



ANALOG MODULES, INC.

Specialists in Analog and Laser Electronics

MODEL 7510-1 HIGH SENSITIVITY APD OPTICAL RECEIVER APPLICATION NOTE

INTRODUCTION

The 7510-1 is a high gain, low noise optical receiver employing an avalanche photodiode (APD) with a nominal bandwidth of 100MHz and superior dynamic range. It incorporates a thermo-electric cooler to help maintain detector performance at temperature extremes. This note discusses the performance, considerations, function and physical constraints of each pin.

PIN 1 BIAS VOLTAGE

Apply bias voltage in the range of 40 to 80V to the APD at this pin. Typical current drawn at this pin is less than 200nA at room temperature but may exceed 4uA at the higher end of the operating temperature extreme. Optimum bias voltage occurs at 1.5V below avalanche break down. Use the TEC to maintain detector's temperature otherwise a control circuitry will be required to maintain signal to noise ratio by compensating the bias voltage to temperature by 0.1V/°C. Monitor detector's temperature at pin 11.

PIN 2 (TEC-) and PIN 6 (TEC+)

These are the thermoelectric cooler pins. Do not exceed 0.6A into these pins which depending on the current's direction may heat or cool the detector. Current flowing from pin 2 to pin 6 will heat the detector while current in the opposite direction will cool the detector. Heat sinking the hybrid to dissipate generated heat is highly recommended. To minimize thermal stress, use a linear/proportional temperature control or a similar method rather than an ON/OFF method. If employing a PWM scheme, beware that noise will be injected into the receiver and is therefore recommended to turn off the controller when receiving. Cooling capacity of the TEC is about 40°C.

PIN 4 -5V POWER SUPPLY

A low noise supply should be used. The maximum current draw is 15mA with a high impedance load, or minimal signal power into the load. Bypass caps should be placed as close as possible to the pin. Filtering is recommended.

PIN 5 GROUND

This Pin should be connected to the PCB ground plane on which the receiver is mounted. It is connected internally to the case.

PIN 9 NO CONNECT

This Pin should be left open circuit.

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PIN 10 OUTPUT

Output pulse will swing negative in proportion to the input power of the optical pulse at a typical ratio of 1MV/W. Saturation will occur at a negative voltage swing of about -5V. DC output component is about 2.5V at room temperature, consequently output signal should be AC coupled. Both the DC output and signal swing will deviate with temperature due to changes in APD's dark current and can be restored by employing the TEC. Careful PCB layout is critical and effort should be made to minimize parasitic capacitance at the output pin since capacitive loading may cause oscillation. If output is connected to a transmission line, proper termination is a must since severe reflections may damage the pre-amp. A series resistor at the output may provide reverse termination and protection with a loss in amplitude.

PIN 11 TEMPERATURE SENSOR

The sensor's main purpose is to enable the user to compensate the voltage bias of the APD for temperature and takes advantage of the fact that biased with a constant current, the voltage across a diode will vary by about -2.5mV per degree C. The diode should be biased with very low current (micro amps) to prevent self heating. Biasing the diode with 301K Ohm resistor connected to a 2.5V reference voltage is sufficient. User should employ the thermoelectric cooler to maintain the detector's temperature at about 30°C (temp sensor voltage of 300mV) to avoid degradation in detector's bandwidth due to diffusion effect. This node should be carefully buffered by a non inverting op-amp to prevent noise injection and loading.

PIN 12 +5V POWER SUPPLY

A low noise supply should be used for a maximum peak current draw of 50mA. Bypass caps should be placed as close as possible to the pin. Filtering is recommended.

OPTICAL WINDOW

The optical window provides no shielding for the sensitive front end of the 7510-1 Receiver. All wiring must be routed behind the window face of the case, or oscillation can result. Additionally, system noise sources such as digital switching circuits, Pockels cell drivers, and switching power supplies should be shielded or arranged so that radiated electrical noise does not enter the receiver through the optical window. It is recommended that all switching power supplies be inhibited during the period of use and circuits supplied from reservoir capacitors.

