LEVEL INDICATOR FOR BOAT GAS TANKS

Stop gas overflow when refueling by monitoring your tank level with a simple comparator circuit

BY JERRY J. HAYES

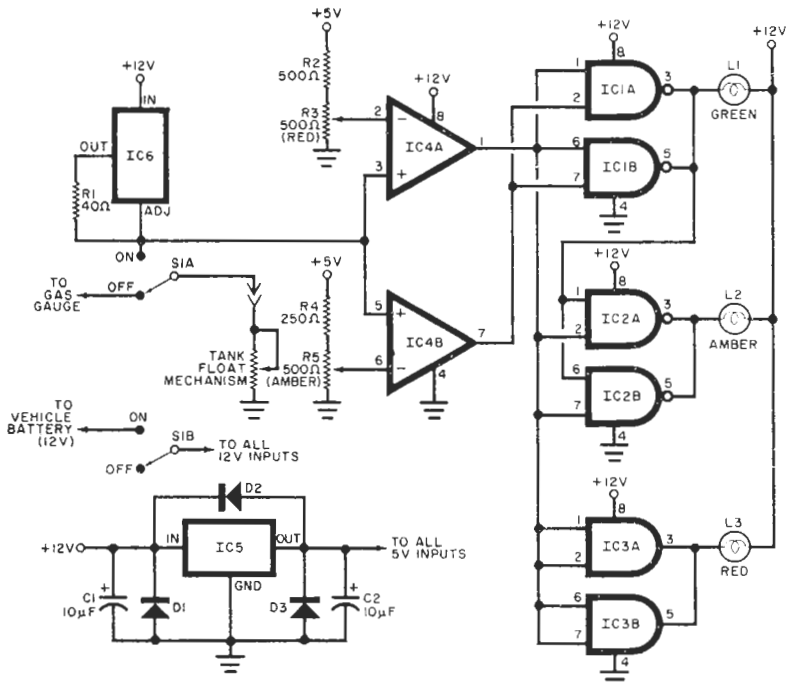
EVEN though most motor boats have fuel gauges, it is difficult for one person servicing the boat to tell how full the tank is before fuel starts spilling out the overflow vent. That's because the fill opening is typically a small-diameter screw plug located some distance from the gas gauge. Since a standard gas pump nozzle cannot be inserted, the pump's automatic shutoff mechanism will not operate. And with overflow vents usually located lower than the fill opening, refueling is often reduced to messy guesswork.

But such problems are quickly overcome by employing a simple comparator circuit that can be switched across the fuel tank's resistive float mechanism. (Normally the resistive float connects to the gas gauge.) As shown in the schematic, this circuit controls three lamps that turn on and off in sequence as the tank fills; the green lamp is on only when there is more than two gallons of air space in the tank; green goes off and an amber bulb lights when 1.5 to 2 gallons of air space remains; then amber is extinguished and a red bulb lights when there is only 1 to 1.5 gallons of air space left.

An accurate estimate of this remaining air space is particularly important when adding fuel to two-cycle outboard engines. That's because two-cycle engines are powered—and lubricated—by a 50-to-1 fuel/oil mixture that must be maintained every time the engine is refueled. Unless some air space is purposely left in the tank after the gasoline is aboard, adding the necessary oil will only cause valuable fuel to be displaced out the overflow vent.

Circuit Description. A dpdt switch controls battery power to this circuit and electrical access to the tank float mechanism. This switch and the three indicator lights should be located close to the tank fill pipe for easy access during fueling.

The *LM317* functions as a current source. It provides a constant 30 mA to the float mechanism. Assuming that float resistance decreases as fuel level rises, the 30-mA level was selected because it produces a voltage across the float (when the tank is full) that is in the operating range of the *LM358* dual op amp. The 500-ohm trimpots (labeled "amber" and "red")



PARTS LIST

C1,C2—10-μF decoupling capacitor
D1 through D3—1N4148 diode
IC1, IC2—DS3632N dual-peripheral power driver
IC3—DS3631N dual-peripheral power driver
IC4—LM358N dual op amp
IC5—LM340T-5.0 5-V voltage regulator
IC6—LM317T 3-terminal adjustable voltage regulator
L1—Lamp holder, green (Littlefuse 930-405X-710GN)
L2—Lamp holder, amber (Littlefuse 930-405X-710AN)
L3—Lamp holder, red (Littlefuse 930-405X-710RN)
R1—40-Ω, 1% resistor
R2—499-Ω, 1% resistor
R3,R5—500-Ω trimpot
R4—249-Ω, 1% resistor
S1—Dpdt switch (Alco MTE-206N)
Misc.—Three miniature bayonet-base lamps 13 V, 0.33 A, 3.0 MSCP; Bud box; hookup wire, mounting hardware, etc.

and their associated series resistance provide the reference points for switching these two lamps on and off. The *3631/3632* drivers provide decode logic and drive capability for the high-current/high-brightness lamps. High brightness is necessary because of frequent use in full sunlight. Parallel drivers are needed to handle the high lamp currents.

Calibration and Modification. The setting of the two 500-ohm potentiometers determine when the amber and red warning lamps come on as the fuel tank fills. Calibrate these settings by carefully siphoning measured amounts of fuel from a full tank then adjusting the potentiometers so that corresponding "trip points" exist. Then the comparators, together with the driver/logic, will always provide an accurate indication of fuel level. Now, whenever the red lamp goes on, sufficient space remains in the tank for adding oil.

Many modifications can be made to this circuit since there aren't any critical components. Almost any op amp can be used for the comparator sections; most any 5-V regulator will work well, the constant-current source could be a series resistor or a FET; and the driver/logic can be any gate capable of handling the current levels involved. This current is strictly a function of the display chosen: LED, incandescent lamp, etc.

For gas tank monitoring applications, the first thing to check is whether your tank-float mechanism either increases or decreases in resistance as the tank is filled. In the case where resistance increases, you must reverse the inputs to the op-amp comparators relative to the connections shown in the schematic. Depending on parts availability and personal inclination, the circuit can be simplified to use only one or two indicator lamps. It would then need only one op amp—a 741 would do nicely. (One caution—gas fumes are explosive. The on/off switch in the parts list is splashproof, but not explosion-proof. Avoid mounting the switch where gas vapor can accumulate.)

Don't think that this circuit is strictly limited to boat fuel-tank monitoring. Actually, any kind of liquid level sensing is possible, provided there is a resistive-type float mechanism available. You could easily adapt the circuit to monitor bilge water below deck, home heating-oil supplies, and—for blind persons—bathtub water level (in this case use the driver/logic to control a Sonalert). ◇