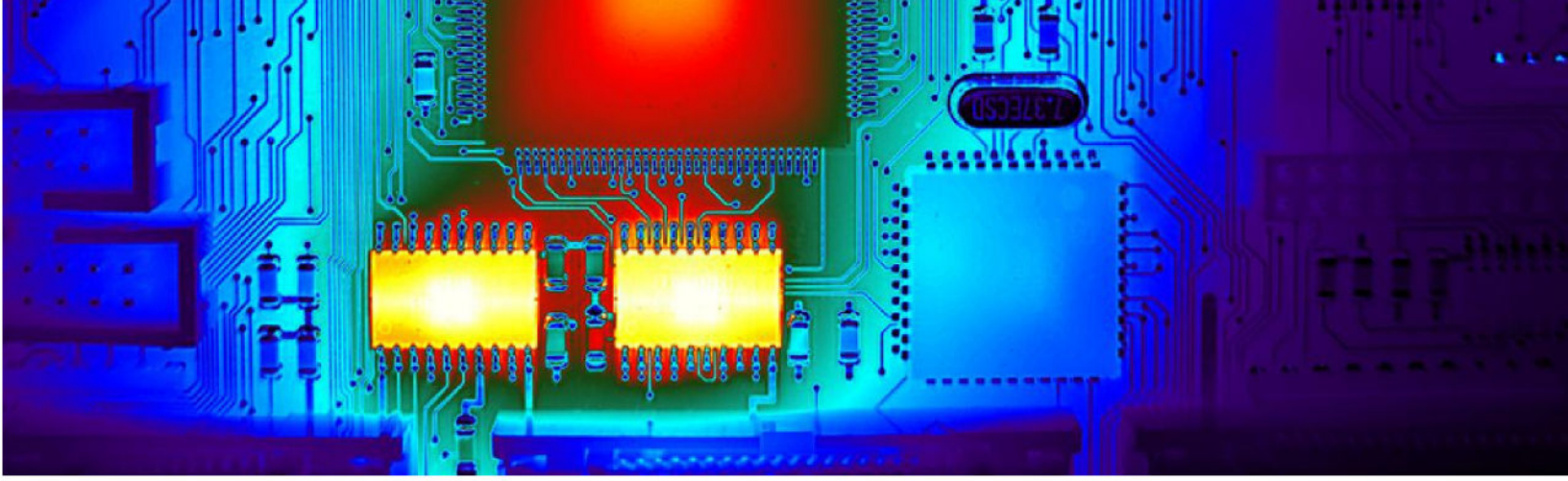
INSULATING YOUR SUPPLY CHAIN

Empowering manufacturers to overcome global microchip scarcity



THE COST OF SEMICONDUCTOR SHORTAGES

Recent global semiconductor shortages have caused significant disruptions for manufacturers, leading to factory closures across Europe, affecting hundreds of industries worldwide. Everything from healthcare machinery, smartphones, aerospace and defense, telecommunications to heavy industry has been impacted.

