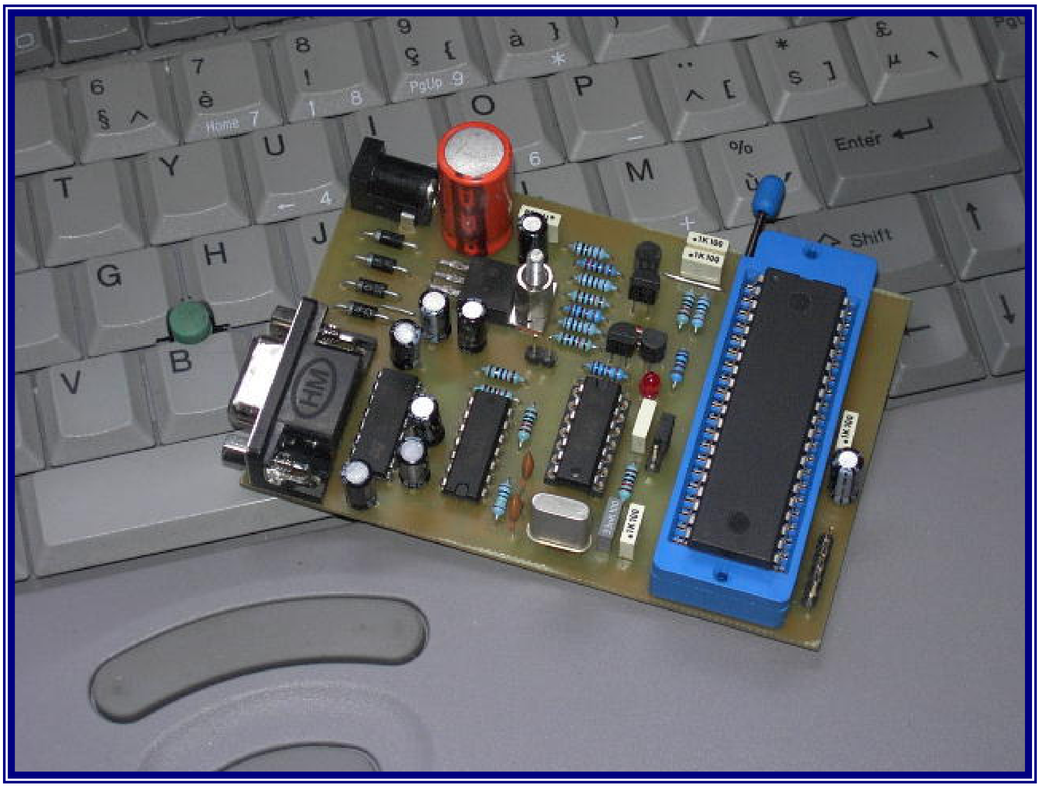
MEGAPROGRAMMER MC68HC908GP32



By Patrick Carlier

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1) INTRODUCTION

This programmer was designed to program the Motorola MC68HC908GP32 micropocessor , in combination with a personal computer , and the progsz08 free software by p&e micro systems .
It was developped for the Megasquirt group and it's offspring , altough it can be used for any MC68HC908GP32 based project .
Features are :
Single sided pcb 100*70 mm (3.9 * 2.7 Inch)
Uses only very comon parts . Sourcing them shouldn't be a problem .
Supports three kinds of oscillator types , and a various number of frequencies .
Uses a wallplug adapter pwr source , any AC or DC 6 to 24V adapter will do .
Designed to use a professional ZIF socket .

2) DISCLAIMER

This project is provided as it is . Great care has been taken in designing the circuit , the pcb and writing this manual . Sofar it has been buid by a number of persons and tested with succes on a various computers , including an 1.8Ghz computer with the latest P&E software . However the designer of this unit will not assume any responsability for hasards that came from using this unit .
Under no circumstances must it be used for devices that are related to life support systems .

3) CREDITS

Special thanks to Ola Cristofferson (Sweden) , SFCillari (The Netherlands) and Ingeom (location unknown) for their kind input in designing the schematic .

4) SOME SOLDERING TIPS

Make sure you have a nice clean working space .
Have all the tools you need available , and nothing more

On this picture , my voltmeter is missing .

