

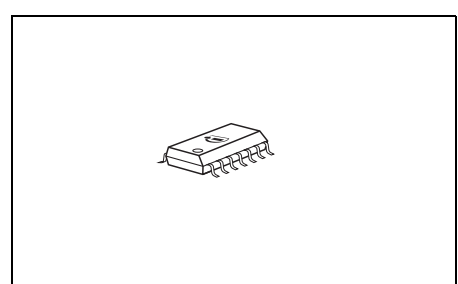
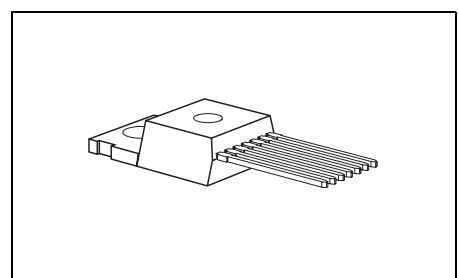
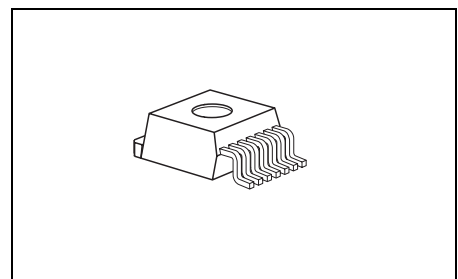
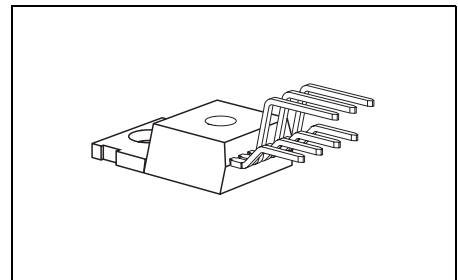


## Features

- Output voltage tolerance  $\leq \pm 2\%$
- 400 mA output current capability
- Low-drop voltage
- Very low standby current consumption
- Input voltage up to 40 V
- Overvoltage protection up to 60 V ( $\leq 400$  ms)
- Reset function down to 1 V output voltage
- ESD protection up to 2000 V
- Adjustable reset time
- On/off logic
- Overtemperature protection
- Reverse polarity protection
- Short-circuit proof
- Wide temperature range
- Suitable for use in automotive electronics
- Green Product (RoHS compliant)
- AEC Qualified

## Functional Description

TLE 4267 is a 5-V low drop voltage regulator for automotive applications in the PG-TO220-7 or PG-DSO-14-30 package. It supplies an output current of  $> 400$  mA. The IC is shortcircuit-proof and has an overtemperature protection circuit.



Type	Package	Type	Package
TLE 4267	PG-TO220-7-11	TLE 4267 S	PG-TO220-7-12
TLE 4267 G	PG-TO263-7-1	TLE 4267 GM	PG-DSO-14-30

## Application

The IC regulates an input voltage  $V_I$  in the range of  $5.5\text{ V} < V_I < 40\text{ V}$  to a nominal output voltage of  $V_Q = 5.0\text{ V}$ . A reset signal is generated for an output voltage of  $V_Q < V_{RT}$  (typ.  $4.5\text{ V}$ ). The reset delay can be set with an external capacitor. The device has two logic inputs. A voltage of  $V_{E2} > 4.0\text{ V}$  given to the E2-pin (e.g. by ignition) turns the device on. Depending on the voltage on pin E6 the IC may be hold in active-state even if  $V_{E2}$  goes to low level. This makes it simple to implement a self-holding circuit without external components. When the device is turned off, the output voltage drops to  $0\text{ V}$  and current consumption tends towards  $0\text{ }\mu\text{A}$ .

## Design Notes for External Components

The 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.  $1\text{ }\Omega$  in series with  $C_I$ . The output capacitor is necessary for the stability of the regulating circuit. Stability is guaranteed at values of  $\geq 22\text{ }\mu\text{F}$  and an ESR of  $\leq 3\text{ }\Omega$  within the operating temperature range.

## 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 the series transistor via a buffer. Saturation control as a function of the load current prevents any over-saturating of the power element.

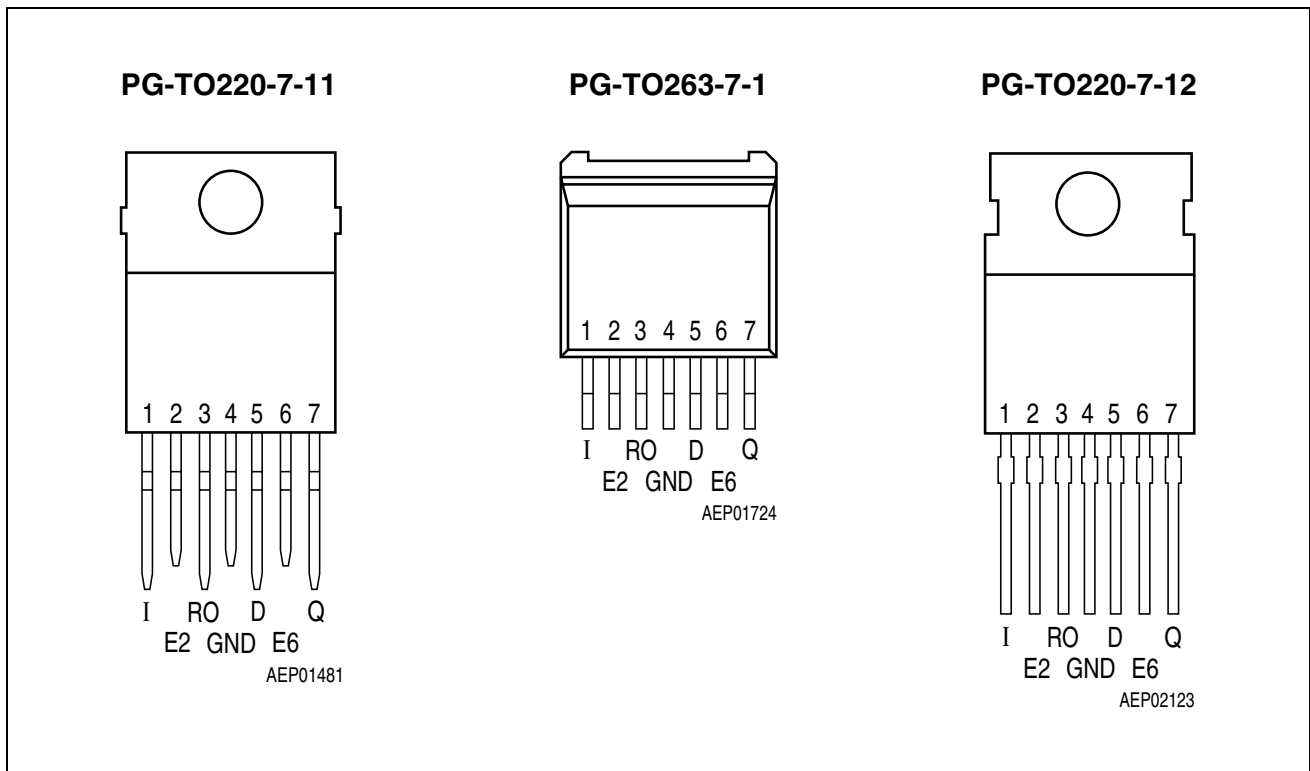
The reset output RO is in high-state if the voltage on the delay capacitor  $C_D$  is greater or equal  $V_{UD}$ . The delay capacitance  $C_D$  is charged with the current  $I_D$  for output voltages greater than the reset threshold  $V_{RT}$ . If the output voltage gets lower than  $V_{RT}$  a fast discharge of the delay capacitor  $C_D$  sets in and as soon as  $V_{CD}$  gets lower than  $V_{LD}$  the reset output RO is set to low-level (see [Figure 6](#)). The reset delay can be set within wide range by dimensioning the capacitance of the external capacitor.

**Table 1 Truth Table for Turn-ON/Turn-OFF Logic**

<b>E2, Inhibit</b>	<b>E6, Hold</b>	<b>V<sub>Q</sub></b>	<b>Remarks</b>
L	X	OFF	Initial state, Inhibit internally pulled-up
H	X	ON	Regulator switched on via Inhibit, by ignition for example
H	L	ON	Hold clamped active to ground by controller while Inhibit is still high
X	L	ON	Previous state remains, even ignition is shut off: self-holding state
L	L	ON	Ignition shut off while regulator is in self-holding state
L	H	OFF	Regulator shut down by releasing of Hold while Inhibit remains Low, final state. No active clamping required by external self-holding circuit ( $\mu$ C) to keep regulator in off-state.

