Gebze Technical University Computer Engineering Departman

CSE 436 Digital Integrated Circuit Homework #2

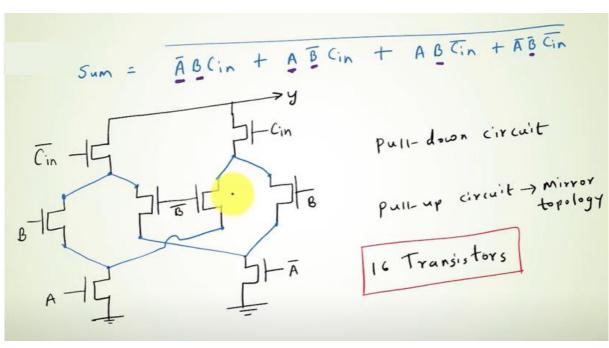
Berkan AKIN 171044073 Note: 1 bit adder works without errors. Full adder makes a total of mistakes.

1 Bit Adder Truth Table

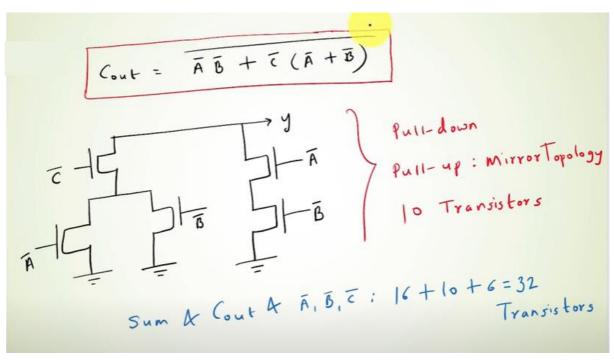
+		+-		+-		+-		+-	+
7	A		В		Cin		Sum		Cout
+	-	+-		+-		+		+	+
()		0		0		0		0
+	-	+-		+-		+		+-	+
()		0		1		1		0
+		+-		+-		+		+-	+
()		1		0		1		0
+		+-		+-		+		+	+
()		1		1		0		1
+		+-		+-		+-		+-	+
[L		0		0		1		0 1
+	-	+-		+-		+		+-	+
[L		0		1		0		1
+		+-		+-		+		+-	+
:	L	Ī	1		0		0		1
+	Ξ	+-		+		+		+	+
:	L	Ī	1		1		1		1
+		+-		+-		+		+	+

Transistor Desing

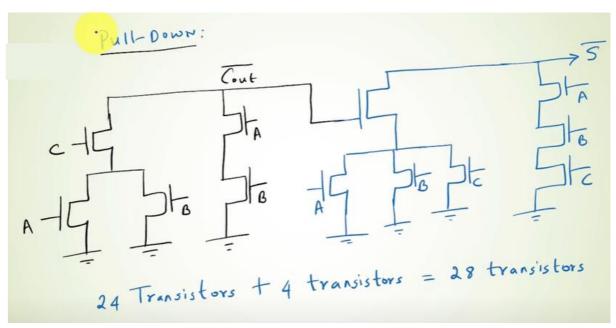
Sum=ABCin+ABCin+ABCin+ABCin



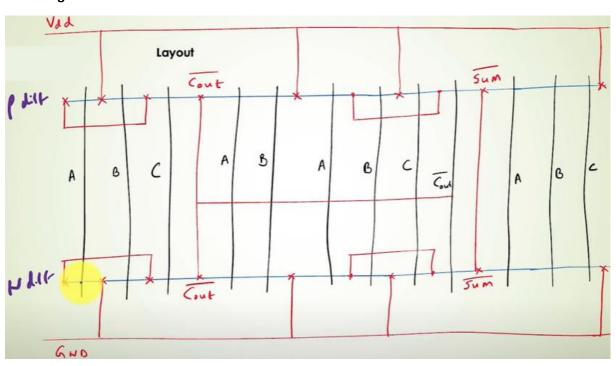
Cout=AB+BCin+ACin



Transistors Diagram(Pull Down Network)

