

# FOTRIC R&D Thermal Cameras

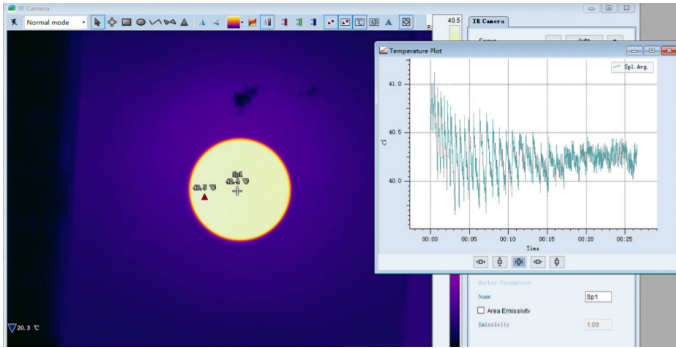
- > Research & Development
- > Industrial Labs
- > PCB & Circuit Board Analysis



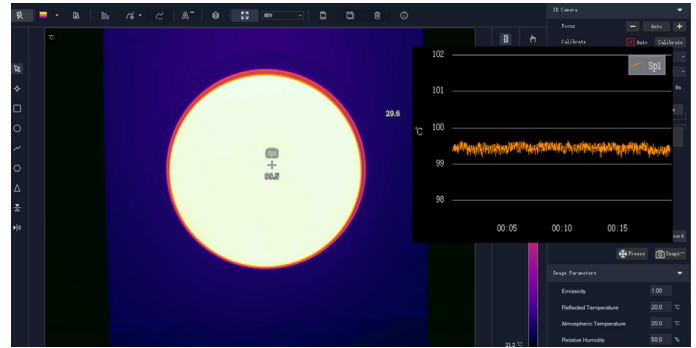
# Ensure Data Integrity

## > Your data is only as trustworthy as your instrument

10 years of unwavering dedication culminates in unparalleled stability.

