ADDING VISUAL/AUDIBLE TURN SIGNAL ALERT TO A MOTORBIKE

OVERVIEW

Only a limited number of motorbikes have self canceling turn signals like those we take for granted in cars. The result is an unusually high number of two wheelers tooling down the road signaling for turns they've already made. It's well documented that one of the biggest risks to bike riders is not being seen … being seen and sending the wrong signal is potentially just as dangerous.

For the most part, even those bikes with visual indicators in their instrument clusters fall short in that these indicators are out of the rider's normal field of vision. There are a number of commercial kits of varying complexity and cost intended to retrofit self canceling turn signals but, given the increasing use of electronics on bikes, these are generally model specific and/or require complex wiring to fully integrate them with the existing bike circuitry.

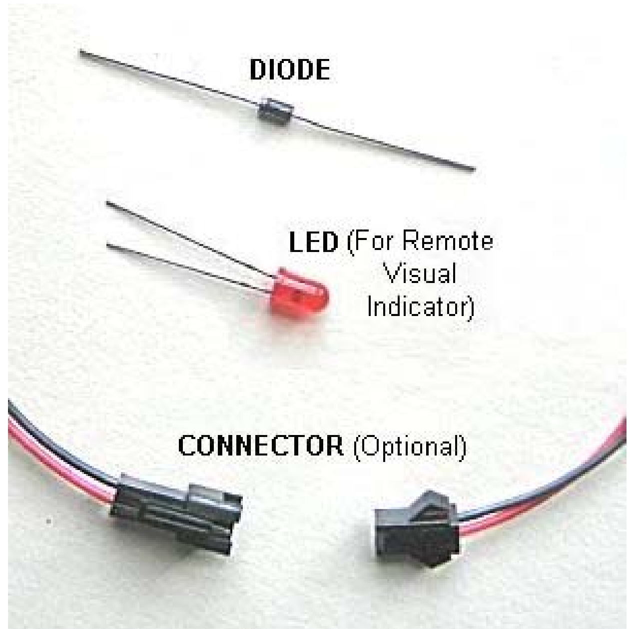
One solution adopted by some manufacturers is to include an audible device that beeps in sync with the flash of the turn signal. Such maintains the rider's attention without requiring a glance at the instruments. Generally these are pretty effective, though many wish their volume was adjustable.

This article provides some guidance on a fairly simple and inexpensive way in which to add remote visual and/or audible turn signal indicators to your ride. Implementation will require some basic mechanical and electrical skills, meaning you're OK with working on your bike and you've the ability to solder wiring (there are twist and crimp type connectors which, though bulky, could probably be used). If you've no such aptitude, you'll need to find a generous friend to give you some assistance. As with all such projects, you're encouraged to read through and understand the entire process before deciding to take the first step. It's a lot easier to progress when you know where you're going. And, as is the case with all "good Samaritan" submissions, I assume no liability and make no guarantees or warranties as to the functionality or suitability of this guide, or as to the attendant loss or damage that may result from your attempting this modification - proceed at your own risk (sad to say, that has to be said). With that depressing bit of disclaimer behind us, on with it!

BASIC COMPONENTS

The core of an audible signal is some manner of beeper or buzzer. The most appropriate unit for this application is a solid state device known as a piezoelectric transducer or, more commonly, a piezo buzzer. They're relatively rugged, and require very little power to operate. A reasonable choice is that shown, Radio Shack 273-060 ($4.49 as of this writing). There are many others that will work. Key to selection is a 12 volt rating and low current draw. This one draws about 5 milliamps.

