User's Guide

SMA11 – DC-Error Controller

A-Series Modules – Laser Frequency Stabilization

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Contents

1 Important Notice

The information given in this guide applies to the SMA11-R17A module and its related documents or hardware

Document	Release Number
SMA11 Printed circuit board	SMA11-DD01-R17B
SMA11 Datasheet	SMA11-SS01-R17A
SMA11 PCB legend	SMA11-AG01-R17A
SMA11 Block diagram	SMA11-SG01-R17B

2 Overview

The SMA11 DC-Error Controller module was designed to control the locking point of a RF-optical heterodyne lock (also known as Pound-Drever-Hall lock).

In a well-designed laser frequency locking electronics, the DC offset of the error signal can be neglected and no lock-acquisition problems should occur. But electronics are not the only source of offset voltages and, faced with a high-level of residual amplitude modulation (RAM) the resulting DC baseline can be large enough to induce significant locking point errors. Moreover, in presence of high-finesse cavities, this DC component due to the RAM makes the lock acquisition difficult, indeed impossible. In such a case, a RAM offset cancellation must be provided.

For this purpose the SMA11 module is used to control the DC level of the error signal delivered by the SMA10 RF Frequency Mixer. The DC level is either adjusted using a front-panel knob or an input voltage. The DC range of the potentiometer (+/-5V or +/-500mV) is selected using a dedicated switch. The control voltage resulting from the combination of these settings can be summed to the mixer output through the analog bus connector. This signal is also copied and fed to the front-panel for monitoring.

Like all SM-Series modules, the SMA11 is shipped with the schematic diagrams of its electronic circuitry providing all required information for advanced users.

3 Operation

3.1 Controlling the DC component of the frequency error signal

Setting the DC component of the error signal in a laser frequency stabilization is easy to implement when the SMA10 RF Frequency Mixer module is used. Because it was designed for demanding laser control applications, the SMA10 features test inputs and among these, the Reference input can be used for the purpose of DC error control. During normal operation, *i.e.* the mixer output IF is enabled, the error output of the SMA10 Mixer module is

$$Error = 10\,(IF + Reference)$$

Although the primary use of the $Reference$ input is dedicated to closed-loop test signals, it can also serve as a DC error control input. This feature is used by the SMA11 DC-Error Controller module to provide both DC control and AC-test signal setting the SMA10 Reference signal as:

$$Reference = DC + EXT$$

where DC refers to the DC voltage adjusted using the front panel knob potentiometer, and EXT denotes the voltage applied to the External Control input. When the SMA11 Reference output is connected to the SMA10 Reference input, the error signal fed to the compensator is:

$$Error = 10\,(IF + DC + EXT)$$

Thus, the DC component can be used to cancel any undesirable offset present in the IF signal, while closed-loop test signal feature is still available using the external control input.

3.2 Front Panel

There are a total of two BNCs, three switches and one knob potentiometer on the front-panel, they are described in this section.

3.2.1 DC Adjust Switch

When the switch is in right (On) position, the DC offset of the **Reference Output** signal can be set anywhere between $+/-5\,\mathrm{V}$ (or $+/-500\,\mathrm{mV}$) using the **DC Adjust Knob**. Setting the switch in left position (Off) disables the potentiometer.

3.2.2 Low/High-Range Switch

This switch controls the actual range of the **DC Adjust Knob**: from $\pm 500\,\mathrm{mV}$ in the left position (Low-Range) to $\pm 5\,\mathrm{V}$ when the switch is in the right position (High-Range).

3.2.3 External Control Input BNC

This signal is used to control the **Reference Output** signal using an external source. Two applications are considered: adding a test signal in the closed-loop at the error level or controlling the induced RAM-component using a remote signal from a DAQ system. Connect the source to this BNC using a coaxial cable. Left open if not used.

3.2.4 External Control Switch

Setting the switch in right position (On) enables the **External Control Input**. When the switch is off, the input is disabled.

