DQG 26650 driver hacking

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79 replies [Last post]

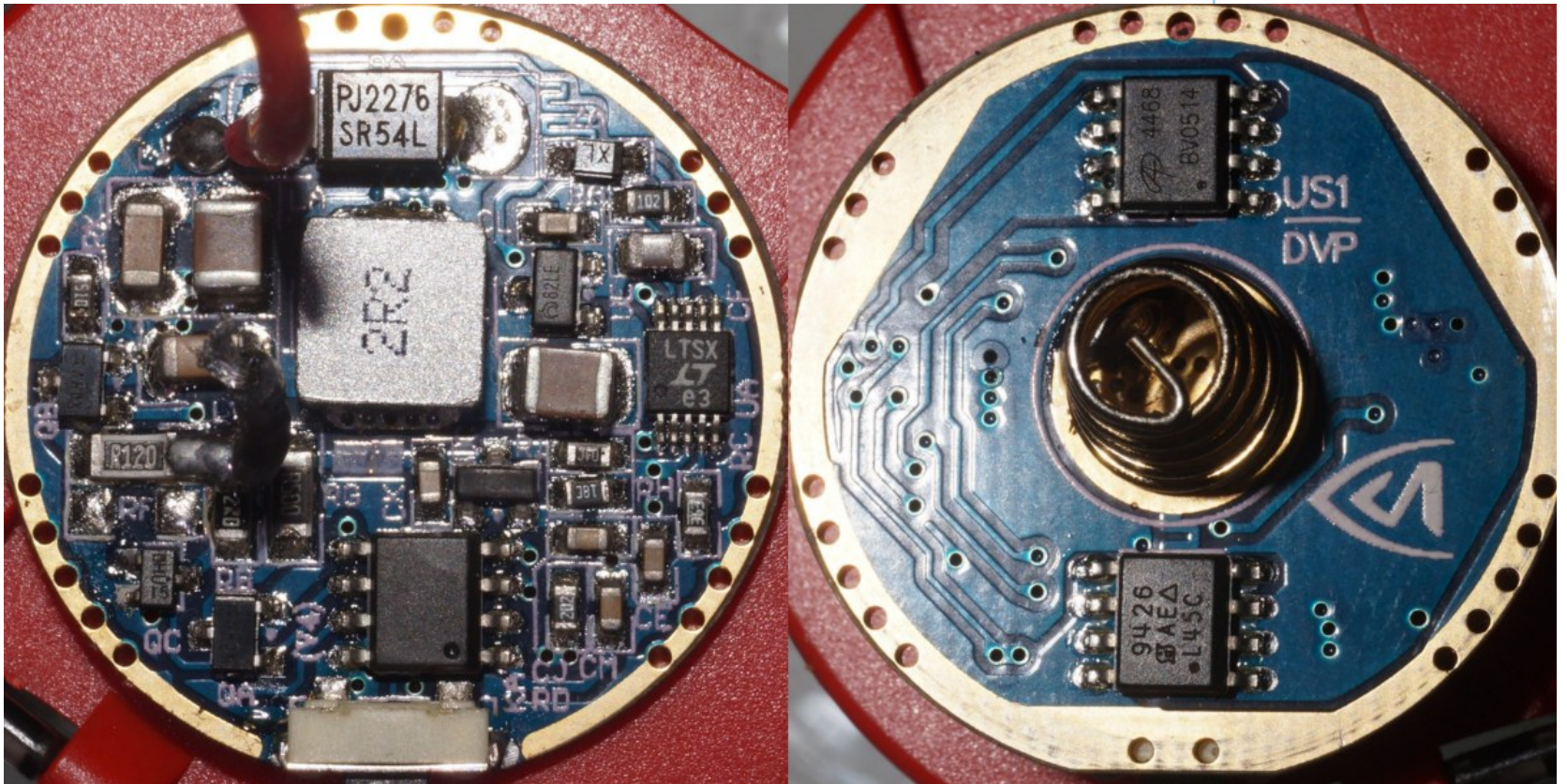Sun, 05/25/2014 - 08:27

comfychair

Offline

Last seen: 12 weeks 2 days ago
Title: ★★★★★
Joined: 01/12/2013
Posts: 5873

I poked and prodded at this a little bit, but not all that much so far, mostly because I can't make any sense of what I found. Can't ID the controller, and the pin layout is utterly alien.

