

5-V Low Drop Fixed Voltage Regulator

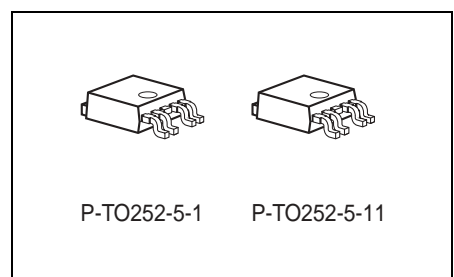
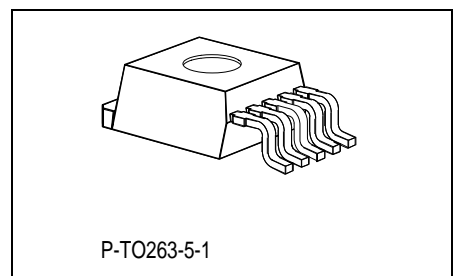
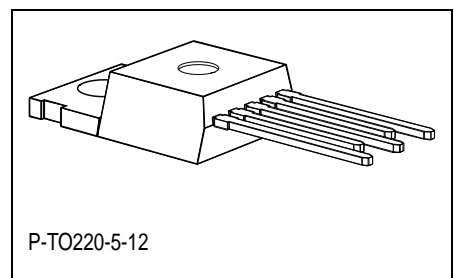
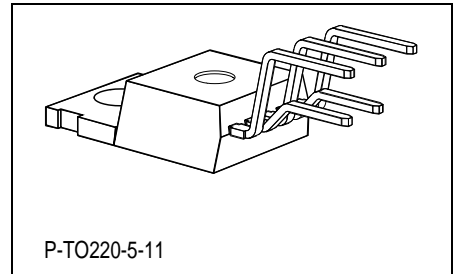
TLE 4270

Features

- Output voltage tolerance $\leq \pm 2\%$
- 650 mA output current capability
- Low-drop voltage
- Reset functionality
- Adjustable reset time
- Suitable for use in automotive electronics
- Integrated overtemperature protection
- Reverse polarity protection
- Input voltage up to 42 V
- Overvoltage protection up to 65 V (≤ 400 ms)
- Short-circuit proof
- Wide temperature range
- ESD protection > 4000 V

Functional Description

This device is a 5-V low drop fixed-voltage regulator. The maximum input voltage is 42 V (65 V, ≤ 400 ms). Up to an input voltage of 26 V and for an output current up to 650 mA it regulates the output voltage within a 2% accuracy. The short circuit protection limits the output current of more than 650 mA. The device incorporates overvoltage protection and a temperature protection which turns off the device at high temperatures.



Type	Ordering Code	Package
TLE 4270	Q67000-A9209	P-TO220-5-11
TLE 4270 S	Q67000-A9243	P-TO220-5-12
TLE 4270 G	Q67006-A9201	P-TO263-5-1
TLE 4270 D	Q67006-A9360	P-TO252-5-1, P-TO252-5-11

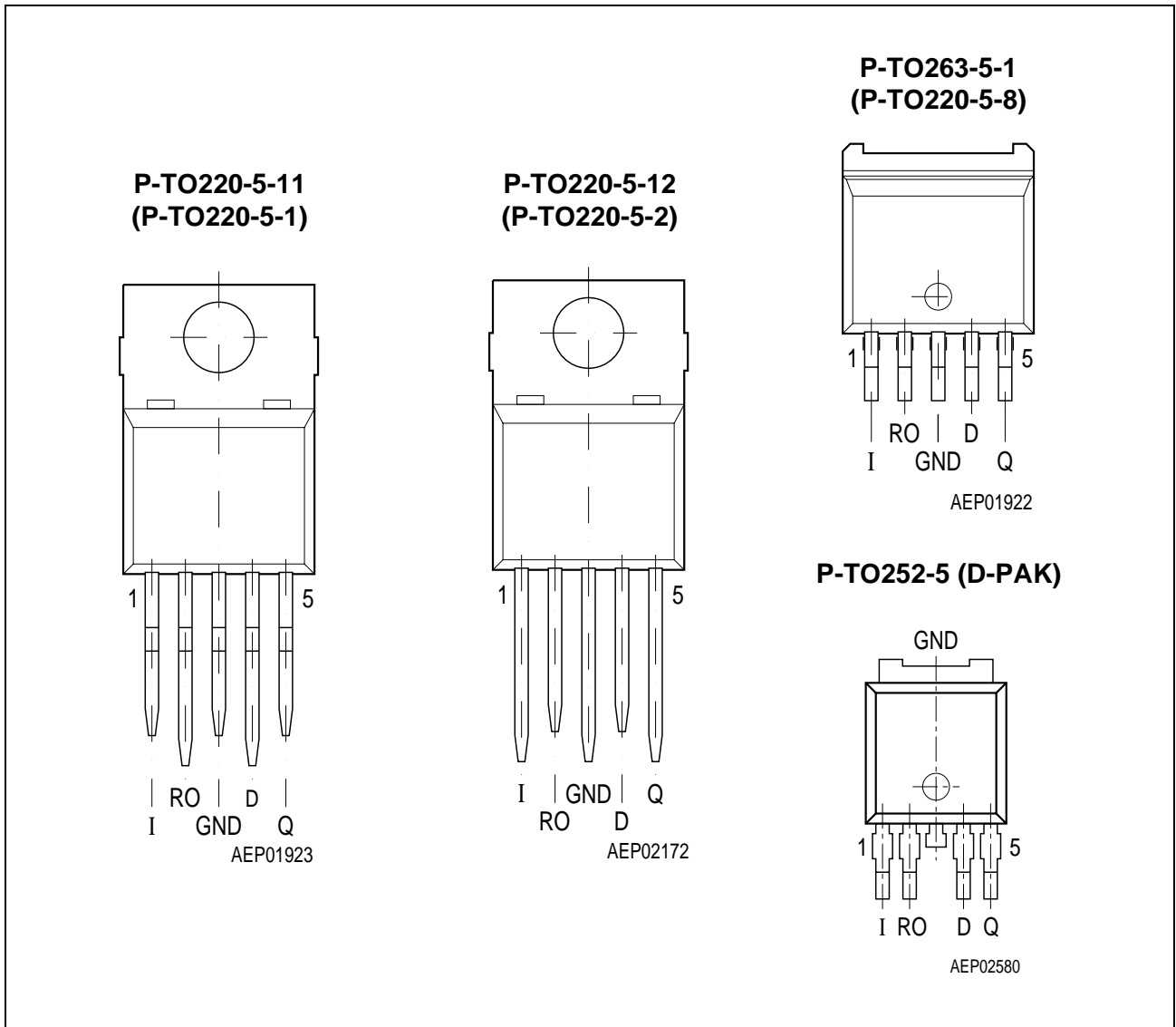


Figure 1 Pin Configuration (top view)

Table 1 Pin Definitions and Functions

Pin	Symbol	Function
1	I	Input ; block to ground directly at the IC with a ceramic capacitor.
2	RO	Reset Output ; the open collector output is connected to the 5-V output via an integrated resistor of 30 kΩ.
3	GND	Ground ; internally connected to heatsink.
4	D	Reset Delay ; connect a capacitor to ground for delay time adjustment.
5	Q	5-V Output ; block to ground with 22 μF capacitor, ESR < 3 Ω.

Circuit Description

The control amplifier compares a reference voltage, which is kept highly accurate by resistance adjustment, to a voltage that is proportional to the output voltage and drives the base of a series transistor via a buffer. Saturation control as a function of the load current prevents any over-saturation of the power element.

