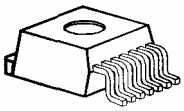
ILE4267

5-V Low-Drop Voltage Regulator

Functional Description

ILE 4267 is a 5-V low-drop voltage regulator. It supplies an output current of > 400 mA. The IC is shortcircuit-proof and incorporates temperature protection that disables the 1C at overtemperature



P-TO 220-7-180
(TO-220 AB/7, Option E3180)

Features

- Output voltage tolerance ≤ ± 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 (≤ 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

Application

The IC regulates an input voltage *V,* in the range 5.5 V < Vi < 40 V to V_{Qrated} = 5.0 V. A reset signal is generated for an output voltage V_Q of < 4.5 V. The reset delay can be set with an external capacitor. The device has two logic inputs. It is turned-ON by a voltage of > 4 V on E2 by the ignition for example. It remains active as a function of the voltage on E6, even if the voltage on E2 goes Low. This makes it possible to implement a self-holding circuit without external components. When the device is turned-OFF, the output voltage drops to 0 V and current consumption tends towards 0 μA.

Design Notes for External Components

The input capacitor Ci is necessary for compensation line influences. The resonant circuit consisting of lead inductance and input capacitance can be damped by a resistor of approx. 1 Ω in series with Ci. The output capacitor is necessary for the stability of the regulating circuit. Stability is guaranteed at values of ≥ 22 μF and an ESR of ≤ 3 Ω 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

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

A comparator in the reset-generator block compares a reference that is independent of the input voltage to the scaled-down output voltage. If this reaches a value of 4.5 V, the reset-delay capacitor is discharged and then the reset output is set Low. As the output voltage increases again, the reset-delay capacitor is charged with constant current from V_Q = 4.5 V onwards. When the capacitor voltage reaches the upper switching threshold, reset goes High again. The reset delay can be set within wide range by selection of the external capacitor.

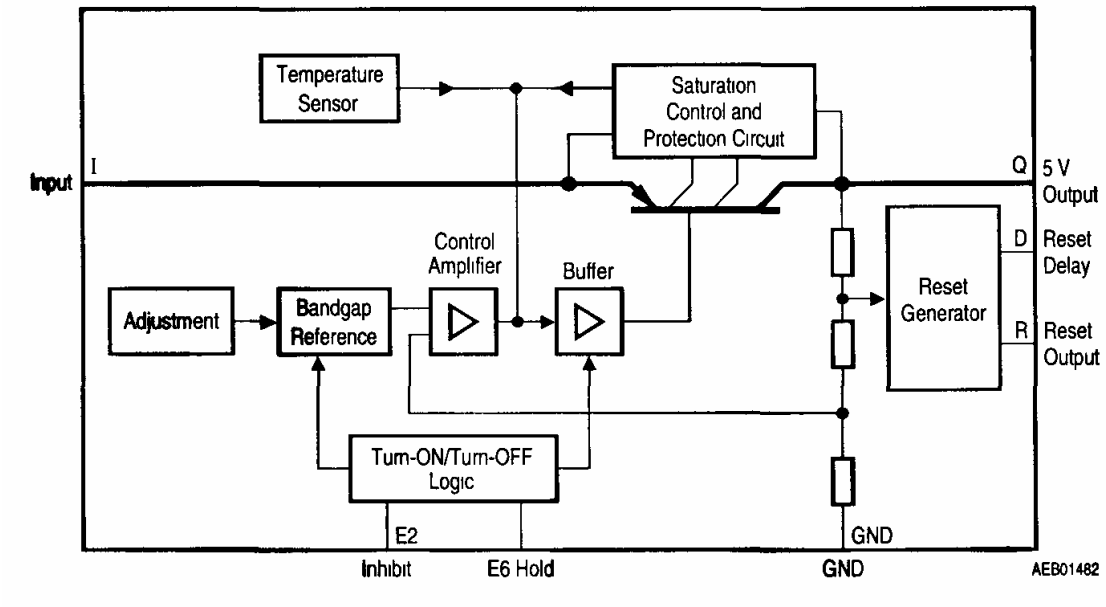
With the integrated tum-ON/tum-OFF logic it is simple to implement delayed tum-OFF without external components.

