

CCLs — The Invisible Bottleneck THEMATIC

M8 → M9 → M10 — the spec migration in AI server laminates, and the names positioned to monetise it

A sheet of resin-impregnated glass cloth, clad in copper foil — the most boring-sounding material in the AI stack, and quietly one of its most supply-constrained.

What is a CCL? — The 30-second primer

A **Copper Clad Laminate (CCL)** is the raw sheet material from which every printed circuit board (PCB) is fabricated. Mechanically, it is a sandwich: a layer of woven glass-fibre cloth (often called "glass cloth" or "fibreglass") impregnated with a thermoset resin, with one or two ultra-thin copper foils bonded to its surfaces under heat and pressure. The PCB fabricator then etches the copper into circuit traces, drills holes for vias, and stacks multiple CCL sheets together to make a multi-layer board. A modern AI server compute board can have 26 to 36 such layers stacked.

The CCL does two things that matter: **(i) it provides the mechanical and dimensional stability** on which all the high-precision circuit features sit, and **(ii) its dielectric properties — the famous "Dk" and "Df" numbers — directly determine how cleanly a high-speed signal can travel from one chip to another**. As signal frequencies climb from 56 Gbps to 112 Gbps to 224 Gbps PAM4 (i.e. the move from 400G to 800G to 1.6T networking), the resin and glass cloth must absorb less and less of the signal — driving the industry up the spec ladder from M4 (standard FR-4) through M6, M7, M8 and now M9 / M10 grades, each demanding fundamentally different raw materials and tighter manufacturing tolerances.

The Top-Down Thesis

CCL is becoming the AI server's silicon-equivalent gatekeeper — a small, technical, oligopolistic market with multi-year qualification cycles, exploding content per rack, and a raw-material bottleneck (Q-glass / T-glass) the industry cannot solve on demand.

The spec ladder is accelerating, and each rung is a different industry. AI servers have moved from M4/M6 (Hopper) → M8 (GB200) → M8U/M8.5 (GB300) → M9 (Rubin switch tray, mid-plane, CPX) — with Nvidia having initiated M10 testing in March 2026 for Rubin Ultra and Feynman platforms. Each generational step requires fundamentally new dielectric chemistry (PPO/PTFE blends), new glass cloth (Q-glass or quartz cloth), new copper foil (HVLP-3, HVLP-4) and new press / lamination processes — and crucially, the qualified supplier list shrinks at every step. M9 currently has fewer than five qualified producers globally.

Content per rack is materially expanding, not just substituting. AI server PCB demand jumped from ~15% of total PCB market in 2025 to over 25% in 2026, with PCB value per AI server unit up >30% generationally. Layer count has leapt from 16–20 layers (general server) to 28–36 layers (AI server). Rubin Ultra's confirmed switch from copper cables to orthogonal backplanes will create *entirely new CCL demand pockets* — three 26-layer M9 boards laminated into 78-layer assemblies per backplane.

Qualification cycles are an absolute moat. Customer qualification at Nvidia / AWS / Google / Meta runs 12–18 months and routinely fails — EMC, the world's #1 specialty CCL maker, failed Nvidia's GB300 compute tray certification in late 2025, handing Doosan an effectively exclusive position on that platform. This is a market where capacity is meaningless without qualified status, and qualified status is irrevocably scarce. The result: when AI demand surges, marginal supply cannot simply scale in — incumbents capture the entire delta.

The raw-material chokepoint is upstream. The advanced glass cloth (Q-glass, T-glass, low-Dk3 variants) needed for M8/M9/M10 grades is produced almost entirely by Japan's Nittobo, with smaller capacity at Asahi Kasei, Shin-Etsu and AGC. Apple, Nvidia, AMD, Microsoft, Amazon and Qualcomm executives have all visited Nittobo in the past year; new capacity does not arrive until 2H 2027. Even tier-1 CCL makers are now bidding against each other for glass cloth allocation. This converts to *structural pricing power* for whoever already has the allocation.

