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Intelligent Measurement
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March. 2002 Printer HP 4500 PS

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OCF-401
Optical Constant Fraction Discriminator

Accurate triggering to optical pulses

Negligible influence of amplitude fluctuations

Time walk < 30 ps for 1ns pulse with 1:10 amplitude fluctuation

1V / 4ns output pulse

Single +5V supply

Trigger indicator LED

Introduction

The OCF-401 is used to derive electrical trigger pulses from optical pulses. Due to the constant fraction trigger principle the trigger point is widely independent of the pulse amplitude. Typical applications are triggering of sampling/boxcar measurements, triggering of streak cameras and synchronisation of photon counting experiments.

The principle is shown in the figure right.

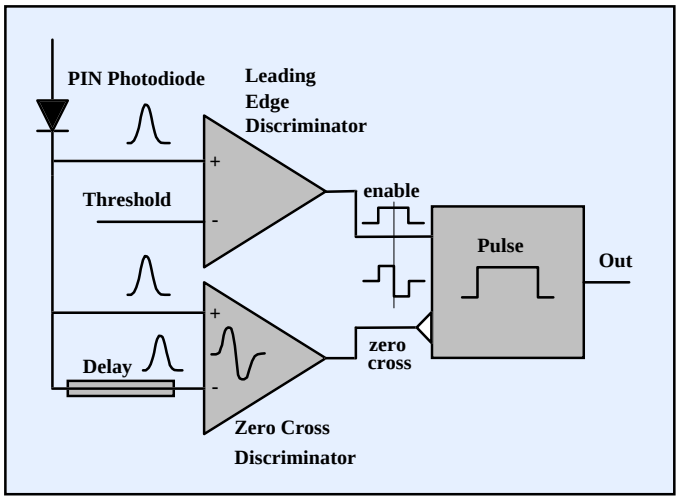

Fig. 1: Block diagram of OCF-401

The optical pulse is detected by a fast PIN photodiode. The electrical pulse goes to a leading edge discriminator and to a zero cross dicriminator.

The zero cross discriminator is a differential comparator that gets the photodiode pulse at both inputs. The pulse at the '-' input is delayed by a fraction of the pulse width. Therefore, the comparator effectively sees a bipolar pulse. Ideally, the zero cross point of this pulse does not depend on the pulse amplitude. Therefore the negative transition of the zero cross discriminator is is a excellent indicator of the temporal position of the optical pulse.

Of course, the switching point of the zero cross discriminator must be close to zero. This causes this discriminator to trigger not only to the light pulses but also to noise and spurious signals. To obtain a defined trigger threshold, a leading edge discriminator is used in parallel with the zero cross discriminator. The leading edge discriminator responds when the pulse exceeds an adjustable threshold. The output pulse of the leading edge discriminator is used to enable the output pulse stage of the OCF-401 a few ns around the transition from the zero cross discriminator.

As a result, the OCF-401 delivers an output pulse only for input pulses above a selectable energy, but the trigger delay is almost idependent of the pulse energy.

Installation

The OCF-401 device is shown in figure 2.

The OCF-401 requires a single +5V DC power supply. Before switching on, please make sure that the power connections are not reversed and a voltage of +5.5V is not exceeded. The device will work in a voltage range of 4.5V to 5.5V. The specifications apply to a supply voltage of 5.0V.

After switching on the power, feed the laser beem to the photodiode of the device. The active area is 0.5mm x 0.5mm wide. Do not focus the light to a smaller area - the linearity degrades at small focus diameters. The best intensity range for pulses of about 1ns width is around a few 10mW at 500nm.

