

## 5-V Low-Drop Voltage Regulator

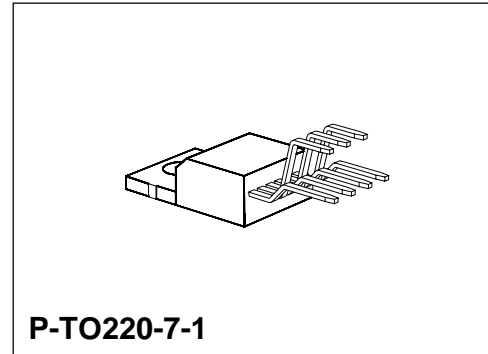
**TLE 4258**

### Preliminary Data

**Bipolar IC**

### Features

- Low-drop voltage
- Low quiescent current
- Reset output
- Protection against reverse polarity
- Overvoltage protection 70 V
- Short-circuit proof
- Suited for automotive electronics
- Inhibit input
- Wide temperature range



Type	Ordering Code	Package
TLE 4258	Q67000-A8238	P-TO220-7-1

The TLE 4258 is a very low drop voltage regulator which provides two regulated 5-V output voltages. The main regulator can be loaded with 750 mA and is turned on and off by pin 5 (pin 5 unconnected = main regulator off). In addition, the main regulator incorporates a short-circuit current limitation and is turned off in case of overvoltage ( $V_I > V_{I\text{OFF}}$ ). The standby regulator can be loaded with 35 mA, it does not incorporate a short-circuit current limitation and remains permanently active at positive input voltage independent of the turn-off functions of the main regulator.

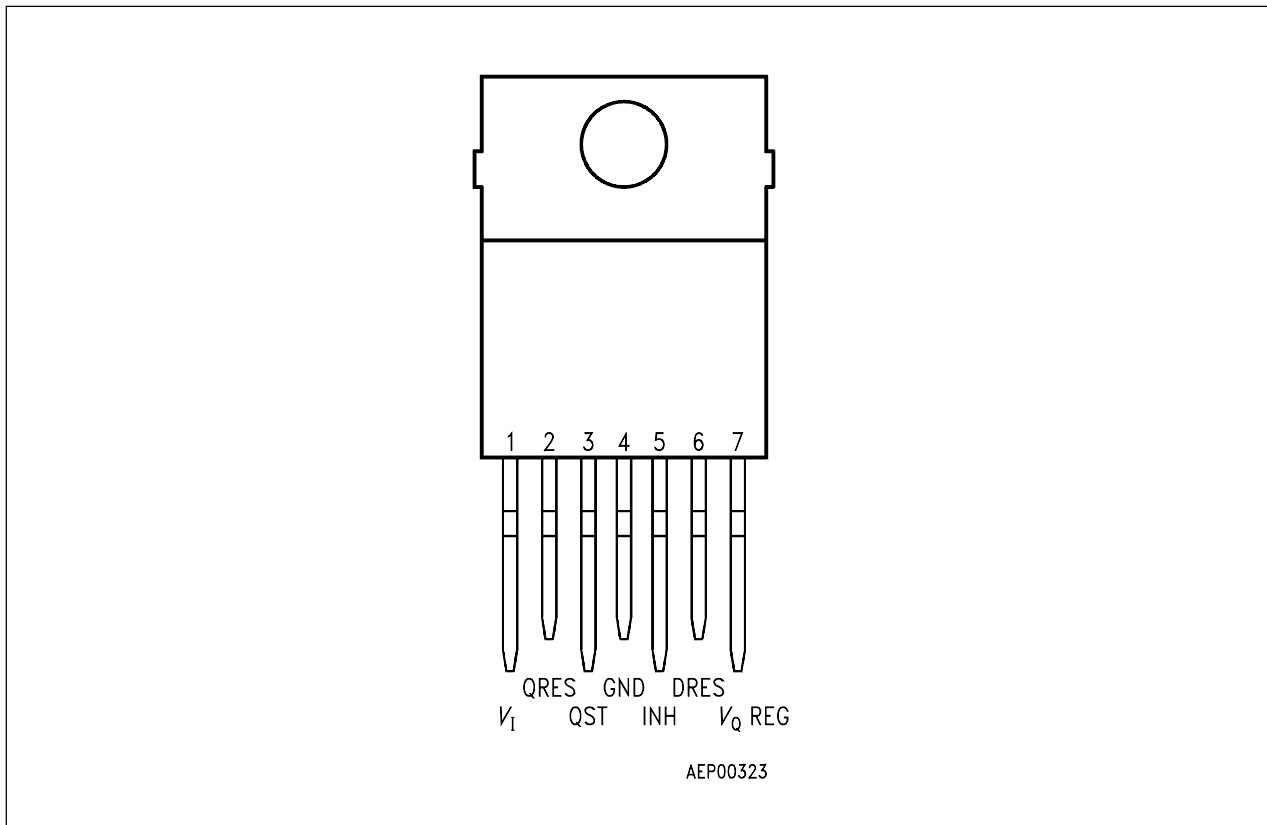
If the main regulator output voltage is less than 4.5 V, the reset output is switched to low without delay. As soon as the reset threshold has been exceeded, a delay time to be set by an external capacitor expires and afterwards the reset output switches to high again.

