8 Calibration

After the assembly of the Brenner8, the programming of the control PIC and the installation of the USB-driver the Vpp-generation of the Brenner8 has to be calibrated.

A non-calibrated Brenner8 can destroy every target-PIC in shortest time! It can produce Vpp-voltages of 25V and above. No PIC survives this!

A small boost-converter is used in the Brenner8 to generate the programming voltage Vpp. The voltage level can be controlled by software. Such every target-PIC gets its ideal programming voltage.
This can function only if the control PIC of the Brenner8 can measure the Vpp level precisely.

The programming voltage is measured by the control PIC via a voltage-divider and compared with a reference voltage (from a zener-diode). During calibration Z-voltage and voltage-divider-ratio are determined.

For the calibration is needed:
- Brenner8
- US-Burn-software
- voltmeter

8.1 Preparation

Connect the Brenner8 with the PC.
Start the US-Burn software on the PC.
In US-Burn select **Options** – **Hardware**.

The following adjustments are done in the „Box" **programming voltage Vpp calibration** in 3 steps:

1. setting the Z-voltage
2. setting the voltage-divider-ratio
3. automatic adjustment of offset and gain

8.2 Step No. 1: Z-Voltage

The Brenner8 contains a 3,3V-Z-diode. Because typical Z-diodes have tolerances of up to 10%, the real Z-voltage has to be measured.
A voltmeter has to be connected between GND/Vss and Pin 5 of the control-PIC. The latest Brenner8-revisions have a test-point LSP2 for the Z-voltage determination.
The measured voltage is entered into the Z-voltage **Z-voltage** field of US-Burn. The both arrow-buttons can be used to adjust the value between 2V and 4V in 0,01V-steps.
To apply the modified Z-voltage setting, the **apply**–button has to be used.
(In the **BASIC**–page of US-Burn is now a calibration value indicated, that should be a little bit smaller than 1.)
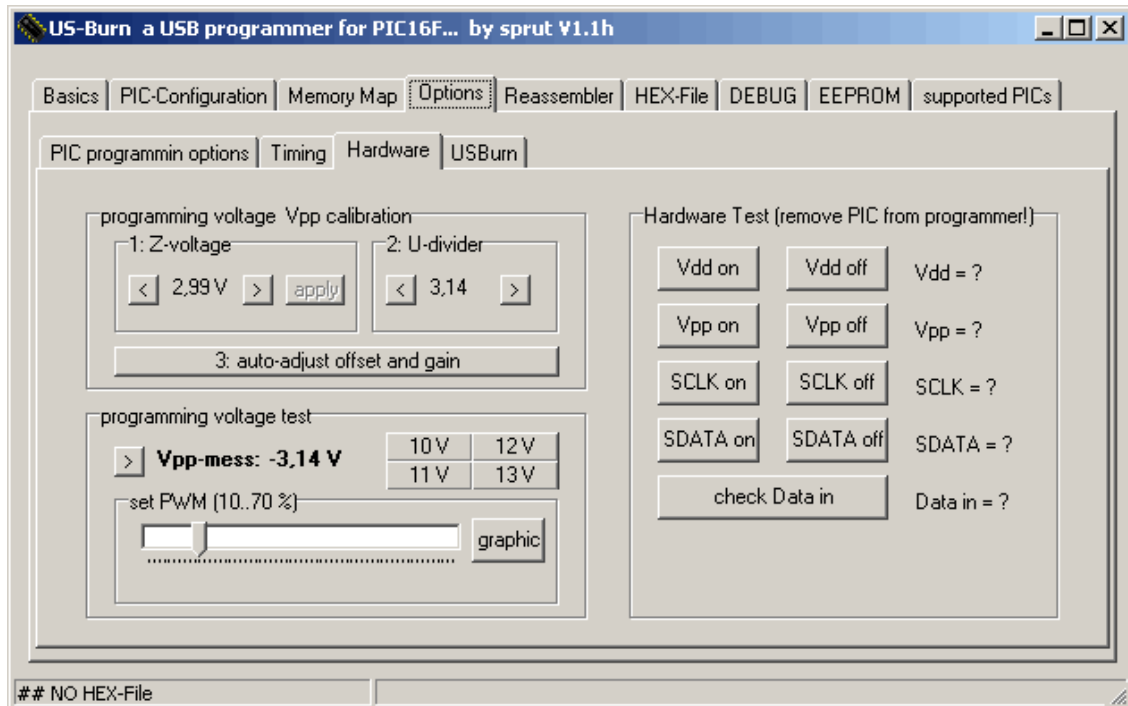
Figure 23 US-Burn - Options-Hardware

8.3 Step No. 2: Voltage divider

The Vpp-voltage-divider is made from the both resistors R4 and R5. There default divider ratio is 3.14. The real value may differ a bit and has to be determined now. The setting is done in the **U-divider**-field.

