



**PERFORMANCE ELECTRONICS**

**Installation Instructions for:**  
**EMS P/N 30-6820**  
**2004 Subaru WRX STI (USDM 2.5L turbo)**

*and*

**EMS P/N 30-6821**  
**2005-2006 Subaru WRX STI (USDM 2.5L turbo)**

**WARNING:**



This installation is not for the tuning novice nor the PC illiterate! Use this system with EXTREME caution! The AEM EMS System allows for total flexibility in engine tuning. Misuse of this product can destroy your engine! If you are not well versed in engine dynamics and the tuning of management systems or are not PC literate, please do not attempt the installation. Refer the installation to a AEM trained tuning shop or call 800-423-0046 for technical assistance. You should also visit the AEM EMS Tech Forum at <http://www.aempower.com>

**NOTE: AEM holds no responsibility for any engine damage that results from the misuse of this product!**

**This product is legal in California for racing vehicles only and should never be used on public highways.**

Vehicle fitment	Series I EMS	Series II EMS
2004 Subaru WRX STI	30-1820	30-6820
2005-2006 Subaru WRX STI	30-1821	30-6821

© 2011 Advanced Engine Management, Inc.  
**ADVANCED ENGINE MANAGEMENT INC.**  
 2205 126<sup>th</sup> Street Unit A Hawthorne, CA. 90250  
 Phone: (310) 484-2322 Fax: (310) 484-0152  
<http://www.aemelectronics.com>  
 Instruction Part Number: 10-6820

Thank you for purchasing an AEM Engine Management System.

The AEM Engine Management System (EMS) is the result of extensive development on a wide variety of cars. Each system is engineered for each particular application. The AEM EMS differs from all others in several ways. The EMS is a stand alone system, which completely replaces the factory ECU and features unique Plug and Play Technology, which means that each system is configured especially for your make and model of car without any jumper harnesses. There is no need to modify your factory wiring harness and in most cases your car may be returned to stock in a matter of minutes.

For stock and slightly modified vehicles, the supplied startup calibrations are configured to work with OEM sensors, providing a solid starting point for beginner tuning. For more heavily modified cars, the EMS can be reconfigured to utilize aftermarket sensors and has many spare inputs and outputs allowing the elimination of add-on rev-limiters, boost controllers, nitrous controllers, fuel computers, etc. It also includes a configurable onboard 1MB data logger that can record any 16 EMS parameters at up to 250 samples per second. Every EMS comes with all functions installed and activated; there is no need to purchase options or upgrades to unlock the full potential of your unit.

The installation of the AEM EMS on the supported vehicles uses the stock sensors and actuators. After installing the AEMTuner software, the startup calibration will be saved to the following folder on your PC:

*C:\Program Files\AEM\AEMTuner\Calibrations\AEM Updates\Subaru\*

Multiple calibrations may be supplied for each EMS; additional details of the test vehicle used to generate each calibration can be found in the Calibration Notes section for that file.

Please visit the AEM Performance Electronics Forum at <http://www.aemelectronics.com> and register. We always post the most current strategy release, PC Software and startup calibrations online. On the forum, you can find and share many helpful hints/tips to make your EMS perform its best.

### **TUNING NOTES AND WARNING:**

While the supplied startup calibration may be a good starting point and can save considerable time and money, it will not replace the need to tune the EMS for your specific application. AEM startup calibrations are not intended to be driven aggressively before tuning. We strongly recommend that every EMS be tuned by someone who is already familiar with the AEM software and has successfully tuned vehicles using an AEM EMS. Most people make mistakes as part of the learning process; be warned that using your vehicle as a learning platform can damage your engine, your vehicle, and your EMS.

Read and understand these instructions **BEFORE** attempting to install this product.

### **Subaru 2004 / 2005-2006 Model Year Differences**

Although there are very few differences between the 2004 and 2005-2006 models, the ECUs are not interchangeable. The 30-1820 EMS must be used in a 2004 vehicle, and the 30-1821 EMS must be used in 2005-2006 vehicles. Consult the pinout chart for further information.

### **Peak and Hold Injector Drivers**

Injectors 1-4 include Peak (4 amps) and Hold (1 amp) injector drivers. These drivers may be used with peak and hold or saturated type injectors. The vehicle's wiring harness may contain a resistor pack to prevent excessive current if low-impedance injectors were used with the stock ECU. With the 30-6820 installed, users can elect to remove and bypass injector resistors for more precise control of low-impedance injectors.

Please note that the injector response time will be different with and without injector resistors installed. If a resistor pack has been removed and bypassed, please use the correct battery offset wizard for your injectors. Most battery offset wizards will specify <P&H DRIVER> if they are intended for use without a resistor pack.

### **Fuel Pump Control**

As supplied from Subaru, the OEM ECU interfaces with a fuel pump control unit (FPCU) to control the speed, high or low, of the fuel pump based on load. The AEM EMS has the ability to replicate this functionality; however it is configured in the Startup Calibration to run the fuel pump at high speed at all times.

The EMS Output COIL8 (Pin B26 for 2004 models, pin B27 for 2005-2006 models) is used to send a 5V signal instructing the OEM fuel pump ECU to energize the fuel pump. Configuring *User PW Out* to use LS12 and, for example, *User PW Analog In* to MAP Volts will allow the voltage sent to the fuel pump ECU to be varied in relation to MAP Volts/pressure. Increasing the duty cycle of the LS12 output will decrease the speed of the fuel pump.

**WARNING:** Reducing the voltage sent to the fuel pump can affect fuel pump output (volume and/or pressure). If you wish to decrease pump speed at light loads or low RPM, monitor fuel pressure and air-fuel ratio very carefully to avoid engine damage!

**WARNING:** Do not use pin B26/B27 to control a fuel pump relay directly, it must be connected to the OEM fuel pump control unit only. If an aftermarket fuel pump relay will be installed, wire it to be controlled using a spare low side output (for instance, LS2 is available on pin A13). Be sure to configure the output to use the Fuel Pump function using Tools>>Configure Outputs.

## Variable Valve Control (VVC)

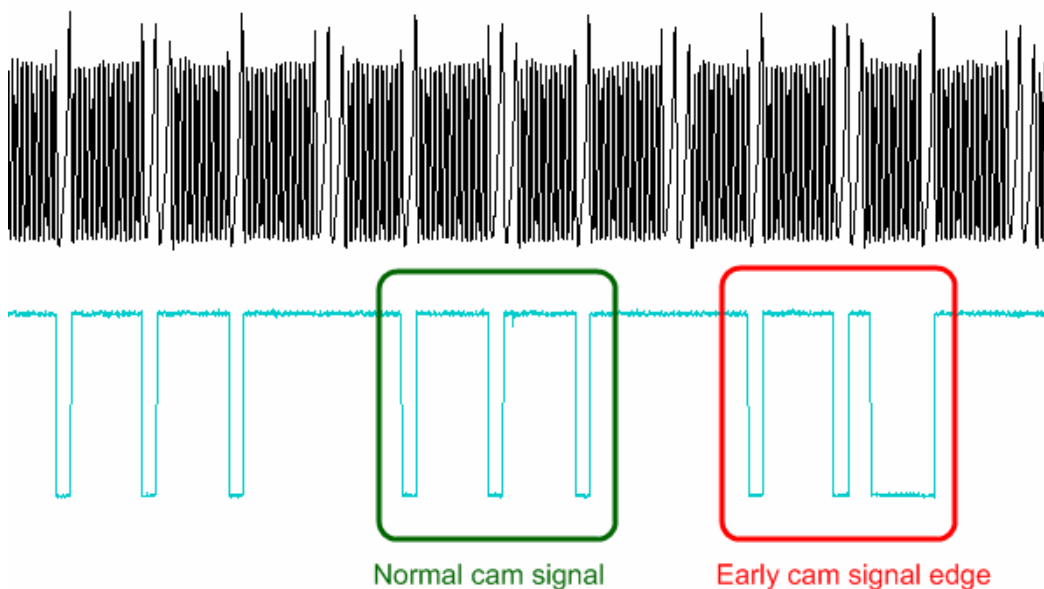
The Variable Valve Control table in the EMS can be used to control the STI's AVCS system, which is used to change the airflow characteristics of the engine by advancing the timing of the intake camshafts. The AVCS outputs (pin A28-A29, Injector 9-10 outputs on the EMS) advance the phase angle of the intake camshafts; this will have effects similar to moving an adjustable intake cam gear. This is controlled by the VVC 1 (RH camshaft) and VVC 1B (LH camshaft) outputs; VVC position is monitored using the T2 and T3 inputs for independent closed-loop feedback. The VVC settings can be adjusted in the VVC tab (which may be hidden in the default AEM workspace).