If the lines to the controller are long, the oscillating circuit of line inductance and input capacitance  $C_I$  can be attenuated by a resistor  $\leq 1 \Omega$  connected in series to  $C_I$ .

### Circuit Description

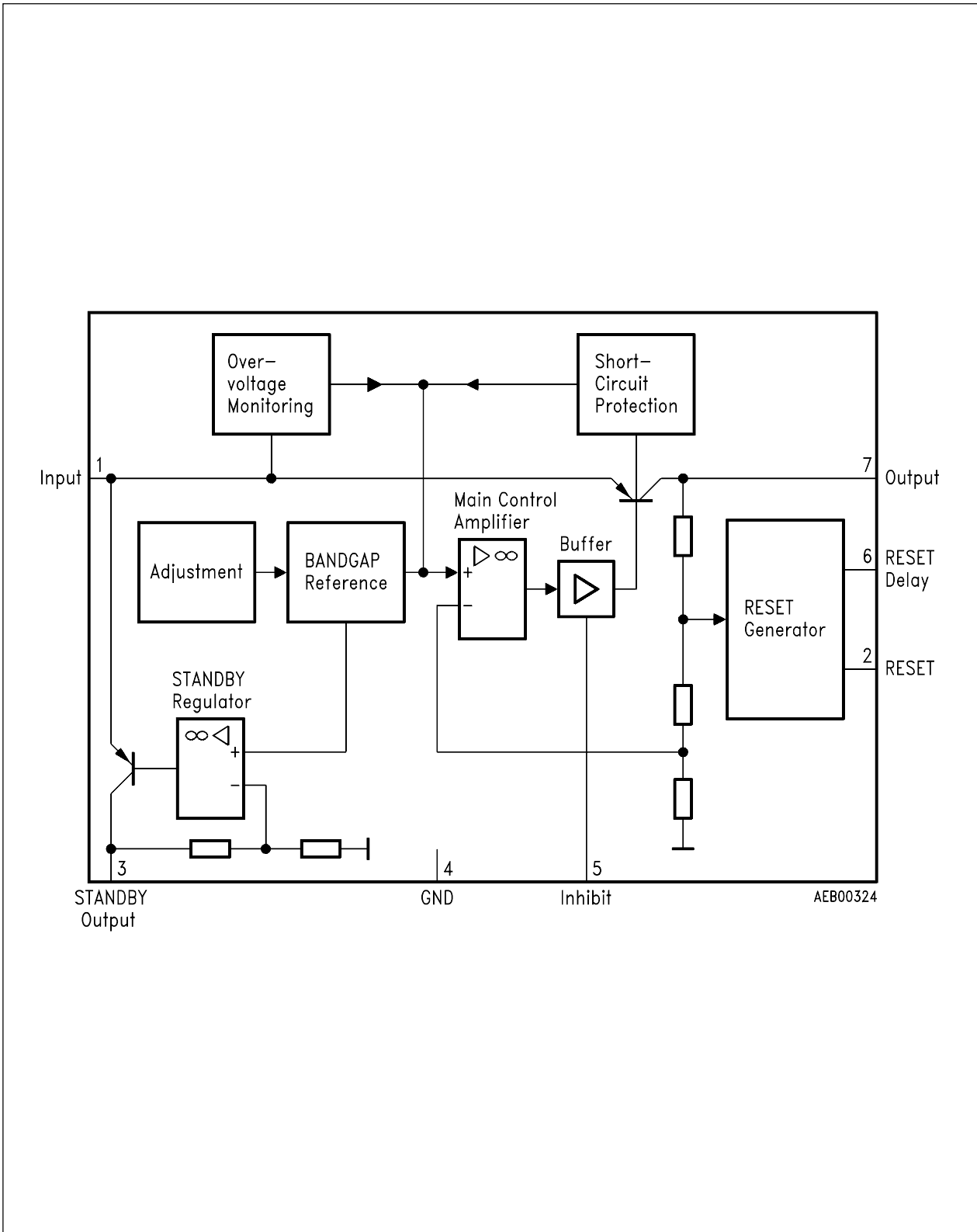
The TLE 4258 incorporates a main and standby-control regulator: The amplifiers regulate the output voltage by comparing the output voltage (from the voltage divider) with a highly precise reference voltage. The standby regulator directly controls the base of a PNP series transistor and the main regulator via a buffer that can be turned off with inhibit pulse at pin 5. If the output voltage  $V_O$  at pin 7 drops below 4.5 V, a reset signal is released which can only be disabled after a delay time to be set at pin 6. The main output is current-limited and remains active up to the input voltage  $V_{I\text{OFF}}$ .

