

# MARPOSS

## TOTAL THERMAL VISION

THERMOGRAPHIC  
PROCESS  
MONITORING



# TOTAL THERMAL VISION

## DESCRIPTION OF THE SYSTEM

Die-casting is a rapidly-evolving technology that enables manufacturers to produce components in a wide variety of shapes and sizes, thanks to the low cost and high precision of the process.

The process uses light alloys that are melted and injected into dies, which are usually made from tool grade steel. This production technology is both cost-effective, since it may be used to produce large numbers of components, and versatile, thanks to the capacity to cast thin wall parts with good quality surface finishing. Due to the high production volumes, the process may generate a wide range of defects at both micro-structural and macroscopic level, compromising the quality of the finished product. The main types of issues encountered are: solidification shrinkage, gas or shrinkage porosity, blistering and solidification cracking.

Controlled, evenly-distributed cooling ensures optimised solidification, reducing the risk of structural defects. By using Total Thermal Vision technology, which uses infra-red vision to analyse the temperature of the dies, it is possible to monitor heat distribution with a high level of accuracy. By constantly monitoring the temperature it is possible to optimise the cycle time, maintaining the correct balance between production speed and product quality. The use of TTV technology permits manufacturers to acquire real-time thermographic images, analyse the heat distribution over the entire surface of the die and correct any issues right from the initial phases of the process. .

This approach not only improves the quality of the casts, but also helps to reduce operating costs, limiting the consumption of release agent, compressed air and energy. Effective temperature control also benefits the environment, by limiting the number of rejects and the volume of effluent produced by the cooling system, while optimising the temperature of the die provides significant economic and operational advantages: extending the service life of the die, reducing the cycle time and limiting non-routine maintenance costs. For this reason Total Thermal Vision represents the ideal solution for high efficiency production applications, since it enables manufacturers to improve both the quality of product and the OEE index, a key parameter in the overall performance of the production system.

## ADVANTAGES

- ▶ Improved quality and fewer rejects
- ▶ Greater productivity and reduced production costs
- ▶ Improved OEE efficiency
- ▶ Increased lifespan of dies and less machine downtime
- ▶ Optimised casting times and reduced restart times and costs
- ▶ Optimised temperature control and energy savings
- ▶ Data logging and batch certification

## TYPICAL APPLICATIONS

- ▶ High pressure die casting (HPDC)
- ▶ Low pressure die casting (LPDC)
- ▶ Gravity die casting (GDC)





## OPTIMISATION OF THE PRODUCTION PROCESS

Modern, intelligent die-casting systems offer features such as real-time monitoring, predictive maintenance and optimised process control, guaranteeing greater productivity and quality. Thanks to the use of advanced, AI sensors, it is possible to acquire and analyse data in real-time, improving each phase of the production process and reducing waste to a minimum.

The HPDC (High Pressure Die Casting) process involves injecting the molten metal into a metallic die at high speeds and pressures. This method is widely used when manufacturing complex metallic components, especially in aluminium, magnesium and zinc, where high precision and good mechanical properties are required. Thermographic die monitoring helps to improve the results achieved using this technology by mapping the heat distribution on the surface of the die. By using thermographic maps, it is possible to identify the most critical areas from the point of view of the cooling process, so as to optimise the spray phase and achieve the optimal surface temperature in as short a time as possible. Reducing lubrication time also results in an immediate reduction in cycle time. Customers who choose TTV benefit from reduced warm-up time, 70% fewer rejects and an increased lifespan of the die.

In the case of LPDC (Low Pressure Die Casting), the molten metal is forced into the die via a riser pipe by means of a

controlled pressure. This process is especially suitable for casting aluminium and magnesium alloys used to produce parts for the automotive and aerospace sectors, such as structural components, alloy wheels and supports. The TTV system fundamentally performs the same functions in this case as those described above. The only practical difference lies in the fact that, in the case of HPDC processes, the TTV system acquires two images (one before and one after the spraying cycle) whereas in the case of LPDC processes, it only acquires one image. Customers who use TTV observe a significant improvement in their production processes, which translates into optimised cycle times and more accurate surface finishing, while also extending the service life of the die.

