# EA to EJ

# The definitive guide to swapping a Subaru EJ engine into your 80s EA Car.



Written by Numbchux

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## 1. Introduction

I hope with this write-up to compile all the available information on the EJ-swap into an EAseries car, specifically a Phase I, OBD I, N/A EJ22 into an EA81 or EA82. The lightweight EA-series chassis is the perfect candidate for the efficient, powerful, 16-valve, MPFI EJ22. With the information included here, you should be able to do this swap with just a Chilton's manual. But a Haynes and a Subaru Factory Service Manual would help.

The First thing to remember when doing something like this is that every situation is different. And you'll have to figure some stuff out on your own to make it all work. Not everything will be covered exactly in this write up. But it should get you off to a huge start. If you're having problems, don't hesitate to post a question on the Ultimate Subaru Forums at www.ultimatesubaru.org.

<u>Links</u>

M. Rose: Great source for the Adapter plates - http://www.mroseusa.com USMB: Full of helpful, knowledgeable Subaru enthusiasts - http://www.ultimatesubaru.org

#### Acknowledgements:

Thanks to all the following users for their contributions to this guide:

88HatchMonster ShawnW Baccaruda Bratsrus 91Loyale Ballitch Suberdave yegoshin

Also, I can be contacted by email or MSN messenger at Numbchux@Gmail.com On AOL or Yahoo Instant Messenger under the username NumbchuxSOAD

Feel free to contact me with questions, comments, or updates.

- Matt "Chux" Alexander

# 2. Transmission

The input shaft on the EA-series transmissions are about a 1/2" longer than those on the EJseries ones. And the upper 2 bolts in the bellhousings are also in slightly different places. An adapter plate will correct both of these issues.

These adapter plates are available through M.Rose, or can be made yourself.

Homemade adapter plates may not center the bellhousings relative to each other (via the 4 pins on the sides); paying for a precision laser/CNC cut plate may be worth it. If the bellhousings are not centered perfectly, it will pressurize the transmission input shaft in the direction of the misalignment, risking failure of the transmission input shaft front bearing.

Here's a picture of the adapter plate that 91Loyale made:



The offset studs were made using a jig to hold them while we welded. You thread them into the engine, put the plate on and it locks them in position, then slide the transmission on a put the 4 nuts on.

Also, a pitch stopper bracket and stopper from an XT will bolt onto the transmission and up to the firewall without modification on an EA82. EA81s have the mount on the firewall off center. So you'll have to be a little creative.

NOTE: If you're swapping in the EJ transmission, a custom driveshaft will need to be used, and you'll need to make sure you have front axles that match the inner spline count (all EJ cars use 25 spline except FWD Imprezas which use 23 spline. turbo EA82s use 25 spline, all other EA cars use 23). Or, you can do a 5-lug swap using EJ front knuckles, and use EJ axles. And you'll also need to shorten the linkage.

An EJ transmission will bolt right up if you use the front and rear crossmember pieces from an XT6 and the center piece from a WRX. The drive shaft has to be shortened 55MM. the rear axles you may have to buy adapters to mount the EJ inners to the EA axles, cost \$6 each from Rockford CV.

# 3. Flywheel

The bolt pattern for the flywheel on the EA cars is a bit smaller than the EJ, and is also asymmetrical so that the timing marks are aligned correctly. The EJ series cam timing marks are on the crank pulley, and since the ignition timing is computer controlled, there's no need for the ignition timing marks. So the bolt pattern is symmetrical.

The ideal way to do this is have a local machine shop weld the holes shut, and then redrill them.

But another way to do it (I did it this way, with great results), is to use the flexplate or flywheel from the EJ as a pattern, and grind the holes out on the EA flywheel with a Dremel. The pilot bearing hole fits perfectly on the crank, so you can't get it off center. And you're modifying almost the exact same amount on all sides of the flywheel, and very close to the center, so balancing it isn't much of a problem (although a shop could balance it for about \$30).

Either an XT6 or a four cylinder EA82 flywheel can be used, however the XT6 flywheel is a bit lighter than the four cylinder version. So for faster revs (street use), the XT6 one is preferable. And for better low RPM torque (off-road & 4WDing), the 4-cyl one would be more useful.

### 4. Clutch & Pressure Plate

An XT6 Pressure Plate should be used to hold the extra torque/hp. (only if keeping the EA transmission)

If using an EA81 transmission, the important part is the pressure plate. Get one for an XT6. You'll also need to get a throw out bearing for an '85 Nissan 720 pickup to run that PP with an EA81 4spd. The stock EA81 clutch plate is more than adequate when paired with an XT6 pressure plate.

For money sake (specifically, I was virtually broke, and happen to have a normal EA82 clutch kit already), I used the 4-cyl disc and pressure plate, and so far it's held. Knock on wood!

### 5. Motor Mounts

Use the EJ motor mounts, and widen the mounting holes in the crossmember slightly, somewhere between 1/4" to 1/2" on either side. A Dremel or similar rotary tool with a grinding stone works great for this.

The EA82 crossmember accepts the motor mount holes without widening (round EJ mounts) EJ mounts may have a centering nipple that needs to be ground off as there is no receiving hole in the EA crossmember as there is in the EJ crossmember.