## Pin Configuration (top view)



## Pin Definitions and Functions

Pin	Symbol	Function
1	$V_i$	<b>Input</b> of voltage regulator
2	Q RES	<b>Reset output</b> ; open-collector output NPN to pin 4. If the output voltage $V_o$ drops below the reset threshold, the output stage becomes conductive.
3	Q ST	<b>Standby output</b> , connect with a capacitor $\geq 10 \mu\text{F}$
4	GND	<b>Ground</b> ; reference potential
5	INH	<b>Inhibit (main regulator ON/OFF)</b> , input for turning on/off main regulator, connected to a 22-k $\Omega$ series resistor. With open input, the main regulator remains turned off.
6	D RES	<b>Reset delay</b> ; pin for reset capacitor; the size of this capacitor determines the delay time of the reset signal typ. 175 ms/ $\mu\text{F}$ .
7	$V_o$ REG	<b>Main regulator output</b> , connected to a capacitor $\geq 22 \mu\text{F}$ .



Block Diagram

## Absolute Maximum Ratings

$T_A = -40$  to  $150$  °C

Parameter	Symbol	Limit Values		Unit
		min.	max.	

### Input (Pin 1)

Supply voltage	$V_I$	- 15	36	V
Polarity reversal with test pulse $t_2 \leq 100$ ms see test circuit	$V_I$	- 70	-	V
Load-dump with pulse shape $t_2 \leq 400$ ms see test circuit	$V_I$	-	- 70	V -
Slew rate $0 \text{ V} \leq V_I \leq 24 \text{ V}$	$SR$	-	100	V/ $\mu$ s
Slew rate $24 \text{ V} \leq V_I \leq 70 \text{ V}$	$SR$	-	10	V/ $\mu$ s
Current	$I_I$	-	2.5	A

### Reset Output (Pin 2)

Voltage	$V_R$	-	8	V
Current	$I_R$	-	10	mA

### Standby Output (Pin 3)

Voltage	$V_{ST}$	-	6	V
Current	$I_{ST}$	-	50	mA

### Ground (Pin 4)

Current	$I_{GND}$	-	1.8	A
Inhibit (main regulator on/off), (Pin 5) Current	$I_{INH}$	-	$\pm 7.5$	mA
Reset delay (Pin 6) Voltage	$V_C$	-	$V_Q$	V
Main regulator output (Pin 7) Voltage $V_I \geq V_Q$	$V_Q$	-	18	V
Current	$I_Q$	-	1.8	A

### Temperature

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

### Operating Range

Input voltage	$V_I$	6	24	V
Junction temperature	$T_j$	- 40	150	°C
Thermal resistance	system – air system – case	$R_{th SA}$ $R_{th SC}$	- -	65 4 K/W K/W

## Characteristics

$V_I = 13.5 \text{ V}$ ;  $T_j = 25 \text{ }^\circ\text{C}$ ;  $V_S > 3.5 \text{ V}$  (unless otherwise specified)

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

## Main Regulator

Output voltage	$V_Q$	4.85	–	5.15	V	$0 \text{ mA} \leq I_Q \leq 750 \text{ mA}$ $6 \text{ V} < V_I < V_{I\text{off}}$ $-40 \text{ }^\circ\text{C} \leq T_j \leq 125 \text{ }^\circ\text{C}$
Input current	$I_Q$	–	–	30	mA	$I_Q = 0 \text{ mA}$ ; $I_{ST} = 0 \text{ mA}$
Current consumption without load	$I_Q$	–	–	150	mA	$I_Q = 450 \text{ mA}$ ; $I_{ST} = 0 \text{ mA}$
	$I_Q$	–	–	300	mA	$I_Q = 750 \text{ mA}$ ; $I_{ST} = 0 \text{ mA}$
	$I_Q$	–	–	300	mA	$V_I = 5.8 \text{ V}$ ; $I_Q = 750 \text{ mA}$ ; $I_{ST} = 0 \text{ mA}$
	$I_Q$	–	–	300	mA	
Turn-OFF voltage	$V_{I\text{OFF}}$	25	–	–	V	$V_I > V_{I\text{off}}$
Output current	$I_Q$	–	–	20	mA	$V_I > V_{I\text{off}}$
Short-circuit current	$I_{SC}$	0.75	1	1.8	A	$V_Q = 0 \text{ V}$ ; $6 \text{ V} \leq V_I < 13.5 \text{ V}$
Drop voltage	$V_{Dr}$	–	0.3	0.5	V	$V_I = 4.5 \text{ V}$ ; $I_Q = 450 \text{ mA}$
	$V_{Dr}$	–	0.5	0.75	V	$V_I = 4.5 \text{ V}$ ; $I_Q = 750 \text{ mA}$
Static load regulation	$\Delta V_Q / \Delta I_Q$	–	–	0.2	$\Omega$	$6 \text{ V} \leq V_I \leq 16 \text{ V}$ $0 \text{ mA} \leq -I_Q \leq 750 \text{ mA}$
Dynamic load regulation	$\Delta V_Q$	–	–	150	mV	$I_Q = 75 \text{ mA}$ of $I_Q = 750 \text{ mA}$ $C_Q \geq 50 \text{ } \mu\text{F}$
Supply voltage-rejection	$\alpha_{SVR}$	60	–	–	dB	$I_Q = 750 \text{ mA}$ ; $V_I = 12 \text{ V} + 1 \text{ V} \cos(2\pi \times 120 \text{ Hz} \times t)$ ; $\alpha_{SVR} = 20 \log(1 \text{ V} / \Delta V_Q)$
Reverse output current	$-I_{QR}$	–	5	30	mA	$V_I = 0$ ; $0 \text{ V} \leq V_Q \leq 4.85 \text{ V}$
Temperature drift of output voltage	$\alpha_{VQ}$	–0.5	–	0.5	mV/K	$6 \text{ V} \leq V_I \leq V_{I\text{off}}$ $\Delta T_j > 50 \text{ K}$