More to come

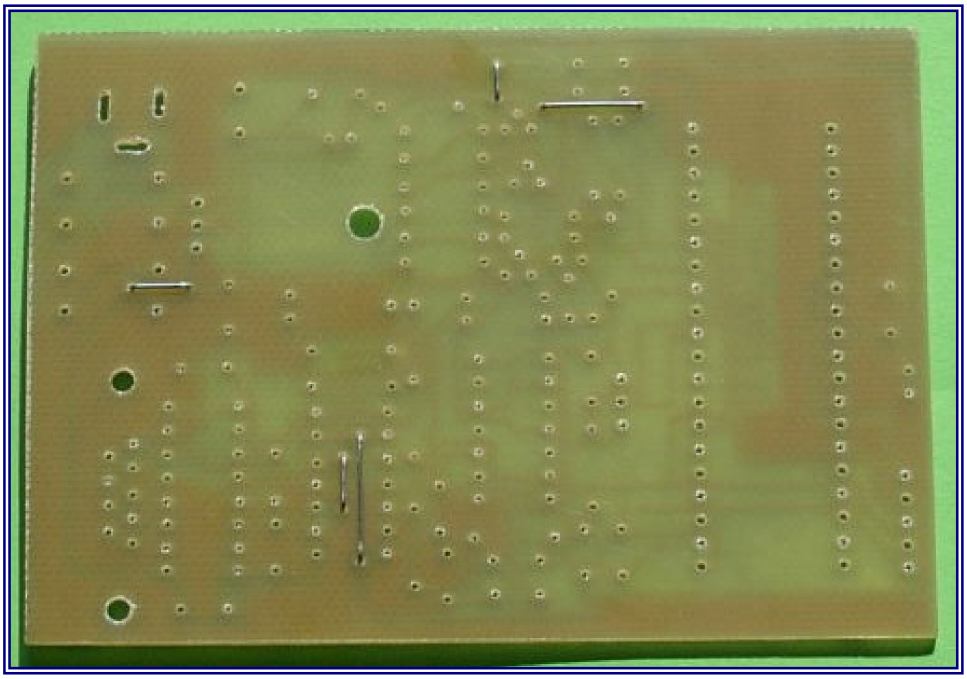
5) ASSEMBLY

The assembly of the programmer is done in a number of sections .
In each section , there will be some test procedures to see if things are working .
Never go to the next section if the test fails .
Orientation : in this manual , the board is always put in front of you with the components side up and the DB9 (serial port) connector in the lower left corner . Just like it' s printed in the silk screen page .

Section 1 : Pwr section

First things first : there are 5 wire bridges to be made . That's the price you have to pay for a single sided design . Cut the lead' s of some resistors and carefully bend them so they match the hole' s in the pcb , and solder them . The solder islands for the wire bridges are square the others are rectangular or round .

Also read "the low voltage mod " in the addendum .



5 Wire bridges . Note that these pictures don't have the low voltage mod .

Next , choose your power source :

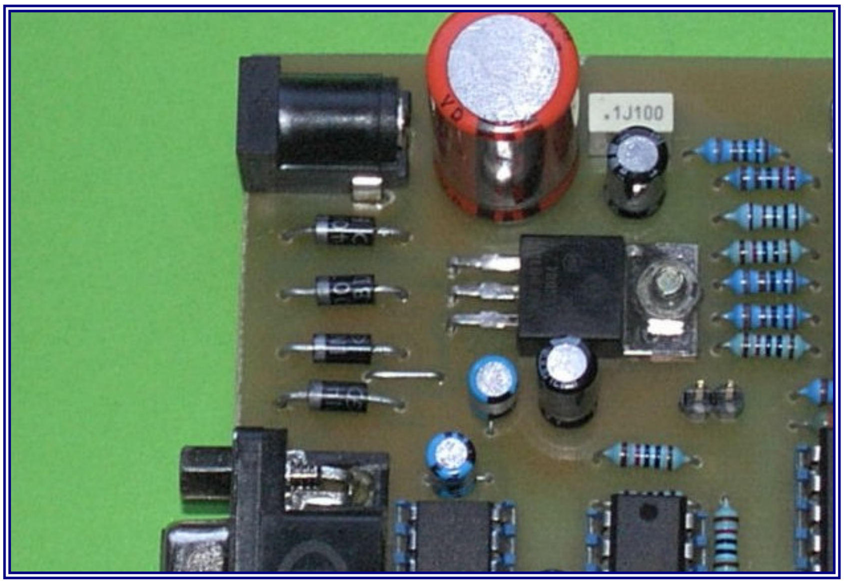
- You can have a high voltage source like a 12V AC or DC wallplug adapter . This is recomended .
  It's cheap , and if you want to build a megasquirt , you can also use it to power your stim . (DC only)
  We'll call anything above 10 Volt's high voltage .

- A 9Volt battery .

- A low voltage power source , like a calculator's 6 Volt adapter . Again AC or DC will do .
  Anything below 9 Volt is called low voltage .

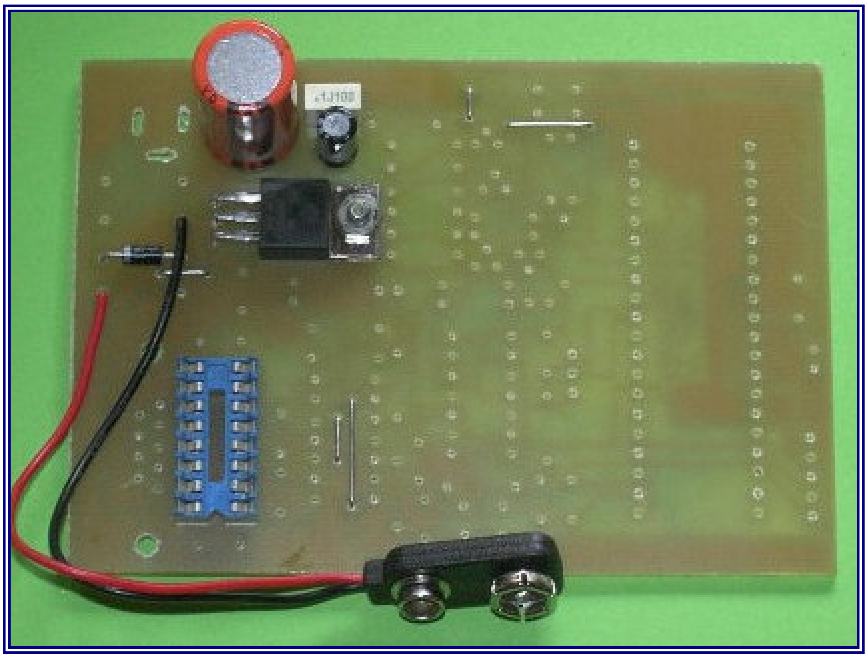
For High and low voltage adapters
Install and solder
D1 (1N400x)
D2 (1N400x)
D3 (1N400x)
D4 (1N400x)
PWR connector
U1 (7805)
C1 (470µF/25V)
C2 (100nF)
C3 (10µF/63V)
U4 socket (16 pin)

