SONY

IMX316 Cat Tree CEC AppNote

Cat Tree Cyclic Error Correction

Description

This document explains the procedure for calibrating the cyclic/wiggling error in IMX316 modules using cat tree environment

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Cat Tree Parts List

Table 1. Parts list of out line

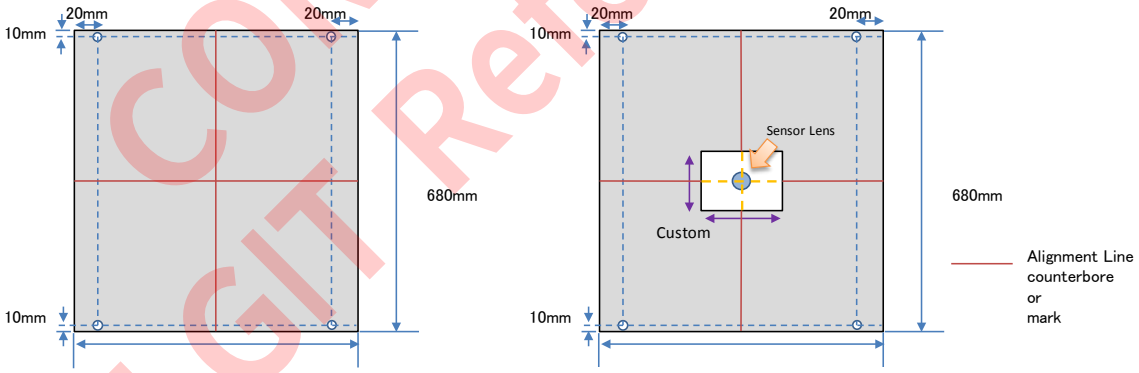
Item	P/N	Qty.
W20H20D1650 Al frame (black)	HFSB5-2020-1650	4
W20H20D880 Al frame (black)	HFSB5-2020-880	7
W20H20D640 Al frame (black)	HFSB5-2020-640	28
W20H20D310 Al frame (black)	HFSB5-2020-310	1
W20H20D220 Al frame (black)	HFSB5-2020-220	3
W20H20D180 Al frame (black)	HFSB5-2020-180	4
L shaped angle to fix Al frame	HBLFSNB5	100
Screw to fix Al frame	CSHHFP2-SUSTBS-M4-10	200
Nut to support screw for Al frame	PACK-SHNTP5-4	2set (100pcs/pack x 2)
Al frame end cap	HFC5-2020-B	8

Bottom plate and Top plate

Material：UNILATE　size : H:640 x V:680 x D:5mm *) Need a hole (size M4) for screw to fix with Al frame.

Top plate：Opening for camera module is needed. Size of opening will depend on capture system including camera module, capture board, socket, etc.

Fig. 1. Bottom and top plate

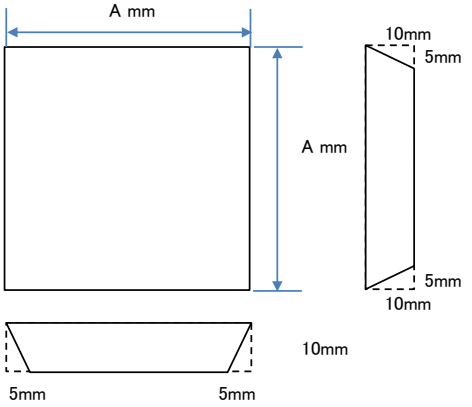


Target

Kapa mount (https://www.modulor.de/en/kapa-mount-aluminium-foil-clad-white.html)

To keep path of illumination, cut backside of target in 30 deg or more. Refer Fig. 9 for reference.

Fig. 2. Target size



object distatnce	Chart Size
600mm	48mm
700mm	56mm
800mm	64mm
900mm	72mm
1000mm	80mm
1100mm	88mm
1200mm	96mm
1300mm	104mm
1400mm	112mm

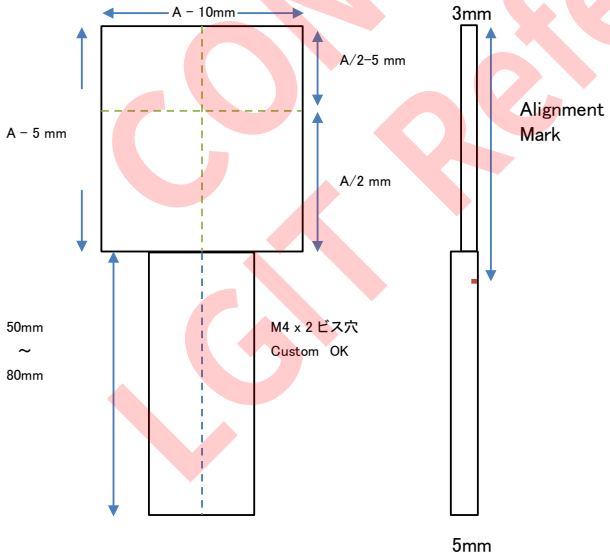
*) precondition: FOV 72.0deg. User need to re-calculate each value depend on FOV.

