

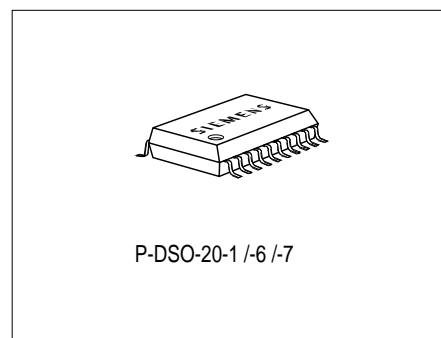
## 5-V Low-Drop Voltage Regulator

TLE 4261

Bipolar IC

### Features

- Very low-drop voltage
- Very low quiescent current
- Low starting-current consumption
- Proof against reverse polarity
- Input voltage up to 42 V
- Overvoltage protection up to 65 V ( $\leq 400$  ms)
- Short-circuit proof
- External setting of reset delay
- Integrated watchdog circuit
- Wide temperature range
- Overtemperature protection
- Suitable for automotive use
- EMC proofed (100 V/m)



Type	Ordering Code	Package
▼ TLE 4261 G	Q67000-A9059	P-DSO-20-6 (SMD)

▼ Not recommended for new design. Please refer to the pin compatible device TLE 4271-2.

### Functional Description

TLE 4261 is a 5-V low-drop voltage regulator in a P-DSO package. The maximum input voltage is 42 V (65 V/ $\leq 400$  ms). The device can produce an output current of more than 500 mA. It is short-circuit proof and incorporates temperature protection that disables the circuit at impermissibly high temperatures.

### Application Description

The IC regulates an input voltage  $V_I$  in the range  $V_I = 6$  V to 40 V to  $V_{Qrated} = 5.0$  V. A reset signal is generated for a maximum output voltage of  $V_Q$  less than 4.75 V. The reset delay can be set externally with a capacitor. A connected microprocessor is monitored by the integrated watchdog circuit. Connecting this input to the input voltage makes the watchdog function inactive. The presence of a voltage less than 2 V on inhibit input disables the regulator. The current consumption drops to max. 50  $\mu$ A.

## Design Notes for External Components

The input capacitor  $C_1$  causes a low-resistance powerline and limits the rise times of the input voltage. The IC is protected against rise times up to 100 V/ $\mu$ s. It is possible to damp the tuned circuit consisting of supply inductance and input capacitance with a resistor of approx. 1  $\Omega$  in series to  $C_1$ .

The output capacitor maintains the stability of the regulating loop. Stability is guaranteed with a rating of 22  $\mu$ F at an ESR of 3  $\Omega$  max. in the operating temperature range.

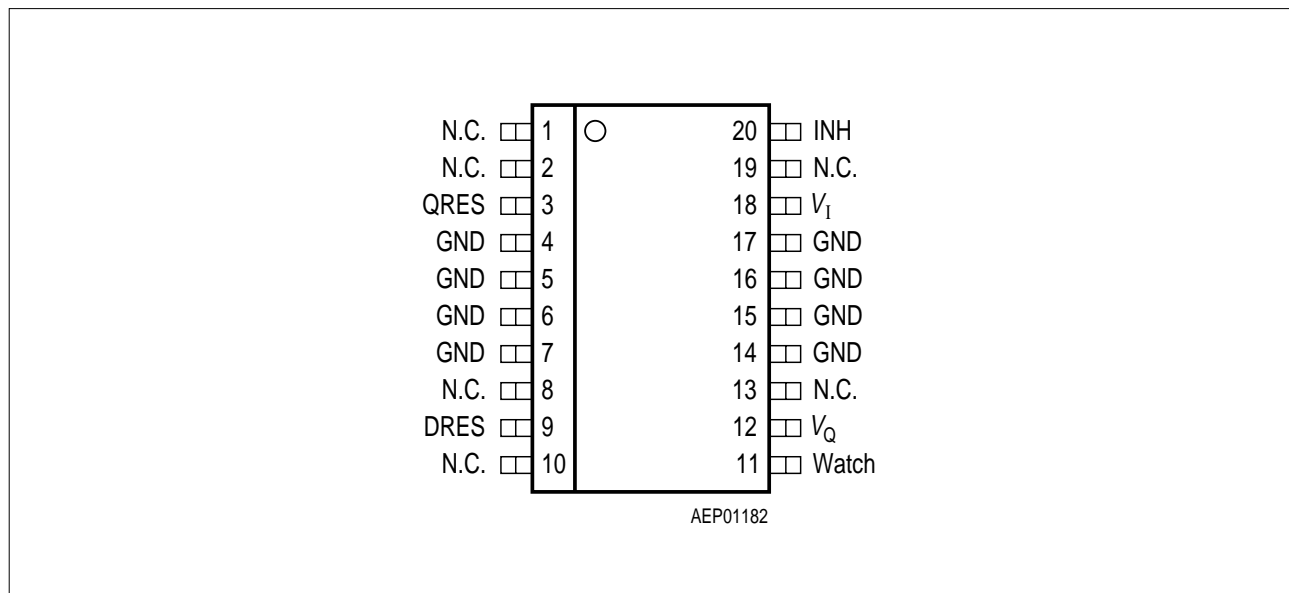
## Circuit Description

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 controls the base of the series PNP transistor via a buffer. Saturation control as a function of the load current prevents any over-saturation of the power element. If the output voltage drops below 95.5 % of its typical value for more than 2  $\mu$ s, a reset signal is triggered on pin 3 and an external capacitor is discharged on pin 5. The reset signal is not cancelled until the voltage on the capacitor has exceeded the upper switching threshold  $V_{DT}$ . A positive-edge-triggered watchdog circuit monitors the connected microprocessor and will likewise trigger a reset if pulses are missing. The IC can be disabled by a low level on the inhibit input and the current consumption drops to < 50  $\mu$ A.

