



Introduction

In the fields of factory automation and process control several output devices are used to drive different types of actuators. Depending on the market and application, the output drivers can be configured in high-side configuration (load to ground) or in low-side configuration (load to supply). Embedded protection and diagnostic are always requested.

These devices are required to switch ON-OFF with very large inductive loads (more than 1 henry), for thousands of cycles during their life. In addition to IEC specification compliance for electro magnetic compatibility (EMC) such as the 2.5 kV burst test, the devices must also fit in very small cases (< 5 mm), so very tiny packages are required.

STMicroelectronics' TDE1708DFT device belonging to the intelligent power switch (IPS) family provides a solution to the above requirements. An IPS integrates a control part (logic, interface, drivers and protection) with a power stage. The TDE1708DFT can work as a high-side driver as well as a low-side driver, offering maximum flexibility in the configuration of the loads.

The chip integrates several blocks for protection against abnormal electrical conditions or faults. It has a pin for output status indication and is housed in the tiny leadless DFN 8-lead with exposed pad package.

1 Device description

The [Figure 1](#) and [Figure 2](#) show the TDE1708DFT in high-side and low-side driver configurations respectively.

Figure 1. High-side driver configuration

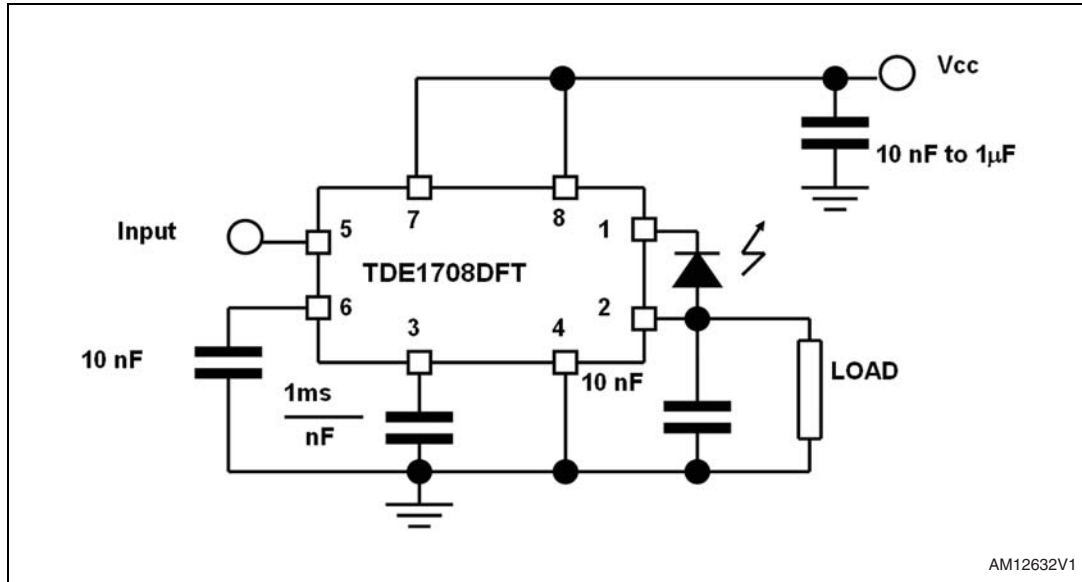
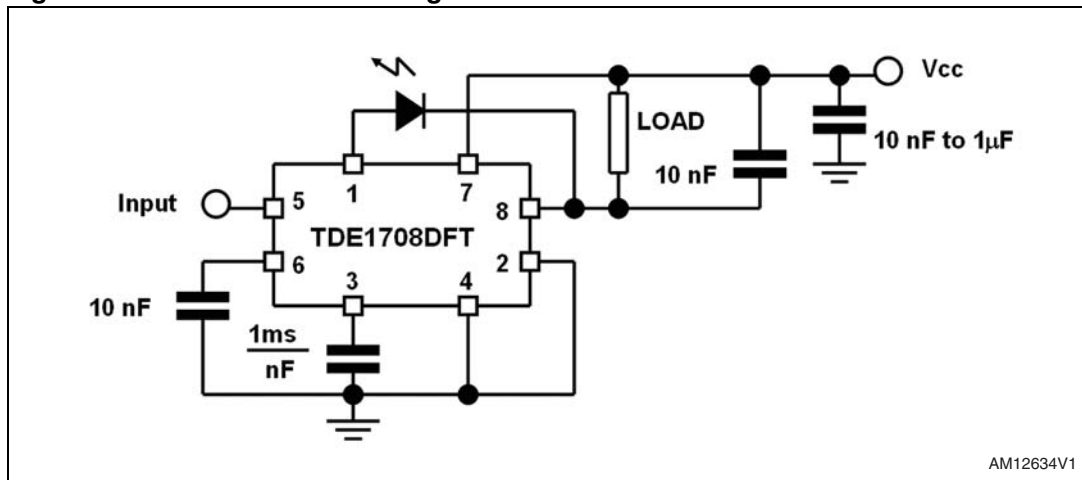
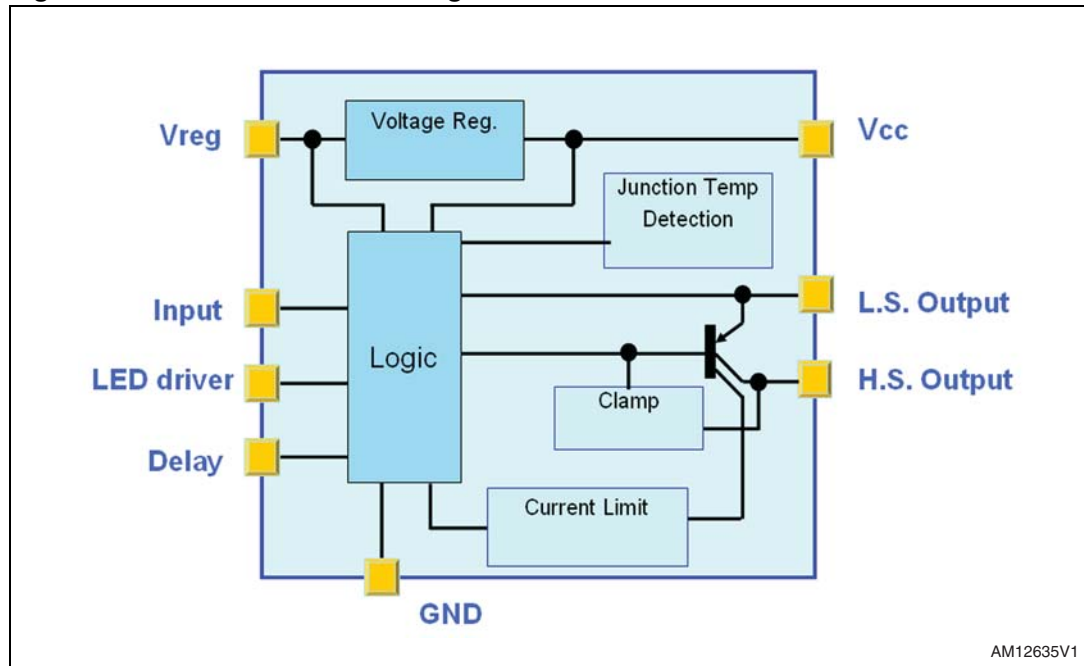


