

Repetitive Overload Performances for the MC33981

1 Introduction

This application note relates the robustness of the 33981 device in cases of repetitive overload conditions.

The 33981 is one in a family of devices designed for low-voltage automotive DC motor applications. Its single ultra-low $R_{DS(ON)}$ MOSFET ($4m\Omega$) can drive a DC motor in pulse widths up to 60kHz, with a duty-cycle from 5% to 100%, for engine cooling or air conditioning.

Configuration, control, and diagnostics are accomplished using parallel I/Os. Its output with a configurable slew-rate improves electromagnetic compatibility (EMC) behavior. Additionally, an external protected low side MOSFET can be driven in order to reduce the power dissipation in freewheeling.

For feature information, refer to the device data sheet for the 33981.

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2 Short-circuit Protections

The 33981 device includes self-protected high side switch with $4\text{m}\Omega R_{\text{DS(ON)}}$ and extended diagnostics, in order to facilitate closed-loop operation for motor speed control, and protect the system against short-circuit fault conditions.

The device proposes a latched over-load protection feature, as described [Figure 1](#). This protection is preferred to conventional current limitations, to minimize the thermal overstress within the device, in case of an overload condition. The delta (T) is drastically reduced to a value which does not affect the device's reliability.

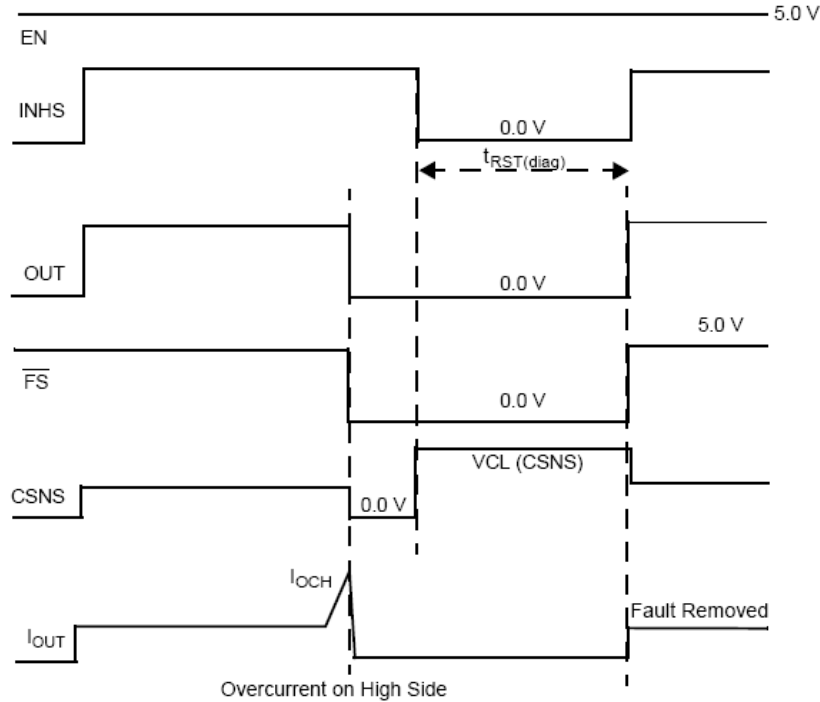


Figure 1. Latched Over-current Protection

The over-current threshold (I_{OCH}) is guaranteed by the following: min=75A, typ=100A, and max=125A.

3 Repetitive Overload Test Setup

The repetitive overload tests have been performed in accordance with [Figure 2](#). The goal is to force the device to switch “on” and “off” cyclically in an overload condition, in order to accelerate the silicon fatigue.

Those tests have been performed for difference conditions:

- output current forced at 75A for -40°C of ambient, 45°C delta (T) estimated,
- output current forced at 50A for $+40^{\circ}\text{C}$ of ambient, 22°C delta (T) estimated,
- output current forced at 50A for $+85^{\circ}\text{C}$ of ambient, 30°C delta (T) estimated.

Figure 2 describes the hardware test setup used with $L_{supply} = 4\mu H$, $R_{supply} = 10m\Omega$, and a programmable current source. The device solders on a 4 layer board with $15^{\circ}C/W$.

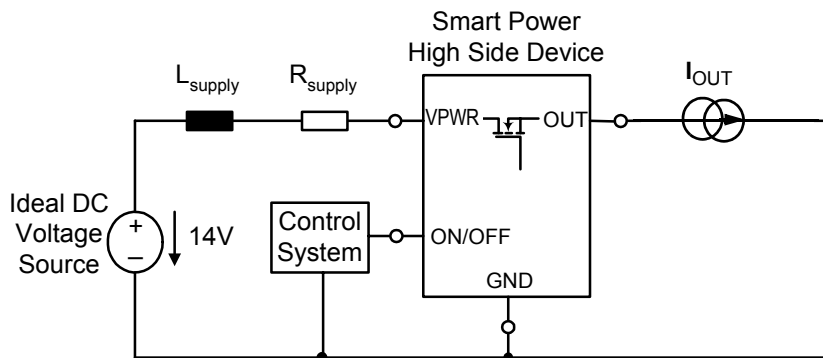


Figure 2. Overload Test Setup

The test escape condition was 200,000 output switching.

4 Repetitive Overload Test Results

Table 1 presents the summary of repetitive test results. 10 engineering samples were used per test.

Table 1. Test Results Summary

Ambient Temperature	Output Current	Cycle Definition	Electrical Signature after 200k cycles
-40°C	75A	ON 1s / OFF 10s	Devices in specification No significant electrical parameters drift
+40°C	50A	ON 1s / OFF 10s	Devices in specification No significant electrical parameters drift
+85°C	50A	ON 1s / OFF 10s	Devices in specification No significant electrical parameters drift

5 Reference

- MC33981 - Switch Data sheet (Single High Side Switch (4mΩ up to 60kHz))

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