TOF V4T-Evaluation Module (EVM) Hardware Guide

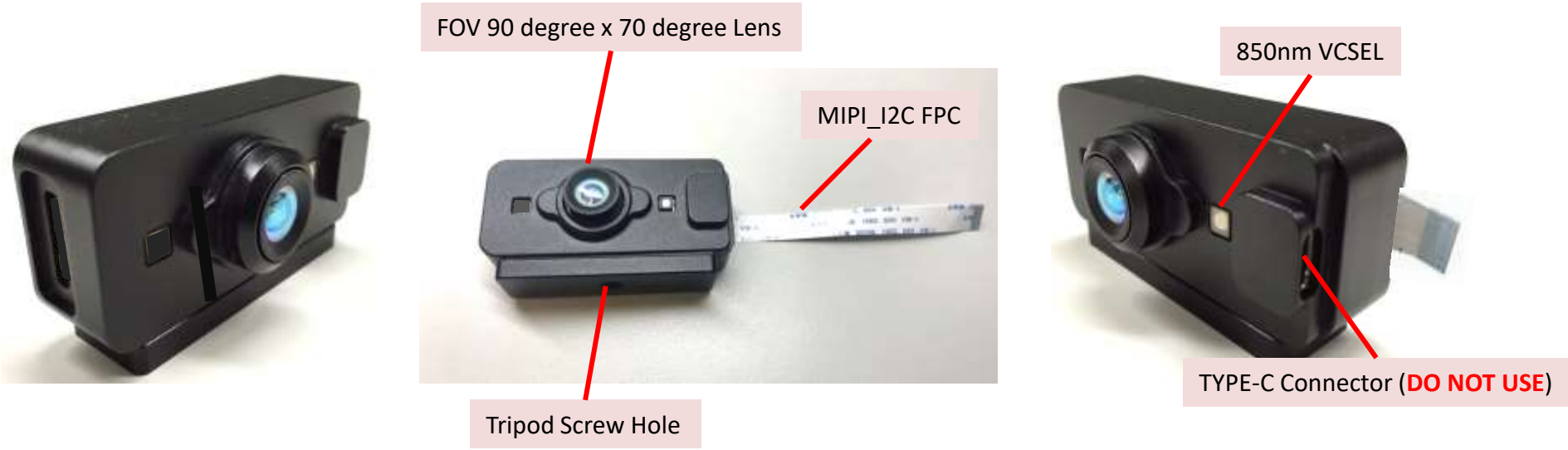
17st Jun. 2019

Ver. 2.5

Contents

Introduction of V4T EVM

■ V4T Module – General Introduction



*** The visual appearance of the module may change due to different module suppliers**

V4T module is a 3D camera module using Panasonic's VGA ToF sensor P/N MN34906. This module can be used to build prototypes of 3D imaging solutions for short to middle range applications. With a small form-factor and light weight, it can be seamlessly integrated to robotics platform, consumer and portable solution prototypes.

This V4T module provides about 1% depth error and 2% depth variation(standard deviation) of depth sensing from 0.2 m to 4.5 m range with 90 degree x 70 degree wide FOV, multiple signal output of depth, IR and background.

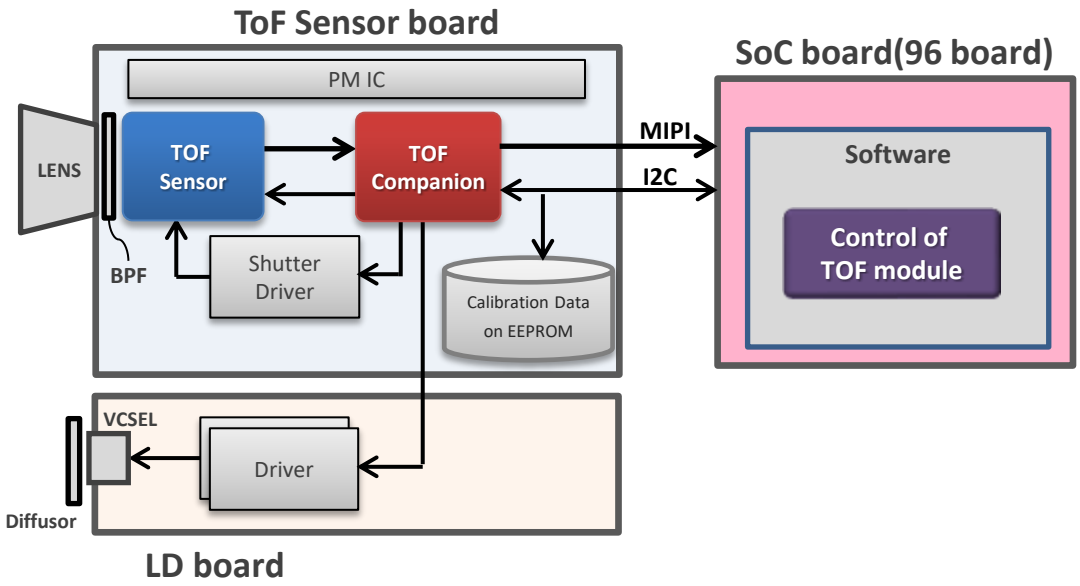
Although, this module is not designed for commercial production, yet it provides a preview of how a commercial 3D camera product using Panasonic's ToF sensor will look like.