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

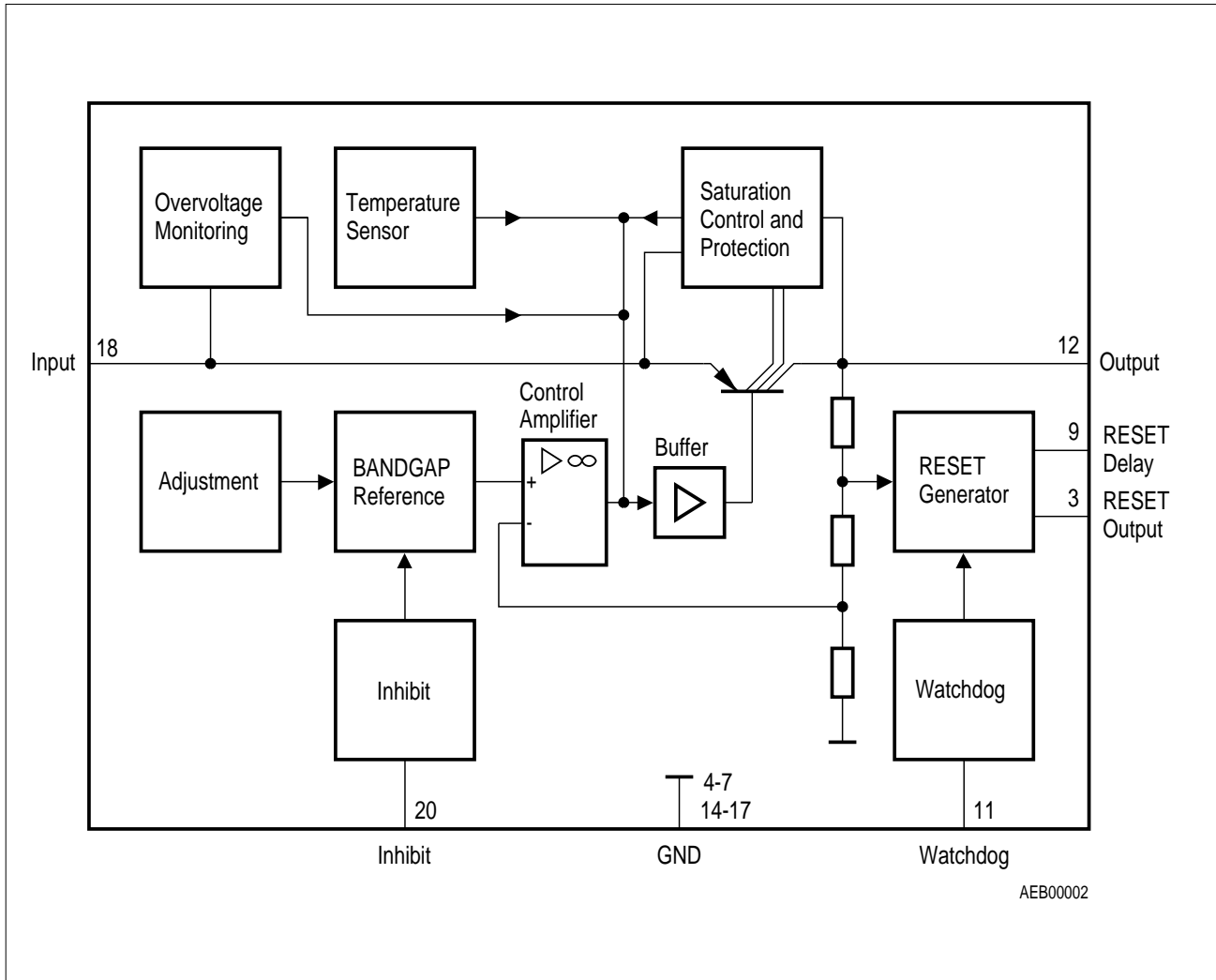
- Overload
- Overvoltage
- Overtemperature
- Reverse polarity

### Pin Configuration (top view)



### Pin Definitions and Functions

Pin	Symbol	Function
18	$V_I$	<b>Input voltage;</b> block a capacitor directly to ground on the IC. The capacitor rating will depend on the vehicle electrical system. Oscillation of the input voltage can be damped by a resistor of approx. 1 $\Omega$ in series with the input capacitor.
20	INH	<b>Inhibit;</b> switches off the IC when low.
3	QRES	<b>Reset output;</b> open-collector output controlled by the reset delay.
4 - 7 14 - 17	GND	<b>Ground;</b> internally connected with pins 14 to 17.
9	DRES	<b>Reset delay;</b> wired to ground using a capacitor.
11	Watch	<b>Watchdog;</b> monitors the microprocessor when active.
12	$V_Q$	<b>5-V output voltage;</b> block to ground using a capacitor of $\geq 22 \mu\text{F}$ . ESR is $\leq 3 \Omega$ in the operating temperature range.
1, 2, 8, 10, 13, 19	N.C.	<b>Not connected</b>



**Block Diagram**

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

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		

**Input**

Input voltage	$V_I$	-42	45	V	-
Input voltage	$V_I$	-	65	V	$t \leq 400$ ms
Input current	$I_I$	-	1.6	A	-

**Inhibit**

Voltage	$V_2$	-0.3	42	V	-
Current	$I_2$	-	5	mA	-

**Reset Output**

Voltage	$V_R$	-0.3	42	V	-
Current	$I_R$	-	-	-	limited internally

**Ground**

Current	$I_{GND}$	-	0.5	A	-
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**Reset Delay**

Voltage	$V_D$	-0.3	42	V	-
Current	$I_D$	-	-	-	limited internally

**Watchdog**

Voltage	$V_W$	-0.3	$V_I$	V	-
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**Output**

Differential voltage	$V_I - V_Q$	-5.25	$V_I$	V	-
Current	$I_Q$	-	1.4	A	-

**Absolute Maximum Ratings (cont'd)**
 $T_j = -40$  to  $150\text{ °C}$ 

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		

**Temperature**

Junction temperature	$T_j$	–	150	°C	–
Storage temperature	$T_{stg}$	– 50	150	°C	–

**Operating Range**

Input voltage	$V_I$	–	32	V	<b>see diagram</b>
Junction temperature	$T_j$	– 40	150	°C	–

**Thermal Resistances**

System-air	$R_{th\ SA}$	–	70	K/W	–
System-case	$R_{th\ SC}$	–	15	K/W	–

**Characteristics**
 $V_1 = 13.5 \text{ V}; T_j = 25 \text{ }^\circ\text{C}; V_2 \geq 6 \text{ V};$  (unless specified otherwise)

