FD3S RX-7 PowerFC FAQ

Version 1.2
August 21, 2006
Written by Dale Clark

CONTENTS

I. Introduction
II. Revision History
III. FAQ
A. About the PowerFC
1a. What is the PowerFC?
2a. What's the history of the PowerFC?
3a. What will the PowerFC do for my car?
B. Purchasing and installation
1b. I want one - which PowerFC's work on my car?
2b. What's the deal with the PowerFC serial numbers?
3b. Where can I get the best deal on a PowerFC?
C. Installation and Setup
1c. I've got my PowerFC now - how do I install it and get the car going?
2c. I've done the idle learn process, but the car revs up and down at idle?
D. Tuning and Using the PowerFC
1d. What mods will the base map that comes with the PowerFC support?
2d. I can't figure out how to use my PowerFC - what do I do?
3d. How do I tune my car with the PowerFC?
E. The FC-Datalogit
1e. What is the FC-Datalogit?
2e. I really want one - where do I get it?
F. Miscellaneous
1f. I have a 2nd generation RX-7. Can I use the PowerFC?
2f. I turned on my car the other day, and the Commander hangs at the Apexi logo screen. Is my PowerFC broken?

I. Introduction

Hello, and welcome to the PowerFC FAQ. This will be a "living"document, and will very likely have many revisions in the future. My goal is to assemble all of the available information about the PowerFC fuel computer into one document.

I've done quite a bit of research on everything that's in the FAQ, but I'm not perfect. There very possibly will be errors, typos, and problems. That said, I'm not liable for any information in this document - if you go out and blow up your engine with the PowerFC, don't hold me responsible.

If you have anything you'd like to contribute or correct, please feel free to do so. My contact information is as follows:

Email: rx7guru@clubrx.org
RX-7 Forum screen name: DaleClark (no space between the first and last names)

I hope you enjoy the FAQ!
Dale

II. Revision history

1.0: First version, April 28, 2005
1.1: April 29, 2005
- Added wiring harness digram of wires to be cut
- Added discussion of AC problem

1.2: August 21, 2006
- Cleaned up a number of unclear sections, fixed a few typos.
- Expanded the AC problem section
- Added info about Chuck’s tuning docs and EFI101
- Added info about PowerFC for the ’89-91 RX-7
- Added shot of error in Sensor Check screen
- Probably added more stuff ☺

A. About the PowerFC

1a. What is the PowerFC?

The PowerFC (or PFC) is a standalone fuel injection computer made by Apexi, a Japanese aftermarket parts tuner. Apexi came up with the concept to have a powerful standalone computer that easily plugs into the stock ECU harness on a car and comes with a ready-to-drive setup programmed in from the factory.

The PFC was a revolution when it came out. Other systems at the time required all new wiring harnesses and sensors, and came with no programming, requiring the end user to do a great deal of work just to make the car start and run with the new computer. The PowerFC is a simple plug-and-play computer, using the stock wiring and stock sensors, enabling the end user to get their car running with the new computer in a matter of minutes. Even though the installation is quick and easy, the PFC has proven itself to be incredibly capable and flexible, with cars running VERY high horsepower numbers with a well-tuned PFC.

The PowerFC is sold as a single unit - the computer itself. It's a small metal box with an electrical connector for the engine wiring harness at one end. There is also the Commander, which is a small hand-held display and control pad that lets the user tune the settings in the PowerFC, as well as monitor engine functions. Most people buy the PowerFC with the commander, since you really need the commander to get the most functionality from the PFC.

2a. What's the history of the PowerFC?

The PFC was sold in Japan for many years before coming to the US. The 3rd gen RX-7 (FD3S) was the first US application of the PowerFC. This is primarily due to one of the top guys at Apexi USA being an RX-7 owner and wishing he could have the PowerFC for his own car. Also, Apexi knew that the FD market was generally more "mature" and could give better feedback on the unit than, say, the Honda guys. As time has gone on, Apexi USA has brought over the PowerFC for other vehicles as well.

The Japanese high-performance car market is a LOT bigger and very different than the US market. In Japan, there are MANY shops that do performance work and tuning on cars. When the PowerFC came out, Apexi Japan went to a number of shops and certified them as "PowerExcel" shops. These shops had a software program called "FC Pro" for tuning customer's cars with. An end user could take their car to a shop, ask for a PowerFC, and the shop would install it and tune it with their FC Pro software. The Commander was designed for the end user to monitor things and make some adjustments - while you can access many of the PowerFC's features, quite a bit of the features were only available with the software.

