DTA Race Electronics

Engine Management Systems

STC USERS MANUAL

The latest version of this manual is available for download from www.dtafast.co.uk. The latest software and wiring diagrams are also available from the same site.

TCwin AND THE STC THROTTLE CONTROLLER

TC win is the control, map editing and diagnosis software for the STC electric throttle controller. The STC is an electronic controller for DC motor driven throttle valves. It is designed to work in parallel with an S series engine ECU providing a multitude of safety features recognising the multiple number of potential failures of individual components.

Each STC is locked with a unique eight digit PIN. This PIN must be known before access to the unit is allowed.

It is neither wise nor sensible to attempt to apply the unit to a pedal and throttle valve pair which has not been checked by DTA as being suitable for the unit. The STC is only intended for motorsport use and any other application is not authorised by DTA.

INSTALLATION

Wire up the unit as per the wiring diagram and the specific instructions which follow it on subsequent pages. Note the following:-

1) The fuse must be fitted as shown. Besides being required to limit fault currents it is part of the reverse battery connection scheme. If the battery is fitted the wrong way round and this fuse is not fitted then the unit WILL be damaged.
2) All four potentiometers must be fitted. If they are not fault protection will inhibit operation of the device.
3) The STC CAN connections must be linked via twisted pair wire to the CAN connections on the S series engine ECU (CAN H to CAN H, CAN L to CAN L) and the appropriate settings made on the engine ECU. If this is not done then operation is again inhibited.
4) The engine ECU must have a pedal sensor connected to the Ana1 input to enable independent checking of match between requested throttle angle (the pedal) and actual angle (the butterfly). This is a vital safety feature. If any fault goes undetected by the controller or the controller cannot shut the butterfly for whatever reason the engine ECU can implement a severe RPM limit at 1750 RPM to give time for the driver to take the appropriate action.
5) It is advisable that the warning light is fitted. If any faults are detected this will give immediate feedback on the fault and a knowledge of the flashing sequence will enable its source to be detected.
6) The end points of throttle and pedal travel MUST be set for each sensor on the system. Using the diagnostics screen click on the button "Throttle Stops". This turns off power to the throttle motor allowing the butterfly to be manually pushed to its closed position to see the current voltage from the two pots on the top left of the screen. Note these values. Open the butterfly to its fully open position and note the voltages again. Be aware that most butterflies will travel further than 90 degrees open so ensure you only open it to 90 degrees for best performance. These values need entering in the Maps/General Settings map.
7) This process needs repeating for the pedal sensors. Once completed press the throttle stops button again to turn back on power to the motor. Various errors will have been triggered during this process so the power must be cycled on the STC and the engine ECU to clear these errors. Both units must be connected to the same power source as it is important the power up together.
8) The STC should now operate successfully. If not take a note of any errors that are shown and discover the source of them.
9) If you are in any doubt at all about how to use the unit, DO NOT USE IT. Throttle controllers are safety critical and it is your life!
10) You the user and installer are completely responsible for ensuring the unit works correctly in your application before driving on the track. It is essential that the wiring is done to a high standard, preferably by a motorsport professional. Correct functioning of the installation must be checked for all operating conditions.

SOFTWARE INSTALLATION

Insert the CD. If the software does not start to load immediately then switch to the CD drive from Windows Explorer. Double click on Setup. Unless you know about PC's install the software in the default directory offered. With certain flavours of Windows you may have a problem with the programme locating certain files it needs. This is not us, it is Mr Gates boys. The default directories for all important information are as below.

Programme   C:\DTASwin
Maps   C:\DTASwin\maps

Set the Com Port (Menu:- File/Choose COM Port) to the COM port you are going to plug into. If your machine does not have a COM port contact us about an approved USB -> COM port adapter.

DEFINITION OF TERMS

CALIBRATION UNITS USED

Engine speed   revs. per minute   (rpm)
Throttle opening   percentage of throttle opening   (%)

