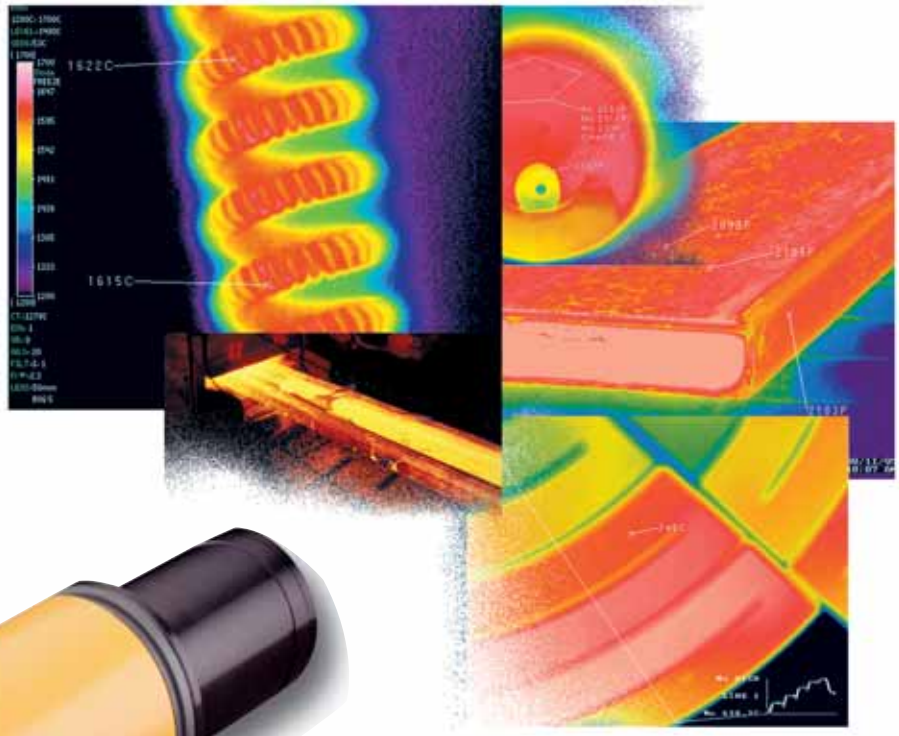
MIKRON INFRARED

# M9103/9104

PYROVISION®
an Imaging Pyrometer

**Unique Ultra High Resolution Thermal Imager**
**for non-contact temperature measurements between 600 and 4000°C**



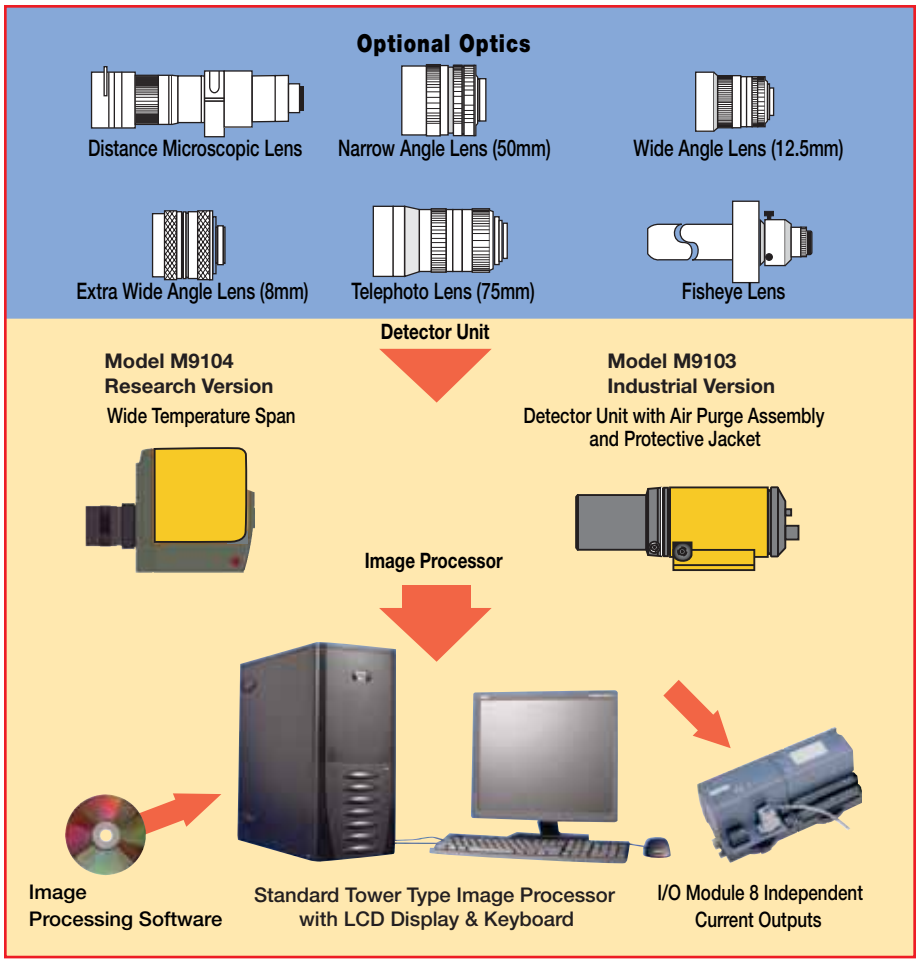

## A Unique Ultra High Resolution Thermal Imager

*for High Temperature Industrial Process and Research for temperature measurement between 600°C to 4000° C*

- Measures temperature at 300,000 points 60 times a seconds
- Minimally affected by emissivity
- Exceptionally high accuracy and resolution
- Advanced FPA technology
- Sees through glass or quartz view ports
- 8-channel isolated current outputs for automated process control
- Versatile real time image processing software

# Ultra High Resolution Imaging Pyrometers for Thermal Imaging of High Temperature Applications

The technique of thermography, or thermal Imaging is based on well established technology and has been used for a wide variety of applications such as medical diagnostics to aerospace research, protective, preventive maintenance of industrial plants or buildings and for process monitoring. The thermal imager produces a black and white or color picture on a monitor screen which displays temperature differences in an object or scene as variations of light and shade or different colors. Computer software allows the user to store and manipulate the images in a variety of ways.




## Why M9103/9104 Pyrovision®

When used for high temperature process applications, the conventional thermal imaging system is limited in its accuracy and general usefulness by several factors. Firstly, the system spectral response is normally limited to the mid-to-far infrared part of the usable spectrum, which will result in significant errors due to changes in process