Another production process where the presence of TTV plays a crucial role is GDC (Gravity Die Casting). In this case, the molten metal is poured into the die exclusively by the effect of gravity, without exerting any external pressure. In this case, the dies are subject to less stress than those used for HPDC processes, which means they have a longer service life. The use of thermographic monitoring during GDC processes enhances thermal management of the die, reducing the percentage of reject parts and improving the quality of the finished product. This allows the manufacturer to produce sturdier components, with enhanced mechanical properties, while also reducing cycle times.

## SYSTEM HARDWARE SETTINGS



Third generation TTV solutions represent the perfect combination of experience and innovation. With over 200 systems sold worldwide, and the experience Marposs has acquired in related sectors, such as automotive and machine tooling, Total Thermal Vision represents a reliable,

durable solution, optimised for the

dis-casting sector, which guarantees a return on investment within a few months.

This is possible thanks to the use of thermographic images, acquired with thermal imaging cameras that are designed to resist exposure to extreme operating environments, such as foundries. In fact, the cameras are equipped with a series of accelerometers and humidity, temperature and pressure sensors, which monitor the state of the devices in real-time, and generate warnings in the event of any anomalies, with the aim of acquiring the most accurate thermographic images possible at any given instant. At the heart of the thermal imaging camera is an infra-red sensor capable of guaranteeing extremely performance specifications, even under the most challenging operating conditions, thanks to its compact casing that provides complete thermal insulation from the surrounding environment (IP65 protection rating). The thermal imaging cameras are also equipped with a series of solenoid valves that are used to regulate a highly efficient cooling circuit, which plays a significant role in optimising the accuracy of the TTV system. The devices also feature a germanium window and guillotine type shutter that protects the window from the external environment: this shutter has been redesigned, modifying the opening and closing speeds and the way the movements are executed, so as to provide the lens with greater protection against dust and dirt. These measures, together with the decision to abandon the lens blower cleaning system, ensure the lens remains cleaner, while also reducing energy consumption. Together with regular, thorough calibration, these solutions ensure the thermal imaging camera remains in optimum operating condition, maintaining maximum accuracy and resolution. All the know-how developed over the years has gone into the design of our third generation TTV solutions, resulting in a system that maintains the strengths of the previous version and eliminates its weaknesses, with the aim of increasing the accuracy and robustness of the system, while also reducing the operating costs of TTV management.

The thermal imaging cameras are connected to a controller, which may be integrated with the machine control systems.

The system has been designed for maximum flexibility, rendering it suitable for use in any application or environment and compatible with any other accessories or devices that may be installed on the machine, such as the sprayer unit or the handling robot. The following configurations are available, depending on the application: bench controller, feet or wheel-mounted pedestal and pre-configuration for a supporting arm. Moreover, to ensure maximum flexibility, the system is also compatible with all the principal machine information exchange protocols, for example: physical Inputs/Outputs, Profinet and Ethernet IP. All the control units equipped with a 21.5" PC touch screen with graphic interface for real time display of the images and data in real time, which may also be analysed and saved subsequently. Without interfering with the production cycle, TTV is able to acquire the thermographic maps of the die, one image after another, permitting the operator to intervene promptly when it is necessary to improve the heat distribution in the die.

In addition to mechanical innovations, digitalisation represents an increasingly significant factor in improving production processes. By integrating the Manufacturing Execution System (MES) and the Internet of Things (IoT) it is possible to monitor processes in real-time, guaranteeing more efficient overall management. The TTV system supports this transformation by collecting thermal data that may be used for both in-process and post-process analysis. Furthermore, the use of artificial intelligence in combination with TTV helps to reduce the scrap rate and increase productivity, while reducing reliance on operator experience.



# SOFTWARE INTERFACE

The TTV visual interface displays a thermal map, which is updated in real-time, enabling the operator to monitor the current surface temperature distribution of each individual cast during the production process, with the need for interruptions.

It is possible to define a recipe for each die, including a series of control parameters, specifying the number of conformation of the ROI (Regions Of Interest) and the permissible temperature limits. If the value recorded exceeds or falls below the limits defined for a given ROI, an alarm is generated immediately.

The images are always acquired in the same area and during the same phase of the production cycle, thus guaranteeing repeatability and comparability of the measurements.