MAP EDITING KEYS

F1   Help
F2   Copy
F3   Paste
F4   Exit and store changes to engine
F5   Manipulate highlighted cells
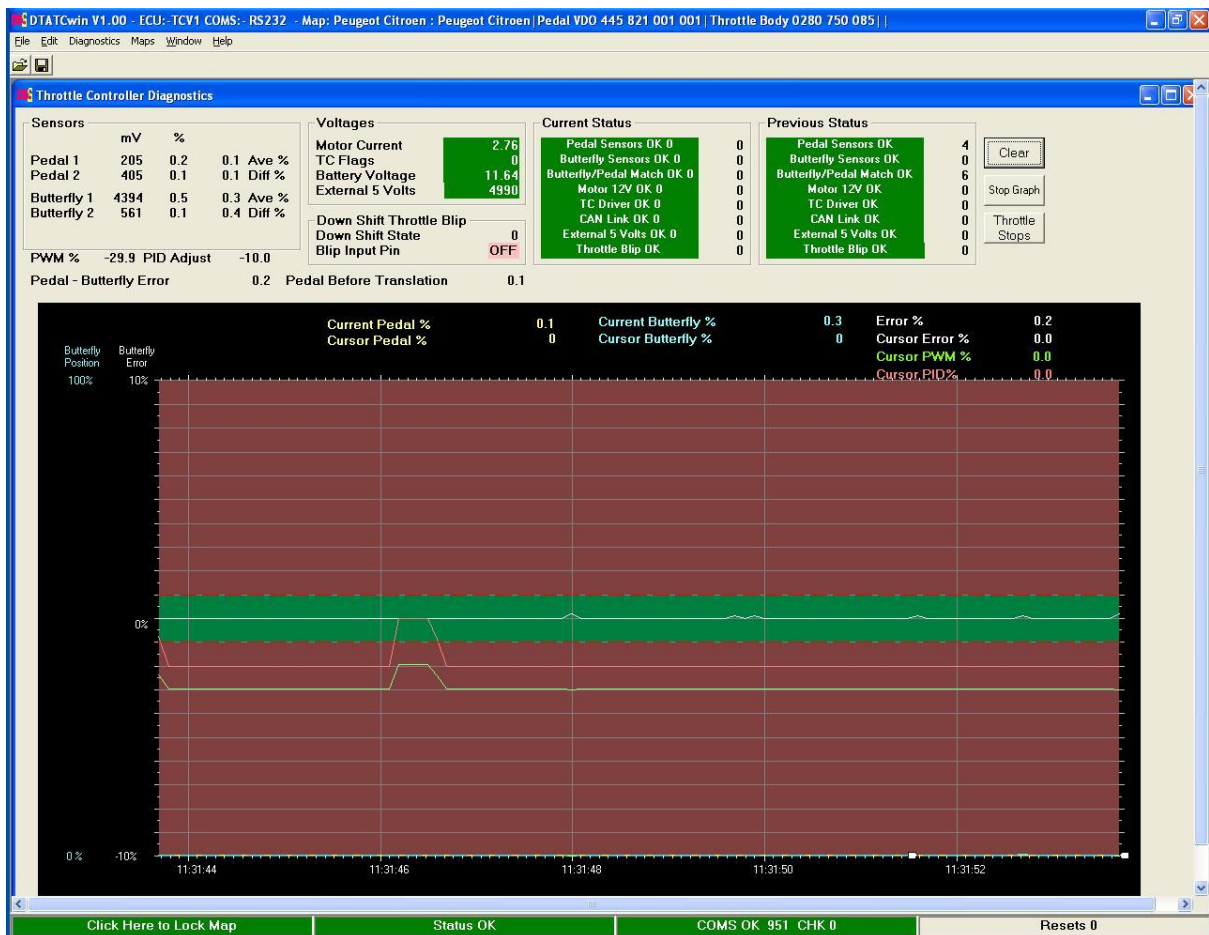
IN 20 x 14 Main Maps

Alt Up Arrow   Nudge Cell to Higher Value
Alt Down Arrow   Nudge Cell to Lower Value
Alt Page Up   Coarser Nudge Cell to Higher Value
Alt Page Down   Coarser Nudge Cell to Lower Value

OTHER KEYS

CURSOR KEYS   Move about maps

DIAGNOSTICS

The diagnostics display tells you everything that is happening with sensors, butterflies, voltages and currents on the STC.

Pedal and butterfly sensor voltages and percentages are on the top left.

Status boxes are on the top right. These indicate the current status which is reset when the power is cycled. The previous status records previous errors and is reset only by clicking the clear button. The numbers to the right of the individual status boxes are a count of the number of errors recorded. The current numbers can be cleared with the clear button, the previous errors can only be cleared by DTA.

The main graph shows how closely the pedal and the butterfly are tracking each other. A current error is also graphed together with the current motor power and PID correction

The throttle blip status is shown. The current status of the input is always reflected even if the function is switched off. The Down Shift State reflects the current status of the Throttle Blip Unit.

0 = Inactive
1 = Blip started, timer running
2 = Post blip lockout timer running
3 = Error condition caused by input being active too long (350ms), starts 2 second lockout of blip
4 = Timing for two seconds, if input cleared return to state 0 ready
5 = End of two seconds input still active, blip function deactivated, Throttle Blip Status set bad, engine low RPM limit engaged.

.

WARNING LIGHT FLASH PATTERNS

The warning light flash pattern is a long gap then several short flashes and gaps. The number of flashes indicates the nature of the problem. There may be more than one problem at a time, if so the flash pattern is the higher of the two.

No of Flashes	Problem
1	Pedal Sensor 1 failure
2	Pedal Sensor 2 failure
3	Pedal Sensor miss-match (both pedal sensors do not agree)
4	Butterfly Sensor failure or miss-match
5	Pedal/Butterfly miss-match
7	5 Volt sensor supply failure
8	CAN Coms with ECU failure
9	H Bridge Driver problem
10	Throttle Blip problem

HOLDING PWM MAP

The holding PWM map is the percentage pulse width given to hold the butterfly in a stationary position. This can be positive at high percentage opening and negative at the closed position.

