

## Front End cards

Ship Of Theseus provides seven new front ends, in addition to Nelson Pass's original card (Toshiba JFETs) shipped with the diyAudio kits, and in addition to the Scourge, Bulwark, Marauder, and Dreadnought cards sold by the diyAudio Store. These new cards are named for American warships. A brief summary of their features is presented here; more thorough discussions follow.

**Nimitz** is a customizable Front End which accepts M2x daughter cards. Builders can bolt whichever M2x card they wish into Nimitz, and that becomes the Front End for a VFET or Theseus amplifier.

**Missouri** is a Front End that accepts balanced inputs. It uses the highly regarded THAT-1200 differential receiver IC for maximum CMRR

**Bon Homme Richard** is a high performance opamp (AD797), plus a discrete JFET input stage, fed by a shunt-mode voltage regulator for maximum PSRR

**Kitty Hawk** is a transconductance (current output) amplifier, which uses a Rush Cascode input stage: PNP follower + NJFET common gate.

**Lexington** is a folded cascode discrete opamp, using a self-generated high voltage supply ("JBOOST2") and no Edcor transformer. The boost circuit includes an isolated DC-to-DC converter module plus extensive filtering.

**Hornet** is a discrete opamp whose unusual all-JFET output stage has no degeneration resistors. The supply filter is cascoded, each of the two constant current sources are cascoded, and the input is a Rush Cascode.

**Pequod** was Captain Ahab's whaling ship in "Moby Dick." Although not a warship, it was American. The Pequod Front End is a simple opamp follower with few parts and relatively modest parts cost. It accepts either dual opamps (e.g. LM4562) or single opamps (e.g. LT1122) and the two opamp sockets are surrounded by blank empty zones, making it easier to fit discrete opamp modules such as Sparkos or Burson, if desired.