Figure 2. Low-side driver configuration



[Figure 3](#) clearly identifies the main protection blocks of the device: junction overtemperature, current limitation (0.3 A typical), auxiliary voltage regulator and the clamping voltage.

Figure 3. TDE1708DFT block diagram



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Junction overtemperature protection and current limit protect the device against overload and short circuit of the load to ground. Turn-ON time during short circuit and/or overload is set by an external capacitor, thus minimizing the power dissipation on the device during these tough electrical conditions.

The clamping voltage protects the final stage against voltage spikes and also performs fast demagnetization of inductive loads (-55 V minimum demagnetization voltage). Although not visible in [Figure 3](#), the device is also protected against reverse supply (-Vcc), reverse output (up to -50 V), loss of ground and loss of Vcc. In case of loss of ground or Vcc, the power stage is switched OFF. In this condition the internal +5 V voltage regulator will not work properly.

The internal voltage regulator supplies all the logic blocks. It can also be used to supply an external circuit. The status of the output is visible by connecting an LED to the LED driver pin of the device. Other features of the device include a maximum supply voltage up to 50 V and high impedance differential input which ensures high noise immunity.

2 Application

Often the TDE1708DFT is connected to proximity detectors to drive actuators in factory automation, process control and building automation.

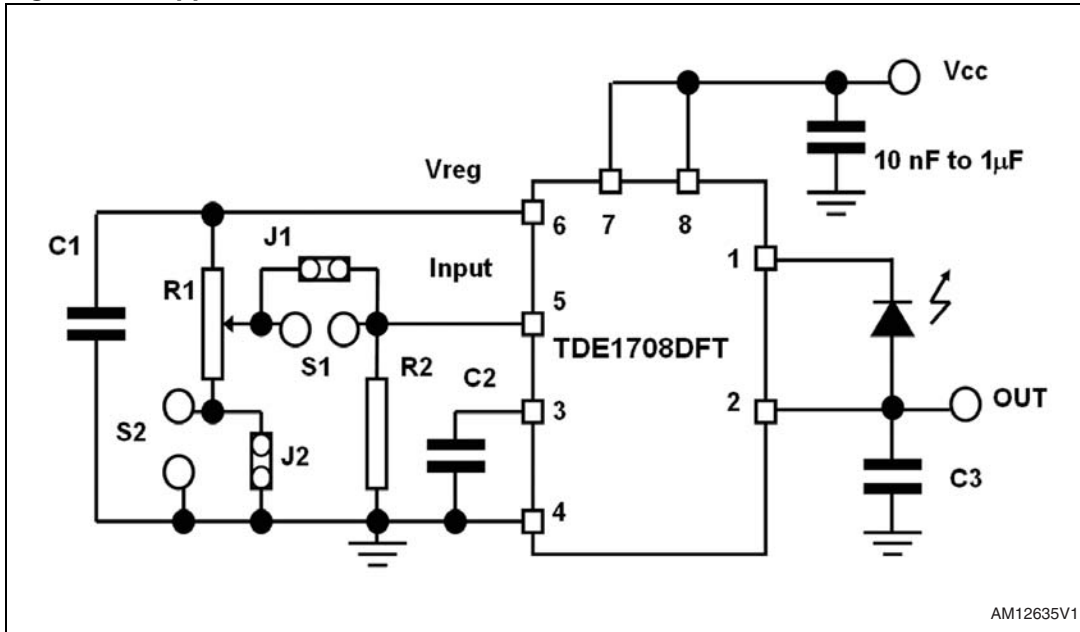
Figure 4. Proximity detector



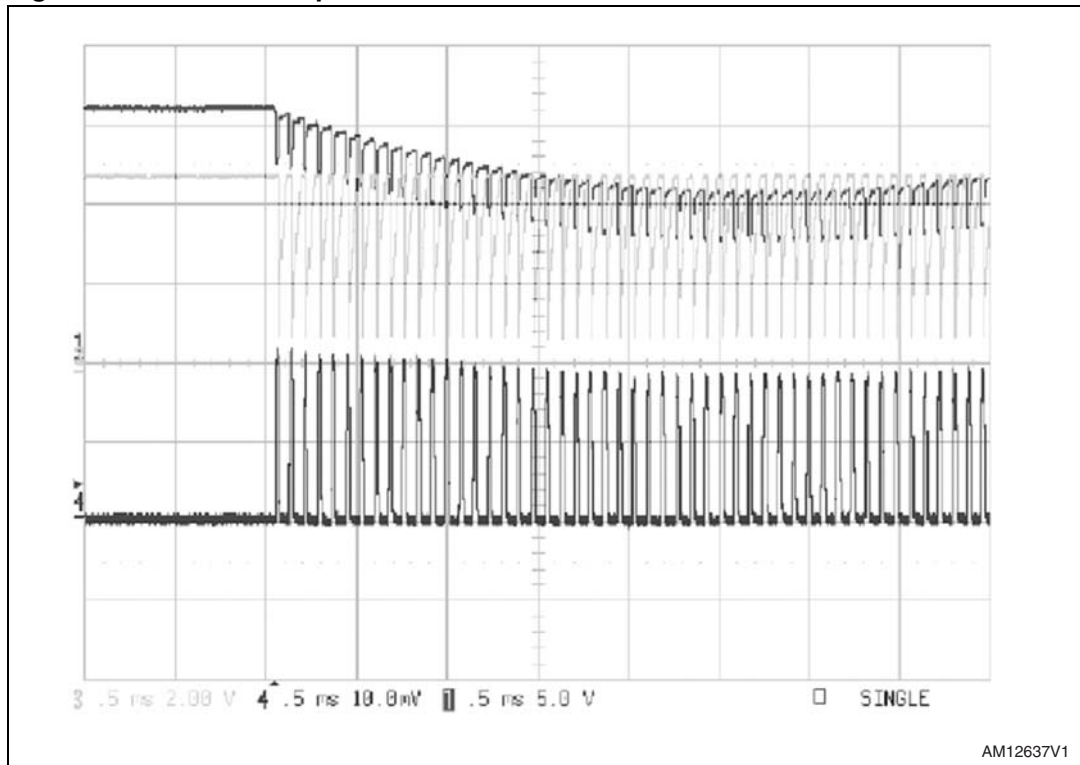
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Figure 5 provides a typical application circuit for proximity detectors. The proximity detector is directly connected to the input of the device. The schematic is optimized to accept detectors with the body connected to ground or with an independent ground (by properly using J1 and J2). Any type of proximity detector can be used thanks to an adjustable input hysteresis through R1. To avoid overvoltages or disturbances caused by serial inductance of the long connection wires between the device and power supply, filtering capacitors on pins Vreg and Vs are adopted. A delay capacitor assures proper behavior during shortcircuit of the output. *Figure 6* reports the Vcc and output current waveforms during short circuit.