When the PowerFC came to the US, Apexi USA tried the same PowerExcel approach without much success. Qualified shops that can do tuning weren't very common in 1999-2000, and were mainly in large urban areas. Not to mention wideband AF meters were VERY expensive at that time and out of the reach of most users - only a few shops could brag that they had one. People also quickly realized that they could buy a PowerFC directly from a mail-order place and tune it themselves, cutting out the expensive trip to a PowerExcel shop.

The uniqueness of the FC Pro software came to an end a few years back when an enterprising New Zealand group came up with the FC-Datalogit. The Datalogit is a small box that plugs in between the Commander and the PowerFC. You hook a laptop up to it, and running the software on your computer you can access all the features of the PowerFC, as well as do a great deal of datalogging, map saving, etc. The Datalogit allows full tuning capability of the base maps and all of the settings in the PowerFC itself.

3a. What will the PowerFC do for my car?

There's quite a bit the PFC is capable of and gives the end user. The first and most popular use is simply to have a tuneable fuel computer. The stock ECU is locked from the factory, and end users can't modify the fuel maps inside. On the 3rd generation RX-7 this is of great concern when modifying a car. The stock ECU isn't designed for modifications to be done to the car (intake, exhaust, raised boost, etc.) and cannot provide the necessary fuel and timing maps to go with the increased horsepower. Without enough fuel, the engine runs lean, which can cause detonation and a blown motor. With a PowerFC, the computer can be tuned to provide the correct fuel and spark for various conditions, allowing the engine to make more power without engine damage.

The PowerFC is also a more advanced computer than the stock ECU. It has a faster processor and the stock map the PFC comes with is tuned for better performance. Many people have reported greater power just from adding the PowerFC to the car, as well as the car running better, better throttle response, etc. The stock ECU also has issues with stumbling around 3000 RPM, especially when cold. The PowerFC doesn't have that problem at all.

The PFC can also monitor all the engine's sensors and inputs. This makes it easy to read engine temperatures, sensor outputs, etc. which is a great benefit for troubleshooting and monitoring the engine's health.

4a. How does the PowerFC compare to other engine control computers?

There are quite a few ways to tune an engine, some better than others, some cheaper, etc. It really comes down to a personal decision. Each car is different, each owner wants different things from their car, so what’s right for one person isn’t necessarily the right choice for someone else.

Mind you, some of the pros and cons are dependant on the situation. If the tuner you're working with only does Haltech ECU's and does an excellent job with them, then it might make more sense to choose that option – an ECU is only as good as the tuner, plain and simple. An excellent tuner with a plain vanilla ECU is much preferable to a slipshod tuner using the absolute best computer.

People have made substantial power with the PowerFC with nearly every imaginable setup – it's a very flexible computer. The strongest point with the FD is the ease of installation, the VERY good base map that it comes with, and the tons of support that is available.

B. Purchasing and installation
1b. I want one - which PowerFC's work on my car?

So, you've decided to get one. Good! There are a few ways to go about getting a PowerFC for your car.

First off, remember that the PowerFC was made for MANY cars, not just the RX-7. You cannot get a PowerFC that's designed for another car and use it on an RX-7 - no way, no how. The units are totally application specific. Don't think the Nissan PowerFC your buddy hooked you up with can be made to work somehow - it isn't gonna happen.

Second, the RX-7 was made in Japan until 2002. Mazda Japan did a major update to the RX-7 in 1996 and again in 1999 - we didn't get either of these updates, as the RX-7 was only sold from 1993 to 1995 in the US. That said, the wiring harness was changed in '96 and again in '99 - if you get a later PowerFC, it WILL NOT work on a '93-95 RX-7. Period. By the same token, if you're in the UK, Australia, or another right-hand-drive part of the world and have a later model Japanese RX-7, you'll need the appropriate PowerFC for your car's model year.