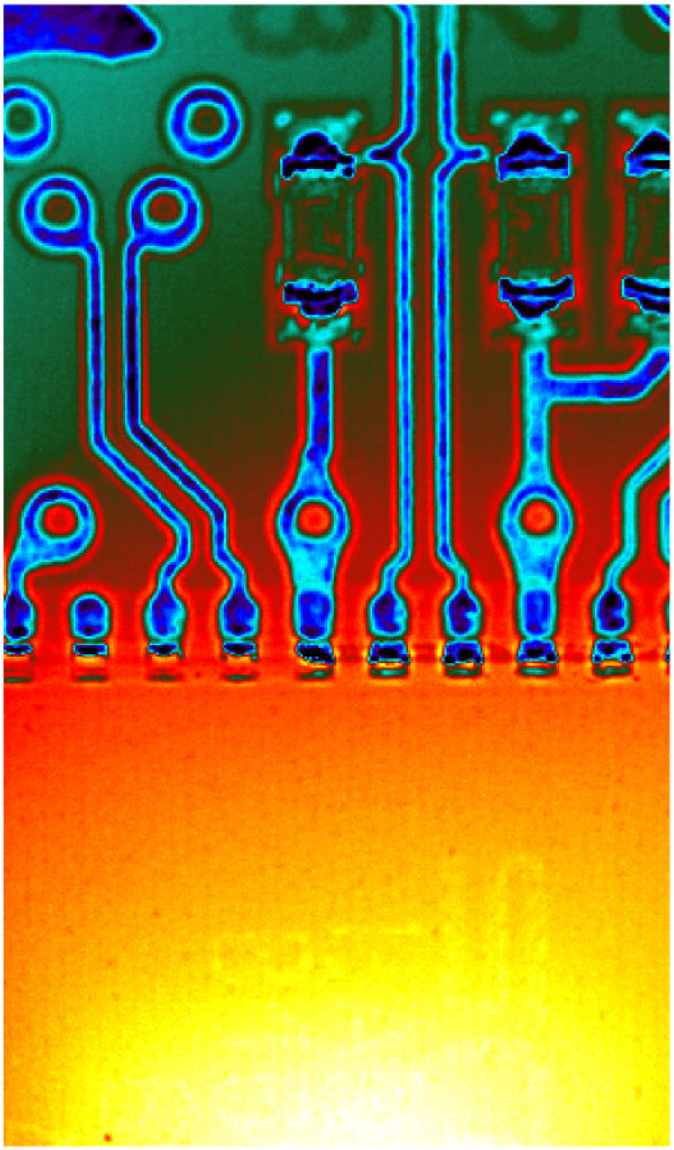
The automotive industry, which accounts for 10% of the global semiconductor market, experienced well-publicized delays as a result with new car registrations globally down 25% in 2022.

These events have shed light on the semiconductor market's overdependence on a small number of companies, or countries, in an increasingly complex geopolitical world.

As the risks become clear, industries are moving to build resilience into supply chains to mitigate further risks.

However, meeting this growing demand will not be easy.

It requires proactive measures now to expand production, strengthen supply chains and foster real innovation within the semiconductor industry.



Investing today to protect chip supplies tomorrow

President Biden has announced The CHIPS Act: a piece of legislation that is poised to unleash $52 billion in upfront funding to alleviate further pressure on US companies to diversify supply.

The legislation will mobilize investments that will empower businesses to generate home-grown semiconductors rather than outsourcing overseas - thereby resolving future supply chain disruptions at the source.

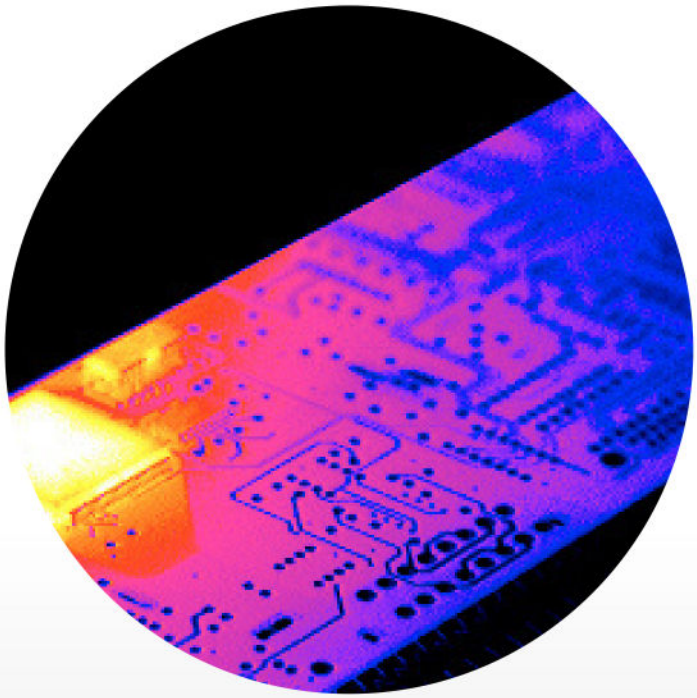
WHY ARE SEMICONDUCTORS SO IMPORTANT IN THE WORLD OF PRODUCTIVITY AND QUALITY?