The IC also incorporates a number of internal circuits for protection against:

- Overload
- Overvoltage
- Overtemperature
- Reverse polarity

Application Description

The IC regulates an input voltage in the range of $5.5\text{ V} < V_I < 36\text{ V}$ to $V_{Q,\text{nom}} = 5.0\text{ V}$. Up to 26 V it produces a regulated output current of more than 650 mA . Above 26 V the save-operating-area protection allows operation up to 36 V with a regulated output current of more than 300 mA . Overvoltage protection limits operation at 42 V . The overvoltage protection hysteresis restores operation if the input voltage has dropped below 36 V . A reset signal is generated for an output voltage of $V_Q < 4.5\text{ V}$. The delay for power-on reset can be set externally with a capacitor.

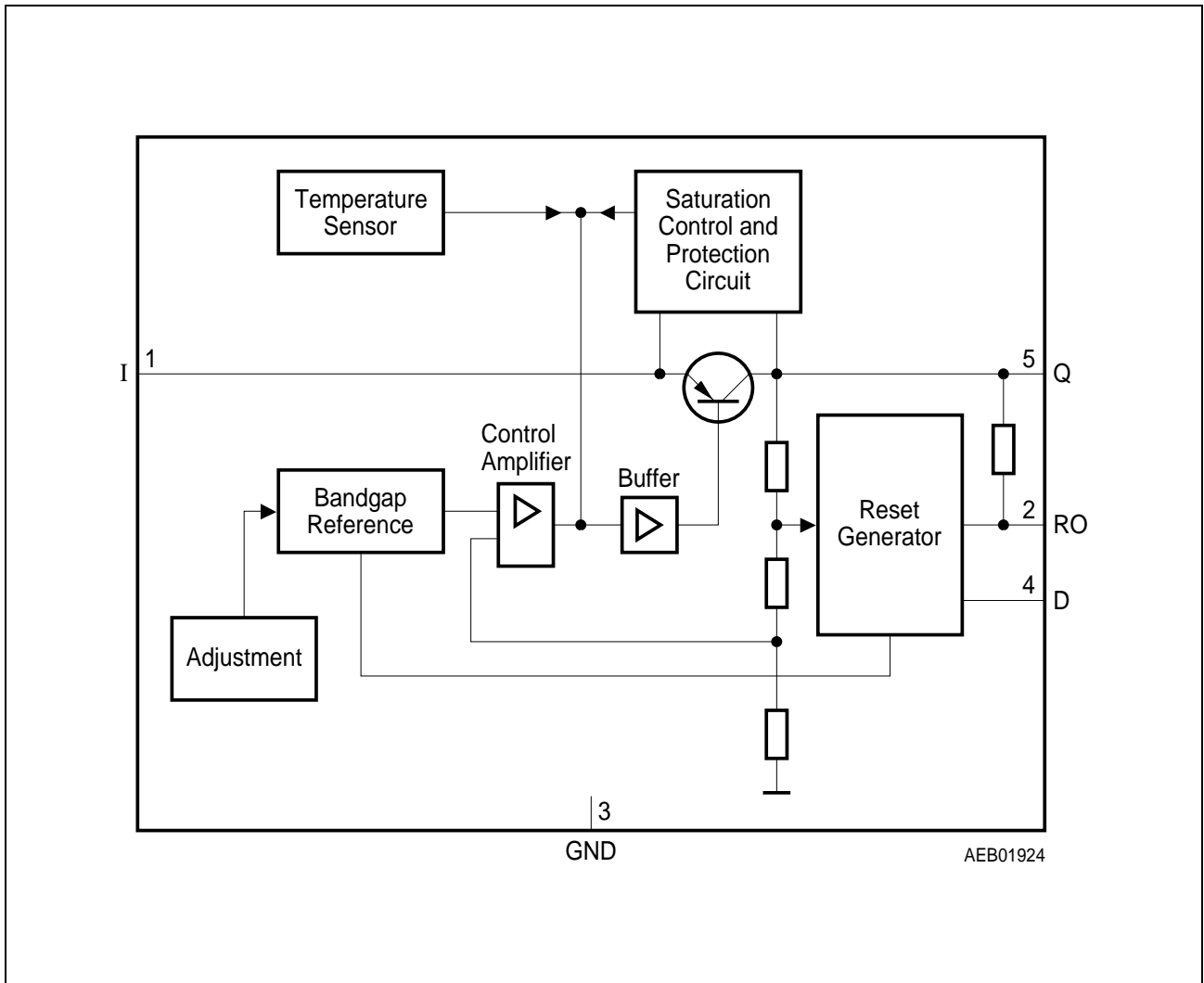


Figure 2 Block Diagram

Table 2 Absolute Maximum Ratings
 $T_j = -40$ to 150 °C

Parameter	Symbol	Limit Values		Unit	Notes
		Min.	Max.		
Input I					
Voltage	V_I	-42	42	V	–
Voltage	V_I	–	65	V	$t \leq 400$ ms
Current	I_I	–	–	–	internally limited
Reset Output RO					
Voltage	V_{RO}	-0.3	7	V	–
Current	I_{RO}	–	–	–	Internally limited
Reset Delay D					
Voltage	V_D	-0.3	7	V	–
Current	I_D	–	–	–	Internally limited
Output Q					
Voltage	V_Q	-1.0	16	V	–
Current	I_Q	–	–	–	Internally limited
Ground GND					
Current	I_{GND}	-0.5	–	A	–
Temperatures					
Junction temperature	T_j	–	150	°C	–
Storage temperature	T_{stg}	-50	150	°C	–

Table 3 Operating Range

Parameter	Symbol	Limit Values		Unit	Notes
		Min.	Max.		
Input voltage	V_I	6	42	V	–
Junction temperature	T_j	-40	150	°C	–
Thermal Resistance					
Junction ambient	R_{thj-a}	–	65 79	K/W K/W	– TO263, TO252 ¹⁾
Junction case	R_{thj-c}	–	3	K/W	TO-220/263 Packages

1) Mounted on PCB, $80 \times 80 \times 1.5$ mm³; 35µ Cu; 5µ Sn; Footprint only; zero airflow.

Table 4 Characteristics
 $V_I = 13.5 \text{ V}; -40 \text{ }^\circ\text{C} \leq T_j \leq 125 \text{ }^\circ\text{C}$ (unless otherwise specified)

Parameter	Symbol	Limit Values			Unit	Test Condition
		Min.	Typ.	Max.		
Output voltage	V_Q	4.90	5.00	5.10	V	$5 \text{ mA} \leq I_Q \leq 550 \text{ mA};$ $6 \text{ V} \leq V_I \leq 26 \text{ V}$
Output voltage	V_Q	4.90	5.00	5.10	V	$26 \text{ V} \leq V_I \leq 36 \text{ V};$ $I_Q \leq 300 \text{ mA}$
Output current limiting	I_{Qmax}	650	850	–	mA	$V_Q = 0 \text{ V}$
Current consumption $I_q = I_I - I_Q$	I_q	–	1	1.5	mA	$I_Q = 5 \text{ mA}$
Current consumption $I_q = I_I - I_Q$	I_q	–	55	75	mA	$I_Q = 550 \text{ mA}$
Current consumption $I_q = I_I - I_Q$	I_q	–	70	90	mA	$I_Q = 550 \text{ mA}; V_I = 5 \text{ V}$
Drop voltage	V_{DR}	–	350	700	mV	$I_Q = 550 \text{ mA}^{1)}$
Load regulation	$\Delta V_{Q,Lo}$	–	25	50	mV	$I_Q = 5 \text{ to } 550 \text{ mA};$ $V_I = 6 \text{ V}$
Line regulation	$\Delta V_{Q,Li}$	–	12	25	mV	$V_I = 6 \text{ to } 26 \text{ V}$ $I_Q = 5 \text{ mA}$
Power supply Ripple rejection	$PSRR$	–	54	–	dB	$f_r = 100 \text{ Hz};$ $V_r = 0.5 \text{ Vpp}$
Reset Generator						
Switching threshold	V_{RT}	4.5	4.65	4.8	V	–
Reset High voltage	V_{ROH}	4.5	–	–	V	–
Reset low voltage	V_{ROL}	–	60	–	mV	$R_{int} = 30 \text{ k}\Omega^{2)}$; $1.0 \text{ V} \leq V_Q \leq 4.5 \text{ V}$
Reset low voltage	V_{ROL}	–	200	400	mV	$I_R = 3 \text{ mA}, V_Q = 4.4 \text{ V}$
Reset pull-up	R_{int}	18	30	46	k Ω	internally connected to Q
Charge current	$I_{D,c}$	8	14	25	μA	$V_D = 1.0 \text{ V}$