- D1,D2,D3 and D4 : the banded end points toward the left side .
- U1 , the 7805 voltage regulator . First bend the leads , put the component on the pcb and bolt it using theM3 bolt and nut . The nut has to be on the components side . Finally solder the leads
- C1 . Watch the polarity .
- C3 . Watch the polarity .
- U4 socket . the notch faces the lower -side of the pcb . Don' t put in the chip yet



For a 9Volt battery .
Install and solder
D2 (1N400x)
9V battery connector
U1 (7805)
C1 (470µF/25V)
C2 (100nF)
C3 (10µF/63V)
U4 socket (16 pin)

Install the plus lead of your 9 volt battery connector to the left hole of D1 .
Install the minus lead of the battery connector to the right hole of D3 .
Leave the other holes from D1 D3 D4 open.



9Volt battery setup

The low voltage mod
This is a last minute modification , so I don' t have any picture' s of it .
Right above R7 , there is a three pole header J6 .
At first , the circuit was designed to use a 12V adapter only . But with a small modification
a low vontage source like a calculator adapter can also be used .
Noramally , the Vtst source is taken from the 12 Volt adapter and reduced to 8.5 volt by U3 . If a low voltage source is used , it won' t be enough to drive U3 . But the max232 produces 9.5 volt' s , wich is just enough .
In case of a low voltage source , we use the max232 to powerU3 .

So , for a 12 Volt source , wire J6 to connect the center pin with the one on the left
And for a low voltage source , and a 9Volt battery , wire the center pin to the one on the right . Use a piece of wire from a resistor , just like the 5 bridges you just made

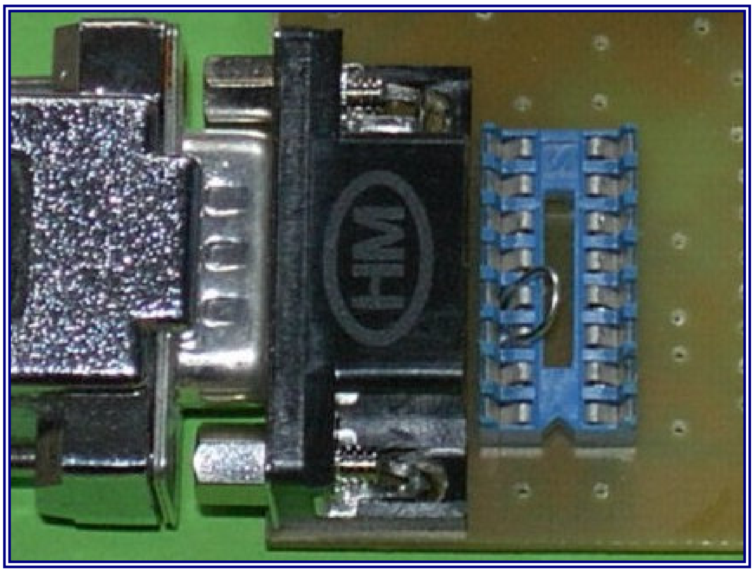
<u>Testing</u>
Get a suitable AC or DC power source . Because of the rectifier bridge D1..D4, the polarity is irrelevant .
If you use a 9 Volt battery , D2 protect' s the circuit from wrong polarity .

Plug it in , and see what happens .... Nothing ? no smoke or exploding parts ? That's the way we want it .
Use a voltmeter and measure the voltage on pin 15 and 16 of the U4 socket . Pin 15 is the negative or ground
You should read 5 Volt . If not , check the voltage on the banded end of D2 and the M3 nut. The nut is the nagetive lead . You should read the adapter voltage minus 2,4 volts , or 9 V battery minus 0.7 volts .
Check for bad solders , polarity of the diodes and capacitors .
Note that adapters with no load will easily produce 16 Volts . This is normal and won't harm the programmer .

Section 2 : Serial communications .

DB9 connector
Install and solder
J3 (DB9 Female)

Firmly press the part to the pcb . Be carefull not to bend the leads .
Now solder the two retaining clip's in the 2.5 mm holes .
Finally , solder the 9 pin's , be carefull not to make any short's .



The DB9 connector, pin 14 and 13 shorted .

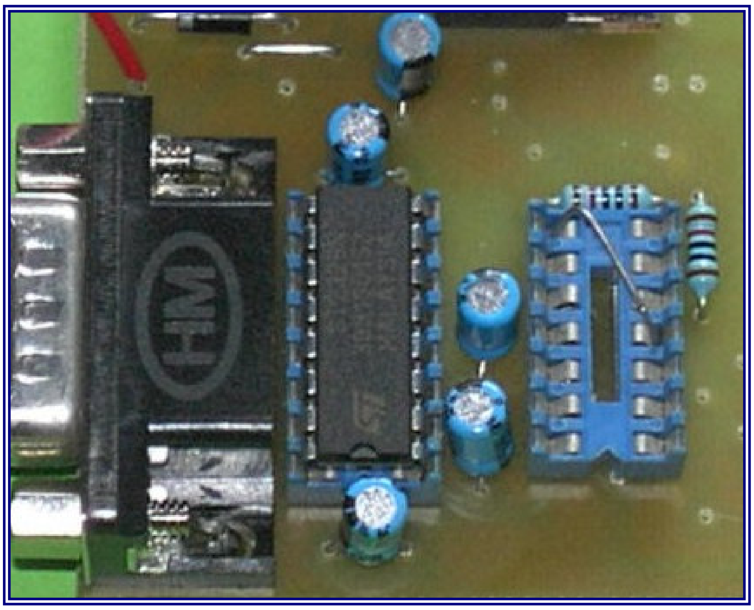
Testing
Get a straight trough 9 pin serial cable .and connect it to the pc .
Don't use a null modem or crossed cable . It won't work .
Load up hypertem or similar and set it to the com port you're using
Set the hyperterm flow control option to "none" .
On the programmer , short pin 14 and 13 of the U4 socket (see picture)

Connect the serial cable to the programmer , no pwr needed .
Now if you type any character , it schould be echoed back to the screen .
Remove the short from U4

More details on this procedure can be found on the megasquirt construction manual .