Most throttle bodies are sprung in such a way that they naturally rest slightly open with no power applied. This is a limp home feature. The exact percentage opening of this resting position must be found. To do this set all the correct end points of the butterfly sensors as described in point 6 of the quick start section. Use the "Throttle Stops" button to turn off the power to the motor in diagnostics and note the butterfly average % opening on the top left panel of the screen.

At this throttle opening percentage the holding PWM should be 0%, below it the holding PWM % should be negative and above it positive as in the example above. The column headers must have an entry at exactly the resting position of the butterfly. A negative percentage reverses the polarity to the body motor and drives it in the reverse direction.

Generally the holding percentage is about 20% for most bodies.

BUTTERFLY ERROR LOW PWM ADDITION

DTATCwin V1.00 TC - Off Line 0 - Map: Peugeot Citroen : Peugeot Citroen | Pedal VDO 445 821 001 001 | Throttle Body 0280 750 085 | |

File Edit Diagnostics Maps Window Help

Butterfly Error Low PWM % Addition

Error % -> RPM	0.3	0.6	1.0	4.6	6.2	7.7	9.2	10.8	12.3	13.8	15.4	16.9	18.5	20.0
100	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
500	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
800	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
1000	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
1500	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
2000	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
2500	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
3000	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
3500	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
4000	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
4500	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
5000	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
5500	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
6000	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
6500	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
7000	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
7500	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
8000	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
8500	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0
8750	0.0	15.0	20.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0	35.0	35.0

Graph

| Click Here to Unlock Map | | | Status | | Resets |

This serves as the P term in the PID control strategy. It is implemented as a look up table (i.e. a map) to allow a nonlinear response to the input. The column input to the table is the pedal/butterfly error term. That is the difference between the requested butterfly position and the actual butterfly position. This table handles the situation where the butterfly position is less than the requested position from the pedal.

As can be seen from the table above a 0.6% error gives a 15% increase to the total PWM% giving a rapid return to the requested position.

BUTTERFLY ERROR HIGH PWM SUBTRACTION

DTATCwin V1.00 TC - Off Line 0 - Map: Peugeot Citroen : Peugeot Citroen | Pedal VDO 445 821 001 001 | Throttle Body 0280 750 085 | |

File   Edit   Diagnostics   Maps   Window   Help

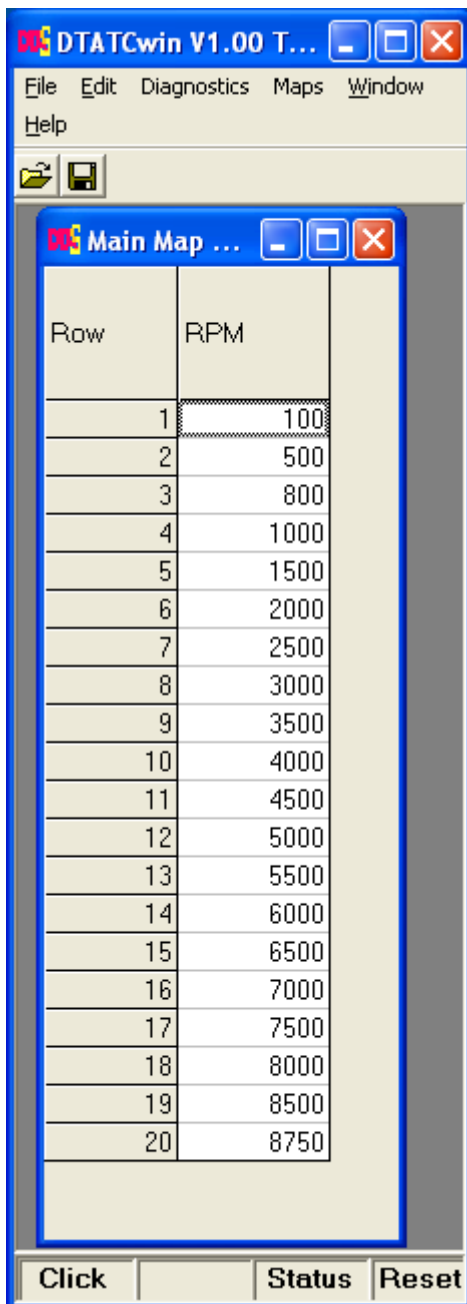**Butterfly Error High PWM % Subbtraction**

Error % -> RPM	0.3	0.6	1.0	4.6	6.2	7.7	9.2	10.8	12.3	13.8	15.4	16.9	18.5	20.0
100	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
500	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
800	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
1000	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
1500	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
2000	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
2500	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
3000	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
3500	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
4000	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
4500	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
5000	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
5500	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
6000	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
6500	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
7000	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
7500	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
8000	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
8500	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0
8750	0.0	-10.0	-10.0	-10.0	-20.0	-20.0	-20.0	-20.0	-25.0	-25.0	-25.0	-25.0	-25.0	-25.0

Graph

| Click Here to Unlock Map | | | Status | | Resets |

This is the opposite of the Error Low condition. If the butterfly is too high these percentages are subtracted from the current PWM% to return the butterfly to the correct position. All numbers in this table should be NEGATIVE.