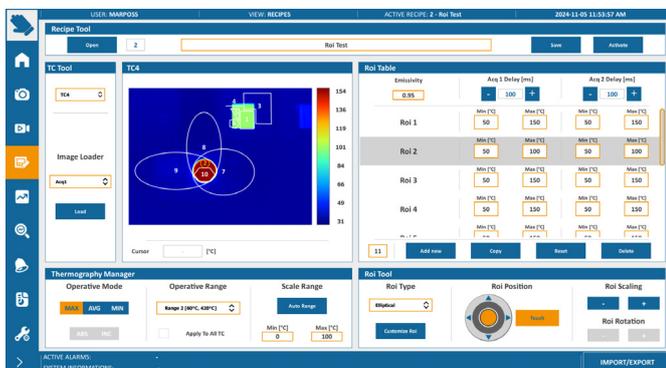
The temperature information is provided in both numerical format and as chromatic representations relative to the reference image.

It is possible to save multiple recipes, which can be easily managed and recalled each time the production batch is changed, optimising operative efficiency.

The TTV system records, displays and saves images, complete with temperature values, including in graphic form if required, during each cycle. These data, together with the alarms and process control conditions, may be used subsequently to analyse the progress of the production cycle.

By using software-based analysis instruments it is possible to provide operators, technicians and quality managers with a clearer understanding of the production parameters, permitting them to improve the process continuously.

The user interface is available in all major western languages, and also supports Chinese, Japanese and Cyrillic characters.



The software updates introduced to ensure the TTV system conforms to the most in-demand market standards have given rise to the following new features:

- ▶ A new, intuitive and user-friendly graphic interface for the operator;
- ▶ The option of saving specific thermographic images manually;
- ▶ The option of creating and modifying recipes simply by rotating the ROI and zooming on the image. An additional function means that it is now possible to create the ROI in greater detail;
- ▶ A trend screen that makes it easier for the operator to evaluate the temperature trends in the ROI.
- ▶ A new display for the system and process alarms providing greater control over every aspect of the system;
- ▶ The option of exporting reports relating to the acquired images in a simpler, more intuitive manner;
- ▶ The option of recording thermographic videos relating to the production process in streaming, defining the duration and acquisition frame.



# THERMAL IMAGING CAMERA

The thermal imaging camera houses the infra-red sensor, the electronic control unit and the solenoid valves.

The electronic unit installed on the camera contains a series of diagnostic sensors designed to ensure correct operation and guarantee the quality of the measurements:

- ▶ **Temperature sensor:** this sensor controls the automatic cooling system, regulating the internal temperature of the camera.
- ▶ **Pressure sensor:** this sensor monitors the pressure of the internal pneumatic system, ensuring the air flow is sufficient to regulate the temperature and protect the optics from adverse environmental conditions.

The control unit connection cables have been redesigned so as to limit their radius of curvature and take up less space: they are available with or without protective metal sheath.

The unit is also available with a graduated, adjustable support so that it can be aligned and regulated according to the requirements of the installation, while ensuring that any such adjustments are repeatable at a later date.

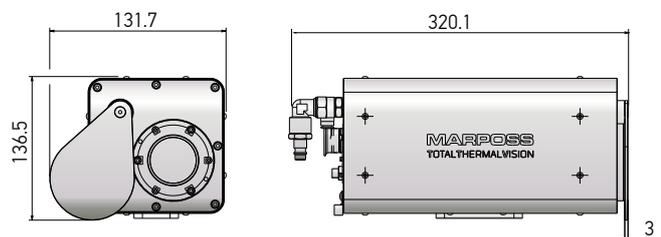
The Marposs TTV thermal process monitoring solutions also include TTV Light, the new thermal imaging camera designed to bring the benefit of TTV technology to small, and medium sized presses. This solution has been designed to finally render thermal monitoring accessible to a much wider range of die-casting applications, without compromising on reliability or performance.

TTV Light is the result of a careful optimisation of the internal design, which has enabled us to offer a compact system that is both highly efficient and simple to use. The guaranteed performance specifications are abundantly sufficient for production process control purposes, making this the ideal solution for all those applications where there is limited space available on the machine and where, until today, the use of a TTV system would have been complex or even impossible.

