Sheet: Output Display

File: Output Display.sch

Sheet: Register XY

File: Register XY.sch

Sheet: Speed Control

File: Speed Control.sch

Sheet: Program Counter

File: Program Counter.sch

Sheet: Clock

File: Clock.sch

Sheet: PC/IF

File: PC_IF.sch

Sheet: Power-on Reset

File: Power-on Reset.sch

Sheet: Instruction RAM

File: Instruction RAM.sch

Sheet: Instruction ROM

File: Instruction ROM.sch

Sheet: Register A

File: Register A.sch

Sheet: Data RAM

File: Data RAM.sch

Sheet: Instruction Register

File: Instruction Register.sch

Sheet: Register B

File: Register B.sch

Sheet: Instruction Decoder

File: Instruction Decoder.sch

Sheet: ALU

File: ALU.sch

Sheet: Serial

File: Serial.sch

Sheet: Execute

File: Execute.sch

Sheet: Bus Display

File: Bus Display.sch

Sheet: Register D

File: Register D.sch

Sheet: Control Word Display

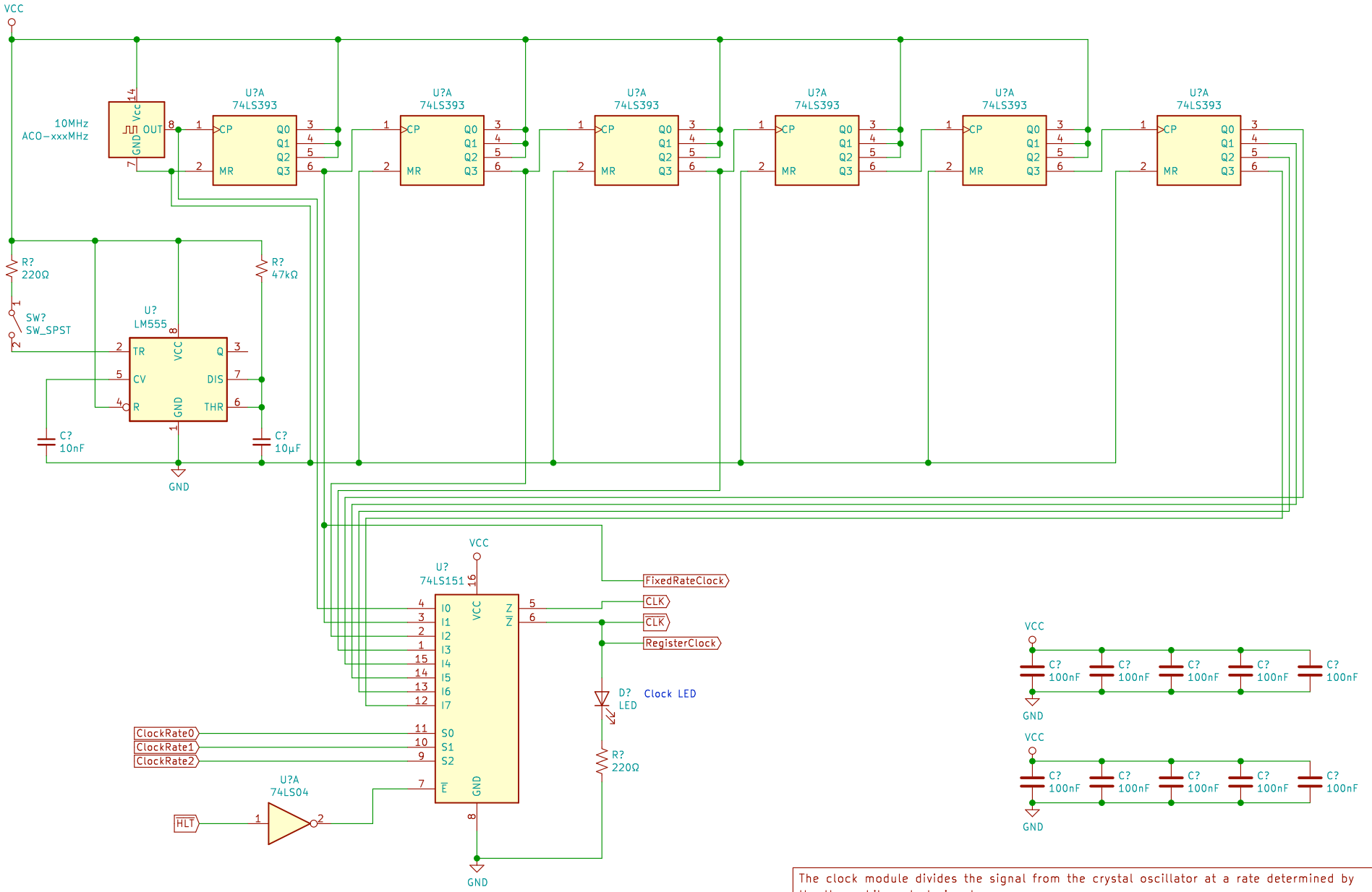
File: Control Word Display.sch

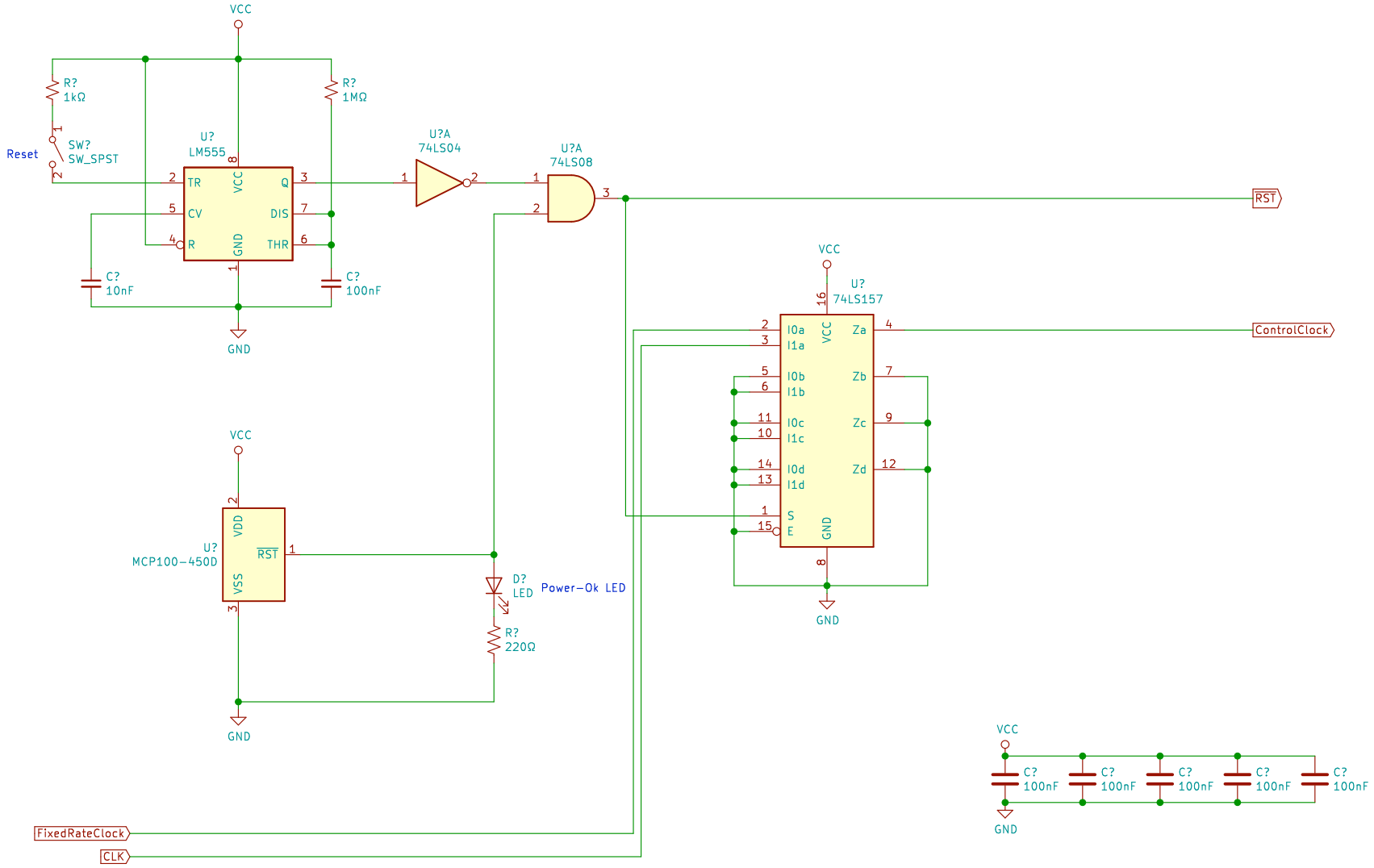
TTL microcomputer built from 74xx series logic chips.

