Scope

50um Al and 70um Cu LMT tapes were thermode soldered to corresponding sites on PP1-W & PP1-N boards, the tapes had a plated gold thickness of 0.2 & 0.4 um (nominal)
The objectives of the tests was to show that reducing the gold thickness reduced the amount of gold tin intermetallic componds formed and led to stronger joints
and also investigate simpler altenatives.

Results

Dwell varied for experiments, all other settings remain constant unless otherwise stated

Test 1 KAPTON/Al/Ni/AU soldered to Cu/SnPb/FR4

Machine settings: Pre-heat 60'C/2s, Ramp 2s, Dwell Varies, Cool to 60'C, P=4

Sample No.	Nominal Gold Thickness	Temperature	Dwell	Pressure	Peel strengths at each tape site on Patch Panels (g)											Average
8	0.2um	300'C	10s	4	742	696	586	898	841	640	739	692	754	480	392	678
1	0.2um	350'C	5s	4	997	913	749	1196	1023	905	998	935	815			948
5	0.2um	350'C	7.5s	4	1340	1017	904	1192	1182	1073	1015	1342	1103	1003	1053	902	1094
7	0.2um	350'C	10s	4	1418	1137	1268	1360	1057	1257	1132	1123	1338	1148	1592	1209	1253
3	0.4um	350'C	5s	4	509	690	438	346	911	401	381	497	418	761	705		551
4	0.4um	350'C	7.5s	4	479	524	317	594	373	455	368	440	568	487	389		454
6	0.4um	350'C	10s	4	475	755	530	490	620	625	487	608	546	552	633		575
2	0.4um	300'C	7.5s	4	354	297	271	82	264	214	158	187	656	126	77		244
9	0.4um	300'C	10s	4	267	464	275	292	306	286	285	189	452	468	616		355

Test 2 KAPTON/Cu/Ni/AU soldered to Cu/SnPb/FR4

Machine settings: Pre-heat 60'C/2s, Ramp 2s, Dwell Varies, Cool to 60'C, P=4

10	0.2um	350'C	10s	4	172	129	104	144	104	100	120	112	131	114	119	122	123
11	0.4um	350'c	10s	4	37	0	30	28	11	36	30	31	36	37	22		27

Test 3 KAPTON/Cu/Ni/SnPb soldered to Cu/SnPb/FR4 (Au stripped with solder, solder cleaned off)

Machine settings: Pre-heat 60'C/2s, Ramp 2s, Dwell Varies, Cool to 60'C, P=4

12	N/A	350'c	10s	4	2427	2329	1203	1719	1867	2272	1342	1708	1288	1677	1517	2104	1788

Test 4 KAPTON/Cu soldered to Cu/SnPb/FR4

Machine settings: Pre-heat 60'C/2s, Ramp 2s, Dwell Varies, Cool to 60'C, P=4

13		300'C	15	4	675	1186	1121	1382	1117								
		350'C	10							2591	3000	3000	3000	2365	2838	3000	2106

Test 5 KAPTON/Al/Ni/SnPb soldered to Cu/SnPb/FR4 (Au stripped with solder, solder cleaned off)

Machine settings: Pre-heat 60'C/2s, Ramp 2s, Dwell Varies, Cool to 60'C, P=4

14	Thin gold stripp	350'C	10	4	2245	2348	1934	1620	2105	1900	1881						
		No fresh flux										2298	1587	1637	1725		1935

Conclusions

Strongest joints are achieved soldering directly to copper or where Al is required Ni plating on Al. (see 12 &13)
Gold is a problem since to much causes weak joints due to the formation of intermetillic compounds
Control of gold thickness is obviously difficult for the supplier
Porous or thin gold allows the Ni to oxidise resulting in very poor joint strengths.

Recommendation

Providing that we are not forming any galvanic cells which could corrode in the presence of moisture
we should switch to a SnPb coating over the Cu and Al/Ni.
It is important that the SnPb is fused to render it prevent oxidation of the underlying layers.

Test 6 KAPTON/Al/Ni/SnPb soldered to Cu/SnPb/FR4 (Au stripped with solder, solder cleaned off)

Machine settings: Pre-heat 180'C/5s, Ramp 9s, Dwell varies, Cool to 180'C, P=4

15 Thin gold stripp	300'C	20	4	1938	1884	2257	1507	2553							
	300'C	10							2059	2468	1999	1924	1866	2394	2077

Conclusion

Results compare well with others achieved at higher temperaure. Increasing the pre-heat temperature is the key.

Recommendation

Repeat with gold coated tapes
Repeat at lower temeprature e.g. 280'C

Test 7 KAPTON/Al/Ni/SnPb soldered to Cu/SnPb/FR4 (Electroplated with solder)

Machine settings: Pre-heat 180'C/9s, Ramp 9s, Dwell varies, Cool to 180'C, P=4

16	300'C	15s	4	1364											
	300'C	15s	4		1633										
	280'C	15s	4			1355									
	280'C	15s	4				1814								
	260'C	15s	4					1930							
	260'C	15s	4						1471						
	240'C	15s	4							1782					
	240'C	15s	4								1377				
	240'C	30s	4									1753			
	240'C	30s	4										1051		
	220'C	30s	4											Fell off before it could be peeled	
	220'C	30s	4												617

Conclusion

By increasing the preheat temperature and time (180'C/9s) a wide processing window can be used from 350'C/15s (earlier results, no damage to KAPTON) to 240'C/15s,
from the lower limits of this boundary time and temperature can be increased until the upper limit is reached.
See below-

	350'C	300'C	280'C	260'C	240'C	220'c
30 s	Possible Kapton damage	Tested	Inferred	Inferred	Tested	Tested
15s	Tested	Tested	Tested	Tested	Tested	Tested
10s	Inferred	Tested	Tested	Probably OK	Inferred	Inferred

Key-		
	Good	Tested means that there are hard results to back up the settings
	Borderline	Inferred means you can assume the settings work because of tested results above, below or beside
	Poor	

Note the failure mode was at the Al/KAPTON interface, I expected the results to be higher than the earlier samples I stripped the gold from and tinned.

Recommendation

If possible repeat with a larger number of samples

Check whether the adhesion of the Al to KAPTON has been compromised somehow during plating e.g. by higher bath temperatures.