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

**Normal Operation**

Output voltage	$V_Q$	4.75	5.00	5.25	V	$25 \text{ mA} \leq I_Q \leq 500 \text{ mA};$ $6 \text{ V} \leq V_1 \leq 28 \text{ V};$ $-40 \text{ }^\circ\text{C} \leq T_j \leq 125 \text{ }^\circ\text{C}$
Output voltage	$V_Q$	4.85	5.00	5.15	V	$25 \text{ mA} \leq I_Q \leq 150 \text{ mA}$ $6 \text{ V} \leq V_1 \leq 40 \text{ V}$
Output current	$I_Q$	–	–	50	$\mu\text{A}$	$0 \text{ V} \leq V_1 \leq 2 \text{ V}; V_2 = V_j;$ $-40 \text{ }^\circ\text{C} \leq T_j \leq 125 \text{ }^\circ\text{C}$
Output current	$I_Q$	500	1000	–	mA	$V_1 = 17 \text{ V to } 28 \text{ V}$
Current consumption; $I_q = I_1 - I_Q$	$I_q$	–	–	3.5	mA	$I_Q = 0; V_W > 6 \text{ V}$
Current consumption; $I_q = I_1 - I_Q$	$I_q$	–	5.0	10	mA	$6 \text{ V} \leq V_1 \leq 28 \text{ V}$ $I_Q = 150 \text{ mA}$
Current consumption; $I_q = I_1 - I_Q$	$I_q$	–	40	65	mA	$6 \text{ V} \leq V_1 \leq 28 \text{ V}$ $I_Q = 500 \text{ mA}$
Current consumption; $I_q = I_1 - I_Q$	$I_q$	–	45	80	mA	$V_1 < 6 \text{ V}; I_Q \leq 500 \text{ mA};$
Drop voltage	$V_{Dr}$	–	0.35	0.5	V	$V_1 = 4.5 \text{ V}; I_Q = 0.5 \text{ A}$
Drop voltage	$V_{Dr}$	–	0.2	0.3	V	$V_1 = 4.5 \text{ V}; I_Q = 0.15 \text{ A}$
Load regulation	$\Delta V_Q$	–	15	35	mV	$25 \text{ mA} \leq I_Q \leq 500 \text{ mA}$
Supply voltage regulation	$\Delta V_Q$	–	15	50	mV	$6 \text{ V} \leq V_1 \leq 28 \text{ V}$ $I_Q = 100 \text{ mA}$
Supply voltage regulation	$\Delta V_Q$	–	5	25	mV	$6 \text{ V} \leq V_1 \leq 16 \text{ V}$ $I_Q = 100 \text{ mA}$

**Characteristics (cont'd)**
 $V_1 = 13.5 \text{ V}; T_j = 25 \text{ }^\circ\text{C}; V_2 \geq 6 \text{ V};$  (unless specified otherwise)

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Ripple rejection	$SVR$	–	54	–	dB	$f_r = 100 \text{ Hz};$ $V_r = 0.5 \text{ V}_{pp}$
Temperature drift of output voltage	$\alpha_{VQ}$	–	$2 \times 10^{-4}$	–	$1/^\circ\text{C}$	$-40 \text{ }^\circ\text{C} \leq T_j \leq 150 \text{ }^\circ\text{C}$

**Inhibit Operation**

Current consumption	$I_1$	–	–	50	$\mu\text{A}$	$V_2 < 2 \text{ V}; I_Q = 0$
Current consumption	$I_2$	–	–	100	$\mu\text{A}$	$V_2 = 6 \text{ V}$
Switching threshold for inhibit	$V_2$	5.0	5.5	6.0	V	IC turned ON
Switching threshold for inhibit	$V_2$	2.0	2.7	3.7	V	IC turned OFF

**Reset Generator**

Switching threshold	$V_{RT}$	94	95.5	97	%	in % of $V_Q$ $I_Q > 500 \text{ mA}; V_1 = 6 \text{ V}$
Saturation voltage, reset output	$V_R$	–	0.25	0.40	V	$I_R = 1 \text{ mA}$
Reverse current	$I_R$	–	–	1	$\mu\text{A}$	$V_R = 5 \text{ V}$
Charge current	$I_d$	18.75	25	31.25	$\mu\text{A}$	$V_C = 1.5 \text{ V}$
Switching threshold	$V_{ST}$	0.9	1	1.1	V	–
Delay switching threshold	$V_{DT}$	2.25	2.50	2.75	V	–
Saturation voltage, delay output	$V_C$	–	–	100	mV	$V_1 = 4.5 \text{ V}$ and $I_d$



**Characteristics (cont'd)**
 $V_1 = 13.5 \text{ V}; T_j = 25 \text{ }^\circ\text{C}; V_2 \geq 6 \text{ V};$  (unless specified otherwise)

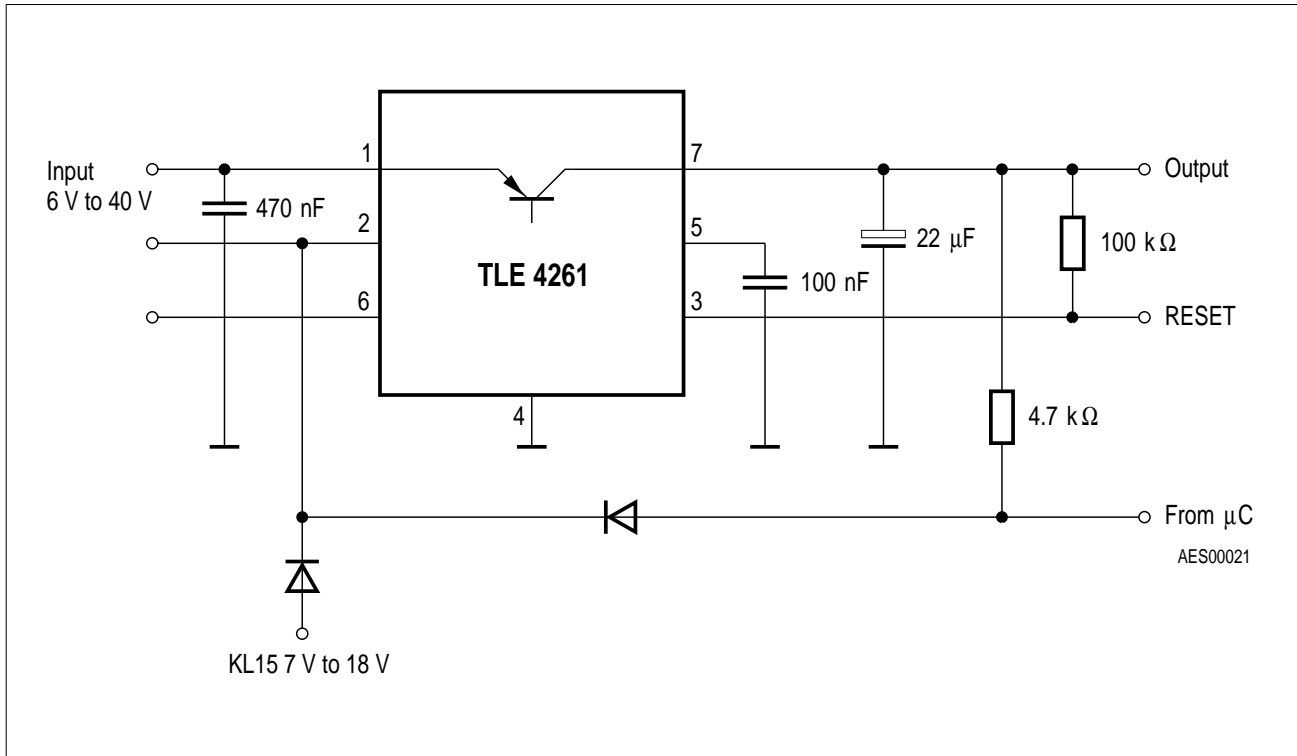
Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Delay time	$t_D$	–	10	–	ms	$C_D = 100 \text{ nF}$
Delay time	$t_t$	–	2	–	$\mu\text{s}$	–