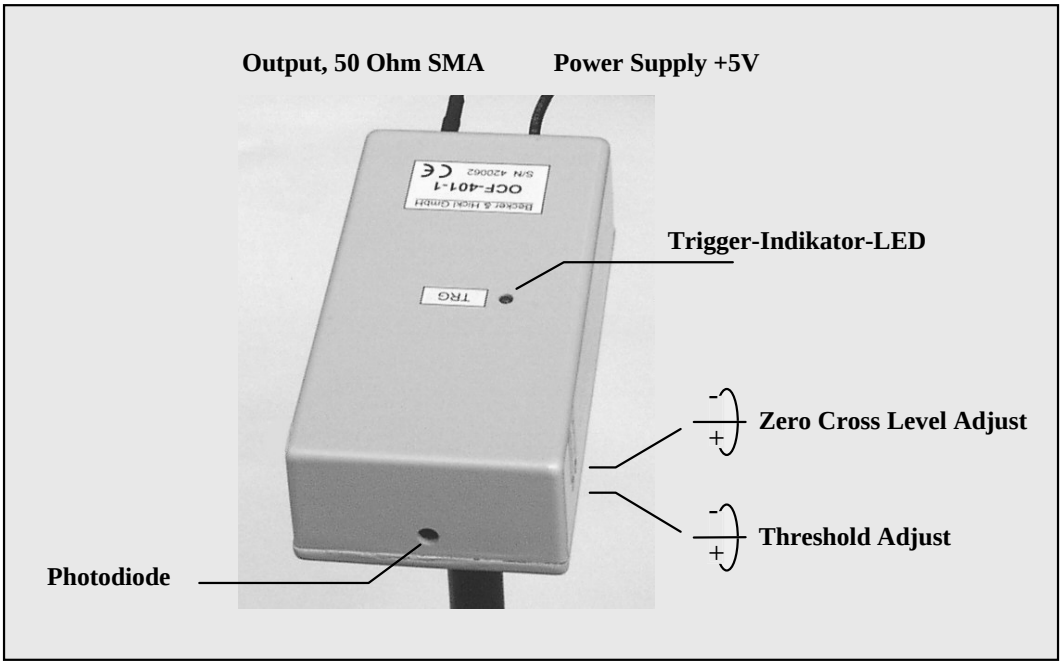

Fig.2: OCF-401

When the light pulses hit the photodiode the trigger indicator LED should flash or turn on steadily at higher repetition rates. Find the intensity at which the device just starts to trigger. For normal operation use about 5 to 10 times this intensity.

The output pulse is +1 V / 4 ns at 50 Ω. Other pulse durations are available on request - contact Becker & Hickl.

The device is optimised for an optical pulse duration of less than 2ns. If you have longer pulses the trigger accuracy can be improved by replacing the delay line for the pulse shaping. Contact Becker & Hickl.

Adjusting Threshold and Zero Cross Level

The OCF-401 module has two adjust screws for the leding edge discriminator threshold and the zero cross level. When delivered by Becker & Hickl, the OCF-401 modules are adjusted to yield good results with most common input pulse shapes. Should there be a re-adjustment required, please observe the following recommendations.

As described in figure 1, the leading edge discriminator enables the zero cross trigger circuitry. When it is enabled, the zero cross trigger will respond to very small signals. Therefore the threshold of the leading edge trigger is adjusted to trigger on the signal pulses from the photodiode but not on small noise peaks or spurious light signals (fig. 3). If the threshold is set too low, the zero cross trigger will be enabled by spurios input signals or it will be always enabled. In this situation false trigger events due to noise and spurious signals can occur. If the threshold is set too high, the sensitivity will be impaired.

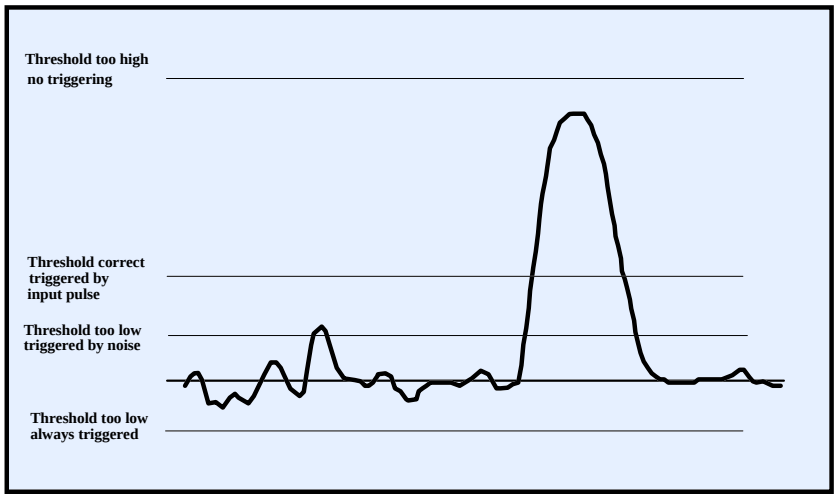

Fig. 3: Effect of threshold adjust

The figure below illustrates the influence of the zero cross level.