Equipment lead times are now 2 years. Per AMI Asia Metal Industries, CCL production line orders are booked through Q1 2028 — lead times have stretched from 8 months to 24 months. Even if a producer wanted to add capacity tomorrow, it physically cannot until 2028. This is the same equipment bottleneck story that ran through HBM in 2023–24, and it directly underwrites ASPs through that window.

Rubin CCL TAM = \$275m (2026) → \$2bn (2027), per GS. Goldman Sachs estimates the Rubin-specific CCL addressable market at \$275m in 2026 ramping to \$2bn in 2027 — a ~7x expansion in one year, and that is just one platform. Add AWS Trainium 2/2.5/3, Google TPU, Meta/Amazon ASICs (all on M8U/M9), and the high-speed CCL TAM is on a 19.8% CAGR through 2032 (QY Research).

A note on valuation: Several names in this report have already begun re-rating as the market starts to price in the M8/M9 spec transition. We view this re-rating as a confirmation — share prices are beginning to reflect what we have identified, while the earnings inflection is still in its early innings. The compounding effect — volume growth from content-per-rack expansion layered on top of ASP uplift from the commodity-to-advanced mix shift — has not yet been captured in consensus estimates. It is the combination of share price momentum validating the thesis and earnings compounding as volume and mix flow through to margins that we expect to propel further gains. The valuation case strengthens as the upgrade cycle matures.

Why This Is Mispriced — The Same Pattern As MLCC

MATERIALS-SCIENCE COVERAGE GAP	BURIED INSIDE CONGLOMERATES	SPEC LADDER MISREAD
CCL names are covered by Taiwan/Korea local analysts and a thin slice of materials specialists — they do not feature in mainstream US/EU AI infrastructure baskets despite being on the critical path. The same coverage gap that delayed HBM recognition in 2022–23.	The two most exposed names globally — Panasonic (MEGTRON) and Resonac (HF/HS CCL) — sit inside large diversified industrial groups where the CCL exposure is mathematically immaterial. The pure-play universe is small, illiquid, and largely Asia-listed.	Investors who treat CCL as a single market miss the bifurcation — commodity M4/FR-4 is structurally over-supplied and price-deflating, while M8/M9 is structurally short and price-rising. Aggregate CCL data masks both signals, leaving the alpha in the granularity.

The Spec Ladder — CCL Grades Across The Nvidia Roadmap

PLATFORM	GENERATION	PRIMARY CCL GRADE	LAYERS / BOARD	KEY MATERIAL INNOVATION	QUALIFIED SUPPLIERS
HGX H100 / H200 Server	Hopper	M4 / M6	16–20	Standard low-loss epoxy	Multi-vendor (8+)
GB200 NVL72	Blackwell	M8 (build-up) + M4 (core)	22	PPO resin + HVLP-3 copper	EMC, TUC, ITEQ, Doosan
GB300 NVL72 Compute Tray	Blackwell Ultra	M8U / M8.5	26+	Lower Df + HVLP-4 copper	Doosan exclusive (post EMC fail)
GB300 NVSwitch Tray	Blackwell Ultra	M8U PTH	22	Same as GB200 NVSwitch	EMC (~70%)
Vera Rubin VR200 — Switch Tray	Rubin	M9-class	26	Q-glass / Q-cloth + PTFE blend	EMC ~100%, Doosan, TUC
Vera Rubin VR200 — Compute / CPX / Mid-plane	Rubin	M6 / M8.5 / M9	22–26	HVLP-4 + low-Dk3 glass	EMC ~15% Compute · multi M9
Rubin Ultra (Kyber) Orthogonal Backplane	Rubin Ultra	M9 (3×26L → 78L)	78 (laminated)	First-ever 78L M9 assembly	EMC, TUC (M9Q), Doosan
Rubin Ultra / Feynman (M10 testing)	Rubin Ultra+	M10 (in qual)	30+	30–40% lower loss vs M9	Multi-vendor (intentional)

Sources: Goldman Sachs (Sep 2025 channel checks), Digitimes (Nov 2025, Apr 2026), TrendForce, GlobalTechResearch substack, Tiger Brokers, KGI Securities, Nvidia GTC 2025 / 2026 disclosures. Note: M8U = "M8 Ultra-low loss"; HVLP = "Hyper Very Low Profile" copper foil; PTH = Plated-Through-Hole. "Multi-vendor" status for M10 is deliberately engineered by Nvidia to avoid single-source dependency seen on GB300 compute tray. Specifications subject to revision; per Goldman Sachs, Rubin final CCL spec is expected to be locked around June–July 2026.