The voltmeter has to be connected between the cathode of D1 and Vss (alternative via C5). The latest Brenner8-revisions have a test-point LSP1 for the voltage determination.
The sliding control **set PWM** is used to adjust the voltage to about 13V (check with voltmeter). (The voltage should be high but has not to exceed 14V!)

The Brenner8 measures the voltage too, and indicates its result as **Vpp-mess**. By adjusting the **U-divider** -ratio (use the arrow-buttons) the Brenner8-measure-result is approximated to the voltmeter-result as close as possible.

8.4 Step No. 3: regulator set-up

The final step doesn't require a voltmeter anymore. Simply click on **auto-adjust offset and gain**. The Brenner8 starts an autocalibration process, which takes about 6 seconds to be completed.

During this autocalibration high Vpp-voltages are generated. Because of that no target-PIC has to be in an on-board test socked or connected to the ICSP-connector.

(On the **BASIC** –page US-Burn indicates some numbers with could be helpful in case of fault analysis.)

To test the calibration now the buttons **10V**, **11V**, **12V** and **13V** can be used to set Vpp to the desired values. The typical acceptable error is about 0.3V.

8.5 Ready

Calibration data is stored in the Brenner8. A backup copy of this data is stored in the **usburn.ini** .
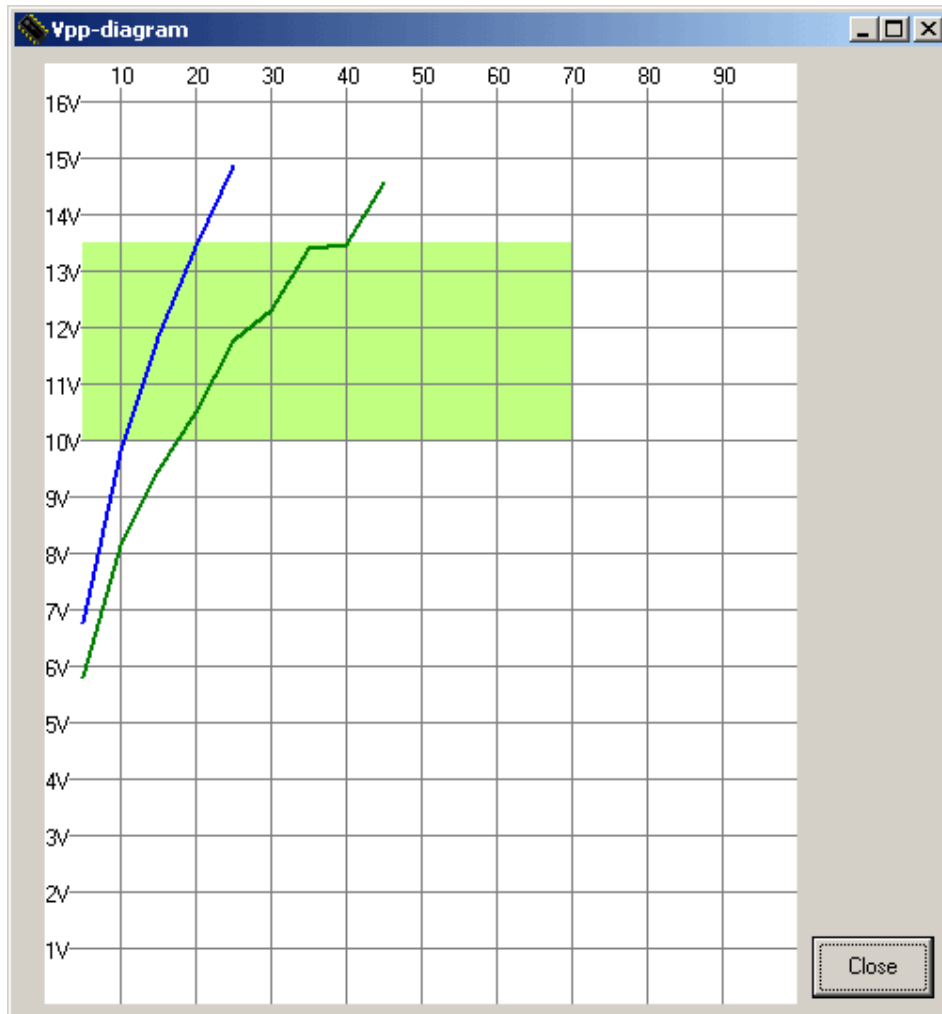
8.6 Error diagnostic

