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: Serial

File: Serial.sch

Sheet: Instruction Decoder

File: Instruction Decoder.sch

Sheet: ALU

File: ALU.sch

Sheet: Register D

File: Register D.sch

Sheet: Execute

File: Execute.sch

Sheet: Bus Display

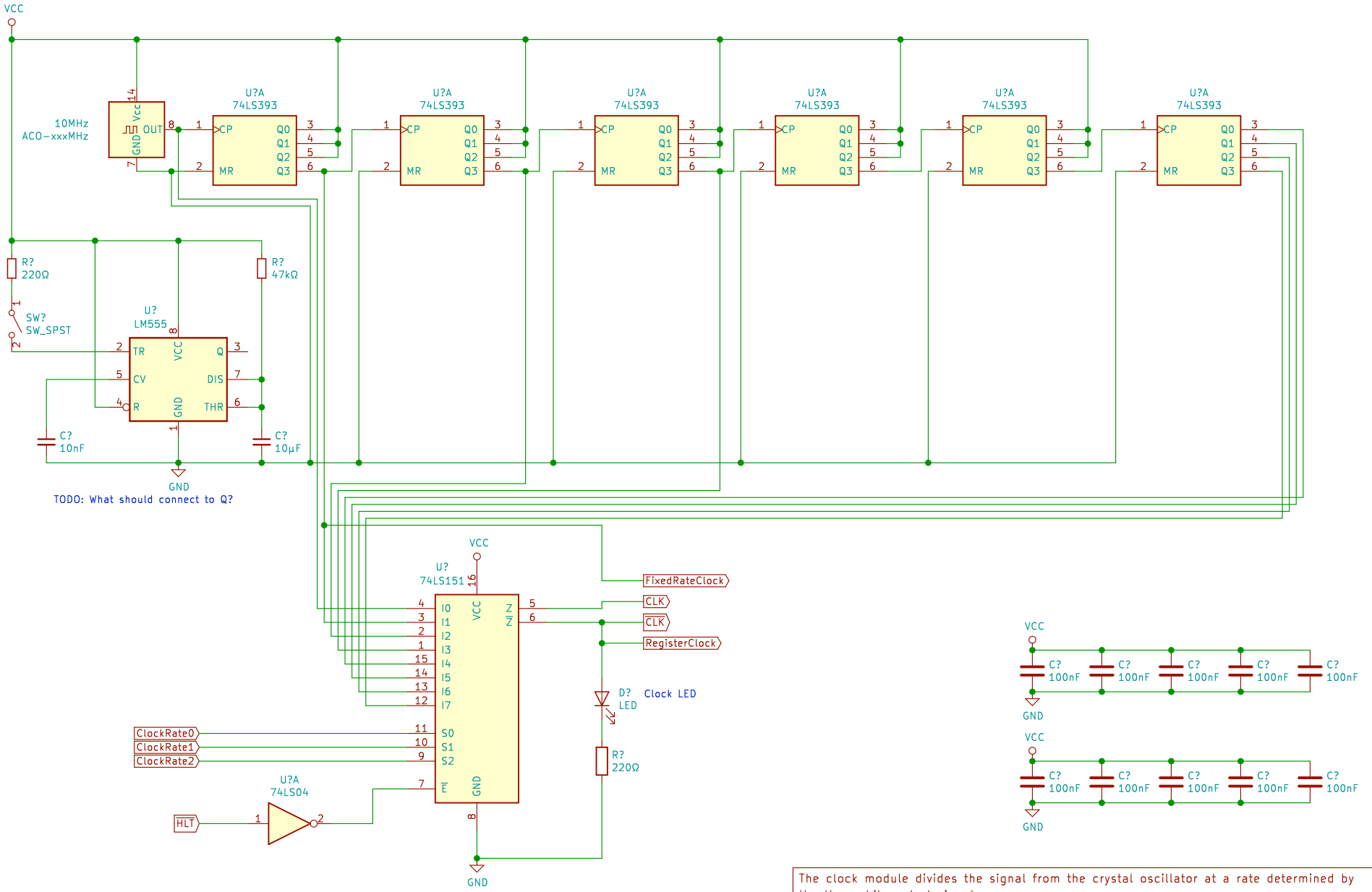
File: Bus Display.sch

TTL microcomputer built from 74xx series logic chips.

Sheet: /
File: TurtleTTL.sch

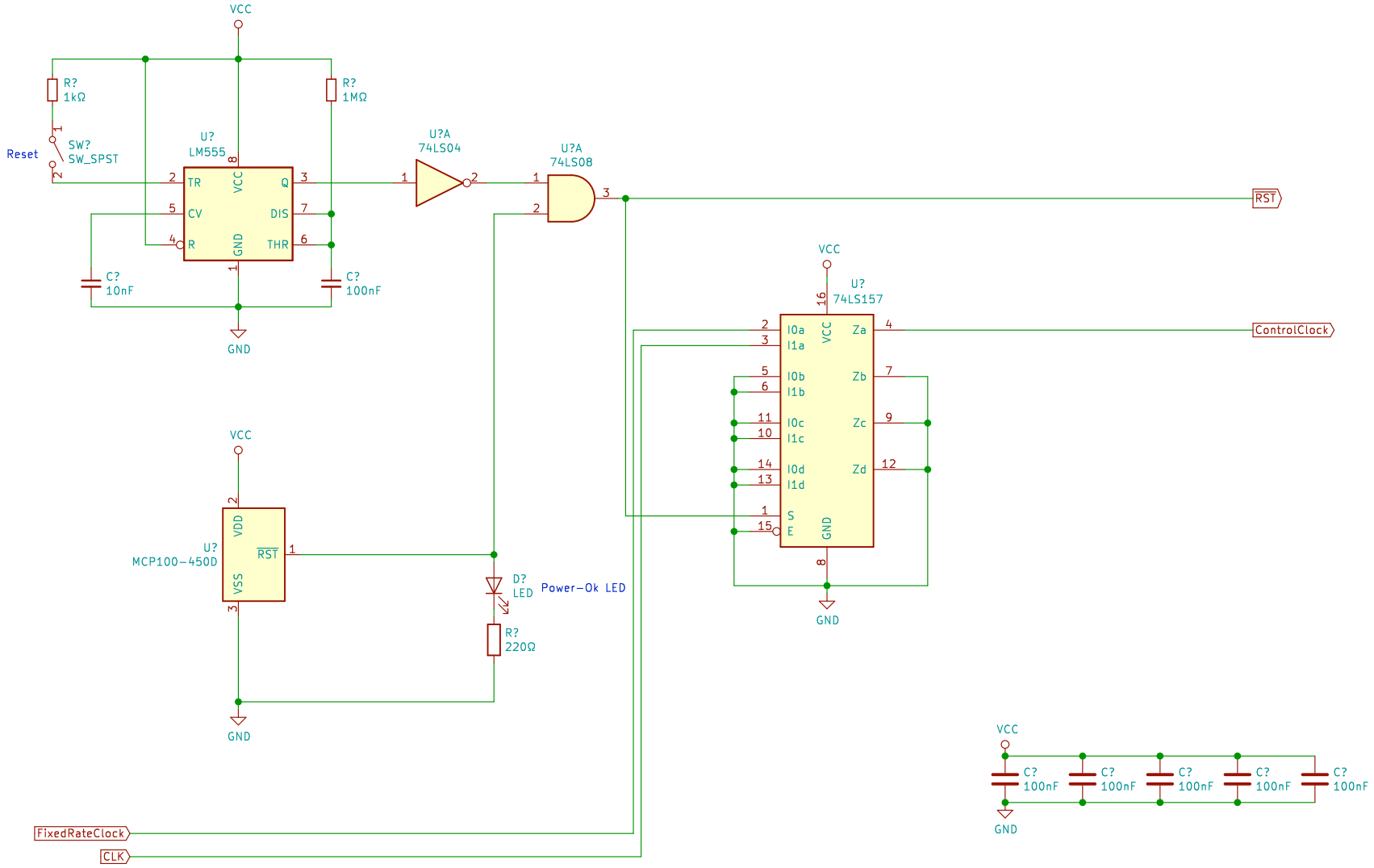
Title: Turtle TTL

Size: A	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 1/20



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:
KiCad E.D.A. kicad (5.1.0-0)	Id: 2/20

