

CANBUS Emulator V2.x

Overview - Installation and Operating Instructions

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Overview

The Subatronics Canbus Emulator enables the use of late model Subaru Engines (that are Canbus equipped) into vehicles or applications that do not have Canbus.

Late model Subaru's use Canbus technology for the Engine Computer, Body Computer, ABS and Traction Control modules to talk to one another. If any of these Canbus modules are absent in an engine conversion using the standard engine computer (ECU), the engine will not run properly and the "check engine light" will illuminate.

The Canbus emulator fixes this problem, by emulating (copying) the signals from the Canbus modules that are not used in an engine conversion. This keeps the engine computer happy and stops it from going into a fault mode.

The Subatronics Canbus emulator can also perform a few extra functions to assist in your engine conversion, including the following:

Speedometer calibrator – Used with the Subaru gearbox speed sensor or another 4-5 pulse sensor, the Canbus emulator can adjust the signal to account for different wheel/tyre combinations and diff ratios so the electronic speedometer can be calibrated to read correctly. Adjustment range is from 50% to 200% of the input signal and can be set using the on screen display and navigation buttons. The speedometer signal is then sent to the dash through one wire, and also transmitted over Canbus for the engine computer.

Note: Most Canbus vehicles do not have a speed sensor in the gearbox, but use the ABS or VDC unit for its vehicle speed measurement. A Subaru speed sensor can usually be fitted to a gearbox that does not have the sensor.

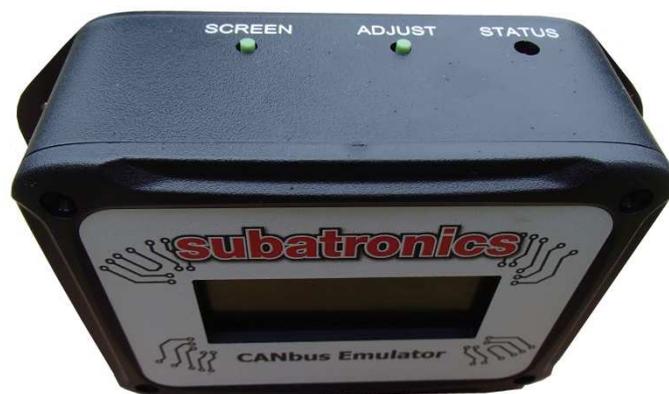
Real time data display – The Canbus emulator includes a backlit 4line LCD screen which can be used to display live running engine data such as RPM, coolant and intake temperatures, battery voltage, mixtures, throttle position and much more.

Engine Diagnostic Trouble Code reader (DTC Reader) – If the engine light has come on, the Canbus emulator can read the codes stored within the engine computer to diagnose any problems. The Canbus emulator can also reset codes that have been fixed, which will turn off the engine light in the dash.

Air pump delete (Turbo engines) – The Canbus emulator can be equipped with an optional pressure sensor. This pressure sensor can then be used to remove the Air pump and associated solenoids. The solenoid wires are re-connected to the Canbus emulator, which uses this to “emulate” the air pump test circuit and provide the atmospheric pressure signal to the engine computer. Other ways to remove the air pump is to remap the engine computer to disable it, however using the Canbus emulator, no remapping or engine computer modification is necessary.

Fuel level emulator– The Canbus emulator can be used to simulate a ¾ to full fuel tank signal into the body computer (also sent to the engine computer). This should be used if a different fuel gauge or sender is used from the Subaru unit, to prevent the engine computer from thinking the car is low on fuel.

The Canbus Emulator is housed in a robust plastic case complete with mounting tabs to enable it to be secured in a suitable position. A single 18way multipole plug and socket is used for all electrical connections. Two buttons are used to change the display screen and adjust parameters such as the speed calibration value.



Installation

Basic Install

The Canbus emulator is contained within a robust plastic enclosure with mounting tabs allowing it to be screwed or tied to part of the vehicle to keep it secure.

