# Sony SOBAX 2500 Calculator

## Contents

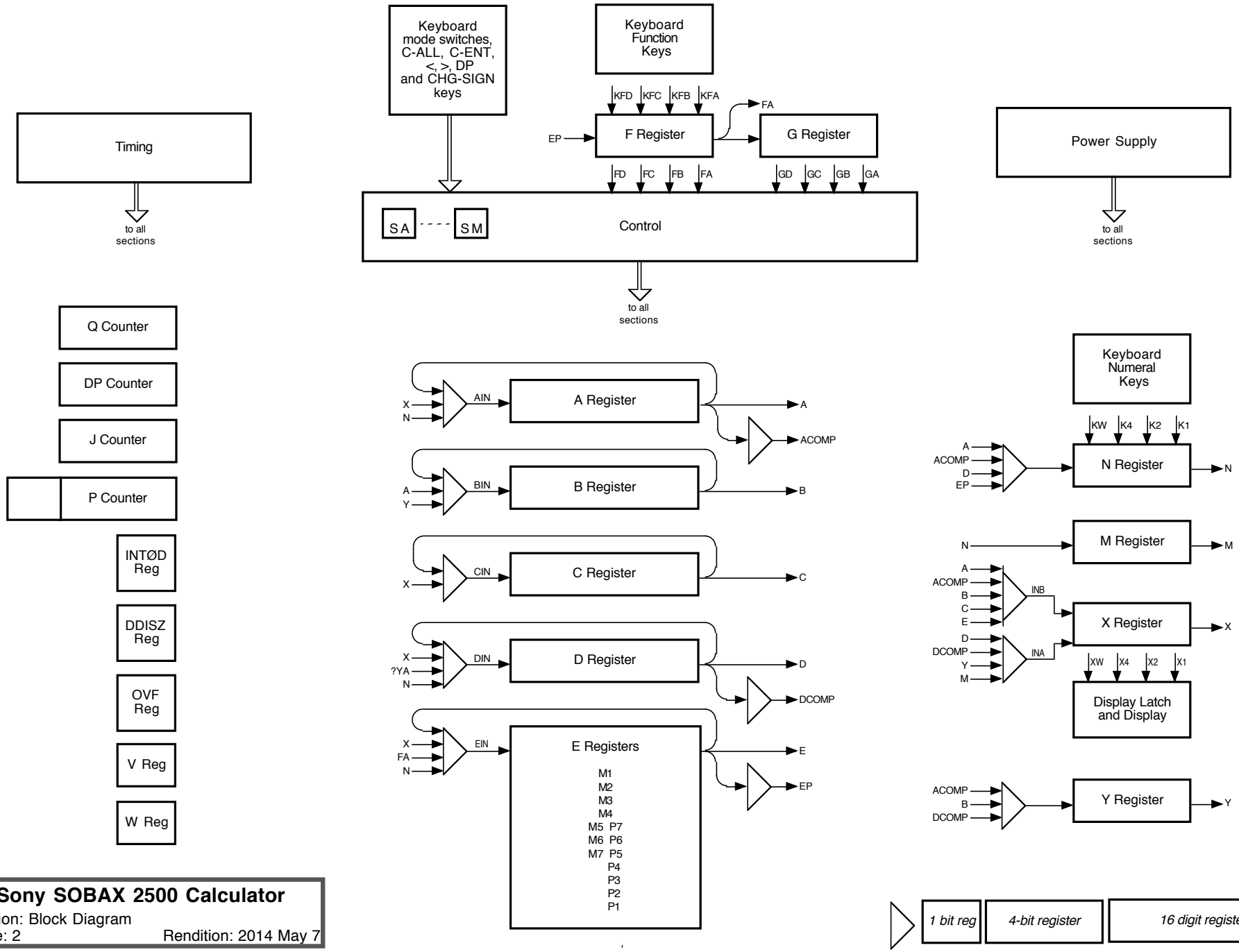


## Notes

- The symbol ▼ denotes V+4.
- ——►► connection between different sections.
  ——▷▷ connection limited to same section.
  Arrows indicate direction of signal or energy flow.
- A lowercase 'n' at the beginning of a symbol name indicates the logical NOT operation.
- Resistance in ohms unless otherwise indicated.
- Capacitance in microfarads unless otherwise indicated.
- The Acoustic Delay Line is based on magnetostrictive principles.
  See the article "Magnetostrictive Delay Lines" in "Electronics World", Jan. 1964.
- These drawings based on unit with Serial No. 620173 which contains a Board F marked with 1-539-224-12. Component values marked with "*" are the values for Board F marked with 1-539-224-11.

## Log

- 1999 Sep-Nov: Initial drawing / bhilpert.
- 2005 Feb 19: MSYNC source corrected, comes from Q7 rather than Q8. Corrections to labels on flip-flops in display page.
- 2005 Feb 20: Some additional labeling of "*" components for board F.
- 2014 May: Backplane connectors correction for V+4/GND, numeric key coupling distinguished, other minor reorganisation.




**Sony SOBAX 2500 Calculator**

Section: Block Diagram

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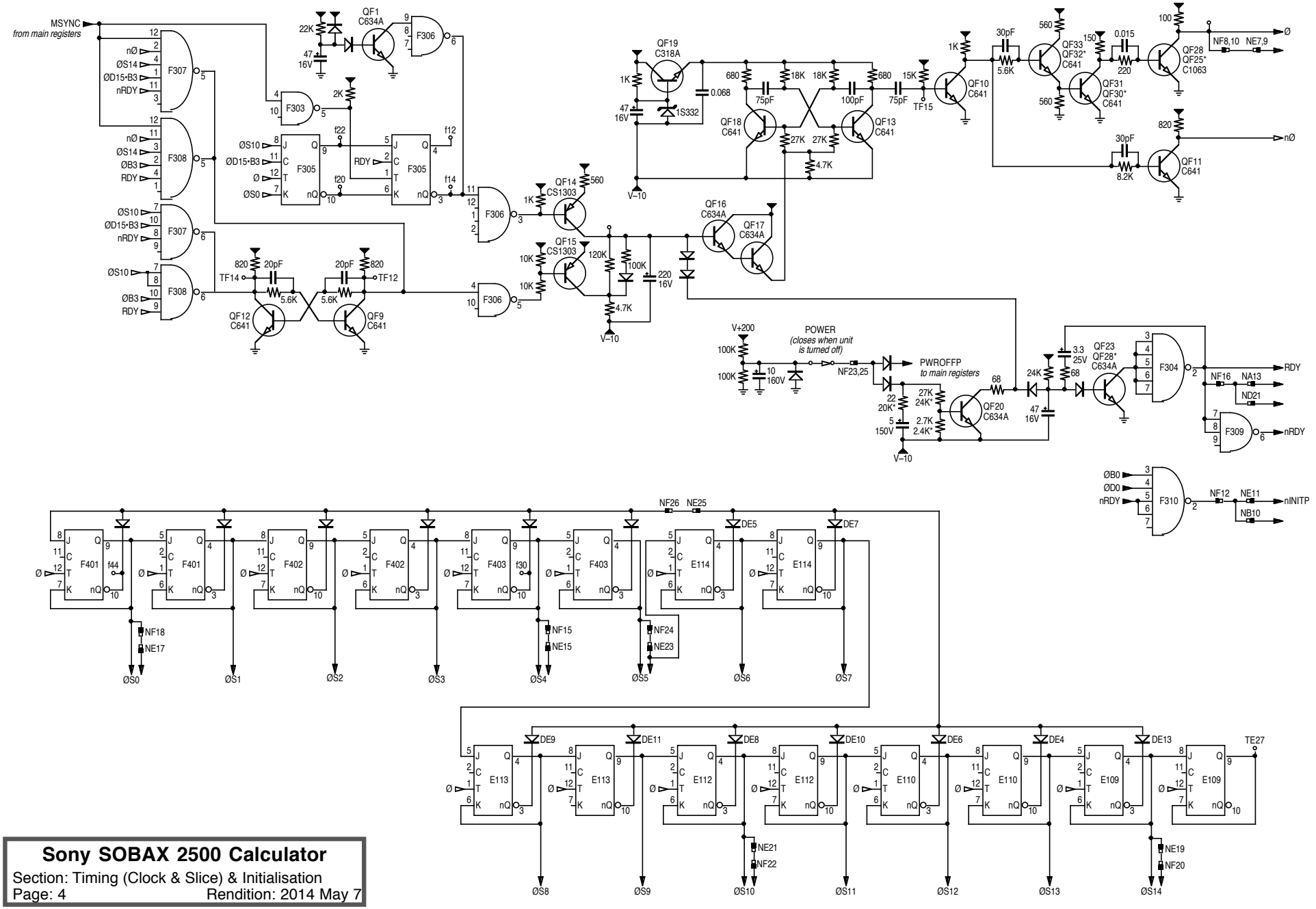
| Section | Signal | Description |
|---|---|---|
| Timing | | Master timing and power-on initialisation. |
| | Ø | Master clock. |
| | ØS... | Sliced bit timing. The bits of the 15 main registers are interleaved in the Acoustic Delay Line by slicing each 'major' bit into 16 parts. The remaining slice is used for synchronizing the frequency of the master clock to the cycle time of the delay line. |
| | ØB... | 'Major' bit timing. |
| | ØD... | Digit timing (4 major bits constitutes a digit). |
| | ØDINS | During some calculation phases, the 16-digit cycle is extended one digit period by inserting another 'digit' between ØD11 and ØD12. The inserted period is ØDINS. |
| | RDY | Ready. Low when power is turned on, goes high after initialisation is complete. |
| | INITP | Initialisation pulses. A stream of pulses during initialisation (not-ready). |
| | PWROFFP | Power Off Pulse. |
| Keyboard | | The keyboard and encoders for numerals and functions. |
| | KMAN | Manual mode. |
| | KAUTO | Execute program mode. |
| | KLEARN | Learn program mode. |
| | KOPER | Operate mode. |
| | KCHECK | Check program mode. |
| | KMAO | Manual / Auto / Operate. |
| | KTON | Tally mode on. |
| | KTREAD | Tally read. |
| | KR54 | 5 up / 4 down rounding mode. |
| | KRDWN | Round down mode (truncate). |
| | KRØD | Selected digit pulse for rounding. |
| | KCA | Clear all. |
| | KCE | Clear entry. |
| | KSL | Shift left. |
| | KSR | Shift right. |
| | KSCS | Shift or change sign. |
| | KDP | Decimal point. |
| | KPS | Program step (S key). |
| | KFA,KFB,KFC,KFD | Encoded function keys. These are the same as FA, FB, FC, FD. |
| | K1,K2,K4,KW | Encoded numeral keys. |
| Control | | Control registers & logic. |
| | F... | 4 bit register for function keystrokes and program instructions to be executed. |
| | G.. | Secondary function register loaded from the F register. |
| | S.. | Assorted state registers. All these registers clock on a 16-digit cycle (17 when ØDINS active). |
| | T... | Misc control logic. These are combinations of the state registers. |
| | U... | More control logic. These are combinations of the function register and state registers. |
| | AISNEG | Indicates the number in the A register is negative. (Appears to also be used for other purposes). |
| | DISNEG | Indicates the number in the D register is negative. |
| | ANEGJ | |
| Q Counter | | 16 squared counter. Counter for16 cycles of 16 or 17 digits. |
| | Q | |
| | QA | |
| DP Counter | | Decimal point timing counter. |
| | DP | Signal to the display to turn on the decimal point at the appropriate times. |
| | UNITØD | Pulses during the digit which is currently the units digit. |
| | CHGSGN | Change Sign. |
| J Counter | | Multi-use counter for fraction fill count, digit position to start zero blanking and more. |
| | J | |
| | JA, JB, JC | |

| Section | Signal | Description |
|---|---|---|
| P Counter | | The program counter. This must select one of the 7 program registers in the E group as well as track a position within the selected register. |
| | PØS | Timing slice for selecting 1 of 7 program registers in the E register group. |
| | P1ST | Program at beginning. |
| | PEXP | Program memory expended. |
| | POVF | |
| | PA | |
| N Register | | 4-bit register for numeric keystrokes. |
| | N | Bit stream from the N register. |
| | NPRESS | Numeric key has been pressed. |
| | NPRESSA | |
| M Register | | 4-bit register to indicate which memory is currently selected. |
| | M | Bit stream from the M register. |
| | MØS | Timing slice for selecting 1 of 7 memory registers in the E register group. |
| | MEM1 | Memory 1 is selected. |
| Main Data Switches | | Data switches to select inputs to the Main Registers. |
| | AIN | Bit stream into the A register. |
| | BIN | |
| | CIN | |
| | DIN | |
| | EIN | |
| | EIN_ENB | Enable the input to the currently selected register in the E register group. |
| | ACOMP | Complementary form of bit stream from the A register in accordance with AISNEG. |
| | DCOMP | Complementary form of bit stream from the D register in accordance with DISNEG. |
| | EP | Bit stream from the E register for program instruction purposes. |
| Main Registers | | 15 16-digit registers for the operands and program instructions. |
| | A | Bit stream from the A register. The A register mimics the D register but with zeroes (1000) mapped to 0000. |
| | B | Bit stream from the B register. |
| | C | Bit stream from the C register. |
| | D | Bit stream from the D register. The D register contains the number being displayed. Displayed zeroes are encoded as 1000 and blanked zeroes as 0000. |
| | E | 11 16-digit registers shared between the 7 memories and program instructions. 4 of these registers are reserved for memories 1,2,3 and 4. 4 are reserved for program instructions. The remaining 3 are shared by memories 5,6,7 and program instructions in reverse overlapping order. Thus a long program will cut into memory 7, then memory 6 then 5. The maximum length of a program is (4+3)*16=112 instructions (functions). |
| | MSYNC | Signal from the delay line to automatic frequency control circuit for the master clock. |
| X Register | | 4-bit register for arithemetic and transferring numerals on their way from the D register to the display. |
| | X | Bit stream from the X register. |
| | X1,X2,X4,XW | Numerals on their way to the display. |
| | XOVF | |
| | CA | Carry Flag. |
| Y Register | | 4-bit register. |
| | Y | |
| | YR54 | |
| | YA,YB,YC | |
| Misc. Registers | | |
| | INTØD | Goes high during digits which are part of the integral portion of the number. |
| | RNDØD | |
| | DDISZ | Output from a register which assesses whether the current register D digit is zero. |
| | OVF | Overflow latch. |
| | V | 1-bit register. |
| | VA, VB, VC | |
| | W | 1-bit register. |