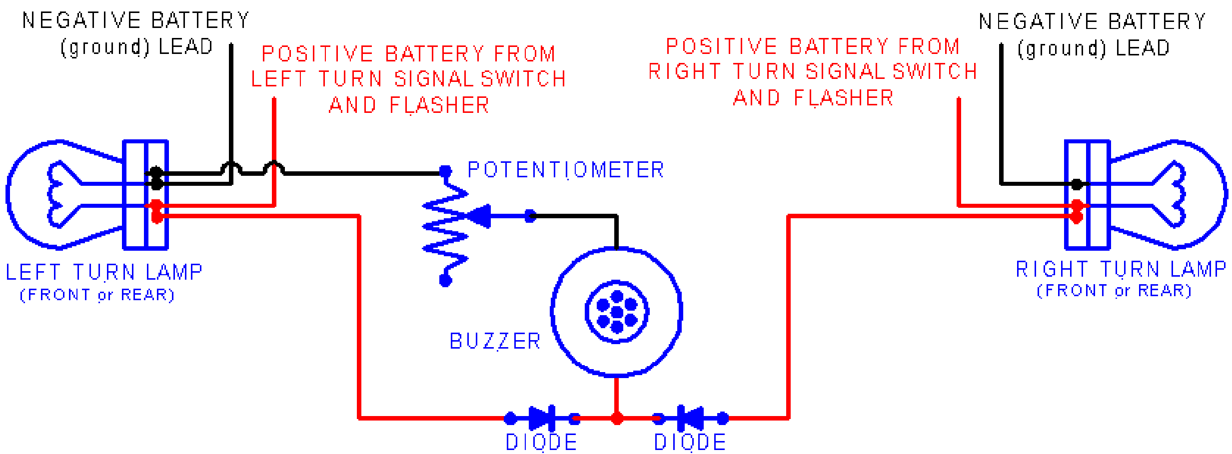
You'll need some diodes and wire. And that's all that's really required for an audible signal. If you want remote visual indication you'll need some LEDs. See RULES OF THUMB below for information on these components. Depending on where you mount the various components, you may also want to use some connectors in order to provide break points for when you disassemble your bike, e.g., LEDs mounted on a windshield will need to be disconnected if you have to remove the windshield. The connectors shown here are from All Electronics (allelectronics.com), part CON-240 ($1.35 or less depending on quantity – buy in bulk with friends to spread shipping cost, or find equivalent locally).



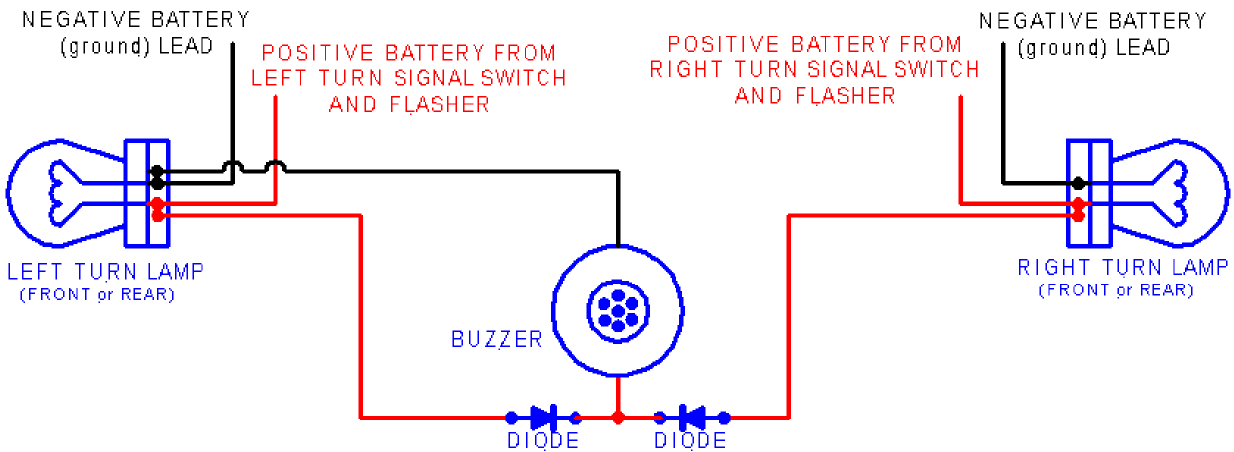
If you want a volume control for your audible signal, you'll need a linear taper potentiometer such as that shown (note that the shaft can be cut down to a length appropriate for whatever mounting position you choose). This is a Radio Shack 271-1715 ($2.99 as of this writing). It's rated at 10 kilo-ohm, .5 watt, 500 volts. This potentiometer has been shown to work with the buzzer above. If you have a different buzzer or potentiometer, you really need to hook them up off of the bike to insure you'll get the volume control you want. Just hook up negative battery to the potentiometer, potentiometer to the negative buzzer lead, and positive buzzer lead to positive battery … then tweak the potentiometer to see what kind of control you get. Depending on where you mount the potentiometer, you may also want to get a knob (not shown) to dress up the shaft (make sure you get one the correct diameter for the shaft).