Overview of V4T EVM

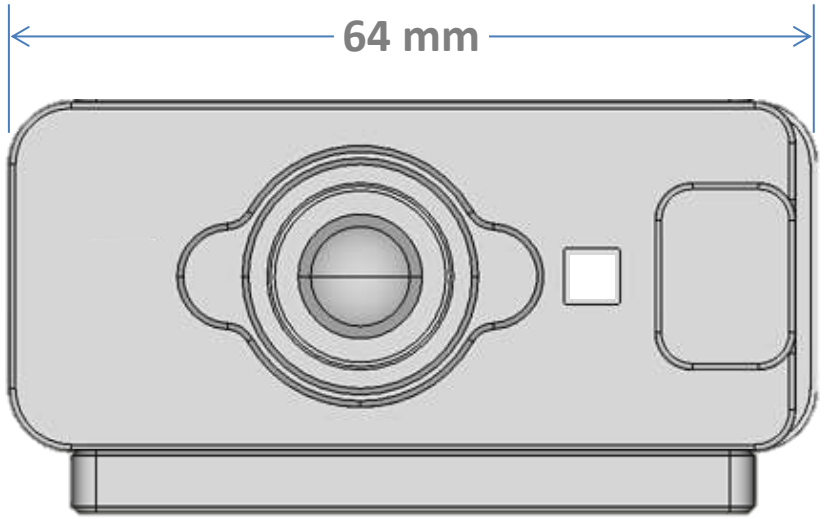
■ Specifications

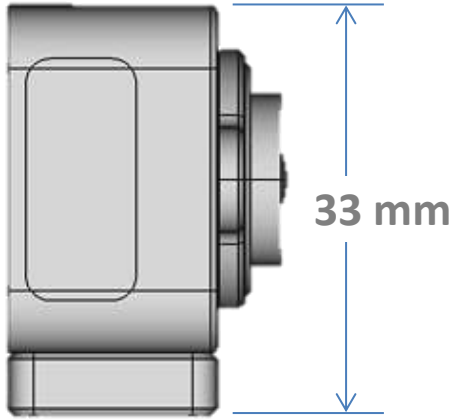
Parameter		V4T-EVM – for in-door use	
TOF Sensor		1/4” VGA /IR – TOF	
Resolution		640 x 480 (VGA)	
Lens	FOV	H: 90° x V: 70°	
	Aperture	F1.2	
VCSEL		850nm x 1pc	
Performance		**Mode 0: Short range**	**Mode 1: Long range**
	Camera Distance	0.2 to 1.2 [m]	0.5 to 4.5 [m]
	Frame Rate	30 fps	20 fps
Interface		MIPI (CSI-2)／I2C	
Module Size		64 x 33 x 19 [mm]	
Supply Voltage		DC 5V (From 4.85V to 5.3V)	
Operating Temperature		Ta= 0 to +60°C	

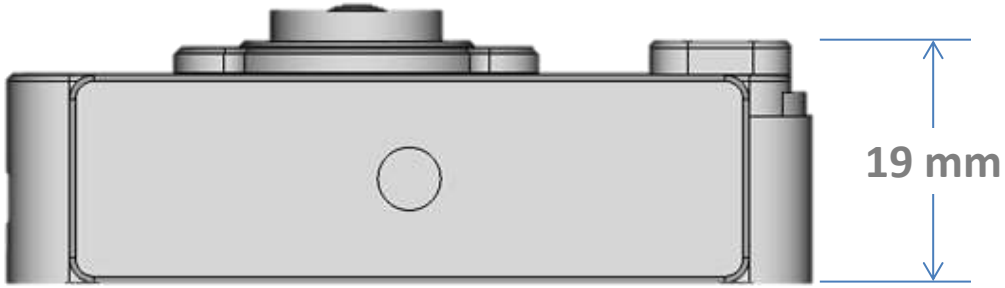
■ Block Diagram



Dimension of V4T EVM







Dimension (mm)	
W	64
D	19
H	33

*** The visual appearance/size of the module may change due to different module suppliers**

Connection of V4T EVM to SoC board

FPC Connector(16 pin) for TOF module
Best(百斯特): 0.5K-AX-NPWB-T/R

TOF module

SoC-board(96 board)

10cm

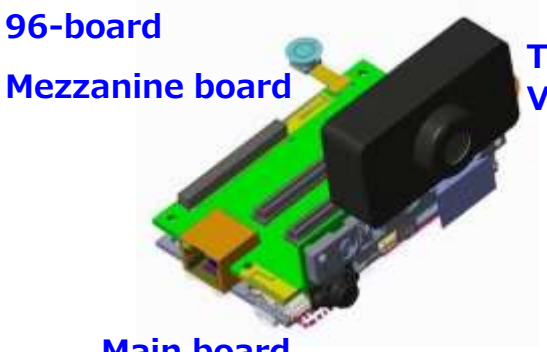
<V4T-EVM>

Data、I2C

V4T-FPC

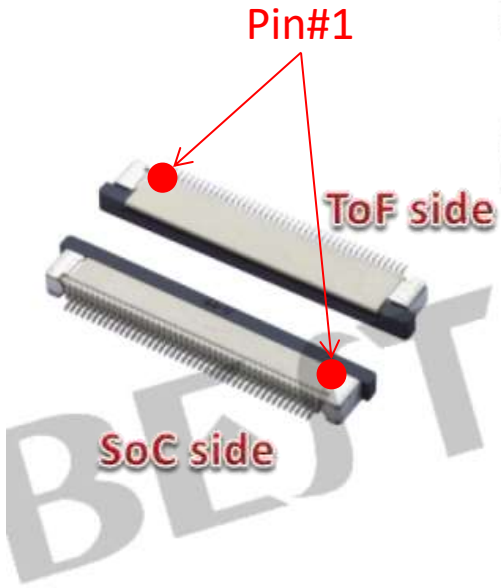
Power
(5V・max 3.0A)