**Sony SOBAX 2500 Calculator**

Section: Timing (Clock & Slice) & Initialisation

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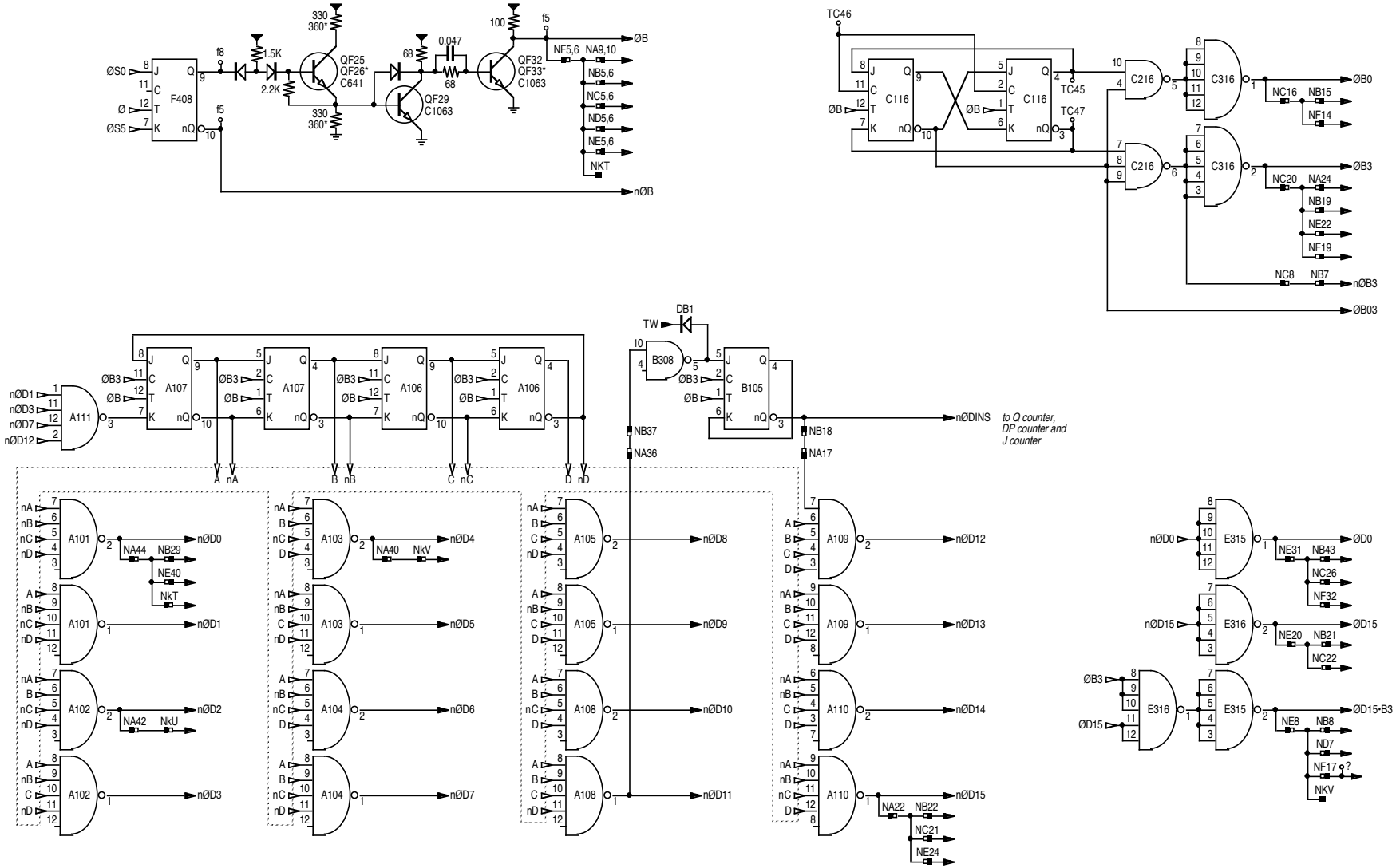


**Sony SOBAX 2500 Calculator**

Section: Timing (Bit & Digit)

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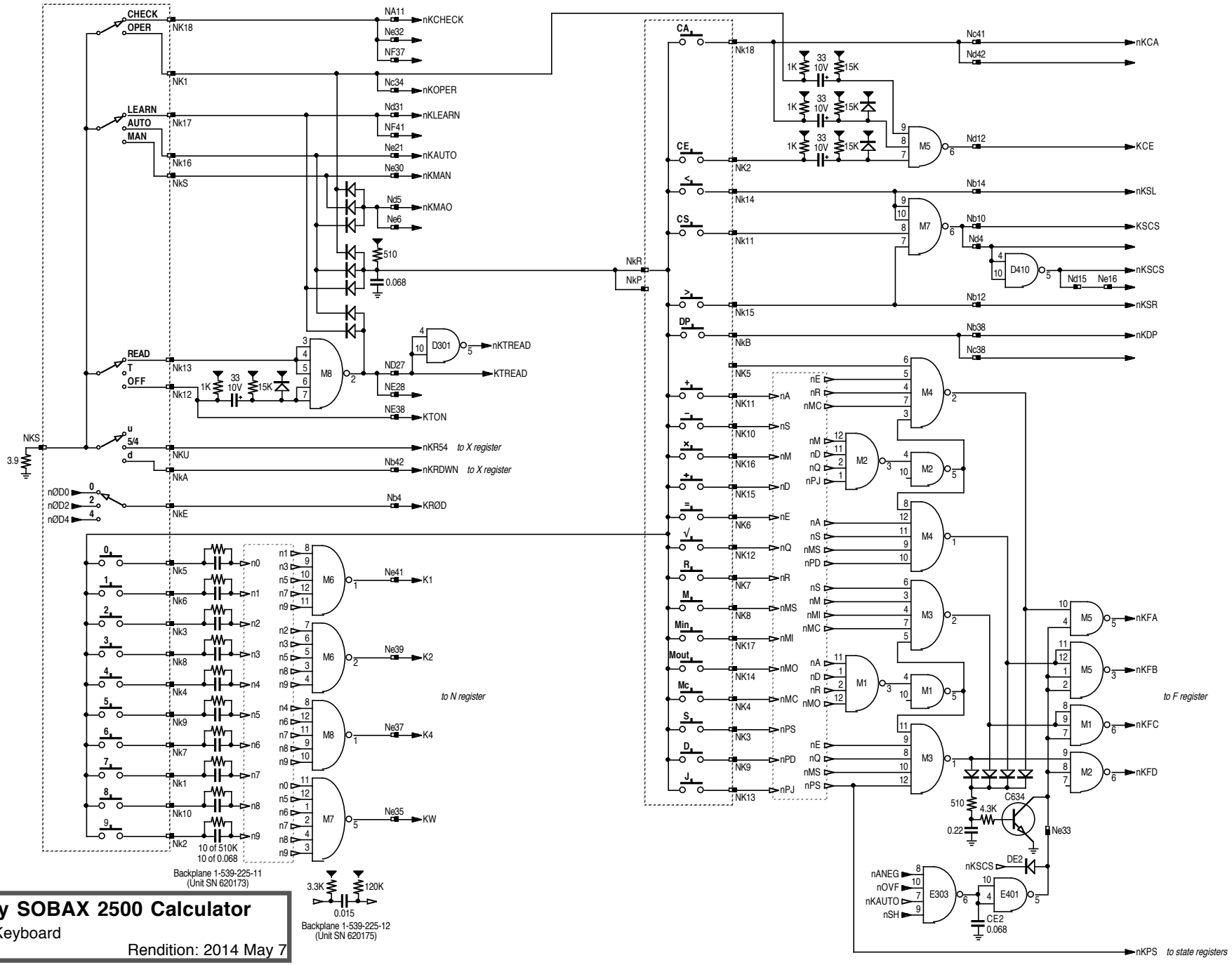


**Sony SOBAX 2500 Calculator**

Section: Keyboard

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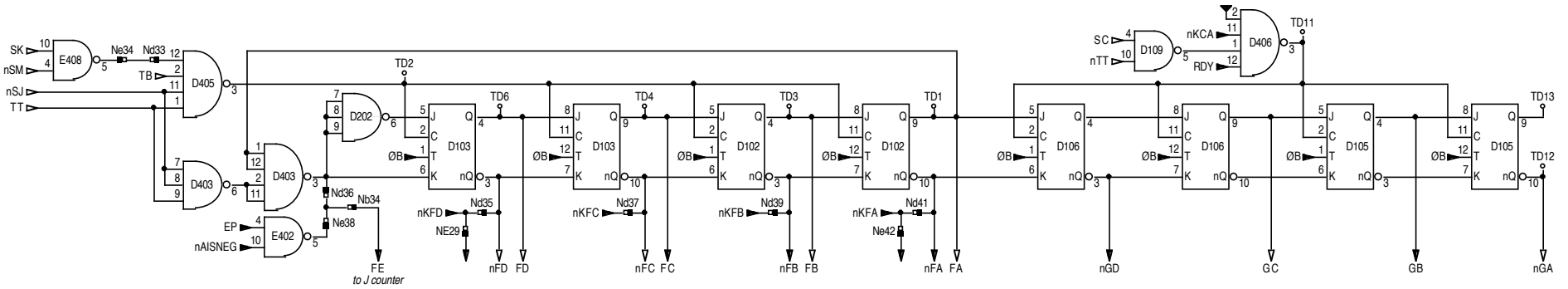


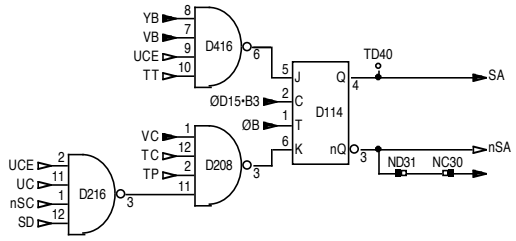


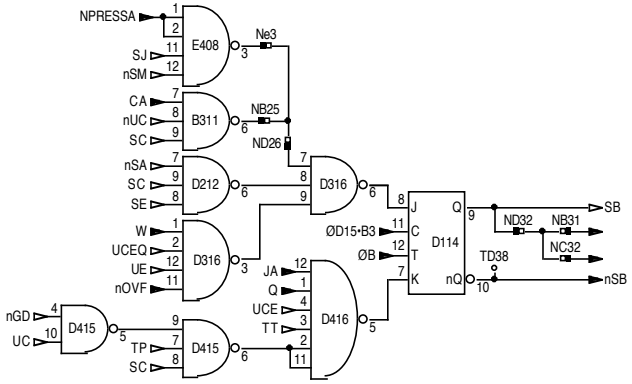


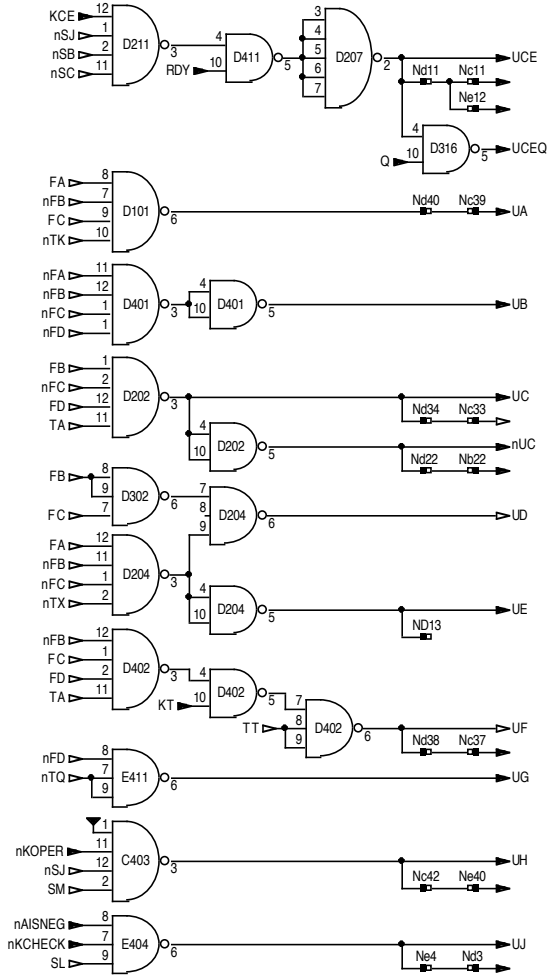


**Sony SOBAX 2500 Calculator**

Section: Control (part 1)

