

# Thermal Gradient Ring

Thermal preference phenotyping for  
**tethered** and non-tethered mice



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# Thermal Gradient Ring (TGR) version 2

*Best Choice for thermal preference phenotyping and drug screening in mice.  
Fully automated temperature preference and temperature avoidance.  
Increased thermal test sensitivity and accuracy.  
Out-of-the box apparatus ready to use in ANY-Maze software.*



## 1 Adjustable swivel holder

We support most of the available swivel on the market, just let us know the one You plan to use.

## 2 Guidance for animal cable



Disk guide for the cable of tethered mice on the top of the central camera holder. Easy set-up change for tethered and non-tethered mice.

## 3 New design of maze walls

2 wall height available  
Easy and fast de-mounting for cleaning (needed when changing animal)

## 4 Automatic start timer

To let apparatus be ready when You come to the Lab

## Background

- The TGR invention paper showed how circular design allowed to dissect exploratory behaviour from thermal selection (2016, F. Touska et al.)
- The [novel circular thermal gradient assay](#) opens new opportunities for thermal preference and avoidance and addresses limitations imposed by classic linear equipment.
- The TGR can [clearly discriminate temperature-dependent phenotypes or drug effects](#) and its advantages over other techniques (i.e. linear corridors, two-choice temperature preference) are well described in the 2024 paper "*Thermal gradient ring for analysis of temperature-dependent behaviors involving TRP channels in mice*" (Ujisawa et al. (Prof. Tominaga Lab)).

## Typical device applications

The TGR has been used to study sensory neuropathies (2020, Valek et al.), diabetic peripheral neuropathy with symptoms of the thermosensory impairment (2022, Sasajima), TRP channels (2022, Ujisawa) and CCI-induced thermal hyperalgesia.

The TGR records and analyses thermal preference phenotyping in mice. For neuropathic pain studies,

peripheral neuropathy, temperature sensitivity and insensitivity assessment in basic research, phenotyping and drug screening.

The new version is designed to use also cabled animals for optogenetics, electrophysiology and other techniques which require the use of wires.

## Product Description

In the TGR, **mice can freely move around the ring**, thereby avoiding the stereotypical habit that mice have of staying in a corner, as occurs in rectangular systems.

An infrared camera is located on the upper side of the apparatus, together with a visible and infrared illuminator and an infrared transmissive inner wall.

The animal is freely moving and its position is **tracked by the camera**, and **no user intervention is required** to gather time spent in each temperature zone (12 zones in duplicate) and many other parameters.

The behavioral data is obtained by video-tracking with

ANY-Maze software and generate measurement parameters, such as:

- **Thermal zone occupancy:** percentage of time spent in a zone.
- **Zone entries:** number of entries in each zone.
- **Preference temperature:** calculated as the weighted preferred temperature.
- **Cumulative distance:** calculation of the cumulative distance per zone or per the whole apparatus.
- **Coordinates of location within the Ring:** can be used to visualize mouse behaviour in the ring with Heat Maps.



Temperature controlled cabinet (-10/+100 °C range temperature) to hold up to two Thermal Gradient Rings under constant temperature and sound isolation, to be not depending on of the lab room temperature (optional item).



ANY-Maze Video-tracking software automatically analyses thermal preference and avoidance parameters. A dedicated (TGR limited) ANY-Maze software version is available at a lower price than the ANY-Maze full version and also includes TGR protocol ready to use.

Features	Benefits
Circular maze design	Duplicate values, no border effects, no spatial cues
New design which includes swivel support and has no obstruction for animal mounted wires	Allows for use of techniques that required cabled animals, such as optogenetics, electrophysiology and others
12 zones per side (specular), 40cm <sup>2</sup> each	Temperature $\Delta$ proportionally divided into 12 (in the method paper 15°C/-40°C = 2.27°C per zone)
CCD-IR-camera (included in the standard package, with its dedicated support) and ANY-Maze video-tracking software (to be order separately)	Behavior recorded automatically during test time
Heater and cooler units on opposite sides, to establish a symmetric thermal gradient	Gradient setup superior to two-plate choice design
Thermal ring-shaped aluminum runway, with special color and special grip floor.	More sensitive than previous methods: bias-free, reproducible data
Designed for tethered and non-tethered mice. (no swivel provided)	For optogenetic, electrophysiology and other tethered animal studies
Thermal sensors embedded in the thermal gradient ring sensing the temperature	The exact temperature gradient measured in real time
Control ambient temperature	Improve temperature accuracy avoiding laboratory temperature oscillations