## Reset Generator

Switching threshold	$V_{RT}$	4.4	4.5	4.6	V	–
Switching voltage	$V_R$			0.8	V	$V_Q < V_{RT}$ ; $I_R = 10 \text{ mA}$
	$V_R$	4.4	–	$V_Q$	V	$V_Q > V_{RT}$
Reverse current	$I_R$	–	–	5	$\mu\text{A}$	$V_R > 4.6 \text{ V}$ ;
Change current	$I_{ch}$	10	–	30	$\mu\text{A}$	$0.5 \text{ V} < V_{Cd} < (0.75 \times V_Q)$
Reset delay time	$t_{D/Cd}$	–	175	–	ms/ $\mu\text{F}$	–

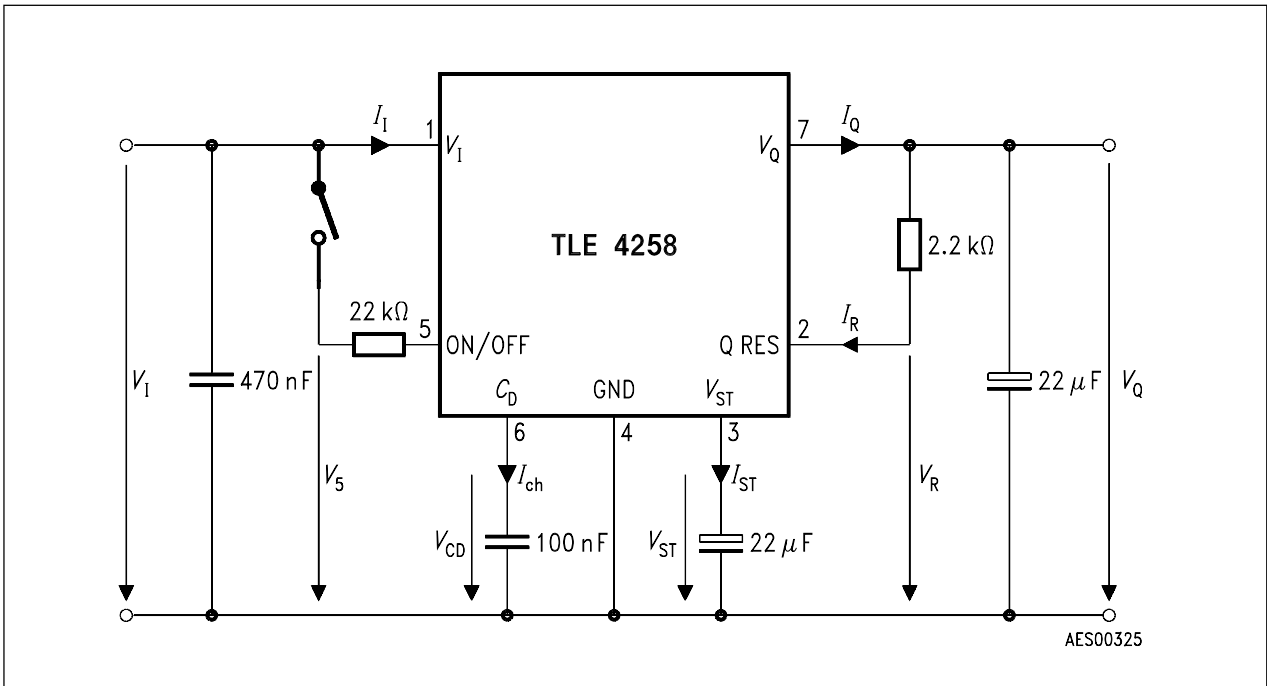
## Characteristics (cont'd)

$V_I = 13.5 \text{ V}$ ;  $T_j = 25 \text{ }^\circ\text{C}$ ;  $V_5 > 3.5 \text{ V}$  (unless otherwise specified)

