Rev.4 - 07/11/2023

SP5601

LED Driver

CAEN
Tools for Discovery

User Manual
DS2477

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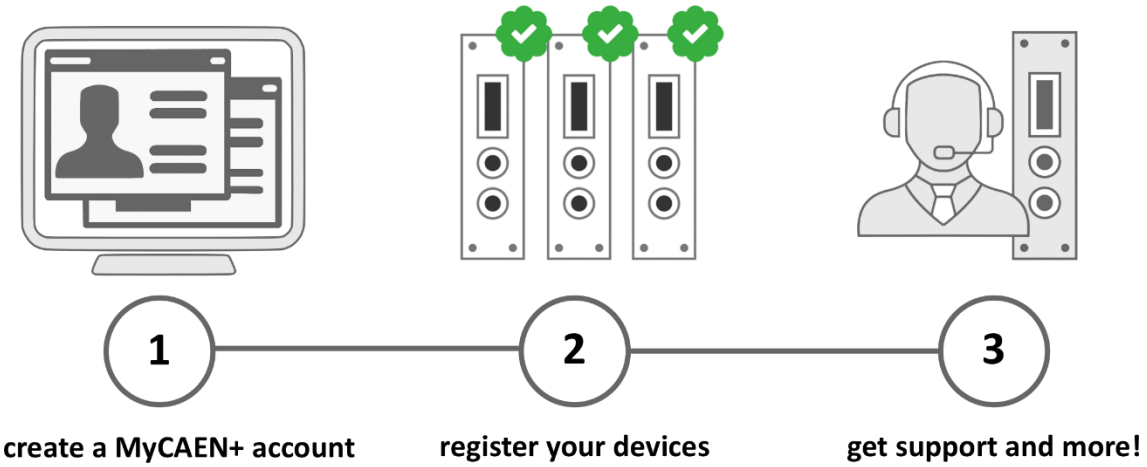
MyCAEN+ dashboard is designed to offer you a direct access to all our after sales services. Registration is totally free, to create an account go to https://www.caen.it/become-mycaenplus-user and fill the registration form with your data.



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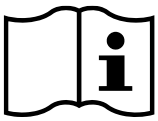
Purpose of this Document



This document contains the full description of the SP5601 LED driver.

Change Document Record

Date	Revision	Changes
30-06-2011	2	Initial release
06-02-2015	3	Updated LED driver tech spec
07-11-2023	4	Updated § SP5601 LED Driver Technical specifications, §Characterization Measurements

Symbols, Abbreviated Terms and Notations

Not Available

Reference Document

Not Available

All CAEN documents can be downloaded at:

https://www.caen.it/support-services/documentation-area/ (**login required**)

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Limitation of Responsibility

If the warnings contained in this manual are not followed, CAEN will not be responsible for damage caused by improper use of the device. The manufacturer declines all responsibility for damage resulting from failure to comply with the instructions for use of the product. The equipment must be used as described in the user manual, with particular regard to the intended use, using only accessories as specified by the manufacturer. No modification or repair can be performed.

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Made in Italy

We remark that all our boards have been designed and assembled in Italy. In a challenging environment where a competitive edge is often obtained at the cost of lower wages and declining working conditions, we proudly acknowledge that all those who participated in the production and distribution process of our devices were reasonably paid and worked in a safe environment (this is true for the boards marked "MADE IN ITALY", while we cannot guarantee for third-party manufactures).

Table of Contents

List of Figures

1 Introduction

The SP5601 is a fast LED driver and represents the ideal tool for SiPM tests and characterization, through a triggered light burst of intensity down to a few photons and up to a number saturating the sensors. The SP5601 features tuneable intensity and repetition rate: the LED driver can be triggered either via the internal pulse generator, or via an external source; the optical signal is routed to the sensor through a fibre, FC interfaced.

2 Available items

Product Code	Item	Description
WSP5601XAAAA	SP5601	Led Driver for SIPM development kit
WAIFC04XAAAA	BF1KFCFC-040M	Optical Fibre 40cm. simplex

3 Front panel components

AMPLITUDE: Vishay Spectrol 10 Turn Dial with Lock lever for pulse light intensity setting
LIGHT: FC Connector (output)

4 Back panel components

POWER: power switch for device turning On / Off; red led, lights up as device is ON
12V: PCB DC 2.1mm Power Socket (RAPC722X Switchcraft, +12V DC Input)
TRIGGER:

- IN: 00-type LEMO connector; External trigger input (TTL, High input impedance)
- OUT: 00-type LEMO connector; Local trigger output (TTL, drives 50 Ohm)
- INT/EXT (switch):
  - INT enables the internal trigger
  - EXT allows to use External trigger input (IN).

