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**5-V Low-Drop Voltage Regulator**

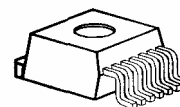
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**Functional Description**

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 IC at overtemperature

**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



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

**Application**

The IC regulates an input voltage  $V_i$  in the range  $5.5\text{ V} < V_i < 40\text{ V}$  to  $V_{Qrated} = 5.0\text{ V}$ . A reset signal is generated for an output voltage  $V_Q$  of  $< 4.5\text{ V}$ . The reset delay can be set with an external capacitor. The device has two logic inputs. It is turned-ON by a voltage of  $> 4\text{ V}$  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  $\mu\text{A}$ .

**Design Notes for External Components**

The input capacitor  $C_i$  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  $\Omega$  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.

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.

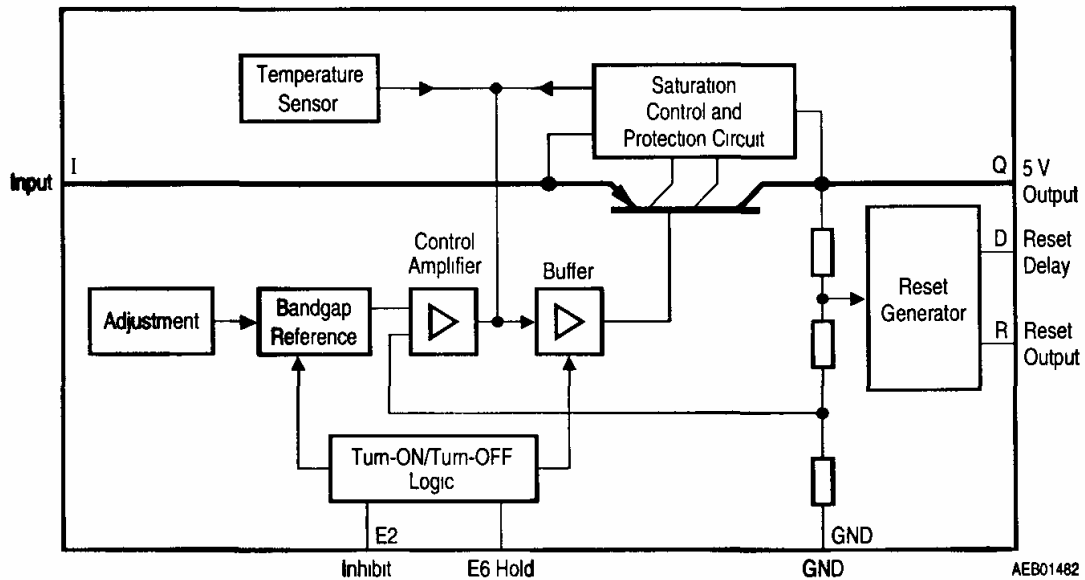
With the integrated turn-ON/turn-OFF logic it is simple to implement delayed turn-OFF without external components.

### 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 ( $\mu C$ ) 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      | <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 pulldown resistor of 100 k $\Omega$                       |
| 3   | R      | <b>Reset Output</b> ; open-collector output internally connected to the output via a resistor of 30 k $\Omega$                      |
| 4   | GND    | <b>Ground</b> ; connected to rear of chip                                                                                           |
| 5   | D      | <b>Reset Delay</b> ; connect with capacitor to GND for setting delay                                                                |
| 6   | E6     | <b>Hold</b> ; see truth table above for function; this input is connected to output voltage across pullup resistor of 50 k $\Omega$ |
| 7   | Q      | <b>5-V Output</b> ; block to GND with 22- $\mu$ F capacitor, ESR < 3 $\Omega$                                                       |



