Re: 555 − Adjustable duty cycle circuit questions

Source: http://sci.tech−archive.net/Archive/sci.electronics.basics/2004−07/1212.html

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From: Rubicon (*no email*)
Date: 07/28/04

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Date: Wed, 28 Jul 2004 06:38:15 GMT
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John,

Thankyou for all the information. It's late after an evening of experimenting and I hope you'll forgive me if I don't post much of a reply.

I'll make up a circuit diagram of what I've got and understand and upload it to some space I have for all to look at and comment upon soon.

Regards,

Andrew.

On Mon, 26 Jul 2004 11:08:07 −0400, John Popelish <jpopelish@rica.net> wrote:

>Rubicon wrote:
>>
>> John,
>>
>> I have a circuit consuming 3.8mA comtrolling another circuit consuming
>> up to 500mA both from a 9V battey and I thought that the 555 (P.D.M)
>> circuit could increase the batteries "life" by having the first
>> circuit on only a part of the time − half a second on/half a second
>> off. As it consumes 3.8mA I hoped that a CMOS 555 with its 10mA output
>> current source could switch it directly.
>
>It certainly will not provide 10 milliamps with zero voltage drop. but
>the drop may be acceptable. This data sheet:
>http://cache.national.com/ds/LM/LMC555.pdf
>specifies no more than a .6 volt drop for pull up with a 5 volt supply
>and a 2 mA load for a pull up resistance of 300 ohms. But with a 12
>volt supply, the pull up voltage drop is no more than 1.5 volts with a
>10 mA load for a pull up resistance of 150 ohms. With a 9 volt
>supply, I would expect a value between these two. Something on the
>order of 200 ohms, perhaps. So a 3.8 mA load would drop about .7 or

>.8 volts across the LMC555 pull up output.
>
>If you could operate your 3.8 mA load during the pull down part of the
>cycle, the LMC555 output resistance would be between 75 and 40 ohms.
>
>> Another problem I have is that the first circuit triggers a CMOS 555
>> to switch on a 3VDC/500mA geared motor for about 15 seconds via a
>> BD139 NPN transistor. The transistor controls a LM317 regulator set to
>> 3VDC out which powers the motor (Motors V+ to LM317 3V+out, Motors V−
>> to transistors collector with LM317 V−). The motor has the required
>> diode and caps and a cap from the LM317 V+out to the transistors
>> emitter. The whole thing works from a 9VDC regulated power supply
>> (wall wart) but not well from a 9V battery. The startup surge of the
>> motor is 500mA then settles to approx 290mA and the geared motor
>> rotates but with less torque. I could adjust the LM317 for more
>> voltage out I suppose.
>>
>> In a previous post when I first started using a 555 and asked
>> regarding the running of a 3VDC motor from a 9V battery and triggered
>> by a 555 John Popelish wrote:
*>> *******
>> Simplest and most efficient are two different solutions. A series
>> resistor that sets the speed to about what you need is probably the
>> simplest. The most efficient would be a something like a second 555
>> timer set to mid ot high kilohertz frequency , gated on by the slow
>> 555 described, above, to act as a pulse duty modulator to lower the
>> average voltage applied to the motor. If it puts out a pulse width
>> that is about 1/3 of the total cycle time, the average voltage to the
>> motor will be about 1/3 of the supply voltage, with no intentional
>> losses. And the battery current will average a little more than 1/3
>> of the motor current, extending the battery life, considerably. But
>> you will have ot pay more attention to transistor turn on and turn off
>> times and use a fast diode (Schottky) across the motor to keep the
>> switching losses low.
*>> *******
>>
>> Not yet figured out the values for the 555 pulse duty modulators or
>> the transistor. I think that the output of one 555 should be
>> capacitively coupled to the trigger of the next but not sure.
>> Not even sure that the LM317 will like being switched by the 555 and
>> the transistor and what exactly is mid to high kHz frequency? 30kHz+?
>>
>> As always any help is appreciated.
>>
>> Andrew.
>
>If you use a 1/3 duty cycle pulse to drive the 3 volt motor from a 9
>volt source, the average voltage is 3 volts (9 volts 1/3 of the time,
>0 volts 2/3 of the time) so there is no use for the voltage regulator
>at all. The duty cycle replaces the regulator. The difference as far
>as the battery is concerned is that with the regulator, the battery

>current equals the motor current at all times, but with the duty cycle
>version, the battery current equals the motor current only during the
>1/3 on time. During 2/3 of the time, the motor current coasts through
>a flyback diode, and the battery current is zero. So the average
>battery current (over the pulse cycle) is about 1/3 of the motor
>current. A 500 mA motor current is produced with an average battery
>current of about 167 mA.
>When the motor gets going and its current falls to 290 mA, the battery
>current will approach 100 mA. The only reason the battery current
>will not be exactly 1/3 of the motor current is he small power loss in
>the switch and flyback diode.
>
>And there is no reason to do this switching at 30 kHz, except ot make
>the process quiet. 5 to 10 kHz is probably plenty fast to allow the
>motor inductance to hold the current roughly constant during a cycle
>(though you should verify the current ripple before finalizing the
>design). Remember that each switching process adds a bit if loss to
>the operation.
>
>– –
>John Popelish