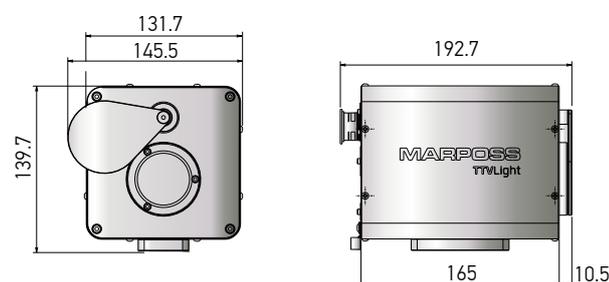
One of the main strengths of TTV Light is the absence of the pneumatic unit, made possible by the new mechanical concept of the thermal imaging camera. Thanks to a series of dedicated accessories that function without the use of compressed air, the system may always be used within its optimal operating window, guaranteeing stability, reliability and continuity of measurement.

These design choices translate to immediate benefits for the Customer: minor operating costs, reduced system complexity, ease of installation and reduced initial investment TTV Light represents the ideal solution for anyone looking to improve process control, increase product quality and optimise costs, benefiting from all of Marposs' experience in a more accessible, market-oriented version.

## TTV



## TTV LIGHT



	TTV	TTV LIGHT
THERMAL IMAGING CAMERA UNIT WEIGHT	6 kg	4 Kg
PRECISION	±2°C or ±2% of the measured value*	±5°C or ±5% of the measured value*
RESOLUTION	640 x 480 px	640 x 480 px
MEASUREMENT RANGE**	60 - 420 °C (140 - 788 °F)	60 - 420 °C (140 - 788 °F)
VIBRATION (IEC 60068-2-6)	39.2 m/s <sup>2</sup> (4g)	39.2 m/s <sup>2</sup> (4g)
COLLISIONS (IEC 60068-2-27)	294 m/s <sup>2</sup> (30g)	294 m/s <sup>2</sup> (30g)
OPERATING TEMPERATURE	10 °C - 50 °C	15 °C - 45 °C
STORAGE TEMPERATURE	-40 °C - 70 °C	-40 °C - 70 °C
AMBIENT HUMIDITY	30% - 80%	30% - 80%
Protection rating (Standard IEC 60529)	IP 65	IP 65

\* whichever is the greater of the two

\*\* within which precision is guaranteed



## CONTROL UNIT

Control unit with fittings for supporting arm



Control unit in support column configuration

Wall-mounted control unit

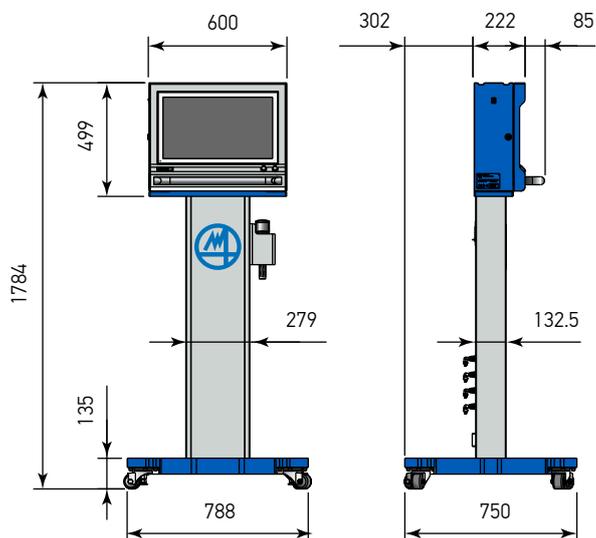


Bench-mounted control unit



The controller is available in three configurations, so that it can be adapted to a range of machine layouts: bench-mounted, on a feet or wheel-mounted support column or with the fittings required for a supporting arm.

The control unit is based on the Marposs E9066T, and is equipped with a 21.5" touch screen monitor. Thanks to Marposs technology, the unit may also be equipped with a dedicated remote service tool.



### CONTROL PANEL

Control panel weight	35 Kg
Pedestal weight (optional)	170 Kg
Operating temperature	-15 °C - 50 °C
Storage Temperature	-40 °C - 70 °C
Ambient humidity	5% - 80%
Protection rating (Standard IEC 60529)	IP54



**MARPOSS**

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D6C11100G0- Edition 02/2026 - Specifications are subject to modifications.  
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