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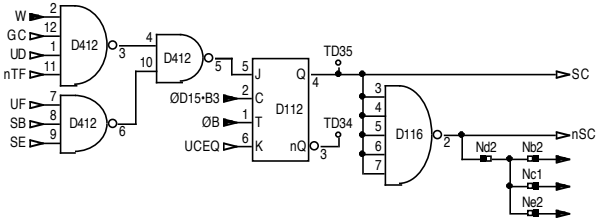


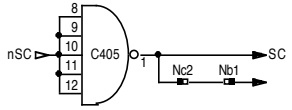


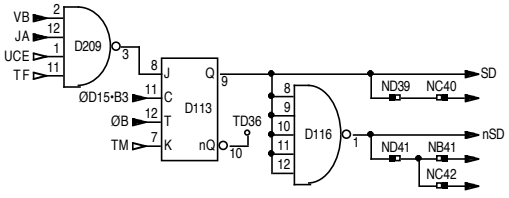





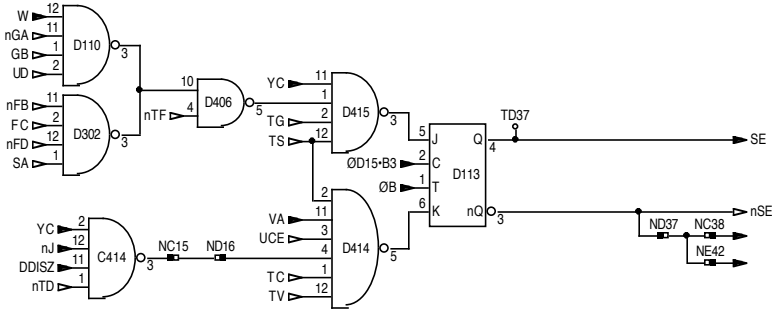


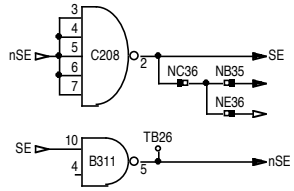


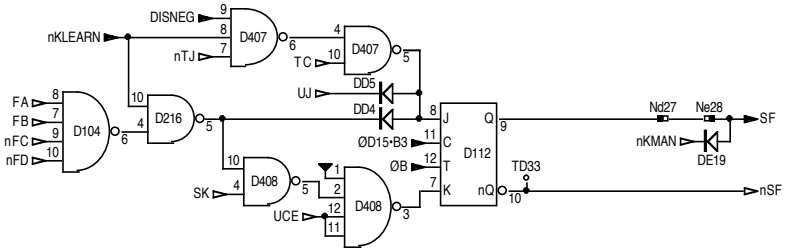


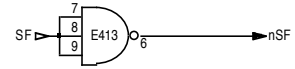


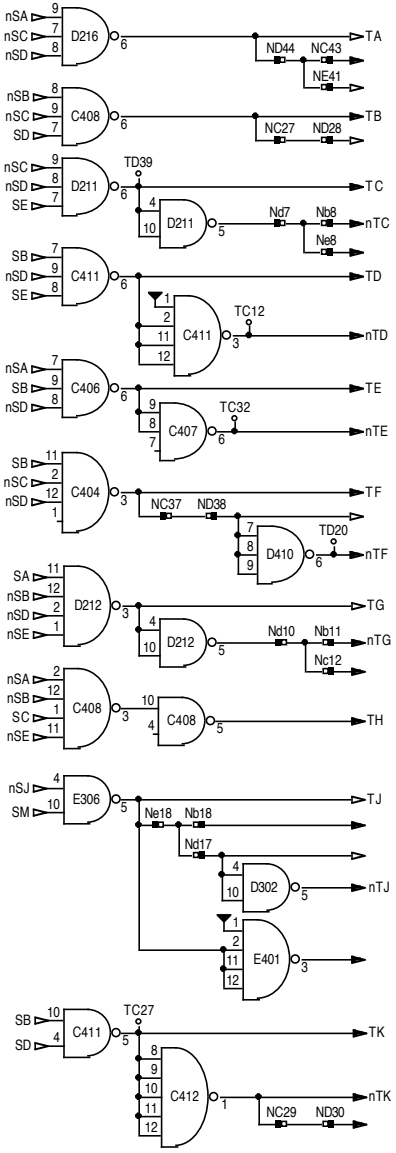


**Sony SOBAX 2500 Calculator**

Section: Control (part 2)

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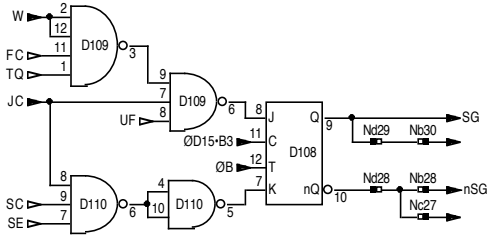


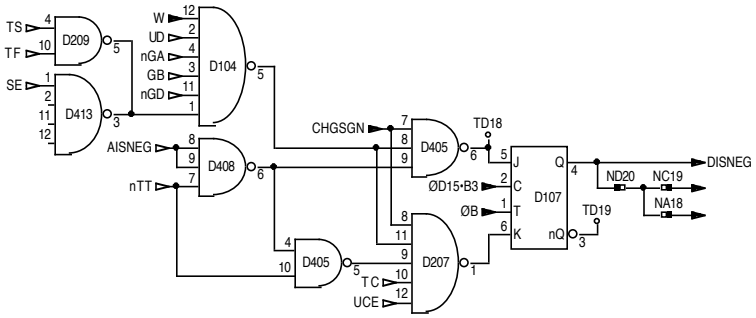


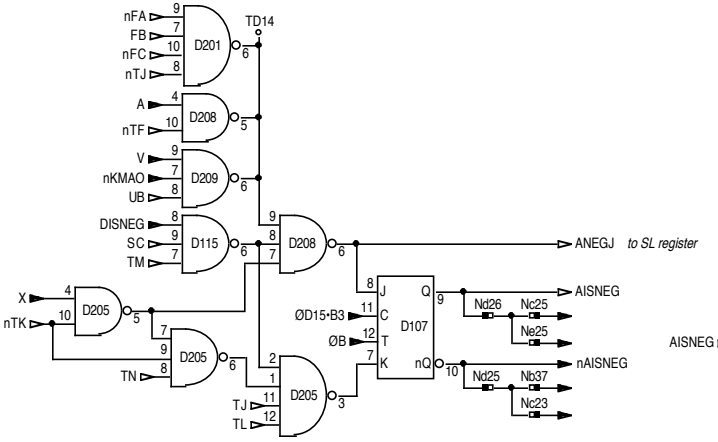


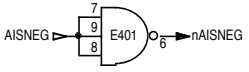


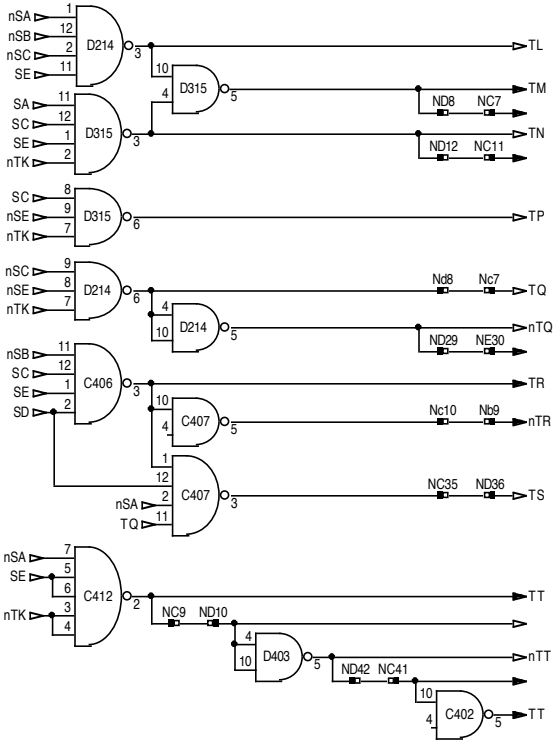


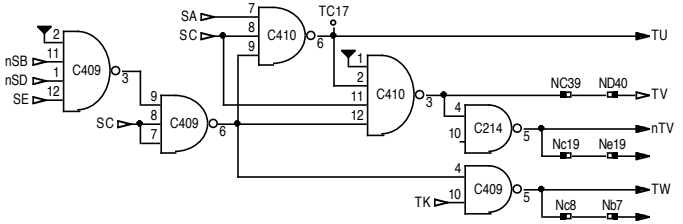


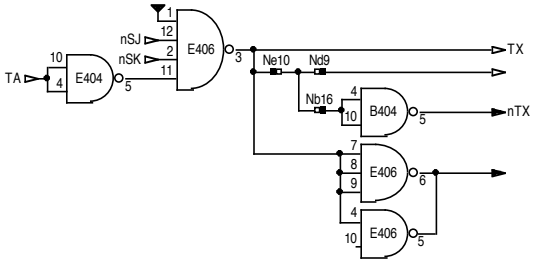


**Sony SOBAX 2500 Calculator**

Section: Control (part 3)

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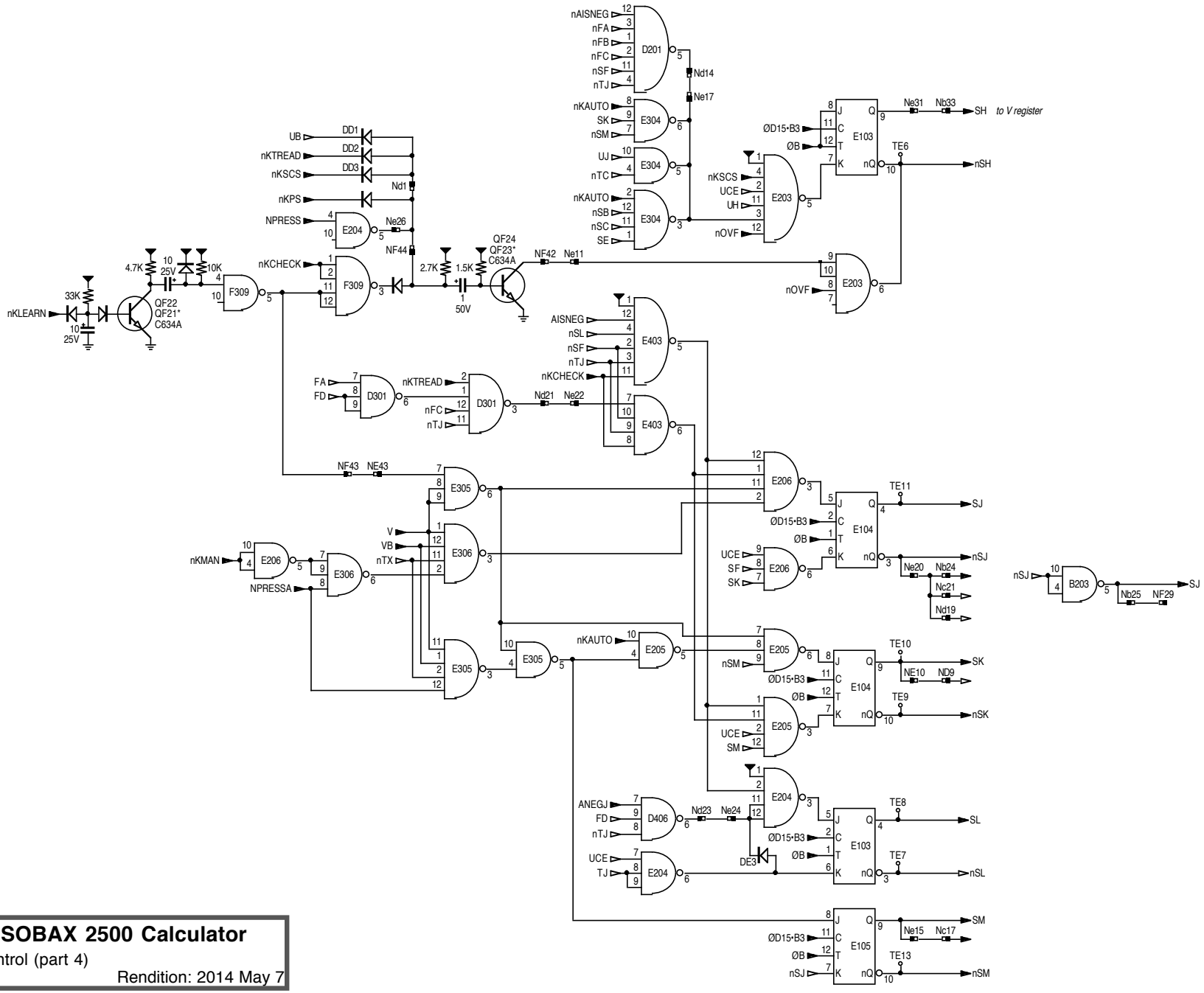


**Sony SOBAX 2500 Calculator**

Section: Control (part 4)

