Contents

1 Harbor Freight Bauer Drill Repair

1.1 Overview

At a company I work for a drill was purchased from Harbor Freight. It was a Bauer 1791c-b1 drill. Sold for about $40 US in 2018. I knew buying anything electrical or electronic was a bad idea from Harbor Freight. It is generally known that while their products are cheap, they are also likely to fail early, and fail often (to steal a word from startup world).

1.2 Background

I was using the drill when it failed. Not in any excessive capacity, instead simply using the drill, moderately. I began to smell something burning, but the drill continued to work. After another moment, the drill was completely failed. What had happened, is that one of the DPak FETs had failed, then the other.

Figure 1: This style seems to be the current favorite (techy red and grip, with a square lithium pack). A trip to the hardware store will reveal other brands with similar looks as of 2018.

1.3 Repair Notes

2 Dpak components have big burnt out holes on them. Need replacement. What is their pinout?
Motor is Mabuchi model: RZ-735VA-A014. Range 6-20 volts. Switch before motor is 7.2 24 volts.
Micro is TI msp430g252. [1] Question is, what is the level of the voltage regulator? Is it 20V? It appears to be an onsemi model such as: CS52015 I can't find an exact match from Digikey which only searches current models, not historical models.
I may be able to throw an adjustable vreg with similar pinout in... The battery is 20V. The dpaks are getting power, only when switch is pressed.

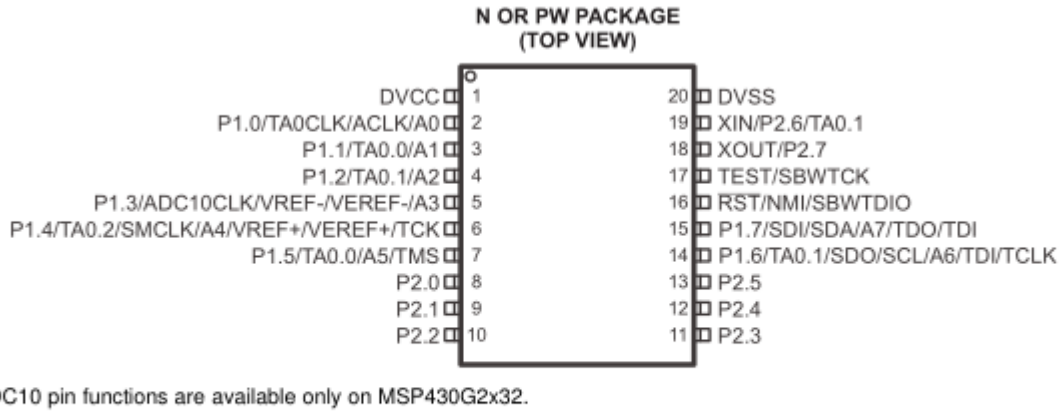

Figure 2: Pinout for MSP430

[1] Wait, this drill needs a microcontroller? As in a computer in a drill? Why not an IOT drill then? But, I suppose having an IOT drill is ridiculous, and likewise so is having source code in a drill.

