

1 Overview

1.1 Features

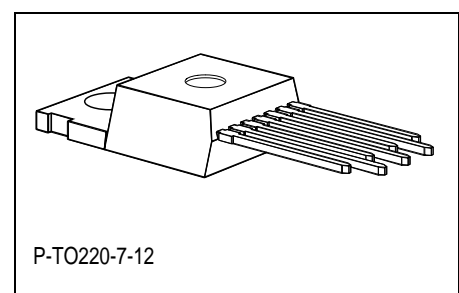
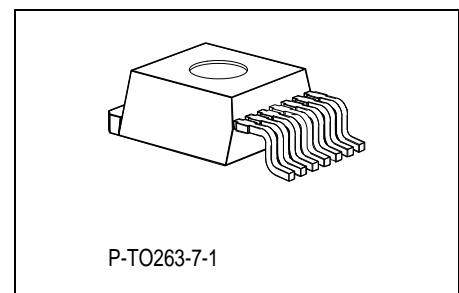
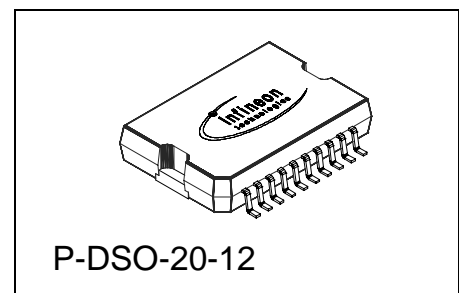
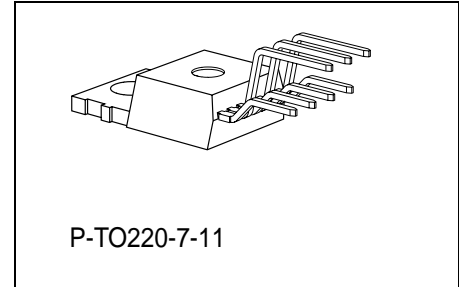
- Delivers up to 5 A continuous 6 A peak current
- Optimized for DC motor management applications
- Operates at supply voltages up to 40 V
- Very low $R_{DS\ ON}$; typ. 200 m Ω @ 25 °C per switch
- Output full short circuit protected
- Overtemperature protection with hysteresis and diagnosis
- Short circuit and open load diagnosis with open drain error flag
- Undervoltage lockout
- CMOS/TTL compatible inputs with hysteresis
- No crossover current
- Internal freewheeling diodes
- Wide temperature range; $-40\text{ }^{\circ}\text{C} < T_j < 150\text{ }^{\circ}\text{C}$

| Type | Ordering Code | Package |
|--------------|---------------|--------------|
| TLE 5205-2 | Q67000-A9283 | P-TO220-7-11 |
| TLE 5205-2GP | Q67006-A9237 | P-DSO-20-12 |
| TLE 5205-2G | Q67006-A9325 | P-TO263-7-1 |
| TLE 5205-2S | Q67000-A9324 | P-TO220-7-12 |

Description

The TLE 5205-2 is an integrated power H-bridge with DMOS output stages for driving DC-Motors. The part is built using the Infineon multi-technology process SPT[®] which allows bipolar and CMOS control circuitry plus DMOS power devices to exist on the same monolithic structure.

Operation modes forward (cw), reverse (ccw), brake and high impedance are invoked from just two control pins with TTL/CMOS compatible levels. The combination of an extremely low $R_{DS\ ON}$ and the use of a power IC package with low thermal resistance and high thermal capacity helps to minimize system power dissipation. A blocking capacitor at the supply voltage is the only external circuitry due to the integrated freewheeling diodes.



1.2 Pin Configuration (top view)

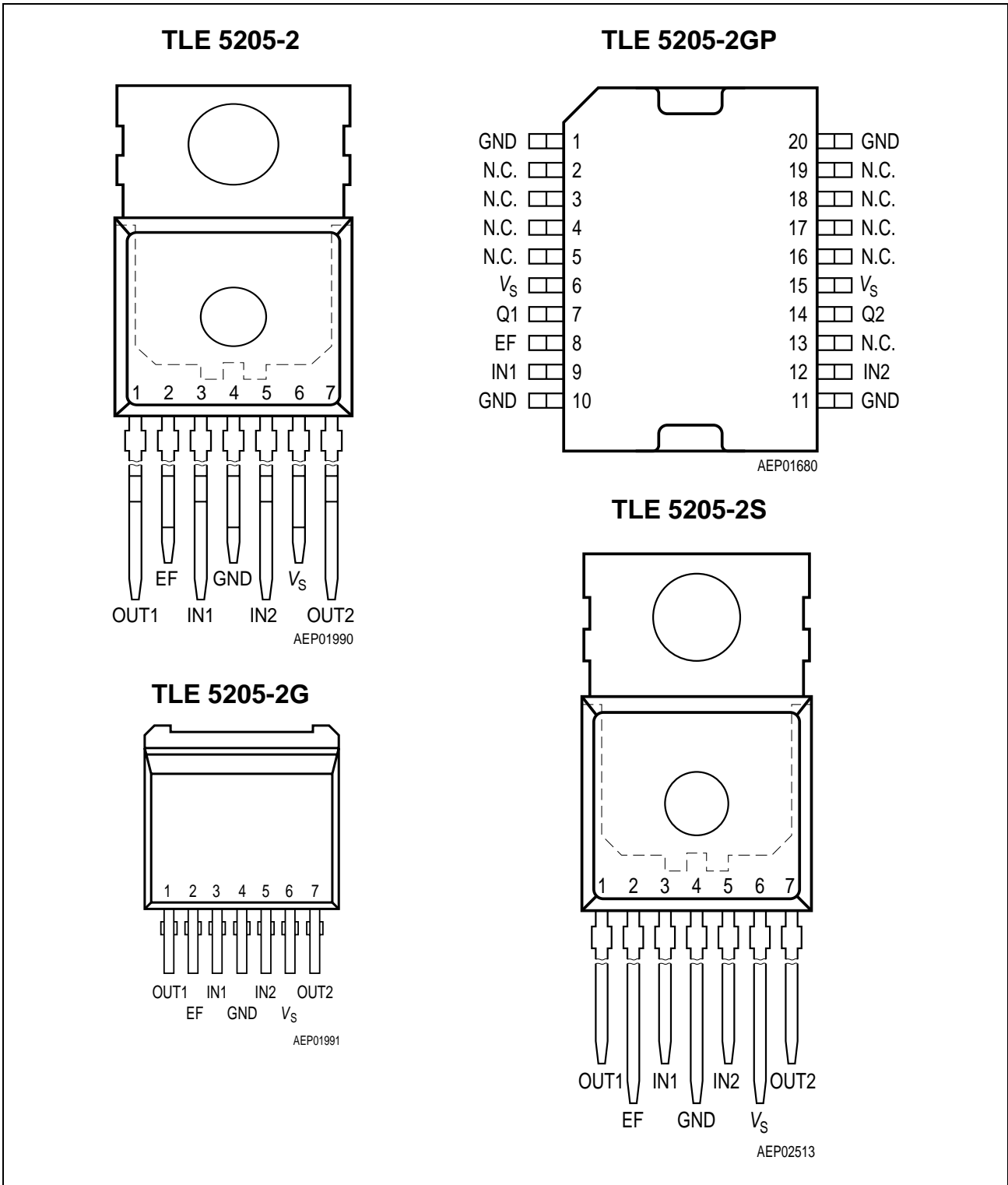


Figure 1

1.3 Pin Definitions and Functions

| Pin No. P-TO220 | Pin No. P-DSO | Symbol | Function |
|--------------------|----------------------------------|--------|--|
| 1 | 7 | OUT1 | Output of Channel 1; Short-circuit protected; integrated freewheeling diodes for inductive loads. |
| 2 | 8 | EF | Error Flag; TTL/CMOS compatible output for error detection; (open drain) |
| 3 | 9 | IN1 | Control Input 1; TTL/CMOS compatible |
| 4 | 1, 10, 11, 20 | GND | Ground; internally connected to tab |
| 5 | 12 | IN2 | Control Input 2; TTL/CMOS compatible |
| 6 | 6, 15 | V_S | Supply Voltage; block to GND |
| 7 | 14 | OUT2 | Output of Channel 2; Short-circuit protected; integrated freewheeling diodes for inductive loads. |
| – | 2, 3, 4, 5, 16, 17, 18, 19 | N.C. | Not Connected |