CIRCUITRY

The following schematics provide various combinations for adding audible and/or visual signals to your motorbike's turn signals. Keep in mind that schematics do not necessarily depict physical layout or wiring, and these do not show points at which you may well need a connector to facilitate subsequent disassembly. That will be dependent upon your components' physical layout and wire routing. The circuits assume your bike has a negative ground, i.e., the negative side of your battery is bonded to the framework and other metal parts. As a result, the ground for any component connected <u>directly</u> to ground may be obtained from any convenient ground wire or ground point.

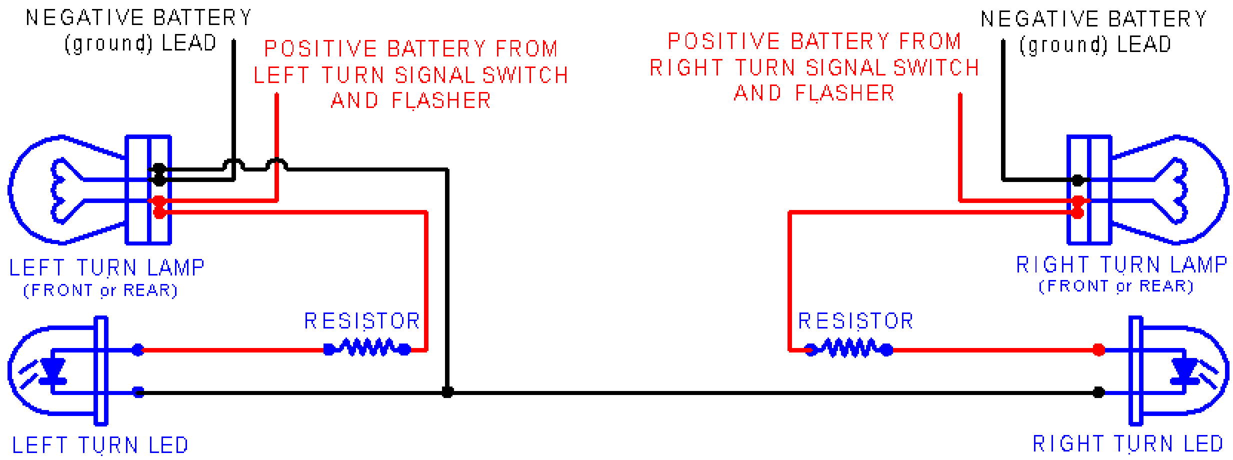


SCHEMATIC FOR AUDIBLE INDICATOR WITH VOLUME CONTROL

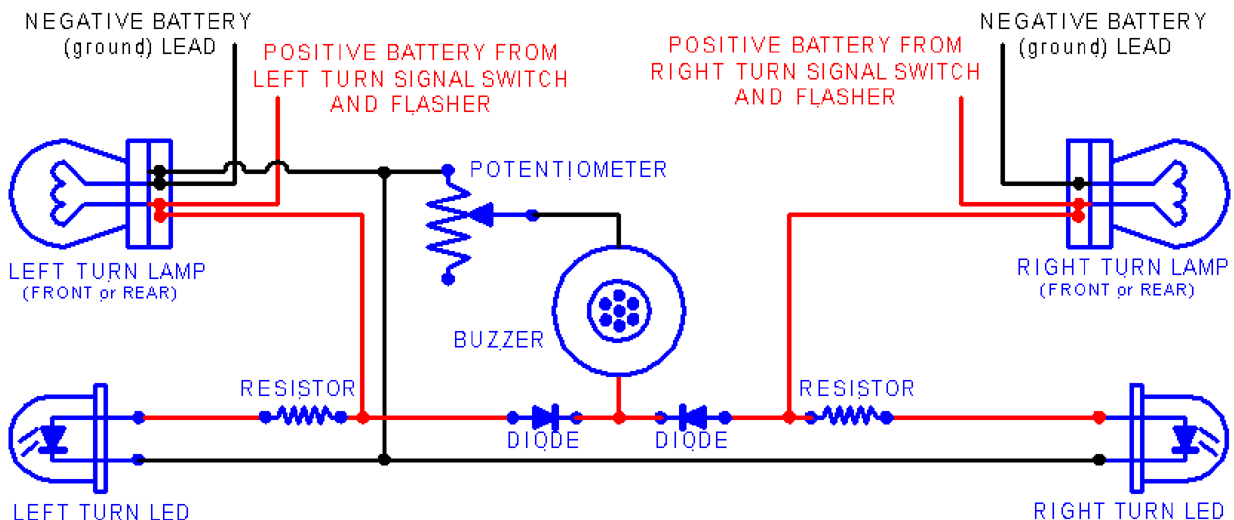


SCHEMATIC FOR AUDIBLE INDICATOR WITHOUT VOLUME CONTROL

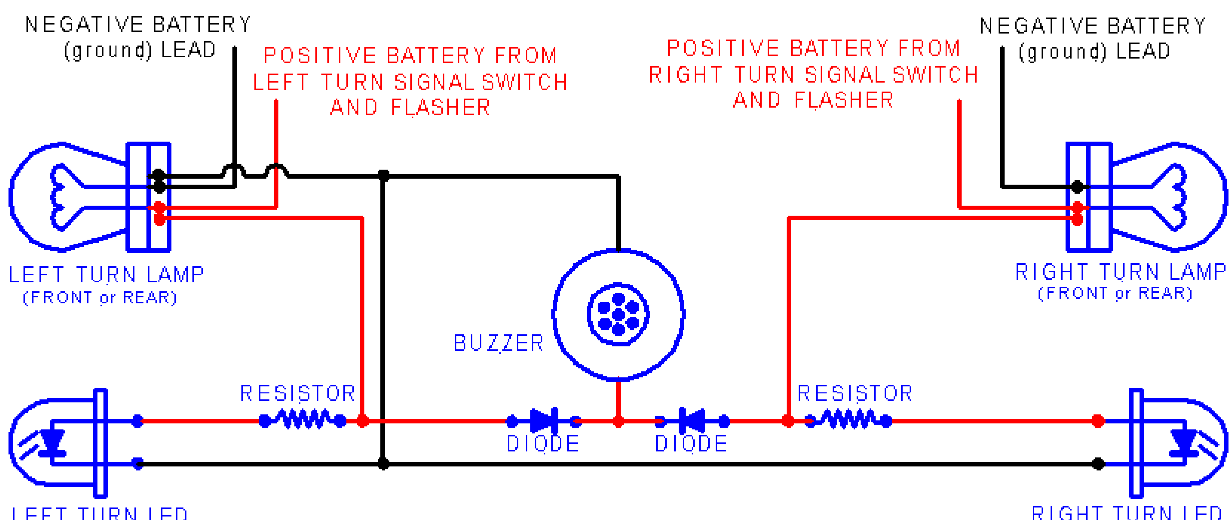
ADDING VISUAL/AUDIBLE TURN SIGNAL ALERT TO A MOTORBIKE



SCHEMATIC FOR REMOTE VISUAL INDICATORS (LEDs) ONLY



SCHEMATIC FOR REMOTE VISUAL INDICATORS (LEDs) &
AUDIBLE INDICATOR WITH VOLUME CONTROL



SCHEMATIC FOR REMOTE VISUAL INDICATORS (LEDs) &
AUDIBLE INDICATOR WITHOUT VOLUME CONTROL

CIRCUIT OPERATION

Though the schematics may look complicated at first glance, the operation is fairly simple. In the case of the remote LEDs, the positive battery which is applied to a turn signal lamp is simply also applied to the corresponding LED / resistor combination, lighting the LED in sync with the lamp. In the case of the buzzer, the positive battery which is applied to the turn signal lamp is also applied to the buzzer via a diode. If the left signal is operating, the left diode passes current to the buzzer while the right diode blocks this current from crossing over and operating the right turn signal lamps. When the right turn signal is operating, the reverse is true. If a potentiometer is in series with the buzzer, the voltage across the buzzer and potentiometer is distributed between the two, reducing the voltage across the buzzer and lowering its volume.

MECHANICAL

This article could not begin to address all the possible options on all manner of motorbikes for the placement of the components used in this feature addition. So what you'll find here are some generic comments and a couple of examples.

