LW800

800 MHz Discriminator with fiber optical isolation

User Manual

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Warranty

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The information in this manual describes the hardware and the software as accurately as possible, but is subject to change without notice.

IMPORTANT NOTES

The TX800 contains a Class 1M **LASER** diode for signal transmission. Please use appropriate LASER safety precautions when handling. Do not look into the invisible LASER beam, as LASER radiation can be potentially harmful.

The **power supplies** for both modules TX800 and RX800 must be **floating**.

When using the TX800 module at high voltage levels take care to use a power supply with sufficient **isolation voltage** capabilities.

It might be a consideration to use a battery pack for powering the TX800 Module at high voltages.

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1. Introduction

The LW800 is an ultra fast fiber optically isolated leading edge Discriminator system. It consists of the 800MHz Discriminator / Transmitter Module TX800 and the Receiver / Output Module RX800. The fiber optically coupling between the TX800 and RX800 modules is ideally suited for decoupling ultra high count rate timing signals from detectors at high voltage levels. The fiber optically connection to the data acquisition system provides full electrical isolation between the detector system and the data acquisition electronics independent of the voltage difference. High voltage capacitors are no longer required to extract timing signals from detector systems at high voltage levels.

It is also perfectly useful for the protection of valuable data acquisition electronics from potentially harmful high voltage sparks or discharges on the detector side.

With the high bandwidth of 800MHz, it is one of the fastest if not the fastest discriminator commercially available today. It is optimized for high count rate timing applications like time resolved single photon and ion counting. It is particularly useful in conjunction with FAST ComTec's range of multiscalers, TOF units like the P788x series or the MCA-3 .

The RX800 Output module provides non-inverted and inverted unshaped fast NIM outputs. The pulse width of these unshaped outputs depend on the input signal being above and below the threshold level.

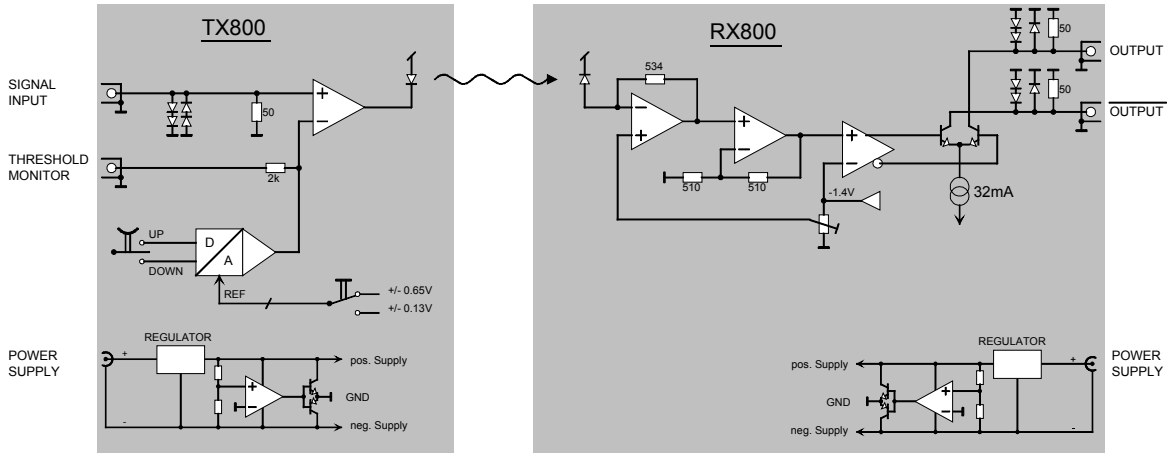

Figure 1.1: Block diagram / principle of operation

Essentially the TX800 module is comprised of a fast comparator driving an 850nm vertical cavity surface emitting LASER (VCSEL) diode. The input signal is compared to the threshold voltage level output from the 8-bit digital-to-analog converter. The threshold is settable via an UP/DOWN switch. The reference voltage range is switch selectable between ± 0.13V and ± 0.65V. On the MONITOR output, the threshold voltage can be observed using a high impedance voltmeter.

