WHY PCB SUPPLIER QUALIFICATION MATTERS.

CAPABILITY • CONTROL • REPEATABILITY • RISK

A good PCB design is only as reliable as the process used to manufacture it.



DESIGN & SPECS

- Layer count
- Materials
- Finish
- Drilling
- Impedance
- Tolerances

SAME FABRICATION PACKAGE

	SUPPLIER A	SUPPLIER B
PLATING CONSISTENCY	Uniform copper thickness ✓	Variable copper thickness ✗
REGISTRATION ACCURACY	Tight layer alignment ✓	Layer mis-registration observed ✗
MATERIAL CONTROL	In-spec laminate and copper ✓	Out-of-spec variation ✗
YIELD	High first-pass yield ✓	Lower yield, more rework ✗
DOCUMENTATION & TRACEABILITY	Complete, clear and traceable ✓	Incomplete or inconsistent ✗
ENGINEERING SUPPORT	Proactive, accurate and collaborative ✓	Reactive, slow responses ✗

VS

REAL CUSTOMER OUTCOMES

- Higher reliability and lower DPPM ✓
- Fewer escapes into assembly ✓
- On-time delivery and predictability ✓
- Lower total cost of ownership ✓

QUALIFICATION IS NOT PROVING ONE ACCEPTABLE SAMPLE — IT IS ESTABLISHING REPEATABLE CONTROL.

1 TECHNOLOGY FIT

Equipment, materials and engineering match the actual board.

- Right equipment for the build
- Qualified materials and finishes
- Engineering understands the design
- Capacity and scalability verified

2 PROCESS CONTROL

Stable windows for lamination, drilling, plating, imaging and finish.

- Defined process parameters
- Monitored and controlled
- SPC and trend analysis
- Corrective action in place

3 OBJECTIVE EVIDENCE

Data that proves capability, not assumptions.

- DFM review and feedback
- CoC, ET, microsection, impedance
- Build records and traceability
- Statistical and trend data

4 RESPONSE TO FAILURE

How the supplier reacts defines the partnership.

- Containment and notification
- Root cause analysis
- Corrective and preventive action
- Transparency and follow-through

CERTIFICATES ARE INPUTS, NOT THE DECISION.

ISO / AQMS CERTIFICATE
Management-system framework. Necessary, but not enough.

→ **CAPABILITY MATRIX**
Claimed limits and processes. Review, validate and challenge.

→ **TRIAL BUILD (REAL EVIDENCE)**
Real boards, real data, under controlled conditions.

→ **AUDIT (ON-SITE / REMOTE)**
See how processes are implemented and controlled every day.

→ **SCORECARD (ONGOING)**
Measure performance continuously and improve.

IPC DEFINES WHAT THE BOARD MUST ACHIEVE — QUALIFICATION EVALUATES THE SOURCE THAT MUST ACHIEVE IT.

DEFINE THE APPROVAL SCOPE AND RISK

TECHNOLOGY • MATERIALS • COMPLEXITY • CONSEQUENCE

DO NOT APPROVE ONLY "PCB SUPPLIER"

Approve a manufacturing site for a defined scope.

SUPPLIER ONLY ✕ → APPROVED SITE & SCOPE

APPROVAL SCOPE (EXAMPLE)

1	BOARD TECHNOLOGY	Rigid multilayer
2	LAYER COUNT	Up to qualified construction
3	VIA TECHNOLOGY	PTH + buried, HDI separately approved
4	MATERIALS	Approved high-Tg FR-4 families
5	CONTROLLED IMPEDANCE	With coupon report
6	PRODUCT CLASS	Class 2 / Class 3 as approved
7	FINISHES	ENIG and immersion silver
8	BACKDRILL	Approved
9	STACKED MICROVIA	Conditional (see notes)
10	DEFENCE / AEROSPACE	Flow-down required

RISK-BASED QUALIFICATION

LOW → MEDIUM → HIGH



TWO-LAYER PROTOTYPE | CONVENTIONAL MULTILAYER | 20-LAYER DEFENCE HDI

RISK FACTORS

- Consequence of field failure
- Technology complexity
- Features near capability limits
- Class / customer requirements
- Volume / replacement cost
- Material substitution
- Single-source dependence
- Country / logistics exposure
- Novel processes
- Supplier maturity

QUALIFICATION DEPTH = PRODUCT CONSEQUENCE + PROCESS COMPLEXITY + SUPPLY RISK

WHAT CAN GO WRONG WITHOUT QUALIFICATION

1. **OVERSTATED CAPABILITY** — Low yield / delays
2. **WEAK PLATING** — Latent via failures
3. **WEAK REGISTRATION** — Breakout / shorts
4. **MATERIAL SUBSTITUTION** — Impedance / reliability change
5. **POOR LAMINATION** — Delamination
6. **WEAK MICROVIAS** — Thermal failure
7. **POOR DOCUMENTATION** — No investigation trail
8. **WEAK CHANGE CONTROL** — Unapproved changes

APPROVAL MUST STATE WHAT IS QUALIFIED, WHAT IS RESTRICTED AND WHAT REQUIRES NEW EVIDENCE.