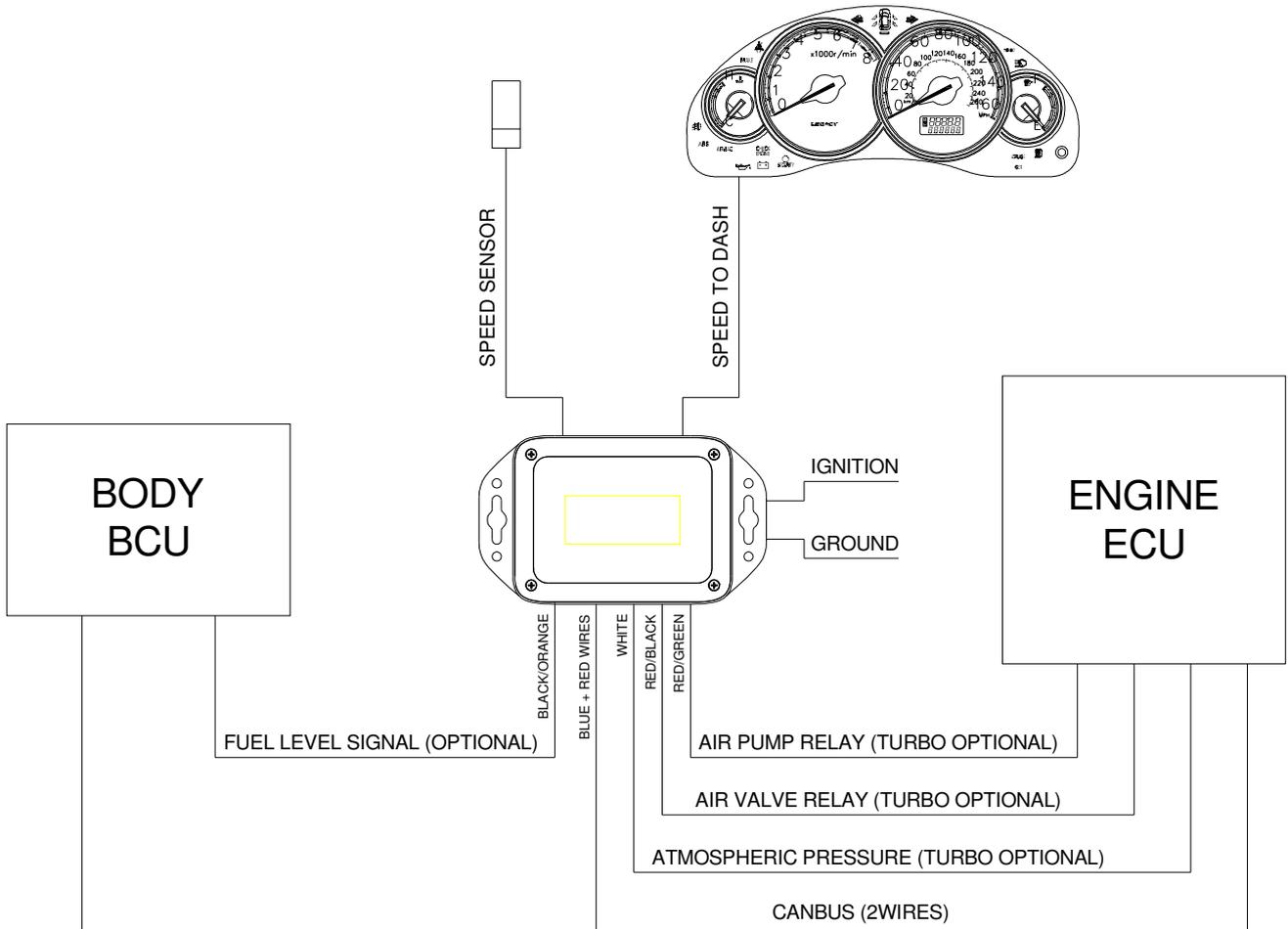
An 18pin multi-pole plug is used to allow easy disconnection and a wiring harness with tails is provided to allow wiring into the vehicles existing wiring harness. Depending on what options are installed on the Canbus emulator will depend on how many wires are provided on the wiring harness.