MAX 232 circuit .
Install and solder
C5 (1µF/50V)
C6 (1µF/50V)
C7 (1µF/50V)
C8 (1µF/50V)
C9 (1ùF/50V)
R10 (10K)
R11 (10K)
U2 socket (14 pin)
U4 (MAX232 Chip)

All 1uF /50V capacitors , observe the polarity for each part .
U2 socket , the notch faces down .
Carefully put the max232 chip in it' s socket , the notch facing down .



MAX232 Circuit

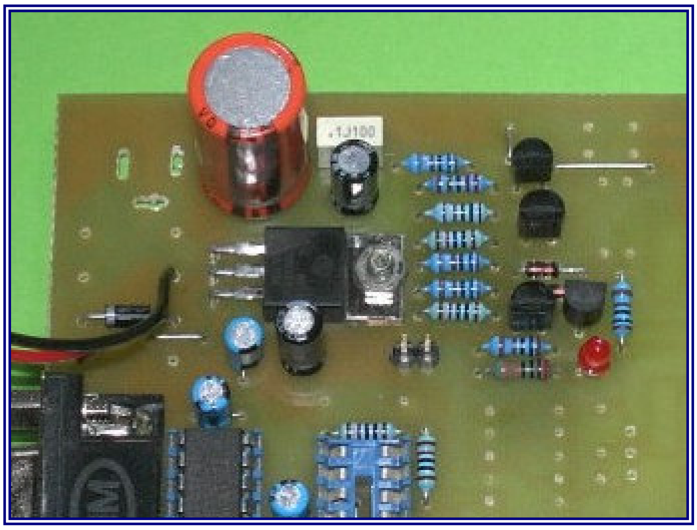
<u>Testing</u>
Put a short on the U2 socket , pin' s 8 & 4 .
Apply pwr to the board , and repeat the above loopback test .
If it work' s , your max 232 is functioning correctly .
Remove the short from U2

Section 3 : Pwr control circuits

Install and solder
R2 (10K)
R3 (1K)
C4 (10µF/63V)
R4 (330Ω)
D5 (led 3mm red)
R6 (1K)
T1 (BC308)
D6 (1N4148)
J2 (2P header)

Test : pwr the circuit , and jumper the man pwr connector . The led should burn .
Remove the jumper and connect the banded end of D6 to the ground with a wire .
(Use the nut on U1)
The led should come on again .

Install and solder
R9 (10K)
R12 (1K)
D7 (1N4148)
T3 (BC308)
R1 (1K)



Finished PWR control' s

Test : pwr the circuit , and measure the voltage on the right lead of R1 .
You should read nothing . Now connect the banded end of D7 to ground .
The led comes on , and you should read something like 12 Volts . Anything above 9 volts is good .

<u>Install and solder</u>
R5 (2K2)
R7 (1K)
U3 (LM431)
J5 (5P header)

<u>Test</u> : pwr the circuit , and measure the voltage on the icp header ' s center pin .
You should read nothing
Now tie the banded end of D7 to ground , the led comes on again and you should measure 8,5 volt' s .

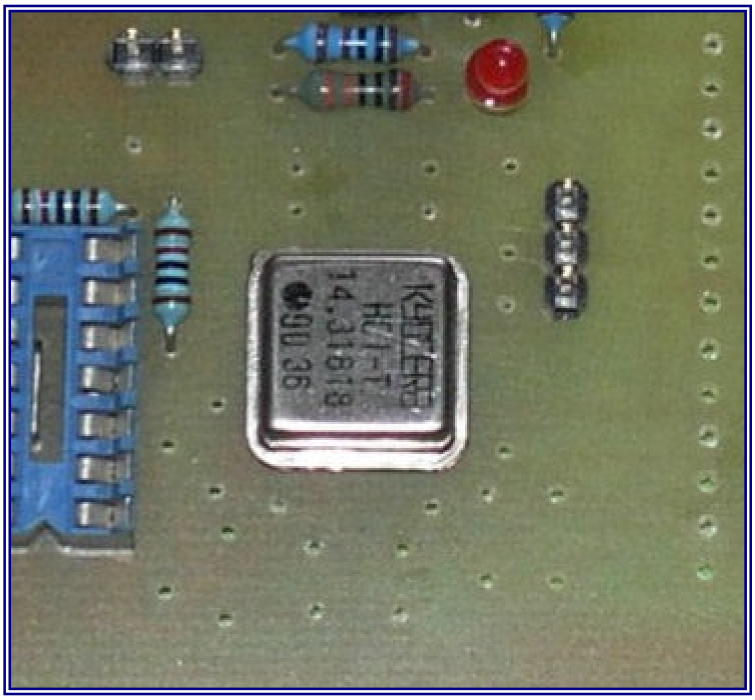
<u>Install and solder</u>
R8 (1K)
T2 (BC337)

<u>Test</u> : apply power and connect U2 socket pin 11 to VCC . You can find VCC on the left pin of J2 .
The led should come on .