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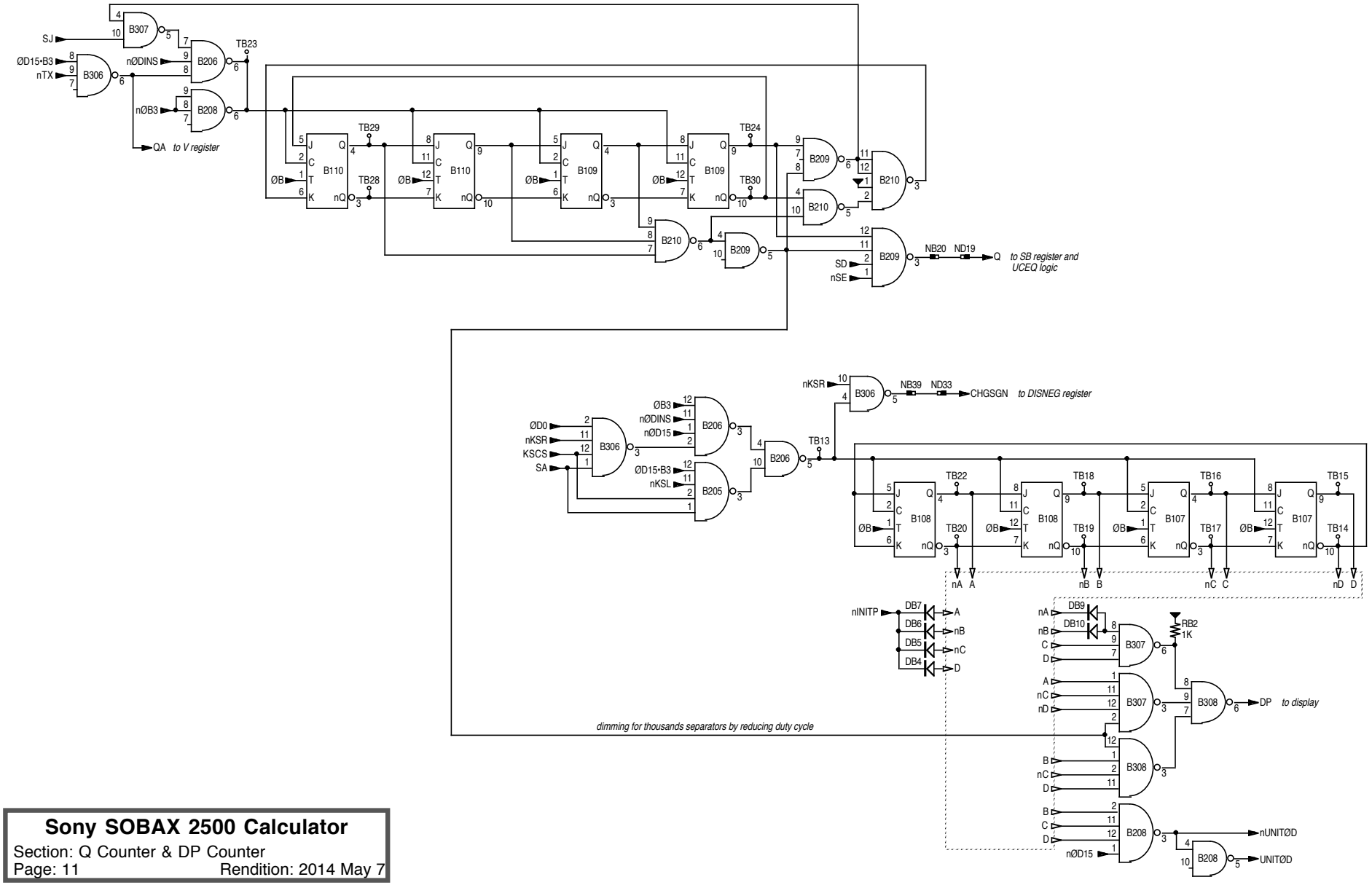


**Sony SOBAX 2500 Calculator**

Section: Q Counter & DP Counter

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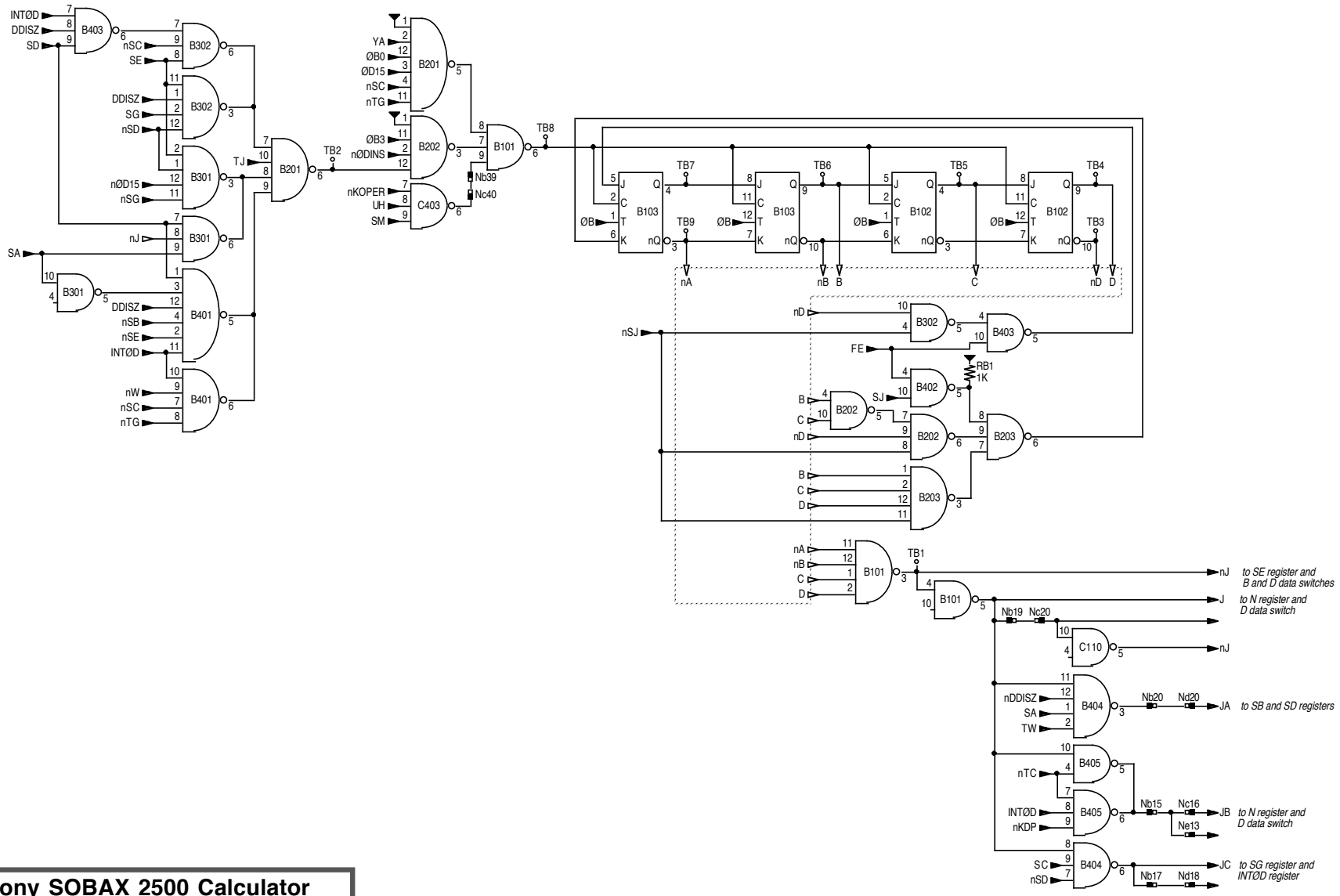


**Sony SOBAX 2500 Calculator**

Section: J Counter

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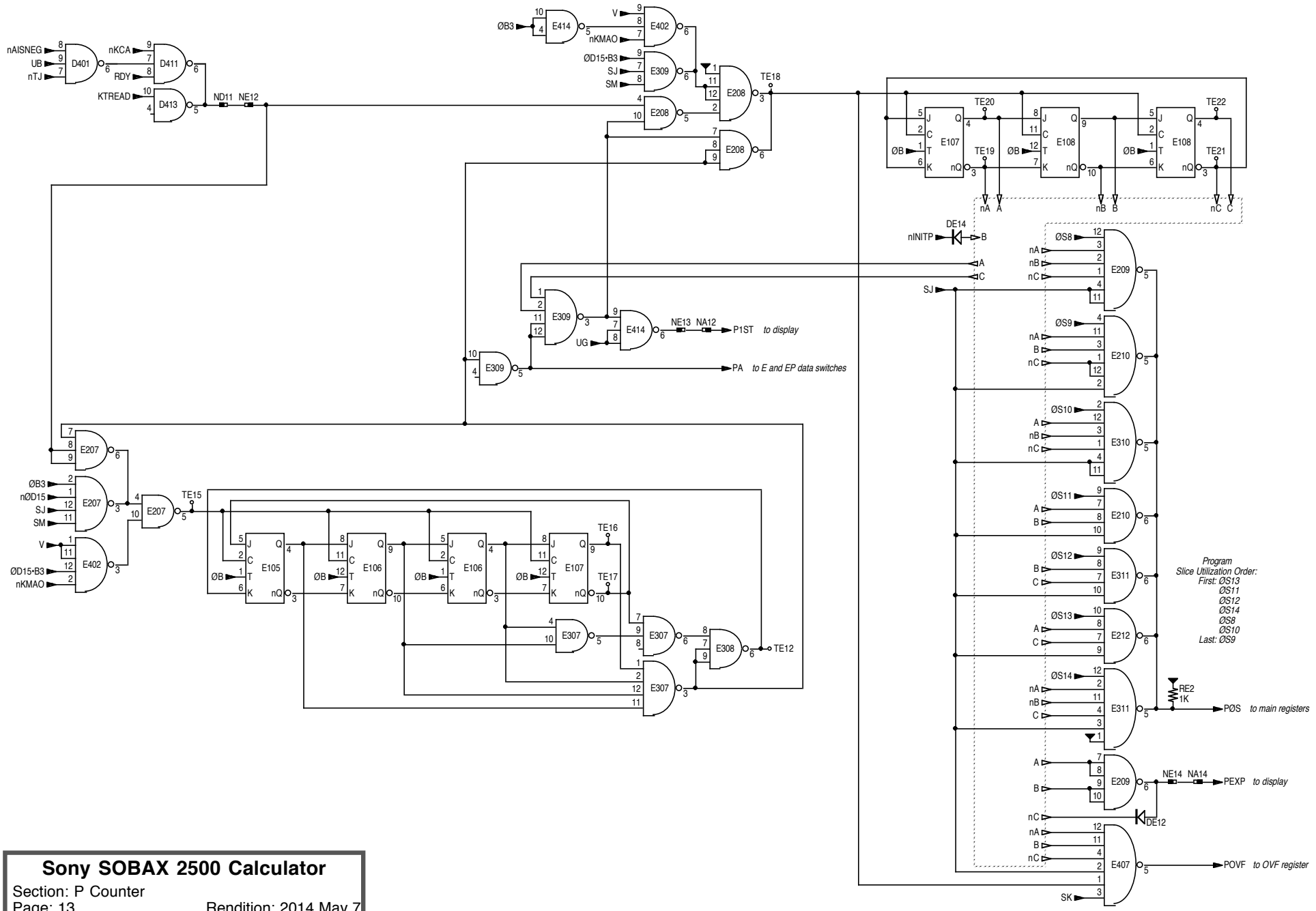


**Sony SOBAX 2500 Calculator**

Section: P Counter

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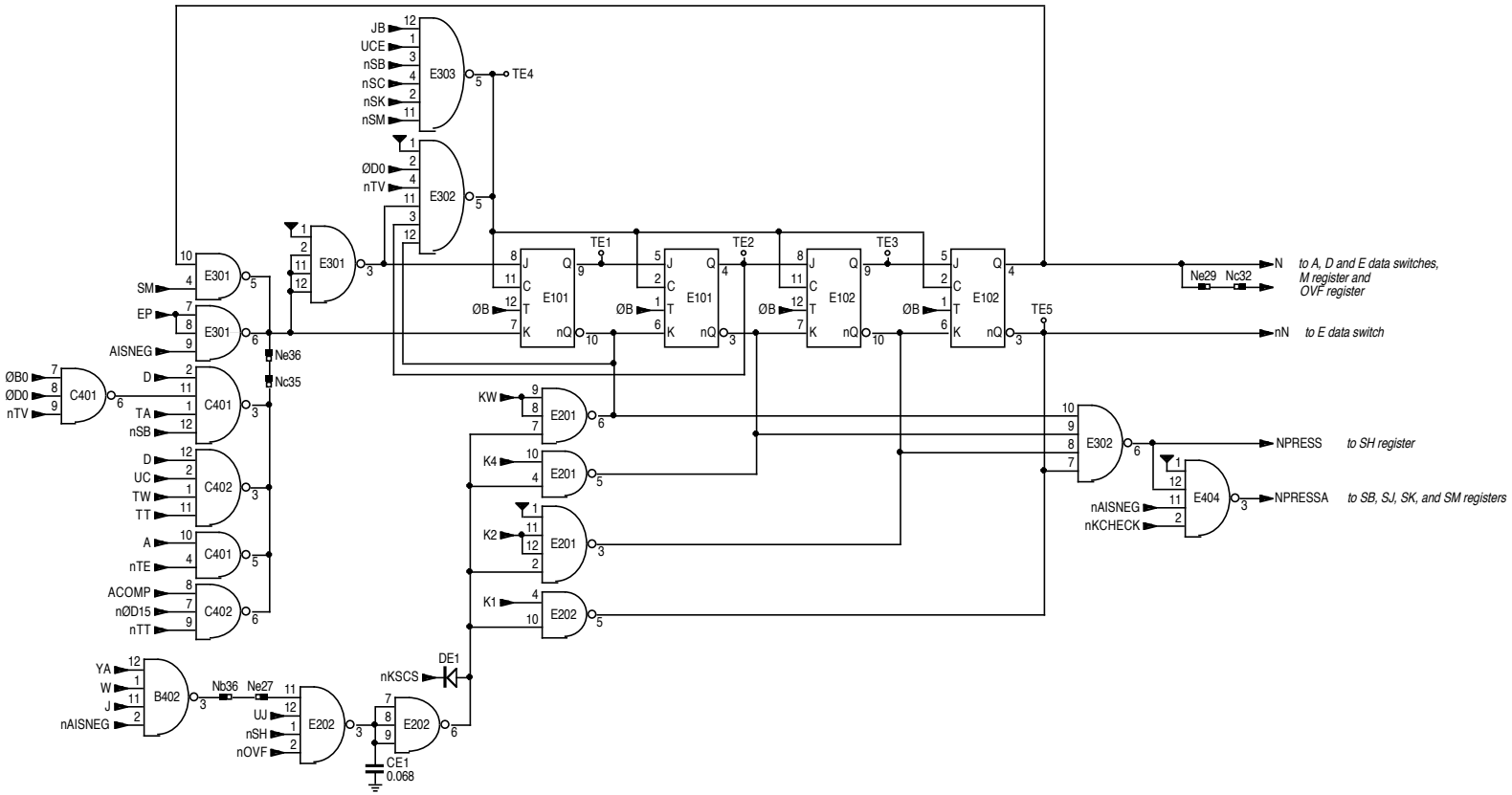