The primary function of the Canbus Emulator is to provide the missing Canbus messages when the engine is placed in a non Canbus environment. For this basic setup, only 4 Wires are needed as shown below.

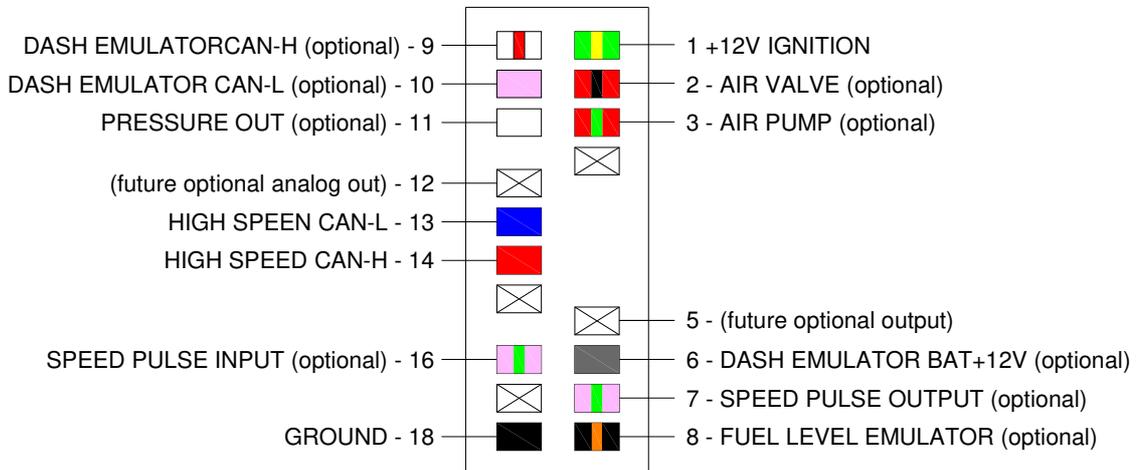
| PIN | MAIN/STRIPE COLOUR | | NAME |
|-----|--------------------|--------|---------------|
| 1 | GREY | Input | +12V IGNITION |
| 13 | BLUE | HS CAN | HS-CAN-L |
| 14 | RED | HS CAN | HS-CAN-H |
| 18 | BLACK | INPUT | GROUND |

These connections can be wired into the steering wheel angle sensor wiring (if equipped) once the angle sensor wiring is removed from the steering wheel (it is only required for ABS). Alternatively it can be spliced into the wires anywhere along the existing circuit.

Connection Diagram



Harness Connector (looking at back of the plug)



With Air Pump Delete Function (optional extra)

The Canbus emulator can be optioned with circuitry to bypass the air injection system if it is not necessary, allowing for air pump and solenoids to be removed from the engine, and providing the necessary signals to the engine computer to make it think the system is still in service. The Canbus emulator contains an Atmospheric Pressure sensor which is used to provide the atmospheric pressure signal to the ECU when the air injection is removed. It also simulates the air pump test function and prevents the Check Engine light from illuminating.

The Air pump system is only installed on some turbo engines and so is offered as an option.

