Original information on partial reasoning for encoder issues. https://github.com/moggieuk/ERCF-Software-V3/blob/master/doc/ENCODER.md

The linked article in the description started me down this 'rabbit hole' as it were to get the original encoder working well. Two things I noticed that were never addressed well in his original dive:

1. Voltages for the sensor
2. Underestimating the reflectivity of the gear even when 'sharpied'

The first issue for this original design is that of supply voltage. But there are two apposing issues here one of the IR Emitter and the IC Gate circuit used to detect the reflections. The most elegant way to alleviate these issues is to build a custom board to drop the voltages to the proper ranges for sensing at our truncated focal length. But, that removes the ease of access to cheep IR modules so it is not a solution.

What is the solution to the voltage problem? Well answers lie in what do the two components need to operate in our limited housing space. Ideally, we would use the nominal voltage from the data sheets for the TRCT5000 at 1.25 volts DC. But we can't do that as the board IC Gate chip needs a minimum of 2 volts DC to start.

So, we now have a target of 2 volts DC. But why do we even care we have 3.3 volts on most of our boards and both components work with that voltage. So just give it 3.3 volts and it will be fine, right.

Well no. If you look at the operating range for the sensor it shows that it can work from .02 to 15 mm and what is worse is that the 'IR collector' circuit has a saturation voltage of 0.4-volt DC. Again, why do we care. This whole encoder works on the idea that parts of it will be highly reflective and other parts are highly absorptive or highly scattering relative to each other. And there must be a discernable pattern that can be 'seen' by the system.

If you look at the gear end on you will notice that there are a lot of curves and flat faces. Each one has some incident angle that can cause a reflection to the 'IR collector' and we that that sensor has a low saturation level.

Without going down the deep dark math hole to determine how reflective the gear is verse how reflective the gear is coated the bare gear reflects in the 75% range and a 'sharpie' gear does not reduce the much maybe a 20% to 30%. There are people much smarter than me that can do all the math and get real numbers but that is out of our scope here. Needless to say, even if there were higher damping from other easy to obtain coatings there is always all the facets of the gear that can cause issues.

Why, the tirade it is because we need to reduce the amount of 'light/IR' bouncing in our encoder to get a cleaner signal for the encoder to work.

So, all that said means we need to get 2 volts DC to the Encoder Board to reduce the light. It also has the side benefits of reducing the working distance of the sensor as well.

Well, we have a voltage but that does not fix the potential for poor signal due to errant reflections. That is where a different 'coating' comes in play. And no, it is not that stealth material the F-117 or the MCRN frigates are made out of. It is much easier to find it is PLA. Yes, that simple we need to coat the gear below the top of the teeth with PLA and make and composite surface that is continuous.

This enables the IR emitter and sensor to have a clear zone of high reflection next to a low reflection zone. And it is the same over the entire gear. What is funny is we actually want to polish the gear metal and PLA to create and higher zone definition.

Anyway, here is my over bad attempt at overfilling the Gear with PLA I use a smaller heat gun it is more what I call a pencil but that is not right. You are going to need a few things:

Heat source. Like I said a heat gun, or maybe a high-powered hair dryer. Lighters and torches are not recommended as they have to high of potential to burn the PLA and cause more issues.

Plyers, vice, hemostats, something to hold the hot gear while you are laying the PLA into it.

Files and sandpaper at least 400 grit and 2000 grit paper files I like for taking the bulk of PLA off to get down to the teeth. But you may be able to skip it if you are more careful in your PLA application.

Some type of smudging device I was using the 90-degree end of a scratch awl. But have used screwdrivers, exato knives and even plyers. Something that you can use to press the PLA into the gear and move it around while at or near the glass point of PLA.

A drill with a normal chuck, no driver or odd chucks you know what I mean a simple 3 jaw chuck it can be keyed or hand lock like I use.

When working with the PLA and shaping it away there are 3 things that you need to be aware of:

1. The outer face that is the ‘bearing’ face for the gear needs to not have any PLA on it.
2. The teeth must be full and have no voids, occlusions, or defects the sensing area/reflecting area for the sensor is a little over 2mm.
3. The inner edge of the tooth profile needs to have a continuous ring around the gear to retain the composite surface together.

Recommendations for PLA is that it is black, most black pigments are made from low reflective materials and other colors may not produce good results.

I used Polymaker Polylite PLA but I expect any quality PLA to work hell some of the worse brands could work as well.

For my TRCT5000 board I ordered a batch of 12 off of Amazon they were listed as 5-volt DC. I measured 4 of them across the VCC and GRD to get an average resistance across the circuit of 500-Ohms. You don’t need the resistance across the OUT channel as it is modulated based on the sensor input. The VCC and GRD is needed to be the control voltage for the IR sensor and the IC Gate chip.

I used the following Digikey.com voltage divider calculator to ‘estimate’ and steer my resistor choice:

https://www.digikey.com/en/resources/conversion-calculators/conversion-calculator-voltage-divider

Any Voltage Divider calculator should work they are all the same math. I guessed at first at 250 half that of the chip and came up short of the target. And work my way down 270-ohm which I had on hand. I could have gone lower but with the tolerance of my resistors I am glad I did not as it meters my voltage under usage under the 2 volts DC that I believe is the hard limit for the IC. But all 4 of the sensors that I have unpacked work with this setup.

If you are using 5 volts to drive the encoder your choices are either 680-Ohm or 750-Ohm as they are the more popular sizes of resistors. An EE or an circuit designer probably know the best resistor in that range for through hole design. This is an estimate and not actually tested but it is an logical starting point if your are using 5-volts DC to power the sensor board.

I am using The Fysetc ERB board that runs 3.3 volts DC to the Encoder. I have a 270-Ohm ¼ watt resistor running my encoder. It meters out at 1.99 volts DC at the terminal of VCC and GRD at the sensor. I have soldered my resistor inline but crimping it in should work. Bear in mind you need to insulate the bare leads of the resistor so as not cause a short. And make sure that the resistor is in a static (no motion) part of the wire run.

The BOM real is only a single resistor:

For 3.3-Volts DC ---- 270-Ohms ¼ watt through hole resistor

<UNTESTED> For 5-Volts DC ---- 680 or 750-Ohms ¼ watt through hole resistor <UNTESTED>

Everyone should have some PLA even if it is only a few inches.