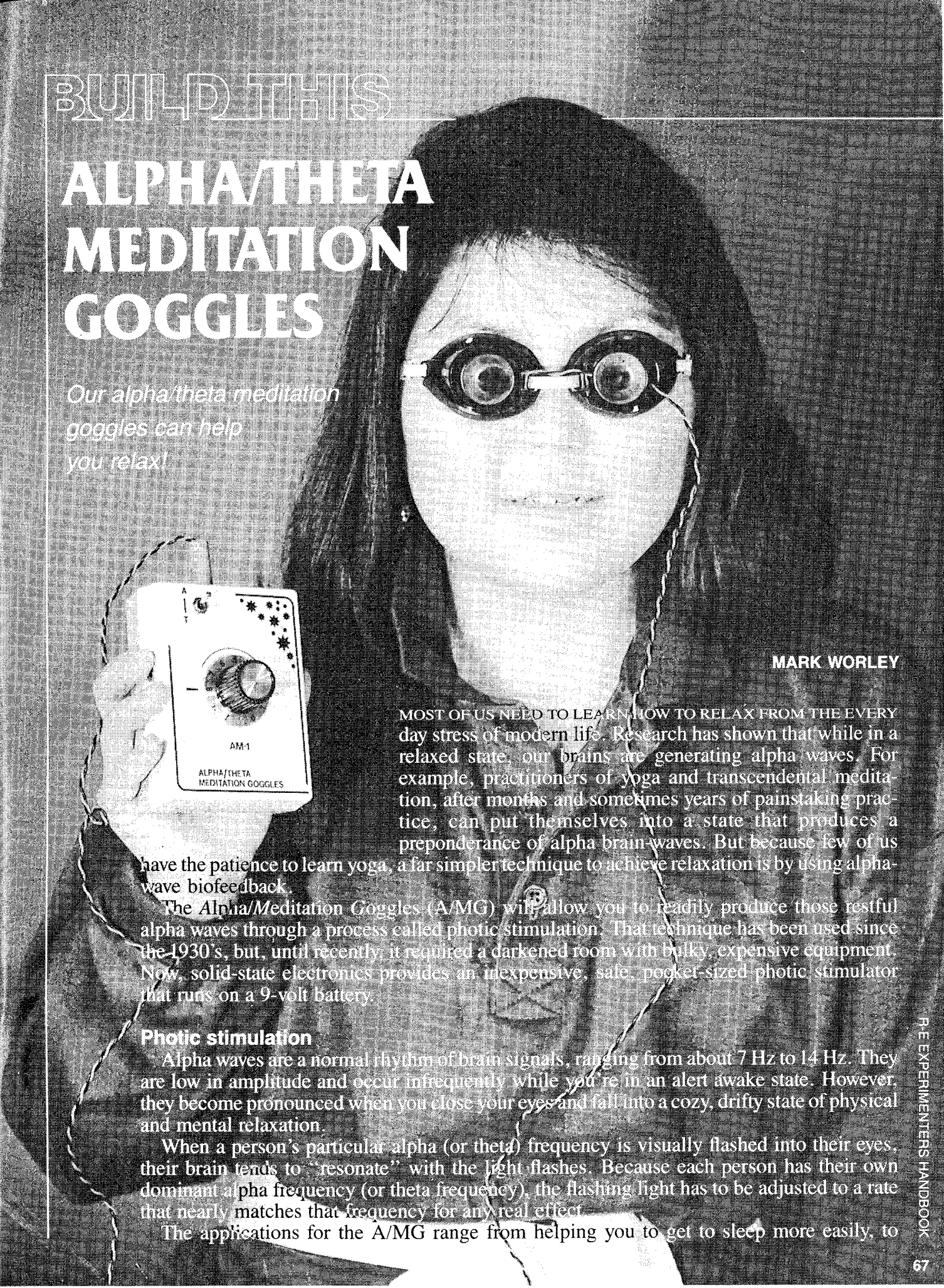
BUILD THIS

ALPHA/THETA MEDITATION GOGGLES

Our alpha/theta meditation goggles can help you relax!



MARK WORLEY

MOST OF US NEED TO LEARN HOW TO RELAX FROM THE EVERY day stress of modern life. Research has shown that while in a relaxed state, our brains are generating alpha waves. For example, practitioners of yoga and transcendental meditation, after months and sometimes years of painstaking practice, can put themselves into a state that produces a preponderance of alpha brain-waves. But because few of us have the patience to learn yoga, a far simpler technique to achieve relaxation is by using alpha-wave biofeedback.

