LAMBDA MANIPULATING DEVICE
LMD

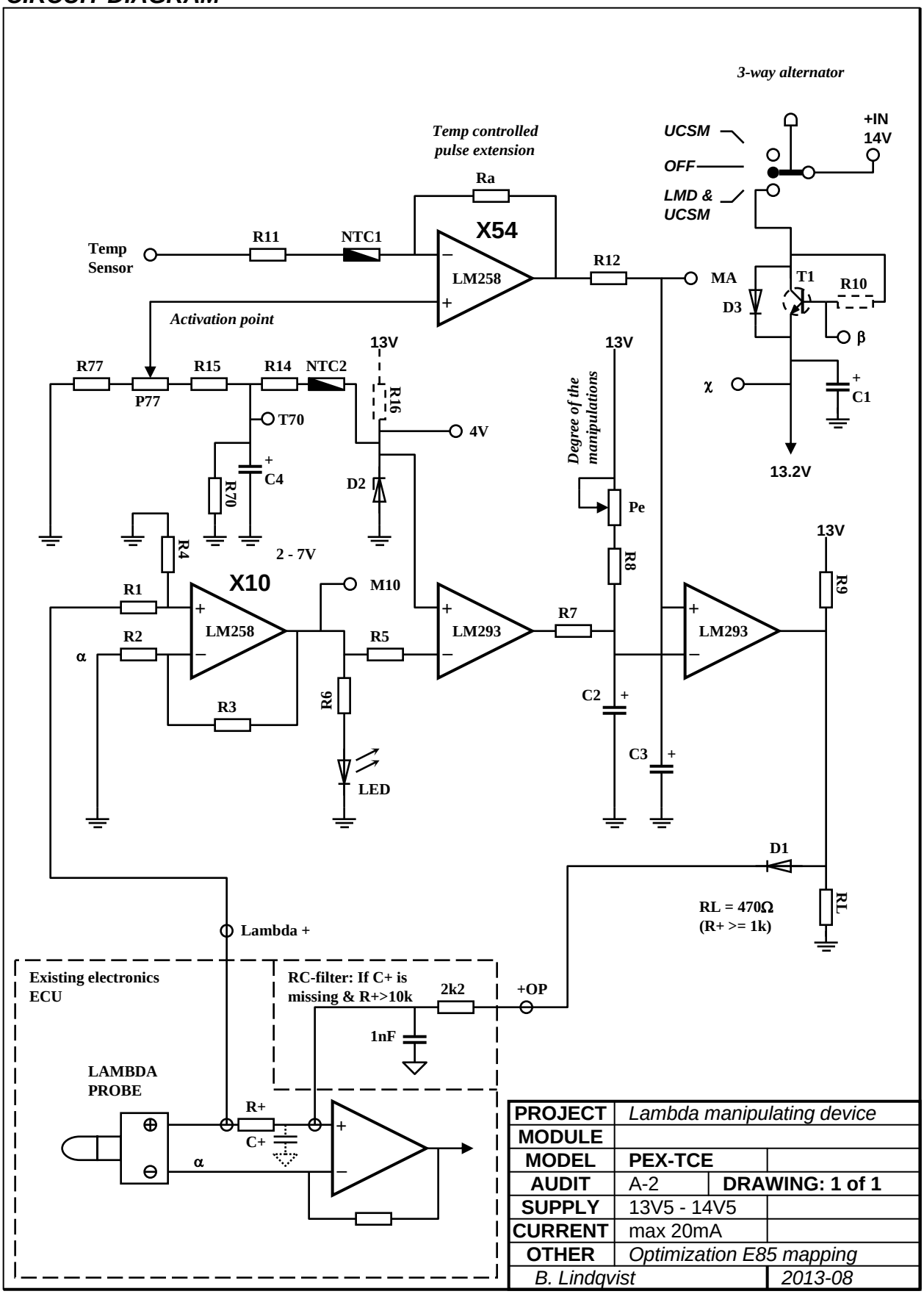
Can also be called: device for optimizing at E85 operation. Which then affects vehicles that are converted from petrol to ethanol - as the requirement of fuel differs slightly in comparison with petrol. LMD is available in three variants: PEX-TCE, PEX-SL and NEX. PEX-TCE (Positive EXtension - Temp Control Enrichment) is used to lean-driving where the SL variant is a slave module if there are multiple oxygen sensors. NEX (Negative EXtension) do the opposite of PEX does, i.e. fatty-up the engine and thus gives machines which not are adapted with today's rules about gasoline mixed up with ethanol - new life! *"extension" refers to the signal from the oxygen sensor. If one extend the positive section of the signal believes the computer that the engine runs fat and decrease the fuel supply. Conversely: If one extends the negative section will it corresponds to an engine running lean and the computer do the opposite - increasing the fuel.*