DETECTOR ALIGNMENT

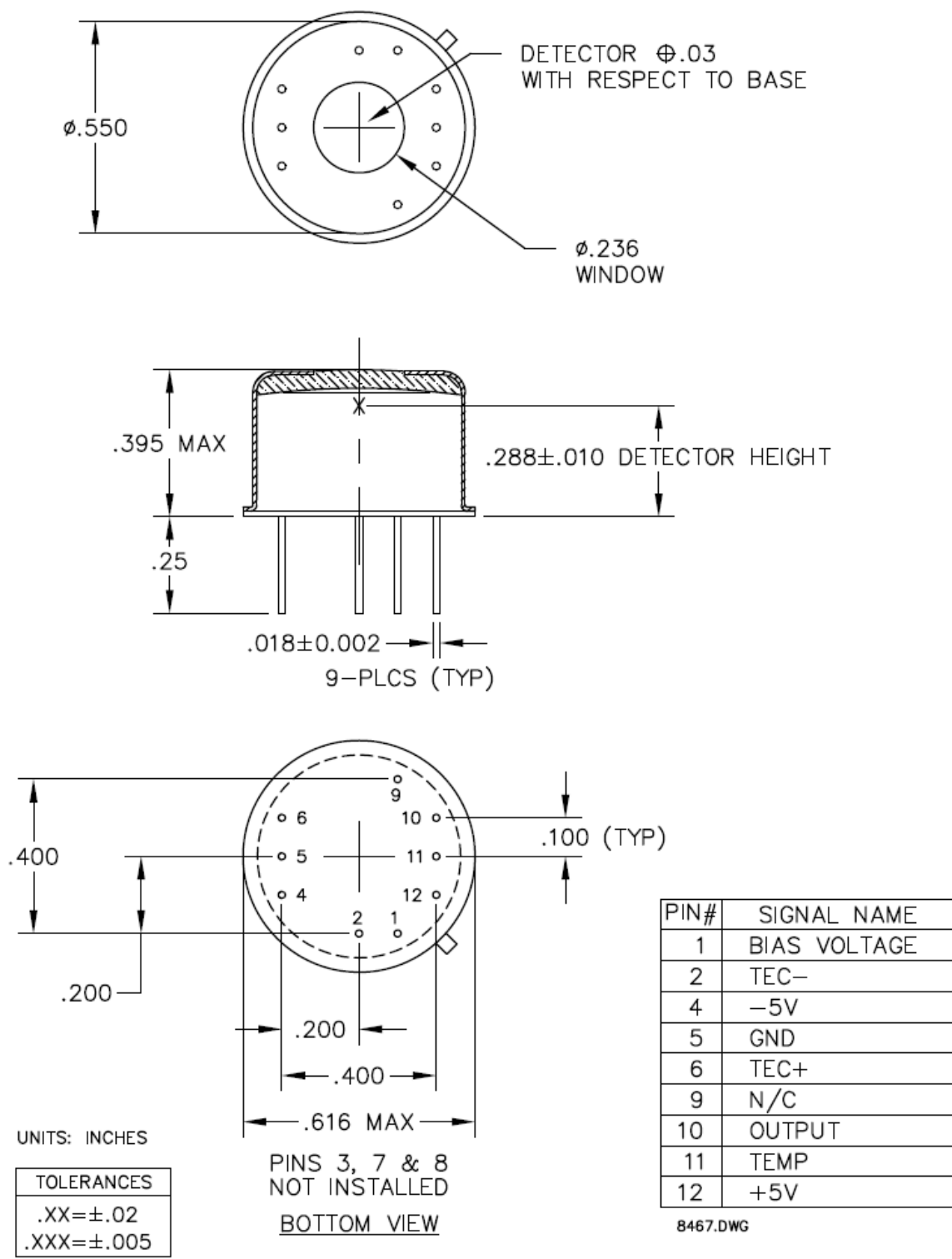
The hybrid should be mounted to allow movement of ± 0.025 " in any direction for optical alignment of the photodiode. If the optical system has adequate flexibility of alignment, adjustment of the receiver position may not be necessary. The focal plane is $0.288" \pm 0.010$ " from the can base.

OVERLOAD CONDITIONS

The maximum optical signal applied to the photodiode surface should not exceed 10W peak or the photodiode may be damaged.

GENERAL HINTS

1. Care should be taken to avoid retro reflections from a laser which could result in detector damage. The optics design should ideally spread the light spot over approximately 80% of the detector active area,
2. A low noise detector biasing power supply is available from AMI (model 523-1-A).
3. The cases are hermetically sealed in production units and are not normally repairable.