There's no direct path to ground on ANY pin. Switch goes between two pins, no path to ground on either switch pin. I only followed the traces out to their first component. Dashed lines are traces on the battery side of the board.
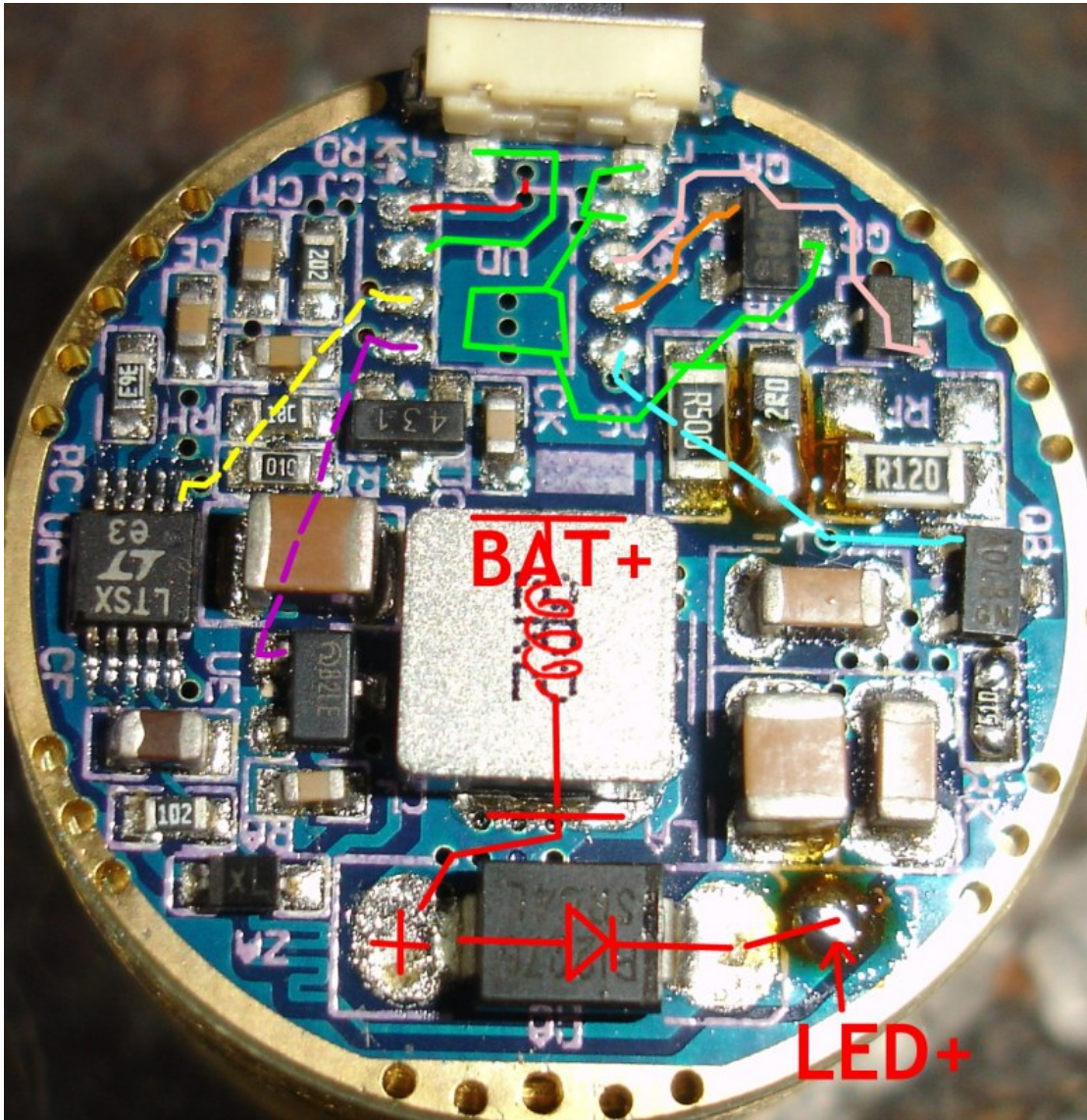
Pin #1 goes to B+. Pin #3 goes to the LTSX e3 boost controller, but it is NOT, from anything I am able to measure, a PWM-ed signal.