Why The Quality Is Going Up — Five Independent Drivers

- (1) Signal speed scaling. The roadmap from 400G to 800G to 1.6T networking forces a step-function reduction in dielectric loss (Df). M6 → M8 → M9 each cuts insertion loss by ~25–30%. There is no way to hit 1.6T signalling on FR-4 — the spec literally requires the new materials, and the upgrade is not negotiable.
- (2) Layer-count escalation. AI compute boards have moved from 22 layers (GB200) to 26+ (GB300) to potentially 30+ (Rubin Ultra). Each additional layer adds CCL content linearly, and the lamination process itself becomes exponentially more difficult — yield falls as layer count rises, further constraining effective supply.
- (3) Orthogonal backplane architecture. Rubin Ultra's switch from copper cabling to PCB-based orthogonal backplanes is a one-time, irreversible architectural shift that creates a brand new product category — single 78-layer M9 assemblies — with no historical demand baseline. Adam Tooze-style "new demand from new architecture", not just substitution.
- (4) HVLP copper foil pairing. M8/M9 grades only deliver their performance benefit when paired with HVLP-3 / HVLP-4 ultra-low-roughness copper foil — itself a small oligopoly (Mitsui Mining & Smelting, Furukawa, Iljin Materials, Nan Ya Plastics). This compounds the qualification problem and further restricts effective production.
- (5) Q-glass / T-glass raw-material lock. M9 requires Q-glass (quartz cloth) or low-Dk3 glass — supplied at production scale almost exclusively by Nittobo, with limited capacity at Asahi Kasei, Shin-Etsu (SQX), and AGC. The CCL supply chain cannot grow faster than the upstream glass cloth supply chain. Nittobo new capacity arrives 2H 2027 at the earliest.

Supply-Side — The Bottleneck Stack

LAYER OF THE STACK	KEY PLAYERS	CURRENT STATUS	IMPLICATION
Q-glass / T-glass cloth	Nittobo (dominant), Asahi Kasei, Shin-Etsu, AGC	Severe shortage	Capacity locked through 2H 2027
HVLP-3 / HVLP-4 copper foil	Mitsui M&S, Furukawa, Iljin	Tight, on allocation	Compounds CCL supply lock
PPO / PTFE resin systems	SABIC, Asahi Kasei, Mitsubishi Gas Chem	Tight, custom blends	High-end resin = high-end CCL
M9 CCL manufacturing	EMC, Doosan, TUC, ITEQ, Panasonic	<5 globally qualified	Effective oligopoly
CCL production equipment	AMI (Asia Metal Industries) and a few peers	2-year lead times to 2028	No marginal supply add
Multi-layer HDI PCB fabrication	Unimicron, Victory Giant, WUS, TTM	Premium HDI capacity tight	PCB ASPs rising in sympathy

Scoring Framework — Three Pillars, Each Scored 1–5

We deliberately use the same three-pillar framework deployed in the LC MLCC thematic (21 May 2026). The two markets are mechanically different but structurally analogous — both are passive material inputs to AI servers, both have content explosions running into hard supply walls, and both reward the same kind of producer: technically advanced, qualified at marquee customers, and concentrated enough in the relevant segment that earnings translate cleanly into share price. Re-using the framework ensures consistency in how we evaluate the broader "AI passives" basket. Pillar selection and rationale below:

PILLAR	WHAT WE MEASURE	WHY IT MATTERS FOR CCL
Technology / IP (1–5)	Ability to mass-produce M8U / M9 / M9-Q grade laminates — measured by qualified product portfolio breadth (M6 through M10), in-house resin / formulation IP, integration with HVLP copper foil partners, and Q-glass / T-glass allocation. Bonus credit for M10 sampling status and orthogonal backplane material qualification.	The CCL market is bifurcating: the commodity (M4/FR-4) end is structurally deflationary, while the high-end (M8+) is on a 19.8% CAGR. Technology is the binary that determines which side a producer is on. Without the chemistry IP and the glass cloth allocation, no amount of capacity is monetisable at premium ASPs.
Qualification (1–5)	Active design-in status at Nvidia (GB200, GB300, Rubin, Rubin Ultra) and tier-1 ASIC programs (AWS Trainium 2/2.5/3, Google TPU v5/v6, Meta MTIA, Amazon Inferentia / Trainium). Bonus credit for orthogonal backplane qualification and M10 evaluation status.	CCL qualification cycles run 12–18 months and are routinely failed even by leaders — EMC's GB300 compute tray failure handed Doosan an exclusive slot in November 2025. Capacity without qualification = zero revenue contribution to the AI thematic. This is the single largest moat in the value chain.
Purity (1–5)	CCL (or Electronic Materials BG, where consolidated) revenue as % of group revenue. Same banding as MLCC piece: >60% = 5; 40–60% = 4; 25–40% = 3; 10–25% = 2; <10% = 1. Pure-play producers receive maximum credit; conglomerate dilution is penalised.	The thesis is sector-specific and the share-price impact must not be diluted by unrelated business lines. Panasonic Industry has world-class MEGTRON technology but the CCL line is <5% of Panasonic Holdings revenue — the trade simply does not move the stock. By contrast, Doosan Corp's Electronic BG is now valued by sell-side as effectively the entire parent's operating value (per Korea Investment May 2026).

Why These Three And Not Others — Pillars Considered And Excluded

Capacity / scale. Excluded — as in the MLCC piece, capacity without qualification is unmonetisable, and qualification without technology is impossible. Adding capacity as a fourth pillar would triple-count the same underlying competence.

Q-glass / T-glass allocation. Considered but folded into the Technology / IP pillar. Glass cloth allocation is the binding constraint in 2026–2027 and is captured implicitly by a producer's M9 qualification status — if you are qualified on M9, you have demonstrably secured glass cloth allocation. The two move together.

Geographic risk. Significant in this market — Taiwan-domicile concentration, China customer / U.S. export exposure, and Korea single-supplier risk (Doosan-Nvidia) are real. Handled as a portfolio-construction overlay, not a scoring axis, to keep the ranking focused on commercial exposure rather than macro-geopolitics.

Valuation. Deliberately excluded. The ranking screens for "what to own"; valuation answers "what to pay" — separate question, handled in name-by-name follow-ups. Mixing them obscures the underlying exposure signal, particularly when names like Doosan have re-rated 50%+ in the past six months.

Composite & Decision Rules

Composite score = simple average of the three pillars, rounded to one decimal — identical methodology to the MLCC piece. Equal weighting preserves the gating-condition logic: a producer scoring 5 on technology but 2 on qualification (e.g. a Chinese newcomer with M9 R&D but no Nvidia design-in) is uninvestable for this thesis, and that imbalance must surface in the underlying scores rather than be hidden by weights.

AI-server torque is reported as a directional tag that combines the qualification depth, purity, and the specific platform exposure (Rubin compute exclusive vs. switch tray vs. ASIC vs. CPX) — this is the position-sizing input. The composite ranks; the torque tag sizes.

Ranking tie-breaks resolved in favour of higher purity, then higher qualification, then higher technology — consistent with the MLCC framework. Where two names are tied on all three pillars, EMC-like leadership names that hold the highest segment share break the tie.