Sheet: /
File: TurtleTTL.sch

Title: Turtle TTL

Size: A	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 1/21


VCC
10MHz
ACO-xxxMHz
U?A
74LS393
CP
MR
Q0
Q1
Q2
Q3
R?
220Ω
R?
47kΩ
SW?
SW_SPST
U?
LM555
TR
CV
R
VCC
GND
Q
DIS
THR
C?
10nF
C?
10µF
U?
74LS151
I0
I1
I2
I3
I4
I5
I6
I7
S0
S1
S2
E
Z
FixedRateClock
CLK
RegisterClock
D?
LED
Clock LED
ClockRate0
ClockRate1
ClockRate2
U?A
74LS04
HLT
C?
100nF
The clock module divides the signal from the crystal oscillator at a rate determined by the three-bit control signal.
Sheet: /Clock/
File: Clock.sch
Title: Clock
Size: A
Date:
Rev:
KiCad E.D.A. kicad (5.1.0-0)
Id: 2/21

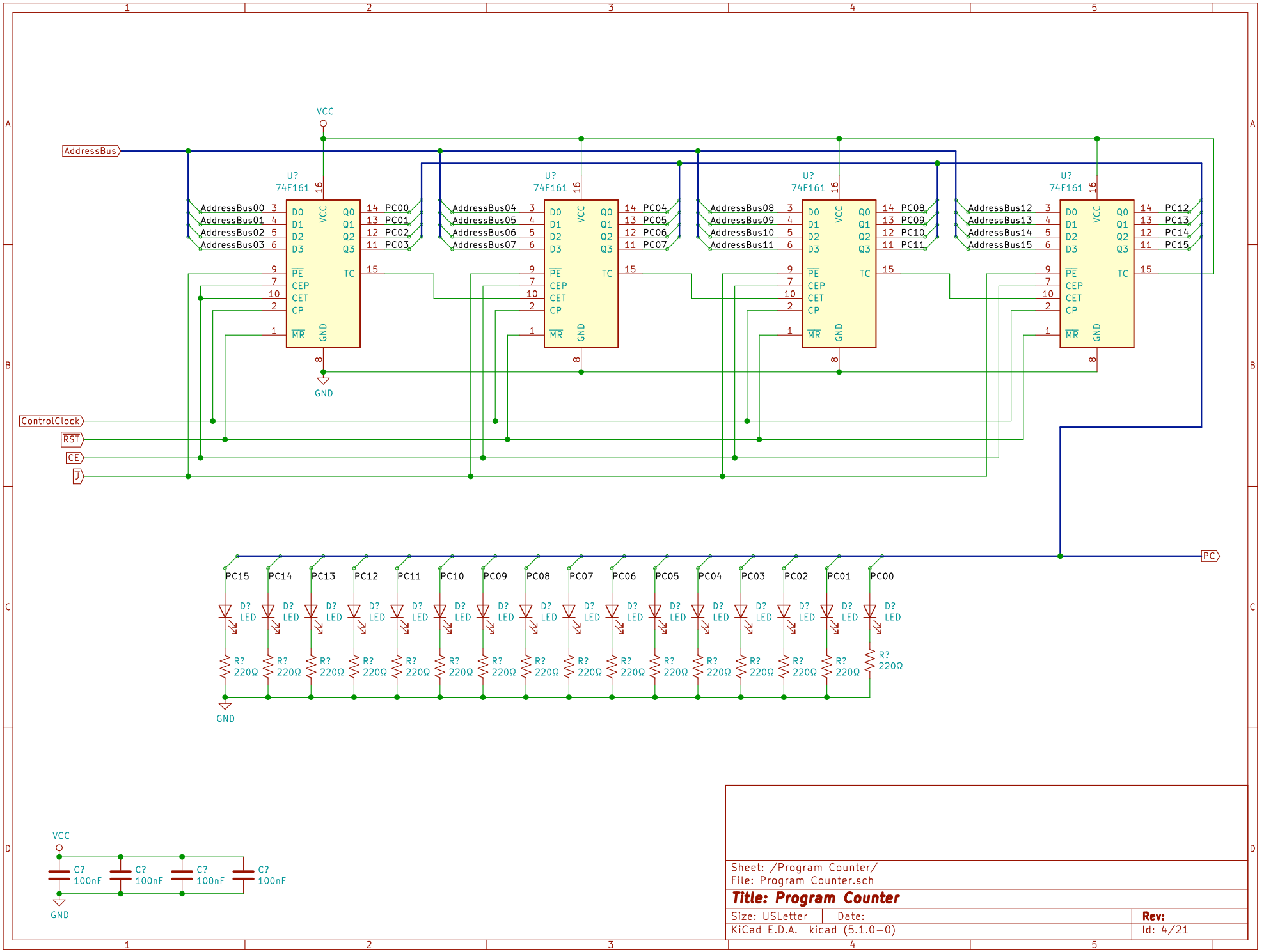


The MCP100 provides Power-on Reset functionality.
A button is also provided to manually reset the machine.
During reset, the control clock is pulsed repeatedly to flush the pipeline.

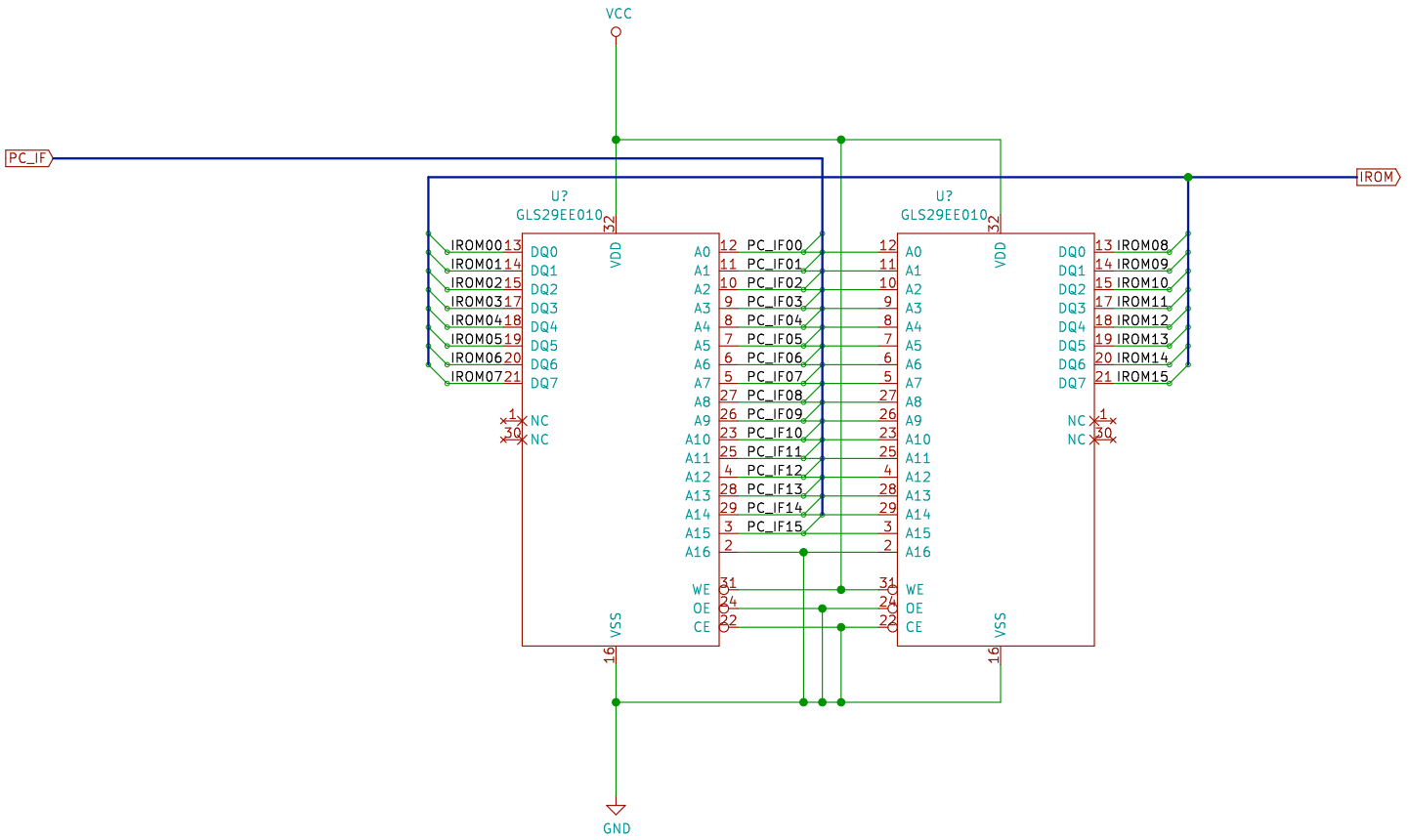
Sheet: /Power-on Reset/
File: Power-on Reset.sch