surface emissivity, and will make it difficult and costly, or sometimes impossible, to measure through view ports. Secondly, images of processes which include very hot, and therefore bright areas, can be obscured by "blooming" due to saturation of the detector by the intense energy emitted from such areas. Finally, general purpose thermal imaging systems usually incorporate far more features than are required or desirable for process use, and this results in a larger than necessary expenditure.

The Mikron 9103/9104 Pyrovision® addresses these limitations and, in so doing, achieves a technological breakthrough in high temperature thermal imaging.

This is how:

- The system is designed with a narrow band spectral response at near infrared region which minimizes measurement errors due to variations in target emissivity. Windows and viewing port materials such as quartz, Pyrex and sapphire cause minimal attenuation of infrared energy at this wavelength.
- Patented, 776 x 484 pixel array detector unit produces a high resolution, bloom-free image of high temperature targets.
- Fast response, 60 frames per second, permits real time imaging of dynamic processes.

## 8-Channel Analog Current Output (optional):

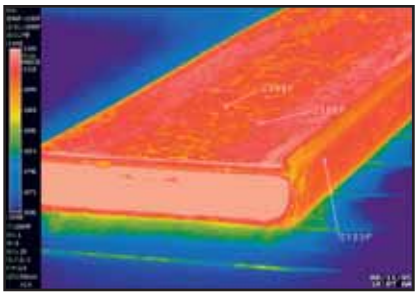
The Mikron MFP-1 is an analog output module for field installation with eight independent isolated 0-20mA or 4-20mA outputs. It can be used for process monitoring or as an input to a controller or PLC for controlling a variety of process devices, such as valves, actuators, pumps and heaters. Power for this module is provided by an internal loop supply of 24VDC. The module is installed on a universal DIN rail that supplies screw terminals for field I/O wiring. A wall mounted enclosure is available for the I/O Modules as an option.

