RETURNED ENERGY

The purpose of this test is to investigate the effects of a desynchronizing step motor on a drive's power supply voltage. The devices under test are:

Drive:	G201 REV-11
Motor:	Superior Electric MO93-FD14

Test equipment used:

Step pulse generator:	G2002 REV-3
Power supply:	Sorensen DCR 80-15B
Oscilloscope:	Tektronix TDS 360

Test conditions:

Power supply voltage:	48 VDC
Motor speed:	6,000 RPM

The motor was accelerated to 6,000 RPM (200,000 step pulses per second) by the G201 drive operating at 48 VDC. The reason for such a high speed was to store as much energy as possible in the motor's moment of inertia.

The energy stored was: Joules = (Kg-m^2) * (rad/sec)^2 / 2 = 0.00018 * 628^2 / 2 = 35.5 Joules

The power supply had a rectifier diode in series with the positive supply lead to the G201 to prevent returned current from flowing back into the power supply. The oscilloscope probe was placed across the G201's power supply terminals. The step pulses were then abruptly terminated and the results were captured by the oscilloscope (Fig. 1).

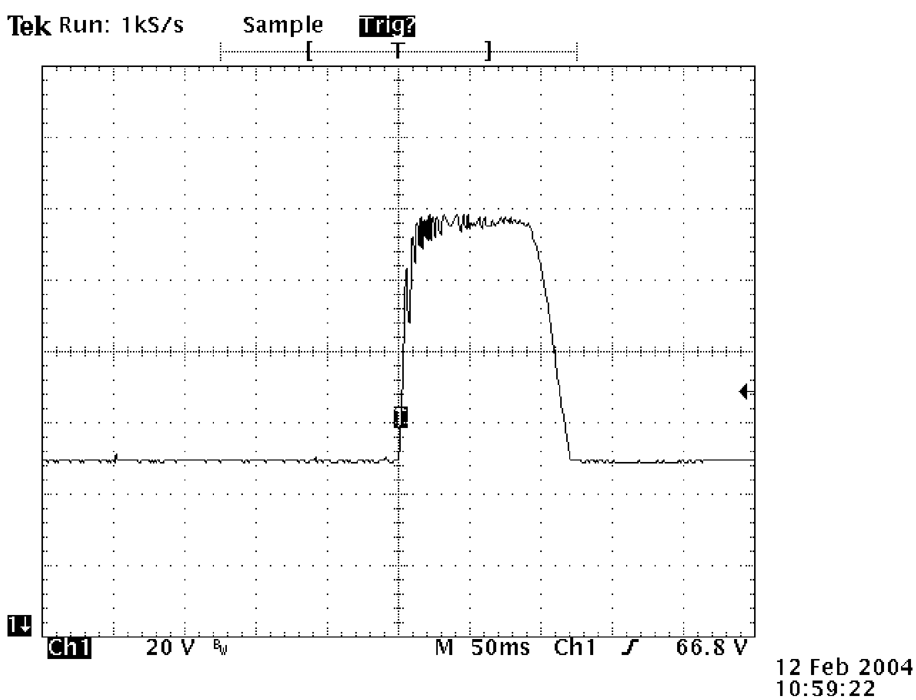

Fig. 1

Note in Fig. 1 the power supply voltage rapidly rises from 48 VDC to 116 VDC at which point the G201's IRF530 MOSFETs enter zener avalanche of its intrinsic drain to source diodes. This avalanche condition lasts for about 100 milliseconds until the motor has decelerated to a speed below which it no longer is returning current. This is a brutal out of spec overload for the G201, yet it survived repeated cycles without damage. Keep in mind the G201 is rated at 80 VDC max.

So, how much energy was returned to the G201? For that answer, a 5,000uF 100VDC capacitor was placed across the power supply terminals and the test was repeated. The results are shown in Fig. 2.

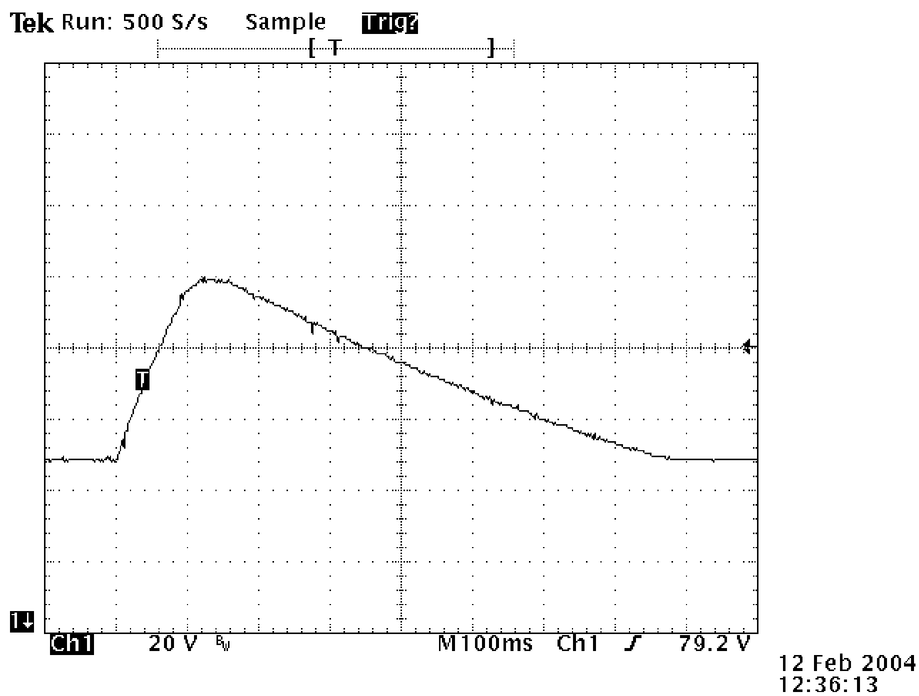

Fig. 2

Note the supply voltage now climbing from 48 VDC to 100 VDC. The energy added to the capacitor is:

Joules = Farads * (V1^2 – V0^2) / 2 = .005 * (100^2 – 48^2) / 2 = 19.24 Joules (A)

The total energy returned is (A) plus the Watt-seconds used by the drive during energy return. This can be calculated from negative slope voltage on the capacitor and is equal to 3.25 Joules. That makes a total of about 22.5 Joules converted back into electrical energy. The difference, 13 Joules (35.5 J – 22.5 J), is mechanically dissipated.

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