A Live-Well Timer

Controls on/off time to adjust oxygen content in live-well water to keep fishing catch alive

By James H. Brown

Have you ever placed the fish you caught in your boat's live well only to find at the end of the day that your catch is no longer alive? If so, your fish died of oxygen starvation or too much free oxygen in the water because you forgot to switch on or off the pump's motor at the appropriate times. Of course, you could purchase a commercial timer that will relieve you of having to remember when to switch on and off the pump for about $30. However, you can build the timer described here for about $10 and pocket the $20 saved for other things.

Our Live-Well timer is a fairly simple device in terms of circuitry. It has only two controls. One is a switch that lets you select between fully automatic and manual operation of the live-well pump or turning off the system altogether. The other is a control that lets you adjust the timer's duty cycle so that it turns on the pump for about 32 seconds every 1.5 to 6 minutes. Power for the circuit is supplied by your boat's 12-volt dc electrical system.

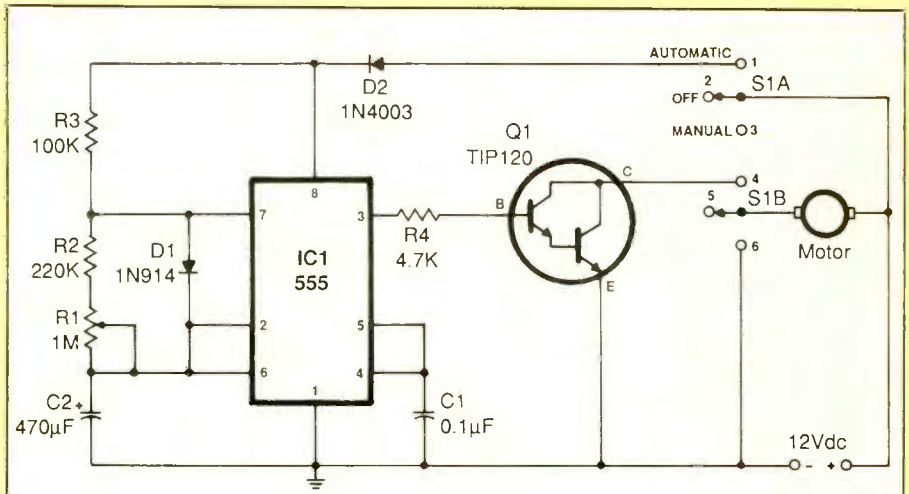
About the Circuit

Shown in Fig. 1 is the complete schematic diagram of the Live-Well Timer. The main elements in this circuit are 555 timer *IC1* and the TIP120 power Darlington transistor. The timer is wired to operate in the astable mode and has a duty cycle of approximately 32 seconds for its on time and an adjustable off time between 1.5 and 6 minutes.

Resistor *R2* and potentiometer *R1* control the off-time period. When the circuit is initially powered, the circuit's on-time is approximately equal to 1.1(R3C2). Thereafter, the duty cycle will be approximately equal to 0.69(R3C2). When the timer is in its on period, *D1* bypasses *R1* and *R2*.

Double-pole, double-throw switch *S1* has a center-off position. Note that this switch is wired into the circuit to provide MANUAL, OFF and AUTOMATIC functions.

The live-well pump motor connects between the toggles of *S1A* and *S1B*, with one side connected directly to the + 12-volt power bus. With this arrangement, with *S1* set to AUTOMATIC, drive power for the motor is through *Q1*, which is turned on and off by the output signal that appears



PARTS LIST

Semiconductors

D1—1N4003 rectifier diode

D2—1N914 or similar small-signal diode

IC1—555 timer

Q1—TIP120 power Darlington transistor (Radio Shack Cat. No. 276-2068 or similar)

Capacitors

C1—0.1-µF ceramic disc

C2—470-µF, 25-volt, radial-lead electrolytic

Resistors (¼-watt, 5% tolerance)

R2—220,000 ohms

R3—100,000 ohms

R4—4,700 ohms

R1—1-megohm linear-taper potentiometer

Miscellaneous

S1—Dpdt switch with center-off (Radio Shack Cat. No. 275-620 or similar)

Printed-circuit board or perforated board with Wire Wrap or soldering hardware; suitable enclosure (Radio Shack Cat. No. 270-230 or similar 3¼" × 2⅛" × 1⅛" project box); control knob; 4-position screw-type terminal strip (see text); lettering kit and spray acrylic; two-conductor zip cord; spade lugs; machine hardware; hookup wire; etc.

