User Guide

SIB71256
256 Channel MAPMT Interface Board
Hamamatsu H13700 Series

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Table of Contents

List of Figures

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General Safety Precautions

Use Proper Power Source

The SIB71256 is powered with a +12V power source. Use with any other power source may result in damage to the product.

Operate Inputs within Specified Range

To avoid electric shock, fire hazard, or damage to the product, do not apply a voltage to any input outside of its specified range.

Electrostatic Discharge Sensitive

Electrostatic discharges may result in damage to the SIB71256. For this reason, the SIB71256 board is intended to be operated in a user's conductive instrument enclosure.

Do Not Operate in Wet or Damp Conditions

To avoid electric shock or damage to the product, do not operate in wet or damp conditions.

Do Not Operate in Explosive Atmosphere

To avoid injury or fire hazard, do not operate in an explosive atmosphere.

Product Overview

- Mounting board for 256 channel Hamamatsu H13700 MAPMT
- Includes anger logic for interface to data acquisition systems
- Reduces channel count from 256 down to 4 outputs
- High speed preamplifier for each anger logic output
- High speed preamplifier for last dynode output
- Two user-selectable gain settings

The SIB71256 multianode photomultiplier tube interface board provides the mechanical and electrical connectivity between the Hamamatsu H13700 256 anode PMT and external signal processing electronics such as Vertilon's PhotoniQ multichannel data acquisition systems. The MAPMT is mounted to the bottom side of the SIB71256 through a pair of socket connectors that route the PMT's 256 anode signals and last dynode output to the board. The high voltage bias to the PMT is supplied separately on its own cable and thus never reaches the SIB71256. The anode signals are routed to an on-board resistive anger logic circuit that generates four anger signal outputs. Each output is fed to an inverting amplifier and made available to the user on an SMB connector. Event position and energy information can be determined by connecting the four anger signal outputs to customer-supplied electronics. For timing applications utilizing the last dynode output of the PMT, the SIB71256 includes a high speed non-inverting preamplifier whose output is also available on an SMB connector. The polarity of the preamplifiers is such that the four anger and last dynode outputs produce all positive going signals.

The various functions on the SIB71256 are described in greater detail on the following pages. When necessary, refer to the functional block diagram shown in Figure 1 below.

Included

- SIB71256 anger logic sensor interface board for Hamamatsu H13700 MAPMT
- Wall mount +12V power supply with international plug set
- Five 120 cm SMB to BNC coaxial cables
- Gain adjustment tool
- User Manual

