

Chapter 8

Standard Combinational Circuits

SKEE1223 Digital Electronics

Mun'im/Arif

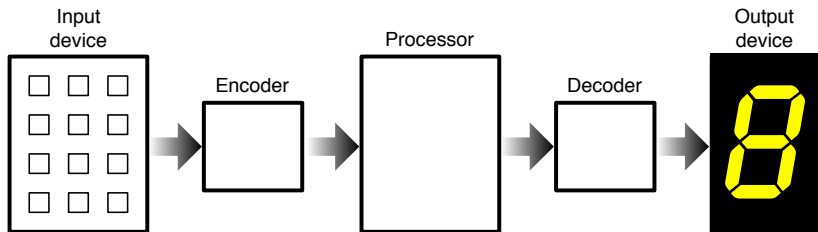
FKE, Universiti Teknologi Malaysia

November 9, 2015

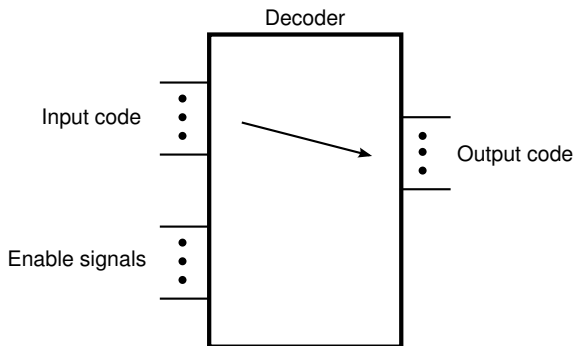
Overview

- 1 Overview
- 2 Decoders
- 3 Binary Decoders
- 4 Decimal Decoders
- 5 Seven-Segment Decoders
- 6 Encoders

Calculator components

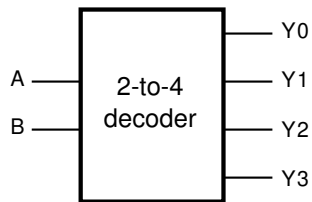


Generic Decoder

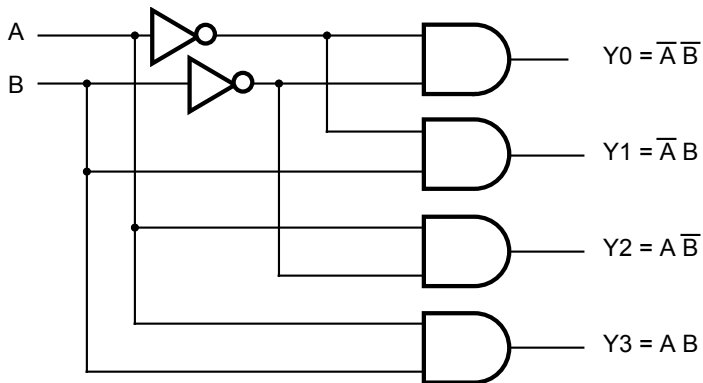


Generic 2-to-4 Binary Decoder

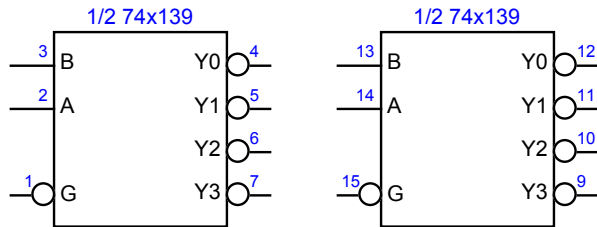
A	B	Y0	Y1	Y2	Y3
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1



Generic 2-to-4 Binary Decoder

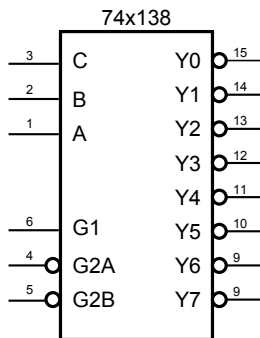


74x139 2-to-4 Binary Decoder Chip



G	B	A	Y0	Y1	Y2	Y3
H	X	X	H	H	H	H
L	L	L	L	H	H	H
L	H	H	H	L	H	H
L	L	L	H	H	L	H
L	H	H	H	H	H	L

74x138 3-to-8 Binary Decoder

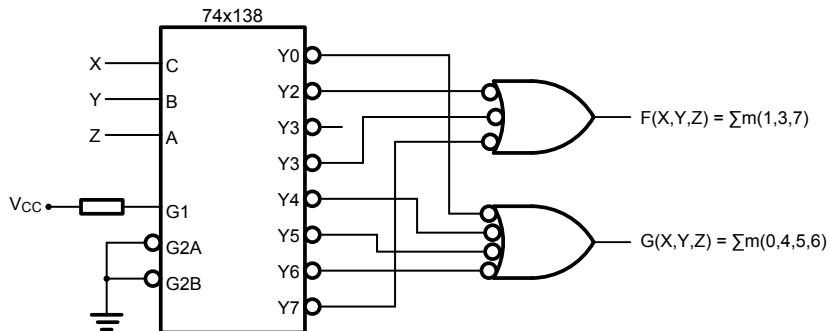


- Active low outputs
- To enable, set
 $G1 = H$
 $G2A = L$
 $G2B = L$
- When disabled, all outputs are high