The *A*lpha/*M*editation *G*oggles (A/MG) will allow you to readily produce those restful alpha waves through a process called photic stimulation. That technique has been used since the 1930's, but, until recently, it required a darkened room with bulky, expensive equipment. Now, solid-state electronics provides an inexpensive, safe, pocket-sized photic stimulator that runs on a 9-volt battery.

Photic stimulation

Alpha waves are a normal rhythm of brain signals, ranging from about 7 Hz to 14 Hz. They are low in amplitude and occur infrequently while you're in an alert awake state. However, they become pronounced when you close your eyes and fall into a cozy, drifty state of physical and mental relaxation.

When a person's particular alpha (or theta) frequency is visually flashed into their eyes, their brain tends to "resonate" with the light flashes. Because each person has their own dominant alpha frequency (or theta frequency), the flashing light has to be adjusted to a rate that nearly matches that frequency for any real effect.

The applications for the A/MG range from helping you to get to sleep more easily, to

meditate, or for self-hypnosis training. You'll find that the alpha waves occur while you're in a state of relaxed awareness, which is often called an *alpha state*.

Circuit description

As Fig. 1 shows, a 555 astable oscillator (IC1), and transistor driver (Q2) are used to flash the series-connected LED's over an adjustable range of about 6.5 pps to 14.5 pps (pulses per second), or, optionally, 3.5 pps to 7 pps.

IC1 is configured as a conventional astable oscillator having an output pulse that goes low for 10 ms at the rate set by potentiometer R1. Resistors R4, R5, and R6 allow the oscillator to be fine tuned to correct for ±20% tolerance error in C2 and R1. You can use a frequency counter on pin 3 of IC1 to set R1's range, so that it has about the same overlap at each end of the 7- to 14-Hz band.

Note: Resistors R4–R6 can be omitted from the project, because it may not be necessary to trim the flash rate of your instrument so precisely. If you like, R5 can be a panel-mounted potentiometer for fine-adjusting R1.

Transistor Q1 is normaly kept off by R8; Q1, in turn, keeps Q2 off. A low-going pulse from IC1 turns on Q1 for 10 ms, and pulses Q2 to momentarily flash the LED's. Resistor R10 will develop 650 mV across it at 54 mA. That 650 mV will turn on Q3 and limit Q2's current to 54 mA. Having that limiter, a constant current passes through the LED's with each pulse, independent of the supply voltage.

Most LED's are rated for about 20 mA of continuous current, but at a 15% duty-cycle, they can handle over 50 mA without harm. The LED brightness is significantly increased, yet the battery drain is still kept quite low. If you find that the LED's are uncomfortably bright, increase R10 to between 15 and 27 ohms.

The specified LED's are high-efficiency versions that emit a surprisingly intense beam of 30-mcd (millicandles are a measure of light intensity) at 20 mA. Standard LED's frequently have an intensity of 1 to 5 mcd, and a scattered, diffused beam. For the best effect, use the specified LED's because they have lightly tinted lenses, higher output, and a narrow beam.

Commonly, red LED's have a forward voltage drop (V_F) of about 1.7 volts at 20 mA, whereas the brighter ones typically have a V_F of over 2 volts.