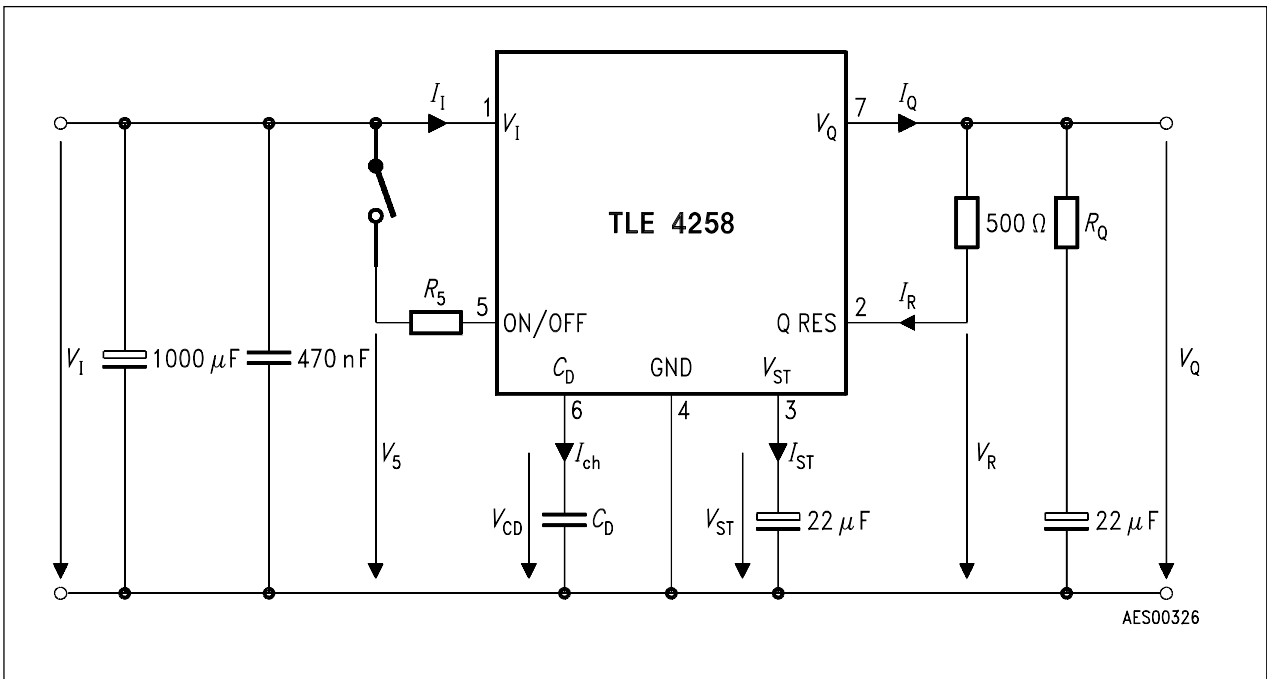
Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Standby regulator	–	–	–	–	–	$V_5 \leq 0.5 \text{ V}$
Output voltage	$V_{ST}$	4.7	–	5.3	V	$0 \text{ mA} \leq I_{ST} \leq 35 \text{ mA}$ $6 \text{ V} \leq V_I \leq V_{I\text{off}}$
	$V_{ST}$	4.5	–	6.0	V	$0 \text{ mA} \leq I_{ST} \leq 35 \text{ mA}$ $V_{I\text{off}} \leq V_I \leq 70 \text{ V}$ ; $t_2 \leq 400 \text{ ms}$
Current consumption without load	$I_{QST}$	–	–	2	mA	$I_Q = 0 \text{ mA}$ ; $I_{ST} = 0 \text{ mA}$
	$I_{QST}$	–	–	15	mA	$I_Q = 0 \text{ mA}$ ; $I_{ST} = 35 \text{ mA}$
Drop voltage	$V_{DrST}$	–	–	0.75	V	$V_I = 4.5 \text{ V}$ ; $I_{ST} = 35 \text{ mA}$
Static load regulation	$\Delta V_{ST}/\Delta I_{ST}$	–	1	–	$\Omega$	$6 \text{ V} \leq V_I < V_{I\text{off}}$ $0 \text{ mA} \leq I_{ST} \leq 35 \text{ mA}$
Supply voltage rejection	$\alpha_{SVRST}$	60	–	–	dB	$I_{ST} = 35 \text{ mA}$ ; $V_I = 12 \text{ V} + 1 \text{ V} \times \cos(2\pi \times 120 \text{ Hz} \times t)$
Reverse current	$-I_{ST}$	–	–	2	mA	$V_I = 0 \text{ V}$ ; $0 \text{ V} \leq V_{ST} \leq 4.7 \text{ V}$

