

A M S T R O N

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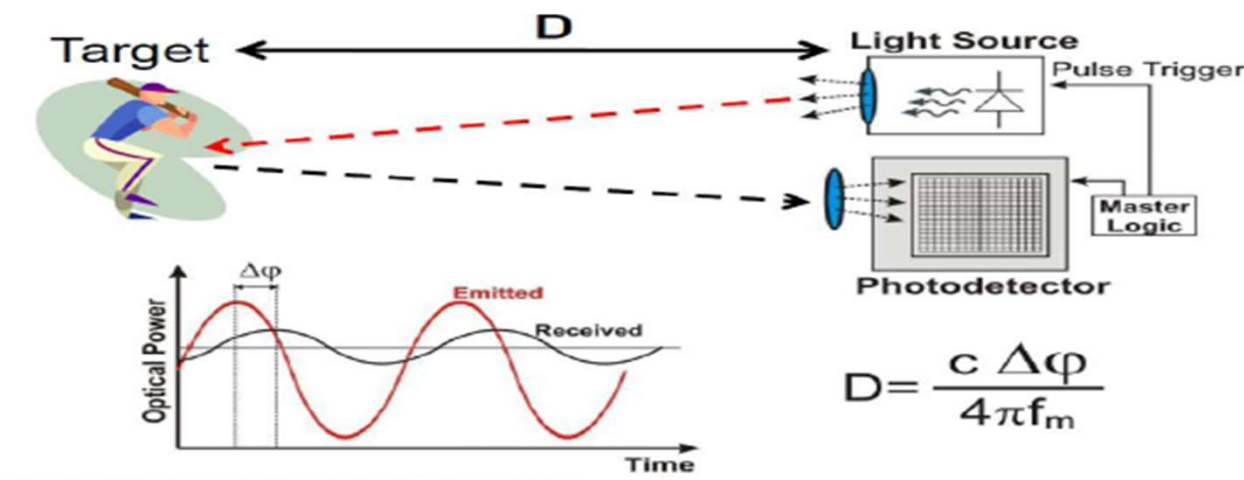
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TOF MODULE INTRODUCTION

KODENSHI AUK

Why Time of Flight (ToF)

- . Intensity based proximity sensors are prevalent today, but..
 - Output is highly dependent on target reflectivity.
 - Ambient Light can impact detection accuracy.
- . What we are trying to do with AUK ToF sensor?
 - Overcome the shortcoming of current proximity sensor and other ToF solutions.
 - Provide customer products with information about their physical environment that adds value.
 - * Presence detect within system Field of view (FoV)
 - * Distance detect

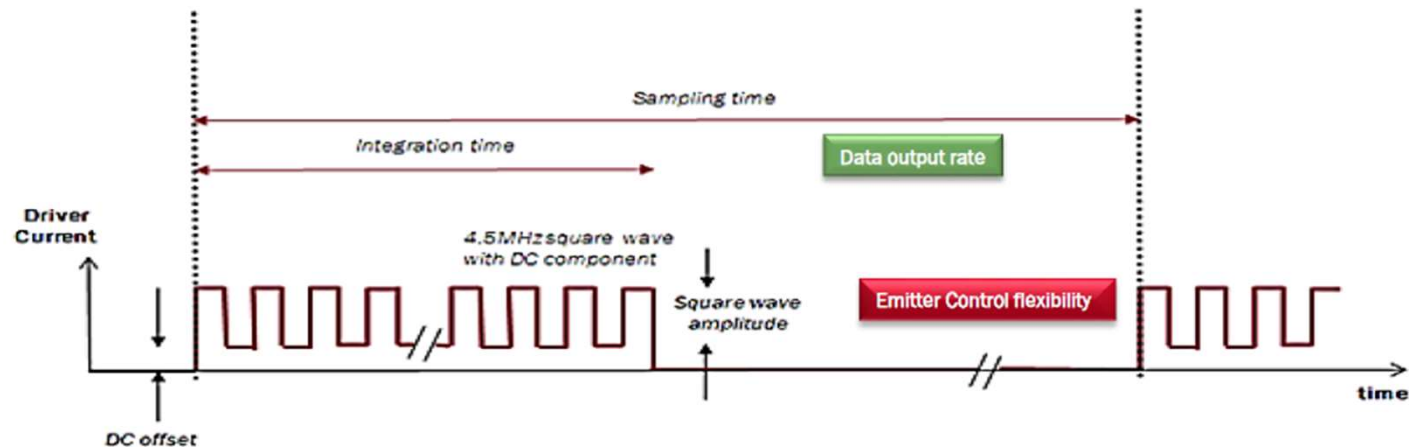


Components of Time of Flight Sensing System

- Light Source – VCSEL
- Light Sensor – Photo Diode
- Driver electronics
 - Emitter carrier at a fixed frequency and user defined current
- Sensing and Computation Engine
 - Detects phase difference between emitted pulse and received pulse
 - Calibrates for crosstalk and other system error sources
 - Computes Distance