Inhibit: E2 Enable function, active High

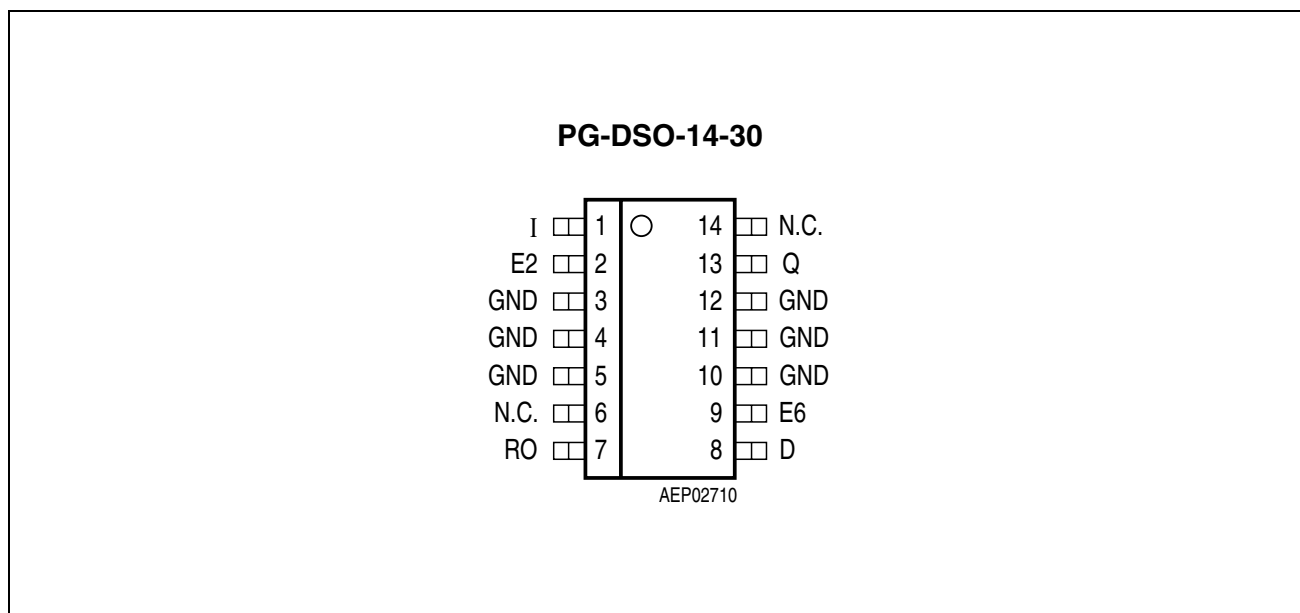
Hold: E6 Hold and release function, active Low



**Figure 1** Pin Configuration (top view)

**Table 2** Pin Definitions and Functions

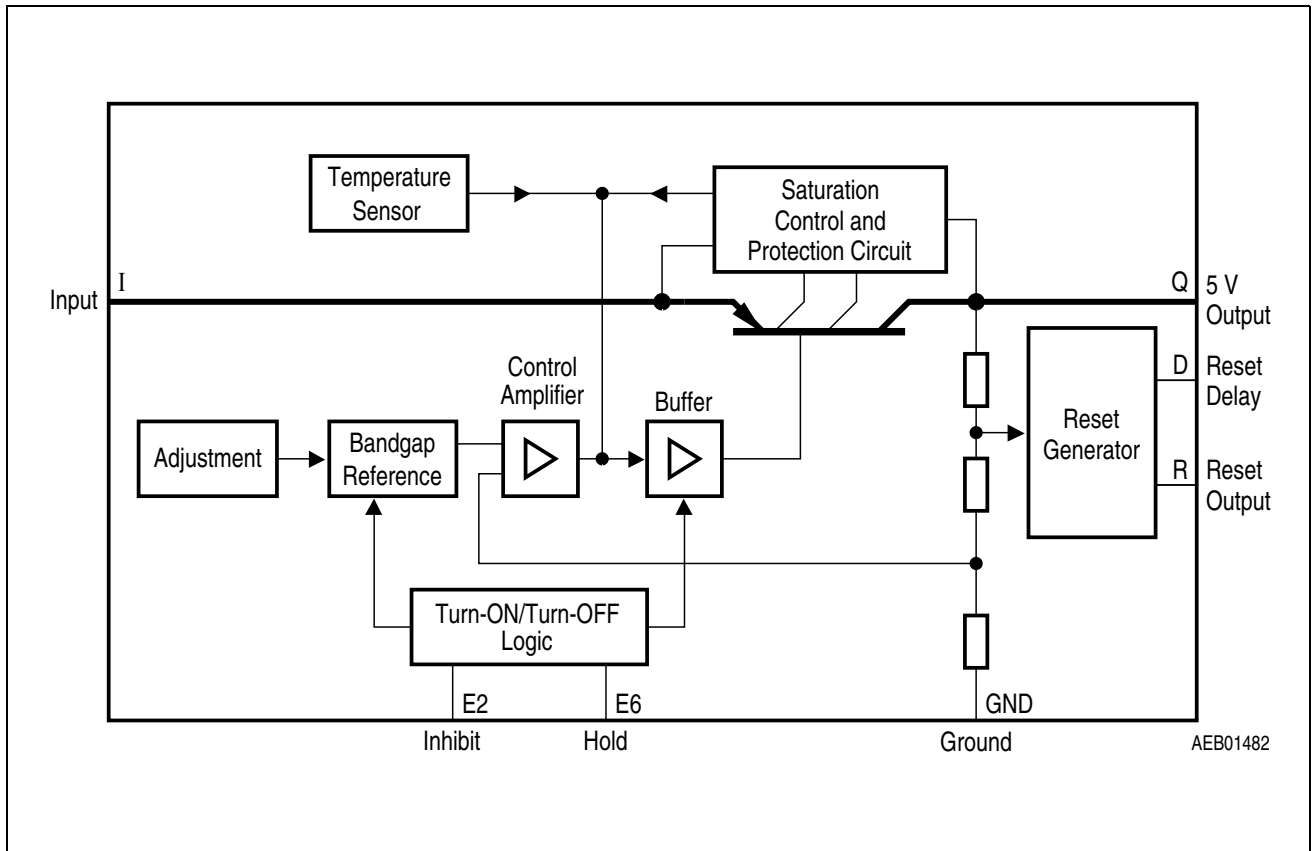
Pin	Symbol	Function
1	I	<b>Input</b> ; block to ground directly at the IC by a ceramic capacitor
2	E2	<b>Inhibit</b> ; device is turned on by High signal on this pin; internal pull-down resistor of 100 kΩ
3	RO	<b>Reset Output</b> ; open-collector output internally connected to the output via a resistor of 30 kΩ
4	GND	<b>Ground</b> ; connected to rear of chip
5	D	<b>Reset Delay</b> ; connect via capacitor to GND
6	E6	<b>Hold</b> ; see <a href="#">Table 1</a> for function; this input is connected to output voltage via a pull-up resistor of 50 kΩ
7	Q	<b>5-V Output</b> ; block to GND with 22-μF capacitor, ESR < 3 Ω



**Figure 2** Pin Configuration (top view)

**Table 3** Pin Definitions and Functions

Pin	Symbol	Function
1	I	<b>Input;</b> block to ground directly at the IC by a ceramic capacitor
2	E2	<b>Inhibit;</b> device is turned on by High signal on this pin; internal pull-down resistor of 100 kΩ
7	RO	<b>Reset Output;</b> open-collector output internally connected to the output via a resistor of 30 kΩ
3, 4, 5, 10, 11, 12	GND	<b>Ground;</b> connected to rear of chip
8	D	<b>Reset Delay;</b> connect with capacitor to GND for setting delay
9	E6	<b>Hold;</b> see <a href="#">Table 1</a> for function; this input is connected to output voltage via a pull-up resistor of 50 kΩ
13	Q	<b>5-V Output;</b> block to GND with 22-μF capacitor, ESR ≤ 3 Ω
6, 14	N.C.	Not Connected



**Figure 3 Block Diagram**

**Table 4 Absolute Maximum Ratings**
 $T_J = -40 \text{ to } 150 \text{ }^\circ\text{C}$ 

Parameter	Symbol	Limit Values		Unit	Notes
		Min.	Max.		
<b>Input</b>					
Voltage	$V_I$	-42	42	V	–
Voltage	$V_I$	–	60	V	$t \leq 400 \text{ ms}$
Current	$I_I$	–	–	–	internally limited
<b>Reset Output</b>					
Voltage	$V_{RO}$	-0.3	7	V	–
Current	$I_{RO}$	–	–	–	internally limited
<b>Reset Delay</b>					
Voltage	$V_D$	-0.3	42	V	–
Current	$I_D$	–	–	–	–
<b>Output</b>					
Voltage	$V_Q$	-0.3	7	V	–
Current	$I_Q$	–	–	–	internally limited
<b>Inhibit</b>					
Voltage	$V_{E2}$	-42	42	V	–
Current	$I_{E2}$	-5	5	mA	$t \leq 400 \text{ ms}$
<b>Hold</b>					
Voltage	$V_{E6}$	-0.3	7	V	–
Current	$I_{E6}$	–	–	mA	internally limited
<b>GND</b>					
Current	$I_{GND}$	-0.5	–	A	–
<b>Temperatures</b>					
Junction temperature	$T_J$	–	150	$^\circ\text{C}$	–
Storage temperature	$T_{stg}$	-50	150	$^\circ\text{C}$	–