1.4 Functional Block Diagram

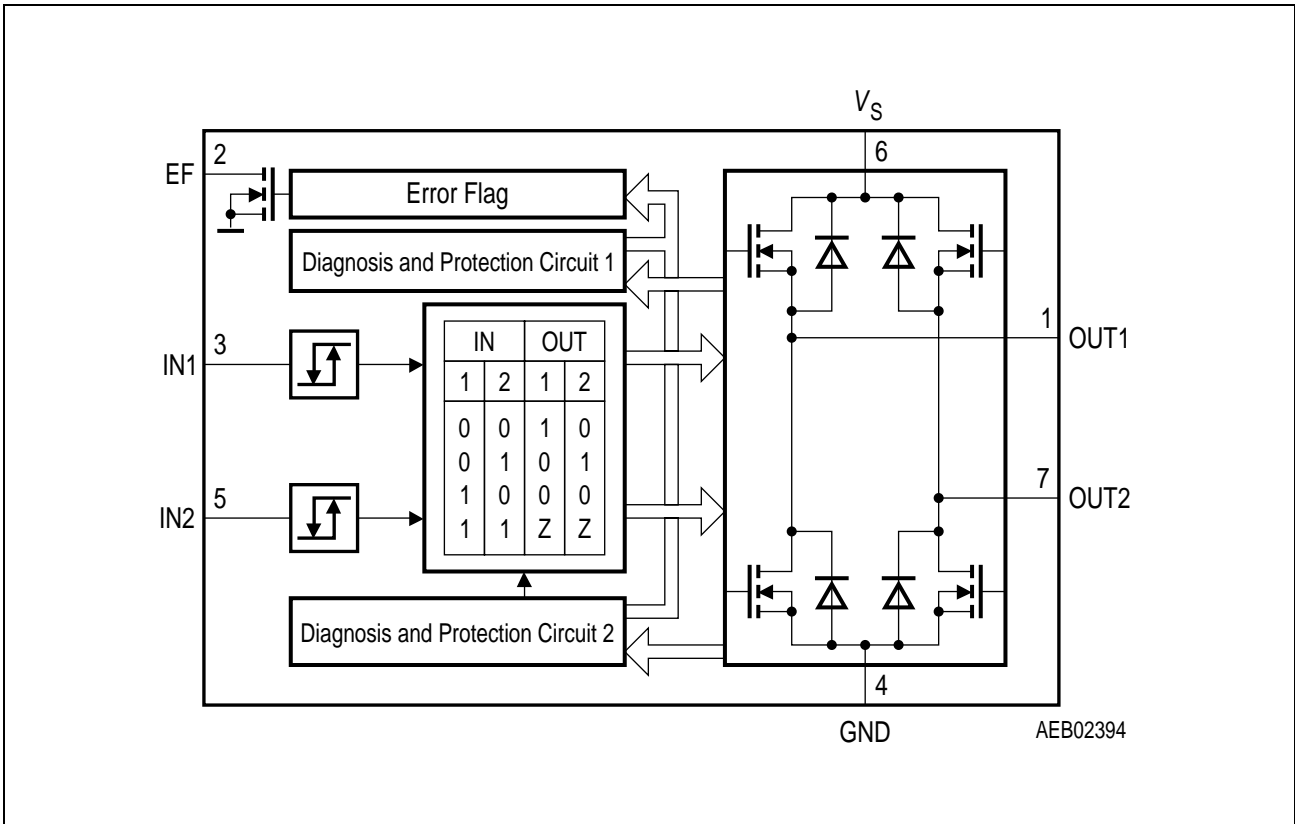


Figure 2 Block Diagram

1.5 Circuit Description

Input Circuit

The control inputs consist of TTL/CMOS-compatible schmitt-triggers with hysteresis. Buffer amplifiers are driven by this stages.

Output Stages

The output stages consist of a DMOS H-bridge. Integrated circuits protect the outputs against short-circuit to ground and to the supply voltage. Positive and negative voltage spikes, which occur when switching inductive loads, are limited by integrated freewheeling diodes.

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.

1.6 Input Logic Truth Table

Functional Truth Table

| IN1 | IN2 | OUT1 | OUT2 | Comments |
|-----|-----|------|------|--|
| L | L | H | L | Motor turns clockwise |
| L | H | L | H | Motor turns counterclockwise |
| H | L | L | L | Brake; both low side transistors turned-ON |
| H | H | Z | Z | Open circuit detection |

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 |
| Z | High side transistor is turned-OFF Low side transistor is turned-OFF |

1.7 Monitoring Functions

Undervoltage lockout (UVLO):

When V_S reaches the switch on voltage $V_{S\text{ ON}}$ the IC becomes active with a hysteresis. All output transistors are switched off if the supply voltage V_S drops below the switch off value $V_{S\text{ OFF}}$.

1.8 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 50 μs and setting of the error flag EF to ground. Changing the inputs resets the error flag.

a. Output Shorted to Ground Detection

If a high side transistor is switched on and its output is shorted to ground, the output current is internally limited. After a delay of 50 μs all outputs will be switched-OFF and the error flag is set.

b. Output Shorted to + V_S Detection

If a low side transistor is switched on and its output is shorted to the supply voltage, the output current is internally limited. After a delay of 50 μs all outputs will be switched-OFF and the error flag is set.

c. Overload Detection

An internal circuit detects if the current through the low side transistor exceeds the trippoint I_{SDL} . In this case all outputs are turned off after 50 μs and the error flag is set.

d. Overtemperature Protection

At a junction temperature higher than 150 °C the thermal shutdown turns-OFF, all four output stages commonly and the error flag is set with a delay.

e. Open Load Detection

The output Q1 has a 10 k Ω pull-up resistor and the output Q2 has a 10 k Ω pull-down resistor. If E1 and E2 are high, all output power stages are turned-OFF. In case of no load between Q1 and Q2 the output voltage Q1 is V_S and Q2 is ground. This state will be detected by two comparators and an error flag will be set after a delay time of 50 μs . Changing the inputs resets the error flip flop.

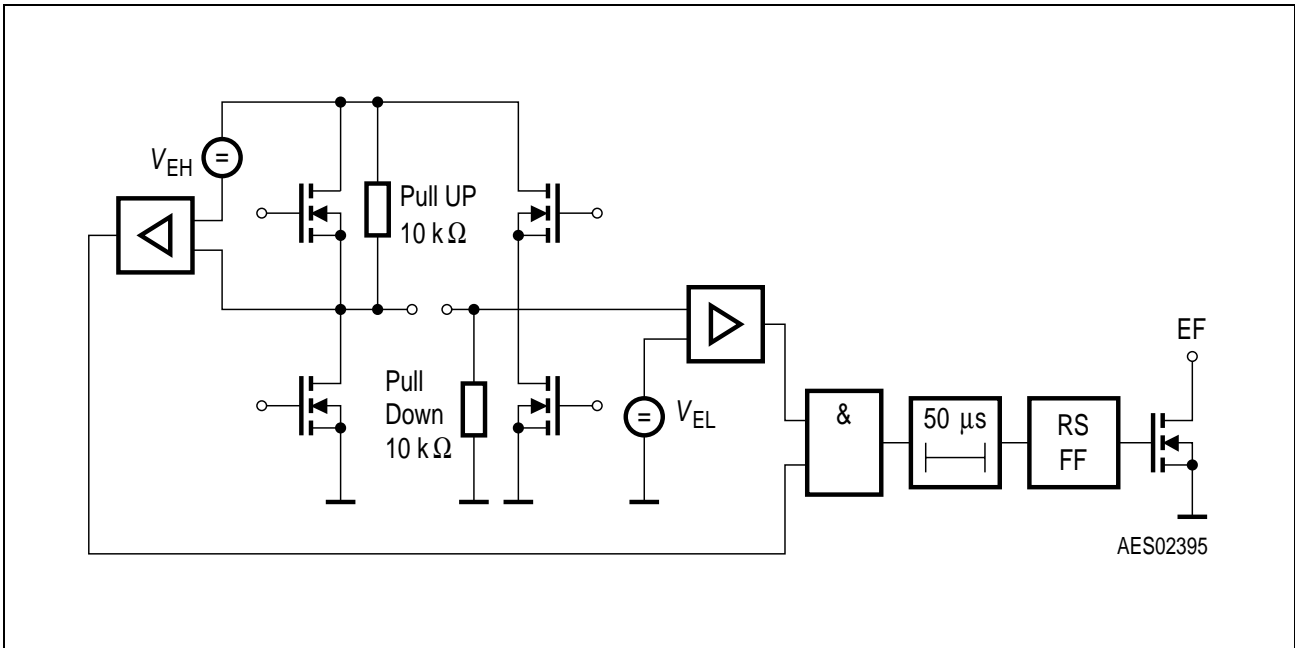


Figure 3 Simplified Schematic for Open Load Detection

2 Diagnosis

Various errors as listed in the table “Diagnosis” are detected. Short circuits and overload result in turning off the output stages after a delay t_{dSD} and setting the error flag simultaneously [EF = L]. Changing the inputs to a state where the fault is not detectable resets the error flag (input toggling) with the exception of short circuit from OUT1 to OUT2 (load short circuit).

