

2023 超大型積體電路電腦輔助設計概論

2023 Introduction to VLSI CAD

Lab 9

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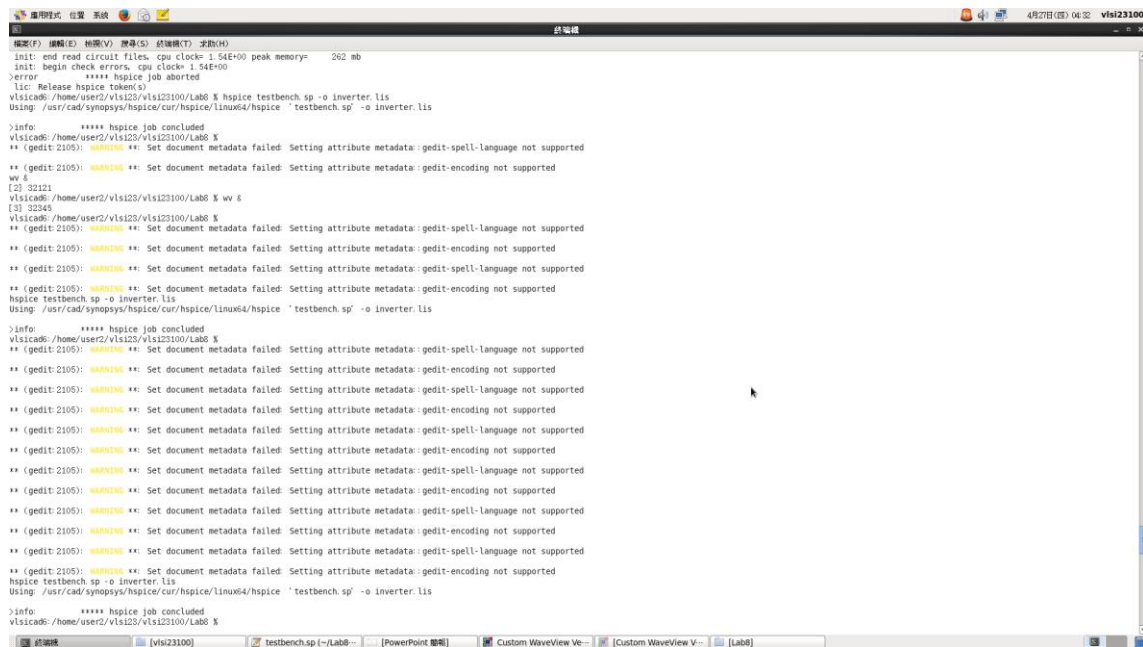
※作業要求的圖請使用**電腦截圖程式**截取，請勿用手機拍照的方式繳交

※Report 檔請以 pdf 的格式繳交

A. NAND

1. Presim

i. 請截取 terminal 顯示 job concluded 的圖



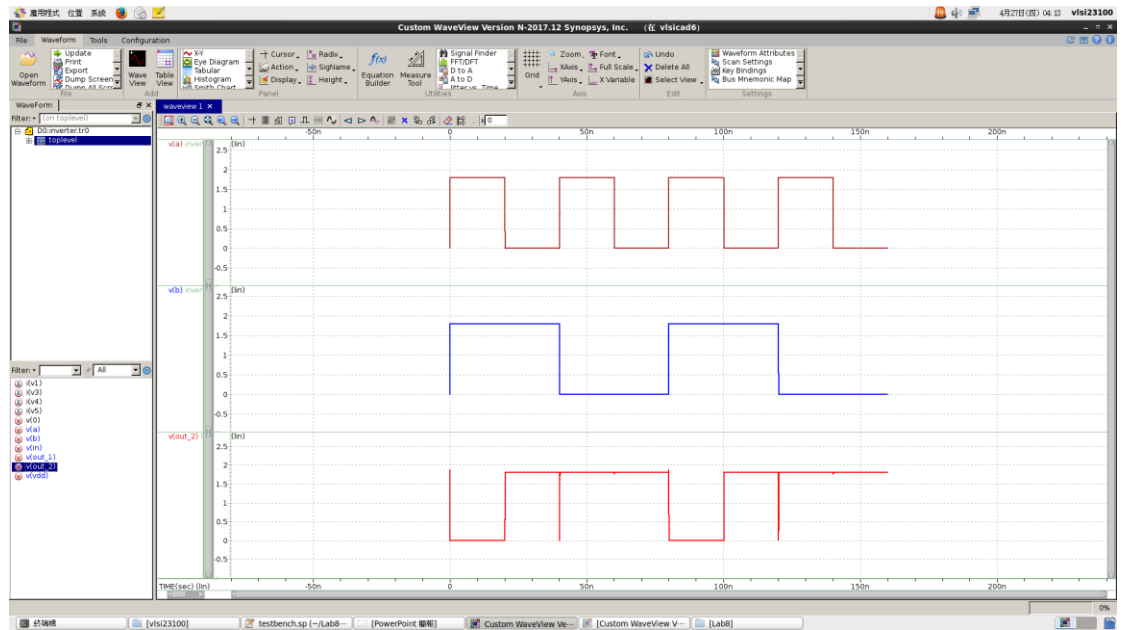
```
init: end read circuit files. cpu clock= 1.54E+00 peak memory= 262 mb
init: begin check errors. cpu clock= 1.54E+00
error: ***** hspice job aborted
lic: Release hspice token(s)
vlsica06:/home/user2/vlsi23/vlsi23100/Lab8 % hspice testbench.sp -o inverter.lis
Using: /usr/cad/synopsys/hspice/cur/hspice/linux64/hspice `testbench.sp' -o inverter.lis

>info: ***** hspice job concluded
vlsica06:/home/user2/vlsi23/vlsi23100/Lab8 %
** (gedit:2105): 40263100 **: Set document metadata failed: Setting attribute metadata: gedit-spell-language not supported
** (gedit:2105): 40263100 **: Set document metadata failed: Setting attribute metadata: gedit-encoding not supported
vv 8
[2] 32121
vlsica06:/home/user2/vlsi23/vlsi23100/Lab8 % vv 8
[3] 32345
vlsica06:/home/user2/vlsi23/vlsi23100/Lab8 %
** (gedit:2105): 40263100 **: Set document metadata failed: Setting attribute metadata: gedit-spell-language not supported
** (gedit:2105): 40263100 **: Set document metadata failed: Setting attribute metadata: gedit-encoding not supported
** (gedit:2105): 40263100 **: Set document metadata failed: Setting attribute metadata: gedit-spell-language not supported
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** (gedit:2105): 40263100 **: Set document metadata failed: Setting attribute metadata: gedit-encoding not supported
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** (gedit:2105): 40263100 **: Set document metadata failed: Setting attribute metadata: gedit-encoding not supported
hspice testbench.sp -o inverter.lis
Using: /usr/cad/synopsys/hspice/cur/hspice/linux64/hspice `testbench.sp' -o inverter.lis

>info: ***** hspice job concluded
vlsica06:/home/user2/vlsi23/vlsi23100/Lab8 %
```

