

Z spacing of the barrel modules

Y. Unno, KEK

- **Requirements**

HV protection:

- **Separation of the adjacent module, 2.5 ~ 2.8 mm, which leaves 1.3 ~ 1.6 mm gap between the surfaces for the module thickness of 1.2 mm (in the edge area)**

- **Avoid aligning the sensor edge (HV) and the bonding pads area (GND), 4.1 mm width**

Hermetic coverage - +/- 2*sigma(interaction points)

Placement tolerance in z - +/- 100 μ m

Calculations

- **d = 2.8 mm**

Edge-to-edge barrel length

1486 mm

- **d = 2.5 mm**

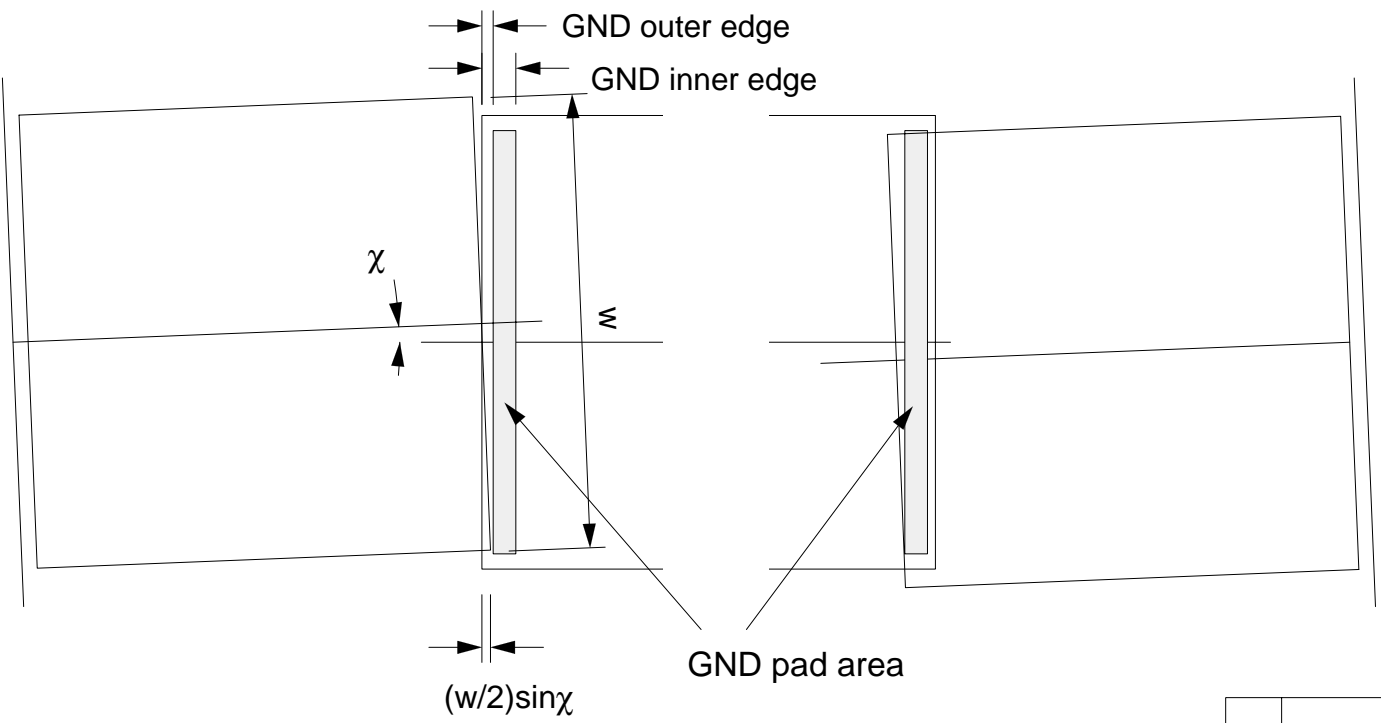
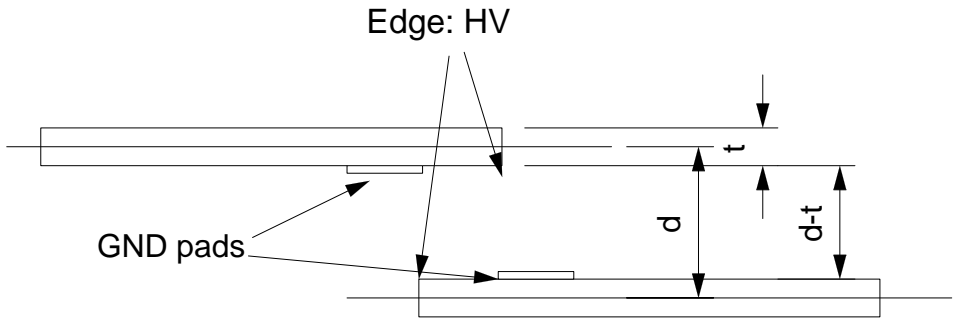
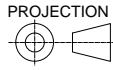
Edge-to-edge barrel length

