Thermal Camera Fever Detection

Thermal Camera
Quarantine at the airport
Fever Screening in public area

COX
#810, Hanwha Biz Metro 1-cha, 242, Digital-ro, Guro-gu, Seoul, Korea (Zip: 08394)
Phone: 82-2-857-3888, Fax: 82-70-7614-3871 E-mail: sales@coxcamera.com
www.coxcamera.com

1. Introduction

As tremendous number of people move from one country to another for reasons such as tourism and trade, respiratory diseases like SARS, Zika virus cases, MERS and the infection by new corona virus have terrorized the world every few years, one after the other. In particular, the respiratory disease caused by the new corona virus, which was recently reported to have started in the Chinese city of Wuhan, has become so rapid that it became a very important task to separate person with fever from others, not only in quarantine officials in all airports and ports but also in schools, hospitals, hotels, resorts, sports stadiums, and other public areas where there are a lot of people coming and going.

COX Co., Ltd. which has devoted itself to the development and production of various un-cooled thermal cameras since its establishment in 2010, proposes reliable and cost-effective fever detection & screening packages that identify a person with a fever in public facilities such as airports, ports, schools, hotels, resorts, sports stadiums, and hospitals based on its various experience in the domestic and overseas markets.

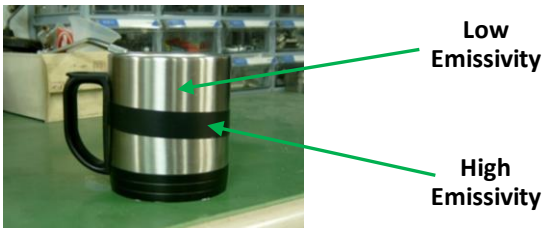
2. Temperature measurement and fever detection

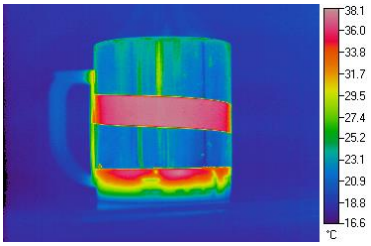
Screening people with fever using a thermal camera is basically utilizing the temperature measurement function of the thermal camera, which is the basic function of the thermal camera.
People who move in public areas naturally wear clothes, so we have to measure the temperature of the exposed face of the body.
Wearing a mask on the face makes the exposed face area too small, and we can measure the temperature of face accurately, and we have to arrange people to take off the mask when people pass by the camera.

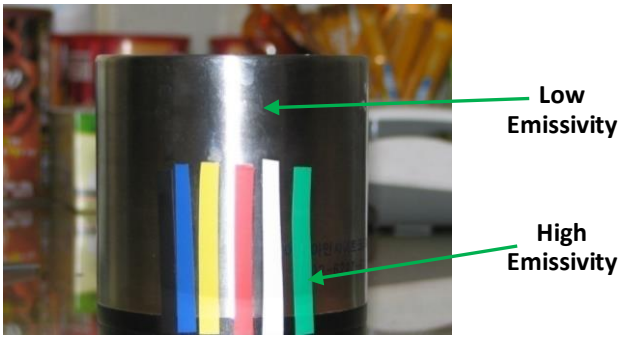
Temperature we measure using radiometric thermal camera is an absolute value?
Some camera companies insist it is absolute value with an accuracy of +/-0.5℃ or even+/-0.2℃ , but we have to frankly say thermal cameras including FLIR cameras measure relative temperature, that is, temperature difference between objects in the image, with an accuracy of +/-2, due to very technical reasons described below.