Truth Table for Turn-ON/Turn-OFF Logic

E2, Inhibit	Hold	V_Q	Remarks
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 (μC) to keep regulator shut off.
Inhibit: E2 Enable function, active High Hold: E6 Hold and release function, active Low			

Pin Definitions and Functions

Pin	Symbol	Function
1	I	**Input**; block to ground directly at the IC by a ceramic capacitor
2	E2	**Inhibit**; device is turned-ON by High signal on this pin; internal pulldown resistor of 100 kΩ
3	R	**Reset Output**; open-collector output internally connected to the output via a resistor of 30 kΩ
4	GND	**Ground**; connected to rear of chip
5	D	**Reset Delay**; connect with capacitor to GND for setting delay
6	E6	**Hold**; see truth table above for function; this input is connected to output voltage across puliup resistor of 50 kΩ
7	Q	**5-V Output**; block to GND with 22-μF capacitor, ESR < 3 Ω



Block Diagram

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Absolute Maximum Ratings T_J = -40 to 150°C

Parameter	Symbol	Limit Values		Unit	Notes
		min.	max.		
Input					
Voltage	Vi	-42	42	V	-
Voltage	Vi	-	60	V	$t \leq 400$ ms
Current	Ii	-	-	-	Limited internally
Reset Output					
Voltage	V_R	-0.3	7	V	-
Current	I_R	-	-	-	Limited internally
Reset Delay					
Voltage	Vd	-0.3	42	V	-
Current	Id	-	-	-	-
Output					
Voltage	V_Q	-0.3	7	V	-
Current	I_Q	-	-	-	Limited internally
Inhibit					
Voltage	V_{E2}	-42	42	V	-
Current	I_{E2}	-5	5	mA	t ≤ 400 ms
Hold					
Voltage	V_{E6}	-0.3	7	V	-
Current	I_{E6}	-	-	mA	Limited internally
GND					
Current	I_{GND}	-0.5	-	A	-
Temperatures					
Junction temperature	T_J	-	150	°C	-
Storage temperature	Tstg	-50	150	°C	-

Operating Range

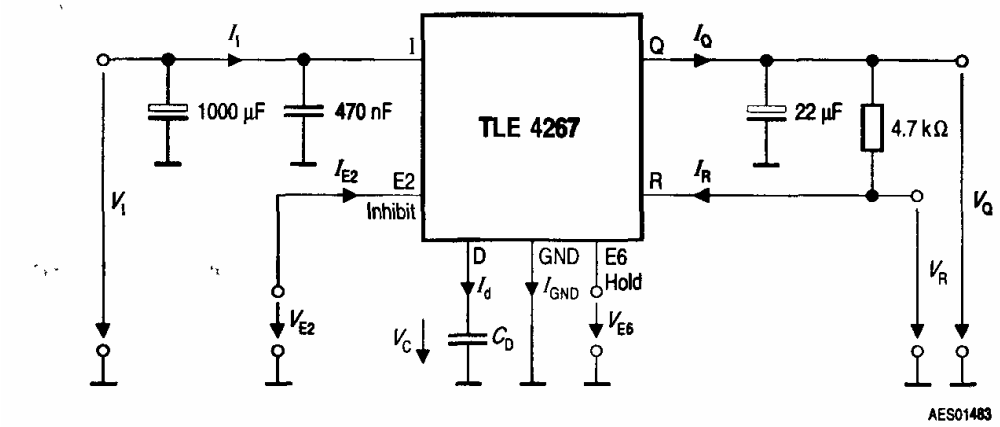
Parameter	Symbol	Limit Values		Unit	Notes
		min.	max.		
Input voltage	Vi	5.5	40	V	see diagram
Junction temperature	T_J	-40	150	°C	-
Thermal Resistance					
Junction ambient		-	65	K/W	P-T0220-7-3 package
Junction-case	Rthjc	-	6	K/W	P-T0220-7-3 package
Junction-case	Zthjc	-	2	K/W	T< 1 ms P-T0220-7-3 package
Junction ambient	Rthja	-	70	K/W	P-T0220-7-180 (SMD) package
Junction-case	Rthjc	-	6	K/W	P-T0220-7-180 (SMD) package
Junction-case	Zthjc	-	2	K/W	T<1 ms P-T0220-7-180 (SMD) package
Junction ambient	Rthja	-	65	K/W	P-T0220-7-230 package
Junction-case	Rthjc	-	6	K/W	P-T0220-7-230 package
Junction-case	Zthjc	-	2	K/W	T< 1 ms P-T0220-7-230 package
Junction ambient	Rthja	-	70	K/W	P-DSO-14-8 package
Junction-pin	Rthjc	-	30	K/W	P-DSO-14-8 package

