



Toyota MR2 Spyder Body Controller Wiring Guide

Contents

1. Overview	3
2. Connectors	3
3. Minimal connection configuration.....	4
4. “Plug and Play” 2AR-FE configuration.....	5
5. “Plug and Play” 2GR-FE configuration	7
6. Using the body controller for a generic OBDII engine swap, including Honda K-series	10
6.1. Required Connections.....	10
6.1.1. Required Relay Control Signals	10
6.1.2. Required interconnect	11
6.1.3. Required grounding	11
6.1.4. Required for gauge cluster functionality	11
6.2. Connections to facilitate your swap	12
6.2.1. Power supplies	12
6.2.2. Drive By Wire	12
6.2.3. Cooling fans.....	13
6.2.4. Reverse lights	13
6.2.5. Starter	13
6.2.6. Charging System.....	14
6.2.7. Daytime running lights	14
6.2.8. OBDII Port	14
6.2.9. Brake Signals	15
6.2.10. A/C System	15
7. A/C Functionality.....	15
8. The Status LEDs	16

1. Overview

The MR2 Spyder body controller is designed to make it easy to swap an engine with an OBDII compatible ECU into the MR2 Spyder.

The following functionality is supported:

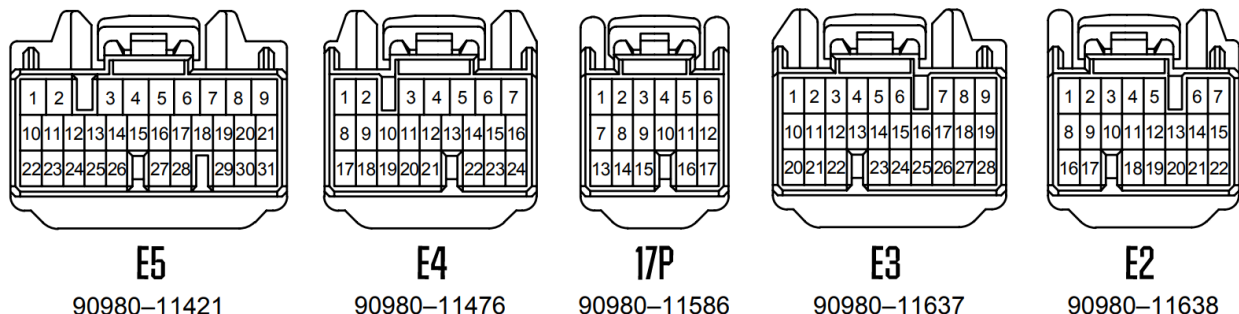
- Coolant temperature gauge functions as normal without adding a second temperature sensor
- Alternator charge light
- Alternator field winding current (for older style alternators that expect a real charge light bulb)
- Oil pressure warning light
- Air conditioning clutch control for any compressor, no need for locked rotor sensor feedback
- Power steering pump control to avoid battery drain
- Two speed cooling fan control, including condenser cooling for air conditioning
- Inverted brake confirmation signal generation

Beyond this, the body controller provides quite a bit of wiring pass through to make the swap wiring significantly easier.

Note: The body controller is shipped as a bare circuit board. The circuit board is designed to fit in the stock 1ZZ-FE ECU housing for protection and mounting in the car. This fits nicely in the car and avoids and wiring harness tangles.

2. Connectors

The body controller uses five connectors, the E2, E3 connectors match the chassis harness in the MR2. The E4 and E5 connectors match the stock engine harness connectors on the MR2 but the pinout on these has been repurposed, the 17P is an extra connector that is normally a blank in the stock ECU, this is used to keep the harnesses subdivided neatly to make things more serviceable.

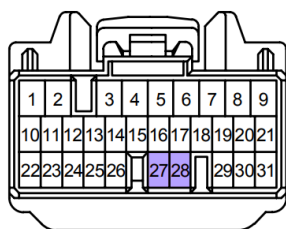


The part numbers below the connector names are what you need if your connectors are damaged and need to be replaced.