VERIFY THE MANUFACTURING PROCESS

CAPABILITY • EQUIPMENT • PROCESS WINDOW • CHANGE CONTROL ///

DESKTOP PRE-QUALIFICATION

LEGAL IDENTITY AND SITE	MARKETS AND YEARS	VERIFIED CERTIFICATES	TECHNOLOGIES AND LAYERS	MATERIALS	IMPEDANCE CAPABILITY	FINISHES AND OUTSOURCE	ET / MICROSECTION AND RELIABILITY	CAPACITY AND LEAD TIME	DATA SECURITY
Registered entity and manufacturing site address	Target markets served and years in business	ISO 9001, IATF 16949, ISO 14001, ISO 45001 and others	HDI capability, layer count and aspect ratio	Material systems, TG options and approved vendors	Dk/Df knowledge, control method and tolerance claim	Finishes offered, outsourced steps and partners	Lab capability, testing methods and reports	Capacity by mix, quoting accuracy and on-time rate	IP protection, access control and NDA

VERIFY ISSUER, NUMBER, EXPIRY, SITE AND SCOPE — DO NOT JUST COLLECT PDFs.

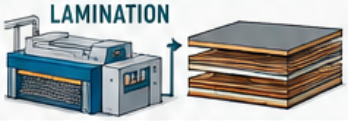
MANUFACTURING PROCESS FLOW AND KEY ACCEPTANCE POINTS

1 MATERIAL CONTROL



- Approved grades and vendors
- Receiving inspection and records
- Controlled storage conditions
- Lot traceability to finished board
- Substitution approval required

2 LAMINATION



- Press cycles and parameters
- Lay-up verification and balance
- Registration and alignment
- Resin flow and void control
- Sequential builds for thick/HDI

3 DRILL & DESMEAR



- Positional accuracy (X/Y, true position)
- Tool life and wear monitoring
- Stack height and drill break-out
- Material-specific preparation
- Backdrill depth control (when req.)

4 COPPER PLATING



- Chemistry and additive control
- Current density and uniformity
- Throwing power and via fill
- Panel distribution and agitation
- Microsection trends and SPC

5 IMAGING / ETCH / REGISTRATION



- Compensation and exposure control
- AOI coverage and criteria
- Fine-line yield and etch factor
- Layer-to-layer / drill alignment
- Annular-ring margin verification

6 SOLDER MASK / FINISH



- Registration to copper features
- Solder mask web and cure
- ENIG/ENEPIG process control
- Coating thickness verification
- Outsourced finish traceability

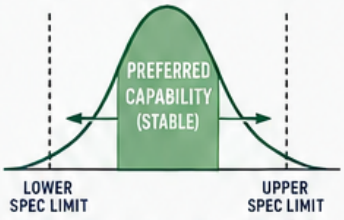
7 IMPEDANCE / TEST



- Production stack-up validation
- Dk assumptions and tolerance
- Representative coupon testing
- Calibrated TDR measurement
- 100% electrical test (when req.)

PREFERRED CAPABILITY VS ABSOLUTE MINIMUM

THE STABLE PRODUCTION WINDOW



Consistent process with margin to both limits results in higher yield and long-term reliability.

ENGINEERING REVIEW LIMIT (ABSOLUTE MINIMUM)



Operating near the limits increases risk, reduces yield and shortens product life.

PRINCIPLE

The smallest advertised number **is not the best supplier.**
The most capable and controlled process is the best supplier.

CONTROLLED CHANGES — REQUIRE NOTIFICATION AND APPROVAL

MATERIAL	SITE	EQUIPMENT / PROCESS	PLATING CHEMISTRY	OUTSOURCED PROCESS	STACK-UP	CAM GEOMETRY	SUB-TIER SUPPLIER	CERTIFICATION STATUS
Change of grade, core, prepreg or foil	Manufacturing location change	New equipment, process flow or parameters	Bath chemistry, additives or supplier change	New supplier or process step transfer	Layer count, construction or material mix	Design rules, tolerances or compensation	Subcontractor or sub-tier change	Expiry, suspension or scope changes

Evaluate impact on quality, reliability, cost and laad time. Update risk assessment and PPAP / control plan as required.

QUALIFY THE PROCESS MARGIN — NOT THE BROCHURE NUMBER.
VERIFY BY EVIDENCE. CONTROL BY DISCIPLINE. DELIVER BY CONSISTENCY.