1484 mm

Conclusion

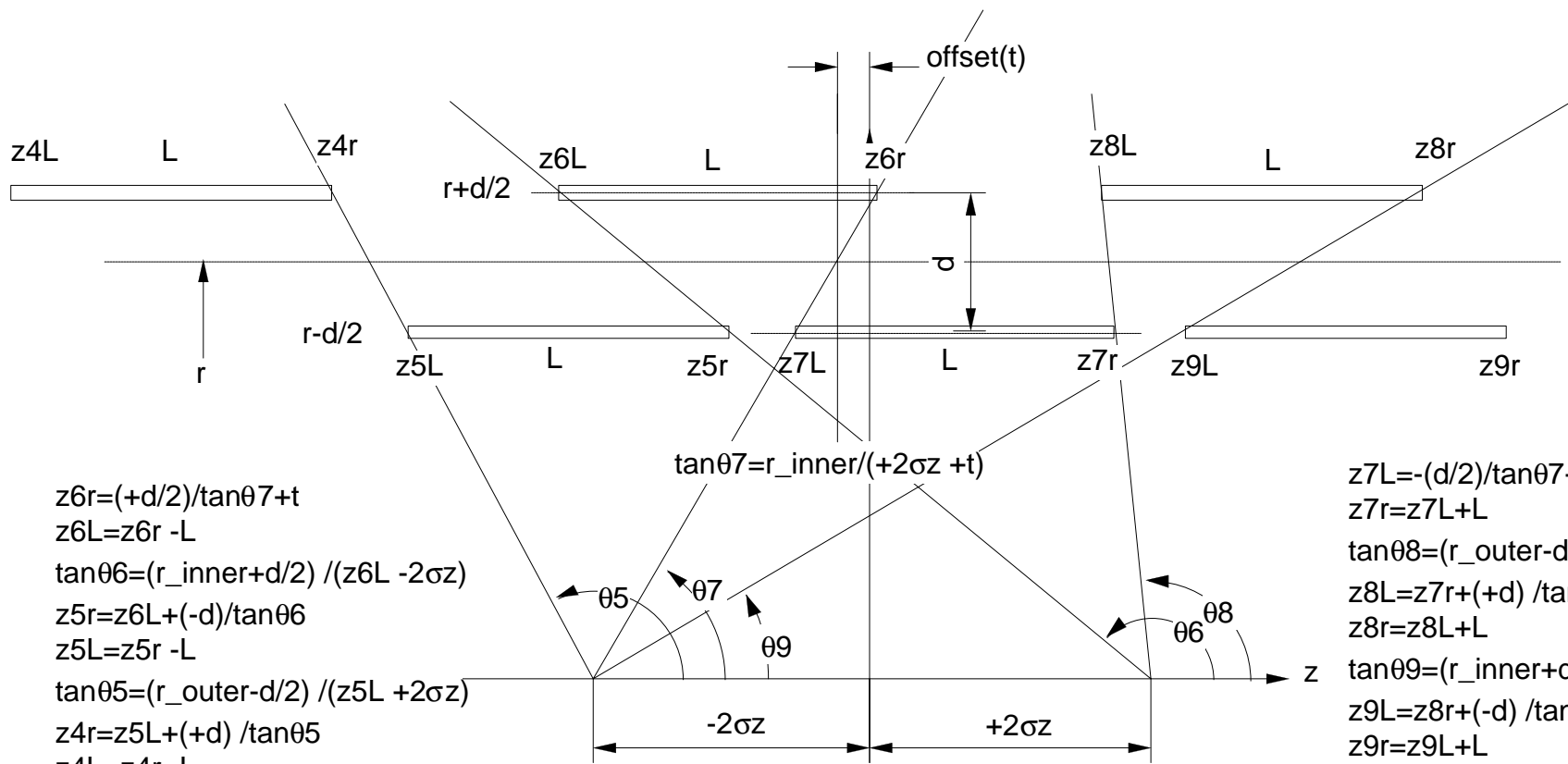
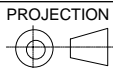
d = 2.8 mm separation