No markings whatsoever on the top of the controller, hidden on the underside is 'OQ1313', which I can't find any relevant info on.
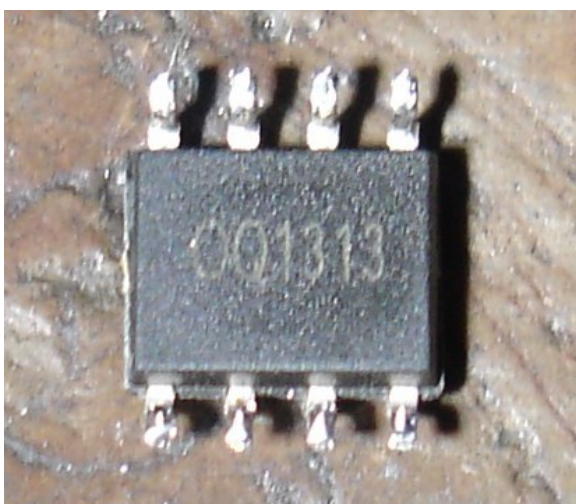
The driver in stock form, being a boost driver, will run a single MTG2 perfectly fine from only one cell... shame there's no room for that in the super-skinny head.

_____

...

Sun, 05/25/2014 - 11:06   #1

wight
Online

Last seen: 5 min 49 sec ago
Title: ★★★★★
Joined: 11/27/2013
Posts: 4179
Location: Virginia, USA

Good work so far. To make

Good work so far. To make sure I understand what you are saying, your DMM does not show continuity between any of the U1 pads and GND?

Is this the chip we suspect LTSX E3 to be: LTC1871 ?

What is the voltage between Pin 1 (red) and Pin 8 (green)? EDIT: in other words, looks like a PIC to me if that voltage is appropriate.

EDIT2: So that's the RUN pin on the LTC1871, looks like it's being used as a shutdown pin here. Pulling that pin low (below 1.248v) should result in no light. Pulling it high should turn the light on. I do not immediately see how modes are handled.

_____

WTS Lux-Pro 2D MT-G2 8xAA HIGH-current e-switch Conversion Kits ~~old teaser thread~~

Released Drivers: 17mm/20mm/26/27mm *single-sided* DD/FET driver [AxxDD-SO8] || 17mm 8x7135 with Zener & dual-PWM [A17PZL] || 22mm 16x 7135 driver [A22-7135]

WIP Drivers: 17mm double-sided & 20mm+ single sided 4Amp+ linear driver [A17LDX] || 17mm+ single sided DD driver w/ low parasitic drain [A17DD-LDO?] || *15mm* single-sidedDD+single-7135: LFPAK33 FET driver with one 7135 for moonlight mode || 17mm *single-sided* DD+single-7135: FET driver with one 7135 for moonlight mode || 17mm DD+7135: linear regulated driver w/ FET turbo || 15mm Low profile DD driver with big FET [A15DD-SO8] || *On Hold: 17mm QX5241 5Amp 1-4 LED 2-4s Li-Ion Buck driver*

Sun, 05/25/2014 - 11:23   #2

comfychair

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Last seen: 12 weeks 2 days ago
Title: ★★★★★
Joined: 01/12/2013
Posts: 5873

None, zero, of the MCU pins

None, zero, of the MCU pins go to ground. Ground's gotta be supplied by one of the other components only after switch-on, and then removing the ground to turn off.

Yes, LTSX chip is LTC1871. I'm hoping to ignore as much of the power side of the circuit as possible - that part works fine, it just needs a way to get a better UI in there. Checking it (MCU #3/LTSX 'RUN' pin) while powered up with the Hz scale on the DVOM shows 0Hz, it just changes the voltage for the different modes. I'm pretty confident that's accurate since the same check on pin #6 of an ATtiny shows Hz that correlates to the firmware version it's running (9kHz/19kHz).

