Display Types

LED

Light Emitting Diode
very inexpensive
long life
lots of wavelength/color choice
can be single or "grouped" (displays)
can control brightness with
current or duty cycle

VFD

Vacuum Fluorescent Display
very bright
blue-green color
used to be more popular
old technology (Nixie Tubes)
medium power

LCD

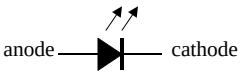
Liquid Crystal Display
very popular
inexpensive
very low power
color determined by backlight/filters
more climate sensitive than LEDs
needs light (passive device)

Plasma Display

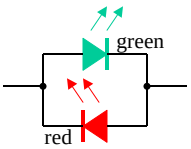
good for low light graphics
compact (compared to CRT)
military uses
uses high voltages
(need to make gas glow)

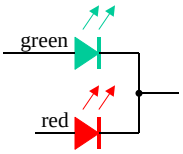
LEDs

Single LED

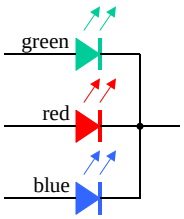


Dual-Color LED

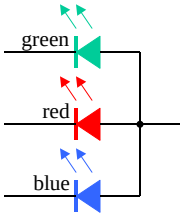




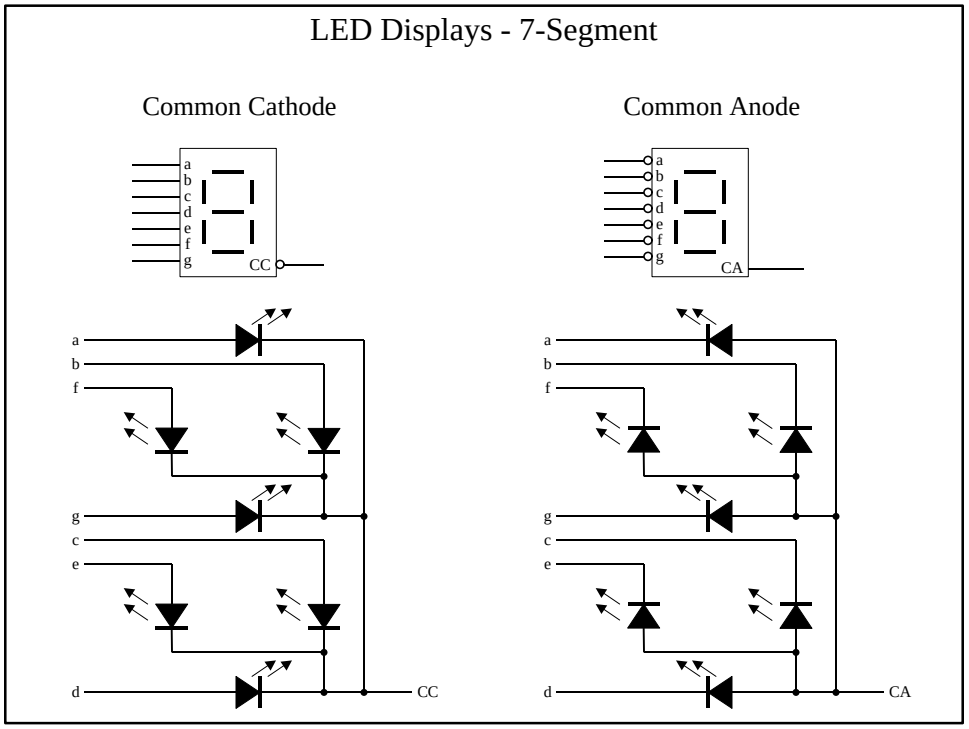
Tri-Color LED

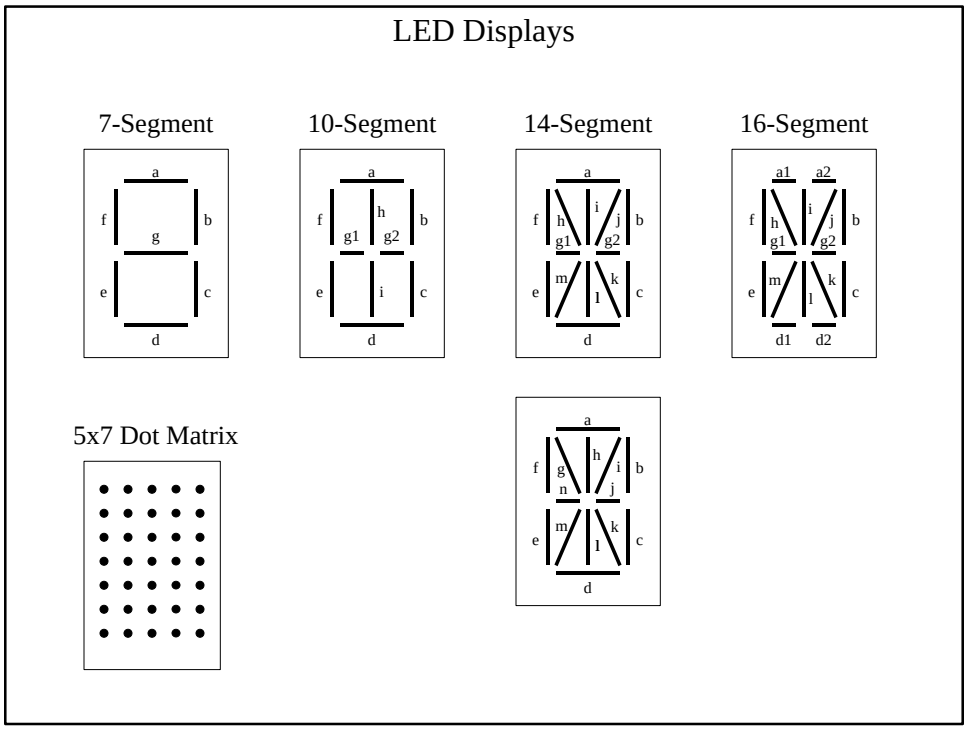


CC - Common Cathode



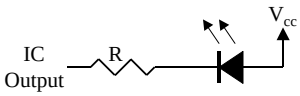
CA - Common Anode


LED Displays - 7-Segment
Common Cathode
Common Anode
a
b
c
d
e
f
g
CC
CA


LED Displays
7-Segment
10-Segment
14-Segment
16-Segment
5x7 Dot Matrix

Driving LEDs

Typical Circuit

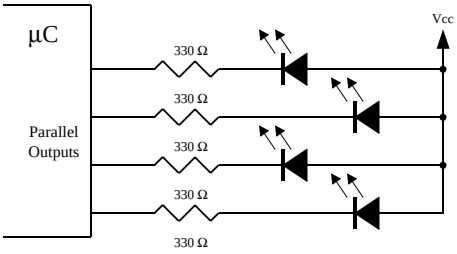


$I_{LED} = (V_{cc} - V_{LED} - V_{OL}) / R$

typically: $R = 330\Omega$
$V_{OL} = 0V$
$V_{cc} = 5V$ ⇨ $I_{LED} = 10$ mA
$V_{LED} = 1.7V$

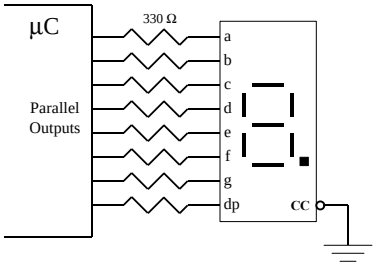
$V_{LED} = 1.7V$ Red
$V_{LED} = 2.1V$ Yellow
$V_{LED} = 2.1V$ Green
$V_{LED} = 3.5V$ Blue
$V_{LED} = 3.5V$ White
$V_{LED} = 1.7V$ IR