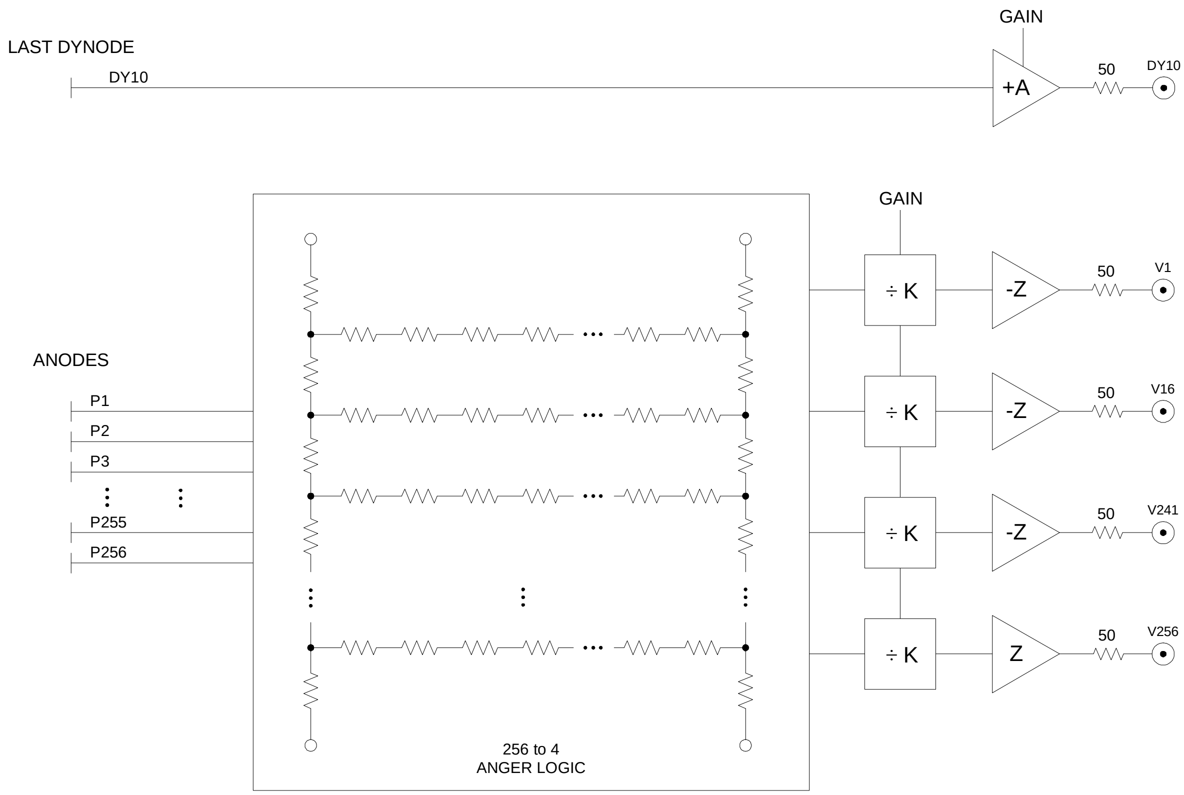

Figure 1: Functional Block Diagram

Typical Setup

A typical setup using a SIB71256 is shown below. The Hamamatsu H13700 MAPMT is mounted to the SIB71256 and positioned to detect incoming light from a scintillator crystal or optical assembly. The four anger logic outputs from the SIB71256 connect to four inputs on a PhotoniQ IQSP418 / IQSP518 multichannel PMT data acquisition system. Digitized output data from the PhotoniQ is sent through a USB 2.0 connection to a PC for display, logging, or real time processing. The amplified last dynode signal from the SIB71256 connects to an external discriminator that generates a trigger to the PhotoniQ. A high voltage bias of up to negative 1200 volts is sent directly to the PMT from an SHV connector located on the rear of the PhotoniQ. Note that the high voltage output is an optional configuration on the IQSP418 / IQSP518.

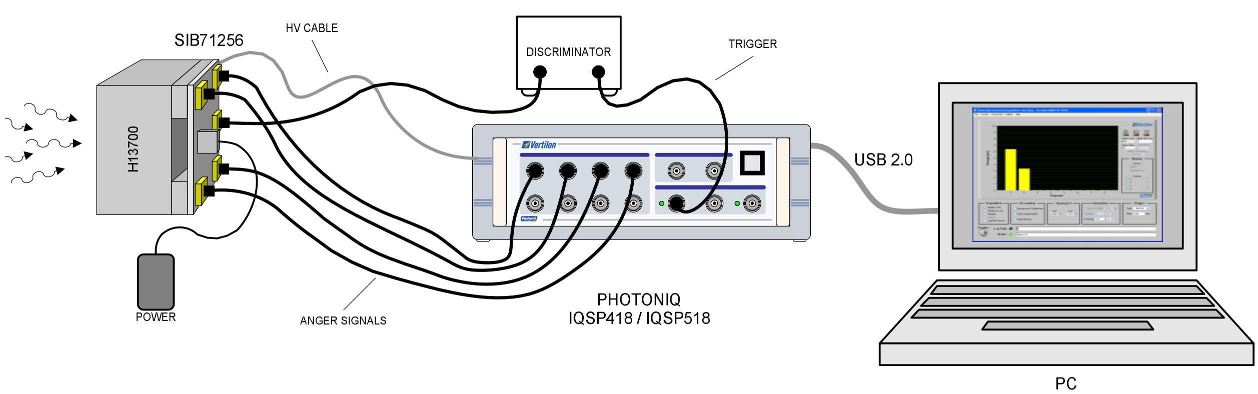

Figure 2: Typical Setup

Specifications

(T_A = +25C, unless otherwise noted)