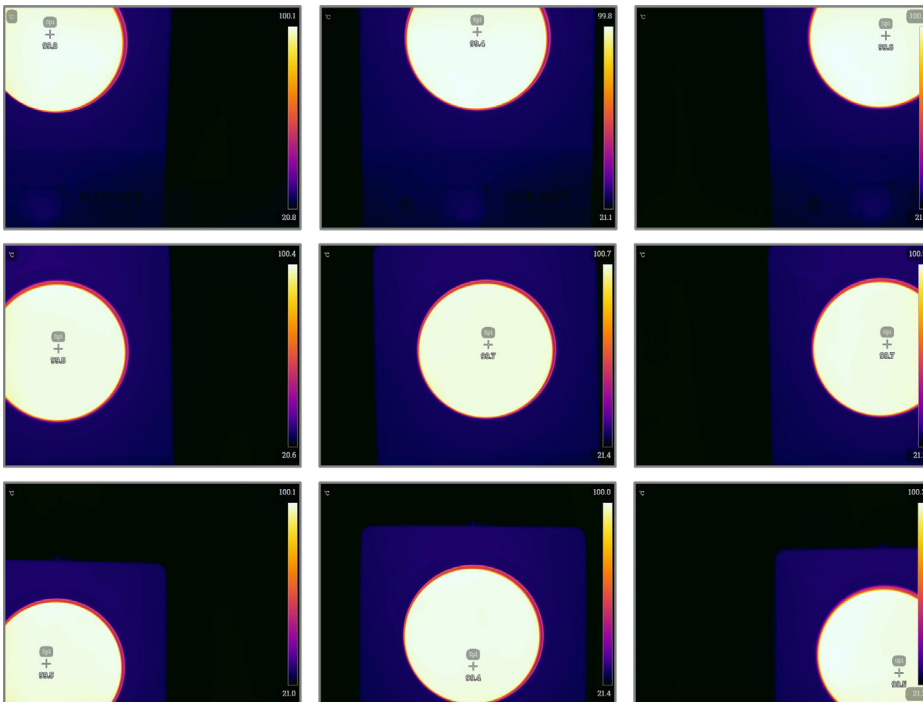


**Then** | 1°C thermal fluctuation, Reaches equilibrium after 20 minutes



**Now** | 0.5°C thermal fluctuation, Reaches equilibrium after 5 minutes

## > Accurate on every pixel

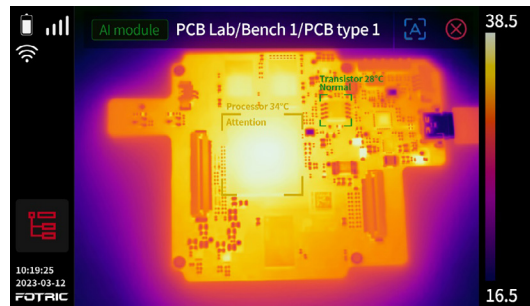


**±0.4°C**  
Extraordinary uniformity

# Enhance Research Efficiency with AI Research Assistant

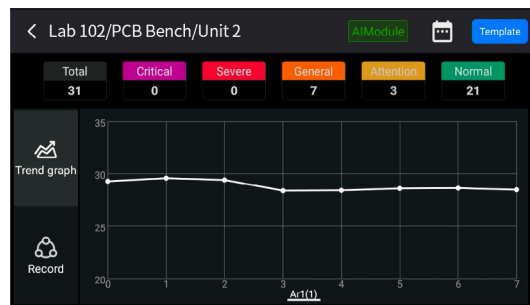
## > AI-powered Object Recognition

The FOTRIC 228 Pro thermal cameras come with an advanced object recognition feature. This functionality automatically identifies components based on previous encounters, generating temperature measurement boxes accordingly. Moreover, it assigns diagnoses according to user-set standards, thereby optimizing both time and energy.



## > On-device Trend Analysis

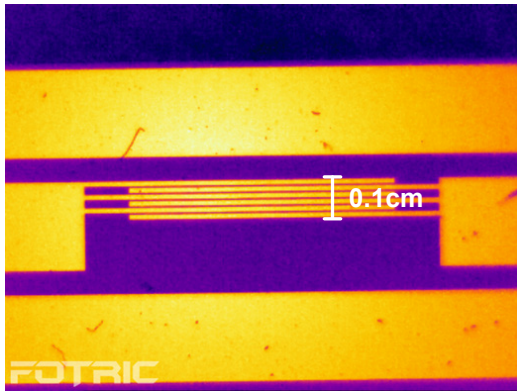
The FOTRIC 228 Pro thermal cameras feature an on-device trend analysis capability. This enables researchers to gain clear insights into the performance of samples across varying environments over time, or to identify thermal defects in production streams efficiently.



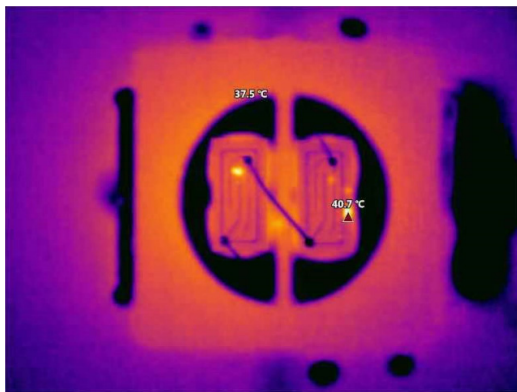
# Unlock Discovery with Unprecedented Clarity

## > Up to 20 $\mu$ m Macro Lens

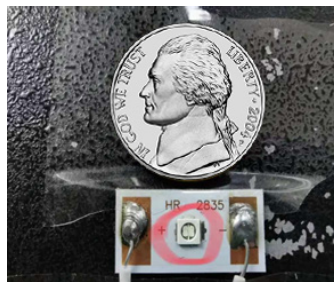
The FOTRIC macro lens boasts outstanding optical performance, effortlessly capturing clear images of extremely fine details and providing precise temperature distribution data.



Electrode etching



LED chip



# Unleash Your Video Data's Full Potential

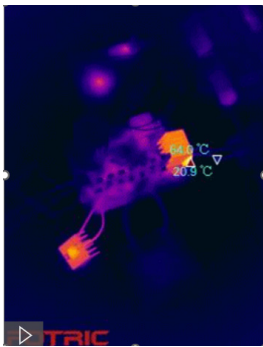
## > Radiometric Mastery

The AnalyzIR software supports dissecting your video data from every aspect.

