part 1

tap preamp

In a previous issue (elektor no. 2), in the article entitled 'Sonant', a new design of audio preamplifier and control unit was discussed, which would complement the power amplifier/loudspeaker combination of the Sonant. This article describes the design and construction of such a 'Pre-sonant', which combines high performance with simplicity of operation.

Elektor readers will by now be familiar with the TAP or Touch Activated Programmer. For reliability and ease of operation all the preamplifier functions are controlled by TAP's and mechanical switches and potentiometers are eliminated. This necessarily leads to some simplification of control functions, as such things as volume and tone control can now be implemented only in discrete steps. This is perhaps no bad thing, as the front panels of some modern amplifiers look like something from 'Star Trek' and one wonders if a training course is necessary to operate them. This design is, therefore, not suitable for the dedicated knob twiddler!

Assuming that the recording engineer has done his job properly, many control functions may be removed from the front panel of the preamp and may be replaced by internal presets. This applies to balance and tone controls, which may be adjusted to suit room acoustics and personal taste, after which no further adjustment should be necessary. The number of control functions was thus reduced to the following:

Input Selection:	Disc, Radio, Tape, Auxiliary.
Volume:	Four preset levels.
Image Width:	Four settings from mono to 'extreme stereo'.
Tone:	Bass lift, 'Presence', Flat, Treble cut.

It is hoped in a later article to include a touch station selector for radio. The layout of the touch panels is shown in figure 1. These are available from the Elektor Print Service.

Four Position TAP

All the controls mentioned above are based on the four-position TAP shown in figure 2, which is designed around an RCA COSMOS IC type CD4011AE, a quad two-input NAND gate. The circuit operates as follows:

When the circuit is first switched on the output of one of the gates will set to '1' and all the others are held at '0' since a '1' is applied to their inputs via the input resistors connected to $+V_b$ and via the diodes from the output of the gate whose output is '1'. Which output sets to '1' on initial switch on is determined by the switching speed of the individual gates and the various resistor tolerances.

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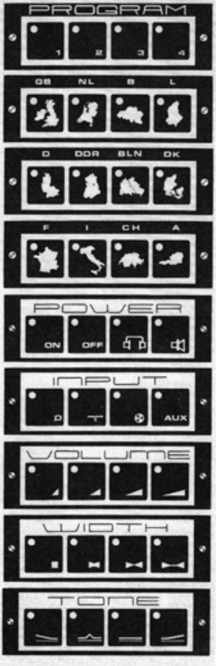

Figure 1. Touch panels for the TAP's. The contact surfaces and legends are nickel plated with a black background.

Figure 2. The circuit of the four-position TAP. Touching one of the input contacts causes the corresponding output to become '1' and all other outputs to become '0'.

Figure 3. Circuit to show the principle of an electronic 'make' contact. The LED indicates that the contact is 'closed'.

Figure 4. Extension of the circuit of figure 3 to control two channels.

Figure 5. The make contact applied to a four-preset-level volume control. The values of R_{15}-R_{22} determine the four preset volume levels.

Figure 6. The electronic 'break' contact. When a '1' appears at input Q_x T_1 and T_2 are cut off and the LED lights to show that the contact is 'open'.

Suppose now that input 1 is touched. Pin 1 of gate N_1 is now held at '0' by the skin resistance, the output therefore becomes '1'. This '1' is applied to the inputs of the other three gates via D_4, D_7 and D_{10} respectively. Since the other input of each of these gates is already at '1' via the input resistors R_4, R_5, R_7, R_8, R_{10} and R_{11} the output of N_2-N_4 becomes '0'. The logic level on the anodes of D_1, D_2 and D_3 becomes '0' and pin 2 of N_1 is held at '0' by R_3. Thus when input 1 is released the output of N_1 remains at '1'. This explanation applies for all the other inputs. Only one output can be a '1' at any time.

The TAP is used to control two types of electronic switch, a make contact, as shown in figure 3 and a break contact as shown in figure 6. When a '1' is applied to the Q_x input in figure 3, T_1 is turned on. Current flows through the LED and resistor into the base of T_2, which is also turned on. The LED lights to indicate that this switch position is activated. The modifications necessary to switch two channels are shown in figure 4. T_1 is now used to switch two transistors and the base resistors are doubled in value (within the limits of preferred resistor values) to keep the LED current the same.

The Break Contact

The circuit of figure 6 operates in an inverse manner to that of figure 4. When the Q_x input is at '0' T_1 is turned off. However, T_2 and T_3 are turned on by current flowing into their bases via the LED, R_2, R_3 and R_4. The 'contact' is thus normally 'closed'. When a '1' is applied to the Q_x input T_1 is turned on thus grounding the bases of T_2 and T_3 and turning them off. Current flows through the LED via R_2 and T_1 so that it lights.

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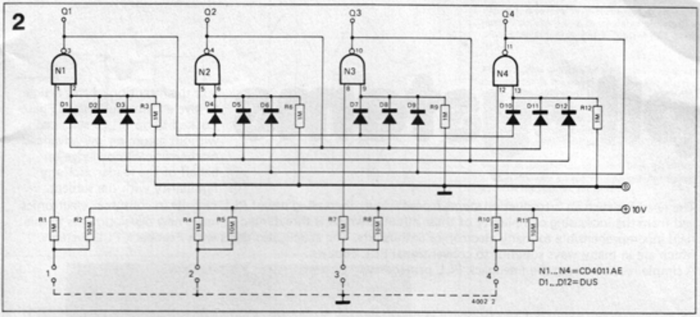

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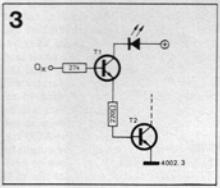

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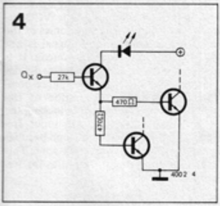

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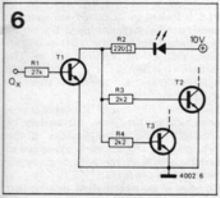

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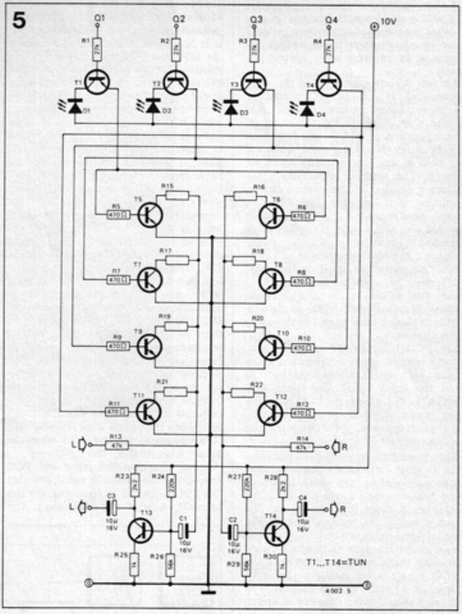

As an example of the use of the make contact a four-setting volume control is shown in figure 5. For the left channel R_{13} and R_{15}-R_{21} comprise a potentiometer, likewise R_{14} and R_{16}-R_{22} for the right channel. When one of the inputs Q_1-Q_4 is high then the corresponding transistors T_5/T_6-T_{11}/T_{12} are turned on, grounding one end of the corresponding collector resistor R_{15}/R_{16}-R_{21}/R_{22}. The attenuation depends on the value of the resistor that is grounded and may be varied to suit personal taste. After attenuation the signal is fed into the base of T_{13} (T_{14}) and the output is taken from the collector. This and the other control circuits will be discussed in greater detail in next month's article.