**Watchdog**

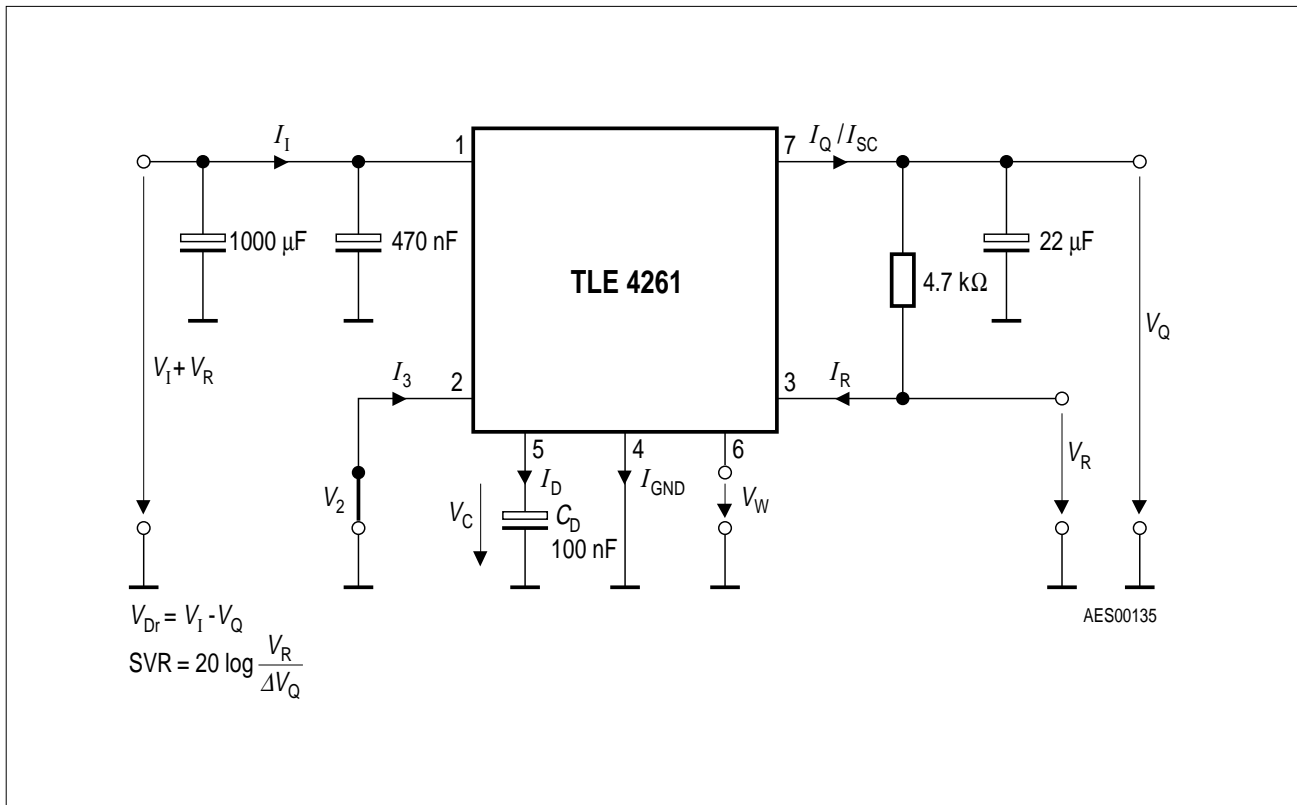
Turn-OFF voltage	$V_W$	5.2	5.6	6.0	V	–
Discharge current	$I_{CD}$	5.6	7.5	9.4	$\mu\text{A}$	$V_C = 1.5 \text{ V}$
Switching voltage	$V_{CD}$	2.95	3.05	3.15	V	–
Pulse interval	$T_W$	–	35	–	ms	$C_D = 100 \text{ nF}$