Table 4 Characteristics (cont'd)
 $V_I = 13.5 \text{ V}; -40 \text{ }^\circ\text{C} \leq T_j \leq 125 \text{ }^\circ\text{C}$ (unless otherwise specified)

Parameter	Symbol	Limit Values			Unit	Test Condition
		Min.	Typ.	Max.		
Upper reset timing threshold	V_{DU}	1.4	1.8	2.3	V	–
Lower reset timing threshold	V_{DL}	0.2	0.45	0.8	V	$V_Q < V_{RT}$
Delay time	t_{rd}	–	13	–	ms	$C_D = 100 \text{ nF}$
Reset reaction time	t_{rr}	–	–	3	μs	$C_D = 100 \text{ nF}$

Overvoltage Protection

Turn-Off voltage	$V_{I, ov}$	42	44	46	V	–
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- 1) Drop voltage = $V_I - V_Q$ (measured when the output voltage has dropped 100 mV from the nominal value obtained at 13.5 V input)
- 2) Reset peak is always lower than 1.0 V.

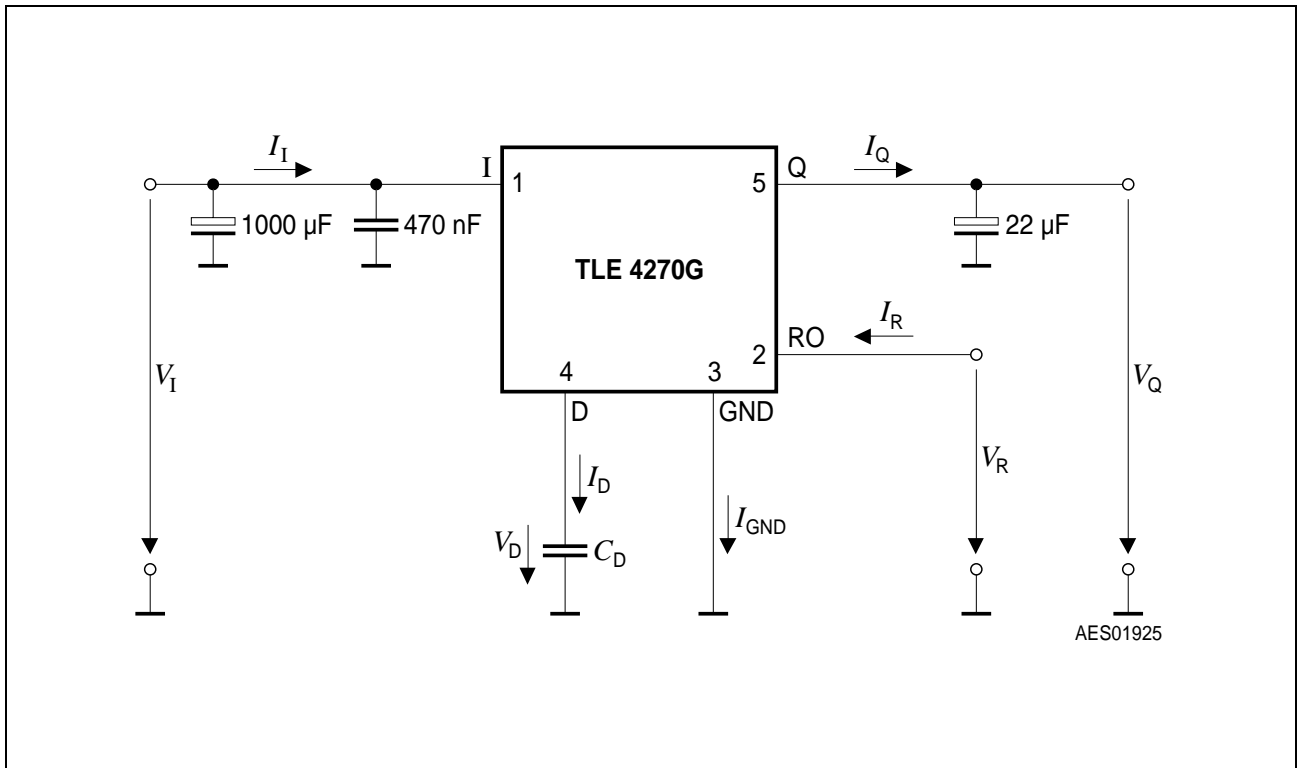


Figure 3 Test Circuit

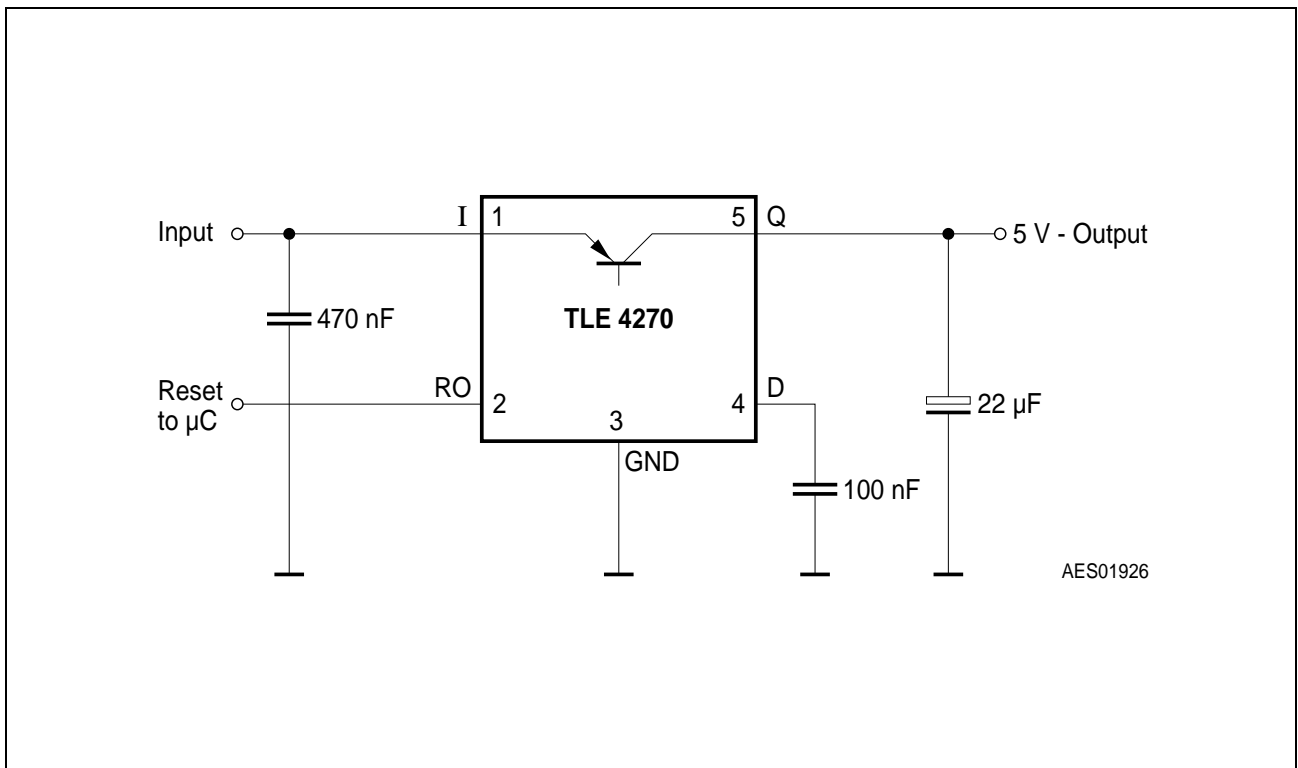


Figure 4 Application Circuit

Design Notes for External Components

An input capacitor C_I is necessary for compensation of line influences. The resonant circuit consisting of lead inductance and input capacitance can be damped by a resistor of approx. 1Ω in series with C_I . An output capacitor C_O is necessary for the stability of the regulating circuit. Stability is guaranteed at values of $C_O \geq 22 \mu\text{F}$ and an ESR of $< 3 \Omega$.

