MeScoot Bernard Handbook

Length	120 cm
Weight	34 Kg
Motor Power	Adjustable, set to max 1 KW
Light brightness	Adjustable, set to ca 5000 Lumen gross, 22°
Battery	LiFePo4, 48v nominal, 15 Ah
Thrust	> 25Kg

Main Features:

- Completely microprocessor controlled.
- Device on/off while closed housing with zero consumption when off.
- Manual fast switch off plus auto switch off, selectable 5/10/15/60 min.
- Regulated throttle controlled by potentiometer on top.
- Constant speed independent from battery voltage.
- Motor power ca. 100W to 1 KW. Current restricted to max. 20A.
- Different selectable ramp up / down time for motor.
- 5 different brightness steps, up to ca. 5000 lumen.
- Water intrusion detection with buzzer and LED warning.
- Buzzer can be switched off permanently.
- Multi color LED to show status.
- Voltage value shown by LED.
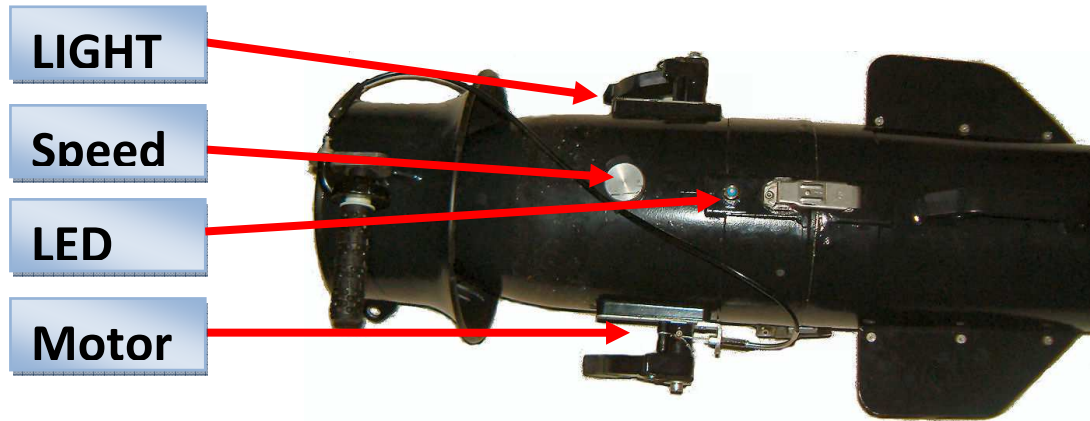- Motor temperature shown by LED.

Index

Command sequences

Simple instruction: Device is handled in the following way.

Start up

1. Load the battery and mount completely.
2. Press both switches for 5 seconds
3. Release throttle first

Normal operation signalization

- LED shows green with growing red phase for voltage (45 to 52 Volts)
- Next LED blue growing to violet for 40 to 65 degrees Celsius

Normal operation motor

- Now pressing throttle starts motor with ramp up.
- Releasing stops with different faster ramp down.

Normal operation light

- Short click on light switch goes one step up. 5 / 15 / 30 / 50 / 100 %
- Longer click steps one down.
- Quite long click switches light off directly.

Shut down

1. Even longer click on light prepares fast device off, shown by blinking red LED.
2. This command is accepted as soon as motor is clicked and released.
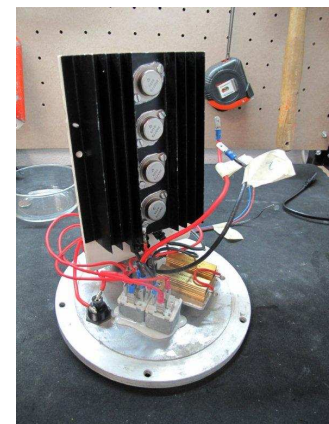
Water intrusion

- Water intrusion is always shown by blinking blue LED and when allowed by buzzer

The mechanics

The body is based on an old military scooter, refurbished by Bernard himself.