The RX800 module uses a high speed PIN photodiode for detection of the transmitted light pulses. A transimpedance amplifier (TIA) converts the received photo current into voltage pulses. These are driving an ECL logic comparator/driver that converts these voltage pulses into fast NIM output signals.

Thus, the discriminated input signals are converted into unshaped fast NIM output pulses while the fiber optical transmission provides for electrical isolation of the detector side and the data acquisition devices.

2. Installation / Setup Procedure

The delivery of a LW800 system includes a TX800 Discriminator / Transmitter module, a RX800 Receiver / Output module, a 50/125µm fiber cable of 2m in length and two AC adapters.

A spare low voltage connector is also provided. It might be used for connecting a custom-made power supply e.g. a battery pack to power the TX800 module. A battery pack might be particularly useful when the detector system and the TX800 respectively are at a high voltage potential. In this case, the isolation capability of an AC adapter might not be sufficient.

Nowadays NiMH rechargeable battery cells are well available with a large capacity of e.g. ~2000mAh for Mignon types or ~8000mAh for Mono cells. Thus, considering the TX800's low power consumption of approximately 200mA a battery pack consisting of 12 (x 1.2V = 14.4V) NiMH Mignon cells will last for about 10 hours of operation. And, about 40 hours using fully charged Mono cells. While 10 x 1.2V would be enough for a 12V supply the recommendation of 12 cells will assure safe operation even when the battery cells are getting near the discharged state.

Figure 2.1: LW800 Scope of supply

2.1. Cable connections

Connect the TX800 Discriminator / Transmitter Module and the RX800 Receiver / Output Module with the supplied fiber cable.

The TX800 Discriminator / Transmitter Module uses a Class 1M LASER diode for optical signal transmission. Please use appropriate LASER safety precautions when handling. The 850nm LASER radiation is invisible to human eyes. Do not look directly into the LASER beam, as the LASER radiation is potentially harmful.

It is recommended to use only the supplied fiber cable. Longer cables might lead to reduced signal quality. The longer the cable the more does the mode dispersion lead to pulse broadening and thus, to a reduced signal quality of the received optical pulse.

Plug in the power supplies.

IMPORTANT NOTE:

The power supplies must be **floating**!

WARNING:

Take care not to exceed the **isolation voltage** capabilities of the used TX800 power supply when connecting the TX800 to a detector system at high voltage level.