ii. 請截取 WaveView 中的波形

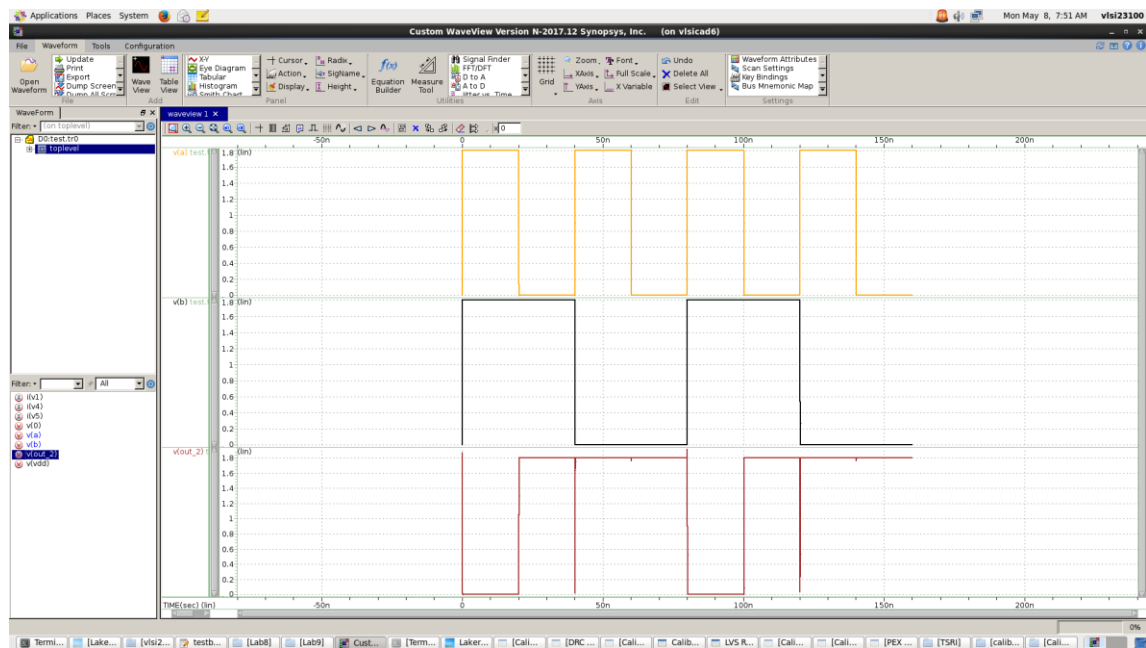


2. Post-sim

i. 請截取 terminal 顯示 job concluded 的圖

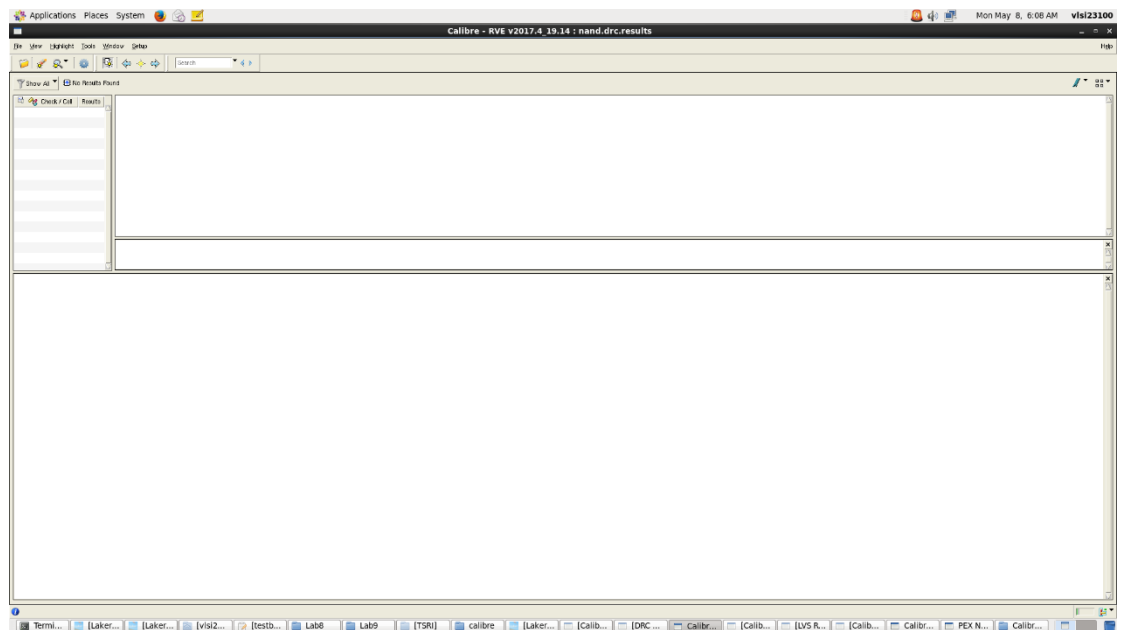