To enable the air pump delete, and extra 3 wires are needed to be hooked up to the engine computer, once the air injection system (including control relays) are removed.

| PIN | MAIN/STRIPE COLOUR | | NAME | CONNECTION |
|-----|--------------------|--------|-------------|---|
| 2 | RED/BLACK | Input | AIR VALVE | Connect to the air valve relay output from the Engine Computer |
| 3 | RED/GREEN | Input | AIR PUMP | Connect to the pump relay output from the Engine Computer |
| 11 | WHITE | Output | AT PRESSURE | Connect to the AT pressure sensor wire into the Engine Computer |

With Speed sensor input (and output correction)

The Canbus emulator can be used as a speedometer calibrator useful for calibrating the speedometer for different ratio differentials and tyre combinations, and different speedometers. It does this by sensing the speed on the speed input wire and changing the frequency between %50 to %200 of the input frequency, adjusted by the user. It sends the adjusted speed signal back onto a speed output wire (for EJ models with speedometer) and also via CAN communications for the engine computer and FA/FB speedometers.

| PIN | MAIN/STRIPE COLOUR | | NAME | CONNECTION |
|-----|--------------------|--------|-------------|--|
| 2 | PINK/GREEN | Output | SPEED PULSE | Connect to speedometer (or speed signal wire on OEM cluster) |
| 3 | PINK/GREEN | Input | SPEED PULSE | Connect to a 4-5pulse 0-12V Input driven off the wheels or gearbox |

With Fuel Tank Level Emulator

The Canbus emulator can be used to provide a signal to the body computer to indicate it has fuel in it (to keep the engine computer from disabling codes due to low fuel). This can be used is the fuel tank sender is incompatible with the sender range of the OEM Canbus sender. It sends a 100Ω resistance to the body computer, making it think the fuel level is ½ to FULL.

| PIN | MAIN/STRIPE COLOUR | | NAME | CONNECTION |
|-----|--------------------|--------|------------|---|
| 8 | BLACK/ORANGE | Output | FUEL LEVEL | Connect to fuel level input wire to body control module |

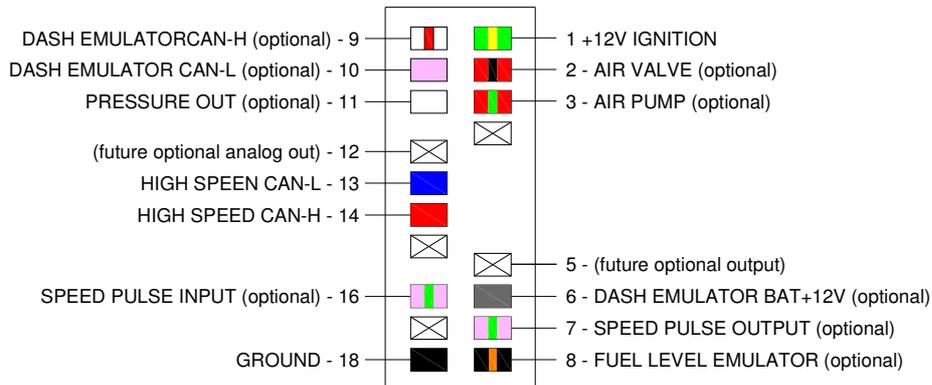
With DASH Emulator (bypass immobiliser security) (optional extra)

The Canbus emulator can be used to provide the security codes needed by the body computer/immobiliser unit. This is needed when the OEM Canbus instrument cluster is not wanted to be used in a vehicle. The Dash Emulator must be programmed at time of order using the instrument cluster from the donor vehicle with the matching key, body computer and engine computer. To wire up the Dash Emulator, the following extra three wires are required.

| PIN | MAIN/STRIPE COLOUR | | NAME | CONNECTION |
|-----|--------------------|--------|----------|---|
| 6 | GREY | Input | +12V | Connect to a constant +12V source |
| 9 | PINK | LS CAN | LS-CAN-L | Connect to the high speed CAN-L wire (to the body control module) |
| 10 | WHITE/RED | LS CAN | LS-CAN-H | Connect to the high speed CAN-H wire (to the body control module) |