3.2.5 Reference Monitor BNC

The **Reference Monitor** carries a copy of the **Reference Output** signal. This output is able to drive a scope or a DAQ system. Can be left open if not used.

3.3 AIO and DIO Interfaces

Like all SMA-Series modules, the SMA11 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 SMA11 operation is described.

3.3.1 Reference Output (AIO A10-REFERENCE)

The SMA11 output signal is intended to drive the Reference Input of the SMA10 Mixer module through the analog connector interface. The switch **Reference Source Selector** located on the PCB should be set to connect the SMA11 output to the SMA10 Reference input.

3.3.2 Power Supply

The module operates from +15 V and −15 V power supplies. It is recommended to use the SMZ00 module to connect these sources.

3.3.3 Pin Assignments of the Analog Bus Connector

Signal label	Pin assignment	Direction
Reference	AIO.4 (SMA10 positive input)	output
AGND	AIO.6 (SMA10 negative input)	output
−15 V	AIO.45	power input
+15 V	AIO.47	power input
AGND	AIO.49	power input

3.3.4 Pin Assignments of the Digital Bus Connector

The SMA11 has no connection to the Digital Bus.

3.4 On-Board Settings

There is one switch provided for configuration purpose. It is located on the printed circuit board.

3.4.1 Reference Source Selector (SW501.1-2)

This switch is used to allow operation of the SMA10 RF Mixer module with the SMA11 DC-Error Controller.

SW501.1-2	SMA10 Reference input
off	from Analog Bus, operation without SMA11
on	from SMA11 output, normal operation using SMA11

3.5 Printed Circuit Board Legend

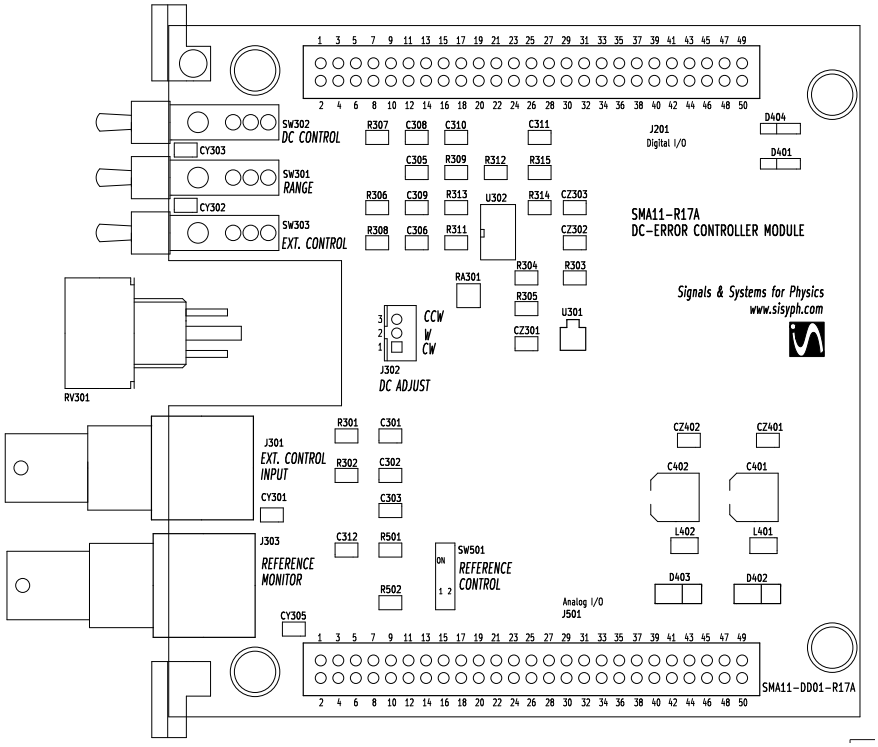

Figure 1: SMA11 Printed Circuit Board legend

Document Revision History

Release	Comments
SMA11-SN01-R17A	first release