Characteristics

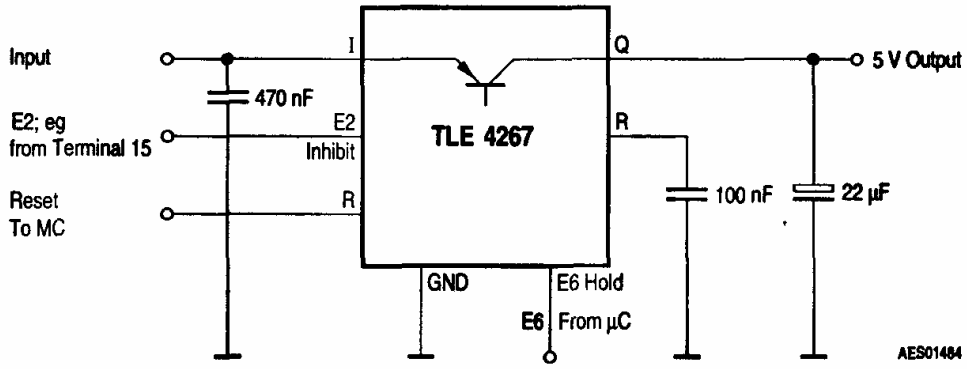
Vi = 13.5 V; - 40 °C < T_J < 125 °C; V_{E2} > 4 V (unless specified otherwise)

Parameter	Symbol	Limit Values	Unit	Test Condition

		min.	typ.	max.		
Output voltage	V_Q	4.9	5	5.1	V	5 mA ≤ I_Q ≤ 400 mA 6 V ≤ Vi ≤ 26 V
Output voltage	V_Q	4.9	5	5.1	V	5mA ≤ I_Q ≤ 150 mA 6 V ≤ Vi ≤ 40 V
Output-current limiting	I_Q	500	-	-	mA	T_J = 25 °C
Current consumption Iq = Ii - I_Q	Iq	—	—	50	µA	Regulator-OFF
Current consumption Iq = Ii - I_Q	Iq	—	1.0	10	mA	T_J = 25 °C IC turned off
Current consumption Iq = Ii - I_Q	Iq	—	1.3	4	mA	I_Q = 5 mA IC turned on
Current consumption Iq = Ii - I_Q	Iq	—	—	60	mA	I_Q = 400 mA
Current consumption Iq = Ii - I	Iq	—	—	80	mA	I_Q = 400 mA V_I = 5 V
Drop voltage	V_{Dr}	-	0.3	0.6	V	I_Q = 400 mA[1)]
Load regulation	ΔV_Q	-	-	50	mV	5 mA ≤. I_Q ≤ 400 mA
Supply-voltage regulation	ΔV_Q	—	15	25	mV	Vi = 6 to 36 V; I_Q = 5 mA
Supply-voltage rejection	SVR	—	54	—	dB	Fr = 100Hz; Vr = 0.5Vpp
Longterm stability	ΔV_Q	-	0	-	mV	1000 h
Reset Generator						
Switching threshold	Vn	4.2	4.5	4.8	V	-
Reset High level	-	4.5	-	-	V	Rext = ∞
Saturation voltage	V_R	-	0.1	0.4	V	R_R = 4.7 kΩ[2)]
Pullup	R_R	-	30	-	kΩ	-
Saturation voltage	V_D,sat.	-	50	100	mV	V_Q < V_{RT}
Charge current	Id	8	15	25	µA	V_D = 1.5V
Delay switching threshold	Vdt	2.6	3	3.3	V	-
Delay	td	-	20	-	ms	Cd = 100nF
Switching threshold	Vst	-	0.43	-	V	-
Delay	t_t	-	2	-	µs	Cd = 100nF
Inhibit						
Turn-ON voltage	V_{E2}	-	3	4	V	IC turned-ON
Turn-OFF voltage	V_{E2}	2	-	-	V	IC turned-OFF
Pulldown	R_{E2}	50	100	200	kΩ	-
Hysteresis	ΔV_{E2}	0.2	0.5	0.8	V	-
Input current	I_{E2}	-	35	100	µA	V_{IP2} = 4 V
Holding voltage	V_{E6}	30	35	40	%	Referred to V_Q
Turn-OFF voltage	V_{E6}	60	70	80	%	Referred to V_Q
Pullup	R_{E6}	20	50	100	kΩ	-
Overvoltage Protection						
Turn-OFF voltage	Vi, ov	42	44	46	V	-
Turn-ON hysteresis	ΔVi, ov	2	-	6	V	-