#### 6. Fuel Delivery

You'll need a fuel pump from a Fuel Injected EA car (if yours isn't already), to supply the necessary fuel pressure.

The pressure regulator is built into the fuel rails on the EJ motor, so the inline ones can be removed (little things on the lines right near the Throttle Body).

Some say that if you've got a carbureted car, you'll need to upgrade your fuel lines to fuel injection grade.

If upgrading from an EA81, a surge tank may be necessary to prevent fuel starve when cornering with under 1/4 tank of fuel.

# 7. Radiator

The EA radiator is plenty to cool a non-turbo EJ motor. The challenge lies in hooking up the hoses. The EJ Radiator hoses are a  $1 \frac{1}{2}$ " ID (inner diameter), whereas the EA ones are  $1 \frac{1}{4}$ ".

Solution 1(the one I used): use bushings to change the ID of the hose. Napa sells these. They're little pieces of hose with a 1 1/2" OD (outer diameter), and a 1 1/4" ID, with a lip on one end. These can be slipped into the larger hose (lip keeps if from sliding in too far), and the clamped onto the smaller end. I used the legacy hoses, I simply trimmed about 1/2" off the ends of the upper hose, and the bottom one worked pretty well since I'm using a Loyale radiator (since the lower port comes out almost straight out, instead of at a steep upward angle).

Solution 2: have a radiator shop braze larger inlets onto your radiator

Solution 3: use a muffler pipe reducer and 2 pieces of hose (this is a pretty small muffler pipe....so it may be hard to come by. it was for me)

Solution 4: Use the smaller size hose, and force it around the larger inlet on the engine (WD40 and/or soapy water will help it slip on).

Solution 5: Napa sells 2 kinds of flex hose. One has coiled wire inside the center of the hose and regular rubber hose on the ends. The other kind they sell is an RV/boat type hose that I think is suited for submersion or something special but it's an absolute &\$^%@ to work with. Avoid the second kind.

The ones that are PERFECT are the ones that are flex in the middle only and are all different lengths and they have some with different size ends..

You may need to be creative with the routing

The single row radiator ea82 seems to be a better fit than the twin row. Of course cooling is sacrificed.

The EA81 radiator is a lot easier for the radiator shop to modify to work with EJ hoses. My guy here modified the lower ea81 radiator pipe with a bigger outlet that pointed in a way that the lift kit would appreciate (90 degree elbow) but for the ea82 radiator he's taking the inlet and outlet pipes and swapping them. This way the top one will have a 90 degree bend and point right into the EJ water pipe and the lower one will be a straight out outlet. I'll still have to use flex radiator hoses from Napa that have different inlet and outlet diameters but that's doable.

For my lower radiator hose (my radiator has the outlets modified to match the size of the EJ22, with the lower outlet given a right angle bend down) I will use Napa #9521. A right angle bend

is not optimal as it reduces the clearance between the outlet and the radiator support corner brace; 45deg. would have been better, or building the outlet to come an extra 1/2" - 1" from the radiator before bending down would have been better.

I'm also going to mention here that you'll need to replace the lines that run to the firewall and then into the Heater Core. They're the same ID, but longer. Pre-formed hose is not necessary, simply take a piece of your old line (5/8" ID if I'm not mistaken), in to Napa and tell them you need about 3 feet of it, and 4 hose clamps to match (don't try to reuse those crappy factory clamps!). Then cut 2 pieces the right length, and clamp them in place

You may want to put a 90° coupler to angle them down around the starter if you're running with a lift, like this:

The part number for the heater hoses I used is Napa #10868 (x2). Each is a long hose with a right angle bend at each end. I trimmed a few inches out of the middle of each, making 4 shorter hoses with right angle bends. Then I put right angle heater hose elbow from the "HELP!" aisle at the auto parts store to push them up over the starter, wiring, etc.



# 8. Radiator Fans

Typically, after this conversion, there isn't enough room between the radiator and the engine for the Radiator Fans. You'll need to replace them with 1 or 2 aftermarket ones and put them on the grill side of the radiator. If you're keeping the A/C, you'll have to get a little creative since the A/C condenser will limit that space (hint: ditch the A/C)

I went to Advanced Auto, and they have a 12" aftermarket radiator fan made by Imperial that can be mounted on either side of the radiator, and has little clips that pull through the radiator itself. No need for any fancy mounting hardware. The same company makes an automatic fan relay, with a remote heat sensor that attaches to the radiator in the same way. this simplifies the wiring, and makes the operation of the fan automatic (if this is in an off-road rig, and there's any chance that the fan will become submerged, wire it to a switch inside, so you can manually turn it off when going through water. if it's on while underwater, the blades will probably bend and take out your radiator!)

EA81 skinny fan fits fine in front of A/C condenser - with the radiator support and hood latch removed. Replace the center radiator support with two "1/3" supports (?) and use hood pins. May not flow enough air though, haven't driven it yet. Tube bumper instead of stock will help with airflow.

#### 9. Oil Pressure Gauge

The EJ cars only have an idiot Oil pressure light, not a gauge. There are a few ways to approach this

Solution 1: wire a light into the harness, and mount it on the dash. And ignore the gauge.

Solution 2: plumb in your EA82 sender, this is doable with about \$50 worth of adapters and lines available from Paragon Performance in CA. contact M. Rose (88hatchmonster on USMB) for more details on this approach

Solution 3: Buy an aftermarket gauge kit. Many of the companies that make these offer a metric sender kit that \*theoretically\* should be a direct replacement for the stock sender (under the alternator).