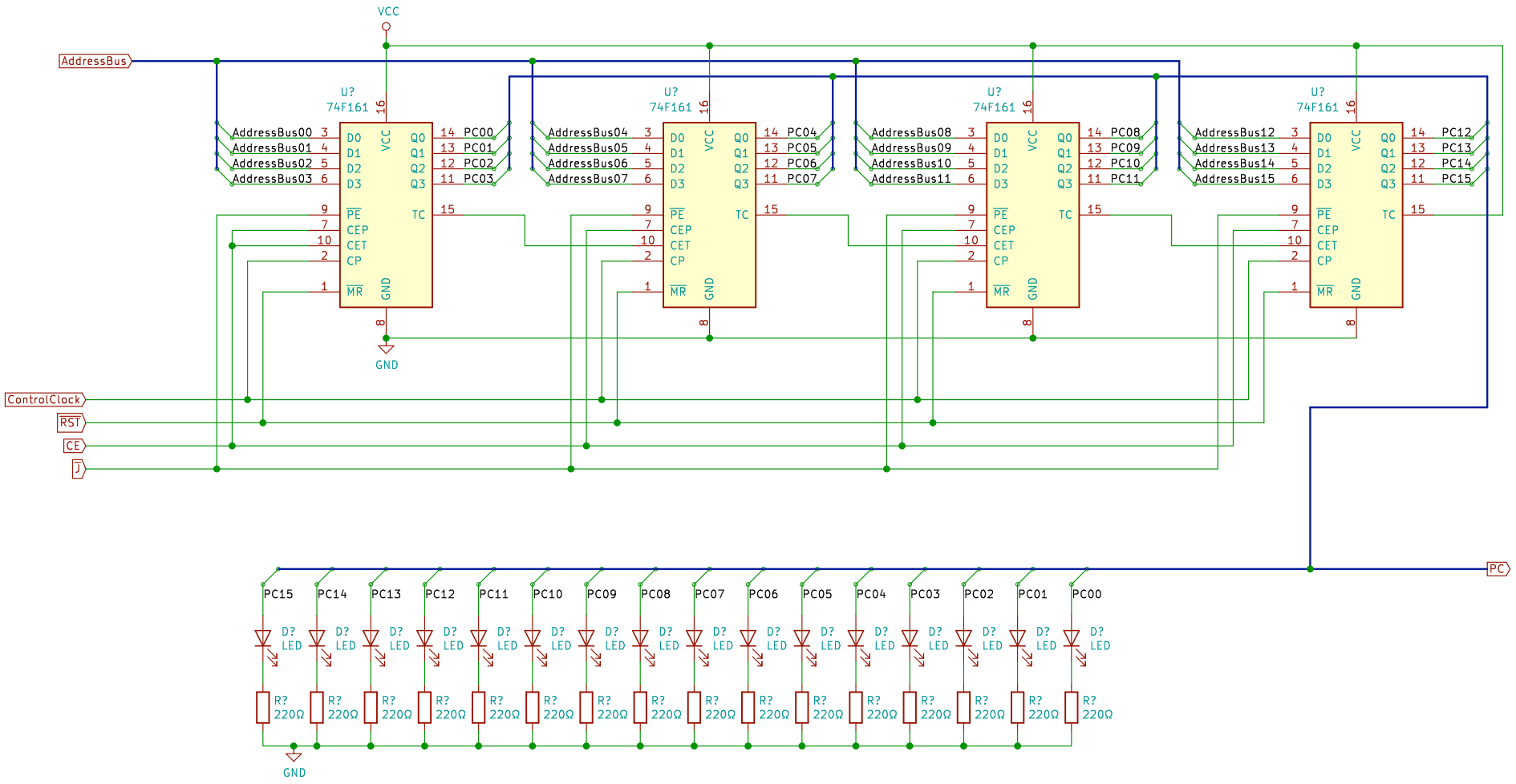


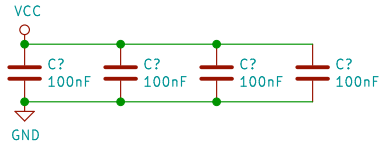
The MCP100 provides Power-on Reset functionality.
A button is also provided to manually reset the machine.
During reset, the control clock is pulsed repeatedly to flush the pipeline.

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

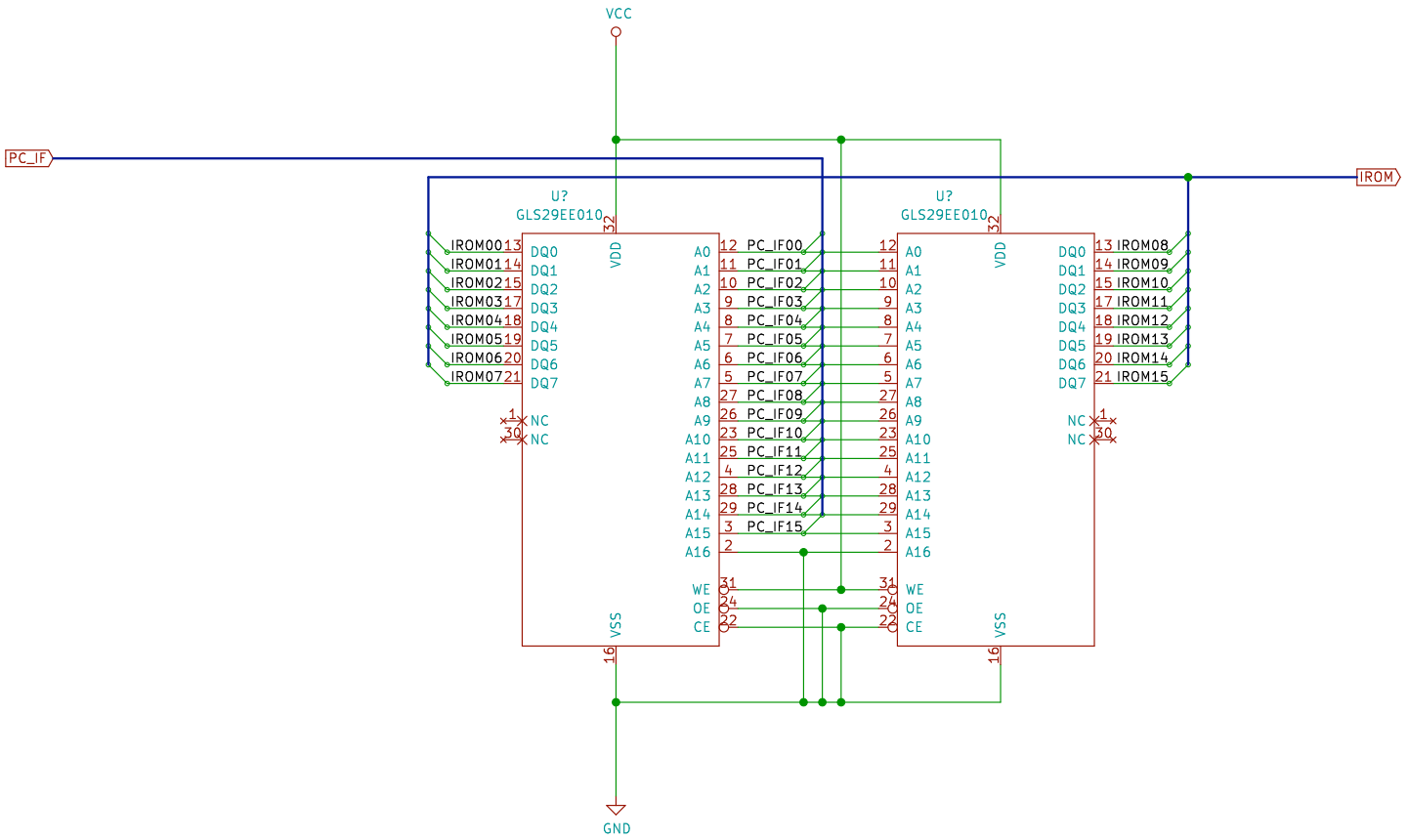
Title: Power-on Reset

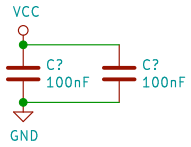
Size: A	Date:	Rev:
KiCad E.D.A. kicad (5.1.0-0)		Id: 3/20





Sheet: /Program Counter/	
File: Program Counter.sch	
Title: Program Counter	
Size: USLetter	Date:
KiCad E.D.A. kicad (5.1.0-0)	Id: 4/20