This system is active on this EMS when used with the provided startup calibrations and can be adjusted through the use of the 'VVC 1 Target' map. Adjustments to the intake cam timing are made by changing the values in the 'VVC 1 Target' map per Engine RPM and Engine Load. The values in the 'VVC 1 Target' map can vary from 0 degrees for zero intake cam advance to 50 degrees for full intake cam advance. The channels 'VVC 1 Advance' and 'VVC 1B Advance' show the measured position of the camshafts.

**WARNING:** Improper use of the Variable Valve Control (VVC) in the AEMTuner software can lead to engine damage!

Be very careful when building or tuning unknown engine combinations or using aftermarket pistons or valve train components. OEM engines and valve trains are not designed or manufactured to allow valve to piston interference at certain cam angles. AEM will not be responsible for engine damage resulting from improper use of the VVC function on engines with valve trains designed to allow mechanical interference.

Please note that some Subaru camshaft sensors will send 'false signals' under some conditions (often light load and low RPM). This can be observed with an oscilloscope or high-speed datalogger, and occurs with the stock ECU as well. These false signals will not cause engine misfires with the Series 2 EMS, but will sometimes be reflected as quick jumps in the measured 'VVC 1 Advance' channels.



### **EMS DC Stepper Motor control (Subaru Tumble Generator Valves)**

There are two sets of Tumble Generator Valves (TGV) found on the intake manifold of the STI. Each set of valves is driven by a DC stepper motor and has a 0-5V feedback signal to monitor valve position. The Motor 1 and Motor 2 Target tables are used to set the position of the valves; valve position can be controlled based on various parameters such as throttle position, vehicle speed, engine RPM, or engine load. The channels "ADCR11" and "ADCR14" display the current position of the valves. When these parameters are near 0 Volts, the valves are open and will allow maximum air flow. When these parameters are near 5 Volts, the valves are closed creating turbulence in the intake stream and restricting air flow. The valves are always open in the AEM-supplied startup calibrations.

**WARNING:** the EMS can be configured to control the left and right bank independently. The engine will run very poorly if one set of TGVs is fully open while the other set is fully closed, so please be sure that the Motor 1 and Motor 2 Target tables are both the same.

### **Subaru MAF sensor, Intake Air Temp sensor**

The MAF (mass air flow) sensor can be removed to help decrease intake air restriction as the base map uses the factory MAP sensor to determine engine load. Please be aware that the IAT (intake air temperature) sensor is integrated into the factory MAF sensor. If the factory MAF / IAT sensor is removed, you may wish to install an AEM IAT Sensor Kit (P/N 30-2010), which includes a sensor, wire connector, and aluminum weld-in bung. While the factory MAF sensor locates the IAT sensor upstream of the turbocharger inlet, it may be preferable to install an IAT sensor downstream of the intercooler to accurately measure charge temperatures.

### **EMS Fuel Map, Boost Fuel Trim Table**

The 30-6820 calibration maps provided utilize the "Boost Fuel Trim Table" to provide a 1:1 fuel compensation above and below atmospheric pressure. To use this table, the "Boost Fuel Trim Table" should be configured to provide twice as much fuel when the manifold pressure is twice as high and half the fuel when the manifold pressure is half as high; this should help simplify the tuning process for different vacuum and boost levels. Notice the values in the main "Fuel Map" do not change significantly above 100 kPa (0 psi boost), the fuel correction is being made by the "Boost Fuel Trim Table."

Note: the "Boost Fuel Trim Table" must be adjusted if a different MAP sensor is installed or if the Load breakpoints are adjusted. The Boost Fuel Trim value should be set to -90 at 10kPa, 0 at 100 kPa, +100 at 200 kPa, +200 at 300 kPa, etc...

### **Check Engine Light**

The Low Side 10 output (LS10) activates the Check Engine Light on the gauge cluster. It is configured to activate at low RPM in the AEM startup calibrations; this can be reconfigured by selecting Tools>>Configure Outputs.

## AEM Electronic Throttle Control System (ETC)

The 30-6820 EMS incorporates an ETC system which controls the OEM electronic throttle body. All components of this system, unmodified and as delivered from the manufacturer, are required for optimum and safe functionality of this system. These components include, but are not limited to, wiring, ETC relay, accelerator pedal assembly, and throttle body.

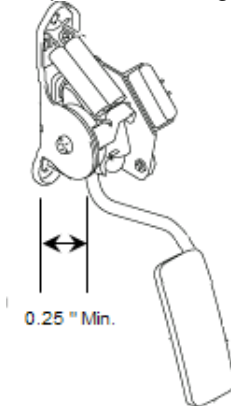
The EMS ETC control system incorporates multiple failsafe strategies such that in the event of a component failure, the system will shut down the ETC system and, if necessary, the engine in a graceful manner. It still remains the user's responsibility to ensure that all vehicle, component, and wiring systems are maintained to a level of workmanship consistent with industry standards.

Note: As the EMS is intended for use on vehicles that are to be operated off-road only, the factory cruise control system will be non-operational after installation of the EMS.

### **Installation Information**

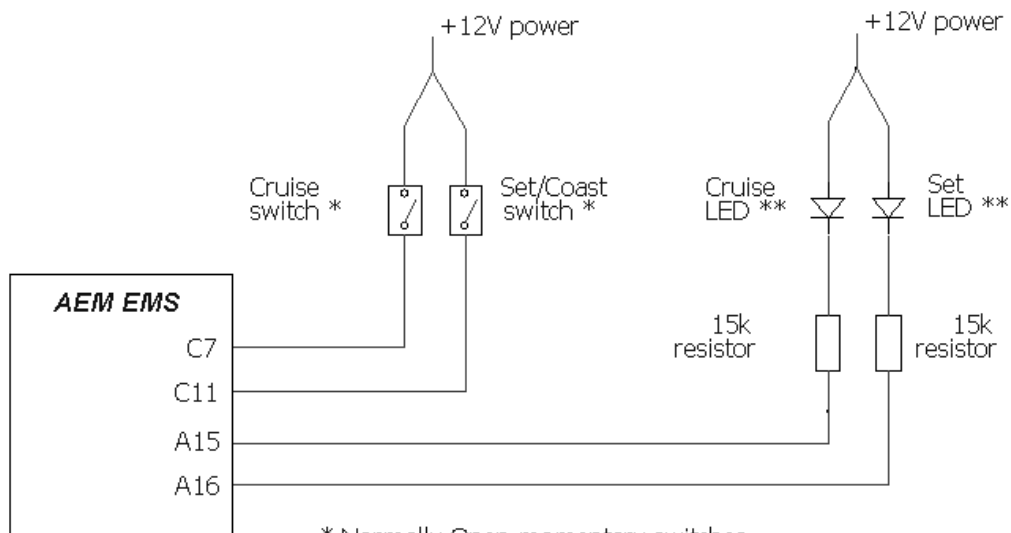
The 30-6820 AEM EMS was designed to work with the vehicle, its components, and wiring as delivered from the manufacturer. If any of the components or wiring have been changed or if the drive-line from the original vehicle has been placed in another vehicle such in a custom race application then the user should take heed of the following notes.

A mechanical Wide Open Throttle/"WOT" accelerator pedal travel stop is installed in the floor and/or carpet of the vehicle as delivered from the manufacturer. If this stop is removed for any reason, such as removing the carpet for use in a race vehicle, the user must ensure that a stop of some sort is fabricated and installed. This stop must be fabricated such that there is a minimum clearance of 0.250 inches between the accelerator pedal mounting bracket and the accelerator pedal actuating rod when the pedal is at WOT. See *Figure 1*.