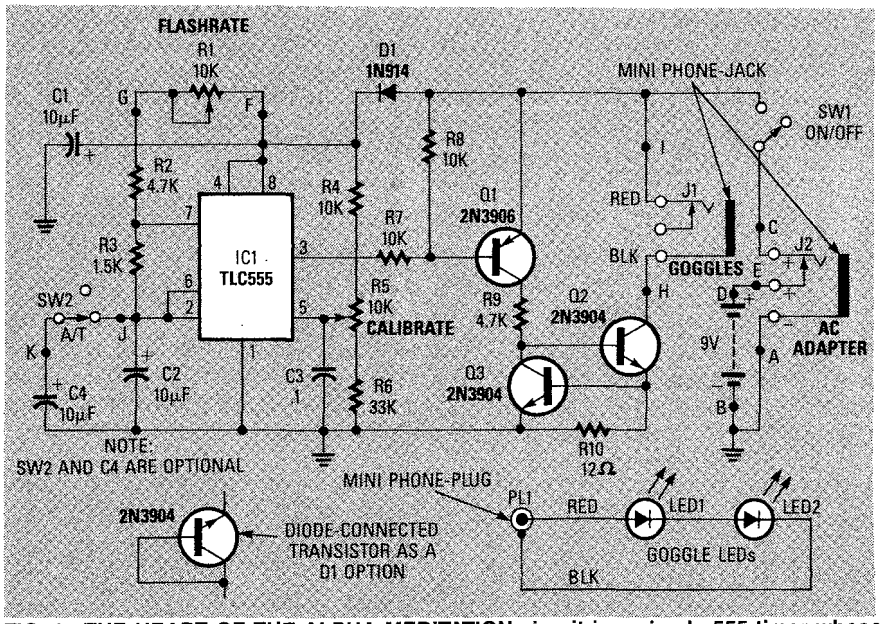


FIG. 1—THE HEART OF THE ALPHA MEDITATION circuit is a simple 555 timer whose pulse frequency is controlled by potentiometer R1. The pulse rate sets the visual flashing rate of the LED's in the goggles.

Therefore, up to four standard LED's can be used in the circuit. However, the V_F of the brighter LED's prevents using four of them with a 9-volt supply.

Diode D1 and capacitor C1 provide better power-supply filtering and isolation for IC1 than a conventional R/C filter. However, a 100-ohm resistor can be substituted for D1 if you desire. For a very-low voltage loss across D1, you could try using a Schottky diode or a diode-connected transistor, such as a 2N2222 or 2N3904 (see Fig 1.). That isn't really necessary, but it may keep some purists happier. Without the filter, the high-current pulses through the LED's can adversely affect the 555's operation, particularly with a weakening battery.

A mini phone-jack, J1, provides a convenient way to disconnect the goggles from the control box for storage. Another jack, J2, allows you to power the A/MG from an AC adapter having a 6- to 12-volt DC output. Make sure that the adapter has the proper polarity (a DC output, not AC), and a rating of 50 mA or more. Remember that a 12-volt adapter will not make the LED's any brighter than a 9-volt battery because of the current limiting.

PC-board assembly

The control circuitry does not need special care in assembly or layout, so perfboard should work just as well as the author's PC-board; the Parts Placement is shown in Fig. 2. For ease of discussion, we'll assume you're using the PC board. Note that the PC board supplied by the author is silk screened with all parts labeled, and solder-pads A through K are identified. All the holes have been drilled to their proper size. The inside of the control box is shown in Fig. 3, while the control box exterior assembly is shown in Fig. 4.

1. To keep the board oriented properly, lay the board on your work surface with the copper side down and S1's mounting holes to your right. Identify the locations of all the component mounting holes, and the mounting pads. Keep IC1 in its antistatic foam until you're ready to install it.

2. Insert the switch into its mounting holes and solder the three leads. The mounting tabs can be soldered to the board, too, but you will have to scrape the black finish from those tabs in order to do that.

3. Install C1, C2, and D1. Those parts are polarized and must be installed as indicated. (C4 should also be installed if it is going to be used.)

4. Install all resistors except R1, and also install C3. There are two ground pads for C3 to accommodate a variety of capacitor styles and sizes. One of C3's leads *must* mount in the hole next to C2's "+" sign.