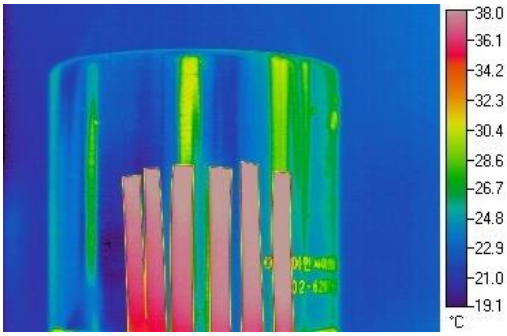
The principle of the thermal camera is to take infrared radiation from the objects above absolute temperature of 0K and then make image and obtain temperature values through a complex algorithm. The amount of infrared radiation from the object depends on emissivity of the object. If the emissivity of the object is high, measured temperature by thermal camera is high.
What is very interesting is emissivity of the object varies by material of object, surface treatment,

color and others.









If the temperature of the human body is 37 degrees Celsius, the temperature of the face is exposed to the atmosphere, which removes heat from the face, and consequently real temperature of the face is naturally below 37℃.

Thick make-up on a person's face would make a difference in emissivity, and even at the same temperature of the body, the temperature of the face measured by the thermal camera would be different. Further, temperature of the face of persons of white, yellow, or black shall be different, even though real body temperature is same. For those who sweat on the face a little more than others, the face temperature measured by thermal camera will appear relatively lower, as the evaporation of the water of sweat will cause them to subtract more heat. It also depends on whether the camera reads the temperature of face by looking directly at the face and looking at the face at the angle. Of course, if camera looks at a person's face and measure it, the temperature measured will be a little higher.

The thermal camera is a very sensitive device, so temperature measurements change if there is a little wind or humidity changes in the area where the camera is installed.

There are a number of other factors that change the temperature of a person's face.

Therefore, when measuring the temperature of a person's face with a thermal camera with a purpose of detecting a person with fever, the measured value should not be considered an absolute temperature value but should be recognized as a relative temperature value.

It should be thought that identifying people who have fever with a thermal camera is identifying people who have relatively high facial temperature compared to others, in a group.

After finding a person whose face temperature is relatively higher than others with a thermal camera, you can accurately measure the temperature in the ear using ear thermometer and determine whether the person has or does not have a fever.
After all, the thermal camera is used to identify people who are likely to have the fever and the final judgment is after you measure the temperature of selected person using ear thermometer.

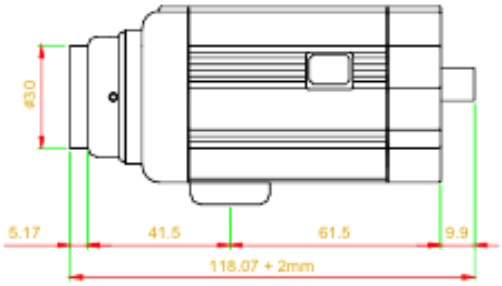
3. Components of the fever detection package

The system includes the following components for screening people with relatively high facial temperature from people pass by the thermal camera.
Since it is usually a measure of a person's face temperature within a distance of 20 meters, consider the camera price and choose a 384x288 resolution camera rather than a 640x480 resolution camera, and the lens with a horizontal FOV between 44° and 20°.

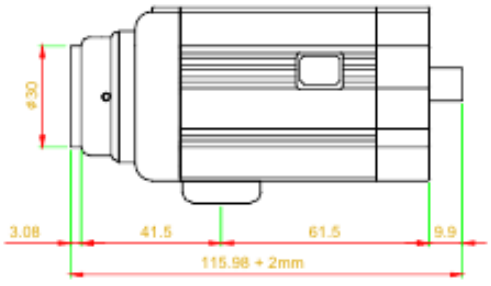
1) Radiometric thermal camera
   Thermal camera for temperature measurement of medial measurement range between 20° and 50° or thermal camera for temperature measurement of normal measurement range which is up to 120°

   Model name of COX thermal camera is CG320.

   Lens: We recommend to adopt athermalized lens of 8.13mm f1.16 and 15mm f1.0.
   FOV of those lenses are 47.4°/35.1° when paired with CG320 and 24.5°/18.5°, respectively.



CG320 paired with 8.13mm athermalized lens



CG320 paired with 15mm athermalized lens

2) PC software

Software that processes the temperature raw data sent by the camera through the IP network to show the thermal image, perform various analysis, send alarm signal to camera for making some device like warning lamp glitter, and record thermal image or temperature data as per the set parameters when a person with a face temperature higher than the set temperature is detected.