The Top 10 — Global CCL Producers Ranked For The AI Spec-Ladder Thesis

RANK	COMPANY	TICKER	DOMICILE	CCL REV SHARE	TECH / IP	QUAL	PURITY	COMPOSITE	AI TORQUE
1	Elite Material Co. (EMC)	2383 TT	Taiwan	~95%+	5	5	5	5.0	Very High
2	Doosan Corp (Electronic BG)	000150 KS	South Korea	~70%* of parent op value	5	5	4	4.7	Very High
3	Taiwan Union Tech. (TUC)	6274 TT	Taiwan	~90%+	4	5	5	4.7	Very High
4	ITEQ Corp.	6213 TT	Taiwan	~95%+	4	4	5	4.3	High
5	Shengyi Technology (SYTECH)	600183 CH	China	~85%	4	4	5	4.3	High (China-cust.)
6	Panasonic Industry (MEGTRON)	6752 JP	Japan	~3–5% of holdings	5	5	1	3.7	Very Low (diluted)
7	Resonac Holdings	4004 JP	Japan	~10%	4	4	2	3.3	Low (diluted)
8	Nan Ya Plastics (NMC)	1303 TT	Taiwan	~25%	3	3	3	3.0	Medium (diluted)
9	Isola Group	Private	US / DE	~95%	4	3	5	4.0	Medium (PE-owned)
10	Kingboard Holdings	148 HK	HK / China	~50%	3	3	4	3.3	Low-Medium (commodity)

** Doosan: per Korea Investment & Securities (May 2026), "it is no exaggeration to say that the entire operating value lies with the Electronic BG" — i.e. parent valuation is functionally a CCL pure-play despite consolidated revenue including Bobcat / Enerbility / Robotics. CCL Rev Share figures are LC estimates from latest available filings, Prismark 2024 CCL market report, Goldman Sachs (Sep 2025), Digitimes channel checks, and TrendForce. Highlighted rows = top-3 conviction names. Composite = simple average of three pillars rounded to one decimal. Isola Group held by Cerberus Capital (private); listed for completeness — investable via secondary market or private credit channels only.*

Top-3 Per-Name Conviction Snapshot

NAME	WHY IT RANKS HERE
EMC (Elite Material) — #1	The undisputed global #1 in specialty CCL, perfect score across all three pillars. ~22.1% share of specialty laminate revenue (Prismark 2024), market leader in both high-speed and halogen-free high-speed segments, +53% YoY revenue growth. Goldman estimates EMC captures 40–45% of Rubin GPU CCL TAM (\$2bn by 2027), with ~100% Rubin switch tray share and 15% Rubin compute tray share. M9 Nvidia certified, M9 mass production expected Q2 2026 with up to 70% market share. October 2025 revenue +38.8% YoY; 10-month cumulative +49.9% YoY. The GB300 compute tray miss is correctly understood as a one-platform setback — EMC recovers fully on Rubin, and remains the dominant Switch / CPX / midplane supplier. The "own the leader" play.
Doosan Corp (Electronic BG) — #2	The contrarian beneficiary with exclusive GB300 compute tray supply. Q1 2026 Electronic BG revenue +53.3% YoY, operating profit +59.9% YoY, OP margin >30%. Korea Investment & Securities target ₩2.45m (initiated May 19, 2026) — valuing the entire parent at ~₩25 trillion based on Electronic BG 2026E EBITDA of ₩833bn at 30x EV/EBITDA. The CCL business is so dominant in the parent's economics that Doosan Corp now trades as a quasi-pure-play. Capex tripling YoY in 2025, Thailand plant expansion (₩180bn, mass production 2H 2028), and "Doosan demonstrated quality competitiveness while EMC faced supply difficulties" per the sell-side. Some recovery / share-give-back to EMC is likely on Rubin, but Doosan retains structural high-end qualification status as the Korean alternative for hyperscalers diversifying away from Taiwan supply concentration. The "geographic diversification beneficiary" play.
TUC (Taiwan Union Technology) — #3	The cleanest pure-play with the strongest momentum. Q3 2025: +18.9% sequential revenue, +48.7% sequential operating income. Entered next-gen ASIC supply at 20%+ share (up from <10% prior-gen) — a material share-gain story. TU-953Q M9Q product qualified for Vera Rubin mid-plane applications; qualified supplier for AWS Trainium 2/2.5/3 alongside Panasonic and EMC; ~16.3% global share of high-speed CCL revenue (Prismark 2023). Capacity expanding from 2.3m sheets/month to 2.6m by Q2 2026, with a path to 3.2m by 2027 via Thailand ramp. Strong position in AI server power board CCL — an under-appreciated growth vector for PSU / DC-DC / HVDC subsystems. Smaller absolute size than EMC means higher earnings beta on the same revenue impulse. The "highest beta, cleanest exposure" play.