**General Data**

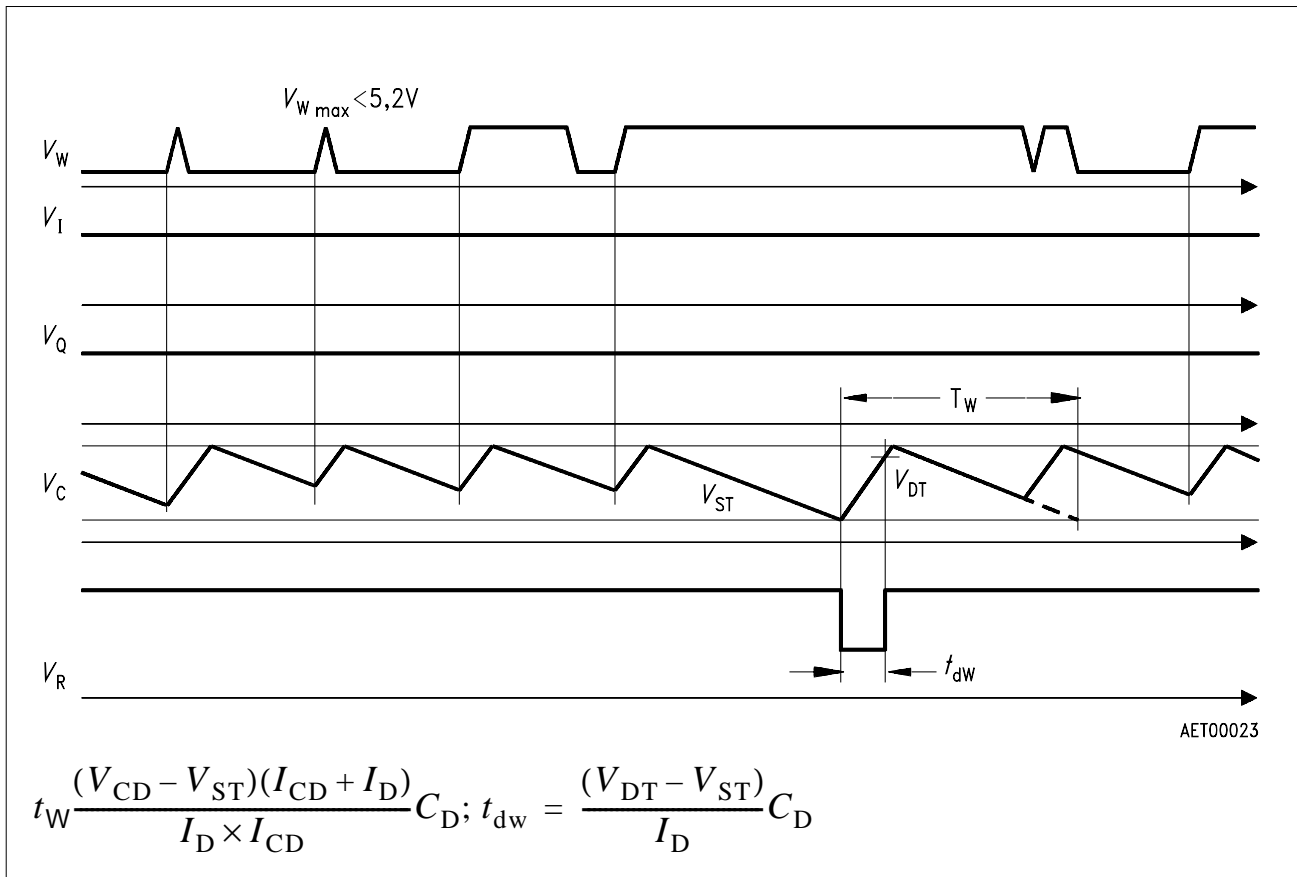
Turn-OFF voltage	$V_{IOFF}$	41	43	45	V	$I_Q < 1 \text{ mA}$
Turn-OFF hysteresis	$\Delta V_1$	–	6.5	–	V	–
Leakage current	$I_{QS}$	–	–	50	$\mu\text{A}$	$V_Q = 0 \text{ V}; V_1 = 45 \text{ V}$
Reverse output current	$I_{QR}$	–	–	1.5	mA	$V_Q = 5 \text{ V}; V_1 \text{ and } V_2 \text{ open}$