Retrofitting

Bernard did a complete cleaning and repainting and exchange of O rings etc.
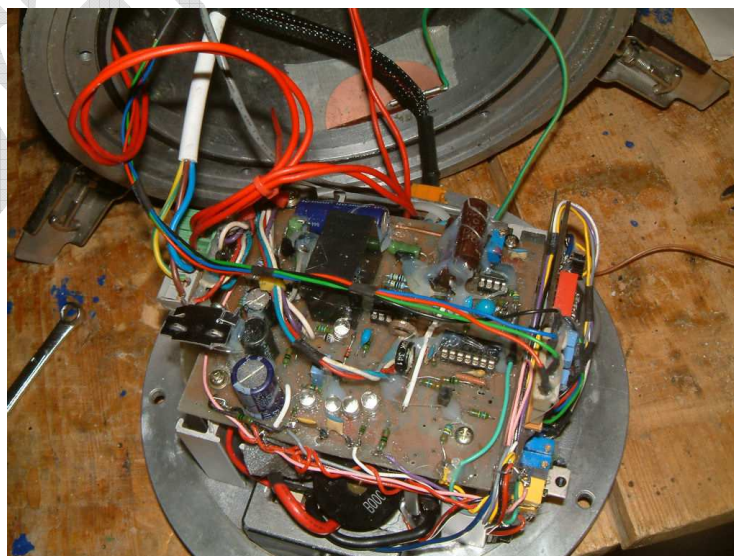
The electronic

The electronic is completely replaced. Old halogen is changed to high power led technique, old led-battery by modern LiFePO4 and motor control is done via low resistance FET technologies.

As the new battery is much more powerful first tests showed motor-power rise from "assigned" 360W to measured > 1.5Kw. After few minutes of test motor shaft broke. Had to be redone by a professional.

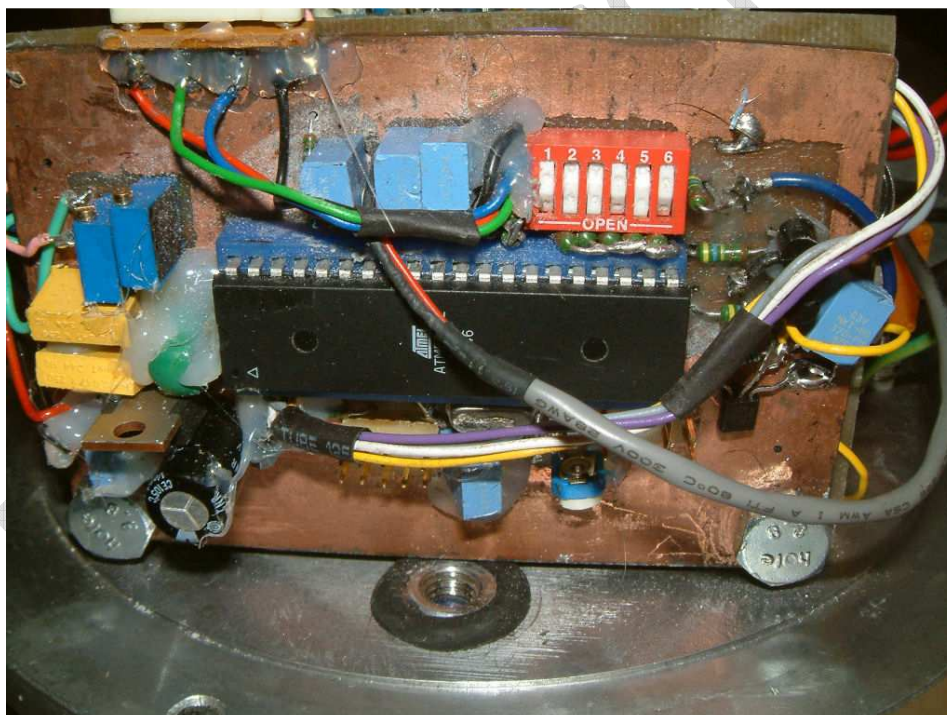Result was a redesign to speed regulation with chopped current regulation. Another demand is the possibility to have the scooter mounted completely with zero power consumption.

Main light is now led based.

Everything is controlled by a microcontroller from Atmel ATMEGA32.