WINDOW: .035 \pm .006" THK.
 RI = 1.469 @ 1550nm; 1.476 @ 1064nm.

FIGURE 1
MODEL 7510-1 DIMENSIONS AND PACKAGE DETAIL

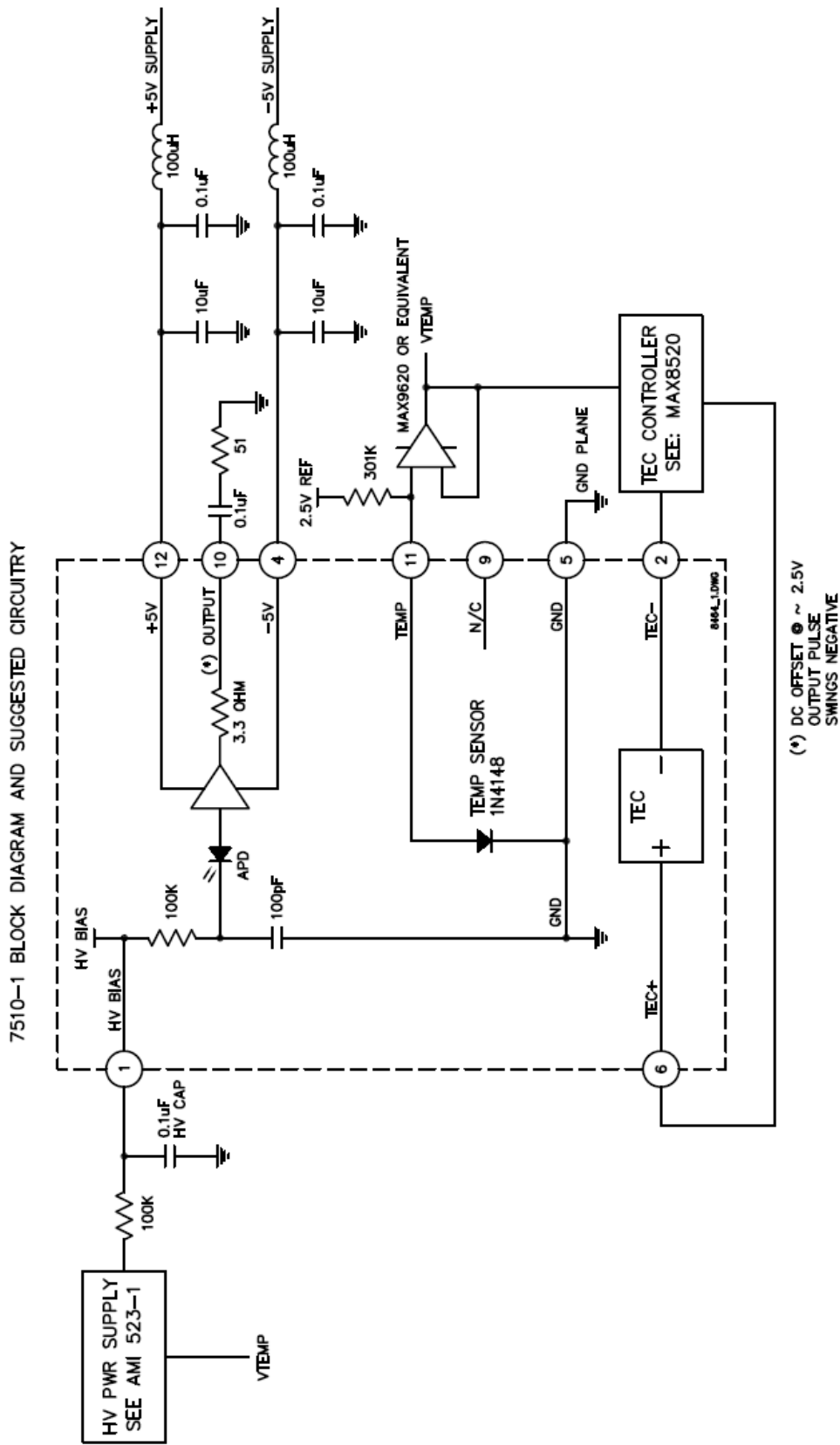


