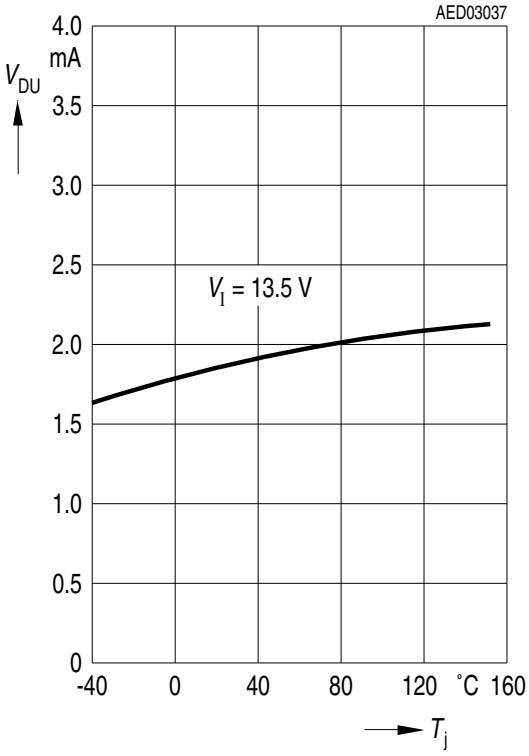
Drop Voltage V_{dr} versus Output Current I_Q



Charge Current $I_{D,c}$ versus Temperature T_j



Upper Timing Threshold V_{DU} versus Temperature T_j



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Package Outlines

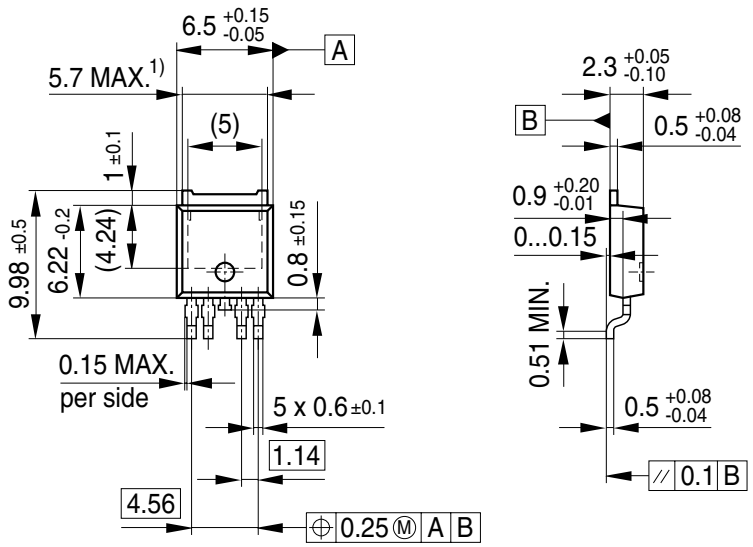

Figure 6 **PG-TO252-5-11** (Plastic Transistor Single Outline)

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).

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SMD = Surface Mounted Device

Dimensions in mm

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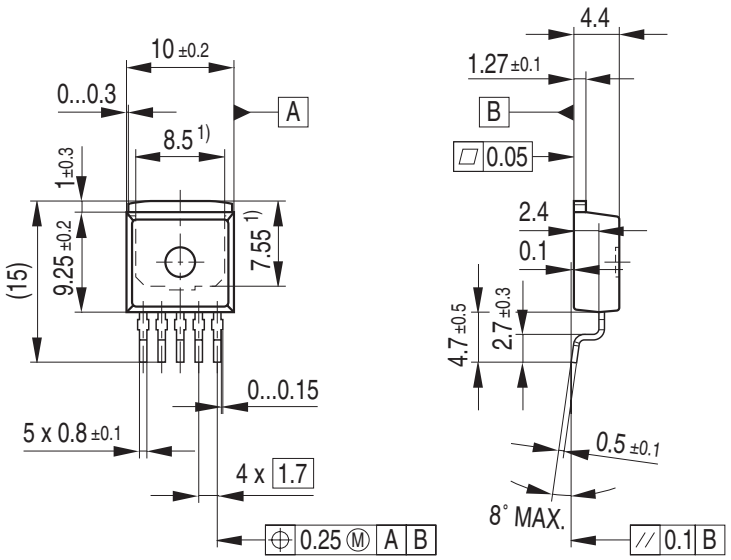

Figure 7 **PG-TO263-5-1** (Plastic Transistor Single Outline)

Green Product (RoHS compliant)

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SMD = Surface Mounted Device

Dimensions in mm

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Revision History

Version	Date	Changes
Rev. 1.7	2007-03-20	Initial version of RoHS-compliant derivate of TLE 4290 **Page 1**: AEC certified statement added **Page 1** and **Page 14**: RoHS compliance statement and Green product feature added **Page 1** and **Page 14**: Package changed to RoHS compliant version Legal Disclaimer updated

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