In the package of CG320, several different kinds of PC software are included free of charge.

a) One channel analyzer

Software that processes data from one camera

b) Quad channel analyzer

Software that processes data from up to four cameras to show the thermal image and perform various analysis

c) Camera controller

Access to the camera via IP network and set various parameters like ROI setting, temperature setting in ROI, and others.

3) PC or laptop

This is to run PC software such as the One channel analyzer or Quad channel analyzer, to execute various analysis, and store thermal images or temperature data as per the parameters set in advance when the alarm is triggered.

Basic PC software for fever detection is One channel analyzer and it is used when we connect one CG320 to PC in 1:1 configuration (1:1 connection).

All settings including ROI (Region of Interest), temperature value in the ROI, recording parameters, alarm setting and others is memorized in One channel analyzer even though we turn off the PC and turn on again next day, and we can start fever screening without setting again next day. Of course, we have to keep camera turned on for about 30 minutes to get stable measurement temperature value (camera stabilization).

Quad channel analyzer is up to 4 channel version of One channel analyzer and basic function available in the software itself is same.

The only difference is we have to have high performance PC to run Quad channel analyzer, because it requires processing by both CPU and GPU to process temperature raw data from up to 4 cameras. Processing temperature raw data from 4 cameras requires big processing capacity and that is why Quad channel analyzer is based on parallel processing which use both CPU and GPU of the PC system.

Detail specification of PC in case user connect up to 4 cameras to one PC is specified in the page 8 and 9.

4) Warning lamp

If the face temperature measured is above the set temperature, the PC software sends alarm signal to camera and the camera outputs an alarm signal.

We recommend to connect some device like LED lamp to #4 and #5 relay port of the camera To make this lamp glitter when PC software detects facial temperature higher than set temperature.

When the warning lamp flashes, the inspector calls the person and checks the temperature inside the ear to check if the person has a fever.

Warning lamps are not within the scope of the COX supply.

The power supply of the warning lamp and the cabling for receiving alarm signals from the camera shall be handled by the user, referring to the information described in this document.

5) Tri-pod

Install the camera and then adjust it in the desired direction so that the camera can take thermal images of the people who move.

If necessary, install the warning lamp on the tri-pod, too.

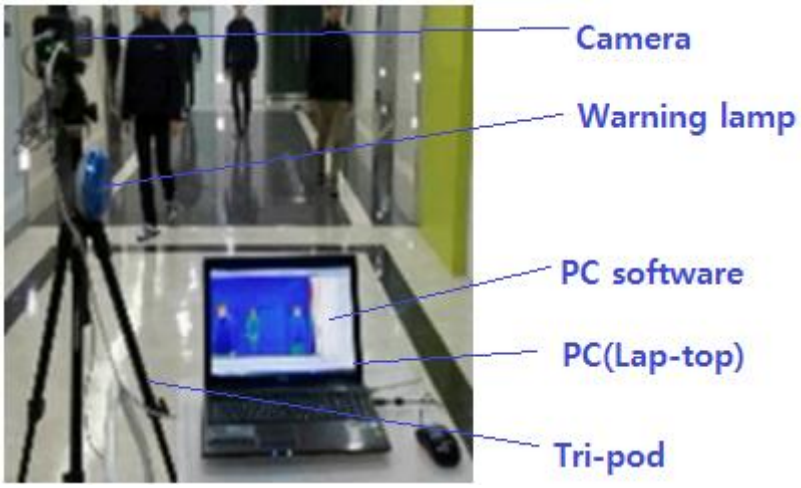
6) Accessories

a) Power adaptor for the camera: 110/220VAC to 12VDC (total length: 2.5m)

b) Ethernet cable: Connect the camera to the PC (total length: 2m)

