PCB, CCL and Substrate

PTFE in NVL576 switch tray, but high-speed CCL upgrade roadmap unchanged

We have recently received many inquiries on the Rubin Ultra PCB material spec, including the potential adoption of PTFE. We believe Nvidia is exploring many material and technology options with the goal of reaching an outstanding electrical performance standard (Df 0.0004 or below), and PTFE is among the options due to its excellent low-loss performance. However, we still see a number of technical issues due to the uncertainties fueled by the many possibilities for material and board manufacturing, which could swing sentiment or trading multiples for many CCL, PCB and upstream materials vendors in the coming years.

- **All about electrical performance: New technology could be introduced by Rubin Ultra.** For months, several CCL vendors have been submitting M10 samples with the goal of achieving the electrical performance required by several extreme connectivity projects, such as Backplane and NVL576 switch board. The majority of the efforts fell a bit short (0.00043-45) vs. the loss target (Df 0.0004 or below). The only M10 samples that came very close (within 5%) were the laminate-only version (aka glass-less, as glass is removed from the CCL), which improves loss performance, but at the expense of structural strength (see Figures 1 and 2). We believe some efforts in technology development are now directed toward hybrid materials, which consist of PTFE (which could achieve 0.0003-0.0004 Df) and glass-less M10. M10/PTFE hybrid (vs. full PTFE) is utilized for the Rubin Ultra due to: (1) the lack of a sufficient high-temp laminator, which is required for pure PTFE stack-up; and (2) better drilling performance with the incorporation of M10 materials.
- **Glass-less, a new approach, potentially with M10 in Rubin Ultra.** In theory, the glass-less material allows the best electrical performance, as glass material is inferior in signal transmission (see Table 1). However, as glass offers the essential mechanical support to the board structure, we believe full-glass adoption could be challenging and that the more probable approach for Rubin Ultra NVL576 is a hybrid solution: glass-less M10 to improve electrical performance, combined with PTFE that retains glass for mechanical support. Meanwhile, low-loss requirements in AI servers are escalating, and progressive approaches (full glass-less PTFE) could also be considered for some extreme-connectivity projects in the longer term. We have seen full glass-less designs utilized on some flexible and substrate boards, which require some mechanical components to provide extra structural support. However, switch boards are larger, and the decreased glass content poses key challenges, including metal-to-laminate attachment and limited supply chain experience. We therefore believe it is too early to conclude that the glass-less options can overcome all challenges, despite the unmatched electrical performance. Outstanding issues include high-voltage sustainability and hole drilling in soft materials, and further adjustments may be required.
- **Sizing up the market/adoption outlook.** If the mechanical and processability issues are resolved, we expect that such an M10/PTFE hybrid could be adopted for the switch tray board for the NVL576 design (8-rack cluster) for Rubin Ultra. Meanwhile, the single-rack format should remain M8, even for Rubin Ultra. Eventually, if barriers such as drilling and PTFE lamination capacity can be overcome by Feynman, we could see the full-PTFE version become one of the options (NV Link switch boards in the multi-cluster design, as well as the

Technology

Jerry Tsai [AC]
(886-2) 2725-9867
jerry.tsai@jpmorgan.com
J.P. Morgan Securities (Taiwan) Limited

Parsley Ong [AC]
(65) 6882-8578
parsley.rh.ong@jpmorgan.com
J.P. Morgan Securities Singapore Private Limited/ J.P. Morgan Securities (Asia Pacific) Limited/ J.P. Morgan Broking (Hong Kong) Limited

Mio Shikanai [AC]
(81-3) 6736 1313
mio.shikanai@jpmorgan.com
JPMorgan Securities Japan Co., Ltd.

Cherry Liu
(86-21) 6106-6200
ye.liu@jpmorgan.com
SAC Registration Number: S1730521090001
J.P. Morgan Securities (China) Company Limited

Josie Yu
(886-2) 2725-9877
josie.yu@jpmorgan.com
J.P. Morgan Securities (Taiwan) Limited

Gokul Hariharan
(852) 2800-8564
gokul.hariharan@jpmorgan.com
J.P. Morgan Securities (Asia Pacific) Limited/ J.P. Morgan Broking (Hong Kong) Limited

See page 6 for analyst certification and important disclosures, including non-US analyst disclosures.

Backplane, if the Kyber structure is ready by then. By Feynman, M11 is potentially another choice, but the performance is hard to gauge, as the resin recipe is an unknown to us at this point (there are limitations to the hydrocarbon material that M9/10 are based on). To size up the PTFE market during the Rubin Ultra generation: Assuming 20% of GPUs are utilized in NVL576 would drive ~US$400mn for CCL values (can be divided roughly 50-50 for PTFE and M10). The material market size could be a lot larger, as the board yield is still a work-in-progress (there is a high probability that it will not reach 50%, even by the time of mass production in late 2027). If the glass is removed, ASPs would be 20%+ below that of the typical CCL material, but margins should be higher (60% or so vs. 50%, per JPMe).