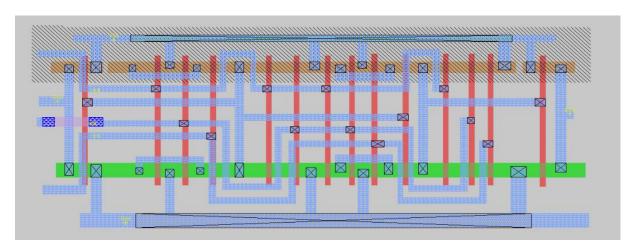


Stick Diagram

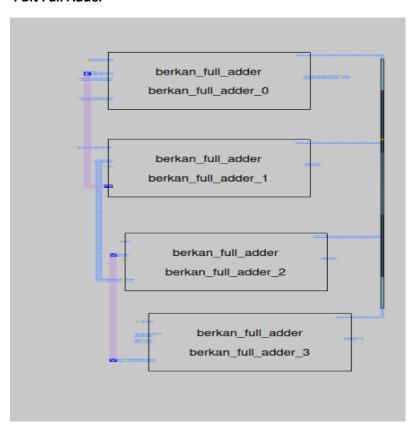


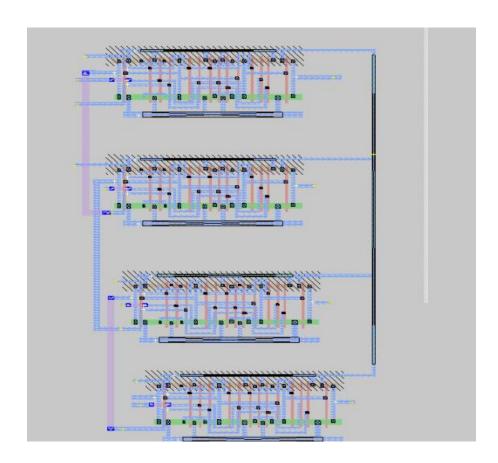
Magic Desing

1 Bit Full Adder



4 Bit Full Adder





Test Case

1 Bit Full Adder

A B C | Sum Cout

0 0 0 0 0

```
Initial Transient Solution
                                                                  VDD VDD 0 DC 5
                                          Voltage
Node
                                                                  VA A 0 0
VB B 0 0
VC C 0 0
vdd
                                      3.23643e-09
sum
                                                                  .tran 1NS 200NS
.controll
                                      3.23643e-09
cout
vc#branch
vb#branch
                                                                  plot V(A) V(B) V(C) V(Sum) V(Cout)
va#branch
                                     -4.72843e-11
vdd#branch
```

A B C | Sum Cout

100|1 0

Node	Voltage
a	5
vdd	5
Ь	0
sum	5
c	0
cout	3.23643e-09
vc#branch	0
vb#branch	0
va#branch	0
vdd#branch	-3.86721e-11

```
VDD VDD 0 DC 5

VA A 0 5
VB B 0 0
VC C 0 0

.tran 1NS 200NS
.controll
run
plot V(A) V(B) V(C) V(Sum) V(Cout)
.endc
.end
```

A B C | Sum Cout

110|0 1

```
Initial Transient Solution

Node Voltage

a 5
vdd 5
b 5
sum 3.23643e-09
c 0
cout 5
vc#branch 0
vb#branch 0
vdd#branch -6.0226e-11
```

```
VDD VDD 0 DC 5

VA A 0 5
VB B 0 5
VC C 0 0

.tran 1NS 200NS
.controll
run
plot V(A) V(B) V(C) V(Sum) V(Cout)

.endc
.end
```