LOW/HIGH (FREQ) switch for frequency range setting:

- Low: 500 Hz – 80 kHz
- High: 60 kHz – 5 MHz

FREQ trimmer: frequency setting within the selected range

5 Power Requirements

The module is powered via the external AC/DC stabilized power supply (Mod. Meanwell GS40A12-P1J 40W, 12V DC Output, 3.34A).

6 5mm Super Violet LED Specifications

The SP5601 LED driver is provided with a OSSV5111A High Power LED.

Absolute Maximum Rating (Ta=25 °C)						
Item	**Symbol**			**Value**		**Unit**
DC Forward Current	I_F			30		mA
Pulse Forward Current[1]	I_{FP}			100		mA
Reverse Voltage	V_R			5		V
Power Dissipation	P_D			120		mW
Operating Temperature	T_{opr}			-30 ~ +80		~°C
Storage Temperature	T_{stg}			-30 ~ +100		°C
Lead Soldering Temperature	T_{sol}			260 °C /3sec		-
Electrical - Optical Characteristics (Ta=25 °C)						
Item	**Symbol**	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
DC Forward Voltage	V_F	I_F = 20 mA	2.8	3.4	4.0	V
DC Reverse Current	I_R	V_R = 5 V	-	-	30	µA
Peak. Wavelength	λ_p	I_F = 20 mA	400	405	410	nm
Radiation Power	P_R	I_F = 20 mA	68	100	150	mW/sr
50% Power Angle	2θ½	I_F = 20 mA	-	15	-	deg

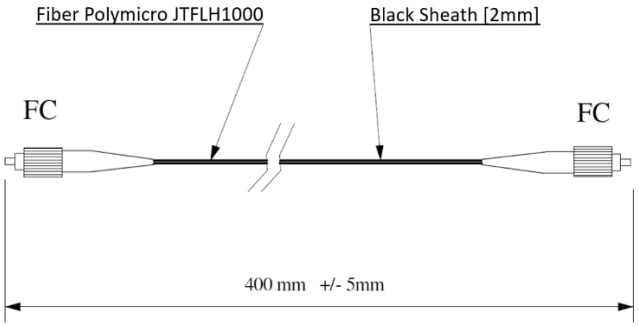
[1] Pulse width Max.10ms Duty ratio max 1/10.

7 SP5601 LED Driver Technical specifications

Dimensions	Width 79 mm, height 42 mm, depth 102 mm
Weight	450 g
Power requirements	140 mA@+12 V (12 V DC External Power Supply)
Width of pulse	8 ns typical @ full amplitude
Trigger Input	TTL, High input impedance; 500 Hz ÷ 5 MHz input frequency
Trigger Output	TTL, drives 50 Ohm ; width: ~110 ns; rise/fall time: < 2ns
Output frequency	From 500 Hz to 5 MHz

Optical Fiber

The optical signal coming from LED Driver is routed to the sensor through an *optical fiber*, FC interfaced. Here below, some details about the optical fiber.



Characteristics:

- Step Index
- Numerical Aperture: 0.37 ± 0.02
- Full Acceptance Cone: 43.4 degrees
- Low -OH Silica Core, Hard Polymer Clad
- Low -OH Core for Vis-NIR Transmission
- Operating Temperature: –65ºC to +125ºC
- Proof Tested from 100kpsi to 150kpsi
- Optional Acrylate, Nylon, or Hytrel® Buffer

Product Descriptor	Core (µm)	Clad (µm)	Buffer (µm)	Proof Test (kpsi)
JTFLH100010351400	1000 ± 15	1035 ± 15	1400 ± 50	100

