

## ***INJECTION-PERIOD EXPANDER for General Fuel Systems***

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### **AUTOGM**

**AUTOGM stands for Automatic (with) Module and works with IPE-GS.**

The purpose is to make an ordinary IPE-GS device to operate in either fully automatic mode or at least in semi-automatic mode. AUTOGM is rather small and can be difficult to build if you do not have sufficient expertise and equipment to produce circuit boards for surface-mounted components, so-called SMD. Mostly of the components is SMD and it is not just to keep the space but also to keep it less than the baseboard (IPE-GS). In fact, all stand-alone modules in G-series have the same size, 57 x 29 mm. SMD is usually cheaper than the corresponding PCB which can be nice to know.

It is a bit of a luxury to bring this project with automatics, but as we all know, there is no limit how lazy a human can be and beyond that, I find it funny and interesting to develop such a thing too.

**AUTOGM is a digital step regulator (integration).** The circuit is based on a binary up/down counter (4516) and one slow oscillator that will count it up or down (with a 20 sec interval) dependence on if the engine is wet or dry. But if the engine getting the fuel it wants - nothing happens. The integrated circuit converts of course the number of digits to a specific voltage. Actually you can call it for a D/A converter. The condition for IPE-GS is a bit special, therefore we have to make an accurate voltage translation here. The controlling voltage named AVT (Automatic Voltage Terminal) have a range about 3.5-4.7 volt, were 3.5 is minimum (zero) extra pulse width and 4.7 is maximum extra pulse width. But if you use the choke, you can raise the voltage up to 7.2 volt. It will place a significant extra amount of fuel into the engine. The module is also protected for long duration of low supply voltage - without releasing the key data (about the size of the voltage). There is even important not consume too much current when the car not being used. I had to work carefully to optimise AUTOGM as long as possible, without making it too complicated.

#### **The main difference between a semi-automatic and full-automatic:**

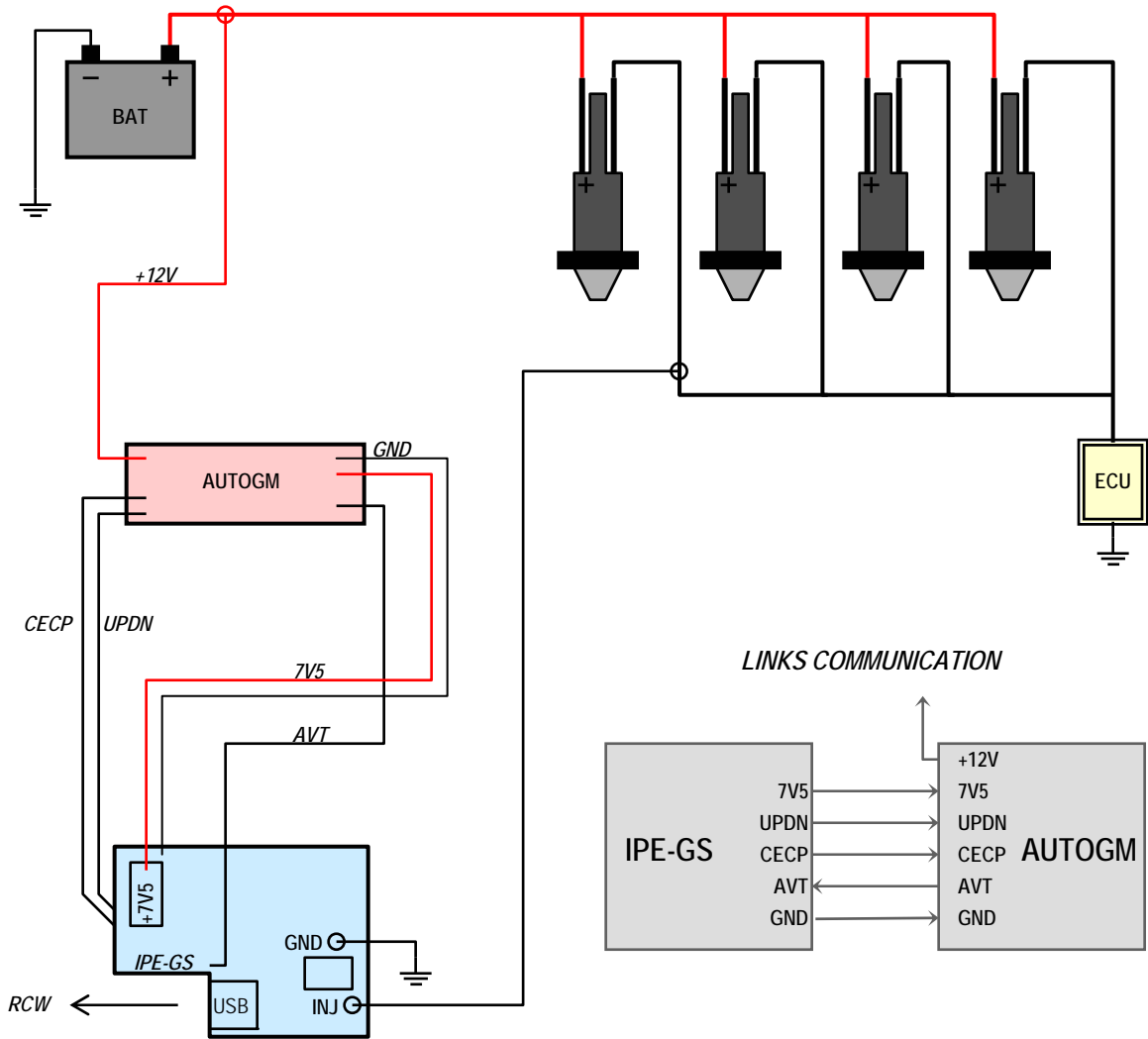
When you decide to use AUTOGM you can build an easier version of the RCW-controller module named RCW2 or RCW3 because you do not need the fuel adjust potentiometer anymore. Well, it not that easy. In fact, I would recommend a switch on the IPE-GS unit so you can switch back to manual mode. Therefore you need a RCW1-module in reserve so it's possible to make it manual. In semi automatic mode you must press a button on RCW to start the automatic balancing. If the system is based on pulse width control (not lambda) you can only do it at idle speed when the engine temperature is normal. If your system is based on lambda control, then you can press the button when you drive your car soft or in idle (when the temperature on the lambda probe is achieved). A press on the button activate the self adjusting system for about one minute.

**And finally:** If you choose full automatic, you not need to think of any button. The system will always adjust itself and then you can actually exclude the RCW-module.

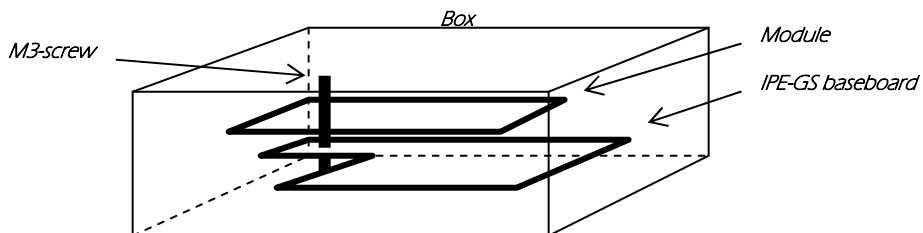
## **INJECTION-PERIOD EXPANDER for General Fuel Systems**

