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# OPI201 Datasheet

## Overview

The OPI201 provides one signal isolation channel with convenient screw terminal connections. If multiple devices are used in an application, extra input-side terminals allow signals (e.g., power rail or GND) to be daisy-chained from one device to another. An LED indicator allows the state of the input signal to be visually observed. The optocoupler device output transistor is uncommitted, allowing it to be used as either a high-side device (non-inverting) or a low-side device (inverting). If needed, the user can easily add their own pull-up or pull-down resistor using extra terminal block positions and thru-hole pads.

Each channel can be activated with a control signal that is anywhere from 3.3V to 24V, making this device suitable for use with 3.3V micros (e.g., Raspberry Pi, Arduino Due), 5V micros (e.g., Arduino Uno, Arduino Mega), 12V PLCs (sourcing or sinking outputs), or 24V PLCs (sourcing or sinking outputs).

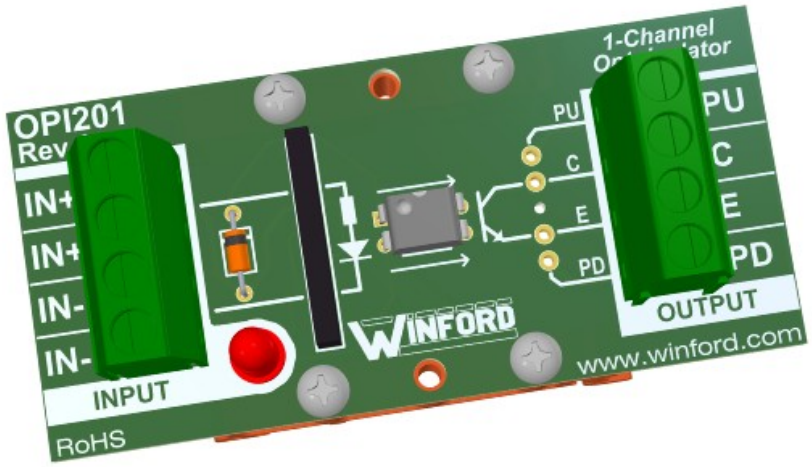



*Figure 1*

## Dimensions (typical shown)

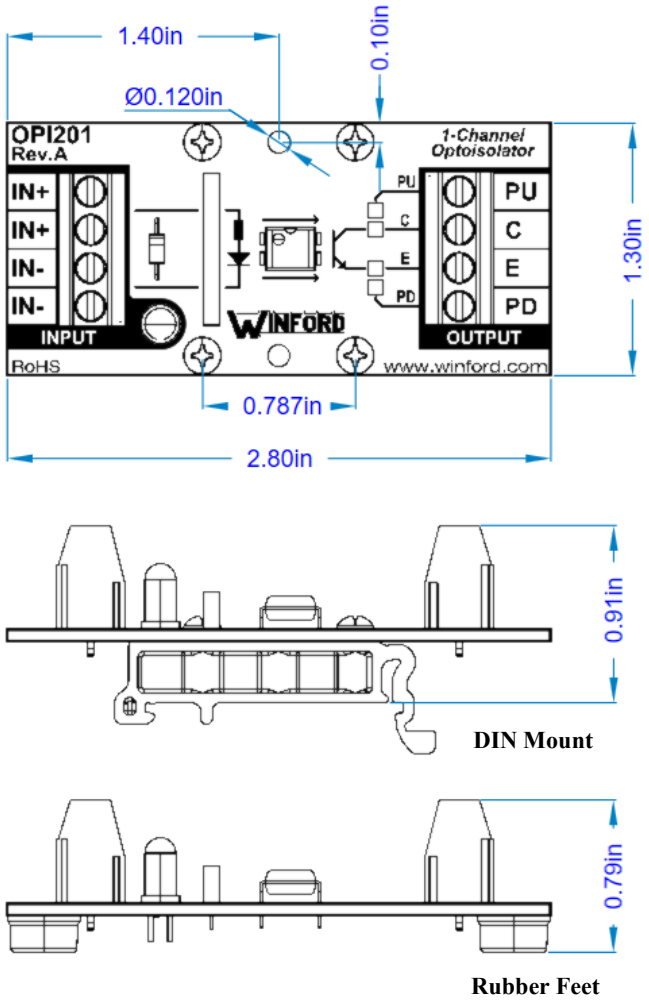



*Figure 2*

## Part Number Ordering Information

| OPI201 | - | 080 | - | 10 | - | |
|---|---|---|---|---|---|---|
| | | 1 | | 2 | | 3 |

## 1. Optocoupler Output Voltage Rating

- **080 = 80V**

## 2. Optocoupler Output Current Rating

- **10 = 10mA**

## 3. Mounting Option

- **FT** Rubber Feet on bottom side of PCB
- **DIN** DIN Rail Mounting Clips

## Simplified Schematic Drawing

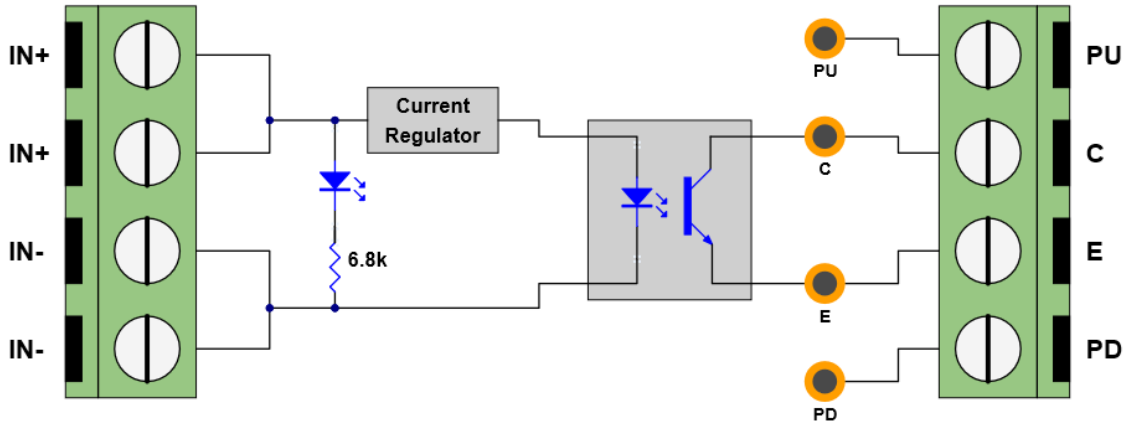



*Figure 3*

When there is sufficient current thru the LED in the optocoupler, the optocoupler turns on, connecting the C and E signals. See later sections in this document for configuration recommendations based on the particular application.

Note that in order to accommodate various application configurations, the design does not include circuit protection (e.g., series resistors) on I/O lines. Be sure to observe (and not exceed!) the published absolute maximum ratings.

