7-Segment Jumbo Displays

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1. Introduction

They do look decorative; those oversized 7-segment displays (see fig. 1). A clock or a thermometer with large digits surly makes an impression in shop windows and homes.

Those large displays in various sizes and designs are available at Kingbright's. A catalogue can be found on:

http://www.kingbright-led.com/Products/LEDDisplays/NUMERIC%20APLPHA-NUMERIC1.htm

See this website for datasheets as well.

Farnell is a German distributor for those displays.

www.farnell.com

Fig. 1 A 7-segment large display in comparison with a EURO coin

A large multi-digit 7-segment display seems to be easily implemented: Just find out its pin assignment, choose a driver circuitry with multiplex operation as possible and connect it to the BASIC-Tiger® as presented in application note 010 – finished. Unfortunately it is not that simple. If you connect such a jumbo display to a MAX7219 nothing will happen at all, simply because producers connect several LEDs in series on each segment to be able to brightly drive them. So forward voltages sum up – with typically 4 diodes the required control voltage increases to about 6 V (4 x 1.5 V). Even the best TTL-IC cannot cope with this, let alone its relatives from the HCT or HC family. Multiplex operation is even more difficult, since higher currents and fast switching operations are required here at least temporarily. For everybody still interested in jumbo displays we will provide some ideas in the following application note.

2. The concept

We would like to operate the display statically, i.e. without multiplexer. We will realise operation with latch in order to keep the controlling effort within reasonable limits and to use BASIC-Tiger® for more than organising the 7 segments of each digit. So we will transmit BCD information to the display, which there will be transformed to a 7 segment format; be saved and be displayed for an arbitrary period of time. This should be done with at least 9 V – a case for the 4000 standard CMOS product family. We choose the CD4511 as our IC. Its data sheet is available on

http://www-s.ti.com/sc/ds/cd4511b.pdf

This CMOS IC can be operated as a 7 segment decoder with latch between 3 V and 18 V. By using a higher supply voltage (~10 V), it becomes simple to drive the fourfold stacked segments, too. Since the CD4511 has kind of a power supply at its outputs, limiting resistors are not required. The circuit is designed for displays with a shared cathode. It requires BCD information at its inputs A, B, C and D for operating. Control lines $\overline{BL}$ (blanking) and $\overline{LT}$ (light test) are usually switched to high. $\overline{BL}$ can be used for switching the display on and off (flashing display). Input $\overline{LE}$ is used for saving information, if the input is low the information is constantly put through, with a low/high edge data are saved in an internal latch.

The CMOS ICs (4000 series) input levels depend on the used operating voltage which can be between 3 V and 18 V. You cannot operate such a circuitry safely at 10 V with ordinary TTL levels as provided by BASIC-Tiger®. That is why we will use simple transistor stages for converting levels in our application. They may negate the information, but this poses no problem to an intelligent system like BASIC-Tiger®.

Virtually the whole system works statically – put the BCD input information at the CD4511, adopt it with low/high edge at LE – finished. In the case of multi digit displays we have to choose either further BASIC-Tiger® control lines (we use L83 – L87 in the underlying case) or a further CMOS IC as a BCD 1-from-X decoder for choosing the according digit. Here level converters have to be provided between BASIC-Tiger® and CD5411, too. In this concept the whole display operates independently, BASIC-Tiger® only has to intervene when new information have to be written. BASIC-Tiger® and its level converters are the core of the circuitry (figure 2), port 8 with its 4 low-order bits provides the digit in a negated BCD format, the high-order bits determine directly which digit (we use four) has to be addressed. This information has to be also negated because of the level converters (i.e. high = active digit). The actual display circuit (figure 3) has a CD4511 for every display. BCD lines are looped through all display elements; every element gets the LE signal individually.

