This document is written by Iwan Keller from www.Rotary-Imports.de as add-on for Apexi PFC FAQ. You can contact me at: iwan@rotary-imports.de

Installation of Apexi PowerFC

FD3S version into

second gen RX-7 FC3S Turbo.

Version	Changes note	Date	by:
1.0	Initial release	October 20, 2006	Iwan Keller
1.1	See version history	January 28, 2007	Iwan Keller

Change notes and version control

Version	Change notes	By
1.0	Initial release	Iwan Keller
1.1	FD igniter pin-up added FC Series 5 wiring diagram added changes to external links Review of document and minor text changes.	Iwan Keller

Version	Changes note	Date	by:
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Introduction

This document describes basics for installation of Apexi PowerFC FD3S Version for FD series I~III build from 10.91 to 12.95 into second gen. RX-7 Series4 and Series5 Turbo.

Please use all the Information provided on this document at your own risk. I will not cover any damages or faults which may result. You will require deep mechanical and electrical skills to perform this modifications. The installation will require modifications to your electrical engine control system, which can cause damage to your car components or the engine from improper installation or use. If you are not common to electrical installations or you don't understand any of described points, do not perform any changes! In this case please ask your preferred workshop about the modifications described here.

This installation is recommended to all, who use aftermarket turbo set-up. You will loose the twin-scroll function from your series4 by following this write up.

I have performed the installation by myself to my cars and all my setups are working very well. My first car is a series4 Japanese spec. FC3S with HKS T04E turbo installed, now upgraded to T04S.

My second car is a series5 Japanese spec. FC3S with HKS T04R turbo installed.

The installation of Apexi PFC FD version into Series4 is slightly different as the installation into Series5. The reason for this is the wiring and different ECU pin- out of both versions. The installation into Series5 is more easy as for series4. We will need to split this document into Series4 and Series 5 section.

Version	Changes note	Date	by:
1.0	Initial release	October 20, 2006	Iwan Keller
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Series4

Before we can begin, we need following parts for our modifications
Parts needed:

- Apexi PFC FD3S I~III version made between 10.1991 and 12.1995
- FD3S Water-Temp sensor and connector
- FD3S Air-Temp sensor and connector
- FD3S wiring loom and connector for slot1 of the Apexi ECU found in FD3S or Series5 FC3S. You can also use wiring-adapter like on the picture bellow.
- FD3S igniter
- FD3S MAP sensor or GM 3BAR map- sensor
- 4x 10 OHM resistors with at least 10 Watts

Sensors:
First you should remove your I/C and the UIM to get access to the sensors and the wiring loom. Replace the water-temp sensor with the FD sensor. Remove your air-temp sensor and replace with the FD sensor (you will need to tap new thread as the FC thread is something like M8x1,0 and the FD is M8x1,25)

Version	Changes note	Date	by:
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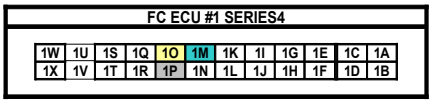
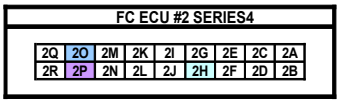
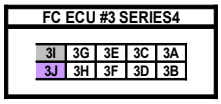
FC Pinout:
You will need to make a new wiring loom or solder the original pins from your old ECU. Let us take a look at the ECU pin- out, and what each pins is used for:







1A	Diag
1B	Diag
1C	Air-Bypass- Relay
1D	Diag
1E	A/C Switch
1F	A/C Relay
1G	Neutral- Switch
1H	Water-temp-sensor
1I	5-th gear switch
1J	Initial-Set Coupler
1K	Change gear light (never seen this one)
1L	Clutch switch
1M	Ign-signal trailing coil
1N	CAS-green wire
1O	Milage- Switch
1P	CAS black wire NE-Signal
1Q	CAS white wire G-Signal
1R	P/S switch
1S	Solenoid port air
1T	CAS red wire ground
1U	Trailing coil (select Signal) this is why we need FD igniter!
1V	Leading coil (Ignition timing signal)
1W	Heat hazard Sensor
1X	Trailing coil (Ignition timing signal)

2A	V-Ref
2B	Boost Sensor
2C	Ground
2D	O2 sensor
2E	Air-flow-meter
2F	Variable resistor
2G	Throttle-Body sensor
2H	Athmospher Sensor
2I	water Thermo Sensor on A/C cars
2J	Airflow-meter
2K	Solid Air solenoid
2L	Intake Air Temp Sensor
2M	Solenoidl Pressure Regulator
2N	EGR Solenoid Valve
2O	Solenoid Switching Solenoid
2P	Relief solenoid valve
2Q	Bypass Air Control valve
2R	Ground

