SIEMENS

5-V Low-Drop Voltage Regulator

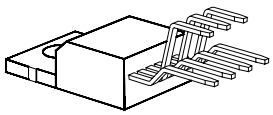
TLE 4258

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



P-TO220-7-1

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 ($V_I > V_{I\,OFF}$). 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.

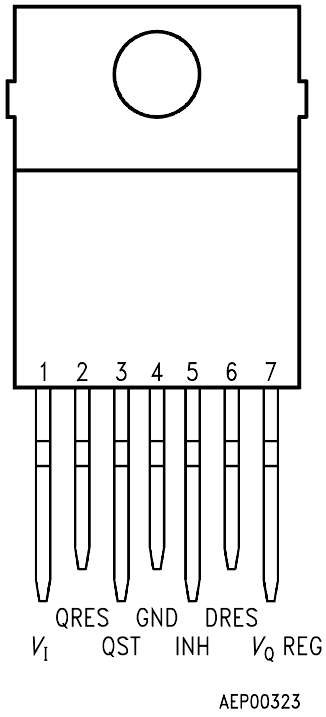
If the main regulator output voltage is less than 4.5 V, the reset output is switched to low without delay. As soon as the reset threshold has been exceeded, a delay time to be set by an external capacitor expires and afterwards the reset output switches to high again.

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

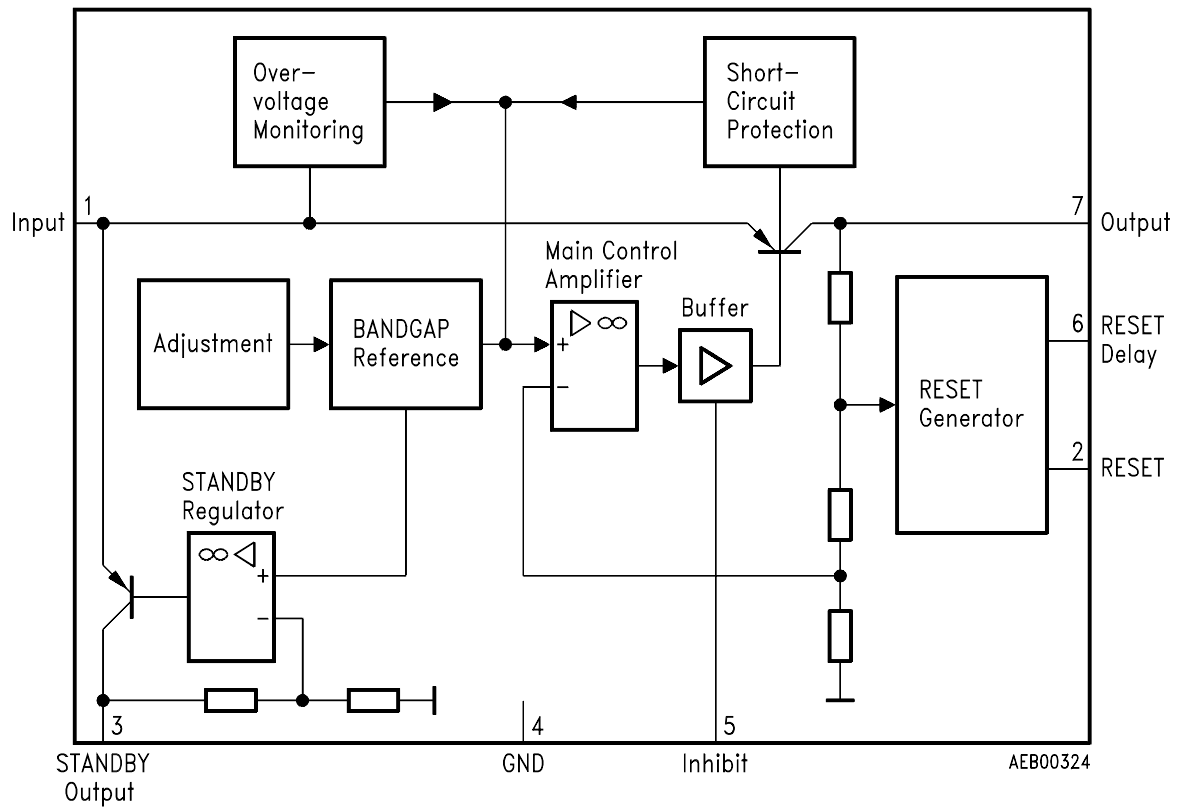
The TLE 4258 incorporates a main and standby-control regulator: The amplifiers regulate the output voltage by comparing the output voltage (from the voltage divider) with a highly precise reference voltage. The standby regulator directly controls the base of a PNP series transistor and the main regulator via a buffer that can be turned off with inhibit pulse at pin 5. If the output voltage V_Q 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 $V_{I\,OFF}$.