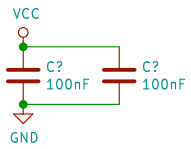
Title: Power-on Reset

Size: A	Date:	Rev:
KiCad E.D.A. kicad (5.1.0-0)		Id: 3/21



Sheet: /Program Counter/	
File: Program Counter.sch	
Title: Program Counter	
Size: USLetter	Date:
KiCad E.D.A. kicad (5.1.0-0)	Id: 4/21





16-bit instructions are read from ROM at the address specified by the Program Counter.

Sheet: /Instruction ROM/
File: Instruction ROM.sch

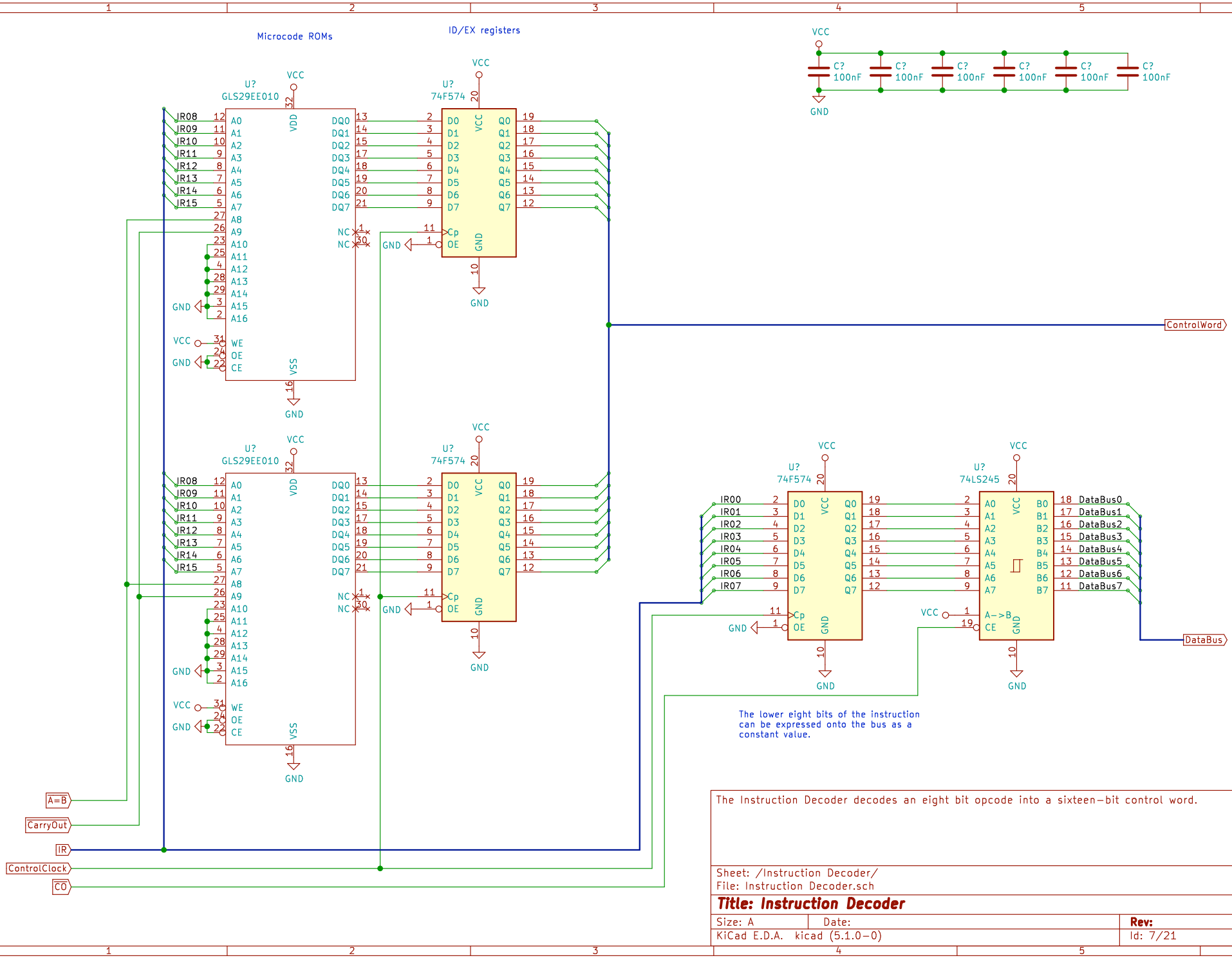
Title: Instruction ROM

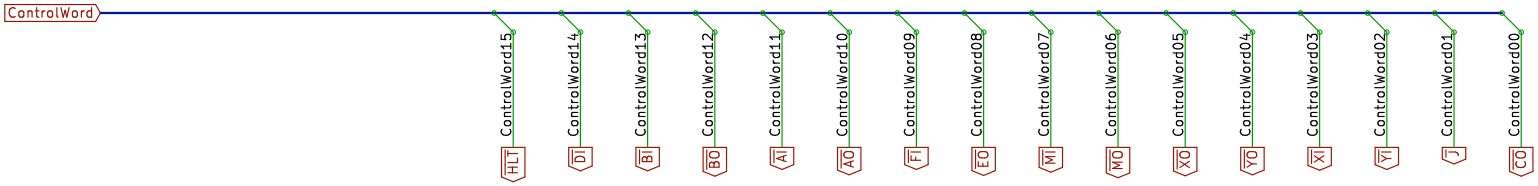
Size: USLetter	Date:	Rev:
KiCad E.D.A. kicad (5.1.0-0)		Id: 5/21

Sheet: /Instruction RAM/
File: Instruction RAM.sch

Title: Instruction RAM

Size: USLetter	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 6/21


Microcode ROMs
ID/EX registers
U?
GLS29EE010
74F574
74LS245
VCC
GND
C?
100nF
IR08
IR09
IR10
IR11
IR12
IR13
IR14
IR15
IR00
IR01
IR02
IR03
IR04
IR05
IR06
IR07
ControlWord
DataBus
DataBus0
DataBus1
DataBus2
DataBus3
DataBus4
DataBus5
DataBus6
DataBus7
A=B
CarryOut
IR
ControlClock
CO
The lower eight bits of the instruction can be expressed onto the bus as a constant value.
The Instruction Decoder decodes an eight bit opcode into a sixteen-bit control word.
Sheet: /Instruction Decoder/
File: Instruction Decoder.sch
Title: Instruction Decoder
Size: A
Date:
Rev:
KiCad E.D.A. kicad (5.1.0-0)
Id: 7/21

