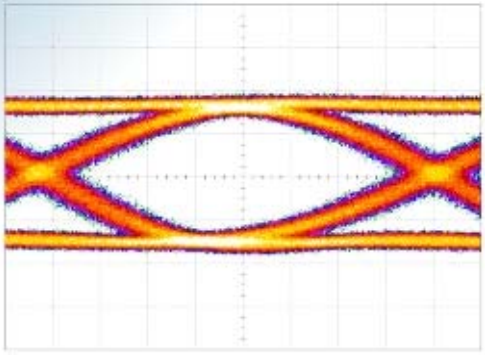
SHF Communication Technologies AG

Wilhelm-von-Siemens-Str. 23 • Aufgang D • 12277 Berlin – Marienfelde • Germany

Phone ++49 30 / 772 05 10 • Fax ++49 30 / 753 10 78

E-Mail: sales@shf.biz • Web: http://www.shf.biz



Application Note

AN-46100A-1

E/O Conversion Module

Description

The SHF 46100 A is an electrical to optical converter designed to produce a high quality optical output signal with a broadband bit rate of up to 44 Gbps and beyond. It consists of a Corning X-cut Lithium Niobate modulator driven by an SHF amplifier. The two are specially matched to ensure the best performance possible. To simplify operation, an automatic bias circuit locates and maintains the optimum operating conditions.

This application note describes the operation of the SHF 46100 A to help the user to get the best use out of the device.

Overview of connectors

Pin/Connector	Description
0.3 Vpp	Electrical data input. A 0.3 V_{pp} signal is sufficient to drive the device; the input should under no circumstances exceed 1 V_{pp}. 50Ω V (1.85 mm) connector.
Optical input/output	For 1550 nm light. To be connected in the direction shown on the cover. Maximum input power: 20 dBm (100 mW). FC/PC connector (others available on request).
5.2…6.5V/0.9A	Power supply pin.
Slope	Allows the polarity of the signal to be switched from inverting to non-inverting and vice versa. Requires a voltage of >1 V to switch.
Gain control	Allows the output voltage of the internal amplifier to be reduced.

Principle of operation

Lithium Niobate modulators have a transfer function similar to the curve shown in Figure 1. If the modulator is to be used as an optical switch, the modulator bias is set to a maximum or minimum on the curve. For digital transmission, the intended use of the SHF 46100 A, the modulator should be biased at one of the quadrature points, exactly between a maximum and minimum.

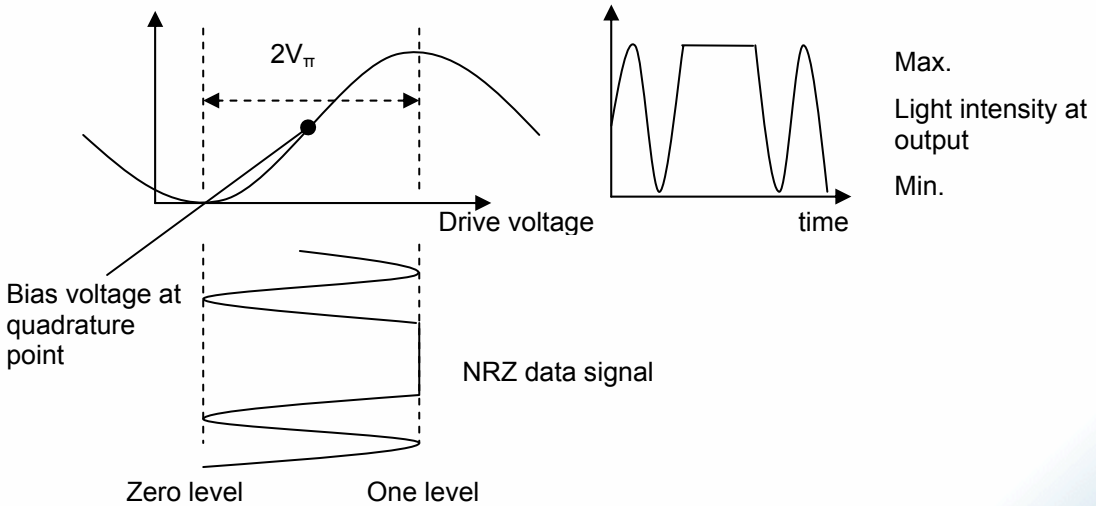


Figure 1. Transfer function of a $LiNbO_x$ modulator, showing the quadrature point for best operation

The automatic bias control (ABC) circuit in the SHF 46100 A sets the bias to one of the quadrature points, and adjusts the bias as necessary to keep operation of the modulator at this point. It does this by adding a low frequency dither signal to the electrical signal. The dither is then detected in the optical output and the modulator bias adjusted until the ABC locates the quadrature point.

