ELECTRONIC POSITION INDICATOR

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The electronic position indicator described here can be used to display the position of electrically actuated flaps, trim systems, or any other components requiring position control. The major advantage of an electronic indicator is that it can easily be located anywhere in the cabin because, unlike a mechanical device, the only connections to it are electrical wiring.

The indicator design is based on the LM3914 Dot/Bar Display Driver integrated circuit (IC). As the voltage sensed by the driver increases from zero an array of 10 light-emitting diodes (LED's) are sequentially illuminated giving an indication of the voltage level. If this voltage level is determined by the position of some mechanism then the display is an indication of this position. The LM3914 will provide the common bargraph mode of illuminating the LED's or it can be used in dot mode, where only one LED is illuminated at a time.

Figure 1 shows the schematic for the position indicator using a single LM3914. Multiple drivers can be chained together to make longer displays but for simplicity only a 10 LED display is shown here. A standard 10-segment LED bargraph display is most convenient for the LED array but individual LED's can be used if desired. The 7805 IC is a voltage regulator that reduces the voltage to 5 volts in the circuit. If using the indicator in bar mode it would be wise to use a heat sink on the 7805, especially if expanding the circuit to more than 10 LED's. The bar mode is selected by connecting pin 9 to V+. The dot mode is selected by leaving pin 9 open, when only a single LM3914 is used. When chaining more than one LM3914 together the selection of dot mode is slightly more complex. Information on chaining multiple drivers together can be found in the application notes for the LM3914.

The voltage applied to pin 5 is the sense voltage that determines the indication on the display. This voltage is determined by the potentiometers R1 and R2. R2 is the position "sensor" and is mechanically connected to the flap linkage, trim system, etc. When R2 is zero the voltage at pin 5 is zero and no LED's are illuminated. This condition can be mechanically set when the mechanism is at an extreme position such as "flaps-up," for example. When the mechanism moves to its other extreme ("flaps down"), R2 increases to some maximum value. At this point R1 is adjusted to turn on LED no. 10. This sets the range of the display to correspond to the range of the mechanical motion.

R2 can be a simple rotary pot with its shaft directly coupled to the rotating shaft of a mechanism or connected by a lever arm and linkage to some point on a mechanism's linkage. A sliding pot may also work in certain applications. Care must be taken in the design of the mechanical connection of R2 to maintain linearity in order to preserve the accuracy of the indicator at intermediate positions. (The fifth LED should represent half-flaps, for example.) R1 can be any type of trim pot. It may be necessary to use different values than those shown for R1 and R2 to suit your particular application. R2 must provide a significant resistance change over the range of the mechanism's motion while R1, when set, must provide enough resistance to prevent an excessive current when R2 is at its zero position. R3 determines the LED brightness. Increasing R3 will dim the LED's. Take care if you attempt to increase the brightness of the LED's by decreasing R3. Too much current through the LED's will damage the IC and/or the LED's. C1 is to prevent the possibility of flicker in the LED's and can be from 0.05 to 2.2 microfarads.

The bar mode works well for systems such as flaps where a range from zero to some maximum is required. For trim systems a plus-minus type display is needed. The easiest way to accomplish this is by using dot mode. When R1 and R2 are adjusted as previously described an LED near the center of the display will be on when the trim is in neutral. Moving the trim away from neutral will cause the "dot" to move accordingly in either direction. For this application, when the trim moves to the R2 = 0 position LED no. 1 may turn off leaving the display blank. To avoid this, install a small resistor between R2 and ground to prevent the sensed voltage from going all the way to zero when R2 is zero. This problem will not occur at the other extreme due to the design of the LM3914. LED no. 10 stays on during an over-range condition at pin 5.

The components shown in Figure 1 can be found at most electronics supply stores and should cost under $15. Kits for etching pc boards are available for about $10 or you can use a generic type pc board. The 10-segment LED array can be mounted in a face-plate of your design and labeled to make an attractive indicator. I have constructed a single unit that contains a 20-segment bargraph flap indicator and a 10-segment dot mode pitch trim indicator.