*Figure 1 - Minimum Pedal to Bracket Clearance*

The **CRUISE** and **SET/COAST** buttons, and the **CRUISE** and **SET** dashboard indicator lights are an integral part of the ETC system calibration and diagnostic functions. It is, therefore, not recommended that these buttons and lights be completely removed from the vehicle such as could be the case with a purpose-built race vehicle. If the OEM steering wheel and/or gauge cluster have been removed, please temporarily re-install them to calibrate the ETC unit, or add switches and lights to the vehicle as shown:



\* Normally Open momentary switches

\*\* LEDs should be rated for at least 10 mA current

## Electronic Throttle Control System Calibration Procedure

The 30-6820 / 30-6821 EMS, as delivered, requires a specific calibration procedure to be performed prior to use. Before beginning this procedure, please be familiar with the location and function of the **CRUISE** and **SET/COAST** buttons on the Cruise Control Steering Column Stalk as depicted in *Figure 2*. Also be aware of the (green) **CRUISE** and **SET** indicator lights on the dashboard, *Figure 3*. **This procedure should be repeated any time any part of the ETC system has been serviced, removed, or replaced.**

Note: Do not attempt to start or run the engine during the calibration procedure. The EMS will disable engine start/running whilst in calibration mode.

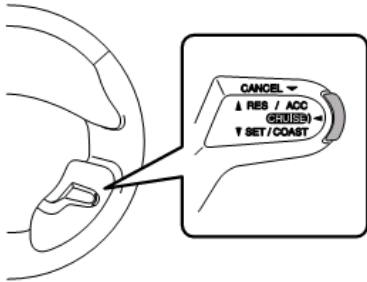


Figure 2 - "CRUISE" and "SET/COAST" buttons

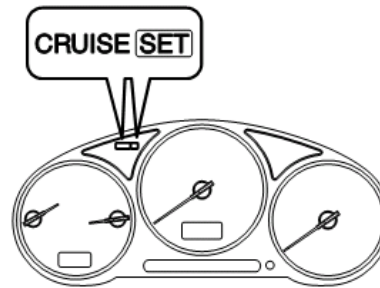


Figure 3 - "CRUISE" and "SET" indicator lights

### 1. Initial Calibration Procedure

- a. Turn the ignition key to the ON position. The **CRUISE** and **SET** indicator lights will begin flashing in unison at a medium rate.
- b. Press and hold the **CRUISE** button (See *Figure 4*) for approximately three (3) seconds until the indicator lights stop flashing.
- c. There will be a brief delay after which the **CRUISE** light will flash once.
- d. Ensure the accelerator pedal is not being depressed and is in the full "UP" position.
- e. The **SET** indicator light will flash rapidly for a few seconds as the EMS calibrates this position.
- f. There will be a brief delay after which the **CRUISE** light will flash twice.
- g. Depress and hold the accelerator pedal to the floor and ensure it is in the full Wide Open Throttle/"WOT" position.
- h. The **SET** indicator light will flash rapidly for a few seconds as the EMS calibrates this position.
- i. There will be a brief delay after which the **CRUISE** light will flash three times.
- j. The **SET** indicator light will flash rapidly for several seconds as the EMS calibrates the ETC throttle body.
- k. If the calibration procedure was successful and all the ETC sensors and actuators are found to be within tolerance then the **CRUISE** and **SET** indicator lights will flash in unison at a medium rate.
- l. If the calibration procedure fails, indicated by the **CRUISE** and **SET** indicator lights flashing in an alternating pattern, please reference the sections entitled **ETC Diagnostics and Calibration Troubleshooting** elsewhere in this document.
- m. Turn the ignition key to the OFF position.
- n. The ETC system is now calibrated and ready for use.

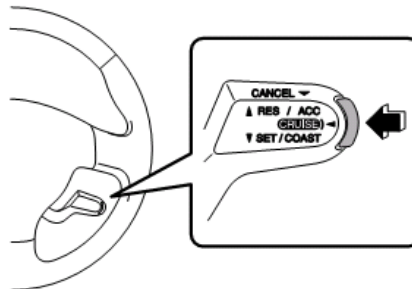


Figure 4 – Pressing the "CRUISE" button

## 2. EMS Calibration

- a. Connect to the EMS using AEMTuner.
- b. Edit the *Idle% vs. Target* table, such that all cells are set to zero (0) percent.
- c. Edit *A/C Idle Load Comp* and/or *Idle Extra <12 Volt Options*, to zero (0) percent.
- d. Verify that the EMS parameter *Idle Position* parameter is zero (0) percent.
- e. Select Wizards >> Set Throttle Range Wizard in the AEMTuner software and complete the procedure.
- f. Restore the above Options to their original values to ensure proper idle control functionality.

### Re-calibrating the Electronic Throttle Control System (ETC) Calibration

Once the ETC system calibration procedure has been performed, it should not need to be re-calibrated unless one or more of the following is true:

- The APP sensor, TPS, or throttle body have been removed, replaced, or adjusted.
- The EMS has been removed and installed in a different vehicle.
- AEM Technical Support has requested it to be performed.

The following procedure describes the steps to re-activate calibration mode on a system that has already been calibrated.

#### Activate Calibration Mode

- a. Ensure the ignition key is in the OFF position.
- b. Press and HOLD both the **CRUISE** and **SET/COAST** buttons. Please note that the **CRUISE** button is activated by pressing the end of the Cruise Control Steering Column Stalk and the **SET/COAST** button is activated by pulling the entire stalk downward as depicted in *Figure 5*. Both buttons must be depressed and held prior to moving on to the next step.

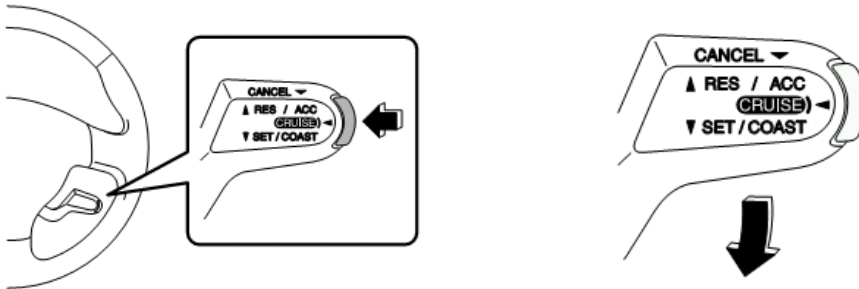


Figure 5 - Pressing the "SET/COAST" and "CRUISE" buttons

- c. Turn the ignition key to the ON position.
- d. Keep holding both the **CRUISE** and **SET/COAST** buttons for approximately ten (10) seconds until the **CRUISE** and **SET** indicator lights (*Figure 3*) begin flashing in unison at a medium rate.
- e. Release the **CRUISE** and **SET/COAST** buttons.
- f. Calibration mode has now been activated. Follow the steps in **Electronic Throttle Control System Calibration Procedure – Initial Calibration Procedure** to complete the process.



## **EMS Idle Control Calibration**

The ETC idle control can be configured and calibrated via the AEMTuner software similarly to more traditional systems that use an idle air bypass valve. There are a few calibration options that are set specifically to allow proper ETC idle control and must not be changed from the values set forth in the 30-1820 startup calibration. The options listed below must remain set as depicted for predictable ETC idle control. The other options that are not highlighted have been set up for stable idle control in the 30-6820 startup calibration but are, however, available for adjustment as the calibrator sees fit.

Idle On if TP Less = 13%

Idle Off if TP Over = 13%

Idle Invert = ON

Idle FB Dir Invert = ON

Idle PW Frequency = 10000.0 uS

## **ETC Fault Management**

The ETC system continuously monitors itself for proper operation. If a fault is detected then the system will be placed in a failsafe mode and power to the electronic throttle body will be turned off. This will allow the engine to start and idle at approximately 1500-2000 rpm as a “limp-home” mode but the throttle body will not respond to accelerator pedal inputs.

The system will continue to monitor itself and assume that the throttle blade will be in its rest position while in this un-powered failsafe mode. If it is detected that this is not the case then the system will enter a second failsafe stage whereby the crank signal to the EMS is interrupted. The tachometer will drop to zero and the EMS will not fire fuel injectors or ignition coils. If the engine is running, it will coast to a stop. If the engine is not running, it will not start.