**Sony SOBAX 2500 Calculator**

Section: N Register

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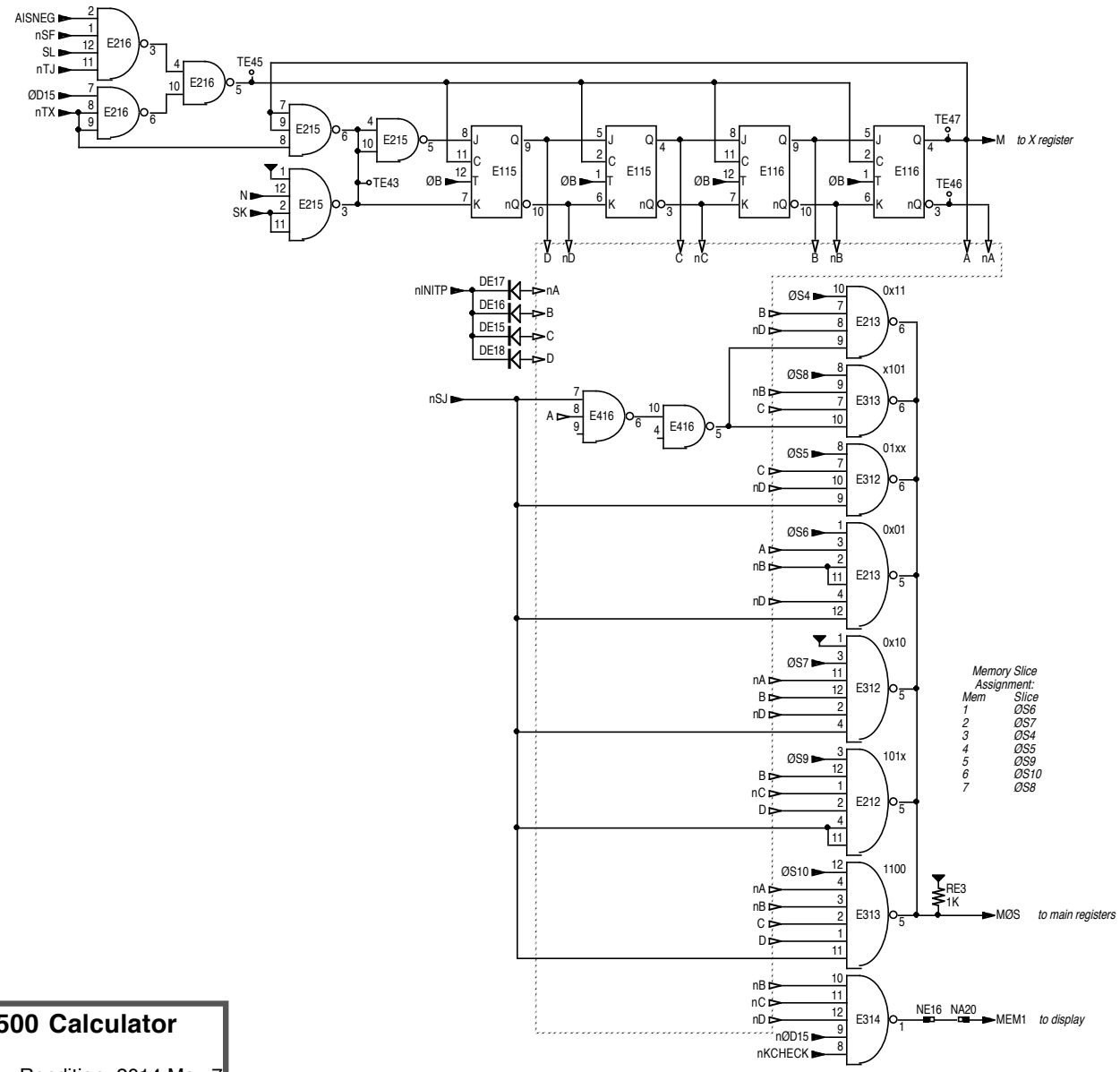


**Sony SOBAX 2500 Calculator**

Section: M Register

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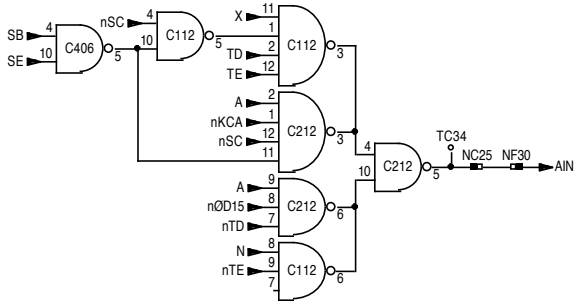
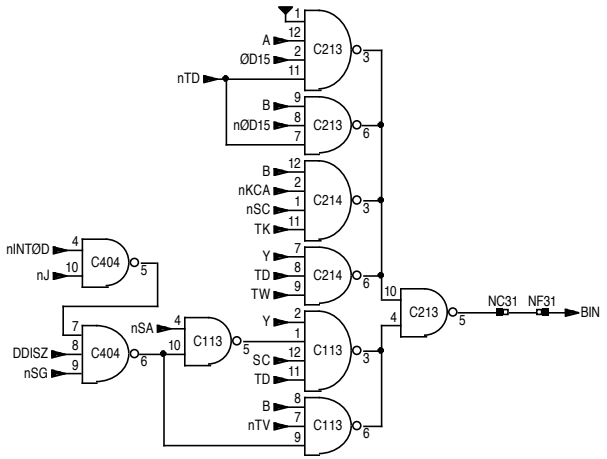
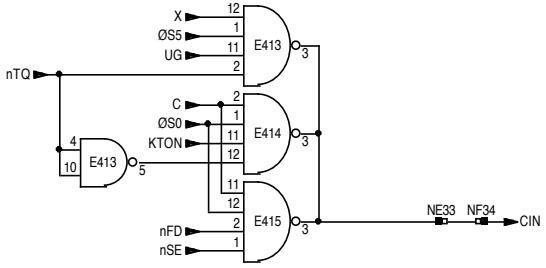
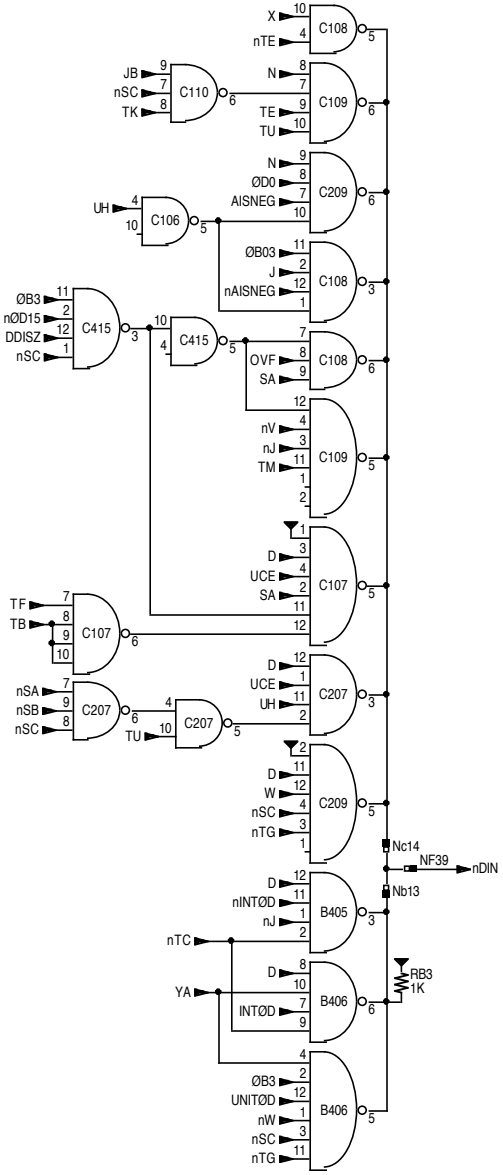
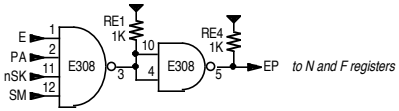
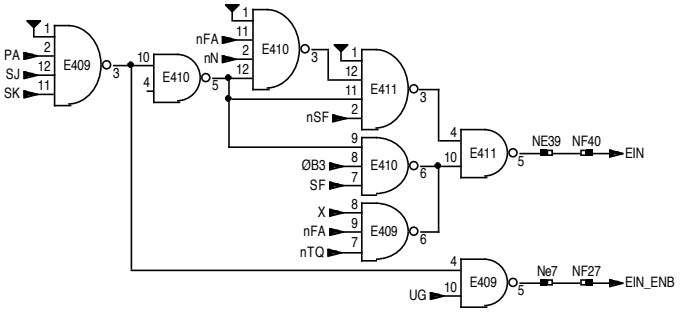


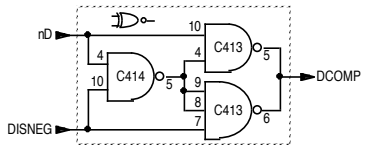



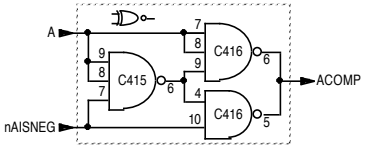



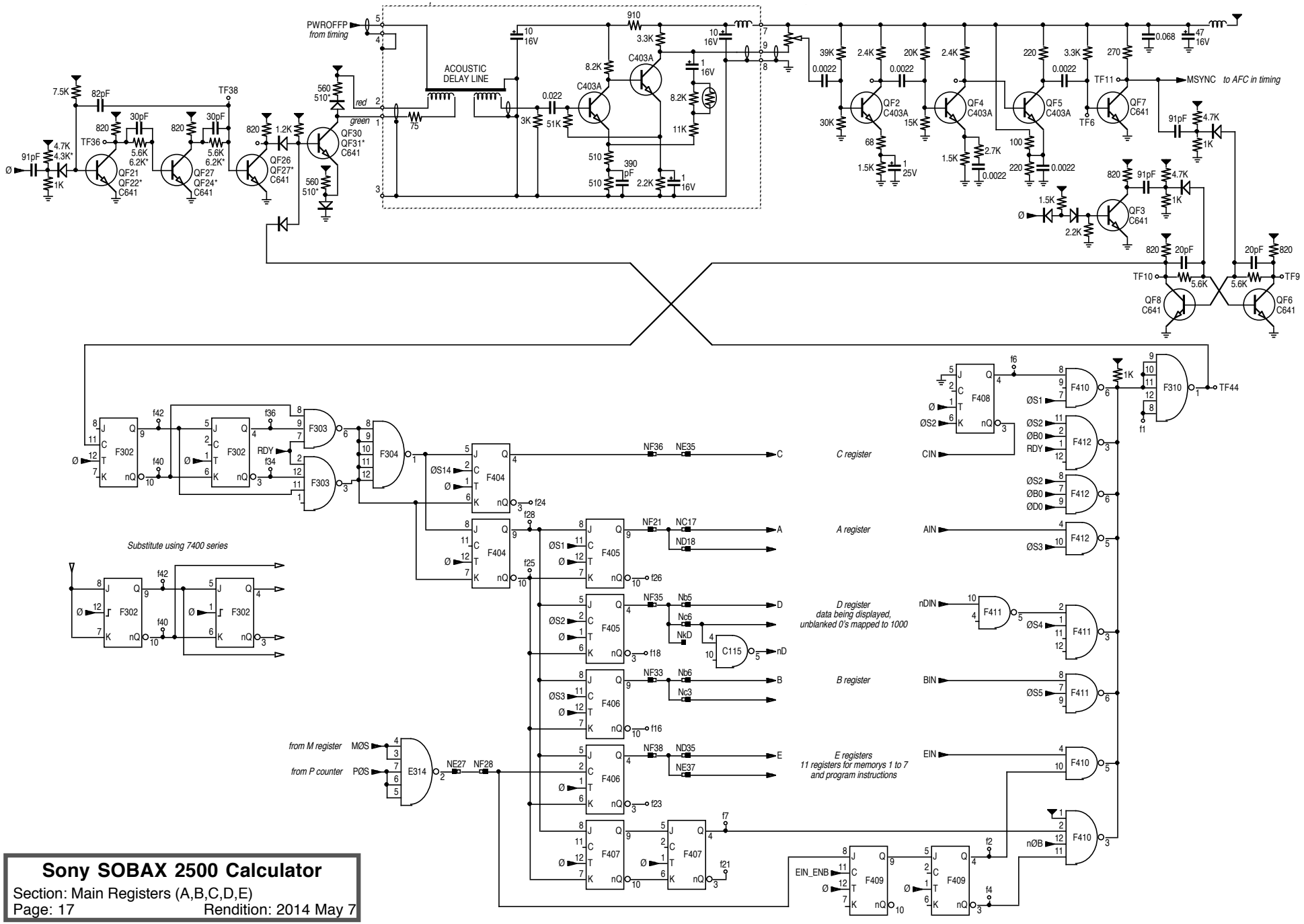




**Sony SOBAX 2500 Calculator**

Section: Main Register (A,B,C,D,E) Data Switches



Rendition: 2014 May 7




**Sony SOBAX 2500 Calculator**

Section: Main Registers (A,B,C,D,E)