An LMD must be connected onto wires belonging to the oxygen sensor just before the operational amplifier or a comparator which the oxygen sensor outputs first is connected to. An intervention in the ECU or the fuel-computer is therefore necessary before one can begin using a LMD. The circuit diagram describes how to do it. A RC filter is recommended if any capacitor is visible or if there is a resistor with high impedance. The RC filter will then function as a protection against over voltage / interference - because all operational amplifier inputs are generally quite vulnerable. The oxygen sensor positive output can be connected without any extra protection.

LMD must be controlled by the engine temperature - to be able to work. The extension of the positive pulse should be done gently so the ECU does not perceive that any irregularities have occurred. The manipulation of the fuel supply is something an ECU (set for petrol) not opposes, because ethanol has a different character at high temperatures and should be adjusted downwards. The flammability of E85 depends on the temperature and is rather bad at low temps but much better at high temps. Tendencies of twitching or weakness at throttle is however something that can happen spontaneously when the pulse extension is in progress but does not usually cause problems. No manipulation on an oxygen probe may be made when an engine is cold or if one starting and driving after a short break. The manipulation must always sneaks in when the engine is warm and firmly run-in. Moreover must the enrichment of the fuel slightly be larger than normal when the engine is cold because the pulse extension is usually adjusted down when this device is in use.

PEX-TCE includes a UCSM (Under Cold Start Module) that is implemented on the LMD circuit (UCSM is a variant of CSD which now replaces the older CSC). It includes both choke and enrichment through the very rugged comparator LM239. PEX-TCE as a whole contains, thus everything needed to get an ethanol converted car to behave at a proper way besides the increase of an injector opening time - that not needs to be based on electronics, such as my IPE circuits. *LMD must therefore be linked to the temperature sensor (the one on the engine block). This assumes a standard sensor type K220 where the voltage at 80 degrees Celsius is close to 0.5 volts, although other configurations may work also. NEX is not limited by temperature or other parameter.*