### **AUTOGM**

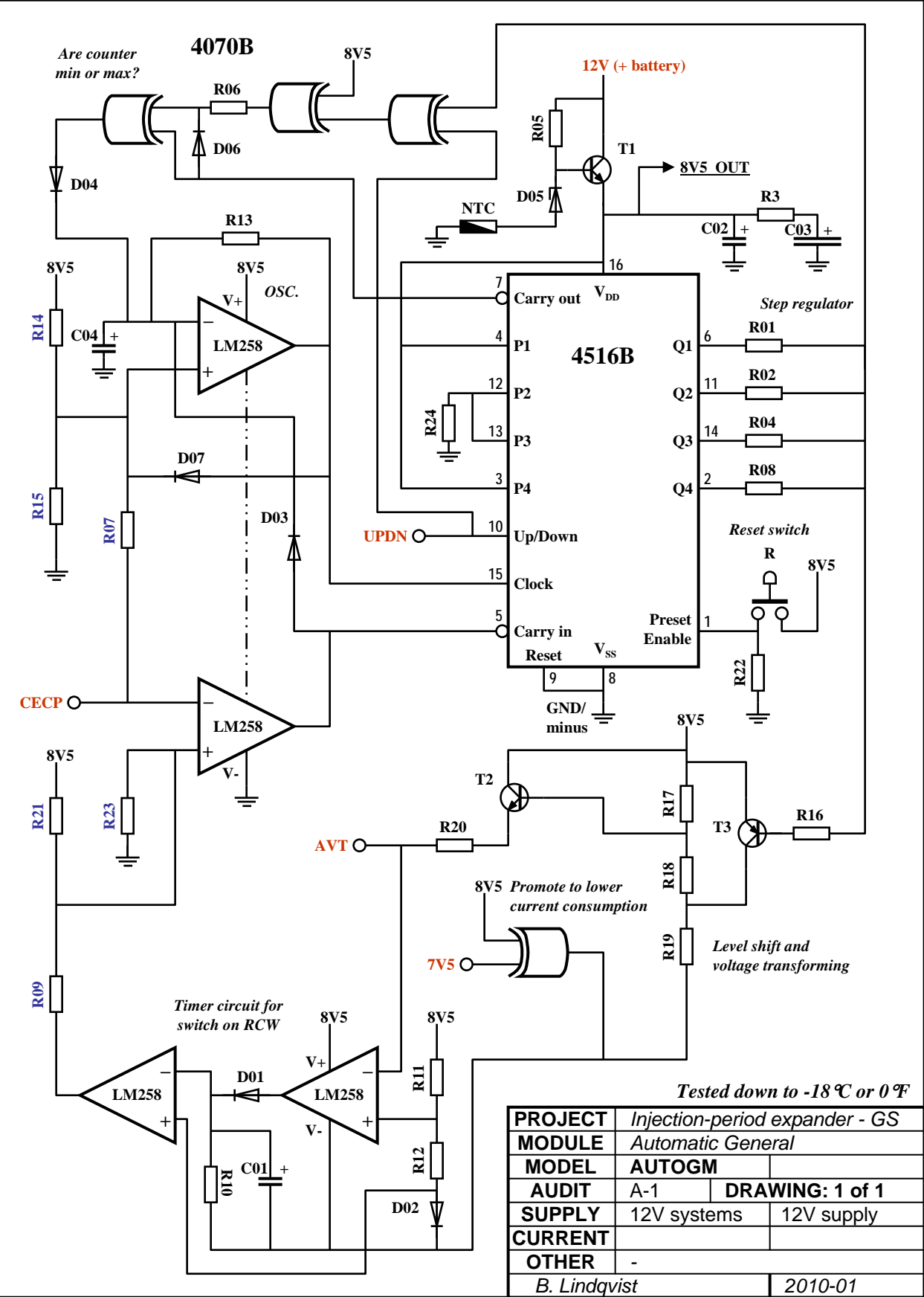
The principle to connect AUTOGM to IPE-GS (it also works for sequential arrangement):



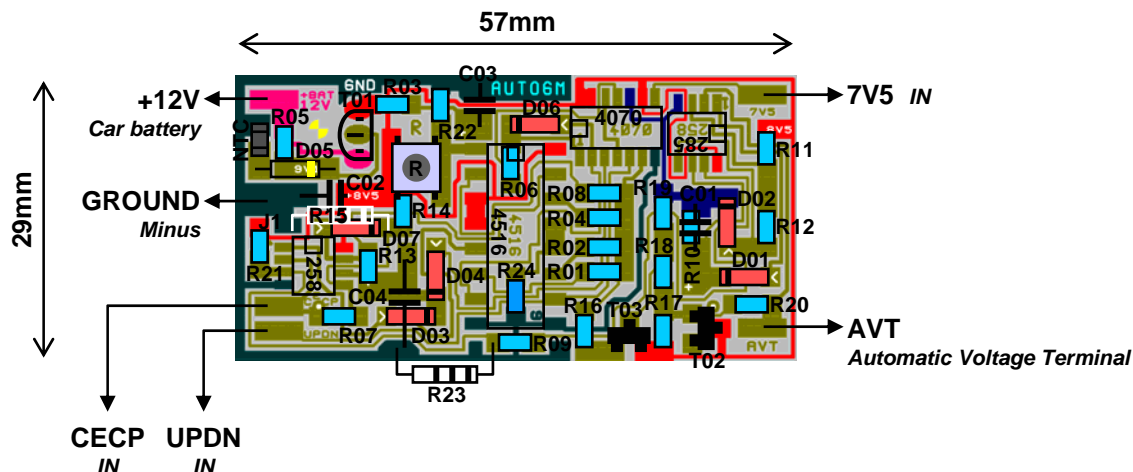
When you use a module next to IPE-GS can you place them in the same box. The best way to arrange it seems to be to stack them on each other and then one can use a long M3-screw to fix them in place. One or more sleeve (not leading) over the screw is also necessary.



CIRCUIT DIAGRAM



## MODULE PLACING OF COMPONENTS



### SMR1206:

R01 = 82k  
 R02 = 39k  
 R03 = 220Ω  
 R04 = 22k  
 R05 = 8k2  
 R06 = 22k  
 R07 = 100k  
 R08 = 10k  
 R09 = X  
 R10 = 2M2  
 R11 = 100k  
 R12 = 68k  
 R13 = 220k  
 R14 = 100k  
 R16 = 1M  
 R17 = 22k  
 R18 = 39k  
 R19 = 3k3  
 R20 = 100Ω  
 R21 = X  
 R22 = 22k  
 R24 = 0-1M

*The blue marked texts indicate that the component either, can have a different value or be excluded - dependent on the method for controlling.*

### Other Components:

R15 = 10k , hole mount  
 R23 = 10k , hole mount  
 NTC = 220Ω (25°C) , SMD  
 C01 = 10μ , 16V , E-lytic , hole mount  
 C02 = 2μ2 , 16V , E-lytic , hole mount or SMD  
 C03 = 1000μ , 16V , E-lytic , hole mount  
 C04 = 22μ , 16V , E-lytic , hole mount  
 R = TACT-Switch, compact snap-in type



### Semiconductors:

D01-D04 = BAS32 , SMD  
 D06-D07 = BAS32 , SMD  
 D05\* = Zener 9V1 , hole mount or SMD  
 T01 = BC546B , hole mount  
 T02 = BC847B , SMD  
 T03 = BC857B , SMD

### IC:

LM258 x 2 = Low power dual OP , SMD  
 4070B = Quad 2-input EXOR gate , SMD  
 4516B = Binary up/down counter , hole mount

\* = Some zener diodes do not have the voltages that is marked on them. If you not get any proper 9V1 is an 6V8 in serial with an 3V3 enough.  
 Assume that the result should be close to 8.5V.

A single side board are enough but if you choice a double side board then you can print and get another module on the other side. No holes need to be drilled but the target marking beside T1 is for an M3-screw. All components shall be handled as SMD, thus made, all soldering take place on the same side.