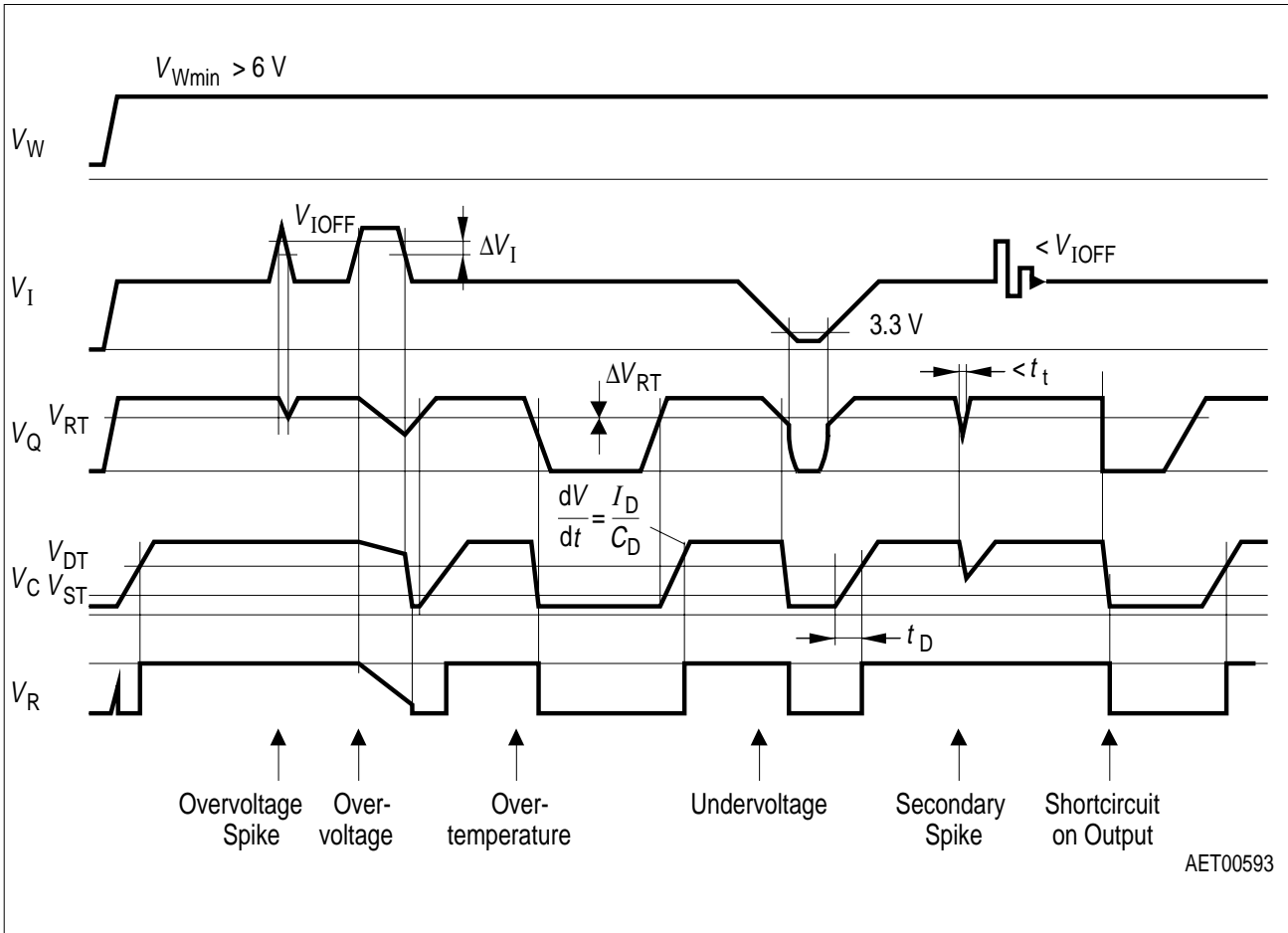
**Application Circuit**



**Test Circuit**



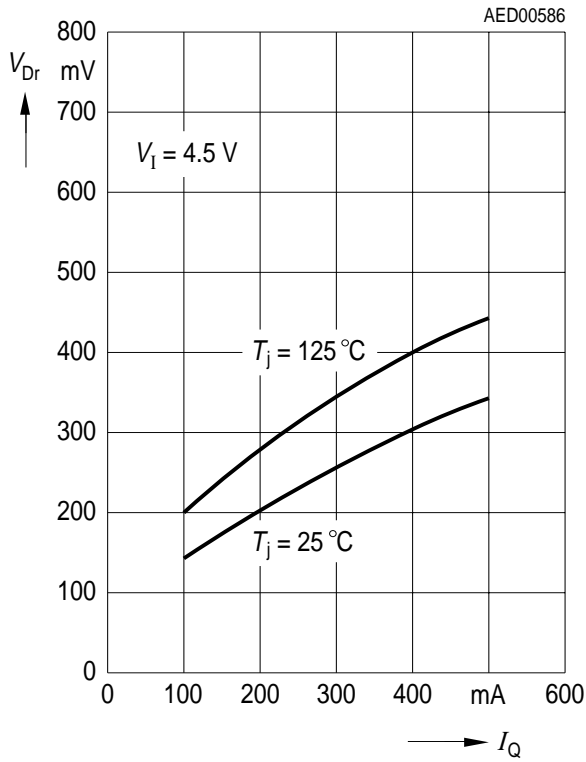
**Time Response in Watchdog Condition**



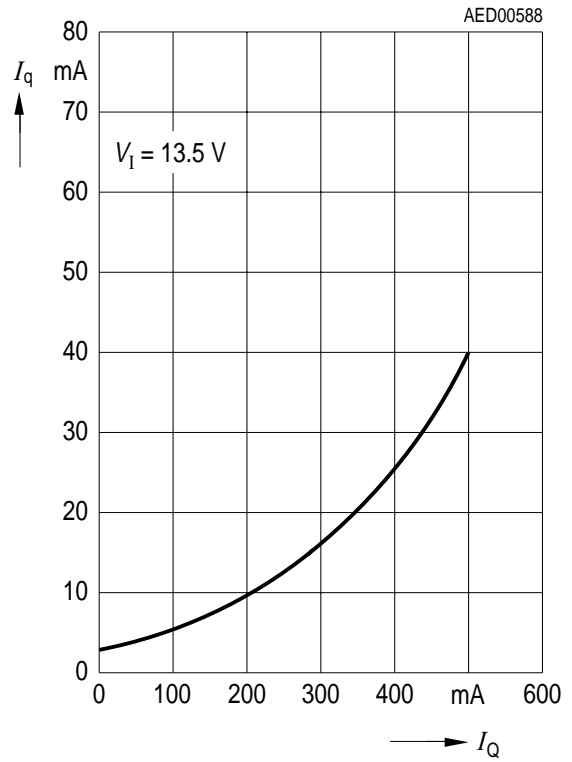
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**Timing with Watchdog OFF**

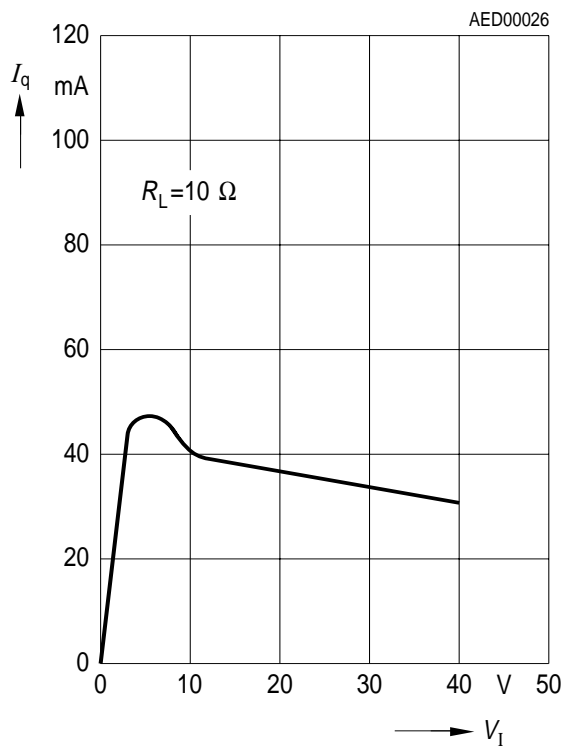
**Drop Voltage versus Output Current**



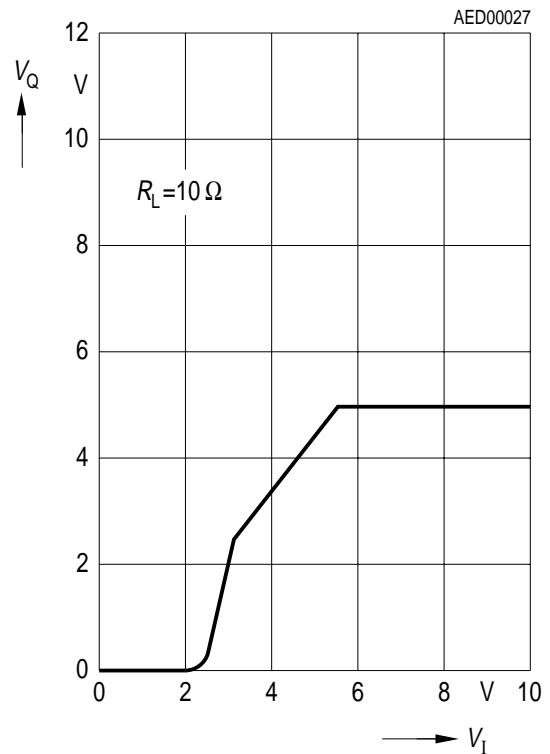
**Current Consumption versus Output Current**