CIRCUIT DIAGRAM

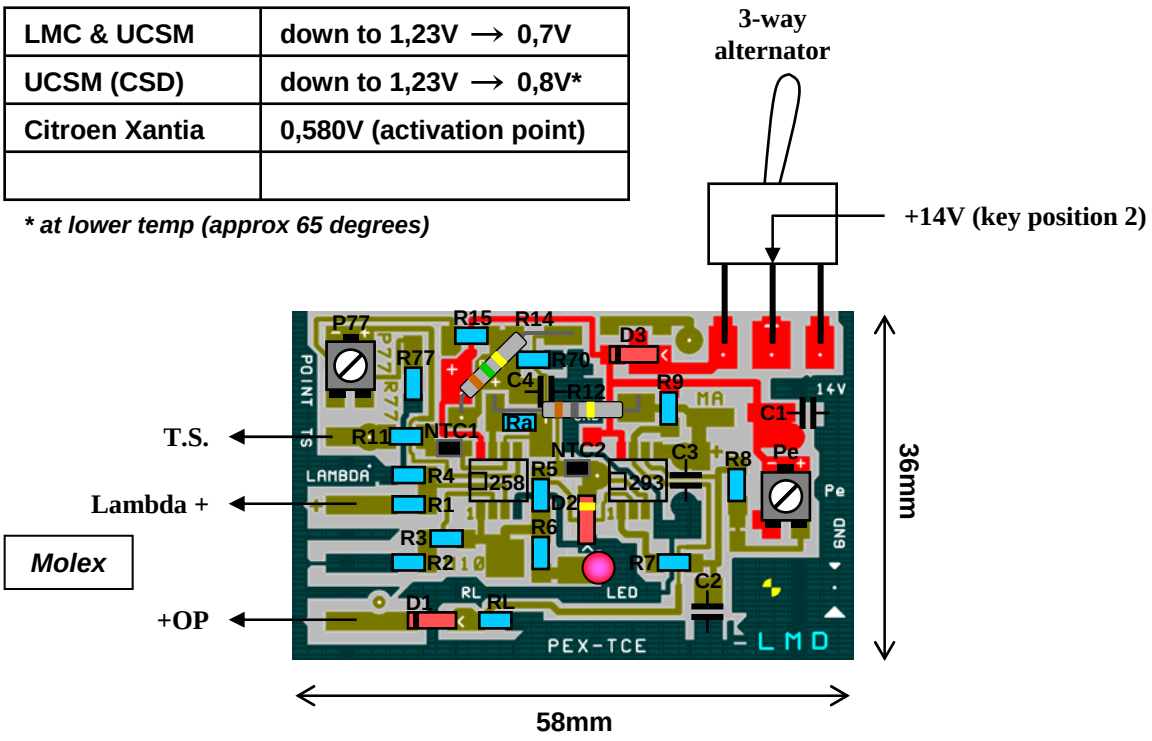


PROJECT	*Lambda manipulating device*	
MODULE		
MODEL	**PEX-TCE**	
AUDIT	A-2	**DRAWING: 1 of 1**
SUPPLY	13V5 - 14V5	
CURRENT	max 20mA	
OTHER	*Optimization E85 mapping*	
B. Lindqvist		*2013-08*

PLACING OF COMPONENTS

LMC & UCSM	down to 1,23V → 0,7V
UCSM (CSD)	down to 1,23V → 0,8V*
Citroen Xantia	0,580V (activation point)

** at lower temp (approx 65 degrees)*



SMR1206:
R1 = 100k
R2 = 100k
R3 = 1M
R4 = 1M
R5 = 22k
R6 = 1k
R7 = 4k7
R8 = 100k
R9 = 4k7
R10 = 4k7
R11 = 180k
R15 = 33k
R16 = 680Ω
R70 = 1M5
R77 = 27k
Ra = 10M
RL = 470Ω

if UCSM is abolished

Other components:
R12 = 180k , hole mount
R14 = 150k , hole mount
NTC1 = 4k7 (25ºC) , SMD
NTC2 = 1k (25ºC) , SMD
C1 = 22µ , 25V , E-lytic , SMD
C2 = 470n , plastic , hole mount
C3 = 220µ , 16V , E-lytic , hole mount
C4 = 1000µ , 6-16V , E-lytic , hole mount
D1 & D3 = BAS32 , SMD
D2 = BZV55-B3V9 , zener 3.9V , SMD
Pe = 500k , chiptrimpot 23B (center position) , SMD
P77 = 5k , chiptrimpot 23B , SMD
T1 = BC846B-NPN , SMD
LM258 = Low power dual operational amplifiers , SMD
LM293 = Low power dual voltage comparators , SMD
LED = EL264-7VRD Red , 3mm , hole mount
Toggle Switch 3-way (on-off-on) , hole mount

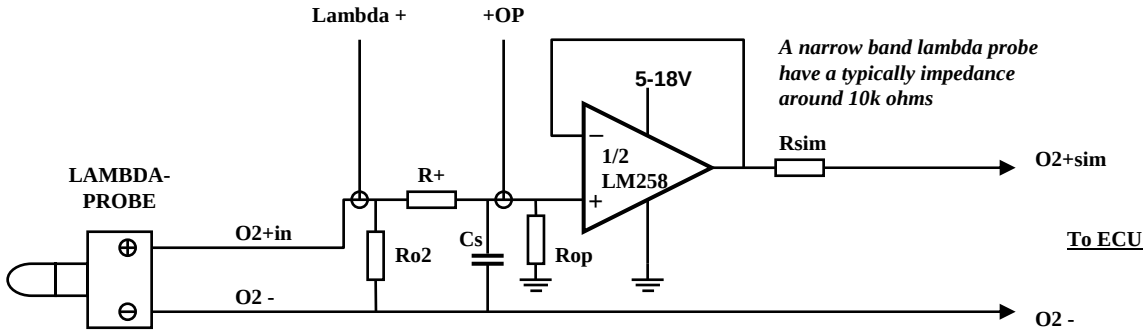
The circuit works with a single side board if UCSM is excluded, which assumes that both choke and enrichment exists (R16 is included then). All components should be handled as SMD, thus made, all soldering take place on the same side. Holes should be drilled for 7 pins.

