



## RF2K+ LDMOS Linear

### Fan Research and Recommendations

Over the last several weeks, I tested 7 different 120mm fans for suitability with the RF2K+ Linear. There was one clear winner:

Darkside Gentle Typhoon AP-60 2150 RPM made by Nidec model D1225C12B6AP-60.

The Nidec Servo Gentle Typhoon D1225C12B6ZPA64 is the PWM version of this fan and works almost as well when operated as a 2 wire fan.

Both of these are 2150 RPM fans. Beware when ordering, as Nidec makes other similar version that run at a slower RPM.

The single 80mm LPF/Tuner fan is not critical. The Noctua NF-R8 1800 RPM fan is very quiet and a good choice.

The seven 120mm fans were evaluated for both air flow and noise level.

I inserted a 25MM shroud on the rear fan. Due to cavitation of the rear air flow, this shroud improved airflow by 28% while reducing the noise by 6dBA. I cut out the motor of a cheap 120mm fan and used it as a shroud. If the extra overall depth is a problem, Phobya makes a 10mm thick fan gasket that worked almost as well. It increases air by 25% and reduces noise by 4.5 dBA when compared to no shroud at all. Their 7mm gasket does not work well.

Published fan specs can be misleading. Most of the fans I tested were designed as computer radiator fans as opposed to an open case fan. The added static pressure caused by the heat sink effects air flow by each fan differently.

In addition to the two GentleTyphoon fans, I tested the following:

Arctic F12

Furious Vardar FF5-120 (3000 RPM)

Noctua NF-F12 Industrial PPC-3000 PWM (3000RPM)

Enermax UCT512A Twister Storm (1500/2500/3500 RPM)

EBM-PAPST 4412F (2900 RPM)

In all cases, the Gentle Typhoon fans produced at least 5 dBA less noise for the same air flow. While the Arctic was a quiet fan, it produced only half the air flow.



## Test Fixture

I built a test fixture using a RF2K+ heat sink, and measured air flow with a MS6252A Anemometer and sound level using an Extech 407730. All fans tested were operated as 2 wire DC fans. I simulated the PWM signal from the PA01 controller by using a switching transistor modulated by a function generator using a 16 khz square wave and varying the duty cycle from 9% to 99%. I ran test at both 12.1 Vdc and 14.7 Vdc to simulate the two available jumper settings.



## PA01 Controller Voltage Settings

The PA01 controller is capable of several fan voltage settings. The 12V and 17V are the two applicable settings for the fans I was testing. The 12Vdc setting has a 1.5 amp limit while the 17V setting has only a 500ma limit. The actual voltage delivered to the fan is a little lower due to the PNP switching transistor. Of the fans tested, only the Arctic F12 and the Gentle Typhoon could be run at 17 Vdc due to their very low current draw. All other would exceed the 500ma limit.