3A	Ground
3B	Starter switch
3C	Injector Primary Rear Rotor
3D	Inhibito Switch
3E	Injector Primary Front Rotor
3F	Injector Secondary Rear Rotor
3G	Ground
3H	Injector Secondary Front Rotor
3I	Main Relay
3J	12V

I do not recommend to use the original wiring loom on series4. The excessive heat under the bonnet will make the original wiring brittle and failure prone, it is highly recommended to make a new wiring loom to make sure, all the wires are properly connected and all the electrical joins are solid. If your wiring was recently replaced by a new, or you know your wiring is in good condition, you don't need to perform the wiring change.

To remove:
When you decide to make your own wiring loom, you can remove following sensors and parts, you will loose the option of twin scroll turbo control.
- AFM (air- mass- flow- meter)
- Stock Series4 MAP-sensor
- BAC valve (install a block-off plate)
- solenoids for emission control and twin- scroll function.
- Variable resistor which is installed near the MAP sensor
- All emission relevant components.

CAS:
Make sure you use shielded wires from the ECU to the CAS. This wires are very important for ignition control of the ECU. Electrical devices like igniter, plug- wires and ignition coils may influence the CAS signal which may lead to improper timing control and engine damage. For this reason, please do not use regular wires for CAS use shielded wires instead. You can solder the green and the red wire together, them are connected to 4H pin on Apexi PowerFC. Make sure, the black and the white wire for NE+ and G+ are connected properly. Please pay special attention to the connectors which will join the CAS and the wiring. On the CAS side of connector the wires red and green are used for NE+ and GE+ on the wiring side to the ECU the colour will change to black

Version	Changes note	Date	by:
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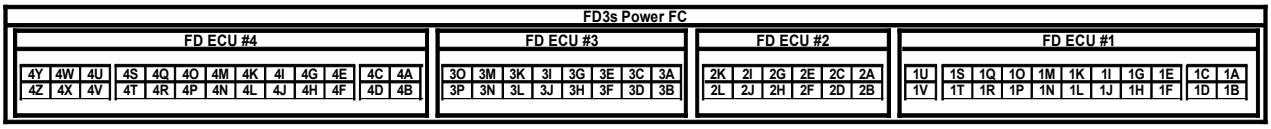
1.1	See version history	January 28, 2007	Iwan Keller

(NE+) and white (G+).

Injectors:
As Series4 has low impedance injectors by default, you need to splice 10 ohm resistors with at least 10 watts into the wiring. You should do this on the wires going from the ECU and not on the 12V main line. Try to install the resistors inside the car, not inside the engine bay, try to keep them away from the engine heat.
Few Series4 cars made for European market were equipped with high impedance injectors. Please check your injector impedance first.

Apexi PFC Pinout:
Let us take a look of the wires we need to install, the wires necessary for engine to work and some nice features used by Apexi ECU are bolt:



4A	**Ground**	3A	Stearing Pump 12V?	2A		1A	**12V with 7,5A fuse**
4B	**Ground**	3B	Zur EL-Unit	**2B**	**RPM Signal**	1B	**12V ignition**
4C	**Ground**	3C	**O2 sensor**	2C		1C	
4D	**Ground for sensors**	3D	Relay Cooling FAN	2D		1D	Daig-connector
4E	**Crank-angle (NE) black wire PLUS +**	3E	**Water-temp sensor**	2E		1E	Thermoswitch
4F	Split air Bypass solenoid valve	3F	**TPS Signal /green-red**	2F	Canada Modell unused	1F	Diag-connector
4G	**Crank-angle (G) White wire PLUS +**	3G	**TPS Signal /black-green**	2G		1G	**Trailing Front ignitor**
4H	**Crank Angle (G und NE) RedWire MINUS -**	3H	Purge control solenoid output	2H		1H	**Leading Ignitor**
4I	Oil Metering Pump	3I	**5V for TPS and MAP Sensor**	2I	Heat Hazard	1I	Diag-connector
4J	Oil Metering pump	3J	EGR Switch input	2J		1J	**Traling Rear Ignitor**
4K	Oil metering Pump Stepping Motor output	3K	Solenoid Valve Relief2	2K	First-Speed Switch	1K	Relay for fuel pump
4L	Oil metering Pump Stepping Motor output	3L	**Air-Temp**	2L	second-Speed Switch	1L	A/C Relay
4M	Solenoid Valve PRC	3M	**Knock Sensor**			1M	Speed Signal
4N	Solenoid Valve Switch	3N	Solenoid Valve Air Bypass			1N	Power Stearing Switch 12V output
4O	EGR Solenoid output	3O	Solenoid Valve double throtle control			1O	**MAP Sensor Green Yellow output signa**
4P	AWS Solenoid output	3P	Solenoid Valve Relief1			1P	
4Q	Solenoid Valve ISC					1Q	Clutch-Switch
4R	Solenoid valve Turbo Control					1R	Neutral- Switch
4S	Solenoid Valve Charge Relief					1S	Brake pedal switch
4T	Solenoid Valve Charge control					1T	
4U	Solenoid Valve Wastegate Control					1U	Fuel temp Sensor
4V	Precontrol Solenoid Valve					1V	
4W	**Injector Primary Front**						
4X	**Injector Secondary Front**						
4Y	**Injector Primary Rear**						
4Z	**Injector Secondary Front**						