# 10. Temp Gauge

The resistance on the temperature sending units is calibrated differently. So if you wire it straight into the EA dash, the gauge will read about half. As usual....there are a couple solutions:

Solution 1: Live with it....it's not that bad, but if the gauge reads 'normal' (or what would be with the stock motor), you're motor is overheating. Mine barely moves past the 'C' mark for operating temp.

Solution 2: Weld a bung for an EA82 temp sensor into a sleeve, and put it inline with your upper radiator hose.

Solution 3: Aftermarket gauge/sender. Same deal as the oil pressure gauge.

Solution 4: In theory, you could wire a 275 Ohm resistor from the wire between the sender and the gauge to ground, like this:



ground

I do not know of anyone doing this successfully, but it should work. If you have done it, please contact me with a confirmation.

### 11. Exhaust

If you want a complete exhaust system, you'll have to have most of it custom made. As the stock EA system won't be compatible with the motor, nor with any other part of the EJ exhaust. And the EJ exhaust is routed differently, so it won't fit right on an EA car.

# NOTE: It is beneficial to use the EJ style exhaust. It has been noted that top end power is greatly reduced with the use of the small diameter EA pipe.

Or, you can do what I did, and use the stock legacy y-pipe and mid-pipe, with no axleback/muffler. In my case, the legacy donor car had 240k miles on it, so there wasn't really anything left of the cats. This setup makes for a pretty throaty sound, and it's the right price, but will be replaced with a full-custom setup soon.

When doing the swap into an EA81 car, the cat will need to be shifted a bit to keep from hitting the crossmember. 88HatchMonster - "I made a small cut in the right side pipe so I could shift the cat away from the crossmember and then had to shorten the left pipe in two places."



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There is a tab on the heat shielding right behind the flanges on either side of the Y-pipe, that I had to pound flat to keep from rubbing on the crossmember.

EJ22 Y-pipe may rub on the crossmembers - shim it down by stacking an extra flange onto the y-pipe's flanges (1cm drop)

There are variations here, just make sure you test-fit everything before committing to it. And in the long run, and full-custom made system may be preferable.

#### 12. Misc Engine Bay Adaptations

The wiring on the EA81 goes through the grommet behind the strut tower without any problem. The EA82 you have to pull the left front fender and run the wiring through that grommet and it's a lot harder to get all the wires through the second hole that the old intake manifold wiring went through, but it does fit.

The EJ22 fits in the EA82 body frame rails better but the clearance between the radiator and the front pulleys are tighter on the ea82.

The EA81 was a lot easier to put the air filter into but both can be done this way: Take the legacy air box, cut the bottom of it off so the bottom of the filter is exposed and then take the legacy airbox mount on the frame rail and make new holes to bolt it in.

I simply zip-tied the stock legacy airbox into the stock location. It's worked great.

Or, the EJ MAF can be adapted to the EA82 turbo airbox:

I drilled new holes in the airbox to accept the MAF and then cut the plenum at a certain angle. I'll admit I went through three of them before finding the proper angle at which to cut because each stretched differently in the section with the accordion joint - fortunately they charge \$3 each per plenum where I get my parts! My plenum is a legacy plenum; I re-drilled the holes in the airbox and I planed 2-3mm off of the edges of the MAF where it would bump the airbox. This is a run of the mill hardware store clamp of some sort used to mate the intake plenum to the MAF. It has a rubber liner inside of the steel clamp. I cut the rubber liner lengthwise and narrowed the diameter by a few cm and glued it back to itself with black RTV silicone, to great effect. I then glued it onto the intake boot with more RTV and slightly beveled the lip inside the sleeve. One end of the tube is a little narrower than the other, if I recall correctly. I could get more of these from wherever-I-got-them if anybody would like. Both sets of power steering lines have the same fittings on either end. So either set can be used. However, the Legacy ones are shaped for the location of the legacy power steering pump, so they will fit better. I used the ones from the Loyale, the routing was a little odd.... but it works fine.



The fittings between the hard lines leading to the Power steering rack (EA82) match the EJ ones, you will have to bend the lines a bit, but they will thread into the flex lines leading up to the pump. This connection is down on the crossmember right by the passenger side axle.

#### 13. Wiring

And last, but certainly not least, Wiring. Now, keep in mind that the EJ22 is completely computer controlled. Not like an old carbureted V8 that's all mechanically driven. Even the EA cars had a distributor. An EJ22 has many sensors that tell a computer (ECU, or Engine Control Unit) what's happening with the engine, and it, in turn, tells the ignition coil and injectors what to do to keep the engine running smoothly. All of the wiring needed to do this will need to be transplanted into your EA car. This is, by far, the most complicated part of the swap. Mechanically speaking, it's a very simple swap, but the electrical system is a huge job. A Chilton's manual will have pretty good wiring diagrams of both the EA car, and the EJ. The Haynes manuals are also handy. But the factory service manuals are best. I'll include many of those pages, so you can get by without one.