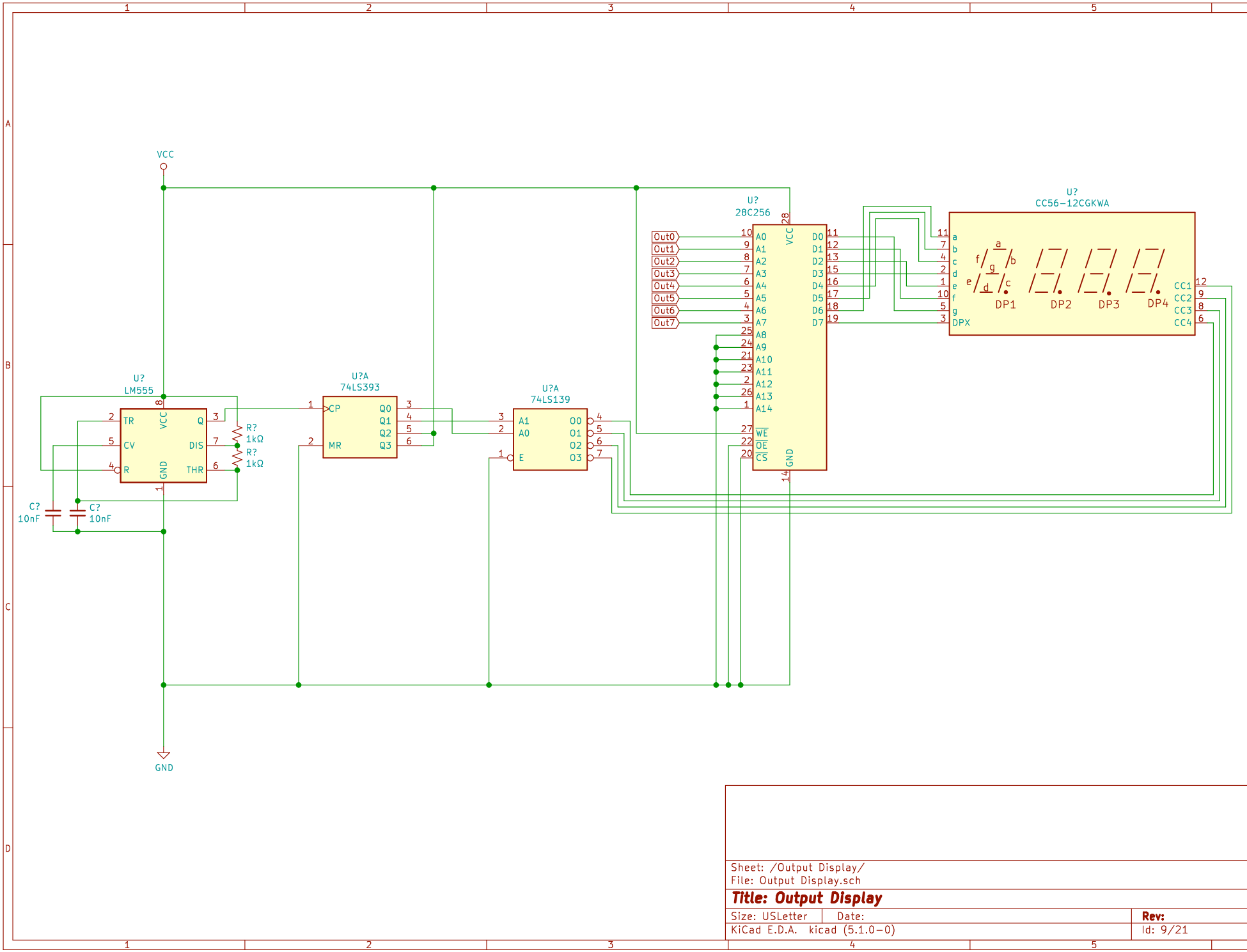


The Execute Unit doesn't do much. At this point, it simply maps the control word to control signals around the board.

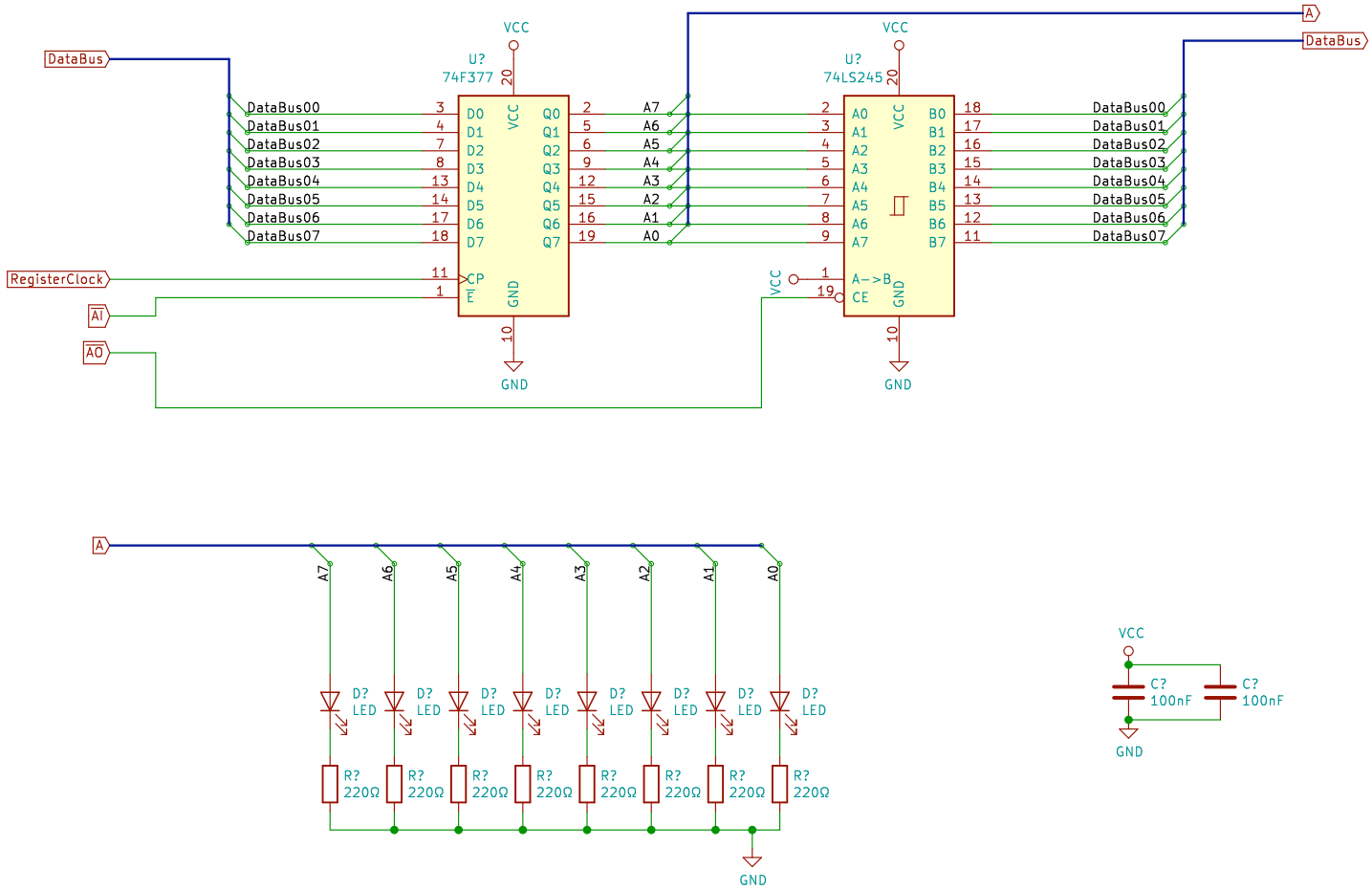
Sheet: /Execute/
File: Execute.sch

Title: Execute

Size: A	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 8/21



Sheet: /Output Display/	
File: Output Display.sch	
Title: Output Display	
Size: USLetter | Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)	Id: 9/21

