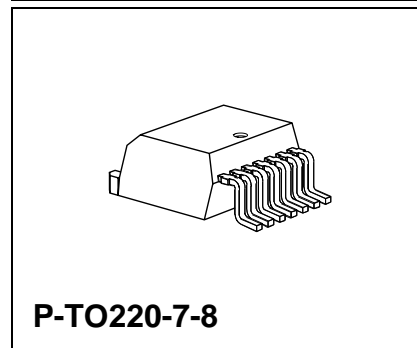
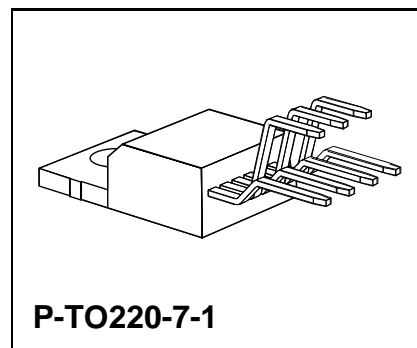


Overview

SPT IC ¹⁾

Features

- Output current ± 3 A
- I/O error diagnostics
- Short-circuit proof
- Four-quadrant operation
- Integrated free-wheeling diodes
- Wide temperature range
- Break low **and** break high, if open load detection is required, the device TLE 5203 will fit



| Type | Ordering Code | Package |
|------------|---------------|-------------|
| TLE 5204 | Q67000-A9177 | P-TO220-7-1 |
| TLE 5204 G | Q67006-A9234 | P-TO220-7-8 |

Description

TLE 5204 is an integrated power bridge with DMOS output stages for driving DC motors. This motor bridge is optimized for driving DC motors in reversible operation. The internal protective circuitry in particular ensures that no crossover currents can occur.

Because the free-wheeling diodes are integrated, the external circuitry that is necessary is reduced to the capacitors on the supply voltage.

The control inputs have TTL/CMOS-compatible levels.

¹⁾ **SIEMENS Power Technology**

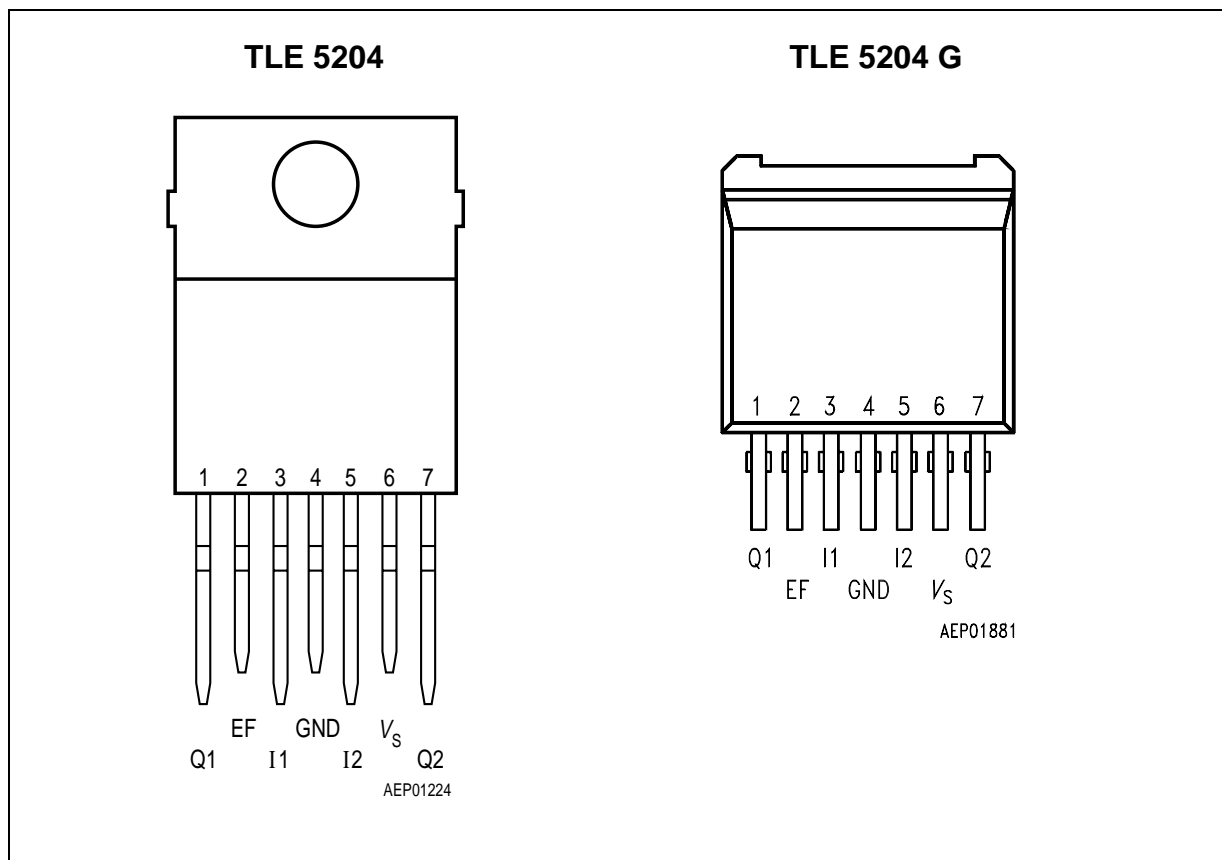


Figure 1 Pin Configuration (top view)

Pin Definitions and Functions

| Pin No. | Symbol | Function |
|---------|----------------|--|
| 1 | Q1 | Output of channel 1; Short-circuit proof, free-wheeling diodes integrated for inductive loads |
| 2 | EF | Error flag; TTL/CMOS-compatible output for error detection (open drain) |
| 3 | I1 | Control input 1; TTL/CMOS-compatible |
| 4 | GND | Ground; connected internally to cooling fin |
| 5 | I2 | Control input 2; TTL/CMOS-compatible |
| 6 | V _s | Supply voltage; wire with capacitor matching load |
| 7 | Q2 | Output of channel 2; Short-circuit proof, free-wheeling diodes integrated for inductive loads |

Circuit Description

Input Circuit

The control inputs consist of TTL/CMOS-compatible Schmitt triggers with hysteresis. Buffer amplifiers are driven by these stages and convert the logic signal into the necessary form for driving the power output stages.