Reset Circuitry

If the output voltage decreases below 4.5 V , an external capacitor C_D on pin 4 (D) will be discharged by the reset generator. If the voltage on this capacitor drops below V_{DL} , a reset signal is generated on pin 2 (RO), i.e. reset output is set low. If the output voltage rises above the reset threshold, C_D will be charged with constant current. After the power-on-reset time the voltage on the capacitor reaches V_{DU} and the reset output will be set high again. The value of the power-on-reset time can be set within a wide range depending of the capacitance of C_D .

Reset Timing

The power-on reset delay time is defined by the charging time of an external capacitor C_D which can be calculated as follows:

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

Definitions:

- C_D = delay capacitors
- Δt = reset delay time t_{rd}
- $I_{D,c}$ = charge current, typical $14 \mu\text{A}$
- $\Delta V = V_{DU}$, typical 1.8 V

V_{DU} = upper reset timing threshold at C_D for reset delay time

$$t_{rd} = \Delta V \times C_D / I_{D,c} \quad (2)$$

The reset reaction time t_{rr} is the time it takes the voltage regulator to set the reset out LOW after the output voltage has dropped below the reset threshold. It is typically $1 \mu\text{s}$ for delay capacitor of 47 nF . For other values for C_D the reaction time can be estimated using the following equation:

$$t_{rr} \approx 20 \text{ s/F} \times C_D \quad (3)$$

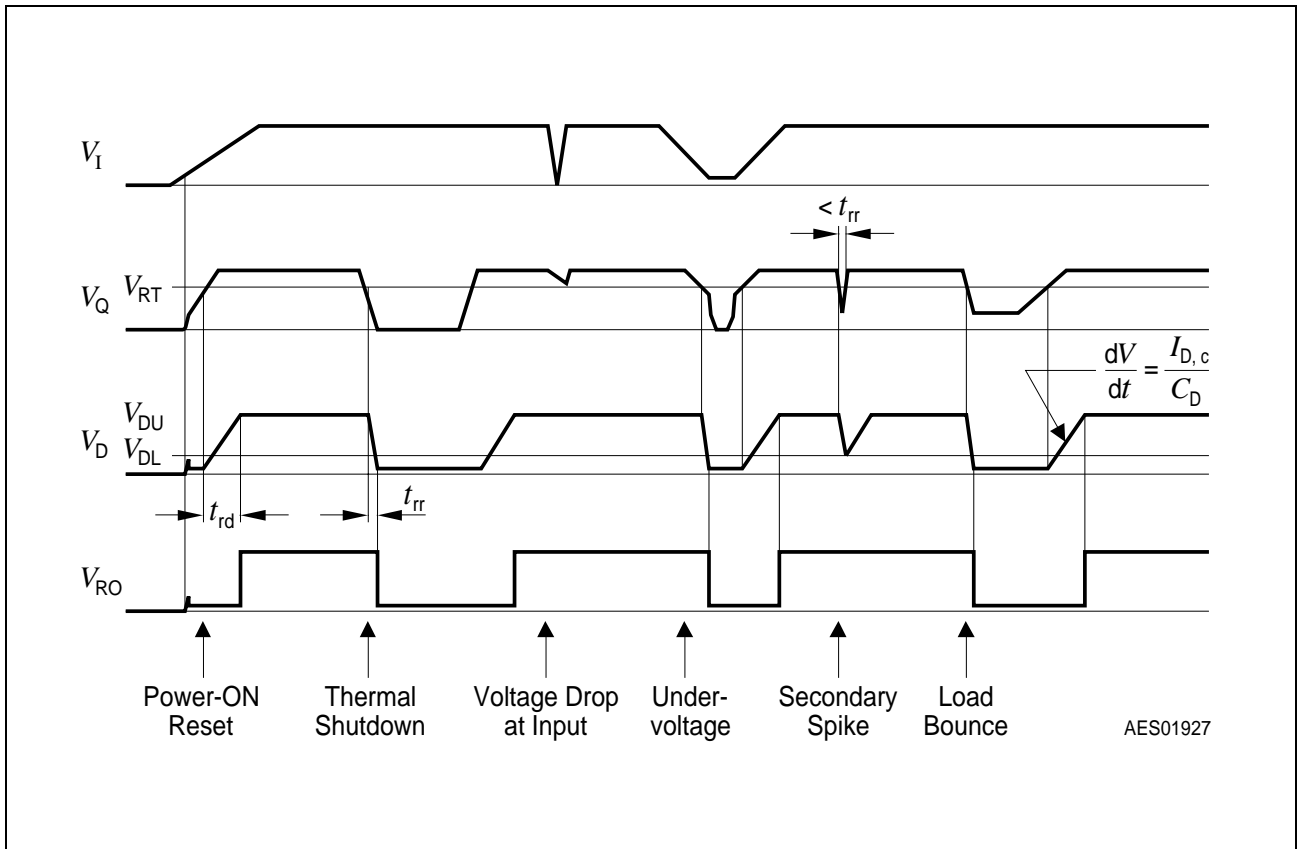
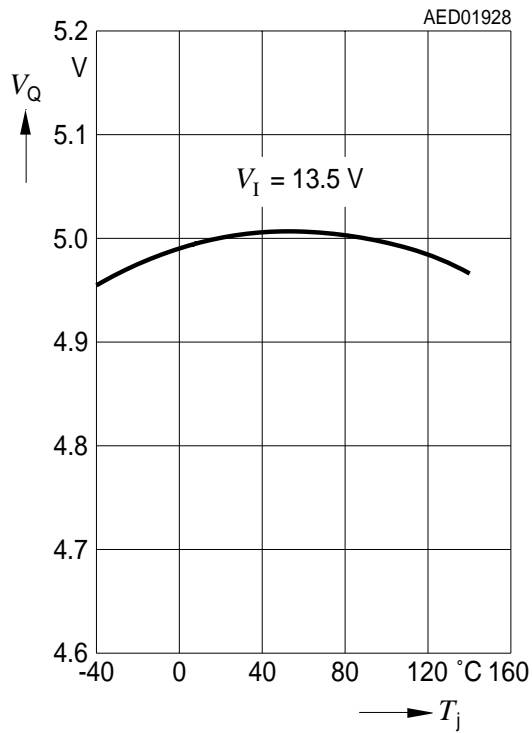
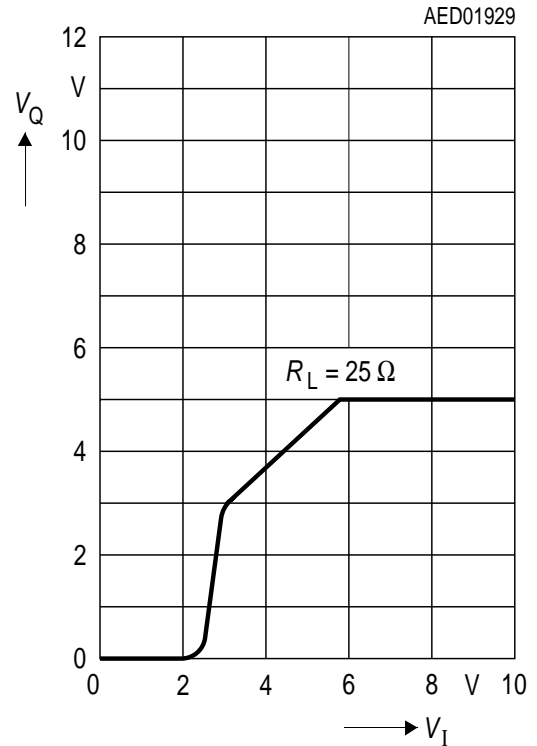


