REPTILE SYSTEMS GOLD INFRARED UNIT AND BULBS TESTS

A look at the R7S halogen lamp unit and bulbs from Reptile Systems

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The details provided in this document are based on sole use, and the document contains both scientific information as well as personal opinion. Other people may have different results. The tests have been performed to our best knowledge. Although, the tests do not substitute that of a laboratory test. There are uncontrollable variables when testing a single batch of any item. Different items of the same model number may differ due to their manufacturing batch or operating conditions.

This document may refer to the overall exotic animal keeping hobby as the “reptile hobby”, but this is a force of habit – Tomaskas Ltd. does in fact mean the keeping of the broader herpetological spectrum, including invertebrates, amphibians, and even birds.

REASONS FOR TEST

These tests were completed independently. Reptile Systems provided a unit and lamps for independent testing, but made no attempt to influence the results of the tests.

Reptile Systems is a brand based under the umbrella company Aquarium Systems, with products sold worldwide. They produce and sell products for the reptile, bird and fishkeeping communities.

In order to provide the hobby with a base understanding of such products, it's important that impartial tests are conducted. We have a duty, as a community, to look out for each other and share appropriate good practice.

These tests aim to discover if products are suitable for the hobby, independent of the manufacturer's claims.

These tests aim to provide a better understanding of the product in question. The product is aimed at primarily providing Infrared-A and B.

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TERMINOLOGY USED

As with many things, there may be more than one correct or colloquial way to describe the same item. There may also be common terms used that may not be correct in everyday usage. I've tried to remain consistent throughout the document so that if I refer to a specific part of an item, you as the reader will know with confidence which part I'm referring to. I'm only human though, and there may be mistakes.

KIT

This refers to everything that comes in a box, including fittings and instructions.

LAMP/BULB

This refers to the physical bulb item in the kit. In this case, different wattages were tested, but were all halogen R7s-style bulbs.

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HALOGEN BULB

The term given to a bulb that has a tungsten-based filament and a quartz glass body. Inside the glass, the area is filled with a halogen gas mixture – allowing the filament to burn hot.

FERGUSON ZONE(S)

The Ferguson Zones are classification markers for different exposure levels to different UVI. There are 4 Zones. Animals that expose themselves naturally to lower UVI are classified as Ferguson Zone 1, and animals that naturally expose themselves to high UVI are classified as Ferguson Zone 4. This document does not aim to educate about this specifically, and further reading is readily available online. By continuing, it is presumed that you have an understanding of Ferguson Zones – including the differences between the different Zones.

COLOUR TEMPERATURE (AND CORRECTED COLOUR TEMPERATURE)

Colour temperature, or CT, is widely used to define the colour appearance of a light source. Colour temperature is technically only used for "true" light sources – defined as a black body that reads close enough to the Planckian locus.

Corrected Colour Temperature, or CCT, is used on a light source that doesn't read close to the Planckian locus.

Both are defined in degrees Kelvin where a Warm White is around 2700K moving to Neutral White at around 4000K to Cool White, 5000K or more. Note that Colour Temperature and CCT do not tell you anything about the colour rendering ability of a light.

This document does not aim to educate about this specifically, and further reading is readily available online. By continuing, it is presumed that you have an understanding of CT/CCT – including the differences and similarities.

COLOUR RENDERING (INDEX)/CRI

Broadly defined as an indication of how well a light source can provide wavelengths that allow for certain colours to be visible to the human eye. This is defined by the CIE in greater detail, along with standardisations on measuring the level of colour rendering capability – referred to as the "index" of colour rendering.

Light with a low CRI is less effective as one with a high CRI. The CRI of unobstructed sunlight is 100.

This document does not aim to educate about this specifically, and further reading is readily available online. By continuing, it is presumed that you have an understanding of CRI.

POWER DENSITY (PD)

This refers to a reading in Watts per square metre (W/m^2) in certain wavelengths.

INFRARED (IR)

IR is the term given to a section of the electromagnetic spectrum on certain wavelengths. It is invisible to humans. The range is so vast that it has been split into subcategories – A, B, and C. Some of these wavelengths (IRA or sometimes "Near IR") are associated with "deep heating" of skin and organs, whereas others (IRC or sometimes "Far

IR") are associated with general warming of the air and generally aren't suitable for "basking".

There is a limited, but growing, understanding of infrared in the reptile hobby and herpetoculture as a whole. We know that there are a multitude of biological benefits that short-wave infrared has on the body. In more recent years, the use of short-wave infrared has become more popular even regarding human physiology and medicine, although it has been noted in scientific literature since at least the 1960's.

It is difficult to measure infrared – specialist hardware is needed in order to measure the true temperature of a black body (although there is a relationship with colour temperature), or to conduct infrared spectroscopy.

However, some assumptions can be made based on our understanding of black body radiation are our knowledge that a tungsten filament acts like a black body radiator (again, there is a direct relationship between kelvin and wavelength).

