



**PSI-2011-11  
QUAD+ MODULATOR BIAS CONTROLLER  
BOARD**

**USER MANUAL**

Rev A

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## 1 DOCUMENT SCOPE:

This document describes basic set-up and operation of the Photonic Systems, Inc. PSI-2011-11 QUAD+ miniature modulator bias controller board. This manual is intended to give the user enough information to place the controller into service using common electronic laboratory tools, instruments and practices. This product is sold as a modulator bias controller intended for use in applications where precise QUAD+ optical modulator control is required over time and temperature.

For initial evaluation purposes and easy set-up, PSI recommends the use of a PSI-2011-99-11 evaluation product kit. This kit allows a user to quickly set-up and operate the PSI-2011-11 MBC.

## 2 PRODUCT DESCRIPTION

### 2.1 *PSI-2011-11 QUAD+ Modulator Bias Controller Features*

- Dither based bias control
- Compatible with most optical modulators – factory set  $V_{\pi}$  @DC required
- Factory adjustable dither amplitude: 20 to 330mVpp
- Compatible with wide power supply range: +/-8V to +/- 13V
- Includes auto-reset
- Low operating current: <10mA typical
- Wide operating temperature range: -20° to +70° C
- Small Size: 1.65" x 0.45", 7-pins

### 2.2 *Overview of the chip-scale bias controller*

The PSI-2011-11 QUAD+ modulator bias controller offers a drop-in solution for precise control of Lithium Niobate (LiNbO3), polymer, silicon or electro-absorption fiber optic modulators. This controller accurately prevents bias point drift away from the QUAD+ bias point.

Control of your optical modulator is simplified through use of the PSI-2011-11 in your system. This device is based on Photonic Systems experience in design of fiber optic systems and components. Intended for use in OEM optical links or customized experiments with optical modulators, the chip-scale bias controller offers users drop-in modulator control, speeding development time and allowing for greater concentration on other design issues.

The controller's internal dither generator is factory adjustable for amplitude. When used in conjunction with an optical photodetector, lock is automatically established on the QUAD+ bias point.

The PSI-2011-11 chip scale modulator bias controller provides precise control of optical modulators with an error of less than 1° at 1% dither of modulator  $V_{\pi}$  operating. Operating from dual power supplies between +/-8 to +/-13VDC, the device draws less than 10mA minimizing power consumption within the optical transmitter. The device is the smallest modulator bias controller available on the market, measuring only 1.65 x .045 inches.

## 2.2.1 Functional description

The PSI-2011-11 QUAD+ modulator bias controller (MBC) operates by adding a very small amplitude dither signal to the DC bias applied to an optical modulator. This dither signal is later detected as a portion of the light output from the modulator under control through an optical coupler and photodetector. The MBC maintains a constant modulator bias point by continuously adjusting the bias voltage to a QUAD+ set point.

At time of order, the dither generator amplitude can be factory adjusted by PSI to meet applications specific requirements. Dither amplitude may be adjusted between 20 and 330mVpp.

An external photodetector is required to complete the feedback path with the modulator under control. This photodetector is connected to the controller with the cathode at J1-pin 1 and the anode at J1-pin 2.

The PSI-2011-11 is contained on a 1.65" x 0.45", 7 pin, 0.45" wide printed circuit board with plug-in connection pins protruding from the bottom of the board.