Pin Configuration
(top view)



Pin Definitions and Functions

Pin	Symbol	Function
1	V_I	**Input** of voltage regulator
2	Q RES	**Reset output;** open-collector output NPN to pin 4. If the output voltage V_Q drops below the reset threshold, the output stage becomes conductive.
3	Q ST	**Standby output,** connect with a capacitor ≥ 10 µF
4	GND	**Ground;** reference potential
5	INH	**Inhibit (main regulator ON/OFF),** input for turning on/off main regulator, connected to a 22-kΩ series resistor. With open input, the main regulator remains turned off.
6	D RES	**Reset delay;** pin for reset capacitor; the size of this capacitor determines the delay time of the reset signal typ. 175 ms/µF.
7	V_Q REG	**Main regulator output,** connected to a capacitor ≥ 22 µF.



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 V ≤ V_I ≤ 24 V	SR	–	100	V/µs
Slew rate 24 V ≤ V_I ≤ 70 V	SR	–	10	V/µs
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}	–	± 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

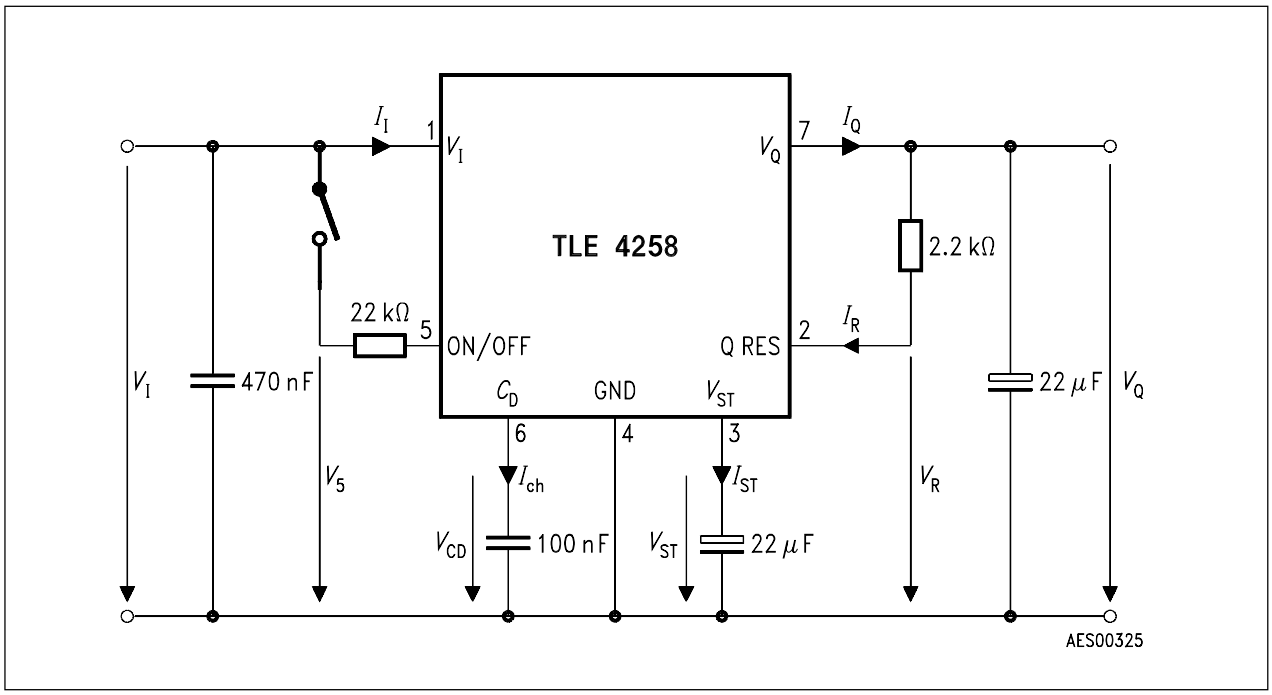
Characteristics

V_I = 13.5 V; T_j = 25 °C; V_5 > 3.5 V (unless otherwise specified)

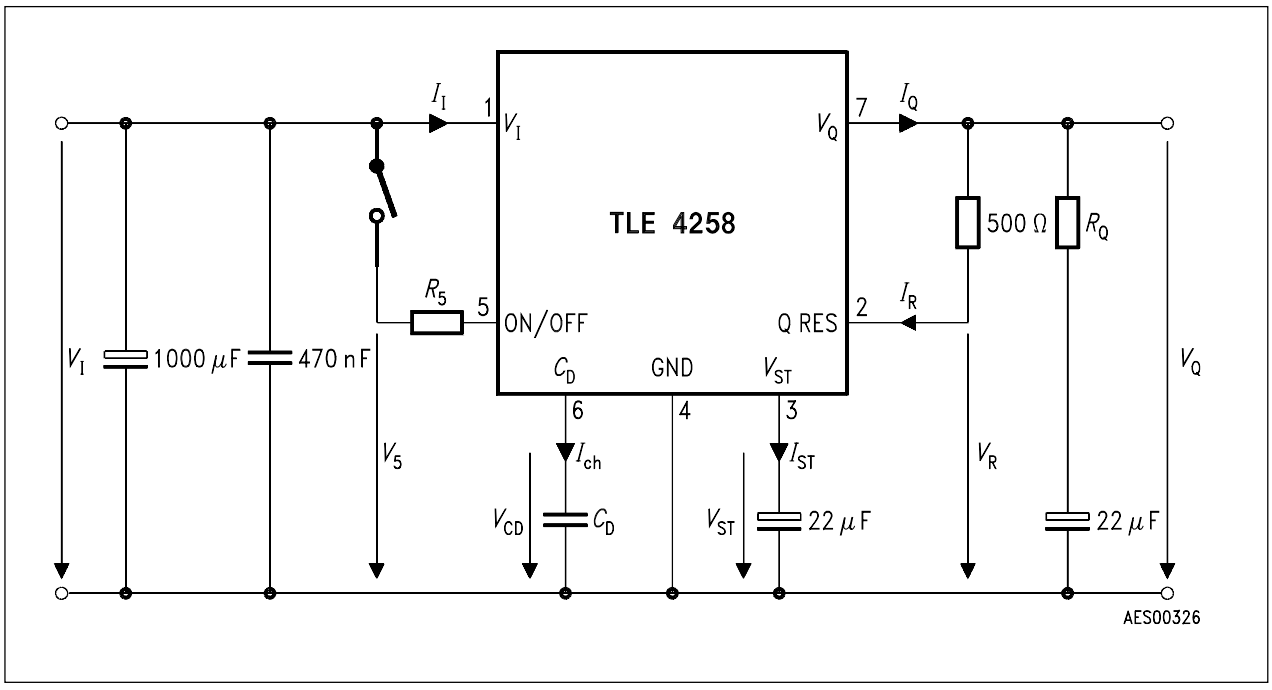
Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Main Regulator						
Output voltage	V_Q	4.85	–	5.15	V	0 mA ≤ I_Q ≤ 750 mA 6 V < V_I < $V_{I\,off}$ – 40 °C ≤ T_j ≤ 125 °C
Input current Current consumption without load	I_Q I_Q I_Q I_Q	– – – –	– – – –	30 150 300 300	mA mA mA mA	I_Q = 0 mA; I_{ST} = 0 mA I_Q = 450 mA; I_{ST} = 0 mA I_Q = 750 mA; I_{ST} = 0 mA V_I = 5.8 V; I_Q = 750 mA; I_{ST} = 0 mA
Turn-OFF voltage	$V_{I\,OFF}$	25	–	–	V	V_I > $V_{I\,off}$
Output current Short-circuit current	I_Q I_{SC}	– 0.75	– 1	20 1.8	mA A	V_I > $V_{I\,off}$ V_Q = 0 V; 6 V ≤ V_I < 13.5 V
