User's Guide

SMD10 *Aiguilhe* – Dual-Edge Pulse Sharpener

D-Series Modules – Subnanosecond Pulse Generator

SISYPH
Signals & Systems for Physics

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1 General Information

1.1 Important Notice

1.2 Scope

This manual provides the user with a description of the operation for the Dual-Edge Pulse Sharpener module SMD10-R20A.

1.3 Related Documents

All documents listed below are available online. See the product page.

Document	Release Number
Datasheet	SMD10-SS01-R20A
Block diagram	SMD10-CG02-R20A

1.4 Certification

Signals and Systems for Physics certifies that this product met its published specifications at the time of shipment.

1.5 Warranty

This *Signals and Systems for Physics* product is warranted against defects in materials and workmanship for a period of one (1) year from the date of shipment.

1.6 Absolute Maximum Ratings

All SMD-Series modules are designed to be operated in laboratory environment.

Parameter	Rating
Environmental Temperature	$> 15°$ C and $< 30°$ C
Environmental Humidity	$< 60\,\%$

1.7 Specifications

All specifications regarding the product are reported in the datasheet available online. See section 1.3.

Contents

2 Overview

The modules of the SMD-Series provide the scientists a complete line of instruments for the generation of short pulses at high repetition rates. First designed for stroboscopic magnetic imaging TEM (Transmission Electron Microscope), the SMD-Series offers a complete solution to deliver sub-nanosecond pulses into 50-Ω loads at repetition rates ranging from DC to 10 MHz.

2.1 Description

Referring to its block diagram(see section 1.3), the SMD10 *Dual-Edge Pulse Sharpener* module consists in a fixed-width pulse generator and two charge-controlled switches. Once triggered from the front panel, the pulse generator provides 10-ns pulses whose amplitude is controlled *via* the supply of its power amplifier.

The high-voltage pulses provided by the generator are delivered to the charge-controlled switches in order to sharpen the pulses' edges. Because these switches are based on step-recovery diodes (SRD), the switching times can be precisely adjusted using their bias currents under control of the user. The output pulses' edges benefit from the fast switching characteristics of the SRDs, resulting in sub-nanosecond rise times. The output of the pulse sharper is available on the front panel along with two coupled outputs useful for synchronisation and monitoring purposes. In order to provide variable amplitude pulses, the output stage of the power amplifier has to be powered from DC-variable voltage. Since this power supply is not generated by the SMD10 itself, the SMD20 module can be used for this purpose.

Due to its internal losses, the pulse generator is able to consume up to 5 W when operating at maximum frequency. Since significant heat has to be remove from a small area, a thermistor is coupled to the power stage to provide a measure of the temperature of the output transistors. This measure can be used by the SMD30 and SMD20 modules (providing both sensor conditioning and fan cooling) to ensure safe operation of the power amplifier. Overloads at the output of the pulse generator are detected by an internal logic to disable the power module is less than 10 ns, protecting the power amplifier from heavy loads at the main output.

The SMD10's settings are controlled using SPI commands. In this way, both bias currents of the SRDs and the trip point of the overload detector are set using the SPI lines, which are controlled by the SMD30 microntroller module. The SMD10 status is also monitored and controlled using additional digital signals reporting any overload detection or trigger condition. Analog monitoring is provided to measure the actual value of the bias current of the SRDs despite their digital control. These measures can be used by the ADC of the SMD30 module to check the actual setpoint of the charge-controlled devices.

3 Operation

3.1 Front Panel

There are a total of four SMAs coaxial connectors and three leds on the front panel, they are described in this section.

Since the front panel leds are not controlled by the SMD10 module itself, the display may differs from the following default specifications.

3.1.1 Red Status Led

By default, this led is lit when a fault condition has been detected by the SMD10, such as an output overload.

3.1.2 Yellow Status Led

By default, this led is turned on if a suitable input trigger signal has been detected.

3.1.3 Green Status Led

By default, this led is lit if the pulse generator is enabled. In this case the power amplifier delivers pulses to the egdes-sharpener.

3.1.4 Input SMA Connector

The trigger input signal is connected to this connector. Refer to the datasheet for maximum admissible ratings.

3.1.5 Output SMA Connector

The output of the edges-sharpener is connected to the 50-Ω load *via* this connector. Use a 50-Ω termination if not used.

3.1.6 Monitor SMA Connector

This output provides an attenuated copy of the output pulse train. This coupled output can be used for measuring the pulse's characteristics during operation. Use a 50-Ω termination. Can be left open if not used. Refer to the datasheet for specifications.

3.1.7 Synchronization SMA Connector

This output provides an attenuated copy of the output pulse train. This coupled output is provided for synchronization purposes. Use a 50-Ω termination. Can be left open if not used. Refer to the datasheet for specifications.