Description	Sym	Min	Typ	Max	Units	Notes
ANODE CIRCUITS						
Quantity	P1 – P256		256			
ANGER SIGNAL PREAMPLIFIER						
Input Resistance	Rin		12.4		Ω	
Current Divider (High Gain)	K		1			
Current Divider (Low Gain)	K		4			
Transimpedance	Z		500		Ω	
Net Transimpedance Gain (High Gain)			250		Ω	Measured at anger output into 50 ohms
Net Transimpedance Gain (Low Gain)			62.5		Ω	Measured at anger output into 50 ohms
Bandwidth			160		MHz	
Slew Rate			450		V/us	
Output Baseline Level			12 55	50 110	mV mV	No load Isink = 5mA
Maximum Output Pulse			4		V	Into 50 ohms
Output Impedance			50		Ω	
LAST DYNODE PREAMPLIFIER						
Input Resistance (High Gain)			50		Ω	
Input Resistance (Low Gain)			12.4		Ω	
Amplifier Gain	A		10			
Net Transimpedance Gain (Hi Gain)			250		Ω	Measured at anger output into 50 ohms
Net Transimpedance Gain (Lo Gain)			62.5		Ω	Measured at anger output into 50 ohms
Bandwidth			160		MHz	
Slew Rate			450		V/us	
Output Baseline Level			12 55	50 110	mV mV	No load Isink = 5mA
Maximum Output Pulse			4		V	Into 50 ohms
Output Impedance			50		Ω	
POWER						
Supply Voltage	Vsupply	+11	+12	+13	V	
Supply Current	Isupply		70		mA	
DIMENSIONS						
Width	W		52		mm	
Length	L		52		mm	
Thickness	T		1.57		mm	(printed circuit board only)

Table 1: Specifications

Photomultiplier Tube Anode Circuit

The 256 anode signals (P1 – P256) from the H13700 MAPMT are routed directly on the SIB71256 to the resistive anger logic circuit shown in the figure below. Each anger signal is amplified by high speed inverting preamplifiers and output on the SMB connectors on the four corners of the printed circuit board. The gain of the preamplifiers can be configured by the user to one of two settings using miniature rotary switches on the PCB. The anger signals can interface to a charge integrating data acquisition system like a Vertilon PhotoniQ IQSP418 or IQSP518 to extract energy and position information.