5. Use a piece of capacitor or resistor lead to jumper the two pads on the 555 (pins 4 and 8). Install the jumper flat

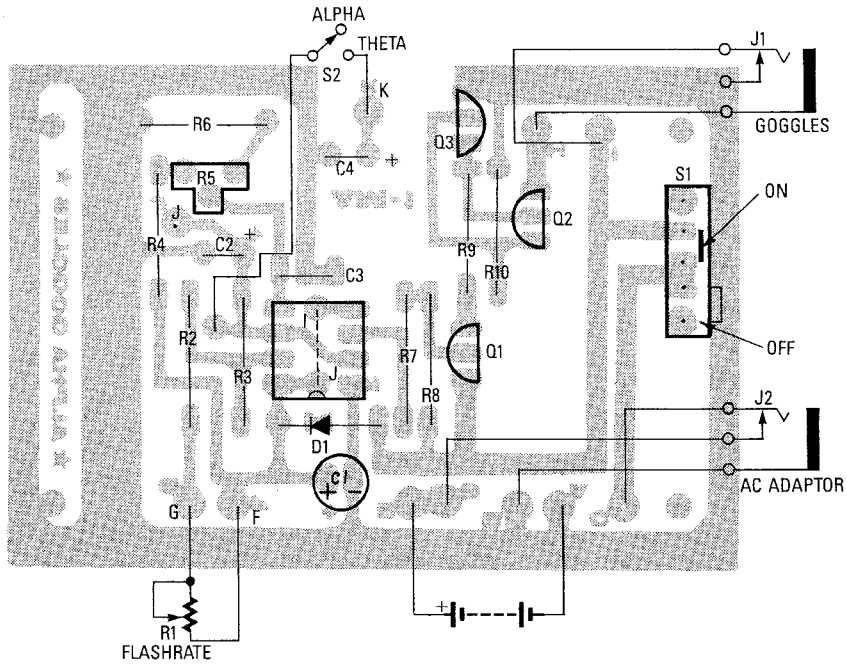


FIG. 2—THE PARTS PLACEMENT for the A/MG PC-board shows switch S1 soldered directly on the board. Notice transistor orientation, and the polarity of capacitors and diode D1.

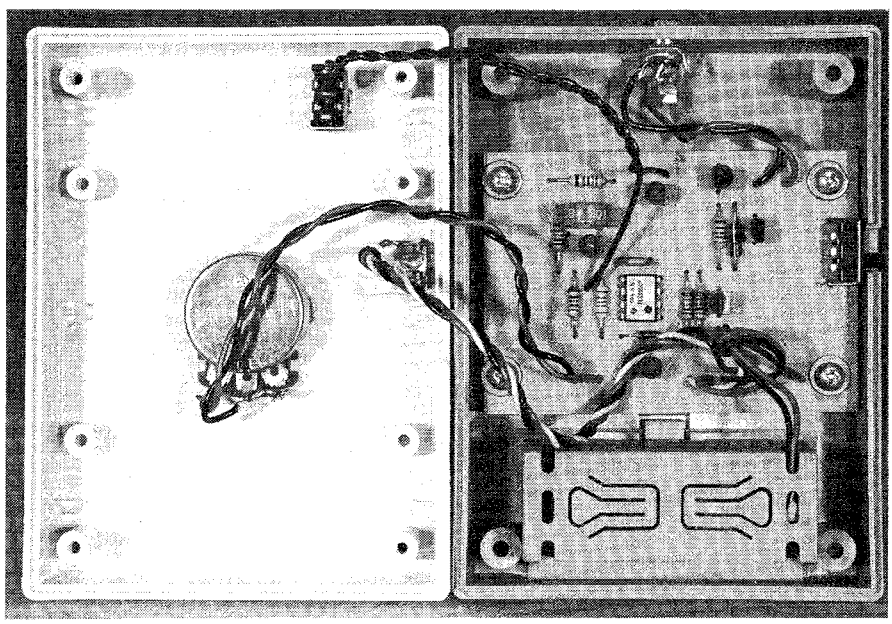


FIG. 3—THE INSIDE VIEW OF THE A/MG control box. Notice the clean layout. A 9-volt-battery compartment is just below PC board.

on the component side of the board. The 555 will be installed on top of that wire.

6. Identify the three transistors, Q1–Q3. Install them with their flat side facing the proper direction, according to the Parts-Placement diagram in Fig. 2.

7. Install IC1 with pin 1 in the lower-right corner near D1. (Pin 1 is also identified on the copper foil.) Be sure the jumper wire has been installed under IC1 before you install IC1 or a socket. We'll continue with the remaining wires later.

8. Temporarily mount the board loosely in the bottom half of the box on top of the mounting bosses, and mark the hole for the on/off switch. Be sure to slide the switch between its two positions when marking the cutout. The plastic is easy to cut, so a small, flat file is all that's required. The switch has a low profile, so the top half of the case does not have to be notched.

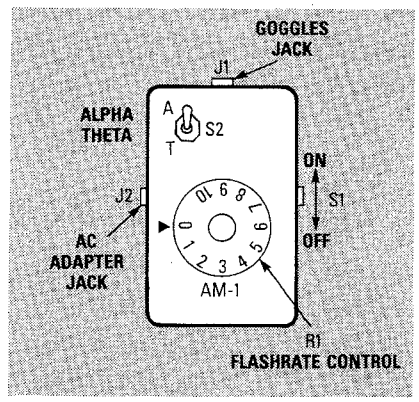


FIG. 4—EXTERIOR DIAGRAM OF THE A/MG control box showing the position of the flashrate control knob, and various jacks and switches.