TURN CLAIMED CAPABILITY INTO EVIDENCE

AUDIT • TRIAL BUILD • REPORTS • SYSTEM RESPONSE

SUPPLIER AUDIT — FOLLOW A REAL JOB

1. ORDER REVIEW
2. CAM/DFM
3. MATERIAL RECEIVING / STORAGE
4. IMAGING / AOI
5. LAMINATION
6. DRILLING / DESMEAR
7. PLATING
8. MASK / FINISH
9. ROUTING
10. ELECTRICAL TEST
11. MICROSECTION
12. FINAL INSPECTION
13. PACKAGING / SHIPPING

AUDIT PRINCIPLE: *VERIFY IMPLEMENTATION, RECORDS AND TRACEABILITY — DO NOT MERELY REPEAT THE QUESTIONNAIRE.*

CONTROLLED TRIAL BUILD

BUILD A REPRESENTATIVE QUALIFICATION PCB

- PRODUCTION-INTENT MATERIALS
- REALISTIC TRACE/SPACE AND VIA STRUCTURES
- CONTROLLED IMPEDANCE
- CHALLENGING REGISTRATION
- REPRESENTATIVE FINISH
- FULL DFM REVIEW
- EVERY REQUESTED CHANGE RECORDED AND APPROVED

WHAT TO REQUEST

- DFM report
- Final approved stack-up
- CoC (Certificate of Conformity)
- Electrical test report
- Microsection report
- Impedance report
- Material certificate
- Surface-finish report
- Dimensional/FAI data
- Reliability/process test data
- Packing and label records

EVALUATE THE BUILD AS A SYSTEM

- QUOTATION ACCURACY
- DFM QUALITY
- RESPONSE TIME
- STACK-UP COMPETENCE
- CONTROLLED-DATA DISCIPLINE
- ZERO UNAPPROVED CHANGES
- LEAD-TIME PERFORMANCE
- BOARD WORKMANSHIP
- INTERNAL MEASURED QUALITY
- DOCUMENTATION COMPLETENESS
- TRACEABILITY END TO END
- PACKAGING QUALITY
- PROBLEM HANDLING

FAILURE RESPONSE — THE RIGHT WAY

DEFECT	CONTAIN	NOTIFY	ROOT CAUSE	CORRECT	VERIFY EFFECTIVENESS
Detect the issue.	Prevent more from escaping.	Inform the right people fast.	Find and verify the cause.	Fix the cause, not the symptom.	Prove the fix worked.

A USEFUL FAILURE CAN REVEAL MORE THAN A PERFECT SAMPLE.

DO NOT QUALIFY A SUPPLIER ONLY BECAUSE THE BOARD POWERS UP.

SCORE, APPROVE AND MONITOR

DECISION • AVL • PERFORMANCE • REQUALIFICATION ///

SUPPLIER SCORING MODEL

Technical capability	Quality / process control	Trial-build results	Documentation / traceability	Delivery / capacity	Communication	Commercial	Business / supply risk
20%	20%	20%	10%	10%	10%	5%	5%

⚠ LOWEST PRICE MUST NOT OUTWEIGH WEAK STRUCTURAL EVIDENCE OR PROCESS CONTROL.

QUALIFICATION STATUS LEVELS

1 PROSPECTIVE	2 UNDER EVALUATION	3 CONDITIONAL	4 QUALIFIED	5 PREFERRED	6 RESTRICTED	7 SUSPENDED	8 DISQUALIFIED
Not assessed	Review in progress	Limited trials/scope	Approved defined scope	Sustained strong performance	Limited technology/orders	New orders stopped	Approval withdrawn

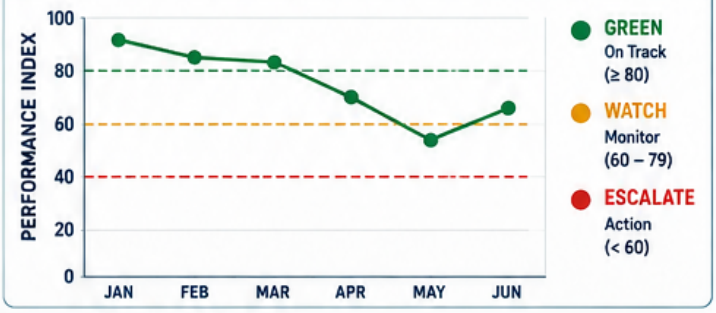
AVL RECORD (APPROVED VENDOR LIST)

Supplier / Site:		Materials:		Open Actions:	
Supplier ID:		IPC Class:		Next Review Date:	
Status Level:		Special-Process Limits:		Owner / Approver:	
Approval Date:		Certificate Expiry:			
Technology Scope:		Trial / Audit References:		Approved By: _____	
Maximum Complexity:		Scores (weighted):	/100	Date: _____	