## Detailed Description

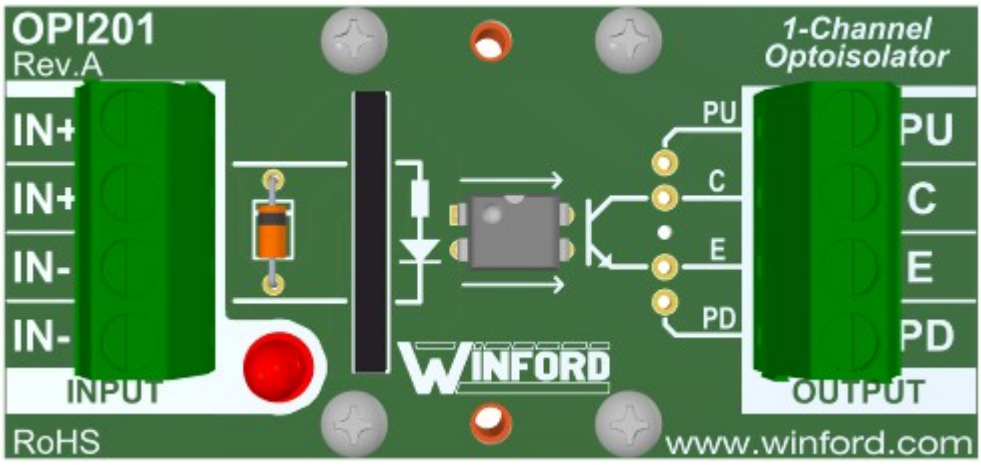



***Figure 4***

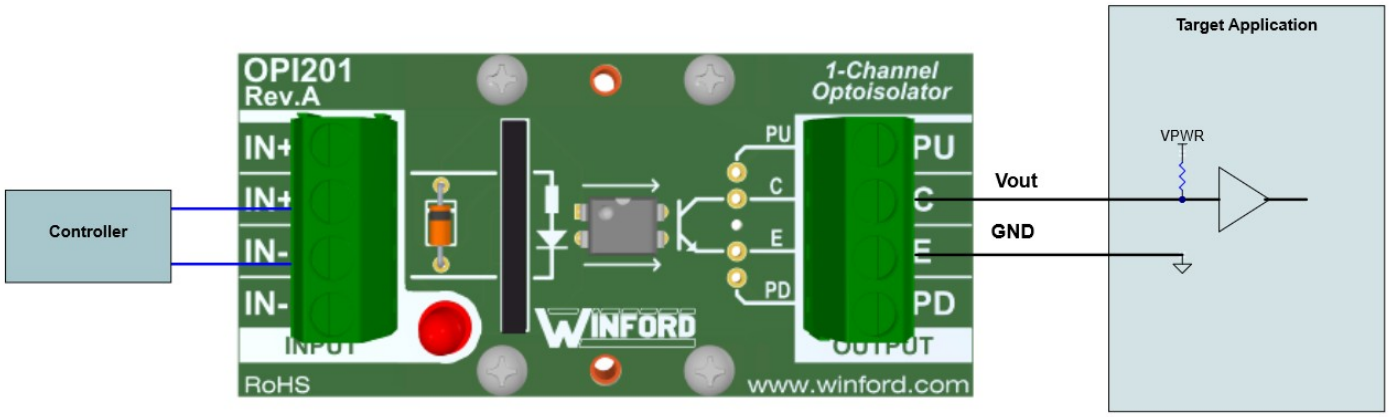
| SIGNAL | DESCRIPTION |
|---|---|
| IN+ | Input control signal |
| IN+ | Input control signal<br>(redundant, to aid in daisy-chaining multiple units if needed) |
| IN- | Reference for input control signal |
| IN- | Reference for input control signal<br>(redundant, to aid in daisy-chaining multiple units if needed) |

| SIGNAL | DESCRIPTION |
|---|---|
| PU | Access point for applying a pullup rail if user has installed a pullup resistor |
| C | Phototransistor collector |
| E | Phototransistor emitter |
| PD | Access point for applying a pulldown rail (e.g., GND) if user has installed a pulldown resistor |

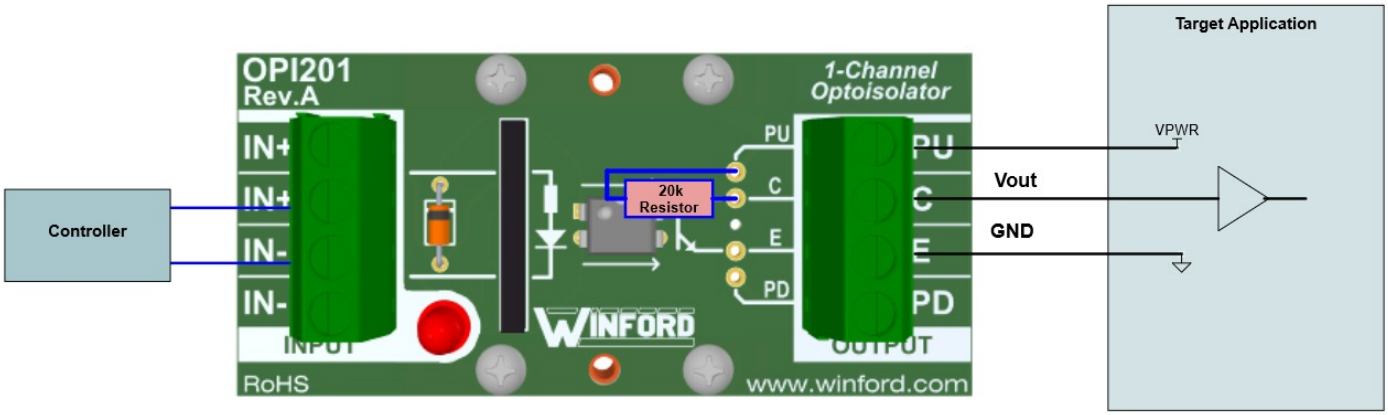
## Typical Application: Low-Side Switch (Open Collector) Configuration

Many industrial modules are designed with inputs that interface to open-collector outputs, with the required pull-up resistor included in the module. For this typical application, as shown in the figure below, the OPI201 signal "C" gets connected to the application's input, and signal "E" gets connected to application ground. Since the pullup is already present (in the module), no other connections to the target application are required.

If interfacing to a microcontroller that has an internal pullup resistor on its input pin, note that typically internal pullup resistors need to be enabled as part of the microcontroller startup sequence.




If the target application module does not include a pullup on its input, then a pullup resistor can be easily installed on the OPI201 board as illustrated below. The pullup rail then must be connected to the PU terminal block position, as shown. If the target application's power rail is not accessible, then a separate DC power supply must be used to provide the pullup rail.



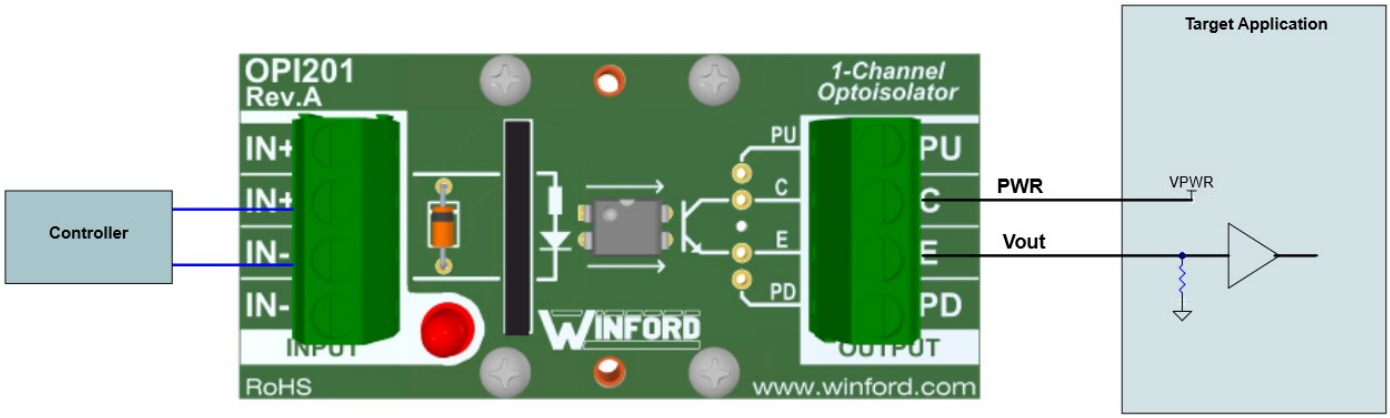

In the low-side switch configuration, the phototransistor emitter is connected to GND, and the phototransistor collector is the output signal. When the input is ON, the phototransistor also turns on, causing the output signal to be low. When the input is OFF, the phototransistor is also off, so the output gets pulled high by the pullup resistor (whether added by the user or included in the target application).

As described, this represents an inverting configuration.