So, for starters, you'll need to remove all of the necessary wiring from the donor car (the following is all based directly off a '90-'94 legacy, although newer models will be somewhat similar, even though they're OBDII). It's a VERY good idea to figure out and label what/where things go to as you remove them, because most of the wires under the dash will be removed and discarded. So here are a few pictures of a Legacy with the dash removed (you'll need to strip it all the way down to the firewall to get everything out, but this gives you a good idea of where everything goes).

When it comes time to thin out the harness, remember, an unplugged wire is the same as a cut wire, except one makes for a much lighter/simpler harness. So, if you know where the connector goes, and therefore know if you'll need/use it, you'll know if you can cut out that wire or not. So pay close attention as you pull things out of the donor car, it'll make things simpler in the long run!

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First off, the relays: You'll only need 2. The Main/Ignition Relay (Brown) and the Fuel pump relay (Green Connector). You will use the EA starter relay, as it's already wired in where it's needed. These 2 relays are located in the far upper left hand corner of the dash, all the way back near the firewall:



Circled here in red is the SMJ (or Super Multiple Junction, more on this later), and in blue are the 2 green 'Test mode' connectors. The black read mode connectors and the yellow select monitor will be near this. You'll want to save these, for future troubleshooting.



There's the Main relay again from below. In the foreground, you can see one of the headlight relays, with the white connector. You'll use the EA headlight relays, so these can be removed.

Also of note, you won't need to use any of the stock legacy fuse panels. The engine control system only needs a little power. You can string one wire and that is enough.

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Next, the cruise control. If your car was equipped with it, you'll have the control box and relay. If not, the wiring and connectors will still be there. This is a good place to start thinning out the harness when it comes time to do so. So make a note where these wires are, and label them, so when the time comes, you'll know what it is.



The cruise control unit is the large grey box here, and the smaller black thing above it is the relay that controls it. Also, you can see the large blue and white connectors that disappear underneath the carpet. These go back to the brake lights, turn signals, trunk light, rear door locks, etc. etc. You will not need any of this. The fuel pump wire is in there, but you can splice that in from closer to the relay.



A shot of a Legacy interior, minus the dashboard:

This car is receiving an aftermarket ECU, so the stock ECU connectors will be cut off, and new ones spliced on. This is why all the wires coming from those connectors are marked. But this wouldn't be a bad idea in an EJ swap either, as it will help you identify wires later. In the background, you can see the 2 connectors circled in red. These go up into the dash for the gauges. You'll only need a handful of wires from there (oil pressure light, temp gauge, tachometer, and Vehicle Speed Sensor). Do not start cutting these wires out until you've identified the ones you'll need to save.

You'll also need to safely rescue the group of wires that passes through the firewall behind the ductwork in the middle. This is a big job, but there are dozens of wires in the cluster that you'll need.

You can also disconnect the SMJ (see picture above) to simplify removal of the harness. It's very easy to identify later, and will drastically simplify the removal process.

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#### Factory Service manual pages:

		Connecting to	-							4.	BULKHEAD	WI
Connecting to			Connector						Connecting to			1
rea	NO.	Automotio chauldes halt limit multah		No.	Pole	Color	Area	No.	Name			
	Ĩ.	LH	E	B81	4		B-4		Cruise control unit			
-2	.46	Front wiring harness		882	20	14/6-34-	8-4	1	Labilities and an IAT and in a start			
	P42	Power window main harness (SMJ)		804	4	Rhok	8-4		Inhibitor relay (At-cruise control)			
	F45	Pront winnig namess (SmJ)		B85	2	Green	8_4	BL	Boom light cord	1		
		Ignition relay		886	3	Black	B-1		Horn relay			
1-1		Fuel pump relay		BA7	2		A-4	1 1	Automatic shoulder belt limit	Δ		
-1	R11	Sunroof cord		000	-	Dius			Switch RH			
-1		AT control unit		880	10	Brown	B-2		Mode actuator			
1	6	1	11	B90	1		C-3		Diagnosis terminal (Ground)		,	
3	17	lustrument panel wiring horness			14	Black	C-3		Diagnosis connector	1		
1	19		11	B91	16	Black	C-3	1	Diagnosis connector			
2-1	P41	Grant daar and 114	11	B92	4	Blue	B_3	1 1	Starter interlock relay (MT)			
-1	P40	From abor cord En		893	2.	Blue	B-3	i37	Instrument panel wiring harness	-		
-1	P39	Power window main harness	1	<b>B94</b>	2	Black	B-4		Diode (Daytime running light)			
-1		F/B			12		B-4		Diode (AT-cruise control)			
		AT control unit	I I	895	14	Brown	B-4		Diode (AT-cruise control) (Canada model)			
B-2		Clutch switch (MT)				ni			Daytime running light relay			
C1		AT control unit	11	846		Black	6-4	1	(Canada model)			
<b>C_3</b>		Check connector		897	4	Blue	8-4		Daytime running light high beam relay (Canada model)			
C-2		MPFI control unit		898	10	1	B-4		Daytime running light control unit	в		/
B-3	DEA	Select monitor connector	11	B99	2	Blue	C-1		Diode (Seat belt)	-		ſ.,
C-2	853	Test mode connector	11.	0122	1.		B 2		(Canada model) Shiald joint connector (ABS)			(
C-2	855		I Ľ	0133					Shield joint connector (AT)		60	26
C-2	B54	Read memory connector	'	B134	6		1 C-2		(Turubo and air suspension model)		- (Ba	20
C-2		MPFI control unit	11	8140	7	Yellow	C-1	AB-1	Airbag harness		(B	32)6
C-2	I	MPFI control unit	11	8150	8		C-2	8151	Shield joint connector (A1)		699	14
¥-	757	Shield joint connector		8151	•		1~"	6150		<u> </u>	(B33	-
•	i Č	(with cruise control)									(B34)	ħΩ.
8-2		Stop light switch	L								(B36)%	17L
C-2		Key warning switch									(837)	1000
C-2	1	Key lock solahold	1							• 1		10
C-2		Combination switch										1
C-2		Cruise control sub-switch	1								(B99)	
C-2		Combination switch								C	(	128
c-2		Combination switch										900
B_9		AT shift lock control unit										6
8_3		Diode (Lighting)	1						16			6
B3		Evaporator thermoswitch										
B-3		A/C cut relay	1							I		
8-4	9	FRESH/RECIRC actuator								2		
B	9	Blower motor resistor	1							_		
6	En I	Biower motor										
2	R2	Rear wiring harness										
8_	P2	Front door and DU								1		
8	PI	) Front obor cord KH										
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										a		
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Fig. 98 1