3. Minimal connection configuration

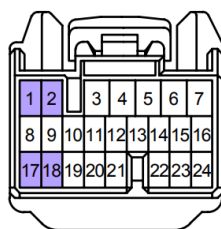
In an existing swap where the car already runs but gauge cluster and A/C control is desired the wiring can be quite minimal:

Connector	Pin	Name	Purpose
E2	1	Batt	Constant 12V battery feed used to power the electronics on the body controller
E2	6	MPX	BEAN bus used to communicate with instrument cluster and climate controls
E2	8	IGSW	Ignition switch input used to turn on body controller
E2	12	ACMG	*ONLY FOR A/C* A/C clutch relay control.
E3	3	FANH	*OPTIONAL* used to control high speed fans if fans are to be controlled by body controller
E3	4	FANL	*OPTIONAL* used to control low speed fans if fans are to be controlled by body controller or if A/C is being used
E3	18	PRE	*ONLY FOR A/C* This is the high-low dual pressure switch for the A/C, it should be grounded when it is in the correct range.
E3	19	PSCT	*OPTIONAL* This is used to disable the power steering pump when the ignition is on but the motor is not running
E4	1	OIL_P	Oil pressure switch
E4	2	ALT_L	Alternator Light Input
E4	17	GND	*ONLY FOR A/C* Ground connection to chassis
E4	18	GND	Ground connection to chassis
E5	27	CANH	OBDII CAN high connection
E5	28	CANL	OBDII CAN low connection



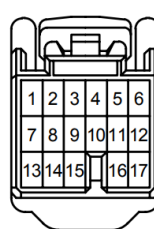
E5

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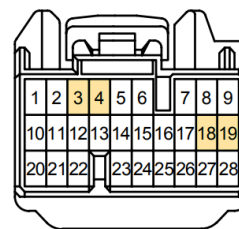
E4

90980-11476



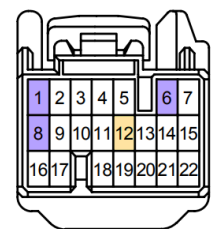
17P

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E3

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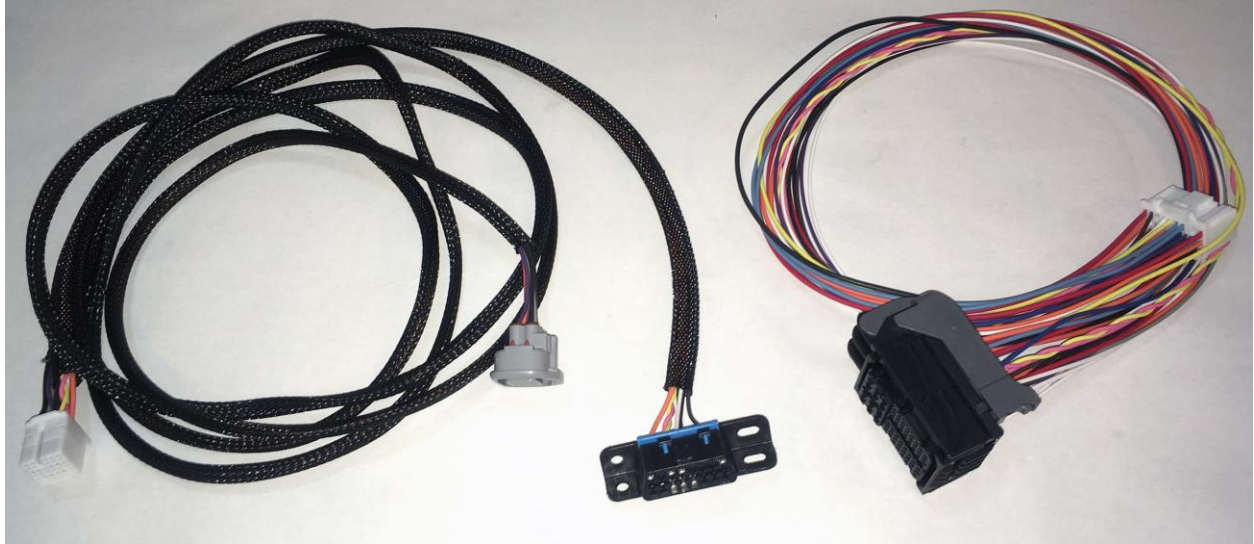
E2

90980-11638

Note: E2 and E3 are the stock pinout so if they haven't been cut off for the existing swap those two connectors can simply be plugged in and only six wires need to be connected to the body controller.