Configurable Sensing System

- Sampling Waveform



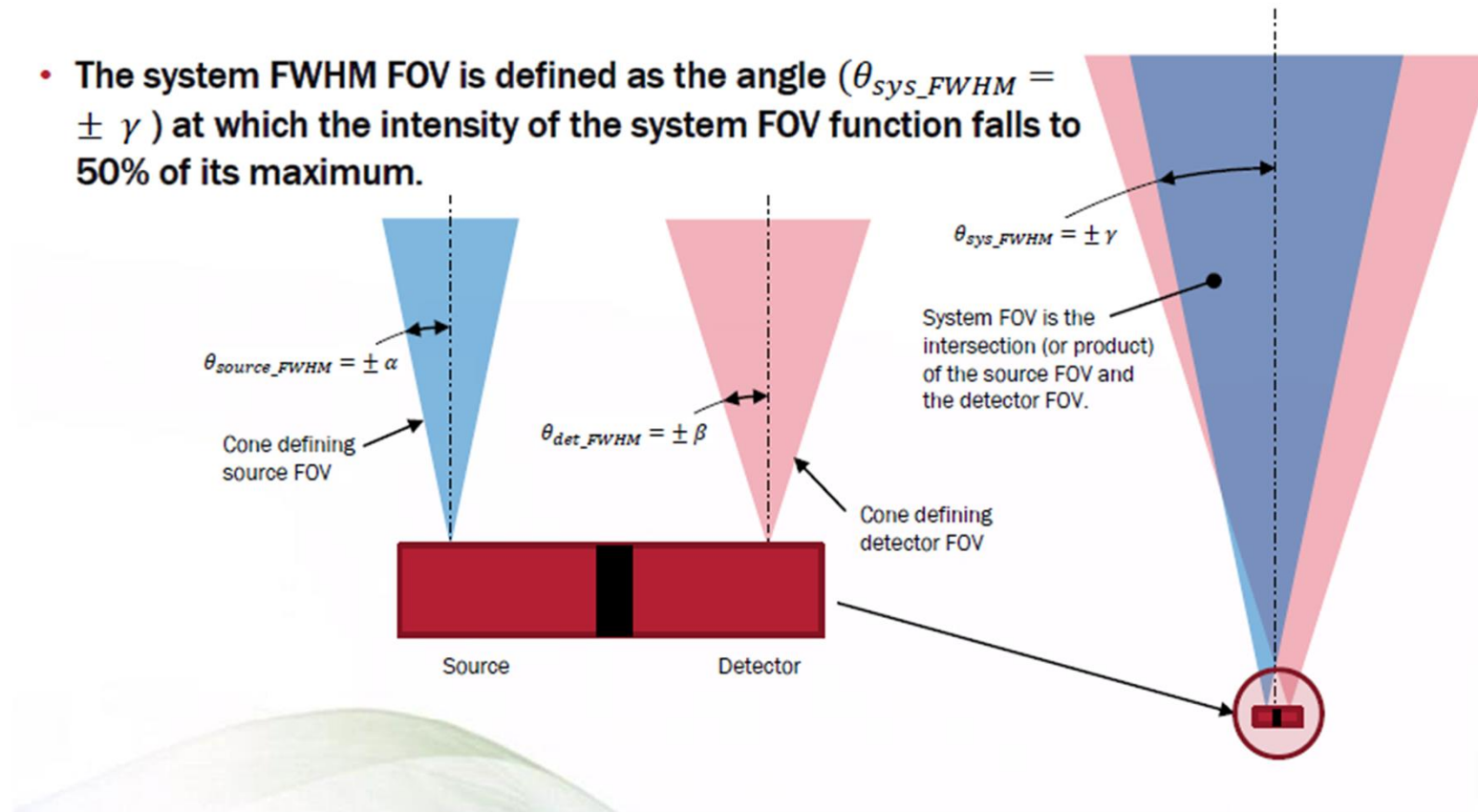
- Programmability
 - Ability to control
 - Sampling Frequency (1ms to 1843ms)
 - Integration time (0.28ms to 145ms)
 - Various Operation Modes
 - Continuous mode
 - Single shot mode

Data Interface

- I2C
 - Support data transfer speed of 400KHz
 - Support 4 addressable I2C device address
- On-chip processing of I & Q (In-phase & Quadrature values) or provides raw data to host for distance calculation.
 - On-chip processing
 - Minimum processing time
 - Interrupt driven
 - Great for standalone low power application
 - Host processing (Raw Mode)
 - Enable host to employ different data processing algorithm
 - Calibration will done on host