Output Stages

The output stages form a switched H-bridge. Protective circuits make the outputs short-circuit proof to ground and to the supply voltage throughout the operating range. Positive and negative voltage spikes, which occur when switching inductive loads, are clamped by integrated power diodes.

Functional Truth Table

| E1 | E2 | Q1 | Q2 | Comments |
|----|----|----|----|---|
| L | L | L | L | Motor brake; both low side transistors turned-ON |
| L | H | L | H | Motor turns clockwise |
| H | L | H | L | Motor turns counterclockwise |
| H | H | H | H | Motor brake; both high side transistors turned-ON |

Notes for Output Stage

| Symbol | Value |
|--------|--|
| L | Low side transistor is turned-ON High side transistor is turned-OFF |
| H | High side transistor is turned-ON Low side transistor is turned-OFF |

Monitoring Functions

An internal circuit ensures that all output transistors are turned-OFF if the supply voltage is below the operating range.

A monitoring circuit for each output transistor detects whether the particular transistor is active and in this case prevents the corresponding source transistor (sink transistor) from conducting in sink operation (source operation). Therefore no crossover currents can occur. Pulse-width operation is possible up to a maximum switching frequency of 1 kHz for any load.

Depending on the load current higher frequencies are possible.

Protective Function

Various errors like short-circuit to + V_s , ground or across the load are detected. All faults result in turn-OFF of the output stages after a delay of 40 μ s and setting of the error flag EF to ground. Changing the inputs resets the error flag.

Output Shorted to Ground Detection

If a high side transistor is switched on and its output is shorted to ground, the output current is limited to typ 8 A. After a delay of 40 μ s all outputs will be switched off and the error flag EF is set to ground.

Output Shorted to + V_s and Overload Detection

An internal circuit detects if the current through the low side transistor is higher than 4 A typ. In this case all outputs are turned-OFF after 40 μ s and the error flag is set to ground.

At a junction temperature higher than 160 °C the thermal shutdown turns-OFF, all four output stages commonly and the error flag is set without a delay.

Diagnosis

| Input | | Output | | Diagnosis | | | EF |
|-------|----|--------|----|----------------|------------------|----------|----|
| E1 | E2 | Q1 | Q2 | Shorted to GND | Shorted to V_s | Overload | |
| L | L | L | L | – | Q1, Q2 | – | L |
| L | H | L | H | Q2 | Q1 | X | L |
| H | L | H | L | Q1 | Q2 | X | L |
| H | H | H | H | Q1, Q2 | – | – | L |

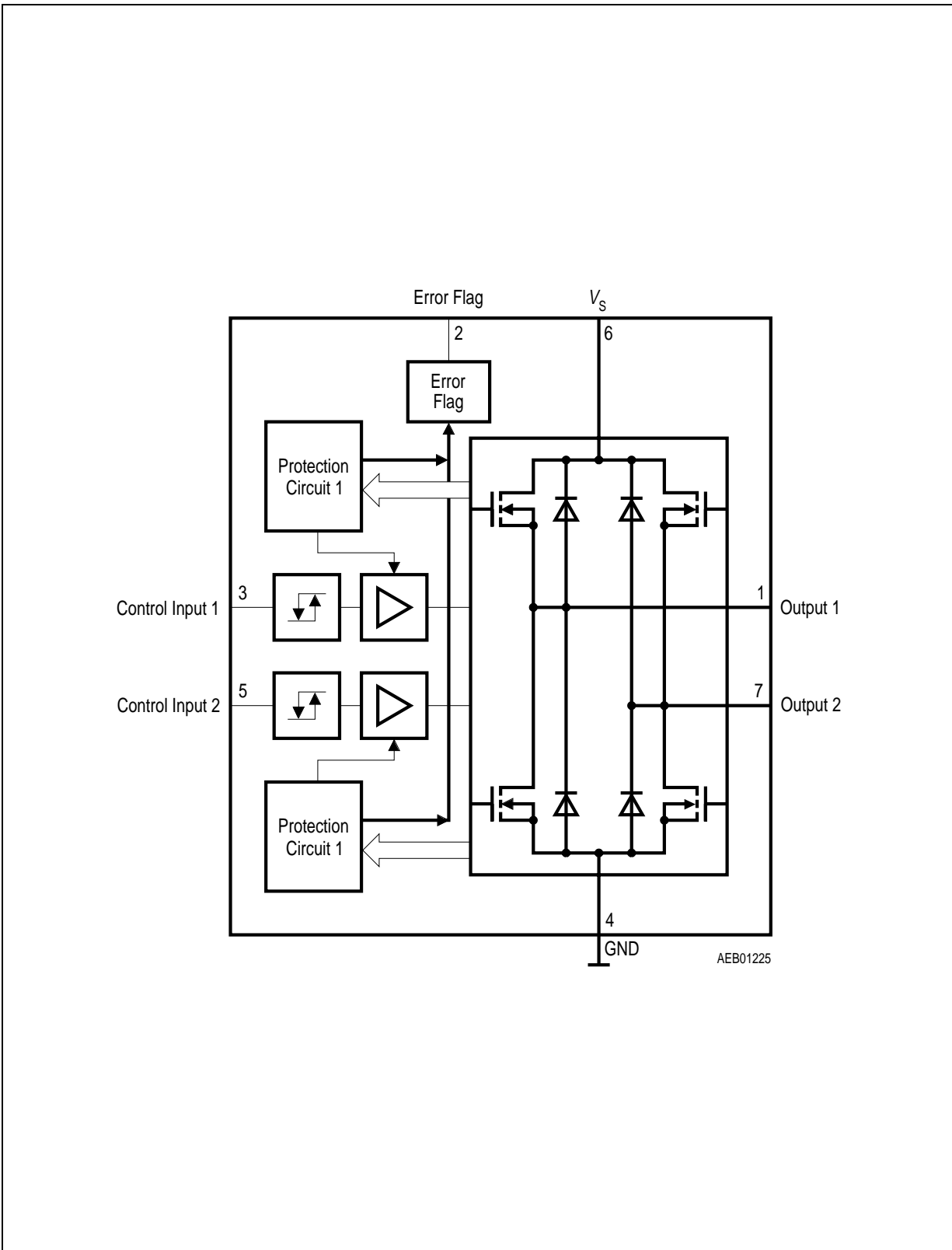


Figure 2 Block Diagram

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

| Parameter | Symbol | Limit Values | | Unit | Remarks |
|-----------|--------|--------------|------|------|---------|
| | | min. | max. | | |