115



There's a pretty good overview of the interior side of things. And the engine side is pretty simple, since it's more obvious where the wires go. Label as many of the wires as you can before removing the harness.

Here's a pinout of the SMJ (referred to in the Chilton's manuals, but not explained.)

Bulkhead Wiring < Harness	Front Wiring Harness
B27 66 Poles	F45 66 Poles
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$

ector		Connecting to							
Color	Area	No. Name							
Sray	B-1		Air flow meter						
Gray	B-2		Dropping resistor (AT)						
Black	B-2		A/C pressure switch						
Black	A-2		FWD switch (AT)						
Gray	A-2		A/S front solenoid RH						
Gray	A-2		A/S front sensor RH						
	A-2		Wiper motor						
Gray	A-3		Ignitor						
Gray	B-3		Brake fluid level sensor						
Black	A3		A/S compressor relay						
Gray	B-4		A/S front solenoid LH						
Gray	B-3		A/S front sensor LH						
Gray	B-3		ABS front sensor LH						
Black	B-3		Starter (Magnet)						
Gray	Gray B-3		Transmission (AT)						
Gray	8-3	E15	Transmission cord (MT)						
Gray	B-3	E19	Transmission (AT)						
Gray	B-2		Cam angle sensor						
Gray	B-2		Crank angle sensor						
Gray	B-2		Knock sensor						
Gray	B-2		O <sub>2</sub> sensor						
Gray	B2		Cruise control pump						
Gray	B-2		ABS front sensor RH						
Black	B-2	l	ABS G-sensor (MT)						
rown	B-2		Pressure exchange solenoid valve (Turbo model)						
Gray	B-1		Pressure sensor (Turbo model)						
Black	B-2		Wastegate control solenoid valve (Turbo model)						
Gray	B-2		Daytime running light resistor (CANADA model)						

Here are the pages from the 1992 factory service manual about the legacy under hood wiring:

(continued over page)

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#### WIRING DIAGRAM AND TROUBLESHOOTING

[0604] 6-3

#### 4 SENSOR-VALVE-SOLENOID-ETC.

ASS G-sensor (Non-TURBO)	Fig.83-5
ABS G-sensor (TURBO)	Fig.84-5
A/S charge solenoid	Fig.83-6
A/S compressor	Fig.83-6
Blower motor resistor	Fig.86-3
By-pass air control valve	· Fig.85-2
Cam angle sensor	' Fig.85-5
CPC solenoid	Fig.85-1
Crank angle sensor	Fig.85-6
Cruise control pump (Non-TURBO)	Fig.83-5
Cruise control pump (TURBO)	Fig.84-5
Daytime running light resistor (Non-TURBO)	Fig.83-4
Dropping resistor (Non-TURBO)	Fig.84-4
Dropping resistor (TURBO)	Fig.84-4
Fuel gauge unit	Fig.86-1
Igniter (Non-TURBO)	Fig.83-1

Igniter (TURBO)	Fig.84-1
Key-lock solenoid	Fig.86-5
Knock sensor	Fig.85-4
Mode actuator	Fig.86-4
Pressure exchange solenoid valve	Fig.84-3
Pressure sensor	Fig.84-3
P/W circuit breaker	Fig.86-6
O2 sensor (Non-TURBO)	Fig.83-2
Oz sensor (TURBO)	Fig.84-2
Shift-lock solenoid	Fig.86-2
Thermometer	Fig.85-2
Throttle sensor	Fig.85-3
Water temperature sensor	Fig.85-2
Waste gate control solenoid	Fig.84-3

#### (1) Engine Room (Non-TURBO)



B6-680E

(3) Engine



Ok, now that you've got stuff figured out and labeled, start taking it out. Unplug everything, and start removing the harness. You'll need to remove the driver's side fender, and disassemble the fuse/relay box under the hood to get it out. You'll also need to strip the dash out all the way down to the firewall, which means disconnecting the heater core lines completely, as well as the A/C lines. Try not to cut any wires until it's all out, just to be safe.