The complete electronic is distributed over three main PCB's.

- The light controller
- The power board
- The processor board

The light controller

The light controller is mounted on the new led based light unit. The unit is fabricated from massif aluminum and is placed between the body and the glass, using the six old screw holes. It is has three LED-TECH 4 x Cree XPGWHT-L1-1T-R5 led-PCB with changeable optics of 22° or 44°.

Brightness
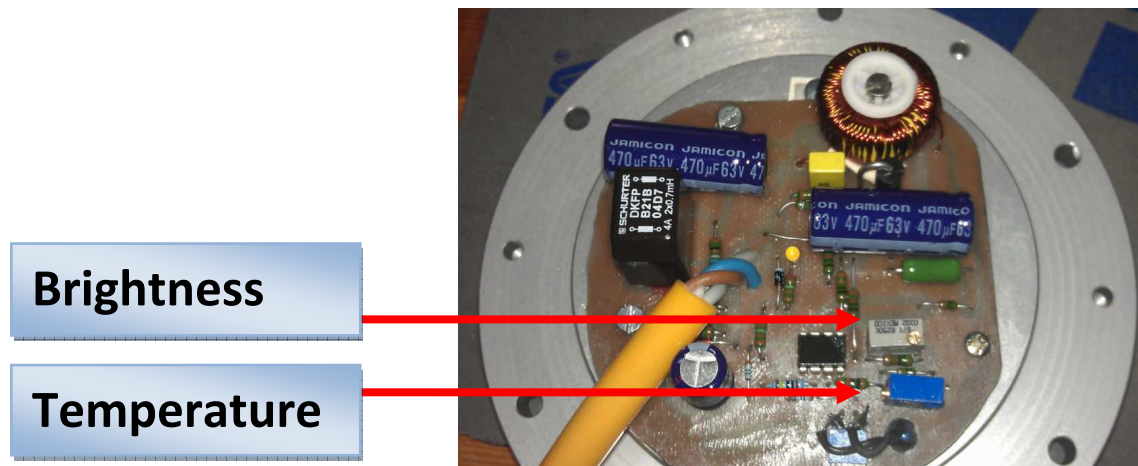
Temperature

Brightness

The potentiometer allows adjusting the maximum brightness by regulating the max current

Temperature

The potentiometer allows adjusting the maximum temperature by cutting down the max current to 20% when threshold is reached. Momentary the temperature is set to ca 50 degrees Celsius of the light-aluminum block.

The power board

The power board consists of the interfaces to power supply, motor, red-contacts, speed potentiometer of the body.

High Speed

Low Speed

Current

MeScoot B Handbook.docx
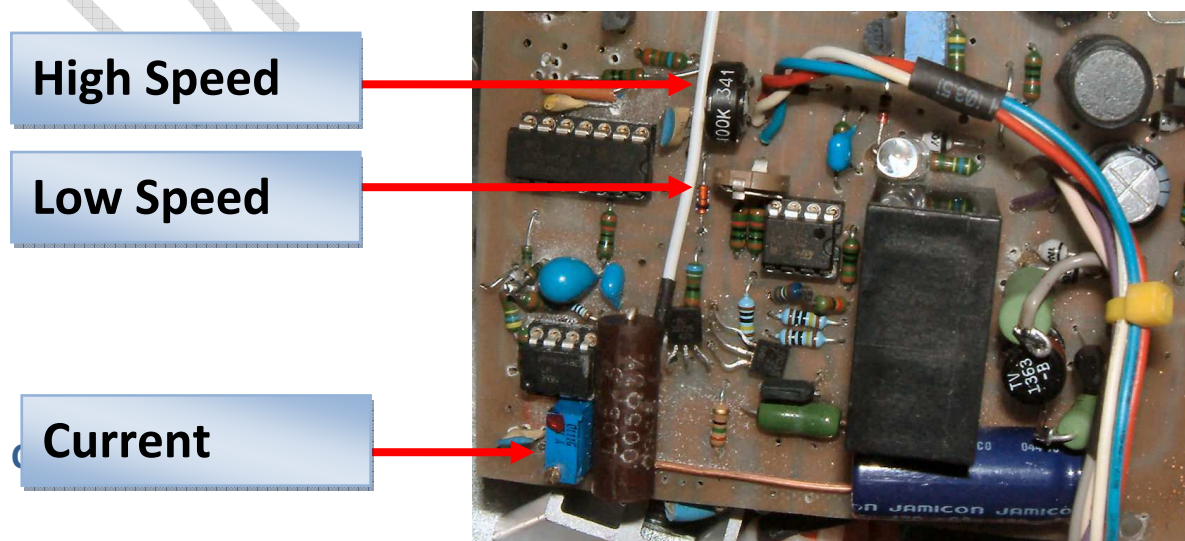
The potentiometer for the current control limits the maximum current thru the motor. Via a comparator and flip-flop it's stopping the main current switch, a FET. The FF is reset with a fixed frequency of ca 25 kHz. That way the battery is protected against to high current when motor is not turning. Momentary it is set to ca 20A.