Edge-to-edge barrel length = 1486 mm



ITEM NO.	TITLE	MATERIAL	QUANTITY	REMARKS
DESIGNED Y. Unno	SCALE /	TITLE z spacing - stereo		
DRAWN	PAPER SIZE A4	DRAWING NO. BC001112-1700B		
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$$z6r = (+d/2) / \tan\theta7 + t$$

$$z6L = z6r - L$$

$$\tan\theta6 = (r_inner + d/2) / (z6L - 2\sigma_z)$$

$$z5r = z6L + (-d) / \tan\theta6$$

$$z5L = z5r - L$$

$$\tan\theta5 = (r_outer - d/2) / (z5L + 2\sigma_z)$$

$$z4r = z5L + (+d) / \tan\theta5$$

$$z4L = z4r - L$$

...

$$\tan\theta7 = r_inner / (+2\sigma_z + t)$$

$$z7L = -(d/2) / \tan\theta7 + t$$

$$z7r = z7L + L$$

$$\tan\theta8 = (r_outer - d/2) / (z7r - 2\sigma_z)$$

$$z8L = z7r + (+d) / \tan\theta8$$

$$z8r = z8L + L$$

$$\tan\theta9 = (r_inner + d/2) / (z8r + 2\sigma_z)$$

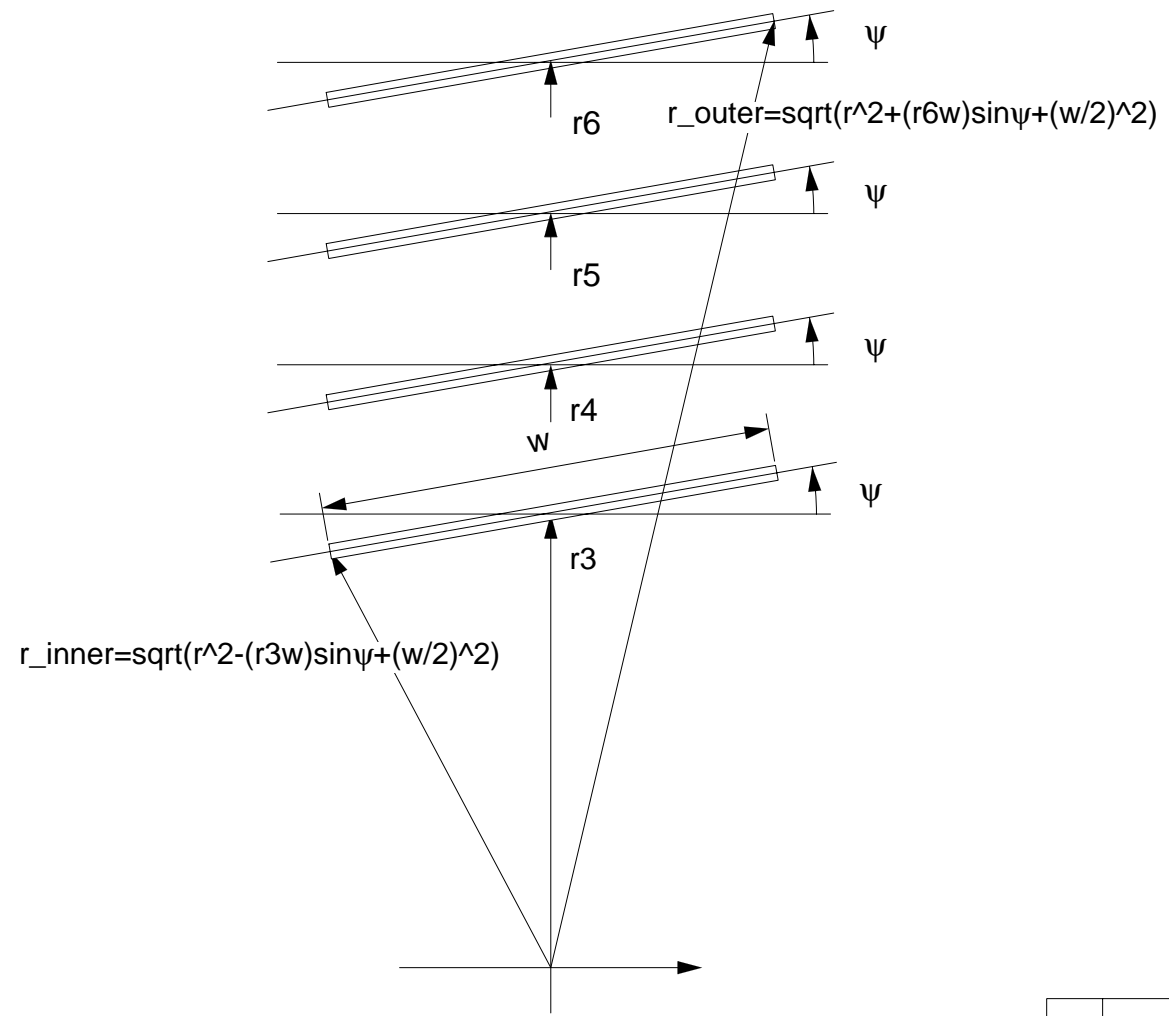
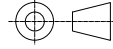
$$z9L = z8r + (-d) / \tan\theta9$$

$$z9r = z9L + L$$

...

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ITEM NO.	TITLE	MATERIAL	QUANTITY	REMARKS
DESIGNED Y. Unno	SCALE /	TITLE z spacing		
DRAWN	PAPER SIZE A4	DRAWING NO. BC001112-1428A		
CHECKED				