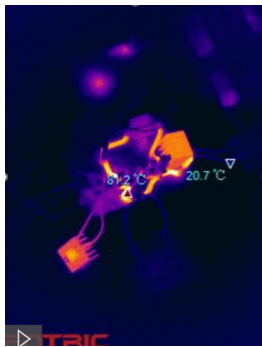


## > Frame by Frame Analysis

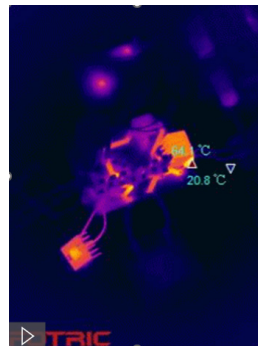
The fleeting moment when the rectifier bridge is pierced by the current.



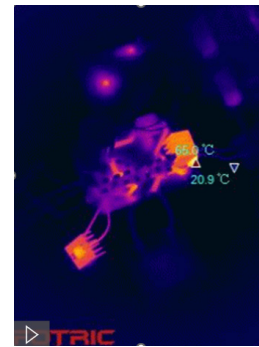
2min 2sec 291ms



2min 2sec 385ms



2min 2sec 525ms

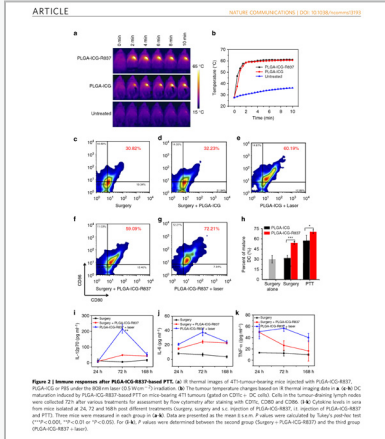


2min 2sec 666ms

After analyzing frame by frame with AnalyzIR, it became evident that the sudden rise in temperature was caused by the current piercing the rectifier bridge, initially suspected to be an issue with the DSP (digital signal processor).

# Trusted by Researchers Across the Globe

## ► Publication List



**Figure 2** Immune response after PLGA-ICG-R837-based PDT. **a**, Normal images of 4T1 tumour-bearing mice injected with PLGA-ICG-R837, PLGA-ICG or PLGA (n = 10) under 810 nm laser irradiation. **b**, The tumour temperature change before and after laser irradiation at a 0.5 W/cm<sup>2</sup> laser power density. **c**, The tumour temperature change before and after laser irradiation at a 0.5 W/cm<sup>2</sup> laser power density. **d**, The tumour temperature change before and after laser irradiation at a 0.5 W/cm<sup>2</sup> laser power density. **e**, The tumour temperature change before and after laser irradiation at a 0.5 W/cm<sup>2</sup> laser power density. **f**, The tumour temperature change before and after laser irradiation at a 0.5 W/cm<sup>2</sup> laser power density. **g**, The tumour temperature change before and after laser irradiation at a 0.5 W/cm<sup>2</sup> laser power density. **h**, The tumour temperature change before and after laser irradiation at a 0.5 W/cm<sup>2</sup> laser power density.

**Article:** «Photothermal therapy with immune-adjuvant nanoparticles together with checkpoint blockade for effective cancer immunotherapy»

**Publication:** «Nature»

**Model:** FOTRIC 225

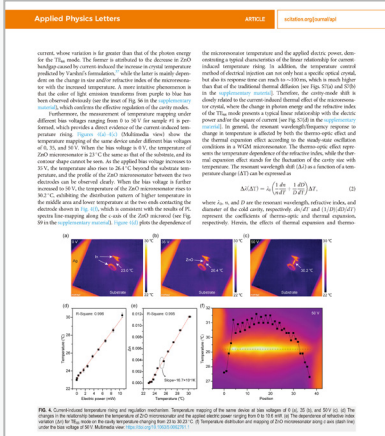
mouse sera after found that mice of IL-12p70, those in sera of ementary Fig. 4). effect of PLGA-stained release of

Such results suggest that R837-containing nanoparticles could potentially act as an adjuvant to promote immunological responses of tumour-associate antigens in cell residues.