Insofar as possible, the components and wiring should be securely mounted in an enclosed area on the bike to protect them from the weather and physical assault. The low voltage and small conductors involved do not present much of a safety concern, however we must always be mindful that even a small spark in the wrong place can trigger havoc … so it behooves one to isolate / insulate electrical devices in so far as possible. It is assumed that, by virtue of the connections shown, all leads are being fed from a fused power supply and are therefore precluded from doing significant damage in the event of a typical "major" failure, e.g., a shorted wire.

LEDs themselves are pretty much water resistant, but their leads are exposed where they exit the LED body. Once connections are made, these leads should be insulated. Heat shrink tubing can be very effective at this (effective taping is very difficult given the small sizes involved). Proper positioning and secure mounting also go a long way to ensure safe, reliable operation.

All connections should be insulated. Again, heat shrink tubing is very effective for this (remember to slide the tubing over the wire on one side of the connection BEFORE finalizing the connection – not doing so means you get to do the connection over – it happens!).

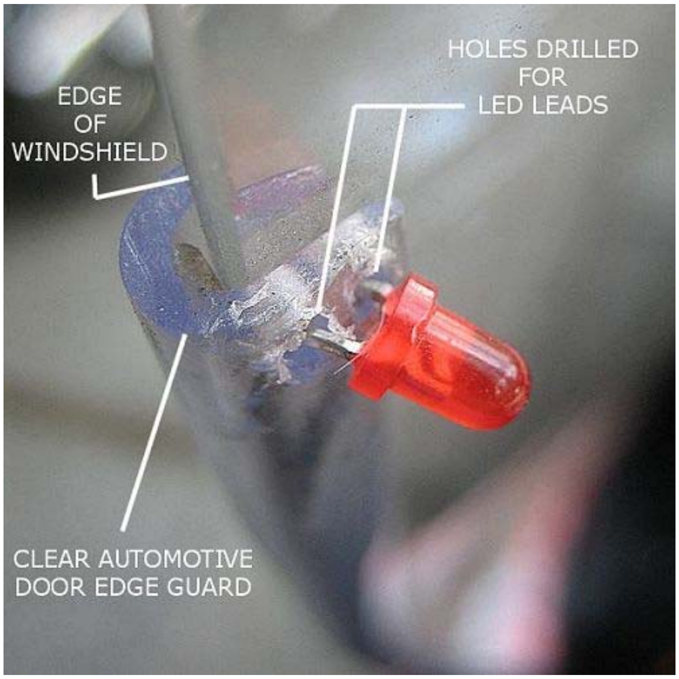
If you're adding a buzzer, hook it up temporarily (a 9 volt battery should work for this) and experiment with various locations while you sit on the bike to ensure you find a place that allows its sound to easily be heard (it will be louder at 12 volts). Up under the front "tupperware" generally seems to work well. The easiest method to secure it in place (after wiring) is with double sided tape or tie wraps, though screw mounting may be possible if you find an appropriate surface.

If you're adding a potentiometer, the obvious location for placement is protruding through a blank space somewhere around the instrument cluster. However, keep in mind that you're not likely to be adjusting it that often so inside a storage compartment is a good alternative (though it would best be one that you can reach into while on the bike). Also, a hidden location precludes passersby from fiddling with it, and generally means you won't really need a knob to top off the shaft.

If you have a schematic for your bike, you'll doubtless see that there are a myriad of places where you might tie in to the bike's turn signal circuitry. Many of these will require splicing your added wires into the existing wiring via some invasive manner (soldering, crimping, etc.). However, if your bike has connectors at or near the bulb assemblies, it may be possible to simply push your new wire (solid wire works much better than stranded here) into the back of an existing connector, forcing it in the plastic connector slot alongside of the metal crimped on the end of the wire that's feeding the turn signal lamp.

An example is shown in the photo to the right. If such isn't available on your bike, look for a connector elsewhere in the feed to your turn signals to make this insertion. The beauty of this approach (aside from its ease) is that you've made no permanent modification to your bike. This is also a good method to pick up the negative (ground) side for your added circuitry. Though you'll only need to pick up ground in one place, you can pick it up in multiple locations if it simplifies your wiring.

If you're adding remote visual indicators (LEDs) you can mount them almost anywhere you can get the wiring to them. You want them to be as visible as possible so mounting them in the vicinity of any existing visual indicator is somewhat pointless (even if you add ultrabright LEDs, they aren't likely to be much more "attractive" of your attention in daylight than indicators already on the bike). So, generally, you want to mount them as high as possible. In most cases the best high (sorry, couldn't pass it up) is on the windshield.



