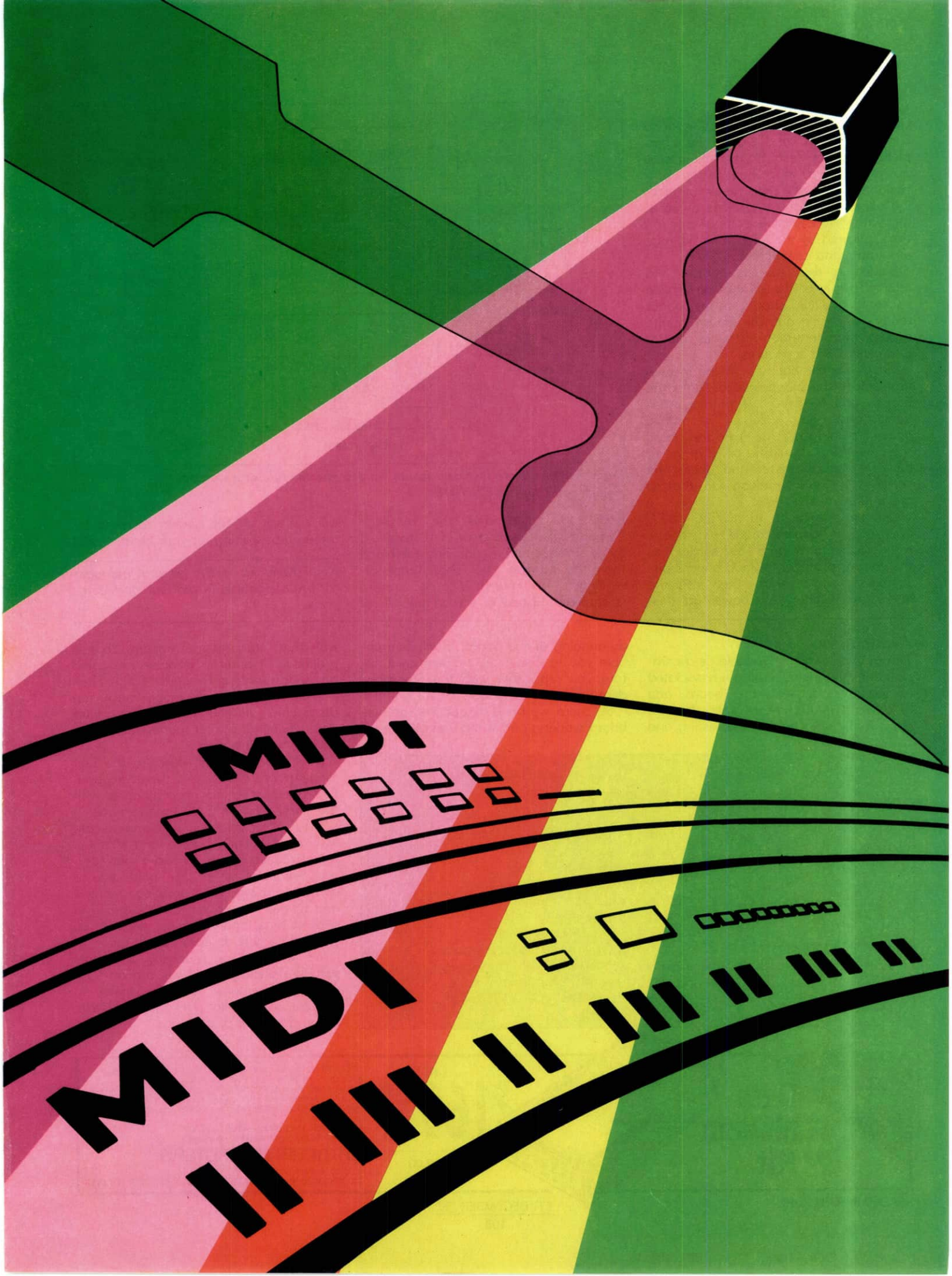
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