Now, once it's all out of the car, you can start reducing it to just the necessary engine control harness. Start by cutting/stripping all the electrical tape and plastic loom from the harness. Then, find a connector somewhere that you know you won't be using (Cruise is a good place to start...), and start cutting out wires. Go one wire at a time, and trace it as far back into the harness as possible, and cut it off. If it splits, cut it before the split. Then proceed to identify the wires from there, cutting them off if you know they're unnecessary (the cruise needs some signals from the ECU and such, things needed for other parts of the engine management, so don't just cut everything out).

As you're going through, take note of all the necessary power and ground wires. Grounds are usually black (obviously) and powers are yellow, or occasionally red. There'll only be a few power wires, but you'll be tying them together into 2 different ones (one switched, and one straight from the battery). Just keep working through the harness, eliminating stuff you won't need. Don't cut anything out unless you know it won't be used. This can most easily be done from the interior side out, since there are far more connectors that won't be used. Under the dash, you'll only need the 4 ECU plugs (all yellow), power and ground for that, the 2 relays, and wiring for those, and wiring for the dash (Check Engine Light, Oil light, Tachometer, Vehicle Speed Sensor, and Temp gauge). As I mentioned earlier, if the connector isn't going to be plugged in, there's no use leaving the whole wire in the harness...and if you run out of things that you know won't be used in the interior, just move to something from the engine bay that you know you won't be using (turn signals, headlights, A/C, wipers, etc.).

Once you've reduced it just down to the crucial Engine control harness. You can begin preparing it for install.

Reduce the power wires to one. Use a thicker gauge wire to hook up right to the battery, with an inline fuse holder. Then split it off, one wire that goes straight to the ECU for the memory wire, and another that goes to the main relay. Then get the grounds together, and tie them all together, with many different places where it can bolt to the car (insufficient grounding is a common problem in this swap). Then make sure you have all the gauge wires marked and ready to tap into the EA cars harness. Now is also a good time to find those same wires in that EA harness.

Here's a simple diagram of how to power the harness:

The three ECU pins shown are:

a15: ECU memory (should always have power)

d23: fuel pump activation (the ECU connects this wire to ground when the fuel pump should come on)

#### 32 EA to EJ – The Definitive Guide Numbchux

c10: Starter switch (should get 10-14 volts while cranking. This changes the fuel mixtures for easier cold starts)

The wire marked "To the rest of the EJ harness" supplies power to everything in the EJ harness requiring power (i.e. ignition coil, injectors, ECU etc.)

The wire on the ignition switch simply marked with a "+" gets 12v power from within the EA harness already. You just have to tap into the switched side of it.

If you'd like, you can wire a manual rocker switch instead of the "on" setting of the ignition switch. This would do 3 things:

1. Kill switch, hide the switch, if someone gets into your car, it still will not start without flipping that switch

2. The key will still be necessary to actually start it (leave the starter relay wired to the ignition switch)

3. You'll be able to leave the car running to warm up without the ignition on (i.e. no headlights, radio etc. AND the steering column remains locked). Be sure to wire your radiator fan into this circuit as well....hate to have it overheat while it's warming up....



Now, before taping anything together, or installing the harness completely, plug it into the engine and ECU.

Then solder up your powers and grounds, and the fuel pump wire. And see if it starts (if you'd like, contact me and I'll send you a video of my wagon when it first started. You can see the ECU and wiring harness draped over the driver's door). I would highly recommend making sure it runs before fully installing the harness. Once you know it runs, you can wrap it with electrical tape and put it in corrugated plastic wiring loom. Then string it through the holes in the inner fender and into the engine bay.

The actual ECU mounting bracket is different on the EJ22 than an EA cars', so you'll have to be pretty creative.

I just used lots of zip ties to keep everything from moving around, and stuffed the ECU and harness up under the steering column. You'll need to tap in a wire from the ignition switch to the ECU so it can essentially choke the engine while cranking (ECU wire needs 12v + when cranking, see attached ECU pinout). The EA82 system as this same circuit, but the switch grounds the wire to the ECU to engage it on the EA82, so you'll need to string your own wire. You'll also need to hook up the rest of the wires under the dash.

There's one wire, pin 11 on B56 in the pinout below that designates a California model. Be sure this wire is not grounded unless the donor car really was a California model...this distinction is not made in the diagrams

Once again, make sure the car starts and runs before putting the dash panel and fender back on. If it does, reassemble the car, double check all fluids etc., and enjoy your new motor!!

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# **Engine Control Module: Diagrams**



