CCSiCUVFlame

SiC Flame Detector

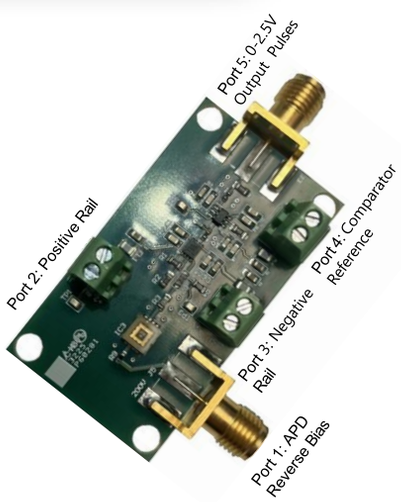
Conventional flame detection systems using Silicon and IR sensors are susceptible to failure due to false detection events, smoky conditions, or contaminated lens systems. SiC UV Photodetectors have a unique set of advantages over these old systems, including inherent visible light blindness, wide temperature range with no degradation (up to 400C), and long-term UV exposure. These factors greatly reduce system volume, as the need for cooling mechanisms and filters is eliminated. All these factors combine for an effective yet simple flame detector system that reduces the number of false alarms and consistently detects the presence of a flame.

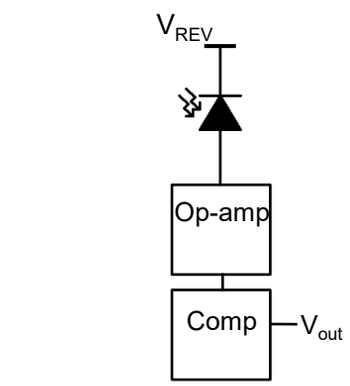
BENEFITS

- Higher sensitivity
- Reduced cooling
- Less false alarms
- Visible-blind

APPLICATIONS INCLUDE

Single-Photon Detection, water filtration systems, environmental compliance, process control, safety systems, industrial burner management, and combustion processes





Simplified Flame Detector Circuit Schematic.

Part Number	Package	Marking
CCSiCUVFlame	PCB	N/A

contact@coolcadelectronics.com Maryland https://coolcadelectronics.com

Features and Board Functionality:

This Flame Detector board is designed for low-light UV detection and produces TTL-outputs of 0-2.5V.

The Flame Detector board includes:

- A CCSiCUVAPD to detect light pulses
- SMA input and output connector bins for biasing the APD and reading out pulses
- Various test points throughout the circuit for troubleshooting
- Terminal blocks for connecting the ±2.5V rails and comparator reference voltage
- Through holes in the corners for mounting

Table 1 lists the physical dimensions of the board.

Figure 1 shows a top side view of the board with key test points and inputs labeled
Figure 2 shows a bottom side view of the board.
Figure 3 shows a block diagram of the board circuitry.
Figure 4 indicates key components and features of the board.