PROJECT	Injection-period expander - GS	
MODULE	Automatic General	
MODEL	AUTOGM	
AUDIT	A-1	DRAWING: 1 of 1
OTHER	-	
B. Lindqvist		2010-01

## **INJECTION-PERIOD EXPANDER for General Fuel Systems**

### **AUTOGM**

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*To continue this project, it is necessary to describe in detail how things should be built and arranged. This is what the rest of this guide will do. We can distinguish three different ways according to the principle of the systems to work for. The method is determined by which module you have under IPE-GS. Is it FFGM or LFFGM?*

- (1) FFGM is only for semi automatic and is based on the injector pulse width.**
- (2) LFFGM is for semi automatic and is based on the lambda probe.**
- (3) LFFGM is for full automatic and is also based on the lambda probe.**

There is a forth option and that is if you have two modules operating in mix mode. The arrangement is still the same for the installation of the AUTOGM. The semi automatic means that you must choose a suitable situation to press the button "auto tune" on the RCW-module - for start the automatic adjustment of the fuel quantity and that procedure will last for about one minute. If you have FFGM, you must stand still on idle during that minute. If you have LFFGM you can press the button "auto tune" whenever you want but especially after you have filled the tank with fresh fuel. **In fully automatic mode** you can skip the RCW-module but if you compile the latest version (RCW3) you can use it to circumvent the built-in timer function on the LFFGM-module. The reason with this delay function is to avoid AUTOGM to work with a cold lambda probe. The delay is about eight minutes after the engine is running but if your engine is warm enough you can bypass the delay by pressing "Auto Tune". With RCW3 (and earlier versions) you can also see if the fuel quantity is correct or defective by the LED's then.

You need to add more components to FFGM or LFFGM - to make them ready to communicate with AUTOGM. For FFGM must you complete with a hole-mounted LM258 and some other components. For LFFGM - three resistors and two diodes.

There is a reset function on the AUTOGM-module. When you press the switch marked with an "R", will the counter (4516) presetable number nine (1+8). This corresponds for a pulse width between min and max (middle - one step). The counter range is 0-15. The "button" is useful when you make a test of the entire system - or in the beginning of the installation.

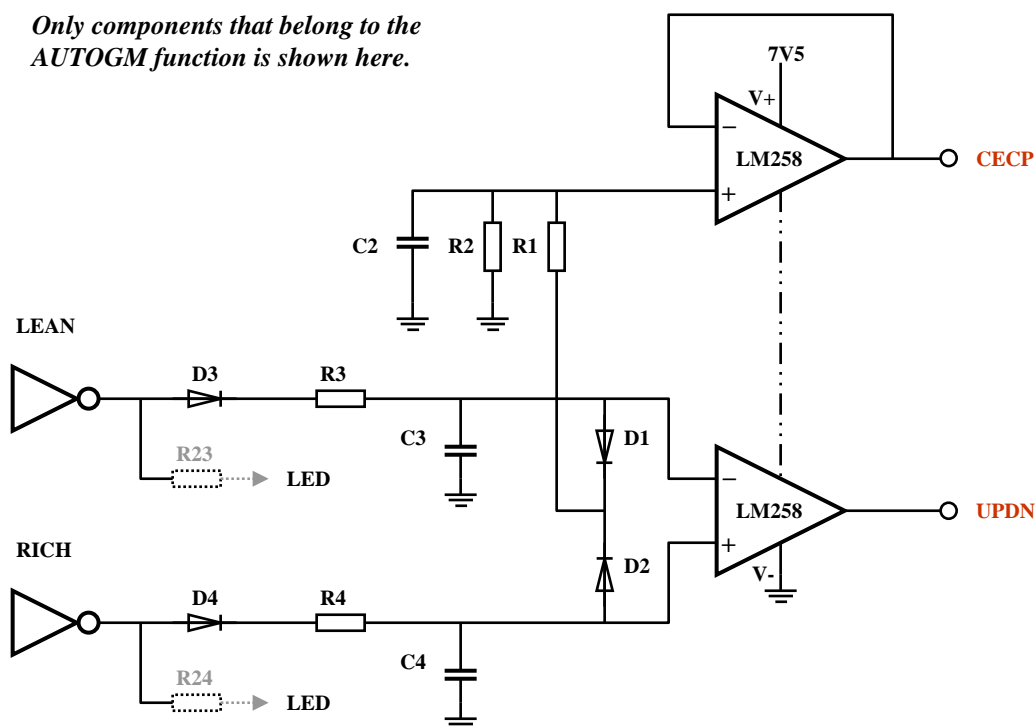
In full automatic mode can you arrange the RCW-module in two ways here. Either you can use RCW2 or RCW3. With RCW2 can you utilize the choke function with the same potentiometer as in RCW1. But the price you pay is that you must always have RCW2-module plugged in (you can not disconnect it when the system is working) - a double key function... With RCW3 is the choke function gone, but you can unplug it or never use it. You must add two resistors on the IPE-GS (and an on/off-switch that affect the injector cable). This two resistors is a replacement for those in RCW2, including the potentiometer.

Well, I hope you will make it to work, after this and the following instructions...

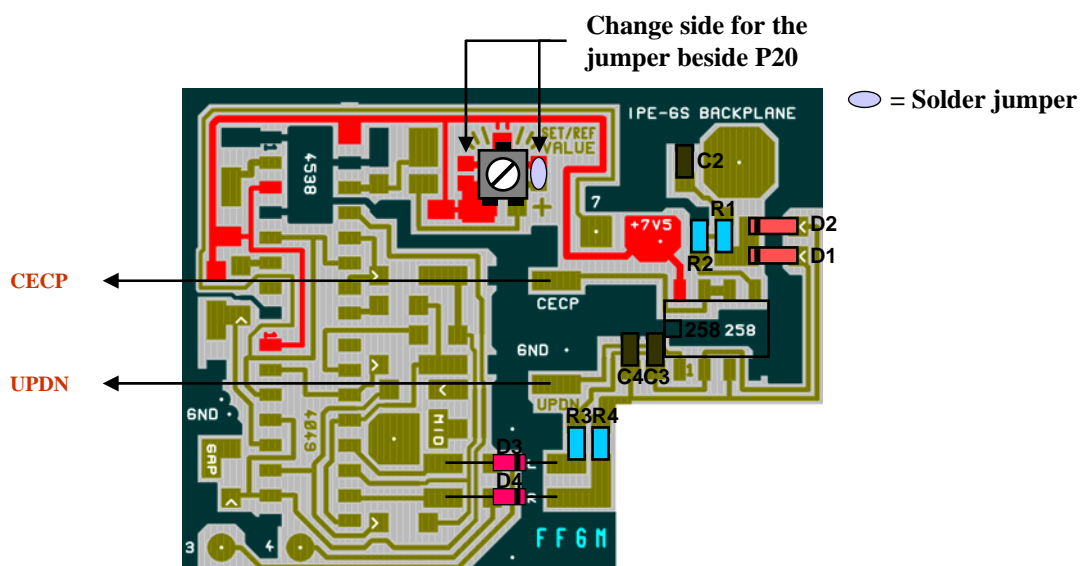
## CIRCUIT DIAGRAM AND PLACING OF COMPONENTS

### Extra components on FFGM for SEMI AUTOMATIC-mode

Only components that belong to the AUTOGM function is shown here.