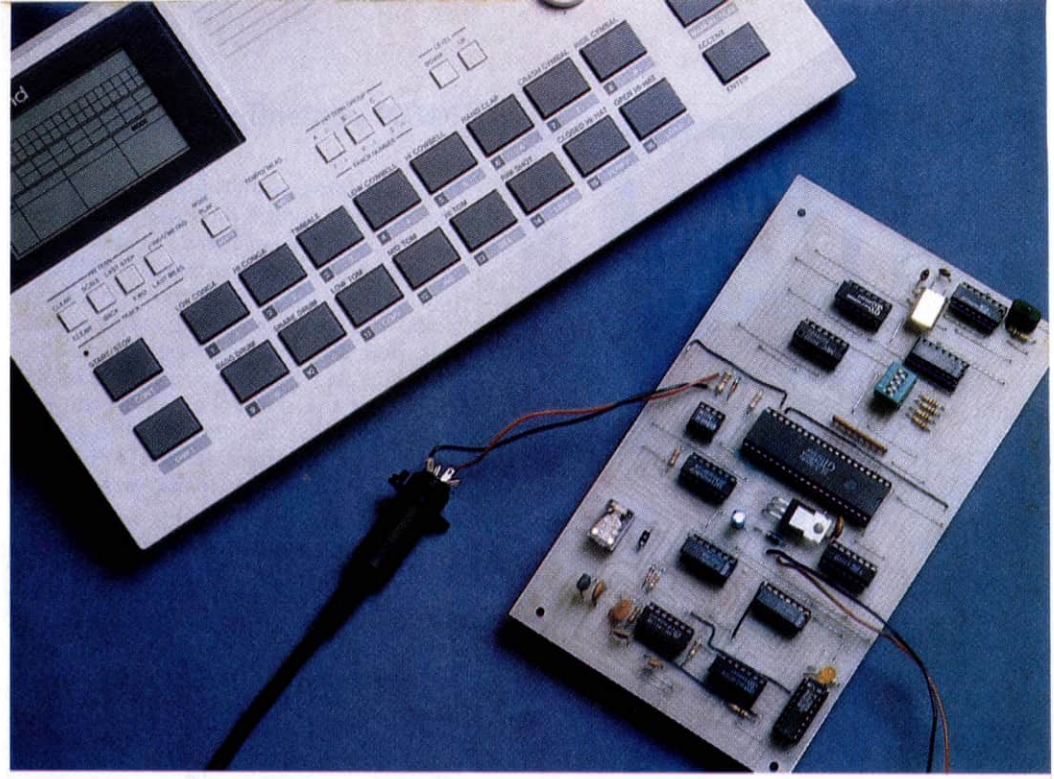