See Appendix – Chart design Flow

Target supporting arm

Material：UNILATE

Fig. 3. Arm to support the target



object distatnce	Alignment mark
600mm	59mm
700mm	53mm
800mm	47mm
900mm	81mm
1000mm	75mm
1100mm	69mm
1200mm	63mm
1300mm	57mm
1400mm	–

*) precondition: FOV 72.0deg. User need to re-calculate each value depend on FOV.

Alignment mark needs to be changed according to arm length and target location.

Match the intersection of green lines and target location.

Light shielding shade

Material: antistatic sheet

P/N : SED-FB

Fig. 4. Example light shielding shade

Outline of Cat Tree CEC environment

Distance to each target from camera module is listed in table 2. Origin of the distance is camera module.

Fig. 5. Outline of cat tree CEC

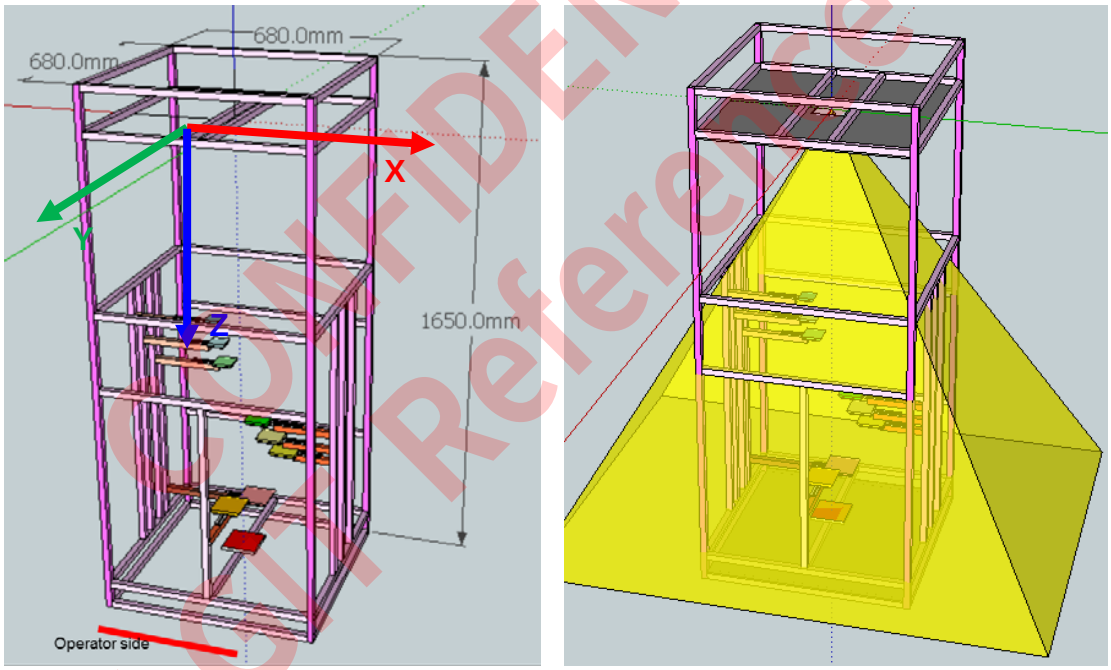


Fig. 6. Simulated camera view

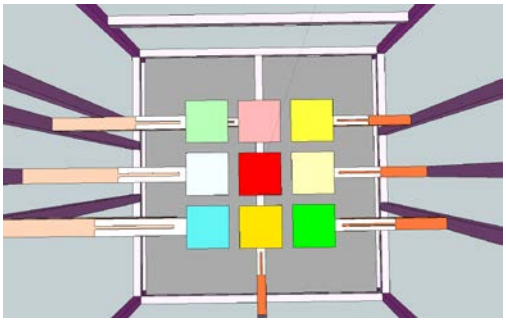


Table. 2. Target location

Chart Info (unit : mm)

object	chart size	X	Y	Z	radial_depth
600mm chart	48	−60	60	600	605.9703
700mm chart	56	−70	0	700	703.4913
800mm chart	64	−80	−80	800	807.9604
900mm chart	72	90	90	900	908.9554
1000mm chart	80	100	0	1000	1004.9876
1100mm chart	88	110	−110	1100	1110.9455
1200mm chart	96	0	120	1200	1205.9851
1300mm chart	104	0	−130	1300	1306.4838
1400mm chart	112	0	0	1400	1400.0000