## Software

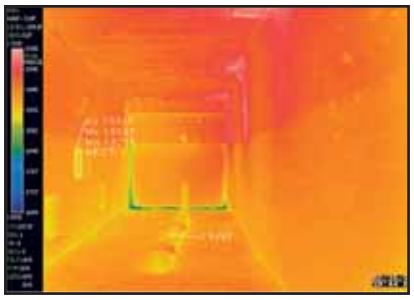
M9100 software can assign current outputs to point, line, rectangle or other shapes and temperatures which can be used for conventional process recording or controlling.
*(See page 7 for details)*

# Typical Applications for M9103/9104 Imaging Pyrometer

- *General high temperature research*
- *Speciality metal for aerospace; such as electron-beam and plasma-arc hearth melting furnaces*
- *Continuous casting, Heat treating furnaces and induction heating*
- *PVD and CVD coating processes*
- *Crystal growing*
- *Forging and ring rolling*
- *Large utility boilers and refining furnaces*
- *Rotating kilns and incinerators*
- *Ultra small heating elements such as lamp filament or electron emitters*



*Steel slab exiting reheat furnace*



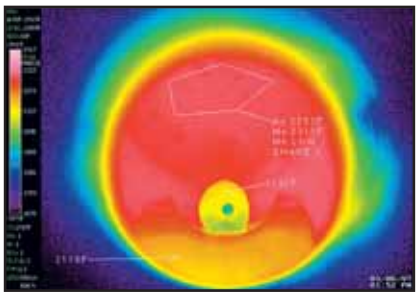
*Interior of reheat furnace for uniformity check*

## Continuous Steel Casting and Rolling

Present day demands of quality standards and production efficiency require more than just temperature measurement to produce good steel. Operator knowledge of temperature distribution can prevent corner "break outs" due to inadequately cooled strands on the caster and the loss of dimensional control and desired metallurgical characteristics in rolled stock. The imaging and temperature profiling capabilities of the M9100 can materially assist towards meeting production objectives in these processes.

## Furnace Temperature Distribution Surveys

The heat treatment of specialty steels and exotic metals requires an accurate knowledge of temperature distribution within the furnace. Thermocouple surveys are costly, time consuming and always have the potential for overlooking hot or cold spots. The M9103 with an optional "fish eye" lens enables a complete survey to be taken from one location, through a small hole in the furnace, in a matter of minutes after set-up, with image and data storage for later review.

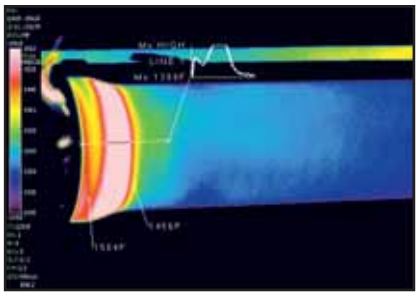


*Interior of high temperature rotating kiln*

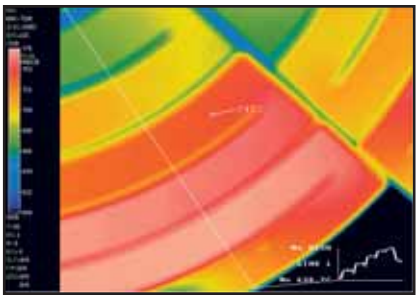
## Rotary Kilns

Rotary kilns used for calcining cement, lime, refractory materials and fertilizers rely for their efficiency on careful control of material flow in the kiln and also of temperature in the burning zone. The M9103 Pyrovision® shows the build-up of material "rings" in the kiln which restrict the material flow, and also provides an image and point temperature measurement for burning zone control.