3.2 Analog I/O Interface Connector

Like all SMC-Series modules, the SMD10 has two 50-pin stack-through headers acting as Analog I/O and Digital I/O interfaces. In this section each pin allocated to the analog interface is described.

3.2.1 LE-Current Monitor

This pin provides the measure of the actual bias current of the leading-edge sharpener. Can be left open if not used.

3.2.2 TE-Current Monitor

This pin provides the measure of the actual bias current of the trailing-edge sharpener. Can be left open if not used.

3.2.3 Thermistor Pos. and Thermistor Neg.

A direct access to the terminals of the 2-lead NTC thermistor is provided by these pins. Can be left open if not used.

3.2.4 Power and Power Ground Inputs

The power supply voltage of the high-voltage pulse generator is connected between these two pins. Refer to the datasheet for maximum admissible ratings.

3.2.5 Analog Power Supply

The analog circuitry of the module operates from +15 V and −15 V power supplies. It is recommended to use the SMZ00 module to connect these sources. The digital ground **DGND** and power ground **PGND** terminals must be tied to the analog ground **AGND**.

3.2.6 Pin Assignments of the Analog Bus Connector

Signal label	Pin assignment	Direction
Power	AIO.30	input
Power Ground	AIO.29	input
Thermistor Pos.	AIO.32	passive
Thermistor Neg.	AIO.31	passive
TE-Current Monitor	AIO.36	output
LE-Current Monitor	AIO.40	output
AGND	AIO.35	output
AGND	AIO.39	output
−15 V	AIO.45	power input
+15 V	AIO.47	power input
AGND	AIO.49	power input
AGND	AIO.43	power input
Chassis	AIO.2	chassis ground input (Earth)

3.3 Digital I/O Interface Connector

Like all SMD-Series modules, the SMD10 has two 50-pin stack-through headers acting as Analog I/O and Digital I/O interfaces. In this section each pin allocated to the digital interface is described.

3.3.1 /Current Set Select Input

The SPI port uses this pin to select the two digital potentiometers setting the bias currents of the edges sharpener. This active low input is controlled by the SMD30 *Controller* module.

3.3.2 /Current Trip Select Input

This pin is used by the SPI port to select the digital potentiometer setting the trip point of the overload detector. This active low input is controlled by the SMD30 *Controller* module.

3.3.3 /Reset Flag Input

Once an overload has been detected, the SMD10 reports a fault condition by rising the /**Overload Output** flag. To reset this flag, the /**Reset Flag Input** has to driven low for a while by the remote controller.

3.3.4 /Enable Input

This pin is driven low to enable the pulse generator. When the pulse generator is enabled, the high-voltage pulses can be delivered to the output through the edges sharpener. Do not drive this pin low when the power input voltage is above +5 V to prevent damage of the power amplifier. Instead, for operation above this level, set first the power input voltage to +5 V, enable the power stage and increase linearly the power supply to its operating level. Apply the reverse procedure when switching the output off.

3.3.5 /Led Green-Bottom Input

Drive this pin low to turn this led on. Can be left open if not used.

3.3.6 /Led Yellow-Middle Input

Drive this pin low to turn this led on. Can be left open if not used.

3.3.7 /Led Red-Top Input

Drive this pin low to turn this led on. Can be left open if not used.

3.3.8 /Overload Output

When driven low, this pin reports that an overload has been processed. When such a fault occurs, the SMD10 disables its power amplifier itself without any intervention of the controller. Can be left open if not used.

3.3.9 /Triggered Output

This pin is driven low when an suitable trigger input signal has been detected. Can be left open if not used.

3.3.10 SCK Input

Connect this pin to the SCK line of the SPI port of the remote controller.

3.3.11 MOSI Input

Connect this pin to the MOSI line of the SPI port of the remote controller.

3.3.12 MISO Input

Connect this pin to the MISO line of the SPI port of the remote controller.

3.3.13 Digital Power Supply

The digital circuitry of the module operates from a +5 V power supply. It is recommended to use the SMZ00 module to connect this source. The digital ground **DGND** terminal must be tied to the analog ground **AGND**.

3.3.14 Pin Assignments of the Digital Bus Connector

Signal label	Pin assignment	Direction
/Current Set Select	DIO.26	input
/Current Trip Select	DIO.25	input
/Reset Flag	DIO.28	input
/Led Green-Bottom	DIO.32	input
/Led Yellow-Middle	DIO.34	input
/Led Red-Top	DIO.36	input
DGND	DIO.27	input
DGND	DIO.29	input
DGND	DIO.21	input
/Overload	DIO.40	output
/Triggered	DIO.42	output
DGND	DIO.39	output
DGND	DIO.41	output
SCK	DIO.44	input
MOSI	DIO.46	input
MISO	DIO.43	output
+5 V	DIO.47	power input
+5 V	DIO.48	power input
DGND	DIO.49	power input
DGND	DIO.50	power input
Chassis	DIO.1	chassis ground (Earth)

Document Identifier

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