ITEM NO.	TITLE	MATERIAL	QUANTITY	REMARKS
DESIGNED Y. Unno	SCALE /	TITLE z spacing - tilt		
DRAWN	PAPER SIZE A4	DRAWING NO. BC001112-1800A		
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z-spacing calculation											
(cf. z-overlap figure (MiniCad) for "non-overlap" region spacing)											
Vertex s_z	56 mm										
Sensor:	Module:										
Full length	64 mm	Centre gap	0.09 mm								
Strip-edge	-1 mm	Full length	128.09 mm								
GND outer edge	-1.515	Z placement error	0.1 mm								
GND inner edge	-3.075	Non-overlap length	125.89 mm								
Cut-edge width	63.6 mm	Stereo angle	0.04 rad								
Strips width	61.44 mm	Cut-edge stereo half-width	1.2716608 mm	x>x2	x-x2>0						
		End stay-clear outer	0.2433392 mm	x<x1	x1-x>0						
		End stay-clear inner	4.3466608 mm								
				Mean radius [mm]							
Centre separation	2.8 mm	B3	299								
Offset	-1.583 mm	B4	371								
Radius inner	299 mm	Tilt	10 deg	B5	443						
Radius outer	514 mm	B6	514								
r_inner	295.21976 mm										
r_outer	520.21491 mm										
Module#	angle(left-ed up(+1) tan(theta_n)	down(-1)	HV-GND offset	non-overlap z_left [mm]	z_right [mm]	module z_centre [mm]	z_left [mm]	z_right [mm]	z-overlap	closeness	
1	-0.4663841	-1	0	-741.995	-616.105	-679.050	-743.095	-615.005	9.139	4.792	
2	-0.4035402	1	0	-623.044	-497.154	-560.099	-624.144	-496.054	0.133	0.111	
3	-1.3543029	-1	0	-495.086	-369.196	-432.141	-496.186	-368.096	6.786	2.439	
4	-0.6106027	1	2.892	-373.782	-247.892	-310.837	-374.882	-246.792	4.347	0.000	
5	-3.7584673	-1	0	-250.039	-124.149	-187.094	-251.139	-123.049	4.450	0.104	
6	-1.2442136	1	0.55	-126.399	-0.509	-63.454	-127.499	0.591	4.347	0.001	
7	2.6736803	-1	-0.55	-2.657	123.233	60.288	-3.757	124.333	4.346	0.000	
8	46.185124	1	-2.207	121.087	246.977	184.032	119.987	248.077	5.589	1.242	
9	0.8262918	-1	0	243.588	369.478	306.533	242.488	370.578	4.346	0.000	
10	2.0149845	1	-3.536	367.332	493.222	430.277	366.232	494.322	7.913	3.566	
11	0.4901008	-1	0	487.509	613.399	550.454	486.409	614.499	-0.506	0.749	
12	1.034735	1	0	616.105	741.995	679.050	615.005	743.095			
				offset				0.000			
Barrel length (Axial module egdge-edge)	1486.190 mm										

z-spacing calculation											
(cf. z-overlap figure (MiniCad) for "non-overlap" region spacing)											
Vertex s_z	56 mm										
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Cut-edge width	63.6 mm	Stereo angle	0.04 rad								
Strips width	61.44 mm	Cut-edge stereo half-width	1.2716608 mm	x>x2	x-x2>0						
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		End stay-clear inner	4.3466608 mm								
				Mean radius [mm]							
Centre separation	2.5 mm	B3	299								
Offset	-3.375 mm	B4	371								
Radius inner	299 mm	Tilt	10 deg	B5	443						
Radius outer	514 mm	B6	514								
r_inner	295.21976 mm										
r_outer	520.21491 mm										
	angle(left-ed up(+1)	HV-GND	non-overlap	module							
Module#	tan(theta_n	down(-1)	offset	z_left [mm]	z_right [mm]	z_centre [mm]	z_left [mm]	z_right [mm]	z-overlap	closeness	
1	-0.4674307	-1	0	-740.905	-615.015	-677.960	-742.005	-613.915	8.383	4.036	
2	-0.4043514	1	4.004	-621.198	-495.308	-558.253	-622.298	-494.208	4.347	0.000	
3	-1.3463683	-1	0	-497.455	-371.565	-434.510	-498.555	-370.465	6.312	1.966	
4	-0.6079214	1	2.821	-375.678	-249.788	-312.733	-376.778	-248.688	4.347	0.000	
5	-3.7086236	-1	0.121	-251.935	-126.045	-188.990	-253.035	-124.945	4.346	0.000	
6	-1.234308	1	0.614	-128.191	-2.301	-65.246	-129.291	-1.201	4.348	0.001	
7	2.7177883	-1	-0.614	-4.449	121.441	58.496	-5.549	122.541	4.347	0.000	
8	54.968882	1	-2.192	119.295	245.185	182.240	118.195	246.285	5.212	0.865	
9	0.8300184	-1	0	242.173	368.063	305.118	241.073	369.163	4.346	0.000	
10	2.0267114	1	-3.38	365.916	491.806	428.861	364.816	492.906	7.292	2.945	
11	0.4910016	-1	0	486.714	612.604	549.659	485.614	613.704	-0.212	0.455	
12	1.0366766	1	0	615.016	740.906	677.961	613.916	742.006			
				offset				0.000			
Barrel length (Axial module egdge-edge)	1484.011 mm										