**Table 5 Operating Range**

Parameter	Symbol	Limit Values		Unit	Notes
		Min.	Max.		
Input voltage	$V_I$	5.5	40	V	see diagram
Junction temperature	$T_J$	-40	150	°C	–
<b>Thermal Resistance</b>					
Junction ambient	$R_{thja}$	–	65	K/W	PG-TO220-7-11 package
Junction-case	$R_{thjc}$	–	6	K/W	PG-TO220-7-11 package
Junction-case	$Z_{thjc}$	–	2	K/W	$T < 1$ ms PG-TO220-7-11 package
Junction ambient	$R_{thja}$	–	70	K/W	PG-TO263-7-1 (SMD) package
Junction-case	$R_{thjc}$	–	6	K/W	PG-TO263-7-1 (SMD) package
Junction-case	$Z_{thjc}$	–	2	K/W	$T < 1$ ms PG-TO263-7-1 (SMD) package
Junction ambient	$R_{thja}$	–	65	K/W	PG-TO220-7-12 package
Junction-case	$R_{thjc}$	–	6	K/W	PG-TO220-7-12 package
Junction-case	$Z_{thjc}$	–	2	K/W	$T < 1$ ms PG-TO220-7-12 package
Junction ambient	$R_{thja}$	–	70	K/W	PG-DSO-14-30 package
Junction-pin	$R_{thjp}$	–	30	K/W	PG-DSO-14-30 package



**Table 6 Characteristics**
 $V_I = 13.5 \text{ V}; -40 \text{ }^\circ\text{C} < T_J < 125 \text{ }^\circ\text{C}; V_{E2} > 4 \text{ V}$  (unless specified otherwise)

Parameter	Symbol	Limit Values			Unit	Test Condition
		Min.	Typ.	Max.		
Output voltage	$V_Q$	4.9	5	5.1	V	$5 \text{ mA} \leq I_Q \leq 400 \text{ mA}$ $6 \text{ V} \leq V_I \leq 26 \text{ V}$
Output voltage	$V_Q$	4.9	5	5.1	V	$5 \text{ mA} \leq I_Q \leq 150 \text{ mA}$ $6 \text{ V} \leq V_I \leq 40 \text{ V}$
Output current limiting	$I_Q$	500	–	–	mA	$T_J = 25 \text{ }^\circ\text{C}$
Current consumption $I_q = I_1 - I_Q$	$I_q$	–	–	50	$\mu\text{A}$	IC turned off
Current consumption $I_q = I_1 - I_Q$	$I_q$	–	1.0	10	$\mu\text{A}$	$T_J = 25 \text{ }^\circ\text{C}$ IC turned off
Current consumption $I_q = I_1 - I_Q$	$I_q$	–	1.3	4	mA	$I_Q = 5 \text{ mA}$ IC turned on
Current consumption $I_q = I_1 - I_Q$	$I_q$	–	–	60	mA	$I_Q = 400 \text{ mA}$
Current consumption $I_q = I_1 - I_Q$	$I_q$	–	–	80	mA	$I_Q = 400 \text{ mA}$ $V_I = 5 \text{ V}$
Drop voltage	$V_{Dr}$	–	0.3	0.6	V	$I_Q = 400 \text{ mA}^{1)}$
Load regulation	$\Delta V_Q$	–	–	50	mV	$5 \text{ mA} \leq I_Q \leq 400 \text{ mA}$
Supply-voltage regulation	$\Delta V_Q$	–	15	25	mV	$V_I = 6 \text{ to } 36 \text{ V};$ $I_Q = 5 \text{ mA}$
Supply-voltage rejection	$SVR$	–	54	–	dB	$f_r = 100 \text{ Hz};$ $V_r = 0.5 \text{ Vpp}$
Longterm stability	$\Delta V_Q$	–	0	–	mV	1000 h

**Reset Generator**

Switching threshold	$V_{RT}$	4.2	4.5	4.8	V	–
Reset High level	–	4.5	–	–	V	$R_{ext} = \infty$
Saturation voltage	$V_{RO,SAT}$	–	0.1	0.4	V	$R_R = 4.7 \text{ k}\Omega^{2)}$
Internal Pull-up resistor	$R_{RO}$	–	30	–	k $\Omega$	–
Saturation voltage	$V_{D,SAT}$	–	50	100	mV	$V_Q < V_{RT}$
Charge current	$I_D$	8	15	25	$\mu\text{A}$	$V_D = 1.5 \text{ V}$
Upper delay switching threshold	$V_{UD}$	2.6	3	3.3	V	–

**Table 6 Characteristics (cont'd)**
 $V_I = 13.5 \text{ V}; -40 \text{ }^\circ\text{C} < T_J < 125 \text{ }^\circ\text{C}; V_{E2} > 4 \text{ V}$  (unless specified otherwise)

Parameter	Symbol	Limit Values			Unit	Test Condition
		Min.	Typ.	Max.		
Delay time	$t_D$	–	20	–	ms	$C_d = 100 \text{ nF}$
Lower delay switching threshold	$V_{LD}$	–	0.43	–	V	–
Reset reaction time	$t_{RR}$	–	2	–	$\mu\text{s}$	$C_d = 100 \text{ nF}$

**Inhibit**

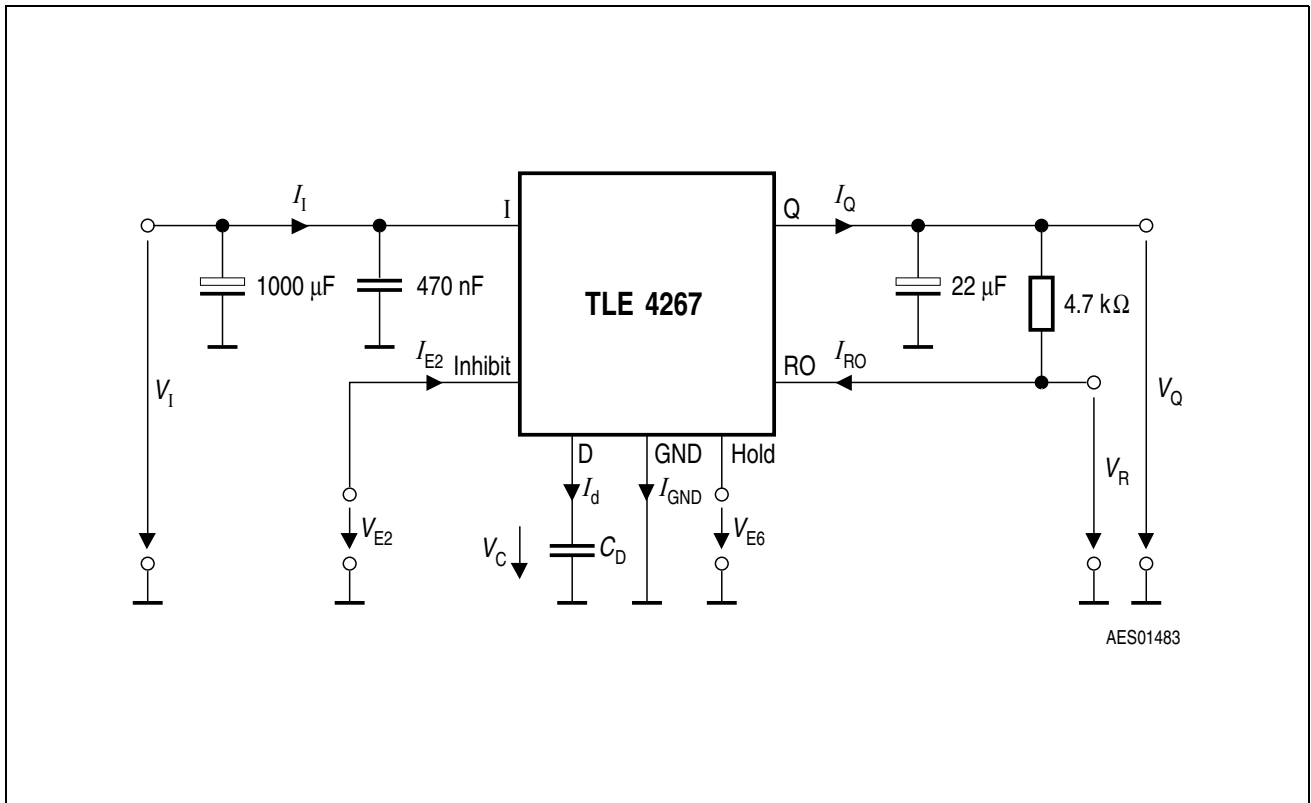
Turn on voltage	$V_{U,INH}$	–	3	4	V	IC turned on
Turn off voltage	$V_{L,INH}$	2	–	–	V	IC turned off
Pull-down resistor	$R_{INH}$	50	100	200	$\text{k}\Omega$	–
Hysteresis	$\Delta V_{INH}$	0.2	0.5	0.8	V	–
Input current	$I_{INH}$	–	35	100	$\mu\text{A}$	$V_{INH} = 4 \text{ V}$
Hold voltage	$V_{U,HOLD}$	30	35	40	%	Referred to $V_Q$
Turn off voltage	$V_{L,HOLD}$	60	70	80	%	Referred to $V_Q$
Pull-up resistor	$R_{HOLD}$	20	50	100	$\text{k}\Omega$	–