## **ETC Diagnostics**

The AEM EMS ETC system uses the **CRUISE** and **SET** indicator lights on the dashboard to display diagnostic information to the user. The indicator lights flash in different ways for different purposes as described in the following sections.

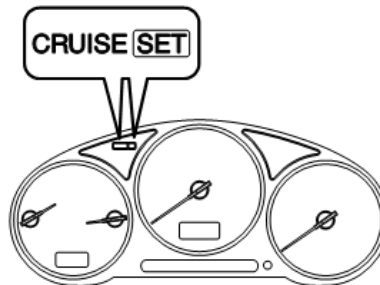


Figure 9 - CRUISE and SET Indicator Lights as diagnostic outputs

### **Boot-Up**

When the ignition key is turned on and the EMS is powered up, both of the **CRUISE** and **SET** indicator lights will flash briefly to signify the ETC system has booted up and that the indicator lights are functioning properly.

### **Fault Detected**

When the ETC system detects a fault, the **CRUISE** and **SET** indicator lights will flash in an alternating fashion to alert the user a fault has been detected. This will happen in one of two situations:

1. Calibration Fault – A failed calibration will be detected if one of the sensors is found to be out of the expected range during the calibration procedure. The indicator lights will flash in an alternating pattern to alert the user of this fault for a period of approximately twenty (20) seconds. After this time period, the **CRUISE** light will remain off and the **SET** indicator light will flash a fault code. Please reference *Table 1* for a description of the fault codes. The system will flash the code repeatedly until the ignition is turned off.

Calibration Faults	
1	APP Minimum
2	APP Maximum
3	TPS Minimum
4	TPS Maximum
5	RP / Relay

Table 1 – System Fault Code

- Operational Fault – When the system detects a fault during normal operation (e.g. driving, idling, etc), the indicator lights will repeatedly flash in an alternating pattern to alert the user of this fault until the ignition key is turned off. Note that the ETC system will not be functional and the EMS may disable engine operation during this mode depending on the severity of the fault.

Once the ignition has been turned off and then on again the indicator lights will flash the fault code for the affected system. The affected ETC system code will be first flashed on the **CRUISE** light after which the failure type will be flashed on the **SET** light. These codes are listed in *Table 2* and *Table 3*. The ETC system will remain un-activated until the following boot-up cycle, i.e. key-off then key-on.

Operational Fault - System	
1	APP
2	TPSA
3	TPSB
4	Target
5	System Voltage
6	Motor Driver
7	WDR
8	EEPROM
9	N/A

Table 2 – System Fault Code

Operational Fault – Failure Type	
1	Out of Range
2	Noise
3	Disagreement
4	General
5	F2
6	N/A
7	N/A
8	N/A
9	N/A

Table 3 – Failure Type Fault Code

## Troubleshooting Calibration Faults

A calibration fault will be reported if the Accelerator Pedal Position (APP) or Throttle Position Sensor (TPS) sensors are found to be outside of the specification limits. *Table 4* details the electrical limits for these sensors.

Sensor	Mechanical Position	Voltage Limit (VDC)
APP1 ( Main )	Minimum ( Idle )	1.00 ± 0.35
	Maximum ( WOT )	4.00 ± 0.45
APP2 ( Sub )	Minimum ( Idle )	1.00 ± 0.35
	Maximum ( WOT )	4.00 ± 0.45
TPS1 ( Main )	Minimum ( Idle )	0.70 ± 0.30
	Maximum ( WOT )	4.10 ± 0.45
TPS2 ( Sub )	Minimum ( Idle )	1.45 ± 0.30
	Maximum ( WOT )	4.10 ± 0.45

Table 4 – Sensor Electrical Calibration Limits

A fault code of “5 - RP / Relay” may be caused by a fouled throttle bore, a malfunctioning or missing ETC relay, or if the throttle body has mechanically failed.

## Troubleshooting Operational Faults

Should an operational fault be detected, please read and follow the following suggestions for each system.

### APP

- Ensure the accelerator pedal position sensor is in good condition and plugged in.
- Double-check that APP sensor is wired per OEM specifications.
- Check all wiring for shorts or intermittent connections.

### TPSA/TPSB

- Ensure the throttle position sensor is in good condition and plugged in.
- Double-check that throttle body/TPS sensor is wired per OEM specifications.
- Check all wiring for shorts or intermittent connections.

### Target

- Ensure throttle body bore is clean and free from obstruction.
- Ensure vehicle battery is in good condition and properly charged.

### System Voltage

- Ensure vehicle battery is in good condition and properly charged.
- Check all wiring for shorts or intermittent connections.

### Motor Driver

- Double-check that throttle body/TPS sensor is wired per OEM specifications.
- Check throttle body wiring for shorts or intermittent connections.
- Ensure EMS has not been installed in an area of extreme heat ( > 120°C)

### WDR

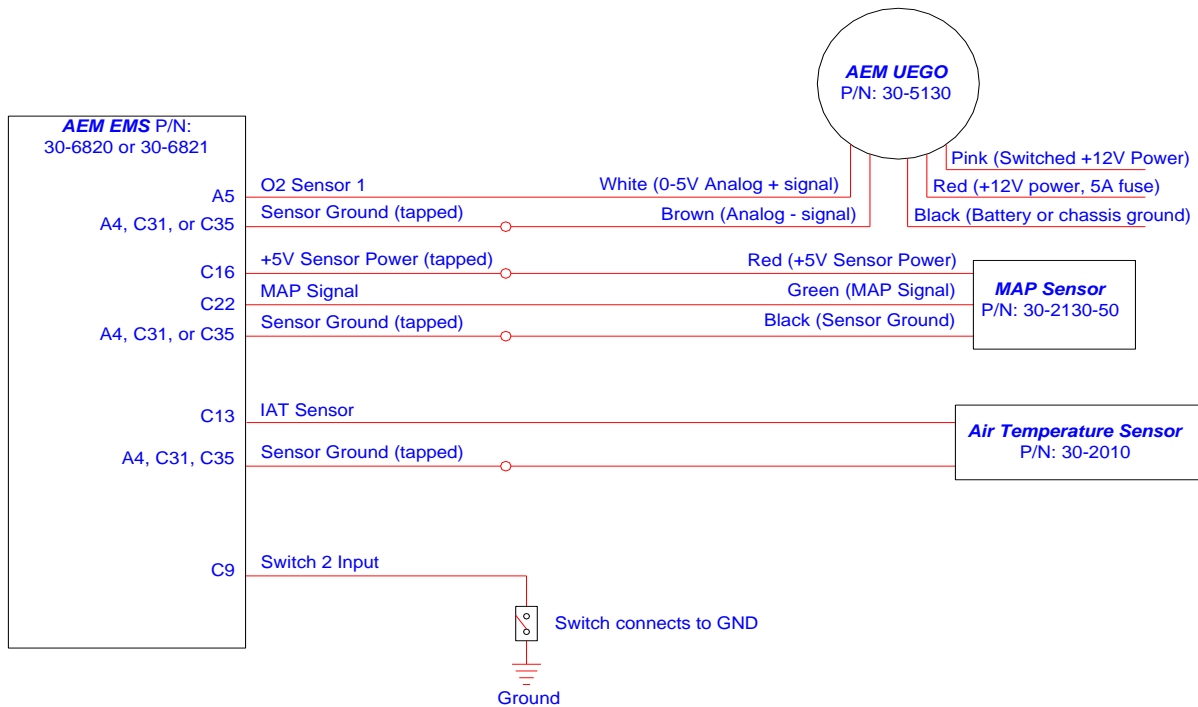
- Contact AEM EMS Technical Support

### EEPROM

- Perform ETC system calibration
- Restore ETC system factory calibration
- Contact AEM EMS Technical Support

## Wiring accessories to the EMS

Please follow this suggested wiring diagram when adding new accessories and retaining original accessories such as the multiplex coolant temperature gauge, air conditioning switch, reverse lockout, UEGO gauges, MAP sensors, IAT sensors, or switches for use with the EMS. Note that wire polarity is not important for the Air Temperature sensor.