Overall Connections

| PIN | MAIN/STRIPE COLOUR | | NAME | CONNECTION REQUIRED | CONNECTION |
|-----|--------------------|--------|---------------|---|--|
| 1 | GREY | Input | +12V IGNITION | Mandatory | Connect to a +12V source powered when the key is in the IGNITION and START position |
| 2 | RED/BLACK | Input | AIR VALVE | Optional (On turbo engines) | Connect to the air valve relay output from the Engine Computer |
| | | | REVERSE SW | Optional (On FA/FB engines from CVT donor using Reversing Camera) | Connect to the Reverse Lamp switch (12V when in Reverse), Ground at all other times) |
| 3 | RED/GREEN | Input | AIR PUMP | Optional (On some turbo engines) | Connect to the pump relay output from the Engine Computer |
| 4 | | | | | |
| 5 | | | | | |
| 6 | GREY | Input | +12V | Optional (only required if dash emulator module fitted) | Connect to a constant +12V source |
| 7 | PINK/GREEN | Output | SPEED PULSE | Optional (if corrected speed signal pulse is required for a speedometer on EJ models) | Connect to speedometer (or speed signal wire on EJ style OEM cluster). FA/FB models do not use this speed pulse. |
| 8 | BLACK/ORANGE | Output | FUEL LEVEL | Optional (if fuel tank sender has incompatible ohms to subaru unit) | Connect to fuel level input wire to body control module |
| 9 | PINK | LS CAN | LS-CAN-L | Optional (use if dash emulator installed and not using OEM instrument cluster) | Connect the low speed CAN-L wire (to the body control module) |
| 10 | WHITE/RED | LS CAN | LS-CAN-H | Optional (use if dash emulator installed and not using OEM instrument cluster) | Connect the low speed CAN-H wire (to the body control module) |
| 11 | WHITE | Output | AT PRESSURE | Optional (On some turbo engines) | Connect to the AT pressure sensor wire into the Engine Computer |
| 12 | | Output | Future | | |
| 13 | BLUE | HS CAN | HS-CAN-L | Mandatory | Connect to the high speed CAN-L wire (to the body control module) |
| 14 | RED | HS CAN | HS-CAN-H | Mandatory | Connect to the high speed CAN-H wire (to the body control module) |
| 15 | | | | | |
| 16 | PINK/GREEN | Input | SPEED PULSE | Optional (if corrected speed signal pulse is required for a speedometer or ECU) | Connect to a 4-5pulse 0-12V Input driven off the wheels or gearbox |
| 17 | | | | | |
| 18 | BLACK | INPUT | GROUND | Mandatory | Connect to a solid Ground (or Battery -ve) |