PROJECT	*Lambda manipulating device*	
MODULE		
MODEL	PEX-TCE	
AUDIT	A-2	DRAWING: 1 of 1
OTHER		
B. Lindqvist		*2013-08*

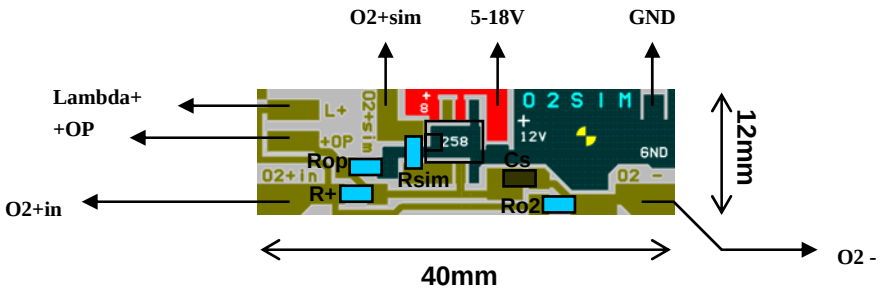
MODULE PLACING OF COMPONENTS AND CIRCUIT DIAGRAM

Many modern cars are hard to rebuild so the lambda probe can be modified in the manner that is described here. If one succeeds to open an ECU remains the problem to locate the resistance that is the first step towards the measuring circuit configuration. Maybe you have several different resistances to choose from and what can happen if not everyone are involved in the manipulation?

The solution is to disconnect the oxygen sensor from the ECU and then drag its terminals to an operational amplifier. The voltage follower output can then simulate the probe (where even "+OP" from any LMD variant can implement the manipulation). Then one feed the car's ECU with this signal.



The procedure entails that the cable to the positive terminal must be cut. The negative terminal just needs to be peeled so that a wire can be soldered. In total there will be three new wires which drawn to LMD. In addition to "O2+in", "OP-" and "OP+sim" needs LMD to be fed by 14 volts and be connected to GND (not included T.S). If one takes the rest from the ECU internal space, then the probes negative terminal can be included and you avoid peel off the cable at the outside.