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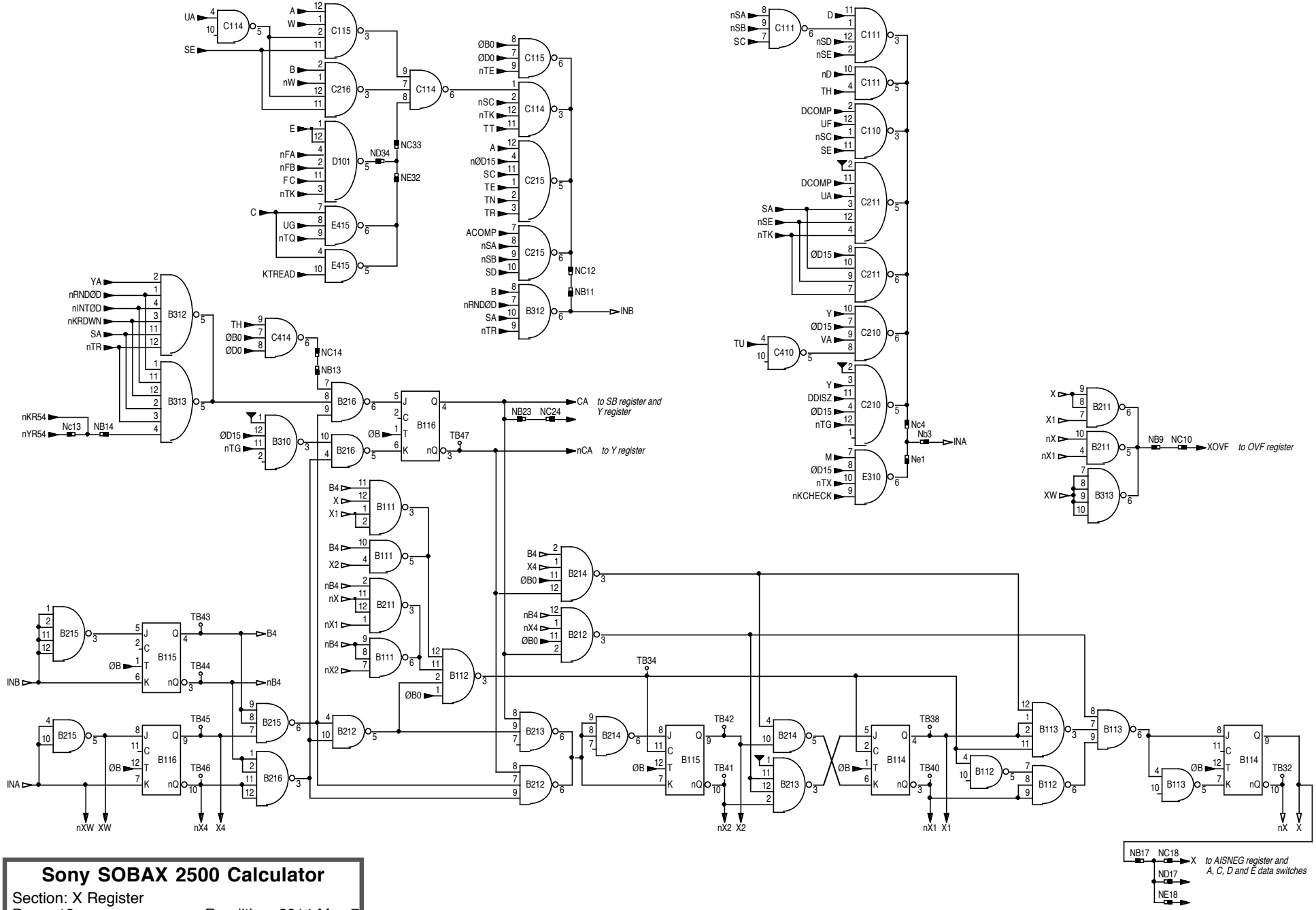


**Sony SOBAX 2500 Calculator**

Section: X Register

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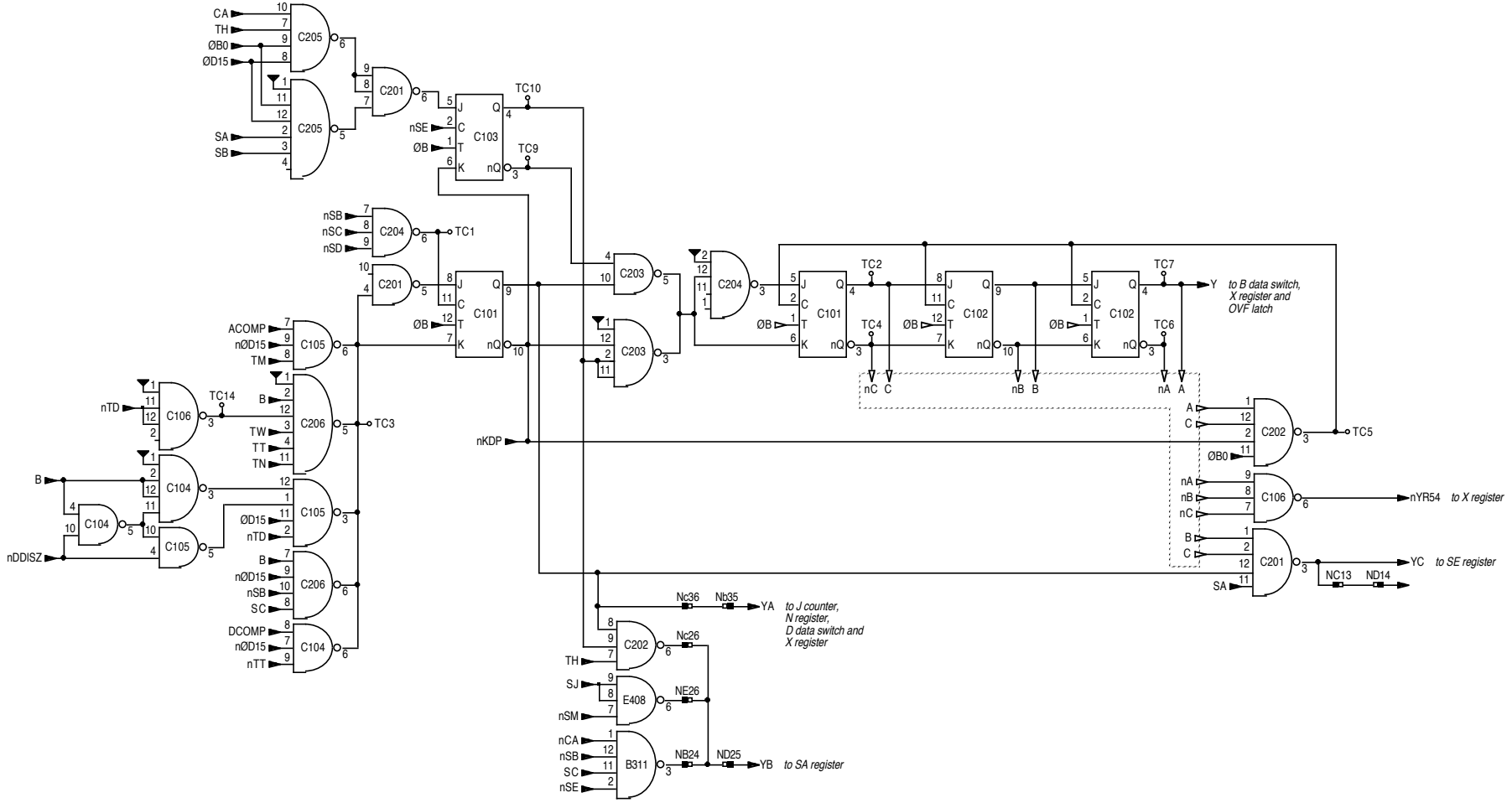


**Sony SOBAX 2500 Calculator**

Section: Y Register

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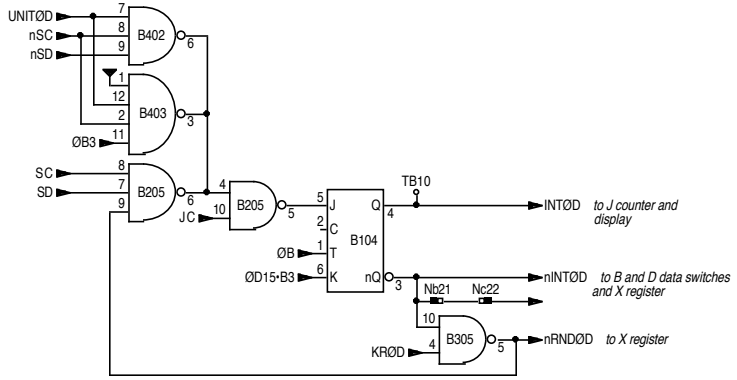