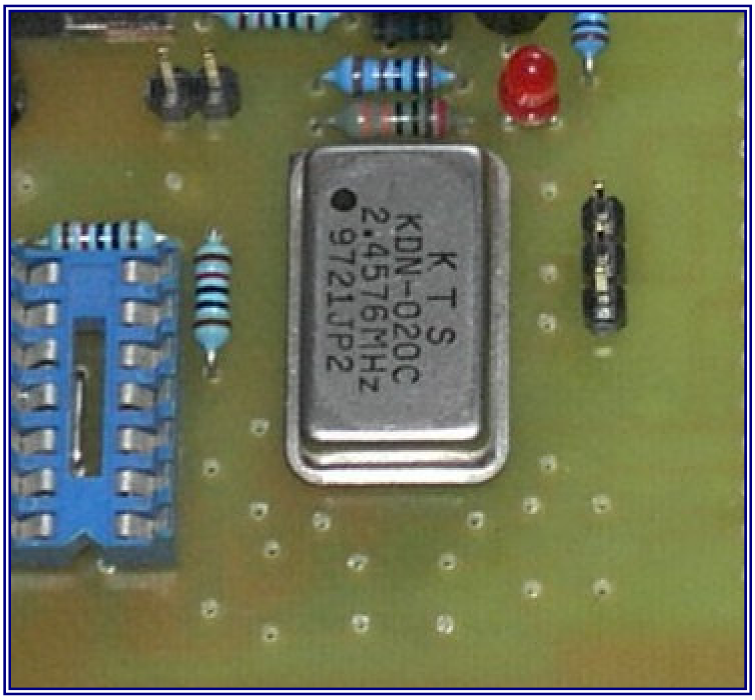
Section 4 : Oscillator section .

The programmer is capable of holding three different oscillator' s .
You choose only 1 setup . This depends on what' s available in your local store or if you bought a kit , it depends on what' s available in my local store . Oscillators can be exchanged freely , meaning if you build the board for an osc type 3 , you can still remove U5 from it' s socket and install a caned oscillator type 1 or 2 afterwards . The parts surrounding U5 are non interfering .

Osc 1 :
A caned oscillator dip 8 .
Has to be installed on the lower half of U4 . Pin 1 of the oscillator corresponds to the little round pad , pin 4 of U4.
You can solder the part to the pcb (recomended) or use an ic socket if you want to be able to exchange oscillators later on .

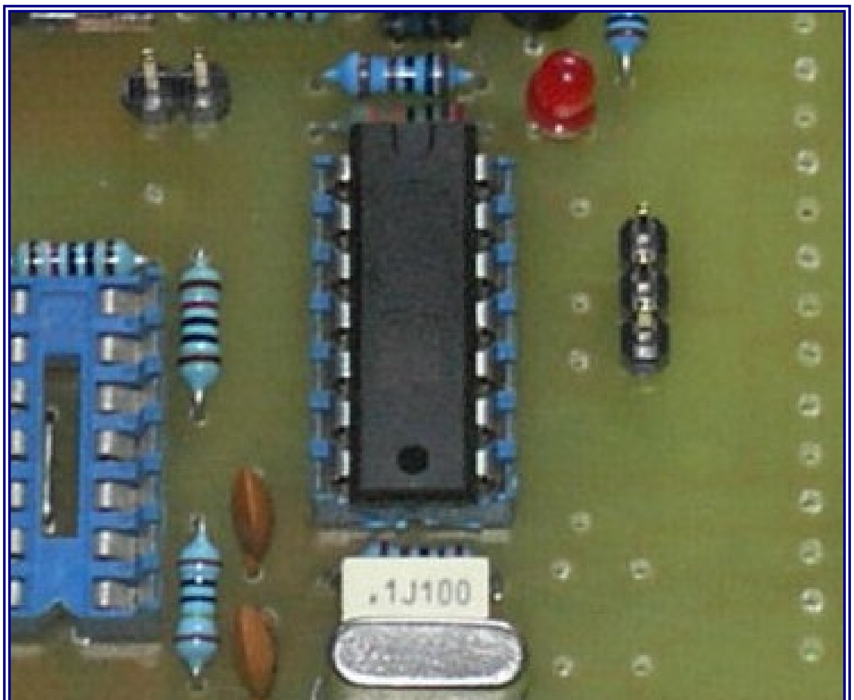


Osc 2
A caned oscillator dip 14 .
Has to be installed instead of U4 . Pin 1 of the oscillator corresponds to pin 1 of U4 .
You can solder the part to the pcb (recomended) or use an ic socket if you want to be able to exchange oscillators later on .



Osc 3
An oscillator using a common crystal , and a few parts .
Install and solder
R17 (1M)
R18 (2K2)
C17 (100nF)
C18 (30pF)
C19 (30pF)
U5 Socket (14 pin)
X3 (crystal)
U5 (74HCU04)

Plug in the 74HCU04 .
Make sure you have the right part 74HC**U**04
A 74HC04 WON' T WORK . The U stand' s for unbuffered , and we need that to make the oscillator work .



Test : for any kind of osc : Apply power , and measure voltage at ICP PIN5 You should read nothing much
Short the man pwr header , you should read roughly 2,5 volts .

