Transient Energy Enhances Energy Co-Efficients

by

R. A. Ainslie & B. C. Buckley

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http://www.thequantumkey.com

QUANTUM

The Journal for the Electronics Professional

October 2002

www.crown.co.za

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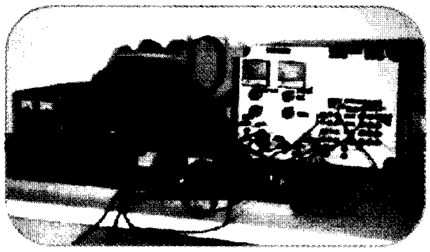
A new technology is proposed that exploits transient energy. Readers are urged to duplicate the experiment and determine the measurements independently.



The experimental apparatus

A switching circuit is applied in an electric system that is intended to dissipate heat in a load. It is widely accepted that it is possible to induce a level of transient voltage that exceeds the voltage potential at the supply source. Therefore, during the 'on' period of a switching cycle, some energy can be delivered and stored in inductive components in a circuit. During the 'off' period this energy can then be delivered back to the energy supply source. The total energy delivered by that supply source would then be the sum of, or difference between, the two cycles. But, if the load is in series with the energy supply source, it would also provide a path of the flow of current.

Energy dissipated in the load is measured as the product of the instantaneous voltage and current applied during both cycles. In effect, energy can be dissipated during both the 'on' and 'off' periods of the switching cycle.

With the following two provisos, experimental results indicate that energy dissipation in a load may be increased by means of the circuit design rather than by increasing the input energy supplied:

The transient voltage must be greater than the potential difference at the supply source.

The switching circuit must provide a path to enable a current flow during both the 'on' and 'off' periods of each switching cycle.

Circuit diagram

This article describes the precise circuit, as depicted in Figure 1, that is used to expose this benefit in transient energy. This is to enable and urge others to duplicate the experiment and determine the measurements independently.

Special components and parameters applied to the circuit

Frequency

There is a variety of settings that can be applied to the duty cycle (note variable resistors) that results in 'over unity' coefficients. But the repeatability of such results depends on the precise components used in that circuit. To ensure that results are repeatable when tested independently, it was decided to apply an oscillating frequency. This setting results in a very high level of energy efficiency where the amount of energy that is dissipated at the load, appears to exceed the amount of energy delivered by the energy supply source. But high frequency voltage waveform analysis requires the use of more sophisticated measuring equipment.

Oscillation, in this application, is intended to describe a switching cycle that is unable to stabilize. The required level of oscillation is achieved by setting the duty cycle at 3.7% 'on' at a frequecy of 2.4 kHz. Reducing the gate

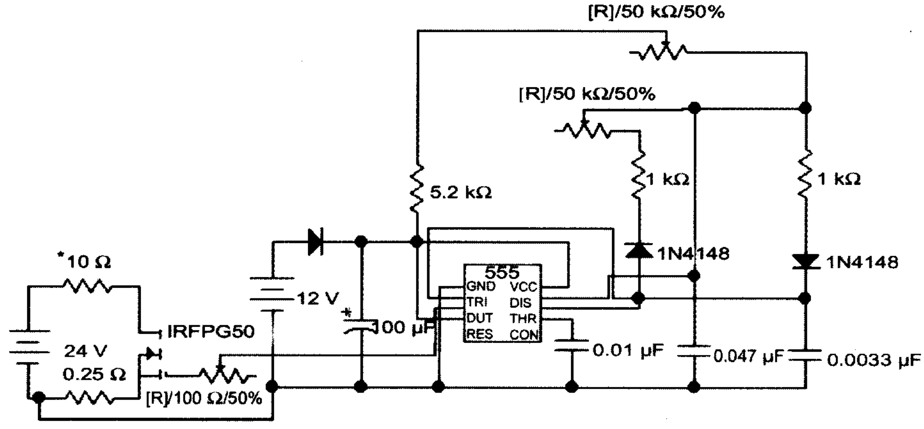


Figure 1: Circuit diagram

current of the mosfet results in an oscillation that overrides the predetermined frequency and duty cycle. The frequency oscillates between 143 kHz and 200 kHz and the duty cycle defaults to approximately 1.3% on.