This document does not aim to educate about this specifically, and further reading is readily available online. By continuing, it is presumed that you have an understanding of IR – including the differences between short wavelength (Near) IR (primarily associated with IRA and IRB) and long wavelength (Far) IR (primarily associated with some IRB and all of IRC).

TESTING METHODS

EQUIPMENT

In order to ensure that results are as true and comparable as possible, I have used readily available measuring devices for the test and industry standard devices too.

To allow for full spectrometry, a calibrated FLAME Spectrometer from Ocean Optics was used alongside their flagship software – OceanView.

Room temperature measurements were taken with an Inkbird branded digital thermometer, with part number IBS-TH2. The manufacturer claims the device to have an accuracy of ±0.3°C.

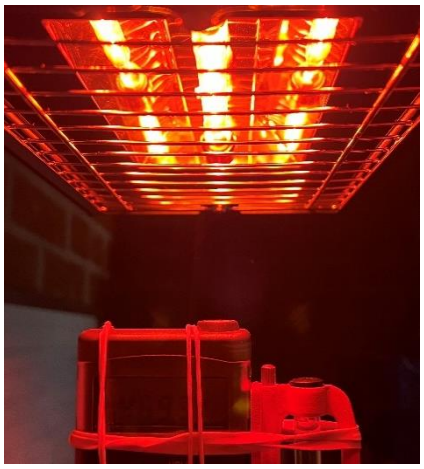
A power meter was used, model KWE-PM01, to monitor power usage.

Power Density was measured with an ISM400 unit from RS. This device responds to wavelengths ranging from 400nm to 1100nm (visible light and some IRA).

Where appropriate, a FLIR ONE PRO (iOS 2022) thermal imaging camera was used.

METHODS

The method for creating ISO Irradiance charts is very close to the method documented by other professionals for UVI charts, and by myself for Power Density charts. The ISM400 was central in relation to the lamp as shown below.



Power Density was measured in the testing room before each test to ensure that results were only measuring the lamps and not any other sources. I also tested the reflected radiation from my whiteboard and found that even at close range, the reflected light detected by the sensor was negligible (3-8W/m²) with a 400W lamp.

The Reptile Lamp Database software, created by Dr. Sarina Wunderlich, was utilised for some technical analysis and graph making – the database itself uses the data from the spectrometer to create usable and easy-to-read graphs and datasets.

The lamps were given 30 – 60 minutes to "warm up" before each individual test, unless otherwise noted. Spectrometer readings were taken in line with standard processes.

The lamps had between 1 – 5 hours of "burn-in" before the tests began, unless otherwise noted. Bulbs were handled carefully, as should be done with any R7s halogen bulb. Before every test took place, a dry microfibre towel was used to wipe the lamp and reflector to ensure that the lamp was clean.

PRODUCTS TESTED

The following product was tested.

REPTILE SYSTEMS GOLD INFRARED LAMP UNIT

Multiple lamps were tested. There was a selection of bulbs sent, including 75W, 100W, 200W, and 400W.

The single provided 75W bulb blew when preparing the bulb for taking some irradiance maps. I had already created one irradiance chart before it blew. This is the nature of such tests, accidents happen. This was my fault and does not reflect on the quality of the product at all.

INITIAL OBSERVATIONS

DESCRIPTION AND BUILD QUALITY

The bulbs are – as expected for any glass lamp – delicate. The bulbs are a standard R7s fitting, and are 118mm long. The bulbs have a gold dichroic coating on them – something often seen in human-grade heaters.

The bulbs show markings for their wattage and voltage, and also have a CE and UKCA marking.

The unit is well made and sturdy. It is black and looks sleek. The power switch is big and feels high quality. Braided wires are used throughout. The main cable is approx. 290cm long, and ends with an EU plug – a fused UK adapter was provided.

The unit is approx. 21.5cm at its widest point. It is approx. 15cm and 7.5cm tall. It has a switched cable that is approx. 290cm in length.

The unit is branded with the Reptile Systems logo. It has a CE marking, and a double insulation mark – meaning that it does not

need a connection to earth. There are other markings such as batch code and item number also.

BOX/PACKAGING

The box looks and feels high quality in general, there is no blurry printing or any off colours. The product's name is clearly visible on every main face of the box (not on the back or one side)

The box is black with red accents. It also features the "Zone" system that features across a range of Reptile Systems products – taking inspiration from the Ferguson Zones. There are also animals featured displaying a wide range of species.

The box does not explicitly state where the product is made. There are significant references to the EU, which implies that this product is made in the EU – however this is not confirmed anywhere that I can see.

The front of the box has a high-quality image of the unit, and some information about IRA, IRB, and IRC. The annotations imply that the unit does not emit IRC, or that it is not a primary IRC emitter.

There is an annotation that implies that the unit reflects 100+% of outputted radiation downwards, out of the face of the unit.