4. "Plug and Play" 2AR-FE configuration

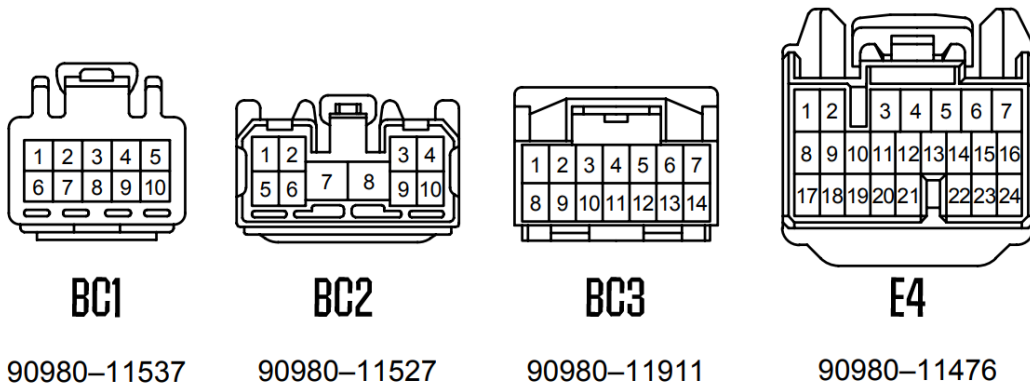
The easiest way to wire the 2AR-FE for the MR2 Spyder is to start by buying the plug and play harnesses available at Frankenstein Motorworks here: <https://frankensteinmotorworks.squarespace.com/mr2-spyder-shop/2ar-fe-wiring-harness> This takes care of the 17P, E5, DBW pedal, OBDII and 2ar-fe ECU wiring. If you would rather make these yourself there is a pdf with their pinout on that store page.



There is a video that goes over this work located here:

https://www.youtube.com/watch?v=fKUaHLryid0&list=PLS6_hJDjAAGYB434Y9xbc9EFnb14DHqja

The connectors that will be needed are the following along with the stock 2AR-FE engine harness:



The E4 connector is on the body controller, the others are on the chassis harness next to the body controller. BC3 is not on the MR2 Spyder in all markets, this is only needed for daytime running lights. If the chassis does not have it you can safely omit it.

For questions please contact Marc@FrankensteinMotorworks.com

The following connections need to be made to the engine harness:

Connector	Pin	Name	Purpose
BC1	1	CG	Connect to Engine Ground, needed for stock OBDII connector
BC1	5	O2PWR	Power for Oxygen sensor heater circuits
BC1	7	RevLt	Reverse light, connection to bulbs
BC1	8	IGN	Power for ignition coils
BC2	3	ALT-S	Battery voltage sense line for alternator
BC2	4	ACClutch	Power for A/C compressor clutch
BC2	5	MAFPwr	Power for Mass Airflow sensor and other 12V sensors
BC2	7	STRSol	Starter Solenoid power
BC2	10	INJPwr	Power For Fuel Injectors
E4	1	OIL-P	Oil pressure switch input
E4	2	ALT-L	Alternator light input
E4	3	RevLtPwr	Reverse light, power source
E4	4	AltIgn	Ignition signal for alternator
E4	6	CGND	Engine ground
E4	19	EGND	Engine ground

The following two connections need to be made amongst these connectors:

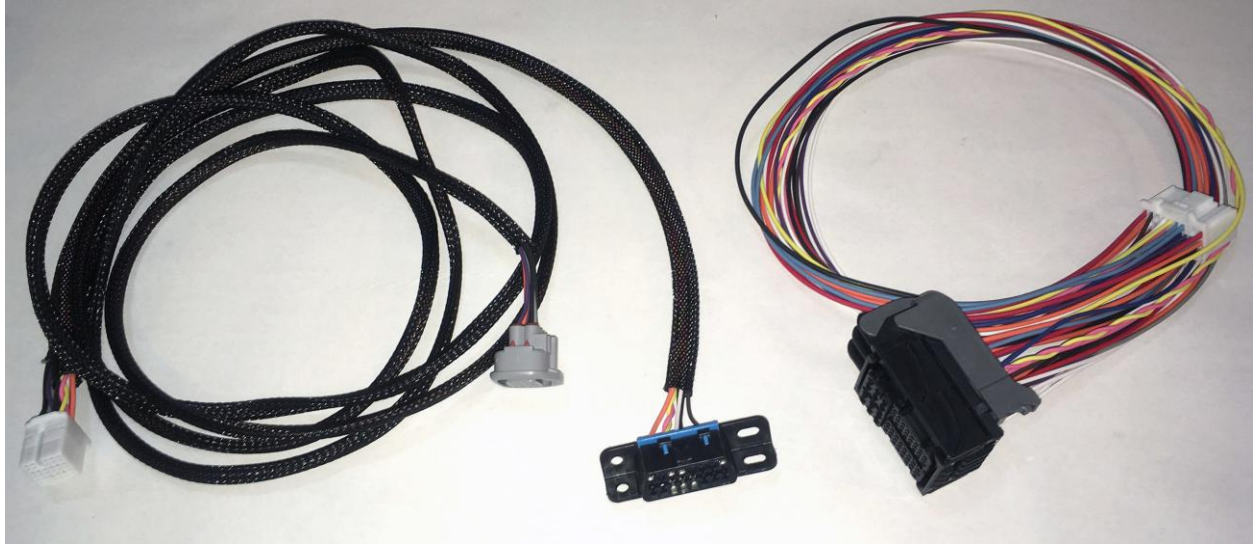
Connector	Pin	Connector	Pin	Name	Purpose
BC1	9	E4	5	AltIgn2	Alternator Ignition power source from chassis.
BC3	7	E4	8	DRL	*OPTIONAL* Daytime running lights enable line

With the above 17 wire connections made everything in the car will function as intended from the factory. It isn't plug and play but it is quite close and significantly more cost effective.

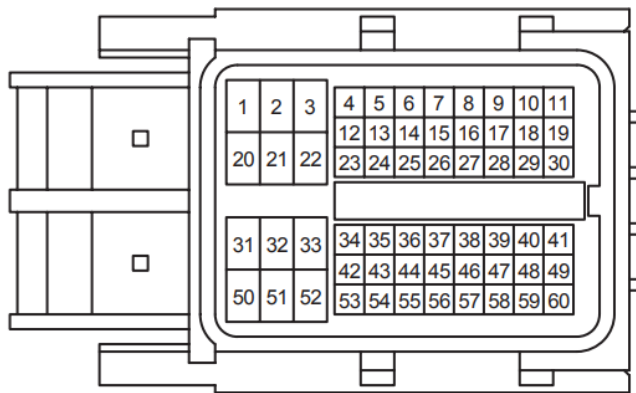
5. "Plug and Play" 2GR-FE configuration

The easiest way to wire a 2GR-FE for the MR2 spyder is to start with the 2AR-FE setup and make a few simple modifications. Purchase the 2AR-FE Plug & Play wiring. This is assuming a RAV4 ECU and harness.

<https://frankensteinmotorworks.squarespace.com/mr2-spyder-shop/2ar-fe-wiring-harness>

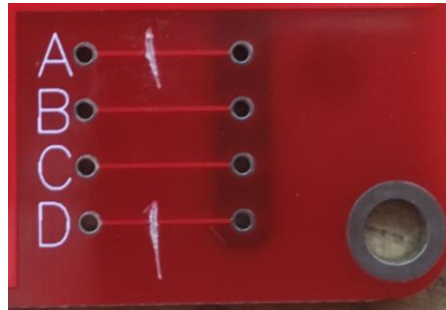


The pigtail on the right will need some adjustments made before it is used. On the ECU side the following pins need to be moved:

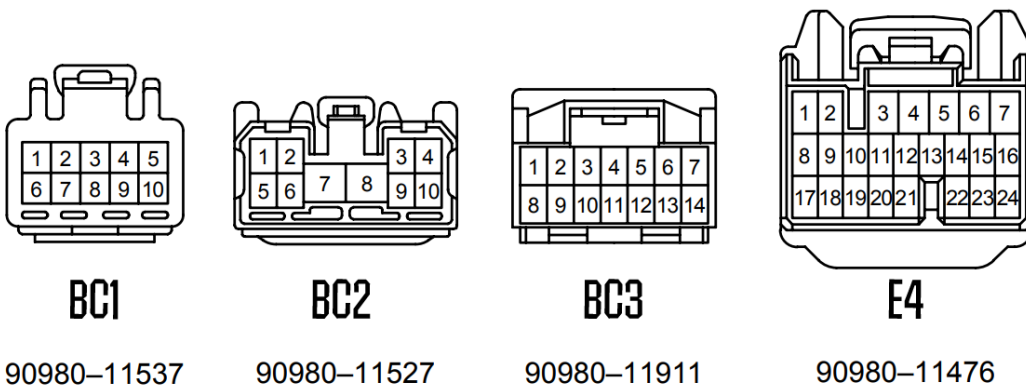


- Blue wire from Pin 6 to Pin 44
- Brown wire from Pin 8 to Pin 7
- Brown wire from Pin 26 to Pin 15
- Pink wire from Pin 36 to Pin 24
- Pink wire from Pin 5 to Pin 49
- Yellow wire from Pin 13 to Pin 41
- White wire from Pin 7 to Pin 27
- White wire from Pin 15 to Pin 8
- White wire from Pin 29 to Pin 36
- White wire from Pin 39 to Pin 35
- White wire from Pin 41 to Pin 33
- Cut or remove both blue wires in pins 21 and 22

Important: Cut trace "A" on body controller, this enables the body controller to take over the radiator fan control since the RAV4 ECU does not manage its own cooling fans.



The engine harness on the 2GR-FE gets routed exactly the same way as the 2AR-FE, many of these pins can just be depinned from the rav4 harness and repinned into the MR2 Spyder harness. Very few crimps are needed.



The E4 connector is on the body controller, the others are on the chassis harness next to the body controller. BC3 is not on the MR2 Spyder in all markets, this is only needed for daytime running lights. If the chassis does not have it you can safely omit it.

The following connections need to be made to the engine harness:

Connector	Pin	Name	Purpose
BC1	1	CG	Connect to Engine Ground, needed for stock OBDII connector
BC1	5	O2PWR	Power for Oxygen sensor heater circuits
BC1	7	RevLt	Reverse light, connection to bulbs
BC1	8	IGN	Power for ignition coils
BC2	3	ALT-S	Battery voltage sense line for alternator
BC2	4	ACClutch	Power for A/C compressor clutch
BC2	5	MAFPwr	Power for Mass Airflow sensor and other 12V sensors
BC2	7	STRSol	Starter Solenoid power
BC2	10	INJPwr	Power For Fuel Injectors
E4	1	OIL-P	Oil pressure switch input
E4	2	ALT-L	Alternator light input
E4	3	RevLtPwr	Reverse light, power source
E4	4	AltIgn	Ignition signal for alternator
E4	6	GND	Engine ground
E4	19	GND	Engine ground

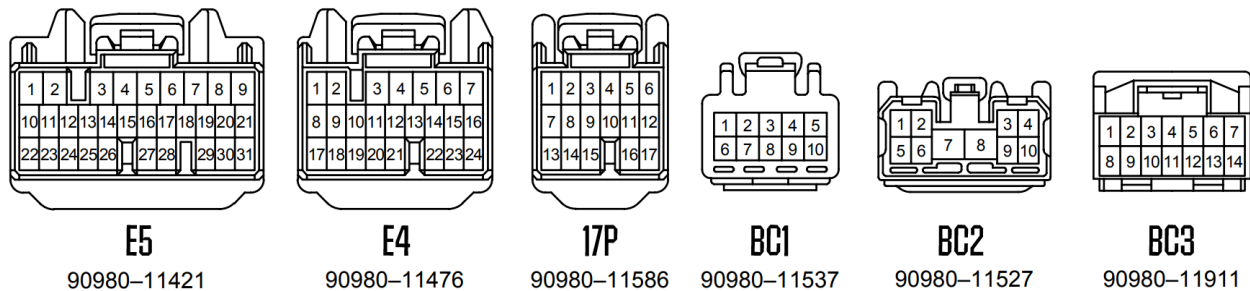
The following two connections need to be made amongst these connectors:

Connector	Pin	Connector	Pin	Name	Purpose
BC1	9	E4	5	AltIgn2	Alternator Ignition power source from chassis.
BC3	7	E4	8	DRL	*OPTIONAL* Daytime running lights enable line

With the simple connections above made the car will work exactly as it should with a fully functional gauge cluster and air conditioning.

6. Using the body controller for a generic OBDII engine swap, including Honda K-series

If you're swapping any engine in that isn't the 2AR-FE or the 2GR-FE into the MR2 Spyder this body controller is still helpful to make the harness work easier as long as the engine controller being used can talk OBDII over CAN. All stock engine controllers since 2000 and some as early as 1995 will be compatible and some aftermarket ECUs even have an OBDII mode that can work with this. You will need to wire the engine to all the following connectors and I've separated their wiring in sections by functionality.