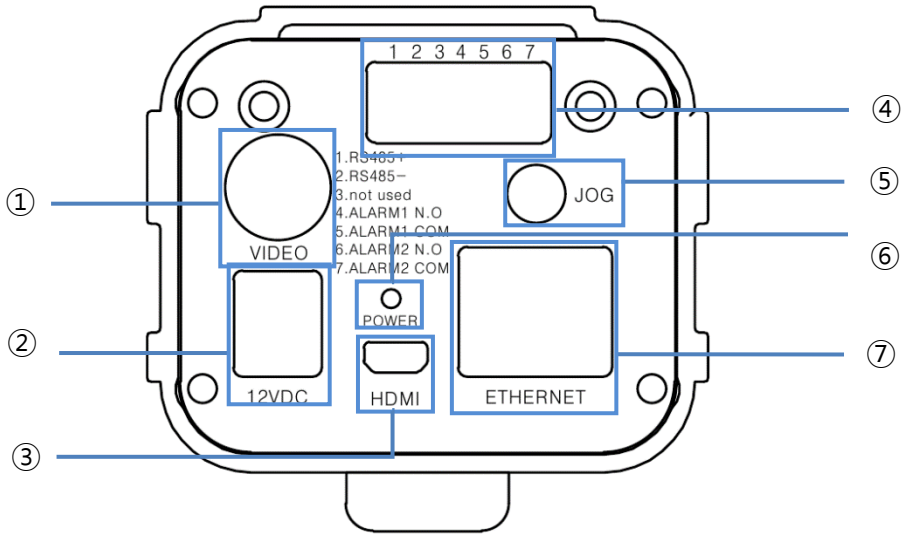
c) CD

The CD contains the user manual of the camera and the user manual of the PC software.



4. Alarm configuration

Camera rear interface



① CVBS (composite video) output (BNC port)
② 12 VDC power in
③ Micro HDM port
④ Digital I/O port

1	2	3	4	5	6	7
RS-485		N/A	ALARM 1		ALARM 2	
RS-485+	RS-485-		SW1 NO	SW1 COM	SW2 NO	SW2 COM

⑤ Jog switch
⑥ POWER LED
⑦ RJ45 port

Cabling for warning lamp (from power and to alarm output relay)

User must provide power to warning lamp separately or other device which will be operated when camera outputs alarm signal, as shown in the picture on the left.

Cabling must be done as shown in the captured image on the left.
Relay I/O port of #4 and #5 play a role of switch. That is, when camera outputs alarm signal, digital I/O port of #4 and #5 is connected and power supply to the warning lamp is completed and warning lamp flashes.

Specification of digital I/O port(relay)

1) Max. Voltage: 250V
2) Max. Current:
   a) AC+DC: 200mA
   b) DC only: 350mA
3) General practice: Normally, engineers in power field use voltage and current under 50% of rating.

5. Thermal camera fever detection demonstration video

This is a demonstration video that shows how to identify people with higher facial temperature than others, while people on the walk using a thermal camera.
When you play the video, you'll see a video taken by mobile phone camera on the right and video taken by the CG320 thermal camera on the right, and the warning lamp will flash when a person with much higher facial temperature pass by the camera.

Video taken by mobile phone camera Thermal video taken by CG320 thermal camera

If a quarantine officer sits in front of a laptop PC and looks at a CG320 camera's thermal video, he or she can recognize which person's face temperature is higher than others.
In addition, we can make the preset wave file play, record the image or make the border of thermal image may flash red, if the face temperature of a person is higher than the set temperature, if we set in the thermal imaging analyzer or quad channel analyzer.
Of course, you can set thermal imaging analyzer or quad channel analyzer to record corresponding thermal images or temperature data at this moment.

<link> Demonstration video

Google drive link to download video sample and other technical document:
https://drive.google.com/open?id=1cqM2bbI4XZN2XP4u5KEsYTHNc_3NeTjm

6. Reference product

1) CG320 paired with 8.13mm f1.16 athermalized lens
2) CG320 paired with 15mm f1.0 athermalized lens

Notes: According to order quantity, we offer a certain rate of discount.
Standard delivery is 4 weeks more or less according to order quantity.