There is also a wattage marker on the front of the box, showing the wattage of bulb that comes inside the box. My box has 50W on it, however I did not receive a 50W bulb to test. This graphic will presumably be different for each different combination of unit and Wattage of bulb.

The box gives graphics of different orientations that the unit can be used in.

The back of the box provides, in a range of languages, some bullet points about the product.

ACCESSORIES

The kit comes with some parts for hanging the unit in a vivarium. Included is a set of clamps also, so that the unit can be clamped into place.

No mounting screws are provided.

PRESUMPTIONS AND GENERAL OBSERVATIONS

The unit is robust. Being a halogen unit, this lamp is expected to have quite a high output.

There are no instructions included, which may be a problem for some people.

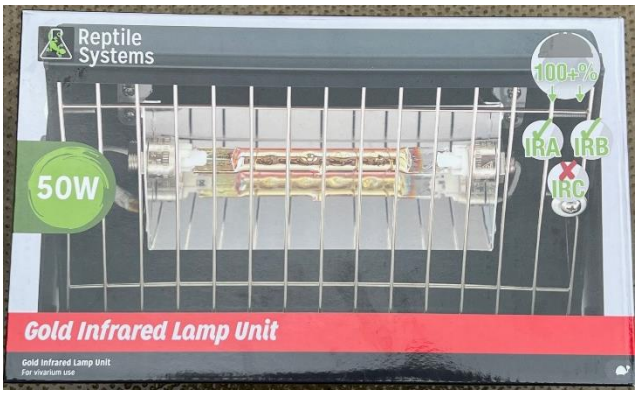
There is a premium feel to the device.

The bulbs emit a red glow when turned on.

PHOTOGRAPHS

Here are some images of the lamp, and box etc. Descriptions are provided where appropriate.

Bulb. This is the 75W, as shown by the wattage note (photograph taken **after** the bulb had blown). Note the gold colouration.



Box in different orientations. Bullet points on the back read:

Unique Gold Infrared Lamp uses the latest heating technology for reptiles.

- *Provides high levels of heat with low visible light.*
- *Rich in Infrared A and Infrared B.*
- *High energy efficiency compared to basking spots.*
- *Should be used with a dimming thermostat.*
- *High wattage model available for large enclosures.*
- *Infrared light contributes to heat regulation within the animal.*
- *Supports digestion, promotes well being[sic] and natural activity.*
- *Suitable to use the main heat source in your terrarium.*
- *Infrared reduces stress by not disrupting the day night cycle.*

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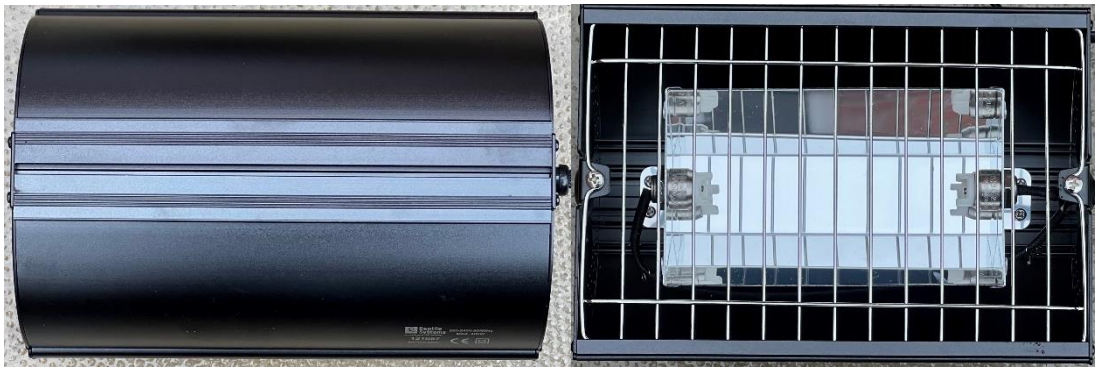

Top and “face” of unit.

Front of unit.

Close up of marks on unit.

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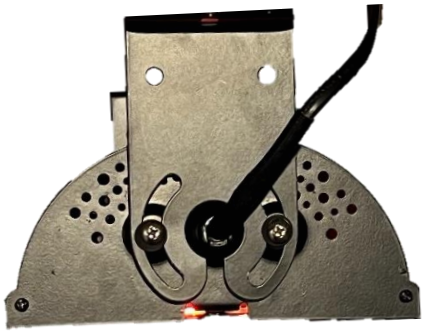
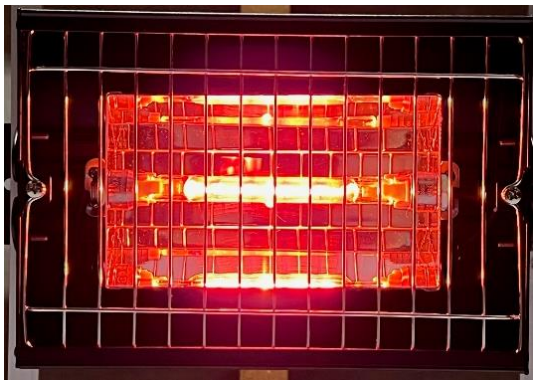


Unit from side

R7s socket inside unit, and braided wire. Socket is a “spring” version, rather than a “push” version.