The BC1, BC2, BC3 connectors are on the chassis next to the stock ECU, the others are on the body controller. Note that not all MR2 Spyderys have the BC3 connector. This is only used for daytime running lights and can safely be ignored if you do not have that connector. All connectors except the 17P connector can be salvaged from the stock MR2 engine wiring harness, the 17P can be ordered online or at the dealer and the extra pins from the E4 and E5 connector that aren't used can be used to populate it.

6.1. Required Connections

6.1.1. Required Relay Control Signals

The MR2 Spyder has a main relay that is controlled by the stock ECU. If the ECU does not have a main relay controller built in, just hook up the MREL signal to the ignition switch signal.

Connector	Pin	Name	Purpose
E5	14	MREL	Main relay control, +12V to activate
E5	8	FC	Fuel pump control, Ground to activate

6.1.2. Required interconnect

The MR2 Spyder uses the alternator ignition power feed for many things. To avoid needing extra splices in the swap harness the body controller acts as a junction point and the power feed needs to be sent to it with the following connection:

Connector	Pin	Connector	Pin	Name	Purpose
BC1	9	E4	5	AltIgn2	Alternator Ignition power source from chassis.

6.1.3. Required grounding

The stock ECU in the MR2 is grounded through the engine only so these connections need to be established in order for the body controller to work. Connect at least two of these but preferably connect all of them to engine ground.

Connector	Pin	Name	Purpose
E4	17	GND	Connect to engine ground
E4	18	GND	Connect to engine ground
E4	19	GND	Connect to engine ground
E5	18	GND	Connect to engine ground
E5	19	GND	Connect to engine ground
E5	29	GND	Connect to engine ground
BC1	1	GND	Connect to engine ground, required for stock OBDII connector

6.1.4. Required for gauge cluster functionality

These connections are required to get the basic gauge cluster functionality working

Connector	Pin	Name	Purpose
E4	1	OIL-P	Oil pressure switch
E4	2	ALT-L	Alternator Light Input
E5	27	CANH	OBDII CAN high connection
E5	28	CANL	ODBII CAN low connection
E5	24	TACH	Tachometer output
E5	17	W	Check engine light

6.2. Connections to facilitate your swap

All of the connections below are optional. If your particular swap does not need the functionality it can just be left disconnected

6.2.1. Power supplies

These are all the different power supplies provided by the MR2 Spyder that can be used for the engine swap:

Connector	Pin	Name	Purpose
BC1	5	O2Pwr	Oxygen sensor heater power supply
BC1	8	IGNCoil	Ignition coil power supply
BC2	10	INJPwr	Fuel injector power supply
E4	4	ALTIgn	Alternator Ignition signal
E5	1	BM+	DBW throttle body power supply (shared with the BATT supply)
E5	9	BATT	12V constant supply
E5	21	B+	12V ignition switched supply
E5	30	IGSW	Ignition switch signal for ECU
E5	31	B+	12V ignition switched supply

6.2.2. Drive By Wire

The body controller has 6 pass through wires for the drive by wire to help avoid the engine harness reaching all the way under the dash. This allows the body controller to act as a junction box. The intent is that the DBW wires from the ECU go into E5 and the DBW to the pedal come from the 17P connector. These signals do not get used by the body controller so their exact purpose is not critical which is why they are labeled A-F instead of with any particular purpose:

Connector	Pin	Name
E5	10	A
E5	11	B
E5	12	C
E5	13	D
E5	22	E
E5	23	F

Connector	Pin	Name
17P	12	A
17P	11	B
17P	10	C
17P	9	D
17P	17	E
17P	16	F

6.2.3. Cooling fans

If the ECU controls the cooling fans they can be hooked up to these two pins

Connector	Pin	Name	Purpose
E5	3	FANL	Low speed fan, ground to activate
E5	4	FANH	High speed fan, ground to activate (high speed requires low speed also)

Alternately, you can tell the body controller to control the cooling fans by simply cutting trace "A" on the circuit board:



Note: even in ECU controlled fan mode the body controller will turn on the low speed fan to cool the condenser when A/C is utilized.