1



#### SMR1206:

R1 = 1M  
R2 = 2M2  
R3 = 10k  
R4 = 10k

#### SMC1206:

C2 = 22n  
C3 = 100n  
C4 = 100n

#### Other Components:

D1 & D2 = BAS32 , SMD  
D3 & D4 = 1N4148 , hole mount  
LM258 = Low power dual OP , hole mount

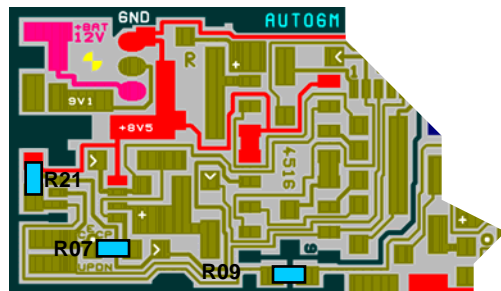
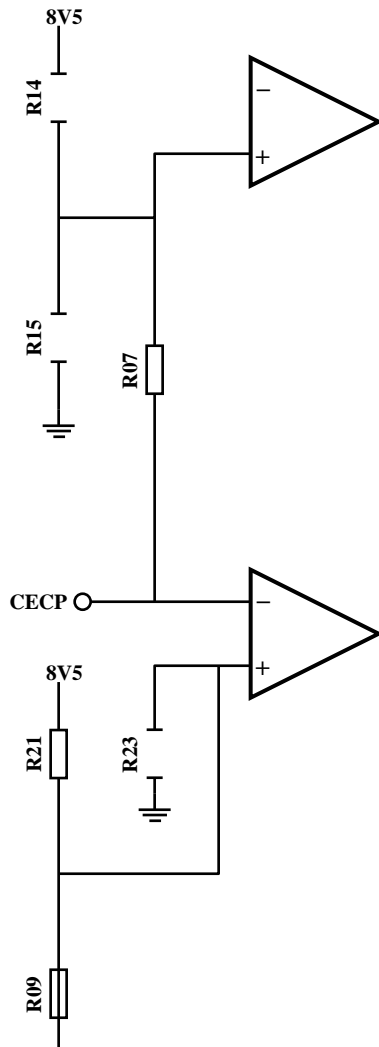
## PLACING OF COMPONENTS

### Arrangement on AUTOGM when using FFGM for SEMI AUTOMATIC-mode

*Only components that is specific to co-operate with FFGM control function is shown here.*

1

#### Part of AUTOGM:



**SMR1206:**  
R07 = 100k  
R09 = 0Ω  
R21 = 150k

**Exclude R14, R15 & R23!**

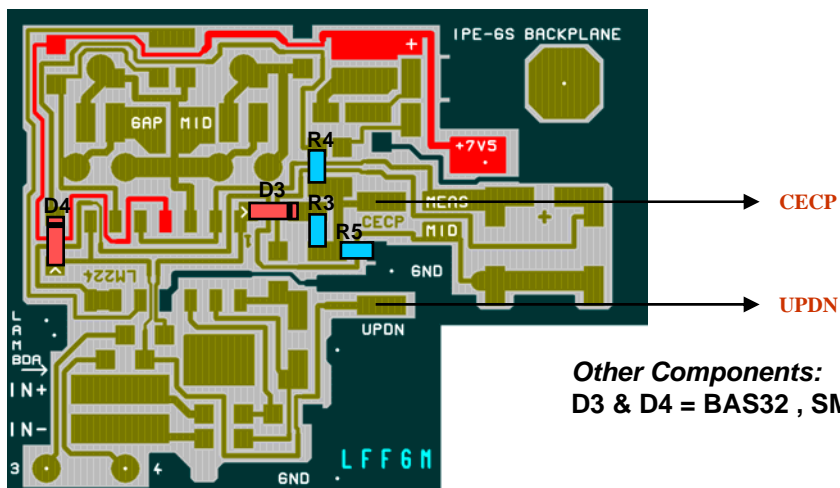
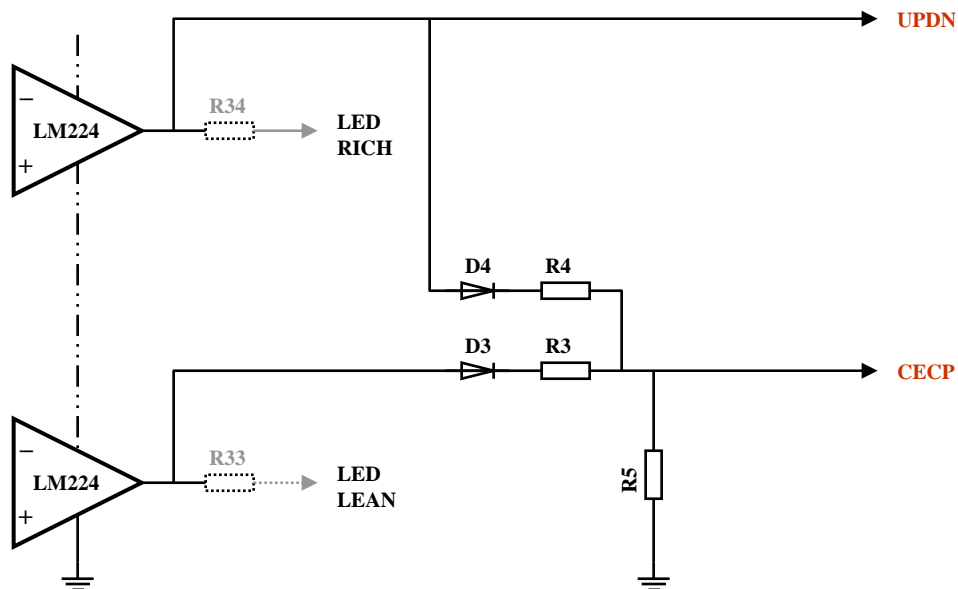
After the rebuilding (if you had a manual control before) must the potentiometer P20 get a new function. It is not only a "reference" adjustment, now it is P20 that determines the point to regulate within, or "set value" for the fuel quantity.

## CIRCUIT DIAGRAM AND PLACING OF COMPONENTS

### Extra components on LFFGM for SEMI AUTOMATIC-mode

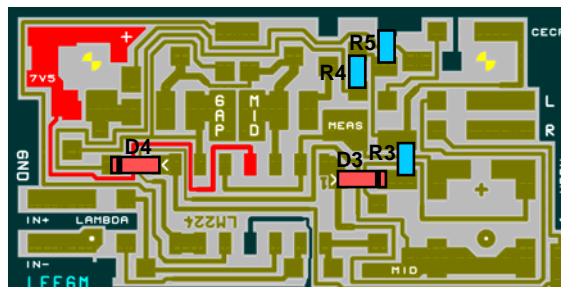
Only components that belong to the AUTOGM function is shown here.

2



Other Components:  
D3 & D4 = BAS32 , SMD

SMR1206:  
R3 = 22k  
R4 = 22k  
R5 = 100k



- The stand alone version.



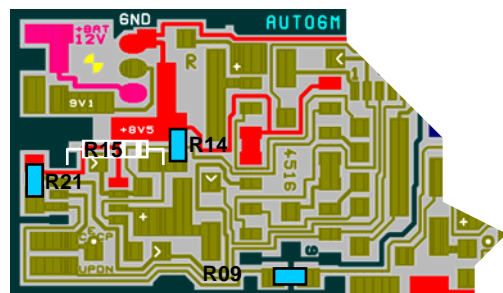
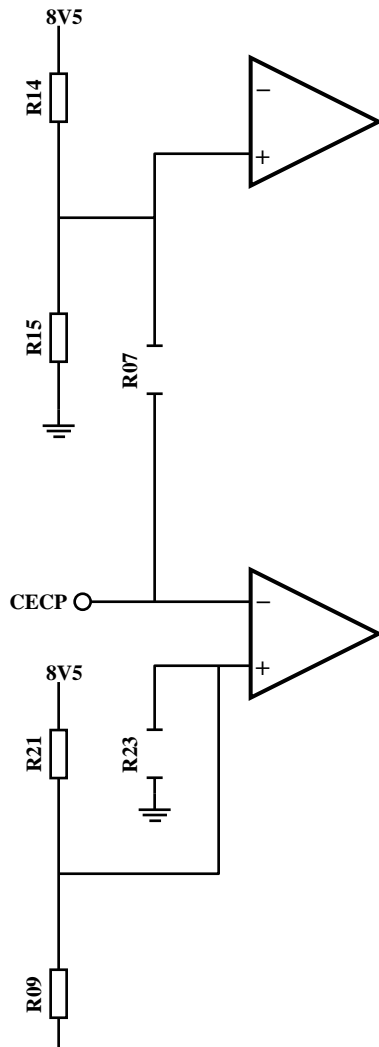
## PLACING OF COMPONENTS