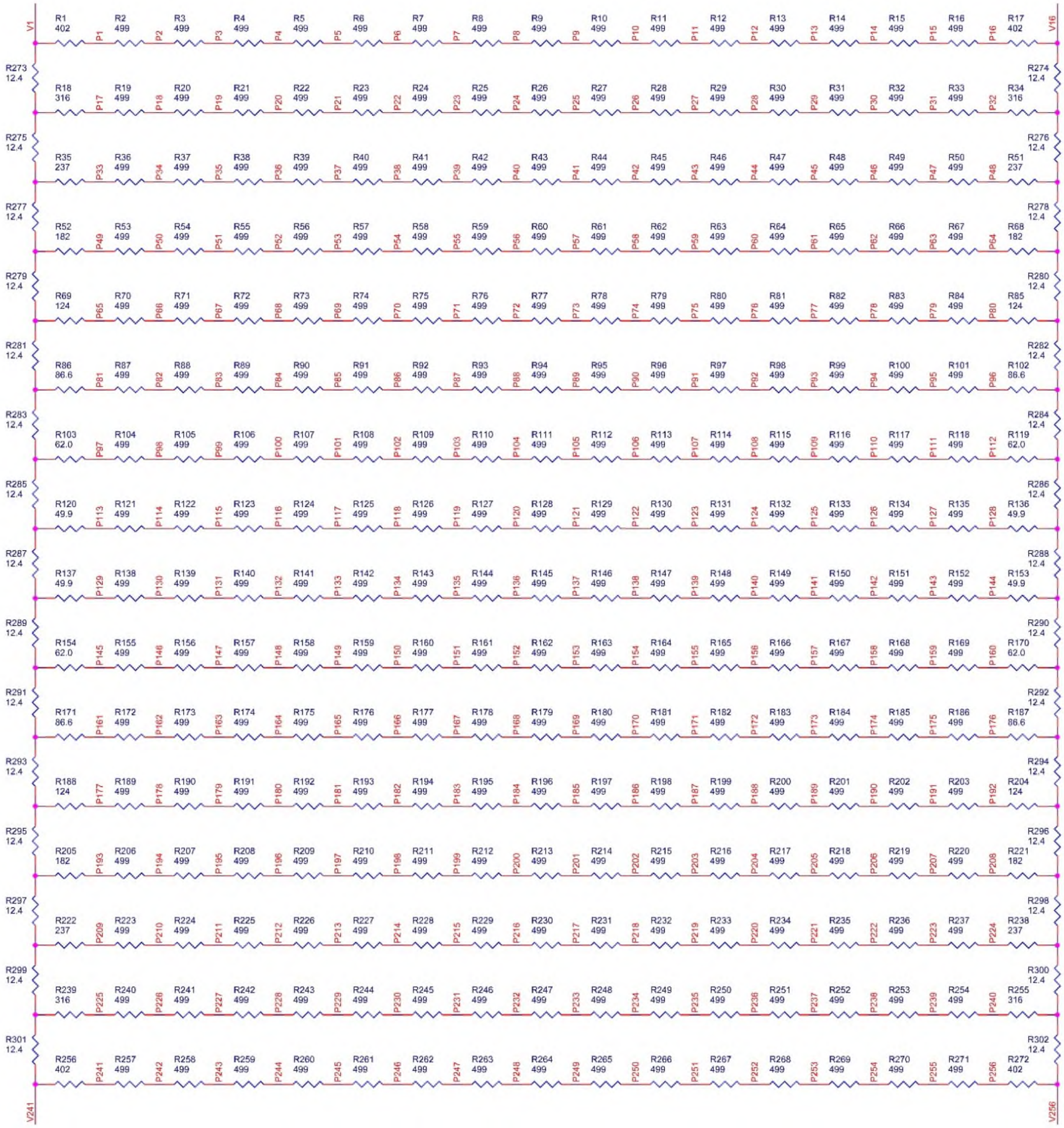

Figure 3: Resistive Anger Logic Circuit

Anger Logic

Position information is obtained from the SIB71256 anger logic circuit using the formulas below to determine the X and Y coordinates.

$$X_{pos} = (V_1 + V_{16} - V_{241} - V_{256}) / (V_1 + V_{16} + V_{241} + V_{256})$$

$$Y_{pos} = (V_1 + V_{241} - V_{16} - V_{256}) / (V_1 + V_{16} + V_{241} + V_{256})$$

An actual plot of the position signal using the above formulas is created by successively injecting a negative DC current into each anode and collecting the charge data using a Vertilon PhotoniQ IQSP418 charge integrating data acquisition system. This is shown Figure 4 below.