_____

...

Sun, 05/25/2014 - 11:36   #3

wight
Online

Last seen: 5 min 49 sec ago
Title: ★★★★★
Joined: 11/27/2013
Posts: 4179
Location: Virginia, USA

What voltages (approximately)

What voltages (approximately) did you see for different modes?

Can you re-install the MCU and check the voltage I asked about (pin 1 to pin 8)?

_____

WTS Lux-Pro 2D MT-G2 8xAA HIGH-current e-switch Conversion Kits ~~old teaser thread~~

Released Drivers: 17mm/20mm/26/27mm *single-sided* DD/FET driver [AxxDD-SO8] || 17mm 8x7135 with Zener & dual-PWM [A17PZL] || 22mm 16x 7135 driver [A22-7135]

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Sun, 05/25/2014 - 11:49   #4

comfychair

Offline

Last seen: 12 weeks 2 days ago
Title: ★★★★★
Joined: 01/12/2013
Posts: 5873

I don't recall the voltages

I don't recall the voltages at the RUN pin; it was B+ or less, otherwise it would have been weird enough I would have written it down. I can resolder and test but I'd rather not if there's other things to check while it's still removed. If what I have on the diagram so far is enough and everything else can be done with it put back together that's no problem.

I also can't find a ground pin at the LTC1871; #6/GND does not go to ground. #10/'SENSE' pin goes to B+, #9/'Vin' does not.

Wait - this is a boost driver, with LED+ going to B+ (through the flyback diode & inductor), this thing boosts by running LED- at a negative voltage? What the hell is that about? What if the MCU #1, that goes to B+ is actually the ground, and the + supply is from a voltage boosted up above B+?

_____

...

Sun, 05/25/2014 - 12:24   #5

wight
Online

Last seen: 5 min 49 sec ago
Title: ★★★★★
Joined: 11/27/2013
Posts: 4179
Location: Virginia, USA

I'm not sure what else to

I'm not sure what else to check with it off. You've taken pics already. You can wait for the rest of the jury to come in, but I think biting the bullet and putting it back together is probably the next step.

Analog voltages coming out of a cheap MCU is pretty abnormal I think, that requires a DAC.

I'm with you on pulling LED- lower than BAT- in order to drive the LEDs from BAT+. The rest of what you said doesn't really add up though, there's no reason to drive an MCU in that way. As far as I know there are only 2 commonly used MCUs that could be in play: PIC and ATtiny. PIC meets the pinout I mentioned, ATtiny doesn't. ATtiny also doesn't match up with the crazy boost-circuit-drives-MCU-theory pad layout, so I think we can set that theory aside until measurements show it should be considered again.

~~There is a negative voltage application circuit in the datasheet.~~ EDIT: nevermind, that's not applicable here. Another look at the application circuits shows that it's probably driving the LEDs with a positive voltage higher than BAT+.

_____

WTS Lux-Pro 2D MT-G2 8xAA HIGH-current e-switch Conversion Kits *old teaser thread*

Released Drivers: 17mm/20mm/26/27mm *single-sided* DD/FET driver [AxxDD-SO8] **||** 17mm 8x7135 with Zener & dual-PWM [A17PZL] **||** 22mm 16x 7135 driver [A22-7135]

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Sun, 05/25/2014 - 12:26 #6

comfychair

Offline

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Title: ★★★★★
Joined: 01/12/2013
Posts: 5873

The LED+ pad goes to the big

The LED+ pad goes to the big diode, then from the diode to the inductor, and the other side of the inductor sits right on top of the vias coming through from the B+ spring on the other side. There's no way for LED+ to be higher than B+ in that layout.

_____

...

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Sun, 05/25/2014 - 12:28 #7

wight

Online

Last seen: 5 min 49 sec ago
Title: ★★★★★
Joined: 11/27/2013
Posts: 4179
Location: Virginia, USA

Take a look at the "Typical

Take a look at the "Typical Application" section on page 1 of the datasheet?