Speed

The speed is controlled by the main potentiometer on the housing. But there are two additional potentiometers which change the max and the min speed.

The processor board

There are two potentiometers for voltage and motor current measure and six switches to set device behavior
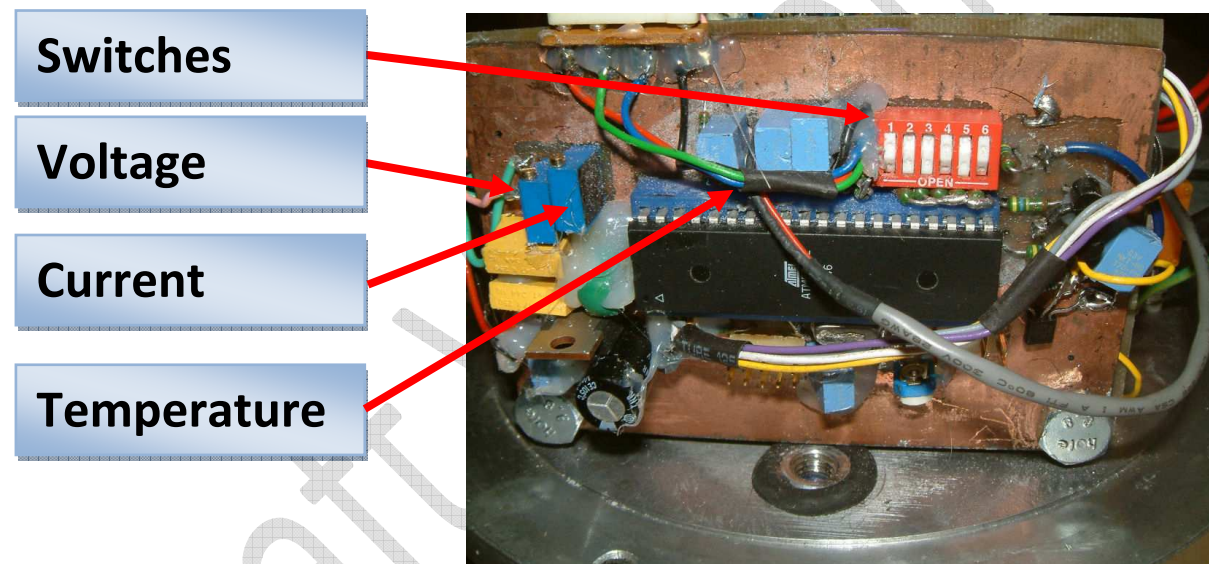
Connector LED

The Led is plugged via a 4-pin connector. That way it is possible to remove the complete electronics without the need of dismounting the led from the waterproof PG, on top of the scooter body.