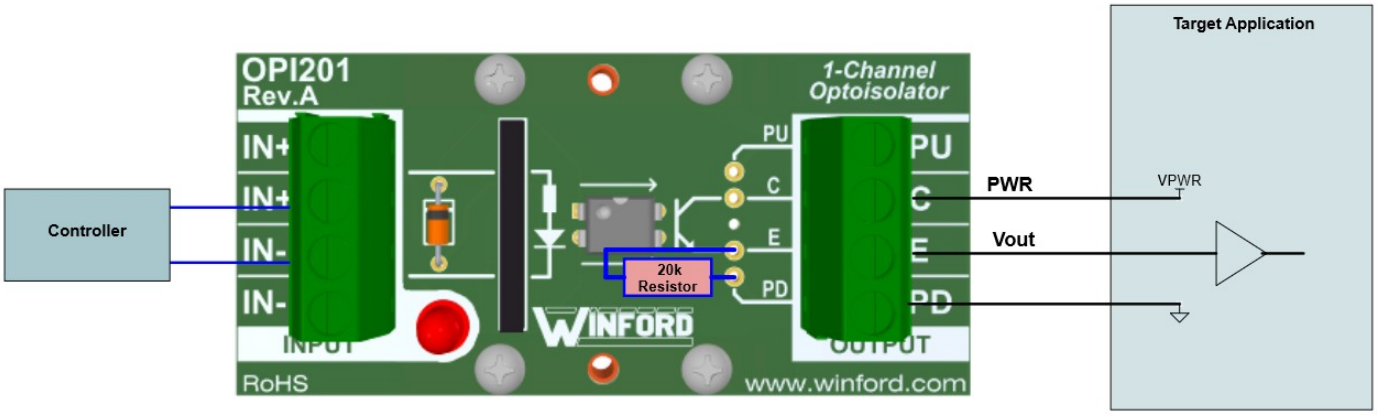
## Typical Application: High-Side Switch (Open Emitter) Configuration

Similarly, the OPI201 can be easily configured to interface to a module that requires an input coming from a high-side switch, with a pulldown resistor included in the module.

If interfacing to a microcontroller that has an internal pulldown resistor on its input pin, note that typically internal pulldown resistors need to be enabled as part of the microcontroller startup sequence.




If the target application module does not include a pulldown on its input, then a pulldown resistor can be easily installed on the OPI201 board as illustrated below. The module's GND reference rail then must be connected to the PD terminal block position, as shown.

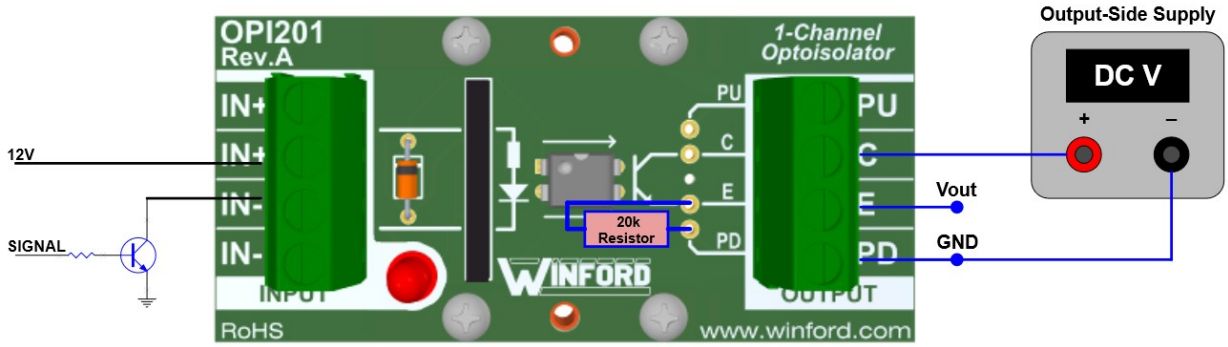



In the high-side switch configuration, the phototransistor collector is connected to the output-side supply voltage, and the phototransistor emitter is the output signal. When the input is ON, the phototransistor also turns on, causing the output signal to be high. When the input is OFF, the phototransistor is also off, so the output gets pulled low by the pulldown resistor (whether added by the user or included in the target application).

As described, this represents a non-inverting configuration.

## Low-Current Control Signal

If the input-side control signal is not capable of sourcing or sinking the current necessary to ensure proper activation of the phototransistor, a small BJT can be used. The figure below illustrates this configuration. In this case, a 12V rail is used to source the control current on the input side, and the BJT is configured as a low-side switch that sinks the control current when the control signal is active. It happens that the output side is wired in a non-inverting configuration in the figure below, but it could be set up in the inverting configuration if desired.




## Operating Conditions

| | |
|---|---|
| Ambient Temperature Range | –30°C to 70°C |
| Relative Humidity Range - not icing or condensing | 5% to 85% RH |

## Absolute Maximum Ratings (25 degC)

### Common Ratings for all OPI201 Part Numbers

| *Specification* | *Symbol* | *Min* | *Typ* | *Max* | *Unit* |
|---|---|---|---|---|---|
| Input Control Signal Voltage relative to V_IN-, for all OPI201 products | V_IN+ | -5V | | 25 | V |

**Exceeding the absolute maximum ratings may result in damage to the product.**

### Ratings for Specific OPI201 Part Numbers (25 degC)

| *Winford Part Number* | *Phototransistor Device Used* | *Phototransistor Output Voltage Abs Max Rating (Collector-Emitter Voltage, off state)* | *Phototransistor Output Abs Max Power Rating* | *Phototransistor Output Current Rating (on state)** |
|---|---|---|---|---|
| OPI201-080-10 | Toshiba TLP785 or similar | 0 to 80V | 150mW | 10mA |
| | | | | |

*Because of the product design targets and the regulation of the phototransistor's LED current, the output current rating for the Winford product may be less than the max current rating shown in the phototransistor mfr datasheet. Output current rating as shown in this table is a simple way to identify a reasonable limit for the output current, so that observing this limit will result in a

VCE across the output that can reasonably support digital on/off thresholds in a typical digital signal application. The actual sink or source capability of the output may be somewhat more than this current rating. See section "Input Behavior and Current Transfer" for information on typical performance at various conditions.

## Electrical Performance and Recommended Operating Conditions (at 25 degC)

| *Specification* | *Symbol* | *Min* | *Typ* | *Max* | *Unit* |
|---|---|---|---|---|---|
| Input Signal Voltage Range for logic HIGH (IN+ signal voltage relative to IN-) | V_IH | 3.2 | | 24 | V |
| Input Signal Voltage Range for logic LOW (IN+ signal voltage relative to IN-) | V_IL | 0 | | 0.8 | V |
| Output Leakage (INx = 0.0V, for voltage at C terminal relative to E terminal = 24V) | I_R | | | 1 | uA |

## Input Behavior and Current Transfer (Typical, at 25 degC)

| | Input Voltage, IN+ relative to IN- (V) | Input Current* (mA) | Output Current Capability** (mA) |
|---|---|---|---|
| OPI201-080-10 | 3.3<br>5.0<br>12<br>24 | 8<br>12<br>14<br>16 | 11<br>14<br>15<br>14 |

**Input current is the sum of the LED current plus the current thru the current regulator device.*
***Output Current Capability is the phototransistor collector current that results in a phototransistor $V_{CE}$ voltage of 0.4V for the given input conditions.*