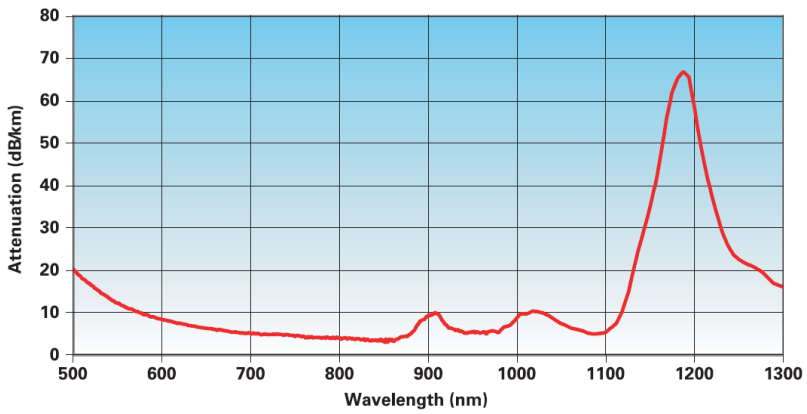


Fig. 7.1: Typical attenuation

8 Characterization Measurements

Complete test and characterization of the SP5601 LED Driver pulses has been performed at the University of Insubria (Como, Italy). The measurements were intended to investigate primarily the light pulse time development, the dynamic range, and the wavelength of the emitted light. The light pulse time development measurement, i.e., the spread in the temporal distribution of emitted pulses, is shown below:

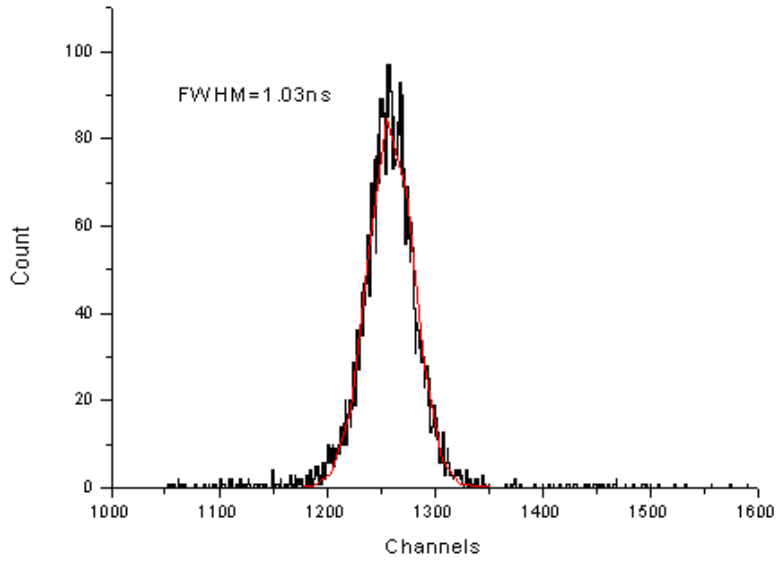


Fig. 8.1: Light pulse time distribution measurement; FWHM is 1.03ns.

The time development of a light burst was reconstructed reducing the pulsed light source to the single photon regime and recording the time of arrival of single photons, pulse by pulse.
The measurement was performed as follows, according to a well-established technique for single photon timing:

- A pulse generator triggered the LED driver and provided a periodic START signal to the Time Digitizer [CAEN V1290 TDC, characterized by a 25 ps granularity].
- The LED light pulse was focused on a Single Photon Avalanche Diode (SPAD)[MicroPhotonDevices PDM-50], characterized by an ultra-fast response able to guarantee 50 ps FWHM time resolution.
- The SPAD output, after a constant fraction discrimination [CAEN V812], provided a stochastic STOP signal to the Time Digitizer whenever a Photon was detected. As a consequence, the Time Digitizer measured the time interval between the SPAD response and the nearest next periodic signal from the pulse generator, actually providing the distribution of time of arrival of the single photons, reproducing the time development of the light pulse.