In our further *in vivo* experiment, BALB/c mice-bearing subcutaneous 4T1 tumours were intratumourally (i.t.) injected with PLGA-ICG or PLGA-ICG-R837 and then irradiated by an 808 nm laser at the power density of 0.5 W cm<sup>-2</sup> for 10 min. As monitored by an infrared thermal camera (Fotric 225), the tumour temperature of mice injected with PLGA-ICG or PLGA-ICG-R837 under laser irradiation quickly rose to ~60 °C, which was high enough to effectively ablate tumours

93 | www.nature.com/naturecommunications

3



**Fig. 4** Controlled temperature field and temperature distribution. **a**, Schematic diagram of the micro-resonator. **b**, Photograph of the micro-resonator. **c**, Temperature profile along the x-axis. **d**, Heat flux profile along the x-axis.

**Article:** «Dynamic regulating of lasing mode in a whispering-gallery micro-resonator by thermo-optic effect»

**Publication:** «Applied Physics Letters»

**Model:** FOTRIC 228S

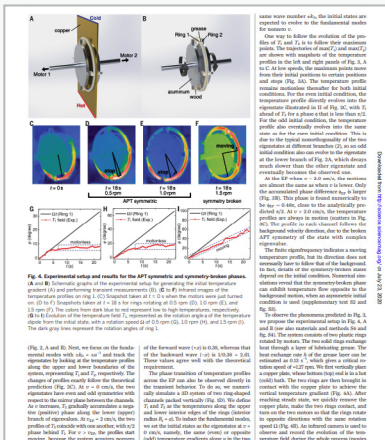
ation of the cavity to develop the photonic

to the ZnO (inductivity to (rial) without see Fig. S1 in by electrical lasing mode effect and the

0.03 nm) equipped with a CCD detector and the optically triggered streak camera (Optronix, Optoscope sc-10). The absorption spectrum is measured by a UV-Vis-NIR spectrophotometer (UV-3600 Plus, Shimadzu). The bias voltage is applied through a low-noise power supply equipment (Keysight, 2961A). The temperature mapping is presented by a thermal imager (FOTRIC, 228S-M20) equipped with an infrared magnifying lens with a resolution of 20 μm. The finite difference time domain (FDTD) method is performed to simulate the electric-field distribution of the fundamental mode confined in the optical microresonator with a resonant wavelength of 400 nm shown in Fig. S2. The structure model of microresonator has a diameter of 5 μm and a refractive index of 2.3.

93 | www.nature.com/naturecommunications

3



**Fig. 5** Experimental setup and results for the anti-parity-time symmetry in diffusive systems. **a**, Schematic diagram of the experimental setup. **b**, Photograph of the experimental setup. **c**, Temperature profile along the x-axis. **d**, Heat flux profile along the x-axis.

**Article:** «Anti-parity-time symmetry in diffusive systems»

**Publication:** «Science»

**Model:** FOTRIC 233S

nd thickness around  $d = 0.5$  mm. According to the derivation following Eq. (S. 1) the rotation speed  $\dot{\theta}$  is  $\dot{\theta} = \kappa_2 (\rho c)^{-1} (h d)^{-1} = 0.13$  s<sup>-1</sup>. Therefore, the critical rotation speed  $\dot{\theta}_c$  is  $\dot{\theta}_c / (\kappa_2 \rho c) = \dot{\theta} = 1.27$  rpm. To generate temperature gradient, the bottom of the copper plate was immersed in 70 °C hot water, while the top was covered by an ice bag. The temperature evolutions were measured with a Fotric 233S infrared camera, whose imaging resolution is 160 × 120 pixel and 0.1 °C, respectively.

