A couple of years back I installed a kicker on my boat

The back story goes like this,
My boat has the B2 outdrive, so lots of traction swinging those big diameter props resulting in trolling speeds that are just too fast for most of our trout gear.
Plus, why rack up the idle time hours on the expensive engine.

I had a list of wants and/or features in mind when selecting components.
Below is that list, but not in any particular order;

1- Must have the ability to troll slow, I'm talking < 1 MPH.
2- Weight of the OB needs to be on the lighter side, at times cockpit loads of up to 1,000lbs with guests and gear so really don't need any additional weight aft.
3- OB control location, really wanted to control the shifting and engine speed from the helm if possible.
4- OB with a charging system, I have electronics onboard as we all do and wanted an engine that could contribute more than just thrust.
5- Didn't want another fuel type or tank on board, so had to be a 4-stroke plumbed to the main tank via standalone plumbing.
6- Steering, control remotely and use with autopilot.

I'll admit, an ambitious list of features.

I spent a couple days looking at what the market had to offer and ended with nothing that met my requirements. So as is my usual M.O. I bought a few items and made a few more.

Items purchased;
1-20" shaft Tohatsu SailPro 6HP engine, this met requirements 1,2,4 and 5.
2-Electrically steered kicker mount, this met most of requirement 6

Items designed, built or modified;

1- Modified the OB steerable mount with a faster reacting actuator.
2- Added a second fuel pickup tube to the main tank for standalone plumbing.
3- Built a CAT6 servo control system with all related hardware to control shifting and throttle from the helm.
4- Added required wiring for electrical components, autopilot and hardware.

Results;
The result was something that hit all wants, but more importantly works well.

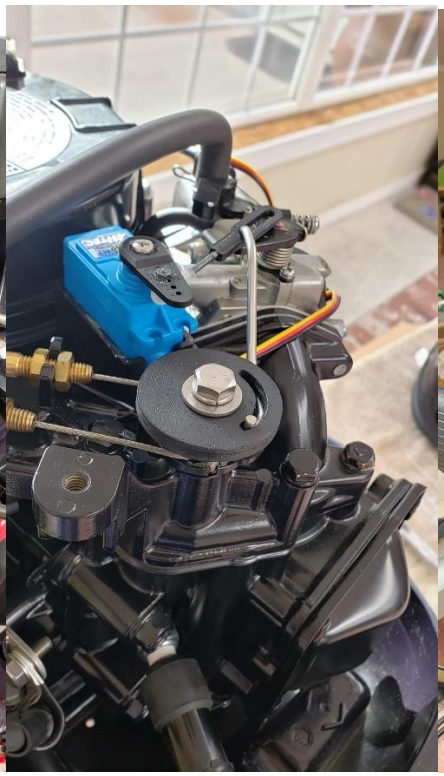
1- Trolling speeds down to 0.8 MPH (flat calm).
2- Total weight added 80lbs.
3- Throttle and shift controlled at helm.
4- 60w charging circuit.
5- Plumbed to main tank with dedicated pickup tube.
6- Steering controlled at helm via Autopilot.

As you could imagine, what took the most time was determining a layout and creating a mounting and routing plan within the confined spaces under the cowling. All components needed to meet the environmental requirements. Those being, vibration, heat, water and ignition RF. In my case, I also wanted easy removal of the kicker for winter storage.

One of the trickier tasks was to design a mixer system that would allow for three-way throttle control. The throttle needs to open when the choke is pulled, when the tiller twist grip is used and when the servo actuates, but none could interfere with the others. Once this was figured out, the rest involved only accurate measurements and to design/build a few component mounts. I used digital programmable servos so that the throw could be set as desired.

Take a look at the images below as they show all the components used in the build.

Of course, every boat and installation will be different, but I hope this helps or inspires someone to do the same. We really enjoy the kicker, should have done it sooner. Plus, it adds a bit of safety should we ever have an issue with the main engine.


-Reporting back on my kicker install after a couple seasons of use-

The engine and all systems have been flawless.
I highly recommend this Sailpro from Tohatsu and would purchase another without hesitation.

My only wish is for better performance in reverse, which is true of every small outboard that I have owned.

My boat is used exclusively for fishing and depending on the time of year and species targeted, we often troll shallow waters. This leads to hanging the bottom on occasion. In an attempt to retrieve our gear, we will reverse and steer a reciprocal course. For this we often start the main engine and back toward the hung-up gear.

With fuel, people and gear typically exceeding 1,000lbs. Getting the boat stopped and heading in the other direction (flat end first) is not an easy task for a small outboard. Not for the lack of power, but for lack of traction. As with most outboards, their primary function and design is to go forward with as much efficiency as possible.

Within this highly efficient combination of engine and propeller, let's talk propeller. We have a propeller designed where its number one purpose is to move the boat forward. Now don't take this lightly, years of research, development and evolution have gotten us to where we are today. The same propeller and its reverse capabilities were a distant second during the design process.