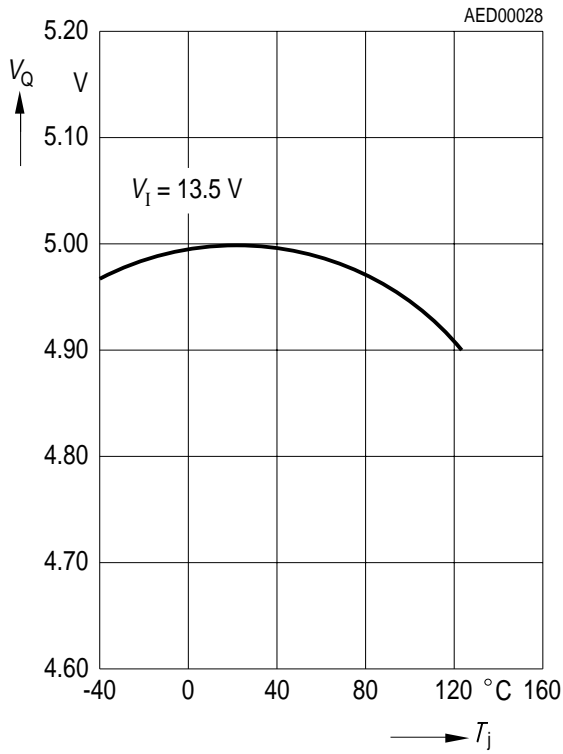
**Current Consumption versus Input Voltage**



