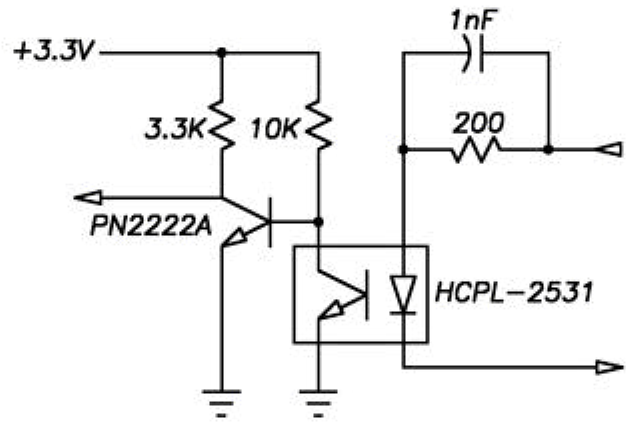
http://groups.yahoo.com/group/Electronics_101/message/35111

Re: optoisolator speed ?



I just posted to the files section a file called "OPTO INTERFACE.gif" I drew up a few months ago. "OPTO SCOPE.gif" is a scope trace showing the behavior of the circuit.

This circuit is scaled for 3.3V operation and will pass a 1MHz squarewave maximum. The opto sensitivity is 2.5mA max thru the LED for full-scale output.

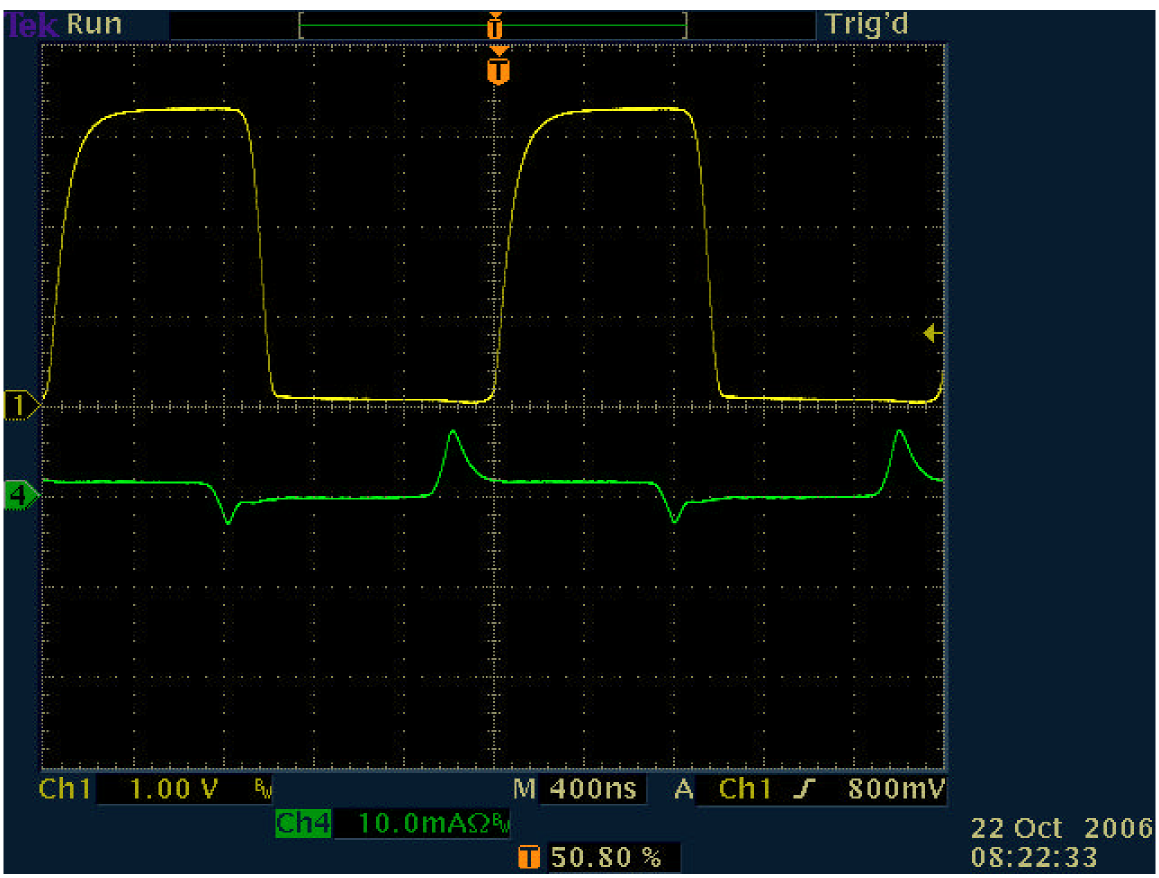
The purpose of the NPN is to overcome the opto-transistor's wretched Miller capacitance effects. It limits the opto collector voltage to a 600mV swing and thus Miller Effect.

The current draw of the circuit is a resonable 1.3mA @ 3.3V on the detector side.

I apologize for the green trace. I used a Tektronics Hall-effect probe around the LED current wire. Unfortunately the 6' (2-meter) coax cable capacitance is what c auses the large leading and trailing edge overshoots. This does not accurately represent the LED current which does not have this passing thru it.

Note the symmetrical 200nS propogation delay times from LED current to opto output voltage.

Mariss



Message #35140

The circuit depends on using an HCPL-2531 opto. It uses a photodide as the detector and its anode connects to the base of a transistor which is the opto output.

Photodiodes are much faster than phototransistors but have a very low gain. The internal transistor brings the gain up to a more reasonable (but still miserable) 0.15. This means it takes 6mA of LED current for every mA of collector current. Good enough.

Like a phototransistor (though it's not), there is no base to emitter DC path. This results in a strong Miller Effect on the transistor which seriously limits collector voltage rise and fall times.

"Miller Effect" is the behaviour of the transistor's collector to base capacitance. As the transistor turns off, its collector voltage rises. As it rises, current begins to flow to charge this capacitor. This current flows into the base and acts to retard turning the transistor off. The result is to slow the rise/fall times on the collector.

The external NPN takes care of the gain and Miller Effect problems.

The NPN base to emitter voltage is 0.6V and it limits the opto tranansistor collector voltage to a 0V to 0.6V swing. This small voltage swing greatly limits the Miller Effect (zero voltage swing = no Miller Effect at all).

Second, the opto collector current is only 330uA (3.3V / 10K). This means about 2mA LED current is enough (330uA / 0.15 gain = 2.2mA). The external NPN has plenty of gain to allow a reasonable 1mA of collector current (3.3V / 3.3K = 1mA). The forced gain is only 3 (1mA / 330uA) so the NPN fully saturates.

The opto LED current limit resistor (200 Ohm) is scaled to operate this circuit with 2.5V logic (2V swing). The LED current becomes 2.5mA then ((2V - 1.5V) / 200 Ohms = 2.5mA). 3.3V logic is 6mA and 5V logic is 15mA.

Ideally:

3.3V logic, use 470 Ohm. 5.0V logic, use 1.2K Ohm.

Lose the 1nF cap across the resistor. It really contributes nothing.

Mariss