Multi Spectral Calibration Lamp with Modified Glow Starters

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Content

1 Introduction

In the past, amateurs often calibrated the red range of spectra with the emission spectrum of neon glow lamps. For additional calibration lines in the green and blue range, this setup was usually supplemented by bulky gas discharge "economy lamps" and – possibly even outdoors – operated directly with mains voltage. Possible alternatives at that time consisted of massive overexposure of the neon spectrum for generating additional short-wave lines, and as a highly sophisticated and prestigous standard, sinfully expensive and delicate hollow cathode tubes. Since 2011, this problem has been solved for amateur purposes, after it was discovered that the small, cheap glass bulbs of glow starters can be modified in a simple way to calibration light sources [1] [2].

Very soon it became clear that, in order to optimize the switching behavior, the various starter models are filled with manufacturer-specific mixtures of the noble gases argon (Ar), neon (Ne), xenon (Xe), helium (He) and, in rare cases, krypton (Kr), sometimes with combinations such as are also found in some professional calibration lamps. In addition, water vapor in the glass bulb of some starter types generates emission lines of hydrogen (H Balmer series) and oxygen (O). This offers a rich palette of differently distributed emission lines for calibration purposes.

2 Description

For demonstration purposes, but also as a backup in case of failure of the "spectrographs on-board calibration", glow starter glass bulbs with different gas mixtures were mounted horizontally on a solderable breadboard. The individual "lamps" are supplied with voltage by a 2x6 multi-switch (e.g. MRA206A from Conrad) from a built-in "low power" inverter 12V DC/230V AC [3]. In this case, the current limiting resistor of 25 kΩ, which is supposed to prevent the bimetal switch in the glass bulb from closing, can also be omitted. Anyway, instead of a direct mains voltage connection, for safety reasons the use of an inverter is strongly recommended! However, any reproduction is here at the user's own risk. The calibration light can be directed into the spectrograph via a modified flip mirror (e.g. Baader FlipMirror II).

Additionally, an OSRAM halogen lamp 12 V/5 W/55 lm is provided here, e.g. for the makeshift recording of optical filter transmission spectra. For mounting, its connecting pins were bent at right angles with two miniature pliers (very delicate – be careful!) and because they are not solderable, they were connected by components of miniature plugs.

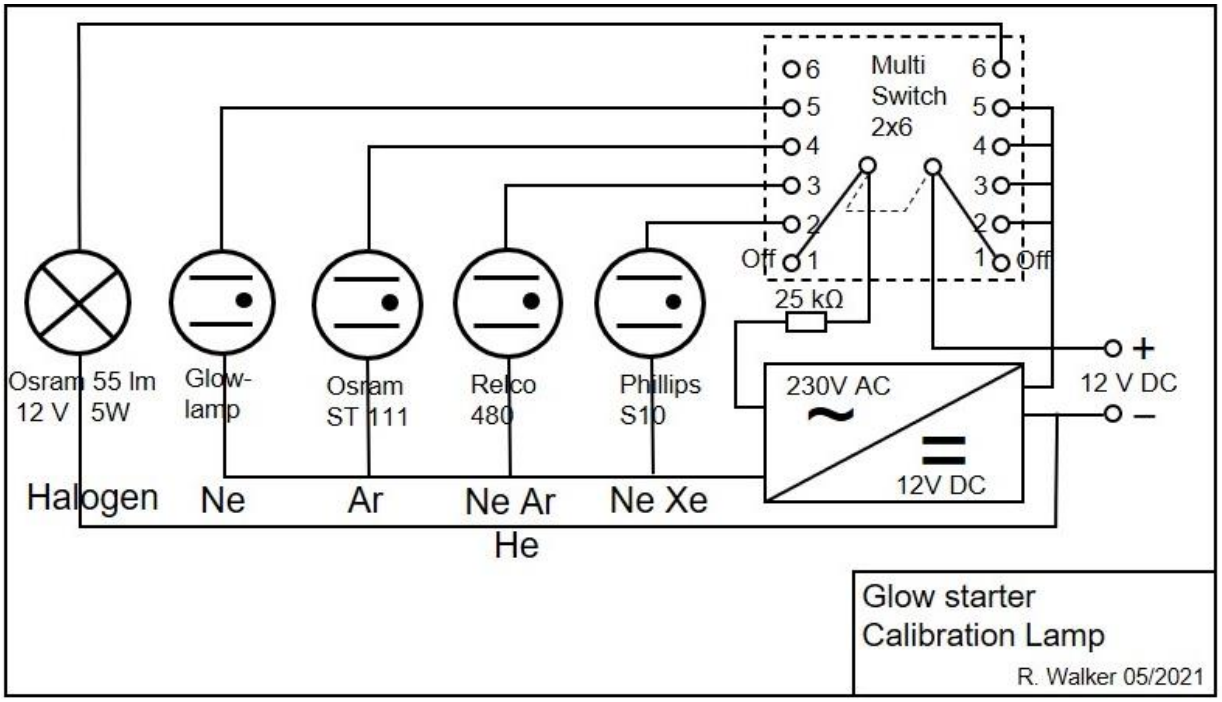
The switching sequence was selected so that, starting from the Off position (Pos. 1), the low-light gas discharge lamps are activated first so that the bright halogen lamp does not disturbe the adaptation of the eyes in th dark during the switching process. Other lamp combinations are of course possible. For a simple function check, or for testing unknown starter types, the inverter voltage may additionally be fed to a separate housing socket.