## General Ratings

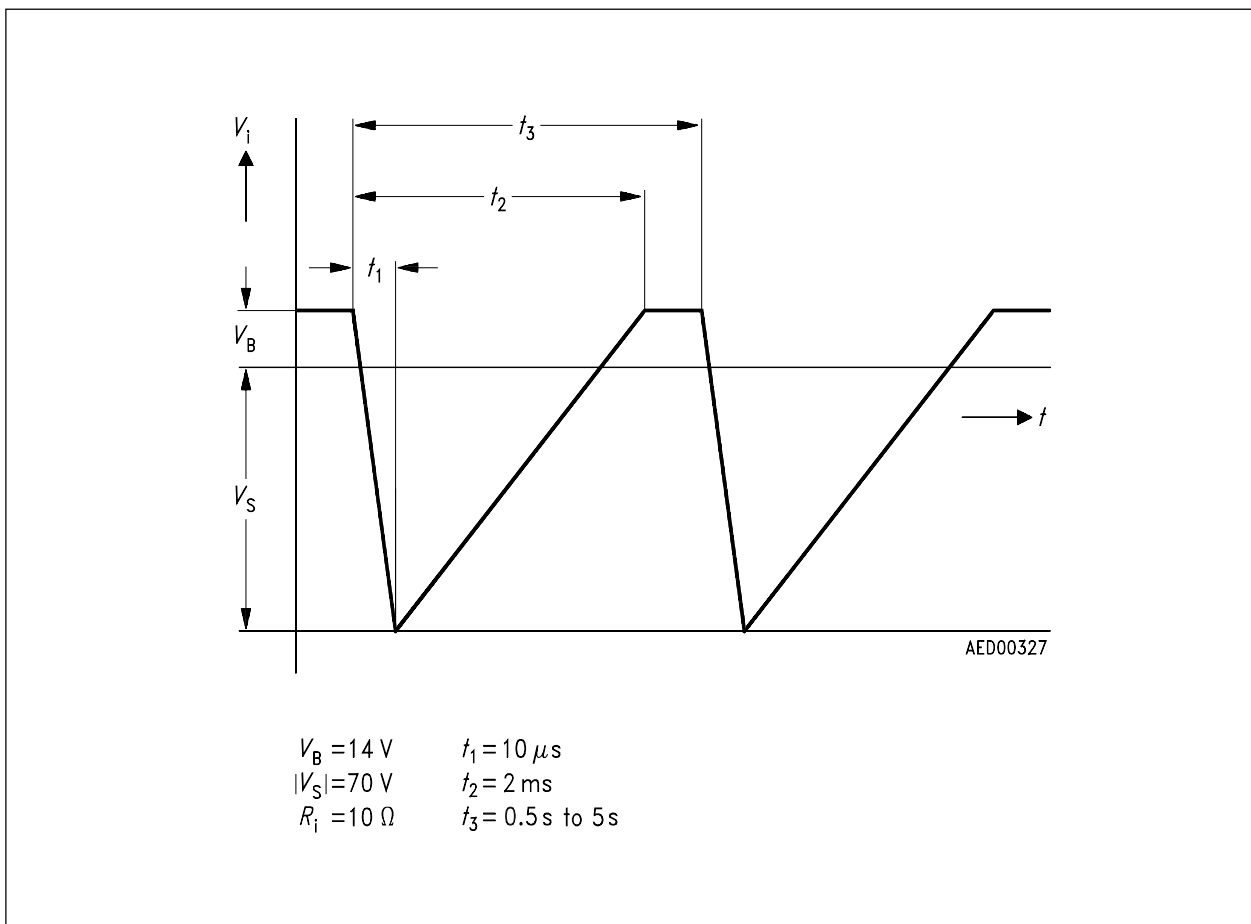
Reverse polarity	$-V_Q$	–	0	0.7	V	$V_I = -15 \text{ V}$
	$-I_Q$	–	0	0.5	mA	$V_I = -15 \text{ V}$
	$-V_{ST}$	–	0	0.7	V	$V_I = -15 \text{ V}$
	$-I_{ST}$	–	0	0.5	mA	$V_I = -15 \text{ V}$
Synchronous operation $V_{ST}$ ; $V_Q$	$V_{ST} - V_Q$	–200	–	200	mV	$0 \text{ mA} \leq I_{ST} \leq 35 \text{ mA}$ $0 \text{ mA} \leq I_Q \leq 750 \text{ mA}$ $6 \text{ V} \leq V_I < V_{I\text{off}}$
Necessary series resistance	$R_5$	12	22	24	k $\Omega$	–
Switching threshold for main regulator	$V_5$	3.5	–	–	V	$V_Q > 3 \text{ V}$ ; $I_Q = 0.5 \text{ A}$
	$V_5$	–	–	0.5	V	$V_Q < 3 \text{ V}$ ; $I_Q = 1 \text{ mA}$
Load impedance	$R_Q$	–	0	2	$\Omega$	$Z_Q = R + (j\omega C)^{-1}$