_____

WTS Lux-Pro 2D MT-G2 8xAA HIGH-current e-switch Conversion Kits *old teaser thread*

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Sun, 05/25/2014 - 12:54 #8

comfychair

Offline

Last seen: 12 weeks 2 days ago
Title: ★★★★★
Joined: 01/12/2013
Posts: 5873

LOL, that's way beyond

LOL, that's way beyond anything I'm able to make sense of, especially in which parts of the example are relevant to the actual driver circuit and which parts are being done in some other way (like, how 'GND' in the diagram is something different than what I see on the driver - it's not battery ground).

_____

...

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Sun, 05/25/2014 - 13:25 #9

wight

Online

Last seen: 5 min 50 sec ago
Title: ★★★★★
Joined: 11/27/2013
Posts: 4179
Location: Virginia, USA

My real guess as to some of

My real guess as to some of this complexity is that they are doing something similar to what I suggested for converting the Knucklehead v3 to e-switch: ~~latching~~ turning all the components "on" while the button is depressed, and then holding (eg latching) them that way with the MCU and some small transistors until such time as the MCU sees fit to turn them off again (further button presses, LVP, etc). If that's what's happening it's in order to eliminate as much parasitic drain as possible. That's a lot of guesswork though.

What manufacturer is the sickle / swoosh mark on the part marked 82LE? I do not recognize the mark.

_____

WTS Lux-Pro 2D MT-G2 8xAA HIGH-current e-switch Conversion Kits *old teaser thread*

Released Drivers: 17mm/20mm/26/27mm *single-sided* DD/FET driver [AxxDD-SO8] **||** 17mm 8x7135 with Zener & dual-PWM [A17PZL] **||** 22mm 16x 7135 driver [A22-7135]

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Sun, 05/25/2014 - 13:25 #10

comfychair

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Last seen: 12 weeks 2 days ago
Title: ★★★★★
Joined: 01/12/2013
Posts: 5873

OK I'm lost. Using a 18650 at

OK I'm lost. Using a 18650 at 3.98v and a single MTG2. In low mode, I get 3.98v at the input side of the inductor, 3.98v at the output side of the inductor, 3.98v at the diode's left pad, and... 5.24v at the diode right pad/LED+, which drops to B+ voltage when turned off.

LED+ to battery ground is 5.24v, LED- to battery ground is just a few mV.

MCU pin 1 to pin 8 is battery voltage. And, now, pin 8 has continuity to the ground plane. Makes no sense - how did reattaching the MCU create a ground, when none of the empty pads go to ground? Pin 8 is still ground even with the battery disconnected, so it's not being supplied by some other component. It's just there now.

(on 'turbo', it sends 6.48v to the MTG2, so in stock form it does a pretty serious output)

_____

...

Sun, 05/25/2014 - 13:27 #11

wight
Online
Last seen: 5 min 50 sec ago
Title: ★★★★★
Joined: 11/27/2013
Posts: 4179
Location: Virginia, USA

eehh. Dunno. Is Pin8 ground

eehh. Dunno. Is Pin8 ground while the light is switched off and the battery is disconnected?

_____

WTS **Lux-Pro 2D MT-G2 8xAA HIGH-current e-switch Conversion Kits** *old teaser thread*

Released Drivers: 17mm/20mm/26/27mm *single-sided* DD/FET driver [AxxDD-SO8] || 17mm 8x7135 with Zener & dual-PWM [A17PZL] || 22mm 16x 7135 driver [A22-7135]

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Sun, 05/25/2014 - 13:29 #12

comfychair

Offline
Last seen: 12 weeks 2 days ago
Title: ★★★★★
Joined: 01/12/2013
Posts: 5873

Pin 8 has continuity to

Pin 8 has continuity to ground at all times no matter what.

_____

...

Sun, 05/25/2014 - 13:31 #13

wight
Online
Last seen: 5 min 50 sec ago
Title: ★★★★★
Joined: 11/27/2013
Posts: 4179
Location: Virginia, USA

Well then.

Well then. 😵 [/offended-by-circuit-that-changes]

Does your meter measure RMS voltage?