MAIN MAP RPM SCALE

Row	RPM
1	100
2	500
3	800
4	1000
5	1500
6	2000
7	2500
8	3000
9	3500
10	4000
11	4500
12	5000
13	5500
14	6000
15	6500
16	7000
17	7500
18	8000
19	8500
20	8750

The RPM range over which the engine operates. It is recommended that the first row is 500 RPM and the last is 500 RPM over the maximum the engine operates at. Making the rows units of something like 500 or 250 RPM makes the scale more readable.

This map provides the "Y" axis for the main maps.

MAIN MAP COLUMNS SCALE

DTATCwin V1.00 TC - Off Line 0 - Map: Peugeot Citroen : Peug...

File Edit Diagnostics Maps Window Help

Map Columns

Column	Pedal % 0 - 100	Error Scale 0 - 100	Modify Pedal to Butterfly By -20 - +20%	Net Butterfly % After Modification %
1	0.0	0.3	0.0	0.0
2	5.5	0.6	0.0	5.5
3	6.0	1.0	0.0	6.0
4	7.0	4.6	0.0	7.0
5	10.0	6.2	0.0	10.0
6	15.0	7.7	0.0	15.0
7	46.2	9.2	0.0	46.2
8	53.8	10.8	0.0	53.8
9	61.5	12.3	0.0	61.5
10	69.2	13.8	0.0	69.2
11	76.9	15.4	0.0	76.9
12	84.6	16.9	0.0	84.6
13	92.3	18.5	0.0	92.3
14	100.0	20.0	0.0	100.0

Use Pedal to Butterfly Translation ☑

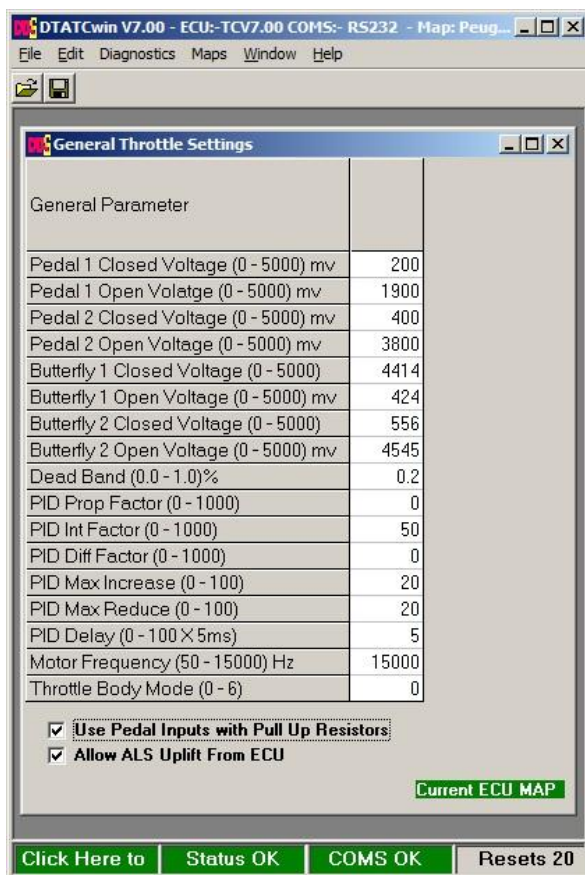| Click Here to		Status	Resets

This represents the columns of each of the main maps. The first column is used as the X axis of the main Holding PWM Map. The first column must have an entry at exactly the "Power off" resting position of the butterfly. The second column is for both positive and negative error maps.

The third column allows some limited translation between a "Real" pedal position and the butterfly requested position. This is activated by the "Pedal to Butterfly Translation" checkmark. The actual pedal position and "Modify" column are added together to give a requested butterfly position. The final column gives an example of the first column pedal positions and what will be the resulting butterfly position.

Note that you can increase or reduce the resulting butterfly position +-20% subject of course to the fact that the butterfly position cannot go less than 0% or more than 100% physically.

GENERAL THROTTLE SETTINGS

General Parameter	
Pedal 1 Closed Voltage (0 - 5000) mv	200
Pedal 1 Open Volatge (0 - 5000) mv	1900
Pedal 2 Closed Voltage (0 - 5000) mv	400
Pedal 2 Open Voltage (0 - 5000) mv	3800
Butterfly 1 Closed Voltage (0 - 5000)	4414
Butterfly 1 Open Voltage (0 - 5000) mv	424
Butterfly 2 Closed Voltage (0 - 5000)	556
Butterfly 2 Open Voltage (0 - 5000) mv	4545
Dead Band (0.0 - 1.0)%	0.2
PID Prop Factor (0 - 1000)	0
PID Int Factor (0 - 1000)	50
PID Diff Factor (0 - 1000)	0
PID Max Increase (0 - 100)	20
PID Max Reduce (0 - 100)	20
PID Delay (0 - 100 X 5ms)	5
Motor Frequency (50 - 15000) Hz	15000
Throttle Body Mode (0 - 6)	0

☑ **Use Pedal Inputs with Pull Up Resistors**
☑ Allow ALS Uplift From ECU

Current ECU MAP

| Click Here to | Status OK | COMS OK | Resets 20 |

This map is a collection of various parameters required for the effectiveness of the throttle controller. Each parameter is described individually below.