| Flag | IN1 | IN2 | OUT1 | OUT2 | EF | Remarks | Nr. |
|------------------------------------|-----|-----|---------|---------|----|----------------|-----|
| Open circuit between OUT1 and OUT2 | 0 | 0 | H | L | 1 | Not detectable | 1 |
| | 0 | 1 | L | H | 1 | Not detectable | 2 |
| | 1 | 0 | L | L | 1 | Not detectable | 3 |
| | 1 | 1 | Z | Z | 0 | | 4 |
| Short circuit from OUT1 to OUT2 | 0 | 0 | $V_s/2$ | $V_s/2$ | 0 | | 5 |
| | 0 | 1 | $V_s/2$ | $V_s/2$ | 0 | | 6 |
| | 1 | 0 | L | L | 1 | Not detectable | 7 |
| | 1 | 1 | Z | Z | 1 | Not detectable | 8 |
| Short circuit from OUT1 to GND | 0 | 0 | GND | L | 0 | | 9 |
| | 0 | 1 | GND | H | 1 | Not detectable | 10 |
| | 1 | 0 | GND | L | 1 | Not detectable | 11 |
| | 1 | 1 | GND | L | 1 | Not detectable | 12 |
| Short circuit from OUT2 to GND | 0 | 0 | H | GND | 1 | Not detectable | 13 |
| | 0 | 1 | L | GND | 0 | | 14 |
| | 1 | 0 | L | GND | 1 | Not detectable | 15 |
| | 1 | 1 | L | GND | 1 | Not detectable | 16 |
| Short circuit from OUT1 to V_s | 0 | 0 | V_s | L | 1 | Not detectable | 17 |
| | 0 | 1 | V_s | H | 0 | | 18 |
| | 1 | 0 | V_s | H | 0 | | 19 |
| | 1 | 1 | V_s | H | 1 | Not detectable | 20 |
| Short circuit from OUT2 to V_s | 0 | 0 | H | V_s | 0 | | 21 |
| | 0 | 1 | L | V_s | 1 | Not detectable | 22 |
| | 1 | 0 | H | V_s | 0 | | 23 |
| | 1 | 1 | H | V_s | 1 | Not detectable | 24 |
| Overtemperature or undervoltage | 0 | 0 | Z | Z | 0 | | 25 |
| | 0 | 1 | Z | Z | 0 | | 26 |
| | 1 | 0 | Z | Z | 0 | | 27 |
| | 1 | 1 | Z | Z | 0 | | 28 |

IN: 0 = Logic LOW OUT: Z = Output in tristate condition EF: 1 = No error
 1 = Logic HIGH = $V_s/2$ due to internal Pull-up/down resistors 0 = Error
 L = Output in sink condition
 H = Output in source condition

Electrical Characteristics
3 Electrical Characteristics
3.1 Absolute Maximum Ratings

$$-40\text{ }^{\circ}\text{C} < T_j < 150\text{ }^{\circ}\text{C}$$

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

Voltages

| | | | | | |
|----------------------------|-------------|-------|----|---|---------------------------------------|
| Supply voltage | V_S | - 0.3 | 40 | V | - |
| | | - 1 | 40 | V | $t < 0.5\text{ s}; I_S > -5\text{ A}$ |
| Logic input voltage | $V_{IN1,2}$ | - 0.3 | 7 | V | $0\text{ V} < V_S < 40\text{ V}$ |
| Diagnostics output voltage | V_{EF} | - 0.3 | 7 | V | - |

Currents of DMOS-Transistors and Freewheeling Diodes

| | | | | | |
|------------------------|--------------|-----|---|---|--|
| Output current (cont.) | $I_{OUT1,2}$ | - 5 | 5 | A | - |
| Output current (peak) | $I_{OUT1,2}$ | - 6 | 6 | A | $t_p < 100\text{ ms}; T = 1\text{ s}$ |
| Output current (peak) | $I_{OUT1,2}$ | - | - | A | $t_p < 50\text{ }\mu\text{s}; T = 1\text{ s};$ internally limited; see overcurrent |

Temperatures

| | | | | | |
|----------------------|-----------|------|-----|--------------------|---|
| Junction temperature | T_j | - 40 | 150 | $^{\circ}\text{C}$ | - |
| Storage temperature | T_{stg} | - 50 | 150 | $^{\circ}\text{C}$ | - |

Thermal Resistances

| | | | | | |
|------------------|------------|---|----|-----|---------------------------------|
| Junction case | R_{thjC} | - | 3 | K/W | P-TO220-7-11/12, P-TO263-7-1 |
| Junction ambient | R_{thjA} | - | 65 | K/W | P-TO220-7-11/12 |
| | | - | 75 | K/W | P-TO263-7-1 |
| Junction case | R_{thjC} | - | 5 | K/W | P-DSO-20-12 |
| Junction ambient | R_{thjA} | - | 50 | K/W | P-DSO-20-12 |

Note: Maximum ratings are absolute ratings; exceeding any one of these values may cause irreversible damage to the integrated circuit.

Electrical Characteristics
3.2 Operating Range

| Parameter | Symbol | Limit Values | | Unit | Remarks |
|---------------------------|-------------|--------------|---------------|------|---------------------------------------|
| | | min. | max. | | |
| Supply voltage | V_S | $V_{UV\ ON}$ | 40 | V | After V_S rising above $V_{UV\ ON}$ |
| Supply voltage increasing | | - 0.3 | $V_{UV\ ON}$ | V | Outputs in tristate condition |
| Supply voltage decreasing | | - 0.3 | $V_{UV\ OFF}$ | V | |
| Logic input voltage | $V_{IN1,2}$ | - 0.3 | 7 | V | - |
| Junction temperature | T_j | - 40 | 150 | °C | - |

3.3 Electrical Characteristics
 $6\text{ V} < V_S < 18\text{ V}$; $IN1 = IN2 = \text{HIGH}$
 $I_{OUT1,2} = 0\text{ A}$ (No load); $-40\text{ °C} < T_j < 150\text{ °C}$; unless otherwise specified

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

Current Consumption

| | | | | | | |
|-------------------|-------|---|---|----|----|---|
| Quiescent current | I_S | - | - | 10 | mA | $IN1 = IN2 = \text{LOW}$; $V_S = 13.2\text{ V}$ |
|-------------------|-------|---|---|----|----|---|

Under Voltage Lockout

| | | | | | | |
|-----------------------|---------------|-----|-----|-----|---|----------------------------|
| UV-Switch-ON voltage | $V_{UV\ ON}$ | - | 5.3 | 6 | V | V_S increasing |
| UV-Switch-OFF voltage | $V_{UV\ OFF}$ | 3.5 | 4.7 | 5.6 | V | V_S decreasing |
| UV-ON/OFF-Hysteresis | $V_{UV\ HY}$ | 0.2 | 0.6 | - | V | $V_{UV\ ON} - V_{UV\ OFF}$ |

Electrical Characteristics
3.3 Electrical Characteristics (cont'd)
 $6\text{ V} < V_S < 18\text{ V}$; IN1 = IN2 = HIGH

 $I_{\text{OUT}1,2} = 0\text{ A}$ (No load); $-40\text{ }^\circ\text{C} < T_j < 150\text{ }^\circ\text{C}$; unless otherwise specified