ii. 請截取 WaveView 中的波形

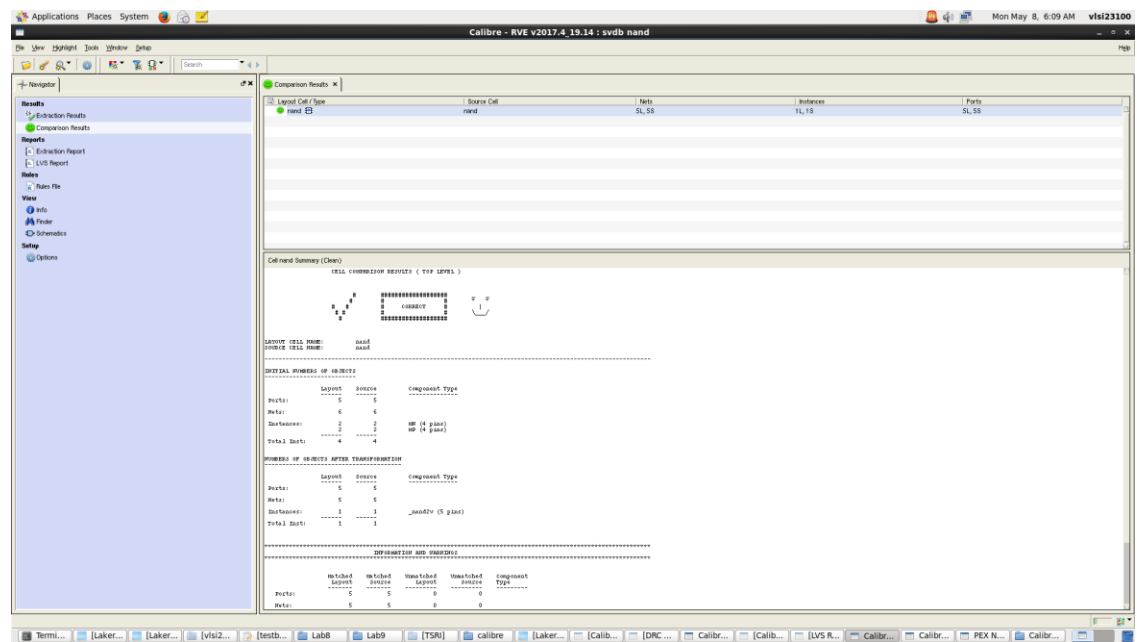


iii. DRC/LVS 結果

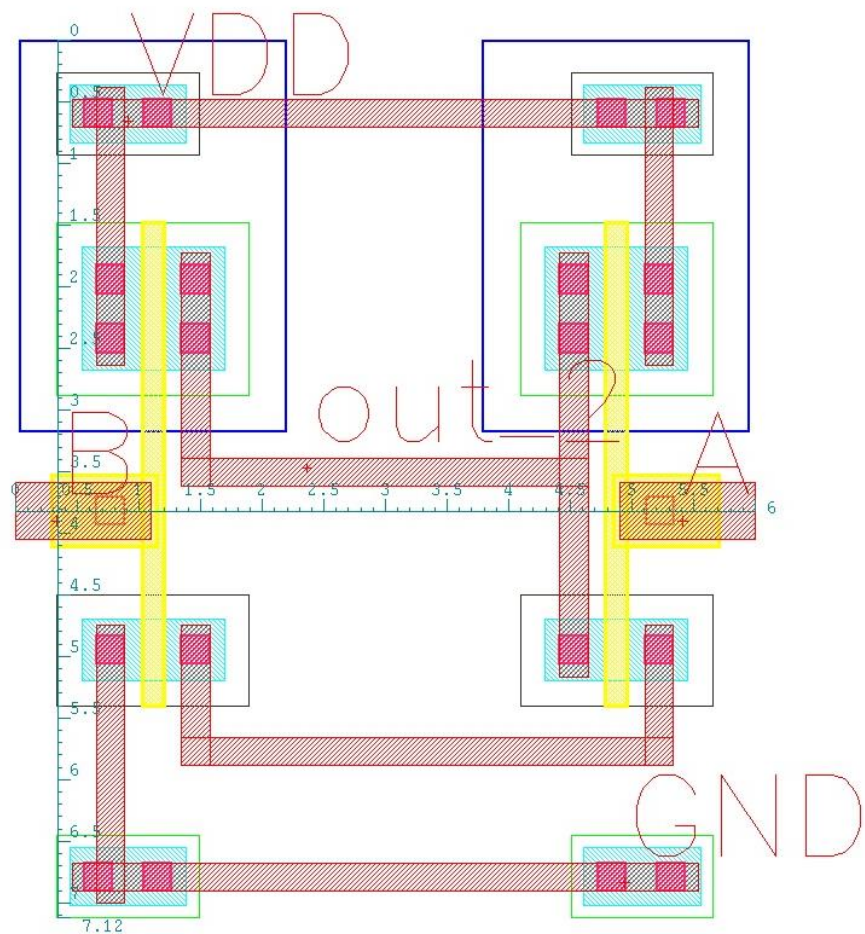
DRC:



LVS:



iv. Layout 截圖



3. 嘗試簡單說明 Presim 與 Post-sim 結果比較

可能由於電路簡單的關係，Presim 和 Post-sim 的波形圖並沒有太大的差異。

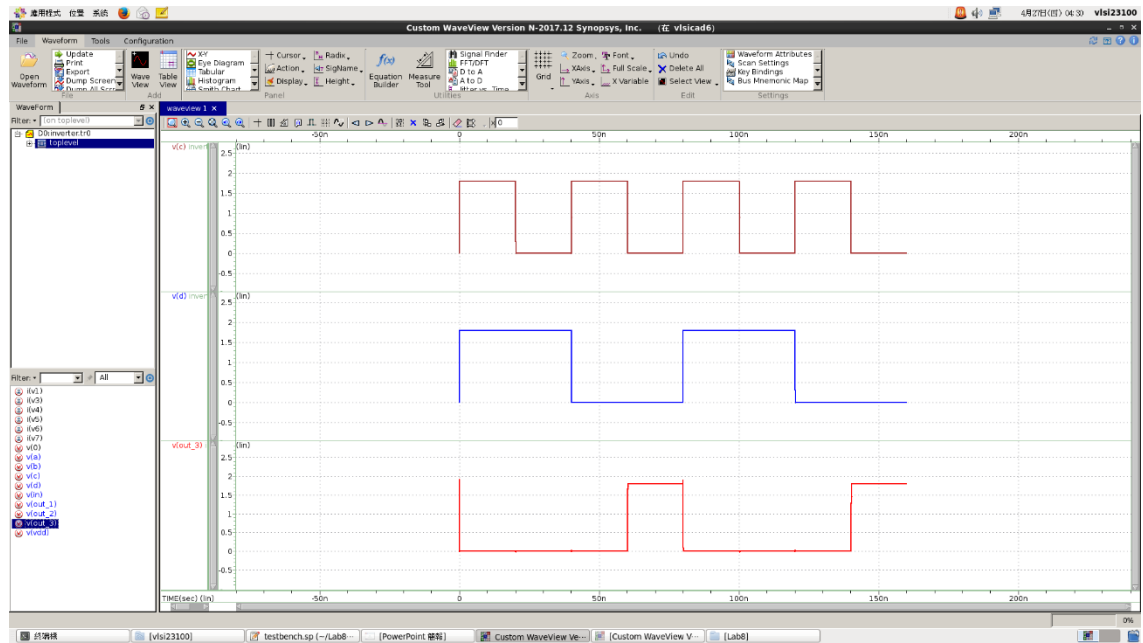
B. NOR

1. Presim

i. 請截取 terminal 顯示 job concluded 的圖

A screenshot of a terminal window with a dark background. The title bar at the top shows standard window controls and the text "终端". The terminal content consists of approximately 20 lines of repeated error messages. Each line starts with a timestamp "[2023-10-27 14:04:23]", followed by a log level "ERROR", a source identifier "hspice:130", and a message "Set document metadata failed: Setting attribute metadata: gedit-spell-language not supported". The messages are repeated for various document IDs like "gedit:2105:", "gedit:2106:", "gedit:2107:", "gedit:2108:", "gedit:2109:", "gedit:2110:", "gedit:2111:", "gedit:2112:", "gedit:2113:", "gedit:2114:", "gedit:2115:", "gedit:2116:", "gedit:2117:", "gedit:2118:", "gedit:2119:", "gedit:2120:", "gedit:2121:", "gedit:2122:", "gedit:2123:", "gedit:2124:", "gedit:2125:", "gedit:2126:", "gedit:2127:", "gedit:2128:", "gedit:2129:", "gedit:2130:", "gedit:2131:", "gedit:2132:", "gedit:2133:", "gedit:2134:", "gedit:2135:", "gedit:2136:", "gedit:2137:", "gedit:2138:", "gedit:2139:", "gedit:2140:", "gedit:2141:", "gedit:2142:", "gedit:2143:", "gedit:2144:", "gedit:2145:", "gedit:2146:", "gedit:2147:", "gedit:2148:", "gedit:2149:", "gedit:2150:", "gedit:2151:", "gedit:2152:", "gedit:2153:", "gedit:2154:", "gedit:2155:", "gedit:2156:", "gedit:2157:", "gedit:2158:", "gedit:2159:", "gedit:2160:", "gedit:2161:", "gedit:2162:", "gedit:2163:", "gedit:2164:", "gedit:2165:", "gedit:2166:", "gedit:2167:", "gedit:2168:", "gedit:2169:", "gedit:2170:", "gedit:2171:", "gedit:2172:", "gedit:2173:", "gedit:2174:", "gedit:2175:", "gedit:2176:", "gedit:2177:", "gedit:2178:", "gedit:2179:", "gedit:2180:", "gedit:2181:", "gedit:2182:", "gedit:2183:", "gedit:2184:", "gedit:2185:", "gedit:2186:", "gedit:2187:", "gedit:2188:", "gedit:2189:", "gedit:2190:", "gedit:2191:", "gedit:2192:", "gedit:2193:", "gedit:2194:", "gedit:2195:", "gedit:2196:", "gedit:2197:", "gedit:2198:", "gedit:2199:", "gedit:2200:", "gedit:2201:", "gedit:2202:", "gedit:2203:", "gedit:2204:", "gedit:2205:", "gedit:2206:", "gedit:2207:", "gedit:2208:", "gedit:2209:", "gedit:2210:", "gedit:2211:", "gedit:2212:", "gedit:2213:", "gedit:2214:", "gedit:2215:", "gedit:2216:", "gedit:2217:", "gedit:2218:", "gedit:2219:", "gedit:2220:", "gedit:2221:", "gedit:2222:", "gedit:2223:", "gedit:2224:", "gedit:2225:", "gedit:2226:", "gedit:2227:", "gedit:2228:", "gedit:2229:", "gedit:2230:", "gedit:2231:", "gedit:2232:", "gedit:2233:", "gedit:2234:", "gedit:2235:", "gedit:2236:", "gedit:2237:", "gedit:2238:", "gedit:2239:", "gedit:2240:", "gedit:2241:", "gedit:2242:", "gedit:2243:", "gedit:2244:", "gedit:2245:", "gedit:2246:", "gedit:2247:", "gedit:2248:", "gedit:2249:", "gedit:2250:", "gedit:2251:", "gedit:2252:", "gedit:2253:", "gedit:2254:", "gedit:2255:", "gedit:2256:", "gedit:2257:", "gedit:2258:", "gedit:2259:", "gedit:2260:", "gedit:2261:", "gedit:2262:", "gedit:2263:", "gedit:2264:", "gedit:2265:", "gedit:2266:", "gedit:2267:", "gedit:2268:", "gedit:2269:", "gedit:2270:", "gedit:2271:", "gedit:2272:", "gedit:2273:", "gedit:2274:", "gedit:2275:", "gedit:2276:", "gedit:2277:", "gedit:2278:", "gedit:2279:", "gedit:2280:", "gedit:2281:", "gedit:2282:", "gedit:2283:", "gedit:2284:", "gedit:2285:", "gedit:2286:", "gedit:2287:", "gedit:2288:", "gedit:2289:", "gedit:2290:", "gedit:2291:", "gedit:2292:", "gedit:2293:", "gedit:2294:", "gedit:2295:", "gedit:2296:", "gedit:2297:", "gedit:2298:", "gedit:2299:", "