PEDAL 1 CLOSED VOLTAGE

The voltage seen by the ECU from pedal sensor 1 when the pedal is in the throttle closed position. Pedal 1 voltage is displayed permanently in diagnostics screen.

PEDAL 1 OPEN VOLTAGE

The voltage seen by the ECU from pedal sensor 1 when the pedal is in the full throttle position. Pedal 1 voltage is displayed permanently in the diagnostics screen.

PEDAL 2 CLOSED VOLTAGE

The voltage seen by the ECU from pedal sensor 2 when the pedal is in the throttle closed position. Pedal 2 voltage is displayed permanently in diagnostics screen.

PEDAL 2 OPEN VOLTAGE

The voltage seen by the ECU from pedal sensor 2 when the pedal is in the full throttle position. Pedal 2 voltage is displayed permanently in the diagnostics screen.

BUTTERFLY 1 CLOSED VOLTAGE

The voltage seen by the ECU from butterfly sensor 1 when the butterfly is in closed position. Butterfly 1 voltage is displayed permanently in diagnostics screen. To measure the value, click on the "Throttle Stops" button. This turns off power to the motor. Push the butterfly to the fully closed position and note the voltage. After setting all four sensor voltages click on the "Throttle Stops" button again and cycle the power on the ECU/STC pair to clear errors generated in the setting process.

12

BUTTERFLY 1 OPEN VOLTAGE

The voltage seen by the ECU from butterfly sensor 1 when the butterfly is in fully open position. Butterfly 1 voltage is displayed permanently in diagnostics screen. To measure the value, click on the "Throttle Stops" button. This turns off power to the motor. Push the butterfly to the fully open position and note the voltage. After setting all four sensor voltages click on the "Throttle Stops" button again and cycle the power on the ECU/STC pair to clear errors generated in the setting process.

Be warned that most throttle body butterflies will open more than 100%. For maximum performance only open the butterfly to the 90 degree position.

BUTTERFLY 2 CLOSED VOLTAGE

The voltage seen by the ECU from butterfly sensor 2 when the butterfly is in closed position. Butterfly 2 voltage is displayed permanently in diagnostics screen. To measure the value, click on the "Throttle Stops" button. This turns off power to the motor. Push the butterfly to the fully closed position and note the voltage. After setting all four sensor voltages click on the "Throttle Stops" button again and cycle the power on the ECU/STC pair to clear errors generated in the setting process.

BUTTERFLY 2 OPEN VOLTAGE

The voltage seen by the ECU from butterfly sensor 2 when the butterfly is in fully open position. Butterfly 2 voltage is displayed permanently in diagnostics screen. To measure the value, click on the "Throttle Stops" button. This turns off power to the motor. Push the butterfly to the fully open position and note the voltage. After setting all four sensor voltages click on the "Throttle Stops" button again and cycle the power on the ECU/STC pair to clear errors generated in the setting process.

Be warned that most throttle body butterflies will open more than 100%. For maximum performance only open the butterfly to the 90 degree position.

DEAD BAND

This is the error between the pedal position and the butterfly position which will be ignored. In other words the butterfly is deemed to be in the correct position. Normally this should be set to about 0.2%

This "non active" band stops the butterfly permanently "hunting" for the optimum position.

PID PROP FACTOR

Usually set to 0 as this is replaced by the error tables.

PID INT FACTOR

See tutorial at the end of this manual.

Allows for small errors not corrected by the error tables to be corrected over a short period of time. Too high a value results in low frequency oscillation, too low results in small errors not being corrected.

PID INT FACTOR

See tutorial at the end of this manual.

Generally left 0 as not needed in most applications.

PID MAX INCREASE/MAX REDUCTION

These values "Clamp" the action of the PID controller to within a specified band. This reduces any inherent instability in the control loop. 10 to 20% would be a useful guideline.

PID DELAY

The inverse of the frequency at which the control loop operates. Most throttle bodies have a natural opening time of around 50 – 100 ms depending on manufacturer so this limits the speed of the control loop. Too fast a loop and the system will oscillate, too slow and the response time will be inadequate.

MOTOR FREQUENCY

The frequency of the main motor PWM pulse train. Usually about 10 kHZ. Too low and the sound is very intrusive, too high and the motor may not respond.

THROTTLE BODY MODE

Different bodies have different sensor sets and output values during operation. The mode takes this into consideration in the internal operation of the unit.

1) Mode 0

Used for most Bosch throttle bodies
With Bosch and Valeo Pedal Sensors. The following is a list for this mode.