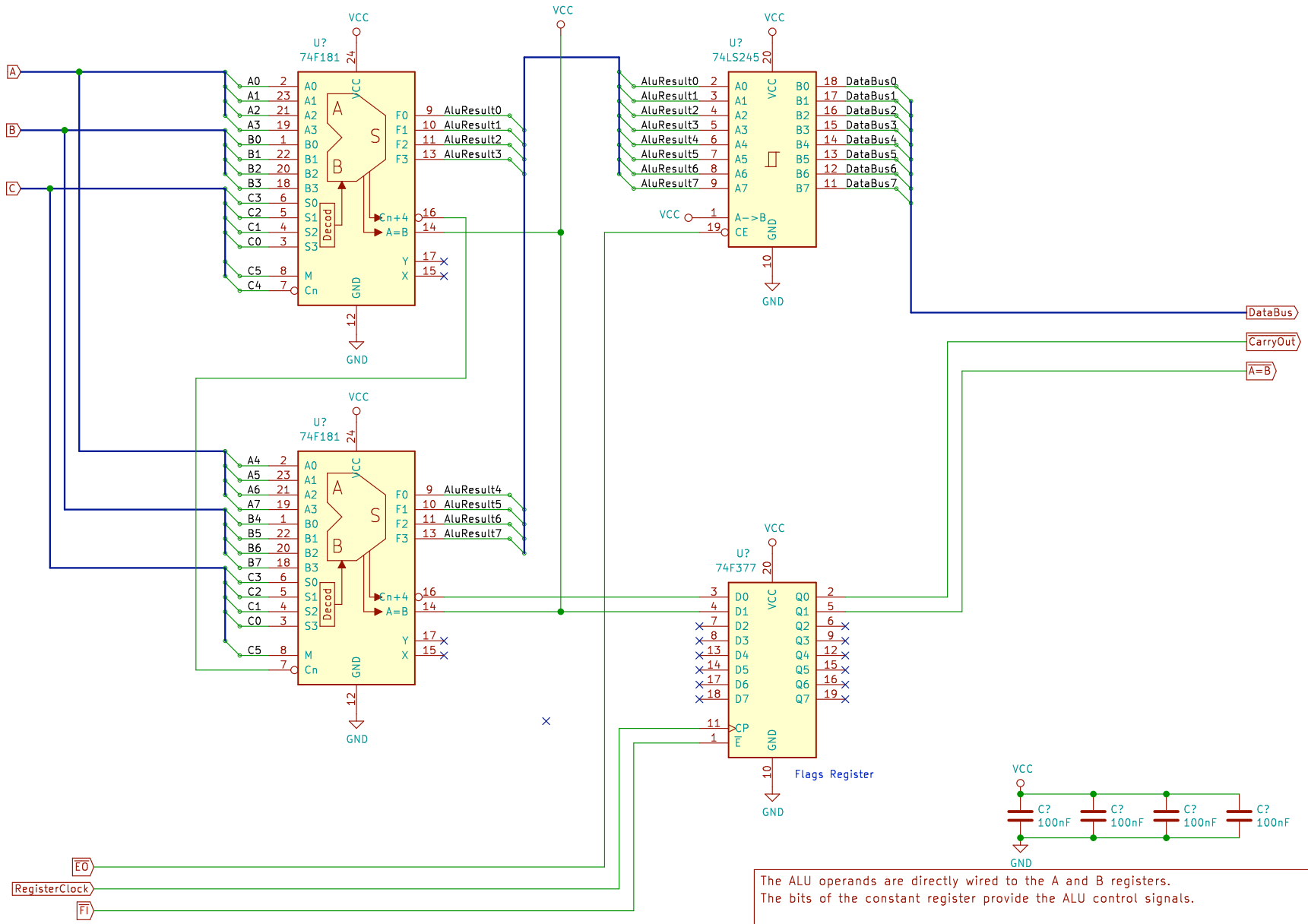


Register A is wired to the ALU's A operand.

Sheet: /Register A/
File: Register A.sch

Title: Register A

Size: A	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 10/21



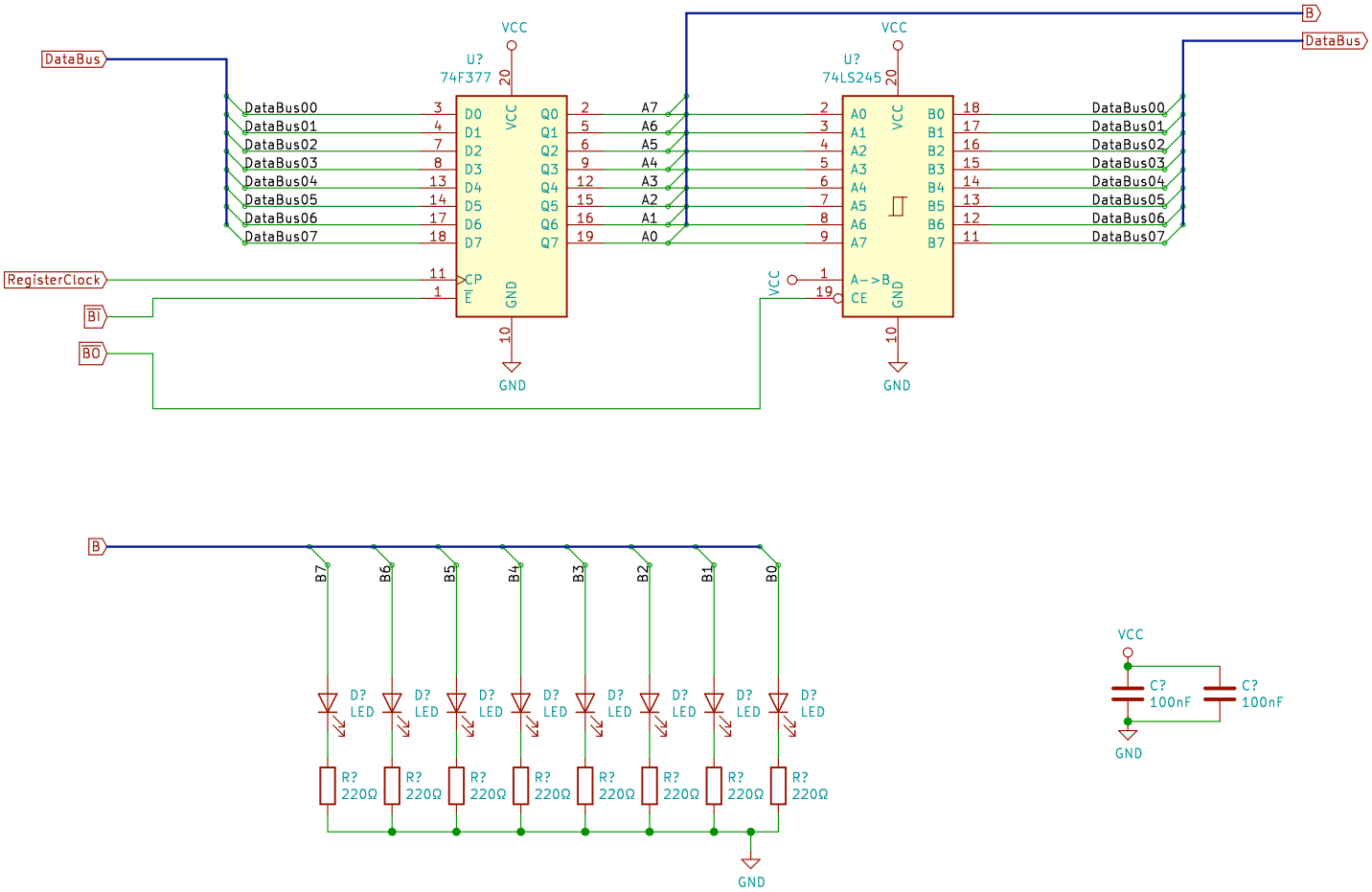
TODO: Verify the order of bits used from the constant register.

The ALU operands are directly wired to the A and B registers.
The bits of the constant register provide the ALU control signals.

Sheet: /ALU/
File: ALU.sch

Title: ALU

Size: A	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 11/21



Register B is wired to the ALU's B operand.

