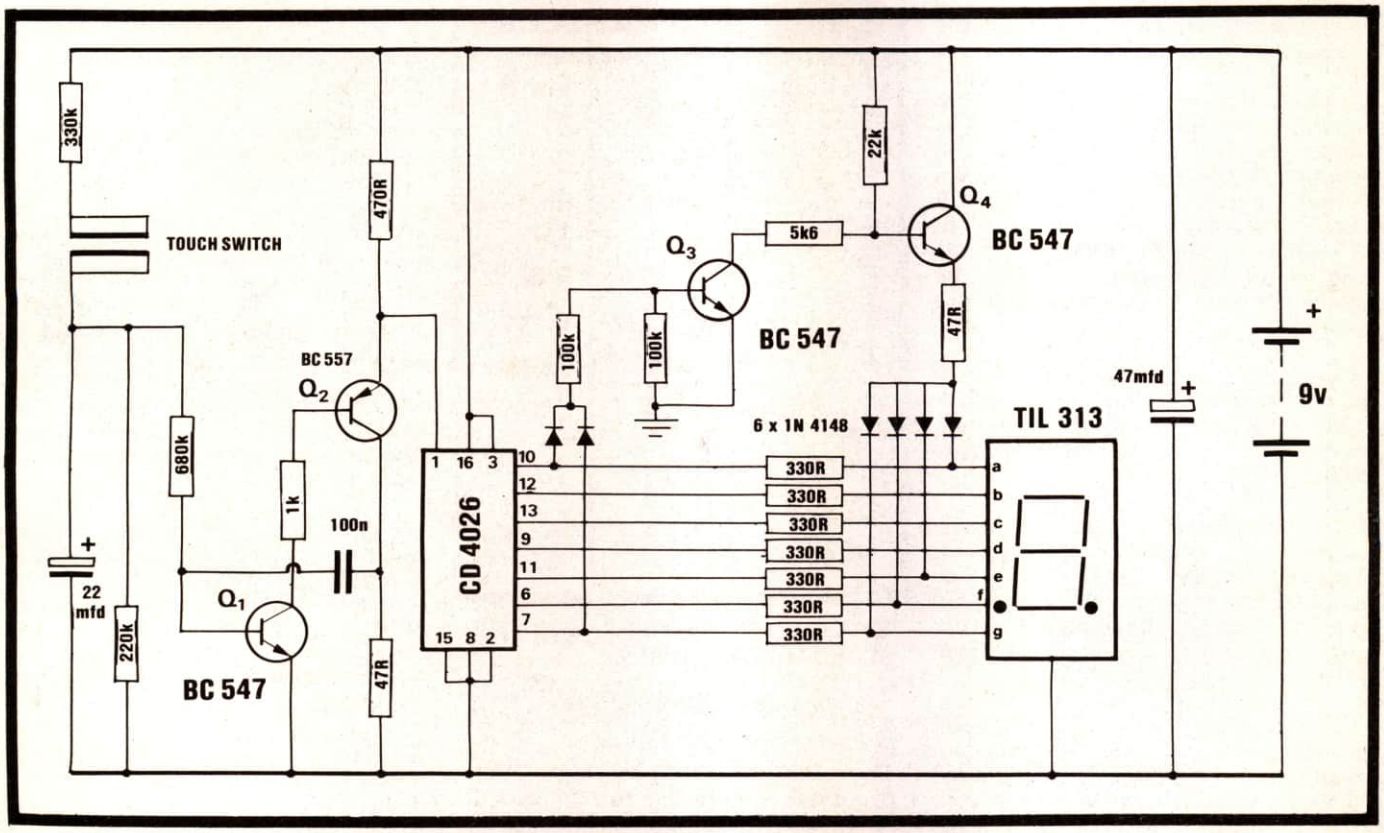
BLACK JACK

$9.30 COMPLETE



COMPLETE BLACK JACK CIRCUIT

Along with our previous range of party games and puzzles, we add our latest project: BLACK JACK.

Designed by our new member of staff, Paul, this project employs a part digital design and part linear design.

By this we mean the circuit has a transistor or two to 'get around' a digital limitation.

As you know, the CD 4026 is a 7-segment display driver and is capable of producing the numbers 0-9.