Temperature sensor

The motor temperature is measured via a fix-cable NTC. The only way to dismount is to unscrew the bracket on the motor and remove the copper bracket with the sensor.
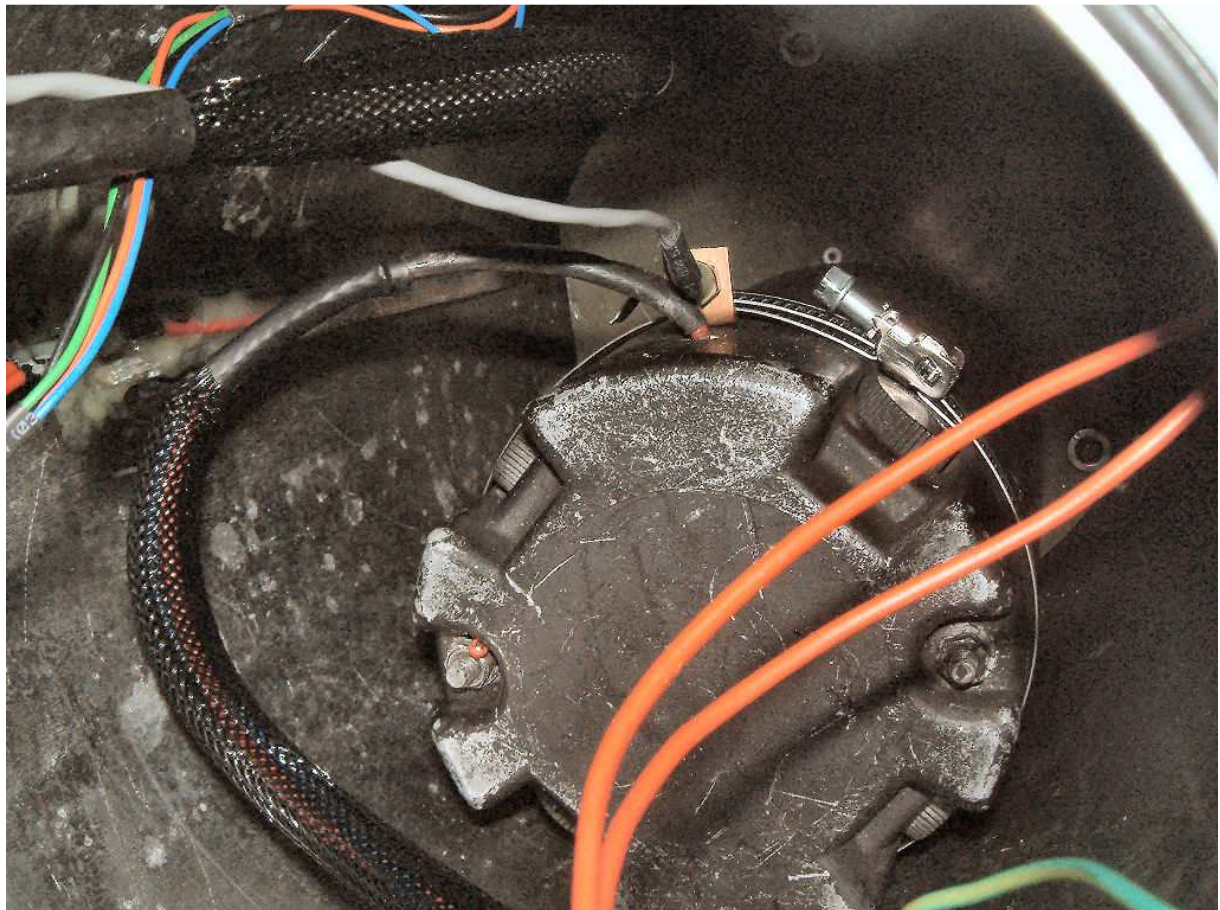
Potentiometer Voltage

The device voltage is measured and used for LED and LCD signalization. Via a potentiometer the value coming from the power board is adapted to the MCU input.

Potentiometer Motor current

The motor current is not identical with the battery current. Via a potentiometer the value coming from the power board is adapted to the MCU input. This value is shown on the LCD.

Switch Auto Off time

The time for auto switch of can be changed via the dip-switches 1 and 2.

Switch 1	Switch 2	Time until auto-off
OFF	OFF	5 minutes
ON	OFF	10 minutes
OFF	ON	15 minutes
ON	ON	60 minutes

Switch Motor ramp timing

The motor has two different ramps for up and down. The can be influenced independently. The time is always the same between slow to fast speed. That means the acceleration is always the same, when potentiometer is on position half speed, time is reached in half of the ramp time.