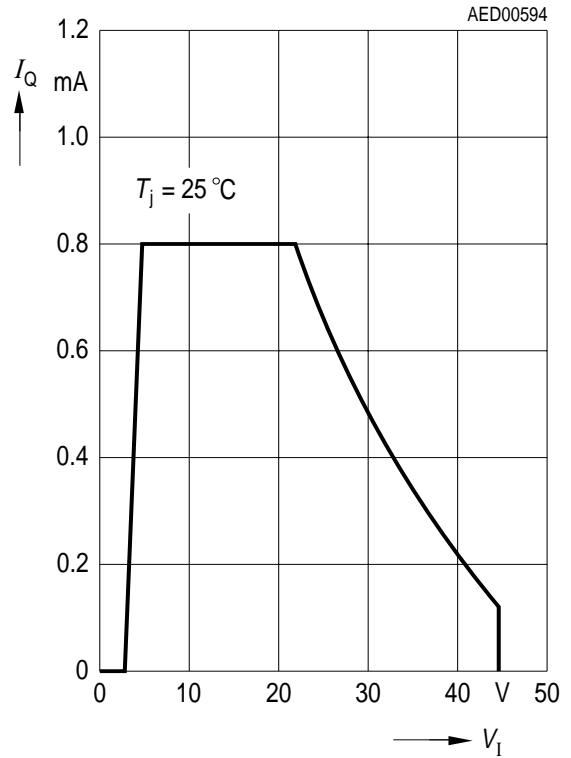
**Output Voltage versus Input Voltage**



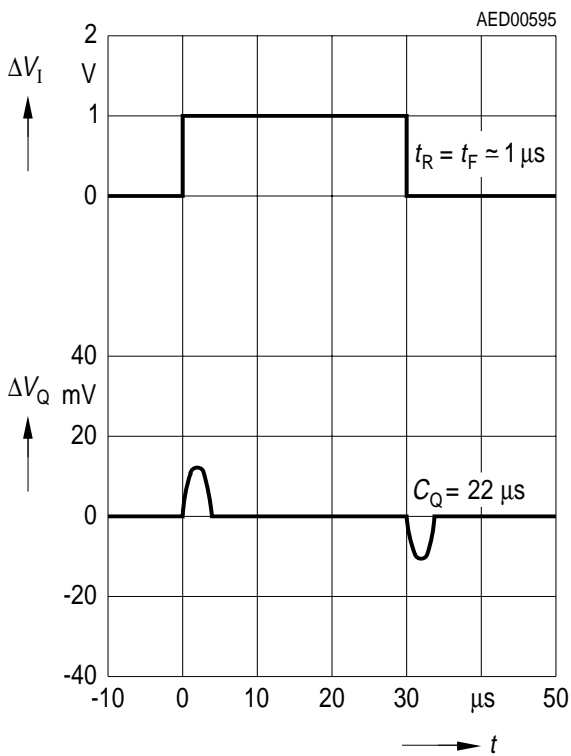
### Output Voltage versus Temperature



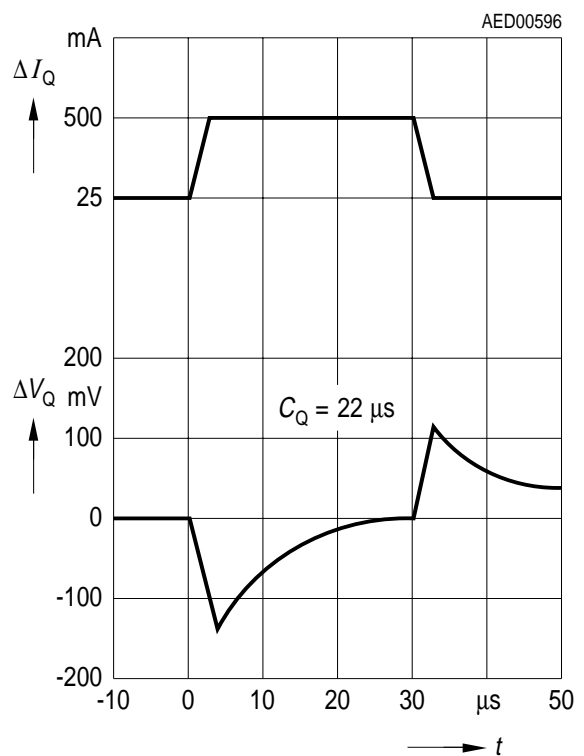
### Output Current versus Input Voltage



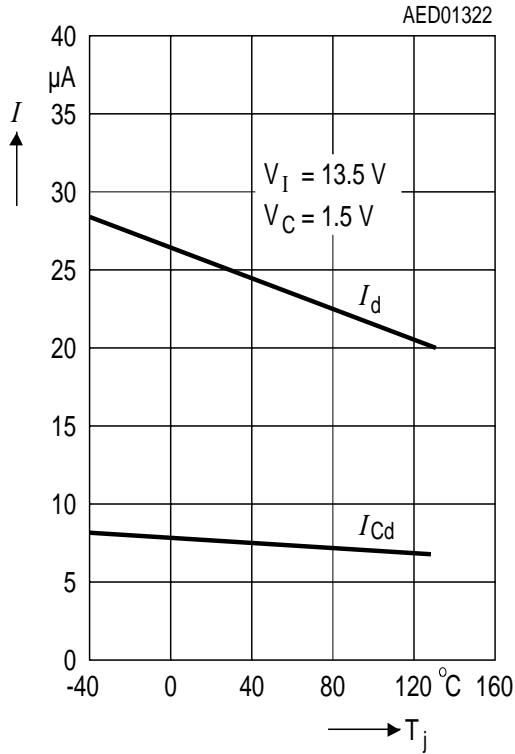
### Input Step Response



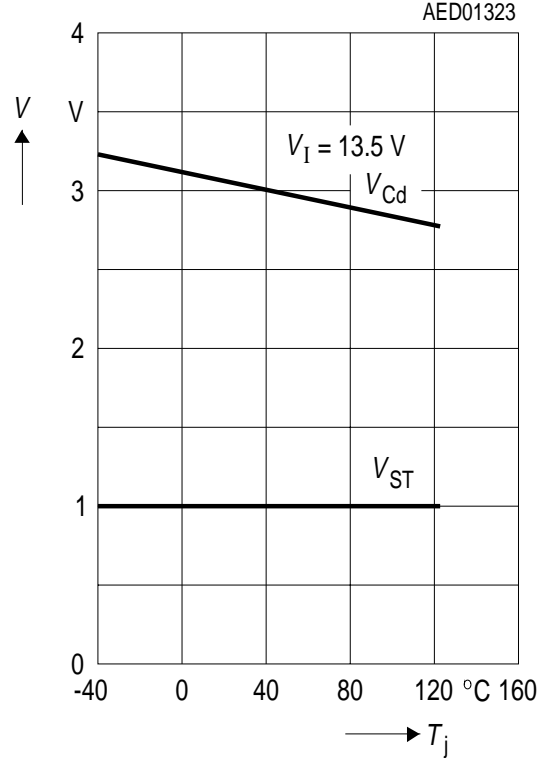
### Load Step Response



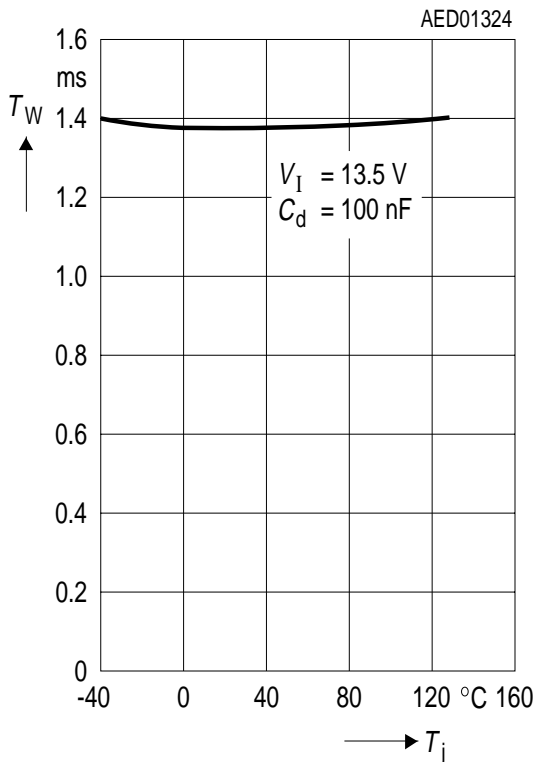
**Charge Current  $I_D$  and Discharge Current  $I_{CD}$  versus Temperature**



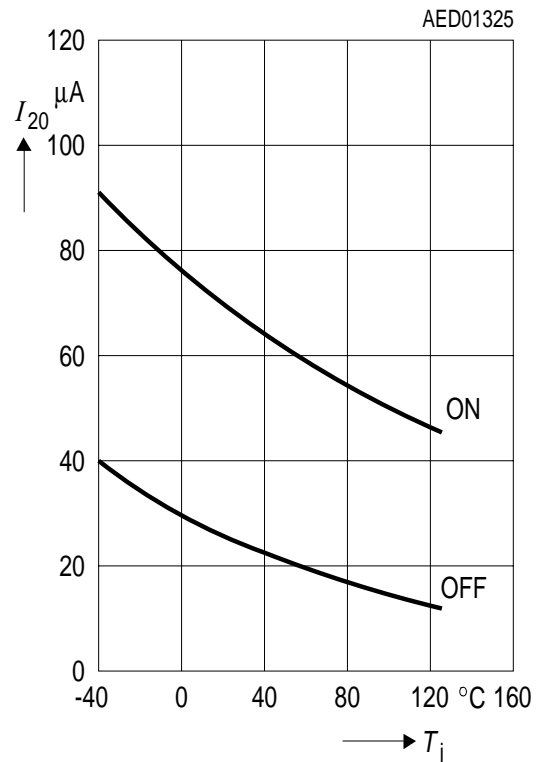
**Switching Voltage  $V_{CD}$  and  $V_{ST}$  versus Temperature**



**Pulse Interval  $T_W$  versus Temperature**

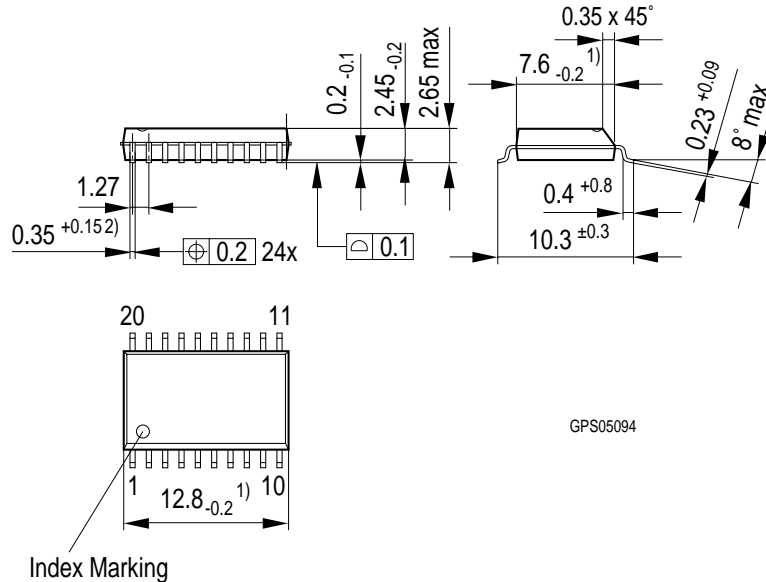


**Current Consumption of Inhibit at the Switching Point versus Temperature**



Package Outlines

**P-DSO-20-6**  
(Plastic Dual Small Outline)



- 1) Does not include plastic or metal protrusions of 0.15 max per side
- 2) Does not include dambar protrusion of 0.05 max per side

Weight approx. 0.6 g

**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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