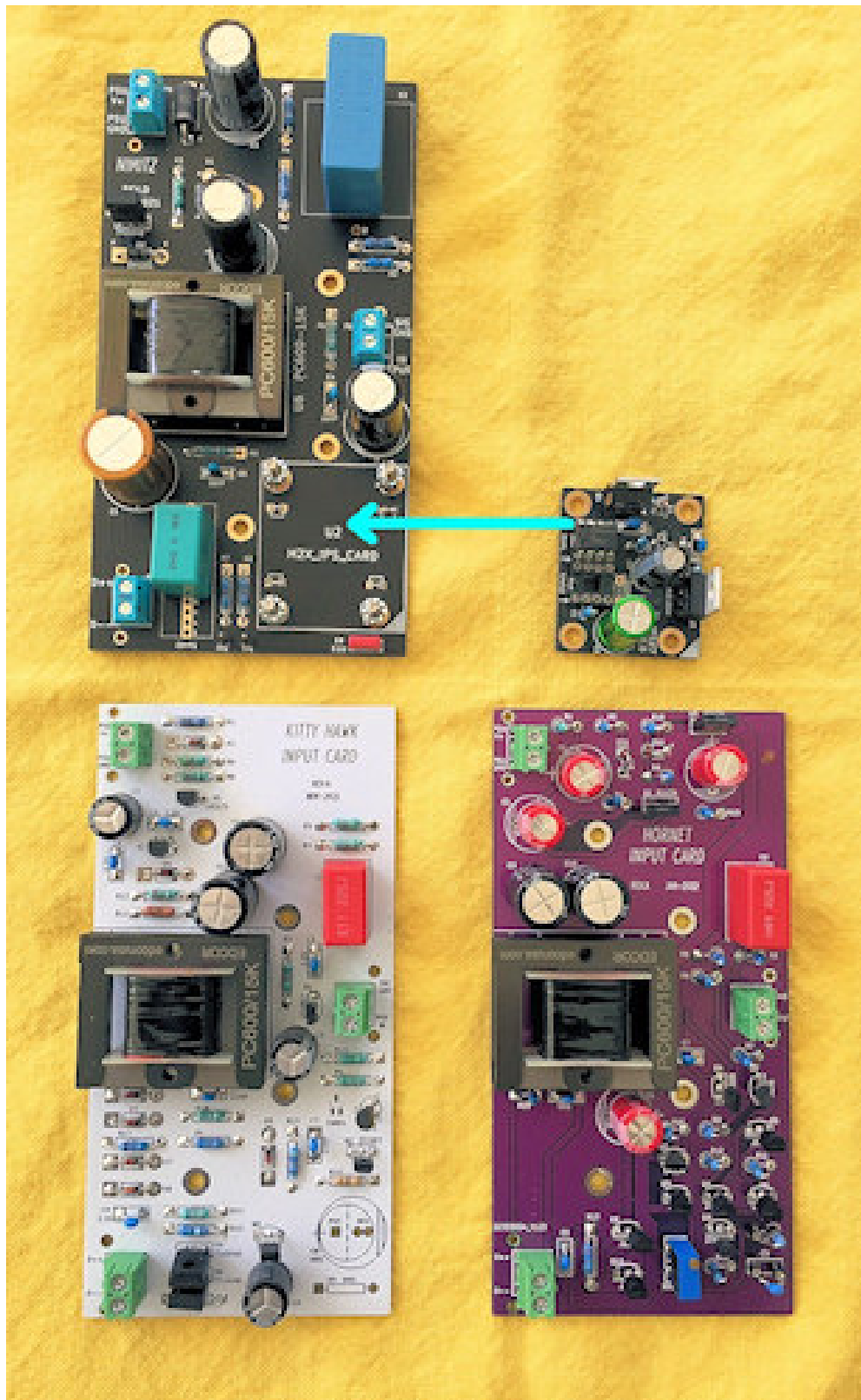


Photo 3: Nimitz, daughter, Hornet, Kitty Hawk

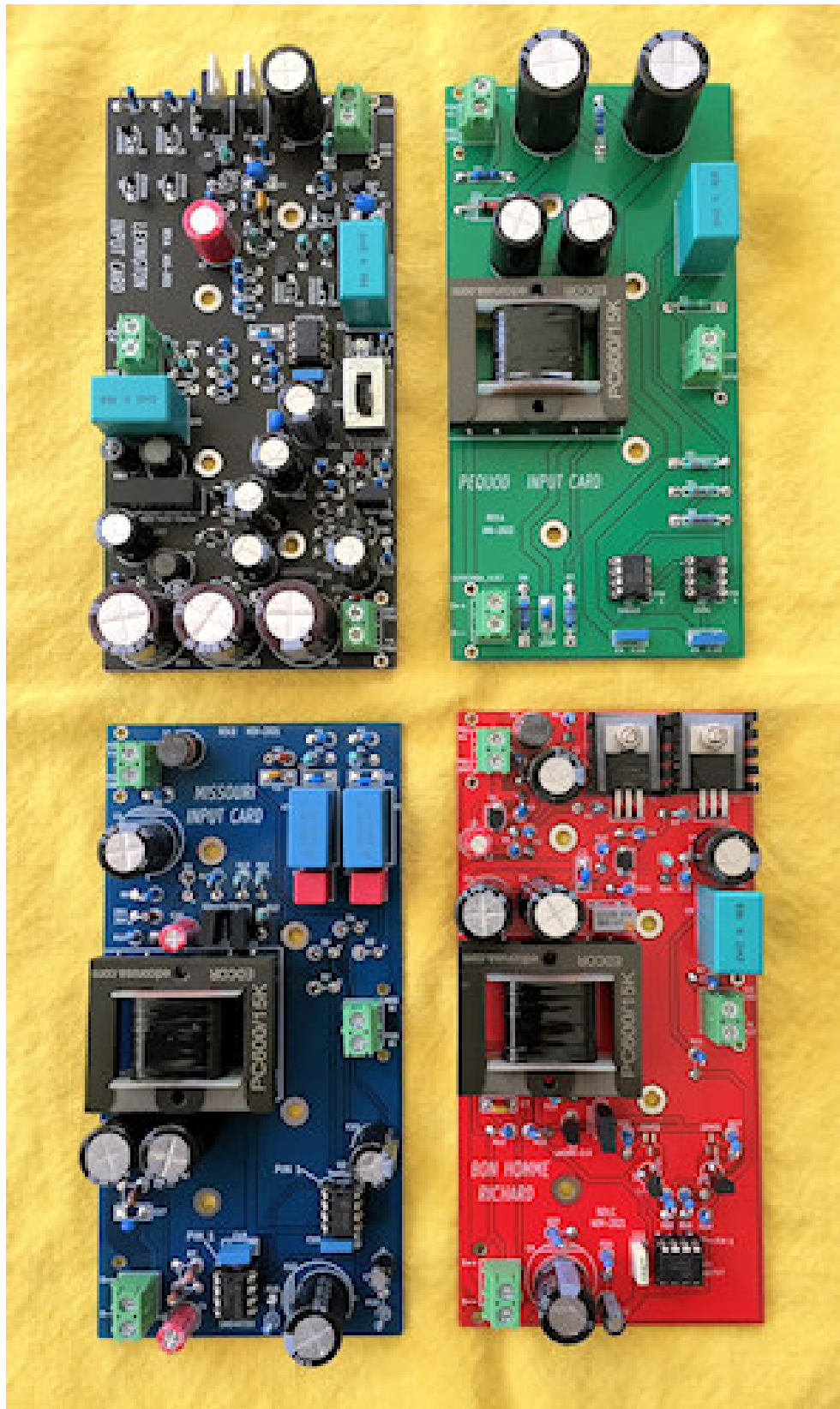


Photo 4: Lexington, Piquod, Bon Homme Richard, Missouri

## Bon Homme Richard Front End

This Front End card is a shining example of the audiophile mantra “anything worth doing is worth over-doing.” BHR starts with a wicked good (expensive!) opamp, adds wicked good power supply regulation, and finishes up with painstakingly hand-matched components.

The resistor matching exercise was discussed / beaten to death during Nov 2021, in a diyAudio thread entitled “Resistor matching error starting with six 1% resistors”. I will attempt to link that thread here:

<https://www.diyaudio.com/community/threads/resistor-matching-error-starting-with-six-1-resistors.379344/>

The power supply section of BHR includes a passive noise filter (L1-R1-C1), followed by a shunt voltage regulator. The regulator consists of a constant current source (Q1-M1), a darlington power transistor as the shunt (Q2), and an error amplifier (U1) connected in a negative feedback loop around Q2. Circuit performance, PSRR, is set by a simple impedance divider, whose upper impedance is the output impedance of the CCS, and whose lower impedance is the output impedance of the shunt device (including NFB). The former is very large and the latter is very small, so the division ratio is extremely small, and the PSRR is a very large negative number of dBs.