Well, let's clarify this a bit. I have seen a wiring adapter to use a '96+ PowerFC on a '93-95 car - the wires are straight through, with no jumpers or other electronics present. It was a professional adapter from a shop in Japan. Which shop is unknown, how to get the harness is unknown, and how to make the harness would be VERY difficult. I have yet to find a pinout diagram of the later ECU's, and finding the correct connectors is EXTREMELY difficult. Overall you'd end up expending a great deal of effort and additional expense - it's just not worth it, you're far better off buying the correct PowerFC for your application.

There are differences in the Commanders as well. The early PowerFC's had Commanders that were specific to that PowerFC - if you had a Mazda PowerFC, you needed a Mazda commander. They later changed that to a universal Commander that works on pretty much *all* PowerFC's. From what I can gather, Apexi Japan is selling the PowerFC with the Commander all in one box now - I'm not even sure you can buy just the PowerFC. Regardless, it's just a good idea to buy both at the same time - you can be sure that it will work together.

The PowerFC's that are sold in Japan and the PowerFC's that are sold by Apexi USA in the US are pretty much the same - I'm not aware of any differences. In theory, some of the tuning might be a bit different, but I've not seen anything to bear this out.

2b. What's the deal with the PowerFC serial numbers?

I finally figured out the serial numbers on the PowerFC. The serial number typically looks like this -

PFC FD3Sx 0000-0000

"PFC" is PowerFC, of course. FD3S is for the 3rd generation RX-7 (of course). The "X" after the FD3S (or lack of the "X") is the key. Here's a chart for the FD3S codes:

FD3S - 96-98 RX-7 old version
FD3S2 - 92-95 RX-7 old version
FD3S3 - 99+ RX-7 old version
FD3S4 - 92-95 RX-7 new version
FD3S5 - 96-98 RX-7 new version
FD3S6 - 99+ RX-7 new version

I believe the weirdness with the earlier numbering scheme was due to the PowerFC coming out while the '96-98 RX-7 was in production. They made it for the new car first, then made it for the older car, then made the '99 version when the new RX-7 came out.

The "0000-0000" is a unit-specific serial number. They're all serialized so Apexi can keep track of them. I'm not sure if there's any further meaning to the serials themselves.

There is little difference between the old and new versions, as far as capabilities and functionality. Either one works great. One caveat, though – the older ones seem to have a less forgiving stock map than the new ones. The “base mod” map floating around is the map that comes with the newer PowerFC’s, and the older ones can be updated to this map fairly simply, maybe even with the Commander (need clarification on this point). The earlier ones will need the Mazda Commander, which can make it trickier to find a Commander if the unit you're buying doesn't come with it. Also, the older ones are supposed to have the ROM in the unit itself socketed, as the new ones have the ROM soldered directly to the board. Apexi Japan does offer a "Pro Upgrade" that adds drag-racing type features like ignition cut - this is a new ROM for the unit. Supposedly you can buy the ROM itself and just swap it out if you have an older PowerFC. A newer unit would require the Apexi factory to actually de-solder and solder the ROM in, which is a tricky proposition to get done for anyone not in Japan. The value of the Pro ROM is hard to say.

Also, you'll see the model years referred to with Roman numerals. I've actually seen quite a few Japanese products use this scheme. They will also show the dates of production to eliminate confusion. Here's a chart with that information -

I-III: '92-95 RX-7, built 12-91 until 11-95
IV: '96-98 RX-7, built 12-95 until 11-98
V: '99+ RX-7, built 12-98 and up.

I think the reason the Japanese refer to the early production of RX-7's as I to III is due to differences between each of the early years. '94s got the new plastic in the interior and the revised rear subframe, the '95s got a revised ABS pump and R-134a air conditioning, etc. I believe they do that differentiation in case there's a product that will only work on, say, a '93 - they can then say it's for RX-7 "I".

Also, there were '92 model year RX-7's in Japan. We got the '93 RX-7 in the US as a VERY early '93 - production started in December of 1991, with the first models off the line for Japan.

3b. Where can I get the best deal on a PowerFC?

There's a few options here. The US shops still carry the separate PowerFC and Commander, with both together running about $950-1050. This comes with a full warranty from Apexi USA and the English manual.

You can also buy new PowerFC's from Japan. JapPartsSpecialist.com has been selling them (PFC and commander) for a while now for $690 plus $40 shipping. Many people (myself included) has bought one, and I've yet to hear of a bum deal. Shipping is extremely fast as well. There have been rumors that they are refurb units, but that might be bellyaching from people who paid too much for their PFC.