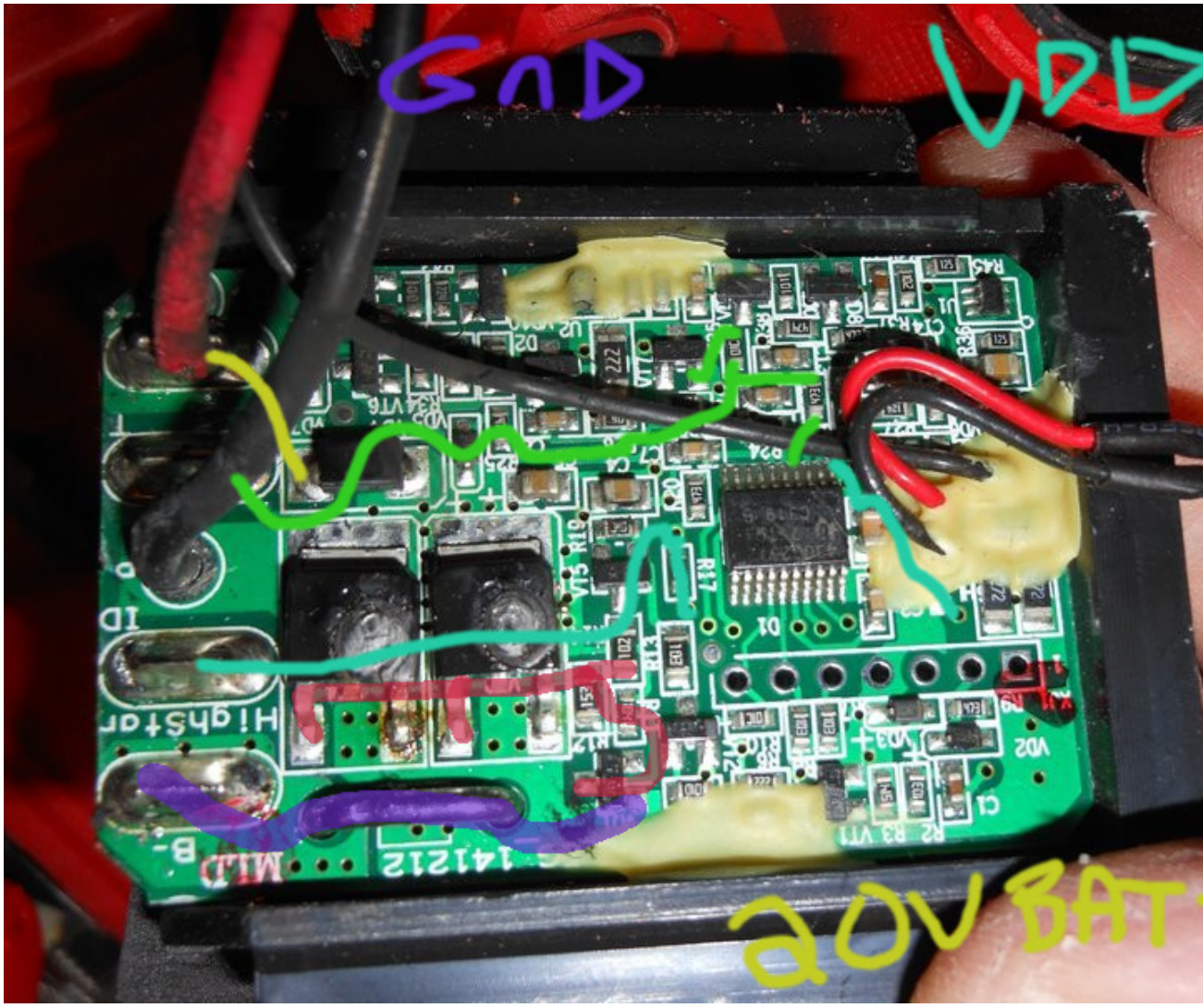

Figure 3: Rough schematic for board (see colour picture in repo). When switch is pressed, there is 20V on the tab of FET. I believe the FET must've overheated and shorted (perhaps counterfeit?). Though Right pin is to GND. Maybe it's a current limiter, not a FET, allowing Tab when V+ to be dropped down and current will flow. Too bad I wasn't able to stop using the drill before both FETs failed. I could've read one of them.

Trying to repair a harbor freight drill, and I need help identifying a Dpak component.

These two DPaks failed (overheated, and shorted I think) on the main circuit board. I'm not sure if they are some kind of constant current driver, or just a power transistor. I don't think they are voltage regulators. When you press the button on the drill, 20V from BAT+ goes to the tab. Pin 1 goes to a few resistors, and pin 3 goes to BAT-. Anyone have any ideas?

There are some other pins that go to the MSP430 micro, the VDD label is the micro's power, which I think is lower than 20V. The green line is from battery to the micro.

The marking on the DPak was melted off, but I could make out a CS something. I found some On Semi adjustable VRegs, but I don't think those are the part (e.g. CS52015) as the pinout seems to indicate something else.

Anonymous 10/22/18(Mon)18:51:16 No.1484857 ▶ >>1484989

>>1484700
They'll probably be switching FETs, and they look to be in parallel, which is odd for semiconductors. Since it's low-side switching they're NMOS, with the source being the pad, the gate being the left-most pin, and the drain being the right-most pin. At least from what I can see. I'd check what switching voltag is used, but it's probably 3.3V. So buy a couple of N-ch MOSFETs with a threshold voltage below 2.5V, V_DS above 24V, and as low an R_DS_on as you can reasonably get.