Switch 3	Switch 4	Time until auto-off
OFF	OFF	Ramp **UP** slow
ON	OFF	Ramp **UP** fast
OFF	ON	Ramp **DOWN** slow
ON	ON	Ramp **DOWN** fast

Switch Buzzer on

The alarm signal for water and auto off is also driving a buzzer, with the switch 5 this function can be canceled permanently.

Switch 5	Buzzer
OFF	Buzzer off
ON	Buzzer on

Switch Water simulation

The water detection can be tested with the switch 6.

Switch 6	Water
OFF	Water detection in normal operation
ON	Water detection simulated on.

The connections of battery and water detection
Both parts of the body can be separated completely.

The battery
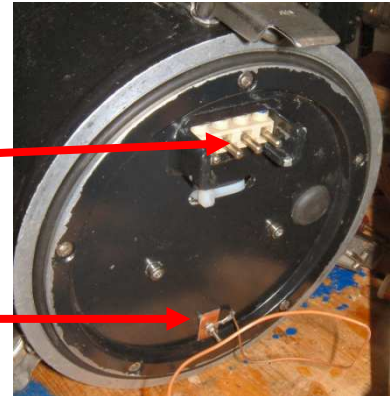The connector includes battery and LED

Battery

Water detection

The water detection
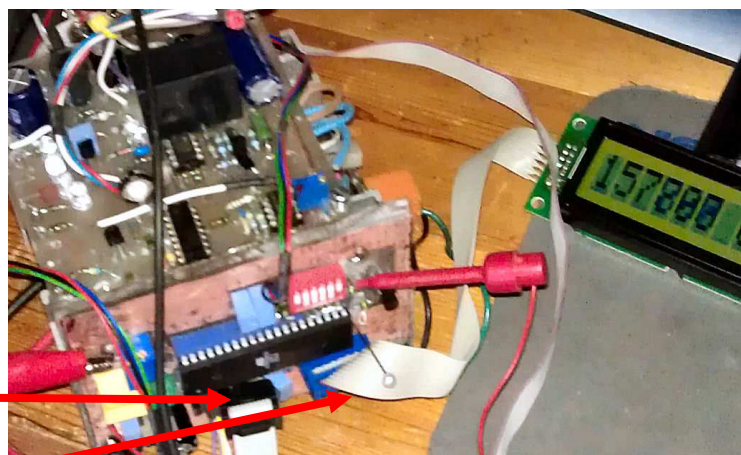The cable has to be connected with the according pin in the body.

The connections of LCD and ISP programmer cable
Its possible to program inline with normal Atmel ISP programmer. And also to connect a text LCD directly to MCU and see internal values for test.
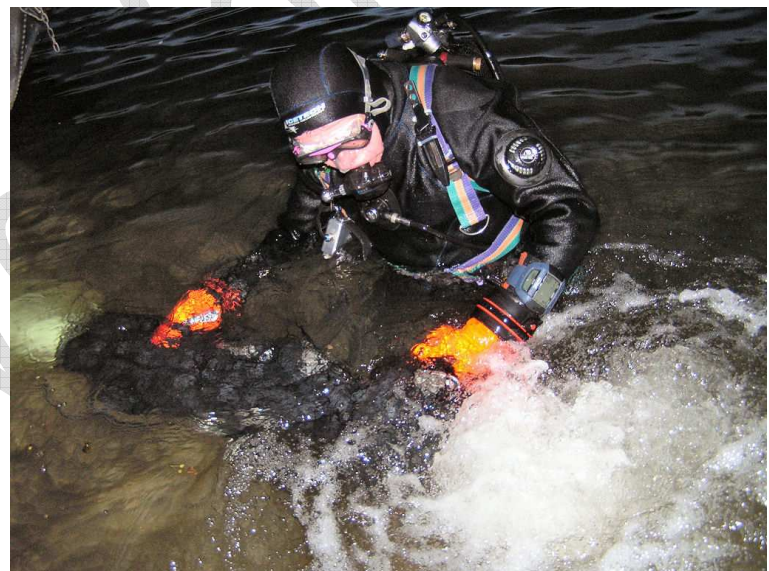
ISP prog. cable

LCD via cable

The test

The test was very successful.