You can also find them used fairly often. They show up used on Ebay and used on the RX-7 Forum classifieds fairly often. Of course, you're at the mercy of the seller as to the condition of the PowerFC - they are fairly sturdy units at least, and I haven't heard of many (or any) cases of the units utterly failing.

C. Installation and Setup
1c. I've got my PowerFC now - how do I install it and get the car going?

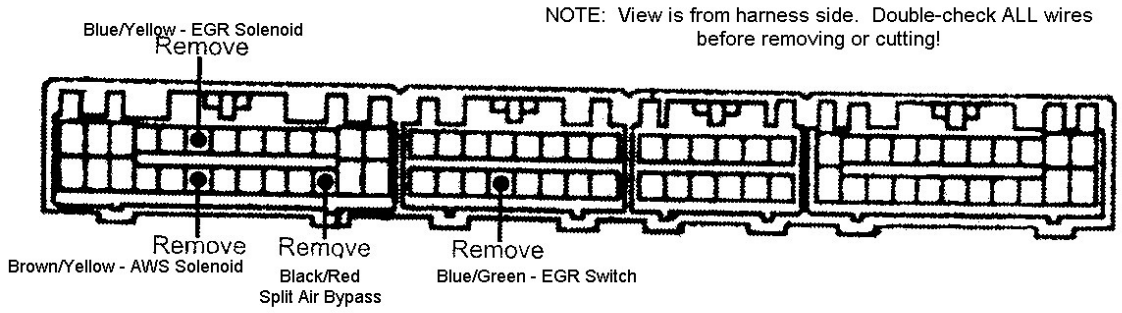
The fortunate thing is it's VERY easy to install and set up. There are a few things that are a really good idea to do before you put the PowerFC on your car.
First off, make sure your car is running 100%. New spark plugs, good plug wires, fresh fuel filter, healthy battery, good boost pattern good oxygen sensor - the car should just be running well to start with. If it's running badly, the PowerFC isn't going to help things - get your car sorted out and running well FIRST.

With everything hunky-dory on your car, time to install the unit itself. Disconnect the negative battery terminal on the car. Remove the scuff plate on the passenger side (the plastic piece with the RX-7 logo) and remove the plastic side panel in the passenger footwell to expose the stock ECU. Remove the various 10mm bolts holding the ECU in place, pull it out, and unplug the 4 connectors to the ECU.

There are 4 wires that need to be disconnected from the wiring harness for the PowerFC to work properly. These 4 wires are for extra emissions devices that were added in the US market, but weren't in the Japanese market. These 4 wires are for the EGR valve control, the EGR switch (the feedback in the California ECU cars to tell the ECU the EGR valve is working), the accelerated warmup system (AWS) which gives you the 3000 RPM startup when cold, and the Split Air Bypass solenoid, which can bypass air going to the main cat back to the airbox.

There are different methods for accomplishing this. You can either simply cut the 4 wires on the stock wiring harness and tape the ends up, cut the wires and splice an electrical connector onto the loose ends so they can be quickly re-attached, pull the pins out of the wiring harness' connector, or break the pins off on the PowerFC itself. Personally, I'm not a fan of breaking the pins off - it's too easy to harm something else or break the wrong pin off. Whatever method you choose, make sure to insulate the bare electrical connection so it doesn't short out against something else.

Here's a diagram of the wires that need to be cut or removed from the harness:



With that done, go ahead and adjust the idle bleed screw. This is just under the throttle body between the 2 10mm bolts that hold the elbow to the throttle body - it's a flathead

screw that's recessed slightly into the throttle body. Turn it all the way in so it's closed, then adjust it back out a half turn. You will need to pull the throttle body elbow off to see this screw and adjust it most likely. This will help the PowerFC learn the idle properly.

With that done, remove the stock ECU from its mounting bracket and attach the PowerFC to the bracket with the supplied Velcro strips, and plug in the wiring. Plug the Commander into the PowerFC, reconnect the battery, and turn the car to On. Make sure the Commander comes up to the main menu and make sure everything's working properly. Go into the Etc. menu and go to Sensor Check. If any sensor values are highlighted in reverse, that sensor is reading out of range, meaning the sensor is bad, the wire to the sensor is bad, something's up. If everything looks good, it's time to start the car and teach the PowerFC how to idle.

