

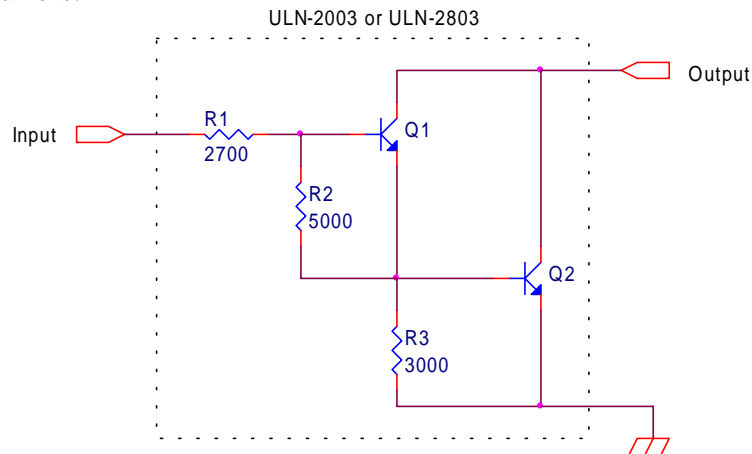
CAT PAPER

CAT Paper: P-3

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Logic Inputs To The CAT Controllers

All CAT controllers use a Darlington Transistor Array (ULN-2003 or ULN-2803) to handle signals like COR (Carrier Operated Relay) inputs, CTCSS (Continuous Tone Coded Squelch System) inputs, and general user function inputs. Internal to these devices are seven (ULN-2003) or eight (ULN-2803) transistor inverting buffers. Below is a schematic representation of the internal buffers.



With the CAT controllers, the inputs come from the main input connector and the outputs are connected to some sort of microprocessor input device. Therefore, the voltage applied to the input connector will determine if the internal darlington transistors conduct and result in the output pulling low toward ground. Therefore to analyze this circuit, we'll look at two DC currents and determine what those values are in the CAT controllers.

The first DC current is applied to the input pin. As this input current increases, both transistors Q1, and Q2, will begin to conduct and we are interested in what that value is.

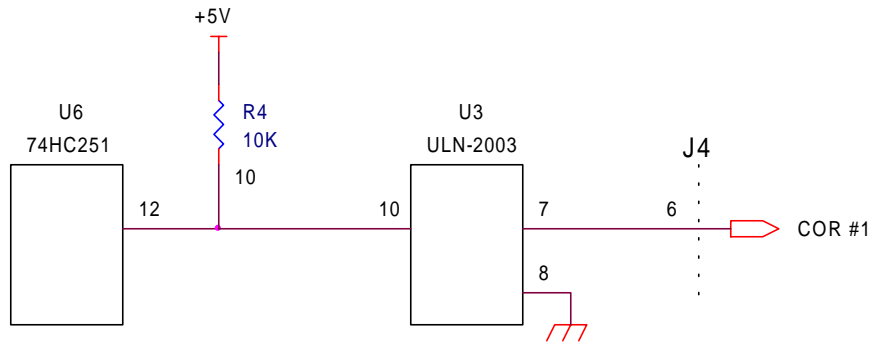
The second current is the output current that flows through Q2 and providing a path (sink) to ground for the external circuit that the output is applied to.



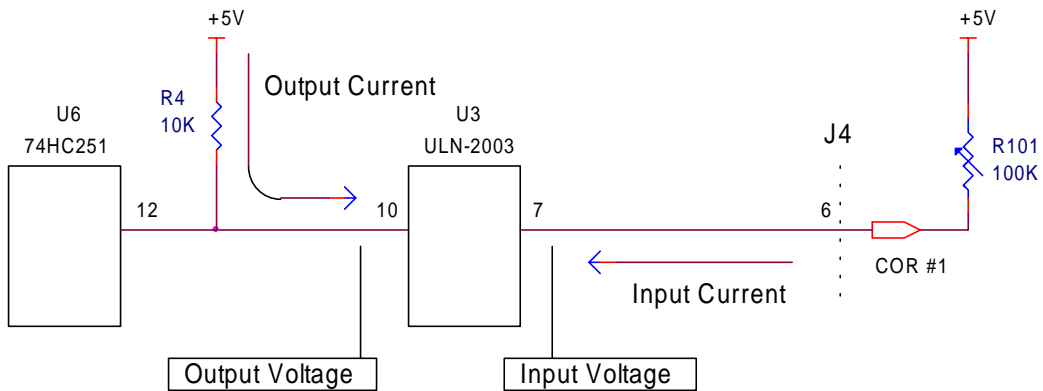
Logic Inputs To The CAT Controllers

Analyzing the Inputs

We'll use the CAT-1000 input as illustrated below and exam the COR input for our example.



By connecting a 100K variable resistor to +5V to the COR input, we'll adjust the resistor while measuring the output voltage of the ULN-2003 (pin 10). Measuring the voltage drop and resistance across the variable resistor (R-101), we can easily calculate the input current required for the output voltage to drop down to near zero volts (U3 saturated).