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

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

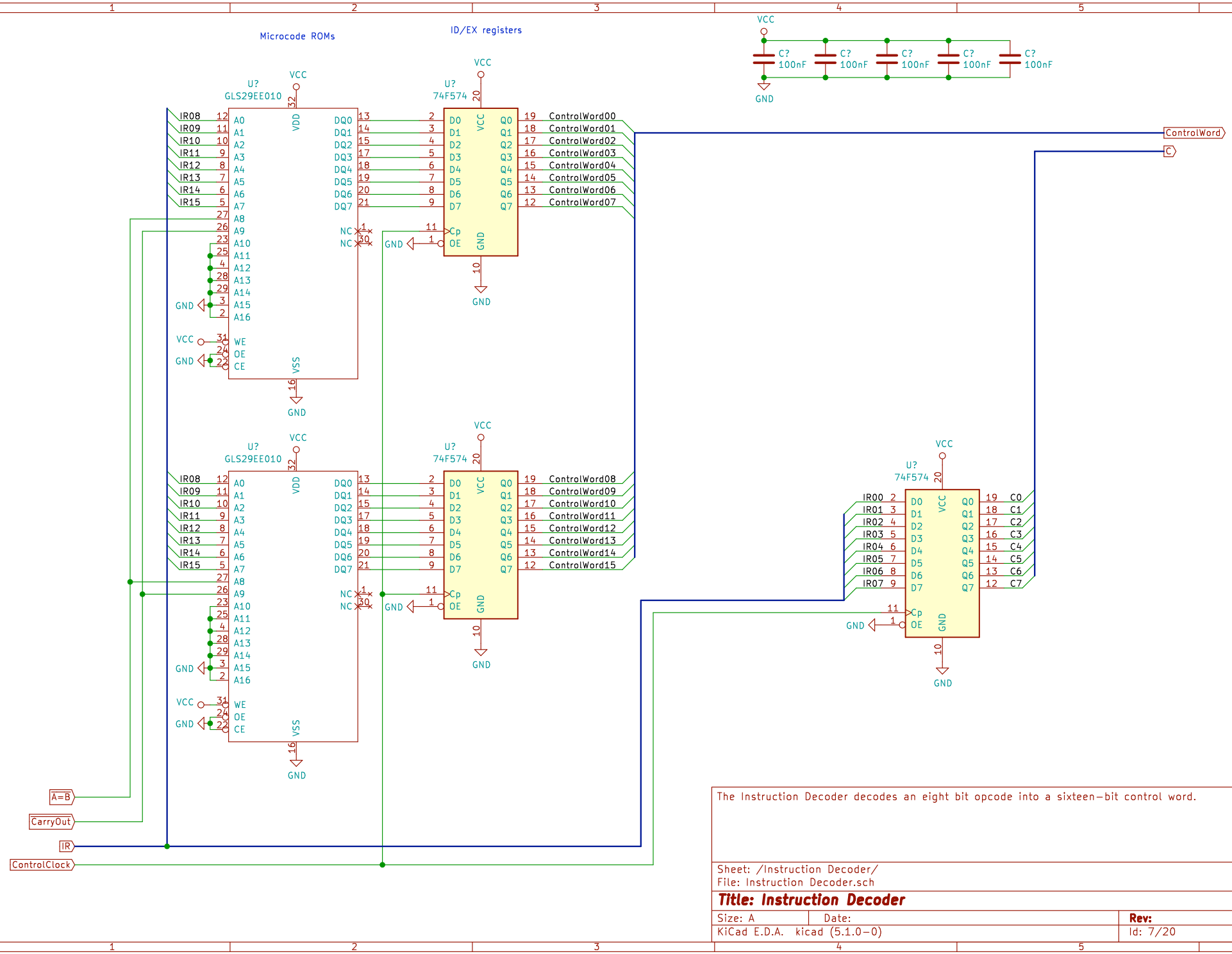
Title: Instruction ROM

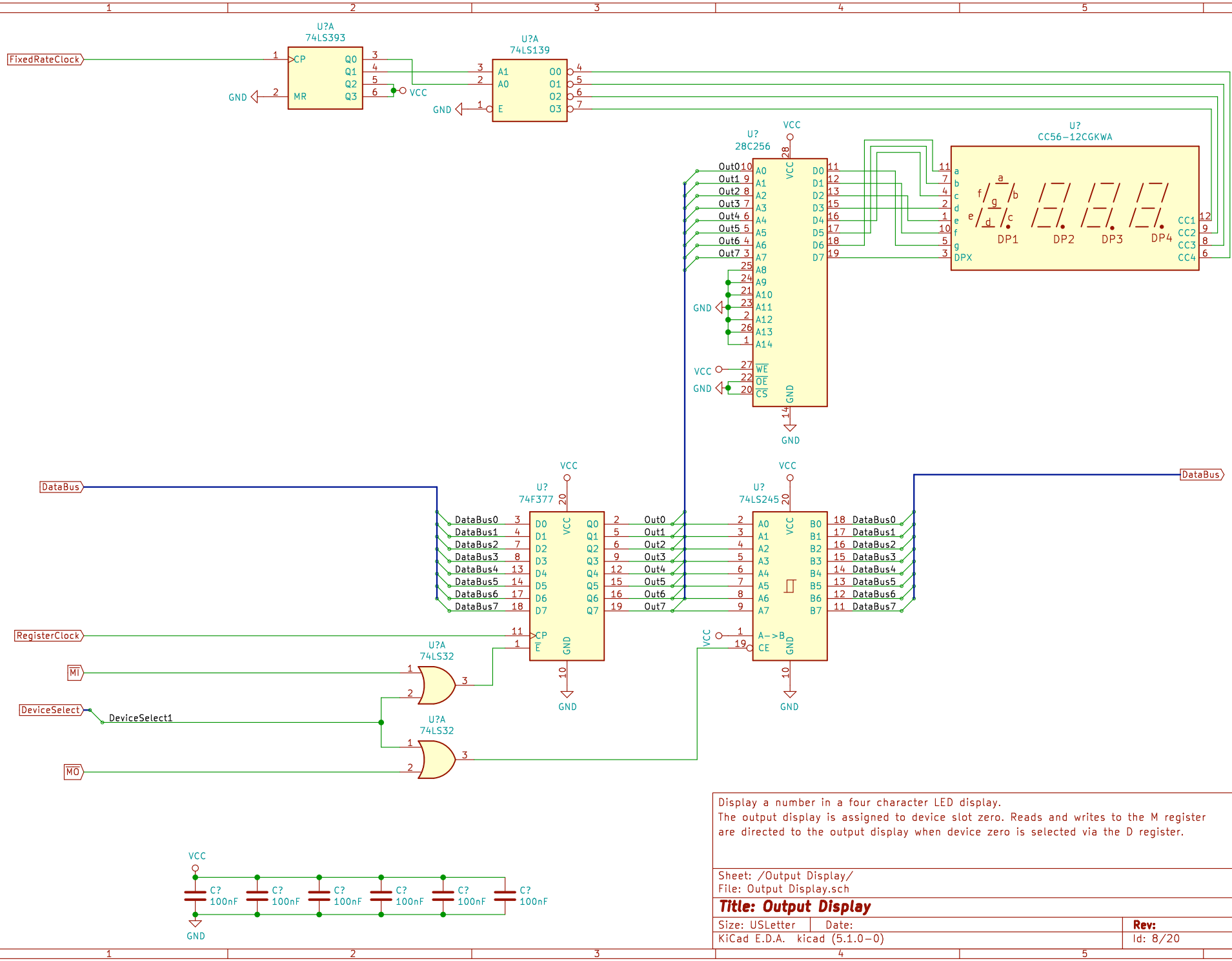
Size: USLetter	Date:	Rev:
KiCad E.D.A. kicad (5.1.0-0)		Id: 5/20

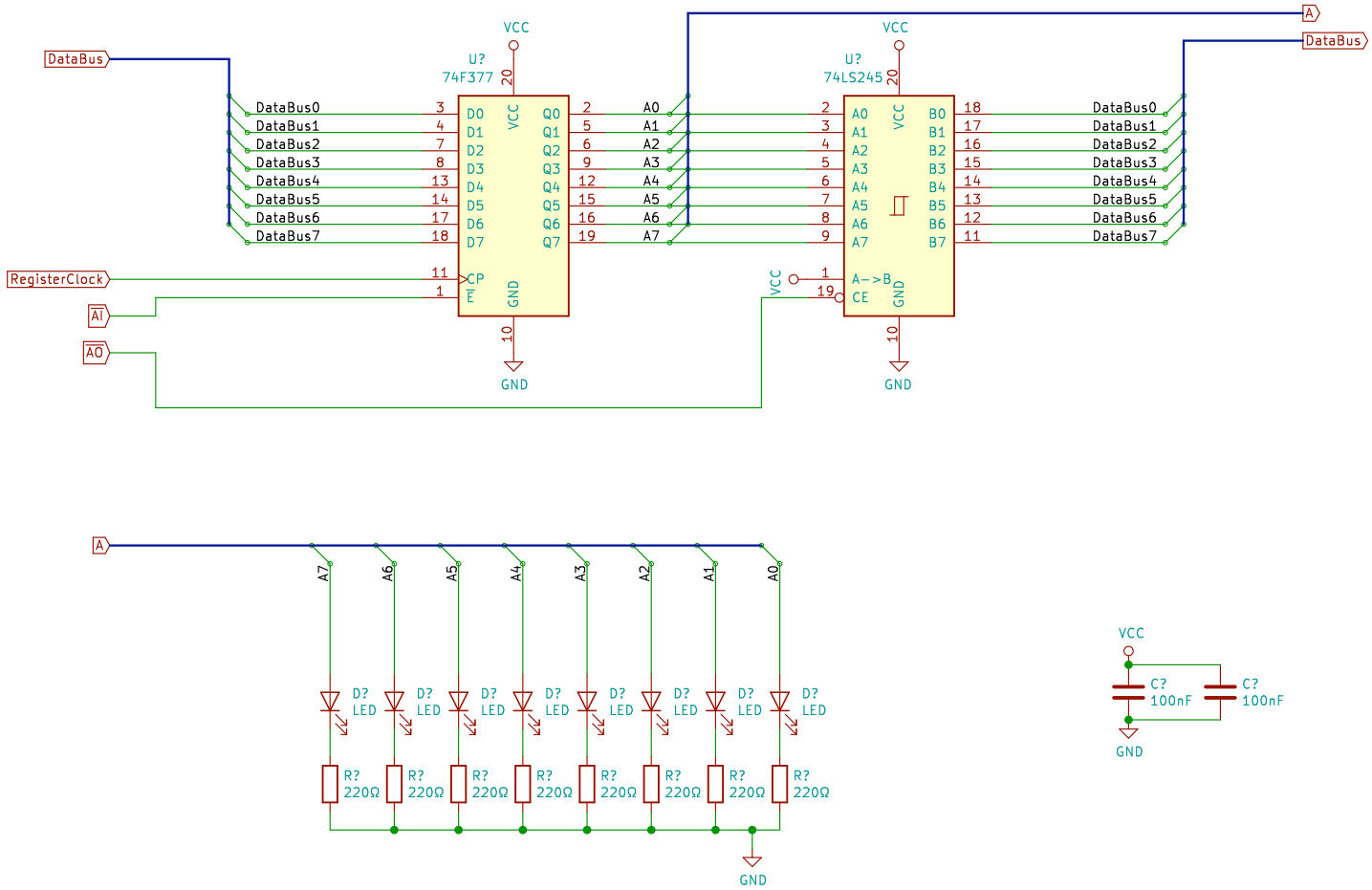
Sheet: /Instruction RAM/
File: Instruction RAM.sch