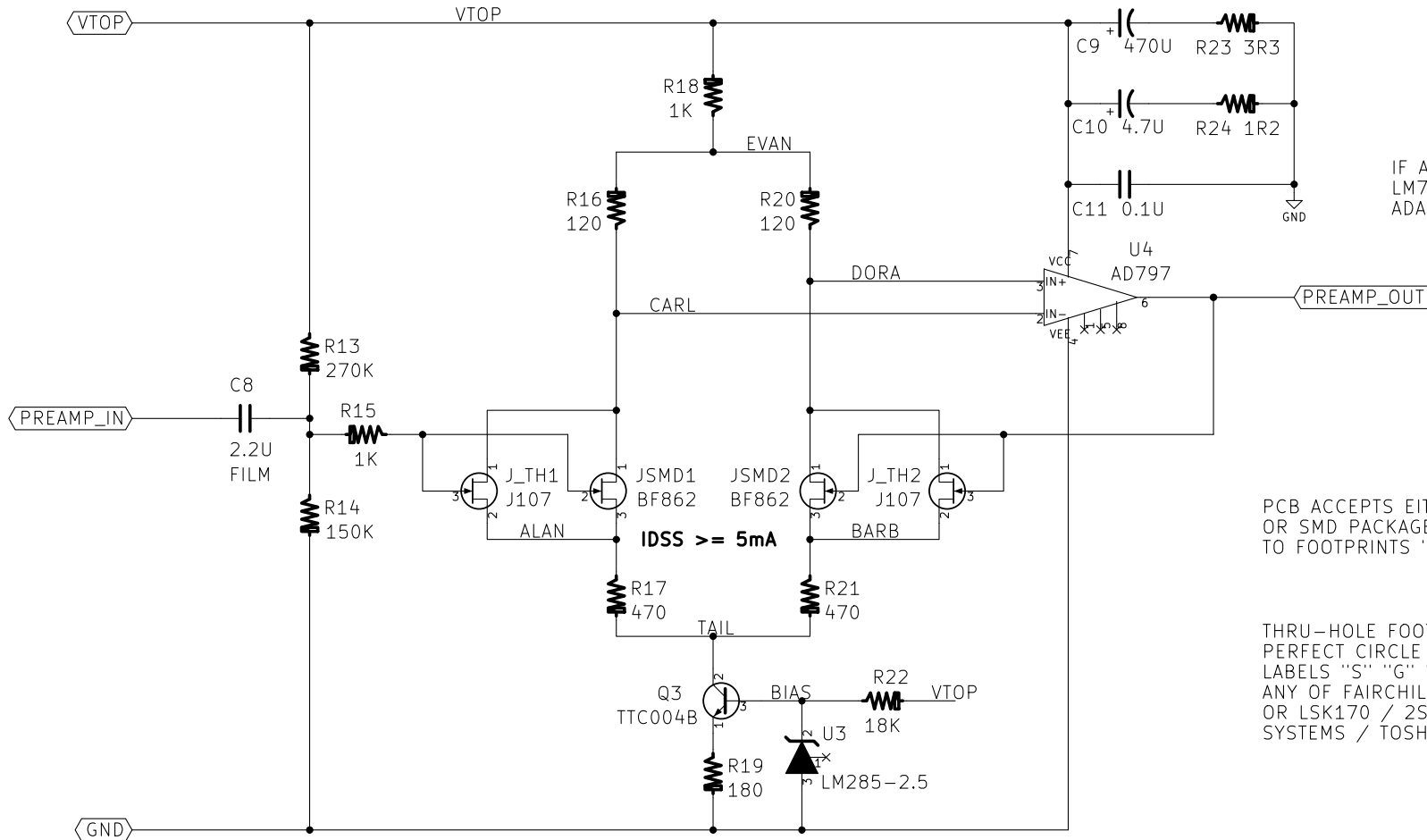
The wicked good opamp, AD797, is notoriously temperamental when operated at unity gain, as is done in Front End cards using an Edcor step up transformer. BHR’s solution is to attenuate the input by a factor of 4X, then operate the AD797 at a gain of 4. Presto, stability and adequate phase margin are preserved. {math note:  $470/120 = 3.917$ , in fact}

The attenuator (schematic page two) is a differential-in, differential-out discrete circuit consisting of two JFETs and four resistors. Its PCB layout accepts either surface mount JFETs or thru-hole JFETs; the builder can choose either.



MATCH R16,R20 WITHIN 0.4%  
MATCH R17,R21 WITHIN 0.4%

REV.C 09 NOV 2021



IF AD797 IS BACKORDERED:  
LM7171, LT1112, LT1363,  
ADAPTER + OPA1611 / AD825

PCB ACCEPTS EITHER THRU-HOLE  
OR SMD PACKAGED JFETS. SOLDER  
TO FOOTPRINTS "J\_TH" OR "JSMD"

THRU-HOLE FOOTPRINT IS A  
PERFECT CIRCLE WITH SILK TEXT  
LABELS "S" "G" "D". CAN ACCEPT  
ANY OF FAIRCHILD J107, J112, J113  
OR LSK170 / 2SK170 FROM LINEAR  
SYSTEMS / TOSHIBA.

TO MATCH R16,R20 WITHIN 0.4% :  
BUY 6 PCS 120 OHMS 1% METAL FILM  
MEASURE ON 3.5 OR 4.5 DIGIT DMM  
CHOOSE THE PAIR WITH BEST MATCH

REPEAT WITH 6 PCS 470 OHM 1% MF

GENERAL CASE USING \*N\* 1% RESISTORS:  
GUARANTEED MATCH  $\leq 2\% / (N - 1)$

## PREAMP\_BHR

Sheet: /preamp\_bhr\_sheet/  
File: PREAMP\_BHR.sch

### Title:

Size: A4

Date:

KiCad E.D.A. kicad 4.0.4-stable

Rev:

Id: 2/2