### **30-1820 (Series 1) vs 30-6820 (Series 2) EMS differences:**

The EMS functions assigned to certain pins have been changed and no longer match the 30-1820 EMS. Unless otherwise noted, the following pins and functions will need to be manually reconfigured after using AEMTuner to convert a 30-1820 Series1 EMS calibration for use with the 30-6820 Series 2 hardware.

Pin	Vehicle harness destination	30-1820 function	30-6820 function	Notes
A2	Front O2 sensor heater	Injector #5	---	Injector 5 moved to pin C2
A3	Front O2 sensor heater	Injector #6	---	Injector 6 moved to pin C1
A4	---	---	Sensor Ground	Additional spare output
A5	---	---	O2 #1	Additional spare output
B13	---	---	Coil 6	Additional spare output
B14	---	---	Coil 5	Additional spare output
B15	Ignition Control #4	Coil #5	Coil 4	Calibration must be updated
B26	Fuel Pump Control	Idle #1/2	Coil 8, LS 12	See 'Fuel Pump Control' on page 3
B28	---	---	CANH	
B29	---	---	CANL	
B34	---	---	HS1	
C1	---	---	Injector 6	
C2	---	---	Injector 5	
C24	---	---	Knock 2	Additional spare input
D17	Main Relay control	FM	Coil 7	Use Coil7 settings in AEM startup cal

### 1) Install AEMTuner software onto your PC

The latest version of the AEMTuner software can be downloaded from the AEMTuner section of the AEM Performance Electronics forums found at [www.aemelectronics.com](http://www.aemelectronics.com). Series 2 units are not supported by the older AEMPro tuning software.

### 2) Remove the Stock Engine Control Unit

- a) Disconnect negative terminal from battery
- b) Access the stock Engine Control Unit (ECU). The location of the ECU on the WRX is underneath the passenger side floorboard. A 10mm socket is required to remove the kick panel that covers the stock ECU.
- c) Carefully disconnect the wiring harness from the ECU. Avoid excessive stress or pulling on the wires, as this may damage the wiring harness. All connectors must be removed without damage to work properly with the AEM ECU. Do not cut any of the wires in the factory wiring harness to remove them.
- d) Remove the fasteners securing the ECU to the car body, and set them aside. Do not destroy or discard the original ECU, as it can be reinstalled easily for street use and troubleshooting.

### 3) Install the AEM Engine Management System

- a) Plug the factory wiring harness into the AEM EMS and position it so the wires are not pulled tight or stressed in any manner. Secure the EMS with the provided Velcro fasteners.
- b) Reconnect the negative battery terminal.
- c) Plug the communications cable into the EMS and into your PC.
- d) Turn the ignition on, but do not attempt to start the engine.
- e) At the time these instructions were written, new EMS units do not require USB drivers to be installed on the PC. The EMS will automatically be detected as a human interface device (HID).
- f) With the AEMTuner software open, select **ECU>>Upload Calibration** to upload the startup calibration file (.cal) that most closely matches the vehicle's configuration to be tuned. Check the Notes section of the calibration for more info about the vehicle it was configured for. These files can be found in the following folder:  
*C:\Program Files\AEM\AEMTuner\Calibrations\AEM Updates\Subaru\*
- g) Set the throttle range: Select Wizards>>Set Throttle Range and follow the on-screen instructions. When finished, check that the 'Throttle' channel never indicates less than 0.2% or greater than 99.8%, this is considered a sensor error and may cause some functions including idle feedback and acceleration fuel to operate incorrectly.

#### 4) Ready to begin tuning the vehicle.

- a) Before starting the engine, verify that the fuel pump runs for a couple of seconds when the key is turned on and there is sufficient pressure at the fuel rail.  
If a MAP sensor is installed, check that the Engine Load indicates something near atmospheric pressure (approximately 101kPa or 0 PSI at sea level) with the key on and engine off. Press the throttle and verify that the 'Throttle' channel responds but the Engine Load channel continues to measure atmospheric pressure correctly.
  
- b) Start the engine and make whatever adjustments may be needed to sustain a safe and reasonably smooth idle. Verify the ignition timing: Select **Wizards>>Ignition Timing Sync** from the pull-down menu. Click the '*Lock Ignition Timing*' checkbox and set the timing to a safe and convenient value (for instance, 10 degrees BTDC). Use a timing light to compare the physical timing numbers to the timing value you selected. Use the *Sync Adjustment Increase/Decrease* buttons to make the physical reading match the timing number you selected.

Crankshaft timing marks are not labeled for some vehicles. Consult the factory service manual for more information.

- c) Note: This calibration needs to be properly tuned before driving the vehicle. It is intended for racing vehicles and may not operate smoothly at idle or part-throttle.

**NEVER TUNE THE VEHICLE WHILE DRIVING**

## 5) Troubleshooting an engine that will not start

- a) Double-check all the basics first. Engines need air, fuel, compression, and a correctly-timed spark event. If any of these are lacking, we suggest checking simple things first. Depending on the symptoms, it may be best to inspect fuses, sufficient battery voltage, properly mated wiring connectors, spark using a timing light or by removing the spark plug, wiring continuity tests, measure ECU pinout voltages, replace recently-added or untested components with known-good spares. Check that all EMS sensor inputs measure realistic temperature and/or pressure values.
- b) If the EMS is not firing the coils or injectors at all, open the Start tab and look for the 'Stat Sync'd' channel to turn ON when cranking. This indicates that the EMS has detected the expected cam and crank signals; if Stat Sync'd does not turn on, monitor the Crank Tooth Period and T2PER channels which indicate the time between pulses on the Crank and T2 (Cam) signals. Both of these channels should respond when the engine is cranking, if either signal is not being detected or measuring an incorrect number of pulses per engine cycle the EMS will not fire the coils or injectors.
- c) If the Engine Load changes when the throttle is pressed this usually indicates that there is a problem with the MAP sensor wiring or software calibration (when the EMS detects that the MAP Volts are above or below the min/max limits it will run in a failsafe mode using the TPS-to-Load table to generate an artificial Engine Load signal using the Throttle input). This may allow the engine to sputter or start but not continue running properly.

### **Sufficient battery voltage during cranking (starting)**

Having enough battery voltage when you crank over your vehicle is critical to the operation of your vehicle and your AEM EMS. For the EMS to function properly, the battery voltage must remain at or above 8 Volts when the vehicle is first starting. This is the time when your electrical system will be worked its hardest and be at its lowest voltage. If you are connected to your Series 2 EMS with a USB communications cable, and you experience disconnecting while the vehicle is cranking, the reason may be a battery voltage of less than 8 volts. If this is the case, you can confirm this by connecting with a serial cable (a serial adapter may be required if your computer is not equipped with a serial port) and check in the AEMTuner software for a Channel called "Run Time". "Run Time" is the amount of time, in seconds, that the EMS has been turned on for. If you notice that this Channel goes to zero while the EMS is communicating with the computer and the vehicle is being cranked, that means the EMS has had lower than 8 Volts at some point and has reset the system. A thorough wiring check may reveal a large voltage drop causing this problem, or it may simply be the need for a new or a larger battery.