But she's a harbour freight drill, so don't expect any lasting performance even after fixing it.

t. never fixed anything

Anonymous 10/22/18(Mon)23:19:57 No.1484989 ▶ >>1484991 >>1485000

>>1484857
Thanks. I didn't buy it, but I did break it, and I figured it would be fun to repair it if possible.
Funny how a couple power transistors can break a drill. I wonder if old drills even have pcbs at all... I doubt it.

Anonymous 10/22/18(Mon)23:32:46 No.1484991 ▶ >>1485000

>>1484989
old drills probably don't have tetchy but power-dense battery packs. the few that had adjustable speeds did it triac-style and certainly didn't have a high power factor. features generally require components, same as ever
(but a microcontroller? that one's new on me)

Anonymous 10/22/18(Mon)23:50:29 No.1485000 ▶ >>1485003

>>1484989
Old drills have the trigger switch mechanically switching the power supply, while the modern ones use transistors such that they can switch far faster as a method of speed control; they PWM the output to change the power going to the motor. Though I doubt that drill has speed feedback.

>>1484991
>triac-style
Never heard of them doing that, though I guess that's since most teardowns I've seen have been of cordless drills.

Anonymous 10/22/18(Mon)23:58:35 No.1485003 ▶ >>1485006

>>1485000
yep just ye olde phase angle fired dimmer switch, with a trigger controlled pot
https://electronics.stackexchange.com/questions/167556/how-does-the-circuit-of-a-basic-variable-speed-electric-drill-work

Anonymous 10/23/18(Tue)00:08:42 No.1485006 ▶ >>1485057

>>1485003
I know how a triac dimmer works, just surprised that that's what they were using. My old Hitachi corded drill has dimming but it's a step-wise switch with discrete speeds, unlike what I'd expect from a triac dimmer with a linear pot inside the trigger switch. So either it's a triac dimmer with a bunch of resistors switched sequentially by wipers or spring contacts within the switch, or it's some sort of less-analogue dimmer. I'd imagine it's sequential spring contacts since it's been going strong for a few decades without any sign of a linear pot wearing out, which is a good enough reason to use such a system. It was made before the common clamshell setup we've got today, the back 1/4 comes off with lengthways screws, with the front gearbox housing and the left quarter being moulded together, if I remember right. Big front-end bearing on it too, only one speed in each direction and certainly no clutch; nothing I'd wa

Anonymous 10/23/18(Tue)04:46:39 No.1485057 ▶

>>1485006
The most common way to produce the stepped effect is to add some mechanical stepping on the otherwise linear pot.
An old Bosch drill I opened a while ago had a thick film hybrid for its dimmer. The hybrid included a linear pot, or more accurately, just the resistive track. would've been a simple matter to replace the track with a bunch of contact pads and some printed resistors. It wouldn't have increased the price either. Ill it actually had one such contact pad at the low end of the pot for the "totally off" position.

Figure 4: A short post to an anonymous image board for assistance

1.4 Work Log 12/2018

I was unable to find the exact pinout for the N-Channel I needed, so thought maybe the user was wrong in his post. I purchased some N-Channels which seem to be standardized with the pinouts being drain on the tab, not source. But these do not work. Short circuit protection appears to kick in, and the Dpak overheats quickly. I did not see any Nchannel Dpaks with the pinout he mentioned. Whether N channel or P channel or high or low side switching I see there are four types, with one being more common, and one being least common. (N Channel - low most common. P channel low least common.). Upon further research, looks like anon was mistaken in pin names, but this link:https://www.embeddedrelated.com/showarticle/98.php seems to show the drain as tab, and source as right pin would be correct here. So after the replacement, the devices spins for a short second, then stops. Something else is broken.

Checking the pins of the msp430 with a scope, I can see it has a sleep mode, a pin to control gate, a pin to control LED. I thought I saw UART, but it's just a CLK input. Led is two or three to the left. There also seems to be some pin, maybe adc monitoring drill (top, right side pin).

Something for another day. Overall, it seems the FETs were woefully unprepared to actually ever power this drill. It was fundamentally flawed. Broken from the day it left its overseas factory.

Figure 5: A dremel was used to help open the drill up, as I had not the required bit to open it (It required a longer torx driver than I had, so I opened up one of the drill inserts slightly).