Unit turned on (75W lamp, camera set to auto-exposure).

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POWER DENSITY PERFORMANCE

The instructions state that this unit is only supposed to be used in an enclosure. The unit can be angled up to 40° according to the box. For this test, the unit was always parallel to the floor and level.

As it can be presumed that most average consumers will not burn-in their lamp (there is no instruction to do so on the box), I have allowed the lamps 5 hours to burn-in and then began taking readings.

I have measured the Power Density (ISM400), from the centre point of the unit at set distances, with the different wattage bulbs installed.

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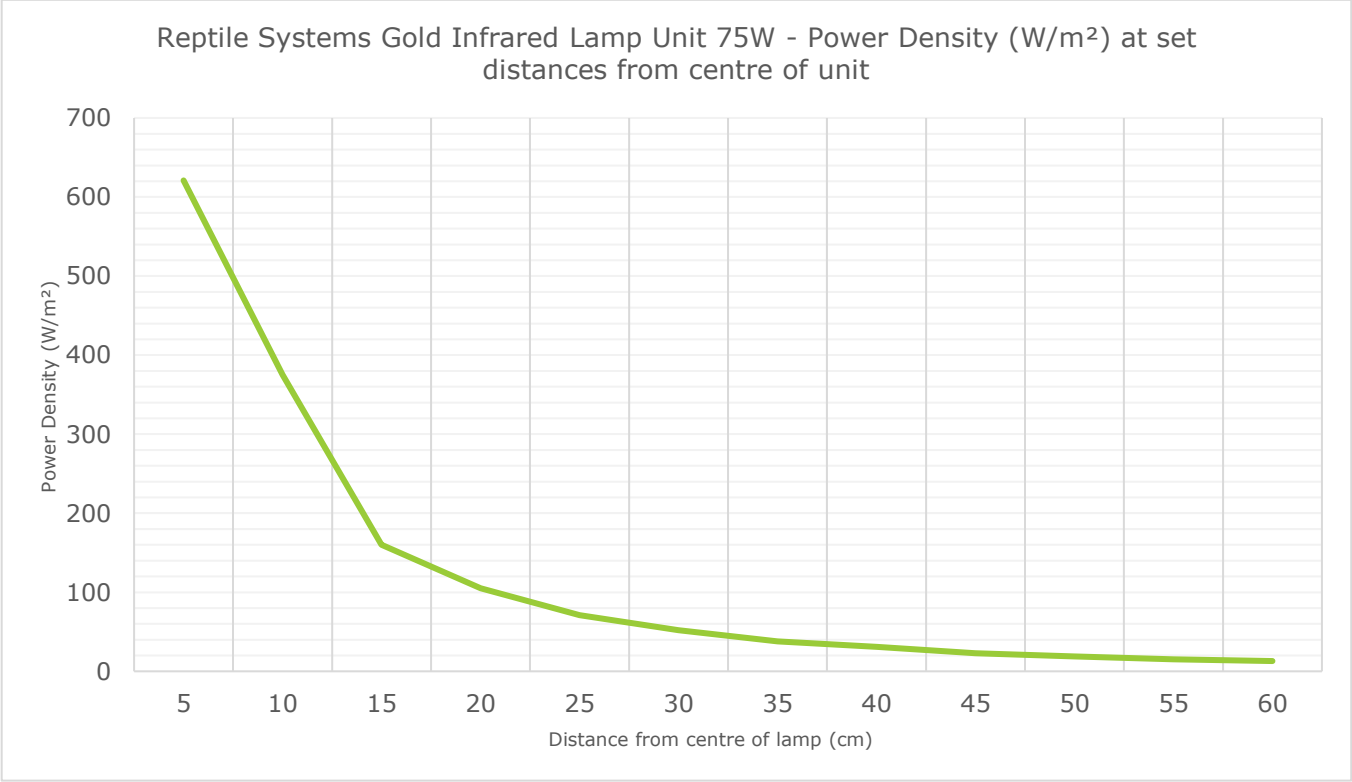
CENTRE POINT AFTER BURN-IN

The below measurements were taken at set distances from the centre point of the unit after a 5-hour burn-in. Values are in W/m².

Distance (cm)	5	10	15	20	25	30	35	40	45	50	55	60
75W	621	375	160	105	71	52	38	31	23	19	15	13
100W	852	392	224	147	99	66	49	37	31	26	23	20
200W	2200	1111	620	404	279	208	161	125	95	78	63	56
400W	(overload)	2200	1330	897	590	401	282	227	188	163	140	124

The following is the same data in graphical format for each different respective bulb.



