110521167 曹寓恆 VLSI Testing HW2

1. (a)

g_0	g_1	x_i	f	$g_{0/0}$	$g_{0/1}$	$g_{1/0}$	$g_{1/1}$	$x_{i/0}$	$x_{i/1}$	$f_{/0}$	$f_{/1}$
0	0	0	0	0	1	0	1	0	0	0	1
0	1	0	0	0	1	0	1	0	1	0	1
1	0	0	1	0	0	1	0	1	0	0	1
1	1	0	1	0	0	1	0	1	1	0	1
0	0	1	0	0	0	0	1	0	0	0	1
0	1	1	1	1	1	0	1	0	1	0	1
1	0	1	0	0	0	0	1	1	0	0	1
1	1	1	1	1	1	0	1	1	1	0	1

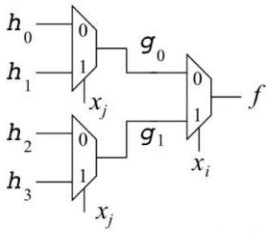
$g_{0/0} \rightarrow g_0 \bar{x}_i$ $g_{0/1} \rightarrow g_1 x_i$

$g_{1/0} \rightarrow g_0 \bar{x}_i$ $g_{1/1} \rightarrow \bar{g}_1 x_i$

$f_{/0} \rightarrow g_0 \bar{x}_i + g_1 x_i$

$f_{/1} \rightarrow \bar{g}_0 \bar{x}_i + \bar{g}_1 x_i$

(b)



if $x_j = x_i = 0$ —fault-free→ $f = g_0 = h_0$
- $g_{0/0} \rightarrow h_0 \bar{x}_j \bar{x}_i$
- $g_{0/1} \rightarrow \bar{h}_0 \bar{x}_j \bar{x}_i$

if $x_j = 1, x_i = 0$ —fault-free→ $f = g_0 = h_1$
- $g_{0/0} \rightarrow h_1 x_j \bar{x}_i$
- $g_{0/1} \rightarrow \bar{h}_1 x_j \bar{x}_i$

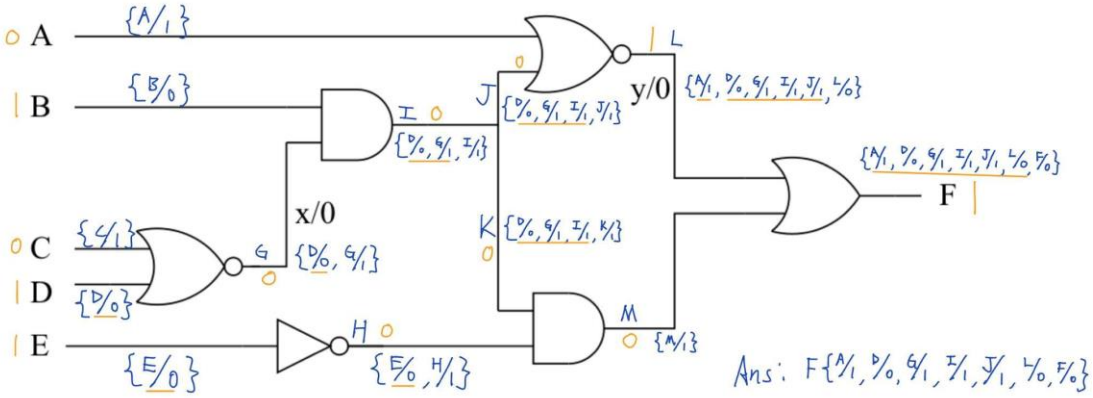
if $x_j = x_i = 1$ —fault-free→ $f = g_1 = h_3$
- $g_{1/0} \rightarrow h_3 x_j x_i$
- $g_{1/1} \rightarrow \bar{h}_3 x_j x_i$

if $x_j = 0, x_i = 1$ —fault-free→ $f = g_1 = h_2$
- $g_{1/0} \rightarrow h_2 \bar{x}_j x_i$
- $g_{1/1} \rightarrow \bar{h}_2 \bar{x}_j x_i$