# Trusted by Researchers Across the Globe

## > Publication List

Publication	Article	Model
Applied Thermal Engineering	Investigation on the microwave drying kinetics and pumping phenomenon of lignite spheres	FOTRIC 226
CARBON	Spray-freezing Induced Multidimensional Morphology Tuning of Assembled Spherical Carbon for Solar-driven Steam Generation	FOTRIC 260
Carbon	Fabrication of core-shell nanostructured poly(3,4-ethylenedioxythiophene)/carbon nanotube composites with enhanced thermoelectric power factor	FOTRIC 226
Science	Anti-Parity-Time Symmetry in Diffusive Systems	FOTRIC 224S
Journal of Food Engineering	Continuous flow microwave system with helical tubes for liquid food heating	FOTRIC 285
ACS Applied Nano Materials	Plasma Cleaning and Self-Limited Welding of Silver Nanowire Films for Flexible Transparent Conductors	FOTRIC 322Pro
Nano Today	Edge confined covalent organic framework with efficient biocompatibility and photothermal conversion	FOTRIC 345
Carbon	A structure evolution mechanism for the modulus loss in electromechanical response of carbon nanotube fiber	FOTRIC 615C
Applied Physics Letters	Dynamic regulating of lasing mode in a whispering-gallery microresonator by thermo-optic effect	FOTRIC 228S
Nature	Non-Hermitian topological whispering gallery	FOTRIC 228S
Foods	Efficient Solar-Driven Water Purification Based on Biochar with Multi-Level Pore Bundle Structure for Preparation of Drinking Water	FOTRIC 226S
Applied Materials Today	Stiffness tunable implanted electrode enabled by magnetic liquid metal for wireless hyperthermia	FOTRIC 228S
Nanomaterials	Design and Analysis of a Hollow Metallic Microlattice Active Cooling System for Microsatellites	FOTRIC 618C
Applied Thermal Engineering	Thermal management of 3D chip with non-uniform hotspots by integrated gradient distribution annular-cavity micro-pin fins	FOTRIC 226S
Advanced Optical Materials	Elucidating Orbital Delocalization Effects on Boosting Electrochemiluminescence Efficiency of Carbon Nitrides	FOTRIC 285
Advanced Materials	Geometric Phase and Localized Heat Diffusion	FOTRIC 347
Advanced Therapeutics	Regulation of ID4 In Vivo for Efficient Magnetothermal Therapy of Breast Cancer	FOTRIC 228S
ACS Nano	Graphene Oxide-Grafted Magnetic Nanorings Mediated Magnetothermodynamic Therapy Favoring Reactive Oxygen Species-Related Immune Response for Enhanced Antitumor Efficacy	FOTRIC 228S
ACS Nano	Ferrimagnetic Vortex Nanoring-Mediated Mild Magnetic Hyperthermia Imparts Potent Immunological Effect for Treating Cancer Metastasis	FOTRIC 228S
Nature	Brown-fat-mediated tumour suppression by cold-altered global metabolism	FOTRIC 285

# Specification of 228Pro

Models	FOTRIC 228Pro
<b>Core Parameters</b>	
Thermal Resolution	640*480
Super Resolution(SR)	1280*960
IR Detector Type	Uncooled FPA infrared detector
Thermal Sensitivity (NETD)	30mk(0.03°C)
Detector Pitch	17µm
Spectral Range	7~14µm
Frame Rate	30Hz
Field of View (FOV)	25°x 19°
IFOV	0.68 mrad
Minimum Focus Distance	0.25 m
f-number (Focal length)	f24.8
Focus Mode	TurboFocus™ Speedy Intelligent Autofocus system for continuous, laser distance, graphic contrast, manual
Lens Detection	Yes
Optional Interchangeable Lens	46° Wide-angle Lens; 20µm Macro Lens
Digital Zoom	1-16x continuous zoom
<b>Unique Features</b>	
NaviTiR	Support
T-DEF	Yes
IREdge	Yes
T-TWB	Yes
<b>Temperature Analysis</b>	
Temperature Range	-20 °C ~2000°C
Temperature Range	-20 °C ~ 120°C, 0 °C ~ 700°C, 300°C -2000°C
Intelligent Range	Support
Measurement Accuracy	Within-20 °C ~ 120°C temperature range, the accuracy is ± 1°C between 0°C and 100°C ; Otherwise ±2 °C or ±2%, whichever is greater
Measurement Tools	Spot: 15; Line: 6; Area: 15 AnalyzeIR: Unlimited ROIs
Line Temperature Distribution	Support
Measurement Parameters	Emissivity, Reflected temperature, Ambient temperature, Humidity, Distance and IR window compensation.
Partial Emissivity	Support
Area Alarm	High temperature alarm and low temperature alarm
Delta T/Temperature Rise	Yes
On Device Analysis	Support Radiometric Video and Image Analysis
PC Software	AnalyzeIR Professional Analytical Software