Figure 5 Reset Time Response

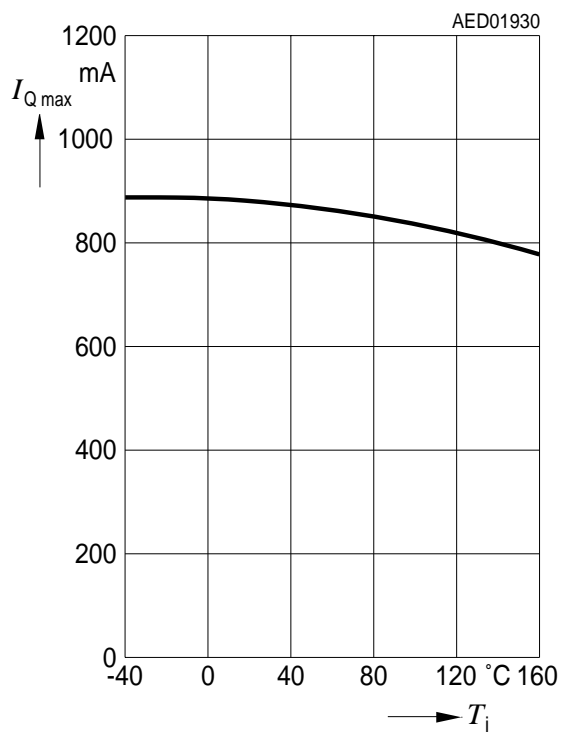
Output Voltage V_Q versus Temperature T_j



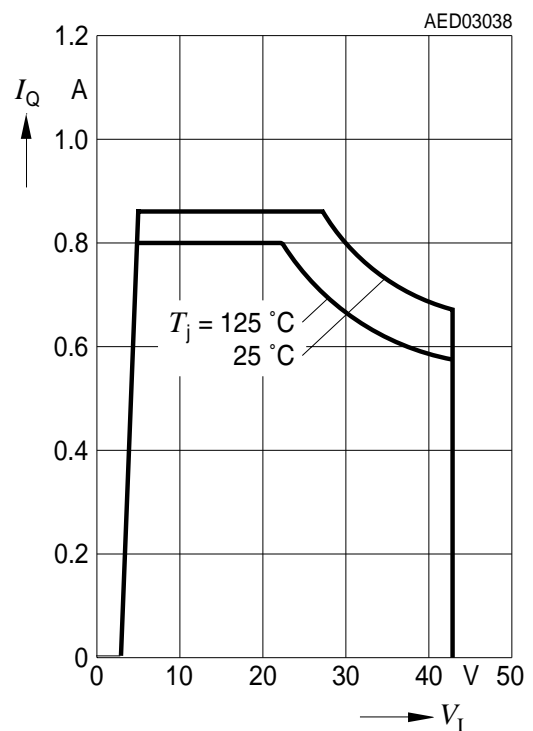
Output Voltage V_Q versus Input Voltage V_I



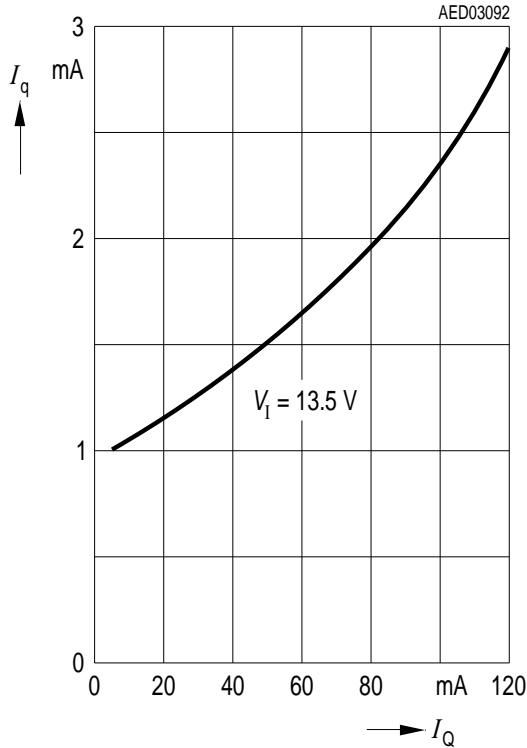
Output Current I_Q versus Temperature T_j



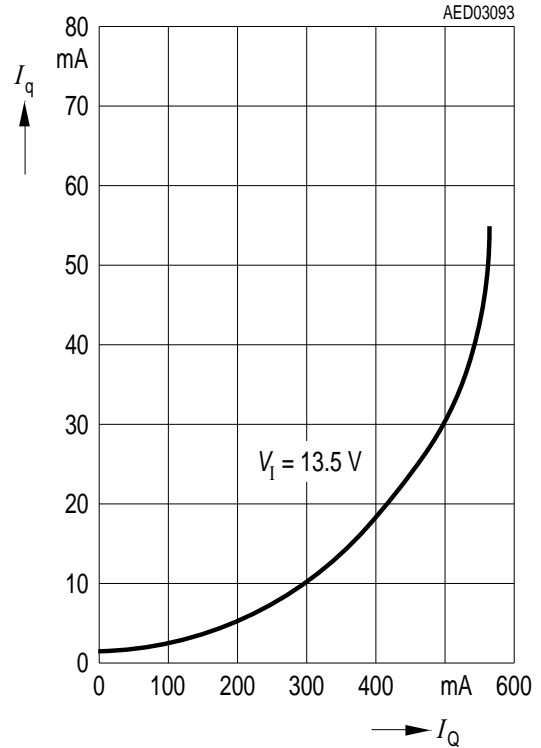
Output Current I_Q versus Input Voltage V_I



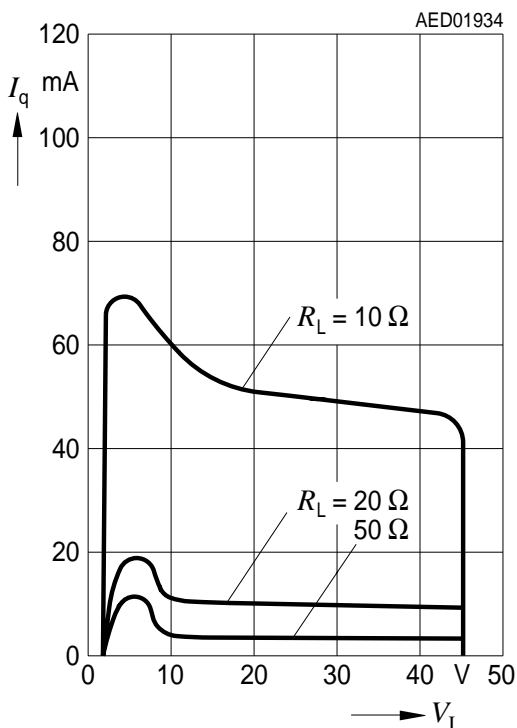
Current Consumption I_q versus Output Current I_Q