By reversing the propeller rotation, we reverse the rolls of a beautifully designed leading and trailing edge. When in reverse these new leading and trailing edges induce a great amount of turbulence and pressure variables into the stream. Now let's add the thousands of hot gas bubbles from the engine exhaust exiting the hub into our horizontal

water column. This mess has left us with turbulence, diluted water density, cavitation, and possible ventilation, it's a wonder that we can get any traction at all. Back in the day (pre-rev limiter) you may recall that outboards had linkage arrangements to limit throttle travel in reverse. This wasn't as much a boating safety issue as it was an overrev issue.

So, is it possible to get this little O/B to perform as well in reverse as it does in forward? Probably not, but we can surely narrow the delta between the two directions. It is important to understand that we are not using this engine at speeds greater than 5 knots, so let's design around that.

Being a engineer with a shop full of tools, I can't leave anything alone. This is why I get up in the morning, and on occasion, why I get myself in trouble.

Now let's have a look at one device designed to work just as well rotating in either direction, a bow thruster. Yes, an impeller in a tube, a nozzle of sorts, but it makes the case for a design without a rotational direction bias. The blades are symmetrical in cross section as well as profile (see figure 1 below).

Figure 1-Vetus bow thruster impellor

Let's also look to a log bronc (non-azimuth pod) and a bow thruster for inspiration, both use propellers or impellers with a symmetrical or nearly symmetrical blade shape, as both forward and reverse performance are a must.

Our goal is simple, to make use of full throttle in both forward and reverse, if possible.

Currently, anything more than 40% (estimated) throttle in reverse and we blow holes in the lake with a mass of bubbles and vibration. We must throttle back and try to hook up again. Yes, the propeller is deep enough, 12" from the surface to the top of the anti-ventilation plate. We are not ventilating here, but a cavitation of sorts. Simply put (as stated earlier) we are losing traction in a diluted mess of hot gas bubbles and turbulence.

So, what's the fix you ask?

We have two items to address in our quest for forward and reverse thrust parity.
1- The exhaust gas issue.
2- The propeller blade shape.

Addressing item #1,

We need to create an option for the exhaust gases to flow in the same direction as the water thrust column regardless of rotation direction. For this we opted to use an oversized outer propeller hub with an area cross section equal to the existing propeller exhaust channel cross section, so as not to impede the exhaust flow in reverse. With this, the exhaust gases can exit the housing turn 180 degrees and flow in the same direction as the reversing water column without first having to travel over the propeller blade faces. While in forward gear, the exhaust gases flow as normal (see figures 2 and 3 below).

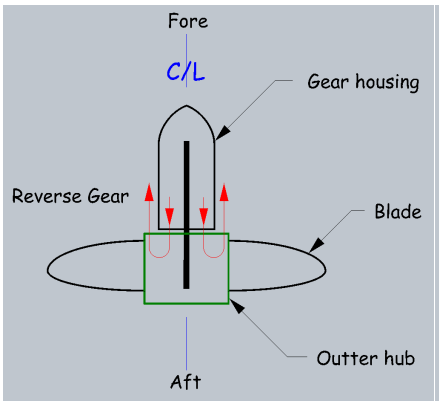


Figure 2-While in Reverse

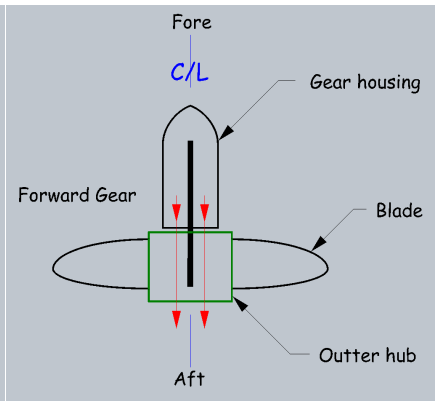


Figure 3-While in Forward

Addressing item #2

While addressing the exhaust gas flow issue, we increased the outer hub diameter. This could potentially lead to a decrease in blade face area if not corrected. So, we looked to a 4 blade solution, hoping to even increase blade face area. So the search began for a, let's call it a donor propeller. One that could be modified to suit our needs. So we bored, pitched, pressed, turned and reshaped.

The results were better than we could have hoped for.
1- We ended up with 31% more blade surface area.
2- We decrease the pitch by 1" to make recommended engine RPM at altitude.
3- Exhaust gases are now flowing through the outer hub in either direction making for clean water flow over the blades in both directions.
4- We can now operate with full throttle (in my case 5200 RPM) in both forward and reverse.

I'll admit it took some getting used to. I had to reprogram my brain to break engine operating procedures for 40 years in the making. Have a look at the resulting propeller, somewhere between a bow thruster, a Bigfoot, and a 50's British Seagull.

My boat sits on a trailer for nearly half of the year as the snow flies, this is how I enjoy boating during the off-season. Why can't I just buy one of these from Mercury, Solas or Tohatsu? I don't know! Thanks for your time.