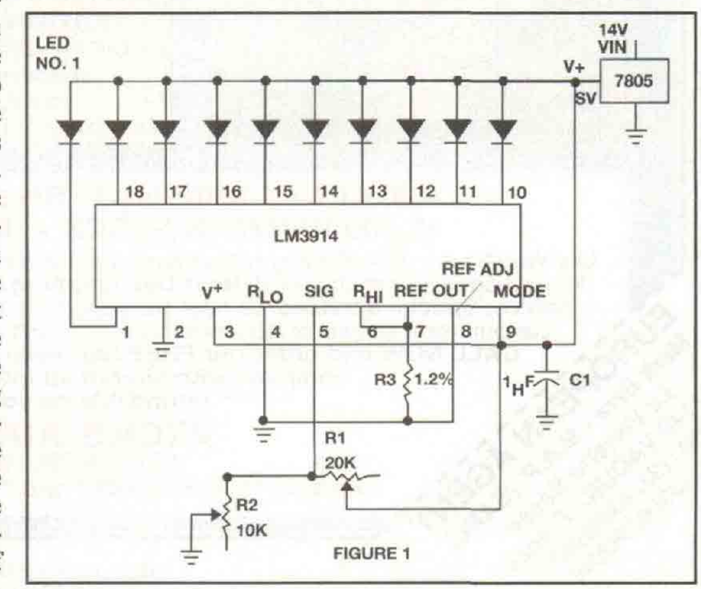

FIGURE 1

PRECISE ANGLE AND ORIENTATION FOR EXHAUST PIPE END CUT

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Detail, detail, detail! Details and craftsmanship are what convert materials of construction into that miracle of handiwork called aircraft. The more attention given to acceptable details, the better will be the end product of our craftsmanship whether for a restoration or new construction.

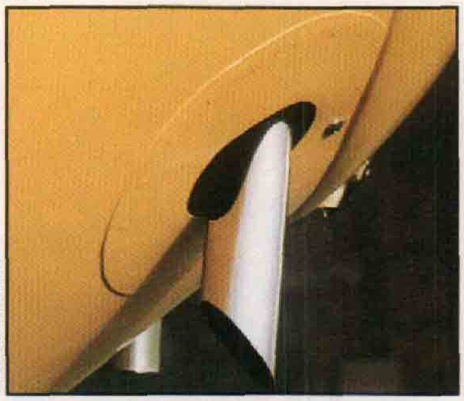
Detail

For detailing your engine installation, it may be necessary to determine and transfer a precise angle and orientation of an end cut on round exhaust pipe(s) in order to duplicate a factory built appearance, as illustrated in the photo, or to achieve an eye pleasing line that blends well with cowl lines. For my restoration project I devised a very simple method, which others may find useful, for pre-establishing the exact angle and orientation for any desired cut-off of circular exhaust pipe. The following method also allows for experimentation to change the angle/orientation of a proposed pipe cut with respect to cowling or thrust lines prior to touching a cutting tool to that expensive exhaust pipe.

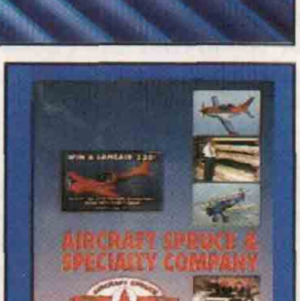
Procedure

1. Obtain a short piece (scrap) of any plastic type pipe or tube having a slightly smaller ID than exhaust pipe OD such that the plastic tube would be a snap fit over the exhaust pipe. Cardboard tube could be utilized that would not be as satisfactory as plastic tube. Length of scrap piece must be sufficient to be held firmly in place for saw cutting in a miter box.
2. Miter cut scrap tube to any desired angle.
3. Cut off mitered end of scrap tube with sufficient length (1-1/2 to 2 inches) to slip over the exhaust pipe end and serve as a marking guide.
4. Saw cut guide lengthwise so it can now be spread apart and snap fitted in place over exhaust pipe.
5. With exhaust pipe(s) and cowlings permanently or temporarily installed on aircraft, snap the guide in place on exhaust pipe and position (rotate/slide) guide to desired orientation.
6. Make and try new guides as desired to test suitability of different cut-off angles.
7. With guide held firmly in place on exhaust pipe, transfer angled cut line from guide to exhaust pipe OD using a suitable marking device. Common practice is to cut off the minimum acceptable amount of exhaust pipe end to allow for later trimming of eroded or damaged edges. Marking devise used will depend on material and surface finish of the exhaust pipe. To prevent movement of the guide during marking, the guide can be taped around circumference so that it grips the exhaust pipe.
8. Remove guide and remove exhaust pipe or leave in place as required. Using a Dremel tool (or equal) with a small cutoff wheel, carefully cut off exhaust pipe end following marked or scribed guide line.
9. Dress down angled pipe cut with a flat file to final edge and clean up burrs on ID and OD surfaces.

By use of the guide as suggested, the angle and orientation detail of exhaust pipe end cut on your aircraft will now be exactly as selected by you, the craftsman.



Steve Castronova



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