Learn to relax with this Stress Monitor

Been feeling a little tense lately? Want to really unwind? Maybe you need to try some meditation — with the help of our Stress Monitor.

by COLIN DAWSON

Actually, the Stress Monitor is a new twist on the lie detector theme. It has long been known that a person's skin resistance can be made to vary quite markedly in response to awkward questions. Theoretically, a dishonest answer will increase the person's level of stress, inducing him to sweat and thereby reduce his skin resistance.

Even when used in conjunction with other bio-measurements (the "polygraph"), lie detector tests are far from universally accepted. Although the skin resistance measurements do appear to bear some relationship to the level of stress, there is much controversy when it comes to interpreting the results. This project is designed to measure stress as a means of "bio-feedback", without any unpleasant implications regarding honesty.

Ultimately, stress measurement in its own right may prove more useful than "lie detection". Apparently, numerous medical complaints are stress related and eliminating the cause of the complaints must surely be preferable to prescribed cures. Although the ability to relax properly is a skill which must be learned, the Stress Monitor may be of assistance to those who are making their first attempts.

Some published information claims that changes in skin resistance for any given environment are a direct indication of the subject controlling his state of relaxation. We can verify that a certain amount of conscious control over skin resistance is possible. While we can not state with certainty that this in itself is relaxation, it does in all probability put the subject in a state conducive to worthwhile relaxation.

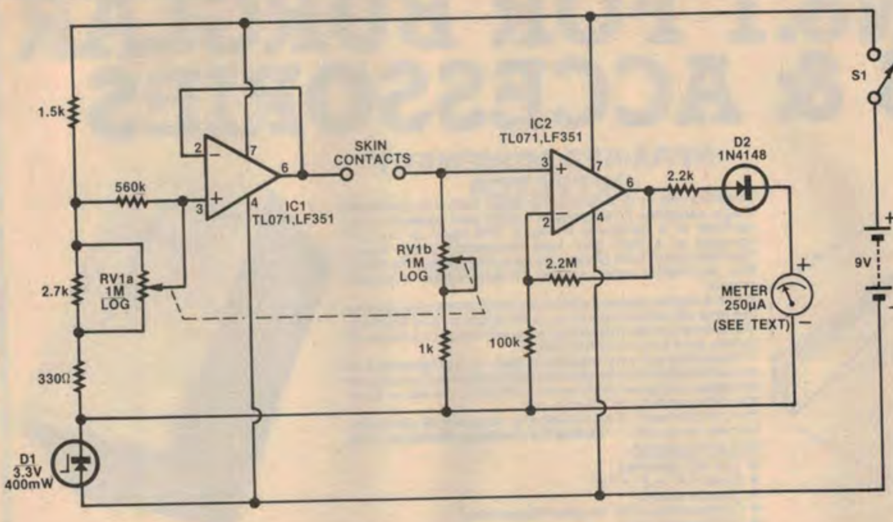
This type of self therapy can be useful in lowering the blood pressure of hypertensive patients. Some people claim that it also contributes to a general sense of well being, although this would probably require frequent and lengthy sessions.

Unfortunately, relaxation is not something which can be achieved by a determined effort. In fact, anyone who approaches stress relief with the intention of forcing himself to relax will usually achieve the opposite effect. Some form of bio-feedback is needed to assist the subject in achieving his objective, and we hope that the Stress Monitor can be useful here.

As there is not sufficient data available, we can not boldly proclaim that stress monitoring is an accepted branch of medicine – at least not by measuring skin resistance. The final assessment of a project such as this rests with each individual constructor.

An obvious question to pose at this stage is "Why can't I just use a multimeter set to its resistance range?" The anwser is that you could – under certain conditions and with limited success. Because skin resistance can be very high (over 10MΩ with poor contacts and low ambient temperature), most analog multimeters would not have sufficient resolution at high resistances. Whilst digital meters would have the resolutuion, the digital display is not suitable for this project.

The circuit described here has



STRESS MONITOR 3/EG/-

PARTS LIST

1 PCB, 70 x 28mm, code 84eg3
1 Meter, 0-250μA (see text)
1 Project box to suit (see text)
1 Scotchcal front panel label, 87 x 62mm
1 single pole, single throw (SPST) switch
1 knob to suit potentiometer
2 4mm panel sockets
2 4mm plugs
2 skin contacts (see text)
1 strip of "Velcro" fastening material
1 9V battery (Eveready 216)
1 battery clip to suit

SEMICONDUCTORS
2 FET-input op amps, LF351 or TL071
1 3.3V zener diode
1 1N4148 diode

RESISTORS (5%, ¼W)
1 x 2.2MΩ, 1 x 560kΩ, 1 x 100kΩ, 1 x 2.7kΩ, 1 x 2.2kΩ (see text), 1 x 1.5kΩ, 1 x 1kΩ, 1 x 330Ω, 1 x 1MΩ dual ganged potentiometer

useful resolution at high resistances and also has the desired analog display. It has two FET-input op amps which enable it to measure skin resistances of over 20MΩ. The sensitivity is adjustable over a wide range to compensate for different test conditions and skin contacts. Adjusting the sensitivity simultaneously adjusts the potential applied to the contacts, although this never exceeds 2V. Because of this "double" adjustment, the response of the circuit is nearly logarithmic – this contributes to the wide range of skin resistances that can be monitored (over 4000:1).