THE BIG TURN ON

MIDI controlled switch

Part 2

Terry Kee this month completes his project for yet another application for the use of MIDI.

Part 1 was published in ETI last month and described the theory of MIDI, applications and how the switch worked. This article puts all that theory into practice.

Construction

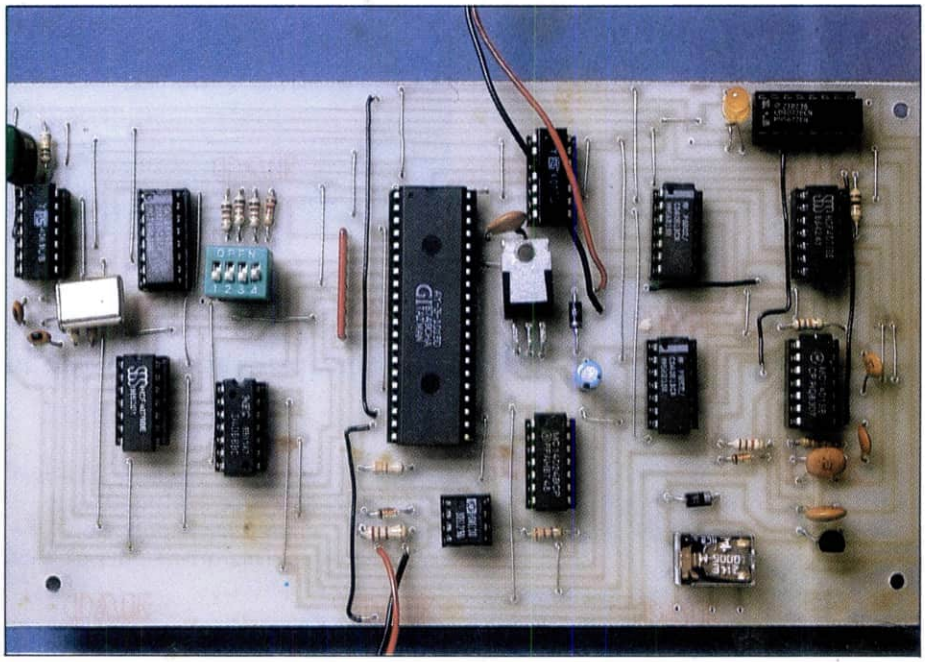
All the electronics are contained on a single-sided pc board measuring 189 mm x 111 mm.The track density is fairly high as is typical with pc boards carrying logic circuits with data busses. The penalty one pays for opting for a single-sided pc board is a fairly large number of links.

The first step in the construction procedure is to inspect the pc board for broken tracks and unetched bits of copper as some of the tracks are quite close together. It is worthwhile doing this even if the pc board was obtained from a board manufacturer. Spotting defects now is much easier than when it is populated with components. Think of the spared heartache and saved time if you find a defect lurking in the tracks. Check in particular where tracks run close together , between ic pins etc. and compare with the artwork to establish if a connection is to be made. Holding the pc board against a light source is a good way of detecting unetched copper and broken tracks.