## 2.2.2 PSI-0204-11 Specifications

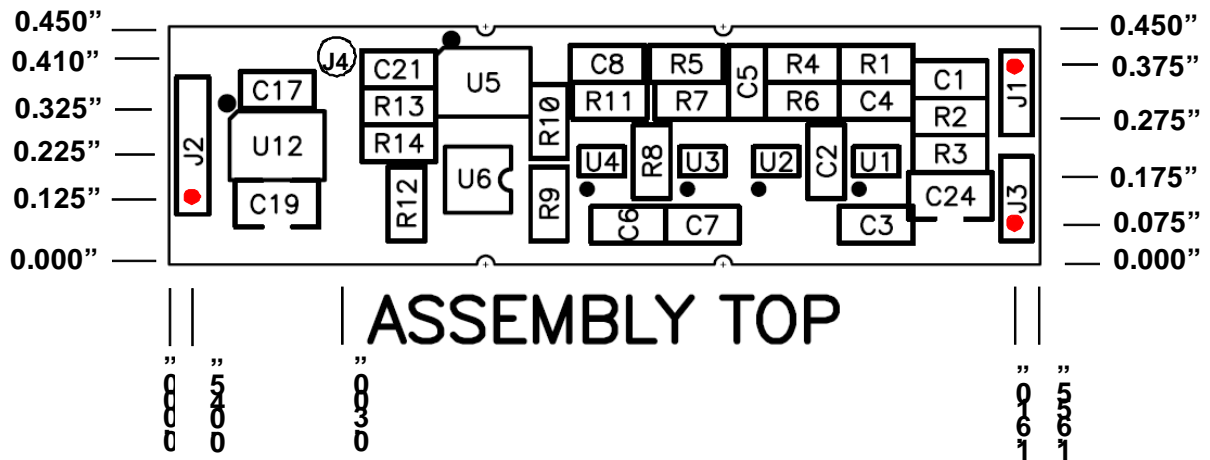
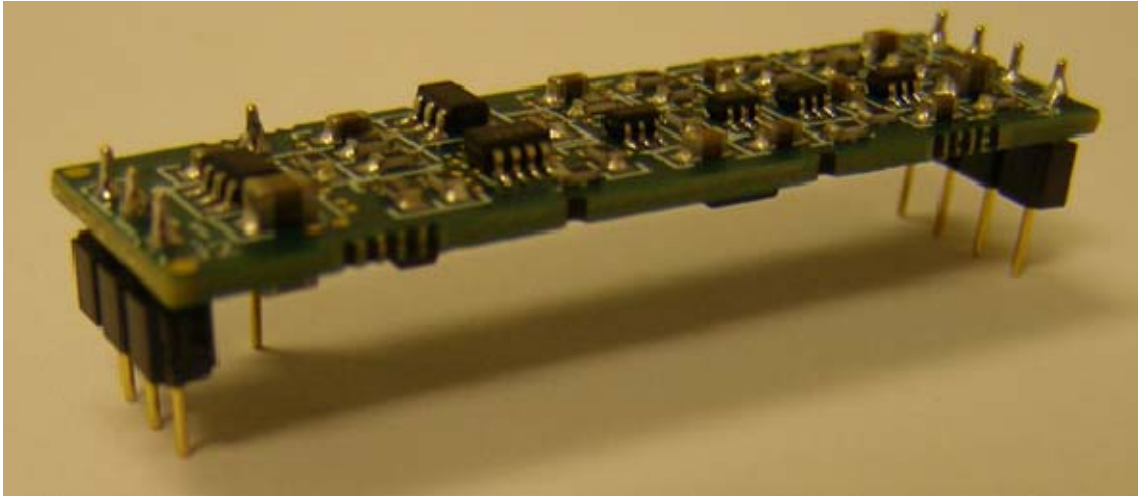
Parameter	Value	Units
Modulating Signal	Analog small	—
Modulators Supported	Mach Zender	—
Output DC Bias Voltage	0.3 less than supply voltage	volts
Maximum Output load capacitance	≤0.2	μF
Dither Frequency	1.0	KHz
Dither Amplitude, peak to peak, 30-320uA at MAX	20 to 330 (factory set)	mVpp
Bias Point Error @ Quad + , 15 to 160 μA photodetector current <sup>1</sup>	1°@1% dither of $V_{\pi}$	degrees
DC Power Supply <sup>2</sup>	+/- 8 to +/-13	volts
DC Operating Current	<10	mA
Operating Temperature Range	-20 to +70	°C
MBC Board Dimensions	1.65 x 0.45 (6.4 x 1.7cm) ; 7 pin package	inches

<sup>1</sup> Equivalent to -8 to -18 dBm of optical power (at quadrature) applied to Fermionics FD-300 or equivalent photo detector. Wider dynamic range controllers available; contact PSI for details.

<sup>2</sup> The MBC will operate at DC power supply voltages as low as +/- 8volts. PSI tests and specifies all parameters based on operation at +/- 12 volts.

### 2.2.2.1 Mechanical Specifications

The photograph and drawing below show top view, bottom view and dimensions for the PSI-2011-11 QUAD+ modulator bias controller. All dimensions are in inches. Tolerances are +/- 0.005 unless otherwise noted.



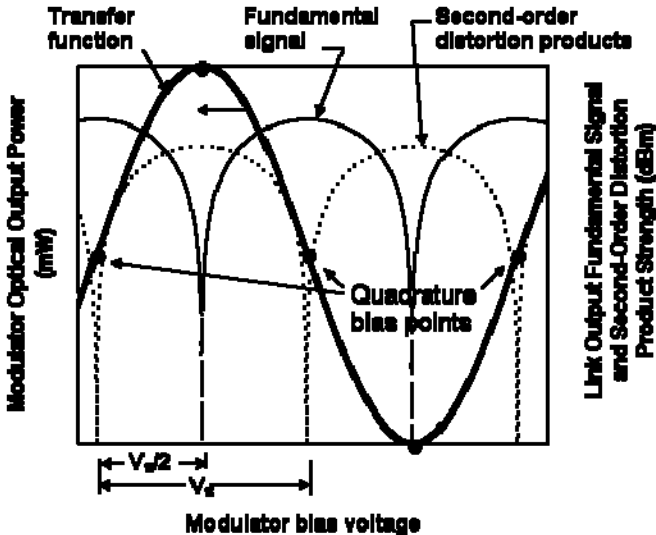
#### PSI-0204-11 Device Pins and Descriptions

