



# AN555

## APPLICATION NOTE

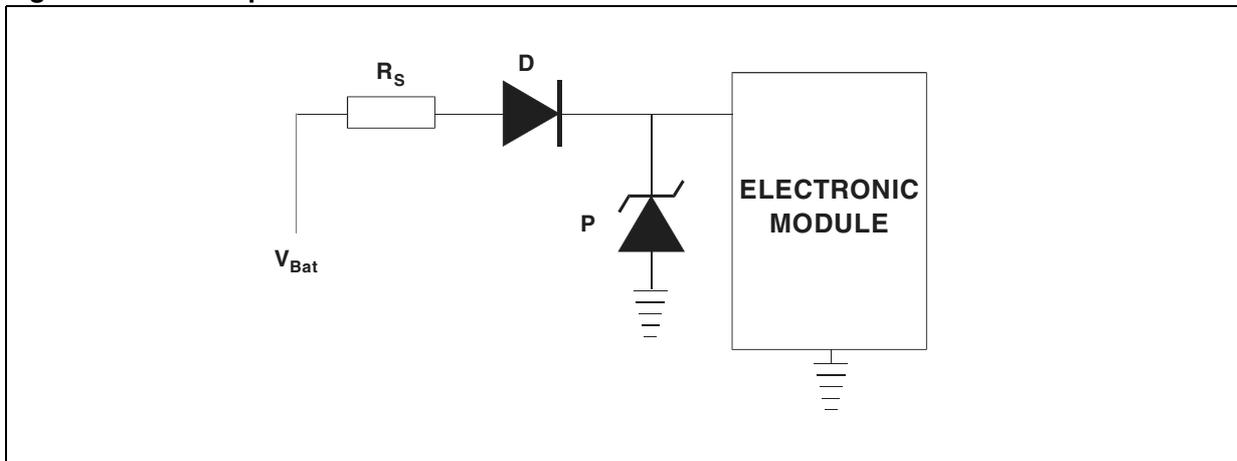
### AUTOMOTIVE PROTECTION WITH THE RBOxx SERIES

#### INTRODUCTION

The harsh electrical environment in automobiles poses problems for the electronic modules present. Even in normal operation, large positive and negative overvoltages due to switch bounce, ignition coil switching and other phenomena are a potential cause of destruction. An additional hazard is the possibility of supply reversal, perhaps caused by faulty wiring. Another danger is the "load dump" effect, caused by battery disconnection while the engine is running. This causes the energy stored in the alternator coils to manifest itself as an 80 V transient lasting around 300 ms : lethal to semiconductor circuits. See application note 4.1: "Protection standards in automotive applications" for more details.

Protection is therefore required, which can be centralized or distributed. Centralized protection attempts to suppress disturbances at their source, for example crowbar devices at the alternator to counter the load dump effect. Distributed protection aims to dissipate disturbances at their destination. Components performing this function are present in the electronic modules themselves and are thus relatively numerous. The RBOxx (Reversed Battery and Overvoltage) series of protection devices from STMicroelectronics has been designed to reduce this distributed protection component count.