7. Fever detection package

COX also propose thermal camera fever detection solution as a package.

This package includes

1) CG320 thermal camera with normal measurement range (up to 120℃)

Power adaptor for camera, Ethernet cable and alarm cables are included in the package.

2) Lens
   - 8.13mm f1.16mm athermalized lens of FOV of 47.4°/35.1°
   - 15mm f1.0 athermalized lens of FOV of 24.5°/18.5°
3) Notebook PC: Samsung 7 Force Core™ i5 / 256 GB SSD
   Intel® Core™ i5 Processor 8265U (1.60 GHz up to 3.90 GHz 6 MB L3 Cache)
   8 GB DDR4 Memory (On BD 8 GB) 1 SODIMM
   NVIDIA® GeForce® GTX 1650 Max-Q Graphics with GDDR5 4 GB Graphic Memory
   802.11ac wave2 2x2 (GIGA Wi-Fi) Gigabit Ethernet [10/100/1000]

   PC software like thermal imaging analyzer or quad channel analyzer already installed on PC.

In case more than one camera up to 4 cameras are connected to one PC, we recommend higher performance of notebook PC as follows, because we need to use processing capacity of both CPU and GPU of the PC.

Core™ i7 / 256 GB SSD + 1 TB HDD

Intel® Core™ i7 Processor 9750H (2.60 GHz up to 4.50 GHz 12 MB L3 Cache)

Intel HM370

NVIDIA® GeForce® GTX 1650 Graphics with GDDR5 4 GB Graphic Memory

Notebook PC can be excluded from the package if customer wants.

4) LED glittering lamp

Glittering when a person whose face temperature is higher than set temperature detected. Double side adhesive tape on the bottom of lamp makes it easy to put on the table on which PC is installed or on the post of tri-pod.

5) Tri-pod

Max. height: 1.43m

6) IR portable thermometer

A thermometer that accurately measures the temperature of a person who is suspected of having a fever. It measures the temperature of the forehead or ear of the face.

Price by components

Components	Price (US$)	Remark
Camera and lens		CG320 paired with 8.13mm f1.16 athermalized lens or 15mm f1.0 athermalized lens. Including AC/DC adaptor, Ethernet cable and cables(alarm and power to prepared for easy installation and connection/Installation and user manual
Notebook PC		PC software installed for readiness in use
		In case more than one camera up to 4 cameras are connected to one PC (use processing capacity of both CPU and GPU/parallel processing is required because amount of data processing so big)
LED glittering lamp		Glittering when facial temperature of a person exceeds set temperature
Tri-pod		Camera is installed on tri-pod to take video of people moving around
Portable thermometer		a portable thermometer to accurately measure a person's temperature when a person is detected with a face temperature higher than the set temperature.
Total		One camera connection configuration

Reference(COX thermal cameras)

In local market(Korea)

Project	Model and quantity	Remarks
Korean Military(2013)	CX600 w/75mm lens, 380 units	
Military Rear Critical Facility Surveillance (1st stage) (2 years from 2017)	CG600-IP w/100mm lens, 86units	
Military Rear Critical Facility Surveillance (2nd stage) (3 years from 2019)	CG600-IP w/100mm lens and 100mm zoom lens, 16 units (in the 1st year)	
Boyoung power plant fire prevention in coal storage	CG320 35mm lens, 32units	Cameras are installed on the ceiling to measure temperature of coal storage yard
POSCO underground utility tunnel fire prevention	CG320 8mm/12mm lens, 32units	Super high voltage power cables and communication cables fire prevention
POSCO fire prevention (furnace area)	CG640 20mm lens 38units	
Han River Bridge Suicide Monitoring System	CG640 35mm lens, 26units	Detect the location of a suicidal man in the water by throwing himself on a bridge.
Marine cops surveillance	CG600-IP 75mm lens, 39units	
Daegu airport Fever detection	CG320 20mm lens, 26uits	2019
Gimhae(Busan) airport Fever detection	CG320 12mm lens, 24units	2019
Incheon airport Fever detection	CG320 12mm lens, 18units	2018
Fever detection in general hospital lobby and other public area	CG320 15mm/8.13mm lens, 120~units Due to the outbreak of the new coronavirus, many cameras have been installed for fever detection in public area, and this number shall be increased much as time goes by.	Several university general hospital, Samsung head office, Sangam football stadium, Gochuck dome baseball stadium, health centers in many provincial governments, shopping centers, hotels, and many others.