Block Diagram

# ILE4267

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

| Parameter            | Symbol           | Limit Values |      | Unit | Notes              |
|----------------------|------------------|--------------|------|------|--------------------|
|                      |                  | min.         | max. |      |                    |
| Input                |                  |              |      |      |                    |
| Voltage              | V <sub>i</sub>   | -42          | 42   | V    | -                  |
| Voltage              | V <sub>i</sub>   | -            | 60   | V    | <i>t</i> ≤ 400 ms  |
| Current              | I <sub>i</sub>   | -            | -    | -    | Limited internally |
| Reset Output         |                  |              |      |      |                    |
| Voltage              | V <sub>R</sub>   | -0.3         | 7    | V    | -                  |
| Current              | I <sub>R</sub>   | -            | -    | -    | Limited internally |
| Reset Delay          |                  |              |      |      |                    |
| Voltage              | V <sub>d</sub>   | -0.3         | 42   | V    | -                  |
| Current              | I <sub>d</sub>   | -            | -    | -    | -                  |
| Output               |                  |              |      |      |                    |
| Voltage              | V <sub>Q</sub>   | -0.3         | 7    | V    | -                  |
| Current              | I <sub>Q</sub>   | -            | -    | -    | Limited internally |
| Inhibit              |                  |              |      |      |                    |
| Voltage              | V <sub>E2</sub>  | -42          | 42   | V    | -                  |
| Current              | I <sub>E2</sub>  | -5           | 5    | mA   | <i>t</i> ≤ 400 ms  |
| Hold                 |                  |              |      |      |                    |
| Voltage              | V <sub>E6</sub>  | -0.3         | 7    | V    | -                  |
| Current              | I <sub>E6</sub>  | -            | -    | mA   | Limited internally |
| GND                  |                  |              |      |      |                    |
| Current              | I <sub>GND</sub> | -0.5         | -    | A    | -                  |
| Temperatures         |                  |              |      |      |                    |
| Junction temperature | T <sub>J</sub>   | -            | 150  | °C   | -                  |
| Storage temperature  | T <sub>stg</sub> | -50          | 150  | °C   | -                  |

## 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  | $^\circ\text{C}$ | -                                         |
| <b>Thermal Resistance</b> |            |              |      |                  |                                           |
| Junction ambient          |            | -            | 65   | K/W              | P-T0220-7-3 package                       |
| Junction-case             | $R_{thjc}$ | -            | 6    | K/W              | P-T0220-7-3 package                       |
| Junction-case             | $Z_{thjc}$ | -            | 2    | K/W              | $T < 1$ ms<br>P-T0220-7-3 package         |
| Junction ambient          | $R_{thja}$ | -            | 70   | K/W              | P-T0220-7-180 (SMD) package               |
| Junction-case             | $R_{thjc}$ | -            | 6    | K/W              | P-T0220-7-180 (SMD) package               |
| Junction-case             | $Z_{thjc}$ | -            | 2    | K/W              | $T < 1$ ms<br>P-T0220-7-180 (SMD) package |
| Junction ambient          | $R_{thja}$ | -            | 65   | K/W              | P-T0220-7-230 package                     |
| Junction-case             | $R_{thjc}$ | -            | 6    | K/W              | P-T0220-7-230 package                     |
| Junction-case             | $Z_{thjc}$ | -            | 2    | K/W              | $T < 1$ ms<br>P-T0220-7-230 package       |
| Junction ambient          | $R_{thja}$ | -            | 70   | K/W              | P-DSO-14-8 package                        |
| Junction-pin              | $R_{thjc}$ | -            | 30   | K/W              | P-DSO-14-8 package                        |

