

Workflow for Outer Tracker Module construction activities

Module construction

9600 2S modules and **8100 [6600] PS modules**, with **8400 [6900] MaPSAs**. Numbers in brackets refer to the layout with the tilted TBPS.

Module assembly and quality control steps:

A) Mechanical assembly of PS module

Preparations for 10 modules (location A)

1. receive module components (20 spacers, 10 CF base plates, 40 hybrids, 10 s-sensors, 10 MAPSA assemblies), unpack, store (1h¹ tech)
2. visual inspection of all components (2h)
3. mechanical/dimensional test of all components (1h) probably need some simple jigs.
4. electrical test of hybrids (assume this was already done elsewhere)
5. electrical test of sensors (assume this was already done elsewhere)
6. glue HV connection to s-sensor (0.5h + 1 day to cure)
7. bond HV connection (1h bonder)
8. encapsulate wire bonds (0.5h + 1 day to cure)
9. glue readout hybrid support pieces
10. parylene coat the bridges (assume this was already done elsewhere)
11. HV electrical test of parylene coating (assume this was already done elsewhere)

This amounts to 5 hours + 1 bonder hour, requires a manual wire bonder.

Mechanical assembly of 10 modules in parallel (location A)

1. retrieve components for day (1h)
2. glue spacers to s-sensors (1h + 1 day to cure) (Jig 1)
3. glue MAPSA assembly to CF base plate (1h + 1 day to cure) (Jig 2)
4. glue s-sensor/spacer assembly to MAPSA/CF base plate assembly (1h + 1 day curing) (Jig 3)
5. check top-bottom sensor alignment (1h) – how?
6. glue service hybrids to CF base plate and thermistor to tab to top sensor (2h + 1 day to cure) (Jig 4)
7. glue readout hybrids to CF base plate (2h + 1 day to cure) (Jig 5)
8. attach s-sensor HV connection (0h)
9. package on carrier (need 10 carriers)

¹ Much of the workflow and time estimates are taken from A. Honma's talk from June 10, 2015

This amounts to 9 hours, requires 5 jigs, carriers, equipment to check alignment.

B) Wire bonding of 10 modules (location B)

1. unpack assemblies from carriers, inspect, store (1h)
2. put assembly on bonding jig and bond s-sensor to readout hybrids (2h) (Jig 6)
3. visual inspection of top side wire bonds (1h)
4. put on bonding jig and bond ROICs to readout hybrids (2h?) how many wire bonds per MPA chip? (Jig 7)
5. visual inspection of bottom side bonds (1h)
6. attach optical driver card, LV, HV and perform full electrical test (1h)
7. put on encapsulation jig and encapsulate top side wire bonds (1h + 1 day to cure) (Jig 8)
8. put on encapsulation jig and encapsulate bottom side wire bonds (1h + 1 day to cure) (Jig 9)
9. visual inspection of encapsulation (1h)
10. attach optical driver card, LV, HV and perform electrical retest (1h)
11. package on carrier

This amounts to 12 hours and requires automatic wire bonder, 4 jigs, a readout system, LV, HV supplies.

C) QC for 10 modules (Location C)

1. unpack modules from carriers, inspect, store (1h)
2. attach optical driver card, LV, HV and perform electrical retest (1h)
3. source/cosmic tests (1h)
4. cold tests (1h)
5. thermal cycling and electrical retests (1h)
6. mechanical precision measurements (1h)

This amounts to 6 hours. It requires a readout system, LV, HV supplies, cosmic ray telescope/rad source station with trigger, thermal cycling station.

Resources required

Task	10 modules	2000 modules	Person-days (6h)	FTE (200d)
Logistics				2.0
Preparation	6h	1200h	200	1.0
Mech. assembly	9h	1800h	300	1.5
Wire bonding	12h	2400h	400	2.0
QC	6h	1200h	200	1.0
Total	37h			8.2

Location A requires 4.5 FTE. Accounting for rework, holidays and illness this location requires about 3 people over 2 years.

Location B requires 2.0 FTE of which 1.5 FTE is a technician trained in operating the wire bonder. Accounting for rework, holidays and illness this location requires about 2 people over 2 years, one of them must be trained in wire bonding.

Location C requires 1 FTE. Accounting for rework, holidays and illness this location requires 1 person over 2 years.

In addition there should be one senior person at each location to supervise operation of the center.