For our arrangement, we require the '1' to be replaced with the letter 'A'. And so to achieve this we needed to add a transistor detector and transistor segment driver.

This makes an interesting circuit design and shows the advantage of thinking 'transistor' as well as digital.

The only slight problem you may encounter with this circuit is its voltage dependence. The circuit is designed for 9v operation and at this level all segments illuminate with equal brightness. If the voltage is decreased to below 6v, the letter 'A' will not have equal brightness in all segments.

Our party games receive a lot of interest from constructors who like to bring out a new game or puzzle at club meetings and the like. Sometimes they modify old game to give them a new slant. Like the Rouled game in which one reader used RED and GREEN LEDs in the circle. Or the Digi Chaser which was increased to 1k of memory by Mr Ohlson and coded with his CW call sign.

The best is the Cube Puzzle which was made impossible by leaving out a link!

Maybe you will be able to think of a variation for this game. If so, let us know.

I don't know much about card games and so I'll pass you over to Paul to describe his project.

PARTS LIST

- 2 - 47R ¼ watt
- 7 - 330R
- 1 - 470R
- 1 - 1k
- 1 - 5k6
- 1 - 22k
- 2 - 100k
- 1 - 220k
- 1 - 330k
- 1 - 680k
- 1 - 100n 50v greencap
- 1 - 22mfd 16v PC electro
- 1 - 47mfd 16v PC electro
- 6 - 1N 4148 diodes
- 3 - BC 547 transistors
- 1 - BC 557 transistor
- 1 - TIL 313 display
- 1 - CD 4026 driver IC
- 1 - 16 pin IC socket
- 1 - battery snap
- BLACK JACK PC board.

BLACK JACK, or 21, as most people prefer to call it, is a game in which players have to get as close to 21 as possible without going over.

Although it is 90% chance, each player can increase his chance of winning by making a few simple decisions.

First, each player is dealt 2 cards. The object of the game is to reach 21 by adding up the value of the cards. The spot cards count as indicated and the COURT cards count as 10. The ACE has a dual value and can count as 1 or 11. This provides about the only mathematical manipulation in the game. The few remaining rules are simple.

If you have a low score, you can pick up another card. On the other hand, if you have a score of 14, you can elect to throw down your hand and pick up one, two or three cards.

A couple of small bonuses also apply to the game. If you are betting, and holding 5 cards with a total score less than 21, you receive a payout which is twice the amount of your bet. If you are holding three 7's, the payout is three times your bet.

This game has always been very popular and we have created an electronic version. The display represents the face of the cards and the following table will show how they are equated. The letter A appears for the ACE. The court cards and the 10-spot are all represented by the number 0 and unfortunately the game is not weighted to take the court cards into account in the same percentage as they appear in the pack. That's the only limitation of this version.

But it has two advantages.

It is much quicker and easier to use, especially for young children, and can accommodate any number of players.

Build the unit and you will soon understand how to play the game.

CONSTRUCTION

All the components are mounted on a printed circuit board.

The first item to solder onto the board is the IC socket. We suggest a socket because the chip is expensive and some constructors have damaged them in the Music Colour project.

You will find a small mark at one end of the socket to identify pin 1. Place this mark over the dot on the PC board to help in later identification.

Add the 18 resistors to the board in the positions shown in the overlay and cut the excess leads off, close to the board. Keep some of the leads for the jumper links and TOUCH WIRES.

CARD:	DISPLAY	SCORE:
ACE	A	1or 11
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
10		
JACK	0	10
QUEEN		
KING		

THE DIGITAL READOUT AND THE SCORE IT REPRESENTS.

The two electrolytics and 100n capacitor are added to the board, followed by the 6 diodes. These must be inserted around the correct way for them to function correctly. Double check them before continuing. Fit the jumper links and TOUCH WIRES.

The circuit requires 3 NPN and 1 PNP transistor. Any type of transistors will be suitable and we have suggested our standard BC series.

Insert the PNP transistor first, making sure it fits into the holes correctly. Then solder the 3 NPN transistors.

The display is not polarised and it is important to insert it around the correct way. The two decimal points can be seen through the diffusing screen and these must be placed downwards.

Solder the battery snap with red lead to positive and black lead to negative. Fit the 4026 IC into the socket with the dot on the chip covering the dot on the board.