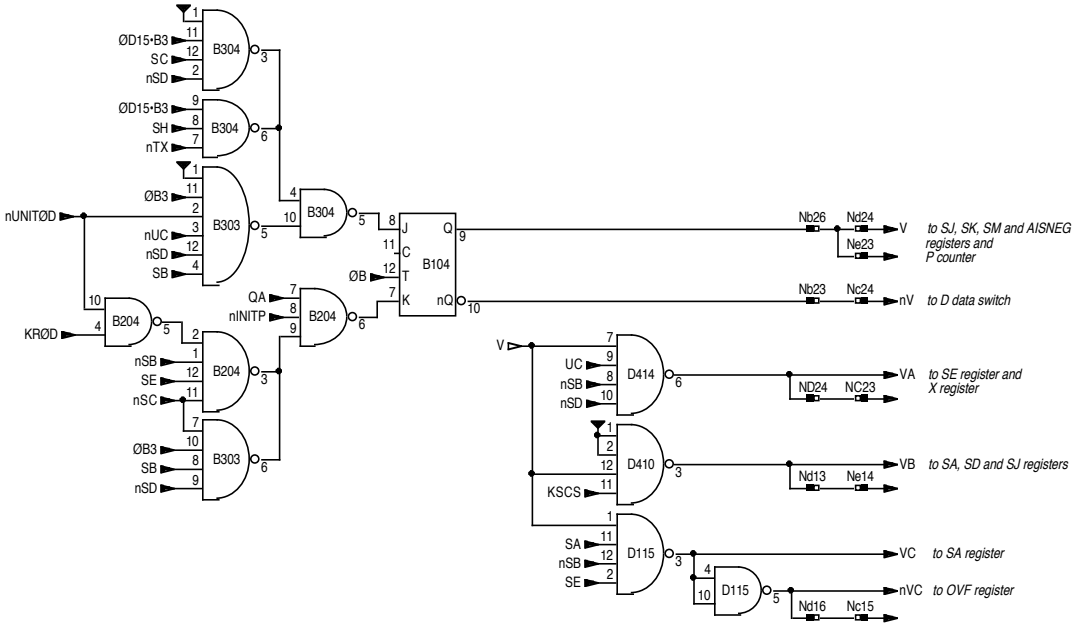


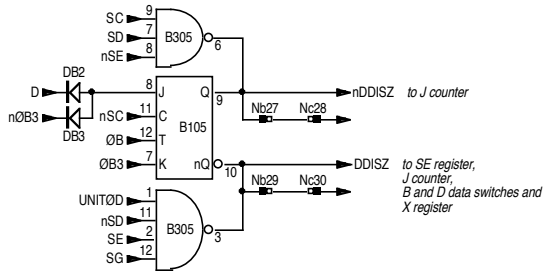


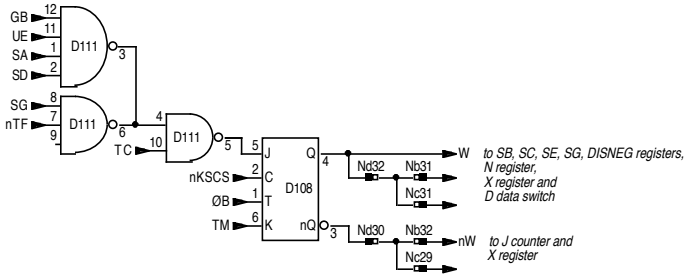


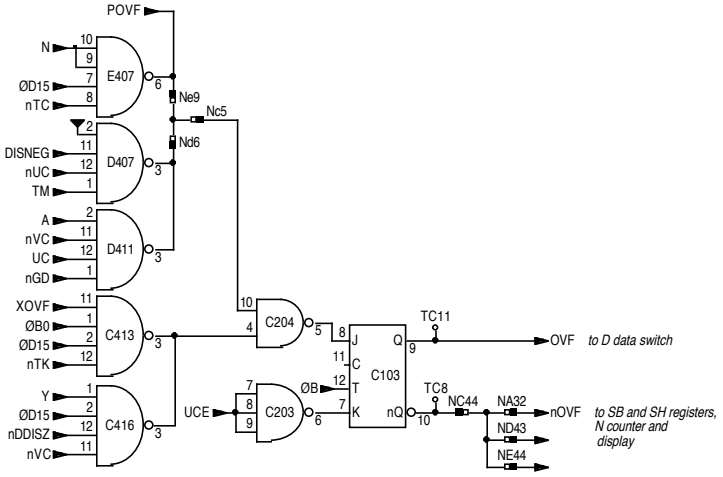


**Sony SOBAX 2500 Calculator**

Section: Misc. Registers

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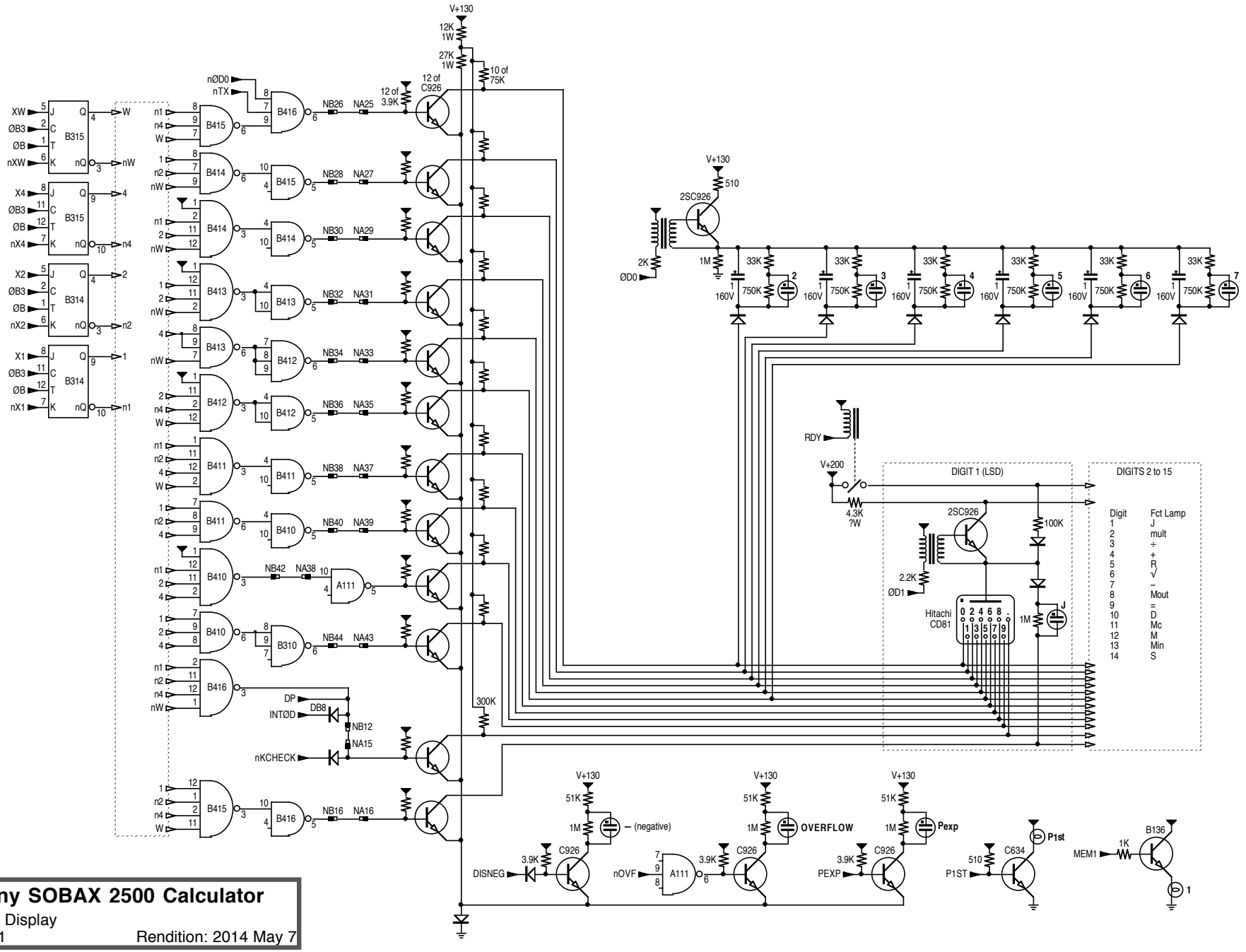
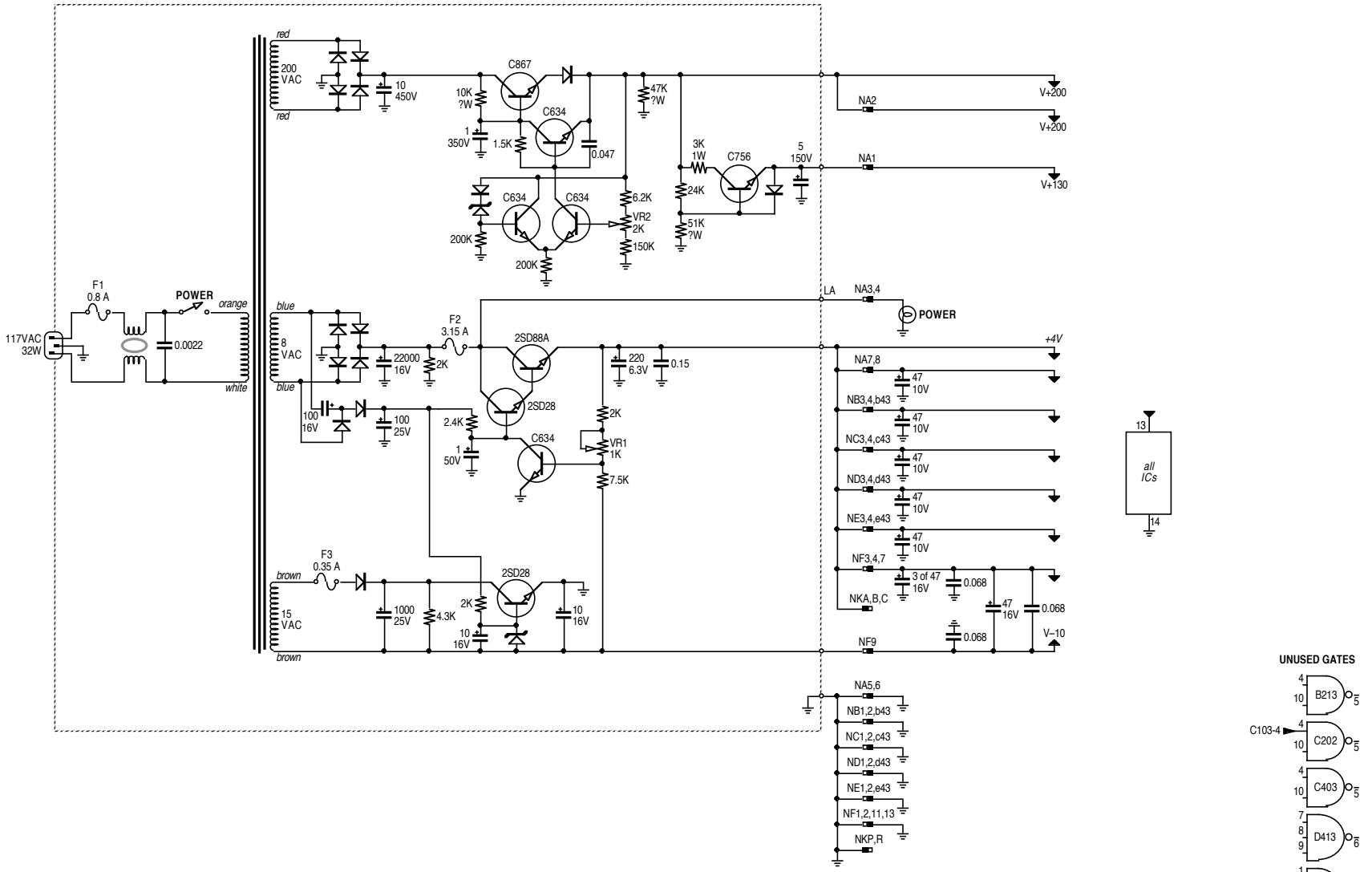



**Sony SOBAX 2500 Calculator**

Section: Display

Page: 21 Rendition: 2014 May 7




**Sony SOBAX 2500 Calculator**

Section: Power Supply & Unused Gates

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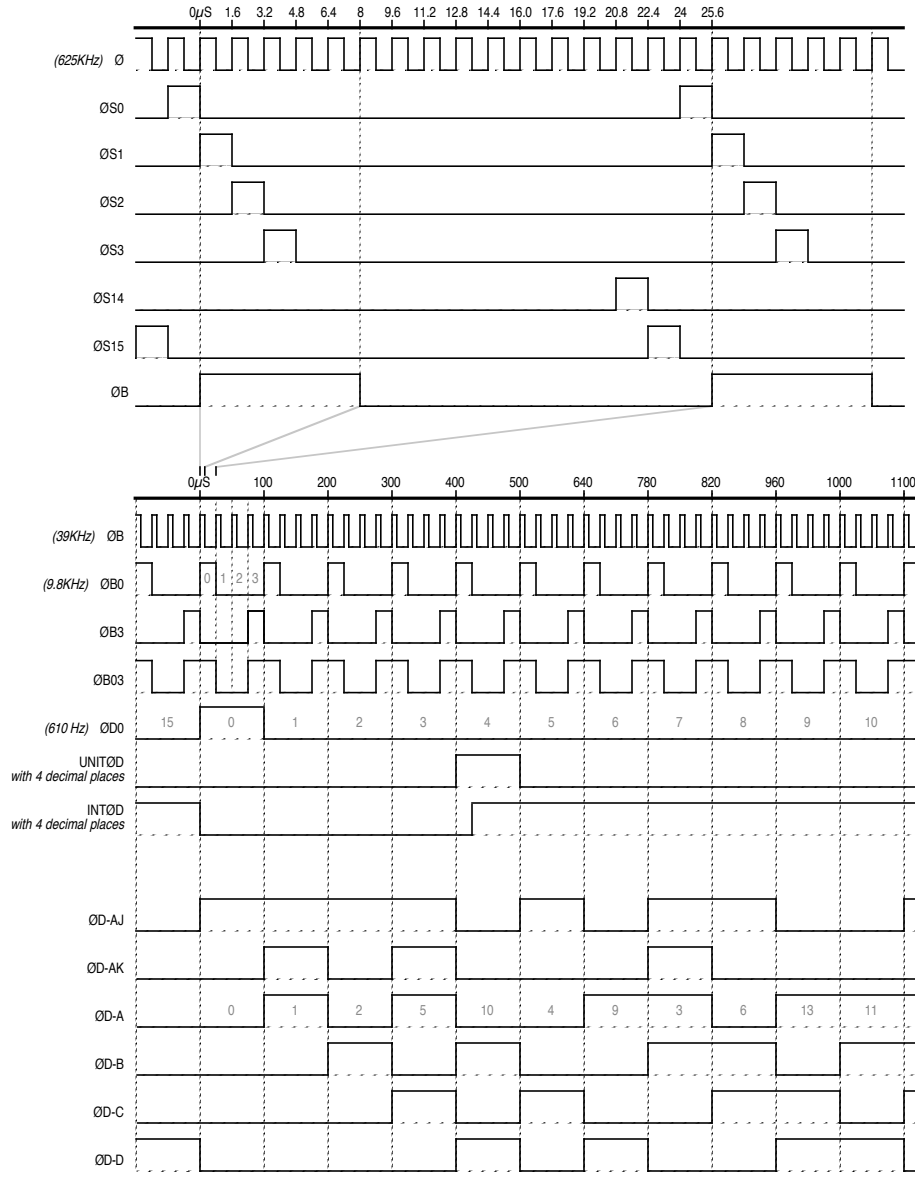
## Timing Signals



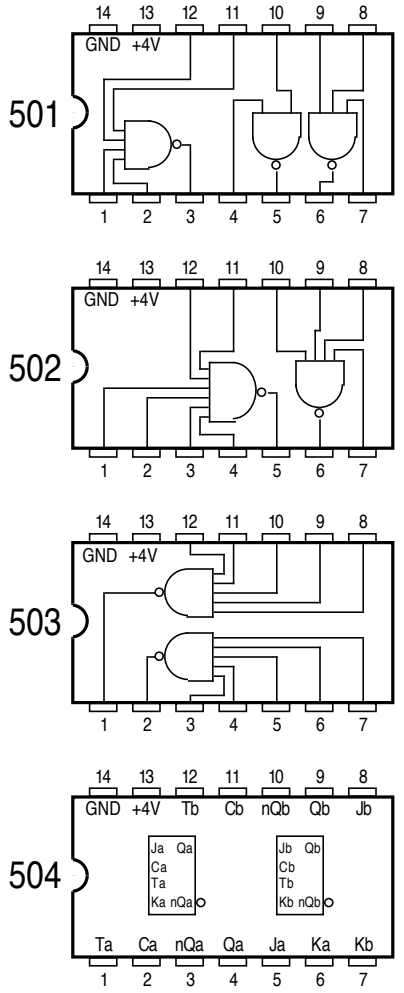

## Bit Codes

| Numeral | W421 |
|---|---|
| *blank* | 0000 |
| 0 | 1000 |
| 1 | 0001 |
| 2 | 0010 |
| 3 | 0011 |
| 4 | 0100 |
| 5 | 1011 |
| 6 | 1100 |
| 7 | 1101 |
| 8 | 1110 |
| 9 | 1111 |
| *function* | 1001 |

Note: The W bit has a weight (value) of 2.

| Function | DCBA |
|---|---|
| + | 1110 |
| − | 0110 |
| × | 0111 |
| ÷ | 1111 |
| = | 1001 |
| √ | 1011 |
| R | 1101 |
| M | 1010 |
| M IN | 0100 |
| M OUT | 1100 |
| M CLR | 0101 |
| S | 1000 |
| D | 0010 |
| J | 0011 |
| *null* | 0000 |

## IC Pinouts




IC technology inferred to be DTL inputs with open-collector outputs.