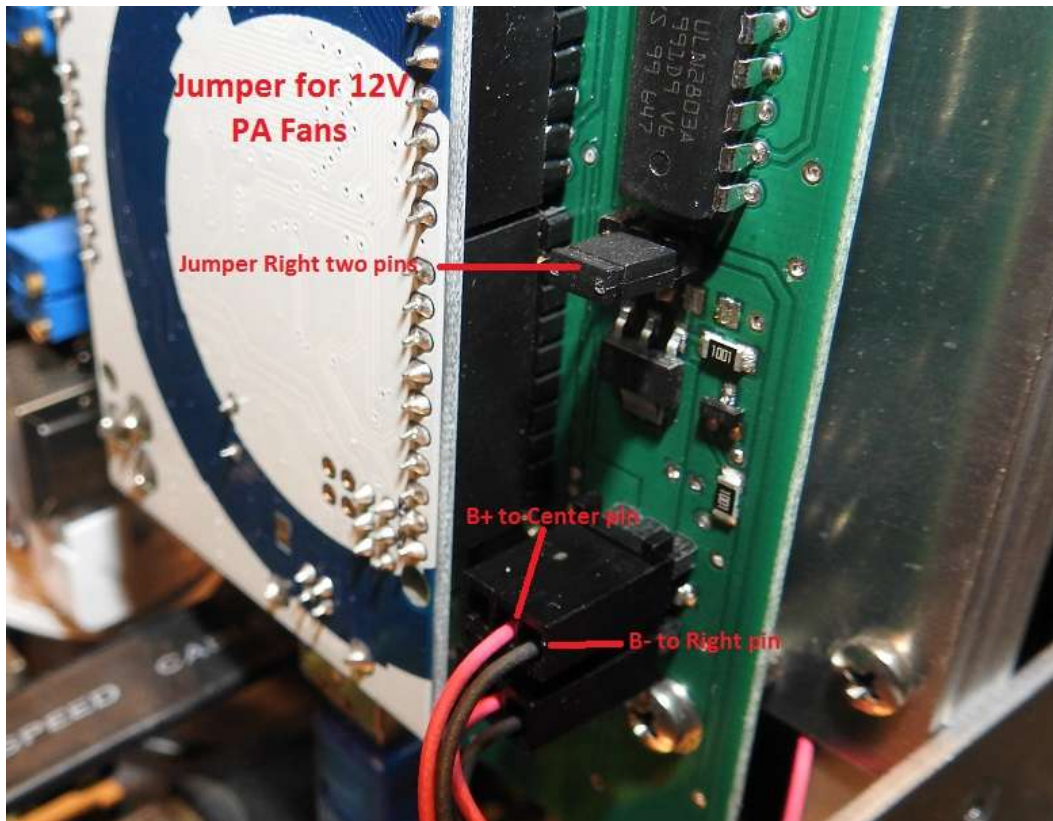
In real SSB test at legal limit, the Gentle Typhoon can easily handle ICAS at the 12V setting. I ran a test for over 2 hours running 1.5KW SSB, cycling the transmitter for 2 minutes followed by 1 minute of receiving. At normal ambient temperatures the RF2K+ never went over 52C. This should simulate SSB under contest conditions.

The nice thing about the Gentle Typhoon is its low current draw. It can be operated on the 17 Vdc setting. I reduced this voltage by adding 3 1N4006 diodes in series as part of the jumper (see photo below). A 5.6 ohm, 1 watts resistor can also be used. This reduces the actual voltage to the fans to approximately 14.7 Vdc. The fan is rated at 13.8 Vdc but I believe this extra voltage will have little impact on the life of the fan due to the low duty cycle. At this voltage, the Gentle Typhoon produces 26% more airflow at only 4 dBA higher noise level. This setting would be very useful on 100% duty cycle ICAS modes while still remaining reasonably quiet.