Sheet: /Register B/
File: Register B.sch

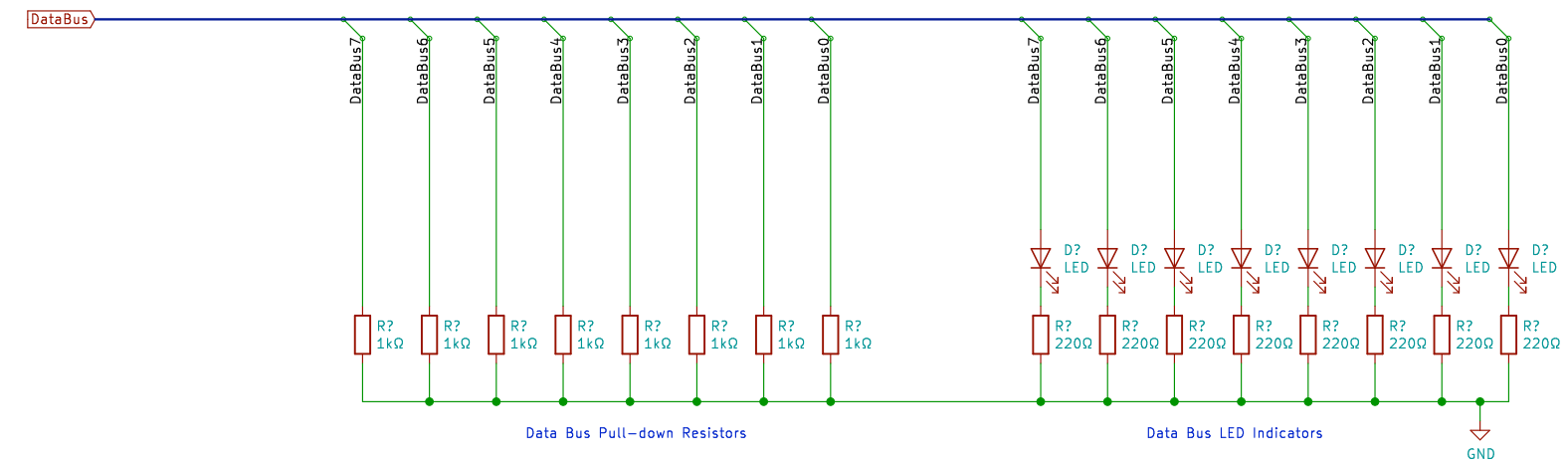
Title: Register B

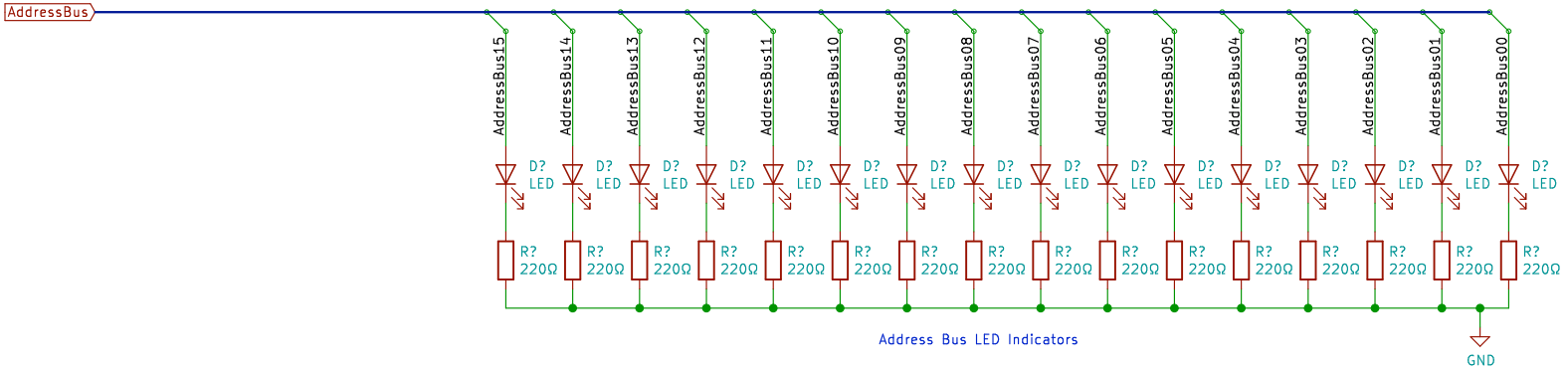
Size: A	Date:	Rev:
KiCad E.D.A. kicad (5.1.0-0)		Id: 12/21

Sheet: /Data RAM/
File: Data RAM.sch

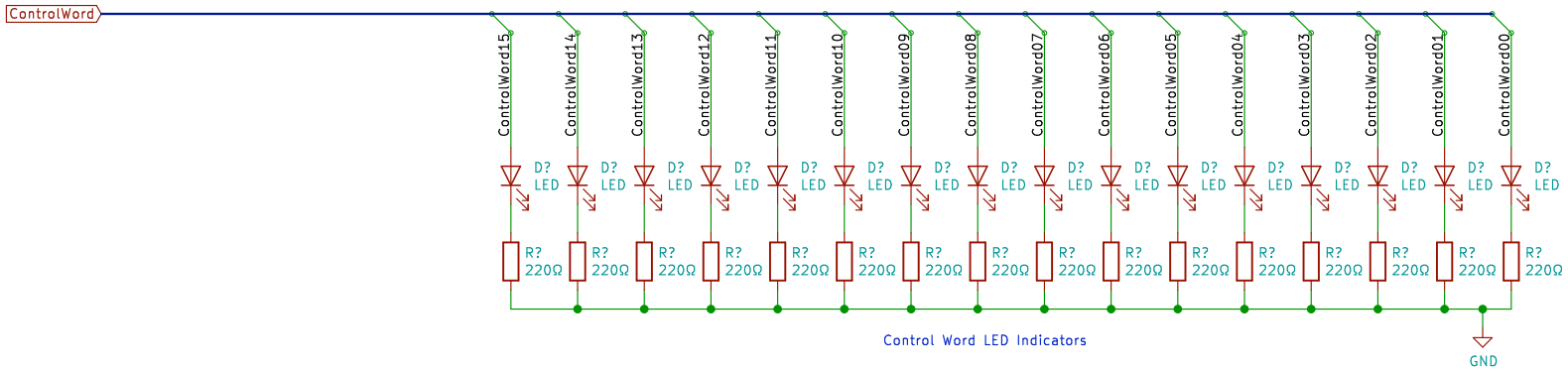
Title: Data RAM

Size: USLetter	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 13/21



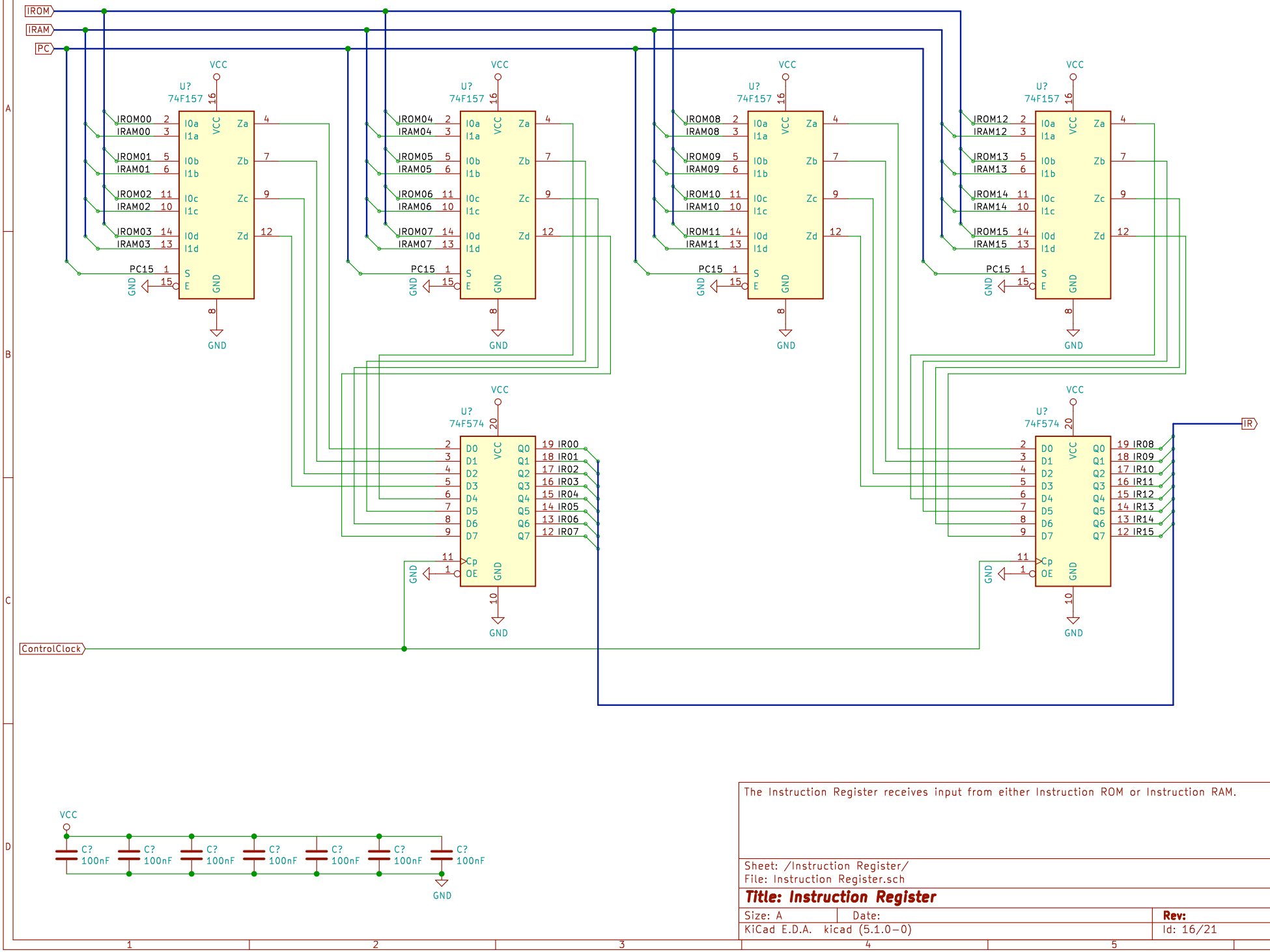


Sheet: /Bus Display/		
File: Bus Display.sch		
Title: Bus Display		
Size: A	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 14/21



TODO: These signals are active-low. The LEDs should be wired to light up when they go active.