SMR1206:
R+ = 47k
Ro2 = 2M2
Rop = 2M2
Rsim = 10k

SMC1206:
Cs = 100n

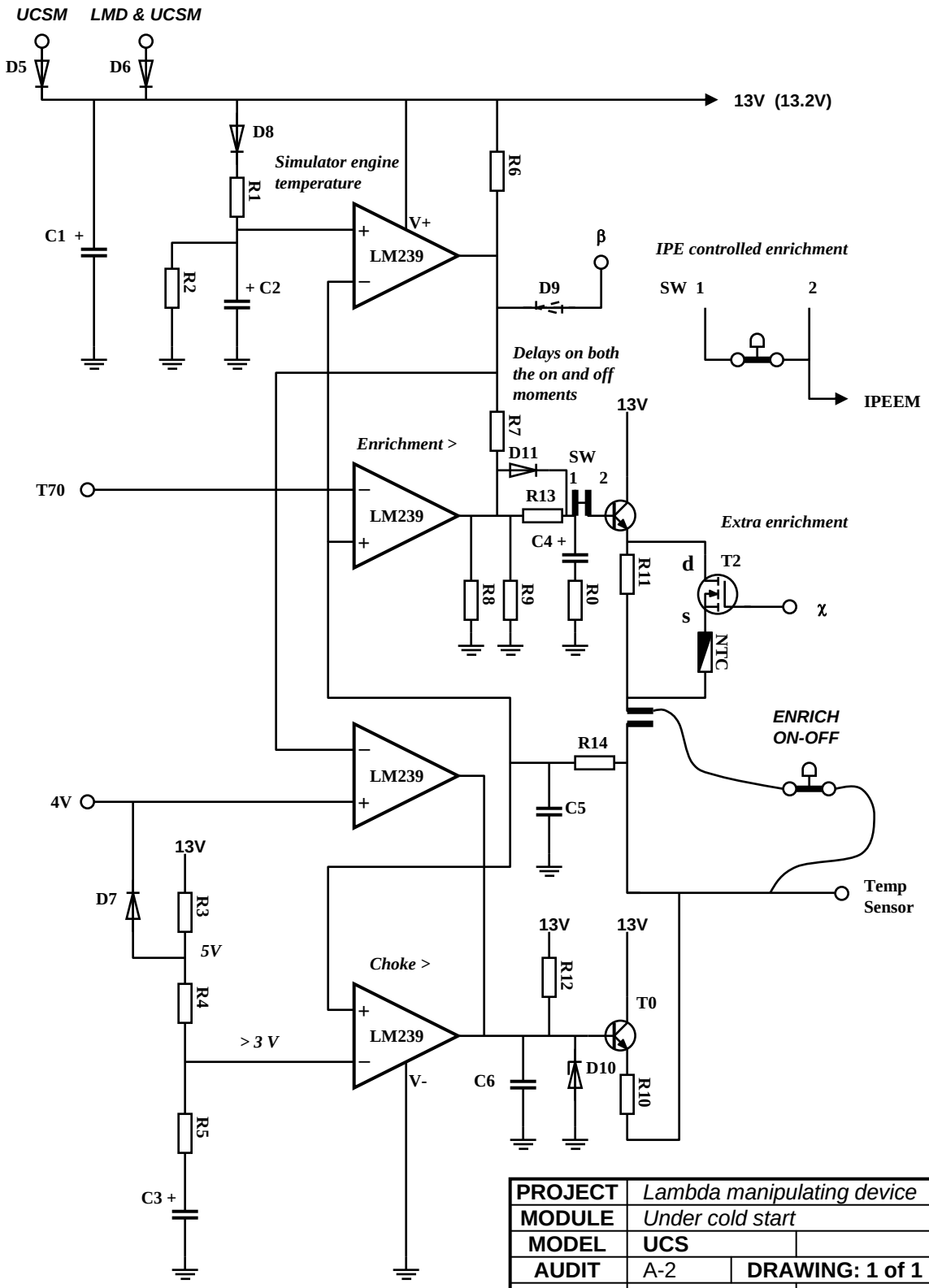
LM258 = SMD

To avoid the flank become too sharp (emulating a worn probe) from the time PEX enters and begins to manipulate the lambda signal: one can provide the PEX with a capacitor equal or lower than 22uF over RL (before D1). This capacitor can be soldered on the LMD board. For NEX: one could add a resistor from +OP to the output of the comparator, around 1M.

A single side board with surface mounted components. The module can be placed over and screwed with the same screw as the one belonging to LMD, plus a distance.

PROJECT	*Lambda manipulating device*	
MODULE	*O2 Simulator Module*	
MODEL	**O2SIM**	
AUDIT	A-2	**DRAWING: 1 of 1**
SUPPLY	12V (5-18)	
CURRENT		
OTHER	*Optimization E85 mapping*	
B. Lindqvist		*2017-04*

CIRCUIT DIAGRAM



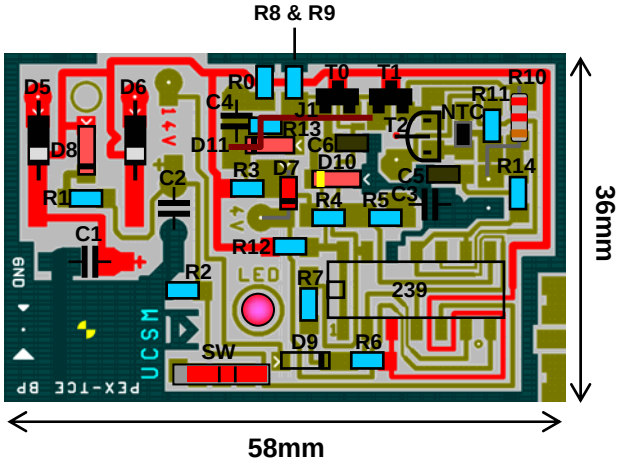
PROJECT	*Lambda manipulating device*	
MODULE	*Under cold start*	
MODEL	**UCS**	
AUDIT	A-2	**DRAWING: 1 of 1**
SUPPLY	13V5 - 14V5	
CURRENT		
OTHER	*Optimization E85 mapping*	
B. Lindqvist		*2013-08*

PLACING OF COMPONENTS

The set voltage 5V across R10 and R11 may not differ (should be identical to the feed the ECU has). It is only possible to realize it through the test and measurement method. Try different values on R3, R12, R8 and R9.

A low zener resistance increases the zener voltage while a high decreases it.

Remember that the voltage five volt over R11 depends on the supply voltage for just your vehicle, R12 and R13!



The LM239

Before soldering:
Fold all legs toward the middle!

SMR1206:	***SMC1206:***
R0 = 0Ω	**C5 = 100n**
R1 = 100k	**C6 = 100n**
R2 = 10M	
R3 = 560Ω	
R4 = 150-180k *15-20 °C*	
R5 = 220k	
R6 = 10k	
R7 = 100k	
R8 = 100k } *100-110k*	
R9 = ? }	
R11 = 2k2 — *K220*	
R12 = 4k7	
R13 = 470k	
R14 = 10k	

Other components:

R10 = 1k2 , hole mount (K220)
NTC = 47k (25ºC) , SMD
C1 = 22µ , 25V , E-lytic , SMD
C2 = 470µ , 16V , E-lytic , hole mount
C3 = 10µ , 16V , E-lytic , hole mount
C4 = 220µ , 16V , E-lytic , hole mount
D5 & D6 = 1N4007 , hole mount
D7 = 1N4148 , hole mount
D8 & D11 = BAS32 , SMD
D10 = BZV55-B5V6 , zener 5,6V , SMD
T0 & T1 = BC847B-NPN , SMD
T2 = BS170 or 2N7000 , N-MOS , hole mount
LM239 = Low power quad voltage comparators , hole mount
SW = PCB slide switch (only for mixed fuels)
J1 = Between the base at T1 to C4

Do not forget to sand the bridge over the D11/R13!