## Main references

- Ujisawa et al. (Prof. Tominaga Lab), 2024, "Thermal gradient ring for analysis of temperature-dependent behaviors involving TRP channels in mice", The Journal of Physiological Sciences
- Lei et al. (Prof. Tominaga Lab), 2023, "Involvement of skin TRPV3 in temperature detection regulated by TMEM79 in mice", Nature Communications
- Valek et al., 2022, "Cold avoidance and heat pain hypersensitivity in neuronal nucleoredoxin knockout mice", Elsevier
- Sasajima et al. (Prof. Tominaga Lab), 2022, "Thermal gradient ring reveals thermosensory changes in diabetic peripheral neuropathy in mice", Nature
- Y. Xue et al., 2022, "The Human SCN9A<sup>R185H</sup> Point Mutation Induces Pain Hypersensitivity and Spontaneous Pain in Mice", Frontiers in Molecular Neuroscience
- Ujisawa et al. (Prof. Tominaga Lab), 2022, "Thermal gradient ring reveals different temperature-dependent behaviors in mice lacking thermosensitive TRP channels", The Journal of Physiological Sciences
- L. Valek et al., 2021, "Prodromal sensory neuropathy in Pink1<sup>-/-</sup>SNCA<sup>A53T</sup> double mutant Parkinson mice", Neuropathology and Applied Neurobiology
- A. Bertamino et al., 2020, "Exploration of TRPM8 Binding Sites by  $\beta$ -Carboline-Based Antagonists and Their In Vitro Characterization and In Vivo Analgesic Activities", Journal of Medical Chemistry
- Z. Winter et al., 2017, "Cold Temperature Encoding by Cutaneous TRPA1 and TRPM8-Carrying Fibers in the Mouse", Frontiers in Molecular Neuroscience
- F. Touska et al., 2016, "Comprehensive thermal preference phenotyping in mice using a novel automated circular gradient assay" Journal Temperature

## Specifications - Operation

Ring temperature range	Heating Plate: from 20°C to 65°C - Heating/cooling Plate: from 4°C to 65°C
Temperature feedback	By 4 thermocouples monitored in real time by ANY-maze software
Animal detection	Via ANY-maze specific protocol for TGR through integrated USB camera
Illumination	Set of 4 dual visible /IR light
Power	Universal input 85-264 VAC, 50-60Hz, 400W max

## Physical

Aluminium runway	Internal diameter 45 cm; External diameter 57,5 cm; Corridor width 6 cm
Maze wall height	15 cm (standard); 25 cm (optional)
Dimensions	76x60x60(h)cm
Weight	49.5 Kg
Shipping weight	69.5 Kg
Packing	120x80x70(h)cm (wooden fireproof crate with pallet)

## Ordering informations

35530	Set-up for Thermal Gradient Ring (Zimmermann's method), including heating and cooling elements, circular corridor with low maze walls (15cm), thermal probes, USB camera, ready for tethered and non-tethered mice. ANY-maze software not included (required) available in TGR limited version or full version.
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## Software (REQUIRED choose one)

60000-TG	ANY-maze software, Thermal Gradient Ring specific version (limited TGR TEST ONLY)
60000	ANY-maze software full license (TGR and all other ANY-maze test included in the full version)

## Optional items

35580-US	Thermal conditioned cabinet ready to hold 2 TGR devices (for USA 220/240 Volt US plug). Temperature range from -10 up to 100 °C
35580-EU	Thermal conditioned cabinet ready to hold 2 TGR devices (for Europe 220/240 Volt EU plug). Temperature range from -10 up to 100 °C
35530-003	Thermal Gradient ring high maze walls (25cm)

## Extra warranty (standard 12 months + 12 months with product registration)

35530-UBC12	UB Care 12 Additional hardware warranty extension 12 months for TGR (valid for SKU 35530)
35530-UBC24	UB Care 24 Additional hardware warranty extension 24 months for TGR (valid for SKU 35530)

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more than 40,000 citations in the main bibliographic search engines.

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**Ugo Basile SRL**  
Via Giuseppe Di Vittorio, 2  
21036 Gemonio (VA) ITALY  
Tel. +39 0332 744574  
Get a quote: sales@ugobasile.com



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