Measurement apparatus

All voltage measurements were taken using a Fluke 199C (200 MHz, dual channel) storage oscilloscope. The instrument's storage facility allows for about 1 200 simultaneous real time samples.

Intrinsic or parasitic diodes

The solid state switching device used is a mosfet. This is because it has an intrinsic (or parasitic) diode. The diode establishes a path through which current can flow during the 'off' period of the switching cycle. Analysis of the waveform across Shunt 1 indicates that this, in fact, occurs during each oscillating cycle

Schedule of components

Parts list for experiment

	Value	Farnell code
R1	50K Pot 10 turn	351-817
R2	50K Pot 10 turn	351-817
R3	1K.25w	509-164
R4	1K.25w	509-164
R5	5K1.25W	509-164
Preset	100R	614-622
Load	10R	*As per description
Shunt	1R2Wx4	Connected in parallel
Caps		
C1	100µF/16V	228-503
C2	10nF	579-129
C3	33nF	579-154
C4	47nF	579-166
Semiconductors		
D1	1N4007	365-282
D2	1N4148	368-118
D3	1N4148	368-118
U1	NE555	409-364
Q1	IRFPG50	355-744
Batteries		
B1	12V	174-804
B2	24V 2x12V 20ah	Battery Centre

Farnell can be contacted at 086 111 00055
Email: info@automation.co.za
UK+44 870 1200 208
Email: export@farnell.com www.farnell.com

The load resistor was made up by Specific Heat CC
Tel: +27 21 674 2566 Fax: +27 21 674 3759

* RESISTOR: 10 Ohm ceramic, hollow core, wire wound resistor. Length is 150 mm. Diameter 32 mm. 48 turns of resistance wire spaced 1mm.

Schedule of calibration certificates

10 Ohm resistor	1563/JN	21 November 2001
0.25 Ohm resistor	1562/JN	20 November 2001
Fluke oscilloscope		19.12.2001

Measurement of energy dissipated in the load resistor

The load resistor was wound to deliberately yield an inductance. This inductance measures 8.64 µH and generates high voltage spikes during the 'off' period of each switching cycle. However, because the load resistor has such a high relative inductive property (considering the frequency of oscillation) the reactance and impedance of the load resistor varies with each oscillating waveform. These variations make it difficult to determine the accurate instantaneous impedance of the load resistor. Therefore, in order to determine a realistic measure of the energy dissipated in the load it was decided to reference caloric measurements.

Measurement of the rate of temperature rise was enabled through the use of a platinum-based temperature probe fixed to the hollow wall of the resistor, as shown in Figure 2 and Figure 3. This instrument was chosen because it is not affected by the applied high frequency. The probe, in turn, was linked to a digital device that displayed instantaneous readings of temperature change (in degrees Celsius). The test was conducted in a draft-free environment. Ambient room temperature was recorded on the digital display linked to a second identical type platinum-based probe positioned inside a similar resistor.

Figure 2: Temperature probe and load resistor

Figure 3: The temperature probe and coupling in the resistor

The test was allowed to run for a period of about an hour until the temperature stabilized. The difference between ambient room temperature and the rate of temperature rise on the load resistor was assumed to represent the actual rate of temperature rise under test conditions.

The temperature rose to about 52 degrees centigrade above ambient after a little over an hour. At this point it stabilized and remained roughly consistent within the fluctuations of ambient room temperature.

Caloric control test

The same load resistor was allowed to cool and then placed across a variable power supply source as a means to measure comparative temperature rise against an applied DC power in the same draft-free environment. The applied DC voltage was varied until the same temperature above ambient was obtained.

The temperature rise over ambient stabilized at 52 degrees centigrade, when the applied DC voltage from the variable power supply was set at 13.32 volts. This represents 13.32 * 13.32 / 10 = 17.74 watts (v squared over r). Results indicated that an average of 17.74 watts was dissipated at the start of the test period.

Measurement of energy delivered by the battery energy supply source

As stated previously, the voltage waveforms resulting from such an oscillating frequency vary greatly from one cycle to another. The transient voltage spikes that are (deliberately) generated to enhance energy efficiency compound this variation. In order to evaluate a reasonable average of the energy delivered, a sample range was chosen spanning 1.2 micro seconds.