A word on osc frequency versus baudrate
The software from P&E supports a number of baudrate' s .
On the programmer these correspond to a certain oscillator frequency . The programmer also has the possability to choose between two dividers for the chip' s internal bus frequency . It' s J4 , located near the zif socket .
This gives the following possible combinations

P&E Baudrate	J4 Jumper	Osc frequency
28800	X2	29.4912 Mhz
19200	X2	19.6608 Mhz
14400	X2	14.7456 Mhz
9600	X2	9.8304 Mhz
4800	X2	4.9152 Mhz
28800	X4	14.7456 Mhz
19200	X4	9.8304 Mhz
14400	X4	7.3728 Mhz
9600	X4	4.9152 Mhz
4800	X4	2.4576 Mhz

I' ve learned that frequency isn' t that critical .
A 10 Mhz crystal will work fine at 19.200 baud with X4 and at 9.600 with X2
A 14.31818 Mhz caned oscillator will also work perfectly at 28.800 and 14.400 Baud .
So , if you source the parts yourself , check with your parts supplier what' s available .
If you have a choice , choose the highest frequency .
If none' s available , choose a 10Mhz crystal or oscillator .

Section 5 : Zif socket

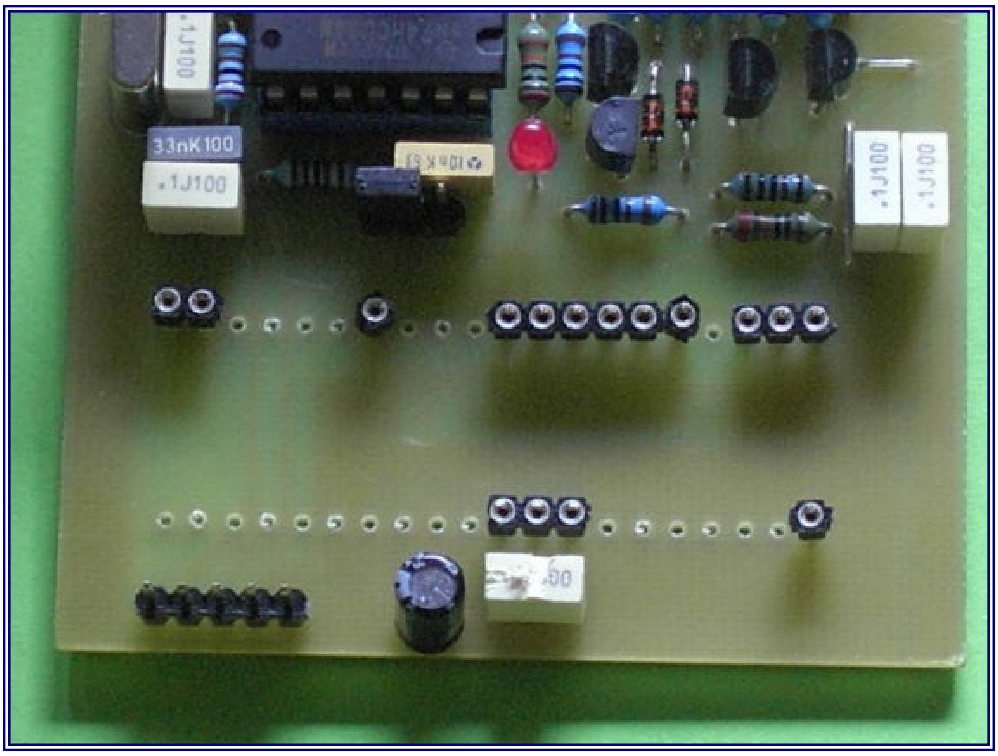
Install and solder the following parts :
R13 (10K)
R14 (100K)
R16 (10K)
C10 (100nF)
C11 (10nF)
C12 (33nF)
C13 (100nF)
C14 (100nF)
C15 (25µF/63V)
J4 (3P header and jumper)
Put U2 in it' s socket
The MCU socket , either a zif or some loose contact' s .

The use of a zif socket :

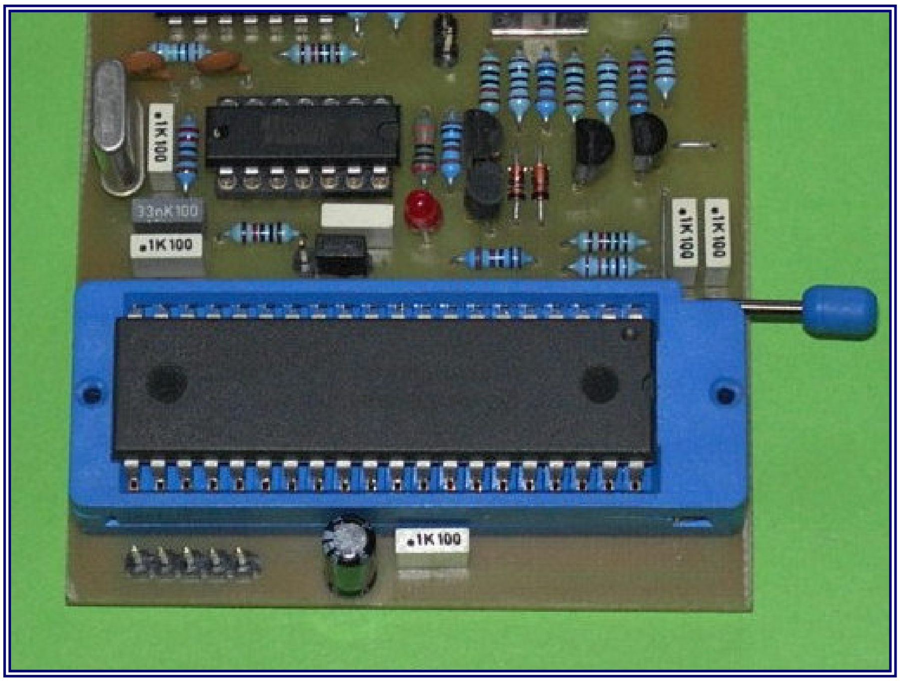
Zif socket' s (zero insertion force socket' s) are expensive . In fact the price of the socket is about 1/3 the cost of the entire programmer . If you intend to use the programmer more then a few times on thesame processor ... buy one . Processor leads are easily damaged .