**To prevent RFI, keep PA fan wires short and away from the Raspberry Pi and color TFT screen.**



## 12 V Jumper setting

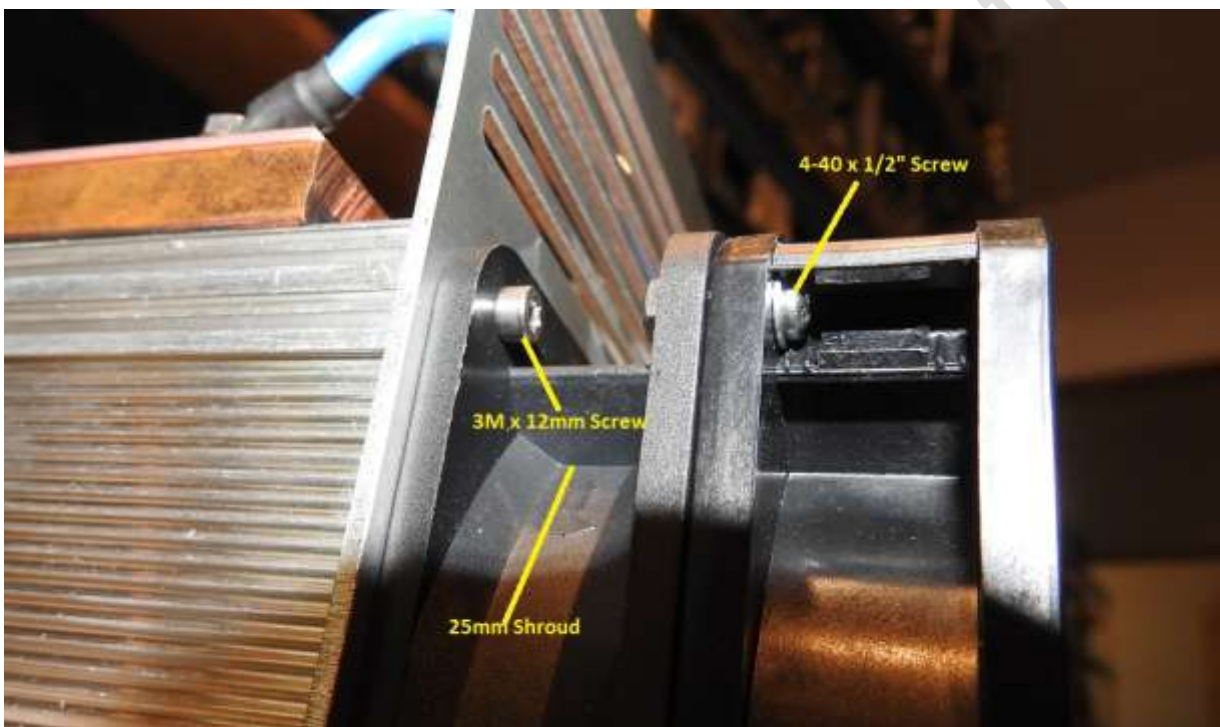


## 15 V Jumper settings

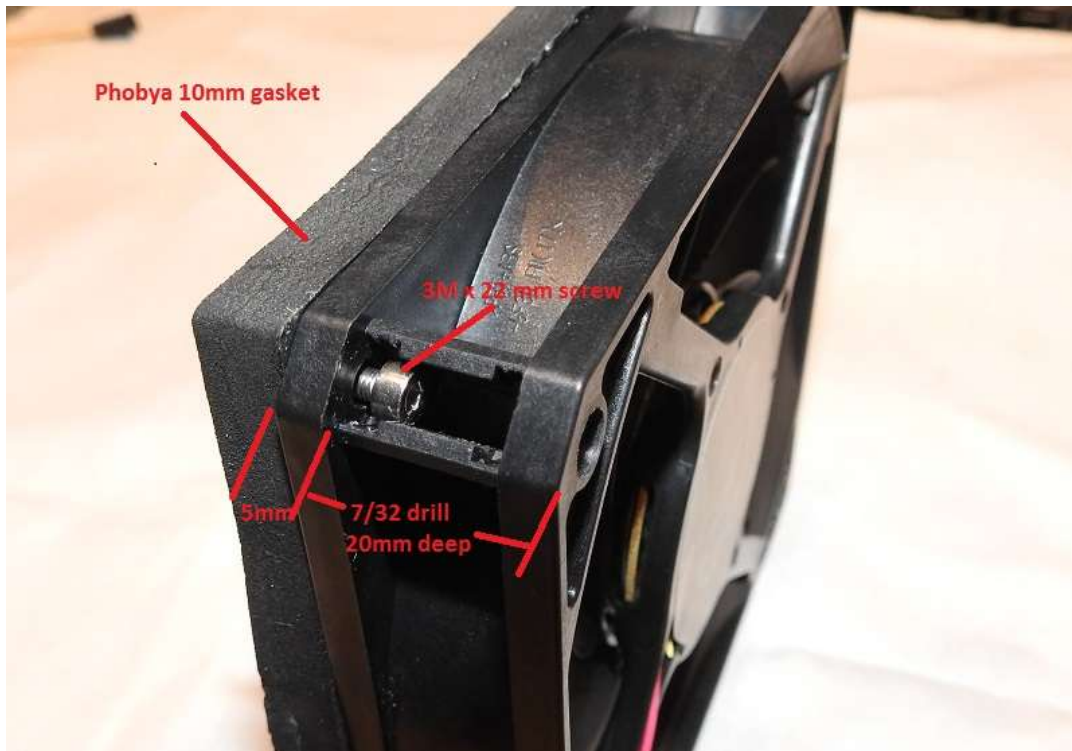


## Rear Mounting using Fan Shroud

A 25mm fan shroud can easily be fabricated from a cheap 120mm fan (ie Arctic F12). Just cut out the motor supports with wire cutters. The wires and plug can be used to extend the cable from the rear fan. The shroud is screwed to the rear heat sink using the 3M x 12mm screws that are supplied with the kit. The fan can then be screwed to the shrouding using 4-40 x 1/2" long screws, washer, and nuts.