**Overvoltage Protection**

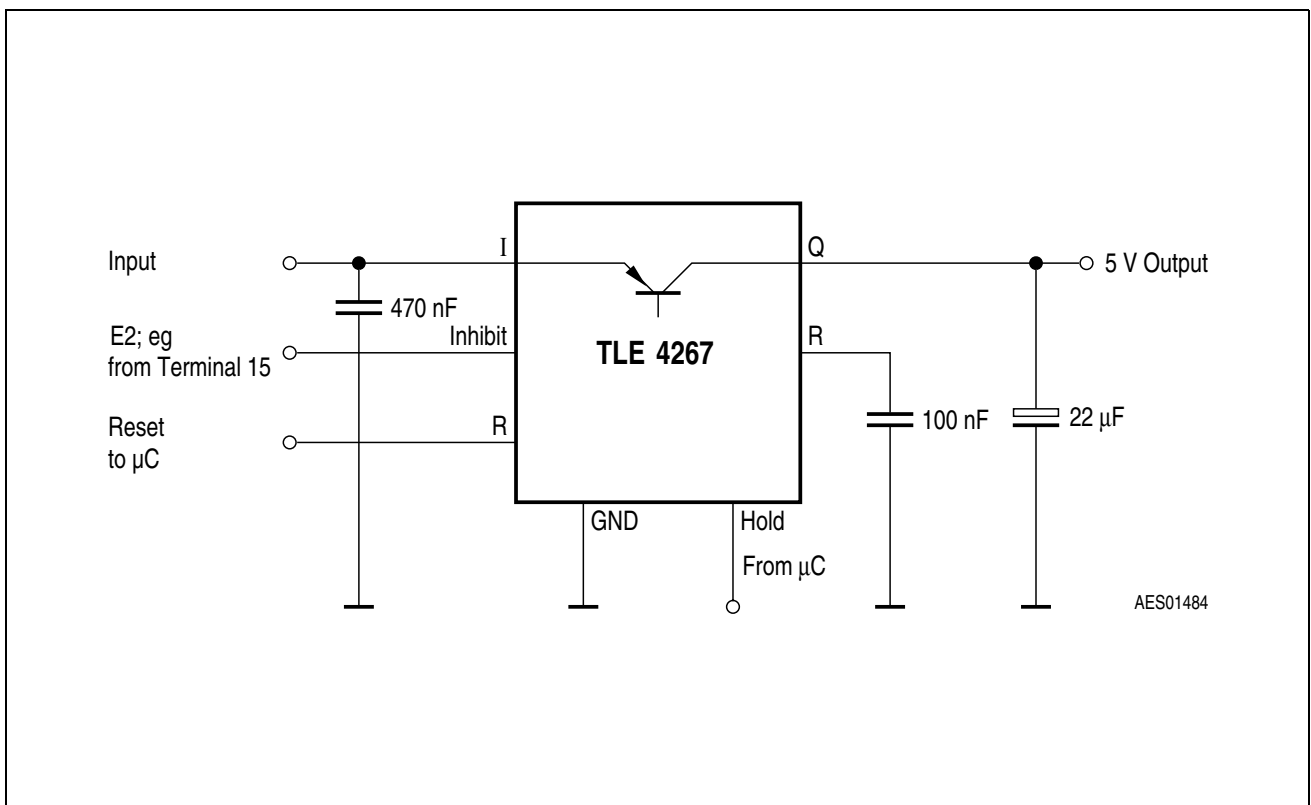
Turn off voltage	$V_{I,OV}$	42	44	46	V	$V_I$ increasing
Turn on voltage	$V_{I,turn\ on}$	36	–	–	V	$V_I$ decreasing after turn off

1) Drop voltage =  $V_I - V_Q$  (measured when the output voltage  $V_Q$  has dropped 100 mV from the nominal value obtained at  $V_I = 13.5 \text{ V}$ )

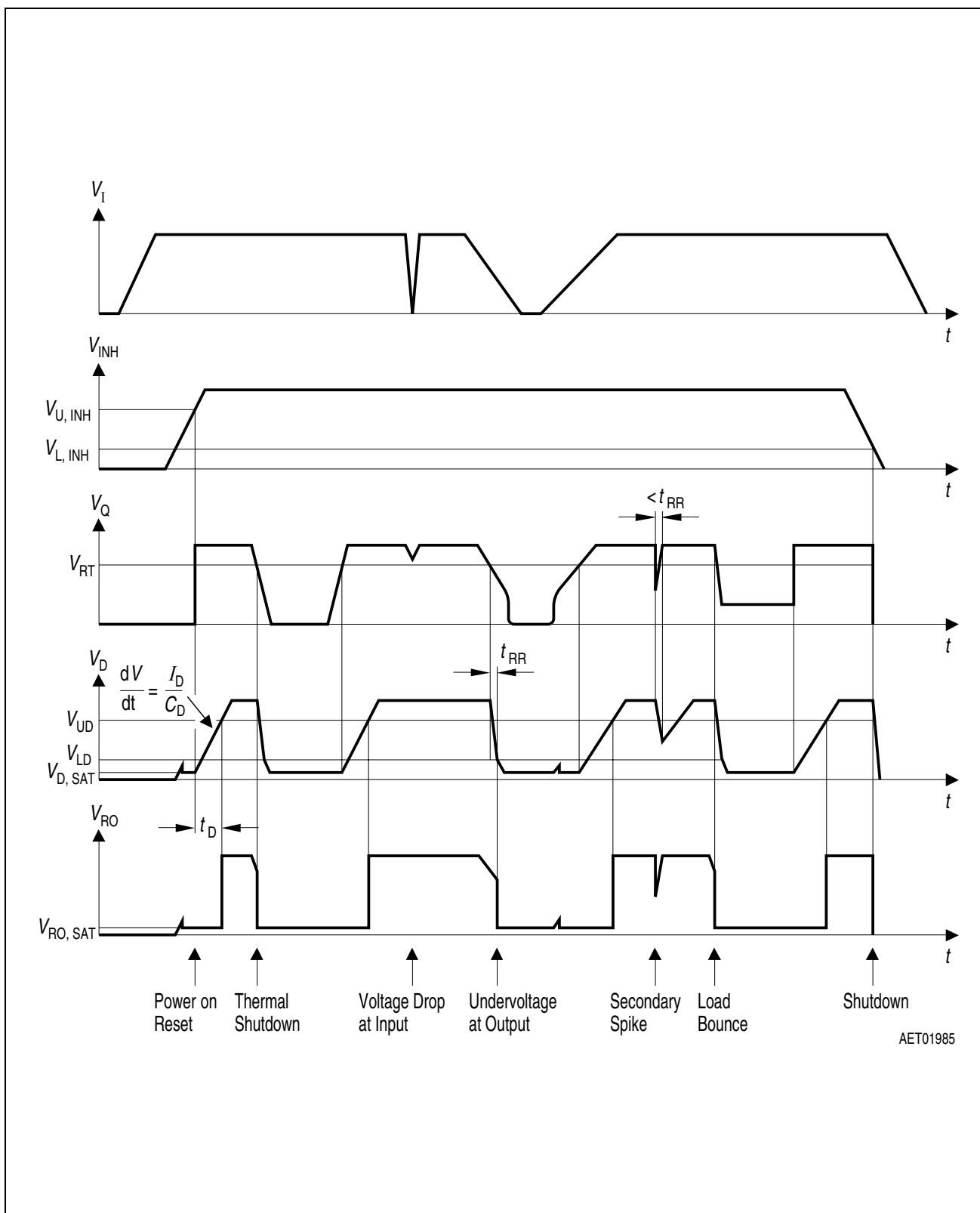
2) The reset output is Low for  $1 \text{ V} < V_Q < V_{RT}$



