Component needs and flow during construction

Component requirements for production (excl. yield)

HDIs

Assumed:

- Inner layers: 18 + 100% spares
- Outer layers: 156 + 50% spares

MuPix11 (thinned and diced)

Needed:

- Inner layers: 108 + 100% spares
- Outer layers: 2736 + 50% spares

Swiss PCB flexes

Needed:

Inner interposer flexes: 36 + 100% spares

Outer interposer flexes needed: 312 + 50% spares

Outer endpiece flexes needed: 78 + 50% spares

Backup: Yield factors in component needs

Sources of losses:

QA: selection of good component before production

Losses in assembly: ($Y_{assembly} = Y_{ladder} \times Y_{module} \times Y_{installation}$) (need to learn these from experience inner and outer layer assembly and installation)

- losses in assembly due to ladder yield (mechanical & electrical) (Y_{ladder})
- losses in assembly due to module assembly (Y_{module})
- losses during installation installation ($Y_{installation}$)

Need to learn these from experience inner and outer layer assembly and installation. Some yield could be recoverable, e.g. if ladders from a failed module can be recovered)

MuPix 11 effective yield: ($EY_{chips} = Y_{chips} \times Y_{assembly}$)

- failure of chips after thinning, dicing and probe test (Y_{chips})

HDI effective yield ($Y_{HDIs} \times Y_{assembly}$) *

- acceptance test yield (Y_{HDIs})

Interposer flex ($Y_{interposers} \times Y_{assembly}$)

- acceptance test yield ($Y_{interposers}$)

Endpiece flex ($Y_{endpiece} \times Y_{assembly}$) (**)

- acceptance test yield ($Y_{endpiece}$)

(*) overall HID yield assumed as 50% for inners and 60% of outers dominated by assembly losses. Based on early estimate inner ladders: ladder assembly yield (mechanical × electrical) 50%. This is likely a conservative number. For Outer ladders yield is much more critical factor in success of the build as there are many more chips on a ladder. Therefore more rigorous tooling and processes. (For HDI production estimate we assumed 60% outer ladder yield)

(**) *in principle recoverable from a failed module*

Component requirements for production(incl. yield)

HDIs (~100k)

- Assumed:
  - Inner layers: 18 + 100% spares, overall HDI yield $EY_{HDIs,inner}$ (assumed as 50% means we need 72 HDIs)
  - Outer layers: 156 + 50% spares, overall HDI yield $EY_{HDIs,outer}$ (assumed as 60% means we need 390HDIs)

MuPix11 (thinned and diced) (~300k?)

- Needed:
  - Inner layers: 108 + 100% spares, overall chip yield $EY_{chips,inner}$ (if assumed 50% need ~ 432 chips or 41 wafers)
  - Outer layers: 2736 + 50% spares, overall chip yield $EY_{chips,outer}$ (if assumed 60% need ~6840 chips or ~171 wafers)

Swiss PCB flexes (~30-50k??)

Needed:

Inner interposer flexes: 36 + 100% spares, overall yield $EY_{interposers,inner}$ (if assumed 50% need ~144)

Outer interposer flexes needed: 312 + 50% spares, overall yield $EY_{interposers,outer}$ (if assumed 60% need ~780)

Outer endpiece flexes needed: 78 + 50% spares, overall yield $EY_{interposers,outer}$ (if assumed 60% need ~ 195)