gedit:2300:", "gedit:2301:", "gedit:2302:", "gedit:2303:", "gedit:2304:", "gedit:2305:", "gedit:2306:", "gedit:2307:", "gedit:2308:", "gedit:2309:", "gedit:2310:", "gedit:2311:", "gedit:2312:", "gedit:2313:", "gedit:2314:", "gedit:2315:", "gedit:2316:", "gedit:2317:", "gedit:2318:", "gedit:2319:", "gedit:2320:", "gedit:2321:", "gedit:2322:", "gedit:2323:", "gedit:2324:", "gedit:2325:", "gedit:2326:", "gedit:2327:", "gedit:2328:", "gedit:2329:", "gedit:2330:", "gedit:2331:", "gedit:2332:", "gedit:2333:", "gedit:2334:", "gedit:2335:", "gedit:2336:", "gedit:2337:", "gedit:2338:", "gedit:2339:", "gedit:2340:", "gedit:2341:", "gedit:2342:", "gedit:2343:", "gedit:2344:", "gedit:2345:", "gedit:2346:", "gedit:2347:", "gedit:2348:", "gedit:2349:", "gedit:2350:", "gedit:2351:", "gedit:2352:", "gedit:2353:", "gedit:2354:", "gedit:2355:", "gedit:2356:", "gedit:2357:", "gedit:2358:", "gedit:2359:", "gedit:2360:", "gedit:2361:", "gedit:2362:", "gedit:2363:", "gedit:2364:", "gedit:2365:", "gedit:2366:", "gedit:2367:", "gedit:2368:", "gedit:2369:", "gedit:2370:", "gedit:2371:", "gedit:2372:", "gedit:2373:", "gedit:2374:", "gedit:2375:", "gedit:2376:", "gedit:2377:", "gedit:2378:", "gedit:2379:", "gedit:2380:", "gedit:2381:", "gedit:2382:", "gedit:2383:", "gedit:2384:", "gedit:2385:", "gedit:2386:", "gedit:2387:", "gedit:2388:", "gedit:2389:", "gedit:2390:", "gedit:2391:", "gedit:2392:", "gedit:2393:", "gedit:2394:", "gedit:2395:", "gedit:2396:", "gedit:2397:", "gedit:2398:", "gedit:2399:", "gedit:2400:", "gedit:2401:", "gedit:2402:", "gedit:2403:", "gedit:2404:", "gedit:2405:", "gedit:2406:", "gedit:2407:", "gedit:2408:", "gedit:2409:", "gedit:2410:", "gedit:2411:", "gedit:2412:", "gedit:2413:", "gedit:2414:", "gedit:2415:", "gedit:2416:", "gedit:2417:", "gedit:2418:", "gedit:2419:", "gedit:2420:", "gedit:2421:", "gedit:2422:", "gedit:2423:", "gedit:2424:", "gedit:2425:", "gedit:2426:", "gedit:2427:", "gedit:2428:", "gedit:2429:", "gedit:2430:", "gedit:2431:", "gedit:2432:", "gedit:2433:", "gedit:2434:", "gedit:2435:", "gedit:2436:", "gedit:2437:", "gedit:2438:", "gedit:2439:", "gedit:2440:", "gedit:2441:", "gedit:2442:", "gedit:2443:", "gedit:2444:", "gedit:2445:", "gedit:2446:", "gedit:2447:", "gedit:2448:", "gedit:2449:", "gedit:2450:", "gedit:2451:", "gedit:2452:", "gedit:2453:", "gedit:2454:", "gedit:2455:", "gedit:2456:", "gedit:2457:", "gedit:2458:", "gedit:2459:", "gedit:2460:", "gedit:2461:", "gedit:2462:", "gedit:2463:", "gedit:2464:", "gedit:2465:", "gedit:2466:", "gedit:2467:", "gedit:2468:", "gedit:2469:", "gedit:2470:", "gedit:2471:", "gedit:2472:", "gedit:2473:", "gedit:2474:", "gedit:2475:", "gedit:2476:", "gedit:2477:", "gedit:2478:", "gedit:2479:", "gedit:2480:", "gedit:2481:", "gedit:2482:", "gedit:2483:", "gedit:2484:", "gedit:2485:", "gedit:2486:", "gedit:2487:", "gedit:2488:", "gedit:2489:", "gedit:2490:", "gedit:2491:", "gedit:2492:", "gedit:2493:", "gedit:2494:", "gedit:2495:", "gedit:2496:", "gedit:2497:", "gedit:2498:", "gedit:2499:", "gedit:2500:", "gedit:2501:", "gedit:2502:", "gedit:2503:", "gedit:2504:", "gedit:2505:", "gedit:2506:", "gedit:2507:", "gedit:2508:", "gedit:2509:", "gedit:2510:", "gedit:2511:", "gedit:2512:", "gedit:2513:", "gedit:2514:", "gedit:2515:", "gedit:2516:", "gedit:2517:", "gedit:2518:", "gedit:2519:", "gedit:2520:", "gedit:2521:", "gedit:2522:", "gedit:2523:", "gedit:2524:", "gedit:2525:", "gedit:2526:", "gedit:2527:", "gedit:2528:", "gedit:2529:", "gedit:2530:", "gedit:2531:", "gedit:2532:", "gedit:2533:", "gedit:2534:", "gedit:2535:", "gedit:2536:", "gedit:2537:", "gedit:2538:", "gedit:2539:", "gedit:2540:", "gedit:2541:", "ged