It is possible for the ABC to experience problems if the electrical input level is too high. In this case, the amplifier is driven very strongly in compression and the dither signal does not make any (or only a small) difference to the output signal. The ABC cannot detect the dither signal, so the quadrature point cannot be located. The effect can be seen when it takes a long time to locate the correct operating point, or if the crossing point in the output eye starts to drift during operation.

If this occurs, the input signal should be reduced. The gain control function can also be used to some extent, which provides a little extra flexibility in operation.

The driver amplifier in the SHF 46100 A is inverting. With the modulator biased as shown in Figure 1, with the quadrature point on a positive slope, the modulator produces a non-inverted signal. Therefore, the amplifier and modulator together will produce an inverted signal.

This is important to remember if the modulator has chirp, for example a Z-cut Lithium Niobate modulator. When the output signal is non-inverted, the modulator is on the negative slope of the transfer function; when the output signal is inverted, the modulator is on the positive slope of the transfer function. Bearing this in mind, the chirp of the system can be set in a predictable way.

Wiring up

The SHF 46100 A is quite easy to set up and operate. A simple setup is shown in Figure 2. The power supply can just be switched on to start operation; there is no need to take any special precautions, such as increasing the voltage from 0 up to the operating level.

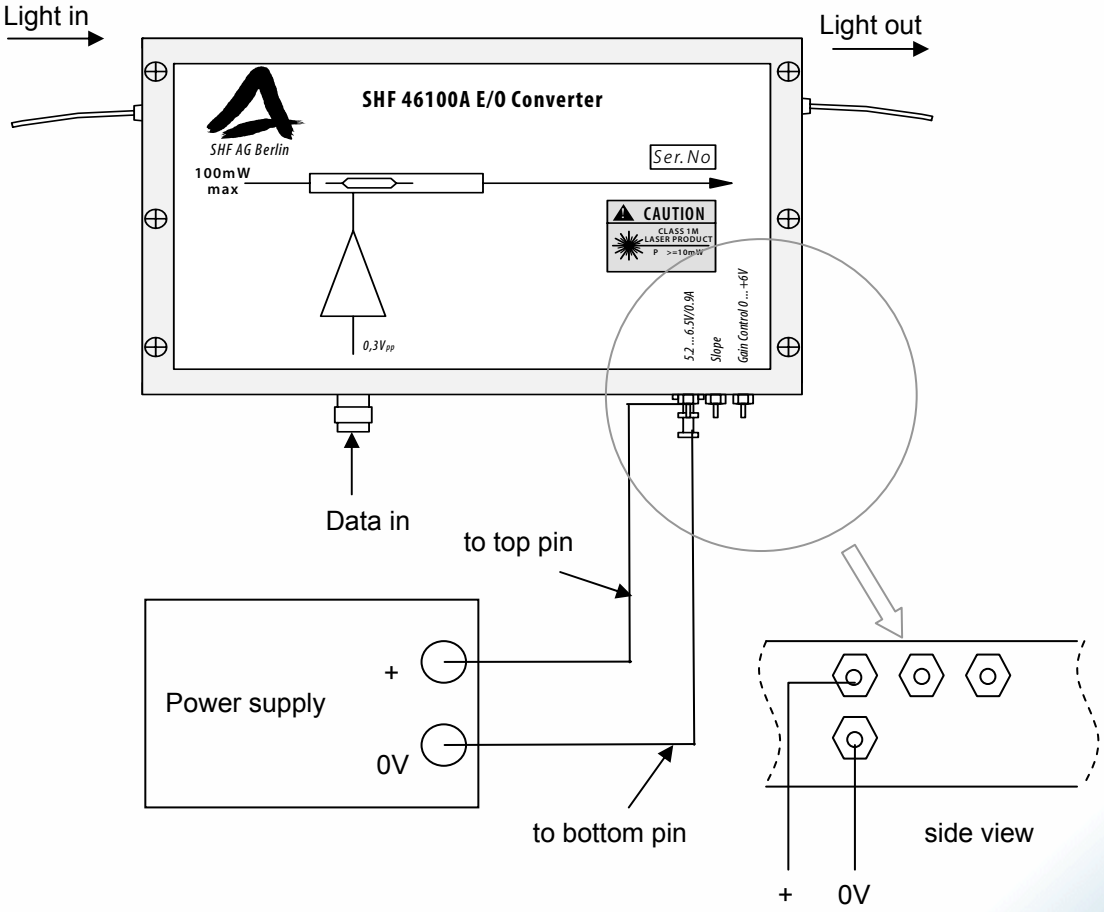


Figure 2: Basic setup of the SHF 46100 A

There are other pins that can be connected to control the gain of the driver amplifier and the polarity (slope). These can be controlled by using separate power supplies, but for convenience, the SHF 46100 A can be set up as shown in Figure 3, with just one power supply.