Inferred for 504 flip-flops:
C = Capture Input
T = Toggle (Clock) Input
The J/K state is captured when C is HIGH and T is LOW.
Q and Q̄ are set in accordance with the captured state when T goes HIGH.

Note: Frequencies shown are approximate, may vary with unit and temperature.

# Sony
# SOBAX 2500 Calculator

Section: Connectors
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Notes:
• Italicised expressions are connections with no signal name in the schematic.

• Bold-faced expressions are signal sources.

**b**

| | | | |
|---|---|---|---|
| GND | 44 | 43 | V+4 |
| nKRDWN | 42 | 41 | – |
| – | 40 | 39 | *c40* |
| nKDP | 38 | 37 | nAISNEG |
| *e27* | 36 | 35 | YA |
| FE | 34 | 33 | SH |
| nW | 32 | 31 | W |
| SG | 30 | 29 | **DDISZ** |
| nSG | 28 | 27 | **nDDISZ** |
| **V** | 26 | 25 | **SJ** |
| nSJ | 24 | 23 | **nV** |
| nUC | 22 | 21 | **nINTØD** |
| **JA** | 20 | 19 | **nJ** |
| TJ | 18 | 17 | **JC** |
| nTX | 16 | 15 | **JB** |
| nKSL | 14 | 13 | **nD** |
| nKSR | 12 | 11 | nTG |
| KSCS | 10 | 9 | nTR |
| nTC | 8 | 7 | TW |
| MBR | 6 | 5 | MDR |
| KRØD | 4 | 3 | X INA |
| nSC | 2 | 1 | SC |

**c**

| | | | |
|---|---|---|---|
| V+4 | 44 | 43 | GND |
| **UH** | 42 | 41 | nKCA |
| *b39* | 40 | 39 | UA |
| nKDP | 38 | 37 | UF |
| **YA** | 36 | 35 | *e36* |
| nKOPER | 34 | 33 | UC |
| N | 32 | 31 | W |
| DDISZ | 30 | 29 | nW |
| nDDISZ | 28 | 27 | nSG |
| **YB** | 26 | 25 | AISNEG |
| nV | 24 | 23 | nAISNEG |
| nINTØD | 22 | 21 | nSJ |
| nJ | 20 | 19 | **nTV** |
| – | 18 | 17 | SM |
| JB | 16 | 15 | nVC |
| **nD** | 14 | 13 | **nYR54** |
| nTG | 12 | 11 | UCE |
| **nTR** | 10 | 9 | – |
| **TW** | 8 | 7 | TQ |
| D | 6 | 5 | *e9* |
| **X INA** | 4 | 3 | B |
| **SC** | 2 | 1 | nSC |

**d**

| | | | |
|---|---|---|---|
| GND | 44 | 43 | V+4 |
| nKCA | 42 | 41 | nKFA |
| **UA** | 40 | 39 | nKFB |
| **UF** | 38 | 37 | nKFC |
| **FE** | 36 | 35 | nKFD |
| **UC** | 34 | 33 | *e34* |
| **W** | 32 | 31 | nKLEARN |
| **nW** | 30 | 29 | **SG** |
| **nSG** | 28 | 27 | **SF** |
| **AISNEG** | 26 | 25 | **nAISNEG** |
| V | 24 | 23 | ***e24*** |
| **nUC** | 22 | 21 | *e22* |
| JA | 20 | 19 | nSJ |
| JC | 18 | 17 | TJ |
| **nVC** | 16 | 15 | **nKSCS** |
| *e17* | 14 | 13 | **VB** |
| KCE | 12 | 11 | **UCE** |
| **nTG** | 10 | 9 | nTX |
| **TQ** | 8 | 7 | **nTC** |
| *e9* | 6 | 5 | nKMAO |
| KSCS | 4 | 3 | UJ |
| **nSC** | 2 | 1 | *F44* |

**e**

| | | | |
|---|---|---|---|
| V+4 | 44 | 43 | GND |
| nKFA | 42 | 41 | K1 |
| UH | 40 | 39 | K2 |
| **FE** | 38 | 37 | K4 |
| *c35* | 36 | 35 | KW |
| *d33* | 34 | 33 | *keyboard* |
| nKCHECK | 32 | 31 | **SH** |
| nKMAN | 30 | 29 | **N** |
| SF | 28 | 27 | *b36* |
| *F44* | 26 | 25 | AISNEG |
| *d23* | 24 | 23 | V |
| *d21* | 22 | 21 | nKAUTO |
| **nSJ** | 20 | 19 | nTV |
| **TJ** | 18 | 17 | *d14* |
| nKSCS | 16 | 15 | **SM** |
| VB | 14 | 13 | JB |
| UCE | 12 | 11 | *F42* |
| **nTX** | 10 | 9 | *d6, c5* |
| nTC | 8 | 7 | **EIN_ENB** |
| nKMAO | 6 | 5 | – |
| **UJ** | 4 | 3 | *D26* |
| nSC | 2 | 1 | **X INA** |

**A**

| | | | |
|---|---|---|---|
| **nØD0** | 44 | 43 | *9* |
| **nØD2** | 42 | 41 | – |
| **nØD4** | 40 | 39 | *7* |
| *n8* | 38 | 37 | *6* |
| **nØD11** | 36 | 35 | *5* |
| – | 34 | 33 | *4* |
| nOVF | 32 | 31 | *3* |
| – | 30 | 29 | *2* |
| – | 28 | 27 | *1* |
| – | 26 | 25 | *0* |
| ØB3 | 24 | 23 | – |
| **nØD15** | 22 | 21 | – |
| MEM1 | 20 | 19 | – |
| DISNEG | 18 | 17 | nØDINS |
| *funct ind.* | 16 | 15 | DP |
| PEXP | 14 | 13 | RDY |
| P1ST | 12 | 11 | nKCHECK |
| ØB | 10 | 9 | ØB |
| V+4 | 8 | 7 | V+4 |
| GND | 6 | 5 | GND |
| V+8 unreg | 4 | 3 | V+8 unreg |
| V+200 | 2 | 1 | V+130 |

**B**

| | | | |
|---|---|---|---|
| ***9*** | 44 | 43 | ØD0 |
| ***n8*** | 42 | 41 | nSD |
| ***7*** | 40 | 39 | **CHGSGN** |
| ***6*** | 38 | 37 | nØD11 |
| ***5*** | 36 | 35 | SE |
| ***4*** | 34 | 33 | nSB |
| ***3*** | 32 | 31 | SB |
| ***2*** | 30 | 29 | nØD0 |
| ***1*** | 28 | 27 | SA |
| ***0*** | 26 | 25 | *D26* |
| **YB** | 24 | 23 | **CA** |
| nØD15 | 22 | 21 | ØD15 |
| **Q** | 20 | 19 | ØB3 |
| **nØDINS** | 18 | 17 | **X** |
| ***funct ind.*** | 16 | 15 | ØB0 |
| nYR54 | 14 | 13 | *C14* |
| **DP** | 12 | 11 | X INB |
| nINITP | 10 | 9 | **XOVF** |
| ØD15•B3 | 8 | 7 | nØB3 |
| ØB | 6 | 5 | ØB |
| V+4 | 4 | 3 | V+4 |
| GND | 2 | 1 | GND |

**C**

| | | | |
|---|---|---|---|
| nOVF | 44 | 43 | TA |
| nSD | 42 | 41 | nTT |
| SD | 40 | 39 | **TU** |
| nSE | 38 | 37 | **TF** |
| **SE** | 36 | 35 | **TS** |
| **nSB** | 34 | 33 | *E32* |
| SB | 32 | 31 | **BIN** |
| nSA | 30 | 29 | **nTK** |
| **SA** | 28 | 27 | **TB** |
| ØD0 | 26 | 25 | **AIN** |
| CA | 24 | 23 | VA |
| ØD15 | 22 | 21 | nØD15 |
| **ØB3** | 20 | 19 | DISNEG |
| X | 18 | 17 | A |
| **ØB0** | 16 | 15 | *D16* |
| *B13* | 14 | 13 | **YC** |
| **X INB** | 12 | 11 | TN |
| XOVF | 10 | 9 | **TT** |
| **nØB3** | 8 | 7 | TM |
| ØB | 6 | 5 | ØB |
| V+4 | 4 | 3 | V+4 |
| GND | 2 | 1 | GND |

**D**

| | | | |
|---|---|---|---|
| **TA** | 44 | 43 | nOVF |
| **nTT** | 42 | 41 | **nSD** |
| TU | 40 | 39 | **SD** |
| TF | 38 | 37 | **nSE** |
| TS | 36 | 35 | E |
| *E32* | 34 | 33 | CHGSGN |
| **SB** | 32 | 31 | **nSA** |
| nTK | 30 | 29 | **nTQ** |
| TB | 28 | 27 | KTREAD |
| *e3, B25* | 26 | 25 | YB |
| **VA** | 24 | 23 | – |
| – | 22 | 21 | RDY |
| **DISNEG** | 20 | 19 | Q |
| MAR | 18 | 17 | X |
| *C15* | 16 | 15 | – |
| YC | 14 | 13 | **– (UE)** |
| **TN** | 12 | 11 | *E12* |
| TT | 10 | 9 | SK |
| **TM** | 8 | 7 | ØD15•B3 |
| ØB | 6 | 5 | ØB |
| V+4 | 4 | 3 | V+4 |
| GND | 2 | 1 | GND |

**E**

| | | | |
|---|---|---|---|
| nOVF | 44 | 43 | *F43* |
| nSE | 42 | 41 | TA |
| nØD0 | 40 | 39 | **EIN** |
| KTON | 38 | 37 | E |
| SE | 36 | 35 | C |
| nSB | 34 | 33 | **CIN** |
| *C33, D34* | 32 | 31 | **ØD0** |
| nTQ | 30 | 29 | nKFD |
| KTREAD | 28 | 27 | **E ØS** |
| **YB** | 26 | 25 | *F26* |
| nØD15 | 24 | 23 | ØS5 |
| ØB3 | 22 | 21 | **ØS10** |
| **ØD15** | 20 | 19 | **ØS14** |
| X | 18 | 17 | ØS0 |
| **MEM1** | 16 | 15 | ØS4 |
| **PEXP** | 14 | 13 | **P1ST** |
| *D11* | 12 | 11 | nINITP |
| **SK** | 10 | 9 | Ø |
| **ØD15•B3** | 8 | 7 | Ø |
| ØB | 6 | 5 | ØB |
| V+4 | 4 | 3 | V+4 |
| GND | 2 | 1 | GND |

**F**

| | | | |
|---|---|---|---|
| *d1, e26* | 44 | 43 | *E43* |
| *e11* | 42 | 41 | nKLEARN |
| EIN | 40 | 39 | nDIN |
| **E** | 38 | 37 | nKCHECK |
| **C** | 36 | 35 | **D** |
| CIN | 34 | 33 | **B** |
| ØD0 | 32 | 31 | BIN |
| AIN | 30 | 29 | SJ |
| E ØS | 28 | 27 | EIN_ENB |
| *E25* | 26 | 25 | *pwr off* |
| **ØS5** | 24 | 23 | *pwr off* |
| ØS10 | 22 | 21 | **A** |
| ØS14 | 20 | 19 | ØB3 |
| **ØS0** | 18 | 17 | ØD15•B3 |
| **RDY** | 16 | 15 | **ØS4** |
| ØB0 | 14 | 13 | GND |
| **nINITP** | 12 | 11 | GND |
| **Ø** | 10 | 9 | V–10 |
| **Ø** | 8 | 7 | V+4 |
| **ØB** | 6 | 5 | **ØB** |
| V+4 | 4 | 3 | V+4 |
| GND | 2 | 1 | GND |