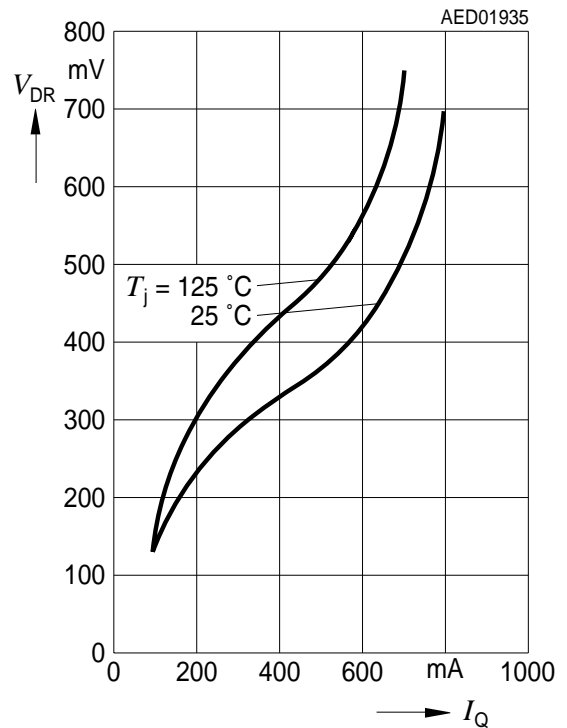
Current Consumption I_q versus Output Current I_Q



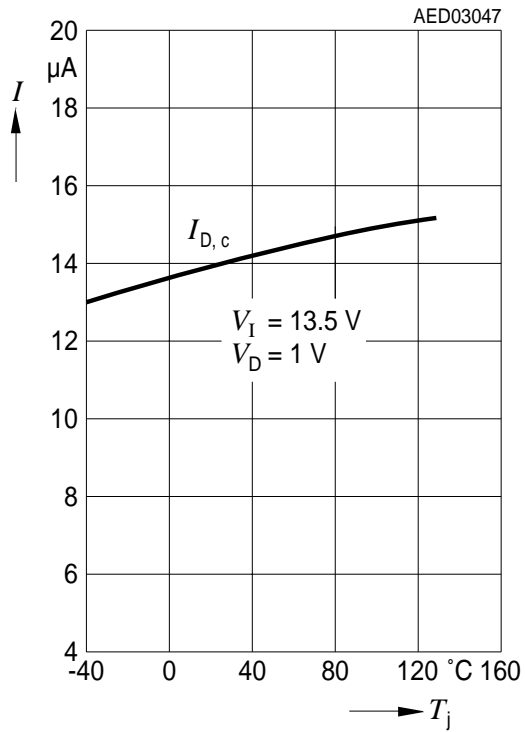
Current Consumption I_q versus Input Voltage V_1



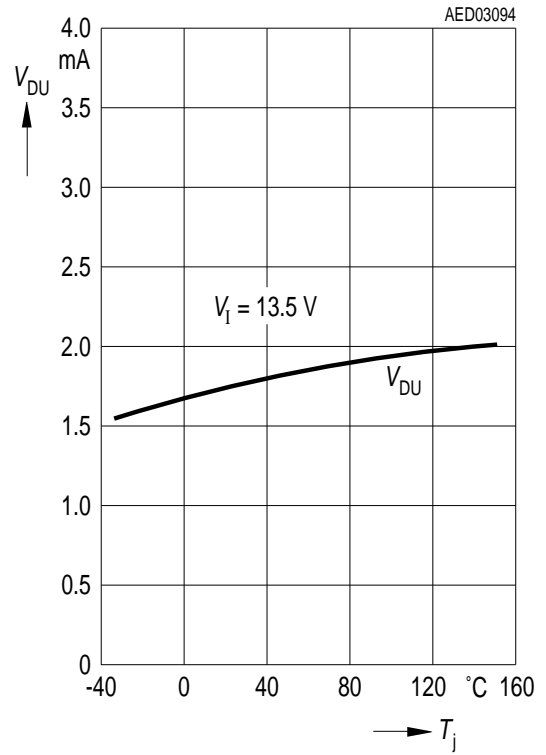
Drop Voltage V_{DR} versus Output Current I_Q



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



Upper Reset Timing Threshold V_{DU} versus Temperature T_j



Package Outlines

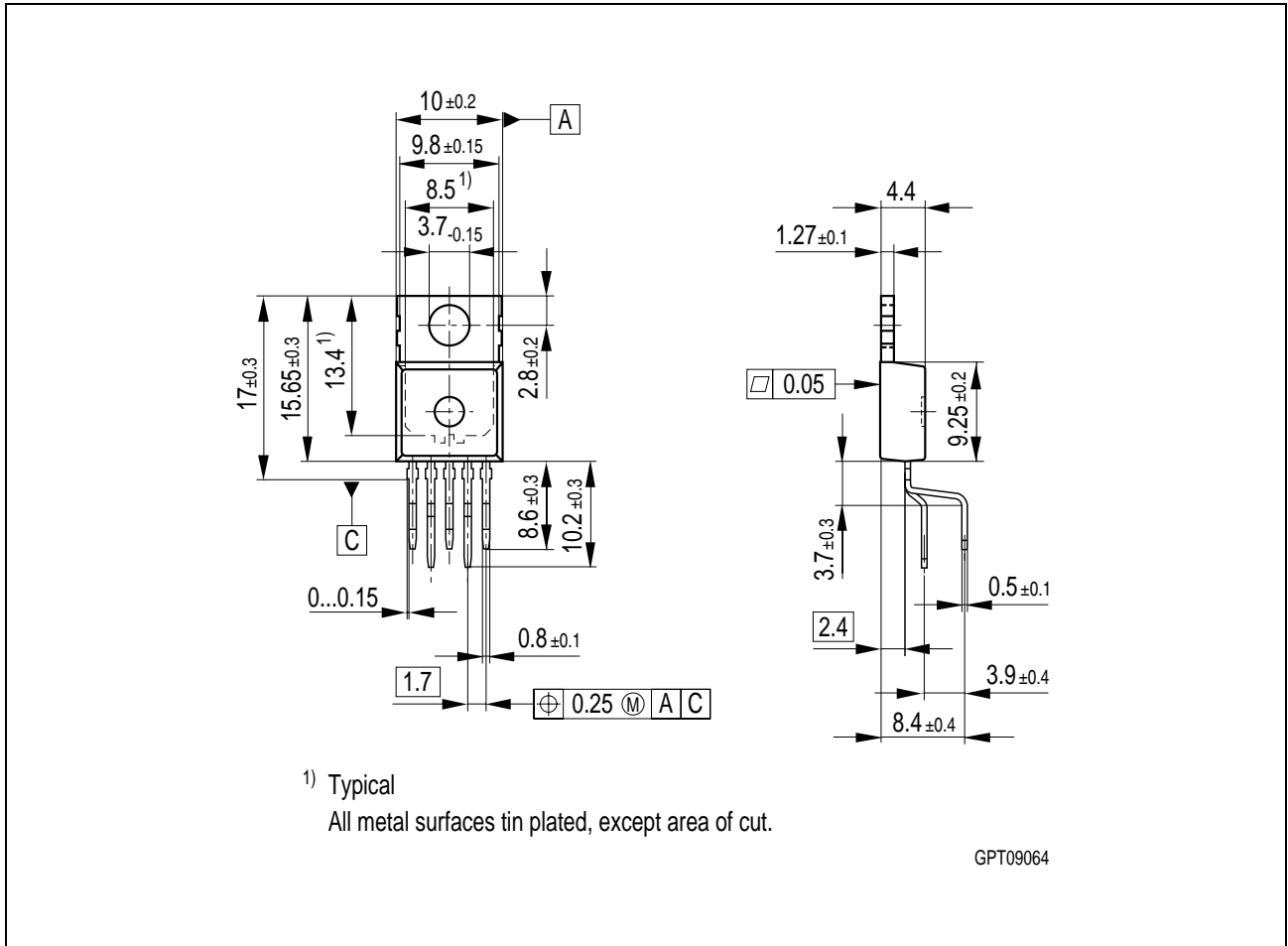


Figure 6 P-TO220-5-11 (Plastic Transistor Single Outline)

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SMD = Surface Mounted Device