Figure 5. Application circuit

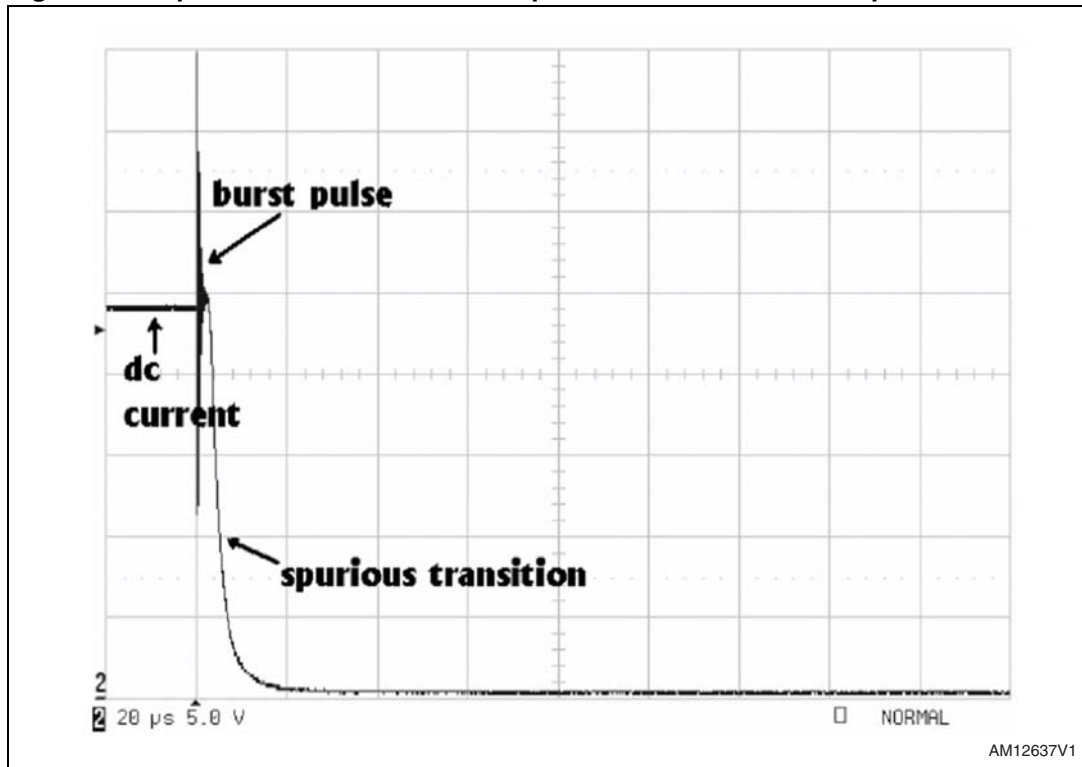


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Figure 6. Shortcircuit protection

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The TDE1708DFT complies with the international standards of programmable logic controllers (PLCs) and with the typical industrial electro magnetic compatibility (EMC) standards. One of the tough EMC tests for an industrial device is the fast transient (burst) immunity test. This test is described in the international rule IEC 61000-4.

Figure 7. Spurious transition of the output transistor due to burst pulse

A burst exceeding the tolerance level causes the output transistor to switch OFF even if the input has not changed its high state. A burst test performed on the TDE1708DFT, with a delay capacitor of 10 nF, provided noise immunity up to +2500 V/-2500 V burst voltage.

3 Conclusion

An intelligent power switch for proximity detectors, and industrial automation in general, has been presented. The device allows reduction of external component count, optimized application performance and provides a high quality and low cost system solution.

4 References

1. "Intelligent Power Switch", TDE1708DFT Datasheet, www.st.com
2. "Effective Filtering of TDE1707", AN495, www.st.com
3. "TDE1707 Noise immunity, shortcircuit and reverse output protection characterization", AN1213, www.st.com

5 Revision history

Table 1. Document revision history

Date	Revision	Changes
24-May-2012	1	Initial release.

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