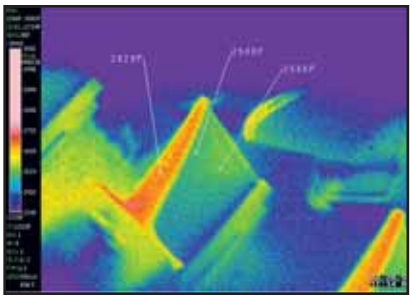
# Typical Applications for M9103/9104 Imaging Pyrometer (continued)



*Induction heating of large diameter shaft*



*Graphite heater profile for crystal melting crucible*



*$AL_2O_3$ Coating of turbine blade in electron beam furnace*

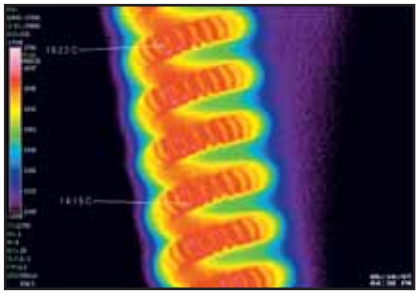
## Induction Heating

A typical induction heating or forging application requires that a particular part must be heated to a preset temperature value and in addition have a desired temperature gradient. The thermal map of heat distribution across a workpiece can provide the designer of induction coils invaluable information for initial set up, and in production mode, a continuous assurance of high quality.

## Research and Development

The flexibility and adaptability of the M9104 System lets the researcher tailor the equipment to the budget and the spread of anticipated applications. The data and image gathering, storage and manipulation power of the M9104 is particularly attractive where complex, dynamic temperature problems are being worked on. Model M9104 has a very wide temperature span and can be considered as most suitable for research applications.

## Micro Thermal Imaging



*Lamp tungsten filament*

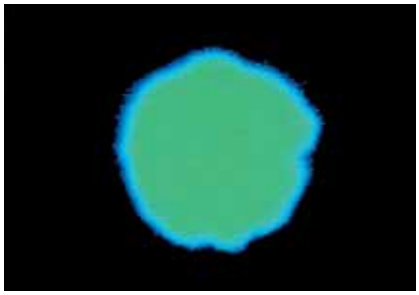


*Image of 100µm aperture in front of 1000°C blackbody source. Spatial resolution of 3 x 3µm is achieved from 100mm distance.*

*Distant Microscopic Lens Assembly with Micro Positioning*

In many research and industrial applications, there is a need to measure and map thermal gradients of very small objects such as filaments of electron guns, lamps, micro heaters or cathodes of heat generating emitters of x-ray equipment. The Mikron long distance microscopic lens attachment allows spatial resolution of less than 3 x 3µm at a comfortable distance of 100mm. This microscopic lens attachment is particularly designed and recommended for use in research or for incorporation into proprietary equipment for continuous measurement of thermal pattern and feedback for correction.

Mikron's family of microscopic thermal imagers have a distortion-free magnification optical system with total magnification range of 3.5x to over 1000. Working distance can be from 25mm to 350mm. Field of view can be achieved to a fraction of $mm^2$.

# Image Processors for M9103 / 9104 "Pyrovision"

## Image Processor

Mikron, in order to satisfy a number of different applications both for research and industrial use, has introduced several styles of Image Processors for the M9103/9104 Detector Unit. For example, while the standard Image Processor version is very popular for research applications, this version may not be suitable for most industrial applications, where the image processor may encounter very harsh environments, such as ambient heat and air borne dust contaminants.

The 4 versions shown below were specifically engineered to be the most suitable for a given application. All versions are readily available with the least expensive version being the standard unit.

*Standard Tower Type Image Processor with LCD Flat Panel Display and Keyboard.*

*19" Rack Mountable Image Processor with LCD Flat Panel Display and Keyboard, Suitable for Control Room Environment. Double Intake Fans and Air Filtering Systems Insure Long Term Reliability.*

*This Version of Image Processor is Recommended for Factory Floor Installation. All Buttons and Display are Sealed Against Water, Oil or Dust.*

*Industrial Portable Image Processor with Built-In LCD and Keyboard. Extremely Useful for Applications that Involve Frequent or Multiple Set-Ups.*

*Shown above is a Picture of how Conveniently the Image Processor can be Transported from one Set-Up to the Next. This Version Comes with Self Protective Enclosures to Contain all Interconnecting Cables.*

# System Specifications for M9103/9104

## Detector Unit

### †Temperature Range

| Model | °C or °F Equivalent |
|---|---|
| M9103 (Select 1 or 2 neighboring range) | 600° to 840° C<br>800° to 1180° C<br>1100° to 1750° C<br>1600° to 3000° C<br>1900° to 4000° C |
| M9104 | 600° to 3000°C<br>Consisting of first 4 ranges |
| M9104W | 600° to 4000° C<br>Consisting of all 5 ranges |