*) radial_depth = sqrt(X^2+Y^2+Z^2)

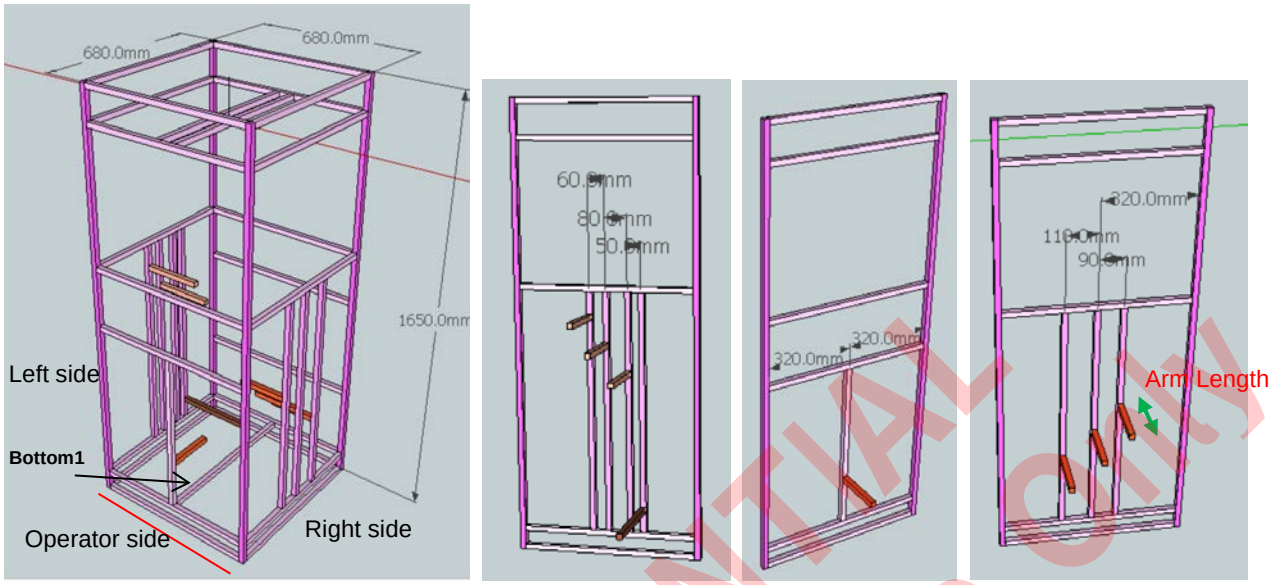
*) precondition: FOV 72.0deg. User need to re-calculate each value depend on FOV.

See Appendix – Chart design Flow

Cat Tree Setup

Outline

Fig. 7. Exploded view



Over view Left Side wall Operator Side wall Right Side wall

Table 3

Left Side wall		Right Side wall		Operator Side wall		Bottom1_profile	
Distance	Arm length	Distance	Arm length	Distance	Arm length	Distance	Arm length
600mm	220mm	900mm	180mm	1200mm	180mm	1400mm	640mm
700mm	220mm	1000mm	180mm				#set center
800mm	220mm	1100mm	180mm				=320mm
1300mm	310mm						

*) precondition: FOV 72.0deg. User need to re-calculate each value depend on FOV.

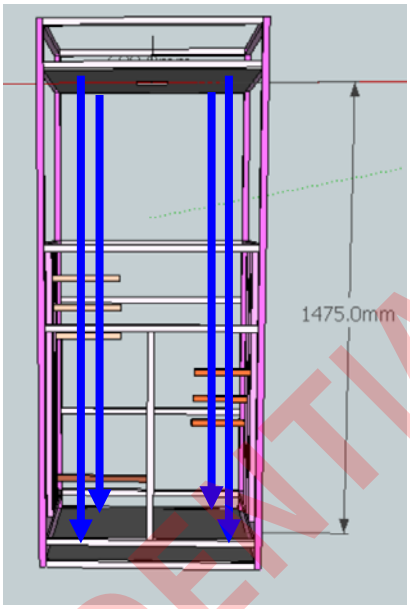
Arm length is determined from the outline of the machine and the target locations.