## Screw Terminal Blocks

- Wire sizes (all positions): 12-28 AWG
- Terminal block pitch: 5.00mm

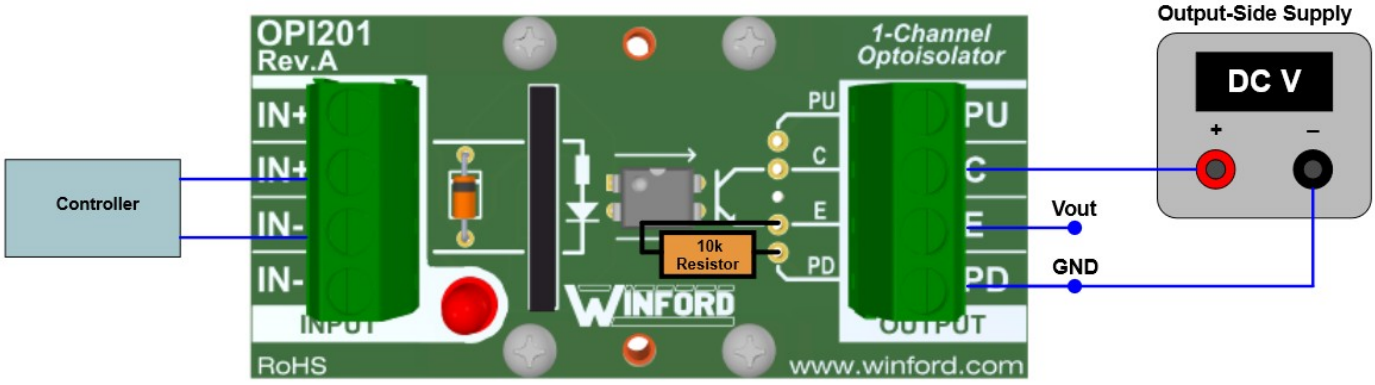
## Component Details

| *Component* | *Manufacturer* | *Manuf. Part Number* |
|---|---|---|
| Optocoupler, OPI201-080-10 | Toshiba | TLP785 or similar |

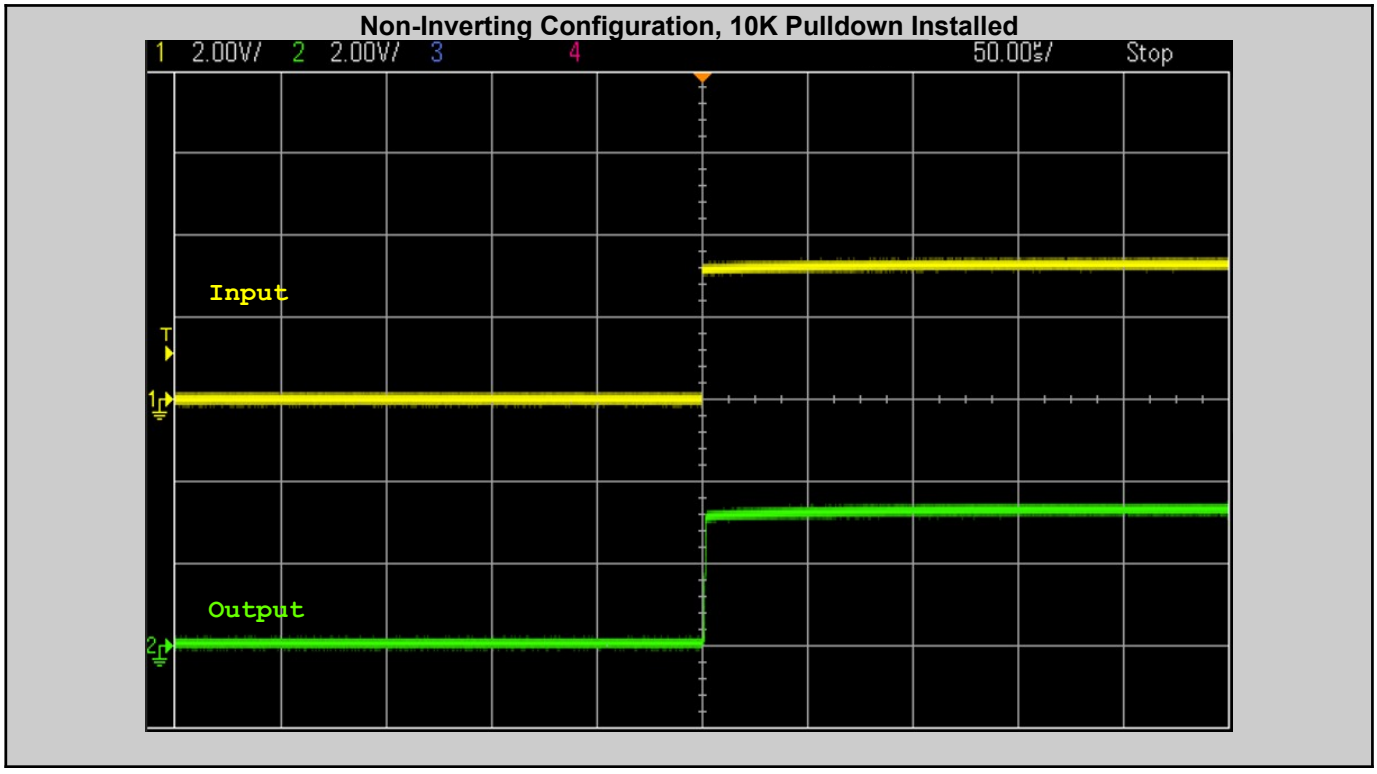
## Typical Timing Performance

For reference, some typical output transition timing plots are provided on the following pages. In all plots, the horizontal time scale is 50us/division.

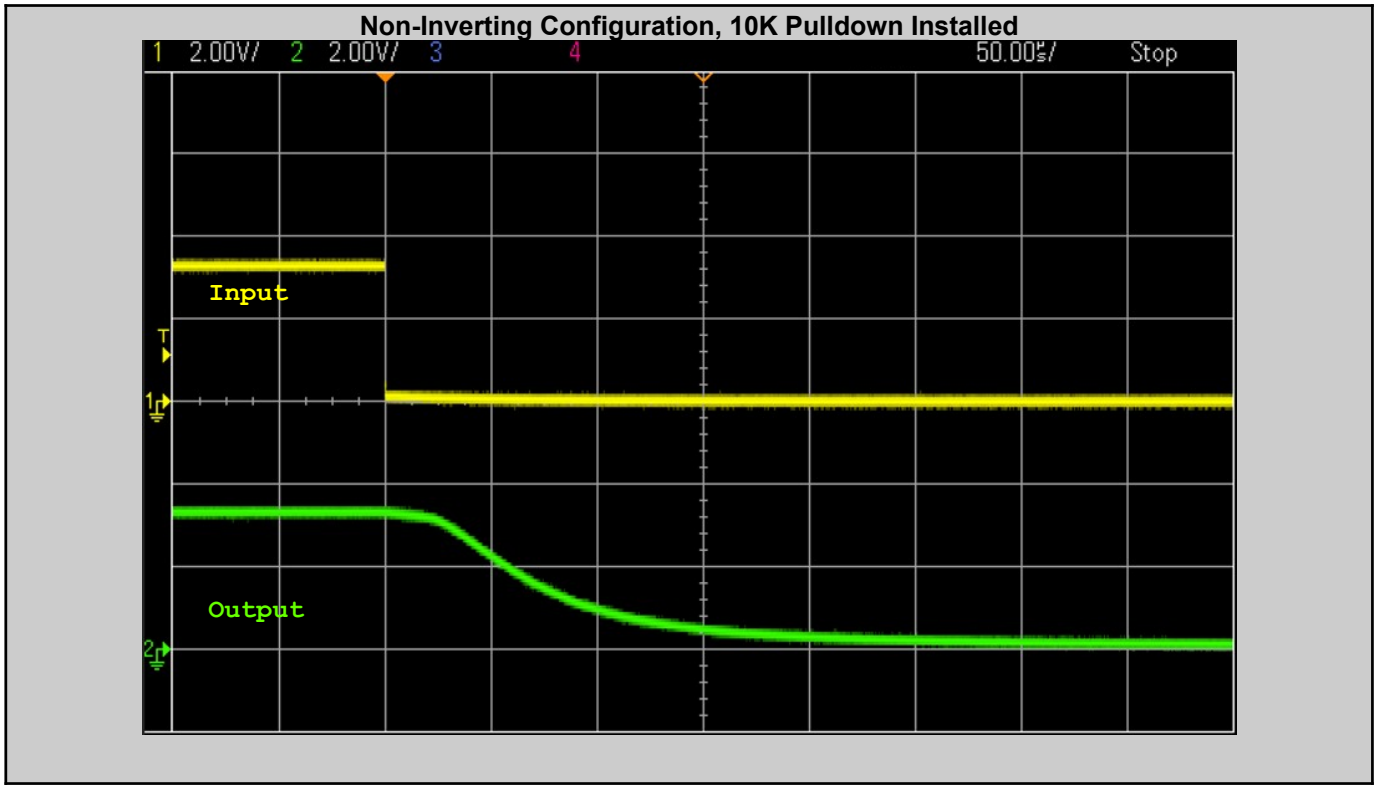
The following non-inverting test setup was used for capturing the typical timing performance for input logic levels of 3.3V and 5.0V. Note that since the module is configured as a high-side device on the output side, a 10k pulldown has been installed between the “E” and “PD” solder pads, as shown.