9. In the bottom half of the case, mount a mini phone-jack (J1) for the goggles. Also, mount a jack for the AC adapter (J2) on the top half of the case. Make sure the jack clears any internal obstructions.

10. Insert the battery-clip leads from inside the battery holder through the slot on the right side. Tie a large knot in the leads to keep them from pulling back through the slot, while leaving 1¼ inch of lead length to solder to the PC board.

11. Solder the black battery-lead to solder pad "A" and the red lead in pad "D." (If you aren't installing an AC-adapter jack at this time, solder the red battery lead to pad "C," and the black lead to pad "A.")

12. Solder a red wire to pad "C" and a black wire to pad "B," then route them to the AC-adapter jack and solder them in place. Make sure that the polarity of the adapter matches the red (+) and black (−) wires. Also, connect a white wire between pad "E" and the switched terminal on the same jack. (That way, the battery will be disconnected when the AC adapter is plugged in.)

13. Solder a black wire between pad "H" and the outer ring terminal of the jack for the goggles, then solder a red wire between pad "I" and the "tip" terminal of the same jack.

14. Drill a hole in the center of the box's cover for the flash-rate potentiometer, R1.

15. If the theta-range option is used, connect a pair of lightly twisted 3-inch wires from pads "J" and "K" and S2, which should be mounted on the instrument's cover. Either wire can go to either pad. When S2 is closed, the A/MG will be operating in

PARTS LIST

All resistors are ¼-watt, 5%.

R1—10,000 potentiometer
R2, R9—4700 ohms
R3—1500 ohms
R4, R7, R8—10,000 ohms
R5—10,000 trimmer potentiometer
R6—33,000 ohms
R10—12 ohms

Capacitors

C1—10μF, 15 volts, electrolytic
C2, C4—10μF, 20 volts, 10%, tantalum
C3—0.1μF ceramic disk

Semiconductors

IC1—Texas Instruments, TLC555CP oscillator
Q1—2N3906 transistor
Q2, Q3—2N3904, 2N2222, or equivalent transistor
D1—1N4148, 1N914, or equivalent diode
LED1, LED2—Dialight #521-9247, red LED

Other components

S1—slide switch, Mouser #10SP018
J1, J2—mini phone-jack, 2 conductor, closed circuit
PL1, PL2—mini phone-plugs, 2 conductor

Miscellaneous: 9-volt battery clip, Amerex box No. 171, ⅜-inch No. 4 screws, No. 4 washers, knob, PC board, pair of goggles, 1-inch diameter black-vinyl caps for goggles, 4 foot of 22-gauge wire (red and black).

Note: The following is available from Mark C. Worley, P.O. Box 261113, San Diego, CA 92126. Kit #AMG2 complete with all parts for alpha and theta frequencies, including goggles, plain white case, wires, PC board, and article reprint: $50 plus $3 shipping and handling *per order*, $53 total. California residents add $3.63 tax per kit ($56.63 total). A silk-screened PC board is available for $7.00 plus $0.75 shipping. CA residents add $0.51 tax per board. Must be payable to Mark C. Worley on a U.S. bank in U.S. funds. Canadians may use Canadian Postal Money Orders. All items are shipped via ground, First Class mail. No guarantee of delivery outside U.S.A. and Canada. All orders will be shipped within 2-6 weeks, usually sooner. Please include a stamped envelope when making inquiries.

the theta mode, otherwise the A/MG will be in the alpha mode. (The unmarked pad between R2 and R3 can be used in place of pad "J" if you find it more convenient.)

16. Mount the PC board with four No. 4 screws and four No. 4 washers, so that S1 is fixed solidly against the inside edge of the box.

Goggle assembly

As shown in Fig. 5, the goggles are built from modified swimming goggles, which can be bought from a variety of department and sporting-goods stores for $5 or less. Choose darkly colored goggles if you have a choice.

1. Carefully identify the center of the lenses; that's where the LED's will be mounted. That way you'll get the maximum exposure from the LED's.

2. Some goggles are made from a plastic that can shatter quite easily when drilled, so use sharp drill bits and operate your drill at the lowest practical speed possible.

3. Drill the LED mounting holes 0.2-inch in diameter, or better yet, measure your LED's with calipers and drill the holes slightly undersized. With care, you'll get a good press fit. If the hole is too large, a little epoxy or *Super glue* will fix that. Don't worry about a little glue mess because it will be covered later.