FIGURE 2
SIMPLIFIED BLOCK DIAGRAM

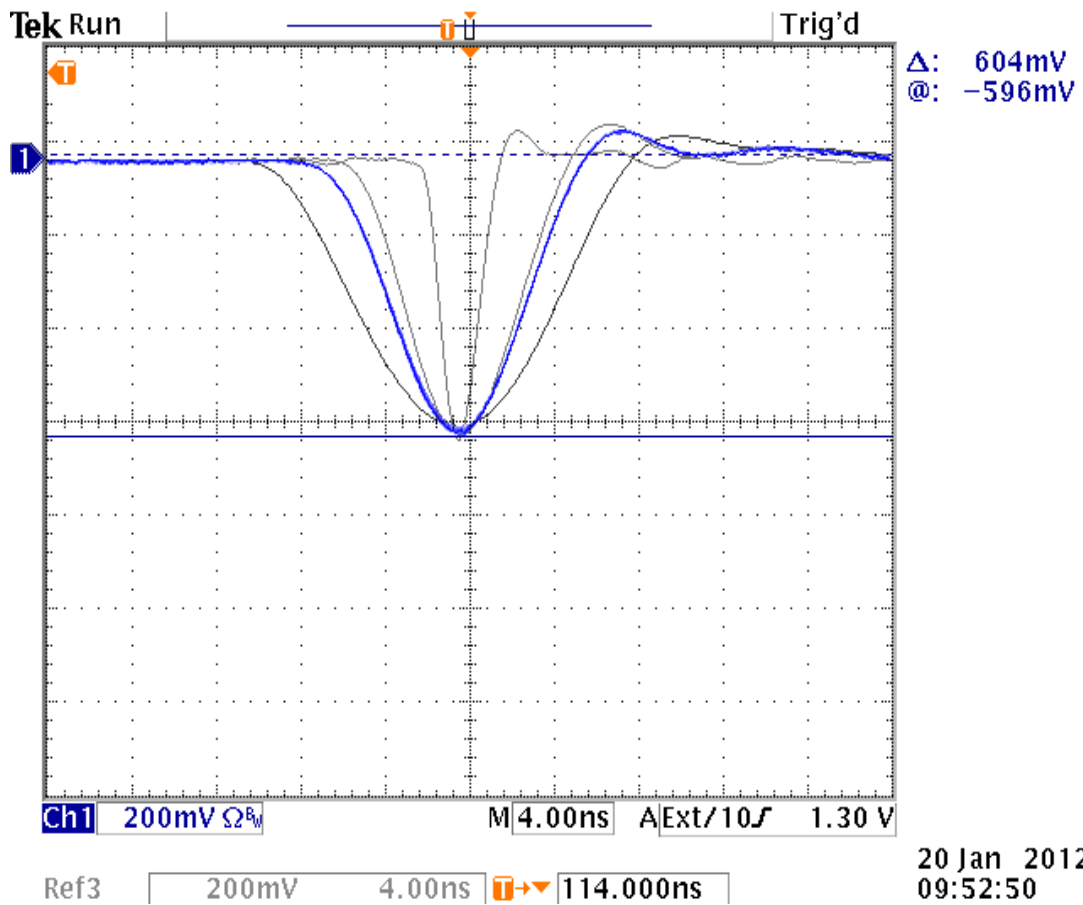


FIGURE 3
OUTPUT RESPONSE FOR 1, 4, 6, AND 10ns PULSES