A potentiometer can be connected with the pole supplying the voltage to the gain control pin. It is important that the power supply voltage is stable and does not contain any ripple. Ripple does not affect the operation of the driver amplifier (as long as the voltage is always at least 5.2 V), but ripple on the gain control pin can adversely affect the signal quality. If ripple on the power supply is causing a problem, a large capacitor should be connected across the terminals of the power supply, as shown in the diagram.

The slope pin changes the direction of the slope on the transfer curve (see Figure 1). At 0V (or if the pin is left floating), the slope of the transfer curve is positive. Because of the inverting driver amplifier, the output signal is therefore inverted. By applying a voltage of 1V or more (up to 6V), the slope is switched to the negative side, so the signal at the output is non-inverted. The SHF 46100 A automatically finds the quadrature point. To change the direction of the slope, a switch can be fitted between the positive terminal of the power supply and the slope pin.

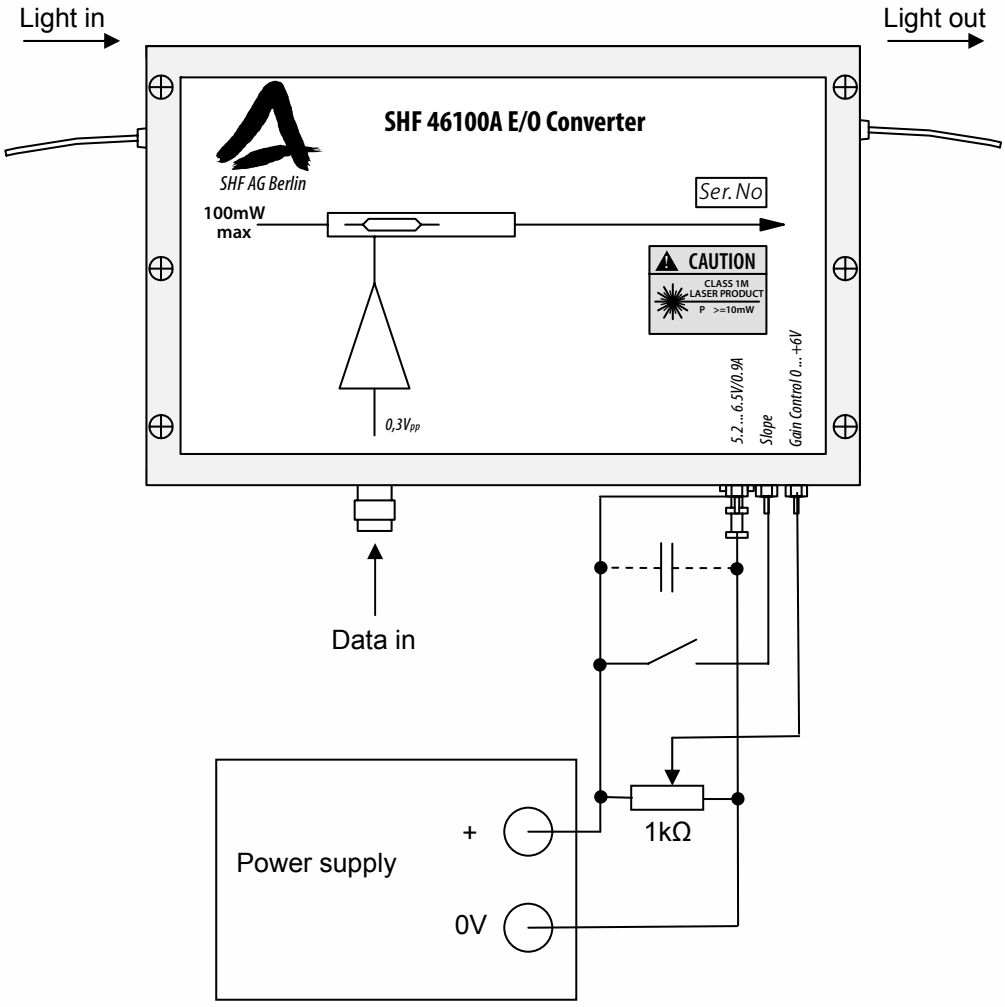


Figure 3: Wiring diagram for the SHF 46100 A with all features used.