Designing TTL Circuits—An Appeal

Here is an appeal to all EFY contributors designing with TTL digital ICs. Personally I feel that several TTL circuits appearing in EFY violate technical considerations in one way or the other. Some of the simple guidelines given here could help EFY readers design TTL circuits faultlessly.

Supply voltage. TTL ICs are specifically designed for operation at 5V ±5 per cent. However, I am shocked to find TTL circuits appearing in EFY time and again with supply voltages ranging from 3V to 6V. In no other magazine of international standards have I seen such blatant carelessness. After all, the 5V ±5 per cent supply could easily be obtained through a 7805 regulator chip or a 5.6V, 5 per cent zener diode with a series-pass transistor.

Driving LEDs. Very often, a need arises for driving LEDs from the output of a TTL IC. A TTL output could sink a current of 16 mA and could thus be used to drive an LED directly as shown in Fig. 1.

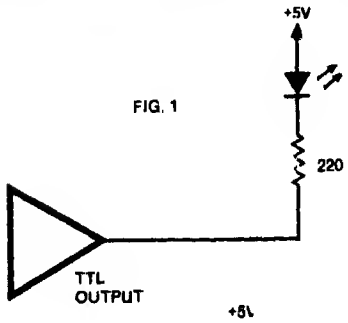

FIG. 1

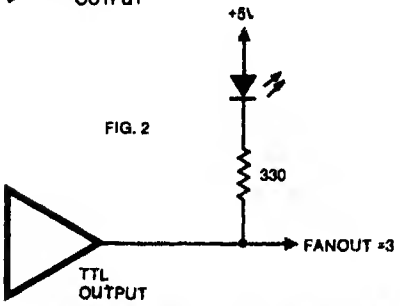

FIG. 2

The arrangement of Fig. 2 could drive an LED as well as three TTL inputs (fanout = 3). The 220-ohm resistor has been increased to 330-ohm to keep the output sink current below 16 mA.

In certain circumstances, it might be necessary for an LED to glow whenever the TTL output goes high. However, since the sourcing capability of a TTL output is very small (0.4 mA), an additional pull-up resistor should be connected as shown in Fig. 3. The value of the pull-up resistor should be greater than 5V/16 mA, i.e. 312.5 ohms. A 330-ohm resistor would suffice.

However, the TTL output can no longer drive TTL inputs since in 'logic 1' state, the maximum output voltage is limited to about 1.6V by the LED as against the minimum of 2V required by a TTL input for 'logic 1' state. This

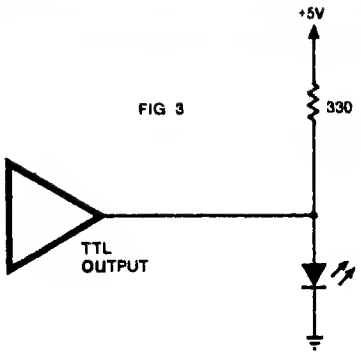

FIG. 3

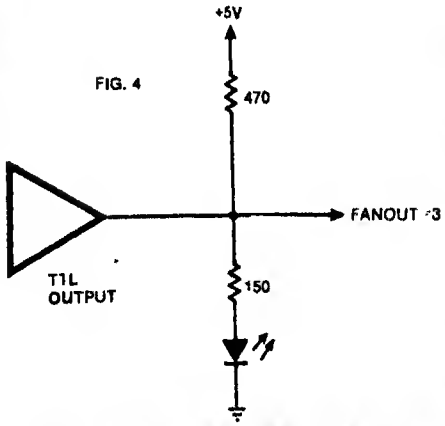

FIG. 4

problem could be overcome by the circuit of Fig. 4, with a slight reduction in brightness level of the LED. It has a fanout of 3 TTL inputs. The circuits apply to LEDs of all colours.

Fanout. The fanout of TTL outputs (totem pole) is 10 in logic '0' state while it is 20 in logic '1' state. Sometimes, the fanout capacity of an output may be exceeded without the designer knowing it. In many occasions, overloading can be prevented. It is a common practice to form inverters out of NAND or NOR gates by shorting their inputs together.

However, the same results could be obtained by using only one input of the NAND or NOR gate and tying the other inputs to +5V (NAND) or to 0V (NOR). This reduces unnecessary load of the driving TTL output.

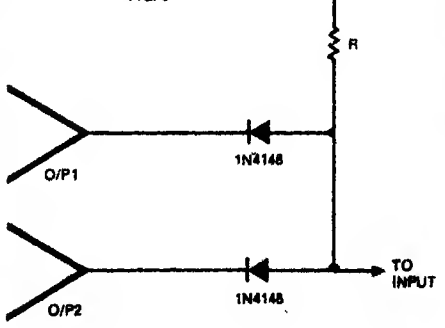

FIG. 5

Noise margin. In many EFY circuits, I have seen diodes being wired as AND gates as shown in Fig. 5.

This type of arrangement, which is economical, may work with CMOS ICs but should never be attempted on TTL. The reason for this is that the maximum input voltage at a TTL input for it to recognise it as 'logic 0' is only 0.6V.

However, by using diodes as NAND gates, there would be an unavoidable 0.7V drop across them. This, in combination with the 0.4V output voltage of the TTL output would raise the voltage at the input to 1.1 volt in 'logic 0' state. Thus we have a negative noise margin of 0.3V!

Why TTL? Yes, I am asking, why use TTL ICs? TTL ICs are greedy and power consuming and require a precise 5V ±5 per cent supply. CMOS, on the other hand, could be operated off 3V to 15V, their quiescent current being a few microamperes.

In EFY, I am pained to see circuits like 'heads or tails', 'dice', etc all designed with TTL ICs. These circuits could in fact be cheaply constructed with CMOS with the advantages of lower current consumption and wider supply voltage range.

The only advantage of TTL over CMOS is the former's high speed. But in a majority of applications, speed isn't the prime concern. Moreover, a single chip like the 4017 could replace 7490 plus 7442.

In many foreign magazines, CMOS ICs are mostly used in simple circuits that don't require high speed. And even when high speed is required, LSTTL is used instead of standard TTL which is far less greedy than TTL and is cheaper too. I don't understand why EFY should not adopt the same practice.

R. SHANKAR
Madras

Electronic Typewriters

This has reference to the April issue of your magazine wherein you have brought out special supplement on 'Electronic Typewriters'. On screening through the feature a lot many deficiencies and discrepencies in the article have surfaced to light. We find that our name has not figured amongst the manufacturers of electronic typewriters although, as on today, we are their single largest manufacturer.

The typewriters manufactured by us are sold in various brand names such as 'Tacker' (by Communication Services (India) Pvt Ltd), 'Gestetner' (by Indian Duplicator Co. Ltd), and 'IRS' (by Indian Reprographic Systems Limited—a division of Modi Xerox). We are also marketing these typewriters in our brand name 'Sun Play-Word'.

The following parties whom you have mentioned as manufacturer are indeed only marketing the product and do not possess any manufacturing licence:

1. Advani-Oerlikon Ltd,
   Ador House, 6K Dubash Marg,
   Bombay.