Fast, non precise measurement showed more than 25 Kg impulse.

Program code

```
' -----[ Program Description ]------------------------------------------------------------
'
' This program is used to control the scooter of Bernard Joly
' It's written for Bascom Version 2.0.7.4  from www.mcselec.com
'
' -----[ Disclaimer ]------------------------------------------------------------
'
' This program is offered on an "AS IS" basis, no warranty expressed or implied. The
' programmer disclaims liability of any damages associated with the use of the hardware or
' software described herein. If you got the permission to use it you use it on your own
' risk. The author is not able to provide any free support.
'
' Copyright (c)1999 - 2012                        Mike Eitel all rights reserved
'
' -----[ Revision History ]------------------------------------------------------------
'
' 131111 - Ver 0.80 Test HW                                          Mike Eitel
' 200212 - Ver 0.90 First LED and LCD implementation                 Mike Eitel
' 200212 - Ver 0.91 Change to multitasking                          Mike Eitel
' 250312 - Ver 0.95 Final HW test implementation                    Mike Eitel
' 250312 - Ver 0.99 First implementation of all features            Mike Eitel
' 160412 - Ver 1.00 First finished implementation                   Mike Eitel
'
' -----[ Basic HW definitions ]------------------------------------------------------------
'
  'ATMEGA32 Sig.  PIN Device                        Sig.  PIN Device
  'PortA.0  AD0   40  Analog_MESS_V+           'PinB.0   T0    01  IN_MOTOR_ON   grey
  'PortA.1  AD1   39  Analog_MESS_V+           'PinB.1   T1    02  IN_LIGHT_ON   white
  'PortA.2  AD2   38  Analog_MESS_V+           'PortB.2  INT2  03  OUT_RELAIS_ON violet
  'PortA.3  AD3   37  Analog_MESS_V+           'PortB.3  OC0   04  OUT_PWM_MOTOR yellow
  'PortA.4  AD4   36  Analog_MESS_CUR          'PortB.4  /SS   05  Db4 LCD Pin 11
  'PortA.5  AD5   35  Analog_MESS_CUR          'PxxxB.5  MOSI  06  ISP
  'PortA.6  AD6   34  Analog_MESS_CUR          'PxxxB.6  MISO  07  ISP
  'PortA.7  AD7   33  Analog_MESS_TMP          'PxxxB.7  SCK   08  ISP

  'PortC.7  TOSC2 29  LED RED                  'PinD.0   RXD   14  IN-Water & SWITCH-6
  'PortC.6  TOSC1 28  LED GREEN                'PortD.1  TXD   15  Buzzer-OUT
  'PortC.5  TDI   27  LED BLUE                 'PortD.2  INT0  16  Rs  LCD Pin 4
  'PinC.4   TDO   26  IN_SW-1                  'PortD.3  INT1  17  E   LCD Pin 6
  'PinC.3   TMS   25  IN_SW-2                  'PortD.4  OC1B  18  Db5 LCD Pin 12
  'PinC.2   TCK   24  IN_SW-3                  'PortD.5  OC1A  19  Db6 LCD Pin 13
  'PinC.1   SDA   23  IN_SW-4                  'PortD.6  ICP1  20  Db7 LCD Pin 14
  'PinC.0   SCL   22  IN_SW-5                  'PortD.7  OC2   21  OUT_PWM_LED

  $regfile = "m32def.dat"                      'regfile match the chip
  $crystal = 8000000                           'crystal must match too
  $regfile = "m32def.dat"                      'regfile match the chip
  $crystal = 8000000                           'crystal must match too
  $prog &HFF , &H44 , &HD9 , &H00              ' generated.
                                               ' FB  Fusebit settings
                                               ' FBH Fusebit High set.
                                               ' FBX Extended Fusebit
' -----[ Define ports ]------------------------------------------------------------

 ………….
```

Electronics principal drawing