Boolean Functions: (devices too complex to be defined by general convention)

AA A DDD D D

- D — drive capability: 1X, 2X, etc.
- D — output type: (same as logic gates)
- DDD — index number
- A — f = fixed
g = generator
- AA — bl

I/O Pads:

AA A A D D D D

- D — I/O type:
  - 0 = normal
  - 1 = complementary
  - 2 = normal tri-state
  - 3 = complementary tri-state
  - 4 = pull down
  - 5 = pull up
- D D — TTL DC drive (mA) or CMOS capacitive drive (15 or 50 pf)
- D — 0 - gnd bus on the top
1 - vdd bus on the top
- A — f = fixed
g = generator
- A — Process:
  - c = CMOS
  - t = TTL
  - b = BI-CMOS
  - u = UNUSED
- AA — Cell Designator:
  - ot OUTPUT
  - in INPUT
  - io IN/OUT
  - ls LEVEL SHIFTER INP.
  - su SEPARATE SUPPLY
  - co BUSS CROSSOVER
  - st SCHMITT TRIGGER
  - vd VDD PAD
  - gd GND PAD
  - cr CORNER CELL
  - pd PAD
  - sp SPACER CELL
  - ex EXTENSION CELL

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Muxes & Decoders:

AAA A D D D

- D — drive capability: 1X, 2X, etc.
- D — output type:
  - 0 = normal
  - 1 = complementary
  - 2 = enabled
  - 3 = open-drain (NMOS)
  - 4 = open-drain (PMOS)
- D — number of inputs
- A — f = fixed / g = generator
- AAA — mux = multiplexer / dec = decoder

Test Devices:

AAA A D D D

- D — drive capability: 1X, 2X, etc.
- D — output type:
  - 0 = N-Channel
  - 1 = P-Channel
  - 2 = Resistor
- D — number of inputs
- A — f = fixed / g = generator
- AAA — tst

Wiring Elements:

AAAA

- AAAA — feed, via, ...

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Binary Counters, Shift Registers:

AAA A D D D D

- D — output drive
- D — output type: 0 = normal, 1 = complementary, 2 = enabled
- D — load & clear controls: 0 = neither, 1 = clear only, 2 = load only, 3 = both load & clear
- D — number of bits
- A — f=fixed, g=generator
- AAA —
  - buc = binary up counter
  - bdc = binary down counter
  - bbc = binary bidirectional counter
  - shu = up-shift register
  - shd = down-shift register
  - shb = bidirectional shift register
  - inc = incrementer
  - dcr = decrementer
  - id = incrementer/decrementer

Delay Elements:

AAA A D D D

- D — drive capability: 1X, 2X, etc.
- D — # of delay units
- D — number of bits of programmability
- A — f = fixed, g = generator
- AAA — del = delay cell

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AND-OR & OR-AND Complex Gates:

AAA A D D D D

- D (last): drive capability: 1X, 2X, etc.
- D: output type:
  - 0 = normal
  - 1 = complementary
  - 2 = enabled
  - 3 = open-drain (NMOS)
  - 4 = open-drain (PMOS)
- D: number of inputs in a gate in first level
- D: number of gates in the first level
- A:
  - f = fixed
  - g = generator
- AAA:
  - ao = AND-OR
  - oa = OR-AND
  - aoi = AND-OR-Invert
  - oai = OR-AND-Invert

Flip-Flops and Latches:

AA A A D D D

- D (last): output drive
- D: output type:
  - 0 = normal
  - 1 = complementary
  - 2 = enabled
- D: internal construction:
  - 1 = NAND/NAND
  - 2 = NOR/NOR
  - 3 = T-gate
- A: f=fixed, g=generator
- A: set & reset controls:
  - n = neither
  - r = reset only
  - s = set only
  - b = both set & reset
- AA:
  - df = D type flip-flop
  - jk = JK type flip-flop
  - la = latch

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Logic Gates & Inverters:

```
AAA A D D D
```

- D (last): drive capability: 1X, 2X, etc.
- D (second): output type:
  - 0 = normal
  - 1 = complementary
  - 2 = enabled
  - 3 = open-drain (NMOS)
  - 4 = open-drain (PMOS)
  - 5 = normal w/ complimentary inputs
- D (first): number of inputs
- A:
  - f = fixed
  - g = generator
- AAA:
  - nan = NAND
  - nor = NOR gate
  - and = AND gate
  - or = OR gate
  - xor = exclusive-OR gate
  - xno = exclusive-NOR gate
  - inv = inverter
  - buf = buffer

Adder Cells:

```
AA A D D D
```

- D (last): output drive
- D (second): output type:
  - 0 = normal
  - 1 = complementary
  - 2 = enabled
- D (first): not used: set to 0
- A: f=fixed, g=generator
- AA:
  - ha = half-adder
  - fa = full-adder

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KEY TO CELL NAMES
FOR THE
ITD CMOS DIGITAL CELL FAMILY

Logic References, Pull Ups, Pull Downs, Node Snappers, Power-On-Resets, Load Devices:

AA A A D D D

- output drive: 0 = resistive (< 1X)
- output type: 0 = normal
  1 = complementary
  2 = enabled
- load type: 0 = RC, 1=...
- f=fixed, g=generator
- u=up, d=down
- lr = logic reference
  pu = pull-up or pull-down
  ns = node snapper
  pr = power-on-reset
  ld = load device

Bilateral Switches:

AA A A D D D

- output drive
- output type: 2 = enabled
- not used - should be set to 0
- f = fixed
  g = generator
- n = NMOS
  p = PMOS
  c = CMOS
- sw = bilateral switch

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