ii. 請截取 WaveView 中的波形



2. Post-sim

i. 請截取 terminal 顯示 job concluded 的圖

The screenshot shows a terminal window with the following text:

```
File Edit View Search Terminal Help
The applicable License Key for such Licensed Products. Synopsis will use information gathered in connection with this process to deliver software updates and pursue software pirates and infringers.

Display localhost:13.0 ==> Current mode : TrueColor
The PseudoColor mode is not available under current setting. Switch to use TrueColor mode.
*** Limitation: Blinking is not supported under TrueColor mode.
FontPath(SPS FONT PATH) = /usr/cad/synopsys/laker/cur/TTFont
Feature "Laker .FID .LIP" checked out successfully (Elapsed Time: 0.14s)
QClipboard::setData: Cannot set X11 selection owner for PRIMARY
QClipboard::setData: Cannot set X11 selection owner for PRIMARY
QClipboard::setData: Cannot set X11 selection owner for PRIMARY
QClipboard::setData: Cannot set X11 selection owner for PRIMARY
QClipboard::setData: Cannot set X11 selection owner for PRIMARY
hspice -i test.sp -o test.lis
Using: /usr/cad/synopsys/hspice/cur/hspice/linux64/hspice -i 'test.sp' -o test.lis

**** hspice job aborted
vlsicad6:/home/user2/vls123/vls123100/Lab9 % hspice -i testbench.sp -o test.lis
