

APPENDIX 1

Process Flow 1: Monolithically Integrated Laser and Modulator

STEP	FUNCTION	DESCRIPTION	Wafer/Bar/Die	Next Step
1	Clean	incom. wafer clean	WAFER	2
2	Incoming_Inspection	Incoming Inspection	WAFER	3
3	MOCVD	70nm InGaAsP (1.25) on InP	WAFER	4
		6.7nm InGaAsP (1.55) and 15.1nm	WAFER	
4	MOCVD	InGaAsP (1.25) on InP		6
5	MOCVD	70nm InGaAsP (1.25) on InP	WAFER	6
6	PL_Test	Post Depositn	WAFER	7
7	PECVD	100nm SiN	WAFER	8
8	HMDS	HMDS Prime	WAFER	9
9	SpinOn_Resist	1.5 micron Polyimide	WAFER	10
10	Prebake	Prebake PMMA	WAFER	11
11	Litho	Lithography	WAFER	12
12	Develop	Develops PMMA	WAFER	13
13	Postbake	Postbake PMMA	WAFER	14
14	Plasma_Etch	100nm PECVD SiN	WAFER	15
15	Asher	Ash 500nm PMMA	WAFER	16
16	Visual_Test	Post Ash Visual	WAFER	17
17	RIBE	256nm InGaAsP	WAFER	18
18	PL_Test	Autom. Inspectn	WAFER	19
19	MOCVD	50 nm InGaAsP (1.10) on InP	WAFER	20
		9.7nm InGaAsP (1.55) and 5.0nm	WAFER	
20	MOCVD	InGaAsP (1.10) on InP		21
21	MOCVD	50 nm InGaAsP (1.10) on InP	WAFER	22
22	Wet_Etch	100 nm PECVD SiN	WAFER	23
23	Spin_Dry	-	WAFER	24
24	PECVD	100nm SiN	WAFER	25
25	HMDS	HMDS Prime	WAFER	26
26	SpinOn_Resist	1.5 micron Polyimide	WAFER	27
27	Prebake	Prebake PMMA	WAFER	28
28	Litho	Lithography	WAFER	29
29	Develop	Develops PMMA	WAFER	30
30	Postbake	Postbake PMMA	WAFER	31
31	Plasma_Etch	100nm PECVD SiN	WAFER	32
32	Asher	Ash 500nm PMMA	WAFER	33
33	RIBE	114nm InGaAsP	WAFER	34
34	Wet_Etch	100 nm PECVD SiN	WAFER	35
35	Spin_Dry	-	WAFER	36
36	Descum	Pre-epi surface clean	WAFER	37
37	MOCVD	120nm Undoped InP Overgrowth	WAFER	38
38	MOCVD	1000nm p-type InP	WAFER	39
39	PECVD	1000nm SiN	WAFER	40
40	HMDS	HMDS Prime	WAFER	41
41	SpinOn_Resist	1.5 micron Polyimide	WAFER	42
42	Prebake	Prebake PMMA	WAFER	43
43	Litho	Lithography	WAFER	44
44	Develop	Develops PMMA	WAFER	45