Voltage

| | | | | | |
|----------------------------|------------|-------|----|---|---------------------------|
| Supply voltage | V_S | - 0.3 | 40 | V | - |
| Supply voltage | V_S | - 1 | - | V | $t < 500$ ms; $I_S < 5$ A |
| Logic input voltage | $V_{I1,2}$ | - 0.3 | 7 | V | $V_S = 0 - 40$ V |
| Diagnostics output voltage | V_{EF} | - 0.3 | 7 | V | - |

Current

| | | | | | |
|------------------------------|-----------|------|-----|----|-------------------|
| Free-wheeling current | I_F | - 4 | 4 | A | $T_j \leq 150$ °C |
| Output current ¹⁾ | I_Q | - 4 | 4 | A | - |
| Junction temperature | T_j | - 40 | 150 | °C | - |
| Storage temperature | T_{stg} | - 50 | 150 | °C | - |

Thermal Resistance

| | | | | | |
|------------------|-------------|---|----|-----|---|
| Junction-case | $R_{th,jc}$ | - | 4 | K/W | - |
| Junction-ambient | $R_{th,ja}$ | - | 65 | K/W | - |

Operating Range

| | | | | | |
|-----------------------------------|------------|-------|-----|-----|---|
| Supply voltage | V_S | 6 | 24 | V | - |
| Logic input voltage | $V_{I1,2}$ | - 0.3 | 7 | V | - |
| Switching frequency ²⁾ | f | - | 1 | kHz | - |
| Junction temperature | T_j | - 40 | 150 | °C | - |

1) During overload condition currents higher than 4 A can dynamically occur, before the device shuts off, without any damaging the device.

2) Depending on load higher frequencies are possible.

Electrical Characteristics $V_S = 6$ to 18 V; $T_j = -40$ to 150 °C

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

General

| | | | | | | |
|-------------------|----------|---|-----|-----|----|------------------------------|
| Quiescent current | I_q | – | – | 10 | mA | $I_L = 0$ A |
| Turn-ON delay | t_{d1} | – | 10 | 20 | µs | Input to output |
| Turn-OFF delay | t_{d2} | – | – | 10 | µs | Input to output |
| Turn-ON time | t_r | – | 10 | 20 | µs | $I_Q = 2.5$ A; cf diagram |
| Turn-OFF time | t_f | – | – | 10 | µs | $I_Q = 2.5$ A; cf diagram |
| Undervoltage | V_S | – | 5.5 | 5.9 | V | $I_{C ON}$ |
| Undervoltage | V_S | – | 4.5 | 5.2 | V | $I_{C OFF}$ |

Logic

| | | | | | | |
|-----------------------------|--------------|------|-----|-----|----|----------------|
| Control inputs | | | | | | |
| H-input voltage | V_{IH} | 2.8 | – | – | V | – |
| L-input voltage | V_{IL} | – | – | 1.2 | V | – |
| Hysteresis of input voltage | ΔV_I | 0.4 | 0.8 | 1.2 | V | – |
| H-input current | I_I | – 2 | – | 2 | µA | $V_I = V_{IH}$ |
| L-input current | I_I | – 10 | – 4 | 0 | µA | $V_I = V_{IL}$ |
| Diagnosis output | | | | | | |
| Delay time | t_d | 20 | 40 | 60 | µs | – |
| L-output voltage | V_{EF} | – | – | 0.4 | V | $I = 3$ mA |
| Leakage current | I_{RD} | – | – | 10 | µA | – |
| Error detection | | | | | | |
| Switching threshold U | V_{EH} | 2 | 2.7 | 3.5 | V | Error low |
| Switching threshold L | V_{EL} | 2 | 2.7 | 3.5 | V | Error high |
| Overcurrent 1 | I_{F1} | 3 | 4 | 5 | A | Error low |

Electrical Characteristics (cont'd)

$V_s = 6 \text{ to } 18 \text{ V}; T_j = -40 \text{ to } 150 \text{ }^\circ\text{C}$

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

Outputs

| | | | | | | |
|-----------------------|----------|---|---|------|----------|---|
| RDSONU | — | — | — | 0.4 | Ω | $V_s > 6 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ ¹⁾ |
| RDSONU | — | — | — | 0.65 | Ω | $V_s > 6 \text{ V}; T_j = 150 \text{ }^\circ\text{C}$ ¹⁾ |
| RDSONL | — | — | — | 0.4 | Ω | $V_s > 6 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ ¹⁾ |
| RDSONL | — | — | — | 0.65 | Ω | $V_s > 6 \text{ V}; T_j = 150 \text{ }^\circ\text{C}$ ¹⁾ |
| Diode forward voltage | V_{FU} | — | — | 1.5 | V | $I_F = 3 \text{ A}$ |
| Diode forward voltage | V_{FL} | — | — | 1.5 | V | $I_F = 3 \text{ A}$ |

¹⁾ Values for RDSON are for $t > 100 \mu\text{s}$ after applying + V_s .