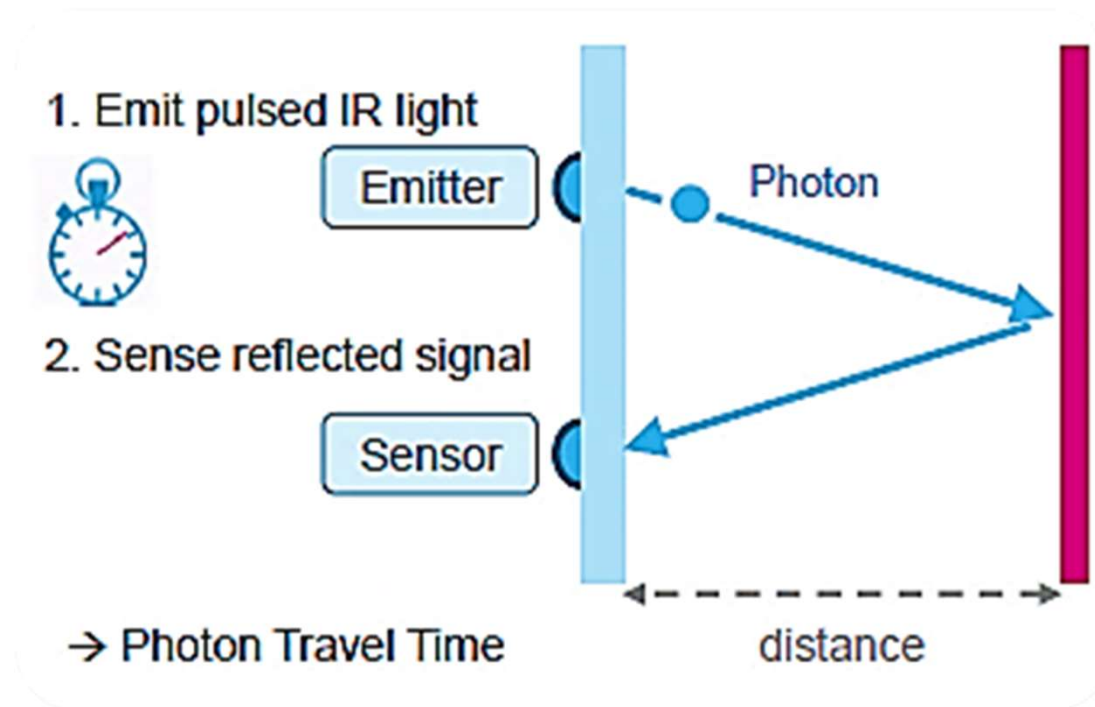
FOV Definition

- The system FWHM FOV is defined as the angle ($\theta_{sys_FWHM} = \pm \gamma$) at which the intensity of the system FOV function falls to 50% of its maximum.



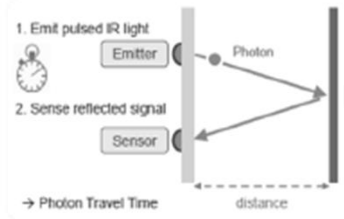
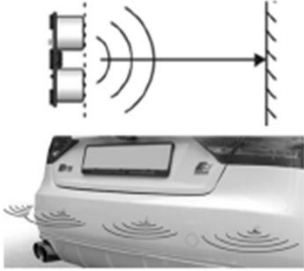
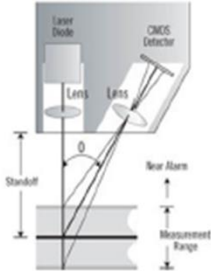

ToF(Time of Flight)

- Method to measure the distance by calculating the time laser irradiated with light then reflected back toward the object.



KMED104C _ Technology

Comparison of Proximity Sensor Technology

ToF (Time of Flight)	Ultrasonic	Positioning Sensing	Image Processing
			
<ul style="list-style-type: none"> • 3D imaging technology (Array methods) • Densely precise measuring and quick, easy integration • Less external environmental influences • Smallest size and competitive price 	<ul style="list-style-type: none"> • Influence from temperature, humidity. • Frequent malfunction in short distance • High price 	<ul style="list-style-type: none"> • Easily affected by ambient light • An additional AD Convertor needed 	<ul style="list-style-type: none"> • Densely measuring for large areas, but very high cost • High proportion of S/W for Image Processing

KMED104C _ Features

Features

- Fully integrated miniature module
 - 940nm Laser VCSEL
 - VCSEL driver
 - Ranging sensor with advanced embedded micro controller
 - 20 x 10 x 7.1mm
- Distance measurement module utilizing ToF (Time of Flight) mode
- Works with outer-cover by special optical system inside
 - Transparent cover is undetected within a certain distance
- Rapid and precise distance measuring (Detecting Dist. : MM)
- Miniaturized module to be widely applied
 - Robot cleaner, refrigerator, dispensing product, etc.
- Eye safe
 - Class 1 laser device compliant with latest standard IEC 60825-1:2014 – 3rd edition



Key USP of our ToF sensing module is :

- Can be used with transparent cover
- High accuracy
- Detectable length, air gap

Key USP	Remarks	Details
Transparent cover	Through a specialized optic structure, our TOF module allows additional transparent cover to be implemented on top of the module	<ul style="list-style-type: none"> • Does not detect transparent cover in certain proximity • Additional air gap can be installed
Higher accuracy	The area of the receiving part is larger : the module can detect even when there is some moisture or external material on the sensor	<ul style="list-style-type: none"> • Can be used in humid & dusty environment • Detects in high accuracy (in mm)
Air gap	<p>Can detect up to 2cm</p> <p>Can be used for rounded designs where there is gap between the sensor and the mechanical housing</p> <p>- Stand alone sensor only supports up to 2mm of air gap</p>	<p>The diagram illustrates two configurations of the sensor. On the left, a cross-section shows a green PCB with a blue TSM sensor. Above the sensor is a layer of 'IR resin or clear cover', and a gap labeled 'Air gap' exists between the sensor and a black rounded housing. On the right, a similar cross-section shows the sensor on a PCB with a 'Cover on housing' indicated by a red dashed circle. Below this is a photograph of the physical black rounded module with 'KODENSHI' branding.</p>