Fig. 1. Overall schematic diagram of Live-Well Timer.

www.americanradiohistory.com

at pin 3 of *IC1*. Setting *S1* to MANUAL completes the return side of the motor circuit to the negative side of the dc power source and energizes the motor continuously.

Power for the circuit can be any 12-volt dc source, such as a boat electrical system or battery, that can supply sufficient energy to power both the Live-Well Timer's controlling circuit and pump motor.

Construction

Because its circuitry is so simple, this is a very easy project to build. There is nothing critical about circuit layout. If you would like printed-circuit wiring, use the actual-size etching-and-drilling guide shown in Fig. 2 to fabricate the board. Otherwise, use a piece of perforated board with holes on 0.1-inch centers and suitable Wire Wrap or soldering hardware to build the circuit. Regardless of the wiring technique chosen, it is a good idea to use a socket for the 555 timer chip.

From here on, we will assume you are wiring the circuit on a printed-circuit board. With the board oriented as shown in the Fig. 3 wiring diagram, plug a socket into the IC1 location and solder it into place. Be careful to avoid creating solder bridges between the closely spaced copper pads on the bottom of the board as you solder the socket into place.

Next, install and solder into place the fixed resistors. Follow with the two diodes (make certain they are properly oriented before soldering their leads to the pads on the bottom of the board), followed by the capacitors (observe polarity with electrolytic capacitor *C2*).

Now cut six 5-inch lengths of stranded hookup wire and strip ¼ inch of insulation from both ends of all of them. Tightly twist together the fine conductors at both ends of all wires and sparingly tin with solder. Plug one end of these wires into the holes labeled S1,1, S1,4, S1,6, GND and R1 (there are two wires for the *R2* potentiometer) and solder into place.

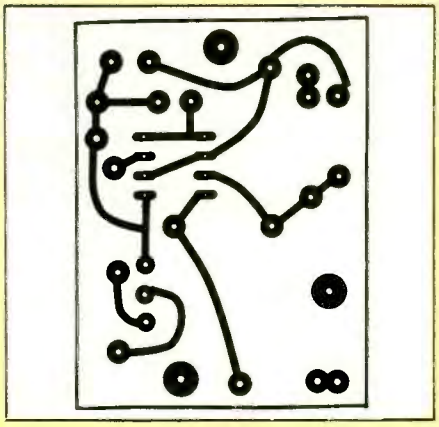


Fig. 2. Actual-size printed-circuit etching-and-drilling guide.

Bend the pins of the TIP120 power Darlington transistor at a right angle to the rear of its case at the points where the pins change from narrow to wide. Plug the pins into the appropriate holes in the board and secure the transistor in place with a 4-40 × ¼-inch machine screw, lockwasher and nut via the holes in its metal tab and the circuit board. Turn over the board and solder the pins in place.

Connect the free ends of the wires coming from the holes labeled S1,1 and GND to +12 and ground or common of a dc supply or battery. Connect the common lead of a dc voltmeter or multimeter set to dc volts to the free end of the wire coming from the hole labeled S1,6 and touch the "hot" probe to the pin-8 receptacle of the IC socket. If your wiring is okay, you should obtain a reading of +12 volts. If not, remove the dc power source and check all your wiring and component installation. Rectify the problem before proceeding.

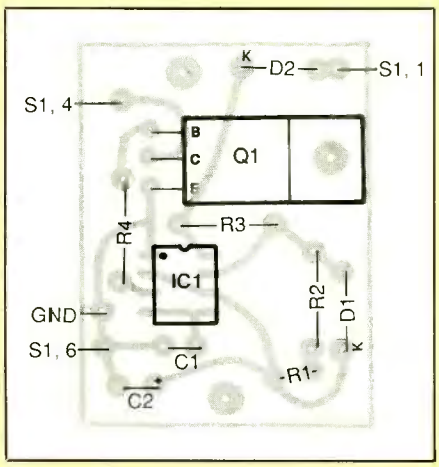


Fig. 3. Wiring guide for pc board. Use this as a rough guide to component layout if you use perforated-board construction.

Once you are certain that your wiring and component installation are correct, plug the 555 into the IC socket. Make sure it is properly oriented and that no pins overhang the socket or fold under between IC and socket as you press home the 555.