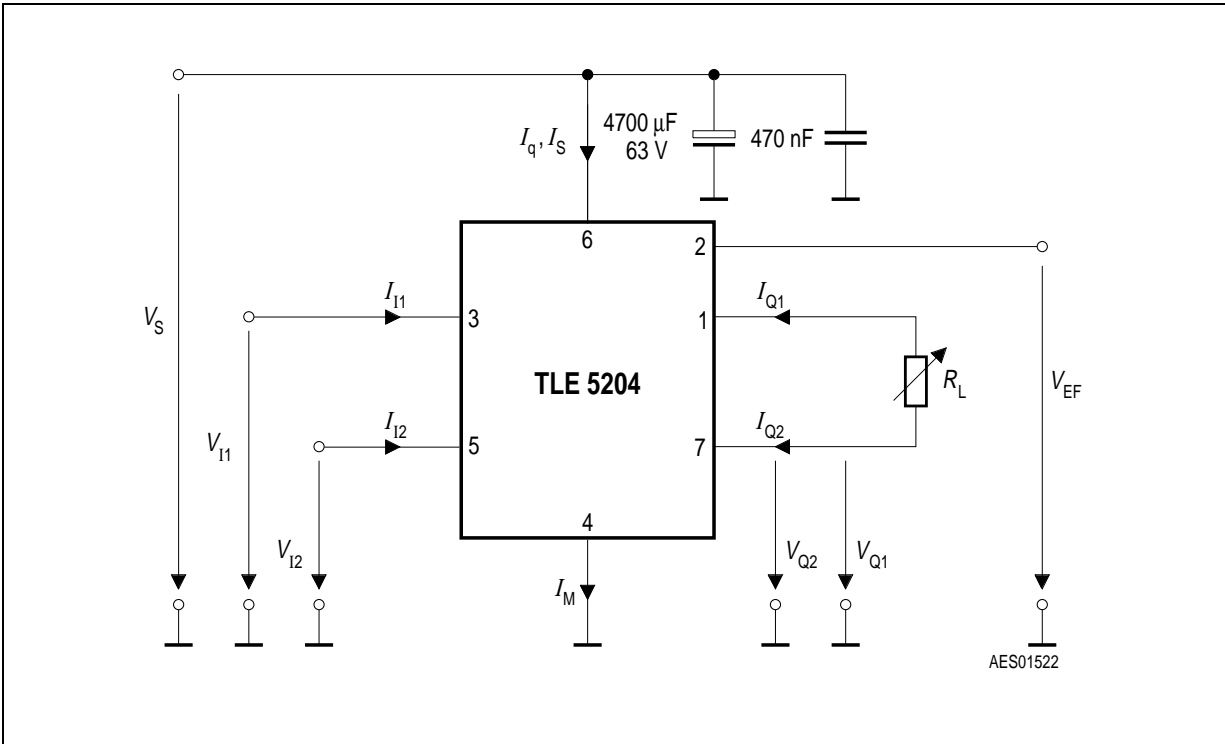


Figure 3 Test Circuit

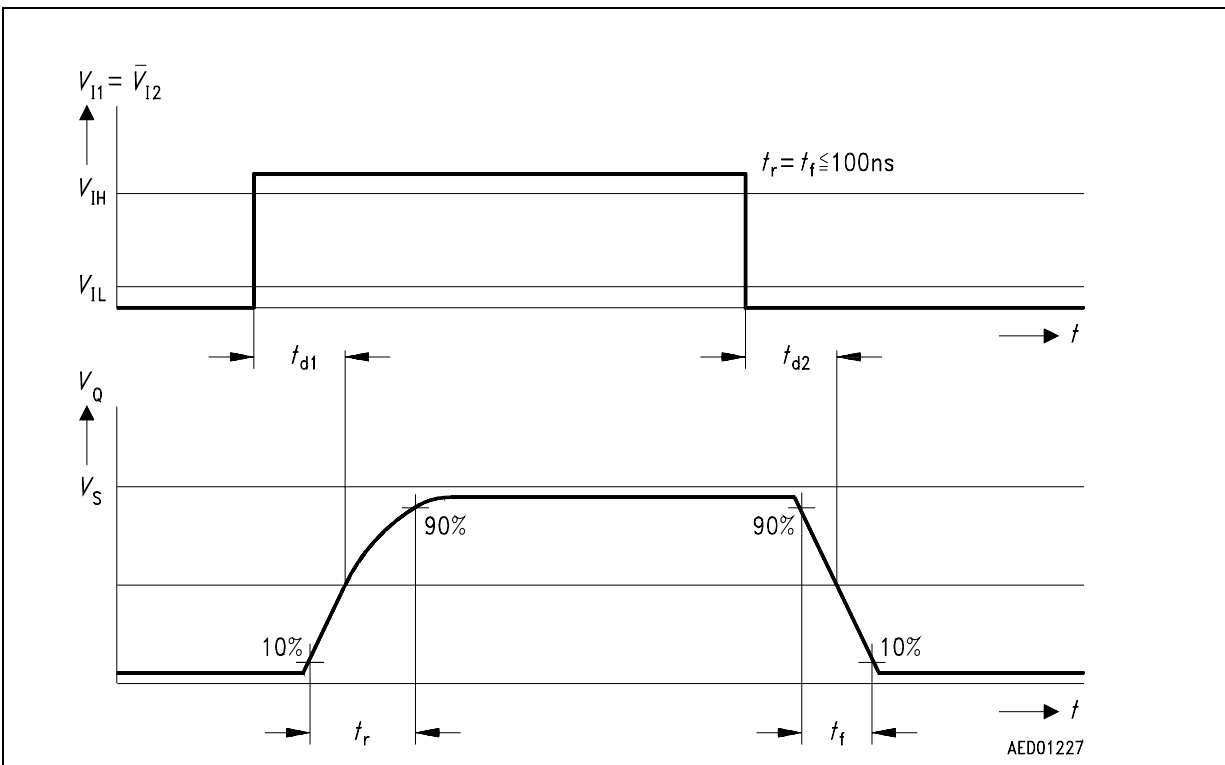


Figure 4 Timing Diagram

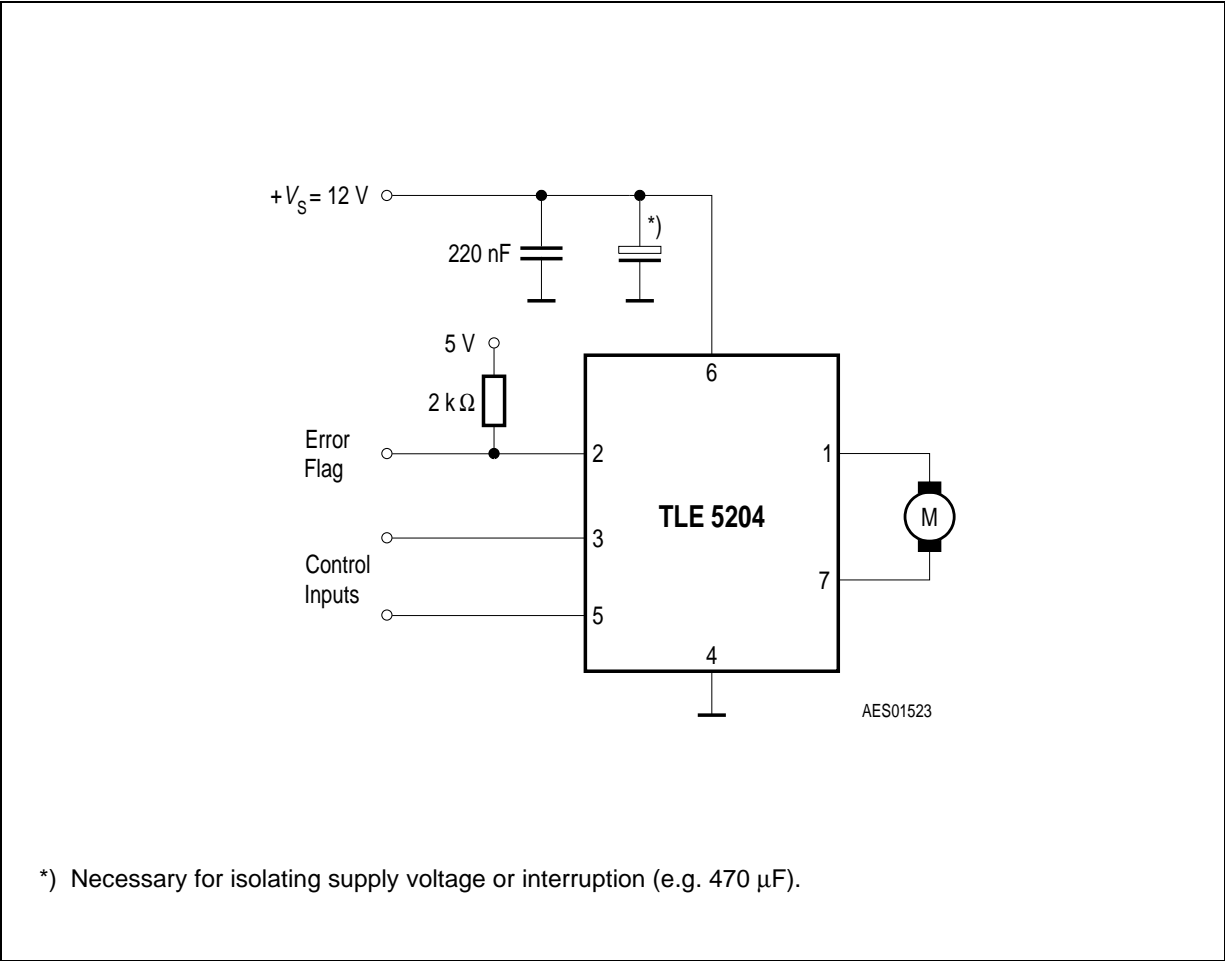
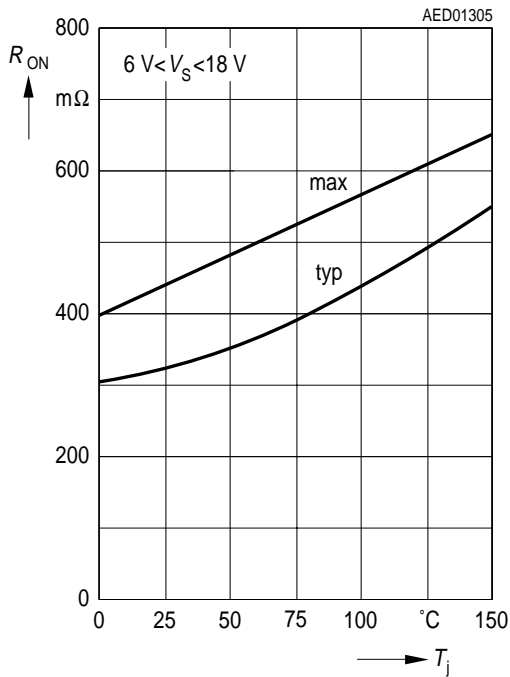