$T_{g_{0/0}} = h_0 \bar{x}_i \bar{x}_j + h_1 \bar{x}_i x_j$, $T_{g_{0/1}} = \bar{h}_0 \bar{x}_i \bar{x}_j + \bar{h}_1 \bar{x}_i x_j$

$T_{g_{1/0}} = h_2 x_i \bar{x}_j + h_3 x_i x_j$, $T_{g_{1/1}} = \bar{h}_2 x_i \bar{x}_j + \bar{h}_3 x_i x_j$

2.



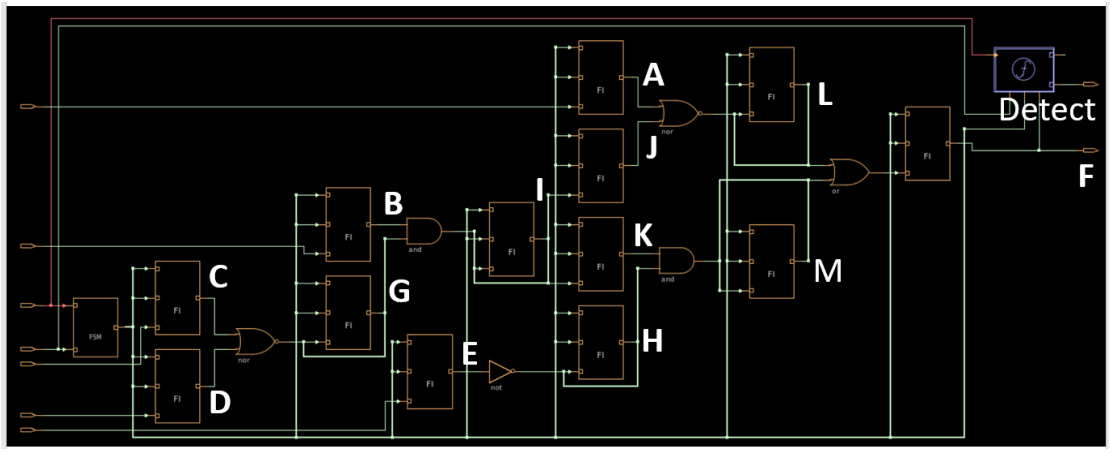
3. (1) 使用多工器來模擬 stuck-at fault，多工器行為如下

A. 若 vdd == 1’ b1，則輸出恆為 1

B. 若 gnd == 1’ b1，則輸出恆為 0

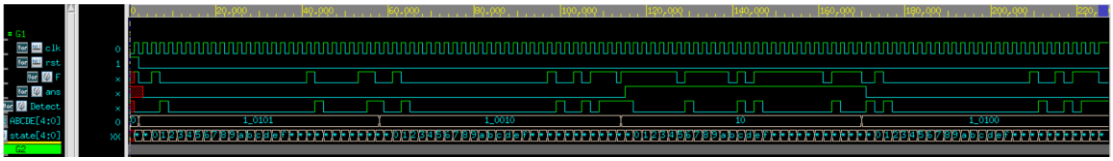
C. 若 gnd == vdd == 1’ b0，則輸出等於輸入

(2) Schematic

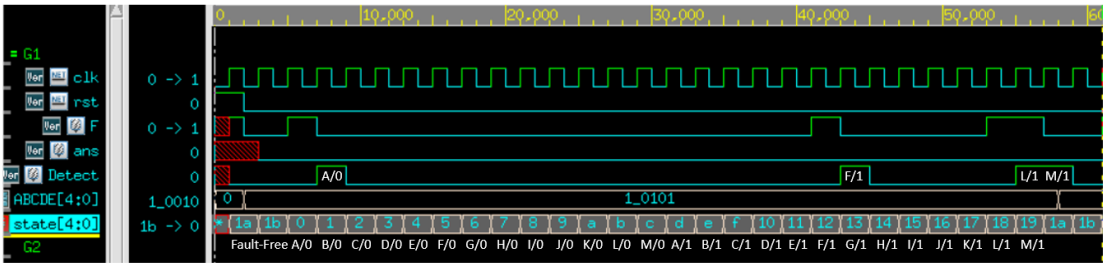


(3) 實驗方法