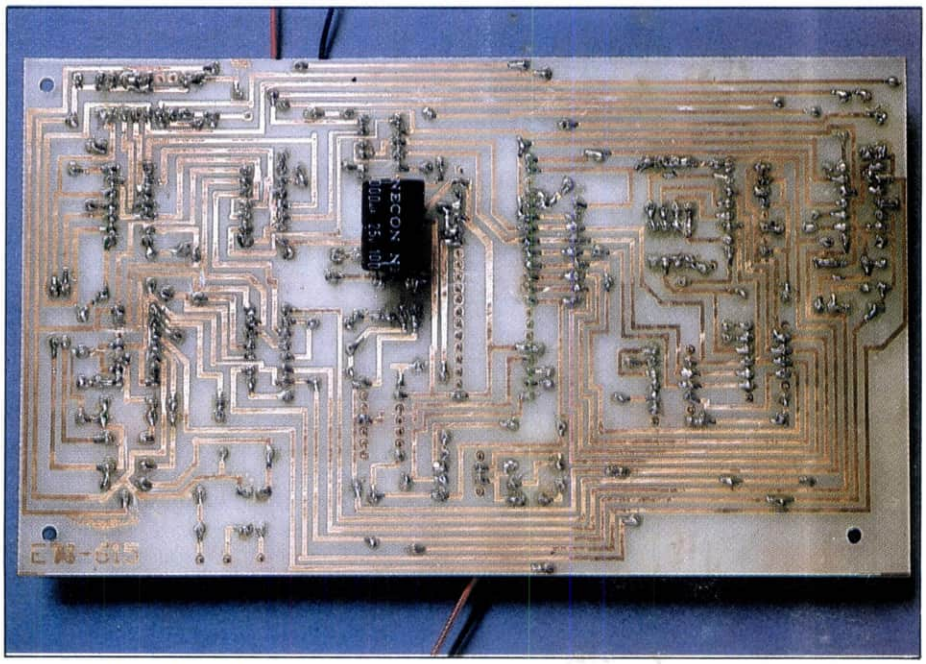
Once you are satisfied with the pc board it is time to do some serious soldering. A finely tipped soldering iron should make the job easier. Insert and solder in the optional ic sockets. I've used them in the prototype as they make trouble-shooting easier. It is advisable to use a 40 pin ic socket for the UART (IC3) as it is a fairly costly chip. Next, insert and solder in the links. Note that some links need to be bent around components, see the overlay and use insulated hook-up wire if there is any possibility of links touching component legs. Solder in the resistors, capacitors, dip switch (SW1) and relay (Rly 1). The resistor network (RN) has the commoned point marked with a dot and is connected to +5 V. The orientation of RN has the dot located towards pin 1 of IC3, as can be seen on the overlay. There is an option to use eight individual 10 k resistors instead of the resistor network (RN). Solder in one end of each resistor and then stand them up vertically. Connect the top end of the resistors together with a length of wire and solder this connection to the commoned point. Note that the values of R13 and C7 are incorrect in the circuit diagram that was published last month. R13 should be a 100 k resistor and C7 a 150 nF capacitor.