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

Outputs OUT1, 2
Static Drain-Source-On Resistance

| | | | | | | |
|--|----------------------|---|-----|------|----|---|
| Source $I_{\text{OUT}} = -3\text{ A}$ | $R_{\text{DS ON H}}$ | – | 220 | 350 | mΩ | $6\text{ V} < V_S < 18\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ |
| | | | – | 500 | mΩ | $6\text{ V} < V_S < 18\text{ V}$ |
| | | | 350 | 500 | mΩ | $V_{\text{S ON}} < V_S \leq 6\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ |
| | | | – | 800 | mΩ | $V_{\text{S ON}} < V_S \leq 6\text{ V}$ |
| Sink $I_{\text{OUT}} = 3\text{ A}$ | $R_{\text{DS ON L}}$ | – | 230 | 350 | mΩ | $6\text{ V} < V_S < 18\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ |
| | | | – | 500 | mΩ | $6\text{ V} < V_S < 18\text{ V}$ |
| | | | 400 | 600 | mΩ | $V_{\text{S ON}} < V_S \leq 6\text{ V}$ $T_j = 25\text{ }^\circ\text{C}$ |
| | | | – | 1000 | mΩ | $V_{\text{S ON}} < V_S \leq 6\text{ V}$ |

Note: Values of $R_{\text{DS ON}}$ for $V_{\text{S ON}} < V_S \leq 6\text{ V}$ are guaranteed by design.

Overcurrent

| | | | | | | |
|---------------------------|-------------------|----|----|----|----|-----------------------------------|
| Source shutdown trippoint | $-I_{\text{SDH}}$ | – | – | 10 | A | $T_j = -40\text{ }^\circ\text{C}$ |
| | | – | 8 | – | A | $T_j = 25\text{ }^\circ\text{C}$ |
| | | 6 | – | – | A | $T_j = 150\text{ }^\circ\text{C}$ |
| Sink shutdown trippoint | I_{SDL} | – | – | 10 | A | $T_j = -40\text{ }^\circ\text{C}$ |
| | | – | 8 | – | A | $T_j = 25\text{ }^\circ\text{C}$ |
| | | 6 | – | – | A | $T_j = 150\text{ }^\circ\text{C}$ |
| Shutdown delay time | t_{dSD} | 25 | 50 | 80 | μs | – |

Electrical Characteristics
3.3 Electrical Characteristics (cont'd)
 $6\text{ V} < V_S < 18\text{ V}; \text{IN1} = \text{IN2} = \text{HIGH}$
 $I_{\text{OUT1,2}} = 0\text{ A (No load)}; -40\text{ }^\circ\text{C} < T_j < 150\text{ }^\circ\text{C}; \text{ unless otherwise specified}$

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

Short Circuit Current Limitation

| | | | | | | |
|----------------|-------------------|---|---|----|---|----------------------|
| Source current | $-I_{\text{SCH}}$ | – | – | 20 | A | $t < t_{\text{dSD}}$ |
| Sink current | I_{SCL} | – | – | 15 | A | $t < t_{\text{dSD}}$ |

Open Circuit

| | | | | | | |
|-----------------------|-------------------|----|-----|----|---------------|---|
| Pull up resistor | R_{UP} | 5 | 10 | 20 | k Ω | – |
| Pull down resistor | R_{DOWN} | 5 | 10 | 20 | k Ω | – |
| Switching threshold H | V_{EH} | 2 | 2.5 | 3 | V | – |
| Switching threshold L | V_{EL} | 2 | 2.4 | 3 | V | – |
| Detection delay time | t_{dSD} | 25 | 50 | 80 | μs | – |

Output Delay Times (Device Active for $t > 1\text{ ms}$)

| | | | | | | |
|------------|----------------------|---|----|----|---------------|--|
| Source ON | $t_{\text{d ON H}}$ | – | 10 | 20 | μs | $I_{\text{OUT}} = -3\text{ A}$ resistive load |
| Sink ON | $t_{\text{d ON L}}$ | – | 10 | 20 | μs | $I_{\text{OUT}} = 3\text{ A}$ resistive load |
| Source OFF | $t_{\text{d OFF H}}$ | – | 2 | 5 | μs | $I_{\text{OUT}} = -3\text{ A}$ resistive load |
| Sink OFF | $t_{\text{d OFF L}}$ | – | 2 | 5 | μs | $I_{\text{OUT}} = 3\text{ A}$ resistive load |

Electrical Characteristics
3.3 Electrical Characteristics (cont'd)
 $6\text{ V} < V_S < 18\text{ V}; \text{IN1} = \text{IN2} = \text{HIGH}$
 $I_{\text{OUT}1,2} = 0\text{ A (No load)}; -40\text{ }^\circ\text{C} < T_j < 150\text{ }^\circ\text{C}; \text{ unless otherwise specified}$

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

Output Switching Times (Device Active for $t > 1\text{ ms}$)

| | | | | | | |
|------------|--------------------|---|----|----|---------------|--|
| Source ON | $t_{\text{ON H}}$ | – | 15 | 30 | μs | $I_{\text{OUT}} = -3\text{ A}$ resistive load |
| Sink ON | $t_{\text{ON L}}$ | – | 5 | 10 | μs | $I_{\text{OUT}} = 3\text{ A}$ resistive load |
| Source OFF | $t_{\text{OFF H}}$ | – | 2 | 5 | μs | $I_{\text{OUT}} = -3\text{ A}$ resistive load |
| Sink OFF | $t_{\text{OFF L}}$ | – | 2 | 5 | μs | $I_{\text{OUT}} = 3\text{ A}$ resistive load |

Clamp Diodes
Forward Voltage

| | | | | | | |
|-----------|-----------------|---|-----|-----|---|--------------------|
| High-side | V_{FH} | – | 1 | 1.5 | V | $I_F = 3\text{ A}$ |
| Low-side | V_{FL} | – | 1.1 | 1.5 | V | $I_F = 3\text{ A}$ |

Leakage Current

| | | | | | | |
|--------|------------------|-------|------|-----|---------------|--------------|
| Source | I_{LKH} | – 100 | – 50 | – | μA | OUT1 = V_S |
| Sink | I_{LKL} | – | 50 | 100 | μA | OUT2 = GND |

Logic
Control Inputs IN 1, 2

| | | | | | | |
|-----------------------------|-------------------|------|-----|-----|---------------|------------------------------|
| H-input voltage threshold | V_{INH} | 2.8 | 2.5 | – | V | – |
| L-input voltage | V_{INL} | – | 1.7 | 1.2 | V | – |
| Hysteresis of input voltage | V_{INHY} | 0.4 | 0.8 | 1.2 | V | – |
| H-input current | I_{INH} | – 2 | 0 | 2 | μA | $V_{\text{IN}} = 5\text{ V}$ |
| L-input current | I_{INL} | – 10 | – 4 | 0 | μA | $V_{\text{IN}} = 0\text{ V}$ |

Electrical Characteristics
3.3 Electrical Characteristics (cont'd)
 $6\text{ V} < V_S < 18\text{ V}; \text{IN1} = \text{IN2} = \text{HIGH}$
 $I_{\text{OUT1,2}} = 0\text{ A (No load)}; -40\text{ }^\circ\text{C} < T_j < 150\text{ }^\circ\text{C};$ unless otherwise specified

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

Error Flag Output EF

| | | | | | | |
|--------------------|------------------|---|------|-----|---------------|-------------------------------|
| Low output voltage | V_{EFL} | – | 0.25 | 0.5 | V | $I_{\text{EF}} = 3\text{ mA}$ |
| Leakage current | I_{EFL} | – | – | 10 | μA | $V_{\text{EF}} = 7\text{ V}$ |

Thermal Shutdown

| | | | | | | |
|--|------------------|-----|-----|-----|------------------|---|
| Thermal shutdown junction temperature | T_{jSD} | 150 | 175 | 200 | $^\circ\text{C}$ | – |
| Thermal switch-on junction temperature | T_{jSO} | 120 | – | 170 | $^\circ\text{C}$ | – |
| Temperature hysteresis | ΔT | – | 30 | – | K | – |
| Shutdown delay time | t_{dSD} | 25 | 50 | 80 | μs | – |

Note: Values of thermal shutdown are guaranteed by design.