Precise measurements of the light wavelength were performed through the use of a spectrophotometer. The result is shown in the following figure:

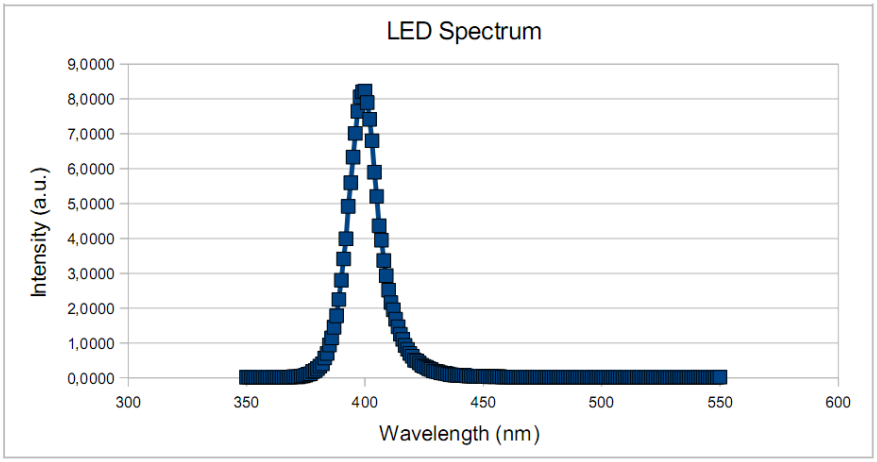


Fig. 8.2: Emitted light spectrum. The peak is at 400 nm.

The LED Driver Dynamic Range, i.e. the Light Intensity Vs. Pulser frequency, has been measured by means of H5783P W/QE PMT. The result is the following:

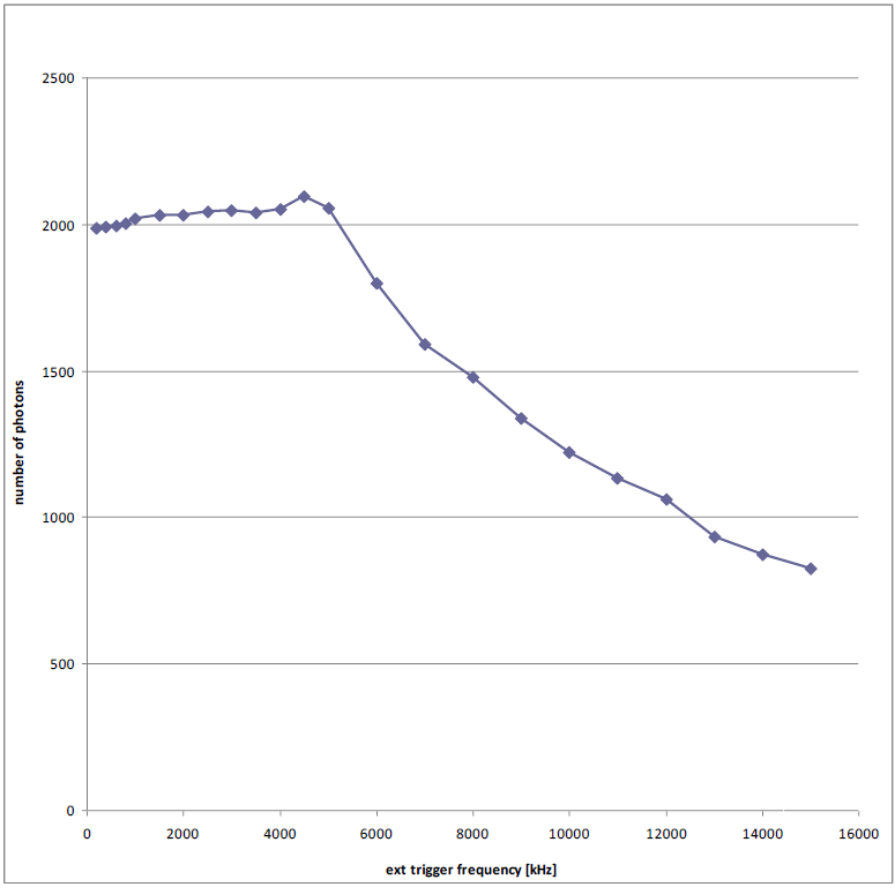


Fig. 8.3: Dynamic Range; the Amplitude knob was set to 6.7.

Clear fiber was used to transport light from driver to PMT. PMT can work in single photoelectron mode so in this case we can calibrate spectra in photoelectrons. Dependence of number of photoelectrons from frequency of external pulse is shown below. The PMT Q.E. for 400 nm of wavelength is equal to 20%.

Additional behavior trends of the SP5601 at room temperature are shown below.