Pin	Function	Description
J1 pin1	PD Bias	Connect to external photodiode cathode
J1 pin2	PD Anode	Photo diode anode (analog ground)
J2 pin1	+V	Positive power supply connection. Acceptable range from +8 to +13 volts; specifications valid at +12 volts.
J2 pin2	Ground	Device Ground

J2 pin3	-V	Negative power supply connection. Acceptable range from -8 to -13 volts; specifications valid when operated at -12 volts.
J3 pin1	Bias Out	To Modulator Bias
J3 pin2	Ground	Device Ground
J4 pin1	Reset	Short to ground to reset MBC

### 2.3 Using the Chip-scale Modulator Bias Controller

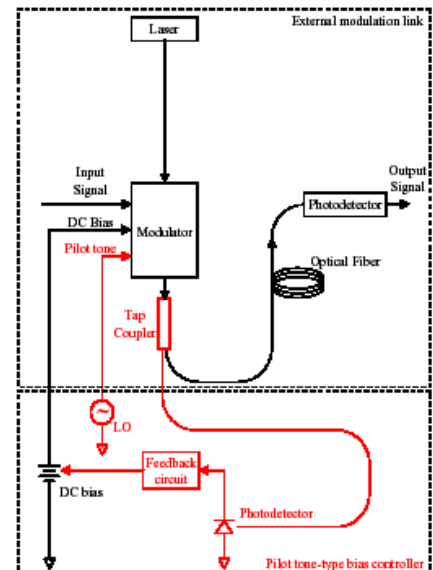
The PSI-2011-11 QUAD+ modulator bias controller may be used in a number of configurations to match different end applications. Common to all applications is the use of a dither tone added to the bias voltage applied to the modulator under control. This dither tone is detected at the modulator's output through an optical coupler and photodetector to maintain a constant optical power.



Specific applications may require the controller to hold bias at different points along the modulator's transfer function curve. The figure below shows a modulator's optical output plotted against an applied bias voltage. The change in applied voltage that results in a change from maximum to minimum power or between quadrature points is defined as  $V_{\pi}$ . Common terminology defines maximum and minimum optical output power as Max and Min points. The median point between Max and Min (quadrature bias points) are defined as Quad + or Quad -, on the positive or negative slope of the transfer function respectively.

The PSI-2011-11 is set only for QUAD+ operation while the PSI-0204-11 MBC allows the user to select operation at QUAD+, QUAD-, MIN, or MAX. The PSI-2011-11 modulator bias controller's dither tone is typically factory set to operate at 1% of a typical LiNbO3 modulator's  $V_{\pi}$ . However, this dither amplitude (and frequency) may be changed depending on application requirements.

The majority of small signal transmission applications will operate at either Quad + or Quad - bias points. This allows for greatest signal transmission integrity because second order distortion products of an applied fundamental are minimized at quadrature. The PSI-2011-11 is configured for QUAD+ modulator bias controller operation. A typical small signal transmission application is shown here with the PSI-2011-11 modulator bias controller. Note that the chip-scale



MBC does not include a feedback photodetector or tap coupler. For the majority of applications, a photodetector such as Fermionics model FD-300 or equivalent is suggested. The tap coupler should be selected based on the optical power present at the output of the modulator does not exceed 320uA at Max, or equal to 160 uA at Quad.

These components must be selected by the user based on application requirements. PSI can provide recommendations for these components as needed, please contact us for assistance.

### **3 WARRANTY**

Photonic Systems, Inc. warrants the PSI-2011-11 QUAD + modulator bias controller, Products must be returned to the manufacturer for service and/or repair at the buyer's shipping expense. The buyer must contact PSI and receive a valid return material authorization (RMA) number prior to returning any products.

The warranty is void if the unit has been subjected to abuse and/or attempts to alter and/or repair it without the prior written approval of Photonic Systems, Inc., or if the unit shows evidence of component tampering while the unit is in the buyer's possession.

Following the warranty period, charges for parts and labor will be as required to repair the unit. Prices for modifications, revisions and non-warranty parts and service, together with labor necessary, will be quoted upon request.

Except as expressly provided above, there is no warranty or guarantee of merchantability or fitness for a particular purpose or of any other kind, express or implied, with respect to the unit or parts furnished or the services performed by the manufacturer. In no event shall the manufacturer be liable for any consequential damages.