Electrical Characteristics

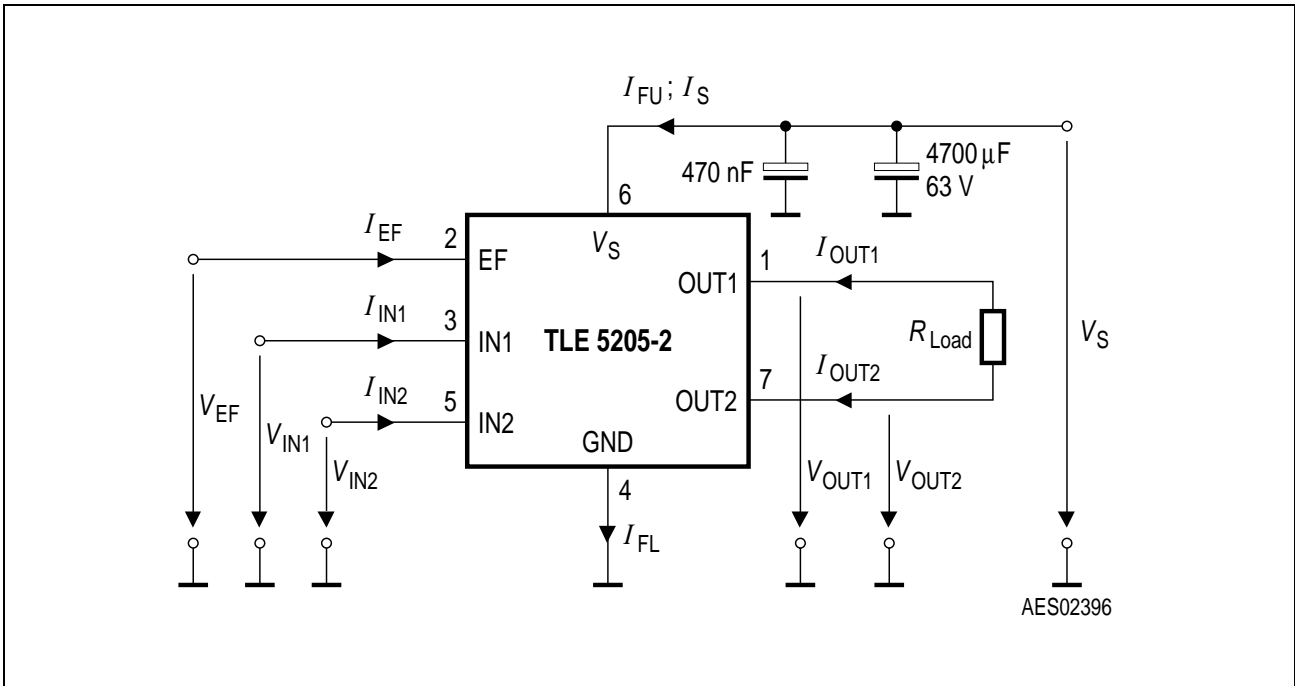


Figure 4 Test Circuit

| | Overcurrent | Short Circuit | Open Circuit |
|-----------|-------------|---------------|--------------|
| I_{OUT} | I_{SD} | I_{SC} | I_{OC} |