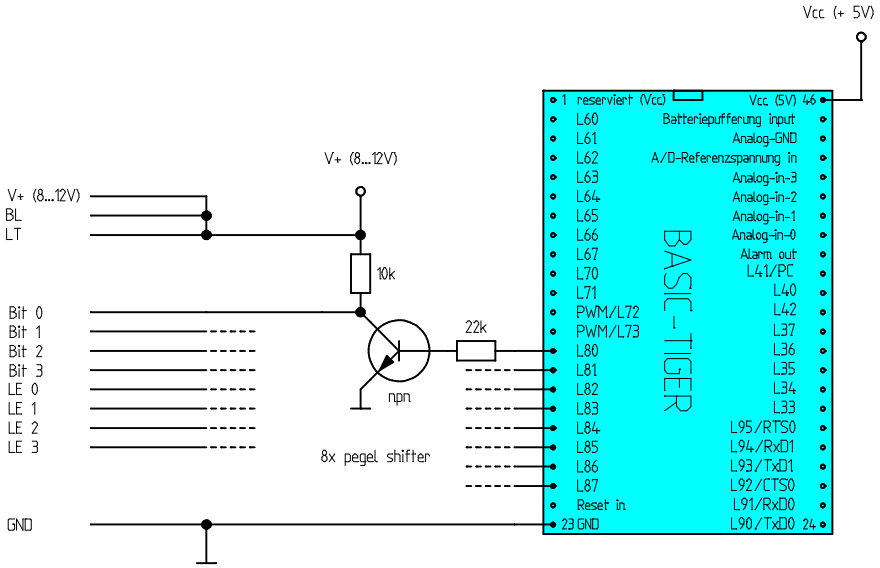

Fig. 2 BASIC-Tiger® with level converters for operating several jumbo displays

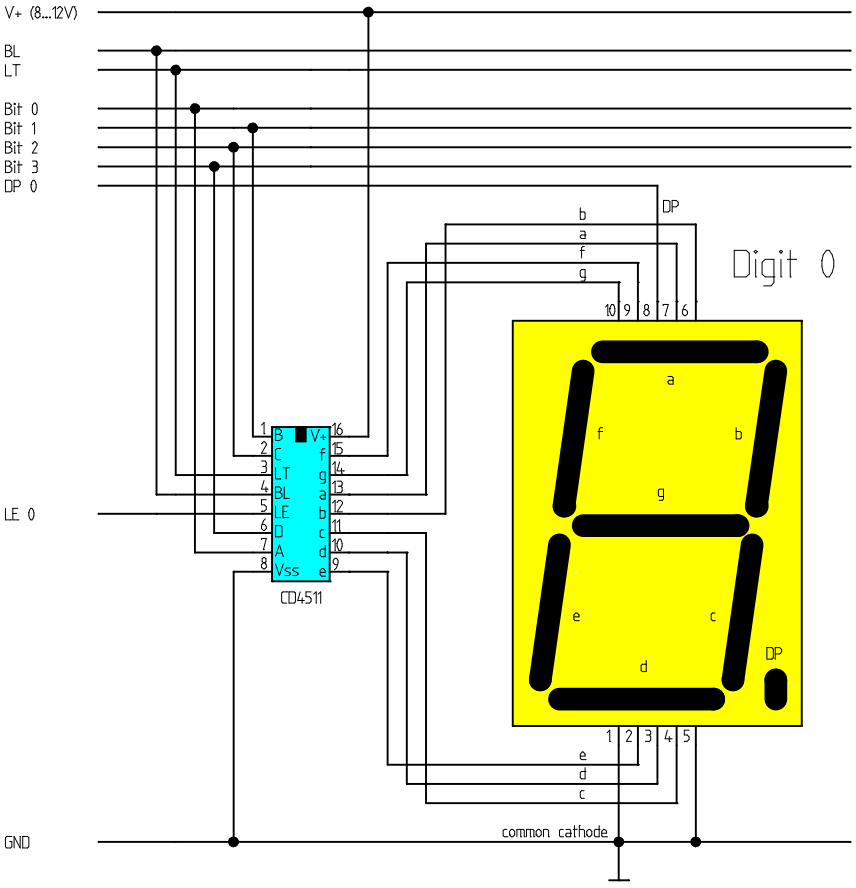

Fig. 3 a display (digit) with a CD4511 7 segment decoder

Thus the display becomes modular – there is one control unit (BASIC-Tiger®) and several display modules having one display and one CD4511 each. The construction allows us to individually put together displays with different digits. The BCD control lines are connected parallel to all CD4511 data inputs. The digit selection lines are also led parallel to all modules. By using jumpers or solder bridges every module gets its "own" line. If more than four digits are needed, other ports or specific ICs can be used additionally. Thereby four-digit clocks, three-digit multimeters, single-digit result displays for ninepins alleys etc. can be produced.

