Atmega 328: Frequency of the 8MHz RC clock is a function of OSCCAL

The Atmega 328 has a built in 8MHz RC clock. When the device is programmed it can be configured to use this clock. A default calibration byte is permanently programmed into the device when it is manufactured. This byte is automatically copied into the OSCCAL register whenever power is applied.

The resulting accuracy of the clock is usually good enough to enable communications with a PC using the UART at speeds up to at least 100kB. This is not always the case however and users can substitute their own calibration bytes.

Two programs are presented here. One measures and prints out the clock error for calibration bytes between 0x0F and 0xF0. The other automatically calibrates the clock. This is necessary where the default calibration byte does not enable communication with a PC. Non default calibration bytes are saved to EEPROM and copied to the OSCCAL register when required.

Variations of these programs have been used to ensure that the calibration error is suitably low every time that power is applied or to enable users to choose a calibration byte that will subsequently be saved to EEPROM and automatically substituted for the default value.

Two timers T1 and T2 are used. T1 is driven from the RC clock and T2 is controlled using a 32.768kHz watch crystal. T2 generates an interrupt every time that it overflows (i.e. counts to 255). This takes 7.8125mS during which T1 counts up to 62,500 if the RC clock is running at exactly 8MHz. OSCCAL is adjusted until the error is 1% or less.

Measurement results for three devices are shown below:

Typical frequency error as function of OSCCAL
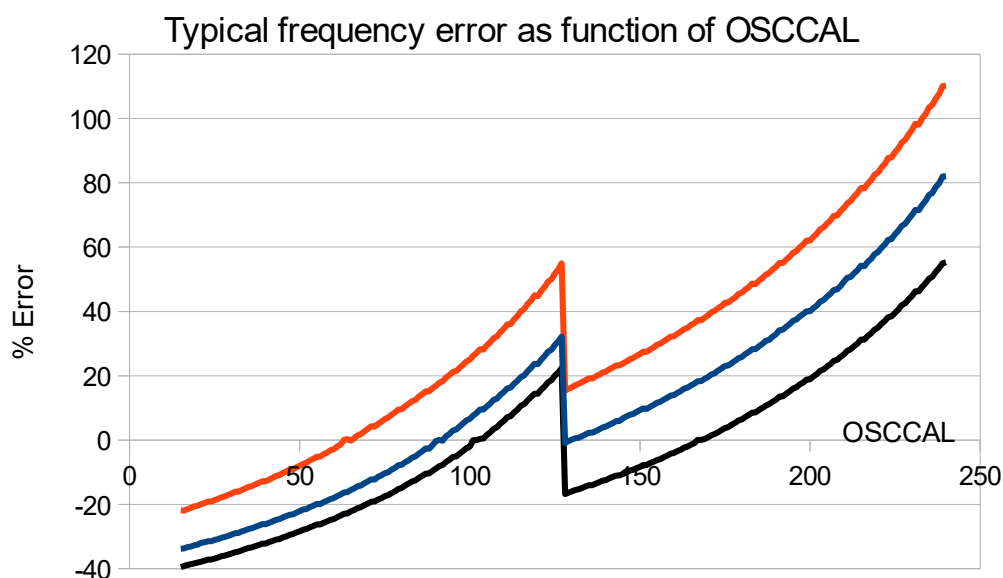
These graphs show that
Some devices will have two suitable values of OSCCAL (black line and possibly the blue)
Some devices will only have one value (red line)
All lines show an abrupt change for an OSCCAL value of about 125. (It is not usually practical to use this value for OSCCAL).

Note: ideally two 18pF capacitors should be used with the crystal but in practice these were not found to be necessary.