Test Circuit



Application Circuit

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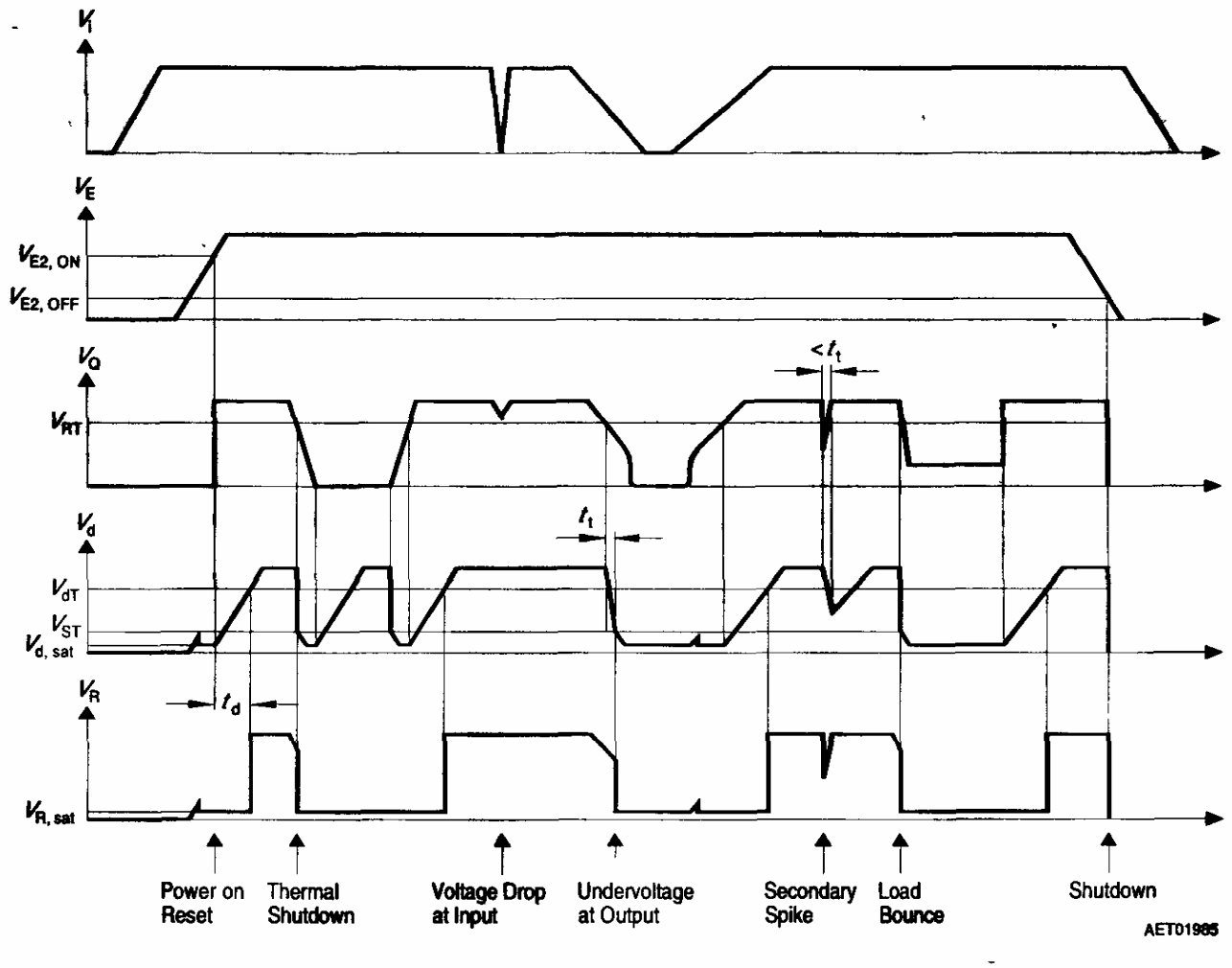