Non-Multiplexed Individual LED Interfacing

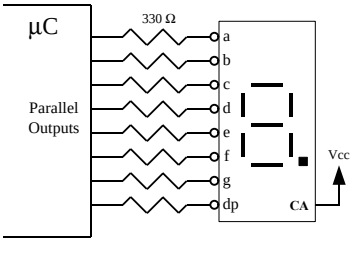


Non-Multiplexed 7-Segment LED Interfacing

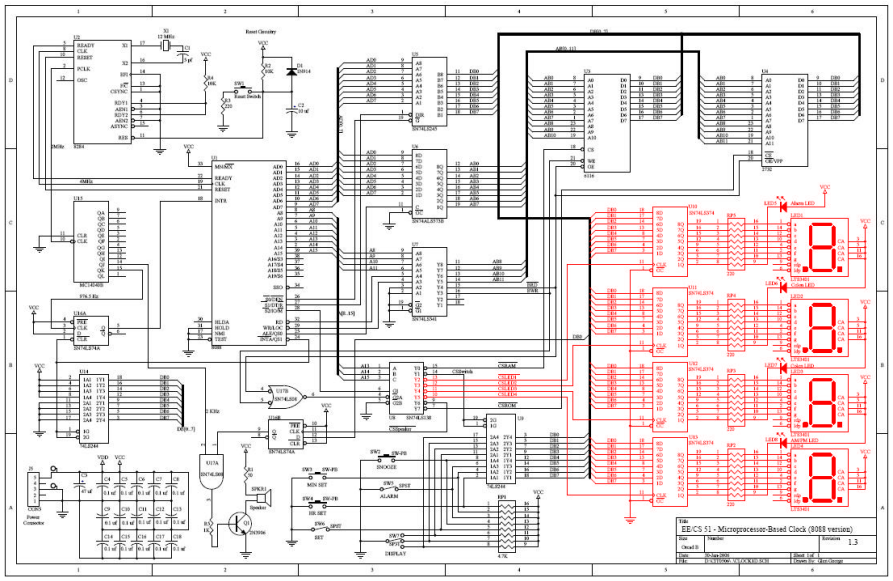
Common Cathode



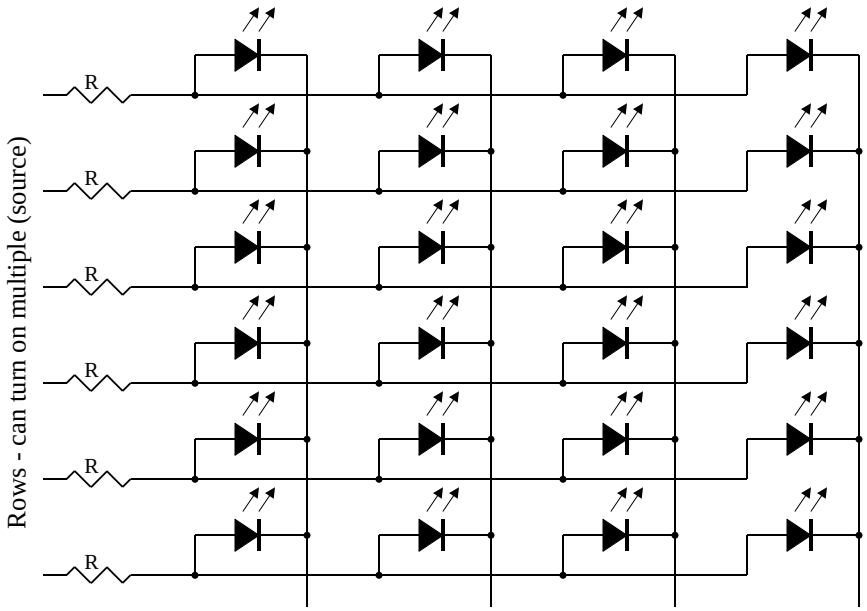
Common Anode



Non-Multiplexed LED Example - 8088 Clock

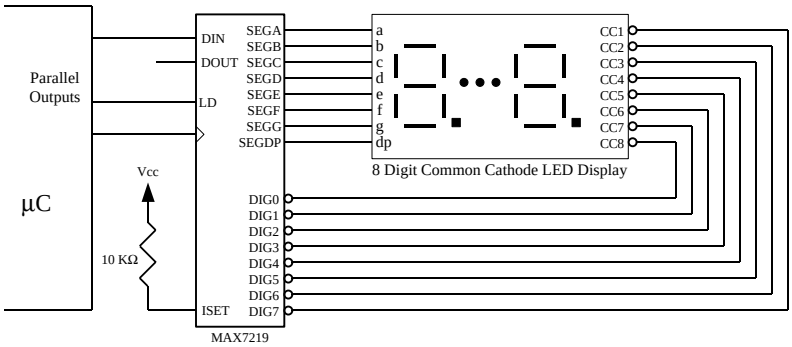