Op amp circuit

The circuit is quite simple, its main elements being the two FET-input op amps, a dual ganged potentiometer and a 250μA meter. Consider first the operation of IC2 which is quite conventional for this type of circuit. It is a non-inverting amplifier which senses the current through the skin contacts and drives the meter. IC2 (an LF351 or TL071) has a gain of 20 which enables it to produce a full scale deflection of the meter for skin resistances up to 20MΩ.

A rather less conventional aspect of the Stress Monitor is its use of a dual ganged potentiometer (RV1a and 1b). This enables simultaneous adjustment of the voltage applied to the contacts and the amount of resistance in series with them. By this means, the sensitivity control is given a greater range of control than could be achieved with a simple linear control. In fact, the Stress Monitor can cope with skin resistances between 5kΩ and 20MΩ.

A 3.3V zener diode provides a reference for both op amps. This voltage is fed into the inverting input of IC2 through a 100kΩ resistor. The non-inverting input of IC2 is connected to a divider consisting of the skin contacts, a 1kΩ resistor and RV1b. This divider is connected across the output of IC1 and the 3.3V reference, with the connection to IC2 being made at the junction of RV1b and the skin contacts.

We estimate that the current cost of components for the project is approximately

$29

This includes sales tax, but not the cost of a battery.

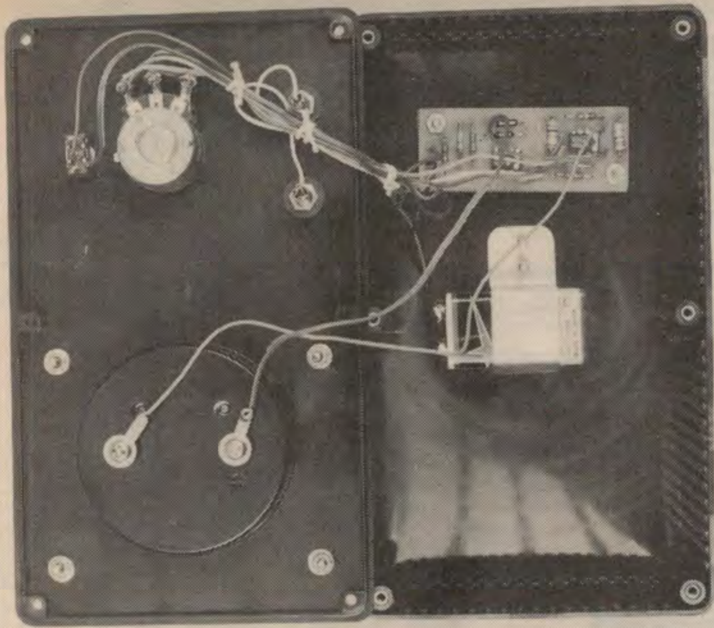
A second, and more complicated divider is used to control the voltage which appears at the output of IC1. RV1a forms part of this divider and swings the voltage at its wiper between 0.3 and 2.5V above the reference. In fact, this is the voltage which must be applied to the skin contacts but it must be buffered (by IC1) first.

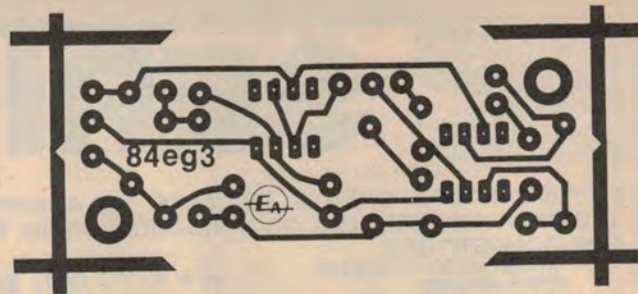
If we were to connect the wiper of RV1a directly to the skin contacts a loading problem would arise when the resistance of the skin is less than the 1MΩ of RV1a. This would alter the test voltage and lead to false indication of relaxation. Of course, the problem could be avoided by using a lower value of resistance for RV1 but that would prohibit the use of a readily available dual gang potentiometer as RV1b must be 1MΩ.