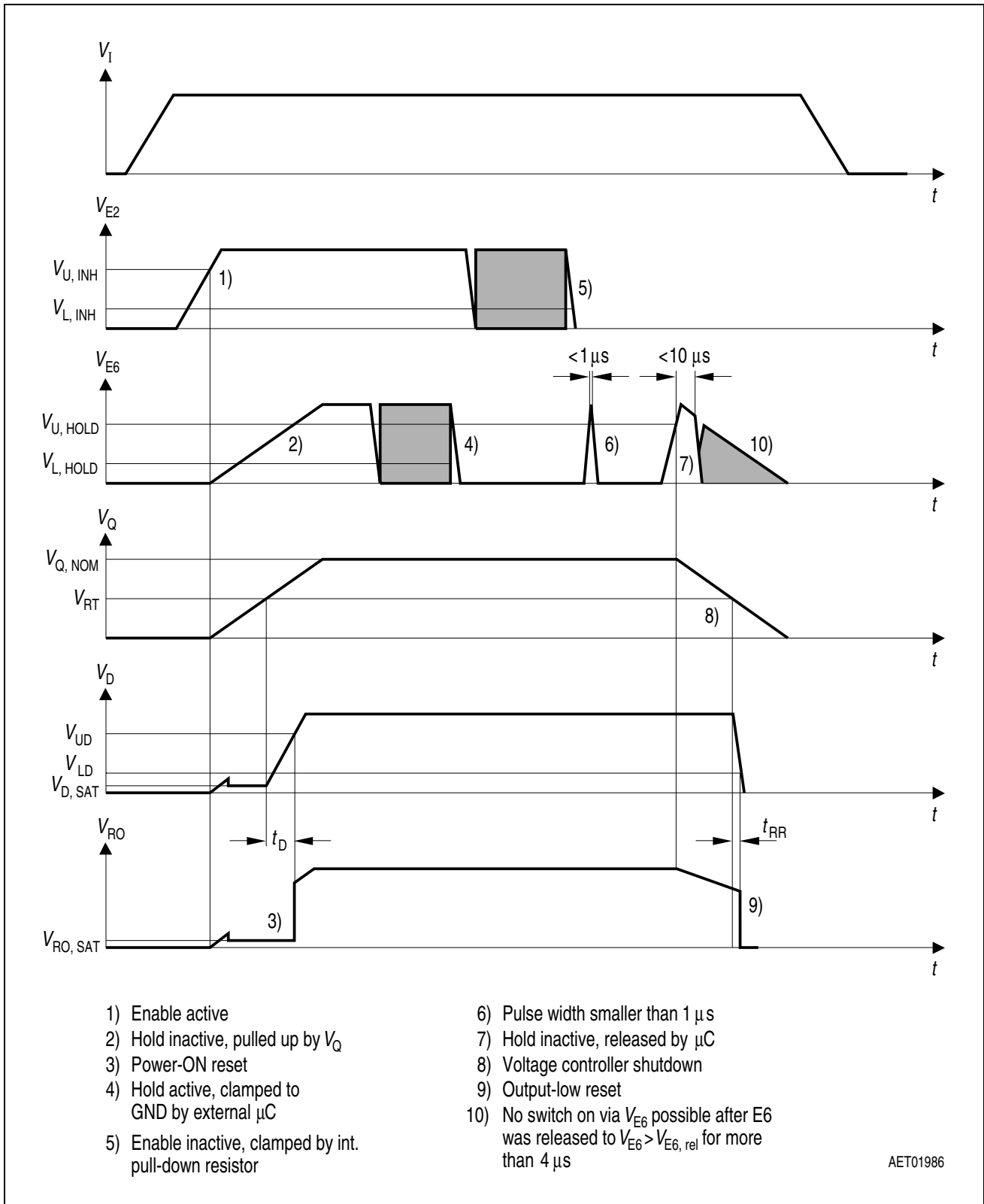
**Figure 4 Test Circuit**



**Figure 5 Application Circuit**

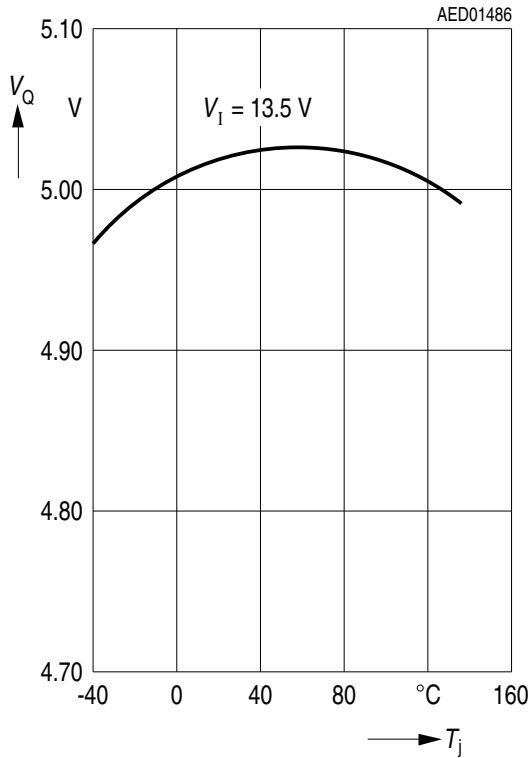


**Figure 6 Time Response**

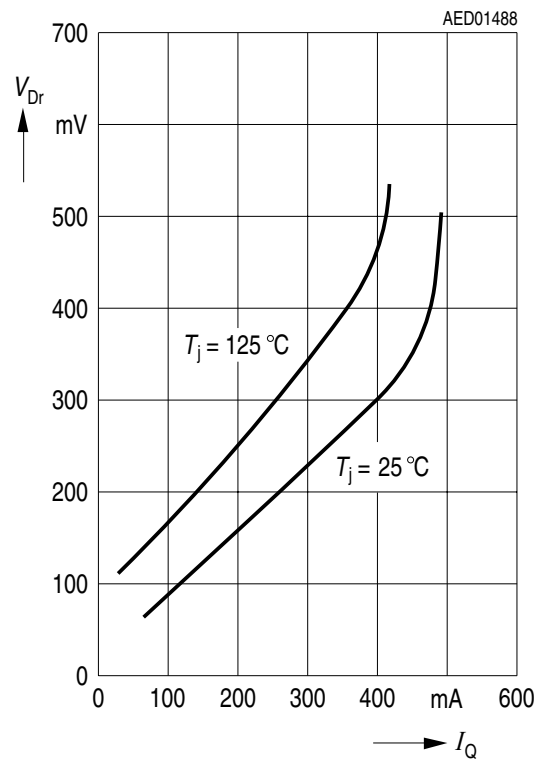


**Figure 7 Enable and Hold Behavior**

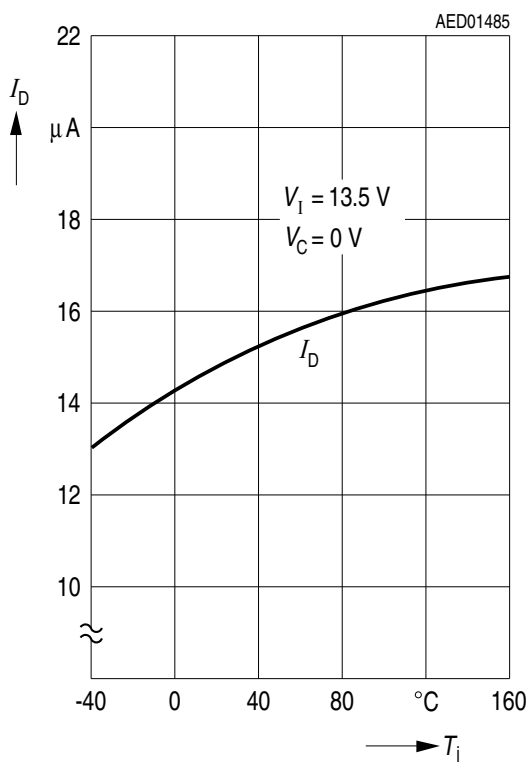
**Output Voltage  $V_Q$  versus Temperature  $T_j$**