The project is now ready for operation. Touch the two links marked TOUCH SWITCH and watch the display.

IF IT DOESN'T WORK

Since the circuit consists of 3 separate sections, the first stage is to find out which stage is at fault.

Obviously you will have to check the soldering, the positioning of all the components and the quality of the battery.

Don't forget the BC 557 transistor. It is a PNP type and must be positioned as Q2 in the circuit.

The display must be type TIL 313 by Texas Instruments. Other displays may work but must be checked first.

Here is our approach to fixing the project:

If the display fails to illuminate it may be the wrong type, inserted around the wrong way or the common line may not be connected.

To test the display, the collector and emitter of Q4 are bridged with a jumper lead. This should illuminate the letter F. If this does not occur, the 47R resistor may be the wrong value or the diodes may be the wrong way around. If the F appears, the display will be OK.

The next area to look at will be the 330R dropper resistors. With one lead lifted from the board, switch your multimeter to the ohms range and check the value.

Next, move to the 4026 IC. For this test, the input line (pin 1), must have all input pulses removed. This is done by removing Q2 from the board so that pin 1 becomes connected directly to the positive rail.

The chip will now be in a static condition and you can check the output pins.

With a multimeter switched to the 10v range, detect a HIGH on all or some of the following pins: 6, 7, 9, 10, 11 and 12. Take pin 10 for instance. When it is HIGH, segment should illuminate. If it doesn't, the 330R resistor may not be connected or it may be an incorrect value. The only other possibility is a cut in the PC track or a dry joint.

Follow this procedure through to segment g. If some of the outputs are not HIGH, place a jumper lead from the negative rail, and touch the other end onto pin 1 of the 4026 chip. This action will cause it to clock. Repeat this a few times and you will eventually clock the chip through its complete cycle and cause each of the output lines to go HIGH.

Under normal conditions no other components would be needed in the display circuit. The 4026 is capable of driving the display without the need for any dropper resistors, provided the voltage is kept to about 5 - 6v. It has its own internal current limiting. But since we need to produce the letter A whenever '1' normally appears on the screen, we need to introduce a lot of additional circuitry.

And the way it works is very clever.

The circuit is basically detecting 2, 3, 4, 5, 6, 7, 8, 9 or 0 appearing on the screen. It ASSUMES that the number 1 will be appearing if the above is not the case.

When the transistor circuit is operating, it puts an F on the display. This is combined with the letter 1 and results in the letter A appearing.

The detection circuit consists of 2 diodes forming an OR gate.

The function of the two 100k resistors is to keep the voltage on the base of Q3 below .6v when the circuit is not required.

The first 100k resistor also separates the base of Q3 from the diodes so that the drive-lines from the chip can rise above 1.2v and illuminate a segment on the display.

If the voltage-dividing circuit were not present, the natural voltage drop across the diode, combined with the slight voltage on the output of the driver chip, (when it is in the LOW condition), would turn the transistor ON slightly.

This would be sufficient to create a glow in the display, which is undesirable.

The 100k resistor to ground halves this voltage and prevents the transistor from turning ON.

The second transistor is an emitter-follower. This means the top of the 4 diodes (connected to the segments) are in-phase with the collector of the first transistor. If the collector is HIGH, the top of the diodes is HIGH and this will turn on the segments. When the collector is LOW, the voltage on the diodes is LOW and the segments will not be lit.

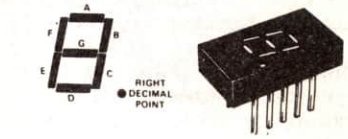
The first transistor is an inverting stage and we can describe how the circuit works in one simple sentence.

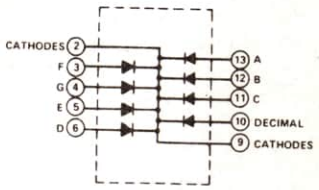
Only when both detecting diodes are LOW, will the collector of the first transistor be HIGH and thus pull the top of the 4 diodes HIGH and illuminate the letter F.

The 47R resistor is a current limiting resistor to adjust the brightness of the letter F to be equal to the number 1 and thus give an evenly-illuminated letter A.