45	Postbake	Postbake PMMA	WAFER	46
46	Plasma_Etch	1000nm PECVD SiN	WAFER	47
47	RIBE	1000nm InP	WAFER	48
48	Asher	Ash 500nm PMMA	WAFER	49
49	Wet_Etch	1000 nm PECVD SiN	WAFER	50
50	Spin_Dry	-	WAFER	51
51	SpinOn_Resist	1.5 micron Polyimide	WAFER	52
52	Cure	Polyimide Cure	WAFER	53
53	RIBE	500nm Polyimide	WAFER	54
54	PECVD	100nm SiN	WAFER	55
55	HMDS	HMDS Prime	WAFER	56
56	SpinOn_Resist	1.5 micron Polyimide	WAFER	57
57	Prebake	Prebake PMMA	WAFER	58
58	Litho	Lithography	WAFER	59
59	Develop	Develops PMMA	WAFER	60
60	Postbake	Postbake PMMA	WAFER	61
61	Plasma_Etch	100nm PECVD SiN	WAFER	62
62	RIBE	1000nm InP	WAFER	63
63	Hion_Implant	1 micron deep H2 Isol. betw. Mod. and laser	WAFER	64
64	Asher	Ash 500nm PMMA	WAFER	65
65	Wet_Etch	100 nm PECVD SiN	WAFER	66
66	Spin_Dry	-	WAFER	67
67	Anneal	Post Implant	WAFER	68
68	Descum	Pre-epi surface clean	WAFER	69
69	Litho	Photolithography	WAFER	70
70	Ebeam	20nm Ti/ 20nm Pt/ 300 nm Au	WAFER	71
71	Anneal	Anneal Ti/Pt/Au	WAFER	72
72	Metal_Liftoff	Strips AZ512	WAFER	73
73	Lapping	-	WAFER	74
74	Clean	post-lapping clean	WAFER	75
75	Spin_Dry	-	WAFER	76
76	Ebeam	25nm Ni/32.5nm Ge/150 nm Au	WAFER	77
77	Anneal	Anneal Ni/Ge/Au	WAFER	78
78	Wafer_Cleave	-	WAFER	79
79	Bar_Cleave	-	BAR	80
80	HR_Coating	-	DIE	81
81	AR_Coating	-	DIE	82
82	Isolated_Die_Test	Post Plant Transfer Test	DIE	83
83	Chip_Bond	COC	DIE	84
84	Cure	COC Epoxy Bond & Cure	DIE	85
85	Wirebond	COC	DIE	86
86	Visual_Test	Post-Wire bond	DIE	87
87	Burn_In	Burn In 1	DIE	88
88	EalacTest	-	DIE	89
89	Burn_In	Burn In 2+3	DIE	90
90	EalacTest	-	DIE	91
91	Visual_Test	Final COC Visual	DIE	92
92	Cooler_Assembly	-	DIE	93
93	Cooler_Assembly	-	DIE	94

94	Assembly_Test	Cooler Asmbly AC Test	DIE	95
95	Bench_Assembly	Sled Assembly	DIE	96
96	Bench_Attach	-	DIE	97
97	Wirebond	Assembly	DIE	98
98	Visual_Test	Assmbly Visual	DIE	99
99	Alignment	Alignmnt 1 -- Horizontal Welder	DIE	100
100	Alignment	Alignmnt 2 -- Horizontal Welder	DIE	101
101	Visual_Test	Pre-Lid Visual	DIE	102
102	Bake	Nitrogen Bake	DIE	103
103	Lidding	-	DIE	104
104	Package_Clean	Plasma Clean	DIE	105
105	Fiber_Attach	-	DIE	106
106	Sleeve_Attach	-	DIE	107
107	Assembly_Test	Post-Bake Test	DIE	108
108	Temp_Cycle	-	DIE	109
109	Assembly_Test	AC Resistance Test	DIE	110
110	Assembly_Test	Final Test	DIE	111
111	Assembly_Test	Special Test	DIE	END

Process Flow 2: Discrete Laser and Modulator in a Single Package

STEP	FUNCTION	DESCRIPTION	Wafer/Bar/Die	Next Step
1	Clean	incom. wafer clean	WAFER	2
2	Incoming_Inspection	Incoming Inspection	WAFER	3
3	MOCVD	70nm InGaAsP (1.25) on InP	WAFER	4
4	MOCVD	6.7nm InGaAsP (1.55) and 15.1nm InGaAsP (1.25) on InP	WAFER	5
5	MOCVD	70nm InGaAsP (1.25) on InP	WAFER	6
6	PL_Test	Post Depositn	WAFER	7
7	PECVD	100nm SiN	WAFER	8
8	HMDS	HMDS Prime	WAFER	9
9	SpinOn_Resist	1.5 micron Polyimide	WAFER	10
10	Prebake	Prebake PMMA	WAFER	11
11	Litho	Lithography	WAFER	12
12	Develop	Develops PMMA	WAFER	13
13	Postbake	Postbake PMMA	WAFER	14
14	Plasma_Etch	100nm PECVD SiN	WAFER	15
15	Asher	Ash 500nm PMMA	WAFER	16
16	RIBE	114nm InGaAsP	WAFER	17
17	Wet_Etch	100 nm PECVD SiN	WAFER	18
18	Spin_Dry	-	WAFER	19
19	Descum	Pre-epi surface clean	WAFER	20
20	MOCVD	120nm Undoped InP Overgrowth	WAFER	21
21	MOCVD	1000nm p-type InP	WAFER	22
22	PECVD	1000nm SiN	WAFER	23
23	HMDS	HMDS Prime	WAFER	24
24	SpinOn_Resist	1.5 micron Polyimide	WAFER	25
25	Prebake	Prebake PMMA	WAFER	26
26	Litho	Lithography	WAFER	27
27	Develop	Develops PMMA	WAFER	28
28	Postbake	Postbake PMMA	WAFER	29
29	Plasma_Etch	1000nm PECVD SiN	WAFER	30
30	RIBE	1000nm InP	WAFER	31
31	Asher	Ash 500nm PMMA	WAFER	32
32	Wet_Etch	1000 nm PECVD SiN	WAFER	33
33	Spin_Dry	-	WAFER	34
34	SpinOn_Resist	1.5 micron Polyimide	WAFER	35
35	Cure	Polyimide Cure	WAFER	36
36	RIBE	500nm Polyimide	WAFER	37
37	PECVD	100nm SiN	WAFER	38
38	HMDS	HMDS Prime	WAFER	39
39	SpinOn_Resist	1.5 micron Polyimide	WAFER	40
40	Prebake	Prebake PMMA	WAFER	41
41	Litho	Lithography	WAFER	42
42	Develop	Develops PMMA	WAFER	43
43	Postbake	Postbake PMMA	WAFER	44
44	Plasma_Etch	100nm PECVD SiN	WAFER	45
45	RIBE	1000nm InP	WAFER	46
46	Hion_Implant	1 micron deep H2 Isol. betw. Mod. and laser	WAFER	47