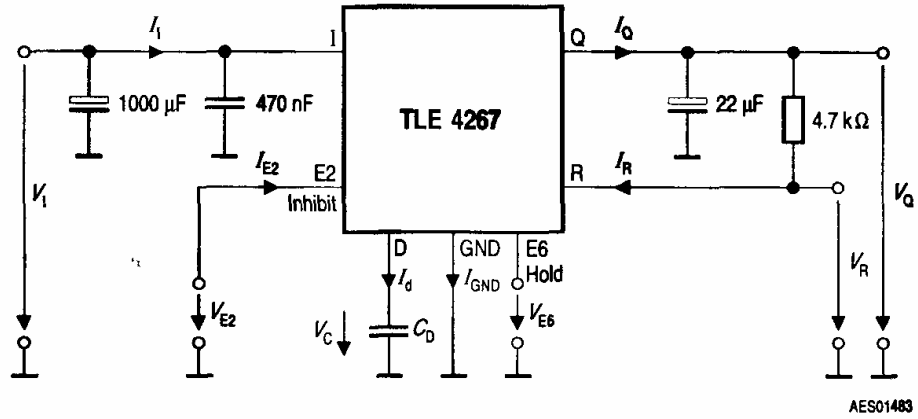
## Characteristics

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

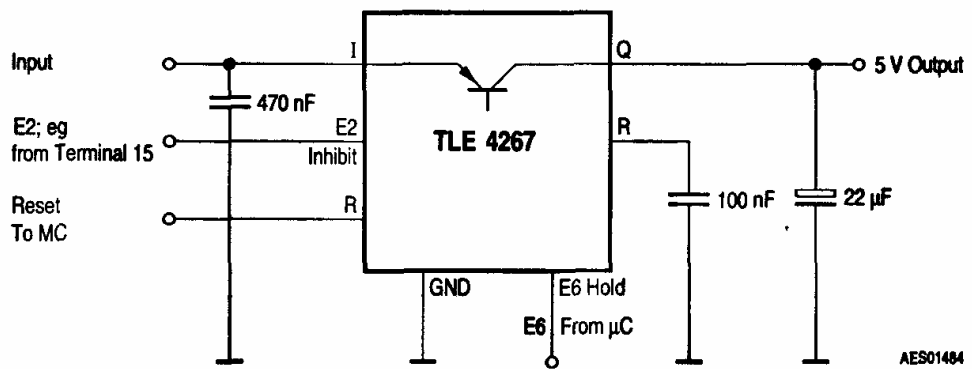
| Parameter | Symbol | Limit Values | Unit | Test Condition |
|-----------|--------|--------------|------|----------------|
|-----------|--------|--------------|------|----------------|