† *Other temperature ranges available upon request*

| | |
|---|---|
| Measurement Accuracy | ±0.5% of reading ±1°C |
| Temperature Resolution | 1°C for upper portion of temperature span |
| Spectral Response | Narrow band pass near infrared filter |
| Detector Type | Uncooled solid state FPA, with unique anti-blooming characteristic, low pattern noise and superior stability |
| Detector Spatial Resolution | 768 elements horizontal 494 elements vertical |
| Field of View for Standard 25mm lens | 10.8° H x 8.1°V. Other fields of view available using optional lenses (see pg 8) |
| IFOV (Spatial) | 0.3 mrad |
| Speed | 60 frame/second (Real time) |
| Focusing Distance | 30cm to ∞ with standard 25mm lens |
| Mounting | 2 Tapped ¼ – 20 holes |
| InterConnecting Cables | 10 meters long (optionally up to 100 meters long) |
| Operating Ambient Temperature | 0° to 50°C without cooling<br>0° to120°C with water cooling |
| Protective Cooling Jacket | Standard: protects detector units at high temperature environments<br>Model M9103 up to 120°C<br>Model M9104 up to 80°C |
| Operating Humidity Condition | 10 to 95% relative humidity non-condensing |
| Storage Environment | -25° to 85°C to 95% relative humidity non–condensing |
| Dimensions | Model M9103: 280mm(L) x 100mm(W) x 110mm(H)<br>Model M9104: 220mm(L) x 130mm(W) x 165mm(H) |
| Weight | Model M9103: 3.0kg (6.6 lbs.)<br>Model M9104: 2.5kg (5.5 lbs.) |

## Image Processor
(see pg 5 for details)

| | |
|---|---|
| Mounting | Tower type, 19" rack mount, portable or sealed for factory floor |
| Operating Environment | 0° to 50°C to 95% relative humidity, non–condensing |
| Storage Environment | -25° to 85°C to 95% relative humidity, non–condensing |
| Image Pixel Resolution | 640 horizontal x 480 vertical |
| Image Data Resolution | 8 bits |
| Temperature Kernal Resolution | Matrix of 3 x 3 pixels |

## Monitor

Standard: 17" LCD Display

## System Power Requirement

90 - 240VAC 50/60Hz 400 watts

## Analog Current Module Model MFP-1

| | |
|---|---|
| No. of Isolated Outputs | 8-channel |
| Type of Current | 0-20mA or 4-20mA |
| Isolation Voltage | 3000VRMS |
| Mounting | DIN rail mounting |
| Operating Ambient | -40° to 70°C |
| Power Requirement | 90-240 VAC 50/60 Hz |

# Description of On-Line Real-Time Thermal Image Processing Software, MikroSpec R/T

## Introduction

The MikroSpec R/T software was designed by Mikron Infrared, Inc. to do temperature profile and analysis of images captured individually or sequentially. By using one or more MIKRON infrared imaging cameras connected to MikroSpec R/T software, temperatures of the processes can be measured accurately to ensure production quality.

The software allows you to view thermal images in real-time as well as those that have been captured and stored to the computer's hard disk drive. By creating up to 32 Regions of Interest (ROIs) in one of ten shapes, you can retrieve details as to the temperature range within the ROIs. Sophisticated graph tools allow you to create graphs of the real-time image temperature analysis, while exporting to Excel allows you to analyze the real-time image temperature data in a numerical context.

*Shown here is a representative number of different capabilities associated with Mikron MikroSpec R/T software.*