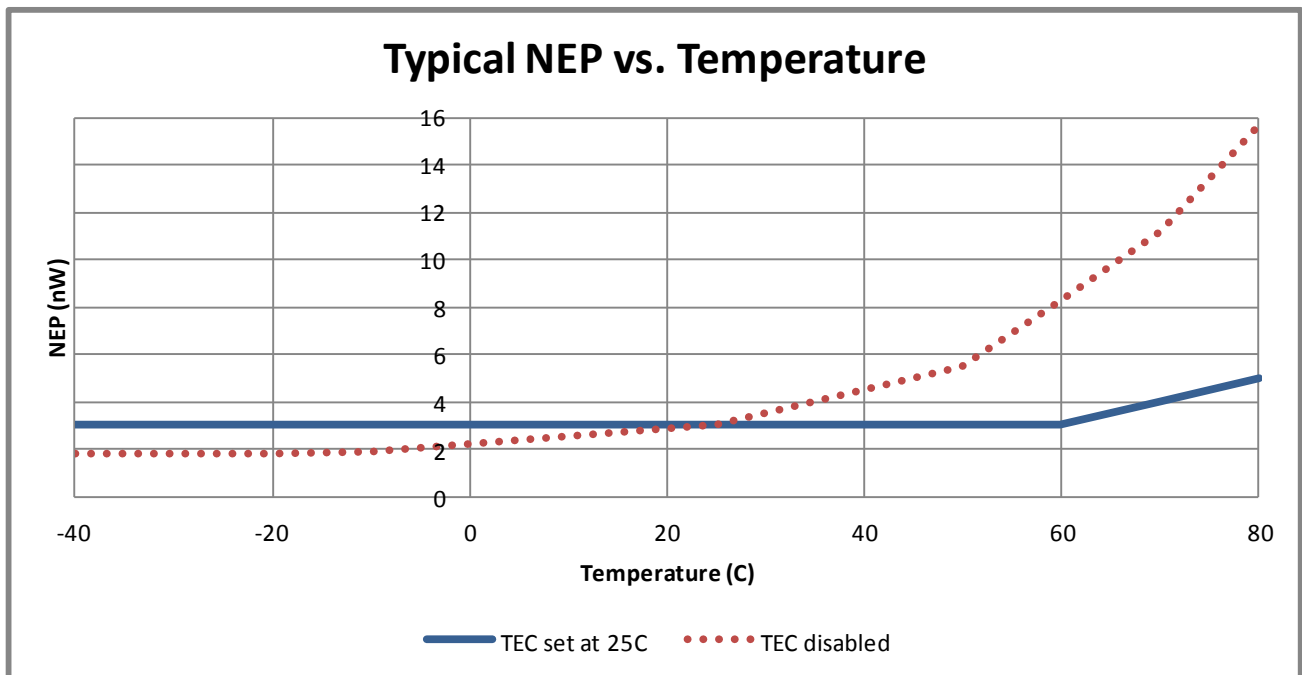


FIGURE 4
NEP VS. TEMPERATURE WITH TEC ENABLED AND DISABLED

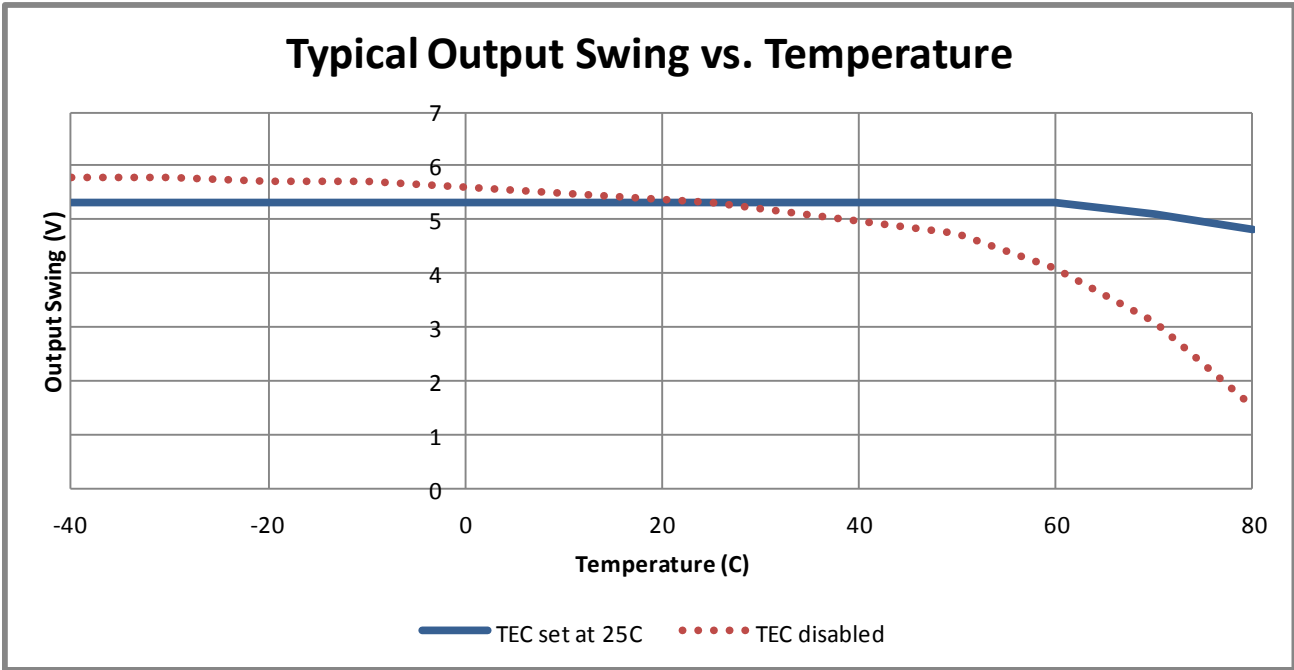


FIGURE 5