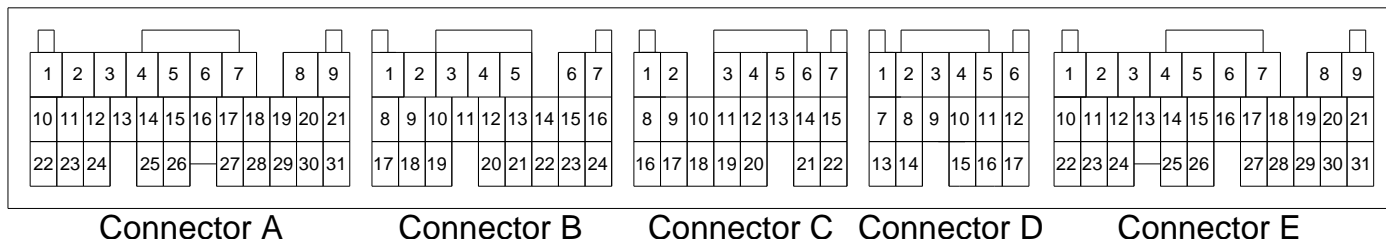
# Application Notes for EMS P/N 30-6820 / 30-6821

## Subaru Impreza WRX STI (USDM 2.5L)

<b>Make:</b>	Subaru
<b>Model:</b>	Impreza WRX STI
<b>Years Covered:</b>	2004 (30-6820 EMS) 2005-2006 (30-6821 EMS)
<b>Engine Displacement:</b>	2.5L
<b>Engine Configuration:</b>	Flat 4
<b>Firing Order:</b>	1-3-2-4
<b>N/A, S/C or T/C:</b>	Turbocharged
<b>MAP Min:</b>	0.8V @ -14.7 PSiG
<b>MAP Max:</b>	4.59V @ 23.8 PSiG
<b># Coils:</b>	4, with internal igniters
<b>Ignition driver type:</b>	0-5V, Falling Edge trigger
<b># of Injectors:</b>	4 (Inj 1-4)
<b>Factory Injectors:</b>	500 cc/min saturated
<b>Factory Inj Resistors:</b>	No
<b>Injection Mode:</b>	Sequential
<b>Knock Sensors used:</b>	1 (Knock 1)
<b>Lambda Sensors used:</b>	2 (aftermarket wideband sensor required, OEM O2 sensors not supported)
<b>Idle Motor Type:</b>	None (Electronic Throttle)
<b>Main Relay Control:</b>	Yes (Switch 1 in, Coil7 output)
<b>Crank Pickup Type:</b>	Magnetic
<b>Crank Teeth/Cycle:</b>	36-2-2-2
<b>Cam Pickup Type:</b>	Hall Effect
<b>Cam Teeth/Cycle:</b>	3
<b>Transmissions Offered:</b>	Manual
<b>Trans Supported:</b>	Manual
<b>Drive Options:</b>	AWD
<b>Supplied Connectors:</b>	---
<b>AEM Extension/patch harness</b>	30-2988
<b>AEM Plug/pin kit:</b>	N/A

Description	Function	ECU Pin #
Spare Injector Driver (max 1.5A):	Injector 5	C2
Spare Injector Driver (max 1.5A):	Injector 6	C1
Spare Injector Driver (max 1.5A):	Injector 7	A6
Spare Injector Driver (max 1.5A):	Injector 8	A7
Spare Coil Driver (0-5V falling edge):	Coil 5	B13
Spare Coil Driver (0-5V falling edge):	Coil 6	B14
Boost Solenoid:	PW 2	A32
EGT 1 Location:	EGT 1	C12
EGT 2 Location:	EGT 2	D20
EGT 3 Location:	EGT 3	D24
EGT 4 Location:	EGT 4	D29
Spare 0-5V Input Channel:	ADCR 13	A33
Spare 0-5V Input Channel:	ADCR 11	C27
Spare 0-5V Input Channel:	ADCR 14	C26
Spare Low Side Output Driver:	Low side 2	A13
Spare Low Side Output Driver:	Low side 3	A12
Spare Low Side Output Driver:	Low side 4	A14
Spare Low Side Output Driver:	Low side 11	A24
Spare Low Side Output Driver:		
Spare Low Side Output Driver:		
Spare Low Side Output Driver:		
Spare Low Side Output Driver:		
Spare Low Side Output Driver:		
Spare Low Side Output Driver:		
Spare Low Side Output Driver:		
Spare Low Side Output Driver:		
Check Engine Light:	Low side 10	A17
Spare High Side Driver:	High side 1	B34
Spare High Side Driver:		
Spare High Side Driver:		
Spare High Side Driver:		
Spare High Side Driver:		
Spare High Side Driver:		
Spare High Side Driver:		
Spare High Side Driver:		
VVC Low Side Driver (RH cam):	Injector 9	A28
VVC Low Side Driver (LH cam):	Injector 10	A29
Spare Switch Input (switch to GND):	Switch 2*	C9
Spare Switch Input (switch to +12V):	Switch 3**	A1
Spare Switch Input (switch to GND):	Switch 4*	D11
Spare Switch Input (switch to GND):	Switch 5*	D13
Spare Switch Input (switch to +12V):	Switch 6**	D16 / D17

### Wire View of AEM EMS



**WARNING:**

\*Switch input pins Switch 2, Switch4, Switch5 must connect to ground; the switch should not provide 12V power to the EMS because that will not be detected as on or off.

\*\*Switch input pins Switch 3, Switch6, must connect to +12V; the switch should not provide GND to the EMS because that will not be detected as on or off.

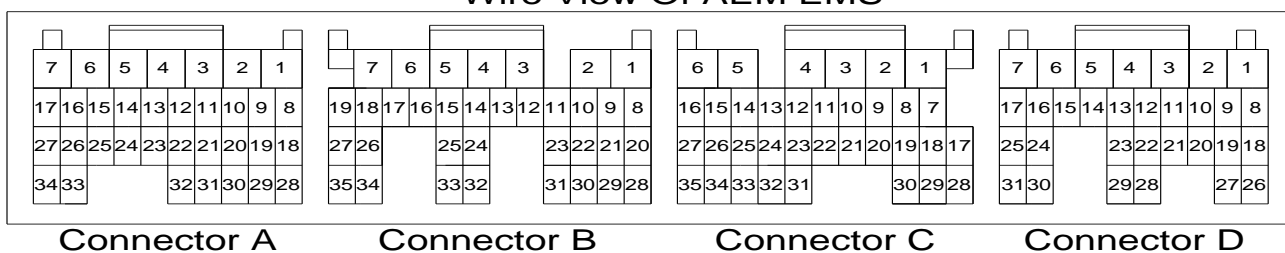


# Connection Diagram for EMS P/N 30-6820

PnP	The Plug and Play system comes with this configured for proper operation of this device. It is available for reassignment.
Available	The function is not currently allocated and is available for use
Dedicated	The location is fixed and cannot be changed
Not used	The AEM EMS does not use this pin location for this application