**Figure 1. Classical protection circuit**

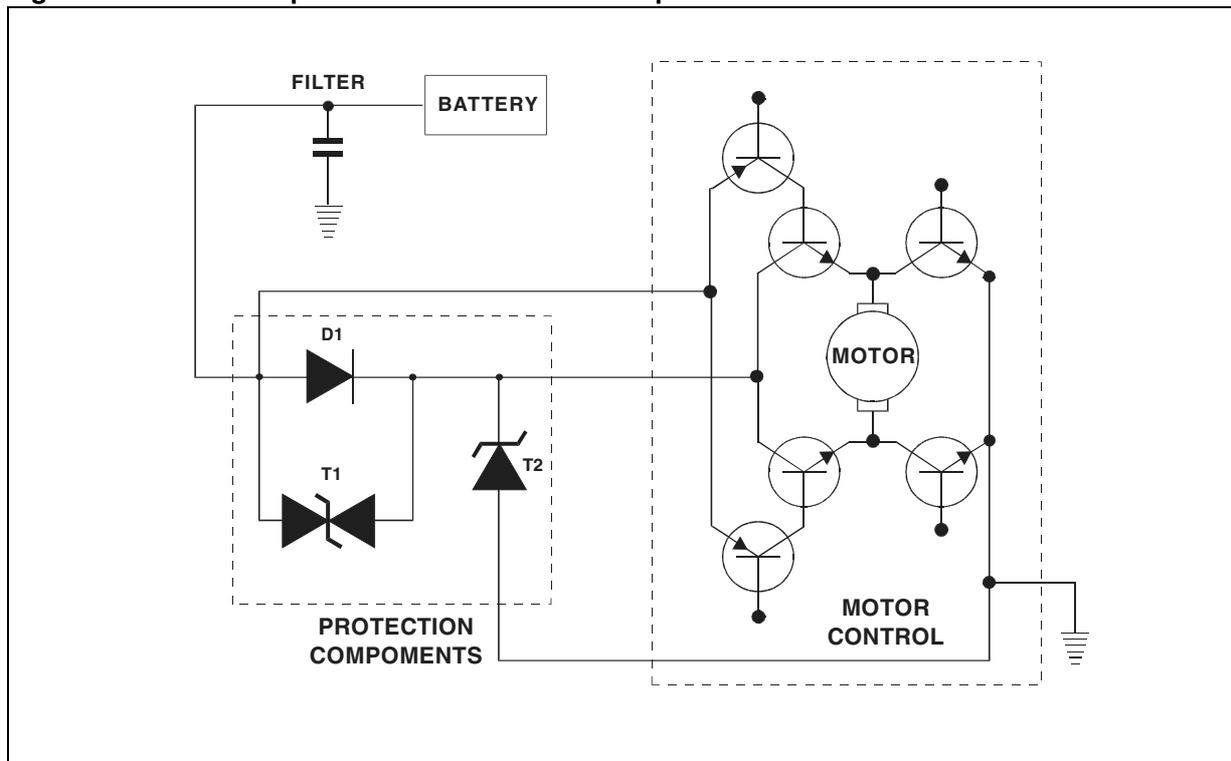


#### CLASSICAL DISTRIBUTED PROTECTION

The circuit shown in Figure 1 protects the module against battery reverse as well as impulsive and continuous overvoltages, both positive and negative. In addition, overvoltages generated by the module are prevented from reaching the car supply network.  $R_s$ , in cases where it can be used, limits the power dissipated in the protection device  $P$ . Note that diode  $D$  is used in reverse-bias to block negative overvoltages, so its peak reverse voltage limit ( $V_{RRM}$ ) must be taken into account.

Motor driver protection is complicated by the presence of transistor circuits which control the direction and magnitude of current flow through the motor. A bidirectional clamping device needs to be added in order to ensure protection of both halves of this circuit. (see Figure 2).

Figure 2. Motor driver protection with discrete components



The NPN transistors supplied via D1 are protected in the classical fashion already described. The PNP devices are connected directly to the car supply network and are protected as follows:

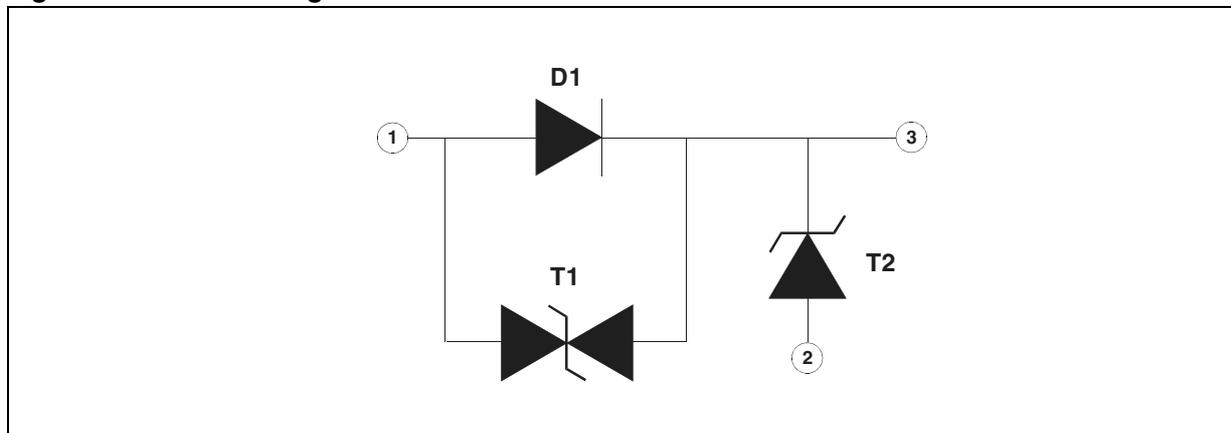
- Positive surges : overvoltage is clamped by T2 with D1 forward- biased.
- Negative surges : These are clamped by T1 with T2 forward - biased.