OUTPUT SWING VS. TEMPERATURE WITH TEC ENABLED AND DISABLED

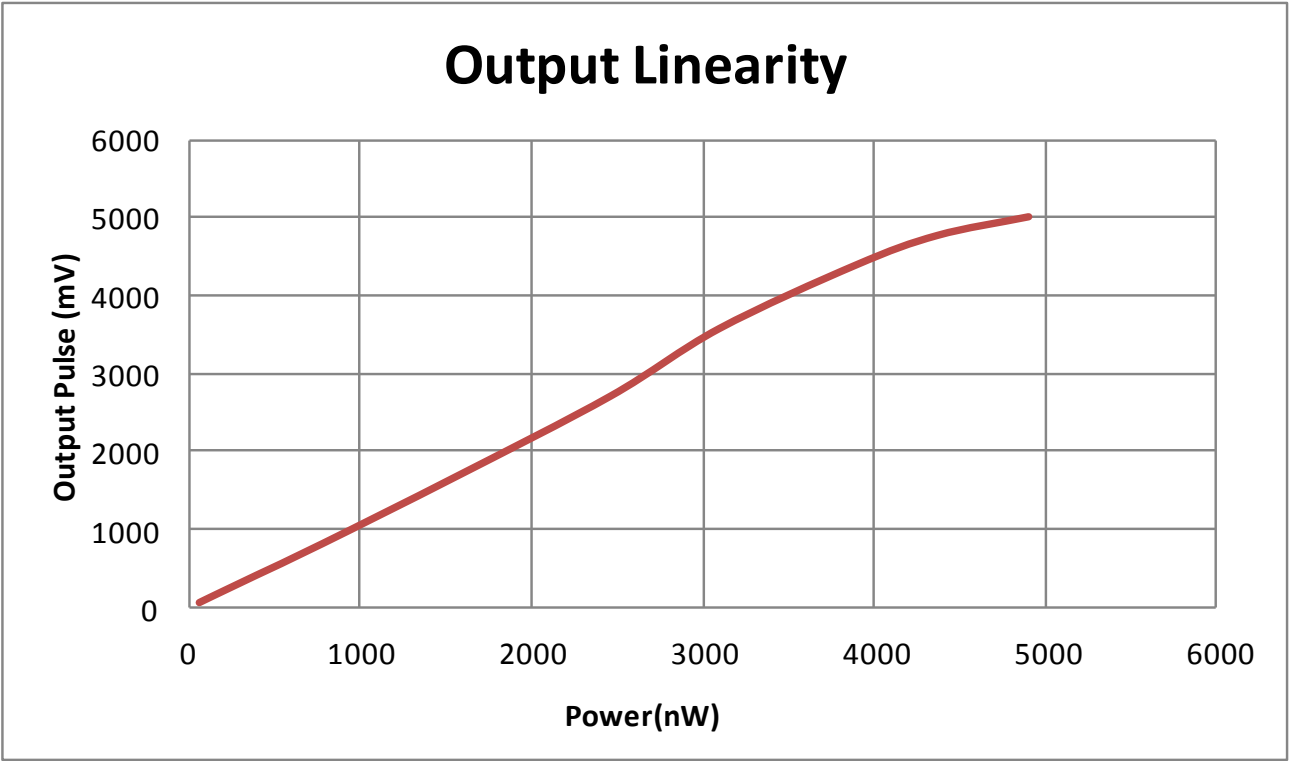


FIGURE 6
OUTPUT SIGNAL VS. INPUT POWER - 6NS PULSE