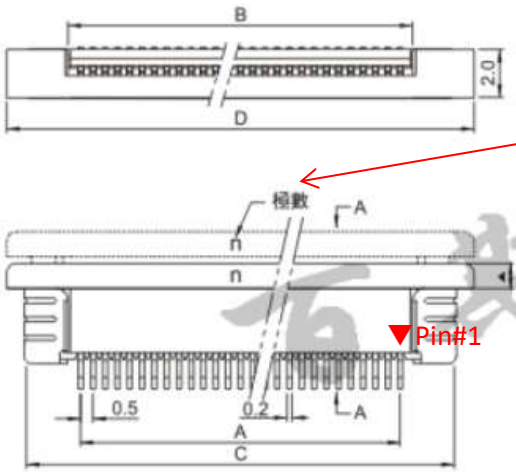
Mezzanine board
and
Main board

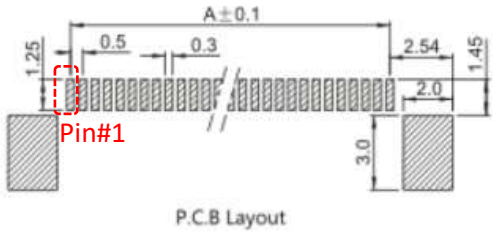


FPC Connector Specs for V4T EVM

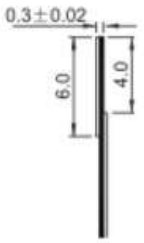
0.5K-AX-NPWB-T/R

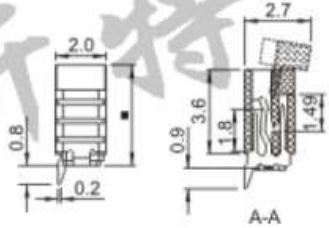




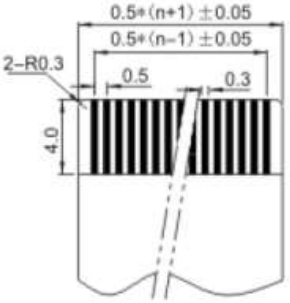


P.C.B Layout





A-A



適用扁平電纜

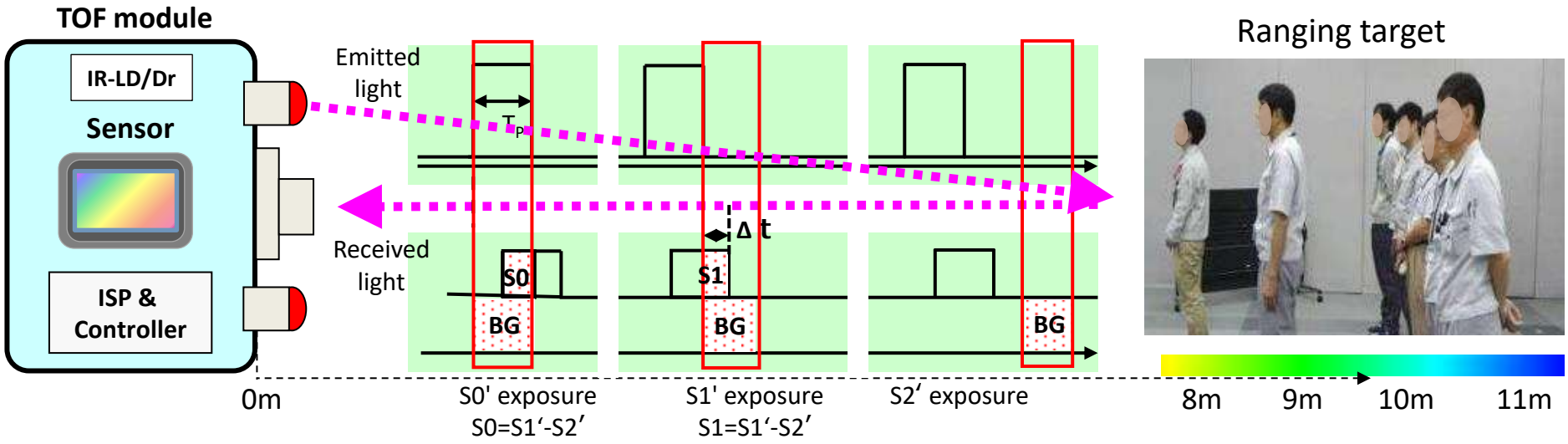
注：“▲”處尺寸為
4Pin~29Pin: 1.50mm;
30Pin~39Pin: 1.60mm;
40Pin~60Pin: 1.70mm;
“■”處尺寸為
4Pin~29Pin: 4.70mm;
30Pin~39Pin: 4.80mm;
40Pin~60Pin: 4.90mm;

空位	A	B	C	D
4	1.50	2.60	6.35	7.65
5	2.00	3.10	6.85	8.15
6	2.50	3.60	7.35	8.65
7	3.00	4.10	7.85	9.15
8	3.50	4.60	8.35	9.65
9	4.00	5.10	8.85	10.15
10	4.50	5.60	9.35	10.65
11	5.00	6.10	9.85	11.15
12	5.50	6.60	10.35	11.65
13	6.00	7.10	10.85	12.15
14	6.50	7.60	11.35	12.65
15	7.00	8.10	11.85	13.15
16	7.50	8.60	12.35	13.65
17	8.00	9.10	12.85	14.15
18	8.50	9.60	13.35	14.65
19	9.00	10.10	13.85	15.15
20	9.50	10.60	14.35	15.65
21	10.00	11.10	14.85	16.15
22	10.50	11.60	15.35	16.65
23	11.00	12.10	15.85	17.15
24	11.50	12.60	16.35	17.65
25	12.00	13.10	16.85	18.15
26	12.50	13.60	17.35	18.65
27	13.00	14.10	17.85	19.15
28	13.50	14.60	18.35	19.65
29	14.00	15.10	18.85	20.15
30	14.50	15.60	19.35	20.65
31	15.00	16.10	19.85	21.15
32	15.50	16.60	20.35	21.65
33	16.00	17.10	20.85	22.15
34	16.50	17.60	21.35	22.65
35	17.00	18.10	21.85	23.15
36	17.50	18.60	22.35	23.65
37	18.00	19.10	22.85	24.15
38	18.50	19.60	23.35	24.65
39	19.00	20.10	23.85	25.15
40	19.50	20.60	24.35	25.65
41	20.00	21.10	24.85	26.15
42	20.50	21.60	25.35	26.65
43	21.00	22.10	25.85	27.15
44	21.50	22.60	26.35	27.65
45	22.00	23.10	26.85	28.15
46	22.50	23.60	27.35	28.65
47	23.00	24.10	27.85	29.15
48	23.50	24.60	28.35	29.65
49	24.00	25.10	28.85	30.15
50	24.50	25.60	29.35	30.65
51	25.00	26.10	29.85	31.15
52	25.50	26.60	30.35	31.65
53	26.00	27.10	30.85	32.15
54	26.50	27.60	31.35	32.65
55	27.00	28.10	31.85	33.15
56	27.50	28.60	32.35	33.65
57	28.00	29.10	32.85	34.15
58	28.50	29.60	33.35	34.65
59	29.00	30.10	33.85	35.15
60	29.50	30.60	34.35	35.65

空位	A	B	C	D
4	1.50	2.60	6.35	7.65
5	2.00	3.10	6.85	8.15
6	2.50	3.60	7.35	8.65
7	3.00	4.10	7.85	9.15
8	3.50	4.60	8.35	9.65
9	4.00	5.10	8.85	10.15
10	4.50	5.60	9.35	10.65
11	5.00	6.10	9.85	11.15
12	5.50	6.60	10.35	11.65
13	6.00	7.10	10.85	12.15
14	6.50	7.60	11.35	12.65
15	7.00	8.10	11.85	13.15
16	7.50	8.60	12.35	13.65
17	8.00	9.10	12.85	14.15
18	8.50	9.60	13.35	14.65
19	9.00	10.10	13.85	15.15

Principle of Time of Flight

The distance measuring principle for V4T-EVM is based on the Time of Flight concept as shown in the figure below:



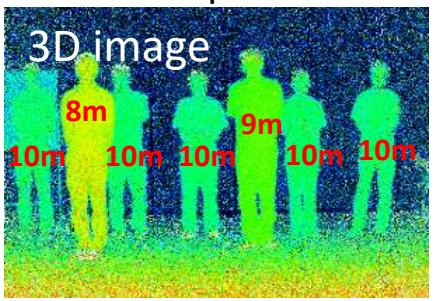
Sensor Output (RAW)

Depth Calculation

$$Z = C \times \frac{\Delta t}{2} = \frac{C \cdot T_P}{2} \times \left(\frac{S1}{S0 + S1} \right)$$

Δt : Time of Flight
C : Light speed
T_P : IR pulse width

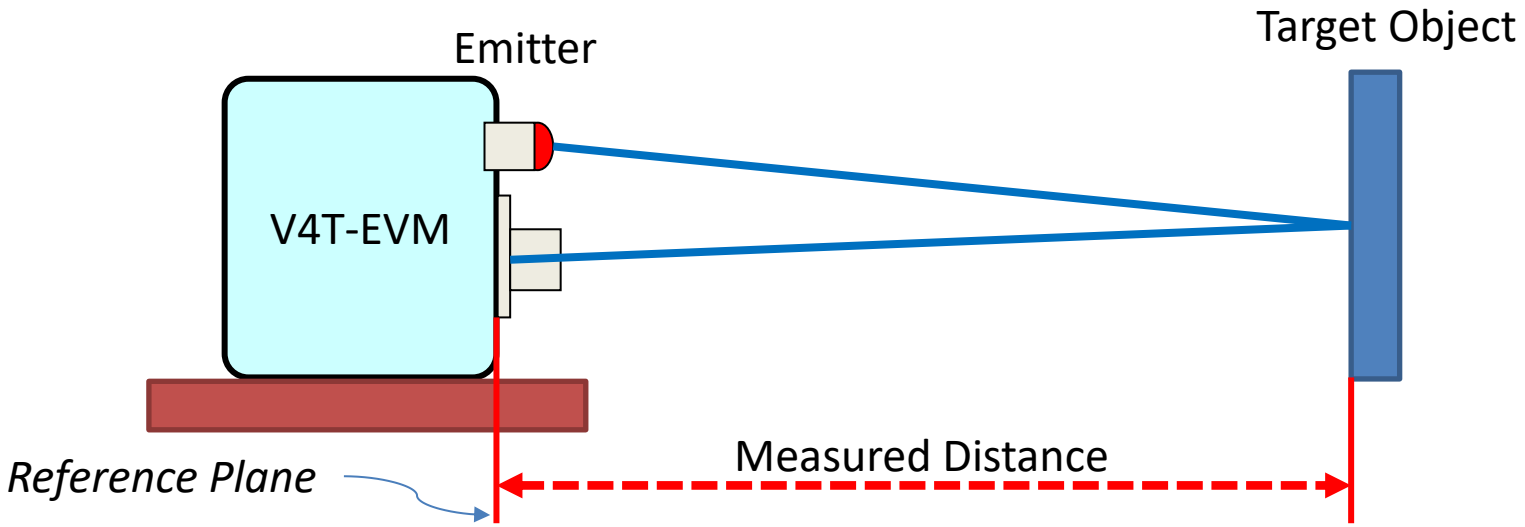
Camera Output



Depth Measurement Guidelines

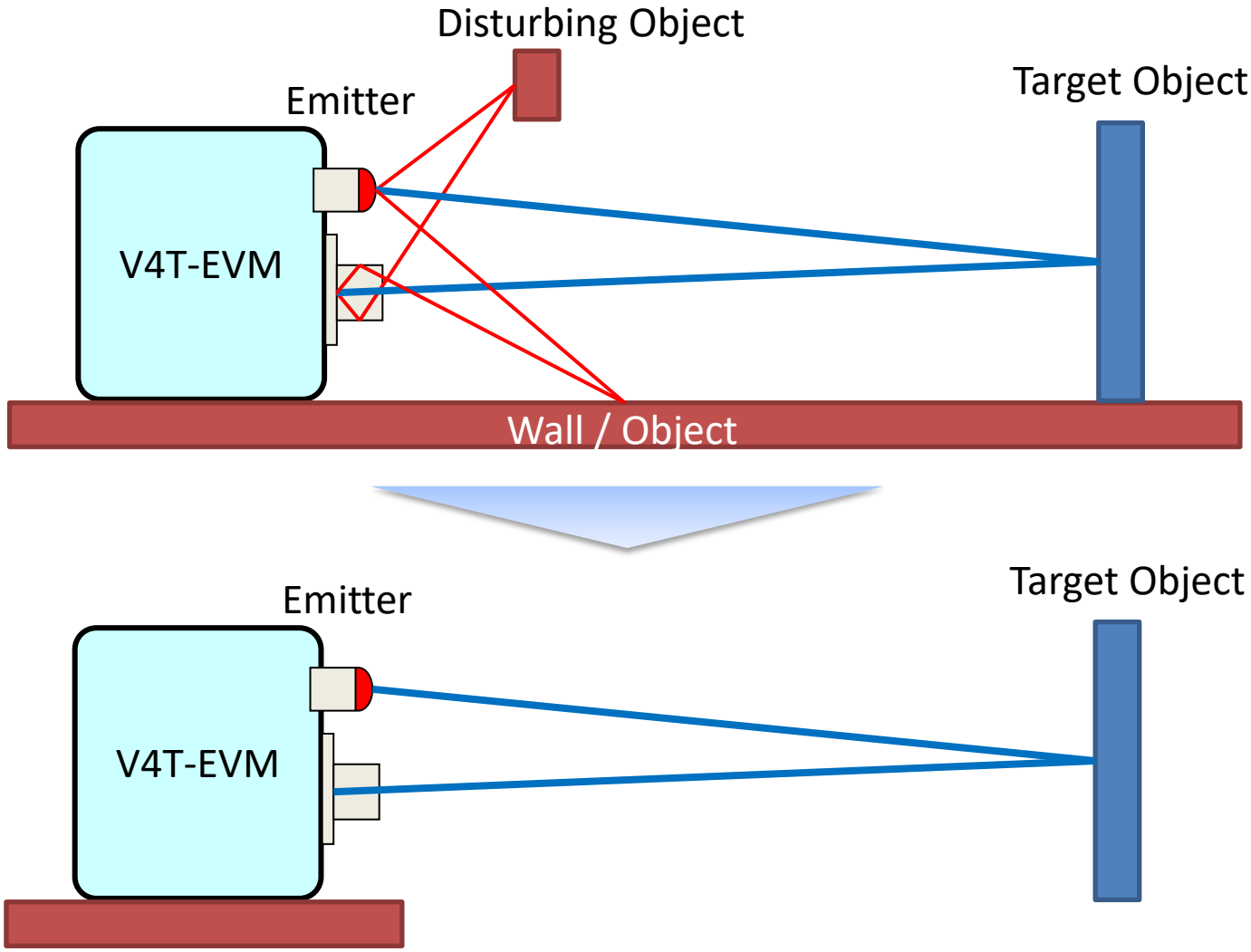
Reference Plane:

- The front edge of module has been used as the reference plane for calibration of V4T-EVM, so all measurements taken by V4T-EVM are values of distance (in mm) from this front edge. Refer to the figure below:



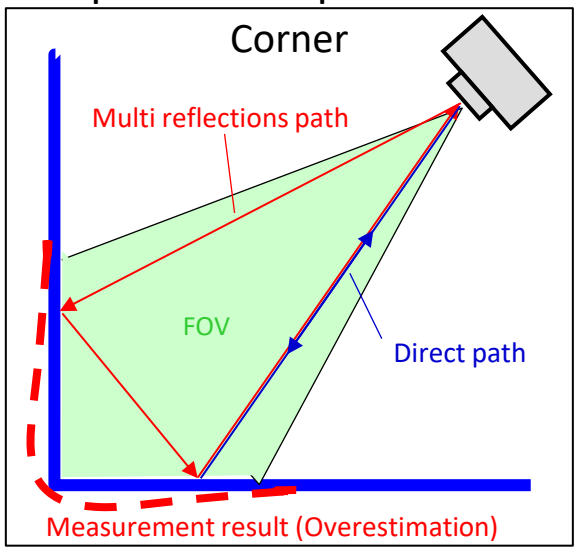
Light Scattering

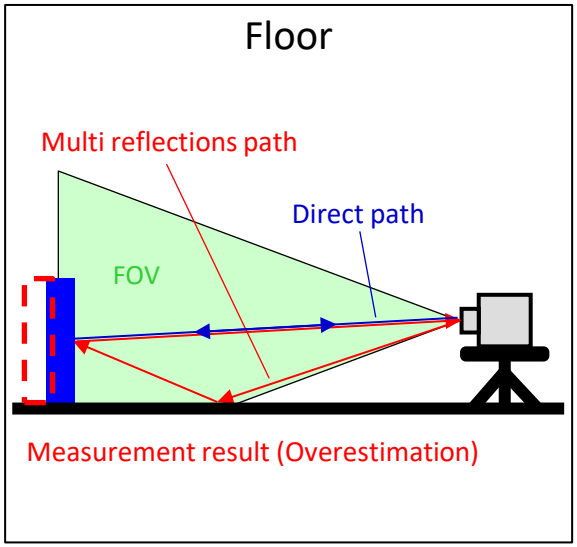
Light scattering occurs due to unwanted reflections within the optics. This cannot be eliminated completely. In order to avoid scattered light issue as much as possible, V4T-EVM should be placed at the greatest distance possible from disturbing object from which light might be reflected.