solder all the necessary wires from the diagram into your loom, not matter if you build your own loom or using the existing wires. Always use heat shrink tube for soldering points and tape all your connecting- points. Check for solid ground when installing electrical devices.

TPS:
The TPS on the Series4 is a full range type. There is no narrow- range TPS on series4, so the narrow- range signal is not used. The PIN 3G on Apexi PowerFC is the only one which needs to be connected. PIN 3F is not used for series4.

Fuel-Pump:
The fuel-pump relay is not controlled by the ECU for unknown reason. I recommend to install a new relay and replace the old fuel-pump wiring with new solid one. In this case, you can remove the fuel pump resistor mounted on the right side of your car near the right head-light.

Version	Changes note	Date	by:
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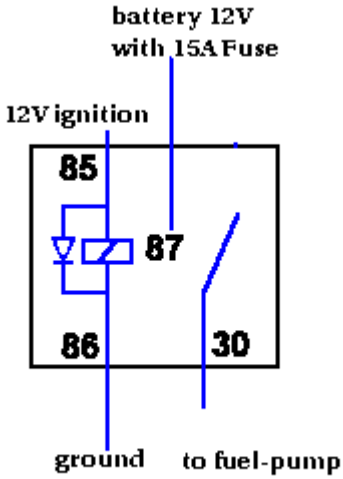
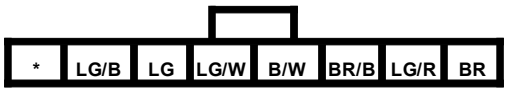


For Bosch type relay use the 87 for battery with a 15A fuse, the 30 should go to the fuel-pump, the 85 to ignition 12V and the 86 to ground. Every time you turn the ignition on, the pump will start working. Do not use the output of the PFC for fuel pump relay it will not work.

Igniter:
You need to use FD igniter for FD3S PowerFC version. As the FD igniter has no tachometer-output as you have it on the trailing coils on second gen, you have to solder the 2B signal from Power FC into the tachometer input on the FC harness (yellow with blue stripe wire on the trailing coil pack wiring.)
Now, install the FD igniter. Take care about the right wiring! Do not use FC igniter!
Using the FC stock igniter will result in no spark at rear trailing plug as there is no 1V select signal from the ECU to control the spark on second trailing spark, only front trailing spark will fire but not the rear one. Also, your tachometer will read half the real RPM value. USE FD IGNITER!

Wiring for FD igniter.



*		Not Used
B/W		12V Ignition
LG	To ECU	1H
LG/B	To coil	Leading
LG/W	To coil	Trailing 2
BR/B	To ECU	1J
LG/R	To coil	Trailing1
BR	To ECU	1G

Version	Changes note	Date	by:
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The FD igniter comes as a box, with male connector build in. So you need a wiring loom with connector, or you can use hot-glue-gun as I have done on my own car to secure the connector- pins. Please make sure, the pins don't touch each other! Use shielded wires for igniter installation and shielded wires from the igniter to the coils.
At this point, I have decided to remove my 21 years old coils (my car is build in nov. 1985!) and replace them with FD coils I had lying around at my workshop. I have also installed MSD6A for my leading coil to improve the spark capability past 3500RPM.

After you've done, check the wiring! When you've done, check the wiring again! Always solder the wires and use shrink tube and tape, lots of tape!