The pc mount MIDI Channel switch (SW1) needs to be mounted in an eight pin ic socket to allow it to protrude through the top panel of the box. Measure the height of the tallest component and allow sufficient lead to bend it over

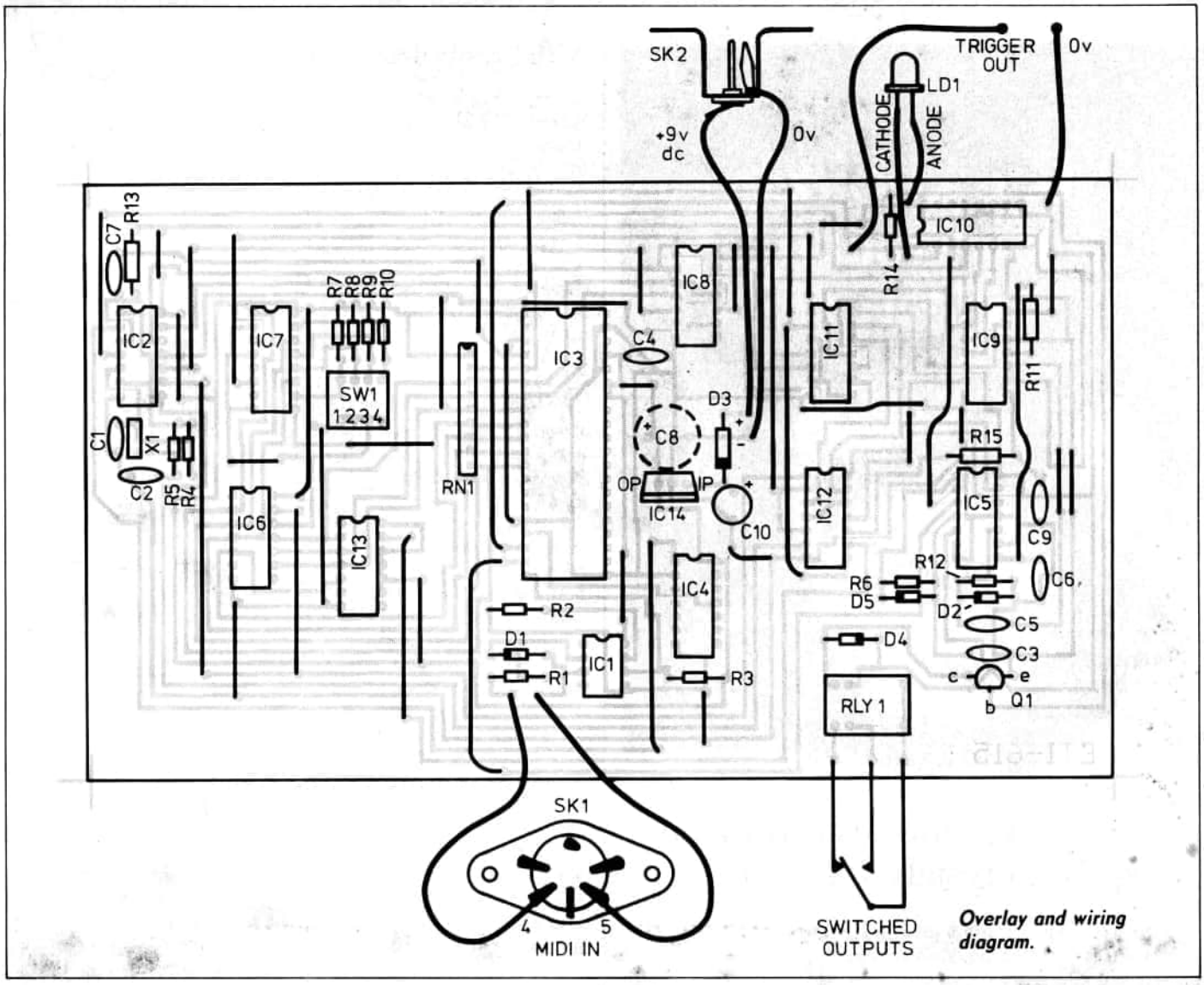
if it interferes with the mounting. Capacitor (C8) can be mounted on the solder side of the pc board. Solder in the crystal (X1), diodes, transistor (Q1) and regulator (IC14). Ensure that the correct polarity orientation of the semiconductors and electrolytic capacitors are observed. Insert the ic's into their sockets. Note that the orientation of all the ic's have pin 1 located towards the top of the pc board, except for IC10. Refer to the overlay carefully to make sure you get this right. If you have not used ic sockets then solder in the ic's carefully. Take the normal precautions with handling and soldering CMOS devices. Solder the LED (LD1) directly to the pc board; the shorter leg (cathode) of the LED should be connected to pin 2 of IC10. Ensure that the LED is inserted on the pc board so that it can be mounted on the front panel of the box. All that remains to be done now is to wire in the MIDI in socket (SK1) and the plug-pack