Content			Connector Terminal		Signal (\		
		No.	No.	-	Ig SW	Engine ON (Idling)	Note
		854		OFF	ON (Engine OFF)		
Non-	Signal (+)	856	1	-	0	•	*Sensor output waveform
TURBO	Signal (-)	856	2	-	0	0	. 48
	Shield	856	3	-	0	0	
-	Signal (+)	858	4	-	0	•	*Sensor output waveform
TURBO	Signal ()	858	5	-	0	D	
	Shield	B58	6		0	0	
Non-	Signal (+)	B58	4		0	•	*Sensor output waveform
TURBO	Signal (-)	858	5	-	0	0	
	Shield	858	6	-	0	0	
	Signal (+)	858	1	-	0	• •	*Sensor output waveform
TURBO	Signal (-)	B56	2	-	0	0	
	Shield	B56	3	-	0	0	
	Power supply	B49	8	-	10 - 13	13 - 14	
Bear	Signal	648 ·	9	-	0 - 0.3	0.8 - 1.2	
	GND	B48	10		0	0	-
	Shield	B48	1-9	-	0	0	_
Signal		B58	2	-	Fully closed: 4.7 Fully opened: 1.6	Fully closed; 4.7 Fully opened; 1.8	-
1SOF	Power supply	658	3	-	5	5	-
	GND	B58	1	-	0	. 0	-
	Shield	B58	7	-	. 0	0	
Non-	Signal	848	8	-	(AT) 0,8 (MT) 0	Rich mixture Lean mixture	e: 0.7 (AT), 1.0 (MT) re: 0 (AT), 0.2 (MT)
TURBU	Shield	B48	17		0	D	-
TURBO	Signal	B48	6	-	0	Rich	mbiture: 1.0
	Shield	B48	17		0	D	-
	Signal	B58	5		3.4	1.4	
ar	Shield	B58	4	_	0	0	_
erature se	nsor	B48	7	0	0.7 - 1.0	07.10	TARes warm up
Vehicle speed sensor		858	-11	-	0 or 5	0 or 5	"5" and "0" are repeatedly displayed when vehicle is driven.
	Signal	B48	4	-	10 - 13	2.4 ++ 2.7	
nsor	Power supply	B40	3		5	5	
	GND	B48	5	-	0	0	
die switch		B56	8		ON:0, OFF:4.6	ON:0. OFF:4.8	_
9-state and Canada/ Celifornia dentification		B56	11	-	-	-	49-state and Canada:12 California:0
tarter switch			10	_	0	0	Cranking: 10 to 14
	Conter Non- TURBO TURBO TURBO TURBO recor Mon- TURBO TURBO TURBO recor Mon- TURBO ar conter turbor	Content           Non- TURBO         Signal (+) Signal (-)           Shield         Signal (-)           TURBO         Signal (-)           Shield         Signal           GND         Shield           Shield         Signal           TURBO         Signal           Shield         Signal           TURBO         Signal           Shield         Shield           Shield<	Content         Connector No.           Non- TURBO         Signal (+)         B56           Shield         B56           Shield         B58           TURBO         Signal (-)         B58           TURBO         Signal (-)           Signal (-)         B58           TURBO         Signal (-)           Signal (-)         B58           TURBO         Signal (-)           Signal (-)         B58           Signal (-)         B58           Signal (-)         B58           Signal (-)         B58           Signal B48         B59           Shield         B59           Shield         B48           Signal         B48           Signal         B48           Signal         B48           Shield         B59           Shield         B48           Signal         B48           Signal         B48	Content         Connector No.         Terminal No.           Non- TURBO         Signal (+)         B56         1           Signal (-)         B56         2           Shield         B56         3           TURBO         Signal (-)         B58         2           Shield         B58         4         3           TURBO         Signal (-)         B58         6           Non- TURBO         Signal (-)         B58         6           Signal (-)         B58         6         5           Signal (-)         B58         6         3           TURBO         Signal (-)         B56         2           Signal (-)         B56         2         5           TURBO         Signal (-)         B56         2           Signal (-)         B56         3         9           GND         B48         10         5           Signal         B48         10         5           Signal         B58         1         5           Signal         B58         1         5           Signal         B48         6         5           Signal         B48 <t< td=""><td>Content         Connector No.         Terminal No.         OFF           Non- TURBO         Signal (+)         856         1            Shield         856         3          Shield         856         3           TURBO         Signal (-)         858         2          Shield         858         3            TURBO         Signal (-)         858         6          Shield         858         6            Non- TURBO         Signal (-)         858         6          Signal (-)         858         6            Signal (-)         858         5          Signal (-)         856         2            TURBO         Signal (-)         856         3          Signal (-)         856         3            TURBO         Signal (-)         856         3          Signal (-)         856         3            TURBO         Signal (-)         856         2          Signal (-)         858         1            Signal (-)         858         1         </td><td>Content         Connector No.         Terminal No.         Ig SW           Non- TURBO         Signal (+)         B56         1          0           Signal (-)         B56         2          0           Signal (-)         B56         2          0           Signal (-)         B56         3          0           Signal (-)         B56         3          0           Signal (-)         B56         4          0           Signal (-)         B58         6          0           Signal (-)         B58         6          0           Signal (-)         B58         5          0           Signal (-)         B58         1          0           TURBO         Signal (-)         B56         2          0           Signal (-)         B56         3          0         13           Signal (-)         B56         2          0         14           TURBO         Signal (-)         B56         1          0           Signal B58</td><td>Content         Connector No.         Terminal No.         Ig SW OFF         Engine CN (Idling)           Non- TURBO         Signal (+)         B56         1         -         0         •           Signal (-)         B56         1         -         0         •         •           Signal (-)         B56         3         -         0         0         •           TURBO         Signal (-)         B58         4         -         0         •         •           Signal (-)         B59         5         -         0         0         •         •           Non- TURBO         Signal (-)         B59         5         -         0         0         •</td></t<>	Content         Connector No.         Terminal No.         OFF           Non- TURBO         Signal (+)         856         1            Shield         856         3          Shield         856         3           TURBO         Signal (-)         858         2          Shield         858         3            TURBO         Signal (-)         858         6          Shield         858         6            Non- TURBO         Signal (-)         858         6          Signal (-)         858         6            Signal (-)         858         5          Signal (-)         856         2            TURBO         Signal (-)         856         3          Signal (-)         856         3            TURBO         Signal (-)         856         3          Signal (-)         856         3            TURBO         Signal (-)         856         2          Signal (-)         858         1            Signal (-)         858         1	Content         Connector No.         Terminal No.         Ig SW           Non- TURBO         Signal (+)         B56         1          0           Signal (-)         B56         2          0           Signal (-)         B56         2          0           Signal (-)         B56         3          0           Signal (-)         B56         3          0           Signal (-)         B56         4          0           Signal (-)         B58         6          0           Signal (-)         B58         6          0           Signal (-)         B58         5          0           Signal (-)         B58         1          0           TURBO         Signal (-)         B56         2          0           Signal (-)         B56         3          0         13           Signal (-)         B56         2          0         14           TURBO         Signal (-)         B56         1          0           Signal B58	Content         Connector No.         Terminal No.         Ig SW OFF         Engine CN (Idling)           Non- TURBO         Signal (+)         B56         1         -         0         •           Signal (-)         B56         1         -         0         •         •           Signal (-)         B56         3         -         0         0         •           TURBO         Signal (-)         B58         4         -         0         •         •           Signal (-)         B59         5         -         0         0         •         •           Non- TURBO         Signal (-)         B59         5         -         0         0         •