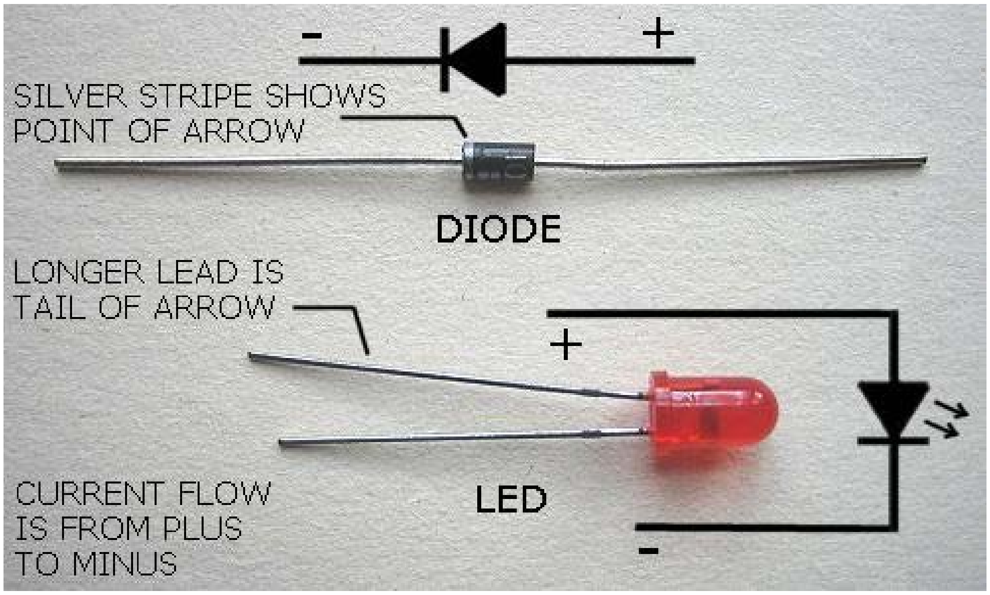
As you probably don't want to modify the windshield to mount LEDs and wires, a possible solution (depending on the edge finish of your windshield) is to buy some clear edge guard that's made for car doors and cut it to length for the side of the windshield to the height where you want the LEDs. Make two small holes on the inside top (facing the rider) of the edging (spaced and sized for the LED leads), push your wires though the holes from the inside, solder the wires to the LED, pull the wires and LED leads back into the edging and bend the LED leads down flush to the inside of the edging. Then push the wires into the crease of the edging taking care to keep the LED leads separated at the top. Slip the edging onto the windshield edge and all that remains is to route and connect the wiring.

RULES OF THUMB

Electrical chicanery can get pretty complicated depending on the nature of the task at hand, but the following discussion of components and their use serves our purposes here. Understanding the following is not really critical to this endeavor, but you might find it interesting, or want to experiment a bit, or wonder why something blew up in your face (hopefully not).

Diode (aka rectifier) – a solid state (no moving parts) semiconductor (conducts in only in one direction) device which passes current in a "forward" direction, but not in the "reverse" direction. The ratings of interest for most general purpose diodes are peak inverse voltage (PIV) and forward current (I_f – "I" being the accepted symbol for current). The PIV is the voltage the diode can safely withstand when the voltage is applied in the reverse direction, in which case no current will flow. I_f is the amount of current the diode can safely carry when the voltage is applied in the forward direction, when current will flow. Exceed either of these values and the diode will fail … perhaps over time if only exceeded by a small bit, but absolutely in a blaze of glory if significantly exceeded – heat, light, noise, fire – energy unleashed can be an awesome thing!

The current of the buzzer shown herein is less than 5 milliamps (that's .005 amps) and the current of the LEDs will be on the order of 20 milliamps (.020 amps). Further, the voltage of a motorbike is not likely to go above 13.8 volts, even at full charge. So a really small diode will suffice. The 1N4001 diode shown here is rated at 1 amp and 50 volts … considerably more than needed but they're easily obtained and pretty cheap - 2 for $.99 at Radio Shack, much cheaper in bulk from a parts house (nickel a piece) should you need a hundred or so.