4. Drill a series of 5 holes (1/16-inch in diameter) across the top of the goggles (not the lenses) to allow them to "breathe." Remember, they are watertight, so we'll need to let any perspiration escape.

5. Use minimum heat and a heatsink when soldering wires to the LED's because they are easily destroyed by excessive heat. Solder the following wires about ¼-inch up from the base of the LED, then clip the LED leads just above the solder point. Tightly twist a pair of red and black 22-gauge wires to form a flexible cable about 3-feet long to connect the goggles and the control box. Solder a 3-inch wire between the cathode of LED1 to the anode of LED2; solder the red wire of the 3-foot twisted pair to the anode of LED1, then solder the black wire of the twisted pair to the cathode of LED2.

6. Finally, attach a mini phone plug to the end of the cable that matches J1, on the control box.

7. After verifying that the LED's flash properly when plugged into the control box, use epoxy, hot glue, or RTV to glue two plastic bottle caps over the exposed lead ends of the two LED's, and then anchor the twisted-pair cable to the side of the goggles to prevent straining the LED solder connections. The caps can be medicine-vial caps, bottle caps, or anything similar that's about 1 inch in diameter.

8. Complete any final assembly work, attach the two halves of the instrument case, and apply power.

Using the goggles

Seat yourself comfortably where you'll have minimal distractions. Put the goggles on and adjust the straps for a comfortable fit. Place the control box where you can easily adjust the flashrate with minimal arm movement. Now close your eyes and turn the A/MG on. Play with the flashrate control for awhile to get a feel for the instrument. At the two extreme ends of the control's rotation, you should

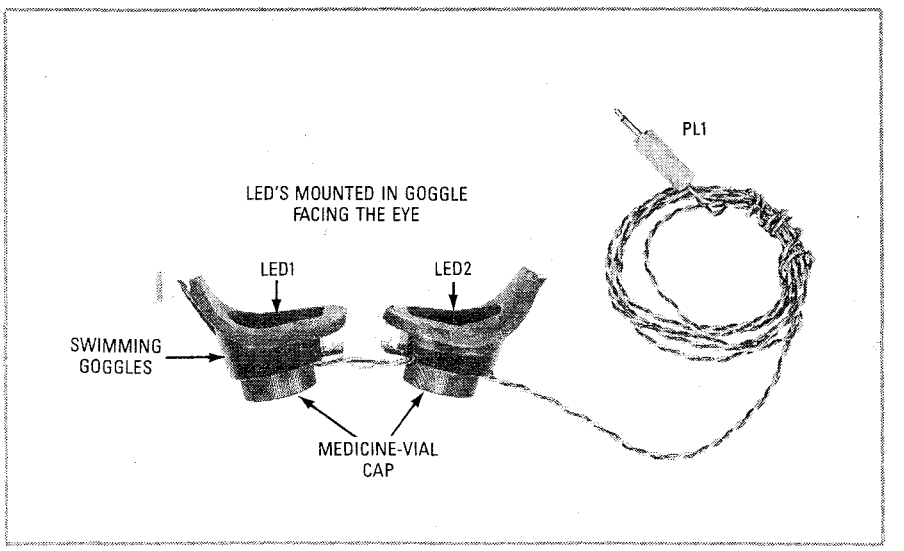


FIG. 5—THE ALPHA-MEDITATION GOGGLES are really common swimming goggles having LED's mounted inside each eye goggle. The LED's are electrically connected in series, and synchronously flash on and off.

feel that the flashrate somehow feels too fast and too slow. Somewhere in between those two extremes is a flashrate that's just right for you.

You should find that even with your eyes closed, there's still a noticeable flashing from the goggles. The LED's aren't bright enough to hurt your eyes, but the best effects are accomplished with your eyes closed. Continue to adjust the control slowly back and forth as you search for your own, personal alpha frequency.

At the correct frequency, you may find that your eyelids tend to flutter slightly in time with the flashes, or the intensity of the LED's may seem to be greater. Also, somehow, the flashrate will feel more comfortable and in tune with you. Don't force the process or worry too much about whether or not the A/MG is working at your frequency. Pick a rate that seems comfortable and try to relax under its effects.

After about 10 minutes, turn the A/MG off. You will almost assuredly find that you are feeling quite relaxed, almost languid, and that the feeling will begin to dissipate with the instrument turned off. That means that you've found the right flashrate for yourself. Make a note of the dial position for future reference. Each person that uses the A/MG will likely have a different setting.