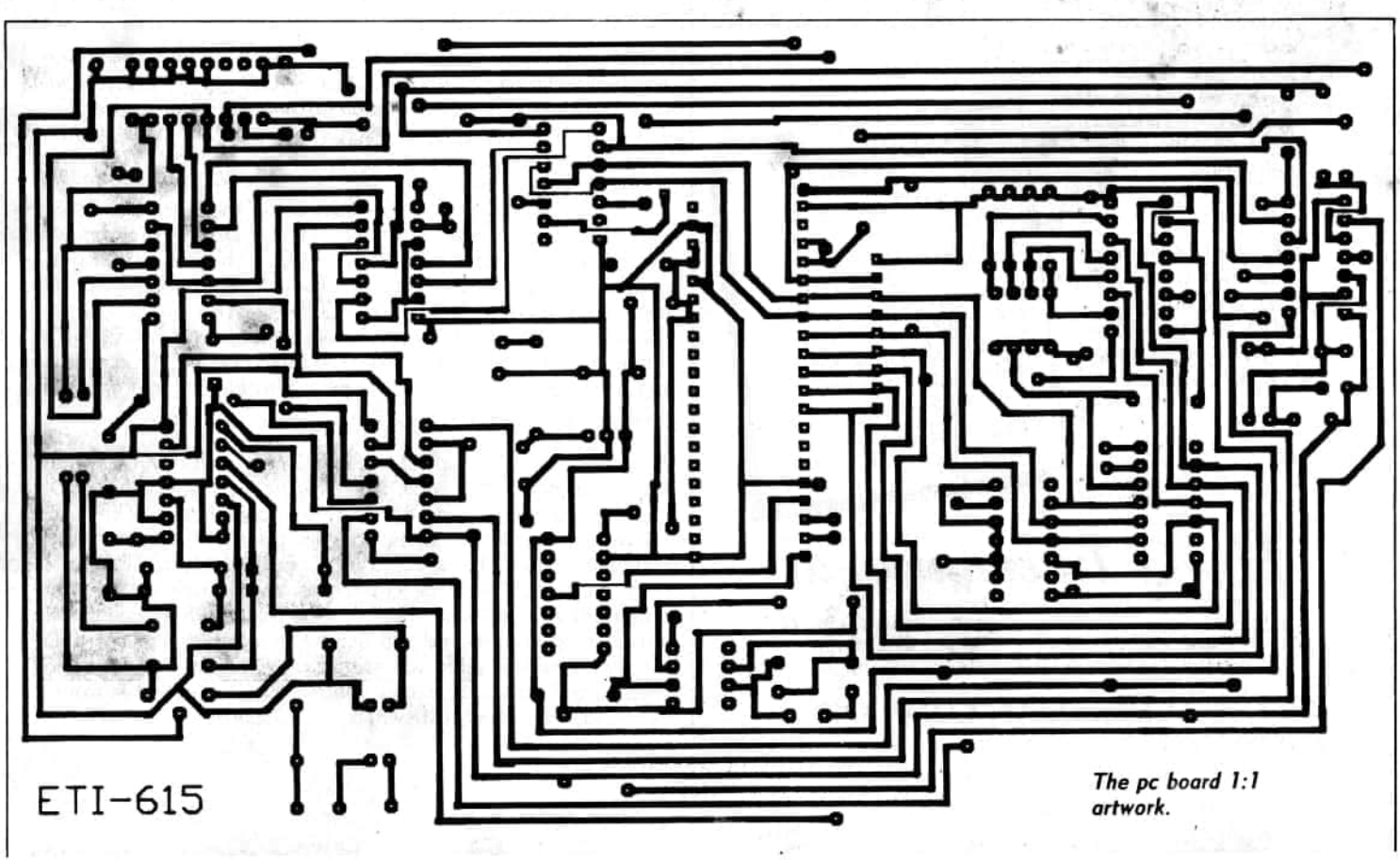
The pc board (component side).