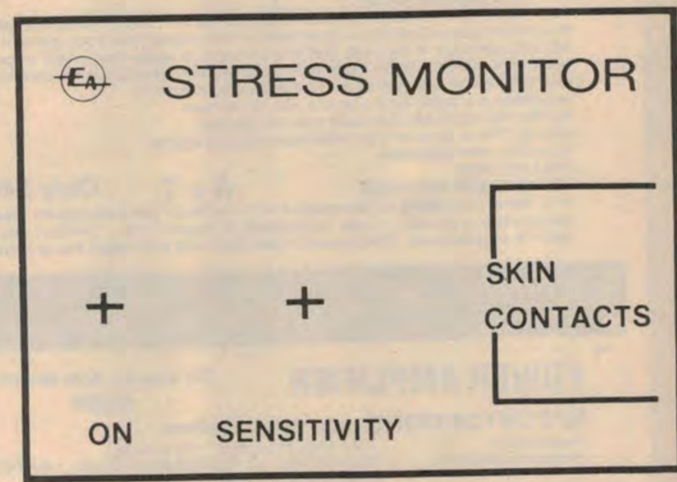
Notice that the output of IC2 is not connected directly to the meter. Rather, it is connected through a series resistor and diode. The diode cancels the effect of any offset voltage which may appear at the output of IC2, thereby ensuring that the meter will read zero when the contacts are open circuit. Because we have used a 250μA meter, a 2.2kΩ current limiting resistor was necessary. This permits the meter to be adjusted to full scale with a skin resistance of 20MΩ, thereby affording maximum protection to the movement. Other meters may dictate that the value of the limiting resistor be changed.

Construction

Assembly of the printed circuit board components is very straightforward and should present no problems. The







Stress Monitor

polarised components are the two ICs and the two diodes – the rest are only resistors and can be mounted either way 'round.

A battery holder of some sort should be provided. We made one from a piece of scrap aluminium measuring about 65 x 20mm.

By far the most difficult aspect of construction is mounting the meter. This is particularly so for meters which are not symmetrical (the coil housing is offset with respect to the mounting screws). Regrettably, there are a number which fall into this category. Our only advice is take care and double check your marking-out.

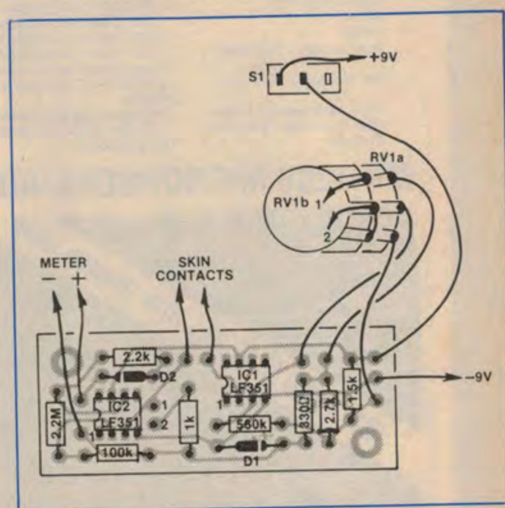
Our skin contacts consisted of two rivets pressed through two strips of Velcro. The Velcro strips are arranged so that they form a bracelet which can be fastened around the wrist or a finger. The strips overlap for about 15mm and this is where the rivets are pushed through. The heads of the rivets will be pressed against the skin when the bracelet is fastened.

We have used a large (100mm) meter and a plastic project box measuring 190 x 110 x 60mm for the project. Both of these items are quite arbitrary and could be replaced with a less expensive alternative. In fact, the meter could be omitted entirely and replaced with a multimeter set to a low current range (about 250μA). It may even be possible to build the whole project into an old multimeter, substituting the dual ganged potentiometer for the rotary control.

Aluminium rivets are best avoided for this project – they will prove rather difficult to solder to the connecting leads. Also, the inevitable thin oxide coating will reduce their effectiveness as "contacts". Plated rivets – either brass or steel – would be more suitable.

Follow the wiring diagram closely. The battery, both potentiometer gangs and the meter must be connected correctly. To test the Stress Monitor, first switch it on without touching the skin contacts. The meter should read "0", irrespective of the "Sensitivity" control adjustment. For the next test, a fixed resistance must be connected between the skin contacts – this could be your skin but a resistor of say 1MΩ might be more convenient. Rotation of the sensitivity control should take the meter through its full range of deflections. If this can not be repeated when the skin contact bracelet is used, the rivets are probably not making good contact.

To be successful, relaxation must be practised in a quiet room free from distractions – take the phone off the hook and certainly turn the TV set off. The object is to clear the mind completely of stress inducing thoughts. Slow and deep breathing (sometimes called "abdomenal breathing" because it originates from the abdomen) is essential. Some people find that it helps to concentrate all of their attention on each part of the body in turn. This starts with the toes, which must be considered individually – at least, that's what the literature says. Next, attention is moved to the feet and then in turn to the lower legs, upper legs, abdomen, chest, neck and finally the face and head. This



process can sometimes produce a tingling sensation when it is particularly effective.

A significant reduction in the level of stress is not something which can be achieved instantly. Particularly for the first few attempts, a subject must be prepared to spend at least 10 minutes per session.

When this relaxation process has been completed, the subject should be largely unaware of his environment, his attention focussed entirely on himself. When he feels that the session has been satisfactory, it is important that the subject does not suddenly end it by standing up or beginning a conversation. Instead, he must slowly become aware of his environment and restore his breathing to its normal pattern.