Attaching top and bottom plate

Check distance and parallelism between top and bottom plate.

Tolerance in distance 1475 +/- 0.1mm at 4-corner and at the center

Fig. 8. Distance between top and bottom plate.



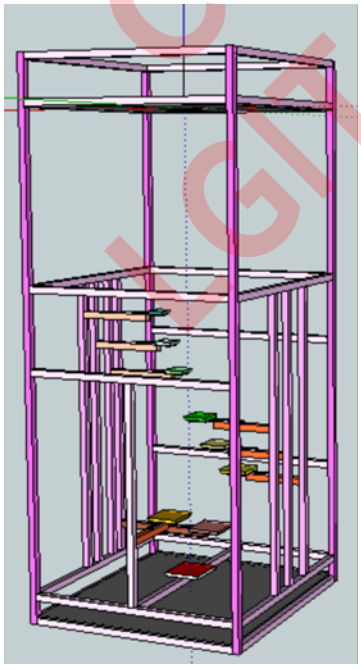
Attaching target and target supporting arm

Distance between top plate to each target needs to be checked.

Distance: TGT +/- 0.1mm (TGT = 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400)

XY alignment: TGT +/- 0.5mm

Fig. 9. Setting up target and arm



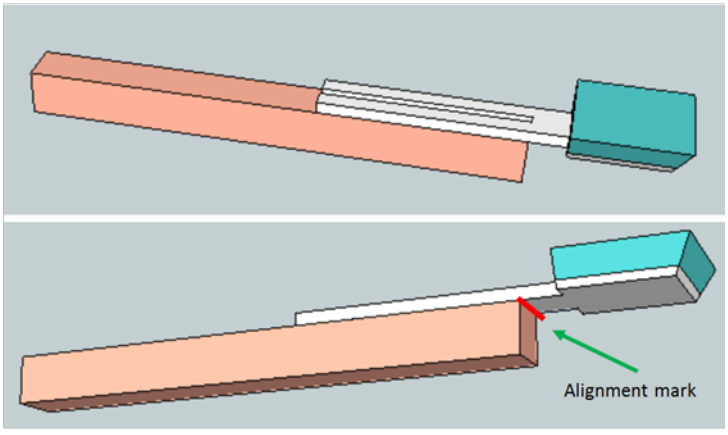


Fig. 10. Curtain laser : GLL 3-80P (BOSCH)

Check alignment of top and bottom plate using curtain laser and alignment mark on plates.

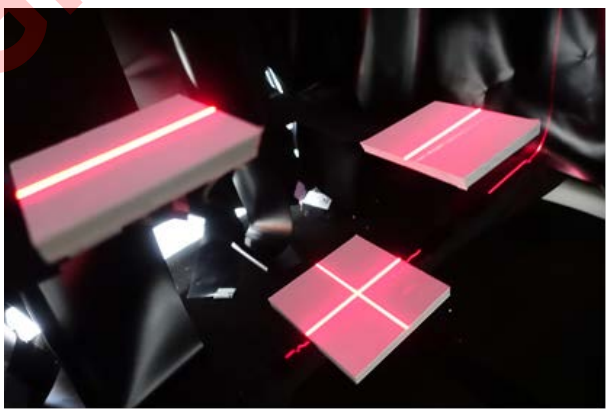
Fig. 11. Alignment check of top and bottom plates

Check 1400mm target XY-center

Check Y-center of 700mm target and 1000mm target

Check X-center of 1200mm target and 1300mm target

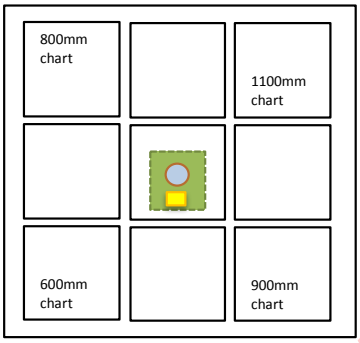
Fig. 12. Checking alignment of targets.



Capture system setup

Center of the sensor needs to be at the center target (1400mm target)

Fig.13. Alignment of capture system will respect to target



Adjusting height of camera module

Place board for height adjustment.

D_base : Distance from surface of top plate to height adjustment board.