Multiplexing LEDs



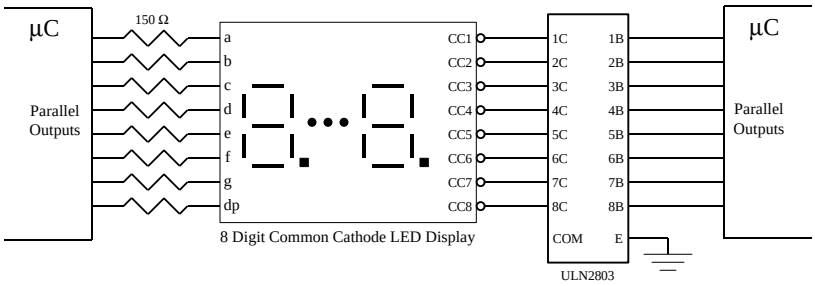
Multiplexed 7-Segment LED Interfacing

Hardware Multiplexing

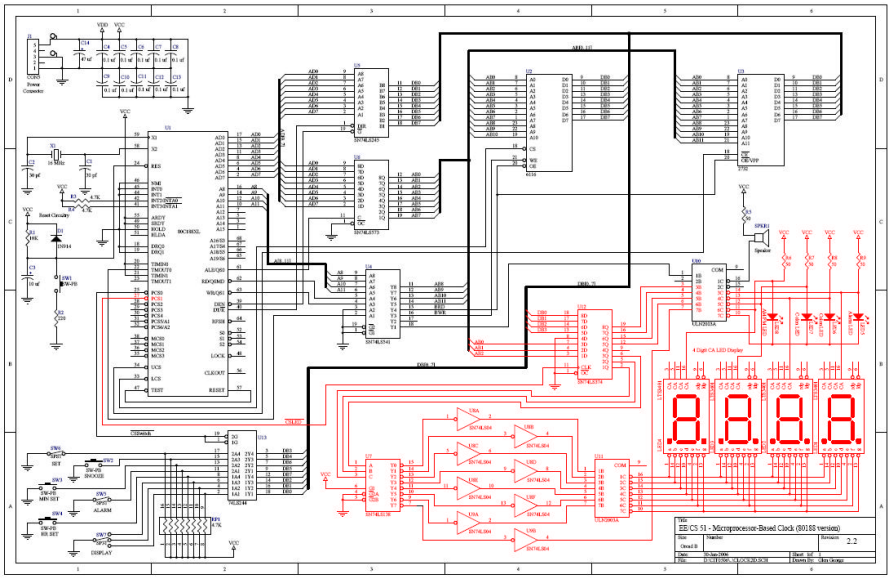


Multiplexed 7-Segment LED Interfacing

Software Multiplexing



Multiplexed LED Example - 80188 Clock



Multiplexed LED Example - AVR Clock