Application Circuit



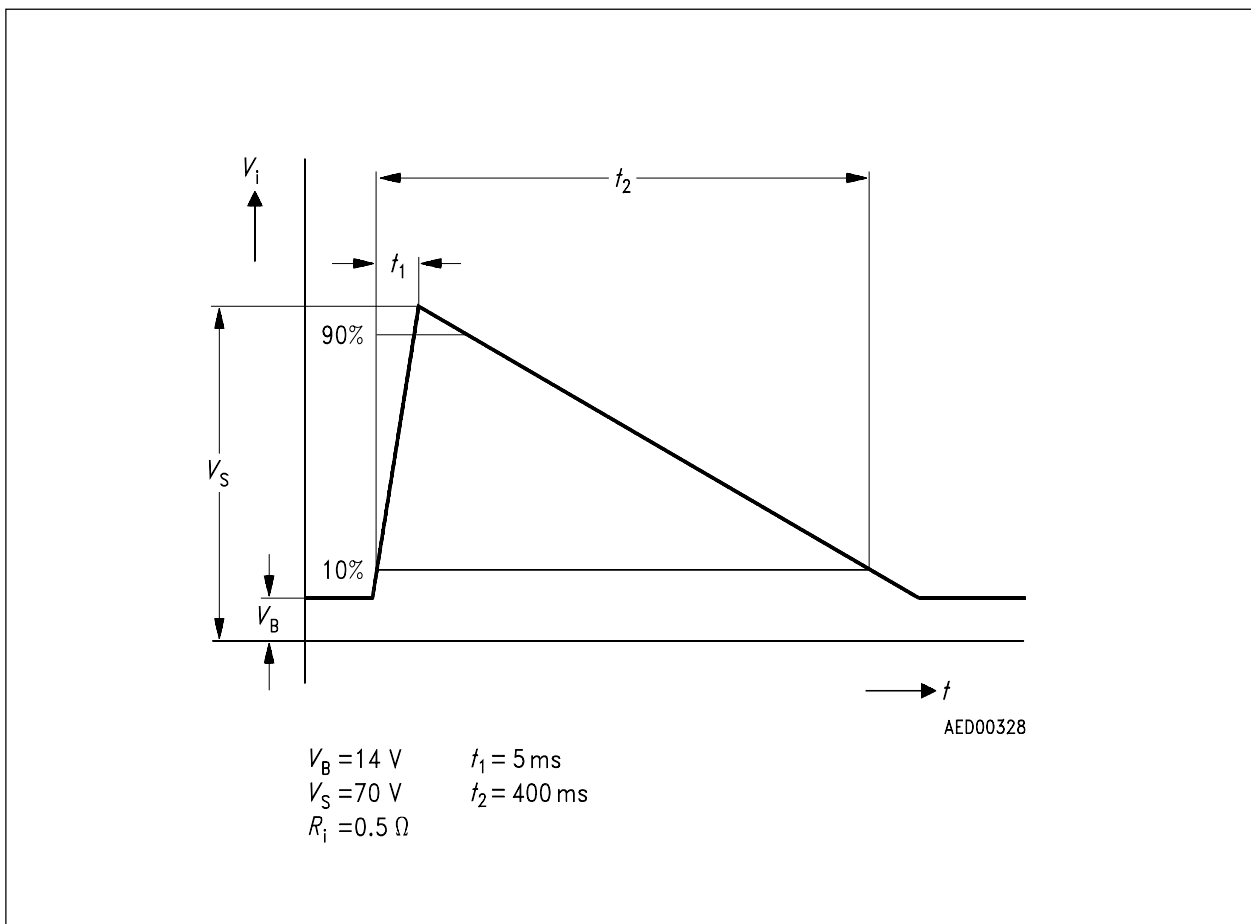
Test Circuit



**1. Test Pulse for Negative Interference Voltages  $V_i$**

$V_B = 14 \text{ V}$	$t_1 = 10 \mu\text{s}$
$V_S = 70 \text{ V}$	$t_2 = 2 \text{ ms}$
$R_i = 10 \Omega$	$t_3 = 0.5 \text{ s to } 5 \text{ s}$



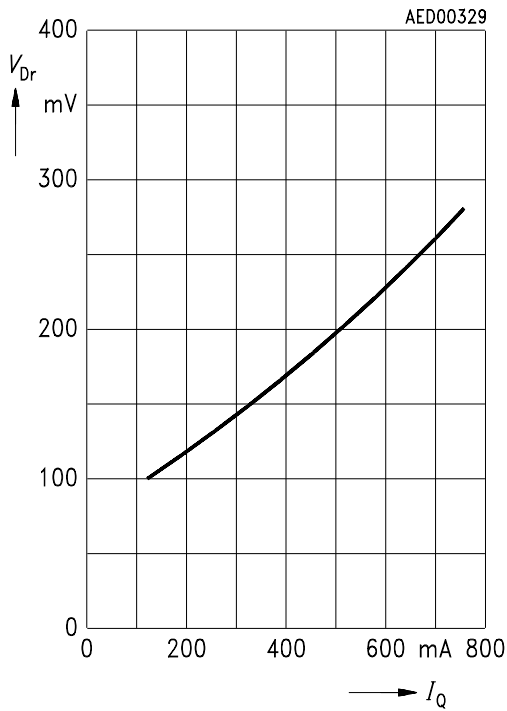


**2. Pulse for Load Dump at  $V_{14}$**

$V_B = 14 \text{ V}$        $t_1 = 5 \text{ ms}$   
 $V_S = 70 \text{ V}$        $t_2 = 400 \text{ ms}$   
 $R_i = 0.5 \Omega$