ONGOING MONITORING

INCOMING ACCEPTANCE (%)	DEFECTS / ESCAPES (PPM)	ET YIELD (%)	MICROSECTION TRENDS
IMPEDANCE YIELD (%)	ON-TIME DELIVERY (%)	DFM QUALITY (FEEDBACK SCORE)	NCR RESPONSE TIME (DAYS)
CAPA EFFECTIVENESS (%)	UNAUTHORIZED CHANGES (CASES)	DOCUMENTATION ACCURACY (%)	COMMERCIAL STABILITY (ON-TIME PAYMENT)

PERFORMANCE TREND (EXAMPLE)



REQUALIFICATION TRIGGERS (ANY MAY INITIATE REVIEW)

Site / Ownership Change	Certification Loss / Expiry	New Technology	Major Equipment / Process Change	Repeated Escapes / Failures	Delivery Deterioration	Unauthorized Substitution	Long Inactivity	Capability Loss or New Customer Requirement

⚠ **APPROVAL IS A CONTROLLED STATUS — NOT A PERMANENT LABEL.**

CONTINUOUS EVIDENCE, PERFORMANCE AND COMPLIANCE ARE REQUIRED TO MAINTAIN APPROVAL.

QUALIFY, CONTROL AND RE-EVALUATE

WORKFLOW • CHECKLIST • RED FLAGS • FINAL DECISION

1. DEFINE TECHNOLOGY & RELIABILITY
2. SCREEN CANDIDATES & CERTIFICATES
3. REVIEW CAPABILITY MATRIX
4. ASSESS RISK & AUDIT DEPTH
5. REVIEW DFM / ENGINEERING
6. AUDIT SITE / PROCESS
7. RUN CONTROLLED TRIAL BUILD
8. REVIEW EVIDENCE & CLOSE ACTIONS
9. SCORE, DEFINE SCOPE & ADD TO AVL

MONITOR → REQUALIFY WHEN TRIGGERED

FINAL QUALIFICATION CHECK:

1	Identity of supplier and manufacturing site verified	☐
2	Certificates of Conformity verified and complete	☐
3	Preferred vs. minimum limits understood and agreed	☐
4	Materials and substitution control process understood	☐
5	DFM/CAM review completed and design rules agreed	☐
6	Lamination process and controls reviewed	☐
7	Drilling and desmear process and controls reviewed	☐
8	Plating process and controls reviewed	☐
9	Imaging, registration and alignment controls reviewed	☐
10	Solder mask and surface finish process reviewed	☐
11	Impedance control method and targets verified	☐
12	HDI / microvia process (if applicable) reviewed	☐
13	Electrical Test (ET) method and coverage verified	☐
14	Microsection plan and reliability plan reviewed	☐
15	Equipment calibration and maintenance program verified	☐
16	NCR, CAPA and root cause process verified	☐
17	Engineering change control process verified	☐
18	Traceability and data retention verified	☐
19	Data security and IP protection verified	☐
20	Sub-tier suppliers and critical inputs controlled	☐
21	Capacity, lead time and business continuity reviewed	☐
22	Controlled trial build completed and evaluated	☐
23	Quality reports and records complete and traceable	☐
24	Scope of approval and restrictions documented	☐
25	Monitoring plan established and requalification triggers set	☐

WARNING SIGNS:

- ✗ Every answer is “no problem” or “standard”
- ✗ Aggressive numbers with no preferred limits
- ✗ Vague, sales-led DFM with no detailed feedback
- ✗ No sample quality reports or only marketing slides
- ✗ Unclear or changing manufacturing site details
- ✗ Uncontrolled outsourcing of key processes
- ✗ Routine material substitutions without review
- ✗ “Class 3” used as a marketing statement
- ✗ Weak or missing microsection traceability
- ✗ CAPA blames operators without root cause
- ✗ Reluctance or refusal to allow audits
- ✗ Unexplained prices significantly below market

SECOND-SOURCE REMINDER

Qualify each supplier’s materials, stack-up and impedance geometry separately. Do not assume second-source equivalence.

FINAL PRINCIPLE – QUALIFICATION IS A CONTINUOUS, EVIDENCE-BASED DISCIPLINE

1. **DEFINE THE NEED** — Define technology, reliability and compliance requirements.
2. **VERIFY THE SITE & PROCESS** — Verify who, where and how it will be manufactured.
3. **PROVE IT WITH A TRIAL BUILD** — Generate objective evidence through a controlled trial build and testing.
4. **APPROVE A SPECIFIC SCOPE** — Approve only a clear, documented scope with defined limits.
5. **MONITOR AND REQUALIFY** — Monitor performance and requalify when triggers are met.

QUALIFY THE MANUFACTURING PROCESS, NOT THE BROCHURE.