47	Asher	Ash 500nm PMMA	WAFER	48
48	Wet_Etch	100 nm PECVD SiN	WAFER	49
49	Spin_Dry	-	WAFER	50
50	Anneal	Post Implant	WAFER	51
51	Descum	Pre-epi surface clean	WAFER	52
52	Litho	Photolithography	WAFER	53
53	Ebeam	20nm Ti/ 20nm Pt/ 300 nm Au	WAFER	54
54	Anneal	Anneal Ti/Pt/Au	WAFER	55
55	Metal_Liftoff	Strips AZ512	WAFER	56
56	Lapping	-	WAFER	57
57	Clean	post-lapping clean	WAFER	58
58	Spin_Dry	-	WAFER	59
59	Ebeam	25nm Ni/32.5nm Ge/150 nm Au	WAFER	60
60	Anneal	Anneal Ni/Ge/Au	WAFER	61
61	Wafer_Cleave	-	BAR	62
62	Bar_Cleave	-	DIE	63
63	HR_Coating	-	DIE	64
64	AR_Coating	-	DIE	65
65	Isolated_Die_Test	Post Plant Transfer Test	DIE	66
66	Chip_Bond	COC	DIE	67
67	Cure	COC Epoxy Bond & Cure	DIE	68
68	Wirebond	COC	DIE	69
69	Visual_Test	Post-Wire bond	DIE	70
70	Burn_In	Burn In 1	DIE	71
71	EalacTest	-	DIE	72
72	Burn_In	Burn In 2+3	DIE	73
73	EalacTest	-	DIE	74
74	Visual_Test	Final COC Visual	DIE	75
75	Cooler_Assembly	-	DIE	76
76	Cooler_Assembly	-	DIE	77
77	Assembly_Test	Cooler Asmby AC Test	DIE	149
78	Clean	incom. wafer clean	WAFER	79
79	Incoming_Inspection	Incoming Inspection	WAFER	80
80	MOCVD	50 nm InGaAsP (1.10) on InP	WAFER	81
81	MOCVD	9.7nm InGaAsP (1.55) and 5.0nm InGaAsP (1.10) on InP	WAFER	82
82	MOCVD	50 nm InGaAsP (1.10) on InP	WAFER	83
83	PL_Test	Post Depositn	WAFER	84
84	HMDS	HMDS Prime	WAFER	85
85	SpinOn_Resist	1.5 micron Polyimide	WAFER	86
86	Prebake	Prebake PMMA	WAFER	87
87	Litho	Lithography	WAFER	88
88	Develop	Develops PMMA	WAFER	89
89	Postbake	Postbake PMMA	WAFER	90
90	Plasma_Etch	100nm PECVD SiN	WAFER	91
91	Asher	Ash 500nm PMMA	WAFER	92
92	RIBE	114nm InGaAsP	WAFER	93
93	Wet_Etch	100 nm PECVD SiN	WAFER	94
94	Spin_Dry	-	WAFER	95
95	Descum	Pre-epi surface clean	WAFER	96
96	MOCVD	120nm Undoped InP	WAFER	97