Title: Instruction RAM

Size: USLetter	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 6/20


Microcode ROMs
ID/EX registers
VCC
GND
C? 100nF
U? GLS29EE010
U? 74F574
IR08
IR09
IR10
IR11
IR12
IR13
IR14
IR15
ControlWord00
ControlWord01
ControlWord02
ControlWord03
ControlWord04
ControlWord05
ControlWord06
ControlWord07
ControlWord08
ControlWord09
ControlWord10
ControlWord11
ControlWord12
ControlWord13
ControlWord14
ControlWord15
ControlWord
C
IR00
IR01
IR02
IR03
IR04
IR05
IR06
IR07
C0
C1
C2
C3
C4
C5
C6
C7
A=B
CarryOut
IR
ControlClock
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: 7/20


U?A
74LS393
FixedRateClock
CP
MR
Q0
Q1
Q2
Q3
GND
VCC
U?A
74LS139
A1
A0
E
O0
O1
O2
O3
U?
28C256
Out0
Out1
Out2
Out3
Out4
Out5
Out6
Out7
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
WE
OE
CS
D0
D1
D2
D3
D4
D5
D6
D7
U?
CC56-12CGKWA
a
b
c
d
e
f
g
DP1
DP2
DP3
DP4
DPX
CC1
CC2
CC3
CC4
DataBus
U?
74F377
DataBus0
DataBus1
DataBus2
DataBus3
DataBus4
DataBus5
DataBus6
DataBus7
U?
74LS245
A->B
CE
B0
B1
B2
B3
B4
B5
B6
B7
RegisterClock
MI
DeviceSelect
DeviceSelect1
MO
U?A
74LS32
C?
100nF
Display a number in a four character LED display.
The output display is assigned to device slot zero. Reads and writes to the M register are directed to the output display when device zero is selected via the D register.
Sheet: /Output Display/
File: Output Display.sch
Title: Output Display
Size: USLetter
Date:
Rev:
KiCad E.D.A. kicad (5.1.0-0)
Id: 8/20

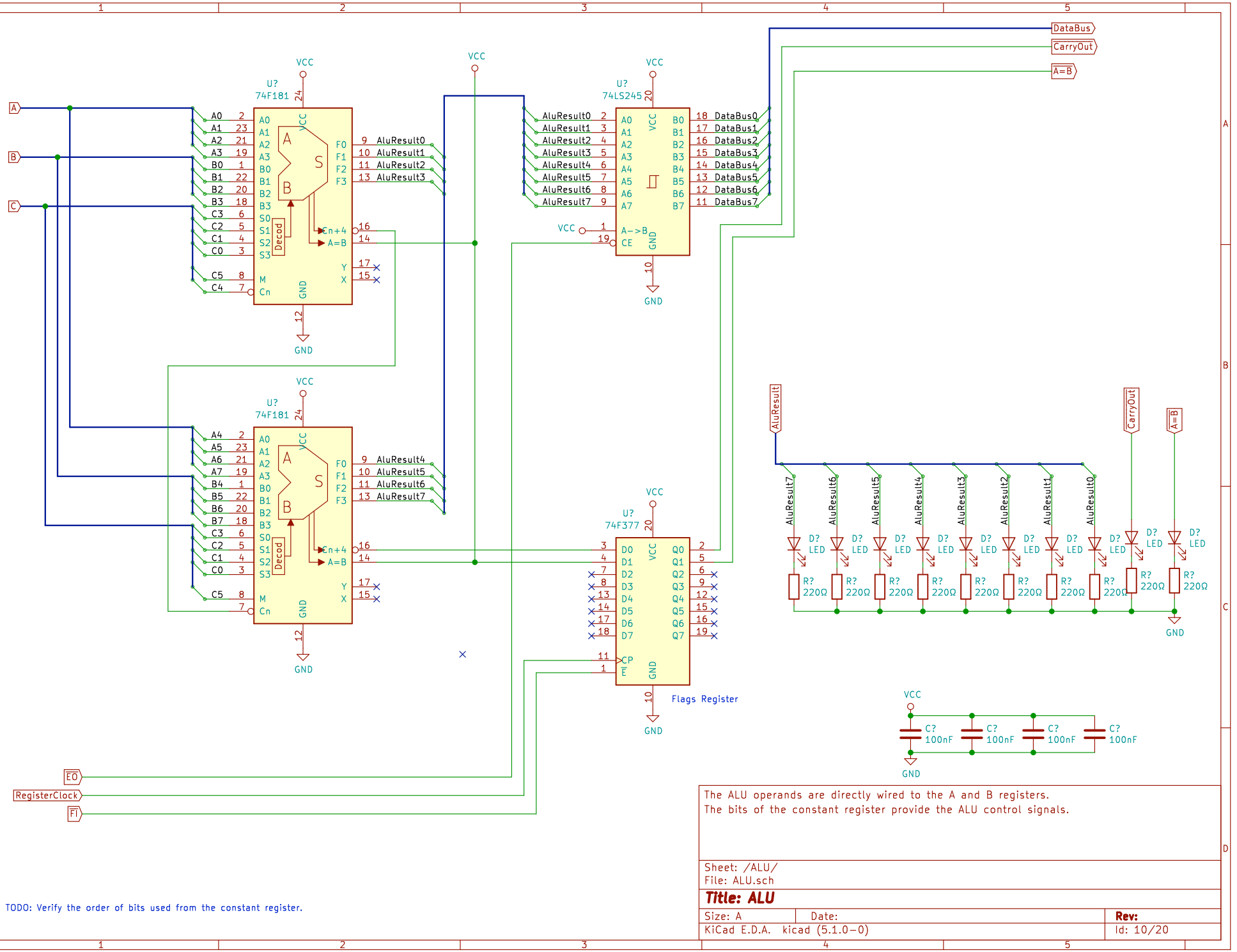


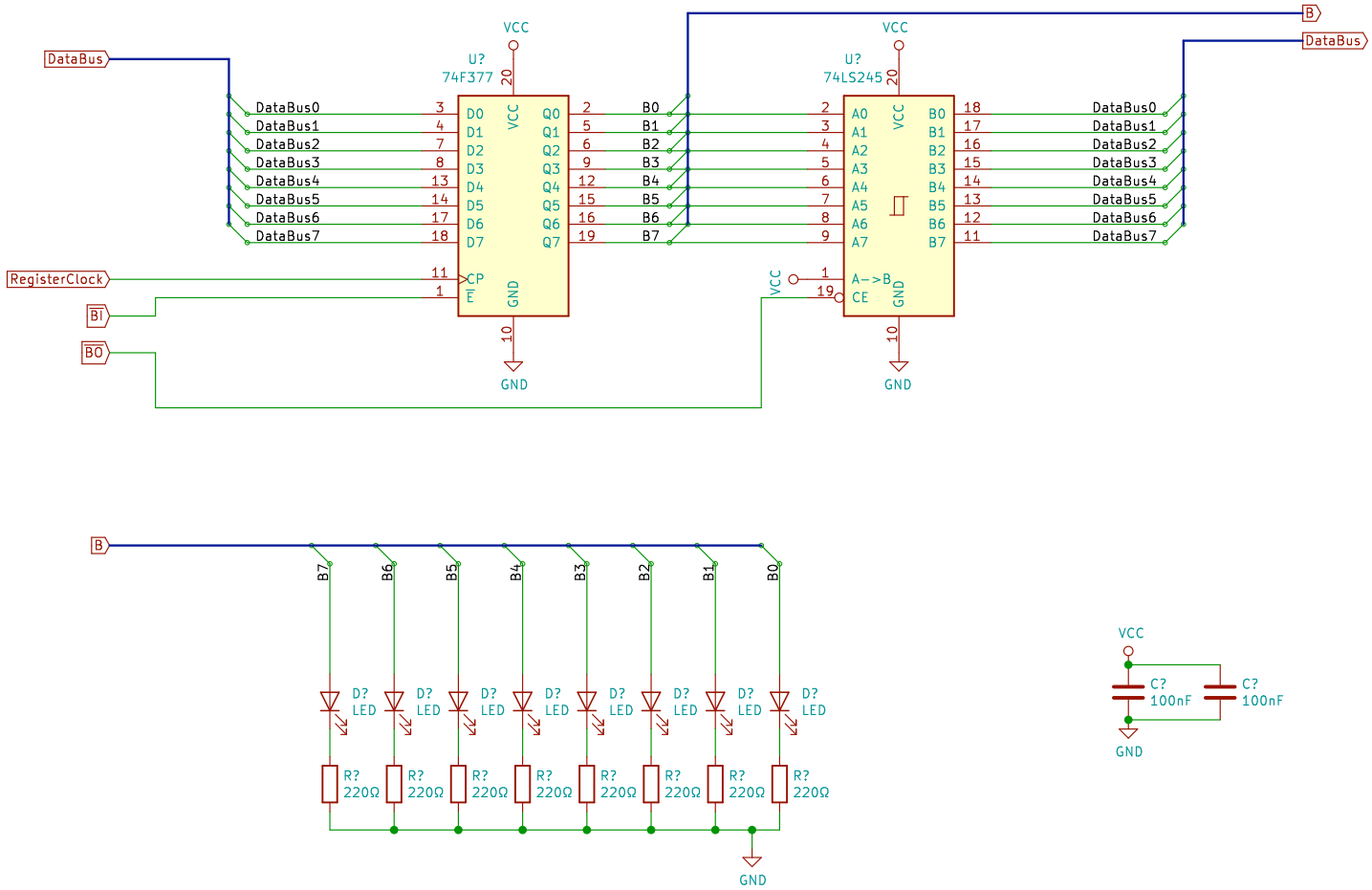
Register A is wired to the ALU's A operand.