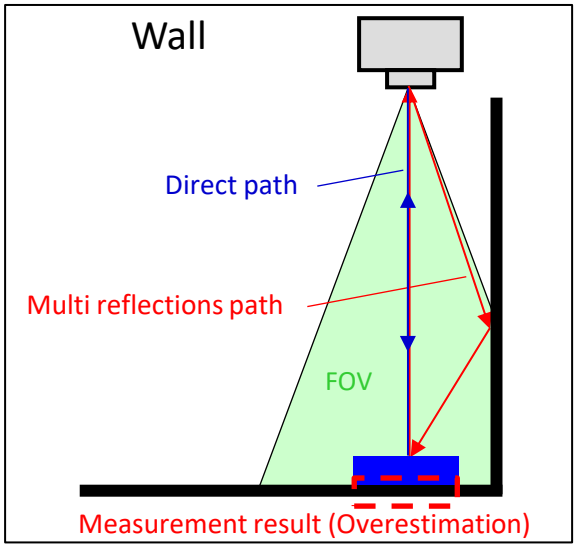


Multipath Interference

1) Example of Multipath Interference

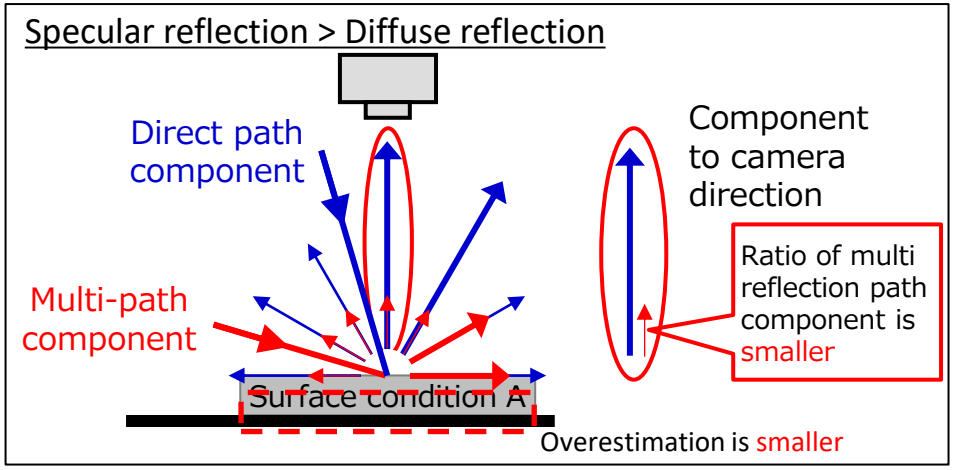


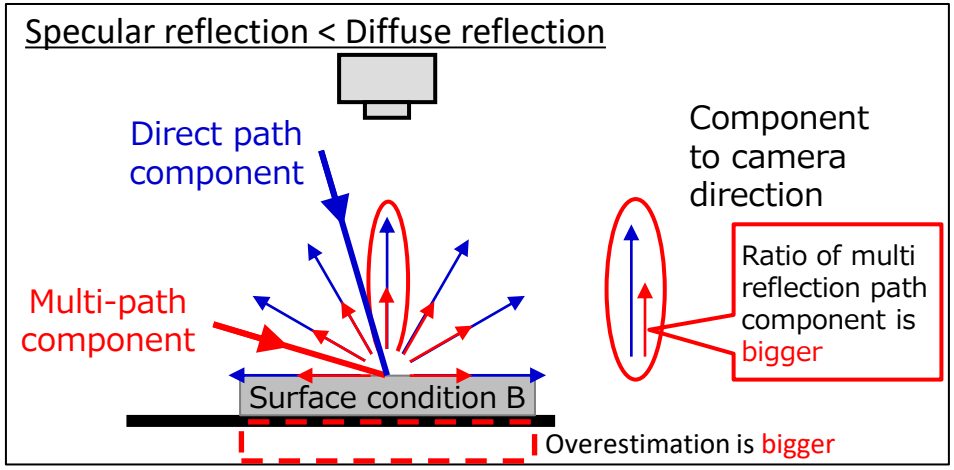




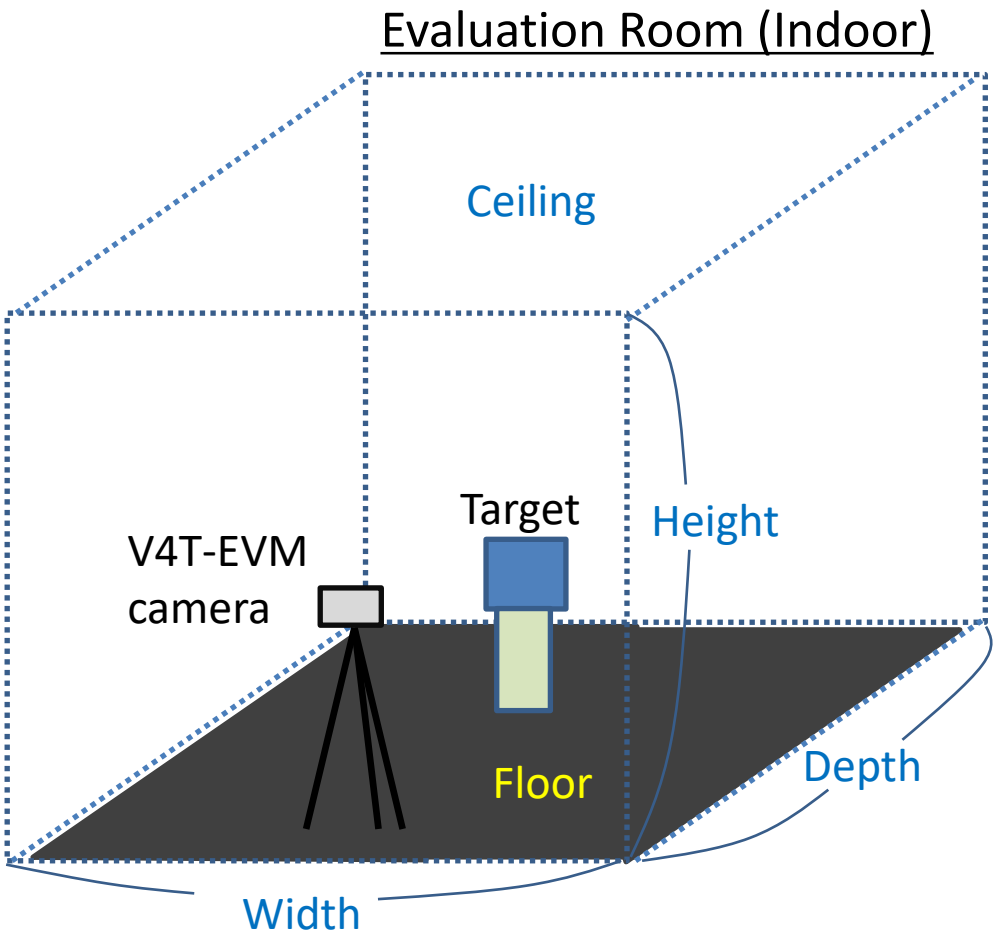
2) Dependency on surface condition of the measured object

Influence level of the multi-path reflection depends on not only the reflectance of the multi-path objects and measured object but also the surface condition of the measured object.





Example of Evaluation Environment

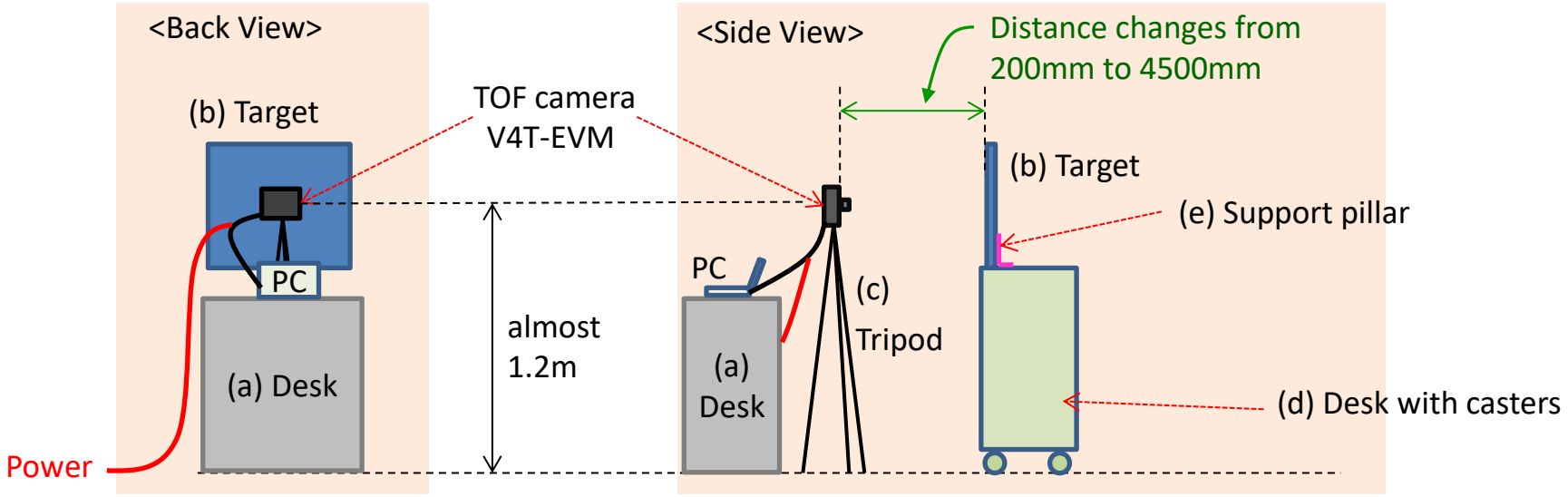


Part	Description
Ceiling	Fluorescent light only
Width	9m or over
Depth	6m or over
Height	3.5m or over
Floor	Black (or low reflectance) rug *

* It is important to reduce the reflectivity of the floor to avoid multipath interference.