### Arrangement on AUTOGM when using LFFGM for SEMI AUTOMATIC-mode

*Only components that is specific to co-operate with LFFGM control function is shown here.*

2

#### Part of AUTOGM:



**SMR1206:**

**Exclude R07 & R23!**

R09 = 10k

R14 = 100k

R21 = 100k

**Hole mount resistors:**

R15 = 10k

*Mount it like an SMD component*

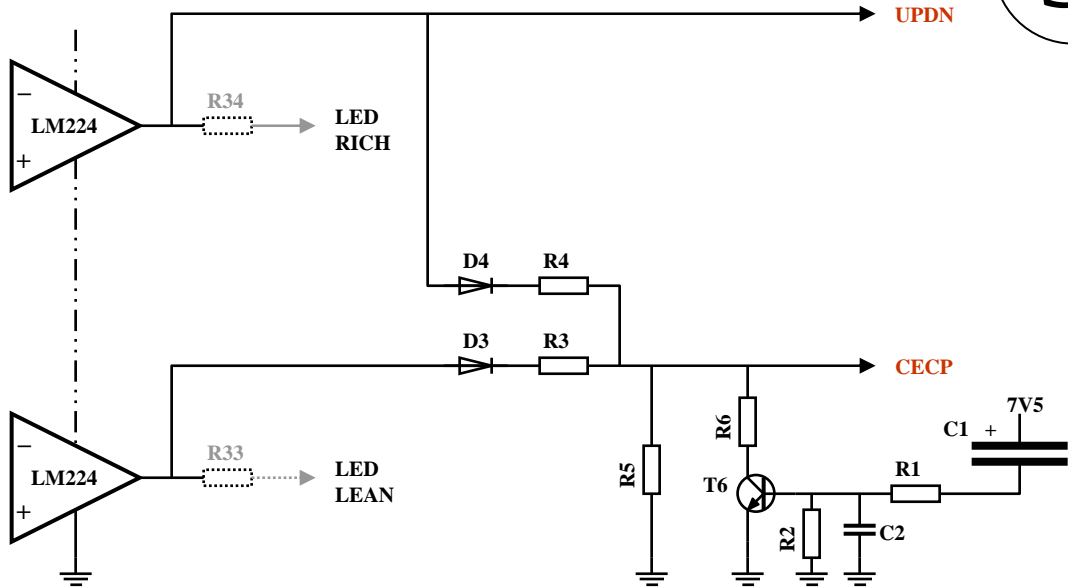
The set value is determined by the size of the GAP and the MID (on the LFFG-module). GAP is determined by P31 and MID by P32. The adjustments shall be done after “wide band” here. Set P31 to 15k and P32 to 4k7 or use common resistors instead of potentiometers. In order to make everything work properly must C4 on the baseboard (IPE-GS) be selected to 2200nF and further D4 ought to be mounted and C5 selected to 10uF.

## CIRCUIT DIAGRAM AND PLACING OF COMPONENTS

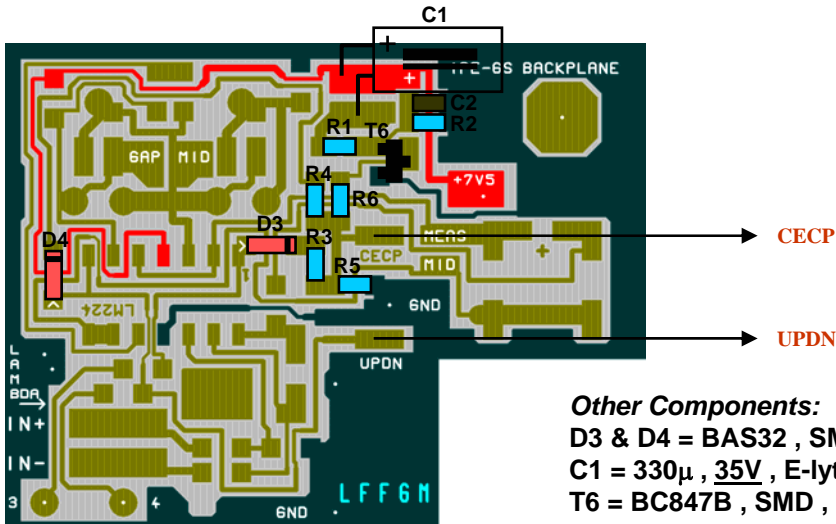
### Extra components on **LFFGM** for FULL AUTOMATIC-mode

Only components that belong to the AUTOGM function is shown here.

3



R2



#### Other Components:

D3 & D4 = BAS32 , SMD

C1 = 330 $\mu$  , 35V , E-lytic , hole mount

T6 = BC847B , SMD , hfe < 300

When the lambda probe not is turned on before it is warm enough have the circuit a built-in time delay that is 8 min, if the car have standing still a long time? C2 must be at least 220n and can be placed above or under R2.

SMR1206:

R1 = 100k

R2 = 10M

R3 = 22k

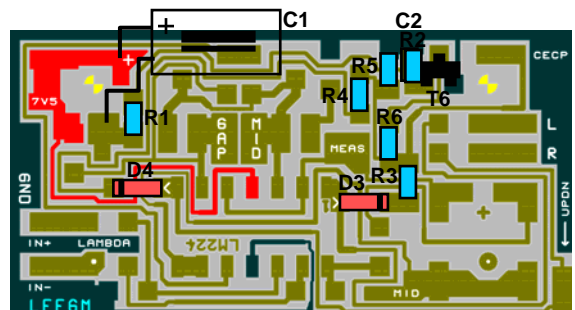
R4 = 22k

R5 = 1M

R6 = 10k

SMR1206:

C2  $\geq$  220n



- The stand alone version.

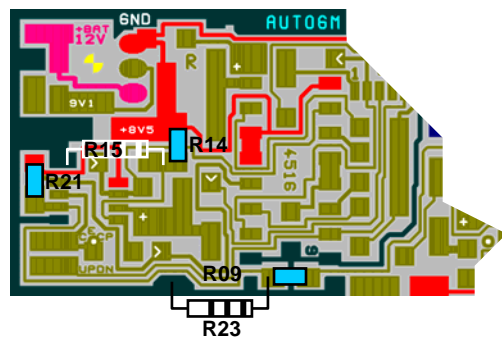
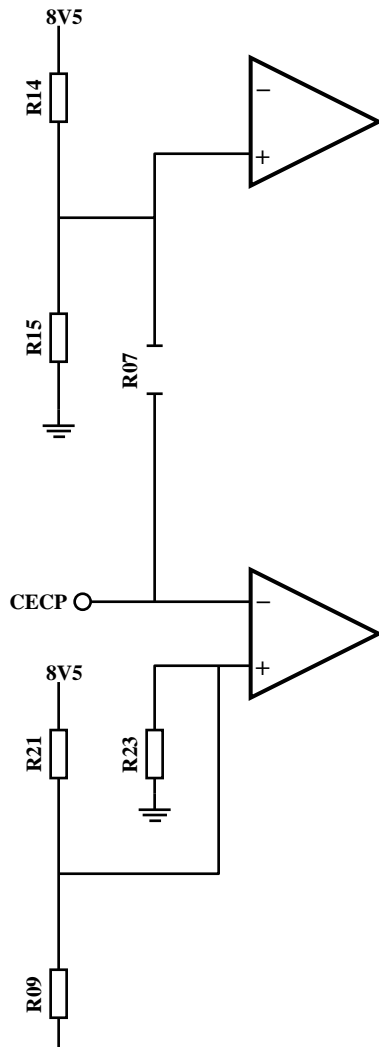
## PLACING OF COMPONENTS