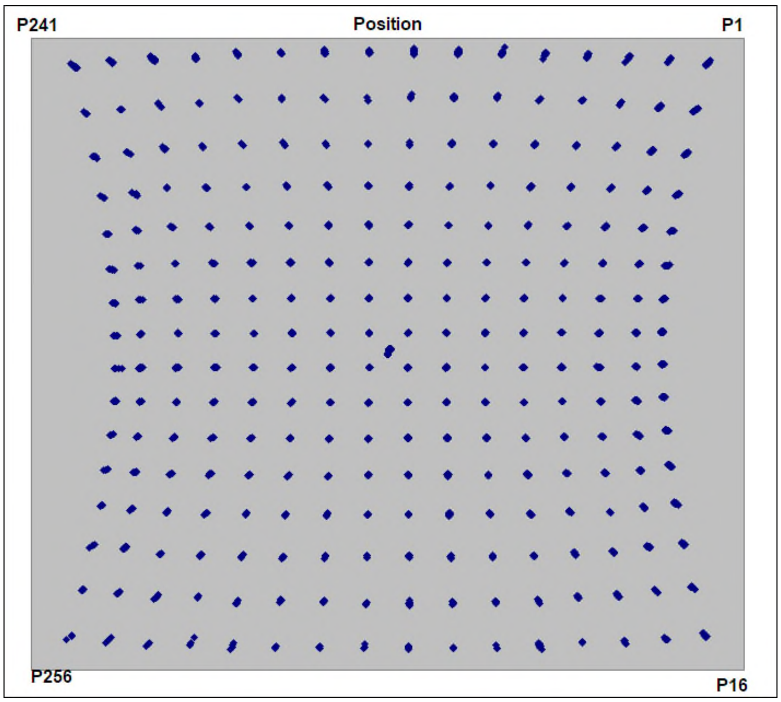

Figure 4: Position Signal Plot

Figure 5 shows the typical response from an anode preamplifier (in the high gain setting) when a charge pulse is injected into one of the four corner anodes (P_1, P_{16}, P_{241}, P_{256}).

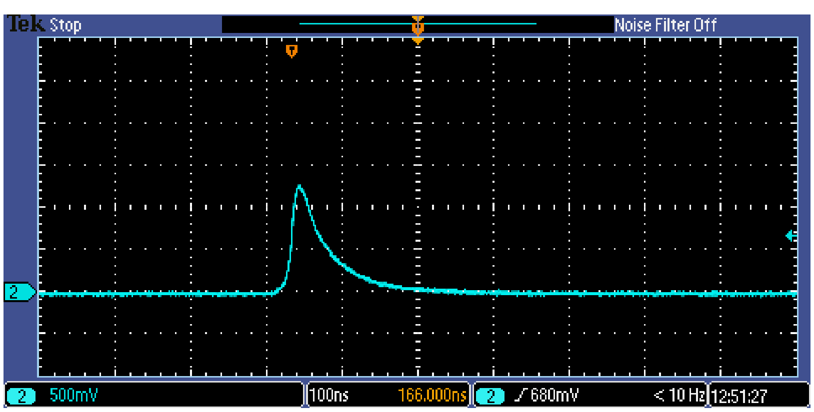

Figure 5: Anode Preamplifier Response

Last Dynode Output

The last dynode of the H13700 is directly connected on the SIB71256 to a non-inverting preamplifier whose output is available on an SMB connector. A miniature rotary switch allows the user to select between one of two gain settings. The last dynode output is typically used with an external discriminator for generating a trigger signal to data acquisition electronics or a time-to-digital converter (TDC) for determining time of arrival or coincidence detection. The figure below shows the last dynode preamplifier response (in the high gain setting) to a voltage signal injected into the DY10 location on the SIB71256.