## ILE4267

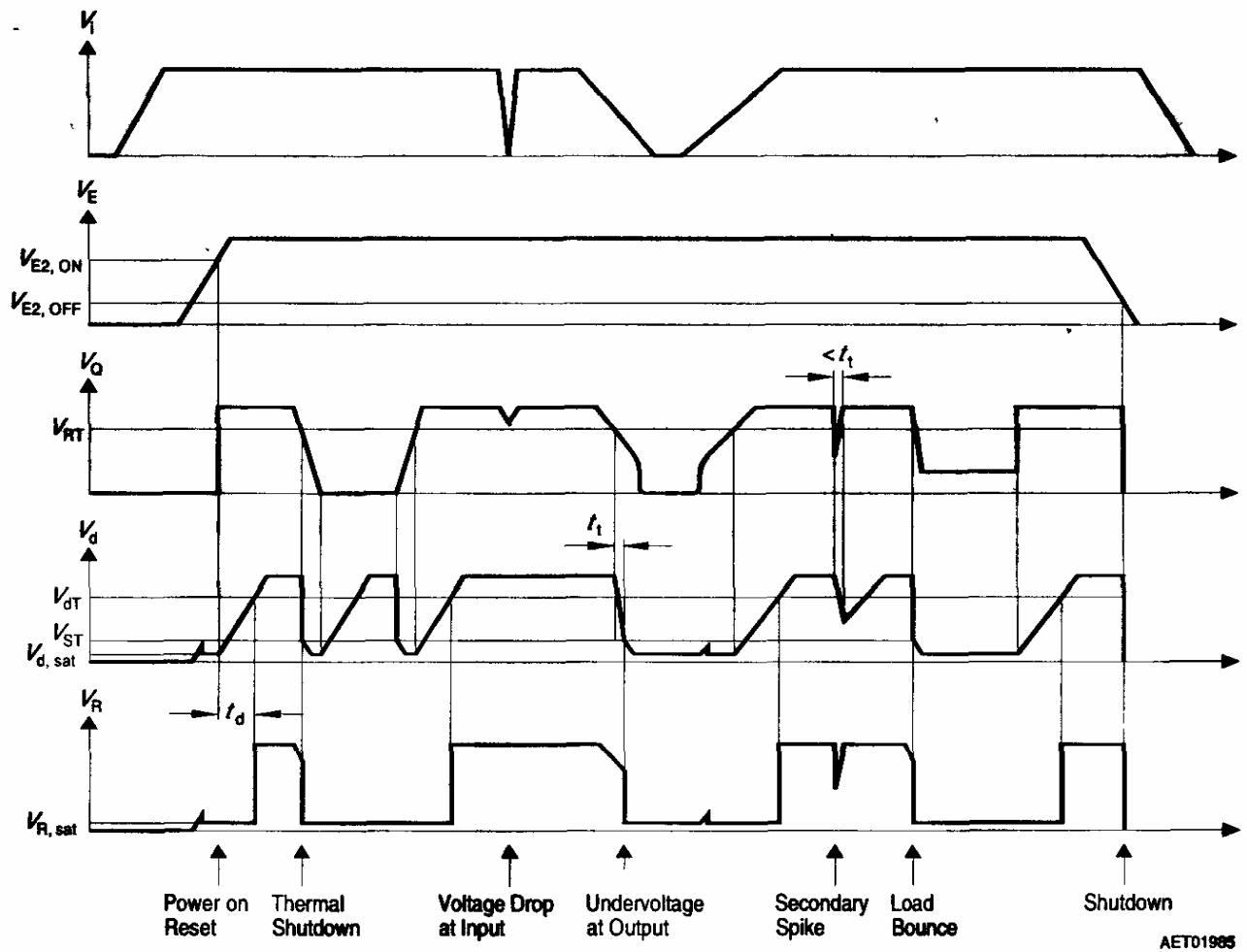
|                                                                         |                     | min. | typ. | max. |    |                                                                |
|-------------------------------------------------------------------------|---------------------|------|------|------|----|----------------------------------------------------------------|
| Output voltage                                                          | V <sub>Q</sub>      | 4.9  | 5    | 5.1  | V  | 5 mA ≤ I <sub>Q</sub> ≤ 400 mA<br>6 V ≤ V <sub>i</sub> ≤ 26 V  |
| Output voltage                                                          | V <sub>Q</sub>      | 4.9  | 5    | 5.1  | V  | 5 mA ≤ I <sub>Q</sub> ≤ 150 mA<br>6 V ≤ V <sub>i</sub> ≤ 40 V  |
| Output-current limiting                                                 | I <sub>Q</sub>      | 500  | -    | -    | mA | T <sub>J</sub> = 25 °C                                         |
| Current consumption<br>I <sub>Q</sub> = I <sub>i</sub> - I <sub>Q</sub> | I <sub>Q</sub>      | —    | —    | 50   | μA | Regulator-OFF                                                  |
| Current consumption<br>I <sub>Q</sub> = I <sub>i</sub> - I <sub>Q</sub> | I <sub>Q</sub>      | —    | 1.0  | 10   | mA | T <sub>J</sub> = 25 °C<br>IC turned off                        |
| Current consumption<br>I <sub>Q</sub> = I <sub>i</sub> - I <sub>Q</sub> | I <sub>Q</sub>      | —    | 1.3  | 4    | mA | I <sub>Q</sub> = 5 mA<br>IC turned on                          |
| Current consumption<br>I <sub>Q</sub> = I <sub>i</sub> - I <sub>Q</sub> | I <sub>Q</sub>      | —    | —    | 60   | mA | I <sub>Q</sub> = 400 mA                                        |
| Current consumption<br>I <sub>Q</sub> = I <sub>i</sub> - I              | I <sub>Q</sub>      | —    | —    | 80   | mA | I <sub>Q</sub> = 400 mA<br>V <sub>i</sub> = 5 V                |
| Drop voltage                                                            | V <sub>Dr</sub>     | -    | 0.3  | 0.6  | V  | I <sub>Q</sub> = 400 mA <sup>1)</sup>                          |
| Load regulation                                                         | ΔV <sub>Q</sub>     | -    | -    | 50   | mV | 5 mA ≤ I <sub>Q</sub> ≤ 400 mA                                 |
| Supply-voltage regulation                                               | ΔV <sub>Q</sub>     | —    | 15   | 25   | mV | V <sub>i</sub> = 6 to 36 V;<br>I <sub>Q</sub> = 5 mA           |
| Supply-voltage rejection                                                | SVR                 | —    | 54   | —    | dB | F <sub>r</sub> = 100Hz;<br>V <sub>r</sub> = 0.5V <sub>pp</sub> |
| Longterm stability                                                      | ΔV <sub>Q</sub>     | -    | 0    | -    | mV | 1000 h                                                         |
| <b>Reset Generator</b>                                                  |                     |      |      |      |    |                                                                |
| Switching threshold                                                     | V <sub>n</sub>      | 4.2  | 4.5  | 4.8  | V  | -                                                              |
| Reset High level                                                        | -                   | 4.5  | -    | -    | V  | R <sub>ext</sub> = ∞                                           |
| Saturation voltage                                                      | V <sub>R</sub>      | -    | 0.1  | 0.4  | V  | R <sub>R</sub> = 4.7 kΩ <sup>2)</sup>                          |