Dimensions in mm

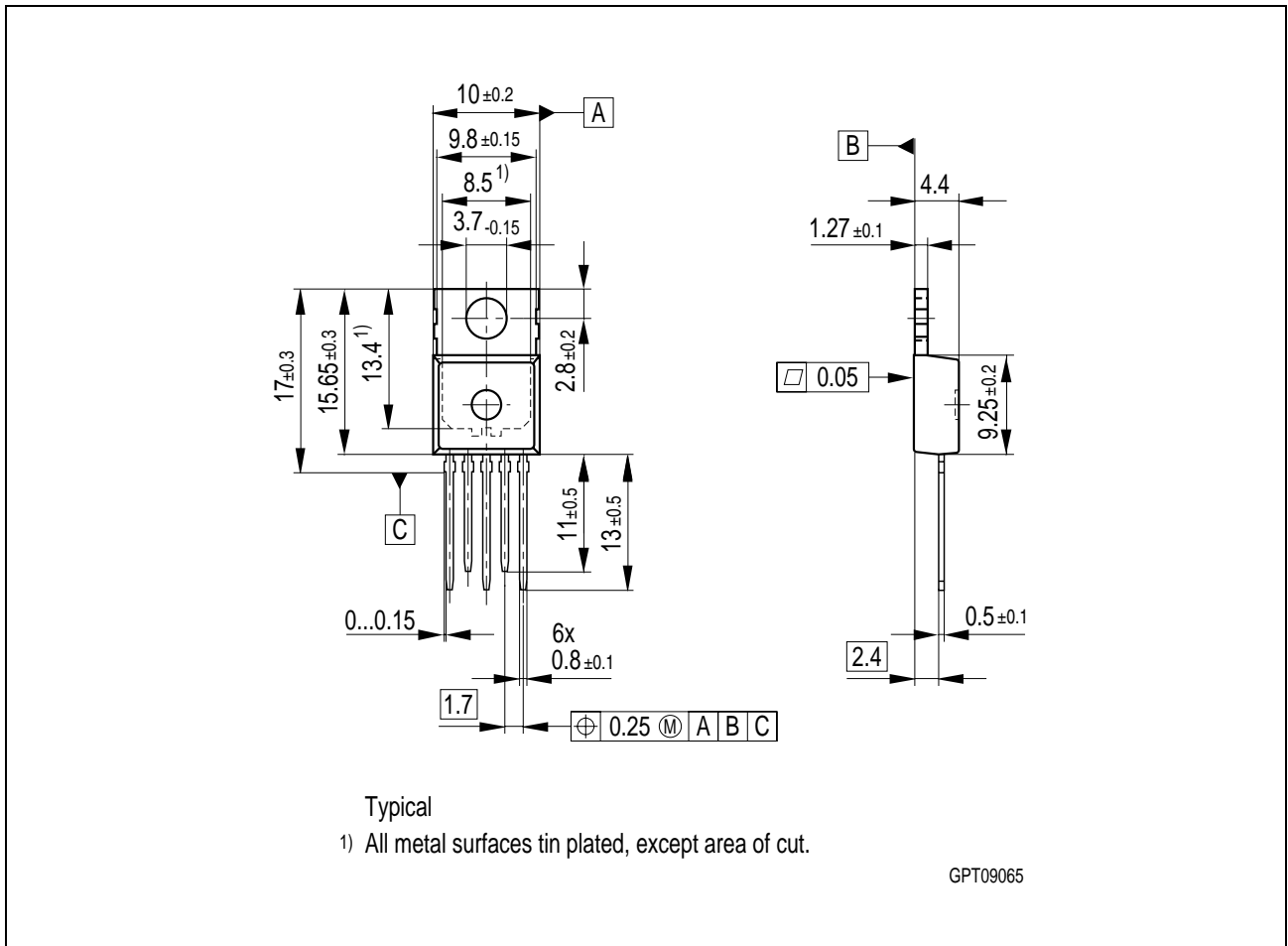


Figure 7 P-TO220-5-12 (Plastic Transistor Single Outline)

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Dimensions in mm

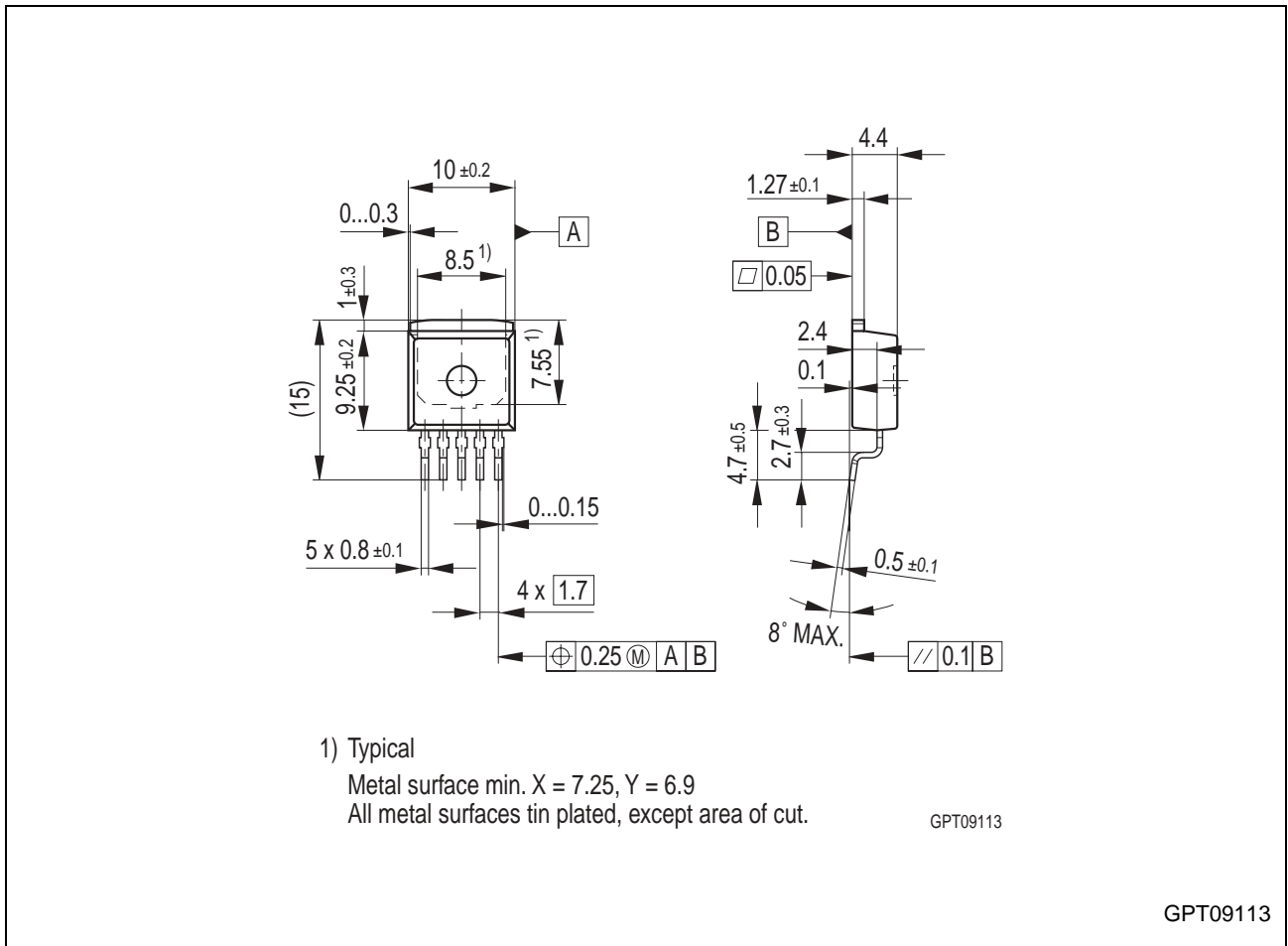


Figure 8 P-TO263-5-1 (Plastic Transistor Single Outline)

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SMD = Surface Mounted Device