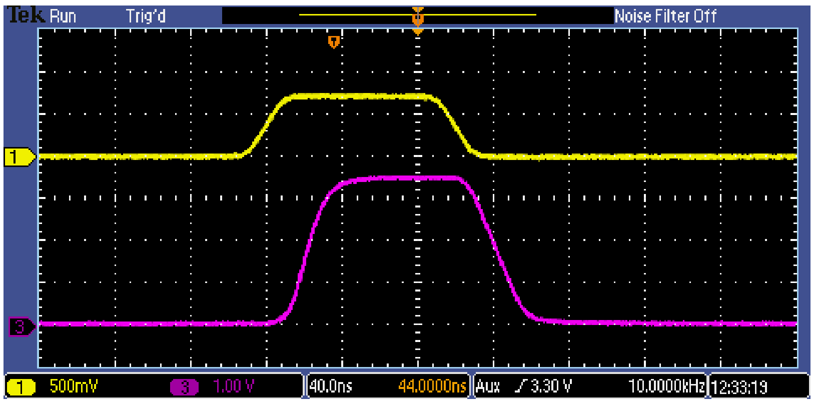

Figure 6: Dynode Preamplifier Response

Gain Switches

The SIB71256 utilizes five miniature two-position switches to adjust the gain of the four anode preamplifiers and last dynode preamplifier. The preamplifier gain can be set to either a low or high setting by using the included adjustment tool to rotate the switches' rotor. It is recommended that the user avoid turning the switches beyond the stops at the end of each position. The figure below indicates the switch position for each gain.