Electrical Characteristics

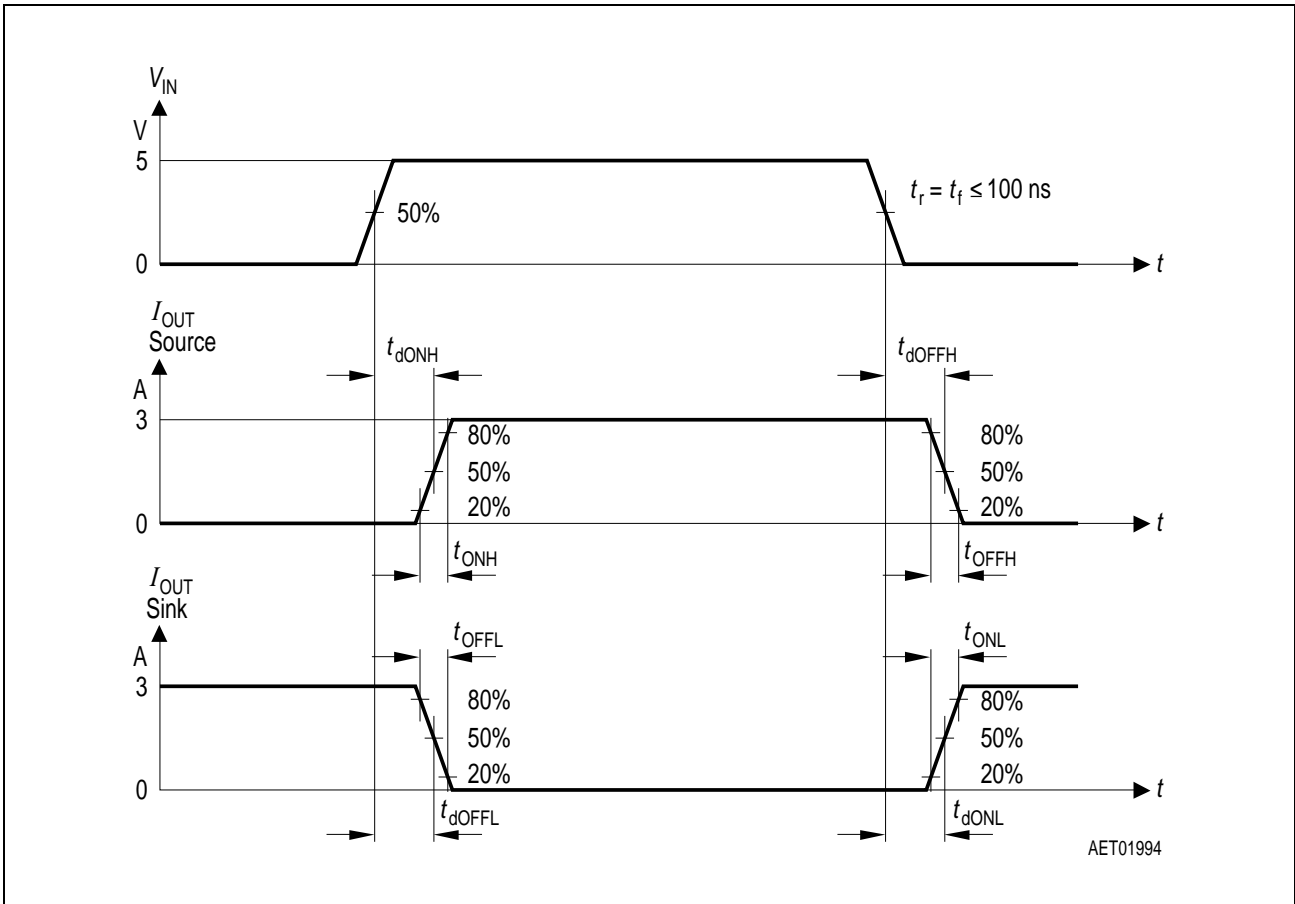


Figure 5 Switching Time Definitions

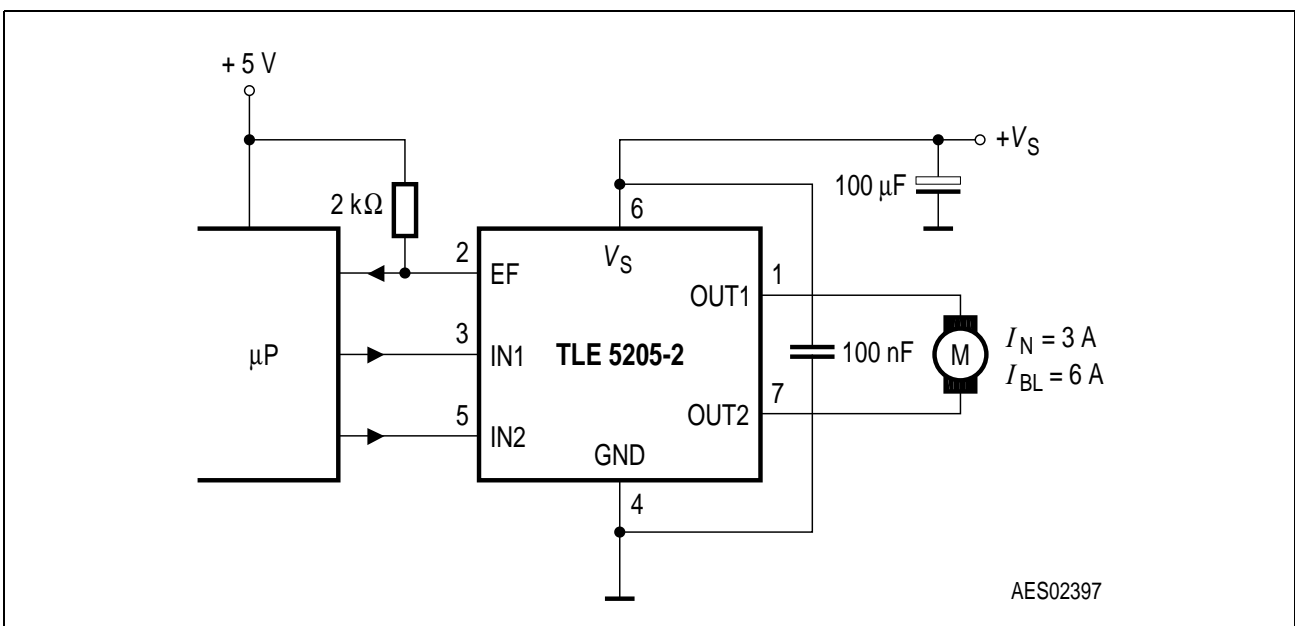


Figure 6 Application Circuit

Electrical Characteristics

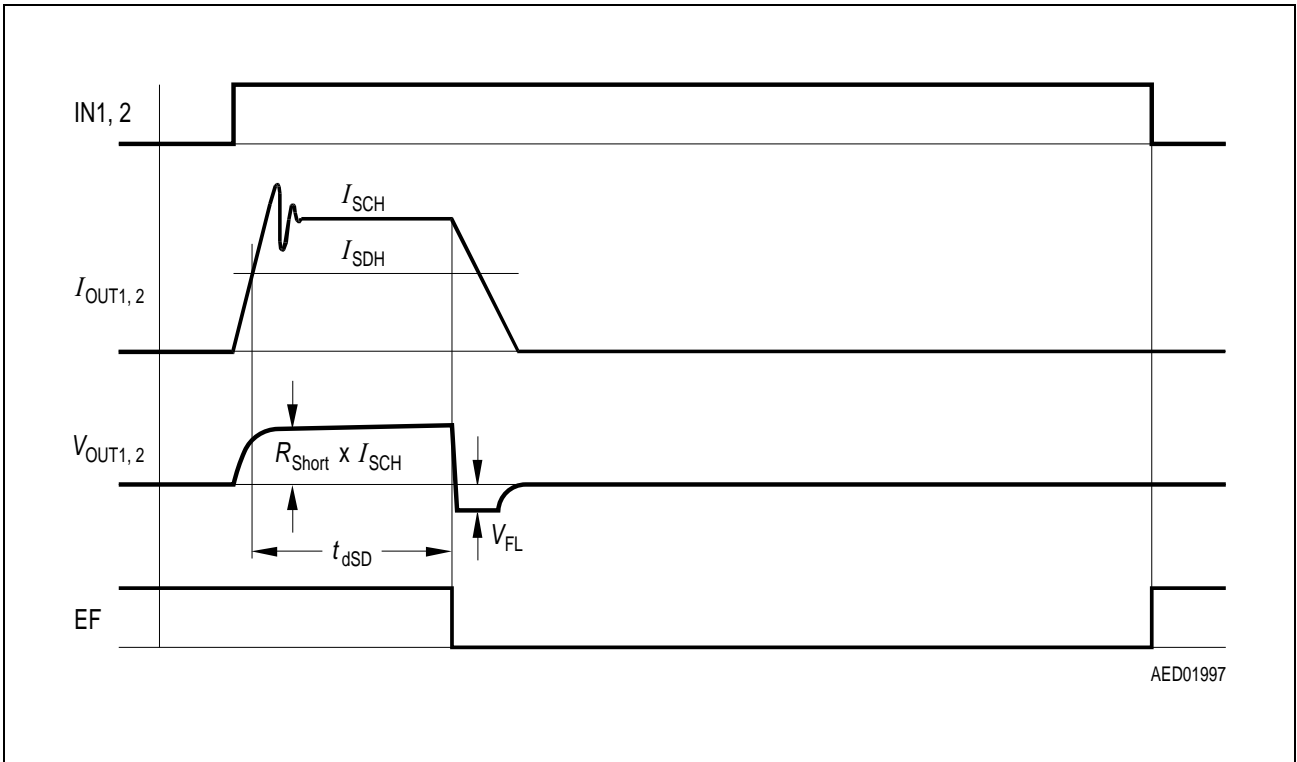


Figure 7 Timing Diagram for Output Shorted to Ground

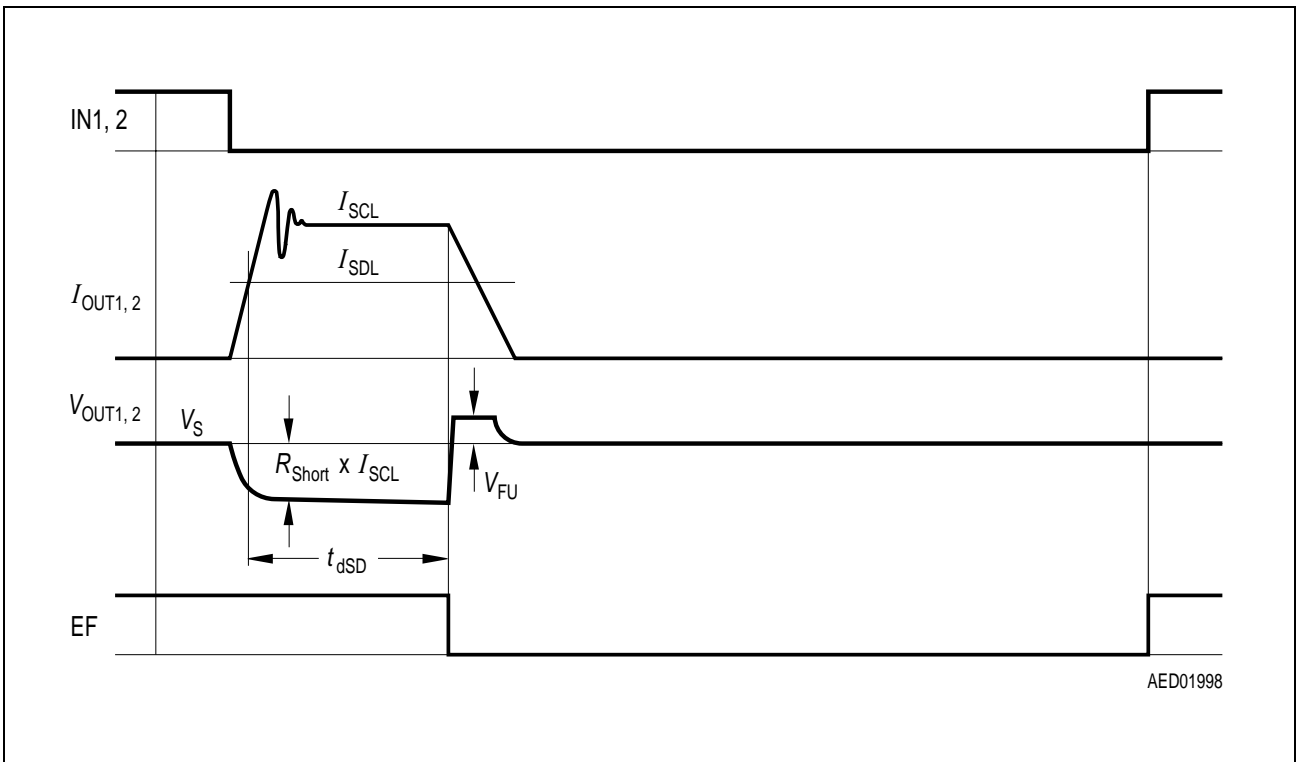
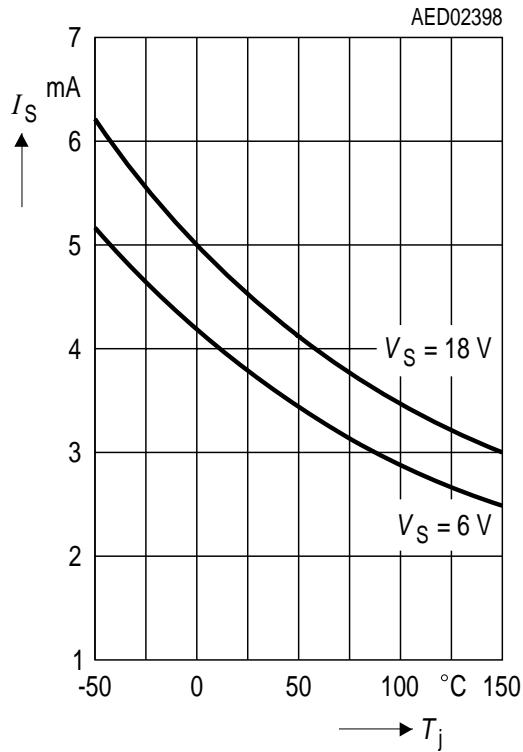