Time Response

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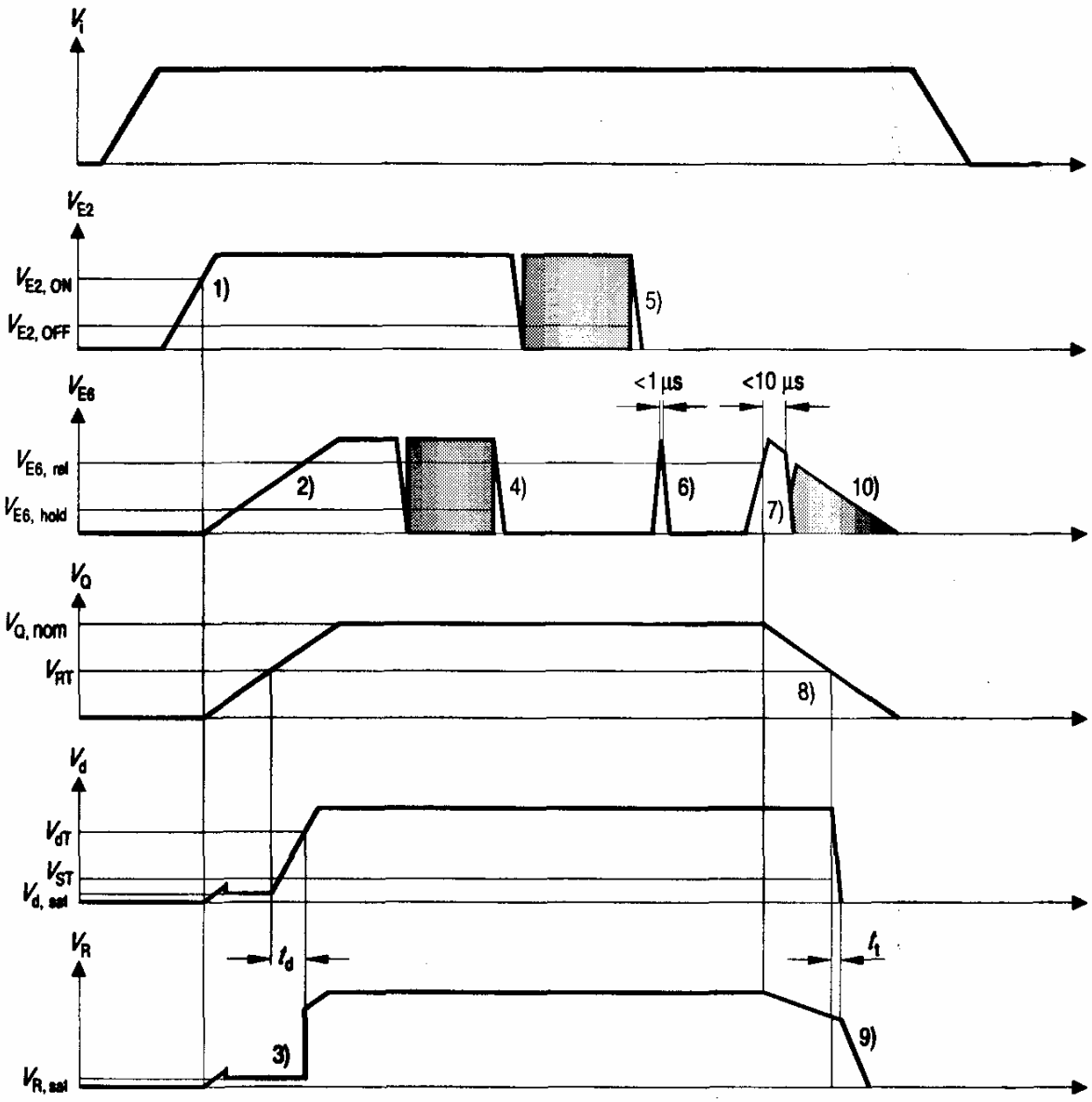