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

Title: Register A

Size: A	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 9/20


DataBus
CarryOut
A=B
U?
74F181
U?
74LS245
U?
74F181
U?
74F377
Flags Register
AluResult
AluResult7
AluResult6
AluResult5
AluResult4
AluResult3
AluResult2
AluResult1
AluResult0
LED
220Ω
100nF
GND
VCC
EO
RegisterClock
FI
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: 10/20

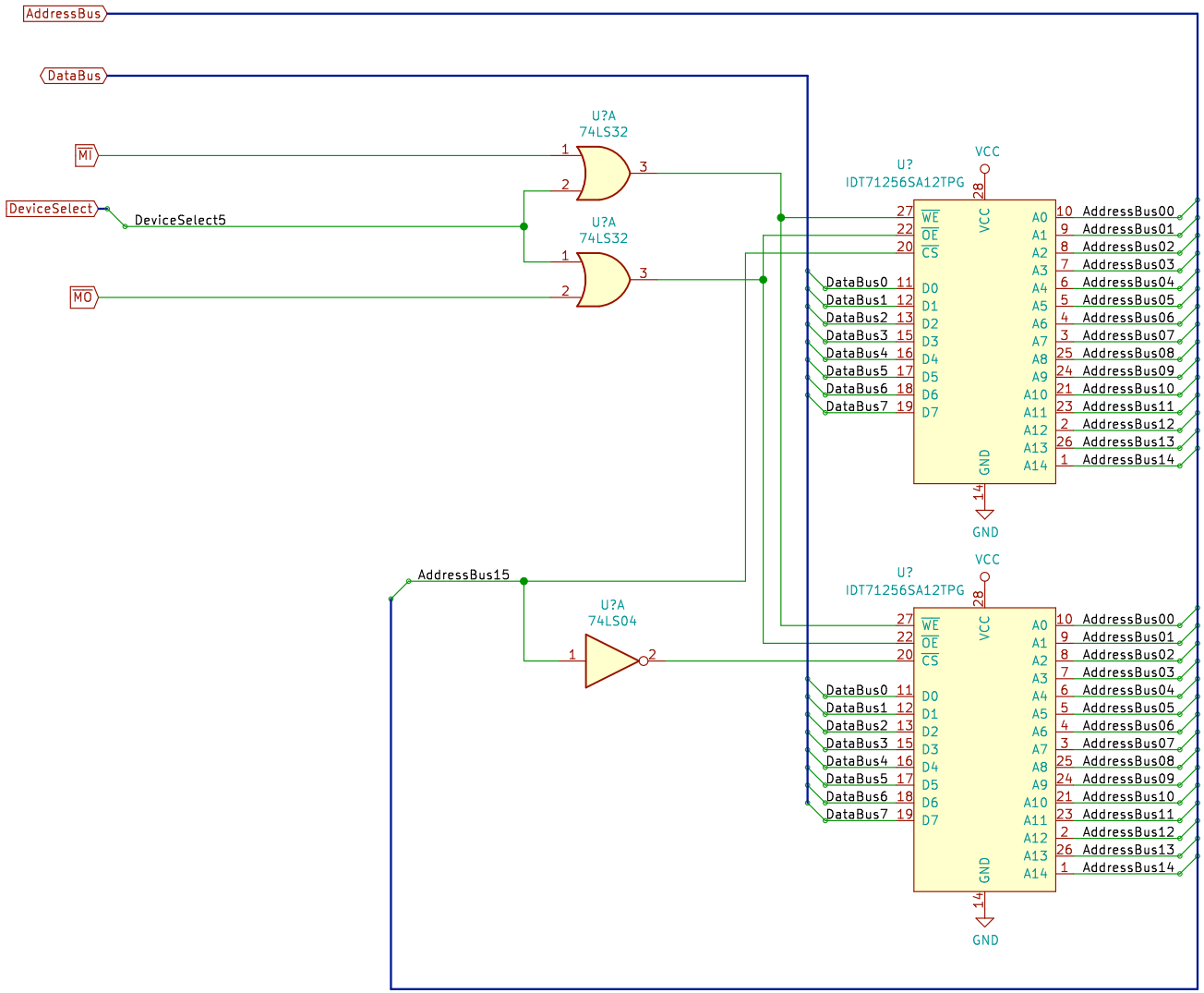


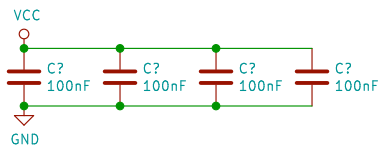
Register B is wired to the ALU's B operand.

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

Title: Register B

Size: A	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 11/20



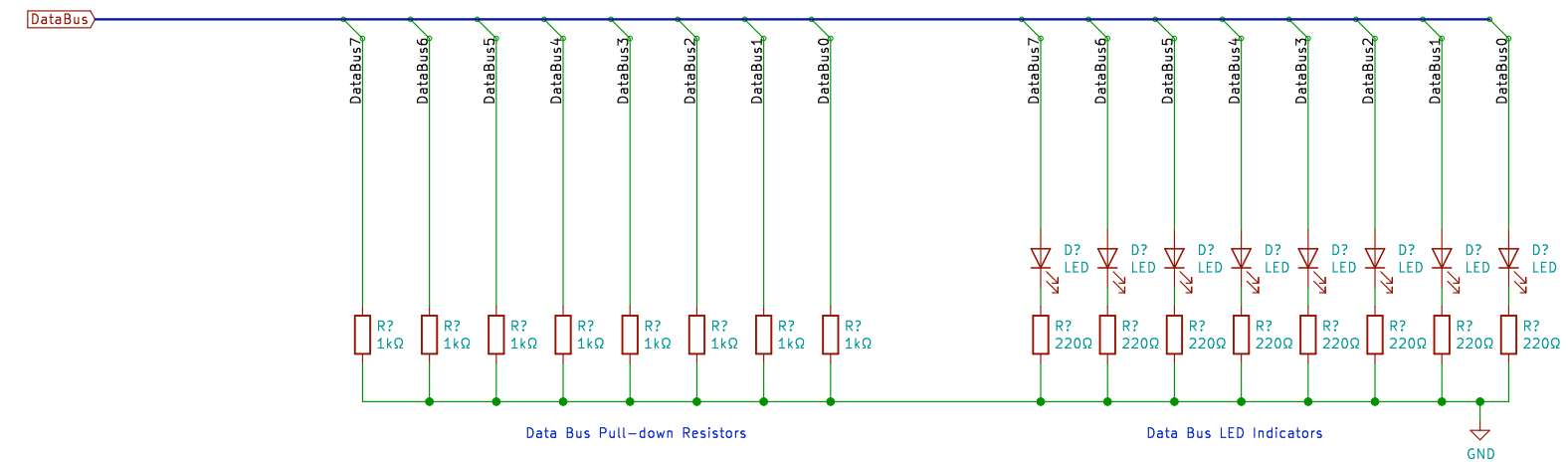


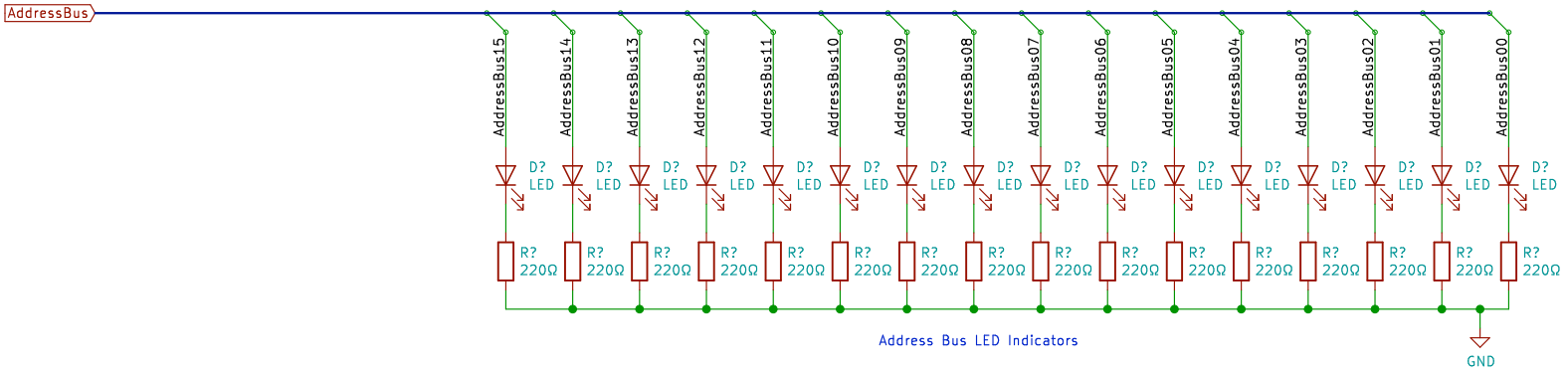
64KB Data RAM is connected to device slot five.
Reads and writes to the M register are directed to Data RAM when device 5 is selected via the D register.
The MSB of the address selects between two 32KB SRAM ICs.