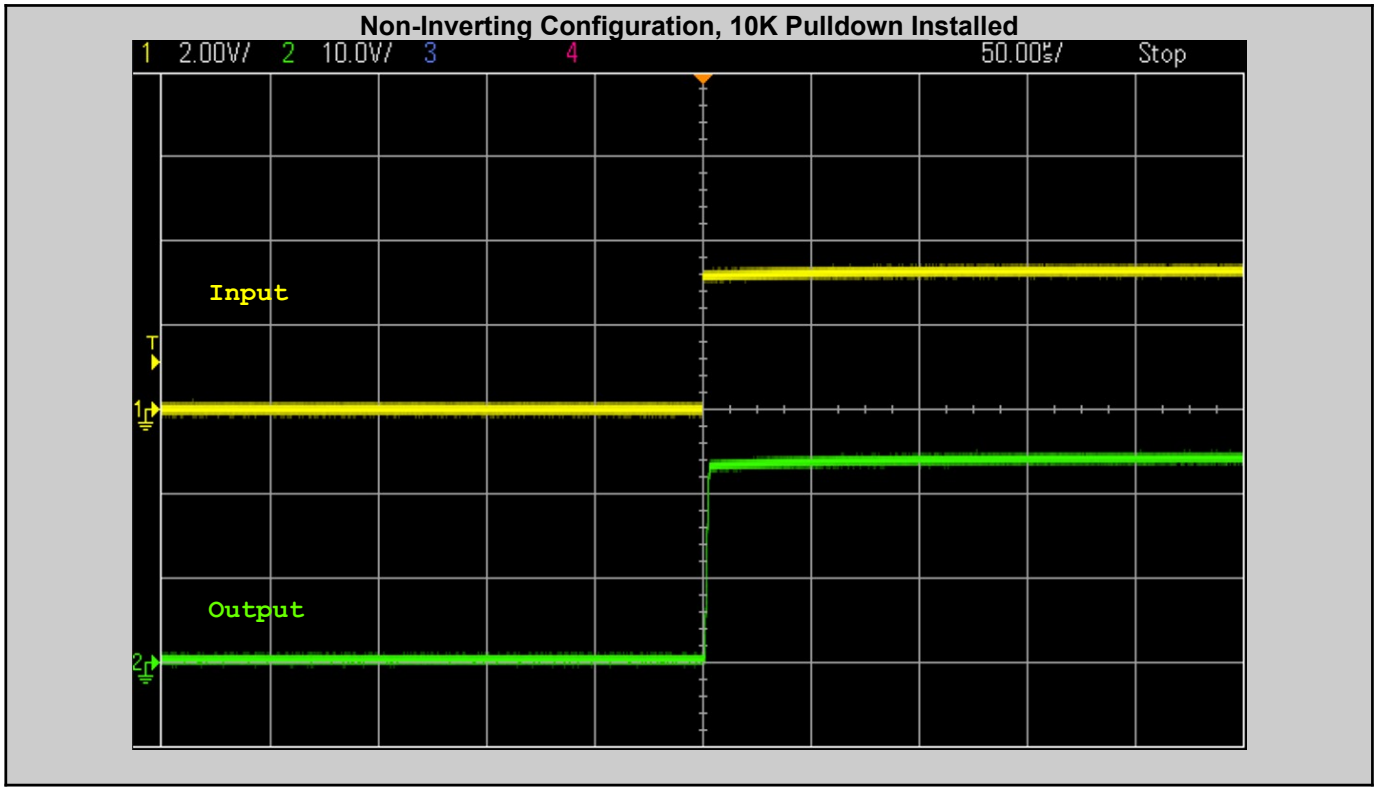
***3.3V Input Signal, 3.3V Output-Side Supply, Rising Edge, OPI201-080-10***