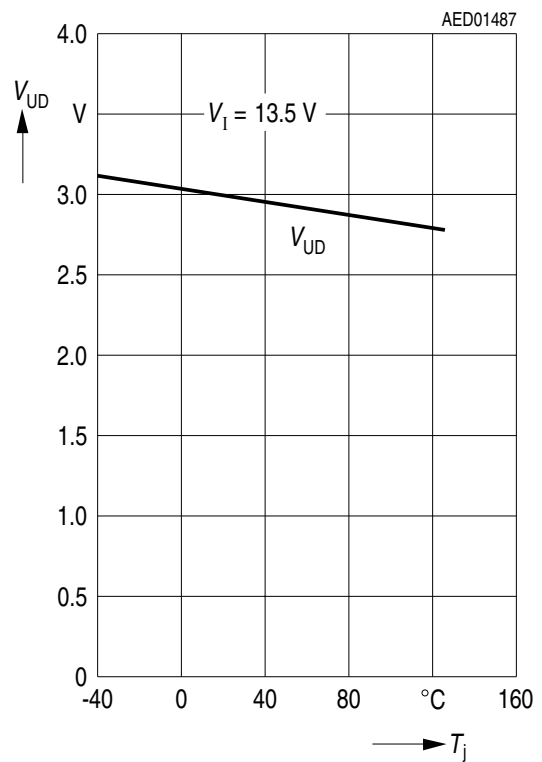
**Drop Voltage  $V_{Dr}$  versus Output Current  $I_Q$**



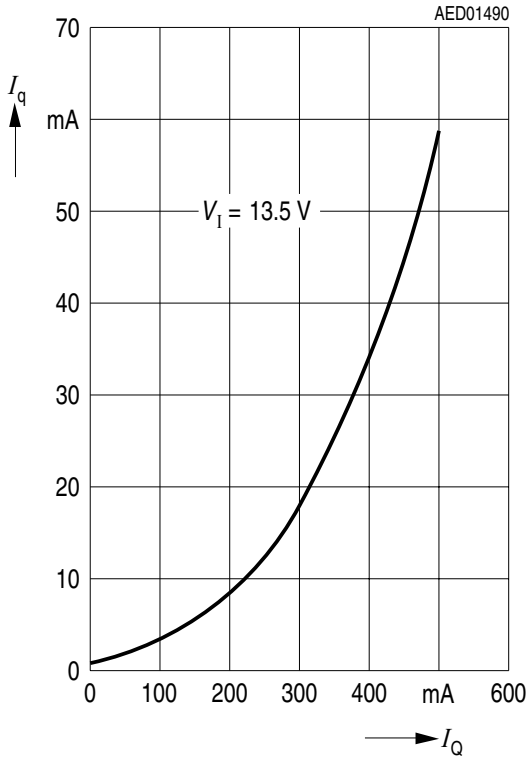
**Charge Current  $I_D$  versus Temperature  $T_j$**



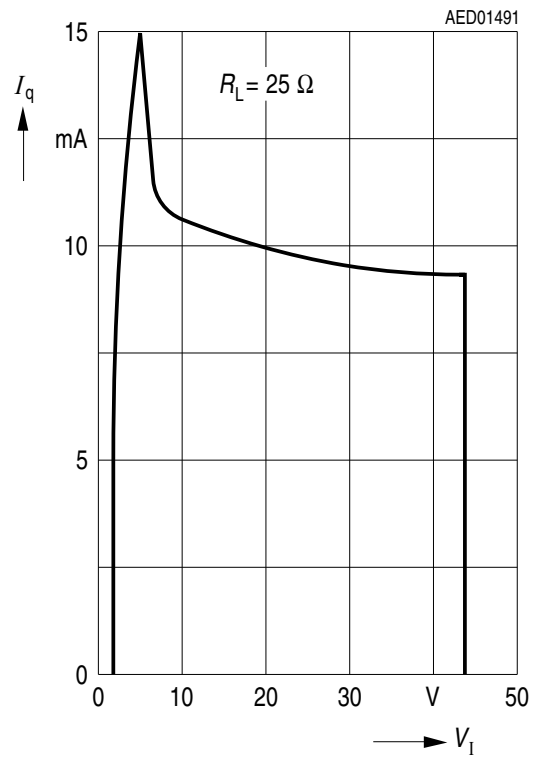
**Delay Switching Threshold  $V_{UD}$  versus Temperature  $T_j$**



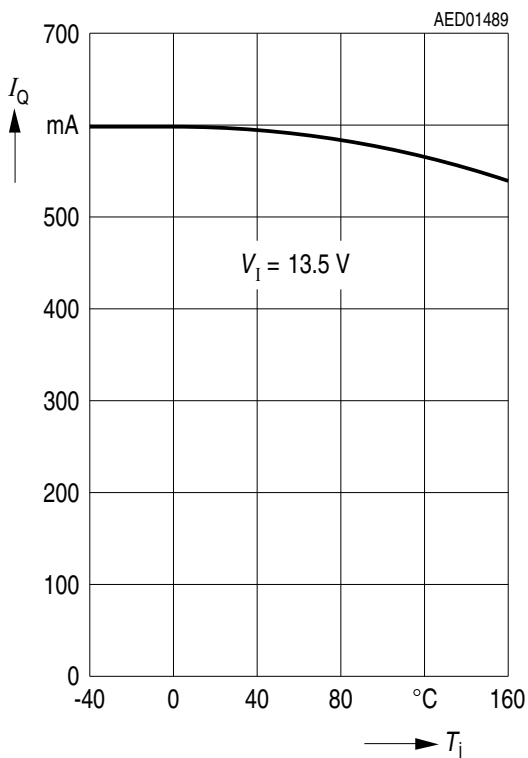
**Current Consumption  $I_q$  versus Output Current  $I_Q$**



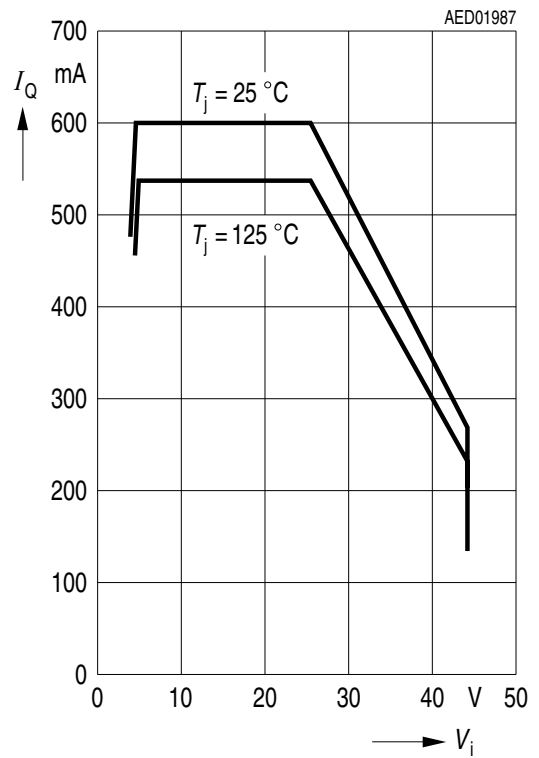
**Current Consumption  $I_q$  versus Input Voltage  $V_I$**



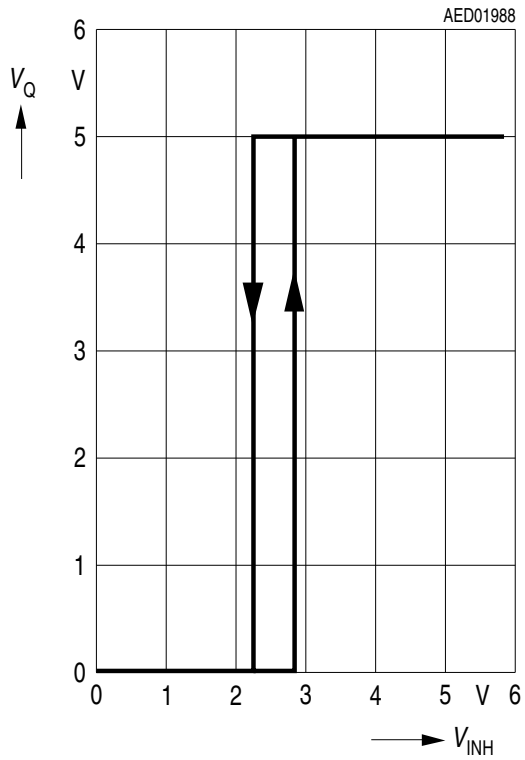
**Output Current Limiting  $I_Q$  versus Temperature  $T_j$**