The probes from channel A and B of the oscilloscope were positioned as detailed in Figure 4.

Current flow to and from the battery was determined from the voltage waveform across the 0.25 ohm shunt resistor, divided by its resistance. Batteries are not typically able to deliver a negative current flow. Therefore, it was assumed that any current delivered by the battery would be determined by the instantaneous voltage across the shunt divided by the resistance of the shunt, measured above ground. Correspondingly any current delivered back to the battery would be determined from the instantaneous voltage across the shunt divided by shunt's resistance, measured 'below ground'. The oscilloscope's coupling was set to determine instantaneous direct current voltage measurements.

Multiple waveforms were stored and downloaded to a spreadsheet for analysis. The equation applied to each of those samples was Sigma V × I × Delta T where V equals battery voltage and current (I) is determined from the voltage waveform across Shunt 1 divided by the resistance of Shunt 1. The instantaneous product of each sample (V × I) was determined and the sum of all the samples was then computed. In order to establish the average power delivered during each cycle the sum of all the samples was divided by that sample number. Results indicated that the average power delivered was 1.13 watts.

Measurement of battery discharge rate over 16.5 hours

The following schedule of results as indicated in Table 1 was taken from an experiment that was conducted over a 16.5 hour period to determine the rate at which 2 × 12 volt batteries discharged their energy. During this time, measurements were taken of the temperature rise over ambient from the load resistor—and the voltage drop across the batteries. The average rate of temperature rise was 51.37 degrees centigrade above ambient. The average wattage, as it related to temperature rise (Caloric Control test) was 17.53 watts.

This, in turn resulted in a total of 1.22 Mega joules dissipated over the entire test period. The wattage measured to have been delivered by the battery energy supply source was 1.13 watts * 997 minutes * 60 seconds being 67 596 joules. The voltage measured across the battery fluctuated during the test period. But there was no evidence of any significant battery voltage reduction that could be reasonably ascertained. Note that the battery voltage remained above 24 V.

This extended test period had the added advantage of testing the experimental results over a more significant duration of time to determine that neither the energy dissipated in the load resistor nor the energy delivered by the battery was a purely transitory phenomenon. The evaluation of the performance of the batteries, in terms of their rated capacities, was omitted as the performance of these lead acid batteries typically vary from their watt-hour ratings. Such evaluations are widely considered to be subject to too many vagaries to represent dependable results.

Time	Computer clock—not calibrated
Minutes	Test period in minutes
Temp on load	Measured on the digital display device linked to the temperature probe coupled to the load resistor on the test circuit
Temp over ambient	Measured on the digital display device coupled to a similar load
Over ambient	Difference between the test and ambient temperature
Battery voltage	Instantaneous battery voltage read from the digital display of the Fluke oscilloscope with probes placed directly across the battery energy supply source