In overseas market

- Swiss tunnel fire surveillance project: 59sets CG640-35mm lens
- Fire surveillance at the French waste disposal project: 38 sets CG640 12mm/20mm lens
- UK psychopathic criminal's prison/Hospital project: 58sets CG600-IP-40/50/55/60mm lens.
- Dubai Army: 335sets Night Vision CN300M.
- BMC in Turkey (manufacturer of armored vehicles): 250sets Night Vision CN300M.
- Dubai Police project: 780 sets Night Vision CN300M(on going project)

FLIR fever screening camera:

The biggest player in the global market for thermal imaging cameras is FLIR based in the U.S., and the global market share is known to be more than 50 percent, combining the security and measurement camera markets.

Among FLIR's thermal cameras, the most commonly used camera for Fever screening applications is the FLIR A325sc series. We compare the A325sc camera with the COX CG320 camera, as follows.

Item	FLIR A325sc	COX CG320	Remarks
Thermal Detector	Uncooled microbolometer		
IR spectral range	7.5-13.5μm		
Detector resolution (pixels)	320x240	384x288	Cox has 44 percent more pixels than FLIR sensors.
Detector pixels pitch	25μm	17μm	FLIR sensor: 8 years ago technology/Cox sensor: 3 years ago technology
NETD (thermal sensitivity)	<50mK @f1.0, 30Hz, 300K		Same sensor thermal sensitivity
Frame rate	60Hz	30Hz/60Hz(optional)	A little better picture quality at 30 Hz
Dynamic range	14 bits		Data processing unit equal
Digital data streaming	GiGa bit Ethernet		
Measurement range	-20℃ ~ 120℃		
Standard accuracy	+/- 2℃ or +/-2% of reading		
Standard lens f/#	f1.3 (18mm(25°) lens	f1.16 (8.13mm)	The lens f/# of the Cox camera is lower and therefore has a higher infrared intensity to be transmitted to the sensor.
Digital data via PC (PC software)	ResearchIR Software	Thermal imaging analyzer	Software configuration is very similar
Operating temperature	-15℃ to 50℃	-10℃ to 60℃	
Size	170mmx70mmx70mm	118mmx62mmx58mm	Including lens

Outdoor fever screening camera:
LTEV01 Housing for COX fever detection thermal cameras

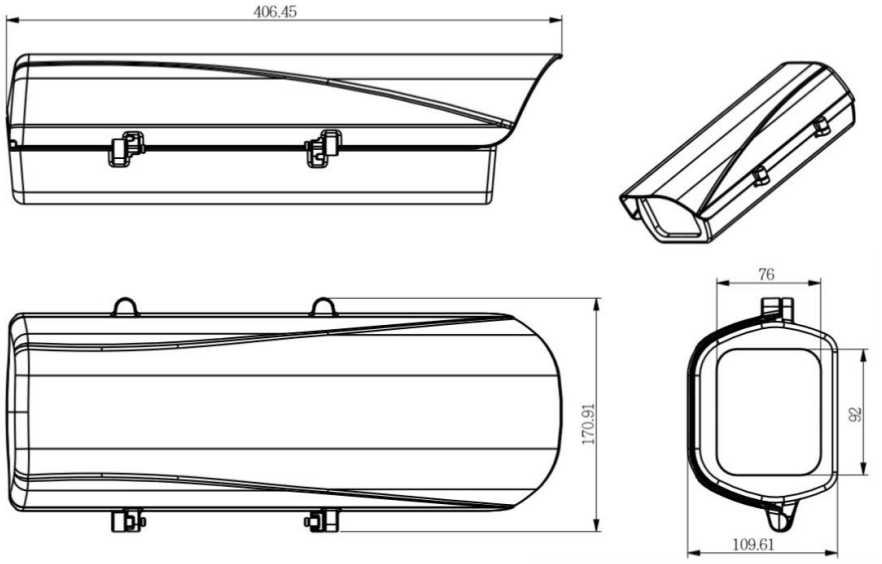
COX supplies IP68 Al die-casting housing suitable for accommodating fever detection thermal camera, for use in harsh atmosphere, like outside of the building.

