THE 1972 DIGEEC NIXIE CLOCK FROM EUROPEAN ELECTRONIC COUNTING LTD (EEC) AND THE MYSTERY 28 PIN *CMOS LSI* CHIP.

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Background:

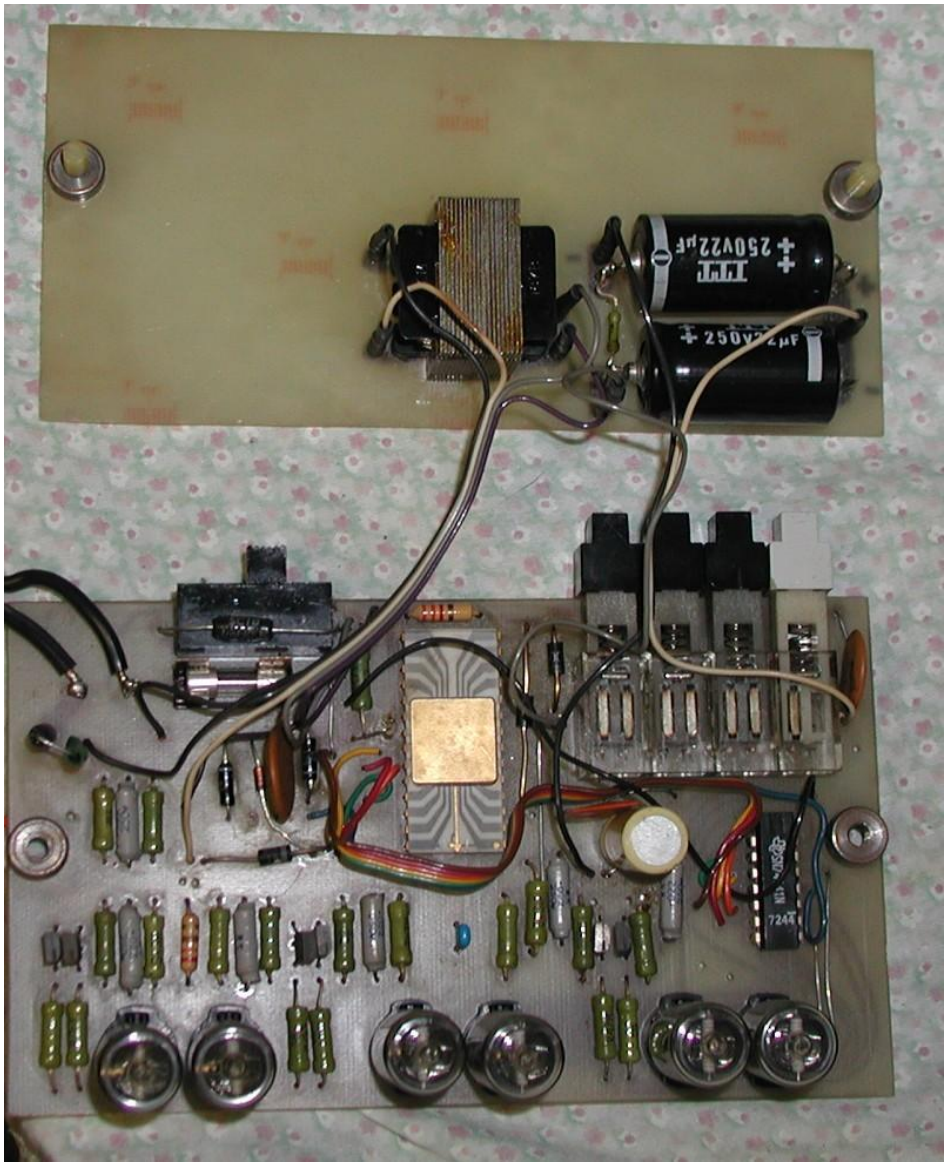
In the early 1970's a number of companies were trying their hands at Electronic Clock making for domestic markets. LED's in seven segment form were already available and many clocks had been built using these and TTL IC's. It was obvious though that all of the requirements for a domestic clock could be built onto one LSI (large scale integration) chip. The pioneers of LSI IC's were AMI (American Microelectronics Inc) and Texas Instruments among others. Also, as another example, in the early 70's circuits using large arrays of TTL IC's (> 60) such as Atari's Arcade Pong game, were quickly replaced by the mid 1970's with the entire game on a single LSI chip for their home Pong units.