Pedal

Bosch 021 907 475D
Valeo 445 821 001 001

Throttle Body

Bosch 0280 750 036
Bosch 0280 750 085

2) Mode 2

Used for pedal and throttle body from Honda K20 engined cars such as the Civic Type R FD2.

USE PEDAL INPUTS WITH PULL UP RESISTORS

Some pedal sensors require the output to be pulled up to 5V by a resistor. This checkmark selects the use of these inputs with a 1K Ohm pull up rather than the inputs with a weak pull down. The pin numbers of each are clearly shown on the wiring diagram.

ALLOW ALS UPLIFT FROM ECU

This allows the engine ECU to open the butterfly for anti-lag system use. The command comes from the CAN network and the amount of uplift is specified in the engine ECU. It is limited to a maximum of 30%

DOWN SHIFT THROTTLE BLIP

For use with an external gearbox controller or a simple micro-switch. Allows the throttle to be opened for a short period to allow for a clutch less down shift on a gearbox.

The maximum time this is allowed to happen for is 500ms or an error will be tripped.

The parameters are individually described below.

DOWN SHIFT PEDAL UPLIFT

The amount the butterfly will be opened to during the blip period. This has a maximum of 50% of maximum throttle opening.

DOWN SHIFT TIME

The length of time the butterfly will be open for when in delay only mode. Delay only mode is used when you have a simple micro-switch activation. If using an external gearbox controller this will be allowed to blip the throttle for 500ms but no more.

BLANKING WINDOW AFTER CUT

Further "blips" are ignored for this amount of time after a blip event. This is to eliminate switch bounce if using a simple micro-switch.

TURN ON SHIFT DOWN THROTTLE BLIP

Activates the blip system.

DELAY ONLY

Used for simple micro-switch activated systems. Other than the limit of 500ms tripping an error activating this checkmark makes the blip time independent of the length of time the switch is active.

NOTE:-

If the 500ms limit is tripped then a two second safety timer is started. If the blip input is still active at the end of this time the blip system is deactivated and a warning set. The engine will also have a low hard rpm limit set until the power is cycled.

PID LOOPS A BRIEF TUTORIAL

Queries about PID loops are about the most common one we receive. PID stands for proportional, integral and differential and it is a long established way of controlling almost anything from industrial oven temperatures to radar aerial rotational speeds.

The technique is used in many places throughout DTA software. Let us use as an example the air fuel ratio PID controller.

It is desirable that the air fuel ratio is held constant at a level determined by power output or emissions requirements. The air fuel ratio delivered is determined by the amount of air being consumed by the engine and the amount of fuel being supplied by the fuel injectors as a result of the main fuel map and all the compensations acting upon it.

The Lambda PID controller modifies the amount of fuel injected into the engine by the following technique. The system measures the current Lambda value from the sensor. It then subtracts this value from the target Lambda value (from either the target Lambdas in the Lambda map or the 20 x 14 Lambda map whichever is in operation) which produces an error number. This is then turned into a percentage change in fuelling to attempt to reduce the error to zero. The calculation uses the PID Prop Factor from the Lambda map in the following calculation.

New Fuel % = Old Fuel % + (Lambda Error x PID Prop Factor / 1000)

This calculation does the bulk of the work.

To correct for minor errors that cannot be removed with the above the PID Integral Factor is used. Every time the Lambda value is measured then the errors are added up and the following calculation is used.

Integral Error = Integral Error + latest Error
New Fuel % = Old Fuel % + (Lambda Integral Error x PID Int Factor / 1000)

To attempt to control rapid changes the differential factor is used in the following manner.

Diff Error = Current Error - Last Error
New Fuel % = Old Fuel % + (Lambda Diff Error x PID Diff Factor / 1000)

The time between each set of the three calculations above is the sample delay. Any system takes a time to respond to any changes. There is no point in looking for the results of any changes until the system has responded fully. If you do there is a good chance that the control loop will oscillate. The S60 has a feature in the Lambda map which will perturb the fuelling by + and – 10% automatically allowing you to log the fuel pulse and the Lambda sensor with fast logging to determine how long the engine / exhaust / sensor takes to respond. The loop delay should be set for say 20% longer than this time.

The following is a modified version of the Ziegler-Nichols guide to PID tuning dating from the 1940's.

1) Set the PID int factor and the PID diff factors to zero.
2) Increase the PID prop factor slowly until you get continuous oscillations.
3) Reduce the PID prop factor to half this value.
4) Try increasing the PID int factor slowly to reduce any error which will not reduce to zero.
5) Try small values of PID diff factor to improve stability and response.

If you cannot understand the above try entering PID control into Google. There are various college primers on the subject out there.

tyco / *Electronics*

AMP

SUPER SEAL CONNECTOR
44POSITION

Instruction Sheet

411-78043

(WAS IM038)
04 JUN 02   Rev O

This manual describes the wiring harness assembly Procedure of
SUPER SEAL CONNECTORS.