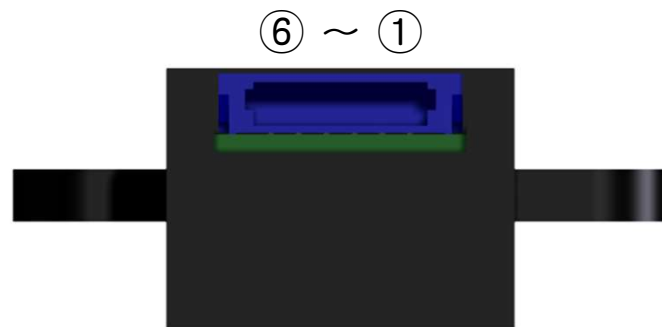
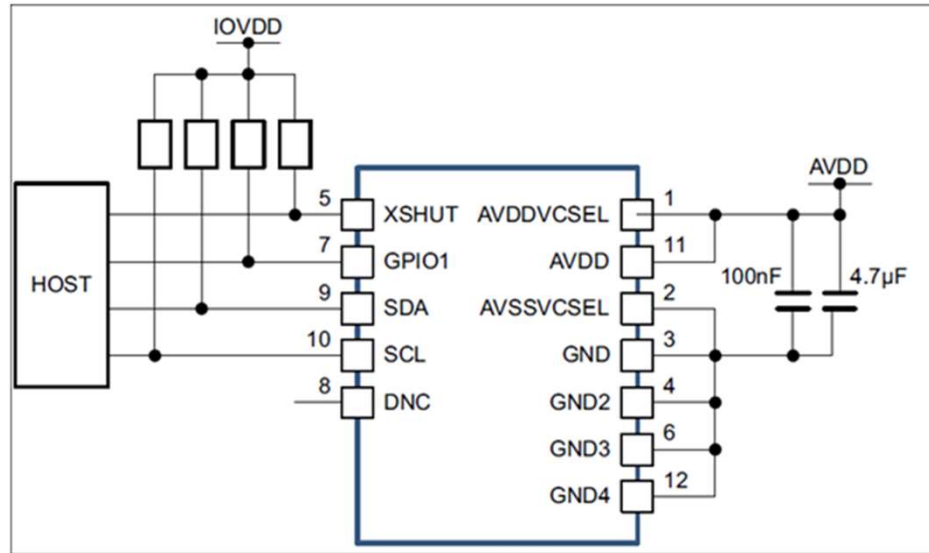
KMED104C _ Specification

Technical specification

Feature	Detail
Package	KMED104C
Size	20 x 10 x 7.1mm (+Housing)
Operating voltage	2.6 to 3.5 V
Operating temperature:	-20 to 70°C
Light source	VCSEL 940 nm
I2C	Up to 400 kHz (FAST mode) serial bus Address: 0x52
Current consumption	(TYP) 19mA
Ranging	max 2000mm