The seven 330R resistors have two functions. Firstly they act as current limiting for the 4026 when driving the display from 9v and secondly they separate the input of the transistor section from the output.

THE TIL 313 DISPLAY

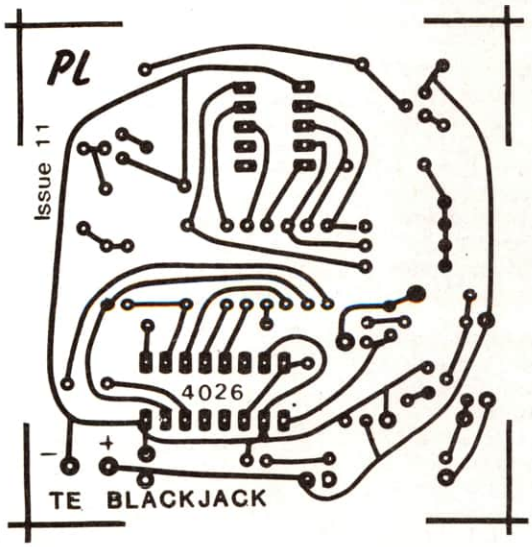


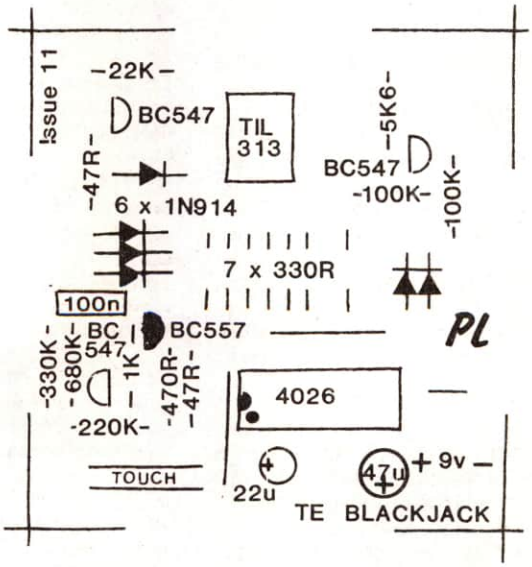


TIL 313 is a COMMON CATHODE display in which pins 1, 7, 8 and 14 are NOT on the unit. Only pins 2, 3, 4, 5, 6, 8, 9, 10, 11, 12 and 13 are present.

No other displays will work in the same set of holes as the TIL 313 as every display has a different pin-out arrangement.

You will have to drill 4 more holes and re-wire the PC board if you intend to use another display. Remember, only a common cathode display will work.





BACK JACK PC LAYOUT AND OVERLAY

If this part of the circuit is operating correctly, we will be able to manually clock the chip through its full cycle and watch the display change. You cannot prevent the chip jumping a few counts every time pin 1 is touched as the chip will pick up switch-noise. Even so, we will be able to see all the numbers.

If the number 1 appears on the screen, the transistor section will be faulty as it will not be generating the letter F.

To operate the transistor section manually, put a 10k on jumper leads and connect one end to the base of Q3. Take the other end LOW and the display should show the letter F as well as whatever number is being generated by the 4026. Take the base HIGH and the F will not show on the display. If this result does not occur, check the voltage on the collector of Q3 and repeat the operation.

If the collector voltage does not alter, Q3 will be at fault. If the voltage changes, place the probe of your multimeter on the base of Q4. It should swing from nearly full rail voltage to about 2 - 3v. If it does not hve this large swing, Q4 will be faulty, (as we have ascertained that the collector of Q3 has a large swing).