Figure 8 Timing Diagram for Output Shorted to V_S

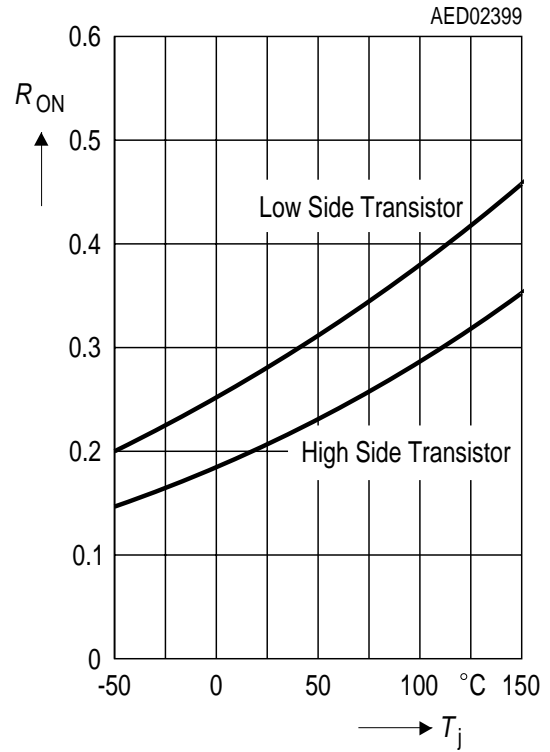
Electrical Characteristics

Diagrams

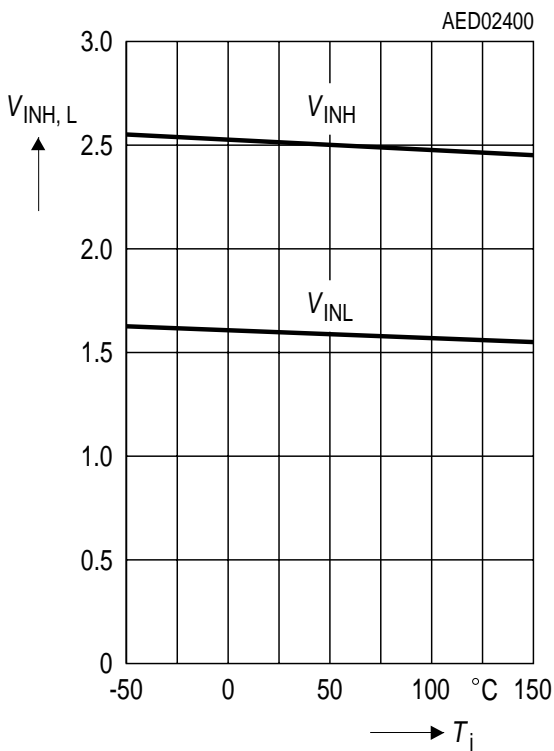
Quiescent Current I_S (Active) versus Junction Temperature T_j



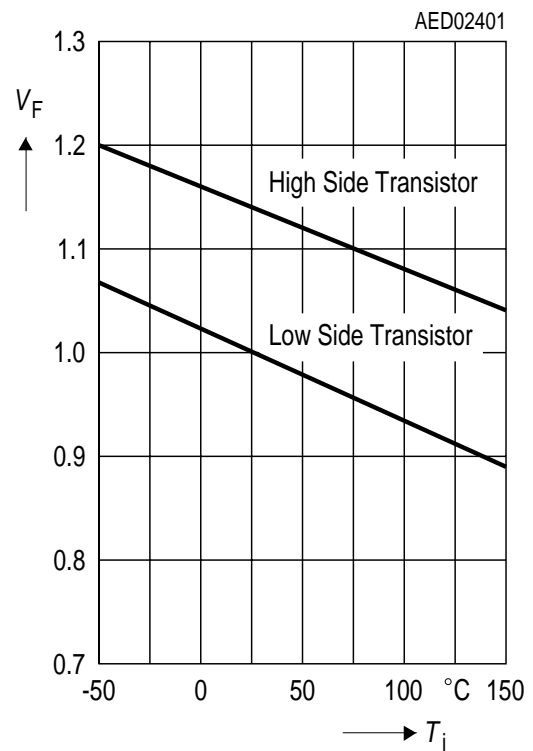
Static Drain-Source ON-Resistance versus Junction Temperature T_j



Input Switching Thresholds $V_{INH, L}$ versus Junction Temperature T_j

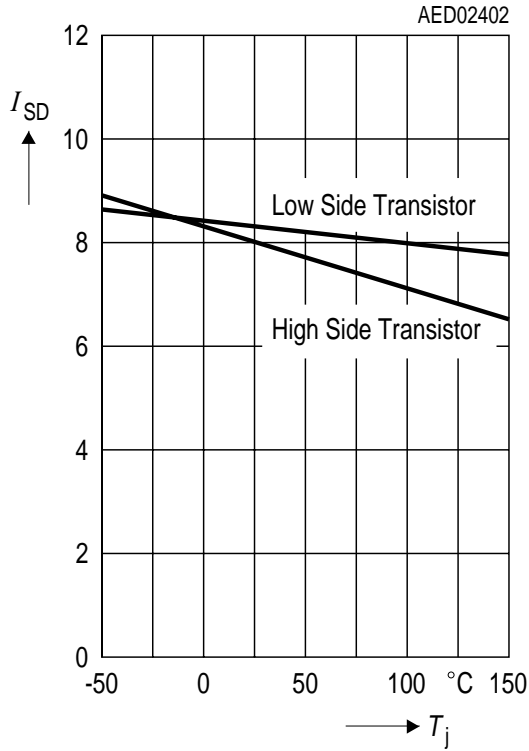


Clamp Diode Forward Voltage V_F versus Junction Temperature T_j

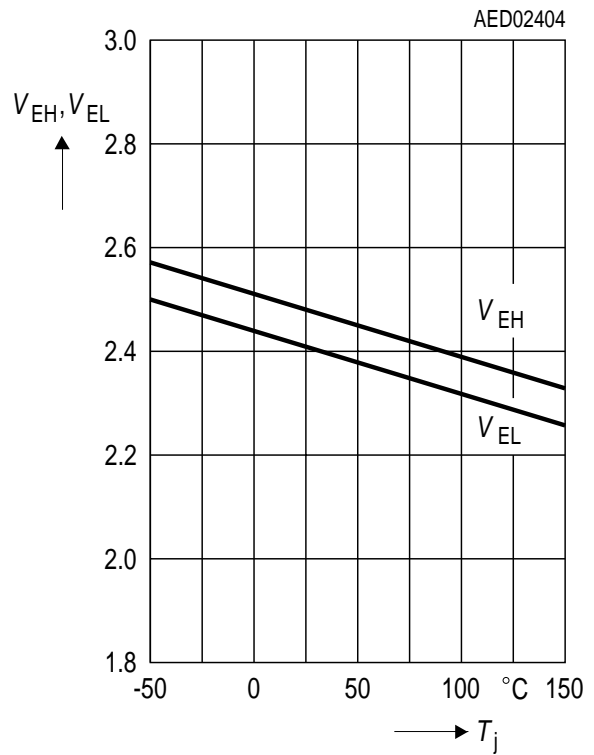


Electrical Characteristics

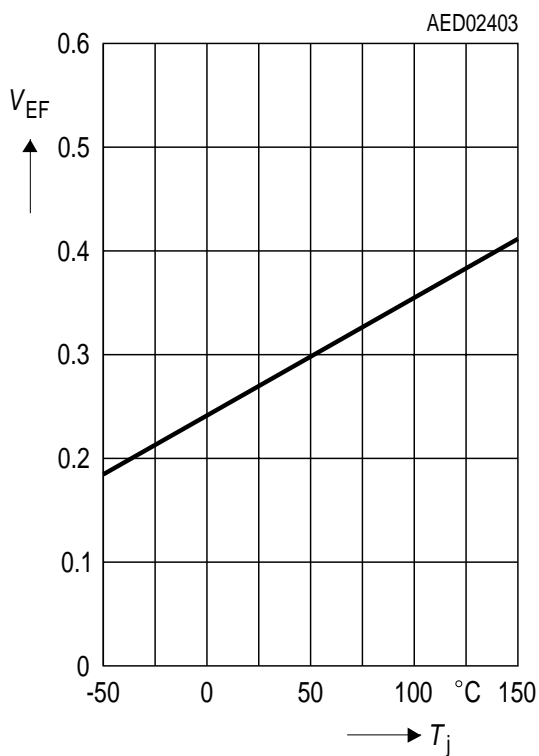
Overcurrent Shutdown Threshold I_{SD} versus Junction Temperature T_j