_____

WTS **Lux-Pro 2D MT-G2 8xAA HIGH-current e-switch Conversion Kits** *old teaser thread*

Released Drivers: 17mm/20mm/26/27mm *single-sided* DD/FET driver [AxxDD-SO8] || 17mm 8x7135 with Zener & dual-PWM [A17PZL] || 22mm 16x 7135 driver [A22-7135]

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Sun, 05/25/2014 - 13:37 #14

wight
Online
Last seen: 5 min 50 sec ago
Title: ★★★★★
Joined: 11/27/2013
Posts: 4179
Location: Virginia, USA

OK, pay no attention to the

OK, pay no attention to the application circuit on page 1. That's bootstrapping the LTC1871 to 5v, so that's not what we want to pay attention to. Page 23 is starting to look like what we have here.

_____

WTS **Lux-Pro 2D MT-G2 8xAA HIGH-current e-switch Conversion Kits** *old teaser thread*

Released Drivers: 17mm/20mm/26/27mm *single-sided* DD/FET driver [AxxDD-SO8] || 17mm 8x7135 with Zener & dual-PWM [A17PZL] || 22mm 16x 7135 driver [A22-7135]

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Sun, 05/25/2014 - 13:42 #15

wight
Online
Last seen: 5 min 50 sec ago
Title: ★★★★★
Joined: 11/27/2013
Posts: 4179
Location: Virginia, USA

For your purposes, let's get

For your purposes, let's get back to the point: We really need to know signal behavior during operation if you want to convert this to run on an ATtiny.

What is the behavior of X pin during on, off, and modes:

- yellow
- purple
- pink
- orange
- blue

I suspect that most of them are simply on/off: they are either pulled high or low when the light is on.

_____

WTS **Lux-Pro 2D MT-G2 8xAA HIGH-current e-switch Conversion Kits** *old teaser thread*

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Sun, 05/25/2014 - 13:58   #16

comfychair

Offline

Last seen: 12 weeks 2 days ago
Title: ★★★★★
Joined: 01/12/2013
Posts: 5873

Highly unlikely on the meter,

Highly unlikely on the meter, it's a cheapie: http://www.prokits.com.tw/en/product/product_detail.asp?catid=1&itemid=M...

I have a Fluke, but it's a low-end model and many many years old.

I'll get back to this later tonight or tomorrow, got a migraine that feels like a small furry sharp-clawed and very unhappy animal is trapped between my brain & skull...

_____

...

Sun, 05/25/2014 - 14:01   #17

wight

Online

Last seen: 5 min 50 sec ago
Title: ★★★★★
Joined: 11/27/2013
Posts: 4179
Location: Virginia, USA

Good luck with the migraine.

Good luck with the migraine.

_____

WTS Lux-Pro 2D MT-G2 8xAA HIGH-current e-switch Conversion Kits *old teaser thread*

Released Drivers: 17mm/20mm/26/27mm *single-sided* DD/FET driver [AxxDD-SO8] || 17mm 8x7135 with Zener & dual-PWM [A17PZL] || 22mm 16x 7135 driver [A22-7135]

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Sun, 05/25/2014 - 14:07   #18

comfychair

Offline

Last seen: 12 weeks 2 days ago
Title: ★★★★★
Joined: 01/12/2013
Posts: 5873

It's a regular thing, if it

It's a regular thing, if it weren't I'd be convinced I was dying. 🙂

_____

...

Fri, 06/06/2014 - 02:35   #19

comfychair

Offline

Last seen: 12 weeks 2 days ago
Title: ★★★★★
**Joined:** 01/12/2013
Posts: 5873

OK... with power connected

OK... with power connected but the light off, I have battery voltage at pins 1, 2, & 4, nothing on the other pins (pin 8 is ground). Switched on, in low mode, puts battery voltage on pin 3. Medium = B+ at pin 7. High = B+ at pin 6. And turbo = B+ at pin 5. The 4 output pins are run only one at a time (when one is 'on', all the others are off). No measurable PWM signal anywhere. 🙄

_____

...