| | |
|---|---|
| Presentation | The system displays a live thermal image in 256 colors. Additional graphics and text are overlaid on the image. Images can also be frozen. |
| Cursor Temperatures | Displays temperature at current cursor location along with x-y coordinates on high resolution screen. |
| Object Data | Object data are available for all objects described below. Data include the maximum, minimum and average temperatures of the pixels within the object. Other statistics such as standard deviation, and temperature distribution, as well as application-specific, proprietary or customized algorithms are available as needed. |
| Temperature Points | Displays up to 25 temperature points. Each point consists of a 1 x 1 pixel array or larger. |
| Line Temperatures | Displays the object data for pixels along a straight line. |
| Rectangles | Displays the object data for regions within a rectangle. |
| Circles | Displays the object data for regions within a circle or ellipse. |
| Shapes | Displays the object data for regions within an arbitrary shape. Shapes can be defined as a polygon with any number of segments or can simply be drawn freehand. |
| Display Rate | Adjusts the rate at which temperature data is updated on the screen. |
| Samples to Average | Number of samples to average when computing object data. This is used to improve the signal-to-noise ratio. |
| Scene Emissivity | Emissivity adjustment from 0.3 to 1.0 in 0.01 steps that apply to the entire image. |
| Object Emissivity | Emissivity adjustment that applies to a specific object. |
| Scene Transmission | Transmission adjustment on an entire image for compensating losses due to viewing ports or windows. |
| Isotherms | Up to 16 simultaneous isotherms may be displayed,each with a variable level, width, and color. |
| Alarms | Low and high alarms may be set on any object to activate external devices via 5V TTL level output. Alarm conditions can be customized as needed. |
| Data Logging | All object data may be logged to disk or exported to other programs such as Excel. |
| Image Recording | Images can be saved to disk either individually or in a high speed sequence. Standard and custom file formats are available. |
| 4-20mA Outputs | All object data may be used to drive industry standard (Optional) current outputs for use with continuous conventional process recorders, PLC's, controllers, etc. Outputs are isolated and available in groups of 8 channels. |

# Optional Equipment

## Optional Lenses

The M9103/9104 is supplied with a 25mm lens as standard. Optional Close Focus, Wide Angle, Telephoto, Fish Eye lenses are also available at additional cost.

**Optically Coated and Calibrated Infrared Wide Angle Lenses**

**Extra Wide Angle Lens**
(6.5mm) FL, FOV 40°H x 30°V

**Wide Angle Lens**
(8mm) FL, FOV 33°H x 25°V
(12mm) FL, FOV 22°H x 17°V

**Narrow Angle Lens**
(50mm) FL, FOV 5.4°H x 4°V

**Telephoto Lens**
(75mm) FL FOV 3.5°H x 2.6°V

**Distance Microscopic Lens:**
Spatial resolution of up to 3 x 3µm resolution

**Fish eye with Stainless Steel Air Purged Jacket**
for viewing through refractory walls up to 75cm (30") thick and exposure to atmosphere of 1315°C (2400°F) temperature.

Length 30cm (12.00"), diameter 38mm (1.5")

Length 45cm (18.00"), diameter 38mm (1.5")

Length 60cm (24.00"), diameter 38mm (1.5")

Length 75cm (30.00"), diameter 38mm (1.5")

## Accessories

A full range of cooling, purging and mounting accessories is available to protect the M9100 Series in harsh environments, some of which are typical of the applications described in this brochure.

**Protective Cooling Jacket (Standard)**

The cast aluminum jacket protects the detector unit from physical damage when located in environments of heavy industry and also dampens the effect of high ambient temperature.

Air Purge Assembly (Optional)

This assembly allows the optics of detector unit to be protected when airborne contaminants can build up on the lens and eventually "blind" the unit.

**InterConnecting Cable**
5 meters long standard
Other lengths up to 100 meters

**Model MFP-I module (optional)**

8-channel isolated current outputs for continuous process monitoring or controlling.

## Off-Line Software

In addition to the standard MikroSpec R/T real time operation, Mikron offers optional MikroSpec 3.0 off-line software for greater in depth analytical and statistical analysis of the temperature profiles.

## Unconditional Warranty

Every Pyrovision® is covered for all defective material and workmanship for one full year after shipment.

## Made in U.S.A.

The Pyrovision® is designed and built by Mikron, the leading innovator in technology of infrared thermography. Manufacturing facility is located in Oakland, New Jersey, USA.

Mikron reserves the right to change specifications to reflect the latest changes in technology and improvements at any time without notice. These changes will be reflected in subsequent editions of our literature when warranted.

***Visit our websites:***
***www.mikroninfrared.com***
***www.IRimaging.com***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FM Approvals
Quality System Registration
ISO 9001:2000 Certified