Start the car without any lights or AC on - switch everything off. Start the car and let it idle for 10 minutes. The idle might be rough, but should smooth out as the PowerFC learns the idle. Turn the rear window defrost on next, and let it idle for 10 minutes - again, the idle might be rough for a bit. Then, switch off the defrost and turn the AC on for 10 minutes. After that, the PowerFC should have learned your idle setup and is ready to go.

2c. I've done the idle learn process, but the car revs up and down at idle?

You need to adjust the idle bleed screw. Under the throttle body elbow between the 2 10mm nuts that hold the elbow to the throttle body is a flathead screw in an indentation. This is your idle adjust screw. Recommended setting is about 1/2 to 3/8ths of a turn out from fully in.

2d. My car stalls and doesn't run that well when cold with my new PowerFC. What's up?

The water temp correction settings the PowerFC comes with aren't perfect for many people. They need to be richened up. Bring the numbers up for the temps where you notice stalling over a few days until you find the best spot to get the car to run well.

D. Tuning and Using the PowerFC
1d. What mods will the base map that comes with the PowerFC support?

This is a tough question. There are supposedly differences between the maps the earlier and later PowerFC's shipped with. The earlier map (called the Base Map) is supposed to only be good for intake and catback, and the later map (called the Base Mod Map) is supposed to be good for intake, downpipe, highflow cat, cat-back, and intercooler. Every car is different - if you really want to be sure, see what kind of air/fuel numbers your car is making under load and go from there.

Here's a good page with various maps for the PowerFC and a program to tell the differences between different maps -
http://opus.bloomcounty.org/~patrick/pfc/

2d. I can't figure out how to use my PowerFC - what do I do?

First thing to do is to actually sit down and READ the whole manual. Yep, you gotta read it. There's a LOT of information in there, some of which takes a few readings to decipher due to some less-than-stellar Japanese to English translation.

If you don't have a manual, you can download a copy here -
http://www.clubrx.org/media/pfc/PowerFC_FD3S.pdf

3d. How do I tune my car with the PowerFC?

This is a VERY big question. Tuning a fuel injection system is more of an art than a science, and really takes some time to get just where it should be. Many times you aren't simply tuning the PowerFC - you also have to tweak, refine, and work with all the systems in the car (boost control, cooling, mechanical condition, etc.) to arrive at a good end result. The best-tuned fuel computer is useless if the car has boost leaks, clogged injectors, and a leaky radiator.

As you probably already know, rotaries are very fickle when it comes to tuning. If you get greedy or sloppy with the tuning process, you're looking at a blown engine. It doesn't take a lot of detonation to kill a rotary!

If you're unsure of your abilities, find a good shop that can tune the car for you. There are now quite a few rotary shops in the US with PowerFC knowledge, a wideband, and a dyno. Tuning fees can easily run into a couple of hundred dollars, but that's a LOT cheaper than a new motor.

There has been quite a lot written about tuning rotaries - hunker down with your PC and start reading. Do a LOT of searching on the forum, make notes, and get things sorted out.

Chuck Westbrook (cewrx7r1 on the RX-7 forum) has made a FANTASTIC tuning guide available, summing up a lot of his PowerFC knowledge that he's gained from many years of tuning and tinkering with the PowerFC. I highly recommend it – I learned a great deal from it. He asks a small fee for a copy of the document, and has been frequently updating and revising the document if you purchased it. PM him on the RX-7 club forums to ask about a copy.

For a really good insight into tuning, I recommend looking into the EFI101 class (http://www.efi101.com). I took the class and learned a GREAT deal about proper tuning. They hold them across the country, and it's well worth the money.

I will eventually flesh this section out with some more general tuning wisdom.

E. The FC-Datalogit

1e. What is the FC-Datalogit?

The FC-Datalogit (or Datalogit) was developed in 2002 by an enterprising group of New Zealanders. It's simply a small interface box that plugs in between the PowerFC Commander and the PowerFC itself, with a serial port to plug a laptop up to. Using the software, you pretty much have full control over the PowerFC, including many functions that aren't available through the Commander. It mimics a great deal of the functionality of the FC Pro software that the Power Excel dealers in Japan use, and in many cases surpasses it.