You can install the circuit-board assembly in any enclosure that will accommodate it and the switch and potentiometer without crowding. Machine the enclosure as needed, including drilling mounting holes for the circuit-board assembly, potentiometer and switch and cutting a slot and drilling mounting holes for a four-contact screw-type terminal strip for making power and motor connections. Deburr all holes and the terminal-strip slot if the enclosure is metal.

Then label the control and switch positions, and use +12V, GND, MOTOR+ and MOTOR– legends for the terminal strip. If you use a dry-transfer lettering kit, spray over the legends two or more light coats of clear acrylic to protect them from scratching. Allow each coat to dry before spraying on the next.

Mount the switch, potentiometer and terminal strip in their respective locations. Now, referring to both Fig. 1 and Fig. 3, connect and solder the free ends of the wires coming from the circuit-board assembly to the lugs of the switch and potentiometer. When the circuit-board assembly is oriented as in Fig. 3, the wire coming from the R1 hole nearer the center of the board goes to the center (wiper) lug of the potentiometer. Also take note of the numbering scheme shown for *S1A* and *S1B*. Use

(Continued on page 80)

www.americanradiohistory.com

this scheme when wiring the free ends of the wires coming from the S1,1, S1,4 and S1,6 holes in the board.

Strip ¼ inch of insulation from both ends of two 5-inch-long stranded hookup wires. Tightly twist together the fine conductors at all four wire ends and sparingly tin with solder. Crimp and solder one end of each wire to the center lugs of the switch (labeled 2 and 5 in Fig. 1). Crimp but do not solder the free end of the wire coming from lug 2 to the MOTOR+ terminal-strip lug. Crimp and solder the free end of the lug 5 wire to the MOTOR – lug.

Trim to length a hookup wire, strip ¼ inch of insulation from both ends, and crimp and solder one end to the MOTOR+ and the other end to the +12V lugs on the terminal strip. Locate the free end of the wire coming from the hole labeled GND in the circuit-board assembly and solder it to the GND terminal-strip lug.

Finish construction of the Live-Well Timer by preparing the cable for connection of the pump motor and dc power source to the project. Use medium-duty zip cord for the cables, making them as long as needed to do the job. Separate the conductors at both ends of the cables a distance of 2 inches. Strip from all conductors ¼ inch of insulation, tightly twist together the fine wires in each and tin with solder.

Terminate the ends of the cables that go to the project in crimp-on spade lugs. If possible use red-coded lugs for "hot" or positive (+) conductors and black- or green-coded lugs for the ground or negative (–) conductors. If the connections at the motor and boat's electrical system are via screw-type terminal blocks, terminate the other ends of the cables in like manner, but make certain that you observe the same polarity scheme at both ends of each cable. Affix to the cables permanent tags that identify one as POWER and the other as MOTOR.

Checkout & Use

With its switch set to OFF, connect the project to your boat's 12-volt electrical system and live-well pump motor via the POWER and MOTOR cables. Observe polarity! Setting the switch to MANUAL should cause the pump motor to turn on and remain running until the switch is set to OFF.

Place a control knob on the potentiometer's shaft and rotate it fully counterclockwise. Set the switch to AUTOMATIC and observe pump action. Initially, the pump motor should run for about 50 seconds and then settle down to about 32 seconds, repeating again about every 1.5 minutes thereafter. If you should note that the time between turn-on and turn-off is more like 6 minutes, the potentiometer is wired backward. To correct this, disconnect power from the project, desolder the outer-lug wire (do *not* disturb the center wire) on the potentiometer and crimp and solder it to the other outer lug on the pot. Reassemble the project.

Reconnect power to the Live-Well Timer and set its switch once again to AUTOMATIC. Let the project run for a half hour or so, trying various settings of the potentiometer. Make panel marks at various settings to indicate times. You can make these permanent legends if you wish. To do so, remove the control knob from the potentiometer's shaft and use a dry-transfer lettering kit to apply appropriate legends. Wrap the pot's shaft and mounting hardware in masking tape and spray several coats of clear acrylic as needed to protect the legends. Again, wait until each coat dries before spraying on the next. Remove the masking tape and replace the control knob.

Mount the project near the live-well pump in your boat. The easiest way to do this is with Velcro strips, but you can use metal clamps and suitable hardware if you wish to make the installation permanent. **ME**

www.americanradiohistory.com