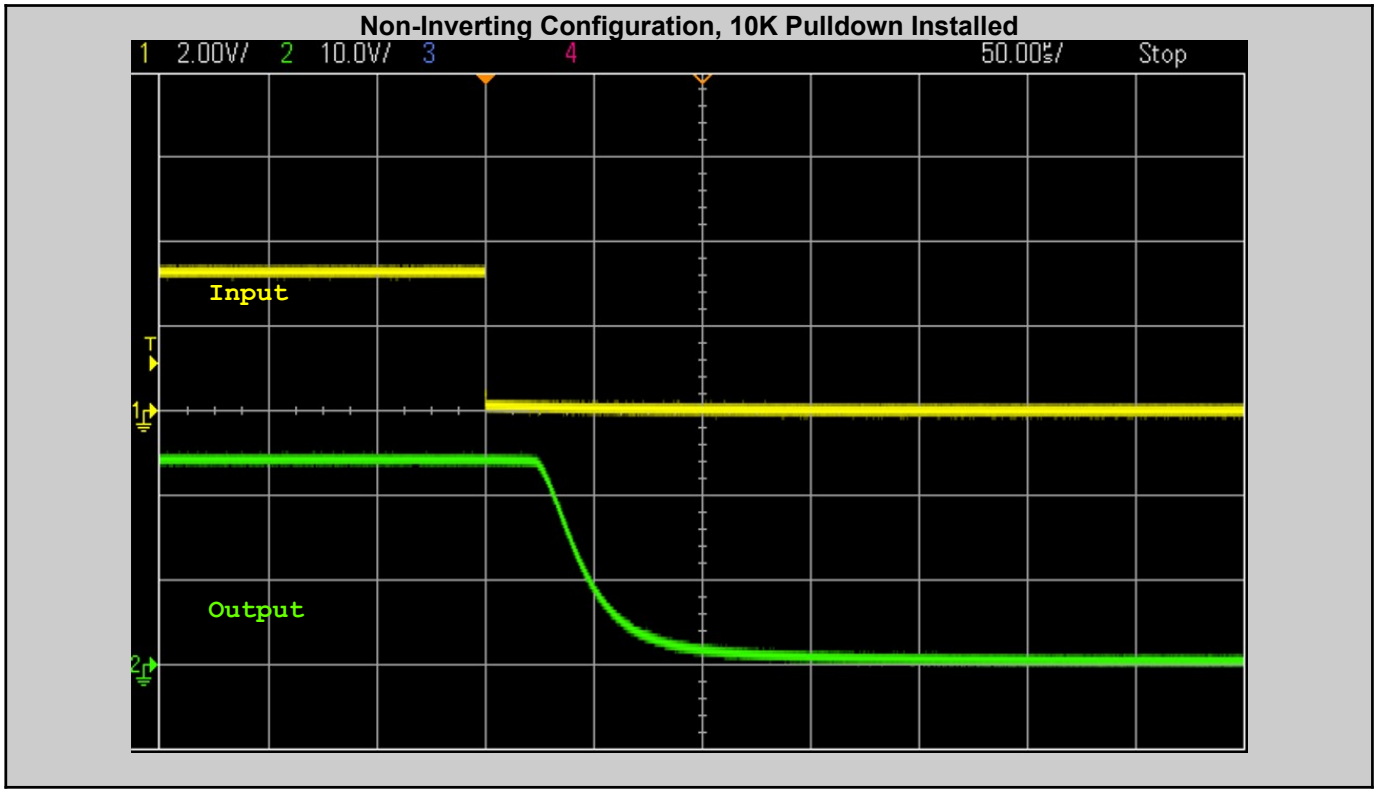

***3.3V Input Signal, 3.3V Output-Side Supply, Falling Edge, OPI201-080-10***



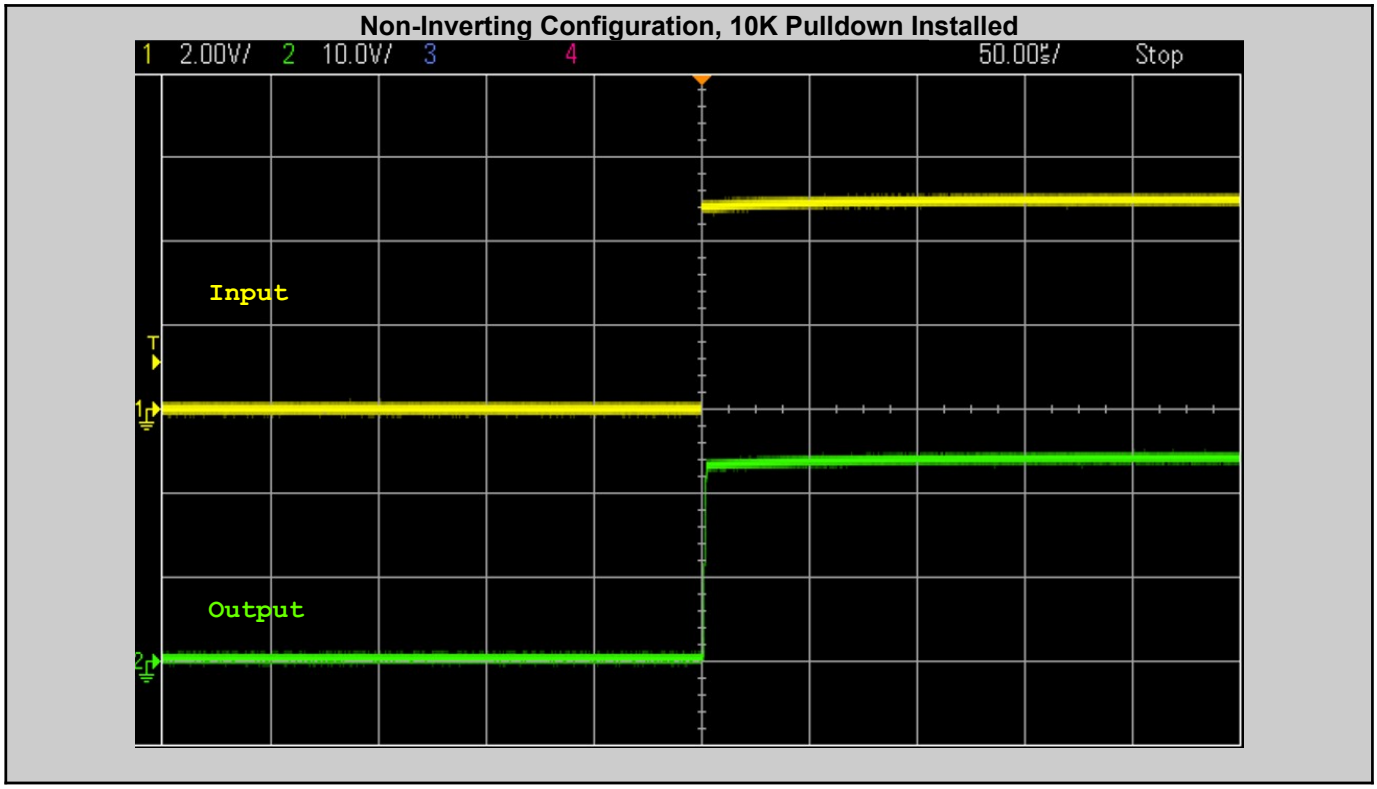
***3.3V Input Signal, 24V Output-Side Supply, Rising Edge, OPI201-080-10***