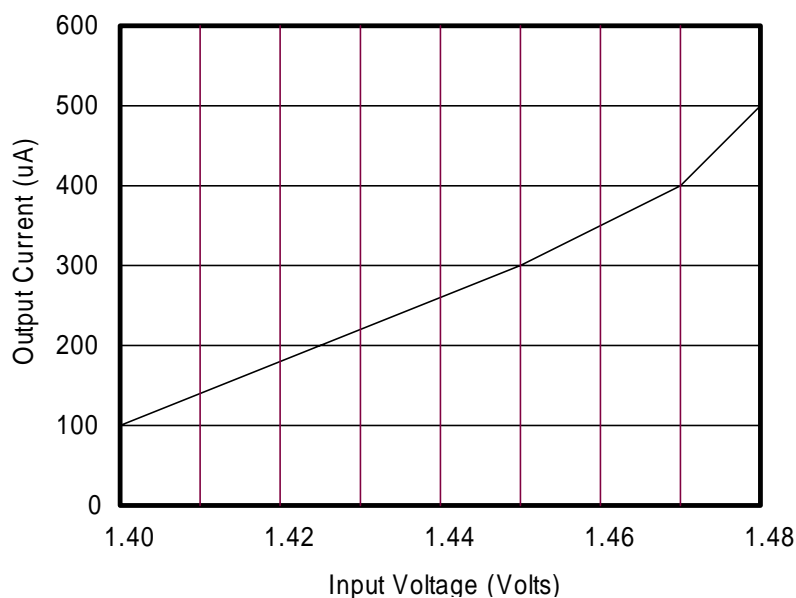




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The listing and chart below shows the results of several different resistor values and the related voltage and currents, both input and output.

Input Voltage	Input Current	Output Voltage	Output Current
1.40 VDC	85 μ A	4.00 VDC	100 μ A
1.45 VDC	87 μ A	2.00 VDC	300 μ A
1.47 VDC	91 μ A	0.65 VDC	400 μ A





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The previous listing and chart illustrates that the ULN-2003 does not require much input current to saturate the output providing the high/low logic necessary for the microprocessor. To safely insure logic switching in temperature changes, etc., we'll take the saturation current and multiply by 5. This should provide safe input current for reliably switching. From our listing, saturation occurred at 91 uA so we'll round that to 100 uA and multiply that by 5 giving us 500 uA of input current. Based on that value, below are some resistor values based on various source voltages. (Remember the input to the ULN-2003 has an internal resistor feeding a darlington transistor bipolar junction)

<u>Source Voltage</u>	<u>Series Resistor</u>
+5 VDC	5.0K Ohm
+10 VDC	15.0K Ohm
+12 VDC	18.5K Ohm
+15 VDC	24.0K Ohm
+20 VDC	33.0K Ohm

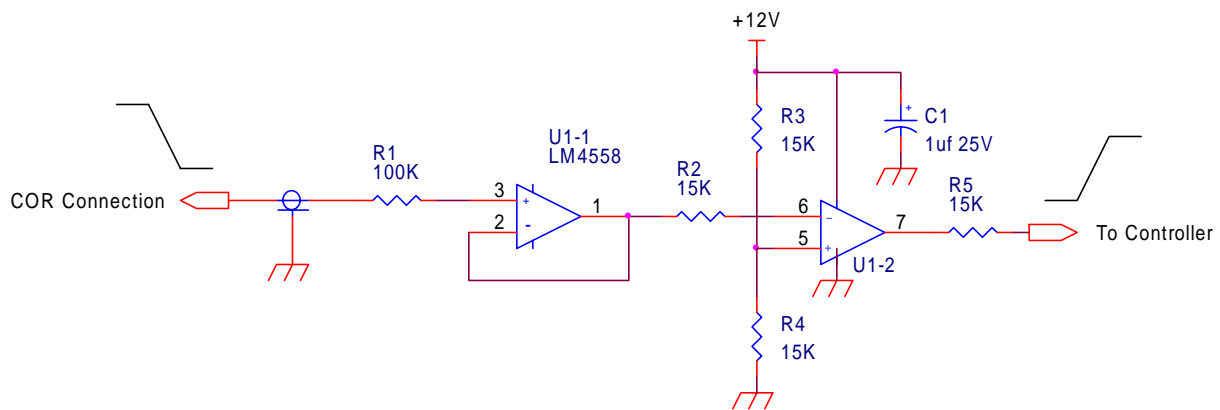
External Isolation And Buffer Amplifier

At times it is necessary to obtain the repeaters COR from a receiver circuit location that is of a high impedance source. This at times causes a loading effect rendering the squelch action unusable with no source voltage necessary for the CAT controller. In this case, it may be necessary to construct an interface to isolate and buffer the controller from the receiver's high impedance source.

Two circuits are illustrated on the next page. The first is if the receiver provides a negative going COR signal. The second circuit supports a positive going COR. In both circuits, the output voltage applied to the CAT controller will be positive going and therefore requires that the configuration Dip-Switch on the controller PC board be set for positive going COR. Please note that when working with high impedance circuits, it is necessary to use shielded cable between the receiver and the buffer circuit input. Also place the buffer as close as possible to the receiver connection point.

Logic Inputs To The CAT Controllers

Negative Going COR Buffer



Positive Going COR Buffer