Three components are thus required per motor driver, representing significant component and area cost.

**DISTRIBUTED PROTECTION WITH THE RBOXX FAMILY**

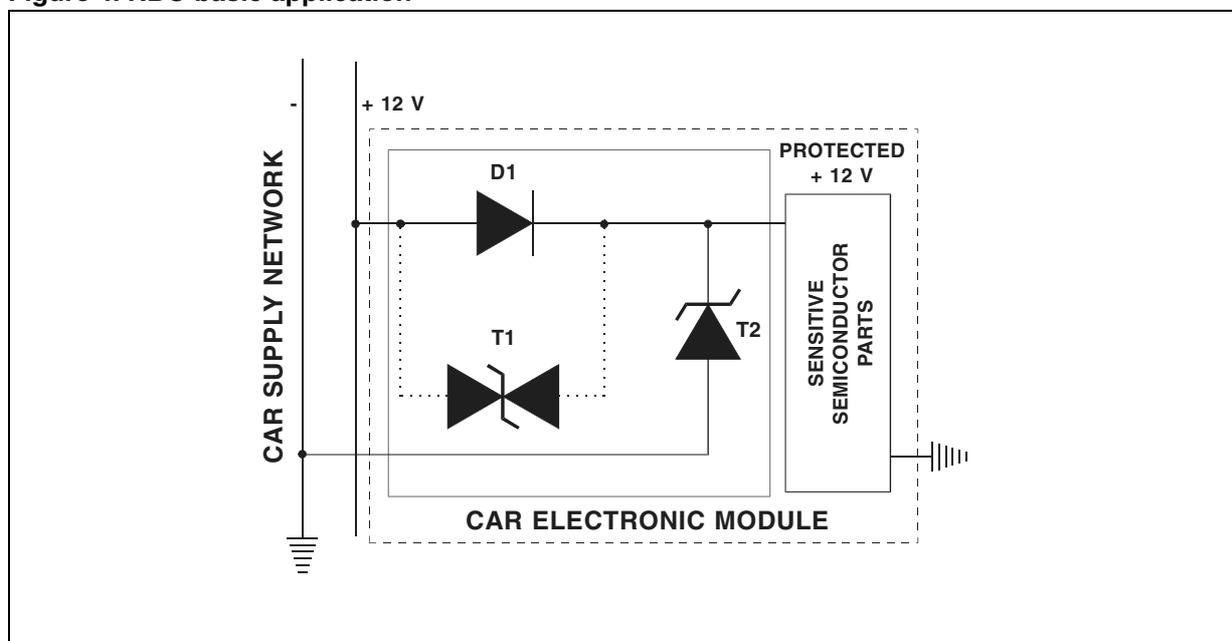
The RBOxx devices integrate all the protection functions required by car electronic modules: (see Figure 3).

Figure 3. Schematic diagram of an RBO device



Diode D1 protects against a reversed battery, while the "Transil" clamping device T2 suppresses positive surges. Negative surges are blocked up to the breakdown voltage of the bidirectional clamp T1. Larger negative surges are suppressed by T1 in avalanche breakdown in series with T2 forward-biased. Figure 4 shows the basic application of the RBOxx.

**Figure 4. RBO basic application**



Note that as the voltage across D1 is clamped by T1, the VRRM of the diode is no longer a concern. The clamping voltage is the same as that of T2, given by the yy digits in the part number of the form RBOxx-yy. The xx digits indicate the average forward current between pins 1 and 3.

Two devices are available at the time of writing: the RBO08-40 and the RBO40-40. The latter device is specifically designed to protect against "load dump" surges due to the greater power capability of T2, while the RBO08-40 is adequate for suppressing the other overvoltages present.

The presence of T1 makes possible an elegant solution to the motor driver protection. The RBOxx replaces the three protection components shown in Figure 2 and protects the motor driver circuit in the same way.

## CONCLUSION

A car power supply network is often contaminated with voltage surges potentially damaging to the semiconductor circuits present. The STMicroelectronics family of RBOxx protection devices enables full protection from these surges with the minimum component count.

**REVISION HISTORY**

**Table 1. Revision History**

<b>Date</b>	<b>Revision</b>	<b>Description of Changes</b>
March-1993	1	First Issue
3-May-2004	2	Stylesheet update. No content change.

Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is a registered trademark of STMicroelectronics.  
All other names are the property of their respective owners

© 2004 STMicroelectronics - All rights reserved

STMicroelectronics GROUP OF COMPANIES

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan -  
Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States

[www.st.com](http://www.st.com)