PFC MAP:
The stock FD3S map may not work on Series4, so you will need to make some changes to the stock map of your PowerFC to suit Series4. You can do it only using the Power- Excel software from Apexi or Datalogit. I can send you my map on request, but some adjustments are needed even to my map, as every engine is different.
You will need to take special care to ignition timings! Mazda changed the design of Rotorhousing at the change from s4 to s5. FD timings are to advanced for 13B-T engines!

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Spark- Check:
After you have checked you wiring, you should check for spark. Remove your trailing leads and connect them to spark plug which is not installed. Start the engine and get the plug to ground at chassis. You should see the spark coming from the sparkplug on T1 and T2. If you car do not start, check for spark on leading side, the same way you can do it on the trailing side, just by cranking the car without starting.

Series5

Parts needed:
Much easier than on Series4, but still some work to do.
Let us start with the parts needed for our ECU change.

- Apexi PFC FD3S I~III version for cars made between 10.1991 and 12.1995
- FD3S Air-Temp sensor and connector
- FD3S igniter
- FD3S MAP sensor or GM 3BAR map- sensor

History:
much less parts needed than on series4. Well Mazda changed many things since 1989! With Comso engine introduced and changes to production of series5 RX-7 are main steps into the development of the third Generation RX-7. The engines
13B – RX-7 second gen.
13B- REW Cosmo engine,
13B-REW FD engine
them all, have some things which are equal. Let us take the rotors, them are the same and some of the ECU internals are same as well. So the second gen RX-7, the Cosmo and the third gen RX-7 are the best cars for the workshop, as many parts are interchangeable. This is the reason, why we do not need so many things for our Power FC installation.
However, we still need FD igniter, FD air-temp sensor and the map sensor.

Sensors:
First you should remove your I/C and the UIM to get access to the sensors and the wiring loom. Replace the water-temp sensor with the FD sensor. Remove your air-temp sensor and replace with the FD sensor (you will need to tap new thread as the FC thread is something like M8x1,0 and the FD is M8x1,25)

TPS:
The TPS on the Series5 is a full and narrow- range type. Please use PIN 3G on Apexi PowerFC for the full- range and PIN 3F for narrow range. You can also refer to the wiring diagram bellow to change the pins on your existing wiring loom.

Diagram:
The installation is described on the www.banzai-racing.com website including all the diagrams and the PIN-OUT of the wiring. Here is a copy of the diagram.

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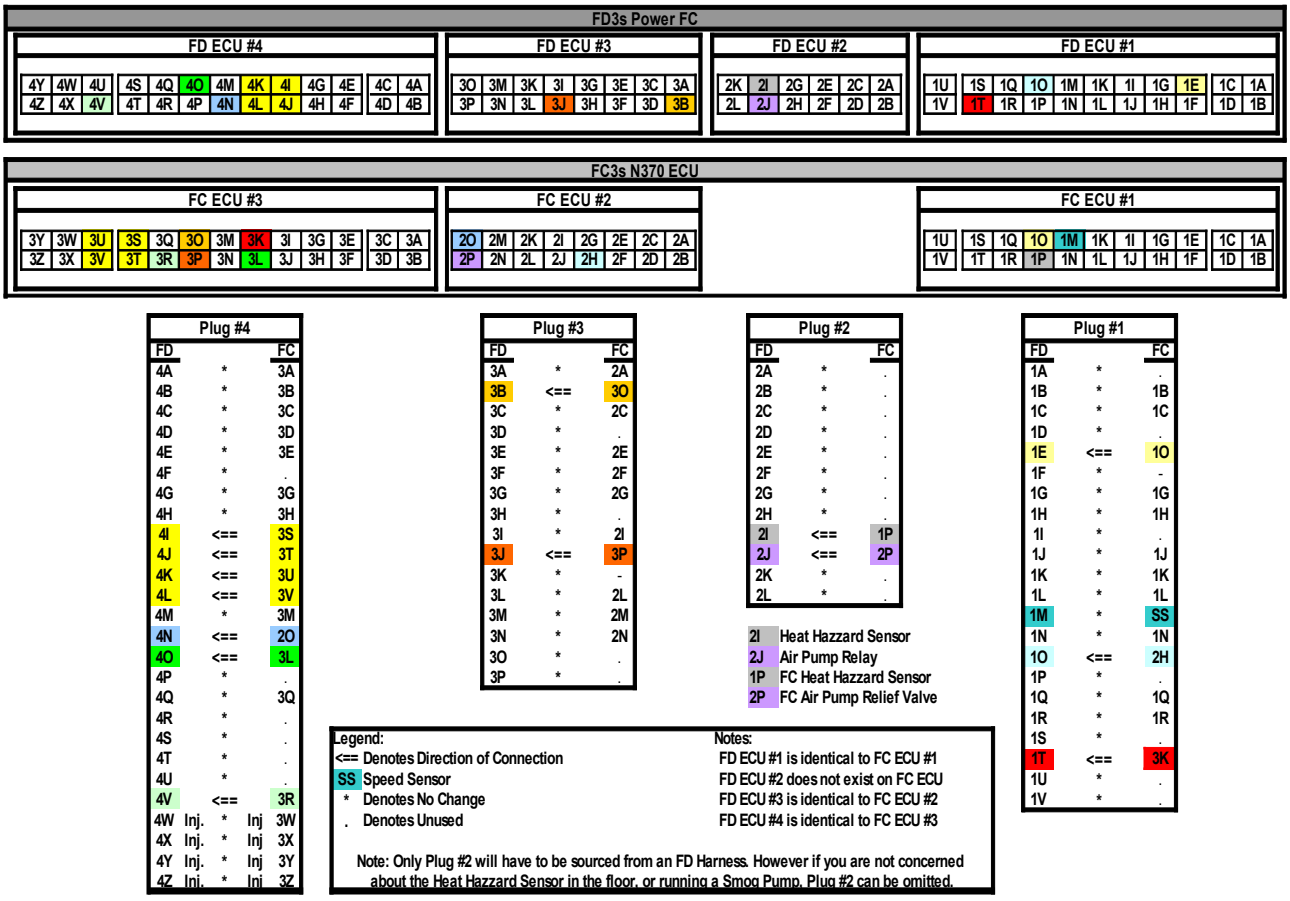