Drop voltage	V_{Dr} V_{Dr}	– –	0.3 0.5	0.5 0.75	V V	V_I = 4.5 V; I_Q = 450 mA V_I = 4.5 V; I_Q = 750 mA
Static load regulation	$\Delta V_Q/\Delta I_Q$	–	–	0.2	Ω	6 V ≤ V_I ≤ 16 V 0 mA ≤ – I_Q ≤ 750 mA
Dynamic load regulation	ΔV_Q	–	–	150	mV	I_Q = 75 mA of I_Q = 750 mA C_Q ≥ 50 µF
Supply voltage-rejection	α_{SVR}	60	–	–	dB	I_Q = 750 mA; V_I = 12 V +1 V cos (2 π × 120 Hz × t); α_{SVR} = 20 log (1 V/ΔV_Q)
Reverse output current	– I_{QR}	–	5	30	mA	V_I = 0; 0 V ≤ V_Q ≤ 4.85 V
Temperature drift of output voltage	α_{VQ}	– 0.5	–	0.5	mV/K	6 V ≤ V_I ≤ $V_{I\,off}$ ΔT_j > 50 K
Reset Generator						
Switching threshold Switching voltage	V_{RT} V_R V_R	4.4 4.4	4.5 –	4.6 0.8 V_Q	V V V	– V_Q < V_{RT}; I_R = 10 mA V_Q > V_{RT}
Reverse current Change current	I_R I_{ch}	– 10	– –	5 30	µA µA	V_R > 4.6 V; 0.5 V < V_{Cd} < (0.75 × V_Q)
Reset delay time	t_D/C_D	–	175	–	ms/µF	–