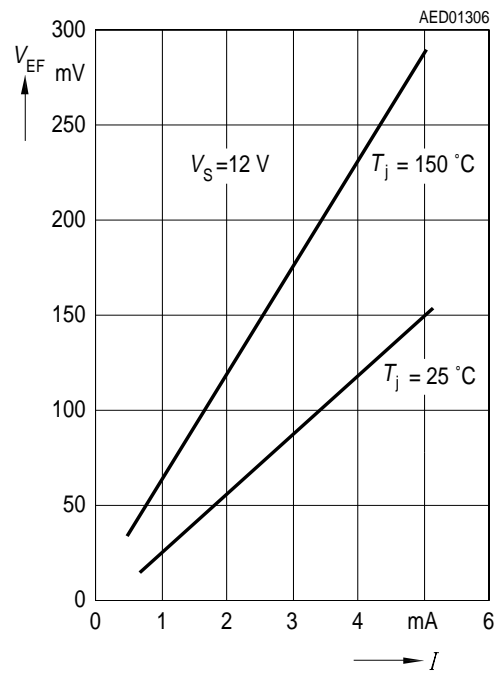
Figure 5 Application Circuit

Diagrams

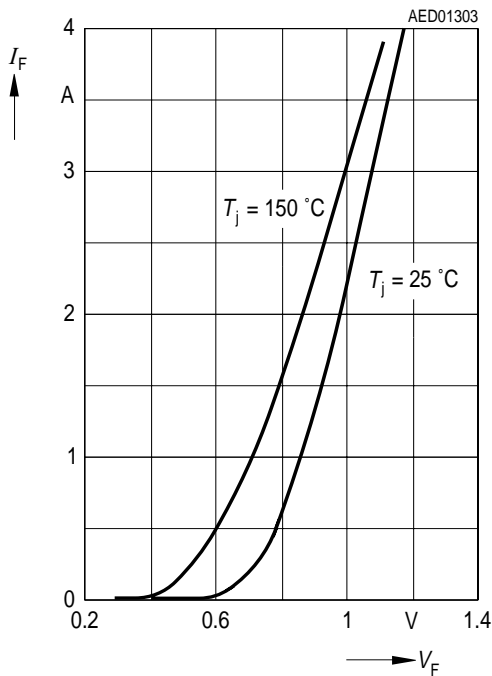
R_{ON} Resistance of Output Stage over Temperature