6.2.4. Reverse lights

The reverse sensor sits on the engine harness, the switch should close when in reverse and connect the two following pins:

Connector	Pin	Name	Purpose
E4	3	RevLtPwr	Power Supply for reverse lights
BC1	7	RevLtOut	Output for reverse light sensor

6.2.5. Starter

The starter solenoid signal wire should be wired as follows:

Connector	Pin	Name	Purpose
BC2	7	STRSol	Starter solenoid signal

6.2.6. Charging System

The charging system should get wired as follows. It is strongly advised to use an alternator with a sense wire input but it is not required.

Connector	Pin	Name	Purpose
BC2	3	ALT-S	Alternator battery voltage sense
E4	4	ALT-IGN	Alternator Ignition signal
E4	2	ALT-L	Alternator Light (Can source 5W for field, ground to light bulb)

Note: ALT-L was already mentioned in required wired but it was listed here again for clarity

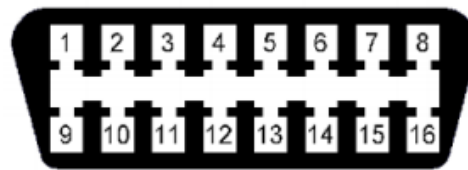
6.2.7. Daytime running lights

For MR2s in countries where daytime running lights are installed, a junction wire between these two pins needs to be provided to enable the daytime running lights. If your car has DRL and you want to disable this feature you can just leave this jumper off with no ill effects.

Connector	Pin	Connector	Pin	Name	Purpose
BC3	7	E4	8	DRL	*OPTIONAL* Daytime running lights enable line

6.2.8. OBDII Port

It's generally easier to add a 2nd OBDII port to this swap but it is possible to add the CAN lines to the existing port. The body controller puts all of the OBDII pins on the 17P connector to keep the wiring clean.



OBDII

Connector	Pin	Name
17P	7	B+
17P	4	GND
17P	15	GND
17P	14	CANH
17P	13	CANL

Connector	Pin	Name
OBDII	16	B+
OBDII	4	GND
OBDII	5	GND
OBDII	6	CANH
OBDII	14	CANL

6.2.9. Brake Signals

The brake signal is passed through the body controller but the body controller also generates an inverted brake signal since some ECUs require this.

Connector	Pin	Name	Purpose
E5	15	STP	Brake signal
E5	16	ST1	Inverted brake signal

6.2.10. A/C System

The entirety of the A/C system is contained inside the chassis wiring, the only part that the engine swap harness needs to be concerned about is the power to energize the compressor clutch

Connector	Pin	Name	Purpose
BA2	4	ACClutch	Power for the A/C compressor clutch

7. A/C Functionality

The body controller puts a few safeguards in place for the A/C system. If there is unexpected behavior this may explain it:

- The A/C light on the climate controls will only turn on if the climate control fan is on.
- If the hi-low switch is out of range, the A/C light will go from solid to blinking within 2 seconds
- If the A/C compressor is on the low speed radiator fans will be on to cool the condenser unless the defrost is on. If the defrost is on it's assumed that the A/C is being used in cold weather to dehumidify the air and the fans would only slow down the vehicle warm-up.
- The low speed fans stay on for 8 seconds after the A/C compressor is turned off to prevent temporarily over pressurizing the system and causing intermittent faults if you try to switch it back on immediately.
- The compressor will remain off for at least 2.5 seconds before turning back on
- To trip the fault state the hi-low switch has to report a fault for the better part of a whole second.
- The compressor clutch will not get energized unless the body controller thinks the engine is running. This is determined by having oil pressure or having an alternator that is charging.

8. The Status LEDs

The body controller has three lights that give feedback to the internal state, This is what the blink patterns mean.

“Heartbeat”: This LED blinks to indicate that the system is up and running, a short blink indicates the engine is not running, a 50/50% blink indicates the engine is running. Note that to determine engine running the body controller uses the alternator charging state and the oil pressure status. If either of those are good the engine is assumed to be running.

“CAN” : This LED blinks once per second if the CAN bus is actively receiving data

“BEAN”: This LED blinks fast (5x per second) to indicate that BEAN data is being transmitted and received. If it blinks once per second but only with a short blink ($1/10^{\text{th}}$ of a second) BEAN data is only being sent, none is being received. If it blinks once per second but with a long blink ($9/10^{\text{th}}$ of a second) then BEAN data is only being received and not sent. If the LED is off no data is being received or transmitted.