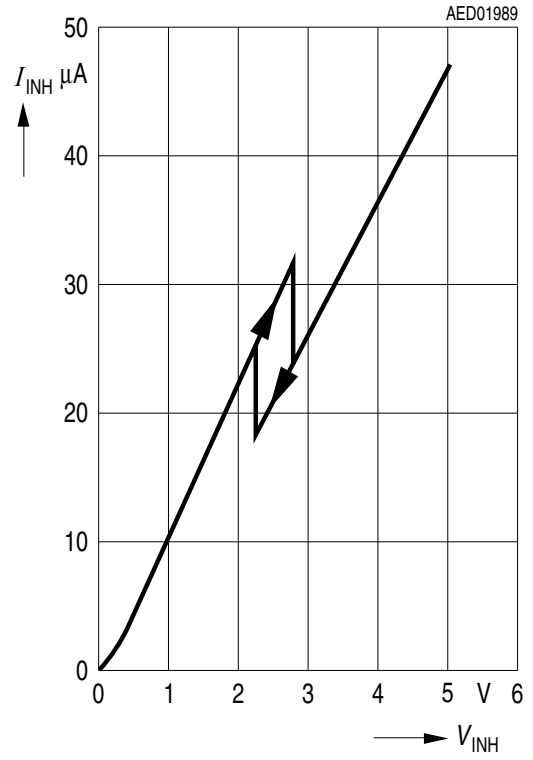
**Output Current Limiting  $I_Q$  versus Input Voltage  $V_I$**



**Output Voltage  $V_Q$  versus Inhibit Voltage  $V_{INH}$**



**Inhibit Current  $I_{INH}$  versus Inhibit Voltage  $V_{INH}$**





Package Outlines

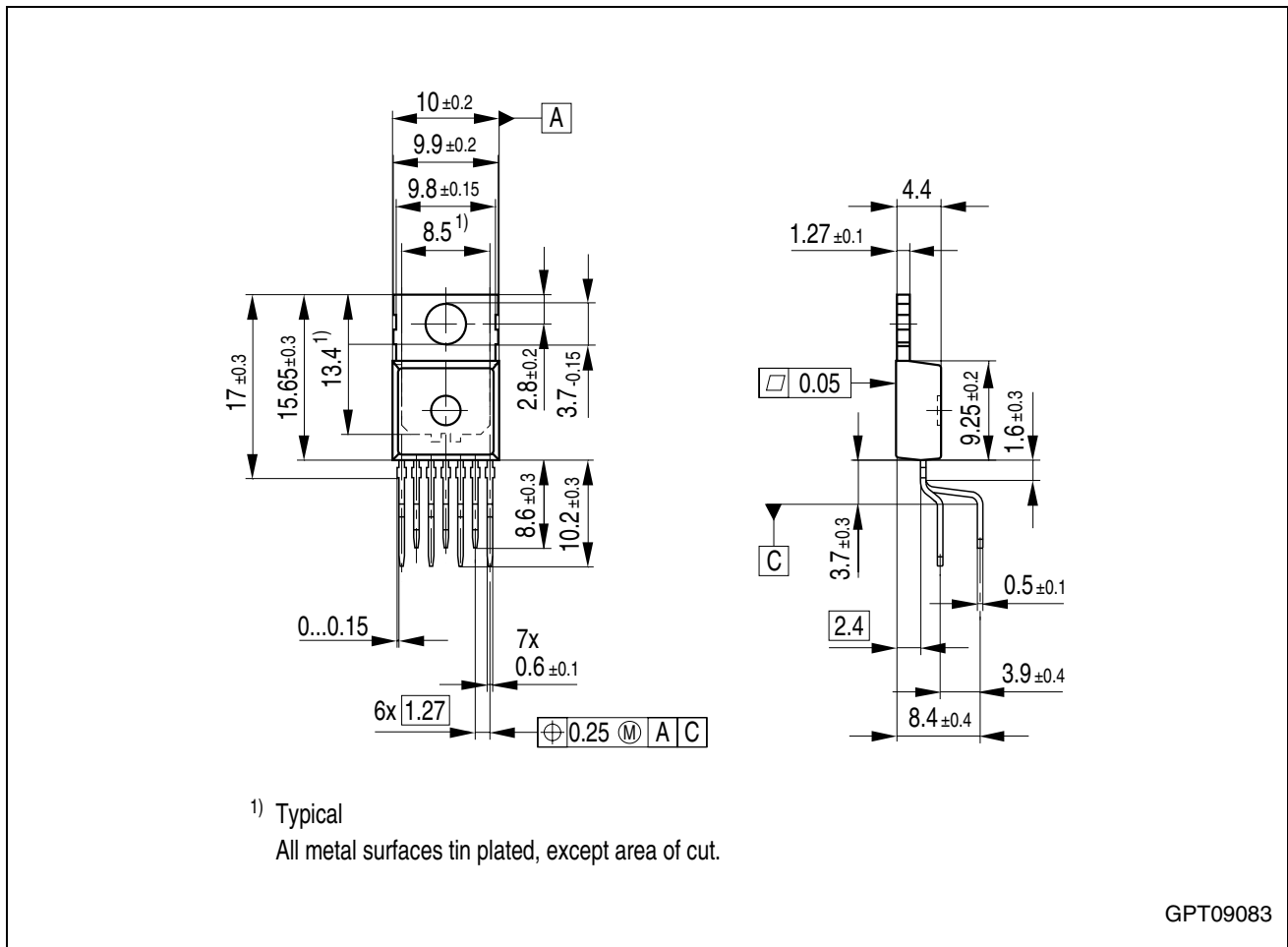


Figure 8 PG-TO220-7-11 (Plastic Transistor Single Outline)

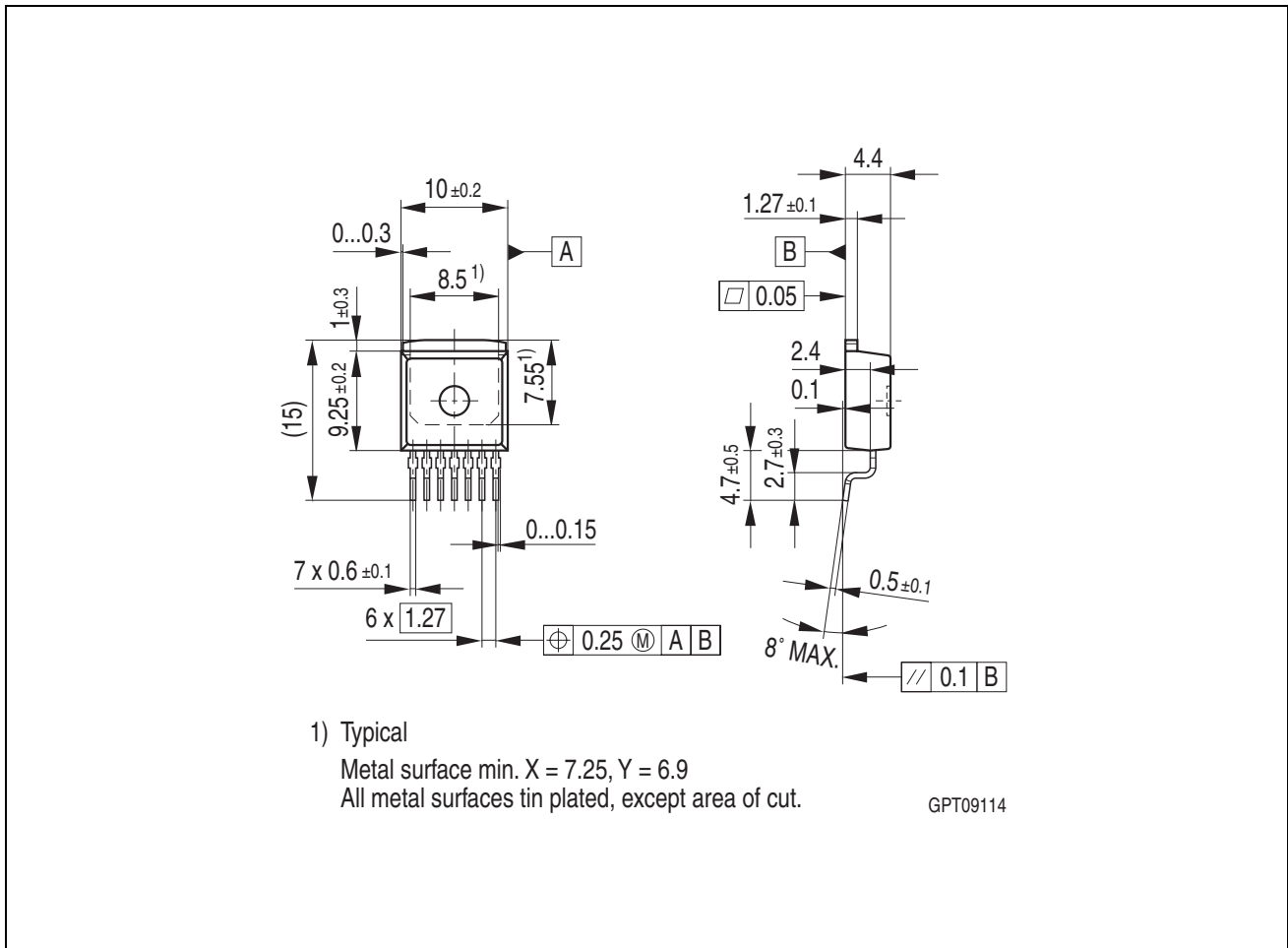
Green Product (RoHS compliant)