The growing demand for more compact products at a lower cost has pushed electronics systems to become more portable and efficient while the overall system complexity actually increases.

With the potential for reliability problems and the increased potential for counterfeit parts being touted on the market, it is more important than ever to test and verify a product throughout its lifecycle.

Each component must be proven to function during a product's manufacturing, from the design stage through to its incorporation into an electronic system and finally, in rigorous quality testing.

Whether it's for government, industrial, consumer products, or wider electronic components, testing is integral from the moment a product is conceived and production begins - this is where FLIR can help.



Thermography reduces downtime: Electronics testing in action

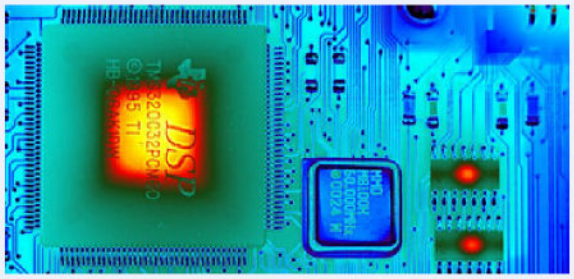
Product recalls are costly and often entirely avoidable with adequate testing procedures.

Thermal imaging cameras help developers see and study the heat dissipation and thermal characteristics of the circuits and components in their development projects. This ensures that thermal efficiency is constantly monitored, preventing costly downtime by making sure parts are fit for purpose.

How FLIR thermography supports your bottom line

Thermal imaging enables companies to:

- Visually detect overheating components before they fail and cause damage to your printed circuit board
- Pinpoint impending problems in everything from discrete components like capacitors and resistors and power components like transformers and transistors
- Detect trace damage from power surges
- Avoid costly product recalls by identifying issues early.



There is a thermography solution suited to every need. Speak to an expert to find out how FLIR thermal imaging can help meet your electronic component and system testing needs.

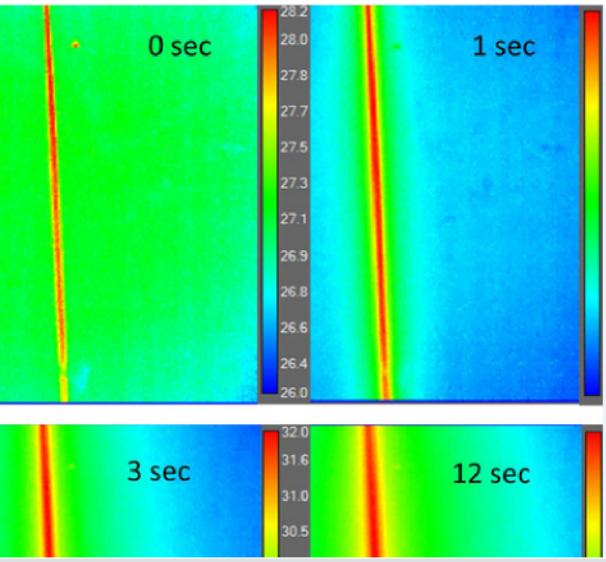
SPEAK TO AN EXPERT.

FLIR CAMERAS REVEAL THERMAL CHARACTERISTICS OF MICROELECTRONIC DEVICES

In the development of electronic and microelectronic devices, transient thermal information is critical to validate whether a device or a specific part of the device is operating properly. What's more, the performance of next generation of microelectronic devices will depend on a better understanding of the thermophysical properties of the various materials used in the microelectronics.

At the University of Texas at Arlington, the team of Dr. Ankur Jain, who heads the Microscale Thermophysics Laboratory, studies a wide range of topics related to microscale thermal transport. The laboratory makes use of diverse modern equipment and instruments, including thermal imaging cameras from FLIR Systems.

Miniaturization has been a key development in the microelectronics industry for the past several decades. Smaller devices can offer faster operational speeds and more compact systems. Advances in nanotechnology and thin-film processing have spread to a wide range of technological areas, including photovoltaic cells, thermoelectric materials, and microelectromechanical systems (MEMS). The thermal properties of these materials and devices are of critical importance for the continued development of such engineering systems. However, a number of concerns related to thermal transport exist in these systems. To efficiently address these concerns, it is critical to fully understand the nature of thermal transport in materials at the microscale.