Characteristics (cont'd)
V_I = 13.5 V; T_j = 25 °C; V_5 > 3.5 V (unless otherwise specified)

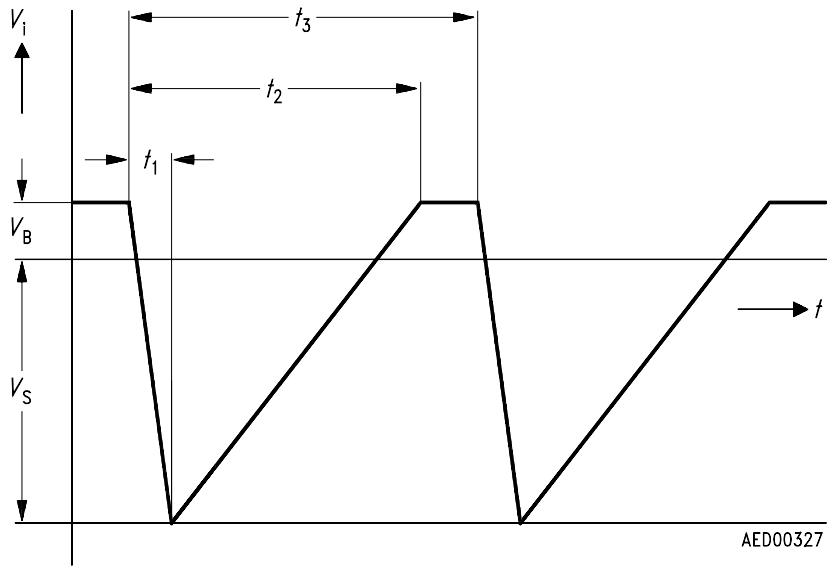
Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Standby regulator	–	–	–	–	–	$V_5 \le 0.5$ V
Output voltage	V_{ST}	4.7	–	5.3	V	0 mA ≤ I_{ST} ≤ 35 mA 6 V ≤ V_I ≤ $V_{I\,off}$
	V_{ST}	4.5	–	6.0	V	0 mA ≤ I_{ST} ≤ 35 mA $V_{I\,off}$ ≤ V_I ≤ 70 V; t_2 ≤ 400 ms
Current consumption without load	I_{QST}	–	–	2	mA	I_Q = 0 mA; I_{ST} = 0 mA
	I_{QST}	–	–	15	mA	I_Q = 0 mA; I_{ST} = 35 mA
Drop voltage	V_{DrST}	–	–	0.75	V	V_I = 4.5 V; I_{ST} = 35 mA
Static load regulation	$\Delta V_{ST}/\Delta I_{ST}$	–	1	–	Ω	6 V ≤ V_I < $V_{I\,off}$ 0 mA ≤ I_{ST} ≤ 35 mA
Supply voltage rejection	$\alpha_{SVR\,ST}$	60	–	–	dB	I_{ST} = 35 mA; V_I = 12 V + 1 V × cos (2 π × 120 Hz × t)
Reverse current	$-I_{ST}$	–	–	2	mA	V_I = 0 V; 0 V ≤ V_{ST} ≤ 4.7 V
General Ratings						
Reverse polarity	$-V_Q$	–	0	0.7	V	V_I = – 15 V
	$-I_Q$	–	0	0.5	mA	V_I = – 15 V
	$-V_{ST}$	–	0	0.7	V	V_I = – 15 V
	$-I_{ST}$	–	0	0.5	mA	V_I = – 15 V
Synchronous operation V_{ST}; V_Q	$V_{ST} - V_Q$	– 200	–	200	mV	0 mA ≤ I_{ST} ≤ 35 mA 0 mA ≤ I_Q ≤ 750 mA 6 V ≤ V_I < $V_{I\,off}$
Necessary series resistance	R_5	12	22	24	kΩ	–
Switching threshold for main regulator	V_5	3.5	–	–	V	V_Q > 3 V; I_Q = 0.5 A
	V_5	–	–	0.5	V	V_Q < 3 V; I_Q = 1 mA
Load impedance	R_Q	–	0	2	Ω	$Z_Q = R + (j\,\omega\,C)^{-1}$