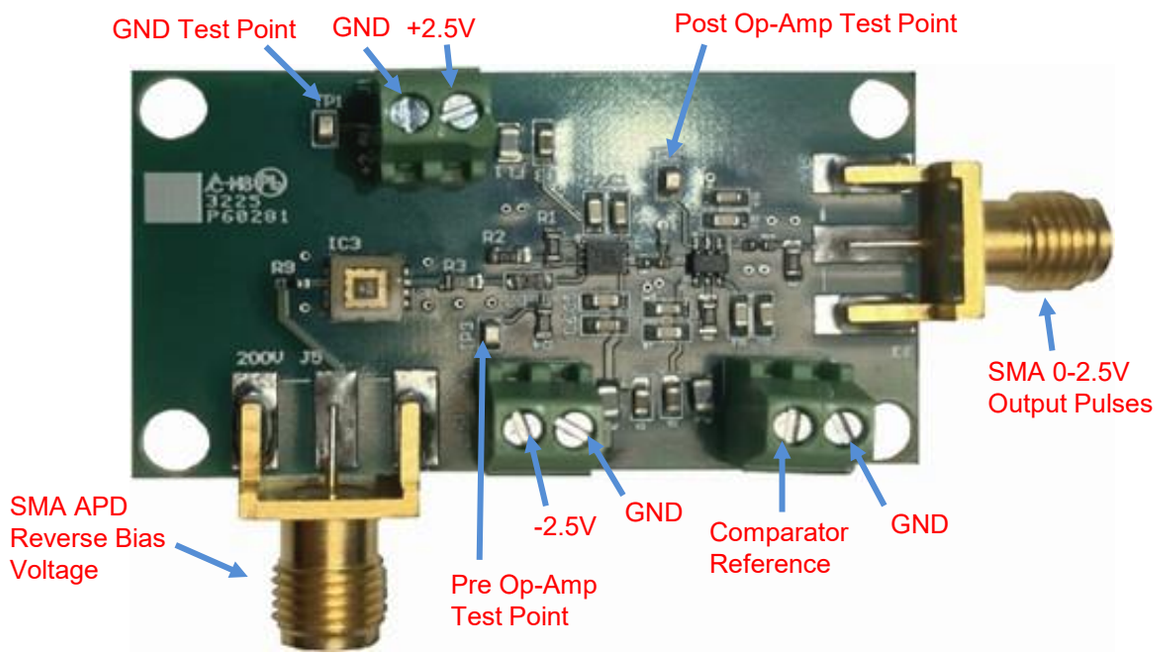


Figure 1 : Flame Detector board: Top side view of test points.

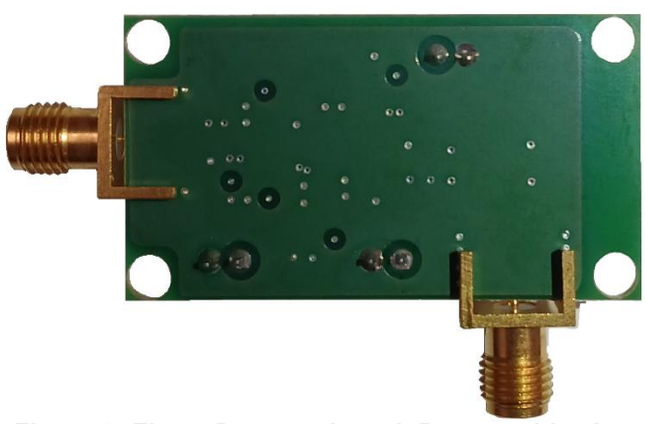


Figure 2: Flame Detector board: Bottom side view.

Table 1: Flame Detector board dimensions.

	Dimension
Length	53mm
Width	34mm

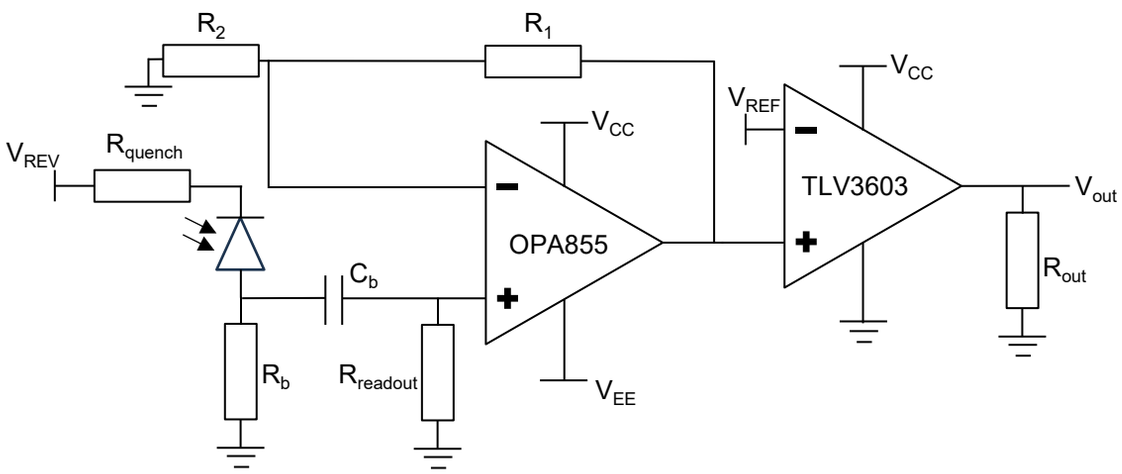


Figure 3: Flame Detector board block diagram.