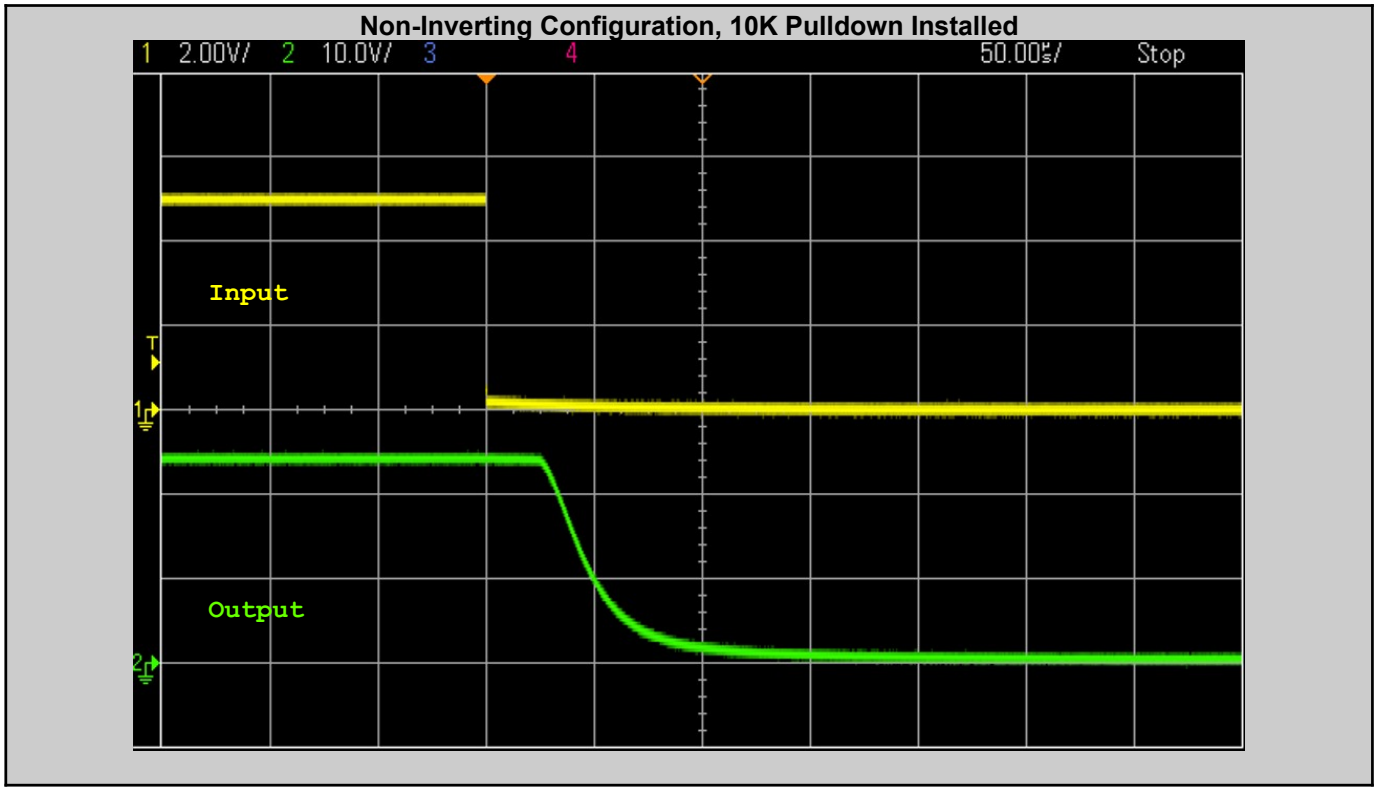

***3.3V Input Signal, 24V Output-Side Supply, Falling Edge, OPI201-080-10***



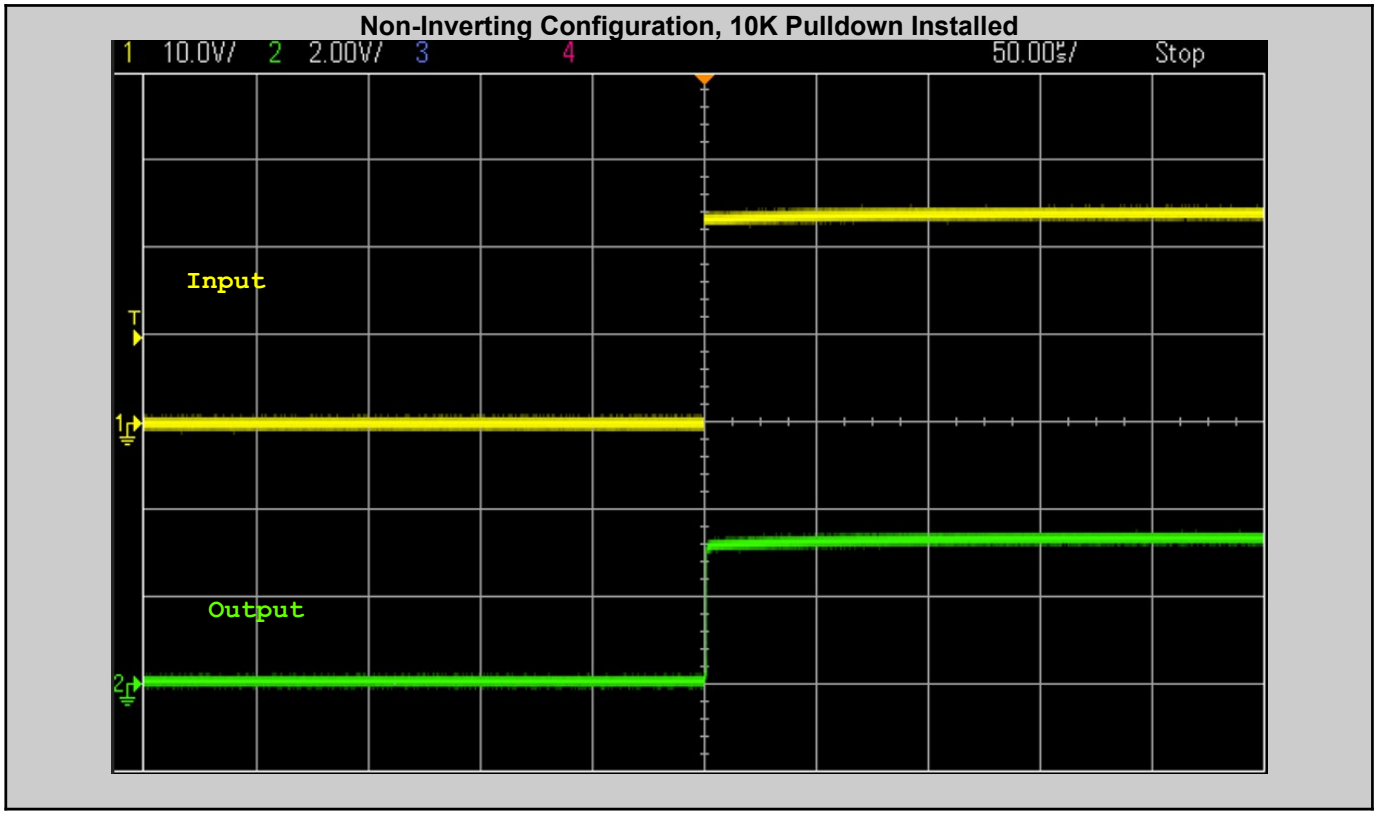
***5.0V Input Signal, 24V Output-Side Supply, Rising Edge, OPI201-080-10***