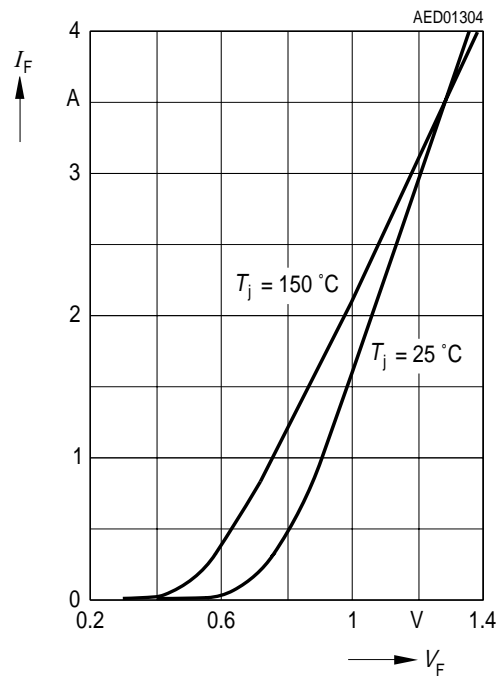
Output Voltage on Diagnostics Output versus Current



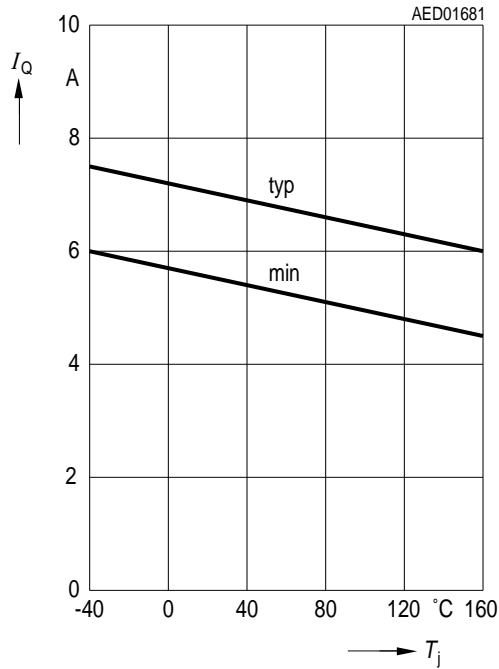
Forward Current of Upper Free-Wheeling Diode versus Voltage



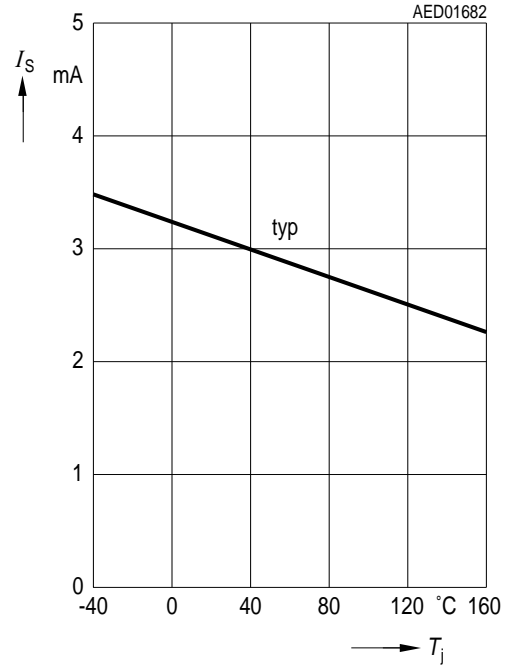
Forward Current of Lower Free-Wheeling Diode versus Voltage



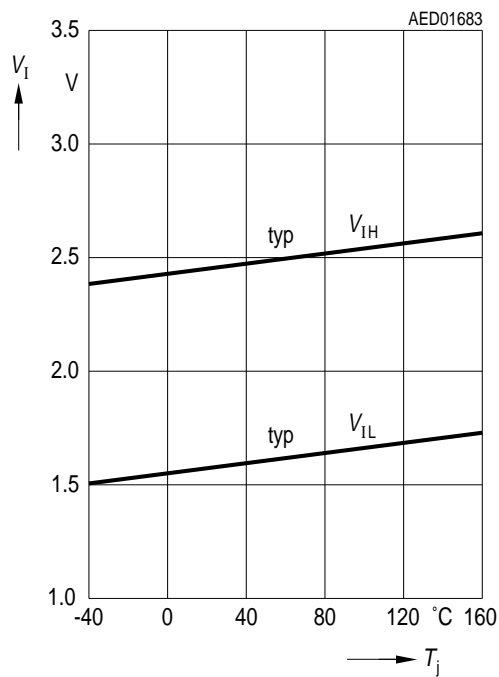
Overcurrent Threshold versus Temperature