KMED104C _ Hardware

H/W Diagram

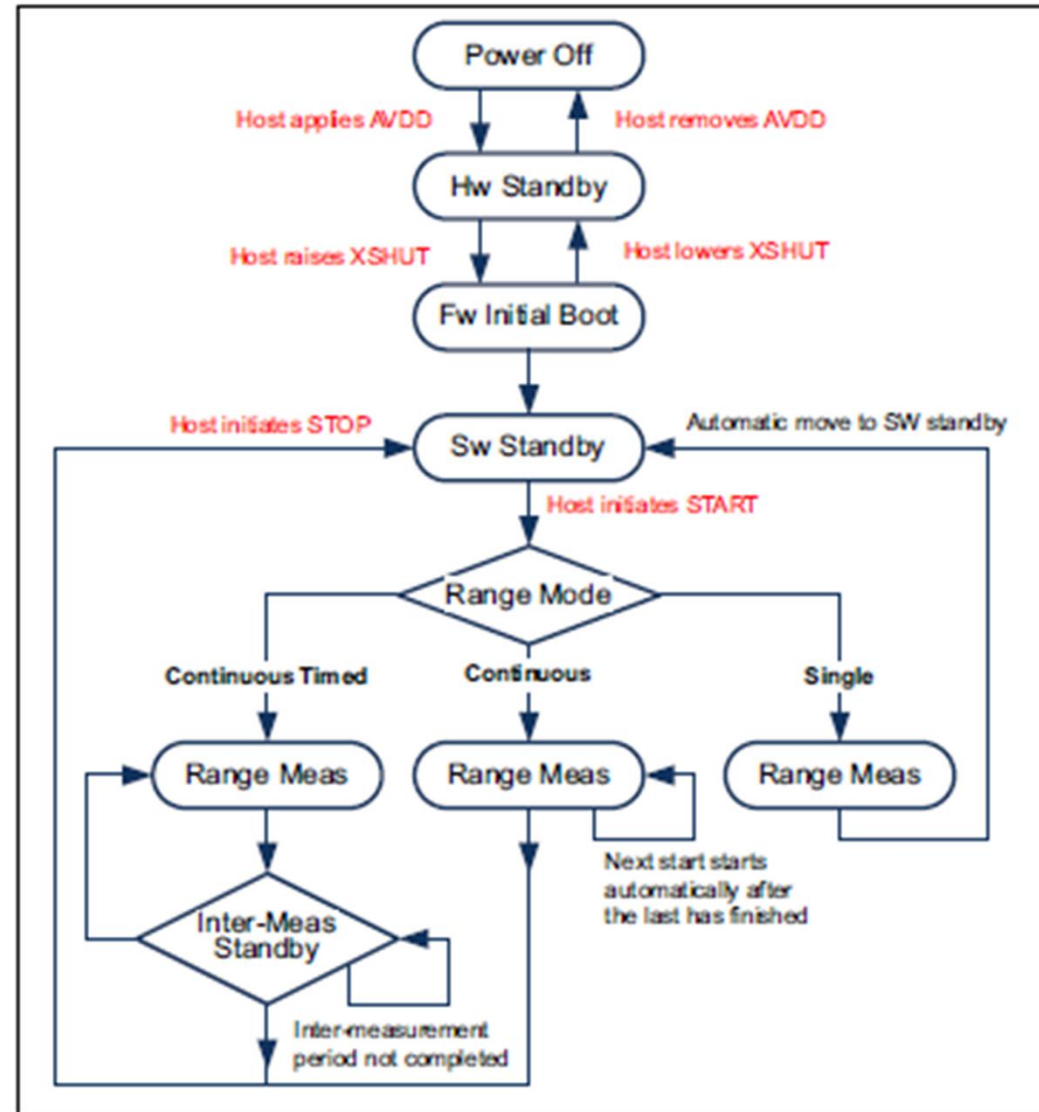


PIN description

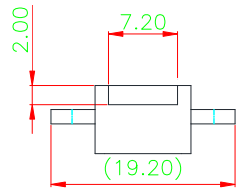
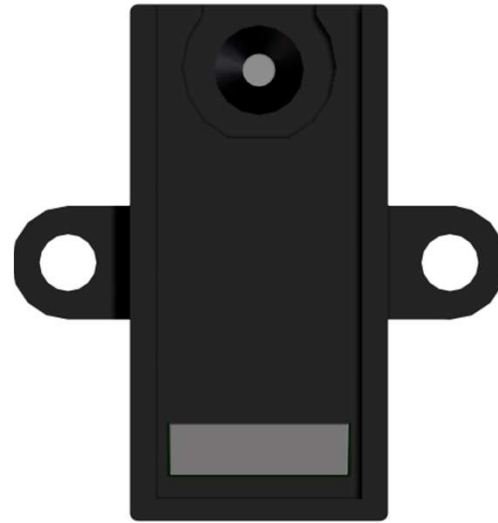
P/N	Signal name	Signal type	Signal description
①	GND	Ground	Ground
②	GPIO	Digital output	Interrupt output. Open drain output.
③	SCL	Digital input	I2C serial clock input
④	XSHUT	Digital output	X shutdown pin, Active LOW
⑤	SDA	Digital Input/output	I2C serial data
⑥	AVDD	Supply	Supply