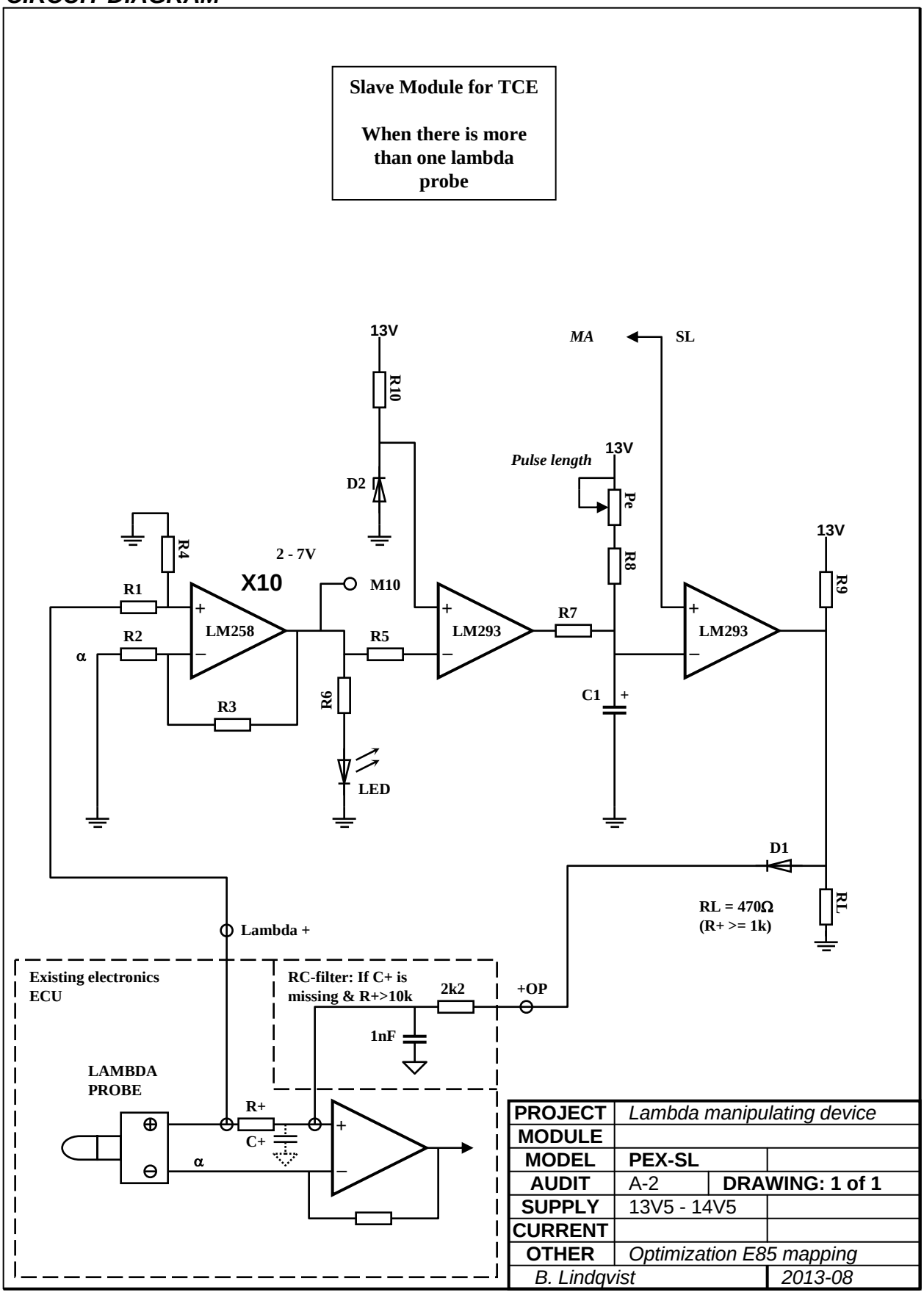
The size of R13 determines the time delay when the enrichment stops.

If there is extreme weather conditions with extreme cold should one reduce or halve the value of R2. The choke will so activated earlier.