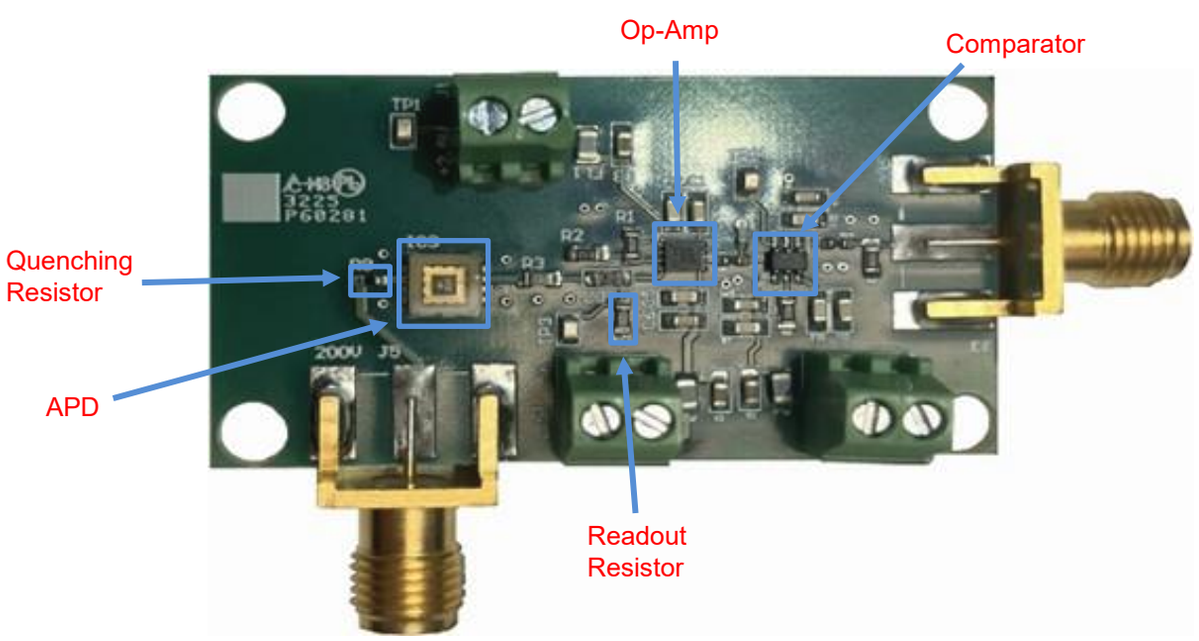


Figure 4: Flame Detector board: Top side view of components.

Table 2: List of important board components that are labeled in **Figures 3** and **4** with a detailed description of their functionality.

Component/Subcircuit	Description
APD	Avalanche photodiode used to generate Geiger pulses for photon detection (CCSiCUVAPD)
Operational Amplifier	Operational amplifier in a noninverting configuration with an approximate gain of 40V/V to boost the output pulses of the APD (OPA855)
Comparator	Compares input pulses from the operational amplifier to the set reference value and converts to 0-2.5V TTL output pulses (TLV3603)
Quenching Resistor	1MΩ resistor to passively quench the APD and arm it for another pulse
Readout Resistor	50Ω resistor to convert the output current of the APD into a readable voltage pulse; allows for impedance matching
SMA Connectors	Connectors for reliably providing high voltage bias for APD as well as reading output pulses of the comparator
Terminal Blocks	Screwable terminals for making external connections to ±2.5/GND for op-amp and comparator supply and V_{REF} for the comparator reference voltage

Table 3: Recommended operating conditions and absolute maximum ratings

Parameter	Symbol	Min	Typ	Max	Unit	Note
APD Reverse Bias Input	V_{REV}	178	180	**200**	V	V_{REV} - GND
High Voltage Rail	V_{CC}	-	**2.5**	**-**	V	-
Low Voltage Rail	V_{EE}	-	**-2.5**	**-**	V	-
Comparator Ref	V_{REF}	0.14	**0.16**	**0.4**	V	V_{REF} - GND
Ambient Temperature	T_A	-40	**27**	**105**	°C	-
Output High	V_H	1.5	**2.2**	**2.5**	V	-
Output Low	V_L	0.04	**0.1**	**0.14**	V	-

Quick Start Instruction:

1. Connect an oscilloscope, counter, or a desired method to observe the output pulses of the Flame Detector.

2. Ensure the board is not resting on any metal or conductive surface, as this can cause components to improperly short.

3. Set all DC biases to turn on comparator and op-amp and set comparator reference voltage.

4. Apply APD reverse bias voltage using SMA connector.

5. Ensure that APD is not obscured or blocked in any way. Light path to APD should be kept clear.

6. If you are not seeing any output pulses, it could be a result of several factors:

   A. *The sensor is not being biased at a high enough voltage, in this case, it is necessary to increase the bias until pulses are observed.*

   B. *The sensor is being oversaturated with light, in this case, the light must be attenuated in some way below the saturation threshold of the sensor.*

7. If it is difficult to discern between light and dark pulses, the bias may need to be decreased, or the light may need to be increased.

