TransGuard®
AVX Multilayer Ceramic Transient Voltage Suppressors
Application Notes: Motor and Relay Application Study

PURPOSE

A significant number of end customers have experienced failures of circuitry in and around low voltage relays and motors. Additionally, EMI problems have been associated with running motors.

This study is aimed at evaluating how TransGuards® can reduce EMI from running motors and clamp transients generated from relays and motors during power off.

DESCRIPTION

Three different motors and two different relays were chosen to represent the wide range of possible devices used by designers. Device choices were as follows:

MOTORS

Cramer	8001 series Geared Motor 12V, 30rpm (4800 RPM armature speed) 170ma Start/Run Torque 30oz
Comair	Rotron DC Biscut Fan - 24V, 480ma
Comair	Rotron DC Biscut Fan - 12V, 900ma

RELAYS

Potter and Brumfield	24V Relay ⅓ HP 120V AC, 10A 240 VAC Rating
Potter and Brumfield	12V Relay ⅓ HP 120V AC, 10A 240 VAC Rating

A Tektronix TDS 784A four channel 1GHz 4G S/s digitizing storage scope was used to capture the -1⁄2 LI2 transient peak from the relays and motors. A x10 probe was connected to the scope and one leg of the relay/motor coil; the probe's ground was connected to the other relay coil/motor wire. The scope was triggered on the pulse and waveforms printed.

When suppression was introduced into the circuit, it was placed directly on the relay coils/motor lead wires. The axial TransGuard® and capacitors had a 19mm (3⁄4") total lead length in each case. Upon careful consideration, it was determined that this was a fairly common lead length for such applications.

SUMMARY

GEARED MOTOR

The Cramer geared motor was tested while running (under load) to determine its "on state" noise as well as under loaded turn off conditions. Both TransGuards® and ceramic capacitors were tested to determine the level of protection they offer.

A 14V axial TransGuard® provided the best protection during running and turn off. The VA100014D300 TransGuard® cut the 60V unprotected turn off voltage spike to 30V. It also cut the on state noise to 4.0V pk-pk due to its internal capacitance. The following is a summary of measured voltages (scope traces are shown in Figures 1, 1A, 2, 2A).

Test Condition	Transient without Protection	Transient with .1µF cap	Transient with .01µF cap	Transient with 14v TransGuard®
Geared motor at turn off	60V	32V	48V	30V
Geared motor during running	12V pk-pk	4.0V pk-pk	4.0V pk-pk	4.0V pk-pk

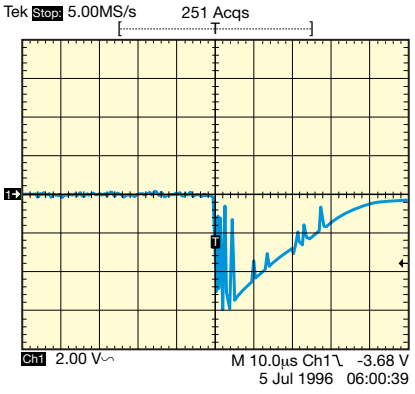

Fig. 1. Geared Motor Transient at Turnoff without protection 60 V Gear Motor 20 V/Division

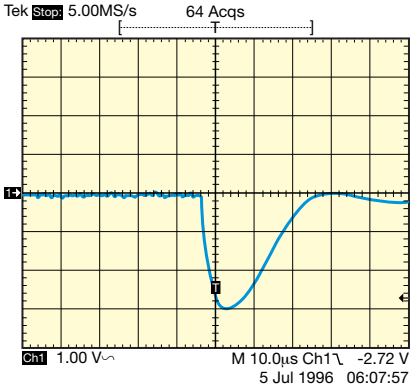

Fig. 1A. Geared Motor Transient at Turnoff with 14 V TransGuard® 30 V 10 V/Division

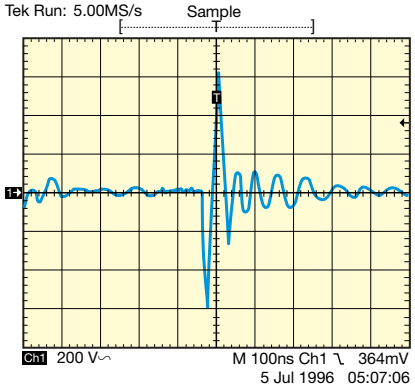

Fig. 2. Geared Motor Running noise without protection 12 V pk-pk 2 V/Division

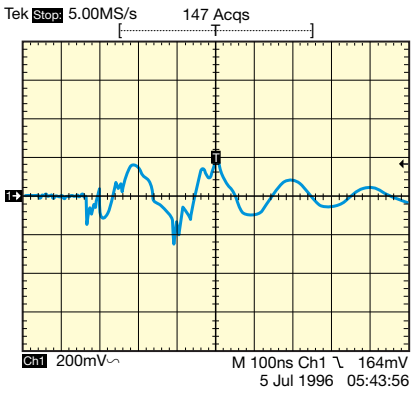

Fig. 2A. Geared Motor Running with 14 V TransGuard® 4 V pk-pk 2 V/Division

BISCUT FAN

The Comair 24V and 12V biscut fans were tested only for transients at turn off. Results of those tests are shown in the table at the right (as well as slope traces 3, 3A, 4, 4A).

Motor Type	Transient without Protection	Transient with .1µF cap	Transient with .01µF cap	Transient with TransGuard®
24V Fan	165V	120V	140V	65V(1)
12V Fan	60V	52V	64V	30V(2)

(1) VA100030D650 TransGuard® / (2) VA100014D300 TransGuard®

Fig. 3. 24 V Biscut Fan without protection 165 V Biscut 50 V/Division

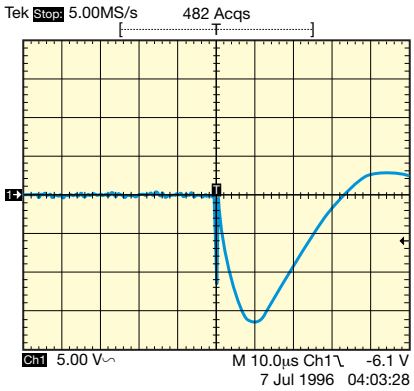

Fig. 3A. 24 V Biscut Fan with 30 V TransGuard® 65 V 50 V/Division

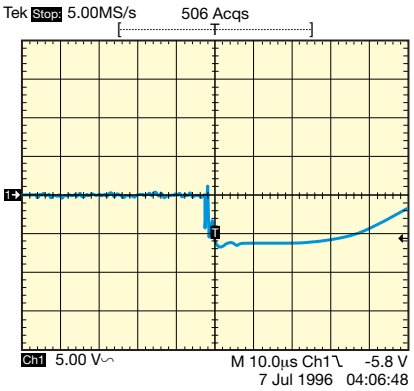

Fig. 4. 12 V Biscut Fan without protection 60 V 20 V/Division

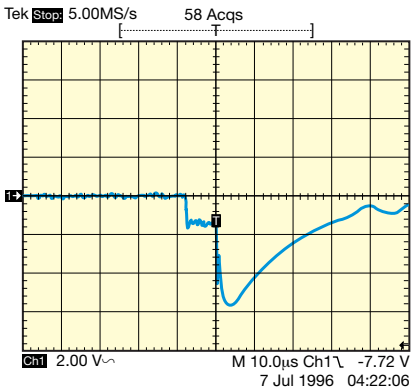

Fig. 4A. 12 V Biscut Fan with 14 V TransGuard® 30 V 20 V/Division