This is the other side which therefore demands a double side board. All components should be handled as SMD, thus made, all soldering take place on the same side.
Holes should be drilled for seven pins.

PROJECT	*Lambda manipulating device*	
MODULE	*Under cold start*	
MODEL	**UCS**	
AUDIT	A-2	**DRAWING: 1 of 1**
OTHER		
B. Lindqvist		*2013-08*

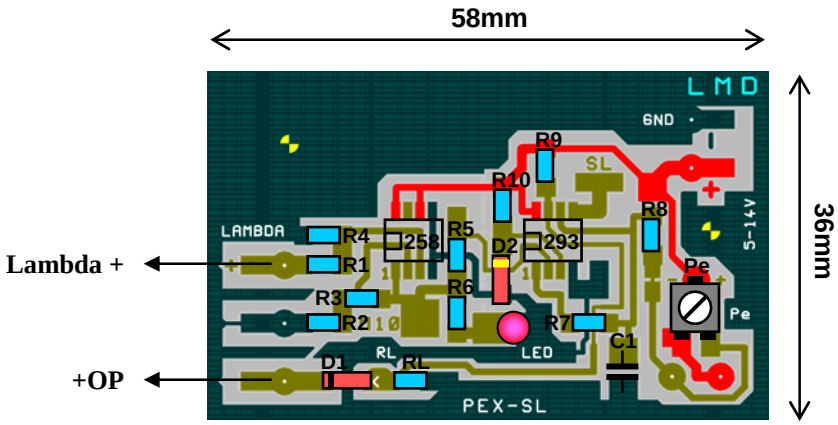
CIRCUIT DIAGRAM



PLACING OF COMPONENTS

Slave Module for TCE

When there is more than one lambda probe



SMR1206:

R1 = 100k
R2 = 100k
R3 = 1M
R4 = 1M
R5 = 22k
R6 = 1k
R7 = 4k7
R8 = 100k
R9 = 4k7
R10 = 680Ω
RL = 470Ω

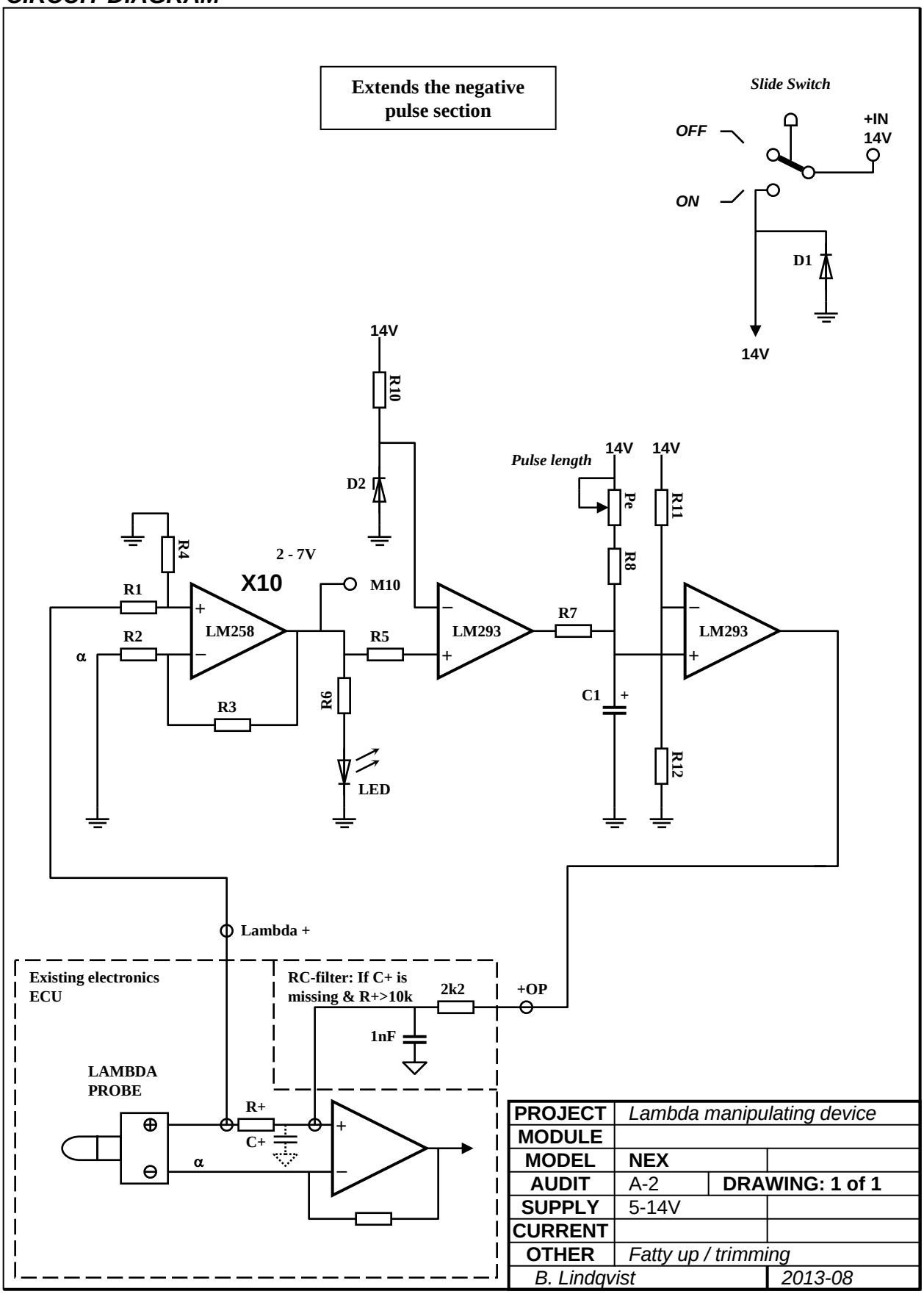
Other components:

C1 = 470n , plastic , hole mount
D1 = BAS32 , SMD
D2 = BZV55-B3V9 , zener 3.9V , SMD
Pe = 500k , chiptrimpot 23B (center position) , SMD
LM258 = Low power dual operational amplifiers , SMD
LM293 = Low power dual voltage comparators , SMD
LED = EL264-7VRD Red , 3mm , hole mount

Single side board. All components should be handled as SMD, thus made, all soldering take place on the same side.

PROJECT	*Lambda manipulating device*	
MODULE		
MODEL	**PEX-SL**	
AUDIT	A-2	**DRAWING: 1 of 1**
OTHER		
B. Lindqvist		*2013-08*

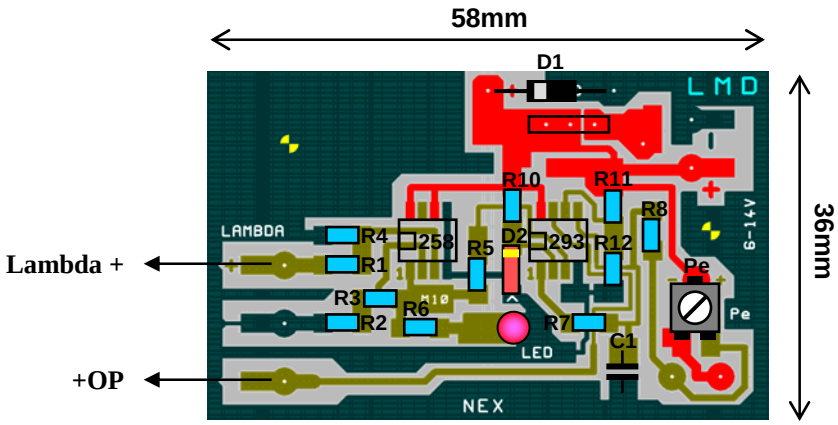
CIRCUIT DIAGRAM



PROJECT	*Lambda manipulating device*	
MODULE		
MODEL	**NEX**	
AUDIT	A-2	**DRAWING: 1 of 1**
SUPPLY	5-14V	
CURRENT		
OTHER	*Fatty up / trimming*	
B. Lindqvist		*2013-08*

PLACING OF COMPONENTS

Extends the negative pulse section



SMR1206:

R1 = 100k
R2 = 100k
R3 = 1M
R4 = 1M
R5 = 22k
R6 = 1k
R7 = 4k7
R8 = 100k
R10 = 680Ω
R11 = 100k
R12 = 470k

Other components:

C1 = 100n , plastic , hole mount
D1 = 1N4007 , hole mount
D2 = BZV55-B3V9 , zener 3.9V , SMD
Pe = 500k , chiptrimpot 23B (center position) , SMD
LM258 = Low power dual operational amplifiers , SMD
LM293 = Low power dual voltage comparators , SMD
LED = EL264-7VRD Red , 3mm , hole mount
Slide Switch

Single side board. All components except D1 and the switch should be handled as SMD, thus made, all soldering take place on the same side.

PROJECT	*Lambda manipulating device*	
MODULE		
MODEL	**NEX**	
AUDIT	A-2	**DRAWING: 1 of 1**
OTHER		
B. Lindqvist		*2013-08*