If the PHOBYA 10MM gasket is used, 3M x 22mm allen socket screws will be needed. (20mm or 25mm will probably work). The back portion of the rear fan needs to be drilled out to clear the head of the screws. A 7/32" or a #2 drill will work. DO NOT drill the entire length of the fan holes. Just drill through the first 20mm. Make sure you know the orientation of the fan, as you need to leave 5MM of the fan hole undrilled that is closest to the shroud.



I experimented with rubber gaskets both in front and back to isolate the fans from the aluminum cabinet. The bearings of the Gentle Typhoon are so quiet that the rubber gaskets made no difference in the noise level.

## Software parameter settings

The next release of software will have some parameter settings for the PWM control of the PA fans. This section will be updated with recommendations once the software is available and tested.

RF2K+ Fan Recommendations



# **Source of Fans and Shroud**

## **USA**

### **Amazon - by Performace-PCs**

[https://www.amazon.com/DarkSide-Gentle-Typhoon-Performance-Radiator/dp/B01LXU81IO/ref=sr\\_1\\_7?ie=UTF8&qid=1497911958&sr=8-7&keywords=Gentle+Typhoon](https://www.amazon.com/DarkSide-Gentle-Typhoon-Performance-Radiator/dp/B01LXU81IO/ref=sr_1_7?ie=UTF8&qid=1497911958&sr=8-7&keywords=Gentle+Typhoon)

### **Performace-PCs**

<http://www.performance-pcs.com>

### **Coolerguys - www.collerguys.com**

<https://www.coolerguys.com/products/gentle-typhoon-120x25mm-2150-rpm-pwm-3pin-fan-d1225c12b6zpa-64>

### **ModMyMods - modmymods.com**

<https://modmymods.com/darkside-gentle-typhoon-performance-radiator-fan-2150rpm-68cfm-black-edition-d1225c12b6ap-60.html>

### **Phobyas 10mm gasket**

<https://modmymods.com/phobyas-radiator-gasket-10mm-for-120mm-fans.html>

## **Europe**

### **Highflow.eu in Rotterdam**

[https://www.highflow.nl/?subcats=Y&pcode\\_from\\_q=Y&pshort=Y&pfull=Y&pname=Y&pkeywords=Y&search\\_performed=Y&q=gentle+typhoon+&dispatch=products.search](https://www.highflow.nl/?subcats=Y&pcode_from_q=Y&pshort=Y&pfull=Y&pname=Y&pkeywords=Y&search_performed=Y&q=gentle+typhoon+&dispatch=products.search)

# Fan Data

<u>Fan model</u>	<u>Start</u>	<u>50% Duty Cycle</u>			<u>100% Duty Cycle</u>		
		<u>I ma</u>	<u>Airflow FPM</u>	<u>Noise dBA</u>	<u>I ma</u>	<u>Airflow FPM</u>	<u>Noise dBA</u>
Gentle Typhoon @12V D1225C12B6AP-60	9%	185ma	352fpm	49.1dBA	254ma	465fpm	55.0dBA
Gentle Typhoon @15V D1225C12B6AP-60	9%	238ma	448fpm	53.7dBA	330ma	586fpm	59.0dBA
Gentle Typhoon @12V D1225C12B6ZPA64	9%	253ma	412fpm	53.2dBA	265ma	448fpm	55.5dBA
Gentle Typhoon @15V D1225C12B6ZPA64	9%	327ma	533fpm	57.7dBA	343ma	568fpm	58.5dBA
Arctic F-12 PWM @12V	19%	270ma	240fpm	45.0dBA	403ma	310fpm	51.0dBA
Arctic F-12 PWM @15V	19%	362ma	310fpm	50.5dBA	514ma	366fpm	54.4dBA
EBM-PAPST 4412F @12V	39%	665ma	138fpm	42.5dBA	940ma	586fpm	66.2dBA
Vadar FF5-120 @12V	6%	671ma	482fpm	62.8dBA	800ma	568fpm	65.3dBA
Noctua NF-F12 @12V	15%	460ma	586fpm	67.0dBA	496ma	620fpm	69.0dBA
Twister Storm 1500 @12V	6%	206ma	226fpm	49.40dBA	260ma	284fpm	53.2dBA
Twister Storm 2500 @12V	6%	469ma	338fpm	58.6dBA	703ma	464fpm	65.1dBA

**Please note that the noise level was measured at 5". The noise level at 1 meter should be 16dBA lower but this is below the level my meter can read.**