The clock featured in this article is a Nixie Display based clock. It was made by EEC in the UK. It features a very early LSI chip. In fact so early as yet I have not been able to identify the type number, or who made it. There are no markings on it. The interesting thing though is that despite this cutting edge LSI technology, the manufacturers went with Nixie rather than LED displays. This LSI chip could have been used with LED's using an appropriated BCD to seven segment decoder IC rather than the "one of 10" style SN74141decoder IC. However it does make for a remarkable and unique clock with the combination of cutting edge and vintage technologies. This particular clock was set up for the American market and configured to run from 110V @ 60 Hz.

Clock design, form & function:

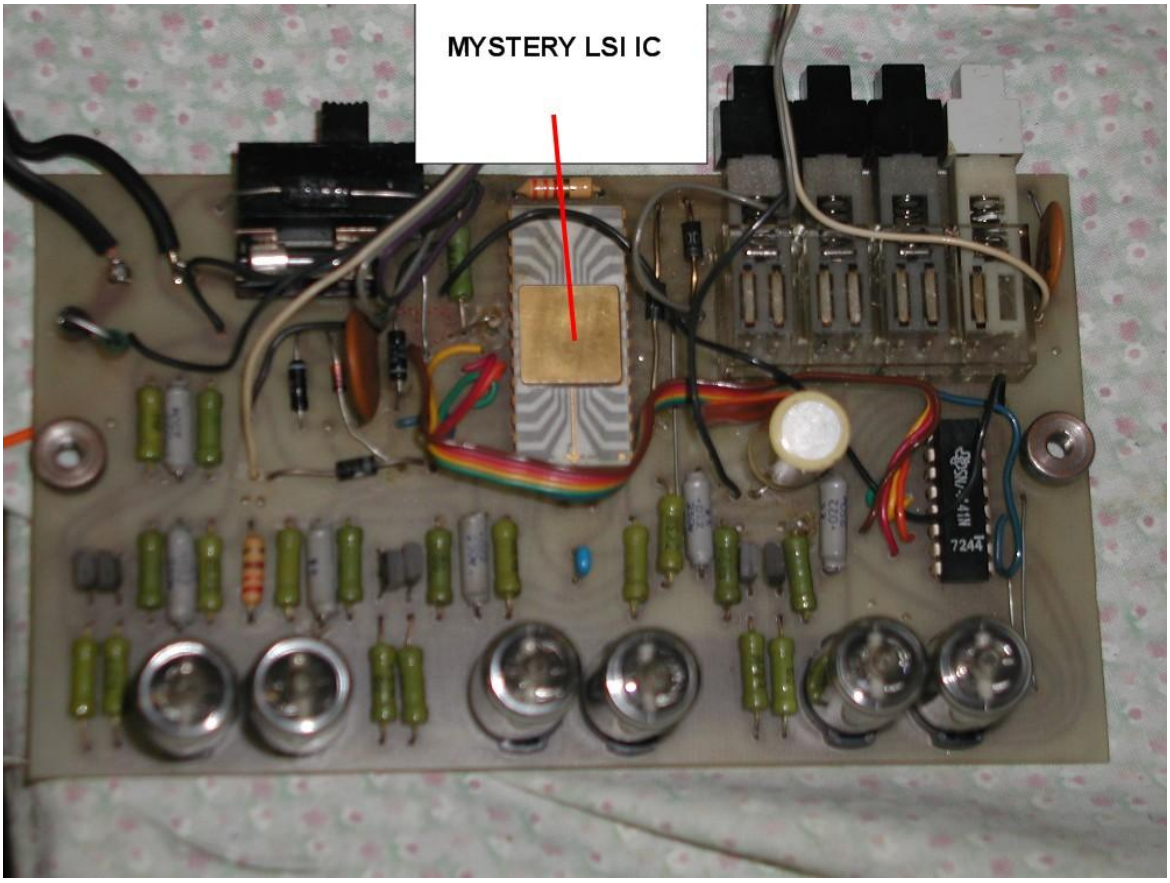
The clock is a 12 or 24 Hr clock which is a good feature. The photo below shows the clock removed from its housing:

The housing is elegant, unpretentious and cleverly put together. There are two side plates, the rear and front panels and the two PCB's. When assembled as shown in the photo above they fit neatly into the external housing. The top PCB contains the power supply components. The photo below shows the two PCB's on the component surfaces:



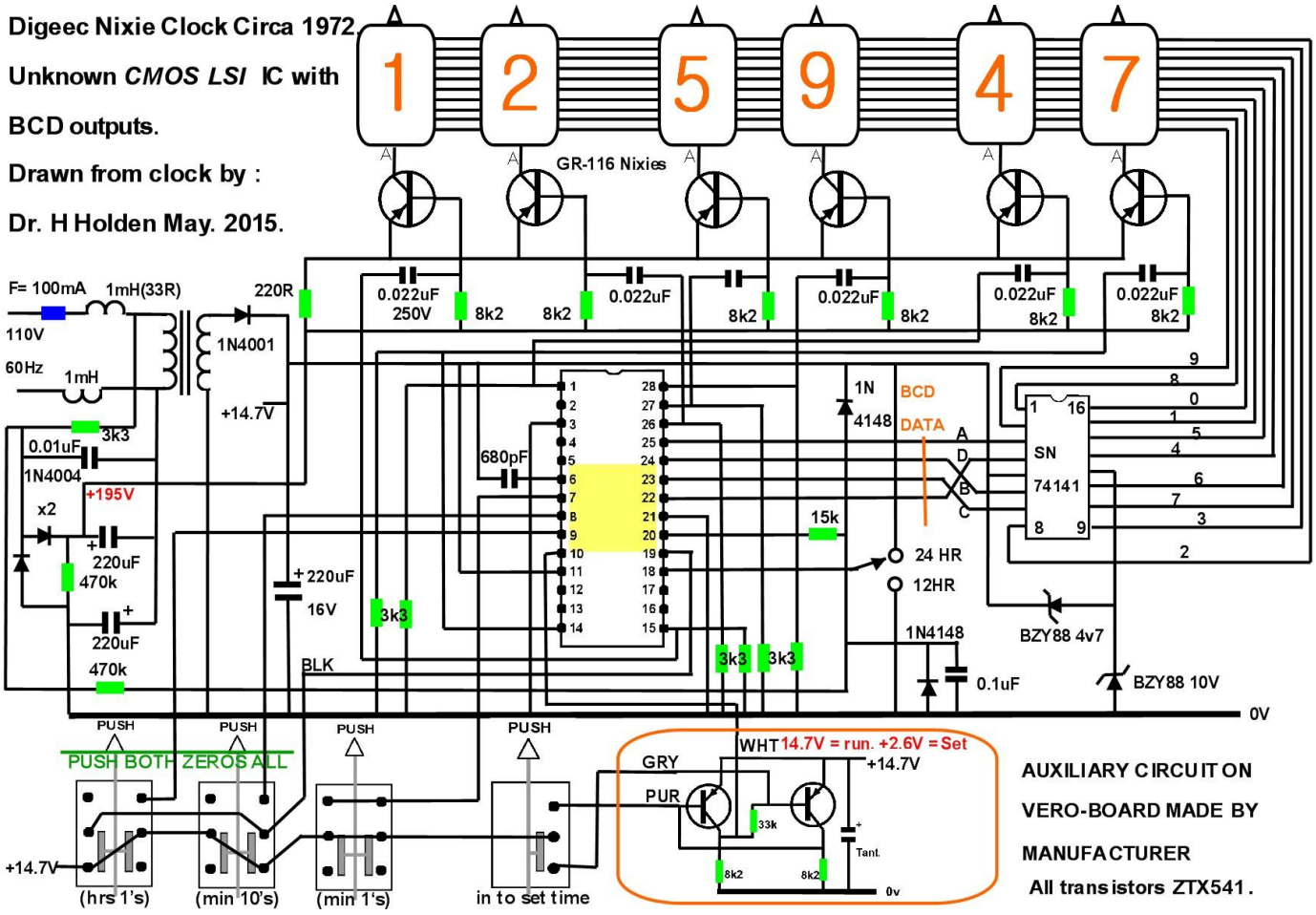
Ribbon cable connects the two pcb's and also the BCD data from the LSI chip is connected to the display driver IC (a SN74141) by a section of ribbon cable rather than pcb tracks. The green resistors are Russian made which is interesting.