| Pullup                                                                  | R <sub>R</sub>      | -    | 30   | -    | kΩ | -                                                              |
| Saturation voltage                                                      | V <sub>D,sat.</sub> | -    | 50   | 100  | mV | V <sub>Q</sub> < V <sub>RT</sub>                               |
| Charge current                                                          | I <sub>d</sub>      | 8    | 15   | 25   | μA | V <sub>D</sub> = 1.5V                                          |
| Delay switching threshold                                               | V <sub>dt</sub>     | 2.6  | 3    | 3.3  | V  | -                                                              |
| Delay                                                                   | t <sub>d</sub>      | -    | 20   | -    | ms | C <sub>d</sub> = 100nF                                         |
| Switching threshold                                                     | V <sub>st</sub>     | -    | 0.43 | -    | V  | -                                                              |
| Delay                                                                   | t <sub>t</sub>      | -    | 2    | -    | μs | C <sub>d</sub> = 100nF                                         |
| <b>Inhibit</b>                                                          |                     |      |      |      |    |                                                                |
| Turn-ON voltage                                                         | V <sub>E2</sub>     | -    | 3    | 4    | V  | IC turned-ON                                                   |
| Turn-OFF voltage                                                        | V <sub>E2</sub>     | 2    | -    | -    | V  | IC turned-OFF                                                  |
| Pulldown                                                                | R <sub>E2</sub>     | 50   | 100  | 200  | kΩ | -                                                              |
| Hysteresis                                                              | ΔV <sub>E2</sub>    | 0.2  | 0.5  | 0.8  | V  | -                                                              |
| Input current                                                           | I <sub>E2</sub>     | -    | 35   | 100  | μA | V <sub>IP2</sub> = 4 V                                         |
| Holding voltage                                                         | V <sub>E6</sub>     | 30   | 35   | 40   | %  | Referred to V <sub>Q</sub>                                     |
| Turn-OFF voltage                                                        | V <sub>E6</sub>     | 60   | 70   | 80   | %  | Referred to V <sub>Q</sub>                                     |
| Pullup                                                                  | R <sub>E6</sub>     | 20   | 50   | 100  | kΩ | -                                                              |
| <b>Overvoltage Protection</b>                                           |                     |      |      |      |    |                                                                |
| Turn-OFF voltage                                                        | V <sub>i, ov</sub>  | 42   | 44   | 46   | V  | -                                                              |
| Turn-ON hysteresis                                                      | ΔV <sub>i, ov</sub> | 2    | -    | 6    | V  | -                                                              |