Measuring temperature fields

Thin film materials have been an essential feature of microelectronics ever since its inception, serving a variety of functions on the chip. In order to precisely understand the thermal behavior of thin films, we need to be able to correlate thermal properties with the evolving microstructure and morphology related to the deposition process. This way, it should be possible to investigate properties such as conductivity, bulk modulus, thickness, and thermal boundary resistances.

In a typical test experiment, microheater lines on a substrate are connected to a power source. The device is heated up through Joule heating. Thus, the temperature field of the substrate evolves as a function of time.

THE INCREASINGLY VITAL ROLE OF THERMAL IMAGING CAMERAS

To measure the temperature on microelectronic devices, the team of Dr. Ankur Jain has used a wide variety of techniques, including thermocouples. A main challenge with this technique is that thermocouples only measure temperature values at a single point. For a more complete and visual picture of the temperature field, Dr. Jain decided to use thermal imaging cameras from FLIR. The FLIR A6703sc thermal imaging camera (now superseded by the FLIR A67 range) has been designed for electronics inspections, medical thermography, manufacturing monitoring, and non-destructive testing. The camera is ideal for capturing high-speed thermal events and fast-moving targets. Short exposure times allow users to freeze motion and achieve accurate temperature measurements. The camera's image output can be windowed to increase frame rates to 480 frames per second to accurately characterize even higher speed thermal events, helping ensure critical data doesn't get missed during testing.

"Thermal phenomena in devices of interest to us occur very rapidly, and we need full field information as opposed to single-point measurements," says Dr. Ankur Jain. "FLIR thermal cameras have helped us during our experiments, because they present us with very fine details of the device being measured."

UNPARALLELED ACCURACY, CONNECTIVITY, AND ANALYSIS

The FLIR Thermal Smart Sensor Cameras have the features automation solution providers need for complex monitoring applications, including product quality.

FLIR A50/A70 Research & Development Kits are affordable, ready-to-use solutions for thermal imaging analysis in proof-of-concept electronics testing and R&D applications. The FLIR A6700 is designed for electronics inspections, manufacturing monitoring, scientific research, and non-destructive testing, making it ideal for high-speed thermal events and fast-moving targets. The FLIR A8580 MWIR camera provides crisp imagery, accurate temperature measurement, and streamlined analysis features needed for industrial, military, and manufacturing R&D applications.

FLIR Solutions for easy product optimisation

FLIR offers several thermal camera system packages to aid engineers and test technicians in streamlining the thermal evaluation of electronic components and systems. The simplified yet robust camera connections help you to set up and start testing quickly, while the FLIR Research Studio software makes it easy to view, record and analyze the thermal data as it's captured.

The entry-level A50 & A70 R&D Kits are a great cost-effective solution for understanding the thermal dynamics of electronics systems and provide insight into potential causes for failure. With a variety of different lens to choose from, the Kits include everything you will need to acquire meaningful thermal data.

The A400, A500, and A700 Science Kits provide additional system flexibility with the ability to accurately measure the temperature of discreet components. With two different options available, the Standard Kit includes a 24° lens with FLIR Macro Mode which provides spatial resolutions down to 50µm per pixel (camera dependent) without the need to change a lens. This allows users to investigate larger printed circuit board assemblies then hone in to further evaluate areas of specific concern.

The A400, A500, and A700 Professional Science Kits build on the Standard Kits with the addition of a visible camera with MSX image enhancement, radiometric data streaming over Wi-Fi and a separate close-up lens for accurate thermal measurements on small components.

For testing scenarios in which thermal sensitivity, speed, and measurement accuracy are critical, FLIR's line of high-performance cooled A-Series cameras offers superior image quality and absolute measurement accuracy. With the ability to acquire 1,000s of frames of data per second, synchronize the image capture to external events, and utilize microscope objective lenses capable of resolving targets down to 4um per pixel, these thermal camera systems ensure you collect precise temperature data to support critical decisions.