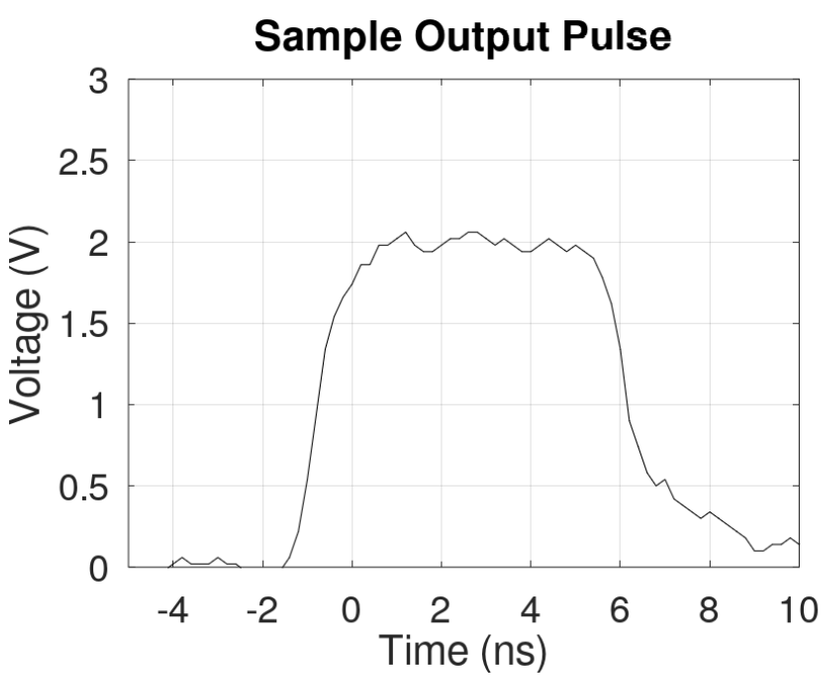


Figure 5: Sample output pulse from Flame Detector board held at 198V under 275nm illumination with comparator reference value of 150mV

Example waveforms:

Figure 6 shows an oscilloscope screenshot from a test that we performed using this Flame Detector board. The red waveform is the output pulses from the board, and the blue is the signal which turned the illumination on and off. The light was on when the signal was high, and the light was off when the signal was low. This test was performed with 1.57nw/mm^2 at 265nm illuminating the device with a 10kHz, 50% duty cycle signal modulating the light. A comparator reference of 140mV was used.

Figure 7 shows plots from a test performed with 16nW/mm^2 at 275nm with a comparator reference voltage of 160mV. Pulses were counted if they exceeded 1V.