Although the inverter generates a square-wave AC voltage, the luminous power of some starter types shows a clear dependence on the "polarity" of the connections. This behavior must therefore be clarified before installation.

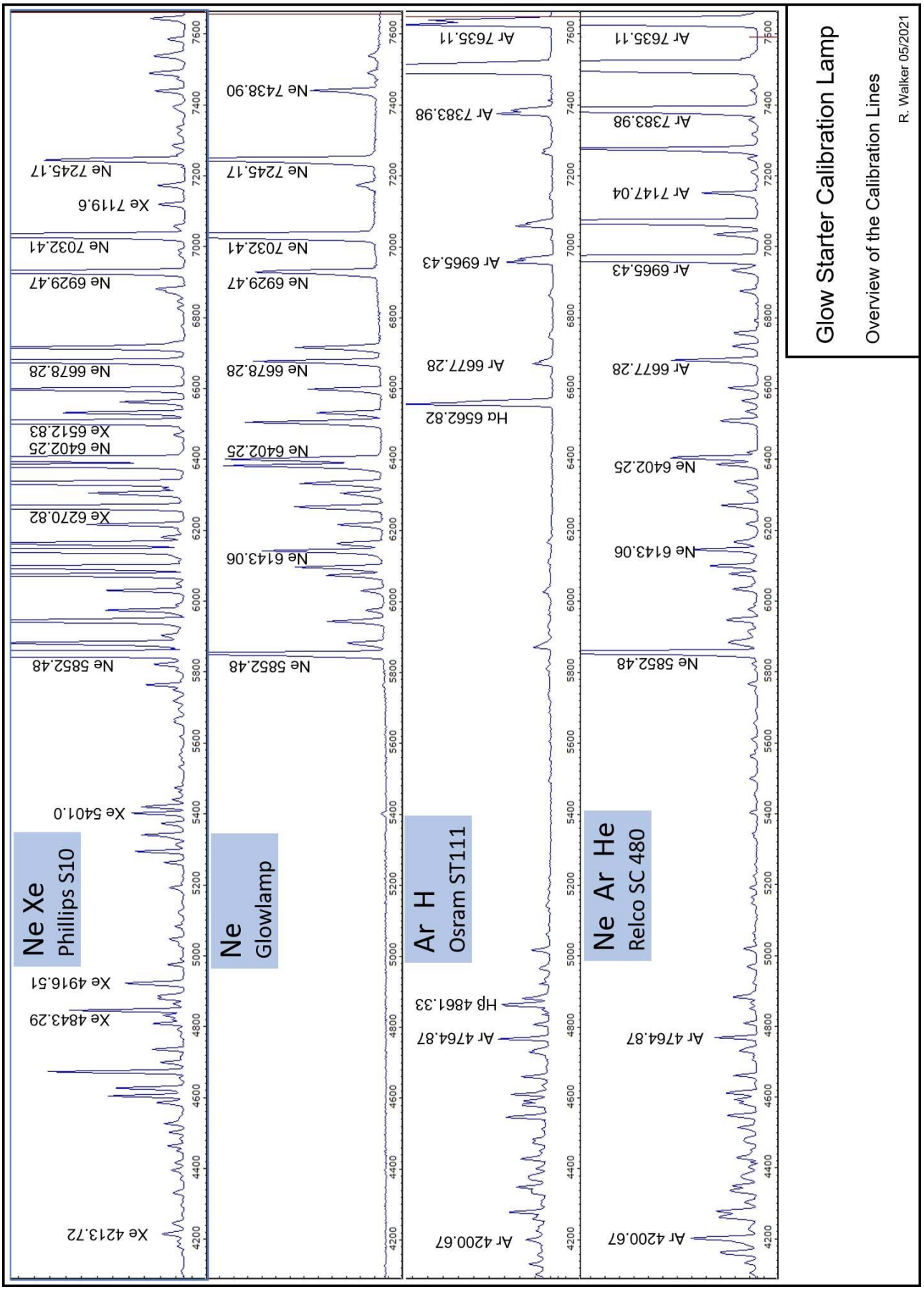
For stable operation, the clock frequency of the inverter should not be regulated to maximum light output, but slightly below. The 12 V power supply is provided externally via a low-voltage socket, but could also be provided by a built-in accumulator.