Light Emitting Diode (LED) – definition is much the same as a diode with an added bonus, current passing through the diode junction gives off light, and generates virtually no heat (incandescent lamps are notorious little heaters, sucking up a lot of energy, i.e., amps, in doing so). The ratings of interest are the same as for a diode, with the addition of one more, forward voltage drop (V_f). Though the ratings of different LEDs vary (especially with color), it's usually a safe assumption that generic LEDs will operate acceptably at a forward current of 20 milliamps (.02 amps). It's also generally assumed that their forward voltage drop is about 2 volts. Most seldom take note, but the peak inverse voltage of an LED is usually pretty close to its forward voltage drop – meaning they don't work very well for blocking reverse current flow. The issue in using an LED in your motorbike is the motorbike voltage approaches 14 volts. It won't matter whether you put the LED in forward or backward, it's going to "disappear" at that voltage. The solution is to put a resistor in series with the diode.

Just about any general purpose LED (your choice of color) will work in this application though you may want to look for those labeled as "superbright" (brighter than "normal") or "ultrabrite" (brighter still) to maximize visibility in daylight. LED brightness is typically measured in mcd (MilliCanDella) and viewing angle. There's a conversion from this data to lumens but we'll not go there. Suffice to say that the higher the mcd rating (if you can even find it), the brighter the LED, assuming the viewing angle is the same. Given two LEDS with the same mcd rating but different viewing angles, the one with the narrower viewing angle will appear brighter … and that's all I'm saying on this topic.

RESISTOR

Resistor – a solid state device that "resists" current flow in either direction. The resistance of these devices is measured in ohms (often represented by the symbol Ω). Their other critical rating is power, measured in watts (W). Tolerance, as a percentage of their nominal resistance, is also given. When a voltage is impressed across a resistor, the fact of its resisting the flow generates heat, and this heat (power) must be dissipated without destroying the device (or getting hot enough to set its surroundings on fire). Resistors may be made from a variety of materials and are available in a long list of standard sizes and wattages. Perhaps the most common (and cheapest) of these are carbon based resistors, readily available in 1/8, ¼, and ½ watt sizes.

Wire – It should be clear by now that the currents involved in this type of circuitry are really pretty miniscule compared to other loads on a motorbike. A buzzer like the one shown and one LED will draw a total of about 25 milliamps or .025 amps. 30 gauge wire is good for 0.8 amps in chassis wiring (as in the "chassis" of your DVR). 22, 24, and 26 gauge wires (typical telephone wire sizes) are rated at 7.0, 3.5, and 2.2 amps, respectively, in such application. All of the "hook up" wire you're likely to find is rated for voltages higher than the 14 volt maximum on most motorbikes (note – voltage rating is related to the capability of the insulation on the wire, not the conductor within). For this application, the bigger concern will be mechanical strength. Solid wire is just that, one solid conductor. Stranded wire consists of multiple conductors twisted together within the wire's insulated covering. Stranded wire is better in areas which will flex a lot, but it doesn't like to "hold its shape" … you'll have to secure it well. Solid wire will flex some but is really vulnerable to breaking if the flex is at a sharp bend, however it has a stronger tendency to stay where you put it (though it still needs to be secured). Solid wire tends to have a bit smaller diameter than stranded wire of the same gauge. The wire used in a prototype of this application was 26 gauge, solid wire salvaged from a multi-conductor telephone cable.

SOME ANALYSIS

So how do we put all this together in a circuit that lights an LED without any unintended consequences? As luck would have it, in 1827 a German physicist (Georg Ohm) performed some experiments which resulted in the formulation of Ohm's Law, which states that current times resistance equals voltage (I*R=V). Know (or fix) any two of these, and you can calculate the third. I know it's somebody else's law (escapes me for the present, maybe Kirkhoff – you getting all this down?), but it's a given that electrical devices in series must all conduct the same current. It's also a given that the voltage across those devices must be split between them. So if we have an LED in series with a resistor (known as the current limiting resistor in such a circuit), and we know the forward voltage drop of the LED is 2 volts, and we assume the highest motorbike voltage is 13.8 volts, we can do a simple subtraction and deduce that the voltage across the resistor must be 11.8 volts. Since we know the current through the resistor will have to be 20 milliamps, we can calculate the required resistance of the resistor using Ohm's law – if I*R=V, then R=V/I and our resistor needs to be 11.8/.02 or 590 ohms. Standard resistor sizes in this area are 560 and 620 ohms. How to decide? The lower value will allow slightly more current flow, the higher one slightly less - 21 mA and 19 mA, respectively (that calculation is left to the interested reader – you've no idea how long I've waited to actually use that phrase). The LED probably won't care, and the resistors' tolerance is going to span that range anyway so I'd go with 560 ohms – the motorbike voltage isn't going to be maximum all the time. But we're not done with the resistor yet. What about power? Turns out (derived from Ohm's law) that power in a device is equal to the current through the device times the voltage across the device. We know both of these, voltage is 11.8 volts and current is .02 amps, so the power dissipation is .236 watts. A 1/8 watt resistor won't do, a ¼ watt resistor will be fine. If you want a bigger margin of safety, use a ½ watt resistor. 560 ohm, ½ watt, 5% tolerance carbon film resistors go 5 for $.99 at Radio Shack.