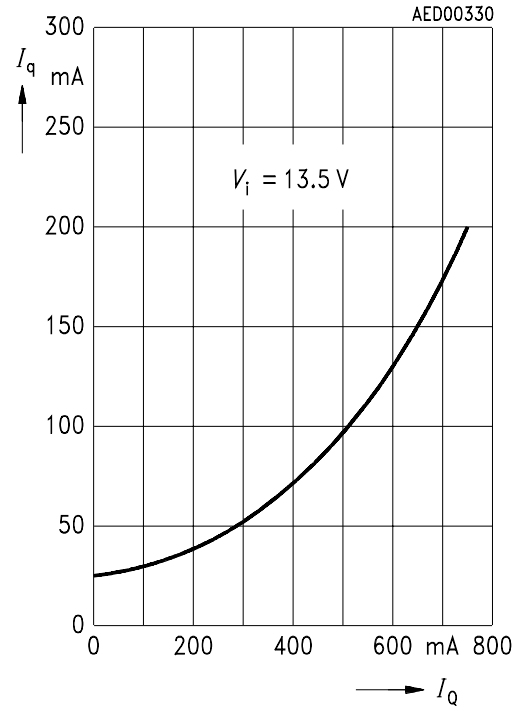
**Minimum Drop Voltage versus Output Current**

$T_c = 25\text{ }^\circ\text{C}$ ;  $V_i = 4.5\text{ V}$



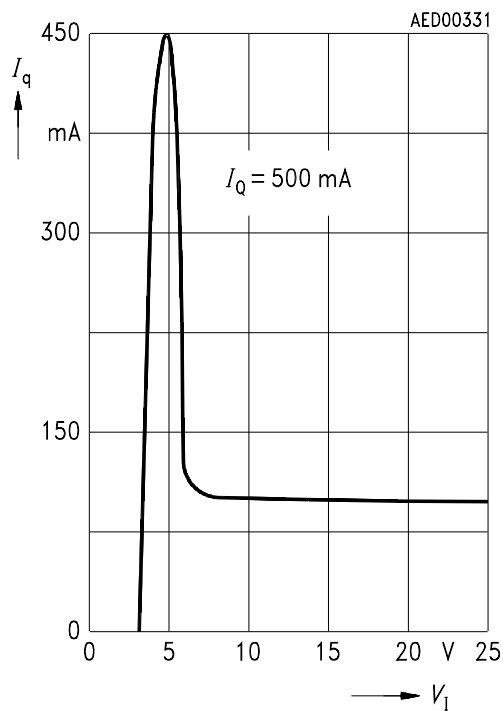
**Current Consumption without Load versus Output Current**

$T_c = 25\text{ }^\circ\text{C}$



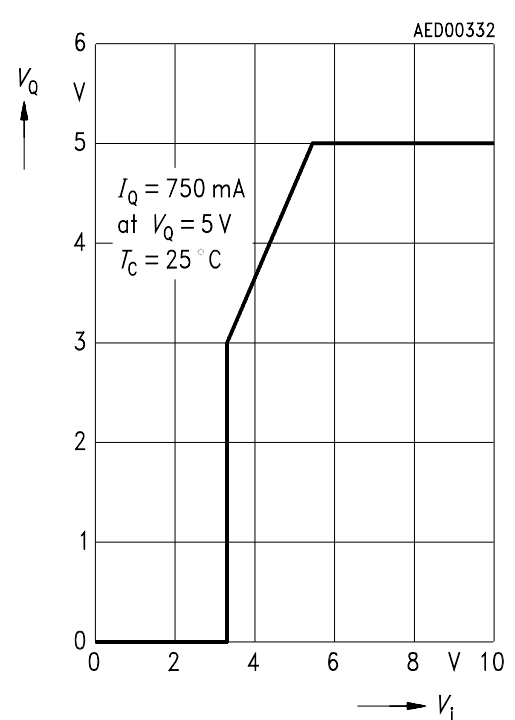
**Current Consumption without Load versus Input Voltage**

$T_c = 25\text{ }^\circ\text{C}$

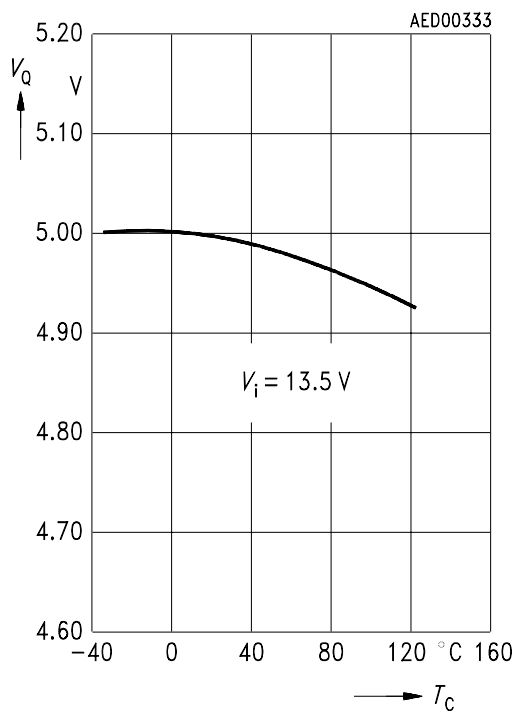


**Output Voltage versus Input Voltage**

$T_c = 25\text{ }^\circ\text{C}$



**Output Voltage versus Temperature**



**Short-Circuit Current versus Input Voltage**

$T_c = 25 \text{ °C}$