Fri, 06/06/2014 - 08:59   #20

RMM
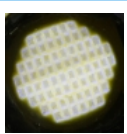
Offline

Last seen: 4 hours 8 min ago
Title: ★★★★★
Joined: 07/23/2013
Posts: 2215
Location: USA

I couldn't figure it out

I couldn't figure it out either when I had a broken one, which had lost the lowest mode. This driver is more complex / alien than anything else I've seen in these lights. Even with all of the components stripped, there isn't really a solid ground signal hardly anywhere. I ended up scraping off some mask around the edge to get a good ground connection for the piggybacked FET driver.

_____

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Fri, 06/06/2014 - 23:31   #21

wight

Online

Last seen: 5 min 50 sec

With comfychair's most recent

~~With comfychair's most recent results, things sound more simple than you might think.~~

~~disclaimer: I'm not going to re-read the datasheet right now. I am a little tired/slow at the moment and I could have stuff wrong.~~

That said, it seems clear from what comfy has checked that varying the Run pin's voltage dims this device. It seems that the Run pin probably feeds a comparator. I don't know why we aren't using PWM on that pin, maybe it's not allowed. Pulling the Run pin low does put the chip in SHDN mode, so maybe that's a problem. Whatever. The point is that in order to feed it a variety of voltages the MCU just turns up different pins. We can easily emulate *that* behavior with an MCU of our own.

Since these 4 voltages are "reference" voltages (negligible current draw), we don't need anything fancy to generate them. We an use a regulated voltage to start with (I think the LTC1871 actually provides one, INTVcc) and then modify it from there. Voltage dividers can be used to provide whatever voltage we want below the reference voltage. I think that's the most flexible method, so that's what I'm thinking they'd use. We'll have to take a closer look. In order to switch the 4 voltages on and off we simply use little transistors to toggle the voltage from the INTVcc to the dividers. That idea may have a problem with too many resistors in play. Maybe we use two transistors for each voltage, one before and one after the divider. Or maybe we throw in some diodes, but that could get messy with tolerances? I'll have to sketch it up and take a closer look at the PCB pics.

Hopefully I get the wheels turning in your heads, I'll come back to this.

EDIT: Wrong.

_____

WTS Lux-Pro 2D MT-G2 8xAA HIGH-current e-switch Conversion Kits old teaser thread

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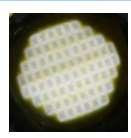
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Fri, 06/06/2014 - 11:32 | #22

RMM

Offline
Last seen: 4 hours 8 min ago
Title: ★★★★★
Joined: 07/23/2013
Posts: 2215
Location: USA

You got the wheels

You got the wheels turning...I am still lost.

_____

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Fri, 06/06/2014 - 19:32 | #23

comfychair

Offline
Last seen: 12 weeks 2 days ago
Title: ★★★★★
Joined: 01/12/2013
Posts: 5873

Pins 1, 2, & 4 have B+ any

Pins 1, 2, & 4 have B+ any time power is connected, light on or off (edit: OK, well I suppose pin 2 will be pulled low while the switch is pressed, but you know...). Pin 8 is gnd. That leaves four pins, 3, 5, 6, & 7.

low:
3: B+, 5: x, 6: x, 7: x

mid:
3: x, 5: x, 6: x, 7: B+

high:
3: x, 5: x, 6: B+, 7: x

turbo:
3: x, 5: B+, 6: x, 7: x

('x' is no voltage/no discernible actual signal... seems to be floating when not being used, reading is a few mV and is affected by connecting/disconnecting the probes, they aren't being used for anything at all)
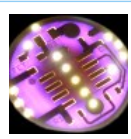
_____

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Fri, 06/06/2014 - 19:36 | #24

comfychair

Offline
Last seen: 12 weeks 2 days ago
Title: ★★★★★
Joined: 01/12/2013
Posts: 5873

Or, maybe pin 8 is pulled

Or, maybe pin 8 is pulled <u>high</u> when the switch is pressed, instead of pin 2 pulled low, given the way #8 did not have a ground until the MCU was re-soldered.

_____

...

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Fri, 06/06/2014 - 22:43 | #25

wight

Online
Last seen: 5 min 50 sec ago
Title: ★★★★★
Joined: 11/27/2013
Posts: 4179
Location: Virginia, USA

Comfy, there is at least one

Comfy, there is at least one small SMD diode in the circuit. That potentially means that the polarity of your DMM leads could matter. Checking continuity from one point to another with a diode in between will only work with the leads on one direction.