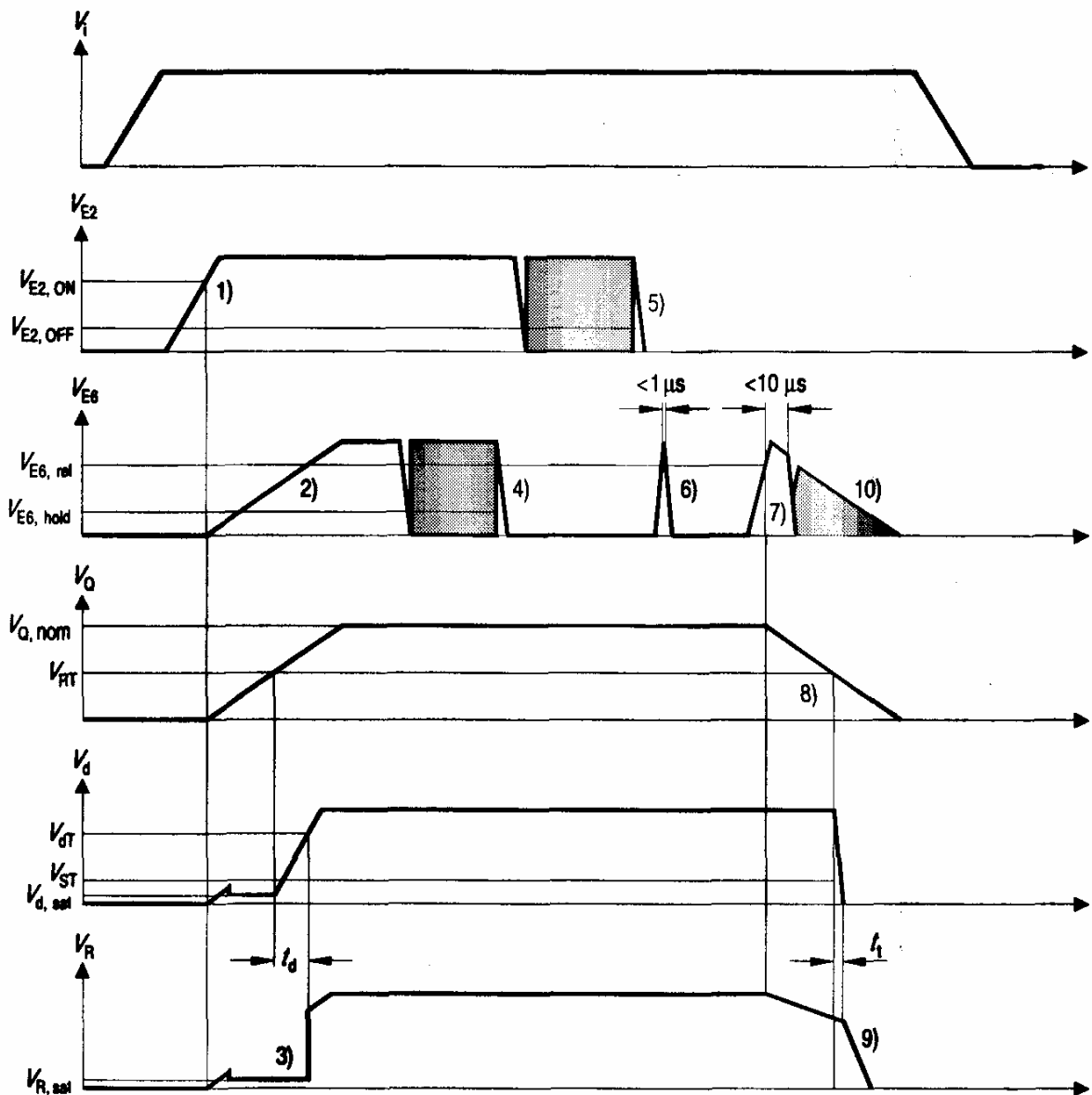
Test Circuit



Application Circuit



Time Response



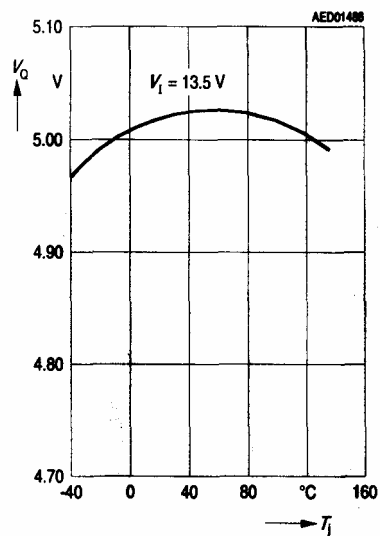
- |                                                        |                                                                                                                  |
|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|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