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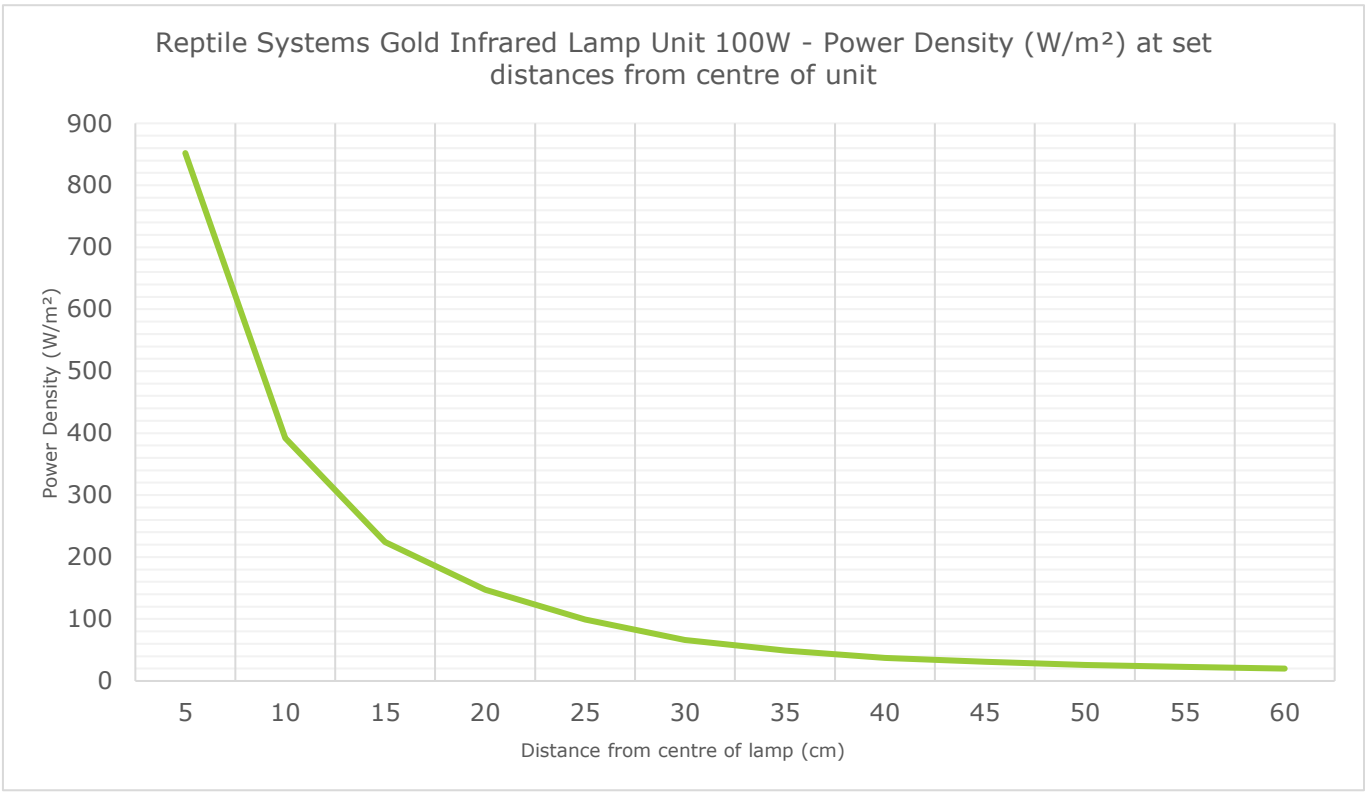