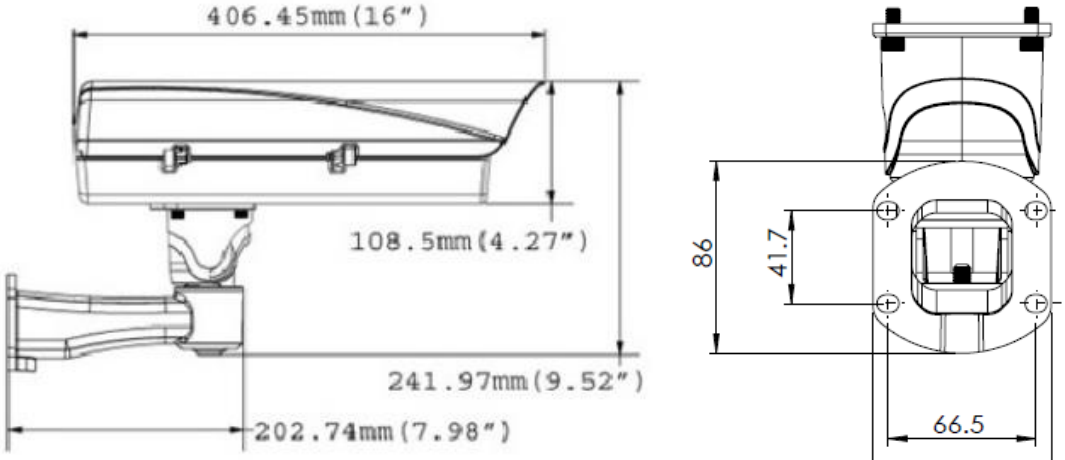
In case fever detection camera must be installed outside of the building, we strongly recommend to put fever detection camera inside LTEV01 housing.

Specification of IP68 housing (COX LTEV01) with wall bracket

Specification	LTEV01 Housing
Weight	4.0 Kg w/o lens and wall bracket 4.4Kg including wall bracket, w/o lens
Internal usable size (L, W, H)	100mm x 80mm x 335mm
Input Voltage	110VAC or 220VAC (housing) 12VDC (camera/adaptor)
Fan & Heater	Included (Heater: On at 15+/-3℃ and Off at 25+/-3℃ Fan: On at 35+/-3° and Off at 25+/-3℃)
IP Rating (dust & water ingress)	IP68
Operating Temperature Range	-40℃ to 60℃
Storage Temperature Range	-55℃ to 70℃
Humidity	0-95% relative
Material/Construction	Aluminum/Die-casting
Cable management bracket	included
Opening way	Side opening
POE	Included(option)
Wiper	Not included (for Ge window/thermal camera)
Ge window	Included Thickness/Diameter of Ge window as per lens paired with COX thermal camera

Dimension of housing





Dimension of wall bracket

Wall mount bracket holes

Max tilting down angle is 60 degrees.

Unit price the housing with Ge windows

Lens	Focal length	Ge window (DLC+AR coating)	Price of LTEV01 housing with Ge window
Thermal camera paired with athermalized lens	7.5mm~25mm	3t/ϕ30	

Note: Above price is based on LTEV01 housing with built-in Fan and Heater.
Wall mount bracket is included in the package.
Power input to housing is 220VAC or 110 VAC.