_____

WTS Lux-Pro 2D MT-G2 8xAA HIGH-current e-switch Conversion Kits old teaser thread

Released Drivers: 17mm/20mm/26/27mm *single-sided* DD/FET driver [AxxDD-SO8] || 17mm 8x7135 with Zener & dual-PWM [A17PZL] || 22mm 16x 7135 driver [A22-7135]

WIP Drivers: 17mm double-sided & 20mm+ single sided 4Amp+ linear driver [A17LDX] || 17mm+ single sided DD driver w/ low parasitic drain [A17DD-LDO?] || *15mm* single-sidedDD+single-7135: LFPAK33 FET driver with one 7135 for moonlight mode || 17mm *single-sided* DD+single-7135: FET driver with one 7135 for moonlight mode || 17mm DD+7135: linear regulated driver w/ FET turbo || 15mm Low profile DD driver with big FET [A15DD-SO8] || *On Hold: 17mm QX5241 5Amp 1-4 LED 2-4s Li-Ion Buck driver*

#26

comfychair

Offline

Last seen: 12 weeks 2 days ago
Title: ★★★★★
Joined: 01/12/2013
Posts: 5873

I had the negative probe

I had the negative probe clipped to the ground ring for everything in the most recent measurements.

_____

...

#27

wight
Online

Last seen: 5 min 50 sec ago
Title: ★★★★★
Joined: 11/27/2013
Posts: 4179
Location: Virginia, USA

I think I misunderstood

I think I misunderstood something you said earlier

> *comfychair* wrote:
>
> it just changes the voltage for the different modes.

Were you saying that the voltage on the run pin changes as modes change **or** that the LED+ voltage changes as modes change?

EDIT: Specifically what I'm asking is whether the voltage on the run pin changes as modes change. If so what kind of values are we seeing?

_____

WTS Lux-Pro 2D MT-G2 8xAA HIGH-current e-switch Conversion Kits *old teaser thread*

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#28

comfychair

Offline

Last seen: 12 weeks 2 days ago
Title: ★★★★★
Joined: 01/12/2013
Posts: 5873

The 'run' pin at the LTC1871

The 'run' pin at the LTC1871 has 0v with power connected but the light off, and battery voltage in all modes when the light is on. The battery voltage drops a little for each higher mode, but it's still the same as whatever Vin is.

_____

...

#29

comfychair

Offline

Last seen: 12 weeks 2 days ago
Title: ★★★★★
Joined: 01/12/2013
Posts: 5873

What about this? (L/M/H/T -

What about this? (L/M/H/T - LTC1871 pins 6-10)

10 sense: 29kHz/890kHz/1.3MHz/1.3MHz
9 Vin: 1.45kHz/32kHz/656kHz/3.24MHz
8 INTVcc: n/a
7 gate: 45kHz/340kHz/657kHz/657kHz
6 gnd: n/a

_____

...

#30

wight
Online

Last seen: 5 min 50 sec ago
Title: ★★★★★
Joined: 11/27/2013
Posts: 4179
Location: Virginia, USA

Thanks, I had a serious

Thanks, I had a serious misunderstanding about that. My theory in post #21 is now shown to be totally out of left field, clearly the Run pins voltage either enables the IC or puts it into Shutdown mode – that's it.

- It took a while to sink in but the LTC1871 is **not** an LED controller. It does not have dimming. It can be configured in several ways, including as a current-controlled boost regulator – this is how I suspect it is configured here. Dimming is achieved through some other means.
- It seems that your list in post #23 must be wrong though? If the Run pin reads the same as BAT+ in Low/Medium/High/Turbo then surely MCU pin #3 must as well (since they are directly connected)?
- I'm unable to identify the 8-pin semiconductor on the bottom marked 9426 / (i) AE Δ / L45C. I think that's the Siliconix logo, but I do not know specifically what the part is. I assume it's a FET of some type. Does anyone know?

_____

WTS Lux-Pro 2D MT-G2 8xAA HIGH-current e-switch Conversion Kits *old teaser thread*

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