Right away those interested in nixie clocks will note there is only one SN74141 driver IC. Many nixie clocks have one IC for each nixie. This is possible because the LSI chip multiplexes the displays (see below). The other photo below shows this mystery LSI chip at a closer view. There are a number of 12-24Hr mode 28 pin clock IC's from the 1970's era. But typically they do not have BCD outputs, they have (not)BCD or inverted BCD outputs and also different pin configurations.



The clock had been modified by the manufacturers for the American market. There is a voltage doubler circuit for the nixie anode supply and also a two transistor circuit built on vero board.

No schematic was available so I copied it out from the actual clock. This was a requirement as I wanted to convert the clock to run on 50Hz not 60Hz:



Circuit Discussion:

When the clock is first turned on, the counter outputs from the LSI chip can correspond to a BCD number greater than 9. Under these conditions the SN74141 IC does not energise any segment, in other words all its outputs are blanked. This results in an odd effect where all of the numbers in the nixie tube simultaneously glow faintly due to the leakage currents via the SN74141 IC's outputs. The manufacturers obviously knew about this quirk so they arranged it so when two of the set buttons (for HRS & MIN) where simultaneously pushed, in the set mode, all the counters in the LSI chip are zeroed setting the display to 00:00:00. When the clock is in operation, those invalid counter outputs seen at "power turn on" never occur due to the internal gating inside the LSI chip.

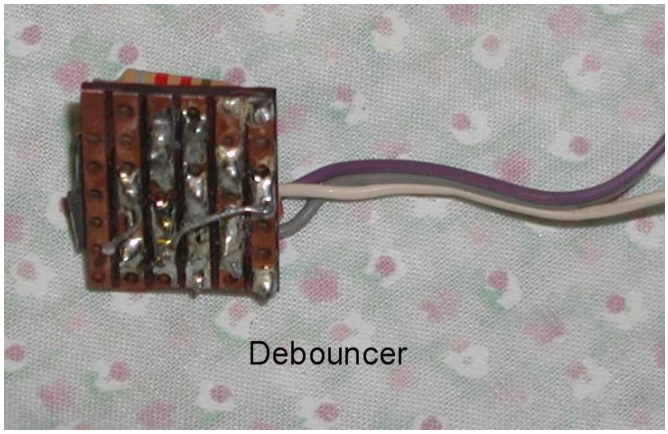
As can bee seen from the circuit, the LSI chip multiplexes the display by alternately switching the correct BCD code to the 74141 while at the same time driving the appropriate nixies anode circuits via AC coupling to the pnp driver transistors to select the correct nixie the decoded BCD data corresponds to.

The power to the LSI IC is kept stable by the two series zener diodes. Due to the fact the transformer is very small and has fairly high primary and secondary DC resistances

(1k2 primary and 85R secondary) they did not have a ballast resistor in series to limit the zener current. Pin 6 has the 680pF capacitor which sets the multiplex timing. Scoping this shows a 35kHz sawtooth like wave.

I noticed on the pcb there had been a modification where pin 21 and 20 had been reversed. In the clock as I received it, it was set for 60Hz operation. I reversed the connections (back to what it would have been unmodified) with now pin 20 grounded and the mains timing frequency injected into pin 21, and it started counting correctly for 50Hz mains frequency. That was a bit of luck, since many other LSI clock IC's have a separate pin to select 50/60Hz operation and I do not have the IC's data sheet.

Of note is the two transistor circuit added by the manufacturer. It was they who added it because the ZTX541 pnp transistor and the resistors match those in the rest of the clock. They did a pretty poor job of making it in my opinion, looking just thrown together on a small section of vero board:



Looking at this added circuit, it is two stages of logic inversion with the output coupled back to the input. This is a contact debounce circuit. I removed it and connected the set time switch input back into pin 10 directly, as it had been before this modification had been made. The clock set function still works, but occasionally, coming out of set mode, the seconds value resets to zero. So clearly this debounce modification was an after thought perhaps to satisfy the American market where the owner might have wanted to exactly synchronise the indicated seconds value by waiting for the real time seconds value to match that on the display before coming out of set mode, since there is no seconds set button on this clock.

If anybody out there knows the type number and manufacturer of this LSI chip, please email me: Hugo.holden9@gmail.com