Theta waves

For those wanting to experiment with the theta band, add a switch on the front panel, S2, that will connect a 10μF capacitor (C4) in parallel with C2, for the lower frequency range. (Refer to step No. 15 in the PC-board assembly instructions.) There's a space on the PC board for C4 just below the legend "AM-1." Watch the polarity of the new capacitor. Because the timing capacitance is doubled with C4 added, the pulse width of each flash has also doubled, but the duty cycle is the same because the pulse period has also doubled.

Here is a list of the more commonly documented brain frequencies, and when they usually occur. That is not to imply that these frequencies occur only during these states, or that all authorities on brain functions agree to the exact frequencies specified for each band.

- **Beta:** 14–30 Hz, predominant frequencies while awake.
- **Alpha:** 7–14 Hz, predominant when sitting or lying down quietly with eyes closed and the mind is at ease.
- **Theta:** 3.5–7 Hz, present during problem solving, also present during sleep or deep trance.
- **Delta:** 0.5–3.5 Hz, present during sleep and, sometimes, illness.

Questions & answers

When do alpha brain waves appear? Alpha waves change under differing conditions and may disappear completely. They are most prominent when the subject is sitting or lying down quietly with the eyes closed and the mind at ease. Considerable mental effort tends to depress alpha waves, such as concentration or emotional excitement can cause their complete disappearance.

What are Alpha goggles? The meditation goggles are photic stimulators that synchronize the brain's natural alpha frequency to that of the goggles. When a close match of the flashing rate and the subject's alpha rate is accomplished, the brain naturally begins to "get in step" with the goggles and increases the amplitude of the alpha waves. Simply put, the flash rate forces the brain to generate alpha waves, resulting in relaxation.

How do you adjust for the proper flash rate? That is a difficult and subjective thing to describe. For the most part, you will notice that as you adjust the rate, it will seem too slow at one point and too fast at another. Somewhere in between those points is a frequency that feels right, somehow. Also, at that rate, you may notice that the flashing lights seem brighter and that your eyelids or other related muscles begin to twitch slightly with the rhythm of the lights. The rate does not have to be set precisely.

How do you know that it's working? Again, that is quite subjective, but easily proved. Lie back, set the rate for what seems right, and relax for a few minutes under the influence of the goggles. Now, leave the goggles on, but turn the switch off, using a minimum of body movement to do so. There will be a noticeable "coming down" feeling as you lose the high state of alpha that was induced by the goggles. You'll also feel quite lethargic and at ease, something you might not have noticed while the goggles were flashing. You're still producing a good level of alpha waves and are still in a meditative state with the goggles turned off, so why not continue your meditation at that time?

What dangers are there? With one exception, epilepsy, none that we know of. Photic stimulation is not a new idea. What is new is the application of solid-state circuitry and sensory-reducing goggles. The lights are low-powered solid-state devices called LED's, virtually the same as used in many digital clocks and appliances. There are no dangerous, eye-damaging light levels used.

If you are a known epileptic, do not use this instrument. Lights flashing at the alpha rate can cause a seizure: see medical alert side box. If you have undiagnosed epilepsy, you may perceive an odd smell, or other unusual effect immediately prior to a seizure. If that happens, remove the goggles immediately!

What about hypnosis? The goggles are also a useful aid in hypnosis when the subject is overly analytical, or critical of the hypnotic techniques used. Likewise, self-hypnosis is more easily achieved through the relaxation the goggles provide.

Will I lose control of myself? An emphatic NO. Except as noted about epilepsy, the goggles cannot control your mind; they are only a tool. You are always in control. The state that the goggles help induce is usually of heightened awareness, so you're more aware of your surroundings, but, because you're relaxed, they aren't as distracting.

Of course, there is the chance that you'll become so relaxed you'll fall asleep and miss your favorite TV program, or maybe you'll be late for supper—but those usually aren't classified as harmful side effects. **R-E**

MEDICAL ALERT

If you are an epileptic, do not not use the A/MG goggles. Persons suffering from epilepsy can experience a seizure when exposed to alpha-rhythm photic stimulation. For example, one commonplace photic stimulation is the "picket fence effect," which gives the sunlight a strobing effect when viewed through trees from a moving vehicle—such photic stimulation is also caused by the A/MG goggles. If you are not known to be an epileptic, but begin to perceive an odd odor, sound, or other unexpected phenomenon while using the A/MG goggles, shut it off immediately and seek professional advice from your physician.