- **Implications for CCL and EMC (2383 TT, OW).** We reiterate our positive view on the high-speed CCL industry, which we believe is still one of the fastest-growing industries under accelerated data transmission requirement. While PTFE could be utilized in advanced AI cluster design (NVL576's switch board and backplane), the main boards in mainstream Nvidia server design (compute and switch boards in NVL72 rack) should stick with M8+ CCL material for the next two to three years. The PTFE discussion confirms our belief that CCL material upgrade is accelerating, as we see potential for compute tray/switch tray/midplane (in NVL72) to upgrade from M8+ to M9 and even M10 in Rubin Ultra or Feynman generations. For EMC (2383 TT, covered by Jerry Tsai), the potential PTFE impact is less than 3% of 2027E total revenue (JPMe). The stock could see volatility on PTFE and M10's update from Nvidia in the coming months, as we expect Rubin Ultra's CCL spec to be finalized in 1Q/2Q27 (one to two quarters before mass production in 2H27). However, we note that: (1) the company is still the top beneficiary of the accelerated CCL upgrade trend, with a dominant market share across the high-end CCL space (EMC holds 70%+/90%+ market share in M8/M9, while we are also positive on its position in M10). Meanwhile, EMC has enough resources to develop M11 while simultaneously developing a strong PTFE product portfolio (if needed), given its significant size and resources. The current major global PTFE vendors include Shenyi Technology (600183 CH, NC), Rogers (ROG US, NC) and Taiflex (8039 TT, NC).
- **NPC (1303 TT, OW): Relatively well positioned within the Taiwan PCB chain.** NPC's (1303 TT, covered by Parsley Ong) fully integrated model allows it to flexibly alter formulas to meet customer requirements, and we believe the company remains in a strong position to win new M8-M9 orders in 2H26-2027, which presents upside risk to our estimates. Based on our understanding, both of NPC's M10 formulas include glass cloth and are epoxy-based. As such, if Nvidia were to opt for PTFE, NPC's M10 formula might have to be modified further to meet customer requirements. NPC previously noted that its lab test results for both formulas are "very good," and, unlike most other Taiwanese CCL companies, NPC has a track record of producing low-Df PTFE CCL, although this has not been the main product for the company due to its high costs and processing difficulties/low board yield. A majority of NPC's CCL margin improvement over the next two years should come from winning M7-M8 orders from large hyperscalers, and we view an M10 order win as a pleasant upside optionality, if it happens. NPC is also commissioning new copper foil capacity that might benefit from rising adoption of high-end copper foil, in addition to a rapidly improving CCL product mix (JPMe AI-grade CCL >50% of revenue mix by 2028 vs. <10% in 2025) and glass cloth. We raised our Dec-27 PT to NT$350 and forecast ROE rising above 40% by 2027 (link).
- **Nittobo (3110 JT, OW): Sales expansion continues, primarily in T and NER.** With the potential for broader adoption of NER glass cloth in M8 and M9, we expect Nittobo (3110 JT, covered by Mio Shikanai) to push back adoption of NEZ, which it had been developing as a next-generation product. Accordingly, the company has postponed the launch timing of NEZ to 2028E (previously as early as end-2027E). We also believe that, even in PTFE-based solutions, the prevailing approach will be to use NE/NER glass cloth to enhance stiffness and mechanical strength; therefore, even if a glass-less approach