Figure 24 Vpp-diagram - normal

In the field **programming voltage test** is the button **graphic**. If one clicks on this button, then a drawing of the Vpp output voltage levels us generated (needs some seconds). The figure shows the voltages Vpp-on (green line) and Vpp-off (blue line) for different duty cycles of the boost converter.

During the drawing process high Vpp-voltages are generated. Because of that no target-PIC has to be in an on-board test socked or connected to the ICSP-connector.

Only voltages up to 15V can be measured by the Brenner8 and are shown in the diagram. The light green area is the normal working area of the boost converter. The both voltage-lines have to cross this area from bottom to top, like seen in the figure above.

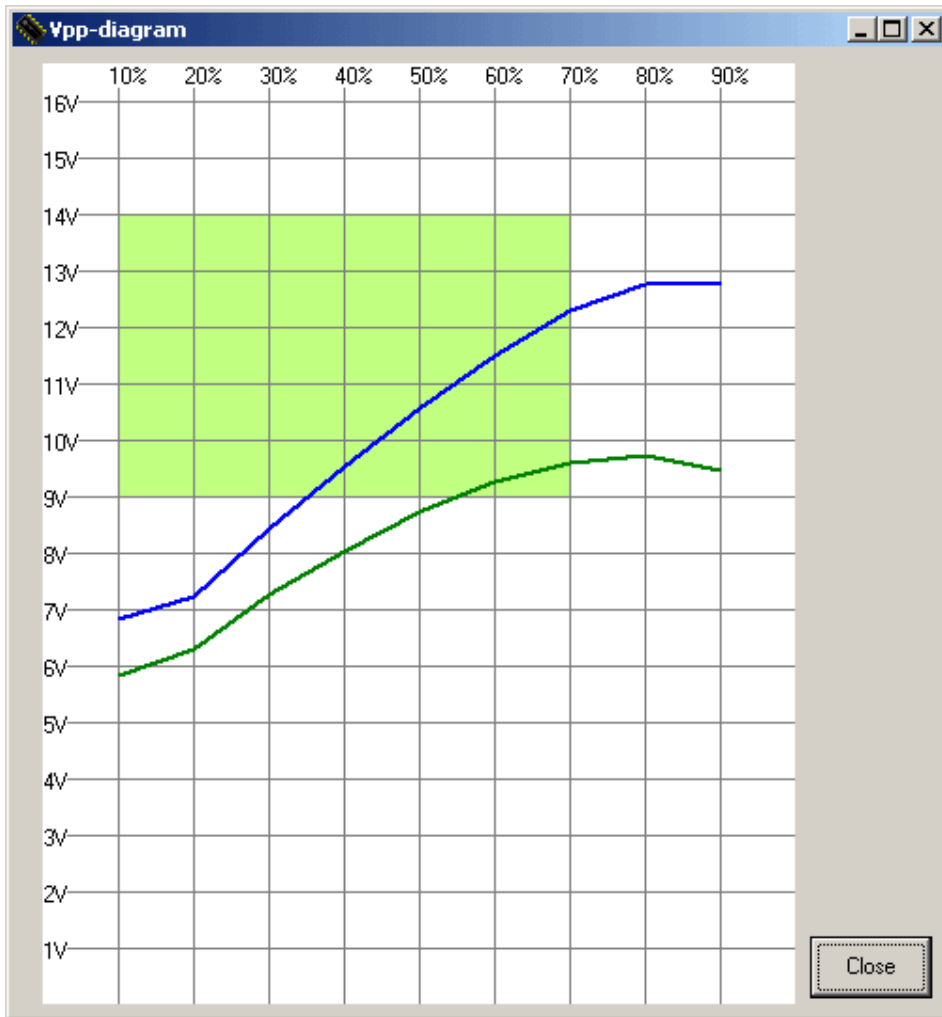The following diagram shows a bad boost converter. The voltages are to low. This is probably a hardware error, e.g. a wrong type of the diode D1.

Figure 25 Vpp-diagram - undervoltage