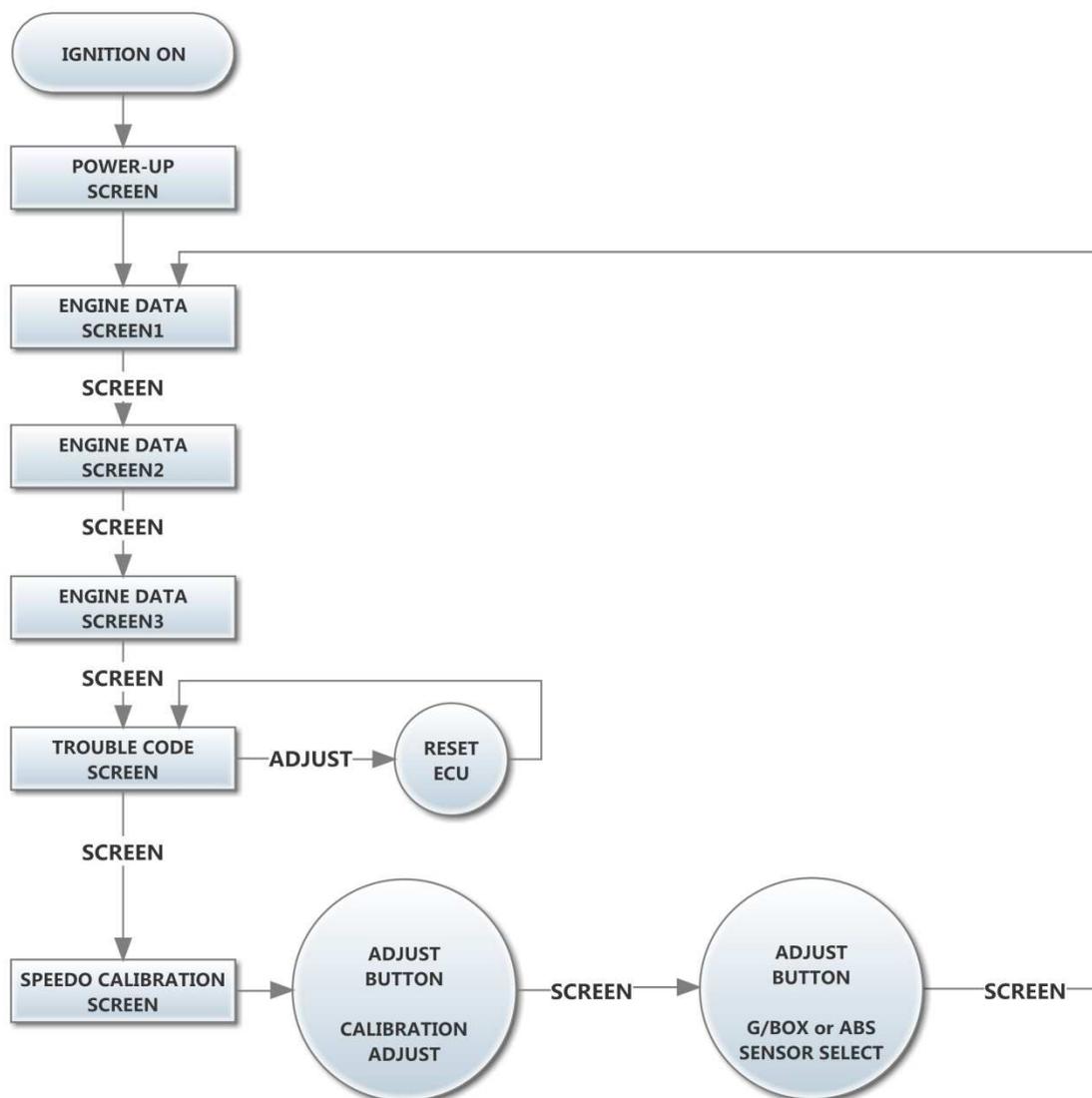
Operation

The Canbus Emulator automatically sends out the required Canbus signals once it is energised with the ignition power. This is shown by the STATUS light.

The Canbus emulator has five “virtual screens” that can be used to show diagnostic data from the engine computer Screens 1-3), display Engine Diagnostic Trouble Codes (DTC’s)(screen 4), and to program the speedometer calibration (screen 5).

To change the virtual screen, simply press the SCREEN button on the Canbus Emulator.

To reset the Engine Computer, and to adjust the speedometer calibration, the ADJUST button is used. See the flowchart below for screen navigation and a detailed description of each screen.



Screen 1 - Engine Data

```
ENGINE 1633RPM  
W TEMP 054°C  
PRESS 21.7inHg  
THROTTLE 14.8%
```

Screen 2 - Engine Data

```
BATT 13.4V  
U. SPD 038km/h  
AT PRESS 100kPa  
MAF 0359/s_
```

Screen 3 - Engine Data

```
AFR 12.9  
LFUEL TRIM +000%  
IN TEMP 037°C  
ENG LOAD 14.3%_
```

Screen 4 - Engine DTCs

```
DTC SAVED CODES  
P0463  
DTC PEND. CODES  
P0463
```

Use the Subaru Workshop Manual for the vehicle to lookup the definition of the trouble code.