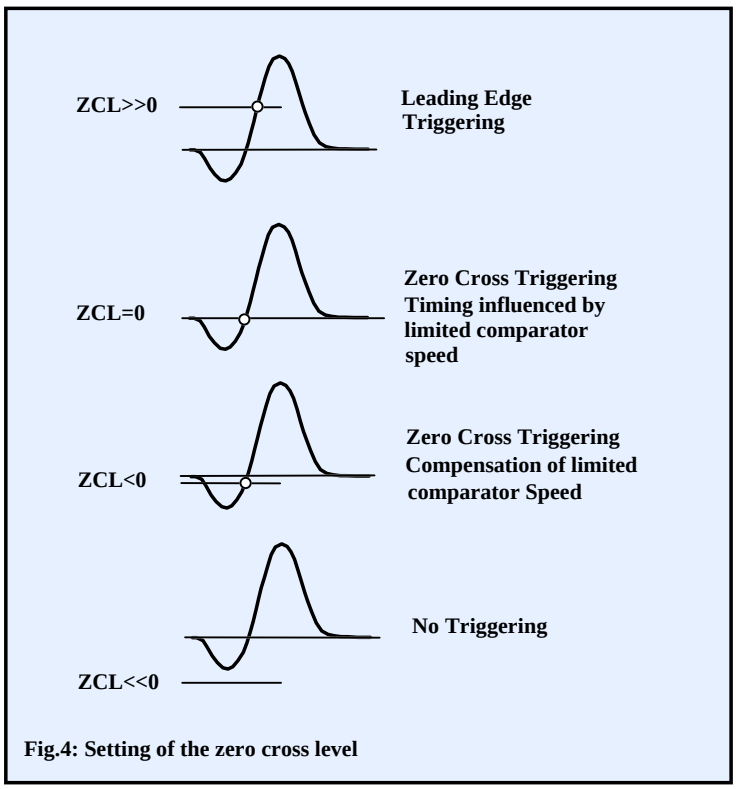

Fig.4: Setting of the zero cross level

True zero cross triggering is achieved with a setting close to zero. In practice a level slightly below zero will yield the best results. The reason is that the delay of the zero cross comparator decreases with with increasing signal amplitude. A slightly negative reference level compensates for this effect.

For higher zero cross levels the behaviour of the device becomes more and more similar to that of a conventional leading edge trigger. The device will trigger, but the delay depends on the input pulse amplitude. For very high zero cross levels the comparator level may be not reached by the signal, and the device does not trigger. The same happens if the zero cross level is set to very high negativ values.

If the OCF-401 is completely de-adjusted we recommend the following procedure:

Set the "Threshold" about three turns from the left end. Apply a signal which just triggers the device. Adjust "Zero Cross Level" and decrease the light intensity until you have found the range where the device has the highest sensitivity. Set the "Zero Cross Level" to the middle of this range. The zero cross level will be close to zero now. Now increase the light intensity to about twice the value found before and increase "Threshold" until the device stops triggering.

After this the device should be in a useful state. To optimize the timing characteristic proceed as follows:

Find the light intensity at which the device just starts to trigger. Apply a light intensity about 5 to 10 times higher than this value. Optimise the "Zero Cross Level" for a minimum delay variation in this range.

Specification

Output pulse amplitude	+ 1V, +2V on request
Output pulse duration	4 ns (higher values on request)
Output rise and fall times	1 ns
Trigger rate	max. 125 MHz
Delay variation with input amplitude	
electrical	+/- 30 ps in 1:100 amplitude range
with photodiode	+/- 30 ps in 1:10 amplitude range
Input pulse power	2 mW to 50mW (1ns, 600nm)
max. input power	400 mW average
Wavelength range	320 nm to 1000 nm
Power supply	4.5 V to 5.5 V
Power supply current	270 mA

All values refer to the nominal supply voltage of +5V and an ambient temperature of 25° C.

Technical Support

We are pleased to support you in all problems concerning the measurement of fast electrical or optical signals. This includes the installation of the OCF-401 and its connection to other bh devices, application and measurement problems, the technical environment and physical problems related to short time measurement techniques. Simply call us or send us an email.

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