### Arrangement on AUTOGM when using LFFGM for FULL AUTOMATIC-mode

*Only components that is specific to co-operate with LFFGM control function is shown here.*

3

#### Part of AUTOGM:



**SMR1206:**

**Exclude R07!**

R09 = 10k

R14 = 100k

R21 = 100k

**Hole mount resistors:**

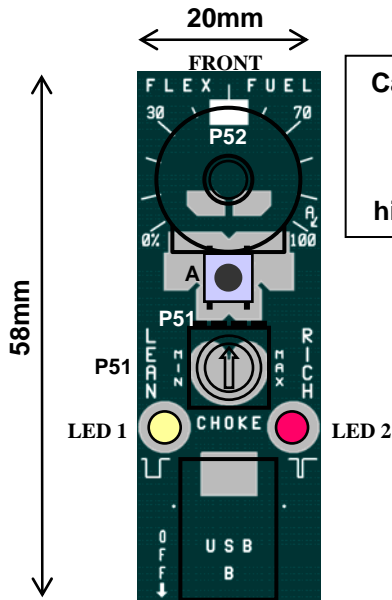
R15 = 10k

R23 = 10k

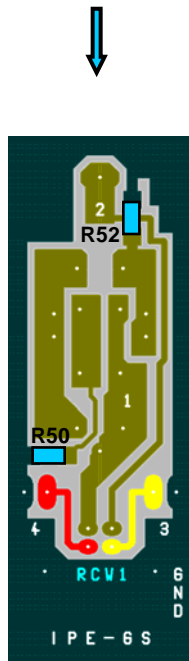
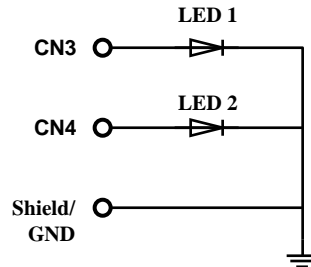
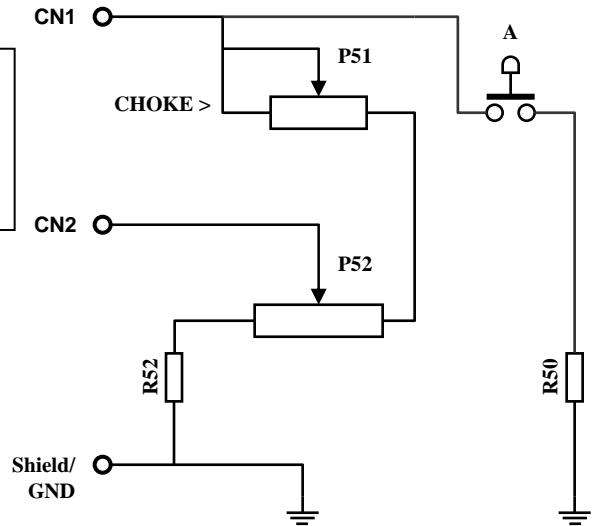
*Mount them like SMD components*

The set value is determined by the size of the GAP and the MID (on the LFFG-module). GAP is determined by P31 and MID by P32. The automatic regulation working best after “wide band” here. Set P31 to 15k and P32 to 4k7 or use common resistors instead of potentiometers. In order to make everything work properly must C4 on the baseboard (IPE-GS) be selected to 2200nF and further D4 ought to be mounted and C5 selected to 10uF.

# MODULE PLACING OF COMPONENTS AND CIRCUIT DIAGRAM



Can be used in automatic mode. P52 must be set high 70 - 100%



SMR1206:  
R50 = 100Ω  
R52 = 22k  
T5 in use

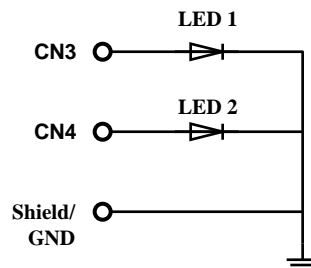
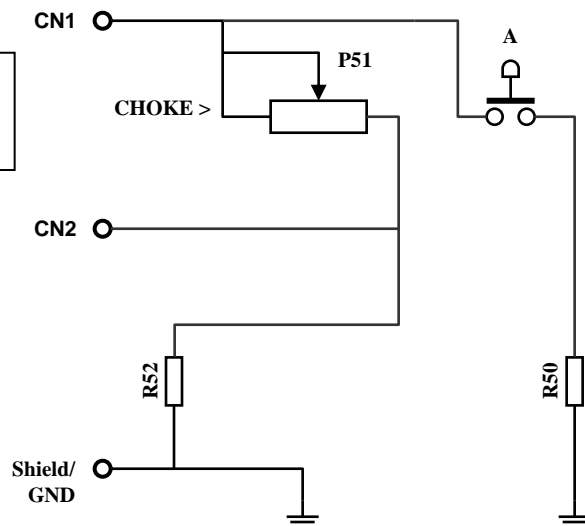
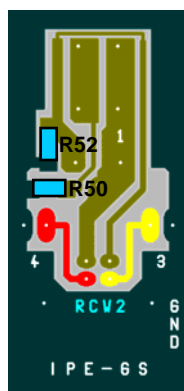
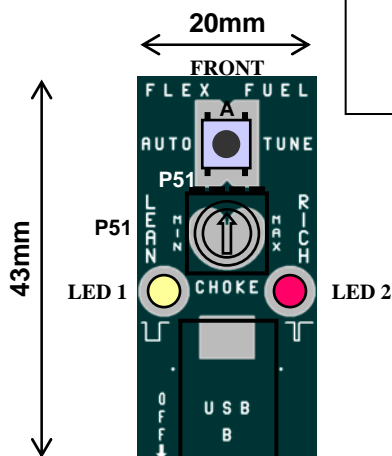
Other Components:  
P51 = 20k , 72PT , hole mount  
P52 = 10k , PT-15NV(17) , hole mount  
Also PT-10 / PTC-10  
USBB = USB Connector , PCB ELFA 42-708-98  
A = TACT-Switch, compact snap-in type  
LED1 = Yellow , EL1224UYC (or similar)  
LED2 = Red , EL1224SURC (or similar)  
LED's shall illuminate about 500 mcd.

If one want to turn off the IPE-function, you only need to unplug the RCW-module from the USB-cable

This module require a double side board and a number of holes must be drilled, since it contain both surface- and hole mount components.