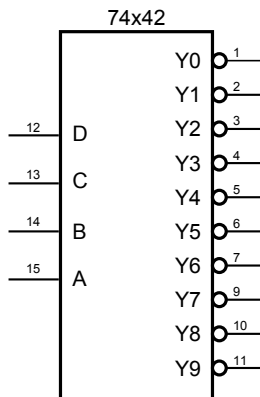
74x138 3-to-8 Binary Decoder

G1	G2A	G2B	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
L	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	H	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	L	H	H	H	H	H	L	H	H	H	H
H	L	L	H	L	L	H	H	H	H	H	L	H	H
H	L	L	H	H	L	H	H	H	H	H	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L

Decoder as Function Generator



74x42 Decimal Decoder



- Active low outputs
- No enable inputs
- When input is greater than 9, all outputs high

74x42 Decimal Decoder

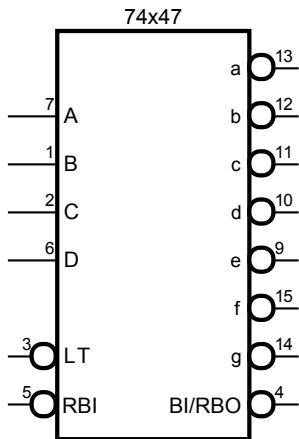
D	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9
L	L	L	L	L	H	H	H	H	H	H	H	H	H
L	L	L	H	H	L	H	H	H	H	H	H	H	H
L	L	H	L	H	H	L	H	H	H	H	H	H	H
L	L	H	H	H	H	H	L	H	H	H	H	H	H
L	H	L	L	H	H	H	H	L	H	H	H	H	H
L	H	L	H	H	H	H	H	H	L	H	H	H	H
L	H	H	L	H	H	H	H	H	H	L	H	H	H
L	H	H	H	H	H	H	H	H	H	H	L	H	H
H	L	L	L	H	H	H	H	H	H	H	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L
H	X	H	X	H	H	H	H	H	H	H	H	H	H
H	H	X	X	H	H	H	H	H	H	H	H	H	H

Seven-Segment Codes



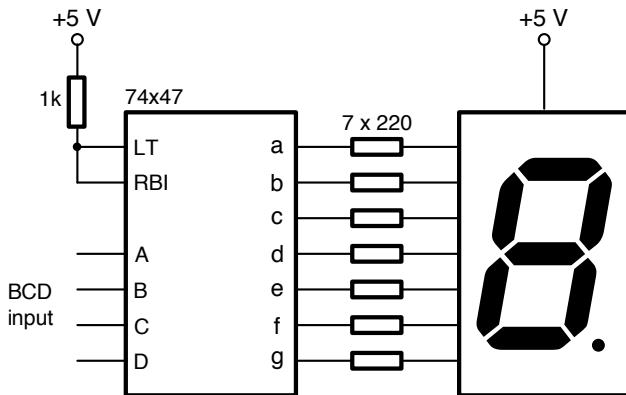
Decimal Value	BCD Code	7-segment Display Code						
		a	b	c	d	e	f	g
0	0000	0	0	0	0	0	0	1
1	0001	1	0	0	1	1	1	1
2	0010	0	0	1	0	0	1	0
3	0011	0	0	0	0	1	1	0
4	0100	1	0	0	1	1	0	0
5	0101	0	1	0	0	1	0	0
6	0110	0	1	0	0	0	0	0
7	0111	0	0	0	1	1	1	1
8	1000	0	0	0	0	0	0	0
9	1001	0	0	0	1	1	0	0