KMED104C _ Software

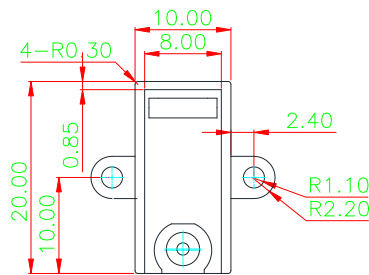
Firmware state machine description



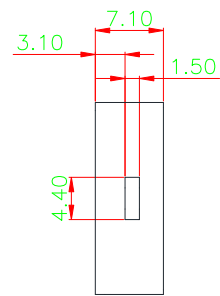
KMED104C Design



TOP



FRONT

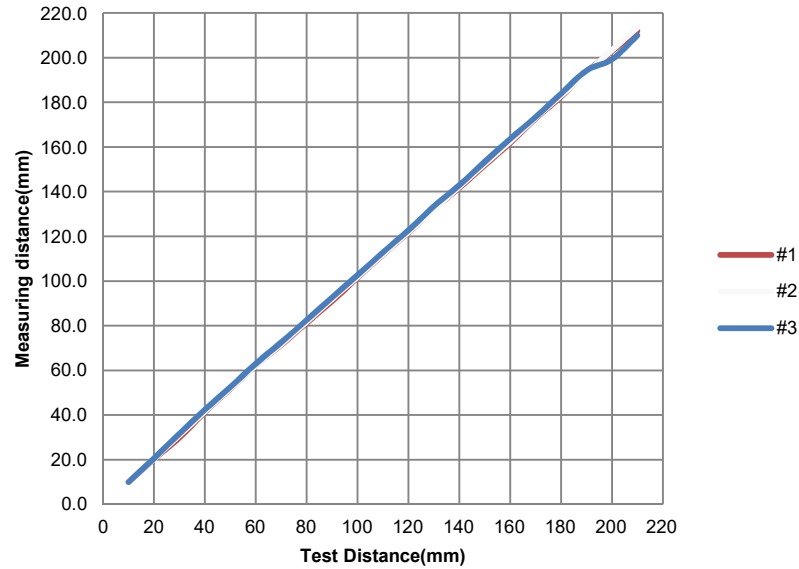


RIGHT

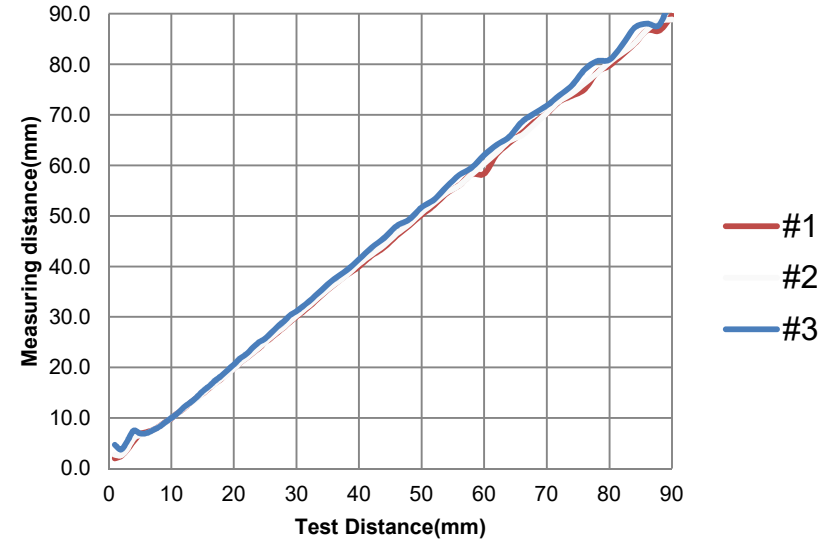


KMED104C_Distance

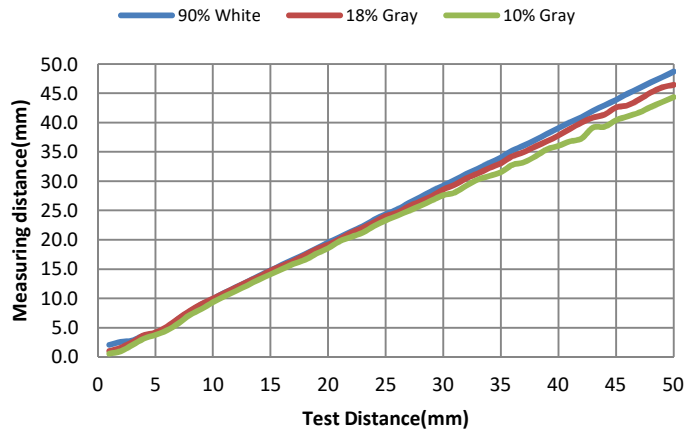
Distance Test _ White paper(90%)



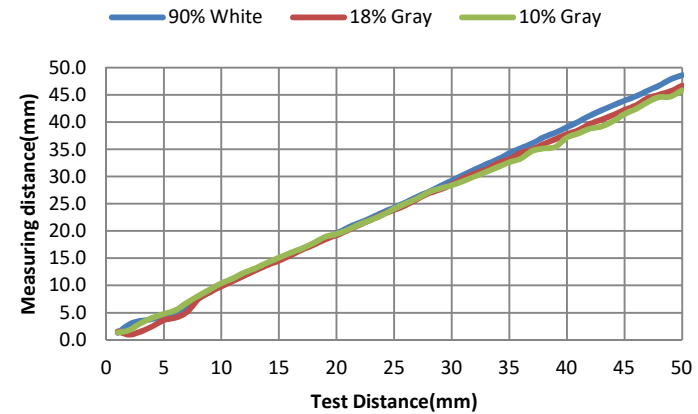
Distance Test _ Gray paper(10%)