FIXED THERMAL IMAGING CAMERA SPECIFICATIONS

Specifications	FLIR A50/A70 R&D Kits	FLIR A400/A500/A700 Standard Science Kits	FLIR A400/A500/A700 Professional Science Kits
IR Resolution	464×348 (A50) or 640×480 (A70)	320×240 (A400), 464×348 (A500), or 640×480 (A700)	320×240 (A400), 464×348 (A500), or 640×480 (A700)
Detector Pitch	17µm (A50), 12 µm (A70)	24µm (A400), 17µm (A500), 12 µm (A700)	24µm (A400), 17µm (A500), 12 µm (A700)
Spectral Range	7.5–14.0 µm	7.5–14.0 µm	7.5–14.0 µm
Detector Type	Uncooled microbolometer	Uncooled microbolometer	Uncooled microbolometer
Thermal Sensitivity/NETD	<35 mK to <60 mk @ 30°C (86°F)	<30 mK to <40 mk @ 30°C (86°F) - Lens and camera dependent	<30 mK to <40 mk @ 30°C (86°F) - Lens and camera dependent
Frame Rate	30 Hz	30 Hz	30 Hz
Standard Temperature Range	-20°C to 175°C (-4°F to 347°F) 175°C to 1000°C (347°F to 1832°F)	20°C to 120°C (-4°F to 248°F) 0°C to 650°C (32°F to 1202°F) A400/A500: 300°C to 1500°C (572°F to 2732°F) A700: 300°C to 2000°C (572°F to 3632°F)	20°C to 120°C (-4°F to 248°F) 0°C to 650°C (32°F to 1202°F) A400/A500: 300°C to 1500°C (572°F to 2732°F) A700: 300°C to 2000°C (572°F to 3632°F)
Accuracy	±2°C (±3.6°F) or ±2% of reading	±2°C (±3.6°F) or ±2% of reading	±2°C (±3.6°F) or ±2% of reading
Included Lenses	Selectable; 29°, 51°, 95°	24°	24°, 2.0X Macro
Min Focus Distance	29°: 0.25m / 51°: 0.2m / 95°: 0.1m	24°: 0.15 m (0.49 ft) 24° f/1.0: 0.3 m (0.98 ft)	24°: 0.15 m (0.49 ft) 24° f/1.0: 0.3 m (0.98 ft) 2.0X Macro: 18 mm (0.71 in)
Smallest FOV at Min Focus Distance	A50 29°: 138mm x103mm A70 29°: 134mm x 101mm	A400 24°: 68mm x 51mm A500 24°: 70mm x 52mm A700 24°: 68mm x 51mm	A400 2X Macro: 15.78mm x 11.83mm A500 2X Macro: 15.78mm x 11.83mm A700 2X Macro: 15.36 x 11.52mm
Smallest iFOV at Min Focus Distance	A50 29°: 0.297mm/pixel A70 29°: 0.201mm/pixel	A400 24°: 0.212mm/pixel A500 24°: 0.150mm/pixel A700 24°: 0.106mm/pixel	A400 2X Macro: 0.049mm/pixel A500 2X Macro: 0.034mm/pixel A7002X Macro: 0.024mm/pixel
Focus Control	Adjustable with included focus tool	One-shot contrast, motorized, manual	One-shot contrast, motorized, manual
Optional Lenses	Fixed, cannot be changed	2.0X Macro, DFOV (24°/14°), 6°, 14°, 42	DFOV (24°/14°), 6°, 14°, 42°
MacroMode	No	Included	Included
MacroMode: Min Focus Distance	-	24° with Macro Mode: 60mm	24° with Macro Mode: 60mm