Overgrowth				
97	MOCVD	1000nm p-type InP	WAFER	98
98	PECVD	1000nm SiN	WAFER	99
99	HMDS	HMDS Prime	WAFER	100
100	SpinOn_Resist	1.5 micron Polyimide	WAFER	101
101	Prebake	Prebake PMMA	WAFER	102
102	Litho	Lithography	WAFER	103
103	Develop	Develops PMMA	WAFER	104
104	Postbake	Postbake PMMA	WAFER	105
105	Plasma_Etch	1000nm PECVD SiN	WAFER	106
106	RIBE	1000nm InP	WAFER	107
107	Asher	Ash 500nm PMMA	WAFER	108
108	Wet_Etch	1000 nm PECVD SiN	WAFER	109
109	Spin_Dry	-	WAFER	110
110	SpinOn_Resist	1.5 micron Polyimide	WAFER	111
111	Cure	Polyimide Cure	WAFER	112
112	RIBE	500nm Polyimide	WAFER	113
113	PECVD	100nm SiN	WAFER	114
114	HMDS	HMDS Prime	WAFER	115
115	SpinOn_Resist	1.5 micron Polyimide	WAFER	116
116	Prebake	Prebake PMMA	WAFER	117
117	Litho	Lithography	WAFER	118
118	Develop	Develops PMMA	WAFER	119
119	Postbake	Postbake PMMA	WAFER	120
120	Plasma_Etch	100nm PECVD SiN	WAFER	121
121	RIBE	1000nm InP	WAFER	122
122	Hion_Implant	1 micron deep H2 Isol. betw. Mod. and laser	WAFER	123
123	Asher	Ash 500nm PMMA	WAFER	124
124	Wet_Etch	100 nm PECVD SiN	WAFER	125
125	Spin_Dry	-	WAFER	126
126	Anneal	Post Implant	WAFER	127
127	Descum	Pre-epi surface clean	WAFER	128
128	Litho	Photolithography	WAFER	129
129	Ebeam	20nm Ti/ 20nm Pt/ 300 nm Au	WAFER	130
130	Anneal	Anneal Ti/Pt/Au	WAFER	131
131	Metal_Liftoff	Strips AZ512		132
132	Lapping	-	WAFER	133
133	Clean	post-lapping clean	WAFER	134
134	Spin_Dry	-	WAFER	135
135	Ebeam	25nm Ni/32.5nm Ge/150 nm Au	WAFER	136
136	Anneal	Anneal Ni/Ge/Au	WAFER	137
137	Wafer_Cleave	-	WAFER	138
138	Bar_Cleave	-	BAR	139
139	HR_Coating	-	DIE	140
140	AR_Coating	-	DIE	141
141	Isolated_Die_Test	Post Plant Transfer Test	DIE	142
142	Chip_Bond	COC	DIE	143
143	Cure	COC Epoxy Bond & Cure	DIE	144
144	Chip_Bond	COC	DIE	145
145	Wirebond	COC	DIE	146

146	Visual_Test	Post-Wire bond	DIE	147
147	Assembly_Test	Post-Bake Test	DIE	148
148	Visual_Test	Post-Wire bond	DIE	149
149	Bench_Assembly	Sled Assembly	DIE	150
150	Bench_Attach	-	DIE	151
151	Wirebond	Assembly	DIE	152
152	Visual_Test	Assmby Visual	DIE	153
153	Alignment	Alignmnt 1 -- Horizontal Welder	DIE	154
154	Alignment	Alignmnt 2 -- Horizontal Welder	DIE	155
155	Visual_Test	Pre-Lid Visual	DIE	156
156	Bake	Nitrogen Bake	DIE	157
157	Lidding	-	DIE	158
158	Package_Clean	Plasma Clean	DIE	159
159	Fiber_Attach	-	DIE	160
160	Sleeve_Attach	-	DIE	161
161	Assembly_Test	Post-Bake Test	DIE	162
162	Temp_Cycle	-	DIE	163
163	Assembly_Test	AC Resistnc Test	DIE	164
164	Assembly_Test	Final Test	DIE	165
165	Assembly_Test	Special Test	DIE	END