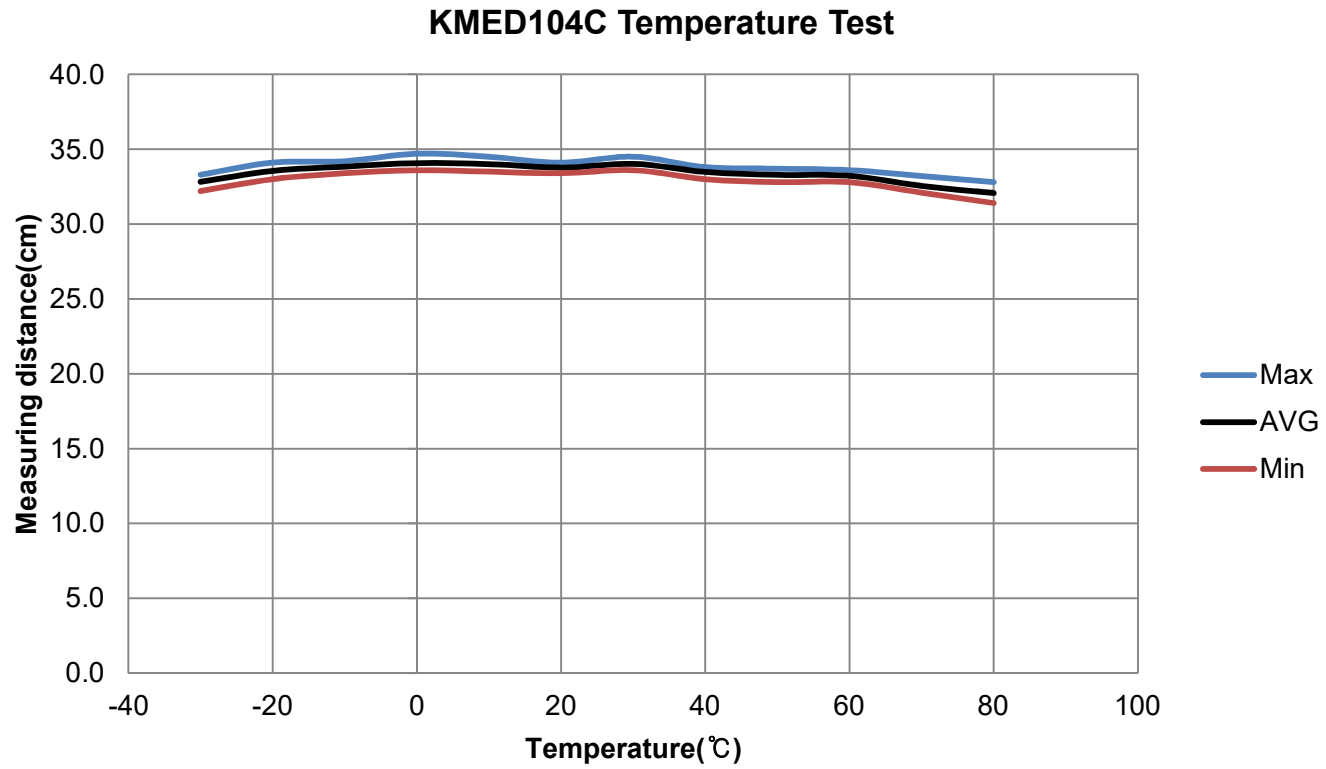
Distance Test(90% Cal)



Distance Test(18% Cal)