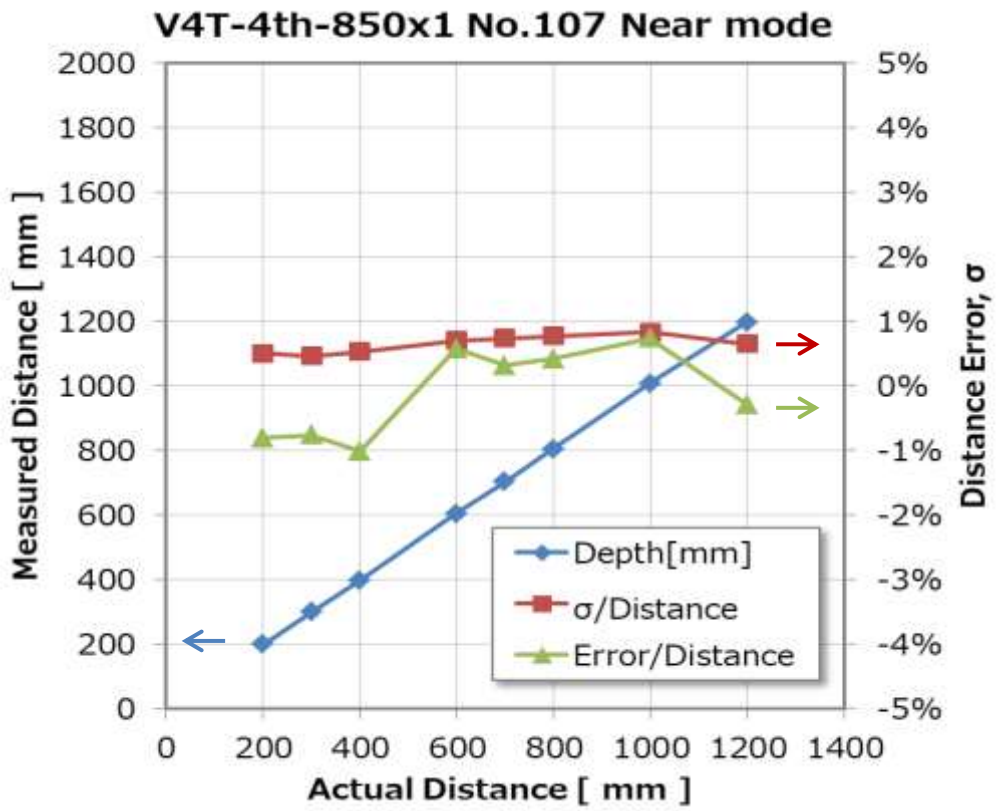
Example of Evaluation Equipment

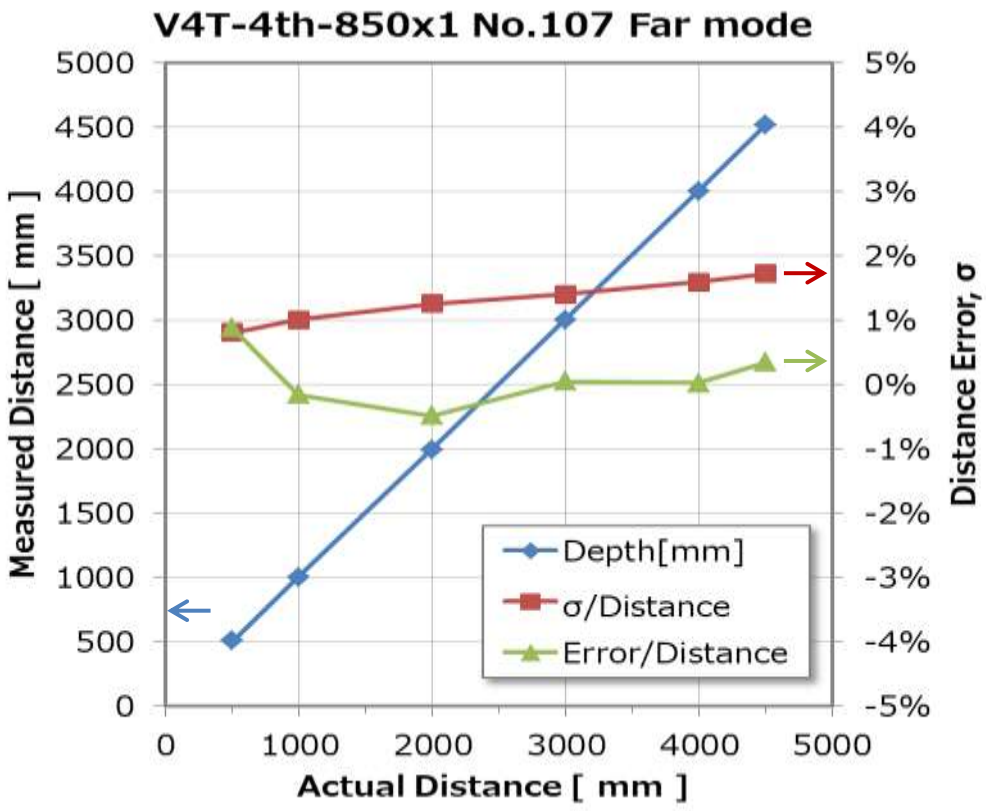
Evaluation equipment

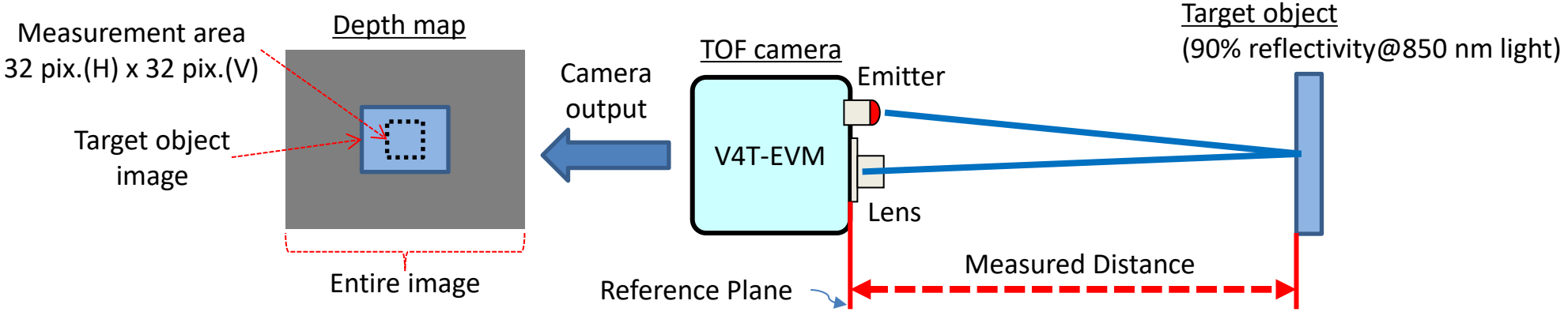


No	Items	Detail specs
(a)	Desk	Normal PC desk.
(b)	Target	- Flat, thin and durable board - Target size is 60 cm (H) x 50 cm(V) - Reflectivity is 90%@850 nm light
(c)	Tripod for camera	Height should be adjusted to around 1.2m.
(d)	Desk with caster	Desk with casters is useful to change the distance between the target and the TOF camera.
(e)	Support pillar	Book stand etc.

Examples of Depth Evaluation Results





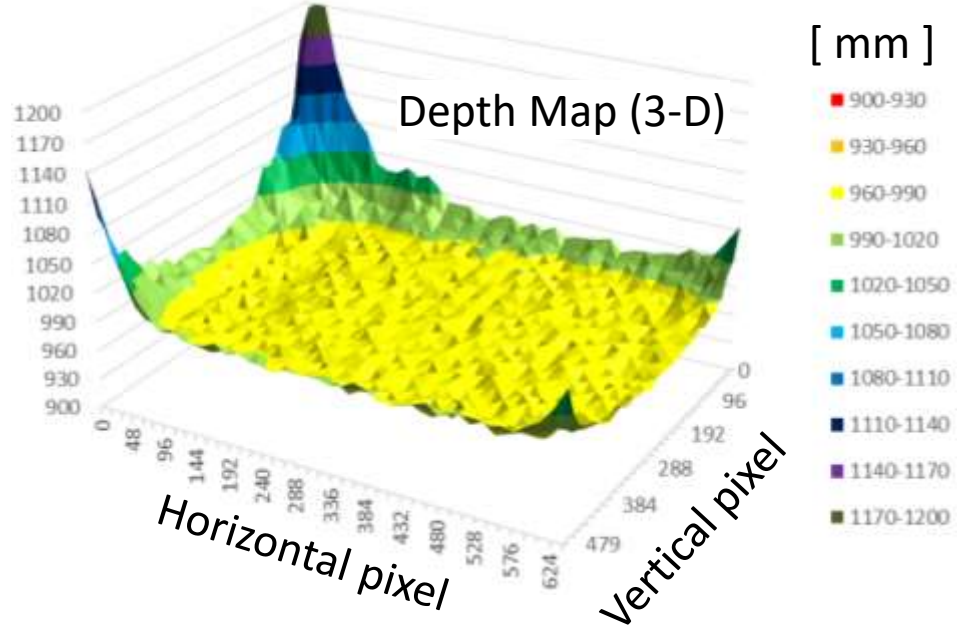


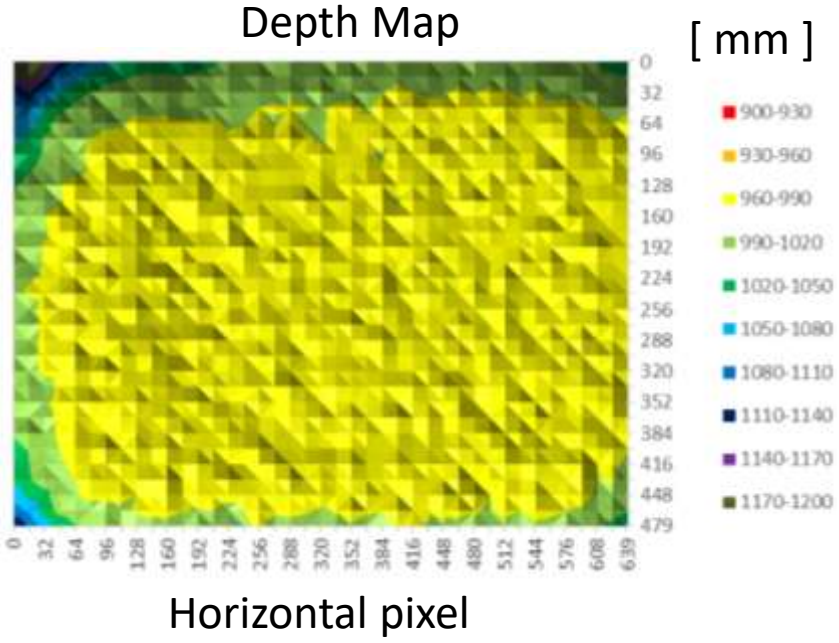
[Note] Depth Uniformity

Corners of depth map has large depth error

[Phenomena]
Due to small mismatch between lens FOV and diffuser FOI of light source in the current TOF module, depth at image corners has large error as shown in the following depth map example.
Please be aware this characteristics when using the current ToF module.

[Example of Depth Map]





Safety Instructions

Please observe the following condition for the safety operation of V4T-EVM.

- In any case, it is **not** allowed to open V4T-EVM or to make any changes to the hardware.
- Only the power supply provided by Thundercomm's 96-board is allowed to be used with the camera.
  Do not use other power supply.
- V4T-EVM is **not** waterproof and dustproof. Do **not** use under rain.
- Do **not** apply any register settings and EEPROM values in V4T-EVM (especially laser emission settings)
- Handle with care for V4T-EVM or power supply connecter.
- Do **not** touch Diffuser or Lens.
- V4T-EVM is **not** certified for any safety related applications.

By using V4T-EVM, the user agrees to indemnify Panasonic against any loss (material, non-material or others). Under no circumstances Panasonic takes any responsibility or liability.

The modules must be used strictly satisfying above guidelines. Any claims for replacement of modules will be by the sole discretion of module supplier.