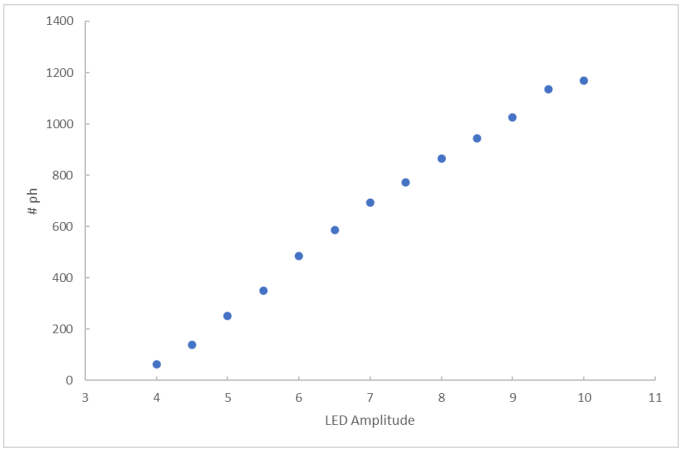


Fig. 8.4: Photons versus LED Amplitude (@2 kHz)

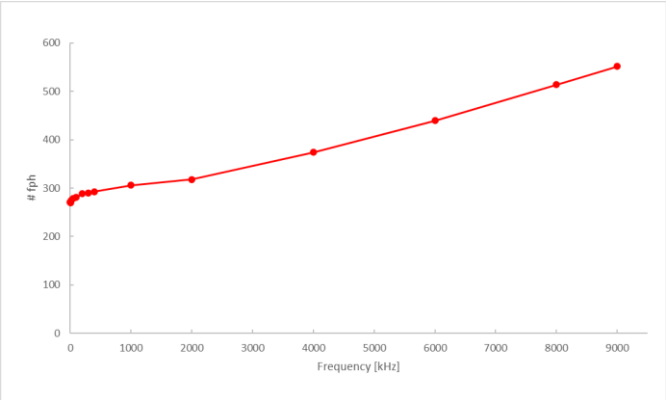


Fig. 8.5: Number of photons versus Frequency [@5 LED amplitude].

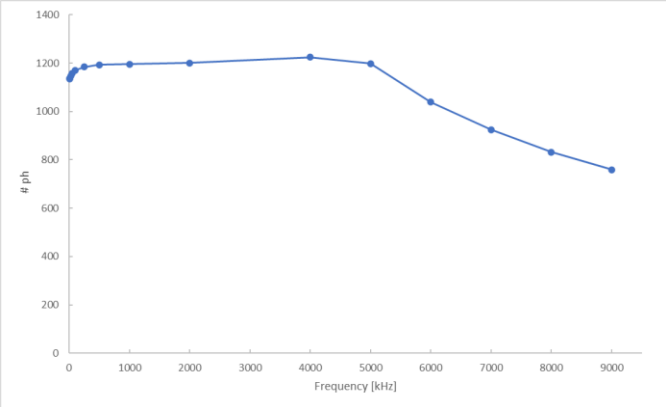


Fig. 8.6: Number of photons versus Frequency [@9 LED amplitude].

As shown, the LED light Intensity as a function of the Pulser Frequency is "quite" linear.

Note: The SP5601 LED Driver is not a calibrated module. The data sheet presents the typical trend of its behaviour as a function of the amplitude and the magnitude order of the emitted photons. However, it is essential to emphasize that each individual device may emit a varying number of photons.
Furthermore, the dynamics may exhibit non-linear behaviour. Therefore, if you need to determine the number of photons accurately, it is necessary to calculate it using a calibrated photon detector.

9 Technical Support

To contact CAEN specialists for requests on the software, hardware, and board return and repair, it is necessary a MyCAEN+ account on www.caen.it:

https://www.caen.it/support-services/getting-started-with-mycaen-portal/

All the instructions for use the Support platform are in the document:

A paper copy of the document is delivered with CAEN boards.

The document is downloadable for free in PDF digital format at:

https://www.caen.it/safety-information-product-support

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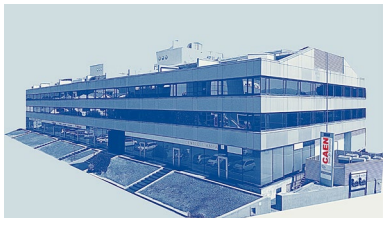

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