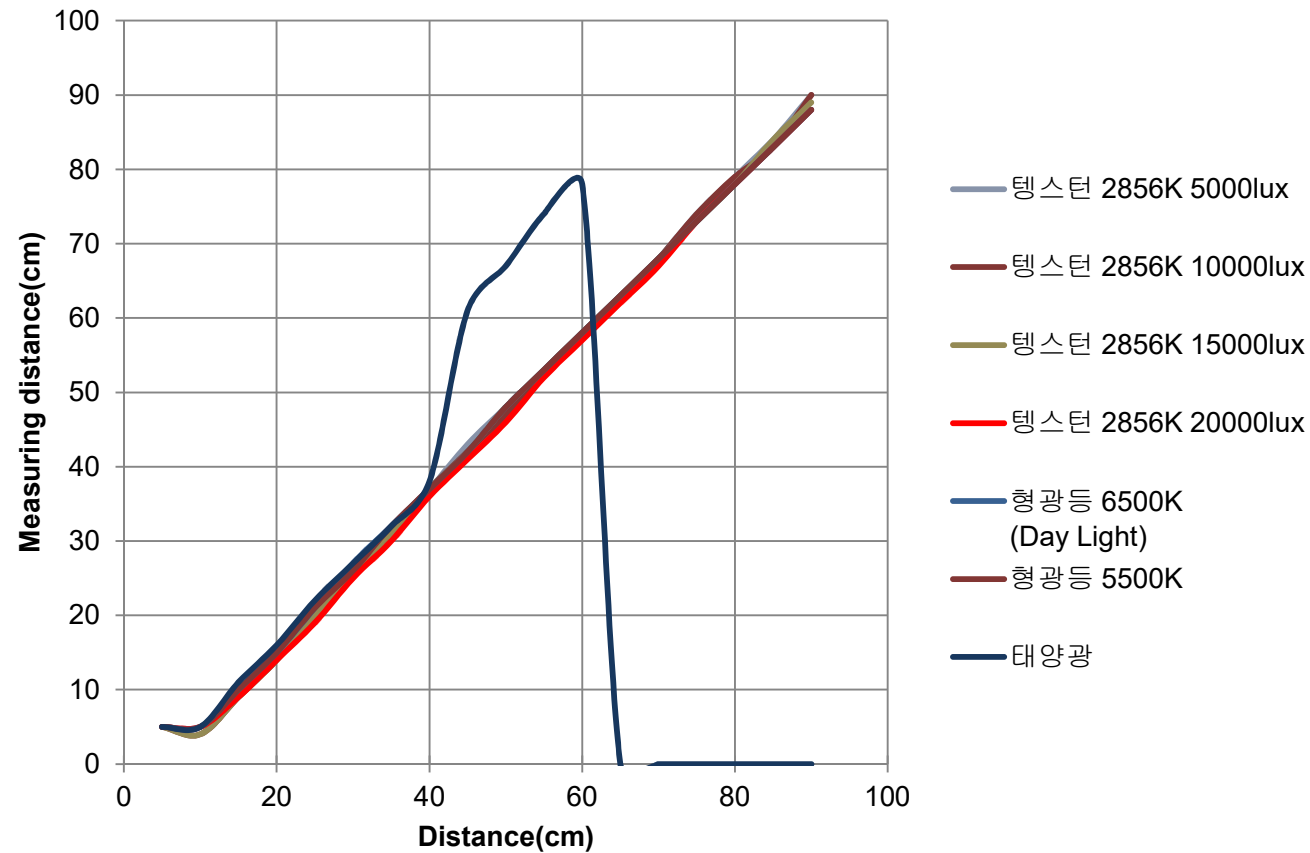


KMED104C _ Temperature

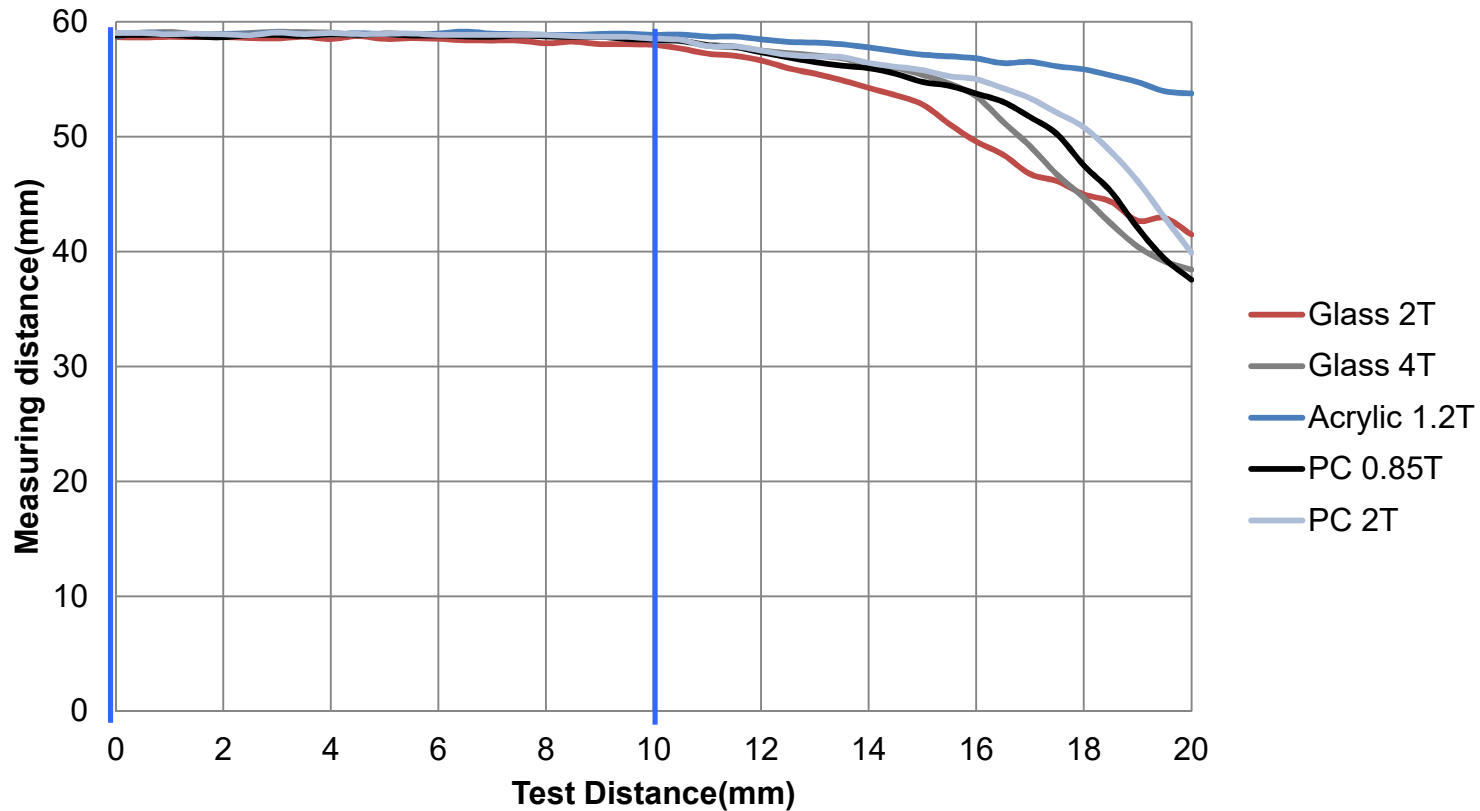


KMED104C _ External light

External Light Test



KMED104C Glass Air Gap



ToF Sensor Module _ Application

- Applications

A. Robot



Robot



Robotic Vacuum



Drone

B. Security



Iris-Scanning



CCTV Camera



Door-lock

C. Industrial



AGB

(Automated-guided Vehicle)



Parking Control



Heavy Machinery

D. Energy-Saving



Intelligent LED



Signage Display Ad



Urinal