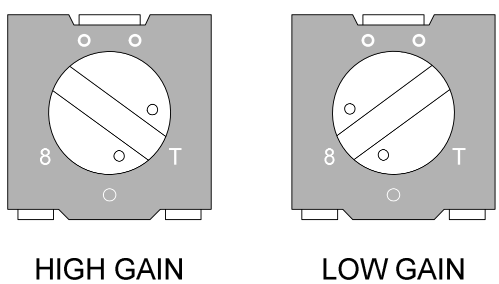

Figure 7: Gain Switch Positions

Top and Bottom Views

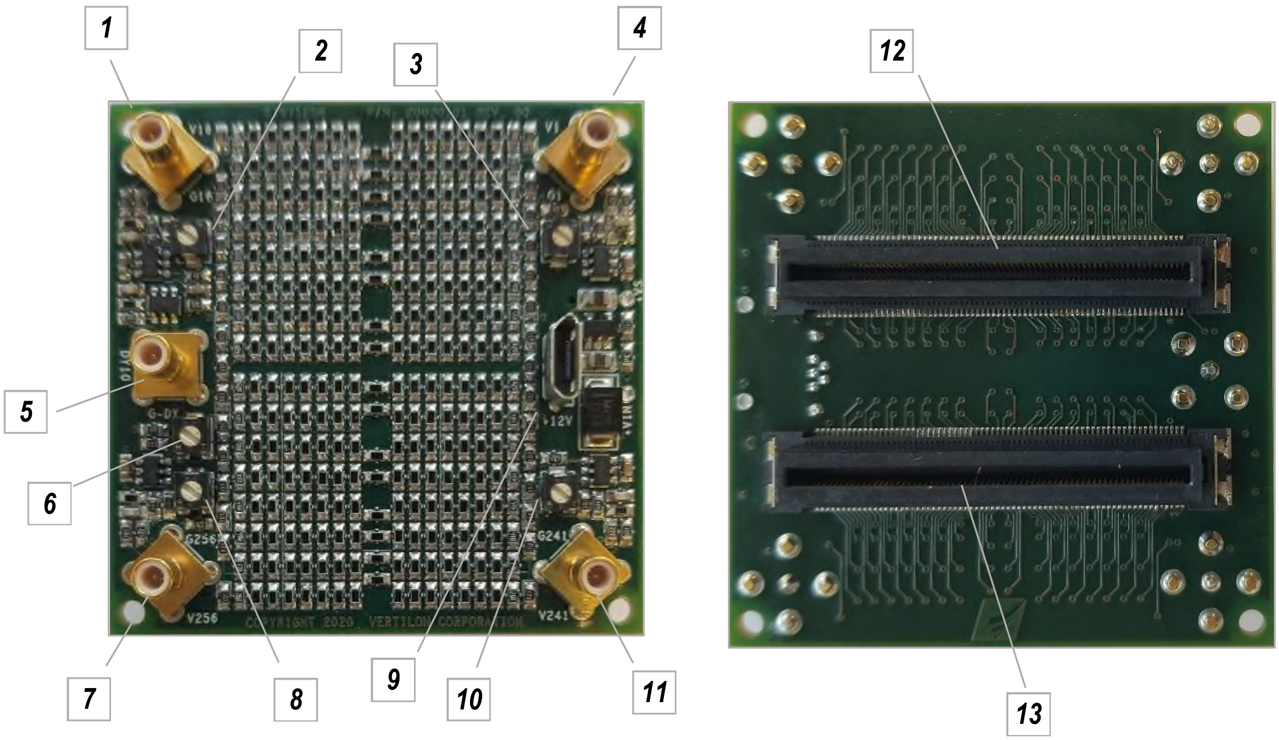

Figure 8: Top and Bottom Views

1. Anger SMB Output V16
2. Gain Adjust G16
3. Gain Adjust G1
4. Anger SMB Output V1
5. Last Dynode SMB Output DY
6. Gain Adjust DY
7. Anger SMB Output V256
8. Gain Adjust G256
9. +12V Power Input (Micro B USB 2.0)
10. Gain Adjust G241
11. Anger SMB Output V241
12. H13700 Mating Connector (SIG1)
13. H13700 Mating Connector (SIG2)

Mechanical Information

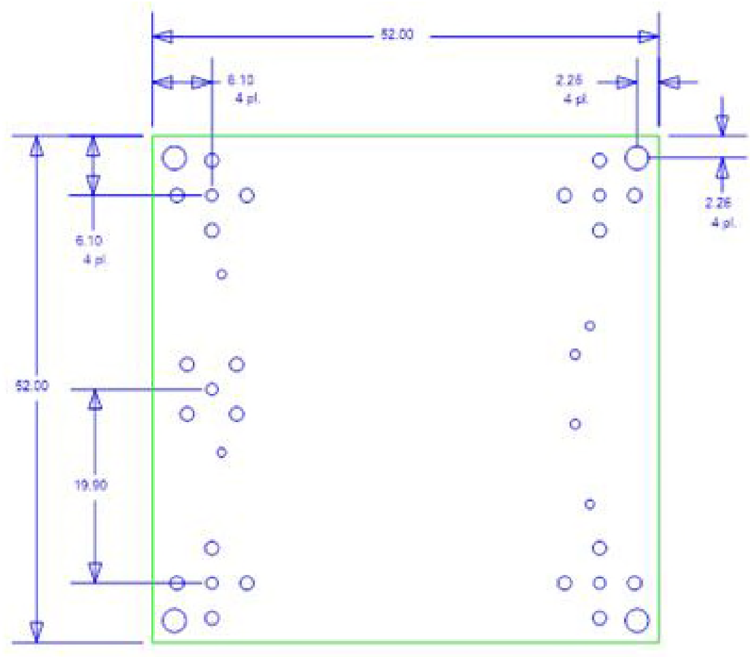

Figure 9: SIB71256 Printed Circuit Board Dimensions

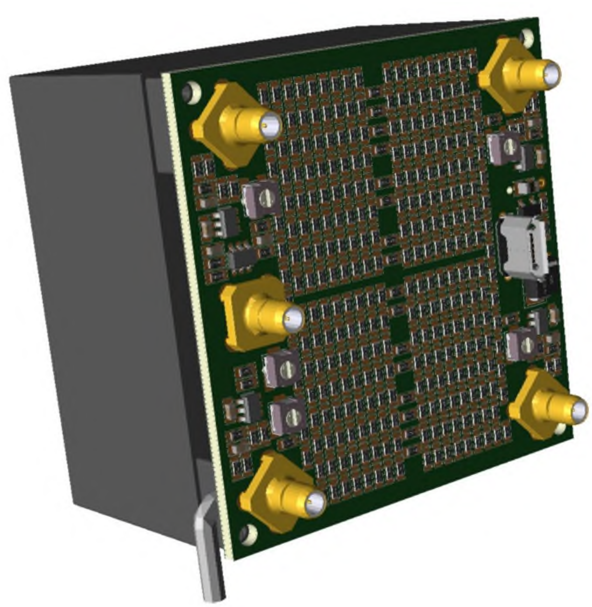

Figure 10: SIB71256 3D View

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