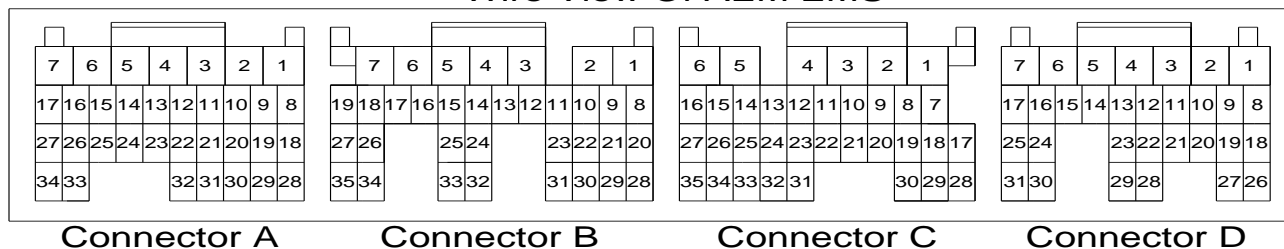
Pin	2004 STI 2.5L / 2005-2006 STI 2.5L	AEM EMS 30-6820	EMS I/O	EMS pin description
A1	Clutch Switch	Switch 3	In	Available, switch should connect to +12V when closed
A2	Front Oxygen Sensor Heater (Signal 2)	Injector 5	Out	Available, can be used for additional injectors (1.5A max)
A3	Front Oxygen Sensor Heater (Signal 1)	Injector 6	Out	Available, can be used for additional injectors (1.5A max)
A4	---	Sensor Ground	Out	Dedicated, sensors only, connects to pin C31
A5	---	O2 #1	In	Available, 0-5V O2 sensor #1, connects to pin A26
A6	GND (Front Oxygen A/F Heater 2)	Injector 7	Out	Available, can be used for additional injectors (1.5A max)
A7	GND (Front Oxygen A/F Heater 1)	Injector 8	Out	Available, can be used for additional injectors (1.5A max)
A8	Tumble Generator Valve RH (close)	Idle 6	Out	PnP for TGV
A9	Tumble Generator Valve RH (open)	Idle 5	Out	PnP for TGV
A10	Tumble Generator Valve LH (close)	Idle 8	Out	PnP for TGV
A11	Tumble Generator Valve LH (open)	Idle 7	Out	PnP for TGV
A12	Pressure control solenoid valve (fuel tank)	Low Side 3	Out	Available, can be used for Switched Ground (1.5A max)
A13	Drain Valve	Low Side 2	Out	Available, can be used for Switched Ground (1.5A max)
A14	Purge Control solenoid valve	Low Side 4	Out	Available, can be used for Switched Ground (1.5A max)
A15	Main light ("Cruise" lamp on dash)	Cruise light	Out	Dedicated, ETC system output
A16	Cruise Set light ("Set" lamp on dash)	Set light	Out	Dedicated, ETC system output
A17	Malfunction Indicator Lamp	Low Side 10	Out	Available, can be used for Switched Ground (1.5A max)
A18	Oil flow control solenoid (RH) Signal (+)	+12V Switched Ignition Power	Out	Dedicated, also connects to A19, B5, B6
A19	Oil flow control solenoid (LH) Signal (+)	+12V Switched Ignition Power	Out	Dedicated, also connects to A18, B5, B6
A20	---	---		Not Used
A21	---	---		Not Used
A22	Alternator	Low Side 1	Out	Available, can be used for Switched Ground (1.5A max)
A23	Engine Speed Output (to OEM tachometer)	Tacho out (LS7)	Out	PnP for Tachometer
A24	Fuel Tank sensor control valve	Low Side 11	Out	Available, can be used for Switched Ground (1.5A max)
A25	Front Oxygen sensor shield	---		Not Used
A26	Front Oxygen sensor signal (-)	O2 #1	In	Available, 0-5V O2 sensor #1, connects to pin A5
A27	---	---		Not Used
A28	Oil flow control solenoid (RH) Signal (-)	Injector 9	Out	PnP for VVC #1 (Active Valve Control Solenoid)
A29	Oil flow control solenoid (LH) Signal (-)	Injector 10	Out	PnP for VVC #2 (Active Valve Control Solenoid)
A30	---	---		Not Used
A31	---	---		Not Used
A32	Wastegate Control solenoid valve	PW 2	Out	PnP for Boost Control Solenoid
A33	Front Oxygen sensor signal (+)	ADCR13	Out	Available, 0-5V sensor
A34	Engine Ground	Power Ground	In	Dedicated, also B1,B4,B12,B31,C32,C33,D1,D2,D7,D31

## Wire View Of AEM EMS



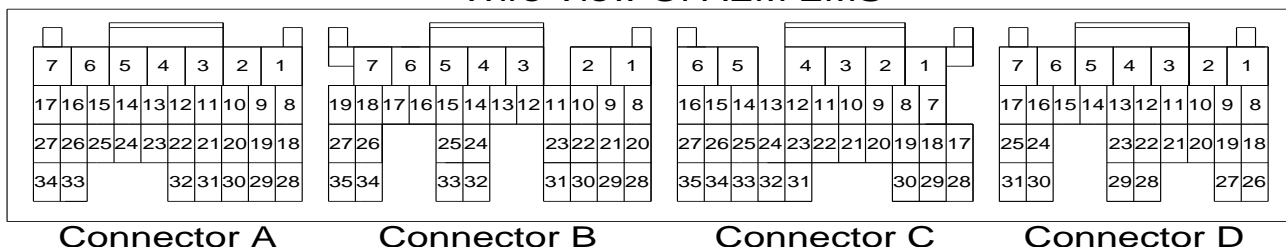
Pin	2004 STI 2.5L / 2005-2006 STI 2.5L	AEM EMS 30-6820	EMS I/O	EMS pin description
B1	GND (Power Supply)	Power Ground	In	Dedicated, also A34,B4,B12,B31,C32,C33,D1,D2,D7,D31
B2	Rear Oxygen Sensor heater signal	---		Not Used
B3	---	---		Not Used
B4	GND (Power Supply)	Power Ground	In	Dedicated, also A34,B1,B12,B31,C32,C33,D1,D2,D7,D31
B5	Control Unit Power Supply	+12V Switched Ignition Power	In	Dedicated, also connects to A18, A19, B6
B6	Control Unit Power Supply	+12V Switched Ignition Power	In	Dedicated, also connects to A18, A19, B5
B7	---	---		Not Used
B8	Camshaft position sensor (LH)	Vehicle Speed	In	PnP for Cam sensor (LH)
B9	Camshaft position sensor (RH)	Cam	In	PnP for Cam sensor (RH)
B10	Crankshaft position sensor Signal (+)	Crank	In	Dedicated
B11	---	---		Not Used
B12	GND (Ignition System)	Power Ground	In	Dedicated, also A34,B1, B4,B31,C32,C33,D1,D2,D7,D31
B13	---	Coil 6	Out	Available Coil 6 output, 0/5V falling edge trigger
B14	---	Coil 5	Out	Available Coil 5 output, 0/5V falling edge trigger
B15	Ignition Control #4	Coil 4	Out	PnP for Coil 4, 0/5V falling edge trigger
B16	Ignition Control #3	Coil 3	Out	PnP for Coil 3, 0/5V falling edge trigger
B17	Ignition Control #2	Coil 2	Out	PnP for Coil 2, 0/5V falling edge trigger
B18	Ignition Control #1	Coil 1	Out	PnP for Coil 1, 0/5V falling edge trigger
B19	Back-up Power Supply	Permanent +12V	In	Dedicated, back-up power for internal datalog memory
B20	---	---		Not Used
B21	---	---		Not Used
B22	Crankshaft position sensor Signal (-)	Timing Ground	Out	Dedicated, timing sensors only
B23	---	---		Not Used
B24	Radiator Fan relay 2 control	Low Side 9	Out	PnP for A/C Fan
B25	Radiator Fan relay 1 control	Low Side 8	Out	PnP for Radiator Fan
B26*	Fuel Pump control unit Signal 1 / Vehicle Speed*	FPCU circuit (Coil 8) / Spare Speed*	Out*	Dedicated, 0-5V signal to Fuel Pump Control Unit
B27*	Vehicle Speed / Fuel Pump control unit sig 1*	Spare Speed / FPCU circuit (Coil 8)*	In*	PnP for wheel speed input, shared with speedometer
B28	---	CANH		Dedicated
B29	---	CANL		Dedicated
B30	---	---		Not Used
B31	Crankshaft Position sensor Shield	Power Ground	Out	Dedicated, also A34,B1, B4,B12,C32,C33,D1,D2,D7,D31
B32	---	---		Not Used
B33	A/C relay control	Low Side 6	Out	PnP for A/C compressor clutch
B34	---	High Side 1	Out	Available switched +12V output driver
B35	Electronic Throttle control motor relay	ETC relay control	Out	Dedicated