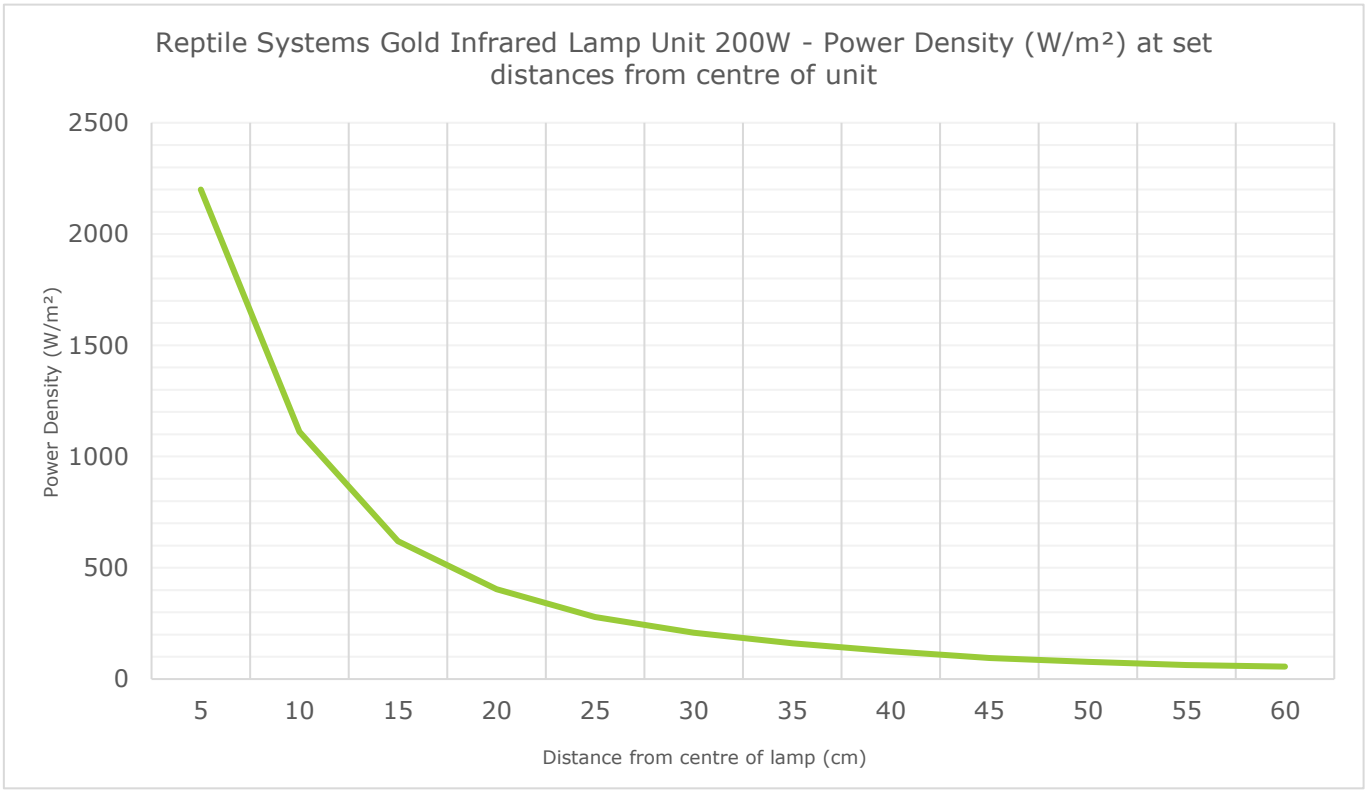

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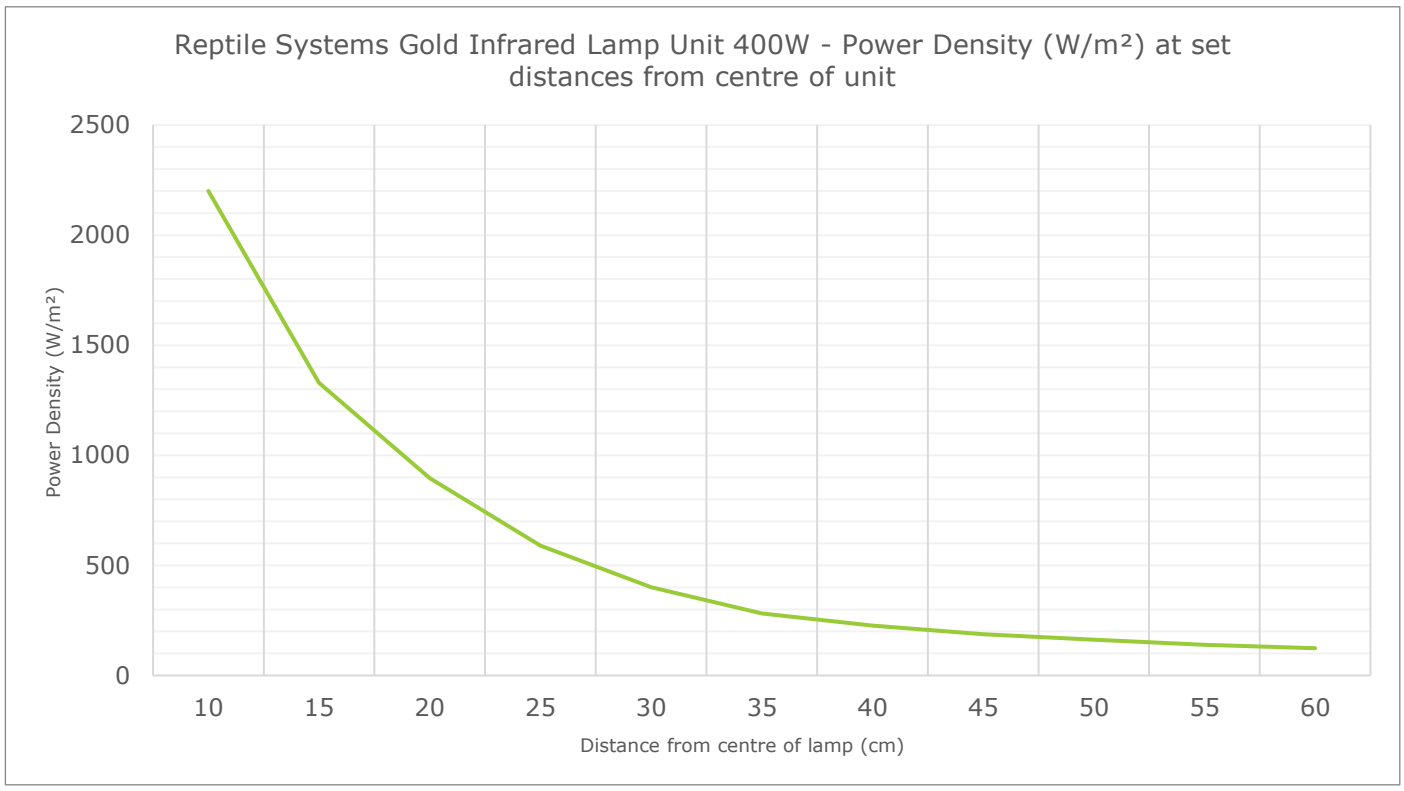