Sheet: /Control Word Display/		
File: Control Word Display.sch		
Title: Control Word Display		
Size: A	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 15/21

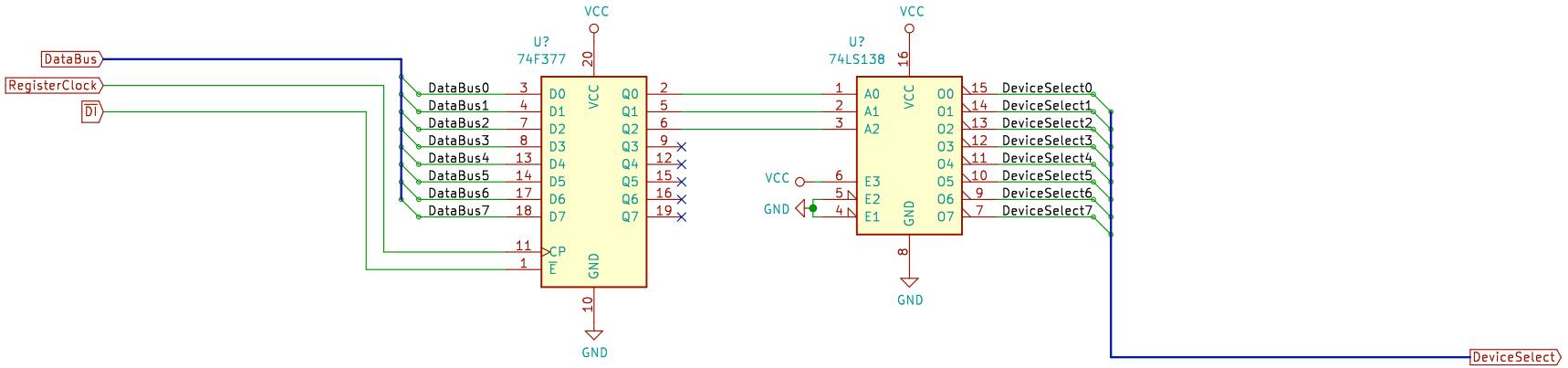


The Instruction Register receives input from either Instruction ROM or Instruction RAM.

Sheet: /Instruction Register/
File: Instruction Register.sch

Title: Instruction Register

Size: A	Date:	Rev:
KiCad E.D.A. kicad (5.1.0-0)		Id: 16/21

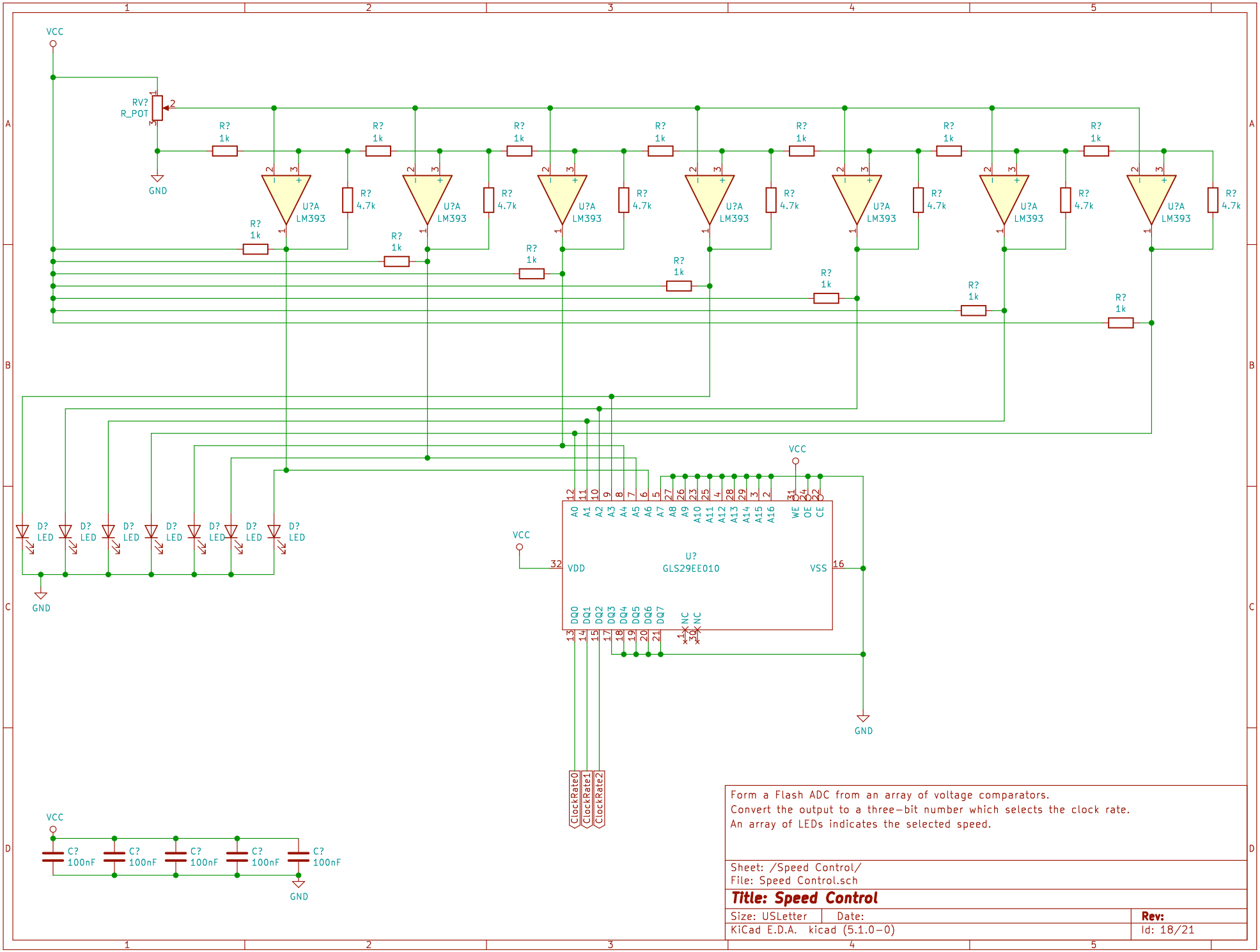


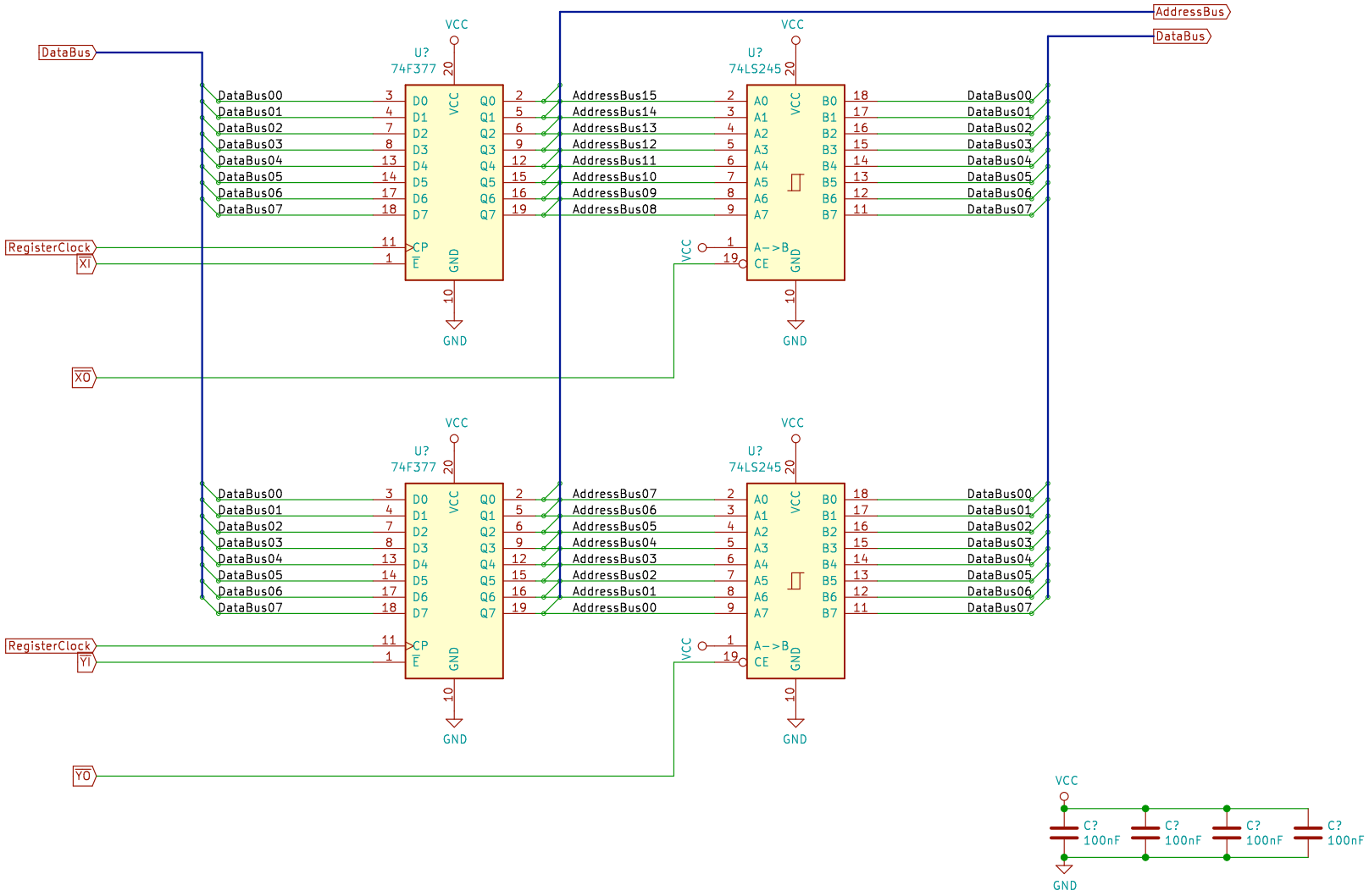
Register D controls the device select lines for peripherals and memory.