### Wire View Of AEM EMS



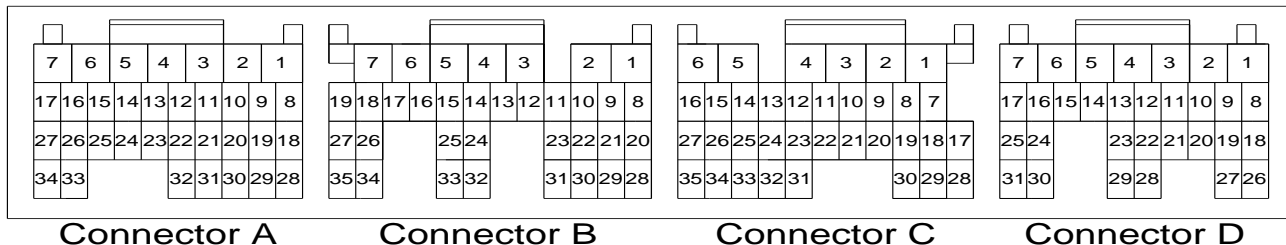
Pin	2004 STI 2.5L / 2005-2006 STI 2.5L	AEM EMS 30-6820	EMS I/O	EMS pin description
C1	---	Injector 6	Out	Available, can be used for additional injectors (1.5A max)
C2	---	Injector 5	Out	Available, can be used for additional injectors (1.5A max)
C3	Fuel Injector #4	Injector 4	Out	PnP for Injector 4 (Peak & Hold 4A / 1A driver)
C4	Fuel Injector #3	Injector 3	Out	PnP for Injector 3 (Peak & Hold 4A / 1A driver)
C5	Fuel Injector #2	Injector 2	Out	PnP for Injector 2 (Peak & Hold 4A / 1A driver)
C6	Fuel Injector #1	Injector 1	Out	PnP for Injector 1 (Peak & Hold 4A / 1A driver)
C7	Main switch	Main Switch	In	Dedicated, ETC system input
C8	Brake Switch 2	---		Not Used
C9	Brake Switch 1	Switch #2	In	Available, switch should connect to GND when closed
C10	Resume / Accel switch	---		Not Used
C11	Set / Coast switch	Set Switch	In	Dedicated, ETC system input
C12	Fuel Temperature Sensor signal	EGT #1	In	Available, jumper set for 0-5V input
C13	Intake Air Temperature sensor signal	AIT	In	PnP for Air Intake Temp sensor, RTD type thermistor
C14	Engine Coolant Temperature sensor	Coolant	In	PnP for Coolant Temp sensor, RTD type thermistor
C15	Accelerator Pedal Position sensor Power	Accelerator Pedal +5V reference	Out	Dedicated, reference power to accelerator pedal
C16	Electronic Throttle control Power Supply	+5V Sensor reference	Out	Dedicated, sensor reference power
C17	Accelerator Pedal Position sensor Main	Accelerator Pedal signal 1	In	Dedicated, main 0-5V signal from accelerator pedal
C18	Electronic Throttle control Main	TPS / Electronic Throttle signal 1	In	Dedicated, main 0-5V signal from throttle motor
C19	---	---		Not Used
C20	Fuel Level Sensor	---		Not Used
C21	Fuel Tank Pressure Sensor signal	---		Not Used
C22	Manifold Absolute Pressure sensor signal	MAP	In	PnP for Manifold Pressure sensor
C23	Mass Air Flow sensor Signal	MAF	In	Available, 0-5V MAF input signal
C24	--	Knock 2	In	Dedicated, software – configurable knock filter circuit
C25	Knock Sensor Signal	Knock 1	In	Dedicated, software – configurable knock filter circuit
C26	Tumble Generator Valve position sensor LH	ADCR14	In	PnP for TGV, 0-5V input
C27	Tumble Generator Valve position sensor RH	ADCR11	In	PnP for TGV, 0-5V input
C28	Accelerator Pedal Position sensor Sub	Accelerator Pedal signal 2	In	Dedicated, secondary 0-5V signal from accelerator pedal
C29	Electronic Throttle control Sub	Electronic Throttle signal 2	Out	Dedicated, secondary 0-5V signal from throttle motor
C30	---	---		Not Used
C31	Mass Air Flow sensor GND	Sensor Ground	Out	Dedicated, sensors only, connects to pin A4, C35,
C32	Mass Air Flow sensor Shield	Power Ground	Out	Dedicated, also A34,B1, B4,B12,B31, C33,D1,D2,D7,D31
C33	Knock Sensor Shield	Power Ground	Out	Dedicated, also A34,B1, B4,B12,B31,C32,D1,D2,D7,D31
C34	Accelerator Pedal Position sensor GND	Accelerator Pedal Ground	Out	Dedicated, ground to accelerator pedal
C35	GND (sensor)	Sensor Ground	Out	Dedicated, sensors only, connects to pin A4, C31,

### Wire View Of AEM EMS



Pin	2004 STI 2.5L / 2005-2006 STI 2.5L	AEM EMS 30-6820	EMS I/O	EMS pin description
D1	GND (control systems)	Power Ground	In	Dedicated, also A34,B1, B4,B12,B31,C32,C33,D2,D7,D31
D2	GND (control systems)	Power Ground	In	Dedicated, also A34,B1, B4,B12,B31,C32,C33,D1, D7,D31
D3	Electronic Throttle control GND (sensor)	Electronic Throttle Ground	Out	Dedicated
D4	Electronic Throttle control motor (-)	Electronic Throttle Motor -	Out	Dedicated, ETC system output
D5	Electronic Throttle control motor (+)	Electronic Throttle Motor +	Out	Dedicated, ETC system output
D6	Electronic Throttle control Motor Power	Electronic Throttle Power	In	Dedicated, ETC power
D7	GND (Injectors)	Power Ground	In	Dedicated, also A34,B1, B4,B12,B31,C32,C33,D1,D2,D31
D8	Starter switch	Main Relay circuit (Switch #1)	In	Dedicated
D9	Neutral Position switch	---		Not Used
D10	Power Steering oil pressure switch	---		Not Used
D11	Rear Defogger switch	Switch #4	In	Available, switch should connect to GND when closed
D12	(not used by stock ECU)	---		Not Used
D13	Blower Fan switch	Switch #5	In	Available, switch should connect to GND when closed
D14*	Test Mode Connector / Ignition Switch*	--- / Main Relay circuit (Switch1)*	*	Not Used
D15*	Ignition Switch / Test Mode Connector*	Main Relay circuit (Switch 1) / - - *	In*	Dedicated
D16*	AC Switch / Main Relay control*	Switch 6 / Main Relay circuit (Coil 7) *	In*	PnP for A/C request switch
D17*	Main Relay control / AC Switch*	Main Relay circuit (Coil 7) / Switch 6 *	Out*	Dedicated, activates main relay with switched GND
D18	---	---		Not Used
D19	---	---		Not Used
D20	SSM / GST communication line	EGT #2	In	Available, jumper set for 0-5V input
D21	---	---		Not Used
D22	---	---		Not Used
D23	---	---		Not Used
D24	Blow-by Leak diagnosis signal	EGT #3	In	Available, jumper set for 0-5V input
D25	Rear Oxygen sensor Signal	Lambda #2	In	Available, 0-5V O2 #2 signal
D26	---	---		Not Used
D27	---	---		Not Used
D28	Fuel Pump control unit Signal 2	Low Side Driver #5	Out	Available, can be used for Switched Ground (1.5A max)
D29	--	EGT #4	In	Available, jumper set for 0-5V input
D30	---	---		Not Used
D31	Rear Oxygen sensor Shield	Power Ground	Out	Dedicated, also A34,B1, B4,B12,B31,C32,C33,D1,D2,D7

### Wire View Of AEM EMS



## **AEM Electronics Warranty**

Advanced Engine Management Inc. warrants to the consumer that all AEM Electronics products will be free from defects in material and workmanship for a period of twelve months from date of the original purchase. Products that fail within this 12-month warranty period will be repaired or replaced when determined by AEM that the product failed due to defects in material or workmanship. This warranty is limited to the repair or replacement of the AEM part. In no event shall this warranty exceed the original purchase price of the AEM part nor shall AEM be responsible for special, incidental or consequential damages or cost incurred due to the failure of this product. Warranty claims to AEM must be transportation prepaid and accompanied with dated proof of purchase. This warranty applies only to the original purchaser of product and is non-transferable. All implied warranties shall be limited in duration to the said 12-month warranty period. Improper use or installation, accident, abuse, unauthorized repairs or alterations voids this warranty. AEM disclaims any liability for consequential damages due to breach of any written or implied warranty on all products manufactured by AEM. Warranty returns will only be accepted by AEM when accompanied by a valid Return Merchandise Authorization (RMA) number. Product must be received by AEM within 30 days of the date the RMA is issued.

Please note that before AEM can issue an RMA for any electronic product, it is first necessary for the installer or end user to contact the tech line at 1-800-423-0046 to discuss the problem. Most issues can be resolved over the phone. Under no circumstances should a system be returned or a RMA requested before the above process transpires.

AEM will not be responsible for electronic products that are installed incorrectly, installed in a non approved application, misused, or tampered with.

Any AEM electronics product can be returned for repair if it is out of the warranty period. There is a minimum charge of \$75.00 for inspection and diagnosis of AEM electronic parts. Parts used in the repair of AEM electronic components will be extra. AEM will provide an estimate of repairs and receive written or electronic authorization before repairs are made to the product.