A protective glass in front of the lamp field was deliberately omitted, since the luminous power of the glow starters is low anyway and thermal problems are to be prevented when operating the halogen lamp.

3 Circuit diagram

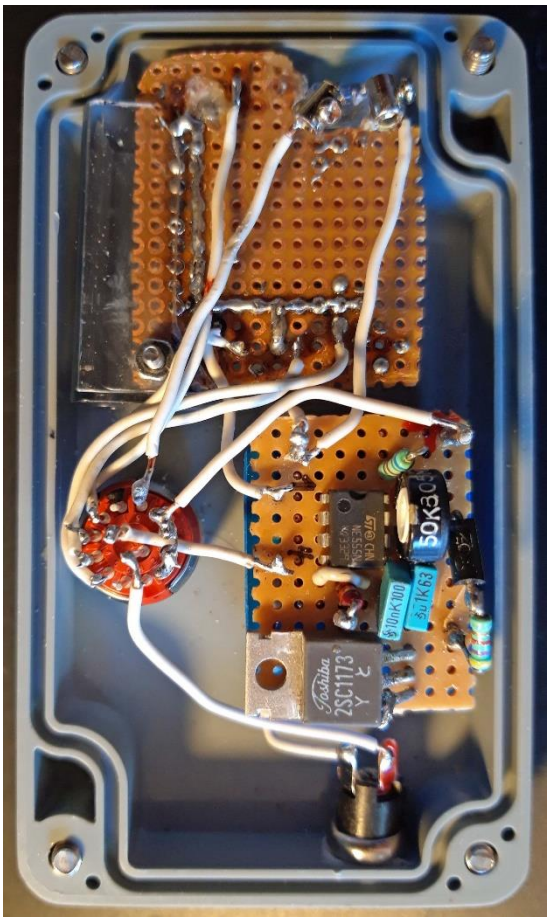


4 Calibrated spectral profiles



5 Photos

Temporary assembly on solderable breadboards



6 Internet Links

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Various publications on the subject of spectroscopy can be downloaded from this link:
http://www.ursusmajor.ch/astrospektroskopie/richard-walkers-page/index.html

[1] *Kalibrierung von Spektren mit dem Glimmstarter ST 111 von OSRAM*
https://www.ursusmajor.ch/downloads/kalibration-mit-glimmstartern-v1.1.pdf

[2] *GlowStarterRELCO SC480, Atlas of Emission Lines*
https://www.ursusmajor.ch/downloads/sques-relco-sc480-calibration-lines-5.0.pdf

[3] *Power Supply for Glow Lamps with Low DC Voltage*
https://www.ursusmajor.ch/downloads/inverter-12v-dc- -230v-ac-3.0-englisch.pdf