The Datalogit can be used in place of the Commander for handling all the tuning functions. It can also log data from the PowerFC, enabling the user to make logged runs to aid in tuning the PowerFC in. The lack of logging with the Commander was a major criticism of the PowerFC when it was first released. There is also a number of inputs for logging a wideband, EGT's, or other parameters that make it incredibly useful.

To learn more about it and see what the software looks like, go to the Datalogit home page -
http://www.fc-datalogit.co.nz/

2e. I really want one - where do I get it?

In the US, the Datalogit is available from Rotary Performance in Garland, Texas.

http://www.rx7.com

If you're outside of the US, check the Datalogit home page (listed above) for a local dealer.

F. Miscellaneous

1f. I have a 2nd generation RX-7. Can I use the PowerFC?

Yes and no. AP Engineering in Japan (which is a shop that's VERY close with Apexi) made a kit for the '89-91 RX-7's. It's basically a 3rd gen PowerFC with a harness to plug it in to the stock FC3S wiring harness, a boost sensor, and an intake air temp sensor. These kits are pretty hard to get your hands on, but do supposedly work. It's not totally known if AP Engineering modifies the map on the PowerFC to work properly on the 2nd generation RX-7s or not.

If you want to try to make it work on your car without the special harness and everything, you will very likely have an uphill battle on your hands. Very few people in the US have used the PowerFC on a 2nd gen RX-7, so there isn't much documented or written about it.

UPDATE: Chris Sanders (BlueTII on the forum) discovered how to use the FD PowerFC on an '89-91 RX-7 with VERY little modification. See his site for the full writeup – http://banzairacing.net/index_S5_pfc_install.htm

Basically, you need the PowerFC, an FD intake air temp sensor, and a GM 3-bar MAP sensor. So, for not a lot more than the cost of the PowerFC you can be up and going. IN THEORY, the PowerFC could work on an '86-88 RX-7, but will require SUBSTANTIAL amounts of work and wiring modification.

Any 2nd gen RX-7 owners who install a PFC in their car SHOULD CONSIDER THE UNIT UNTUNED. The car *should* start and drive fine, but full throttle or any boost could easily kill the motor. The secondary injectors also have to be changed to 550cc injectors from the FD's 850cc injectors (unless, of course, you have larger injectors, and then the proper settings should be made).

2f. I turned on my car the other day, and the Commander hangs at the Apexi logo screen. Is my PowerFC broken?

Nope. People have reported that it's due to a wire inside of the commander coming from the cord to the PowerFC breaking loose of its solder joint. A simple re-soldering of the wire seems to fix the problem – the brown wire inside the unit is the most common culprit.

I have seen on mine that the connection from the commander to the PowerFC came loose – turn off the car, unplug the commander, plug it back in, and that can solve the problem.

3f. My AC doesn't work on certain speeds. How do I fix it?

This is a common problem with the PowerFC. There's been a great deal of speculation over the years as to the hows and whys of this problem.

First, a little background. FD's in the US came with 2 air conditioning systems - MANA and Nippondenso. MANA systems were in all non-Touring cars - these systems were installed at the port when the cars arrived in the US. The system was designed and supplied by MANA (Mazda North American Operations). Reasons why seem to be due to extra taxes or cost for bringing the cars over with air conditioning already installed. Touring models came from Japan with the AC system already installed - the system was made by Nippondenso, hence the name.

There are some subtle differences between the two systems, and it's believed that the PowerFC will work better with the Nippondenso AC system, as that's what all the Japanese cars have and it was designed for the Japanese market.

The glitch seems to primarily be on certain fan speeds. Some people have had success with pulling the fan speed knob out of the car and cleaning the electrical contacts. The PowerFC seems to be more sensitive to resistance that the stock ECU, and dirty contacts will increase the resistance in the circuit.

There have also been some fixes involving bypassing the ECU's control of the AC. This can be a problem, as the ECU is designed to shut the AC compressor down at high RPM or high load to prevent damage. You take the AC input and output wires going to the ECU and splice them together – this takes the ECU out of the loop for AC control. Problem is the AC will not disengage at high RPM or load, which will bog the car down and could also harm the AC compressor, as it’s not designed to be running at 8000 RPM.

It’s really pot luck if your AC will work perfectly with the PowerFC or not. My car works 100% - all fan speeds, everything works just like normal.