D_datum : Distance from height adjustment board to camera module

Adjust height of camera module so that D_datum will be equal to D_base with a tolerance of +/-0.1mm

Fig. 14. Camera module height adjustment

Camera posture specifications (Capture system)

- XY alignment : ±1.0mm
- Pan / Tilt / Yoh : +/-1deg

Light shielding

Need a light shielding cover to all surface

When illumination is radiated to inner surface of cat tree environment, light shielding sheet (SED-FB) will cause multi-path. Followings action or actions can be taken for countermeasure.

- Make external frame of cat tree environment bigger in x and y direction to make wall (light shielding sheet) away.
- Use sheet which absorbs IR light or sheet which suppress diffuse/direct reflection
- Design umbrella as shown in figure 15 so that illumination to area other than target will not reflected to camera module.

Fig. 15. Example umbrella design for multi-path prevention

Appendix

Chart layout design

- Size of ROI need for calculation for each target: 10x10pix
- Need 3 to 5pix of space between targets from top view need for laser to reach target at far end.
  (assuming distance between Tx and Rx is 10mm)
- Arrange targets to the center of the image as possible

Fig.16 Chart design[pixel]

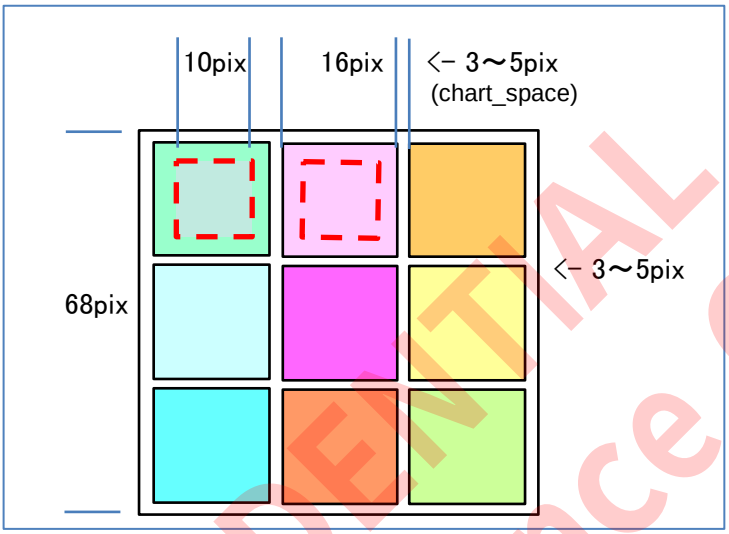


Chart design flow

Calculate chart size and layout

-Calculate chart size

$chart\_size_{distance}$ = chart_size_500mm / 500.0 * distance (distance = 600.0, 700.0, …)

chart_size_500mm = 16[pix] * size_mm_per_pix[mm/pixel]

size_mm_per_pix [mm/pixel] = length_mm_sim / d_pixel

length_mm_sim [mm]= distance_sim * tan(dFOV / 2) * 2

distance_sim [mm] = 500.0

d_pixel [pixel] = $sqrt(h\_pixel^2+v\_pixel^2)$

ex. dFOV = 72.0[deg] ⇒ size_mm_per_pix = 2.4218 [mm/pix]

16pix * size_mm_per_pix = 38.8[mm]

round to simplify the design 38.8[mm] ⇒ 40.0[mm]

ex. Target size @ 600mm

40.0x(600/500) = 48.0mm

Calculating target locations

Space between targets need to have 3pix or more to let illumination reach the target at far end. In order to make calculation simple, we have set space between targets as 10mm (10mm/size_mm_per_pix = 4.14pix) at distance of 500mm.

target_location_left_distance_x = (- chart_size_500mm - chart_space) / 500.0 * distance [mm]

target_location_center_distance_x = 0.0 [mm]

target_location_right_distance_x = (chart_size_500mm + chart_space) / 500.0 * distance [mm]

left_distance = 600.0, 700.0, 800.0

center_distance = 1200.0, 1300.0, 1400.0

right_distance = 900.0, 1000.0, 1100.0

target_location_top_distance_y = (- chart_size_500mm - chart_space) / 500.0 * distance [mm]

target_location_center_distance_y = 0.0 [mm]

target_location_bottom_distance_y = (chart_size_500mm + chart_space) / 500.0 * distance [mm]

top_distance = 800.0, 1100.0, 1300.0

center_distance = 700.0, 1000.0, 1400.0

bottom_distance = 600.0, 900.0, 1200.0