If you don' t want to buy a zif , you can use some loose ic contacts . In that case , you only need to put
15 contact' s on the board . Don' t put on more as you' ll only put more stress on the processor .
To know wich pad' s needs contact' s , look at the pcb , and see wich pad' s have a lead

PAd nr' s are : 1,2,3,5,6,7,8,10,14,19,20,31,32,33,and 40.
Note that on the pic below , pad Nr 9 has a contact . It' s not really needed , its just easier to solder the entire row .



No zif .



ZIF !

<u>Final test'</u> s
Hook up power , short the man pwr .
Check the voltage ' s at the following pin' s of the MCU socket .

1 and 2(gnd) 5 Volt
31 and 32(gnd) 5 Volt
20 and 19(gnd) 5 Volt

Now the big moment has arrived ....
Disconnect the man pwr , and put in a MC68HC908GP32 chip .
Connect the serial cable and start progsz08 .
Choose the correct baudrate , according to your oscillator frequency and the position of the div jumper .
If the jumper is shortening the center and the lower pin , then you' re wired for X4 if the jumper is shortening the center and the upper pin , it' s X2 .
If it all goes right , the programer should connect on the first attempt

Good luck !!

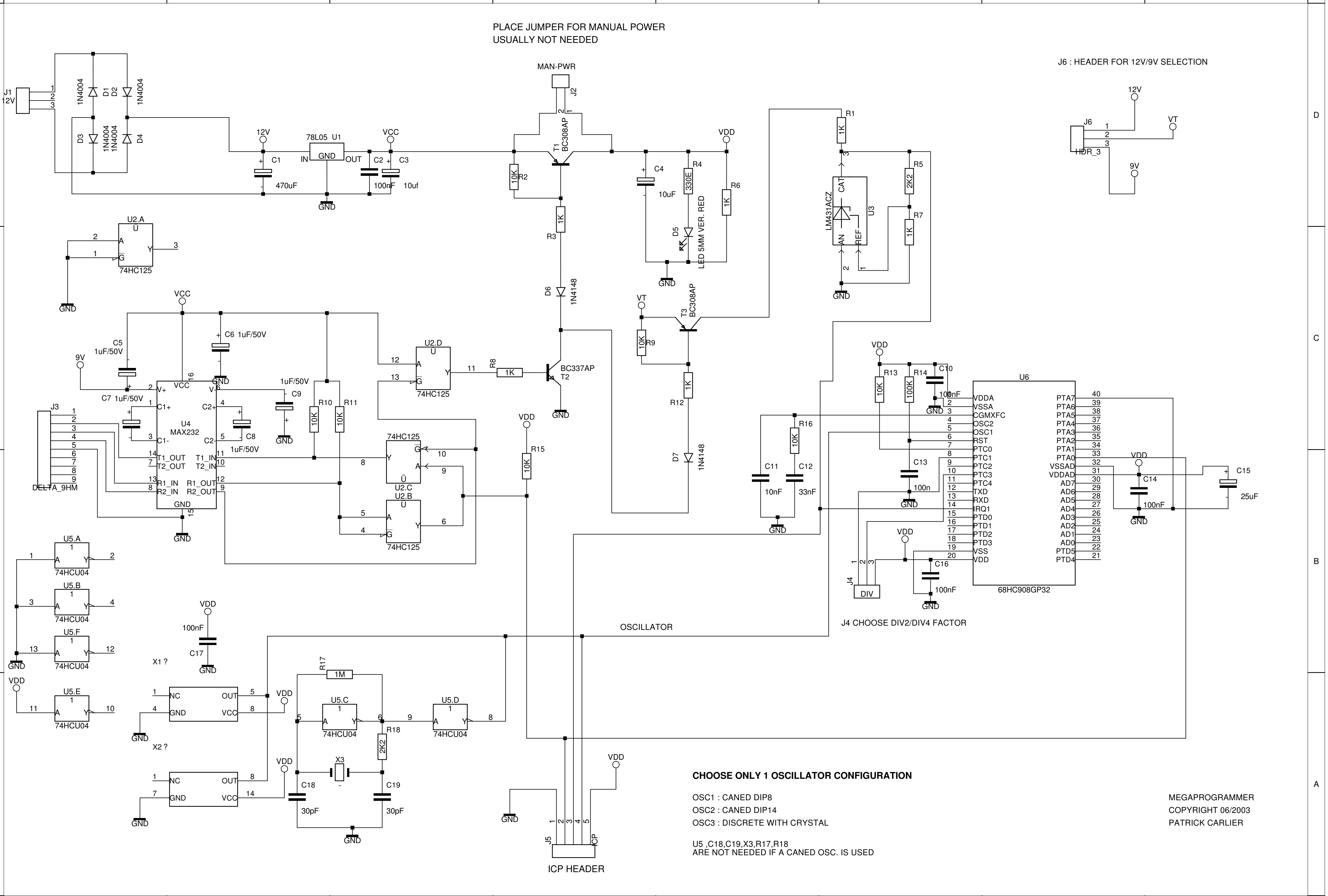
Patrick Carlier

6) ATTATCHMENTS

A. Ordering stuff

I will be able to provide PCB, partial kits, full kits and assembled and tested units. Contact me at p.carlier@pandora.be.