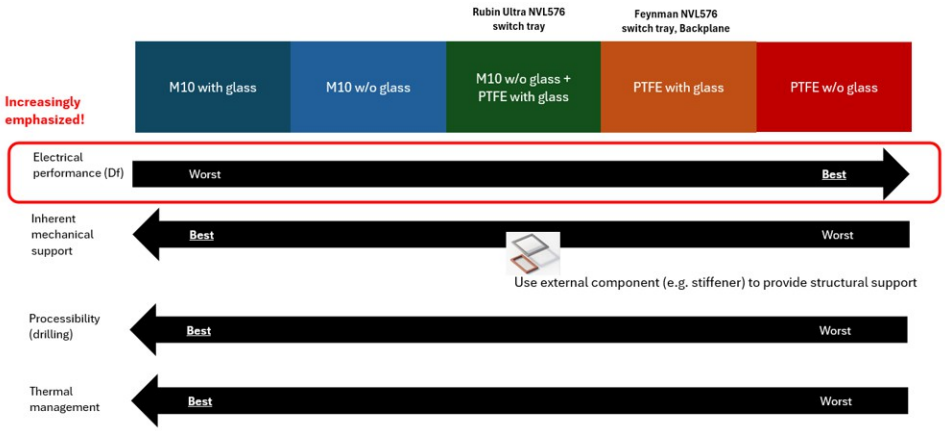


Jerry Tsai [AC]
(886-2) 2725-9867
jerry.tsai@jpmorgan.com

were to emerge, the direct impact on Nittobo's earnings would be limited. Nittobo is expanding NER capacity to prepare for a growing TAM (we estimate that the company is planning a ~60-70% YoY capacity increase from FY26-end to FY27-end), which should help it maintain its leading market position and support continued revenue growth. That said, barriers to entry appear somewhat lower than for T-glass, so we will continue to monitor pricing dynamics (our understanding is that the company is not currently pushing for a price hike), as well as the development and commercialization timing of next-generation glass.

- **VGT (2476 HK, OW): Benefits from rising PCB fabrication complexity.** While the debate around new solutions continues, VGT (2476 HK, covered by Cherry Liu) observed a stronger order outlook into 2027 and plans to accelerate its capacity expansion, bringing the target of Rmb100bn annual value-output one year ahead, to end-2027E. As Nvidia platforms continue to evolve, we expect PCB content value to rise significantly, driven not only by the adoption of higher-end materials, but also by increasingly complex manufacturing processes. Against this backdrop, capacity scale and proven high-volume delivery capabilities should remain key determinants of wallet share. In addition, we believe the close collaboration between existing AI PCB vendors and Nvidia should continue to stack technology moat from rapid material/spec migration (link).

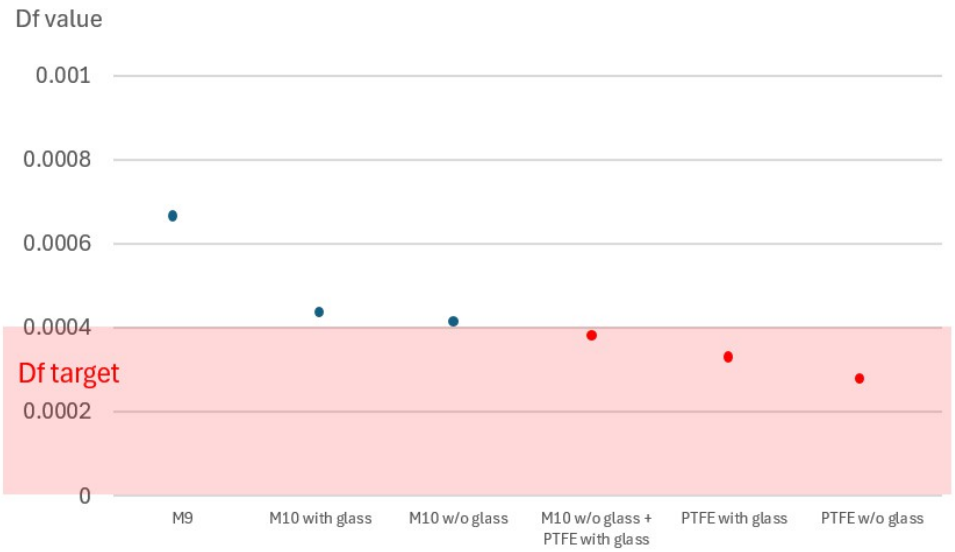
Figure 1: Nvidia project CCL resin material migration



Source: J.P. Morgan, Jentech.

Jerry Tsai [AC]
(886-2) 2725-9867
jerry.tsai@jpmorgan.com

Figure 2: CCL resin material comparison: Best electrical performance achieved so far



Source: J.P. Morgan estimates.

Table 1: Upstream material: Overall comparison

	Electrical performance	Inherent mechanical support	Processibility (drilling)	Thermal management
Glass fiber (E/low-Dk/T glass)	Worst	Best	Best	Best
M series CCL material (PPO/Hydrocarbon/BCB)	Moderate	Moderate	Moderate	Moderate
PTFE	Best	Worst	Worst	Worst

Source: J.P. Morgan estimates.