Why all this detail? Well, someone may want something slightly different than what's presented here. Knowing how to get here may help them create their own. Perhaps one has slightly different specs for the components they're actually going to use. This will guide them through sizing calculations specific to their components. Or maybe they want two LEDs per signal, i.e., in series with each other and the resistor. Now the drop across the resistor will be 9.8 volts so it need only be 490 ohms, .196 watts (470 ohms is a standard size).

Someone will likely observe that if you put 7 LEDs in series, you wouldn't need a resistor at all. It might work, it might not. The problem is that we assumed the forward drop of the LED was 2 volts. Depending on manufacturing tolerance, color, etc., it may be 1.7 volts, or 2.3 volts, or something higher or lower or in between. Even if the LEDs' nominal forward drop is 2 volts, the likelihood of every LED having a drop of exactly 2 volts is pretty slim. And anyway, even if they did, they would each be .03 volts short with the motorbike at 13.8 volts … and it's going to be less than that a lot of time. Been there, done that! I built a sequenced turn signal indicator using 7 LEDs per segment for my car years ago. When the car is running (i.e., charging at max voltage), it works great … but just running off of the battery, not so much. It's that close. Many design guides suggest that for maximum reliability every LED should have its own current limiting resistor … meaning if you want multiple LEDS you should connect them and their individual resistors in parallel. For a critical application, this is likely good advice. For "experimental flying", that's really not required (all those resistors "waste" power). They also caution against putting LEDs in parallel and sharing a current limiting resistor. Not following this advice may be an even worse idea as reliable success in such a case depends on the LEDs being virtually identical (electrically) … and that's not too likely.

Nota Bene: A little knowledge can be a dangerous thing. The rules of thumb depicted and used above are just that, rules of thumb … good enough for this type of application but not really all you need to know for more complex circuits or (perish the thought) AC powered devices.

COMPONENT SUMMARY

As discussed previously, there are a variety of components that could be used in the circuits presented here. Should you choose to use the exact parts mentioned herein, they're listed below for ready reference.

Audible:
Buzzer – (1) Radio Shack #273-060
Diodes – (2) 1N4001 Radio Shack #276-1101
Audible with Volume Control, add:
Potentiometer – Radio Shack #271-1715
Remote Visual:
LEDs – (2) Radio Shack #276-330, 5mm, 120mcd, red (check parts house/on-line for something brighter) or (2) Radio Shack #276-351, 5mm, 1900 mcd, yellow (this should be pretty bright, 1900 mcd vs. 120 mcd for the red)
Resistors – (2) 560 ohm, ½ Watt, 5% Tolerance, Radio Shack #271-1116
Miscellaneous:
Wire – small gauge (22-26), stranded or solid
Connectors – two conductor pigtail type (example: All Electronics CON-240)
Solder & Heat Shrink Tubing or some type of Crimp Connectors (see Radio Shack items 64-3081 and 64-3073 for examples – I don't like or use them, but if you've no other means …)
Modicum of Patience – Fishing wires and making connections in tiny spaces can be very frustrating and prompt a liberal application of George Carlin's seven unspeakable words. Take a deep breath - and leave a little slack in the wires.

A FINAL NOTE

If you've not undertaken this type of project before, but really want to try it, first put the circuitry together off of your bike. If you can make it work on the workbench, you can probably make it work on the bike. As Thomas Edison once said, "Hell, there are no rules here, we're trying to accomplish something."