Application Circuit



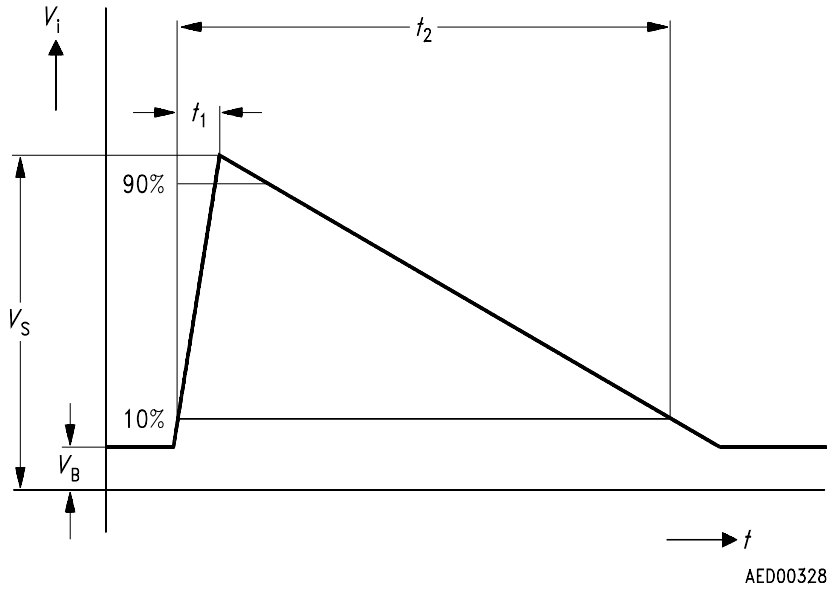
Test Circuit



V_B = 14 V t_1 = 10 μs
$|V_S|$ = 70 V t_2 = 2 ms
R_i = 10 Ω t_3 = 0.5 s to 5 s

1. Test Pulse for Negative Interference Voltages V_I

V_B = 14 V t_1 = 10 µs
V_S = 70 V t_2 = 2 ms
R_i = 10 Ω t_3 = 0.5 s to 5 s

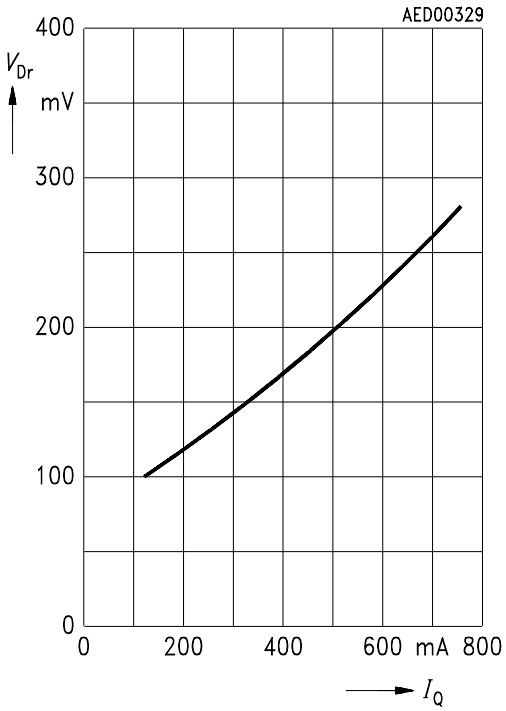


V_B = 14 V t_1 = 5 ms
V_S = 70 V t_2 = 400 ms
R_i = 0.5 Ω

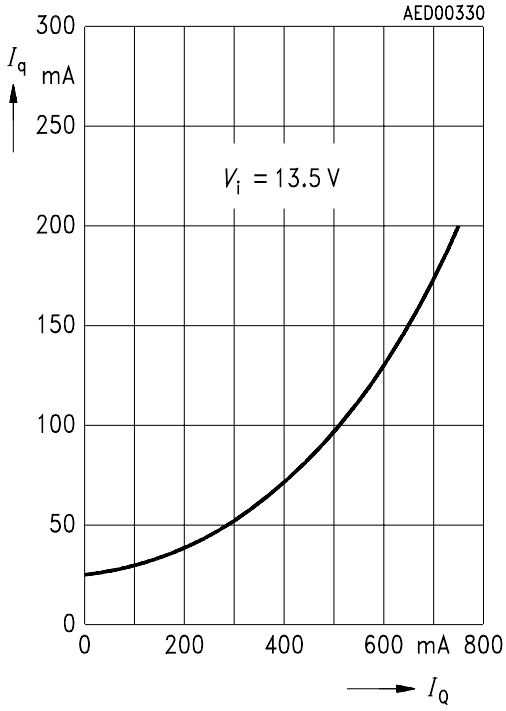
2. Pulse for Load Dump at V_{14}

V_B = 14 V t_1 = 5 ms