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



**Figure 9 PG-TO263-7-1 (Plastic Transistor Single Outline)**

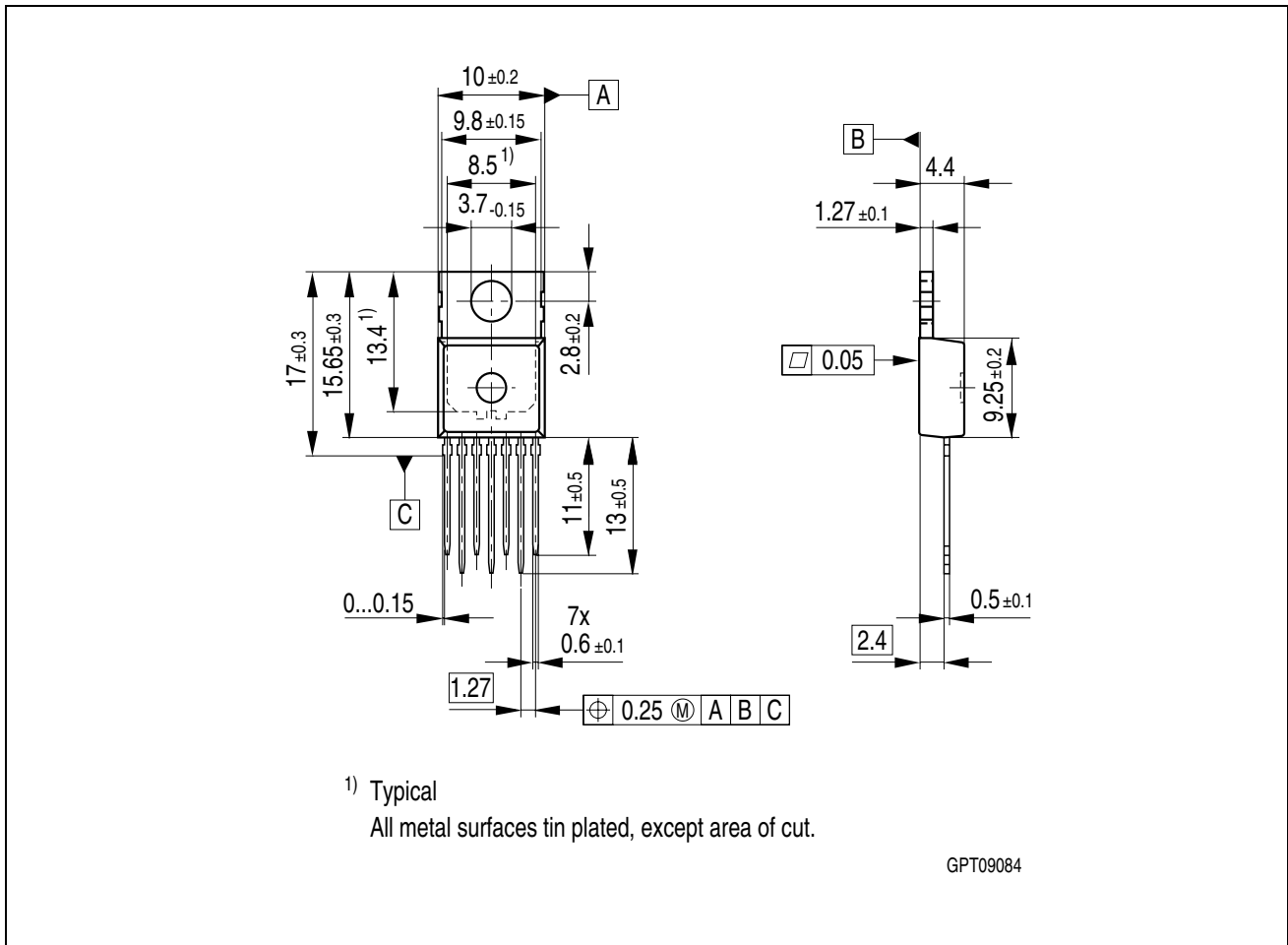
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SMD = Surface Mounted Device

Dimensions in mm



**Figure 10 PG-TO220-7-12 (Plastic Transistor Single Outline)**

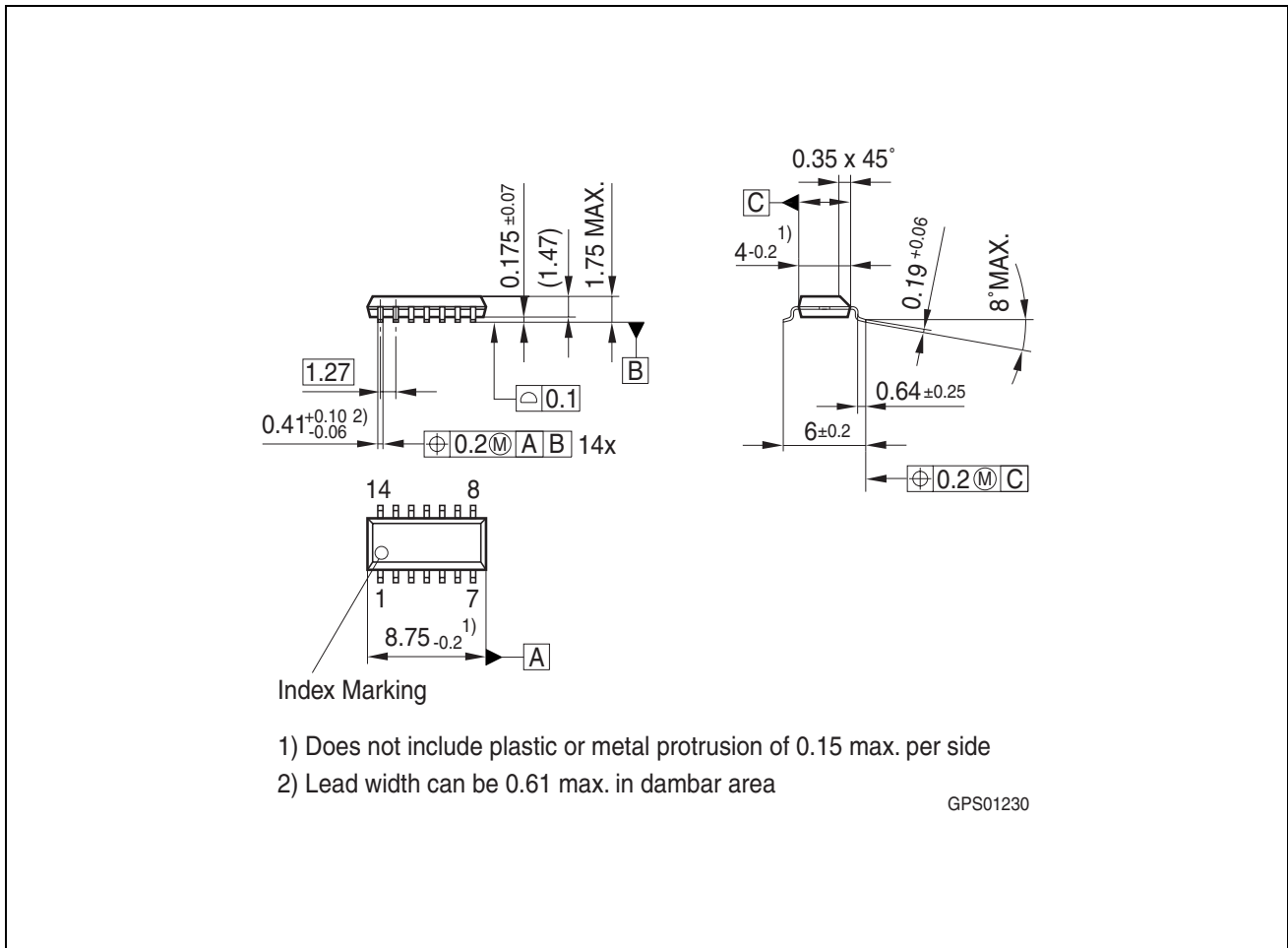
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SMD = Surface Mounted Device

Dimensions in mm



**Figure 11 PG-DSO-14-30 (Plastic Dual Small Outline)**

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SMD = Surface Mounted Device

Dimensions in mm

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**Revision History**

<b>Version</b>	<b>Date</b>	<b>Changes</b>
Rev. 2.5	2007-03-20	Initial version of RoHS-compliant derivate of TLE 4267 <b>Page 1</b> : AEC certified statement added <b>Page 1</b> and <b>Page 17</b> ff: RoHS compliance statement and Green product feature added <b>Page 1</b> and <b>Page 17</b> ff: Package changed to RoHS compliant version Legal Disclaimer updated

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