Switching Threshold V_{EH} , V_{EL} versus Junction Temperature T_j

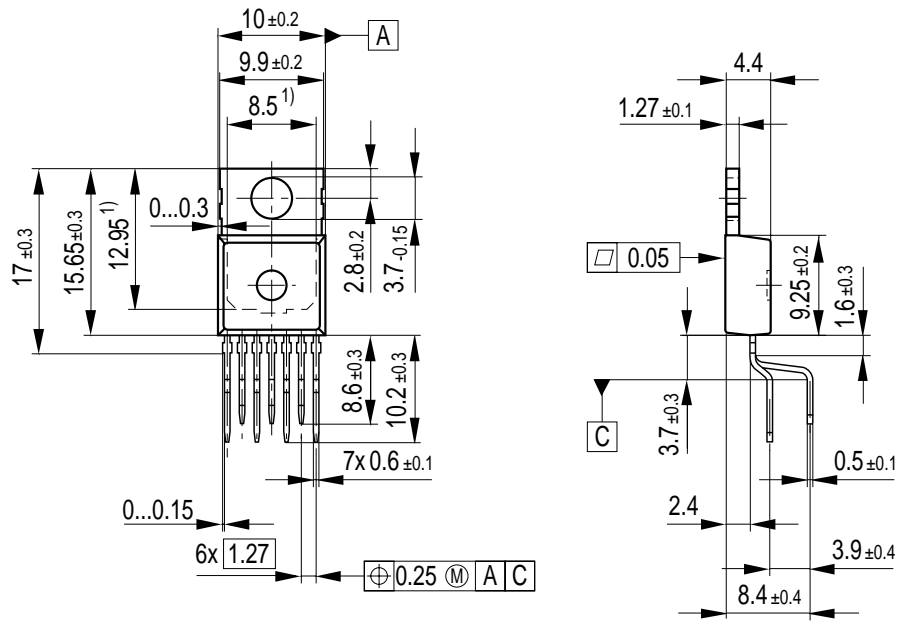


Error-Flag Saturation Output Voltage V_{EF} versus Junction Temperature T_j



4 Package Outlines

P-TO220-7-11
(Plastic Transistor Single Outline Package)



1) Typical
Metal surface min. X=7.25, Y=12.3
All metal surfaces tin plated, except area of cut.

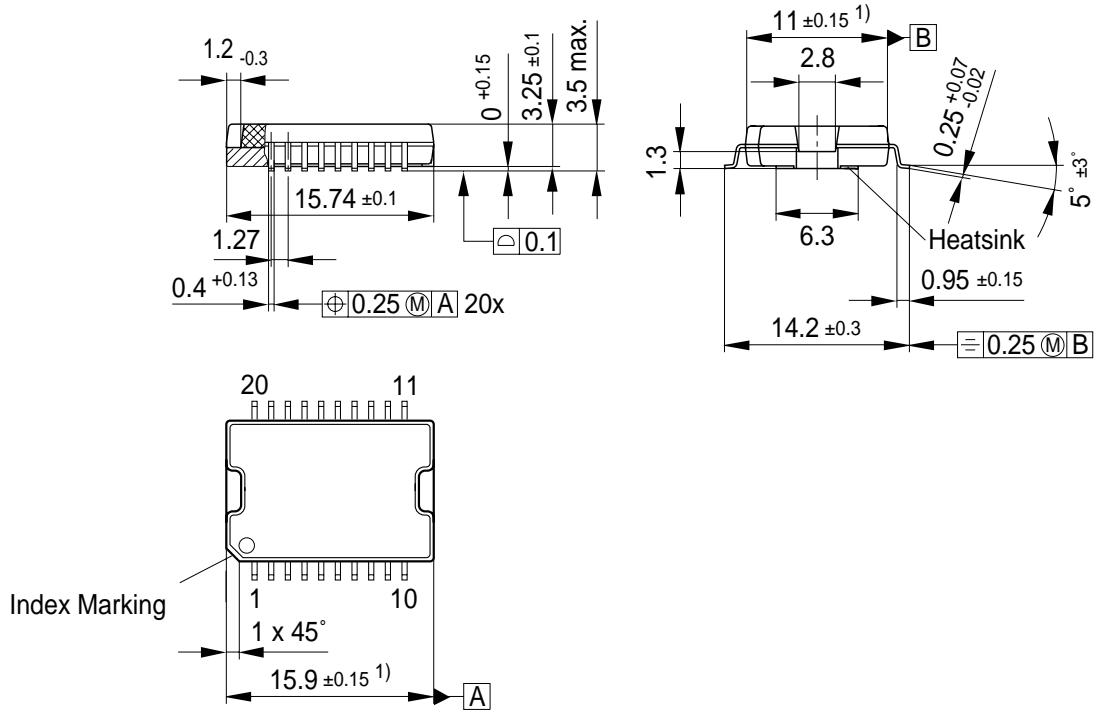
GPT09083

Sorts of Packing

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

Dimensions in mm

P-DSO-20-12
(Plastic Dual Small Outline Package)



1) Does not include plastic or metal protrusion of 0.15 max. per side

GPS05791

Sorts of Packing

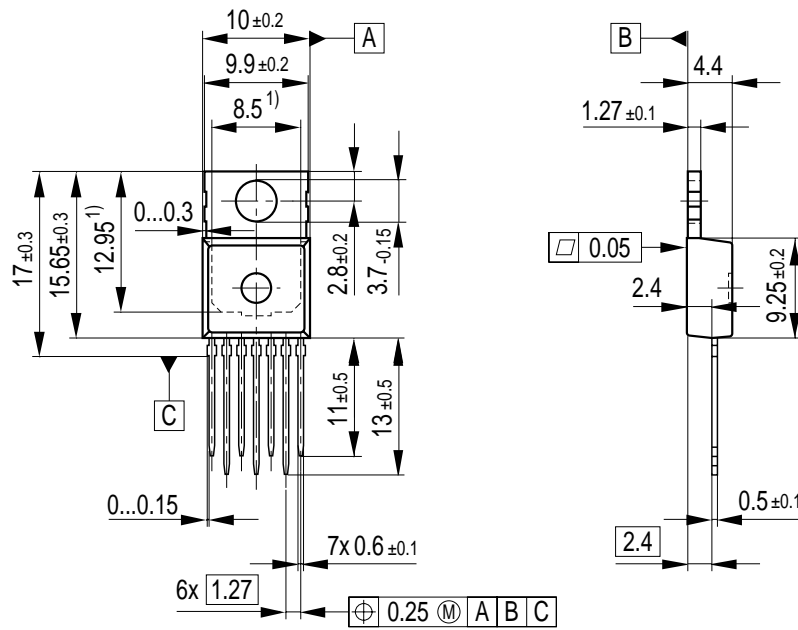
Package outlines for tubes, trays etc. are contained in our Data Book "Package Information".

SMD = Surface Mounted Device

Dimensions in mm

P-TO220-7-12

(Plastic Transistor Single Outline Package)



¹⁾ Typical
 Metal surface min. X=7.25, Y=12.3
 All metal surfaces tin plated, except area of cut.

Sorts of Packing

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

Dimensions in mm