74x47 Seven-Segment Decoder

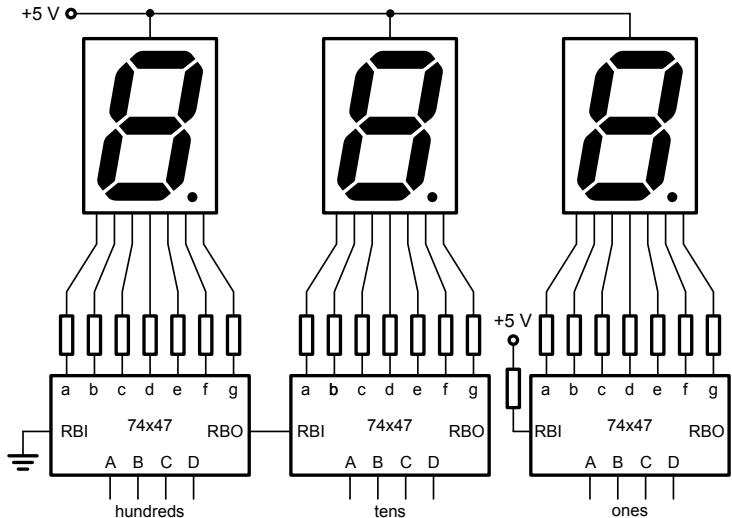


- Active low outputs (low = LED on, high = LED off)
- When input is greater than 9, outputs are meaningless
- 74x48 is companion chip for active high displays.. less bright..

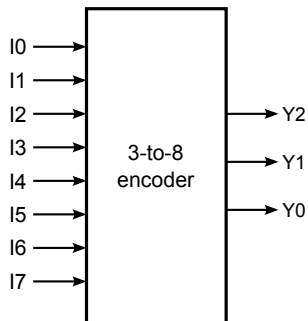
Connecting the 74x47 with LEDs



Connecting the 74x47 with LEDs



Ideal 8-to-3 Encoder

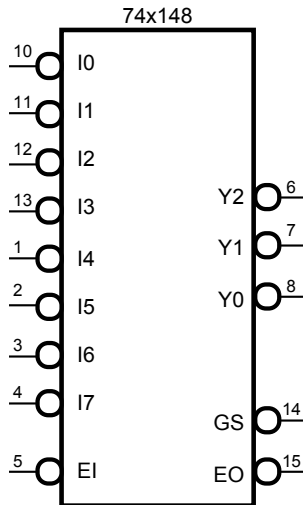


I0	I1	I2	I3	I4	I5	I6	I7	Y2	Y1	Y0
1	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0	1	0
0	0	0	1	0	0	0	0	0	1	1
0	0	0	0	1	0	0	0	1	0	0
0	0	0	0	0	1	0	0	1	0	1
0	0	0	0	0	0	1	0	1	1	0
0	0	0	0	0	0	0	1	1	1	1

8-to-3 Priority Encoder

I0	I1	I2	I3	I4	I5	I6	I7	Y2	Y1	Y0
1	0	0	0	0	0	0	0	0	0	0
×	1	0	0	0	0	0	0	0	0	1
×	×	1	0	0	0	0	0	0	1	0
×	×	×	1	0	0	0	0	0	1	1
×	×	×	×	1	0	0	0	1	0	0
×	×	×	×	×	1	0	0	1	0	1
×	×	×	×	×	×	1	0	1	1	0
×	×	×	×	×	×	×	1	1	1	1

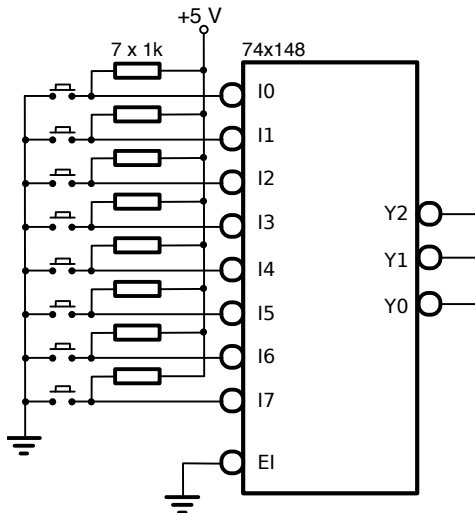
74x148 8-to-3 Priority Encoder Device



74x148 8-to-3 Priority Encoder Device

EI	I0	I1	I2	I3	I4	I5	I6	I7	Y2	Y1	Y0	GS	EO
H	x	x	x	x	x	x	x	x	H	H	H	H	H
L	H	H	H	H	H	H	H	H	H	H	H	H	L
L	x	x	x	x	x	x	x	L	L	L	L	L	H
L	x	x	x	x	x	x	L	H	L	L	H	L	H
L	x	x	x	x	L	H	H	H	L	H	L	L	H
L	x	x	x	L	H	H	H	H	H	L	L	L	H
L	x	x	L	H	H	H	H	H	H	L	H	L	H
L	x	L	H	H	H	H	H	H	H	H	L	L	H
L	L	H	H	H	H	H	H	H	H	H	H	L	H

Using the 74x148 Device





<https://www.openlearning.com/courses/SKEE1223x>