. . . and the solder side.



Overlay and wiring diagram.



The pc board 1:1 artwork.

MIDI controlled switch

socket (SK2) with hook-up wire and the MIDI switch is complete.

The choice of box is not critical and any enclosure with dimensions to fit the pc board will be suitable.

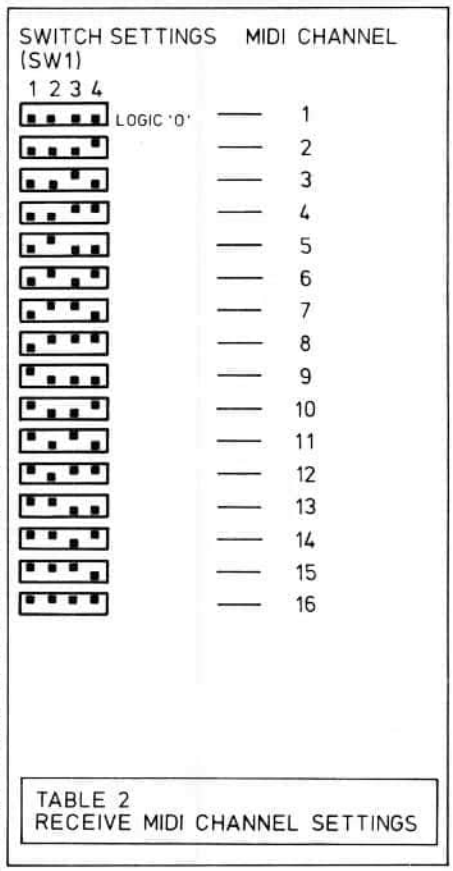


TABLE 2
RECEIVE MIDI CHANNEL SETTINGS

Testing

After you have rechecked the pc board for bad solder joints, solder splashes and corrected any mistaken component orientation, it is time to connect a 9 Vdc plugpack to the circuit. The circuit draws a maximum of 67 mA with the relay activated so a 9 V plugpack rated at 300 mA is ample. Check the polarity of the plug on the plugpack and wire the dc socket (SK2) accordingly. Use an insulated socket if the positive volts is not connected to the centre pin. Apply power and check with a multimeter, set to measure volts dc, that the power rails are at 5 V. With the power rails checked, no smoke from the board, and no nasty burning smells, the situation looks healthy.

The next step in the test procedure is to determine the transmit channel of the MIDI instrument you intend to use. Most keyboards tend to default to channel 1 on power up. The setting of the receive MIDI channel of the MIDI switch can then be set accordingly on the dip switch (SW1). The channel number setting of the switch is in binary notation with switch 4 (refer to the overlay) being the least significant bit of the four bit word. The actual MIDI channel is the number set on the switch plus 1 i.e: 0000 is channel 1 ; 0001 is channel 2 ; 0010 is channel 3 and so on. The switch position away from the resistors (R7 to R10) represents a logic low. A drawing of the switch positions and the corresponding MIDI channel is shown in Table 2. This table can be glued to the top panel of the box, near the switch to identify the channel numbers quickly.

Connect the MIDI out of the instrument to the MIDI switch via a suitable MIDI cable. Set up the corresponding MIDI channel numbers and start playing some notes. The LED should light up when a key on a keyboard is depressed and extinguish when the key is lifted. You should also hear the relay latching. The MIDI switch will always decode the last note data in a series of notes that are played. For example, if ten keys on a keyboard are played simultaneously, the LED will light and the relay will switch over. Lifting one key and keeping the others depressed means that a note off is transmitted last and the MIDI switch turns itself off.

Change the transmit channel of the MIDI keyboard, and at the same time change the switch on the box to correspond, and check that the relay responds to the correct channel. Next, change the receive MIDI channel of the switch so that it does not correspond to the transmit channel and the switch should ignore all the data on the MIDI line. Repeat the procedure for the other channels.

The final test is to check that the switch ignores the MIDI realtime messages such as clock, start and end of song etc. A MIDI drum machine or sequencer is required for this test.

Testing with drum machines

I used a Roland TR505 drum machine to test the MIDI switch. It can also be a useful tool for fault-finding. The facilities of a drum machines will differ for different brands and models, however a lot of features are common to most machines. Refer to your manual if you are uncertain of the features of your machine.

When a drum sound is initiated the 505 transmits on the selected MIDI channel a note on, note and velocity value and, about 8 mS later, a note off. The switch will decode the data as an 8 mS pulse and the LED will flash briefly each time the note data are received. The relay will switch over its contacts in sympathy. MIDI clock data are also interleaved with the note data and the switch should ignore it.

Start by assigning each drum voice to one of the 16 available MIDI channels. Set the machine to manual play so that pressing the keys activates the drum voices. Connect the MIDI out of the drum machine to the MIDI switch and set the receive MIDI channel to 1. Press the drum voice key transmitting on channel 1 and the LED should flash in sympathy. The other keys should not have any effect. Change the receive channel and repeat the procedure. Each time the channels are matched the switch becomes activated. Program a drum sequence and hit the start button. The switch should only respond to the selected drum voice on the matched MIDI channel.

Trouble-shooting

There should not be any problems if you were careful with your soldering. The prototype worked first time! If you do not have access to an oscilloscope then trouble-shooting could be a bit more difficult. All is not lost though, as there are tests you can carry out. All you need is a drum machine and a dmm.

To test that MIDI data is received and converted to parallel form correctly, use a drum machine and monitor the data bus of the UART (IC3). Set the drum machine to transmit MIDI clocks to the MIDI switch. The 505 transmits clocks automatically with the MIDI Sync turned off, and clock transmission occurs even when the machine is in the stop mode.