The display supply voltage can be easily conducted from the BASIC-Tiger® Vcc raw voltage in most cases. However, this should be stable and efficient to some extent. A stabilized power supply unit (at 9 V or 12 V) is well suitable for our application. Each digit of the display requires about 200 to 300 mA when controlling all segments.

If a comma is needed, you can either hard-wire it (DP via a suitable resistor at +9V) or control it in the same way as the segments from free BASIC-Tiger® pins via levels converters and transistor stages if necessary. Of course the LED current of DP has to be limited in a suitable way here.

3. Software for a large display

To assure that our display achieves the right effect, we will present two versions of controls in this application note. The first one uses of course BASIC-Tiger® as a command centre. The program JUMBO01.TIG is simple demo software which counts a four-digit number from 0 to 9999 and displays it via the presented hardware base. A four-digit display is of course needed for this.

The PC software JUMBO01.TST is again based on TestPoint and is executable as a runtime module on a Windows® PC (e.g. Windows®98). It displays PC time via the monitor and the parallel interface. The connection is done according to figure 4. Please note that you require an additional power supply at 8...12 V for the display and of course the level converters. Figure 5 shows JUMBO01.TST on a PC monitor. Figure 6 shows a four-digit display which is controlled by this program via a parallel interface LPT1.

Principally it is also possible to control an ordinary LED 7 segment display using this circuitry and the sample software. In this case the 5 V of the BASIC-Tiger® power supply (Vcc) is sufficient. Please note that the CD4511 always requires displays with a shared cathode.

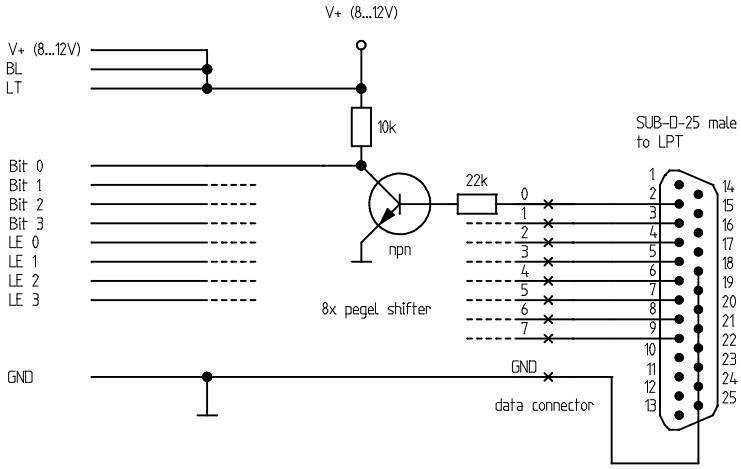

Fig. 4 Connection to the parallel PC interface LPT1

Fig. 5 JUMBO01.TST is a PC clock program and ...

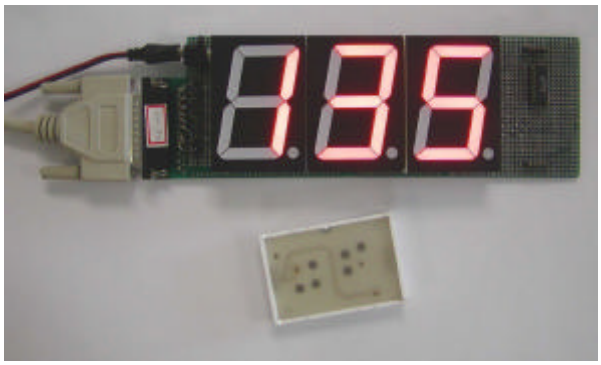

Fig. 6 ... it controls a 7 segment large display via LPT1

Have fun experimenting with the new jumbo display!