V_S = 70 V t_2 = 400 ms
R_i = 0.5 Ω

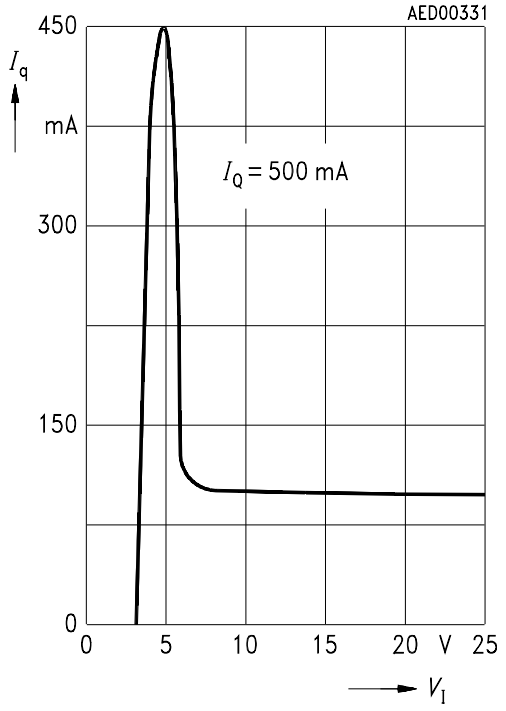
Minimum Drop Voltage versus Output Current
T_C = 25 °C; V_i = 4.5 V



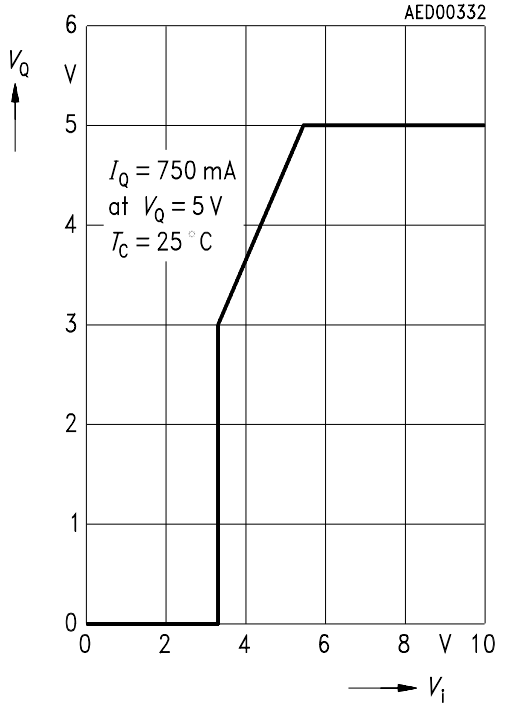
Current Consumption without Load versus Output Current
T_C = 25 °C



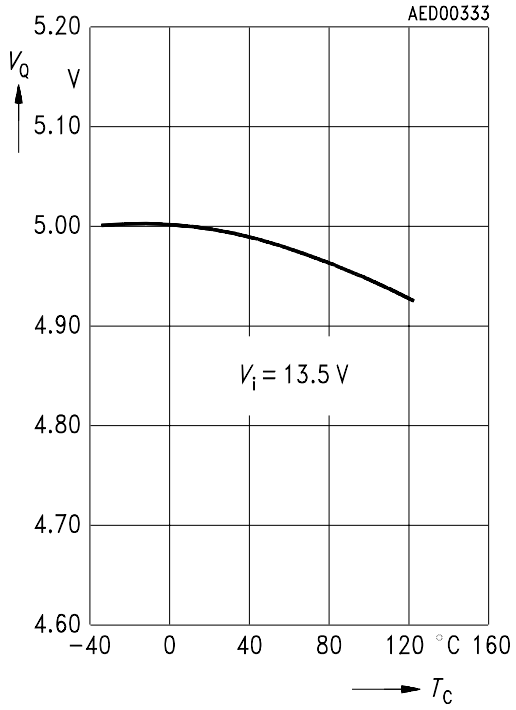
Current Consumption without Load versus Input Voltage
T_C = 25 °C



Output Voltage versus Input Voltage
T_C = 25 °C



Output Voltage versus Temperature



Short-Circuit Current versus Input Voltage
T_C = 25 °C