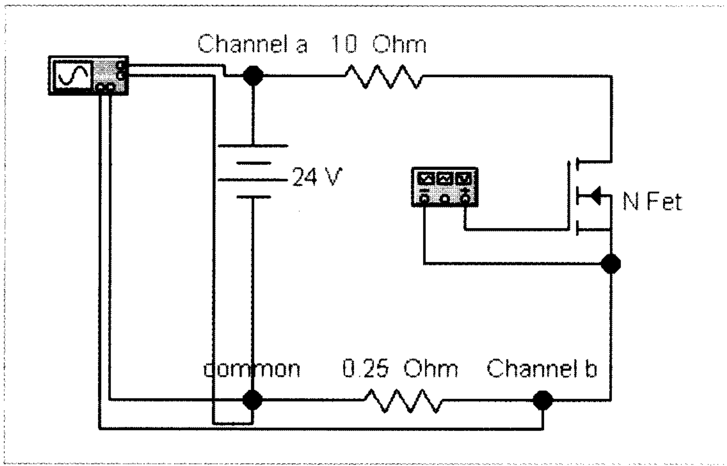


Figure 4: Oscilloscope probes positioning

Time	Minutes	Temp Load	Temp Ambient	Over Ambient	Battery Volts	Joules	Control Watts
17.31		69.50	21.40	48.10	24.80		16.41
18.00	29	69.50	18.40	51.10	24.80	30333.37	17.43
19.00	89	69.70	17.70	52.00	24.80	94731.64	17.74
20.00	149	69.50	17.60	51.90	25.10	158290.68	17.71
21.02	211	68.50	17.40	51.10	24.80	220701.39	17.43
22.01	270	68.90	17.50	51.40	24.70	284072.11	17.54
23.02	332	68.10	17.30	50.80	24.60	345226.01	17.33
24.00	390	67.60	17.30	50.30	24.60	401545.08	17.16
8.08	878	65.10	16.60	48.50	24.30	871641.65	16.55
9.30	960	64.80	16.10	48.70	24.70	956977.91	16.61
9.53	983	71.10	16.80	54.30	25.10	1092584.58	18.52
10.07	997	76.50	16.60	59.90	24.30	1222429.15	20.44
Results	997			51.37	24.76	1222429.15	17.53

Table 1: Schedule of results over 16.5 hours test period

Joules	Watts per Control Watts × time
Control Watts	Calorific Control test determined that 17.74 watts represents a temperature rise of 52 degrees centigrade over ambient. (See paragraphs *Measurement of Energy Dissipated* in Load Resistor and Caloric Control Test). Therefore, 17.74/52=0.34 watts as a factor per degree centigrade over ambient. Power (Watts) is therefore determined as the difference between test and ambient temperature times this factor, to give a broad indication of power (watts) dissipated at the load resistor.

Results

Energy dissipated at load resistor	1.22 Mega joules
Energy delivered by the 2 × 12 volt batteries	67.6 Kilo joules

Review of experimental results

The method to involve independent entities and authorities was proposed as a supplementary method to review the experimental results. It was determined that this process was required because of the anomalous and contentious nature of the claims that are associated with this proposed technology.

The companies listed below have approved the inclusion of their name in this article and, together with the authors of this article, recommend a wider forum for systematic and statistical consideration of this experiment and its results:

- The Cape Hope Metrology Laboratory confirmed that test equipment had been calibrated at Tellumat's Metrology Laboratory
- Spescom, as distributors of Fluke instruments, who attended demonstrations
- ABB Electric Systems Technology Institute in North Carolina who conducted independent tests. Here tests were confined to the evaluation of instantaneous power delivered simultaneously by the battery supply source and dissipated in the load—measurements enabled through the use of four channel oscilloscopes
- Jonathan Green of BP (Africa) who applied tests to measure the effect of the energy gains on battery duration.
- Sasol representatives who are offering a bursary award to encourage further research.
- J De Bruto of Power Engineers.

Conclusions

It would be reasonable to assume a maximum of 10% error on all temperature measurements as the caloric test conditions were crude.

Error margin ratings applied to the Fluke 199 C oscilloscope, as this relates to the voltage measurements across the Shunt 1 and the battery, are 10% and 1.5% respectively, at the highest frequencies applied to these tests. By discounting all the negative voltage sample measurements by 10%, results still indicate a coefficient in excess of 16 over the energy delivered.

Because of the approximations related to the measurement of energy—based on the rate of temperature rise—it was necessary to reference values that were significantly greater than ambient. To this end, a 24 volt (2 × 12 volt) battery was used to supply energy to the test circuit.

However, the switching circuit could not be energized directly from this battery because its fluctuating voltage reached voltage levels that were incompatible with components used for the switching circuitry. Therefore a separate 12 volt, dry cell, 4 ampere hour battery supply source was used to supply energy to the switching circuit. This battery was fully charged and measured 12.45 volts prior to being connected to the switching circuit.

At the conclusion to the 16.5 hour testing period, its open-terminal voltage was measured to be 12.04 volts. This voltage reduction was consistent with the small current flow (0.039 A) required to drive the switching circuit over the 16.5 hour test period. Therefore the apparent additional energy that was introduced to the experimental system could not have emanated from this source.

The experimental circuit and results are easily repeatable. Classical models of energy transfer preclude any advantage to using a switching system to enhance efficiency for purposes of dissipating heat. It would, therefore, have been an extraordinary undertaking to test classical hypotheses, unless there was also some reason to question classical models of energy transfer.

Although a great deal of investigation of the phenomenon is still required to develop the mathematical constructs for application of this technology, preliminary investigations and reports reveal findings that may be consistent with claims of this technology. Q