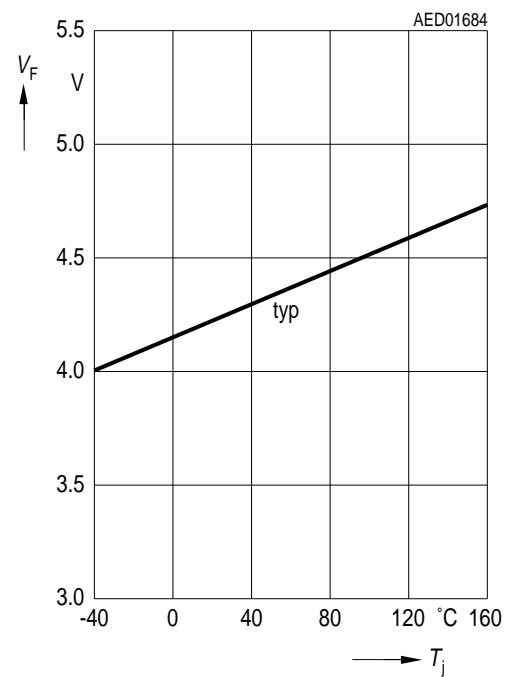
Quiescent Current versus Temperature



Input Threshold versus Temperature



Switching Threshold $V_{EL, EH}$ versus Temperature



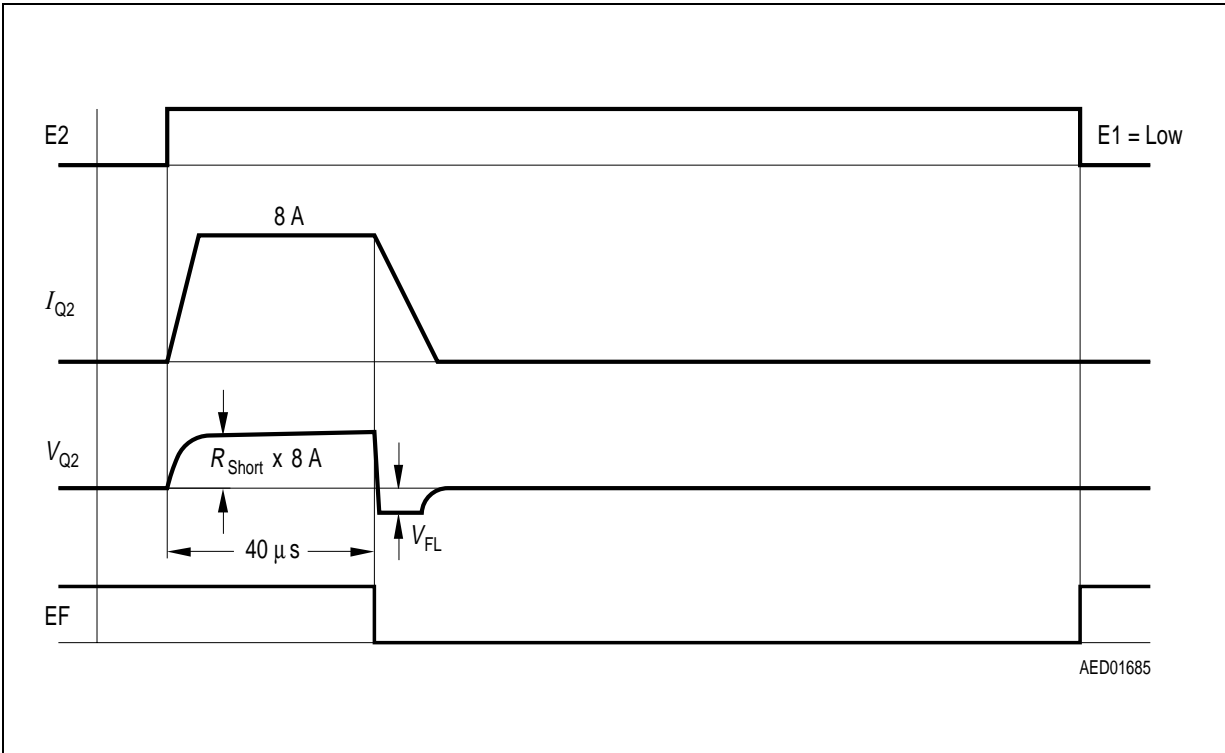


Figure 6 Timing Diagram for Output Shorted to Ground

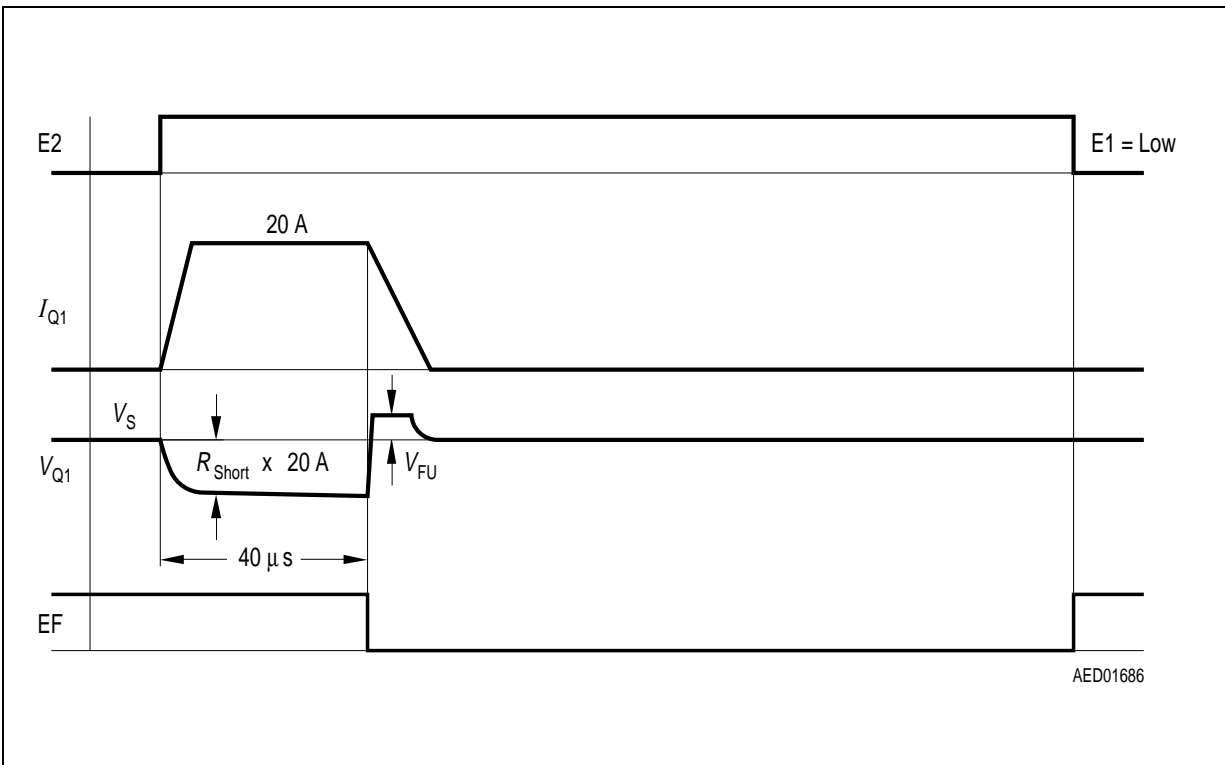
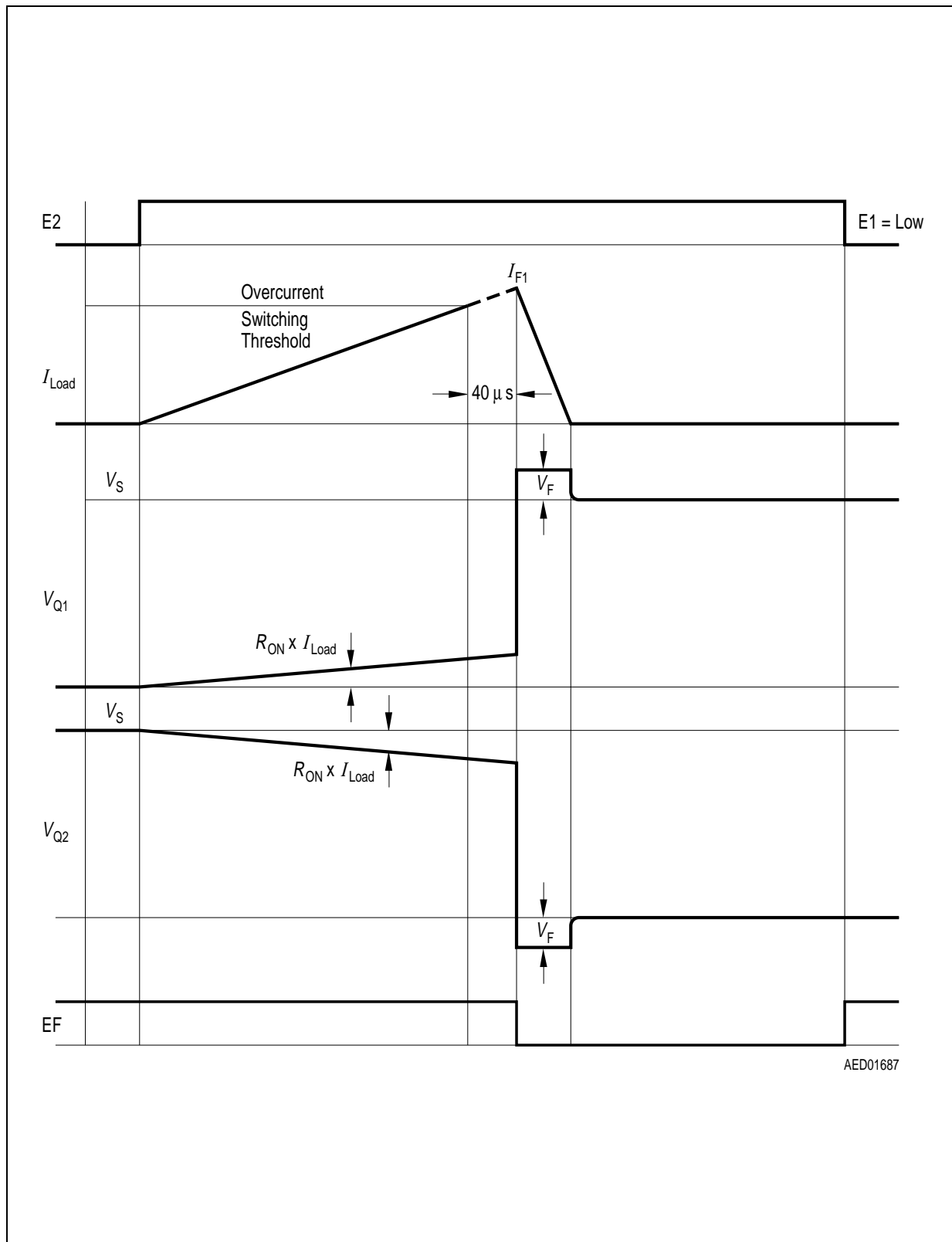


Figure 7 Timing Diagram for Output Shorted to V_s

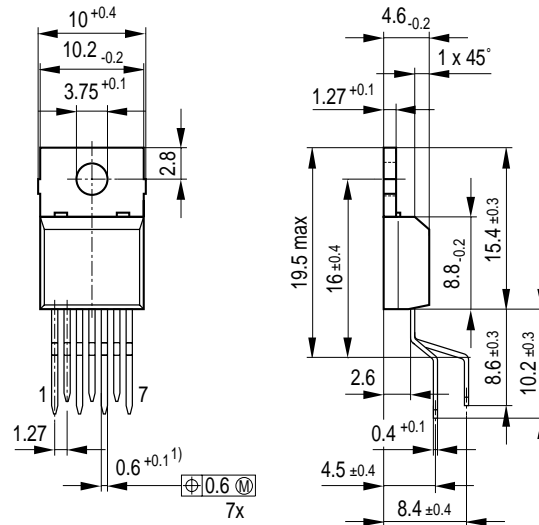


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Figure 8 Timing Diagram for Overcurrent

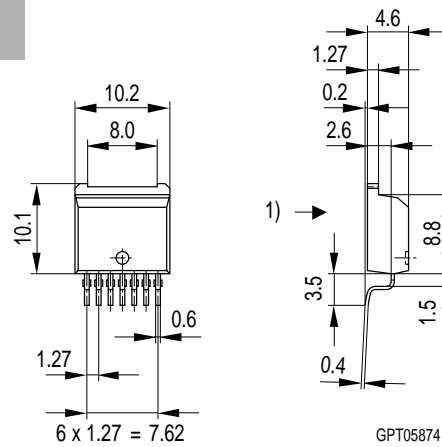
Package Outlines

P-TO220-7-1
(Plastic Transistor Single Outline)



- 1) $0.75_{-0.15}$ at dam bar (max 1.8 from body)
 - 1) $0.75_{-0.15}$ im Dichtstegbereich (max 1.8 vom Körper)
- GPT05108

P-TO220-7-8 (SMD)
(Plastic Transistor Single Outline)



- 1) shear and punch direction burr free surface
- GPT05874

Sorts of Packing

Package outlines for tubes, trays etc. are contained in our Data Book "Package Information".

SMD = Surface Mounted Device

Dimensions in mm