Dimensions in mm

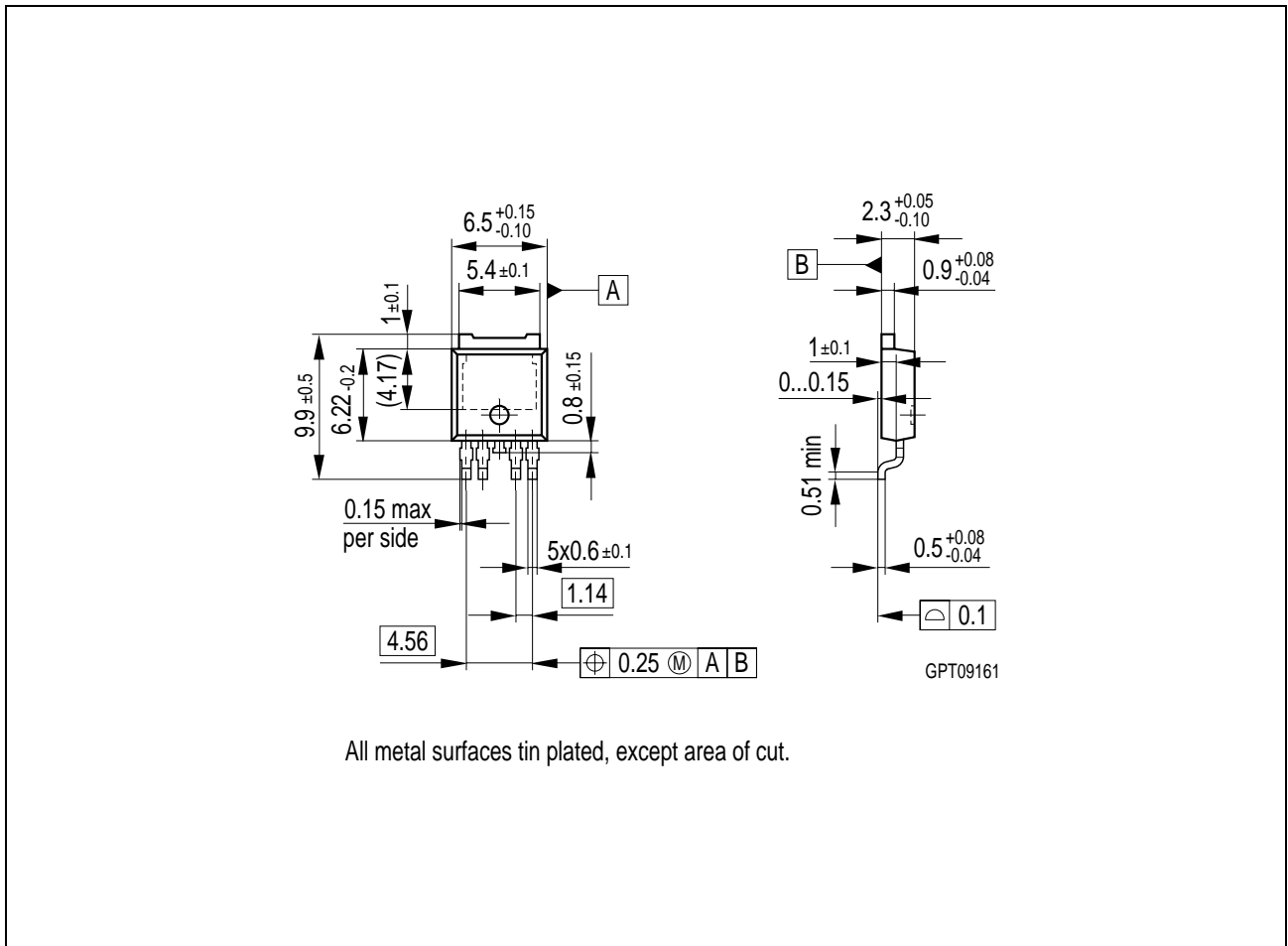


Figure 9 P-TO252-5-1 (Plastic Transistor Single Outline)

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SMD = Surface Mounted Device

Dimensions in mm

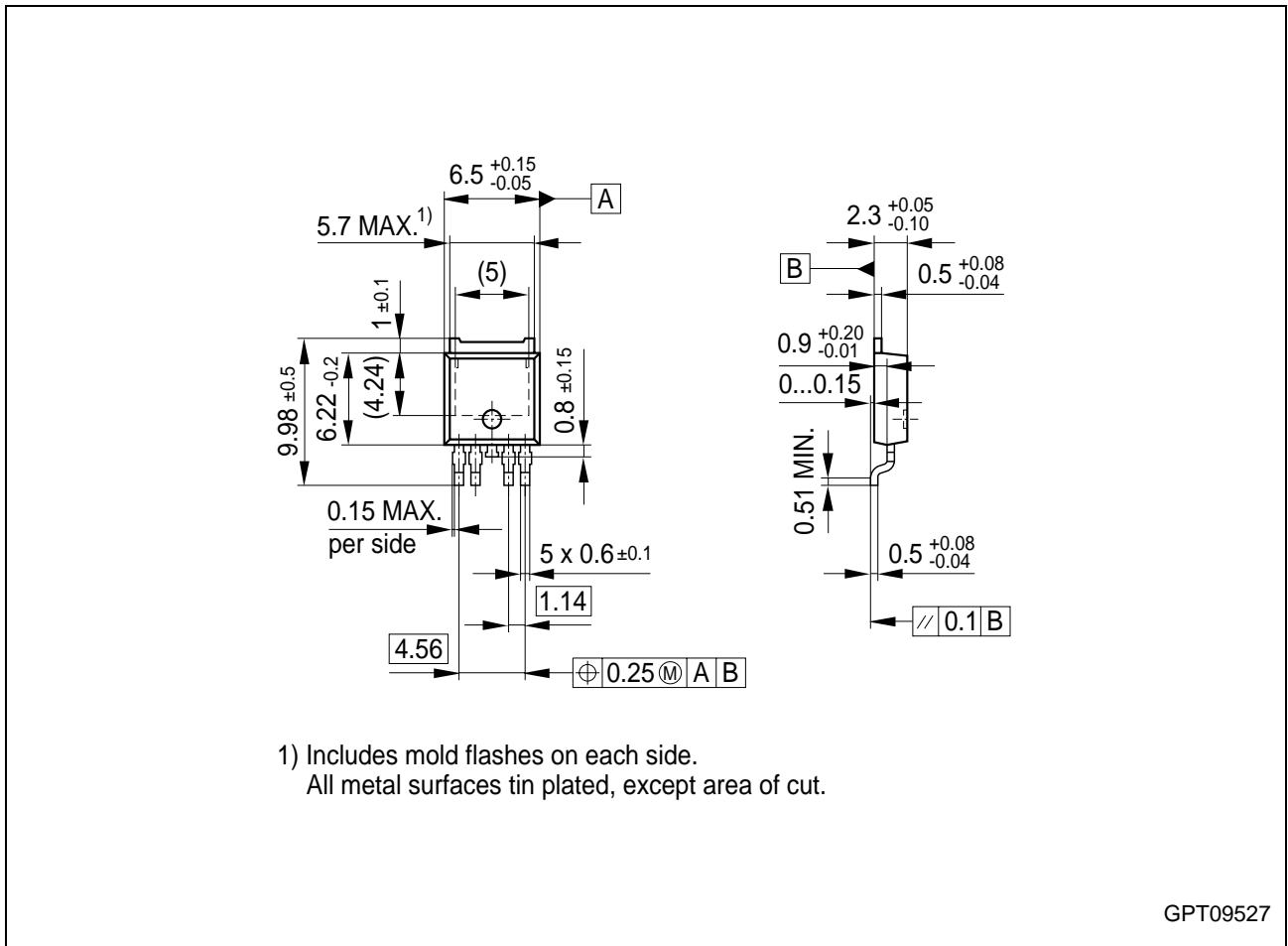


Figure 10 P-TO252-5-11 (Plastic Transistor Single Outline)

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SMD = Surface Mounted Device

Dimensions in mm

Remarks

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