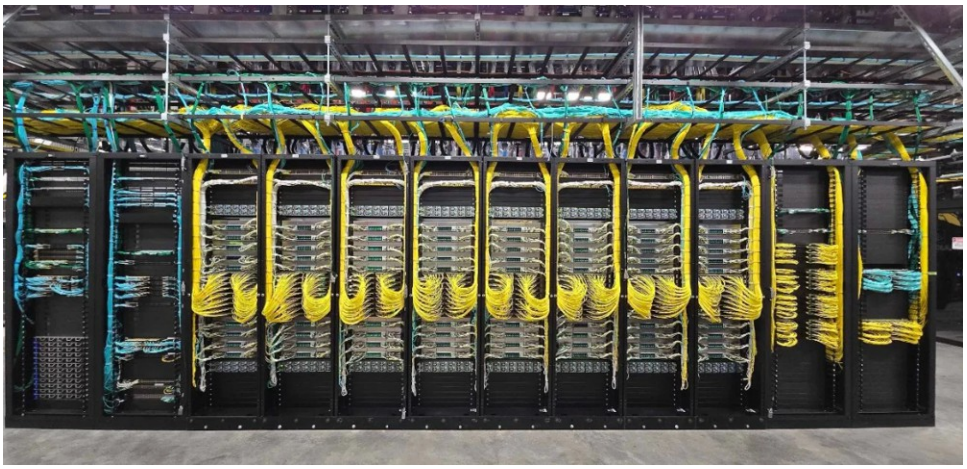
Table 2: Scenario analysis: PTFE impact on Rubin Ultra CCL TAM

Rubin Ultra	Scen 1	Scen 2	Scen 3
Chip shipment (whole gen) (mn)	10	10	10
# rack (NVL72) (K)	139	139	139
NVL576 penetration (%)	10%	20%	40%
# rack for NVL576 cluster (K)	14	28	56
Switch tray per rack	18	18	18
# switch tray for NVL576 (K)	**250**	**500**	**1,000**
1 CCL sheet can cut into xxx layers	6	6	6
Layers required per board	16	16	16
# CCL sheet required per tray	**2.7**	**2.7**	**2.7**
ASP per CCL sheet (US$)	**300**	**300**	**300**
NVL576 Switch Tray CCL TAM (US$mn)	**200**	**400**	**800**
PTFE TAM (US$mn)	100	200	400
PTFE impact of RBUltra CCL TAM	2%	5%	9%

Source: J.P. Morgan estimates.

Jerry Tsai [AC]
(886-2) 2725-9867
jerry.tsai@jpmorgan.com

Figure 3: Nvidia NVL576 rack



Source: Company data.

Table 3: Valuation comparison: CCL/upstream material

Industry	Company	Ticker	Price (LCY$)	PE (x)			PB (x)			NI yoy (%)			ROE (%)		
				2025	2026E	2027E	2025	2026E	2027E	2025	2026E	2027E	2025	2026E	2027E
CCL upstream material															
	Nitto Boseki Co	3110 JP	3,145	14	30	4	3	3	1	225%	-55%	46%	28%	10%	13%
	Taiwan Glass Ind	4958 TT	61	N.A.	29	16	1	N.A.	N.A.	N.A.	N.A.	84%	-1%	11%	17%
	Fulltech Fiber	4958 TT	129	99	27	17	N.A.	N.A.	N.A.	978%	307%	62%	N.A.	20%	27%
	Nan Ya Plastics	1303 TT	235	412	21	13	5	5	4	35%	1820%	62%	1%	24%	35%
	Co-Tech Devt	8358 TT	526	124	50	22	18	14	10	16%	128%	126%	15%	27%	42%
	Mitsui Kinzoku C	5706 JP	28,825	22	18	16	4	3	3	17%	19%	12%	N.A.	20%	19%
	Furukawa Elect	5801 JP	3,858	52	26	20	7	5	4	58%	94%	31%	N.A.	22%	23%
	Shengyi Tech C-A	600183 CH	144	100	53	35	20	16	13	103%	95%	52%	21%	35%	43%
CCL															
	Elite Material	2383 TT	5,640	135	50	26	40	28	16	55%	172%	91%	34%	65%	77%
	ITEQ	6213 TT	550	137	36	19	10	8	6	78%	269%	85%	7%	23%	33%
	Taiwan Union	6274 TT	1,450	118	39	19	25	15	9	34%	211%	104%	22%	45%	59%
	Shengyi Tech C-A	600183 CH	144	100	53	35	20	16	13	103%	95%	52%	21%	35%	43%
	Nan Ya Plastics	1303 TT	235	412	21	13	5	5	4	35.3%	1820%	62%	1.3%	24%	35%
	Doosan Co Ltd	000150 KS	1,191,000	106	39	22	15	10	8	N.A.	167%	67%	10%	26%	29%
	CCL average				40	23		14	9		456%	77%		36%	46%

Source: J.P. Morgan estimates, Company data, Bloomberg Finance L.P. Share prices are as of 1 September 2026. For J.P.Morgan covered names Nitto Boseki (3110 JP, covered by Mio Shikanai), Nan Ya Plastics (1303 TT, covered by Parsley Ong) and EMC (2383 TT, covered by Jerry Tsai), forward financials are based on J.P.Morgan estimates. For the rest of the companies, forward estimates are based on Bloomberg Finance L.P.