### 1.   NAME / CAT. NO. OF APPLICABLE PRODUCTS

		Part Number	Old Part number
·Receptacle Contact ASS'Y	╱	3-1447221-3	3900187-01
		3-1447221-4	3900187-02
·Plug Housing ASS'Y	╱	2-1447232-6	3900281-441
		1376886-1	3900281-442
·Hole Plug	╱	4-1437284-3	3400130

2.   CONTACT CRIMPING

— The contacts should be crimped in accordance with Crimping
Specification 114-78011(Old PS-1191),114-78011-1(Old PS-1191-1).

3.   CONTACT INSERTION

— The contact should be protected from an unnatural external force so as not
to be deformed or bent before it is inserted into the housing. (If the contact
is deformed or bent,   that contact should not be used and a new contact
should be crimped.)
— It should be confirmed that two final locking "protrusions" of the housing
protrude.
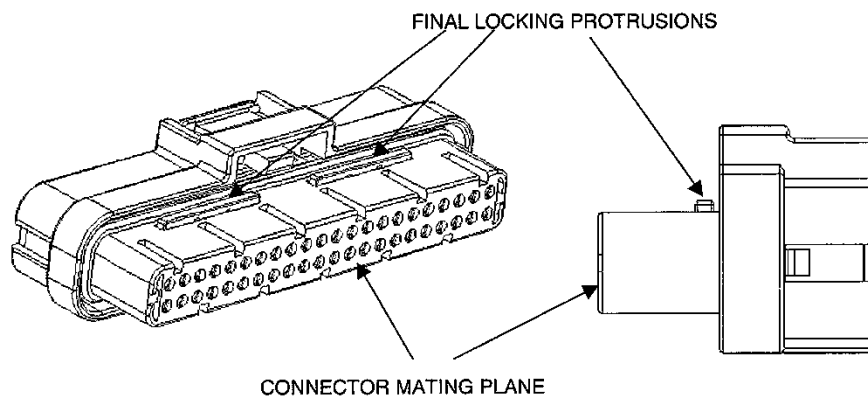
FINAL LOCKING PROTRUSIONS

CONNECTOR MATING PLANE

HOUSING CONFIRMATION

Revised Per EC FJ00-1074-02

— As shown in the following figure, the contact should be held by the part near
the crimping and inserted into the housing as vertically as possible.
(The contact should be inserted as far as it hits the part of the housing to avoid
the halfway insertion.)

RECEPTACLE   WIRE
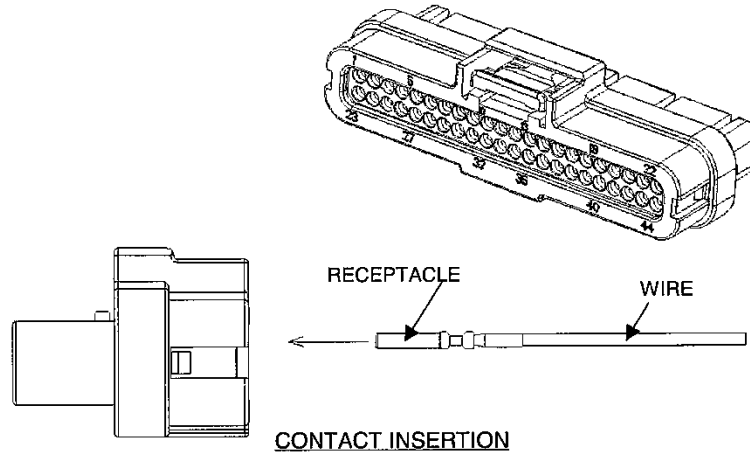
CONTACT INSERTION

— It should be confirmed that the contact stays in a correct position from both
the connectors mating plane and the contact insertion plane.
— If the contact is inserted into an incorrect position, the contact should be
removed from the housing in accordance with the Sec. 5 of this manual and
inserted again.

RECEPTACLE CONATCT
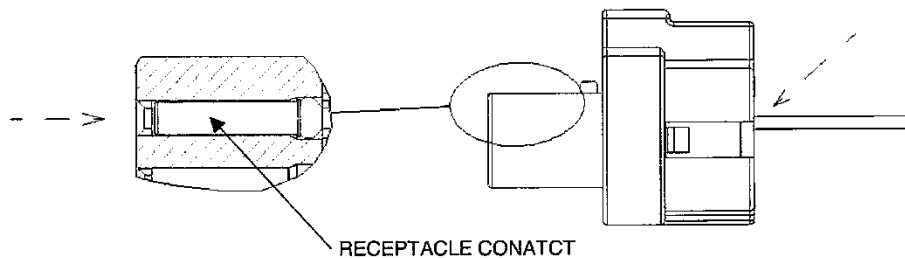
— When the insertion of the contacts in finished, it should be confirmed that the
contacts are inserted into all the necessary positions. (The insertion of the hole
plugs should be also checked.)

4. FINAL LOCKING OF CONTACT

— After all the contacts are inserted, two final locking "protrusions" are pushed simultaneously into the housing by fingers for locking (latching feeling should be confirmed). If the nails are blocked halfway, it means that the halfway insertion of the contact is detected. In such case, therefore, it should be checked again whether the contact stays in the correct position or not without applying further pushing force.