MacroMode: Smallest iFOV	-	A400 24°: 0.101mm/pixel A500 24°: 0.071mm/pixel A700 24°: 0.050mm/pixel	A400 24°: 0.101mm/pixel A500 24°: 0.071mm/pixel A700 24°: 0.050mm/pixel
Visual Camera	Yes	Optional	Yes
Wi-Fi	Yes	Optional	Yes
Image Presentation	Via workstation running included Research Studio Software	Via workstation running included Research Studio Software	Via workstation running included Research Studio Software
Data Streaming & Control	Gigabit Ethernet (RTSP, GigE Vision), Wi-Fi	Gigabit Ethernet (RTSP, GigE Vision)	Gigabit Ethernet (RTSP, GigE Vision), Wi-Fi
Digital Data Connection Type	M12 8-pin X-coded, female	M12 8-pin X-coded, female	M12 8-pin X-coded, female
Dynamic Range	16-bit	16-bit	16-bit
Digital Input	2× opto-isolated	2× opto-isolated	2× opto-isolated
Digital Output	3× opto-isolated, 1× dedicated as fault output	3× opto-isolated, 1× dedicated as fault output	3× opto-isolated, 1× dedicated as fault output
Digital I/O Connection Type	M12 Male 12-pin A-coded	M12 Male 12-pin A-coded	M12 Male 12-pin A-coded
Power	24/48 V DC, 8 W max	24/48 V DC, 8 W max	24/48 V DC, 8 W max
Power Configuration	Power over Ethernet or External	Power over Ethernet or External	Power over Ethernet or External
Size [L x W x H]	107 × 67 × 57 mm, without bottom cooling plate	123 mm × 77 mm × 77 mm (4.84 in × 3.03 in × 3.03 in)	123 mm × 77 mm × 77 mm (4.84 in × 3.03 in × 3.03 in)
Mounting	1/4-20 UNC depth 7 mm + Ø5 depth 2.7 mm	UNC ¼"-20 on 2 sides 4× M4 on 4 sides	UNC ¼"-20 on 2 sides 4× M4 on 4 sides
Microscope Stand	Optional	Optional	Optional
Encapsulation	IEC 60529 and IP66	IEC 60529, IP 54, IP66 with accessory	IEC 60529, IP 54, IP66 with accessory
Operating Temperature	-20°C to 50°C (-4°F to 113°F), with included cooling plate, Maximum camera case temperature: 65°C (149°F)	20°C to 40°C (-4°F to 104°F) (in free air) 40°C to 50°C (104°F to 122°F) (mounted on cooling plate accessory) Maximum camera case temperature: 65°C (149°F)	20°C to 40°C (-4°F to 104°F) (in free air) 40°C to 50°C (104°F to 122°F) (mounted on cooling plate accessory) Maximum camera case temperature: 65°C (149°F)
Shock	IEC 60068-2-27, 25 g	IEC 60068-2-27, 25 g	IEC 60068-2-27, 25 g
Vibration	IEC 60068-2-6, 0.15 mm at 10 Hz to 58 Hz and 2 g at 58 Hz to 500 Hz	IEC 60068-2-6, 0.15 mm at 10–58 Hz and 2 g at 58–500 Hz, sinusoidal	IEC 60068-2-6, 0.15 mm at 10–58 Hz and 2 g at 58–500 Hz, sinusoidal