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IRRADIANCE CHARTS

PURPOSE

The charts in this chapter are an indication of Power Density (ISM400) output from the unit at set distances, with each respective bulb.

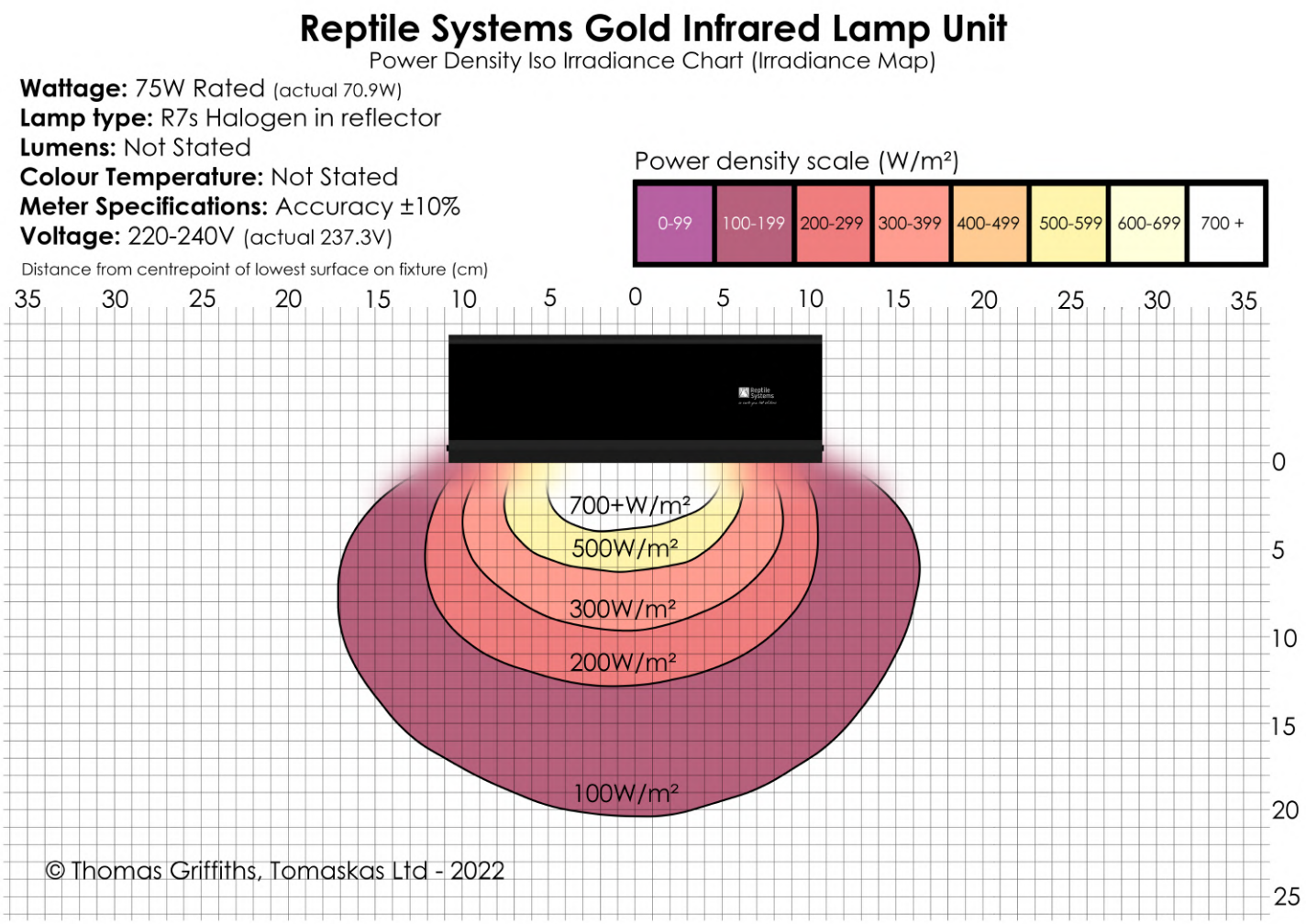
It is possible to visualise how the unit emits radiation as a whole, using Power Density as a measure. This is a good way to see the "spread of light and infrared" or the "beam of light" from the unit.