PROJECT	Injection-period expander - GS	
MODULE	Remote control by wire	
MODEL	RCW1	
AUDIT	A-1	DRAWING: 1 of 1
OTHER	Working for manual or automat.	
B. Lindqvist		2010-01

MODULE PLACING OF COMPONENTS AND CIRCUIT DIAGRAM



**SMR1206:**  
R50 = 100Ω  
R52 = 33k  
T5 in use

**Other Components:**

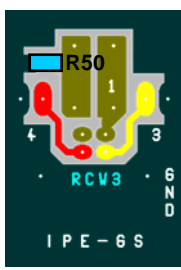
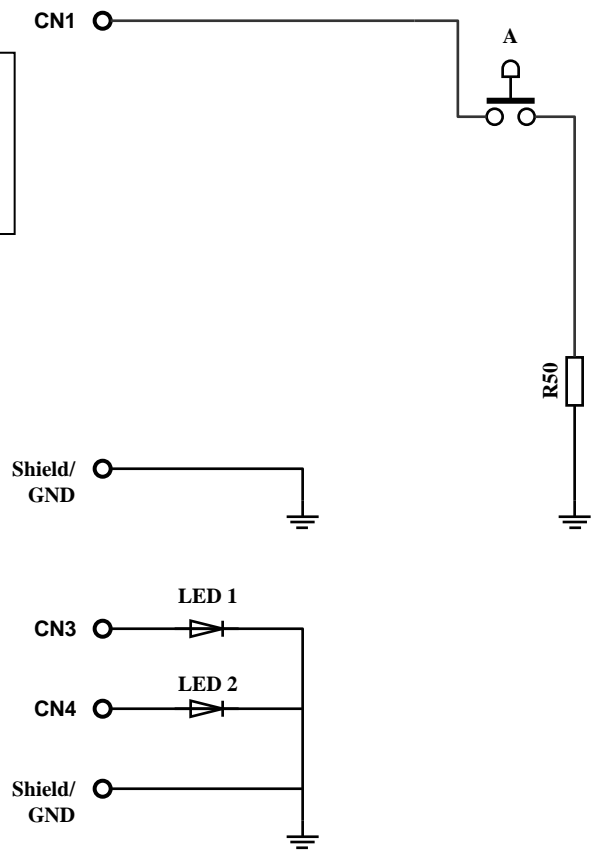
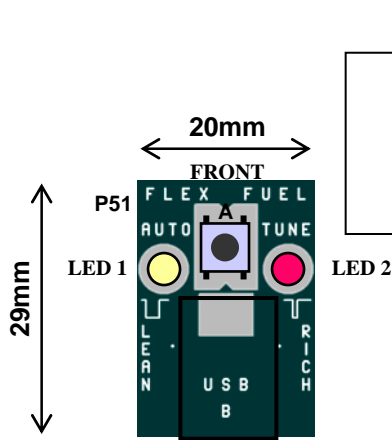
P51 = 20k , 72PT , hole mount  
USBB = USB Connector , PCB ELFA 42-708-98  
A = TACT-Switch, compact snap-in type  
LED1 = Yellow , EL1224UYC (or similar)  
LED2 = Red , EL1224SURC (or similar)  
LED's shall illuminate about 500 mcd.

If one want to turn off the IPE-function, you only need to unplug the RCW-module from the USB-cable

This module require a double side board and a number of holes must be drilled, since it contain both surface- and hole mount components.

PROJECT	Injection-period expander - GS	
MODULE	Remote control by wire	
MODEL	RCW2	
AUDIT	A-1	DRAWING: 1 of 1
OTHER	Working for semi or full automat.	
B. Lindqvist		2010-01

MODULE PLACING OF COMPONENTS AND CIRCUIT DIAGRAM



One can not turn off the IPE-function by unplugging the RCW-module from the USB-cable

SMR1206:  
R50 = 100Ω

Other Components:  
USBB = USB Connector , PCB ELFA 42-708-98  
A = TACT-Switch, compact snap-in type  
LED1 = Yellow , EL1224UYC (or similar)  
LED2 = Red , EL1224SURC (or similar)  
LED's shall illuminate about 500 mcd.

This module require a double side board and a number of holes must be drilled, since it contain both surface- and hole mount components.

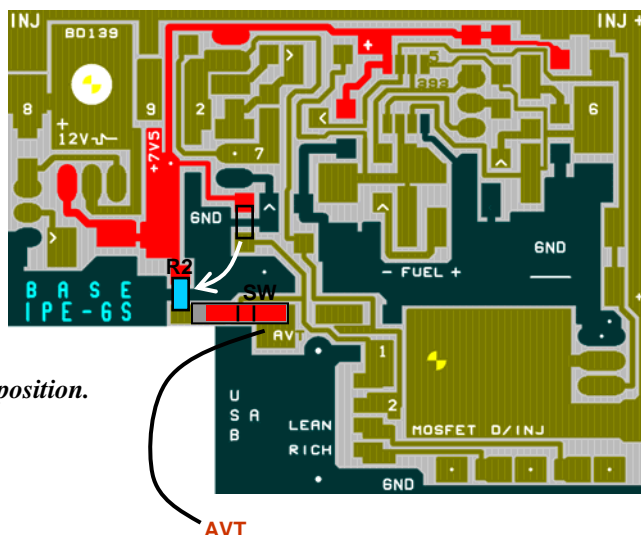
PROJECT	Injection-period expander - GS		
MODULE	Remote control by wire		
MODEL	RCW3		
AUDIT	A-1	DRAWING: 1 of 1	
OTHER	Working only for full automat.		
B. Lindqvist		2010-01	

## PLACING OF COMPONENTS

When you have build the module AUTOGM and decides to utilize that for automatic control in semi or full mode, you should adapt a switch on the IPE-GS baseboard. With the switch you can change between manual control and automatic control.

**This arrangement is for FULL or SEMI automatic function**

***With a switch can  
the unit shift to  
manual function.***



***In automatic mode:***

- *RCW1*
- *RCW2*

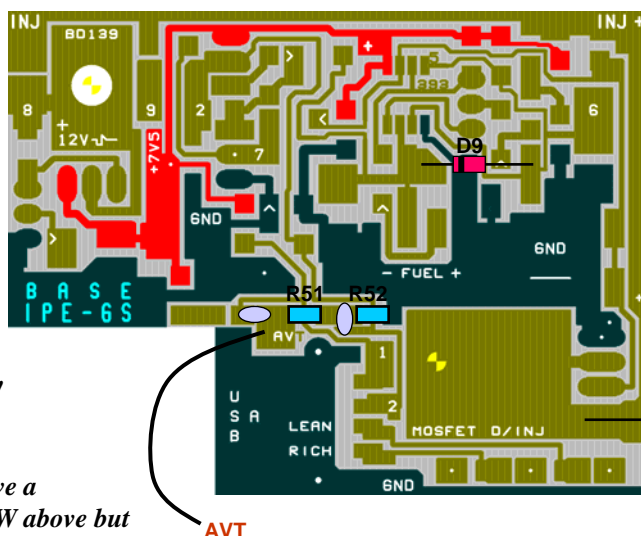
*In manual mode:*

- *RCW1*

*Move R2 to the new position.*

**This arrangement is only for FULL automatic function (no choke function)**

***With a switch can  
the unit shift to  
manual function.***



*In automatic mode:*

- *No RCW module*
- *RCW3*

*In manual mode:*

- *RCW1*

 = Solder jumper

***Exclude R2 and SW!***

*One can actually have a man/aut-switch as SW above but it must have two poles (and shall be located somewhere else), coz it also need to turn off the voltage divider: R51+R52 to CN2. The solder jumper will not be used then.*