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1.111								
Ignition swi	tch		858	12	D	10 - 13	13 - 14	-
Neutral swit	tch	-	858	10	-	[AT] N Bange: 0 Other: 8, min. [MT] N Position: 8, min. Other: 0	[AT] N Range: 0 Other: 8, min. [MT] N Position: 8, min. Other: 0	
Parking swi	tch (AT)		B58	9	-	P Range: 0 Other: 8, min.	P Range: 0 Other: 8, min.	-
Test mode	connec-	Non-TURBO	858	13	-	[AT] 10 - 13 [MT] 5	(AT) 13 - 14 (MT) 5	[AT] When connected: 0
104		TURBO	BS8	13	-	5	5	When connected: 0
Read memo	bry con-	Non-TURBO	B56	12	-	(AT) 10 - 13 (MT) 5	(AT) 13 - 14 (MT) 5	(AT) When connected: 0
		TURBC	858	12	-	6	5	When connected: 0
AT/MT iden	tification	Non-TURBO	848	20	-	[AT] 0 [MT] 5	(AT] 0 [MT] 5	-
Peak up an		TOHBO	848	20		6	5	-
Back-up pov	wer supp	<u>y</u>	848	16	10-13	10 - 13	13 - 14	-
Control unit	power su	apply	D46	- 2	-	10-13	13-14	
	IN-	#1.#2	E47	10		10-13	13 - 14	
Instice	TURBO	#3. #4	F47			IATI O OL IMTIO	-	-
control		#1. #2	F47	10	-	0		-
	TURBO	#3. #4	F47	8	-	0	_	
		#1	F47	13	10 - 13	10 - 13	12 - 14	
		#2	F47	12	10 - 13	10 - 13	13 - 14	_
Fuel injector	r	#3 .	F47	11	10 - 13	10 - 13	13 - 14	
		#4	F47	26	10 - 13	10 - 13	13 - 14	-
Buones etc	Non-	OPEN and	F47	2	-	[AT] 7 [MT] 12 → *0	-	*1 min. after ignition switch CN.
control so- lenoid	TURBO	CLOSE and	F47	1	-	[AT] 6 [MT] 0	-	-
valve	TURBO	OPEN end	F47	2	-	0 → *12	-	*1 min, after ignition
		CLOSE end	F47	1	-	12 -+ *0	_	switch ON.
Fuel pump r	elay cont	rol	F47	23	-	ON: 0 OFF: 10 - 13	0	-
Air condition	ner out re	lay control	F47	22	-	ON: 0 Off: 10 - 13	ON: 0 OFF: 13 - 14	
Redistor fon	control		F47	17	-	ON: 0 OFF: 10 - 13	ON: 0 OFF: 13 - 14	-
Salf-shutoff	control		F47	5	-	10 - 13	13 - 14	-
Wastegate c	ontrol (TI	JRBO only)	F47	3	-	10 - 13	13 - 14	-
CHECK ENG	INE light		F47	19		-		Light "OFF": 10 - 14
Pressure exe (TURBO only	nge so	alenoid valva	F47	20	-	ON: 0 OFF: 10 - 13	ON: 0 OFF: 13 - 14	-
Engine tach	ometer ou	Aput	866	16	-	_	-	-
Purge control solenoid valve			F47	6	-	ON: 0 OFF: 10 - 13	ON: 0 OF: 13 - 14	-
TURBO only)			B48	16	-	-	-	-
GND (sensors) GND (injectors) GND (injectors)			648	21	-	0	0	_
			F47	24	-	0	0	
			P47	25	-	0	0	-
GND (power supply)			F47	16	-	0	0	-
and though			F4/ B49	14	-	0	0	
GND (control	systems	)	849	22	-		0	-
			Rta			0	0	_
Select Monit	or Signal		856	7		-	-	-
					-	-	-	-

**Control Unit Pin Identification**