# Specification of 228Pro

Image Display	
Display Screen	5inch (landscape)1280*720
Image Mode	Thermal\Digital\Picture-in-Picture\T-DEF®
Palette	16 standard palettes: Grey、Iron10、Iron、Rainbow、Grey10、GreyRed、MidGrey、Yellow、Rain、Rain10、Blue、GlowBow、Medical、Medical10、MidGreen、Prism
Inverted Palettes	Support
Minimum Temperature Span	Auto (Minimum Temp Span 3°C ), Manual (Minimum Temp Span 2°C ), Touch-screen(Minimum Temp Span 2°C
Color Alarm	High temperature, low temperature, and interval isotherms
Hot and Cold Spot Tracing	Yes
Shooting Function	
Digital Camera	5-mega pixel and 13-mega pixel
Storage Card	SD card of 128GB memory, support expansion to 2TB
Capture Mode	Single frame and Time-lapse
Image Format	JPEG(Radiometric)、Visible light image
Video Format	IRS(Radiometric)、MP4(Non-Radiometric)
Freeze Image	Support
QR Code	Support
Annotations	Voice, text, tag, favorite
Radiometric Video Recording	Support
Non-Radiometric Video Recording	Support
Gallery	Support viewing, editing and deleting image and video files
Network Connection	
WiFi Connection	Support 2.4GHz and 5 GHz frequency, support 802.11a/b/g/n/ac
Bluetooth Connection	BT4.2 LE, connectable to bluetooth headphone
USB Connection	USB type-C type; conforms to USB 3.0 / 2.0 specification, supports USB OTG; USB 3.0 has a maximum speed of 5Gbps; USB 2.0 supports a maximum speed of 480Mbps, and is downward compatible with full speed (12Mbps) mode
HDMI Connection	Micro HDMI type,Comply with HDMI 1.4 specification, support 1080p image video transmission at 60Hz frame rate
FTP Data Transfer	Accessible through WiFi or Hotspot, rapid data transfer
Remote Access	
PC	Remote Control Via AnalyzIR
Web Browser	Support Checking, Editing Images and Remote Control Camera
General Specifications	
Software Upgrade	Support on OTA upgrade and local upgrade through USB
Laser Ranger/Pointer	Independent key activation; Laser level: 2; Wavelength: 635nm; Power:<1mW
Area Measurement	Support
GPS	Yes
Compass	Yes
LED	Yes

# Specification of 228Pro

Power System	
Battery Type	3.6V, 10000mAh lithium
Battery Life	Over 4 hours per battery
Battery Charging System	Battery charger, DC 13V charging, USB charging
Battery Charging Time	2.5 hours to 90% full charge
Power Saving	User-selectable screen-off modes
AC Operation	AC operation with included power supply (100V ac -240V ac, 50/60Hz)
Reliability Test	
Safety	EN 62368-1:2014+A11:2017 (Power Supply)
Electromagnetic Compatibility	EN 61326-1:2013 (immunity) EN 61326-1:2013 Class A (emission) FCC 47 CFR Part15 Class A (emission)
Enclosure Rating	IP54
Shock	25g(GB/T 2423.5-2019/IEC 60068-2-27:2008)
Vibration	2g(GB/T 2423.10-2008/IEC 60068-2-6:1995)
RoHS	Compliant
Physical Parameters	
Operating Temperature	-20°C ~ 50°C
Storage Temperature	-40°C ~ 70°C without batteries
Relative Humidity	<95%RH
Size	175*151*95mm
Weight	1.3kg(Without Lens)
Battery Weight	0.2kg
Warranty	
Warranty	2 years (standard), extended warranties are available, 10 years for core detector
Recommended Calibration Cycle	2 years
Language	
Supported Languages	English, Spanish, French, German, Italian, Korean, Portuguese, Traditional Chinese
Standard Configuration	
Standard Configuration	Thermal imaging camera, lens, lens cap, 2 rechargeable lithium batteries, battery charger, power adapter, B5 R&D Bench, USB Type-C to USB interface cable, Micro HDMI interface to HDMI interface cable, SD card, SD card reader, accessory bag (wrist strap), information bag (packing list, calibration certificate, user manual), portable soft bag, hard case