Note on ITEQ. ITEQ deserves recognition as a high-quality #4 — M9-grade Nvidia certified, Thailand 800G switch CCL ramp, 1.6T switch and CPO shipments accelerating from November 2025. The reason it ranks below TUC is principally the technology pillar: TUC's M9Q is a more advanced sub-grade qualified specifically for Rubin mid-plane, and TUC has explicit AWS Trainium 2/2.5/3 design-in alongside EMC and Panasonic. ITEQ is a strong second-tier pure-play and likely sees comparable share-price impact in absolute terms.

LIGHTHOUSE CANTON

Singapore

16 Collyer Quay #11-02
Collyer Quay Centre
Singapore 049318

☎ +65 67130570

India

Unit No-104A, Worldmark
2 Asset Delhi Aerocity,
New Delhi 110037

☎ +91 9650473961

Unit No 507/508, A Wing,
INS Tower, G Block, BKC,
Mumbai- 400051

☎ +91 9650473961

UAE

The Exchange Gate Village 11,
Unit 802 Dubai International
Financial Centre PO Box 507026
Dubai, UAE

☎ +971 45 861500

1st Floor, WeWork37,
Cunningham Cross Rd,
SRT Road Vasant Nagar,
Bengaluru-560001

☎ +91 9900096873

RK Swamy Centre, Hansa
Building, Door No:3, Thousand
Lights,
Chennai-600006

☎ +91 9650473961

UK

24 Hanover Square,
London W1S 1JD

☎ +44 164 2843 487

Suite 502, Building 450, Central
Plaza, Genome Valley,
Shameerpet,
Hyderabad 500 078

☎ +91 9650473961

Unit No FF-10, FF Floor, Pragya
Accelerator, Block 15T GIFT CITY,
Gandhinagar
Gujarat-382355

☎ +91 9650473961

✉ info@lighthouse-canton.com

🏢 Lighthouse Canton

DISCLAIMER

The contents of this document are confidential and are meant for the intended recipient only. If you are not the intended recipient, please delete all copies of this document and notify the sender immediately.

This document, provided as a general commentary, is for informational purposes only and is not to be construed as an offer to sell or solicit an offer to buy any financial instruments in any jurisdiction. This does not constitute any form of regulated financial advice, and your independent financial advisor should be consulted prior to taking any investment decision(s).

This document is based on information from Sources which are reliable but has not been independently verified by Lighthouse Canton Pte Ltd and its affiliate companies ("LC"). LC has taken the reasonable steps to verify the contents of this document and accept no liability for any loss arising from the use of any information contained herein. Please also note that past performances are not indicative of future performance.

Information contained herein are those of the author(s) and does not represent the views held by other parties. LC is also under no obligation to update you on any changes made to this document.

This document is prepared by Lighthouse Canton Pte Ltd and its affiliate company, Lighthouse Canton Capital (DIFC) Pte Ltd, which are regulated by Monetary Authority of Singapore ("MAS") and Dubai Financial Services Authority ("DFSA") respectively. MAS and DFSA has no responsibility for reviewing, verifying and approving the contents of this document and/or other associated documents. The contents of this document may not be reproduced or referenced, either in part or in full, without prior written permission from LC.

This document is confidential and is only intended for Accredited Investors and/or Professional Clients, as defined by MAS and DFSA.