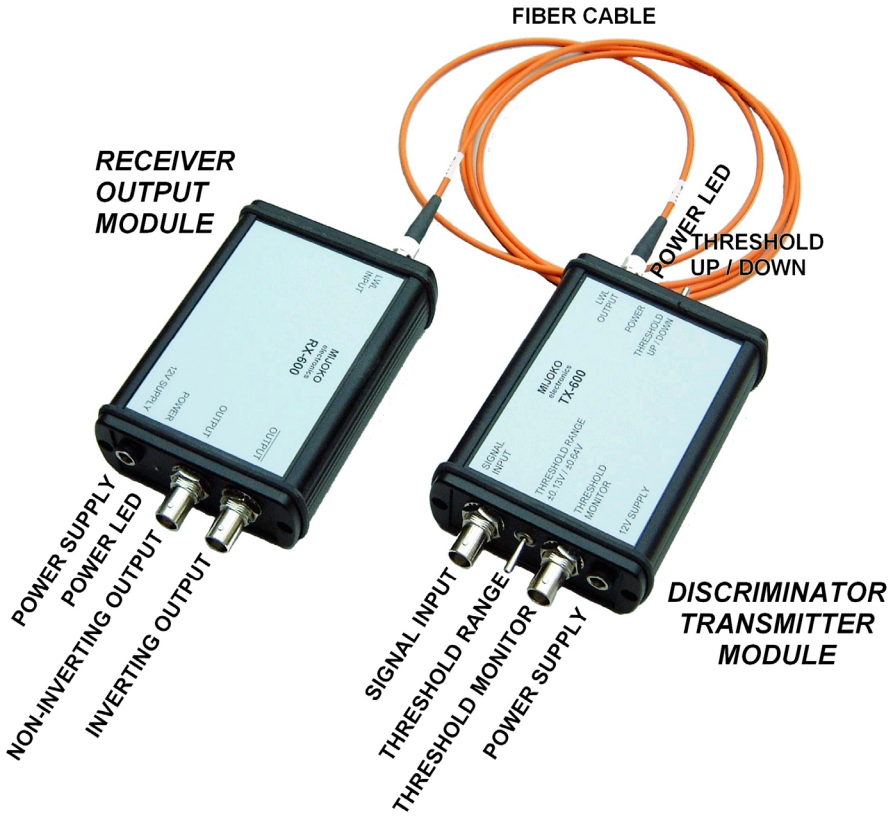

Figure 2.2: LW800 connections

Connect the inverting and/or non-inverting fast NIM output. Use 50Ω coaxial cables with appropriate 50Ω termination.

2.2. Threshold level

To control the threshold voltage level connect a high impedance (≥ 10MΩ) digital voltmeter to the *THRESHOLD MONITOR* output. Adjust the threshold level according to your input signals. In general, the best performance is achieved at about 50% pulse height. When the pulse width is low, a threshold level of some 30% of the pulse height might improve the experimental results. For further optimization the fast NIM outputs of the RX800 module might be observed with an oscilloscope.

The threshold level is adjusted by the corresponding UP/DOWN switch. An 8-bit nonvolatile Digital-to-Analog converter is incremented/decremented by each depressing of the THRESHOLD UP/DOWN button. When the button is kept depressed the DAC will keep incrementing/ decrementing at a rate of about one step every 250ms, i.e. four steps per second. After 1 second, the DAC will change to a rate of one step every 50ms (i.e. 20 steps/sec) until the switch is released.

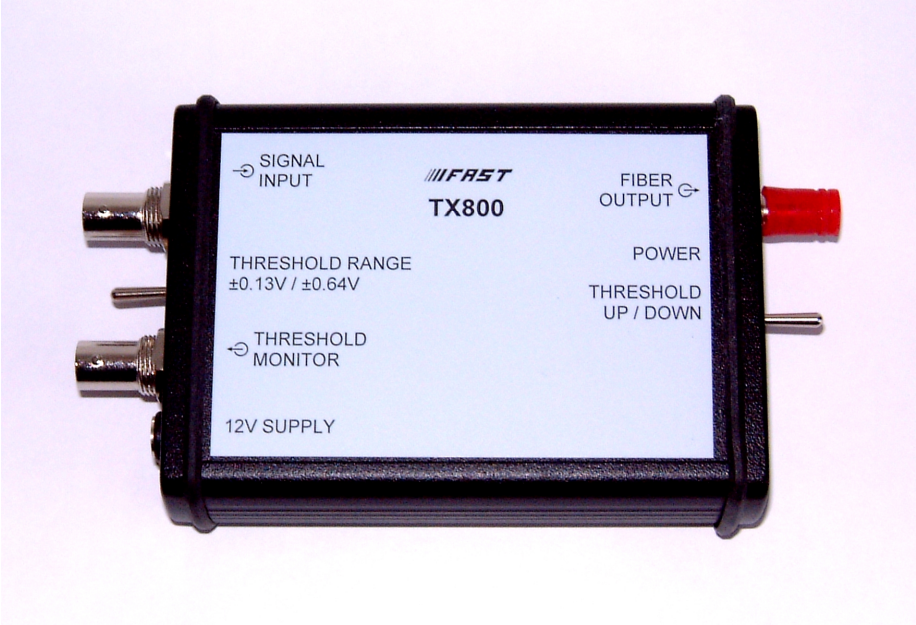

Figure 2.3: TX800 Discriminator / Transmitter top view

The DAC setting is saved in an internal EEPROM and the last used value is restored at power-up.

The threshold voltage range is switch selectable between ± 0.13V and ±0.65V. The corresponding voltage steps are ±1mV and ± 5mV.