Igniter:
Banzai-Racing.com do not cover the installation of FD igniter but we need the FD igniter, as the FC igniter is not able to fire the rear trailing plug due to missing of 1V select signal from the ECU.
Also, Cosmo igniter will not work with PowerFC for FD3S. You need to perform the same changes to ignition as on series4, so please refer to the series4 section.
You can use FC coils with FD igniter, or install FD coils or any coil you prefer. Also, CDI ignition is a good mod at this point. Always use shielded wires from igniter to the coils.
To install all other connectors, please use the wiring-diagram from the banzai-racing website, it shows all the wires which you need to change on the series5 harness.

Wiring loom/ Injectors:
I still recommend to build your own wiring for your engine, even on the series5. Please always check your injector impedance, even on series5. PowerFC can not handle low- imp injectors, so you need to change to high impedance, or install resistors into the loom.

Fuel-Pump:
Please install new solid wires for your fuel pump and install the fuel- pump relay the same way as for series4.

PFC Map:
The stock FD3S map may not suit s5 engine, so you need to perform some major changes to the

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map. You will need to do so using Power Excel or Datalogit. I can provide a basic s5 map on request, but minor changes are still required as all engines are different.

Troubleshooting:
After you have checked your wiring, you can start your car. If you car don't start, check your wiring again. After you performed all the inspections but your car still don't start, try to follow this guide:

Check for RPM at crank. Use Datalogit and check if the ECU sees the right signal from CAS at crank. Datalogit should read about 250 RPM at crank. If Datalogit don't display anything, you should check your CAS wiring. Pay attention to the connector between the CAS and your wiring loom. Remember, on the CAS side, the red and the green wires are signal wires, where as the two black wires are ground. On the harness side, the colour will change! Now we need to look at the black white wire (the should join the red, green on the CAS wiring) and not for the red green, at the red green on the loom side is connected to the ground (the two black wires on the CAS).

Check for right installation of FD igniter. Remove your leading spark- lead and connect it to spark plug (not the installed one). Crank the car and take the spark to chassis and look for spark. If you have no spark, check your igniter installation. Perform same check with both trailing sparks.

Fuel pump: Well, the best way is to listen for the fuel pump noise. If you can not hear anything, check your wiring and your new relay.

After you have done the installation, you should have something like this:
ECU installed....!

Version	Changes note	Date	by:
1.0	Initial release	October 20, 2006	Iwan Keller
1.1	See version history	January 28, 2007	Iwan Keller

OK now, turn the ignition “on”

Version	Changes note	Date	by:
1.0	Initial release	October 20, 2006	Iwan Keller
1.1	See version history	January 28, 2007	Iwan Keller

now just turn you key to start the engine.....up and running!

Version	Changes note	Date	by:
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Now, it is time to book your next dyno for final setup.

If you have any questions, you can contact me at iwan@rotary-imports.de

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