This feature may differ with different drum machines. If you are uncertain then clear a drum pattern in memory and hit the start button. Listen to the output to ensure that no drum sounds are present. The drum machine should only be transmitting MIDI clocks in this mode. Use a dmm to measure the dc voltage on pins 5 to 9. These points are the 8 parallel data outputs of the UART (IC3), where pin 5 (D7) is the most significant bit and pin 12 (D0) is the least. The dc voltages on pin 5 to 9 should be 5 V i.e: logic high. Pins 10 to 12 should be at logic lows (>100 mV).

If the readings do not correspond then a fault exists in the circuitry around IC 1,2a,2b,3,4 or 5a. Check that a 500 kHz clock signal is present on pin 17 of the UART (IC3). If all is well then the fault lies in the decoding circuits.

To check that the MIDI receive channels are being decoded correctly set the switch settings of SW1 to channel 9, refer to the switch chart in Table 2. With the drum machine set to transmit MIDI clocks as described previously, pin 6 of IC7 should be at a logic high i.e: 5 V only on channel 9. If this is not the case then check the circuitry around the switch (SW1) and IC7.

On power-up pin 13 of IC5b and pin 1 of IC10a should be reset to logic 0 by R13, C7 and IC2f. If this is not the case then check that R13 is a 100k resistor and C7 is a 150 nF capacitor and not the values as stated in the circuit diagram.

Switched outputs

The pc mount relay (RLY1) as used in the prototype is an SPDT device and its contacts are rated at 500 mA at 120 Vac. Care must be taken not to exceed these ratings and this relay must not be used to switch 240 V mains voltages directly.

Using the MIDI switch is straightforward. It really comes into its own when it is controlled by a pre-programmed device such as a sequencer or a drum machine. The trigger output provides a 5 V logic signal when the switch is activated and 0 V when de-activated. Because of the general-purpose nature of the switched outputs, the configuration of the relay contacts is left to the reader. Happy switching. eti

Parts List ETI-615

Resistors
All 1/4 W, 5% unless stated otherwise.

R1, R3	220R
R2	3K3
R4	8M2
R5	8k2
R6, R7, R8, R9, R10	12k
R13	100k
R11	10k
R12	270k
R15	27k
R14	4k7
RN	10k dil 8-commoned resistor network or 8 off 10k resistors (see the construction section)

CAPACITORS

C1, C2	33p ceramic
C3, C4	10n greencap
C5	470p ceramic
C6	220p ceramic
C7	150n greencap
C8	100u/25V electro
C9	47p ceramic
C10	10u/25V electro

SEMICONDUCTORS

IC1	16n138 Opto-coupler
IC2	4069B CMOS hex inverters
IC3	AY-3-1015D UART
IC4	4024B CMOS 7-stage Binary Counter
IC5	4013B CMOS Dual D-type flip flop
IC6	4078B CMOS 8-input Nand gates
IC7	74HC85N CMOS 4-bit comparator
IC8	4002B CMOS 4-input Nor gates
IC9	4071B CMOS quad 2-input Or gates
IC10	4027B CMOS Dual J-K flip flop
IC11,12	4081B CMOS quad 2-input AND gates
IC13	4068B CMOS 8-input Nand gates
IC14	7805 5V regulator
Q1	BC338
D1, D2,D5	1N914/1N4148
D3, D4	1N4001
LD1	LED

MISCELLANEOUS

X1	2 MHz Crystal
SK1	5 pin DIN socket (180 degree)
SK2	dc plug pack socket
RLY1	dil socket mount relay, 5 V coil at 56 ohm. Contacts rated at 1A. Dimensions 11 (H) x 16 (W) x 11 (D) mm Jaycar cat SY-4058 or similar
SW1	4 way 8-pin dip switch 9 V dc plugpack rated at 300 mA, ic sockets.