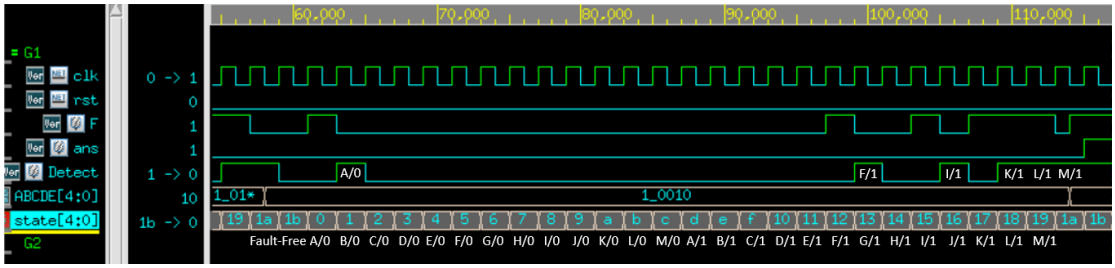
使用 FSM 加上 decoder 控制所有多工器，在 fault-free 階段會更新暫存器 ans 的值，接下來分別從 A/0 掃描到 M/1，只要電路的輸出 F 和 ans 不相同時 Detect 轉態為 1，標示檢測到 stuck-at fault，以下為波型截圖，經過紙筆驗證結果皆正確。



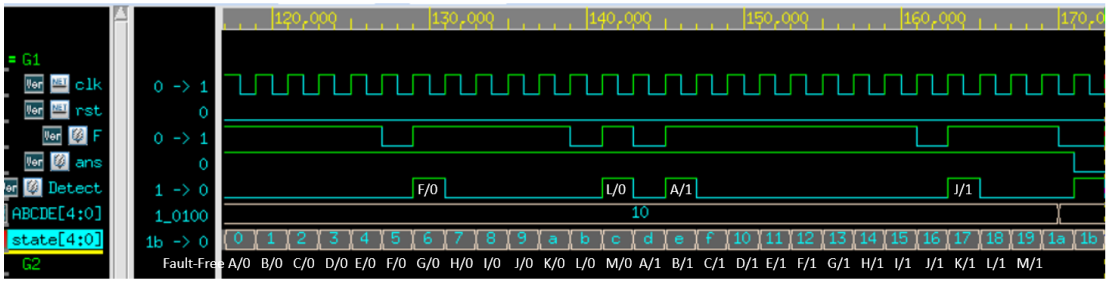
Full waveform



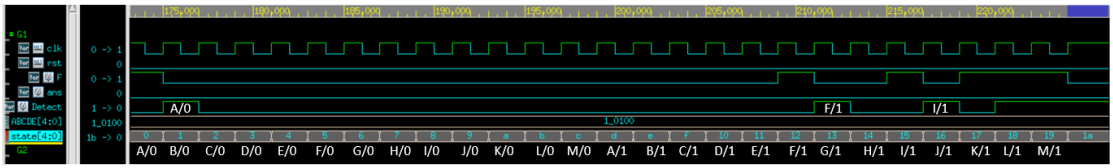
ABCDE = {10101}, detect A/0, F/1, L/1, M/1



ABCDE = {10010}, detect A/0, F/1, I/1, K/1, L/1, M/1



ABCDE = {00010}, detect F/0, L/0, A/1, J/1



ABCDE = {10100}, detect A/0, F/1, I/1

Fault coverage: {A/0, A/1 ,F/0, F/1, L/0, L/1, M/1, I/1, K/1, J/1} /26 = 10 / 26