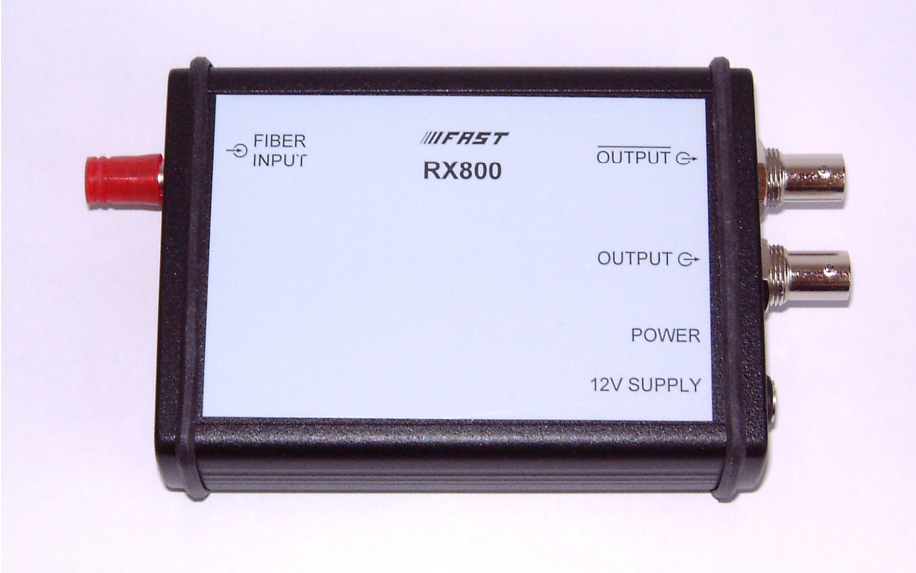

Figure 2.4: RX800 Receiver / Output Module top view

3. Appendix

3.1. Performance Characteristics

Bandwidth: ..... ≥ 800MHz[1]

Pulse width high/low: ..... > 625ps

Time Resolution: ..... 47ps FWHM
Gaussian peak fit of a 550MHz square wave fast NIM signal measured with a FAST ComTec P7887, 500ps multiscaler

LW800 contributed noise ..... 10ps FWHM[2]
measured with a FAST ComTec 7072T TADC and a MCA-3 multichannel analyzer

3.2. Specifications

3.2.1. Absolute Maximum Ratings

Signal input:

input voltage: .....± 1.8V

continuous input current: .....± 215mA

non repetitive peak input current: ..... ± 2A @ 1µs
..... ± 1A @ 1ms
..... ± 0.5A @ 1s

3.2.2. Recommended Operating Conditions

Operating temperature: ..... 0 to +50°C

3.2.3. Power Requirements

External Power Supply, one each for TX800 and RX800

TX800: ..... 12 - 15V_{DC}
..... 200mA_{DC}
..... **floating**

RX800: ..... 12 - 15V_{DC}
..... 250mA_{DC}
..... **floating**

[1] Measured with a fast NIM square wave signal and a HAMEG frequency counter

[2] Noise directly (without LW800) measured = 24ps FWHM, noise with LW800 = 26ps FWHM ➔ $(26^2 - 24^2)^{1/2}$ = 10ps

3.2.4. TX800 Connectors

Signal input

Connector: ..... female BNC

Impedance: 50Ω

Input voltage range: ..... ± 1.2V

Input sensitivity: ..... < 100mV$_{PP}$

Threshold voltage: switch selectable range ..... ± 0.13V / ± 0.64V
..... ± 3% of full scale
in 255 steps of ..... ± 1mV / ± 5mV

Threshold monitor output

Connector: ..... female BNC

Impedance: 2kΩ

Fiber output

Connector: ..... optical ST type
..... for 50/125µm fiber cables

Power input

Connector: (+) at center pin ..... 2.1mm center pin type

3.2.5. RX800 Connectors

Signal outputs

Connectors: ..... female BNC

Impedance: .....back terminated 50Ω

Signal: fast NIM / current mode ..... 16mA into 50Ω

Fiber input

Connector: ..... optical ST type
..... for 50/125µm fiber cables

Power input

Connector: (+) at center pin ..... 2.1mm center pin type

3.2.6. Fiber cable

Type:		50/125µm
Length:	recommended	≤ 2m
Connector:		optical ST-type

3.2.7. Physical

Case size:	each module	approx. 35 x 85 x 150mm
Weight (module alone):	TX800	240g
	RX800	230g