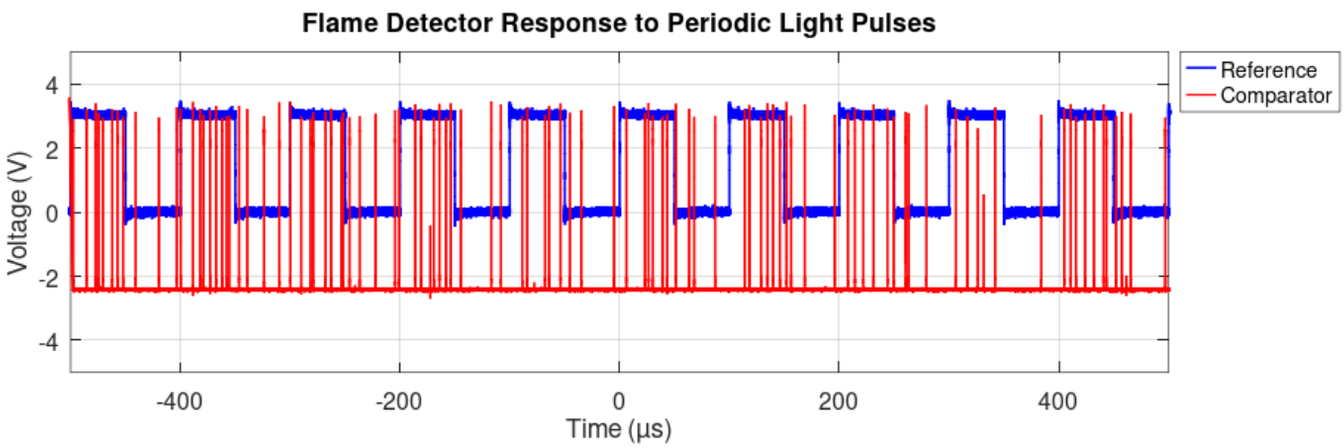
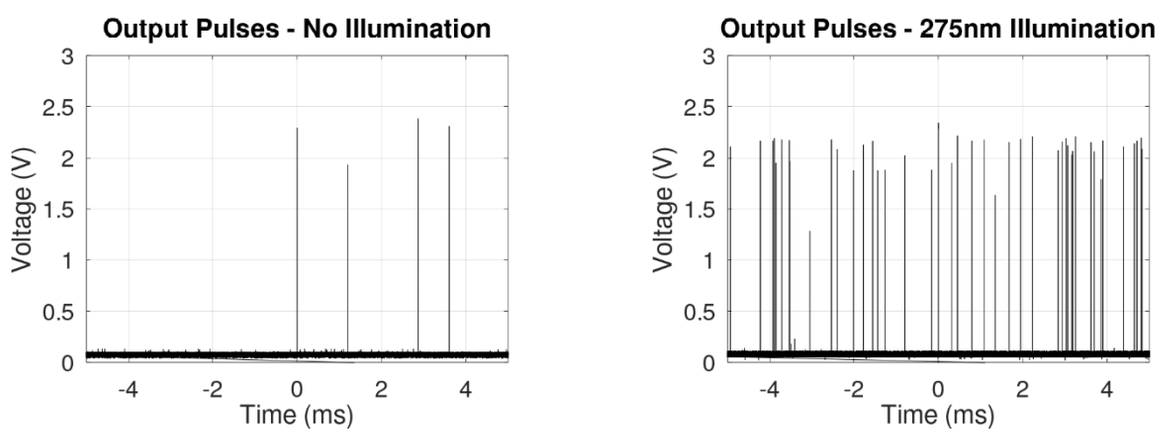


Figure 6: Oscilloscope waveform obtained during a test using modulated light at 265nm



	Dark	275nm
Pulse Count	4	47
Pulse Rate (Pulse/s)	399	4691

Figure 7: Oscilloscope waveforms obtained during a test using 275nm light

Warnings

1. The Flame Detector board should only be used by experts, knowing and understanding of its configuration.

2. The choices of external components and timing specifications require understanding of the circuit operation.

3. The user is responsible for the electrical safety and the proper handling and use of the evaluation board. It is your responsibility to use this board correctly and safely.

4. When using this board at high voltage, use it in an environment where sufficient safety measures have been taken.

5. CoolCAD Electronics is not responsible for accidents or injuries caused when using this board.

6. CoolCAD Electronics is not responsible for any consequences arising from the use of this board.

7. The board is provided as is without any warranties, except for in the case of shipping damage or existing manufacturing issue. The customer should alert CoolCAD Electronics within 30 days of purchase of this board for warranty.

8. If this board is modified or damaged by the customer, it cannot be replaced.

9. This datasheet is provided for reference only.

10. The data collected using this board may not be considered as a guarantee of components characteristics. Components must be tested thoroughly depending on intended application as adjustments may be necessary.

11.This board cannot be commercialized or sold by incorporating it into another product or equipment.

12.CoolCAD Electronics reserves the right to make any or all changes to the board's documentation, reference manuals, designs and specifications at any time without notice.

13.Diagrams and photos may differ from the actual board you have.

14.Please contact the distributor you purchased from for any inquiries.

CAUTION: These devices and circuits are ESD sensitive. Use proper handling procedures.

Disclaimer: These specifications may not be considered as a guarantee of components characteristics. Components have to be tested depending on intended application as adjustments may be necessary. The use of CoolCAD Electronics components in life support appliances and systems are subject to written approval of CoolCAD Electronics.

contact@coolcadelectronics.com Maryland https://coolcadelectronics.com