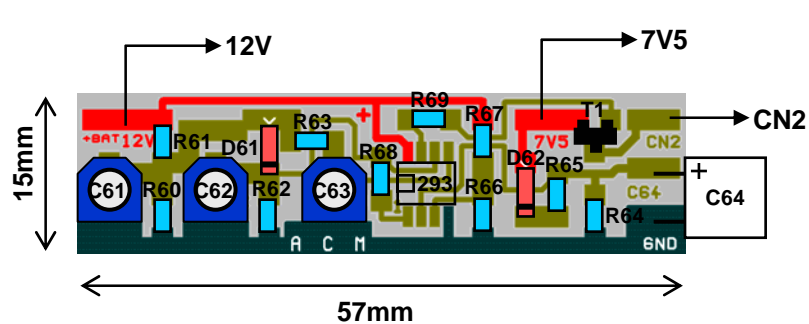
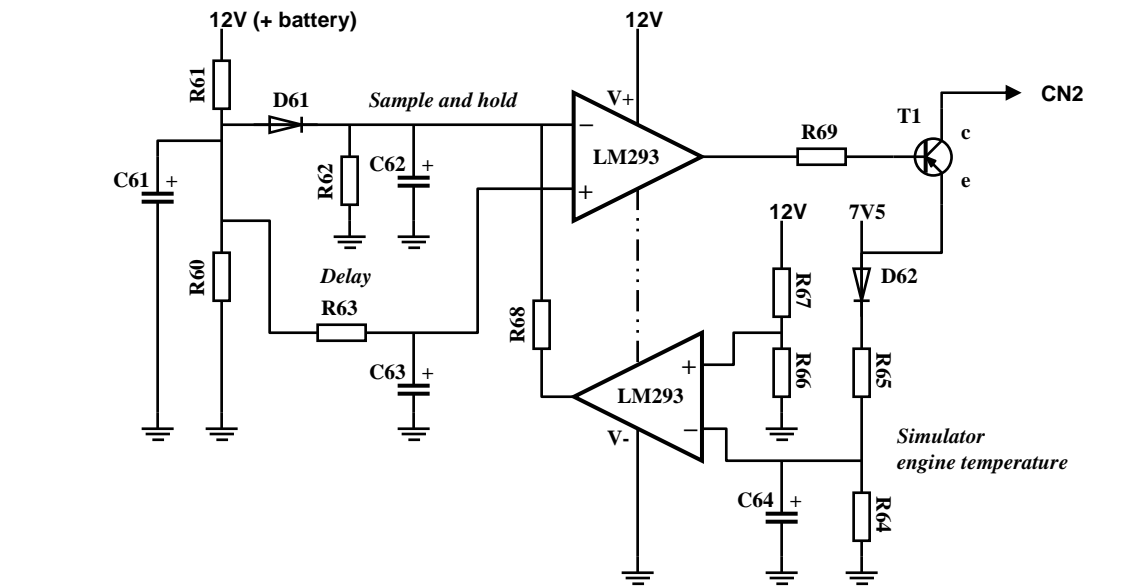
**SMR1206:**  
R2 = 100Ω  
R51 = 22k  
R52 = 33k

**Switch (man/aut):**  
SW = PCB-Switch (change over slide switch)



MODULE PLACING OF COMPONENTS AND CIRCUIT DIAGRAM

An automatic choke is necessary if one chooses to build a fully automatic fuel control, which do not necessarily have to be able to adjust or monitored (with an RCW-module), i.e. a completely sealed unit that takes care of itself. ACM satisfy the condition, when the module controlling the car battery voltage. If this falls below about 1 volt and the voltage does not rise after 2 sec. reacts ACM. A big electrolyte simulating the engine temperature. After the engine has been running for about 20 sec. switch ACM and become blocked, but becomes active when the engine is not used for an extended period of time - about 3 hours. ACM is tested in real environment.



- SMR1206:  
R60 = 330k  
R61 = 100k  
R62 = 10M  
R63 = 220k  
R64 = 10M  
R65 = 100k  
R66 = 100k  
R67 = 470k  
R68 = 2k2  
R69 = 4k7

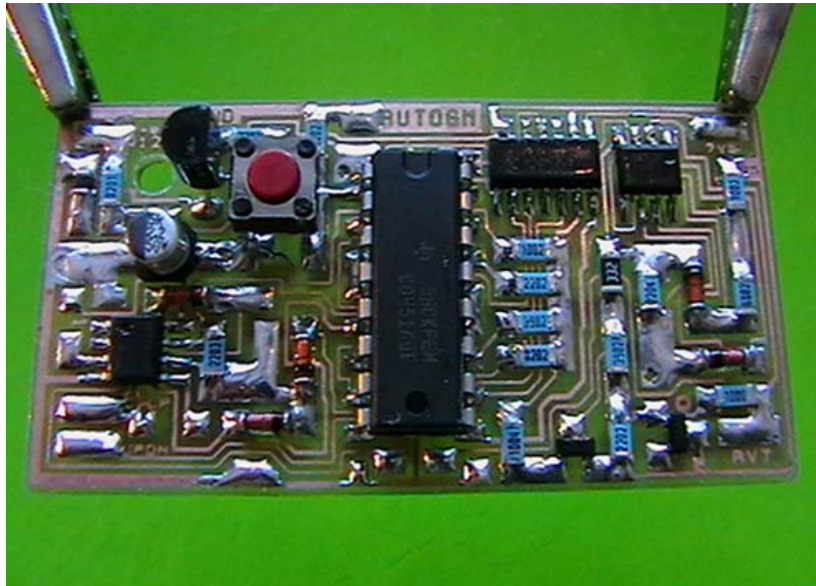
- Other components:  
C61-C63 = 22µ , 16V , E-lytic , SMD / hole mount  
C64 = 470µ , 16V , E-lytic , hole mount  
D61-D62 = BAS32 , SMD  
T1 = BC857B , SMD  
LM293 = Low power dual voltage comparators , SMD

The module requires only a single side board.  
No hole need to be drilled for any component.

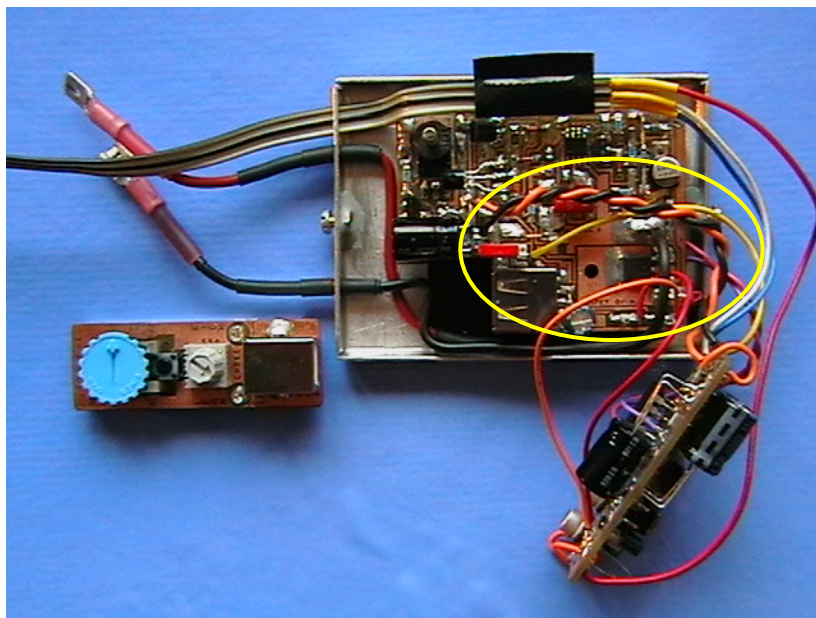
PROJECT	Injection-period expander - GS	
MODULE	Automatic Choke	
MODEL	AC	
AUDIT	A-1	RITNING: 1 of 1
OTHER	Zero-load current ~0.6mA	
B. Lindqvist		2011-04



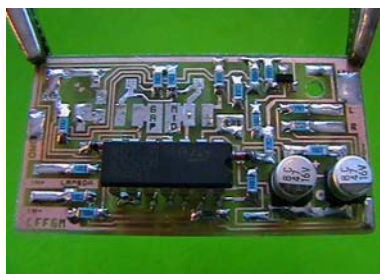
## PHOTOS



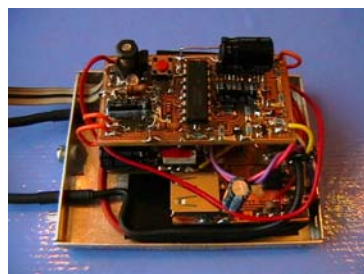
*AUTOGM (the most capacitors is missing here)*



*AUTOGM connected to IPE-GS (note; twisted power supply wire)*



*LFFGM (the underneath of AUTOGM)*



*Full automatic*