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

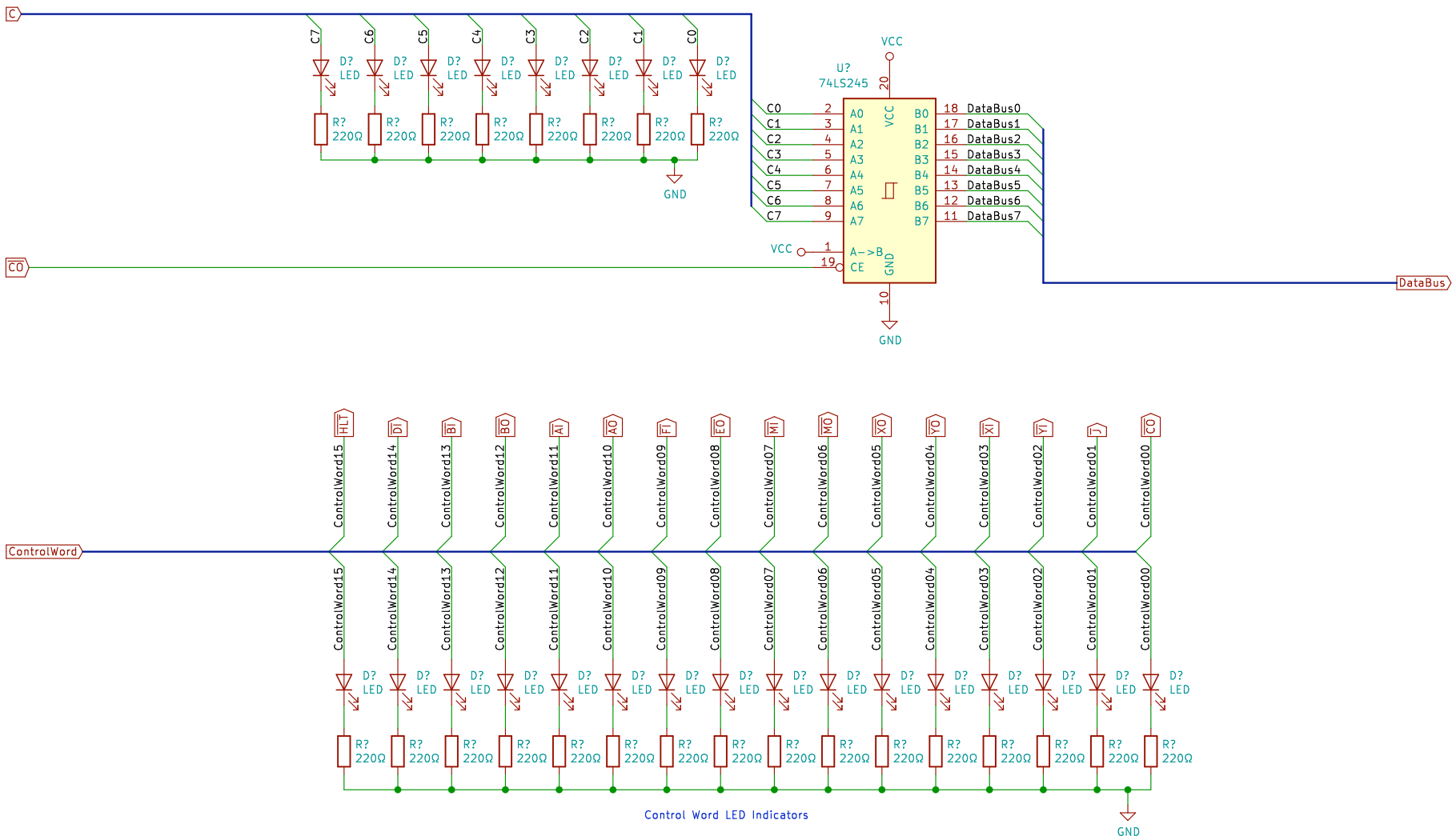
Title: Data RAM

Size: USLetter	Date:	Rev:
KiCad E.D.A. kicad (5.1.0-0)		Id: 12/20





Sheet: /Bus Display/		
File: Bus Display.sch		
Title: Bus Display		
Size: A	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 13/20

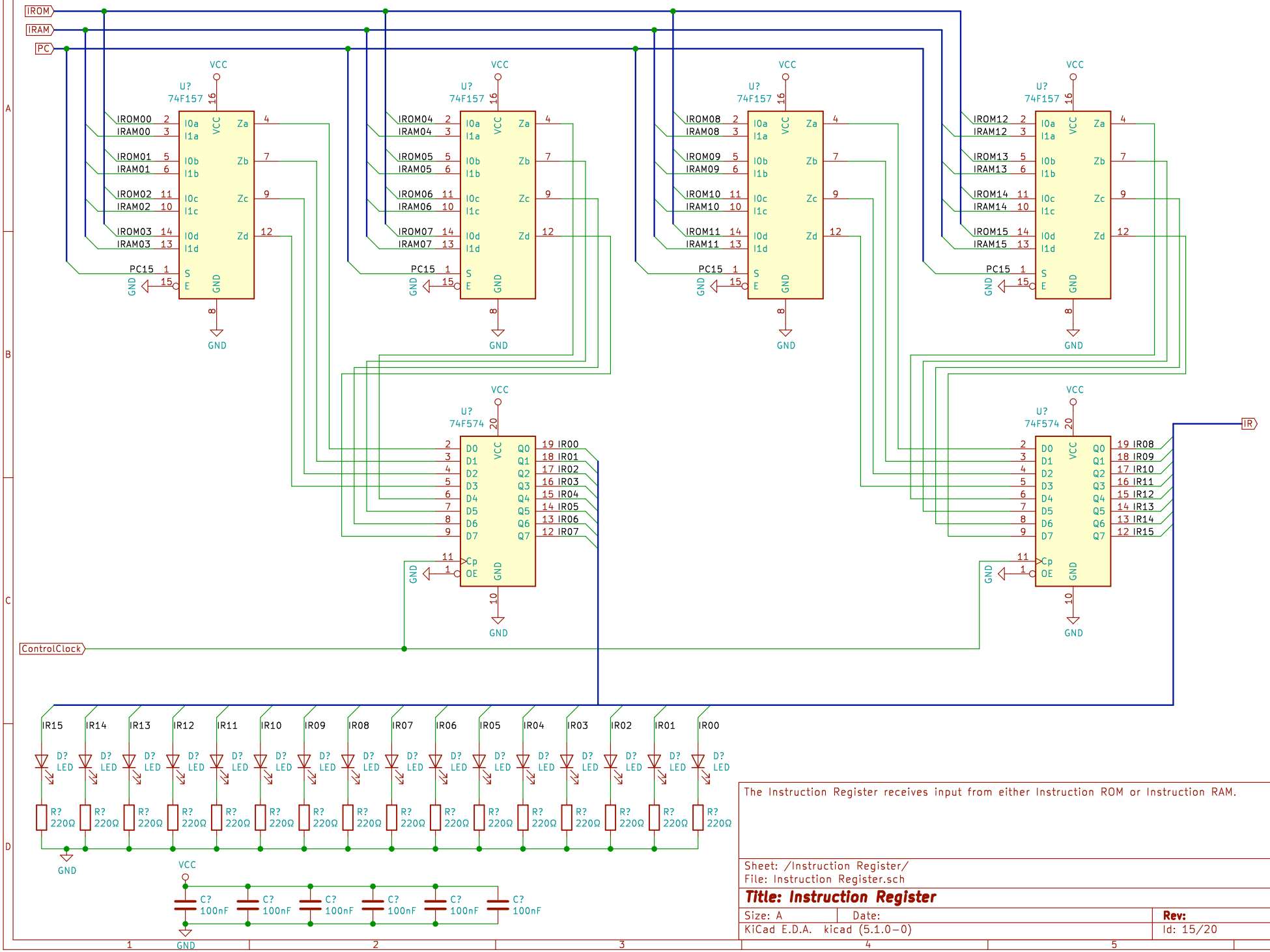


The lower eight bits of the instruction register can be expressed onto the data bus as a constant value.