FIXED THERMAL IMAGING CAMERA SPECIFICATIONS

A6701 MWIR Package w/ Macro Lens & Stand	A6701 MWIR Package w/ 1X Microscope Lens & Stand	A8581 MWIR Camera
640x512	640x512	1280x1024
15 µm	15 µm	12 µm
3.0–5.0 µm	3.0–5.0 µm	3.0–5.0 µm
Indium Antimonide (InSb)	Indium Antimonide (InSb)	Indium Antimonide (InSb)
<20 mK	<20 mK	≤ 30 mK (≤ 25 mK typical)
60Hz (640x512, full window) 240Hz (320x256, half window) 480Hz (160x120, quarter window)	125Hz (640x512, full window) 407Hz (320x256, half window) 1,123Hz (160x120, quarter window) 4,130Hz (16x4 min window)	CXP: 60Hz, GigE: ~45Hz (1280x1024, full window) 192Hz (640x512, half window) 526Hz (320x256, quarter window Max 3,709Hz (32x4, min window)
-20°C to 55°C 10°C to 90°C 35°C to 150°C 80°C to 200°C 150°C to 350°C	-10°C to 55°C 10°C to 90°C 35°C to 150°C 80°C to 200°C 150°C to 350°C	-20°C to 55°C 10°C to 90°C 35°C to 150°C 80°C to 200°C 150°C to 350°C
±2°C (±3.6°F) or ±2% of reading		±2°C (±3.6°F) or ±2% of reading
Macro Lens (50mm)	1X Microscope	Selectable (see availalble optional lenses)
100mm	30mm	1X Microscope: 30mm 3X Microscope: 30mm 5x Microscope: 20mm
12.6mm x 10.1mm	9.6mm x 7.68mm	1X Microscope: 15.4mm x 12.3mm 3X Microscope: 5.1mm x 4.1mm 5x Microscope: 3.1mm x 2.5mm
19.6µm/pixel	15µm/pixel	1X Microscope: 12µm/pixel 3X Microscope: 4µm/pixel 5x Microscope: 2.4µm/pixel
Manual	Manual	Manual or Motor Focus (lens dependent)
17mm, 25mm, 50mm, 100mm, 200mm, 1X Microscope, 3X Microscope, 5X Microscope	17mm, 25mm, 50mm, 100mm, 200mm, Macro (50mm), 3X Microscope, 5X Microscope	17mm, 25mm, 50mm, 100mm, 200mm, Macro (50mm), 1X Microscope, 3X Microscope, 5X Microscope
No	No	No
-	-	-
-	-	-
No	No	No
No	No	No
Via workstation running included Research Studio Software, SDI Video	Via workstation running included Research Studio Software, SDI Video	Via workstation running included Research Studio Software, HD-SDI Video
Gigabit Ethernet (GigE Vision)	Gigabit Ethernet (GigE Vision)	Gigabit Ethernet (GigE Vision), CoaXpress
RJ45	RJ45	RJ45, BNC
14-bit	14-bit	14-bit
Sync Input	Sync Input	Sync In, Trigger In
-	-	Sync Out
BNC	BNC	BNC
24 VDC (< 24 W steady state)	24 VDC (< 24 W steady state)	24 VDC (< 24 W steady state)
Provided AC-to-DC Power Supply	Provided AC-to-DC Power Supply	Provided AC-to-DC Power Supply
226 x 102 x 109mm (8.9 x 4.0 x 4.3 in.) w/o lens	226 x 102 x 109mm (8.9 x 4.0 x 4.3 in.) w/o lens	226 x 117 x 135 mm (8.9 x 4.6 x 5.3 in) w/o lens
2 x 1/4" -20 tapped holes 1 x 3/8"-16 tapped holes 4 x 10-24 tapped holes	2 x 1/4" -20 tapped holes 1 x 3/8"-16 tapped holes 4 x 10-24 tapped holes	2 x 1/4" -20 tapped holes 1 x 3/8"-16 tapped holes 4 x 10-24 tapped holes
Included	Included	Optional
Not encapsulated, <95% relative humidity, non-condensing	Not encapsulated, <95% relative humidity, non-condensing	Not encapsulated, <95% relative humidity, non-condensing
-20°C to 50°C (-4°F to 122°F)	-20°C to 50°C (-4°F to 122°F)	-20°C to 50°C (-4°F to 122°F)
40g, 11msec ½ sine pulse	40g, 11msec ½ sine pulse	40g, 11msec ½ sine pulse
4.3 g RMS random vibration, all three axes	4.3 g RMS random vibration, all three axes	4.3 g RMS random vibration, all three axes

About Teledyne FLIR

Teledyne FLIR designs, develops, manufactures, markets, and distributes technologies that enhance perception and awareness. We bring innovative sensing solutions into daily life through our thermal imaging, visible-light imaging, video analytics, measurement and diagnostic, and advanced threat detection systems.

Teledyne FLIR offers a diversified portfolio that serves a number of applications in government & defense, industrial, and commercial markets. Our products help first responders and military personnel protect and save lives, promote efficiency within the trades, and innovate consumer-facing technologies. Teledyne FLIR strives to strengthen public safety and well-being, increase energy and time efficiency, and contribute to healthy and intelligent communities.

Teledyne FLIR building in Täby, Sweden

Speak to the team