# Specification of 600R&D

Models	FOTRIC 618C R&D Station		FOTRIC 616C R&D Station	
<b>Basic Parameters</b>				
Infrared resolution	640*480		384*288	
Detector type	Uncooled infrared focal plane detector			
Thermal sensitivity NETD)	< 0.03°C @30°C ,30mk		< 0.05°C @30°C ,50mk	
Infrared spectral band	7μm~14μm			
Standard lens	29°*22°		30°*22°	
I FOV	0.79mrad		1.36mrad	
Minimum focus distance	0.1m		0.15m	
Focal length	21.6mm		13mm	
Optional macro lens	M20	M50	M50	M100
Focal length	20mm	50mm	50mm	20mm
Image pixel size	20μm	50μm	50μm	100μm
Lens to object distance	12.8mm	66.3mm	45.2mm	110.6mm
Focus type	Manual			
<b>Measurement Analysis</b>				
Temperature Measurement Range	-20°C -150°C ; 0°C -650°C			
Accuracy	± 2°C or ± 2 % , whichever is greater ( ambient temp between 15°C ~35°C )			
Measurement parameters	Emissivity; Ambient temperature; Reflected temperature; Relative humidity; Distance; External optics compensation			
Partial emissivity	Support			
<b>Image Display</b>				
Palettes	10 standard palettes and 10 inverted palettes			
Image process	Non-uniform calibration, digital enhancement			
Mirror mode	Left-right, up-down, center			
Video compression standard	H.264			
Radiometric stream	25Hz radiometric stream		30Hz radiometric stream	
Pan-tilt-zoom station compatibility	Support Pelco-D protocol			
Measurement tools	5 points, 10 lines and 10 regions, support Modbus output			
Software	AnalyzeIR			
<b>Network Connection</b>				
Ethernet type	10M/100M/1000M adaptive			
Simultaneous stream	Mainstream and substream: 10; Radiometric stream: 1			
IP connection interface	ONVIF			
<b>Electrical Connection</b>				
Power connector	Screw-on wire terminal			
Network connector	Screw-on RJ45 with status indicator LED			
Serial port	RS-485 : 1 input 1 output			
Alarm input/output	Relay: 1 input 1 output, load capacity: 24V, 1.5A Optocoupler: 1 input(5~15mA) 1 output(<35mA) 1 GND, Voltage: 3.3-24V			

# Specification of 600R&D

Power System	
Power supply	12V/24V DC, PoE
Power consumption	4W
	3W
Reliability and Certificates	
Safety standards	GB 4943.1-2011   EN 62368-1:2014+A11:2017; GB/T 19870-2018
Electromagnetic compatibility	GB/T 18268.1-2010   EN 61326-1:2013 GB 17625.1-2012   EN IEC 61000-3-2:2019 GB/T 17625.2-2007   EN 61000-3-3:2013/A1:2019 GB/T 19870-2018 GB 4824-2019 EN 55032:2015/A11:2020 EN 55035:2017 FCC CFR47 Part15 subpart B
Protection level	IP40
Impact	25g, GB/T 2423.5-2019   IEC 60068-2-27:2008
Vibration	2g, GB/T 2423.10-2008   IEC 60068-2-6:2007
RoHS compliant	Directive 2011/65/EU and amendment (EU) 2015/863
Physical Parameters	
Working temperature	-20°C -65°C
Storage temperature	-40°C -70°C
Relative humidity	< 90%
Size	112mm*68mm*60mm (without lens or base)
Weight	485g (without lens or base)
Outer casing material	Aluminum alloy



Whole package of 600 R&D camera and test bench

# **FOTRIC**

**CONNECTING THE DIGITAL FUTURE**

FOTRIC INC. All Rights reserved

Mar 2024

[www.FOTRIC.com](http://www.FOTRIC.com)