Sheet: /Execute/
File: Execute.sch

Title: Execute

Size: A	Date:	Rev:
KiCad E.D.A. kicad (5.1.0-0)		Id: 14/20

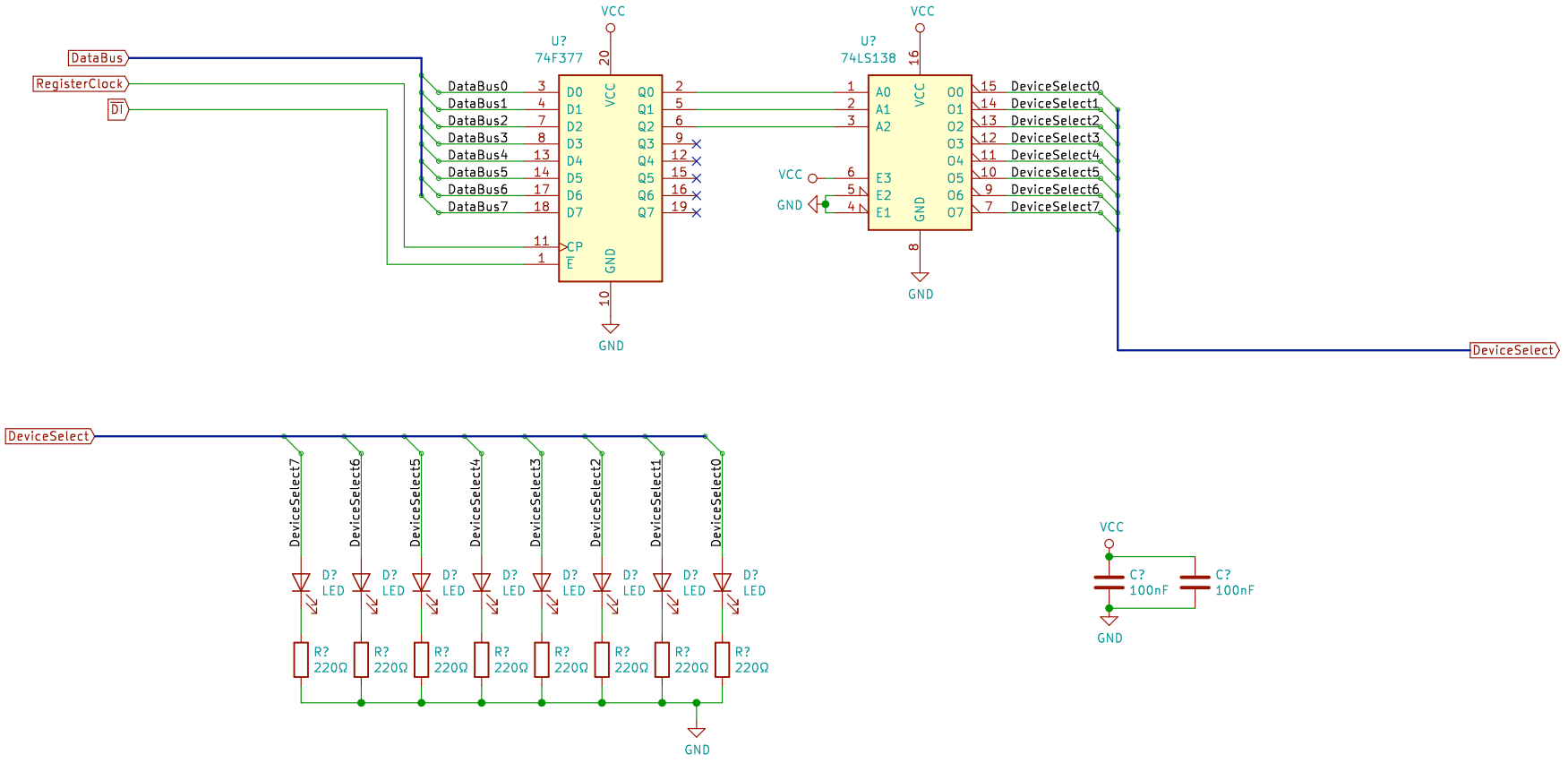


The Instruction Register receives input from either Instruction ROM or Instruction RAM.