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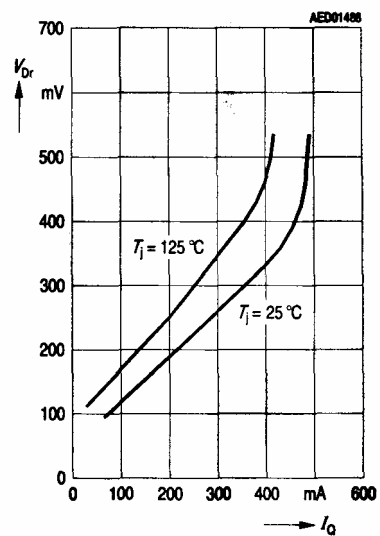
## Enable and Hold Behaviour



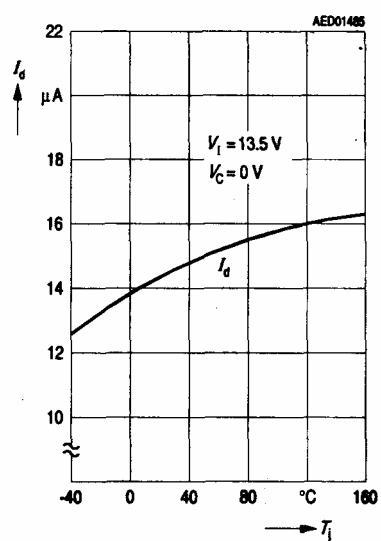
Output Voltage  $V_o$  versus Temperature  $T_i$



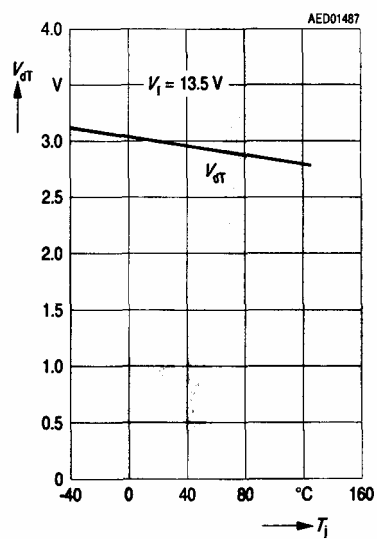
Drop Voltage  $V_{Dr}$  versus Output Current  $I_o$