1) Enable active
2) Hold inactive, pulled up by V_Q
3) Power-ON reset
4) Hold active, clamped to GND by external µC
5) Enable inactive, clamped by int. pull-down resistor
6) Pulse width smaller than 1 µs
7) Hold inactive, released by µC
8) Voltage controller shutdown
9) Output-low reset
10) No switch on via V_{E6} possible after E6 was released to $V_{E6} > V_{E6, rel}$ for more than 4 µs

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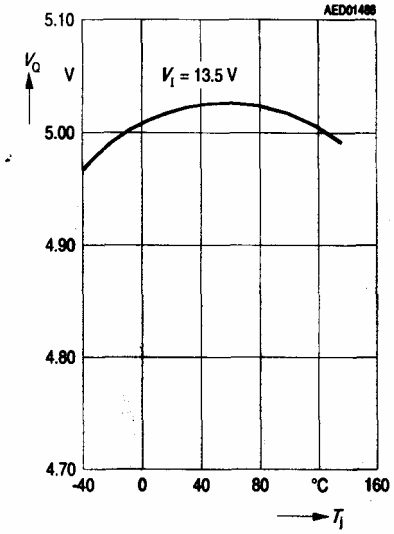
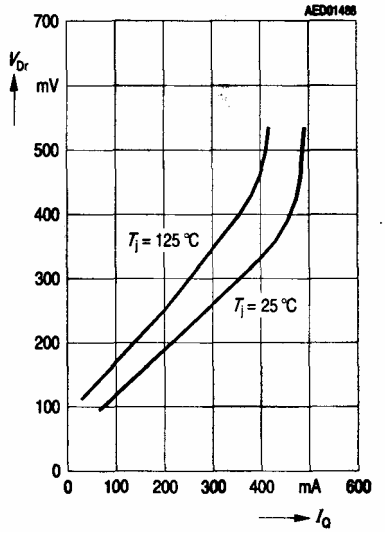
Enable and Hold Behaviour

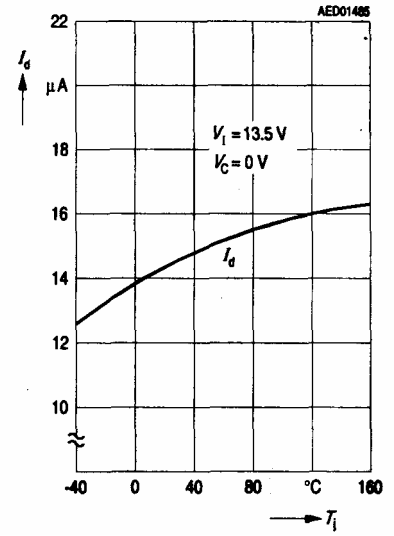
Output Voltage V_Q versus Temperature T_j



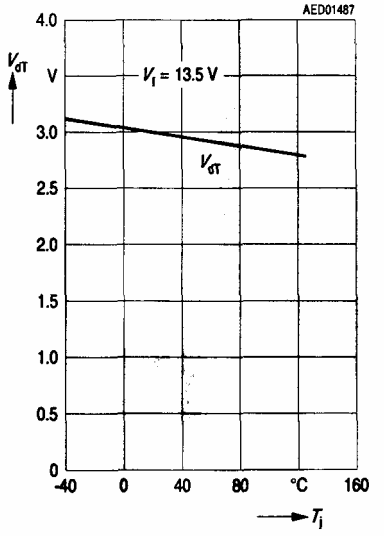
Drop Voltage V_{Dr} versus Output Current I_Q