Sheet: /Register D/
File: Register D.sch

Title: Register D

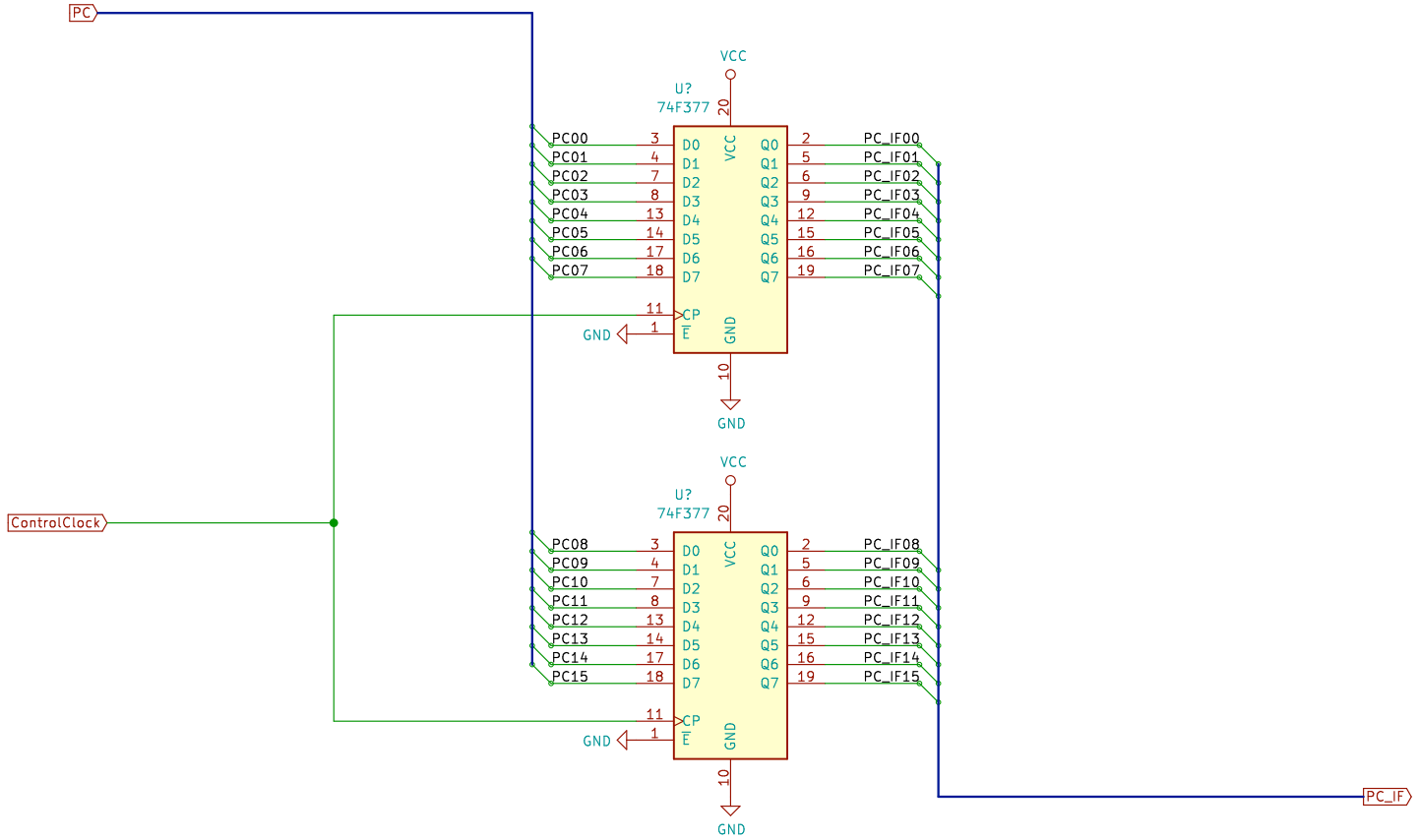
Size: A | Date: | **Rev:**
KiCad E.D.A. kicad (5.1.0-0) | Id: 17/21

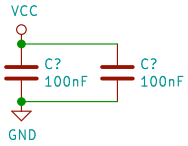

VCC
RV?
R_POT
GND
R?
1k
4.7k
U?A
LM393
D?
LED
U?
GLS29EE010
VDD
VSS
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
A16
WE
OE
CE
DQ0
DQ1
DQ2
DQ3
DQ4
DQ5
DQ6
DQ7
NC
ClockRate0
ClockRate1
ClockRate2
C?
100nF
Form a Flash ADC from an array of voltage comparators.
Convert the output to a three-bit number which selects the clock rate.
An array of LEDs indicates the selected speed.
Sheet: /Speed Control/
File: Speed Control.sch
Title: Speed Control
Size: USLetter
Date:
Rev:
KiCad E.D.A. kicad (5.1.0-0)
Id: 18/21



The XY register pair sets the value on the sixteen-bit Address Bus.

Sheet: /Register XY/	
File: Register XY.sch	
Title:	
Size: USLetter Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)	Id: 19/21



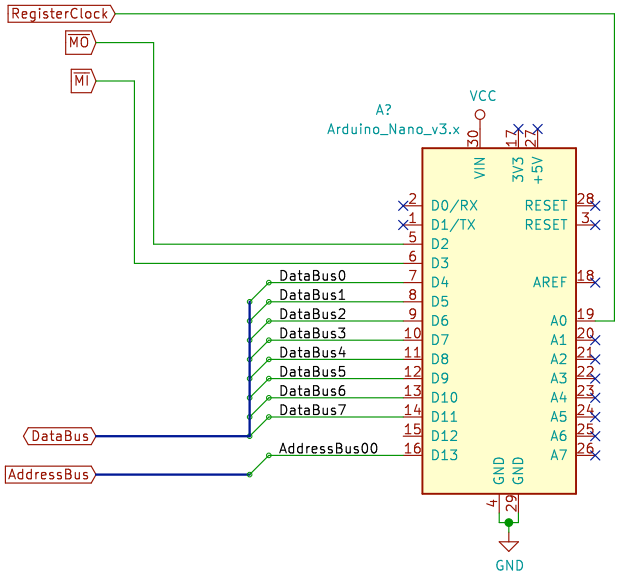


The PC/IF register sits between the program counter and the Instruction Fetch stage. This alleviates timing constraints related to the phase shift between the register clock and the control clock.

Sheet: /PC/IF/
File: PC_IF.sch

Title:

Size: USLetter	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 20/21



An Arduino Nano serves as a serial interface module.

Sheet: /Serial/
File: Serial.sch

Title:

Size: USLetter | Date: | **Rev:**
KiCad E.D.A. kicad (5.1.0-0) | Id: 21/21