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

Title: Instruction Register

Size: A	Date:	Rev:
KiCad E.D.A. kicad (5.1.0-0)		Id: 15/20

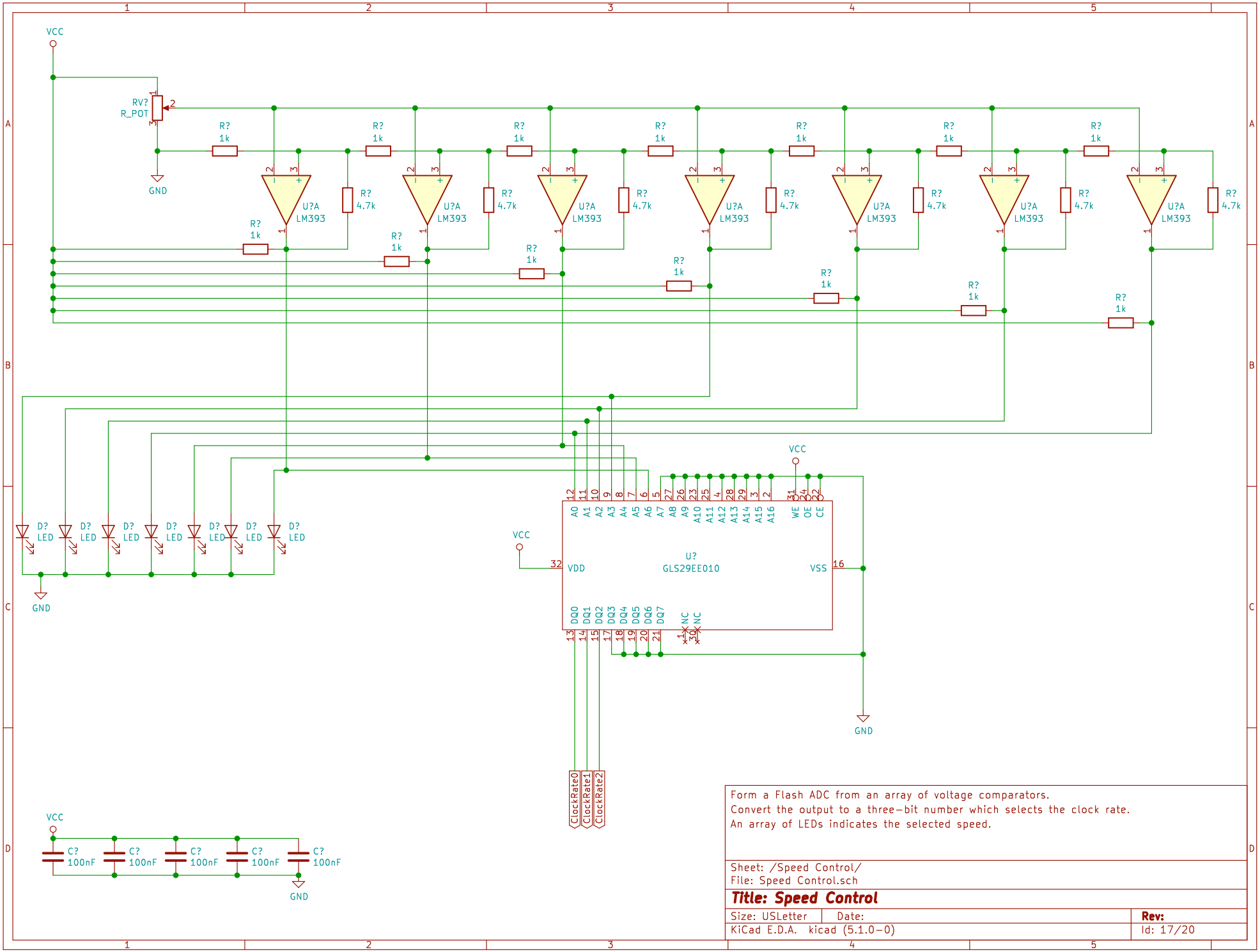


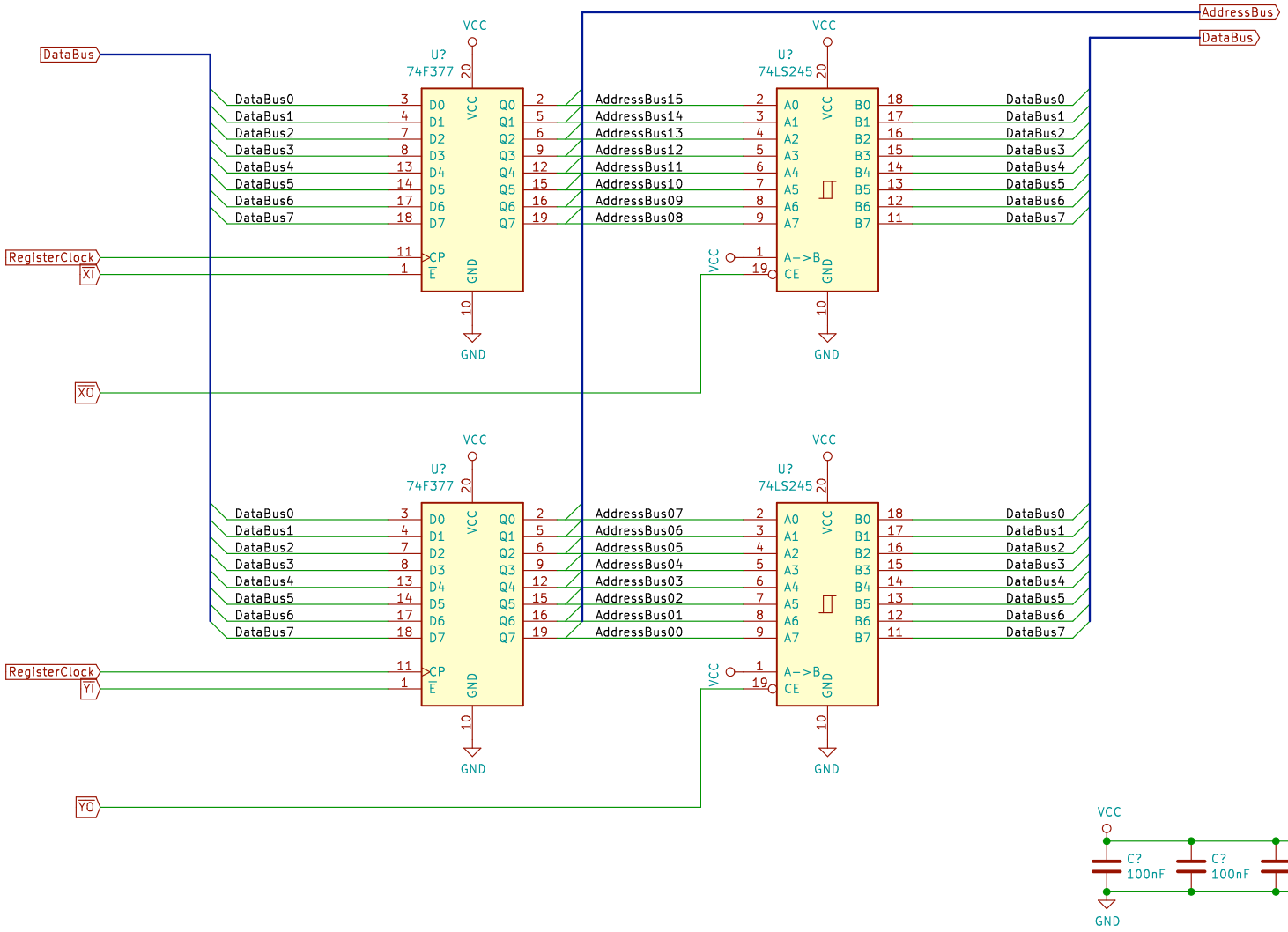
Register D controls the device select lines for peripherals and memory.

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

Title: Register D

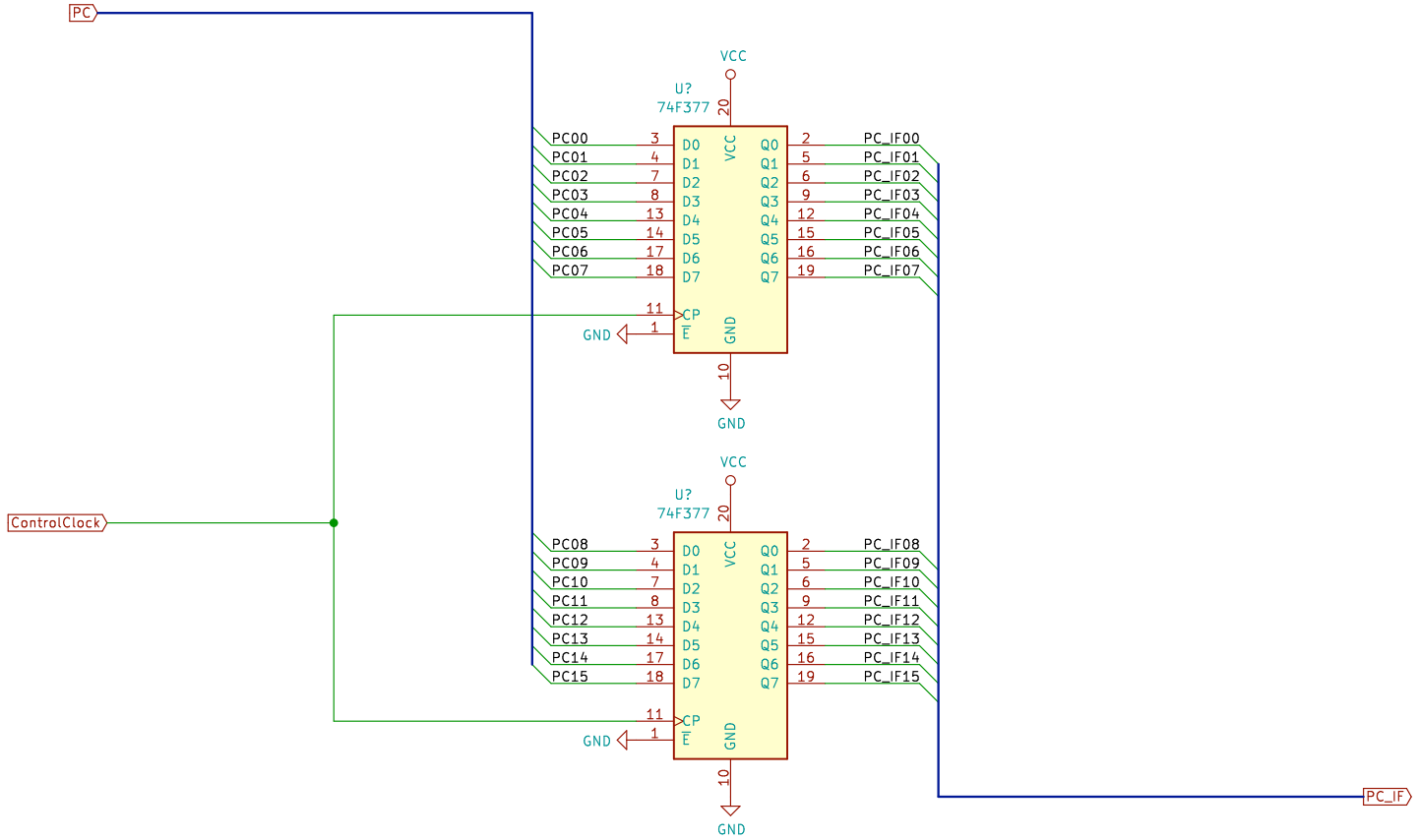
Size: A	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 16/20

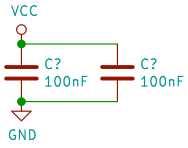

VCC
RV?
R_POT
GND
R?
1k
4.7k
U?A
LM393
D?
LED
U?
GLS29EE010
VDD
VSS
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
A16
WE
OE
CE
DQ0
DQ1
DQ2
DQ3
DQ4
DQ5
DQ6
DQ7
NC
ClockRate0
ClockRate1
ClockRate2
C?
100nF
Form a Flash ADC from an array of voltage comparators.
Convert the output to a three-bit 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: 17/20



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

Sheet: /Register XY/	
File: Register XY.sch	
Title:	
Size: USLetter	Date:
KiCad E.D.A. kicad (5.1.0-0)	Id: 18/20



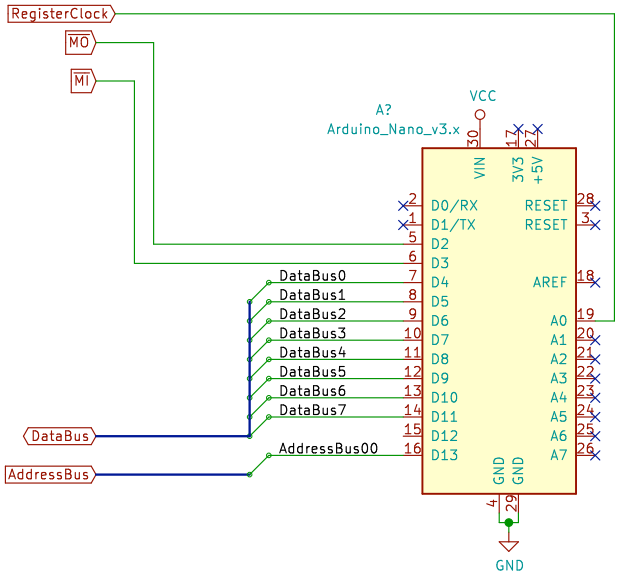


The PC/IF register sits between the program counter and the Instruction Fetch stage. This alleviates timing constraints related to the phase shift between the register clock and the control clock.

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

Title:

Size: USLetter	Date:	**Rev:**
KiCad E.D.A. kicad (5.1.0-0)		Id: 19/20



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: 20/20