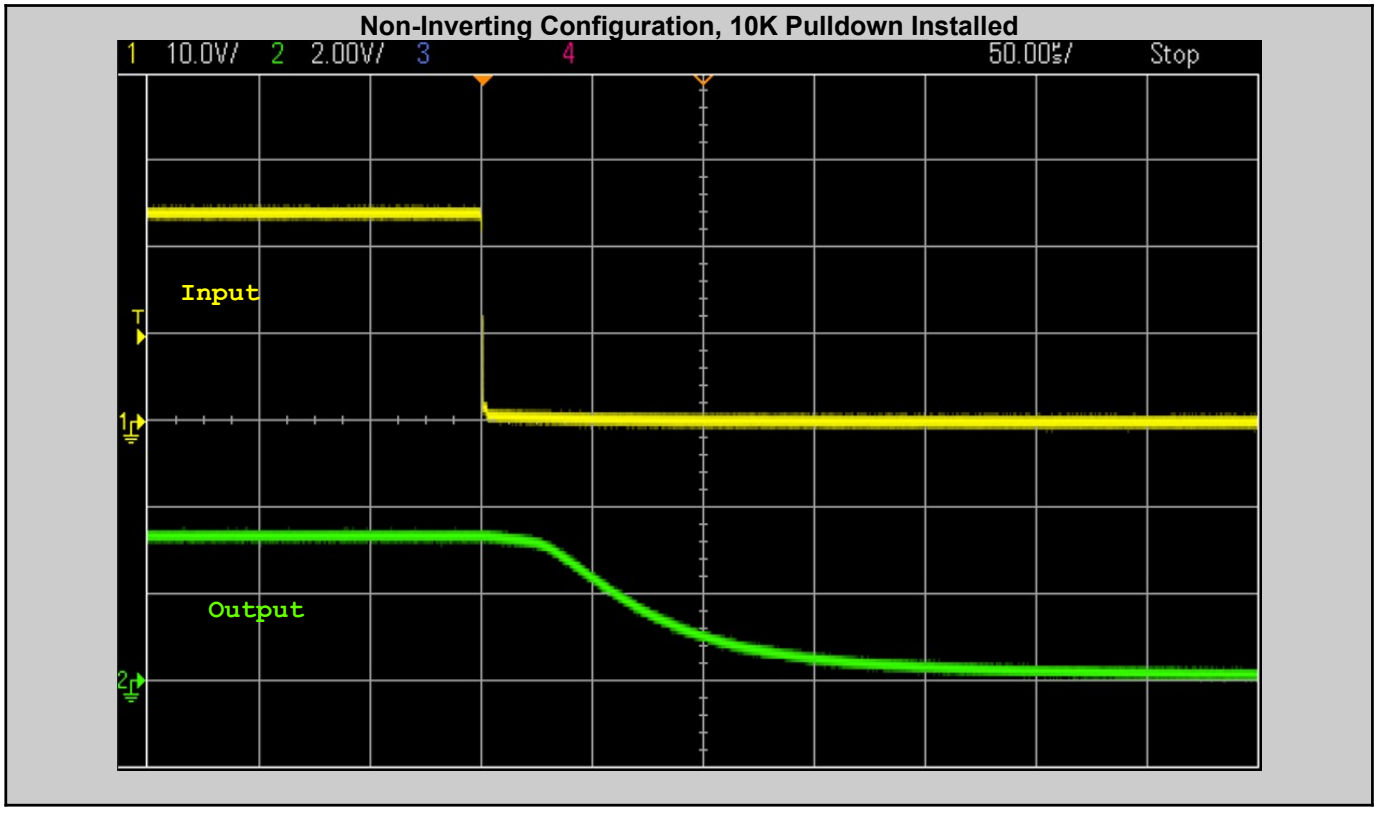

***5.0V Input Signal, 24V Output-Side Supply, Falling Edge, OPI201-080-10***



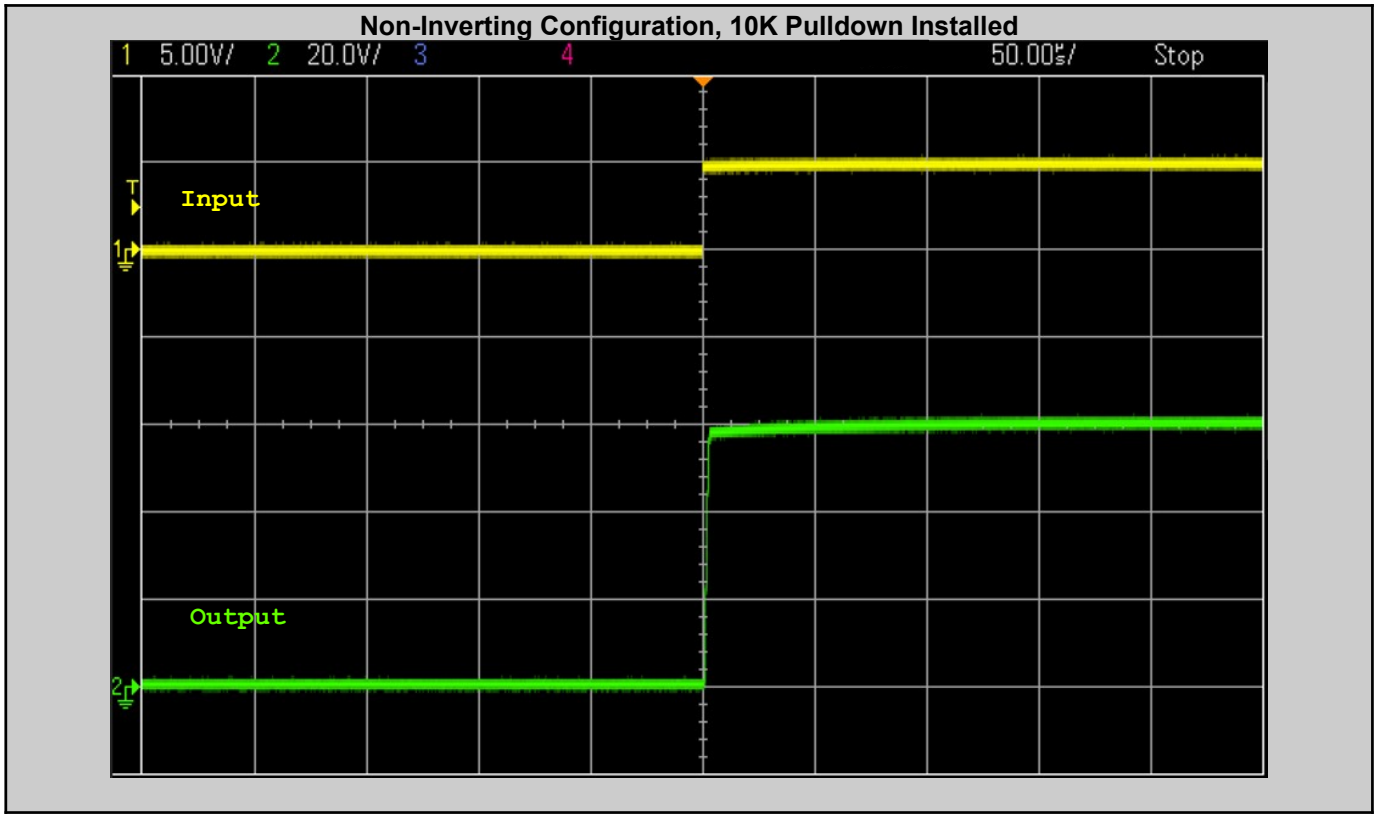
***24V Input Signal, 3.3V Output-Side Supply, Rising Edge, OPI201-080-10***



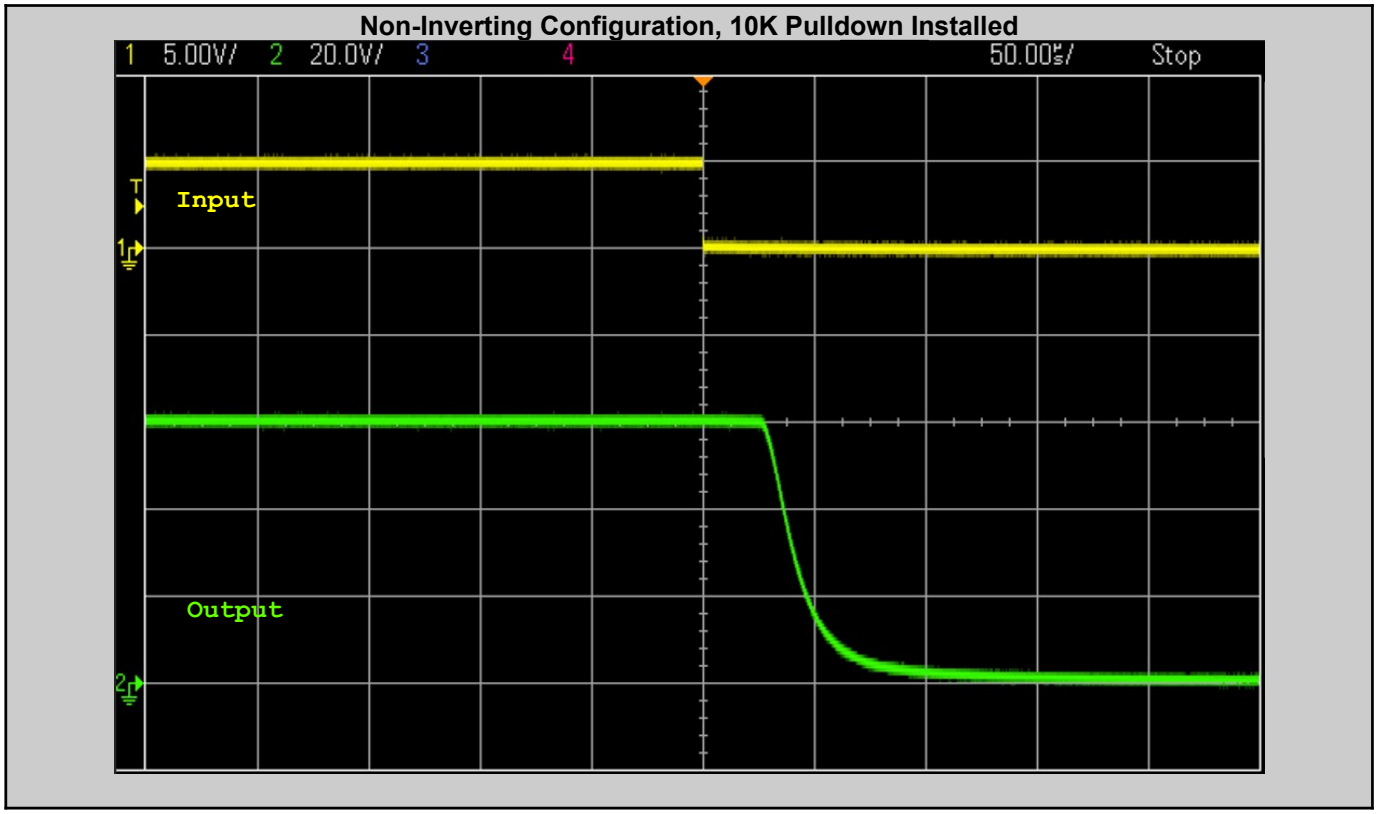

***24V Input Signal, 3.3V Output-Side Supply, Falling Edge, OPI201-080-10***



***5V Input Signal, 60V Output-Side Supply, Rising Edge, OPI201-080-10***




***5V Input Signal, 60V Output-Side Supply, Falling Edge, OPI201-080-10***



## System Analysis: Failure Modes & Effects

When designing any system, it is advisable to ensure that there is a thorough understanding of what will happen when each piece of the system fails. It is the responsibility of the system designer to ensure that the failure effects are understood, and that appropriate countermeasures or redundancies are implemented if warranted.

If there are additional questions about using this product in a particular application, please contact Winford Engineering for more information.

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