INCOMPLETE INSERTIION
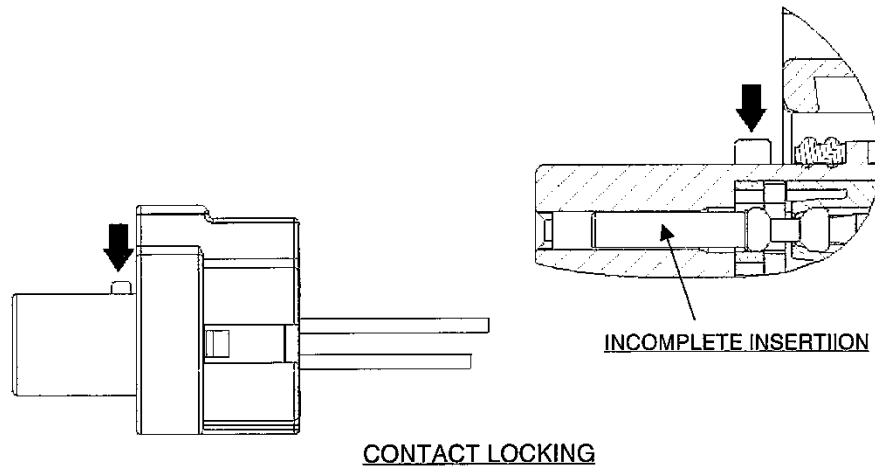
CONTACT LOCKING

5. CONTACT REMOVAL

— If the final locking protrusions have already been pushed into the housing, the releasing side (one position) of the final lock is pushed up by a finger nail or a tool such as a minus driver. (Latching feeling should be confirmed. The release of the final lock should not be repeated more than 10 times.)

LOCK RELEASE
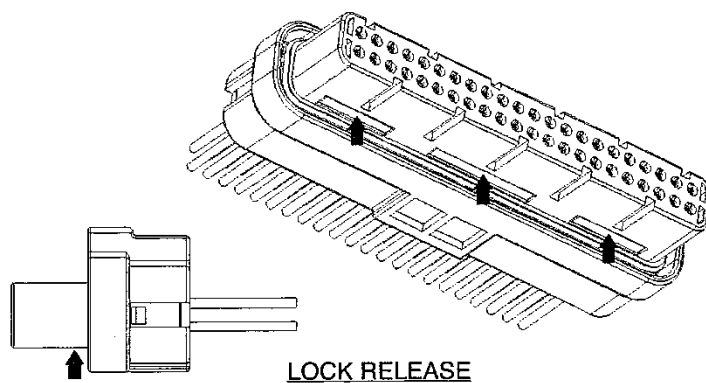
— If it is confirmed that both the final locking "protrusions" protrude, the wire crimped with the contact to be removed is drawn out as vertically as to the housing.
(The removal of one position should not be repeated more than 3 times.)

MUST PROTRUDE!
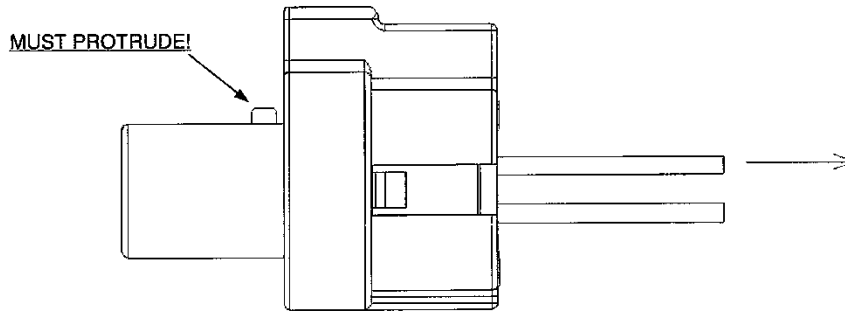
CONTACT REMOVAL

6. OTHERS
— When the wires are bundled (by taping, etc.), care should be taken not to apply a tensile force to one arbitrary wire.
— If the wires are bent approximately 90 degrees, the bent position should be approximately 20mm apart from the connector and the bending form, the bundling position, etc. should be considered.
   ① in order not to apply a tensile force to the wire outside the bend.
   ② In order not to apply a compression load to the wire inside the bend and deform the wire.
— The housing should not be dismantled.

≒30
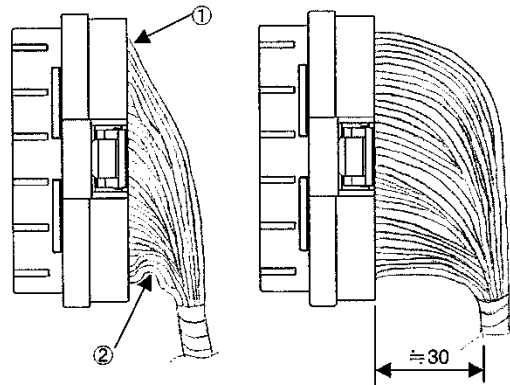
BEND OF WIRES

— The housing should not be dismantled.