To Reset the engine computer, and clear the codes, press the ADJUST BUTTON. If the fault has gone, the code will disappear from the screen, and the ENGINE light should go out. If the fault is still present, the code will reappear.

Screen 5a – Speed Sensor Calibration



To calibrate the speedometer, press the ADJUST button to change the calibration value by one unit (from a range of 25-250%). Use the following equations to work out what the calibration value should be

$$\text{CALIBRATION VALUE} = (\text{ACTUAL SPEED} / \text{MEASURED SPEED}) \times 100$$

The easiest way to determine the ACTUAL SPEED is to use a GPS that can display the speed (or a smartphone app). Drive in a straight flat road at a constant speed and take note of the reading from the GPS unit, this is your ACTUAL SPEED. At the same time observe the MEASURED SPEED (on screen2).

If the speed signal is not used, put the calibration value to 0. This will send a constant speed signal of 38km/h to the engine computer.

Screen 5b – Speed Sensor Type



Two types of speed sensor can be used.

The most common is using a gearbox sensor (4-5pulse, negative switching 0-12V output wheel speed sensor). This type of sensor is used for most gearbox speed sensors, including the Subaru unit. To use this sensor you need to select the G/BOX sensor in the Emulator configuration.

If a gearbox speed sensor cannot be used, an alternative is to use an ABS style sensor. These sensors have between 40-50 Pulses per revolution, so to use this, you need to select the ABS sensor type in the Emulator configuration. NOTE: To use this sensor, a ABS sensor interface must also be installed, to convert the ABS sensor's output, to a 0-12V negative switching output that can be used with the Emulator.

Troubleshooting

| Symptom | Solution |
|-----------------------------------|--|
| No display after Subatronics Logo | No Can Communication has been detected/ Check the Canbus connections |
| Erratic Speedometer | Electrical Noise (some sensors may require an additional resistor on the sensor wire to IGN to reduce electrical noise |

Important Details on using late model Subaru Canbus motors for conversions

The late model Canbus motors are an ideal choice for engine conversions as they are newer, generally have lower km's, and more economical than older models. The Canbus wiring and control is a little more complex than the older non-Canbus engines, however in most cases there will actually be less wires!

A few things to note before attempting a Canbus Subaru conversion:

The engine immobiliser uses the Engine Computer (ECU), Body Computer (BIU), Instrument Cluster, the ignition barrel, and of course the key with the transponder chip. All of these components need to be matching, otherwise the engine will only run for 2 seconds, if at all. Preferably, these components, along with the wiring harness, should be removed from the same donor car as the engine. Subaru can reprogram the security codes of the components and keys, however this can be difficult without the components being in a working car.

The Instrument cluster is part of the immobiliser system, however if you do not wish to use the Subaru instrument cluster, the security function can be copied and replaced with a dash emulator the size of a matchbox (or added to the Canbus Emulator). For the instrument cluster to be copied, it must be sent to **AGT Engineering** to allow the security codes to be extracted from it. If an instrument cluster is not available, the rest of the components must be reprogrammed by Subaru to match an existing dash emulator that can be copied.

The list below details the parts required from a donor Subaru for a Subaru conversion:

Engine

Wiring loom (including wiring between Engine and Engine Computer (ECU), Body Computer (BIU), Instrument Cluster (if used), accelerator pedal sensor, engine fuse and relay block (holds engine, fuel pump fuses and relays).

Engine Computer (ECU)

Body Computer (BIU)

Key and Key antenna (on the ignition barrel)

Instrument Cluster (dash) – Needed to copy security if it is not used

Accelerator Pedal (Canbus motors are drive by wire with no throttle cable)

Ignition Switch Barrel and Key (including the key transponder pickup coil)

Fuel Pump Controller (some models only, mainly turbo or H6)

Fuel Pump (Or a suitable alternative)

Steering Wheel (Optional – However useful for the cruise control buttons if equipped. Note: cruise control will also need the Subaru switches added to the Brake and Clutch pedals)