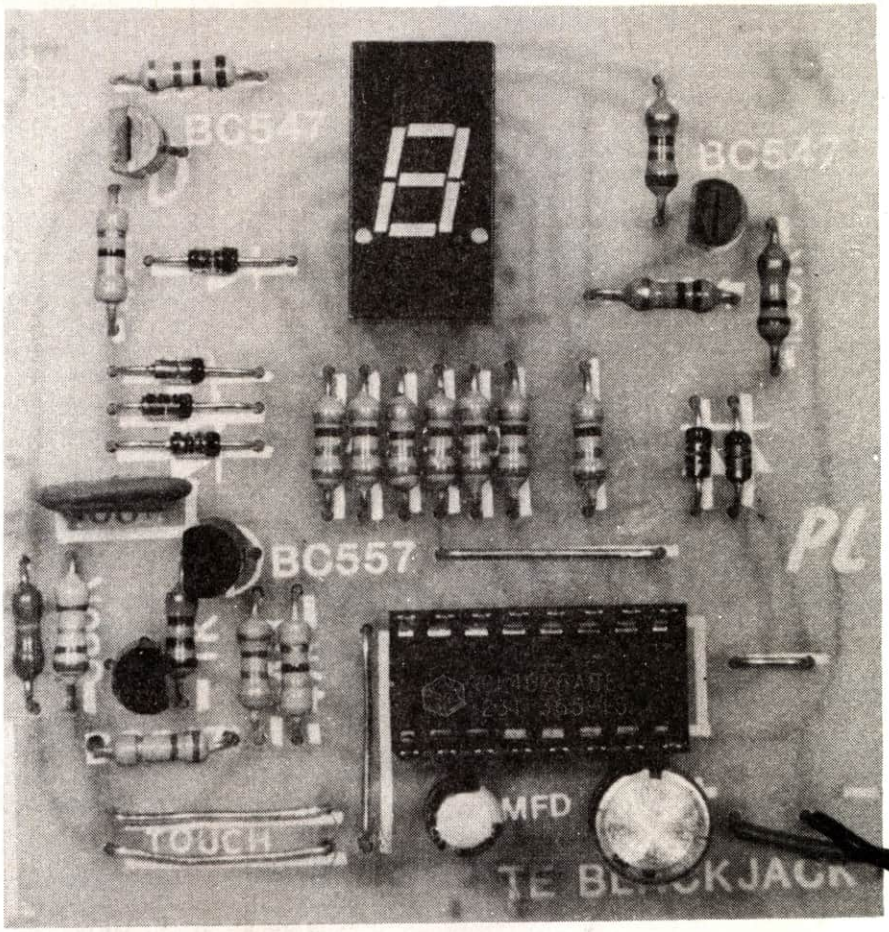
Finally, if the emitter of Q4 does not closely follow the base, the transistor itself will be faulty.

The last section to trouble-shoot is the oscillator.

Re-connect the BC 557 transistor and place a LED in series with the 470R resistor (in the collector circuit). This is done by removing one end of the 470R and connecting the light emitting diode with the cathode facing towards the negative terminal of the battery.

To check the oscillator it is necessary to test the two transistors in a DC state. This requires removing the 100n capacitor. The circuit now becomes a 2 transistor DC coupled amplifier. Touch the TOUCH SWITCH and the LED will gradually come on. If this does not occur, you will have to test each transistor individually.

A 4k7 resistor placed between collector and emitter of Q1 will turn the LED on. If this does not occur, Q2 may be faulty. If the LED comes on, the problem may lie with Q1. To check the DC operation of Q1, connect a 10k resistor between its base and the positive rail. If this does not turn the LED on, Q1 may be faulty.



A CLOSE-UP VIEW OF THE COMPONENTS

Note the neat placing of the components. Use only ¼watt resistors and small capacitors to keep everything in 'balance'. You can use molex pins to create a socket for the display.

If these tests are successful, the only remaining area is the feedback section. This is more difficult to test as the AC voltages are small and the pulse durations are very short.

To turn the oscillator on, re-fit the 100n capacitor and measure the voltage on the base of Q1 while shorting across the TOUCH SWITCH. The voltage range for the base is .55v to .65v. Above this, the oscillator jams. The function of the 680k resistor is to separate the voltage on the 22mfd electrolytic from the base and allow the oscillator to function.

To test the oscillator, firstly discharge the 22mfd electrolytic by shorting across its terminals. Bridging across the TOUCH SWITCH will turn on the oscillator and increase its speed until it jams. Repeat this operation but use your finger across the switch. If it fails to start-up, your finger may have a very high resistance and fail to charge the electrolytic.

If you are careful, your BLACK JACK will work as soon as the battery is connected but if you encounter a 'bug', let's hope you find it and get it working quickly.

Black Jack is an ideal project for parties. It can be passed around more conveniently than a pack of cards.

We hope you build it and get as much pleasure as we did.

Paul.