Using: /usr/cad/synopsys/hspice/cur/hspice/linux64/hspice -i 'testbench.sp' -o test.lis

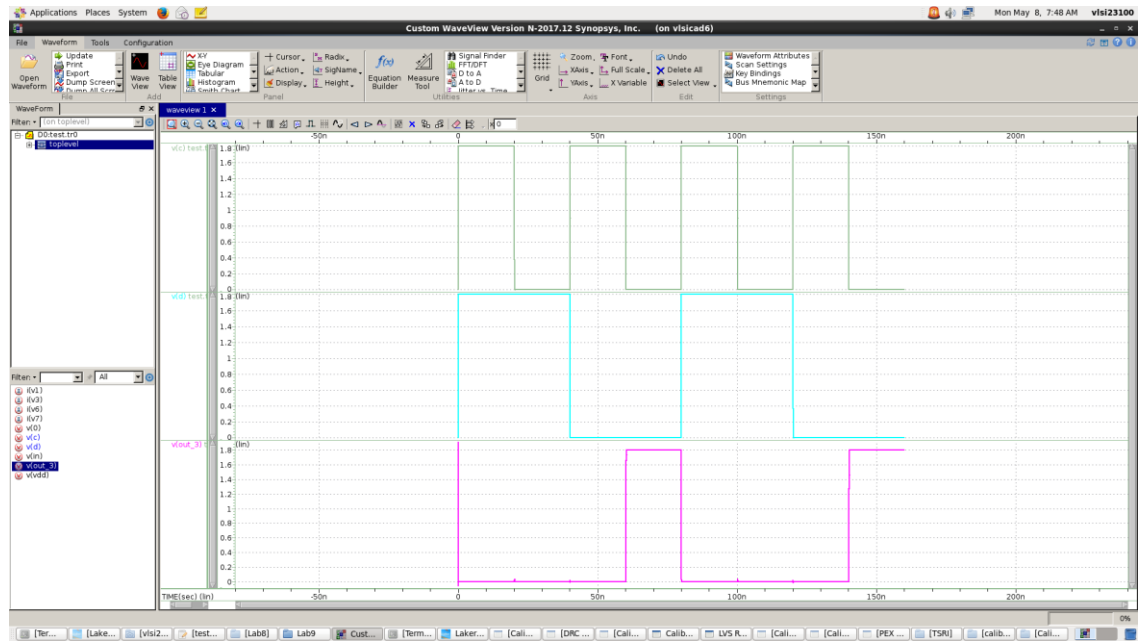
**** hspice job concluded
vlsicad6:/home/user2/vls123/vls123100/Lab9 % hspice -i testbench.sp -o test.lis
Using: /usr/cad/synopsys/hspice/cur/hspice/linux64/hspice -i 'testbench.sp' -o test.lis

**** hspice job concluded
vlsicad6:/home/user2/vls123/vls123100/Lab9 % vv &
[2] 7805
vlsicad6:/home/user2/vls123/vls123100/Lab9 % QClipboard::setData: Cannot set X11 selection owner for PRIMARY
QClipboard::setData: Cannot set X11 selection owner for PRIMARY
QClipboard::setData: Cannot set X11 selection owner for PRIMARY
hspice -i testbench.sp -o test.lis
Using: /usr/cad/synopsys/hspice/cur/hspice/linux64/hspice -i 'testbench.sp' -o test.lis
^Z
Suspended
vlsicad6:/home/user2/vls123/vls123100/Lab9 % hspice -i testbench.sp -o test.lis
Using: /usr/cad/synopsys/hspice/cur/hspice/linux64/hspice -i 'testbench.sp' -o test.lis

**** hspice job concluded
vlsicad6:/home/user2/vls123/vls123100/Lab9 % hspice -i testbench.sp -o test.lis
Using: /usr/cad/synopsys/hspice/cur/hspice/linux64/hspice -i 'testbench.sp' -o test.lis

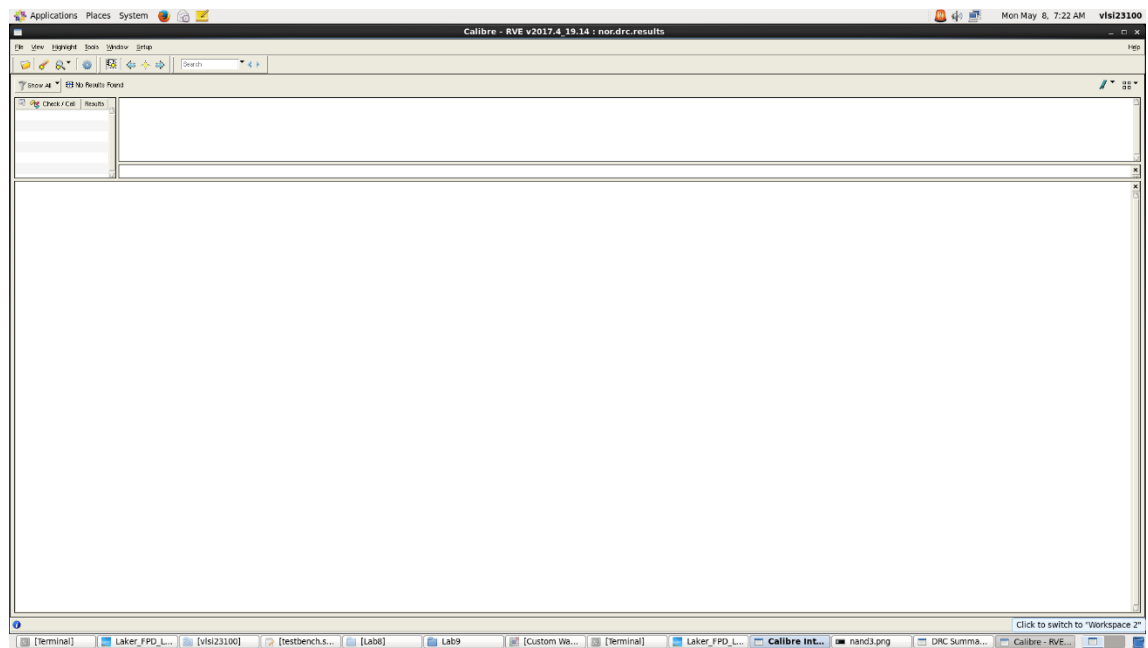
**** hspice job concluded
vlsicad6:/home/user2/vls123/vls123100/Lab9 %
```

ii. 請截取 WaveView 中的波形



iii. DRC/LVS 結果

DRC:



LVS:

Calibre - RVE v2017.4.19.14 : svdb nor

Comparison Results

Layout Cell / Type	Source Cell	Nets	Instances	Parts
nor	nor	SL, SS	1, 18	SL, SS

Cell: nor Summary (Close)

CELL COMPARISON RESULTS (TOP LEVEL)

LAYOUT (CELL NAME: nor)
SOURCE (CELL NAME: nor)

INITIAL NUMBERS OF OBJECTS

	Layout	Source	Component Type
Nets:	5	5	
Surfaces:	2	2	MP (4 pins)
Tracks:	4	4	MP (4 pins)

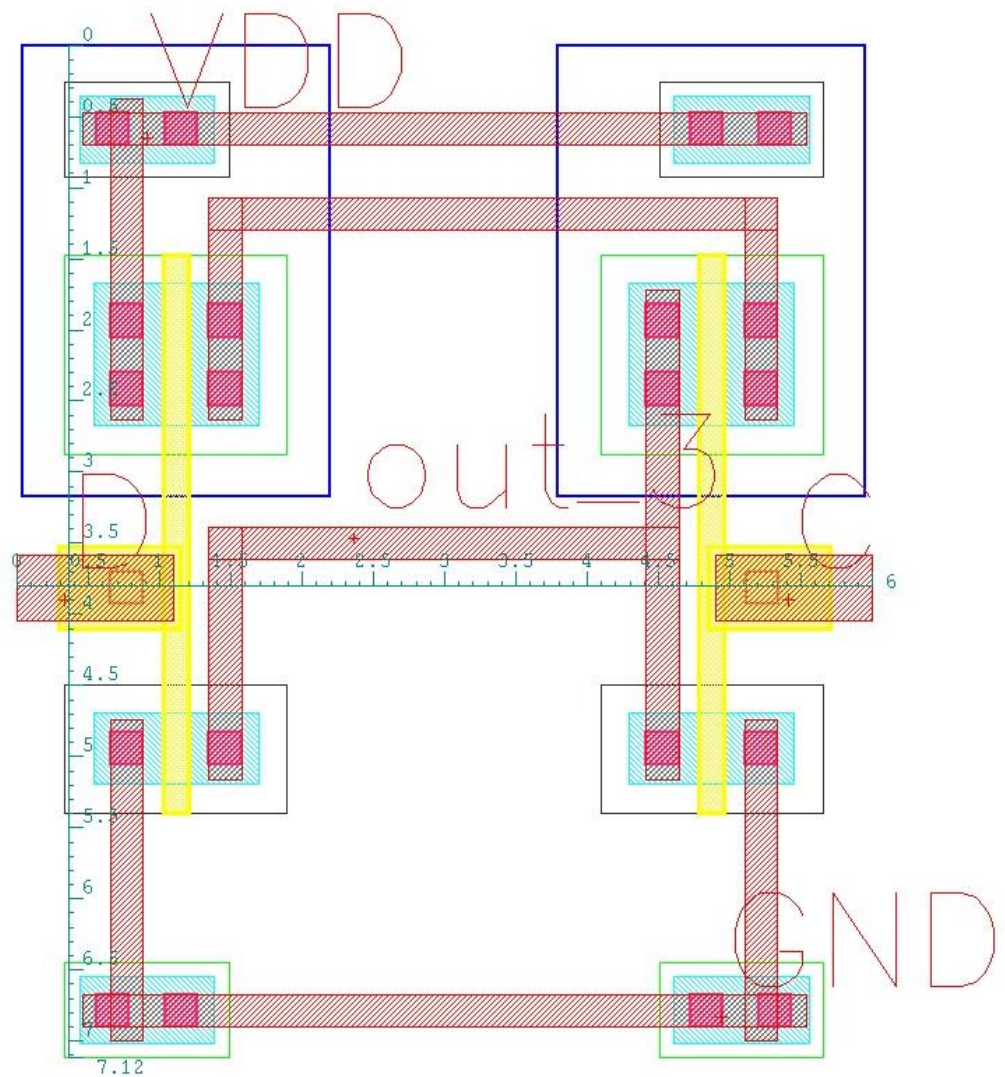
NUMBERS OF OBJECTS AFTER TRANSFORMATION

	Layout	Source	Component Type
Nets:	5	5	
Surfaces:	1	1	_pwr0 (5 pins)
Tracks:	1	1	

MISMATCHES AND UNMATCHED

Matched Layout	Matched Source	Unmatched Layout	Unmatched Source	Component Type
5	5	0	0	
1	1	0	0	

iv. Layout 截圖



3. 嘗試簡單說明 Presim 與 Post-sim 結果比較

可能由於電路簡單的關係，Presim 和 Post-sim 的波形圖並沒有太大的差異，只有極少地方的震盪有些微差異。

C. 心得討論

第一次學習畫 layout 發現尺寸不僅是照著講義畫，還要符合此製程的所有規範，也發現 DRC->LVS->PEX 的測驗是越來越嚴格，

除此之外也發現其實 PMOS 和 NMOS 可以共用蠻多東西的，可以再改良得更好。