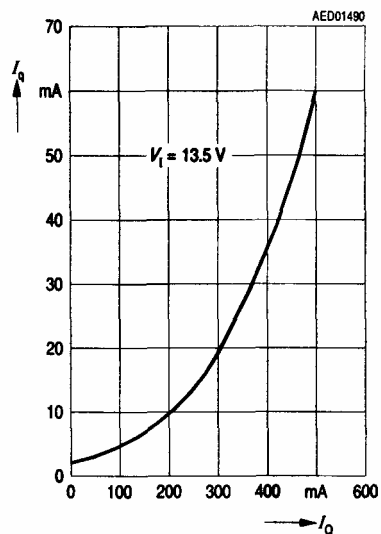
Charge Current  $I_d$  versus Temperature  $T_i$



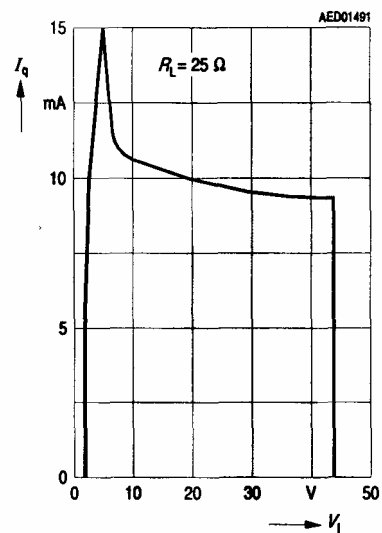
Delay Switching Threshold  $V_{dT}$  versus Temperature  $T_i$



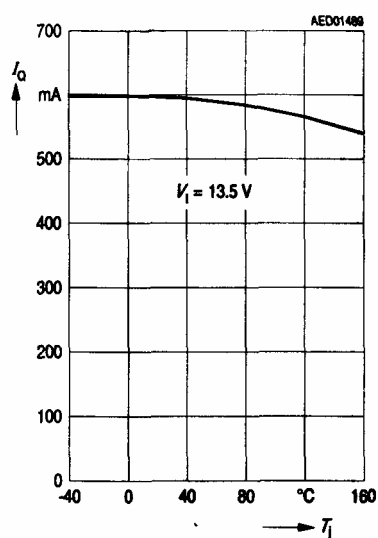
Current Consumption  $I_q$  versus Output Current  $I_o$



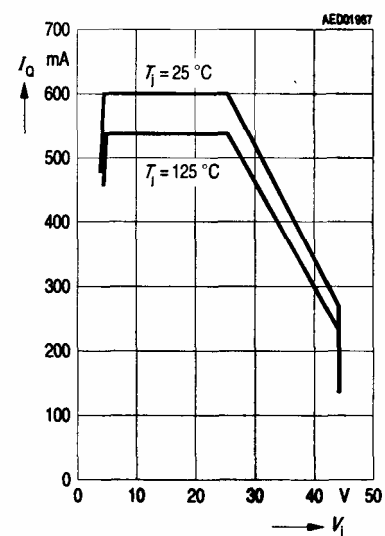
Current Consumption  $I_q$  versus Input Voltage  $V_i$



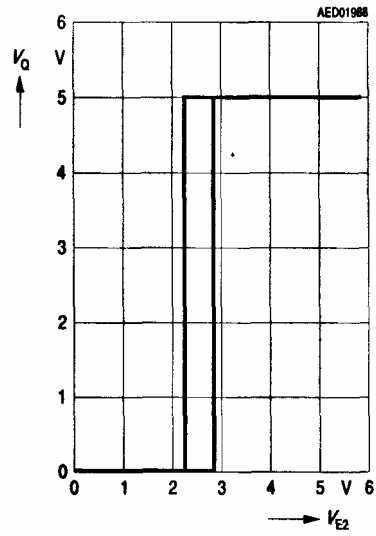
Output Current  $I_o$  versus Temperature  $T_i$



Output Current  $I_o$  versus Input Voltage  $V_i$



Output Voltage  $V_o$  versus  
Inhibit Voltage  $V_{E2}$



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