If there is enough demand I' ll organise a group buy for the PCB . I can get real good prices for 50 pieces.



CHOOSE ONLY 1 OSCILLATOR CONFIGURATION

OSC1 : CANED DIP8
OSC2 : CANED DIP14
OSC3 : DISCRETE WITH CRYSTAL

U5 ,C18,C19,X3,R17,R18
ARE NOT NEEDED IF A CANED OSC. IS USED

MEGAPROGRAMMER
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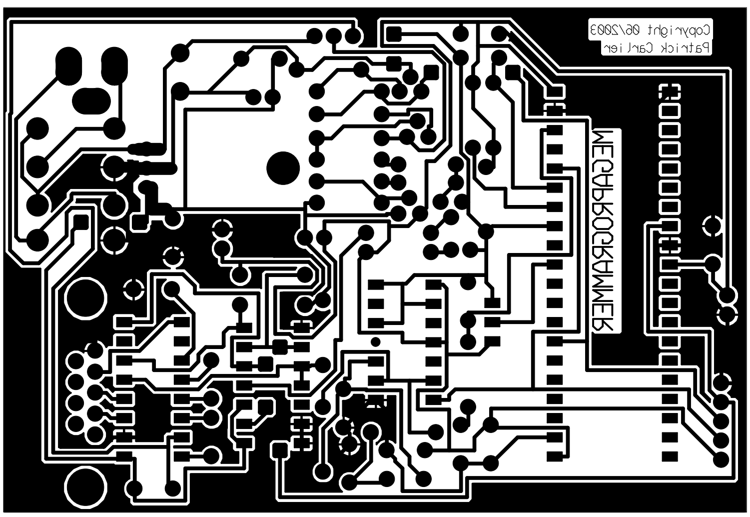
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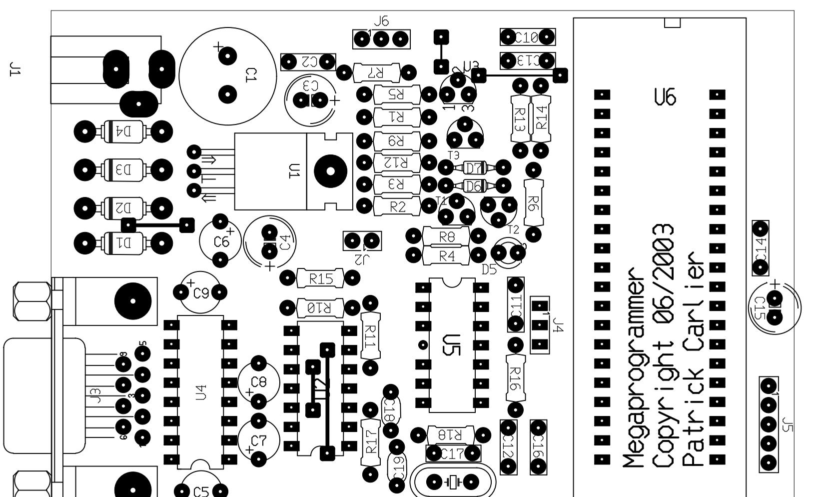
U6
Megaprogrammer
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MEGAPROGRAMMER PARTLIST AND PRICES IN EURO (•)				
Prices are from my local shop , and are indicative				
Part	**Descr**	**Qty**	**Price**	**Total**
C1	470uF	1	0,5352	0,5352
C11	10nF	1	0,1788	0,1788
C12	33nF	1	0,1788	0,1788
C15	25uF	1	0,0888	0,0888
C18,C19	30pF	2	0,0888	0,1776
C2,C14,C16,C17,C10,C13	100nF	6	0,1392	0,8352
C3,C4	10uf	2	0,1956	0,3912
C5,C6,C7,C8,C9	1uF/50V	5	0,1188	0,594
D3,D4,D1,D2	1N4004	4	0,093	0,372
D5	LED 5MM VER. RED	1	0,144	0,144
D6,D7	1N4148	2	0,12	0,24
J1	PWR Con	1	1,104	1,104
J2	HDR 2	1	0,036	0,036
J3	DELTA_9HM	1	0,6276	0,6276
J4,J6	HDR 3	2	0,048	0,096
J5	HDR 5	1	0,084	0,084
R1,R3,R6,R7,R8,R12	1K	6	0,06	0,36
R14	100K	1	0,06	0,06
R15,R2,R16,R9,R10,R11,R13	10K	7	0,06	0,42
R17	1M	1	0,06	0,06
R18,R5	2K2	2	0,06	0,12
R4	330E	1	0,06	0,06
T2	BC337AP	1	0,108	0,108
T3,T1	BC308AP	2	0,18	0,36
U1	78L05	1	0,4884	0,4884
U2	74HC125	1	0,684	0,684
U3	LM431ACZ	1	1,368	1,368
U4	max232	1	2,4972	2,4972
U5	74HCU04	1	0,612	0,612
U2 , U5 socket	14 p socket	2	0,24	0,48
U4 socket	16 p socket	1	0,36	0,36
M3 bolt and nut		1	1,2	1,2
16 IC contact's replacing the zif		1	1,7556	1,7556
X1 caned osc dip 8	XTAL-1	1	0	0
X2 caned osc dip 14	2,54 Mhz	1	0	0
X3 x-tal	10mhz crystal	1	2,0904	2,0904
PCB	Etched and drilled pcb	1	11,028	11,028
TOTAL				**29,7948**
ZIF SOCKET	40P zif socket	1		19,66
Shipping and handling outside europe		1		7