Charge Current I_d versus Temperature T_j



Delay Switching Threshold V_{dT} versus Temperature T_j



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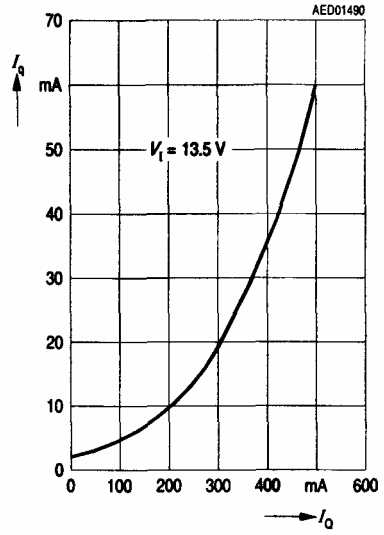
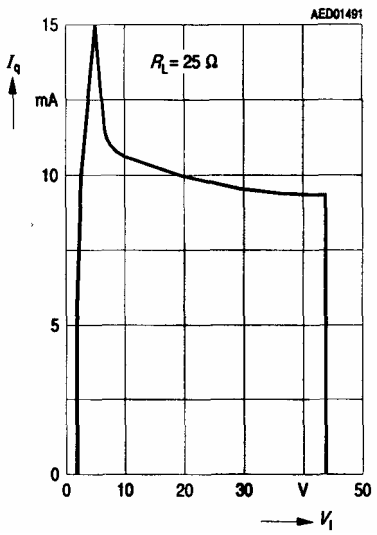
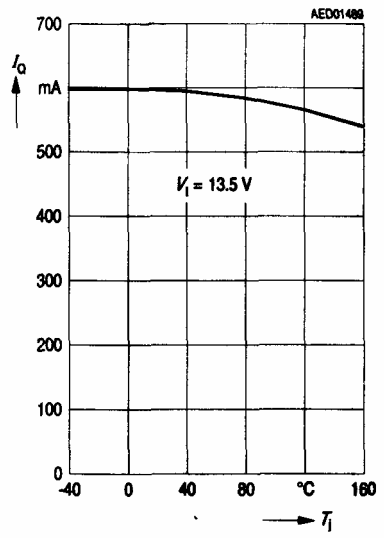
Current Consumption I_q versus Output Current I_Q



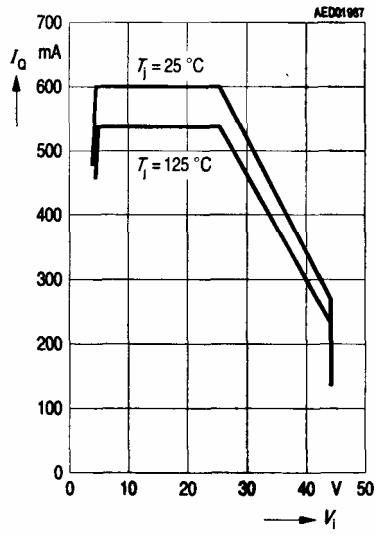
Current Consumption I_q versus Input Voltage V_I



Output Current I_Q versus Temperature T_j



Output Current I_Q versus Input Voltage V_I



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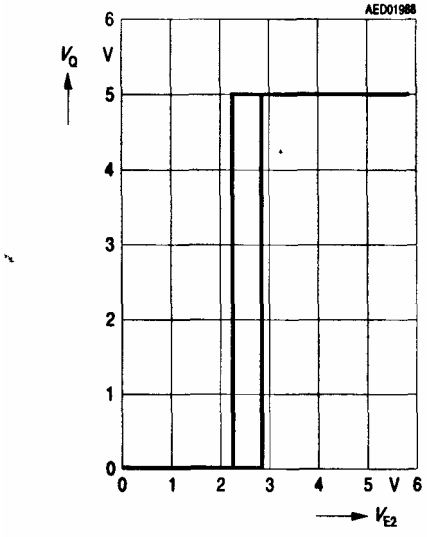
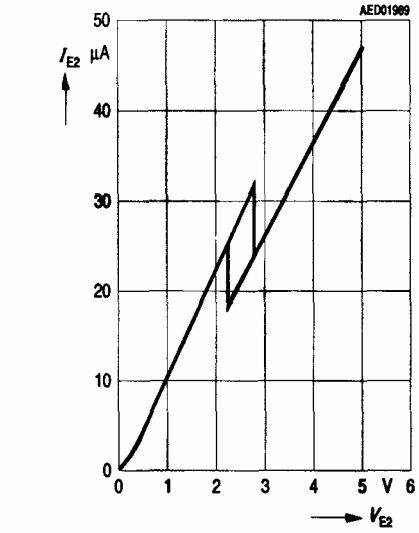
Output Voltage V_Q versus Inhibit Voltage V_{E2}



Inhibit Current I_{E2} versus Inhibit Voltage V_{E2}



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