A B C | Sum Cout

111|1 1

4 Bit Full Adder

A4 A3 A2 A1 + B4 B3 B2 B1 = Sum4 Sum3 Sum2 Sum1

0000 + 0000 = 0000

Initial Transient Solution		VDD Vddbig @ DC 5
Node	Voltage	
		and the second s
a1	0	VA1 A1 0 0
vddbig	5	VB1 B1 0 0
gndbig	0.6175	
b1	0	VC1 C1 0 0
sum1	0.6175	
c1	0	mana ki ki
berkan_full_adder_1/c	0.6175	VA2 A2 0 0
a2	0	VB2 B2 0 0
b2	0	
sum2	0.6175	and the second s
c3	0.6175	VA3 A3 0 0
a3	0	VB3 B3 0 0
b3	0	AD2 D2 Q Q
sum3	0.6175	
C4	0.6175	VA4 A4 0 0
a4 b4	0	101 01
	0	VB4 B4 0 0
sum4	0.6175	
berkan_full_adder_3/cout vb4#branch	0.6175 0	A 100 20000
va4#branch	0	.tran INS 200NS
vb3#branch	0	.controll
va3#branch	0	run
vb2#branch	0	1.50
va2#branch	0	plot V(A1) V(B1) V(A2) V(B2) V(A3) V(B3) V(A4) V(B4) V(C1) V(Sum1) V(Sum2) V(Sum3) V(Sum4)
vc1#branch	Ö	
vb1#branch	0	d.
va1#branch	0	.endc
vdd#branch	-1.84255e-10	.end

A4 A3 A2 A1 + B4 B3 B2 B1 = Sum4 Sum3 Sum2 Sum1

0001 + 0000 = 0001

Node	Voltage
a1	5
vddbig	5
gndbig	0.6175
b1	0
sum1	5
c 1	6
berkan_full_adder_1/c	0.6175
a2	6
b2	0
sum2	0.6175
c3	0.6175
a3	6
b3	0
sum3	0.6175
c4	0.6175
a4	0
54	0
sum4	0.6175
berkan_full_adder_3/cout	0.6175
vb4#branch	e
va4#branch	•
vb3#branch	0
va3#branch	0
vb2#branch	•
va2#branch	0
/c1#branch	0
vb1#branch	0
va1#branch	0
vdd#branch	-1.75018e-10

A4 A3 A2 A1 + B4 B3 B2 B1 = Sum4 Sum3 Sum2 Sum1

0011 + 0000 = 0011

lode	Voltage
1	5
ddbig	5
ındbig	0.6175
01	0
sum1	5
:1	0
erkan_full_adder_1/c	0.6175
12	5
02	0
sum2	5
3	0.6175
3	0
3	0
um3	0.6175
1	0.6175
4	0
4	0
um4	0.6175
erkan_full_adder_3/cout	0.6175
b4#branch	0
a4#branch	0
b3#branch	0
a3#branch	0
b2#branch	0
a2#branch	0
:1#branch	0
b1#branch	0
a1#branch	0
dd#branch	-1.65782e-10

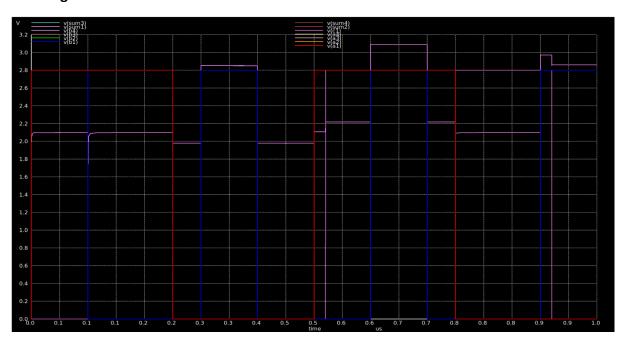
A4 A3 A2 A1 + B4 B3 B2 B1 = Sum4 Sum3 Sum2 Sum1

0011 + 0011 = 0110

! It produces wrong results

Initial Transient Solution	
Node	Voltage
a1	2.5
vddbig	2.5
berkan_full_adder_0/gnd	0.531207
b1	2.5
sum1	0.531207
c1	0
berkan_full_adder_1/c	2.5
a2	2.5
berkan_full_adder_1/gnd	0.500549
b2	2.5
sum2	2.5
c3	2.5
a3	0
berkan_full_adder_2/gnd	1.79957
b3	0
sum3	2.49994
C4	1.79957
a4	0
berkan_full_adder_3/gnd	1.09936
b4	O
sum4	2.5
berkan_full_adder_3/cout	1.09936
vb4#branch	O
va4#branch	0
vb3#branch	О
va3#branch	O
vb2#branch	0
va2#branch	О
vc1#branch	0
vb1#branch	0
va1#branch	0
vdd#branch	-1.22397e-10

Meaningless Plot Occurred



Resources

https://www.youtube.com/watch?v=N3H-QsGNIiI&t=1317s