DISCLAIMER

The charts do not make claim to the safety of the lamps, as there is no data on the spectrum included in the charts. The charts are a guide only. The charts are to scale. A 60-minute warmup was given.

Unfortunately I did not manage to collect data for a chart "side view" for the 75W version as the bulb blew after moving the unit into position.

75W – FRONT VIEW



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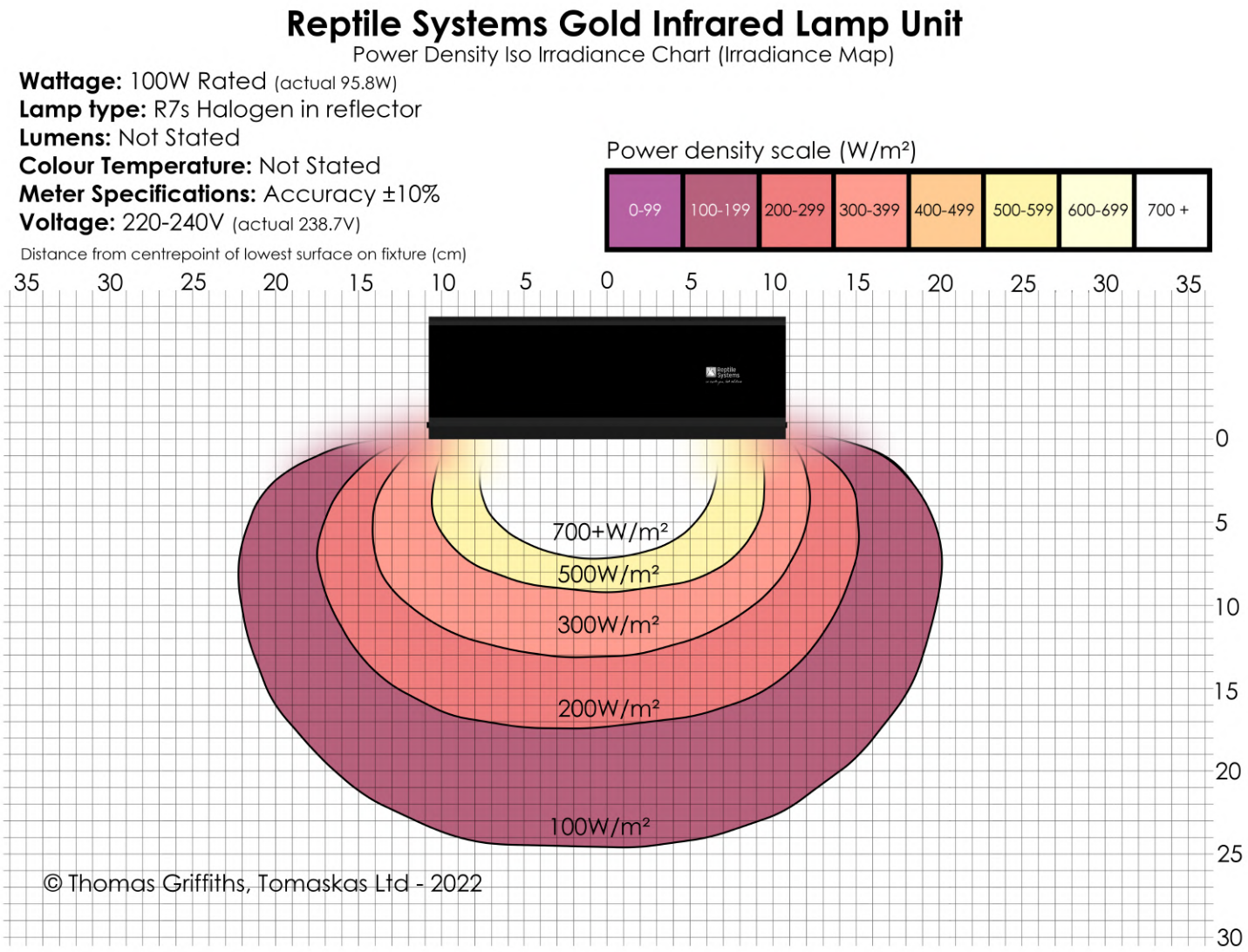
100W – FRONT VIEW



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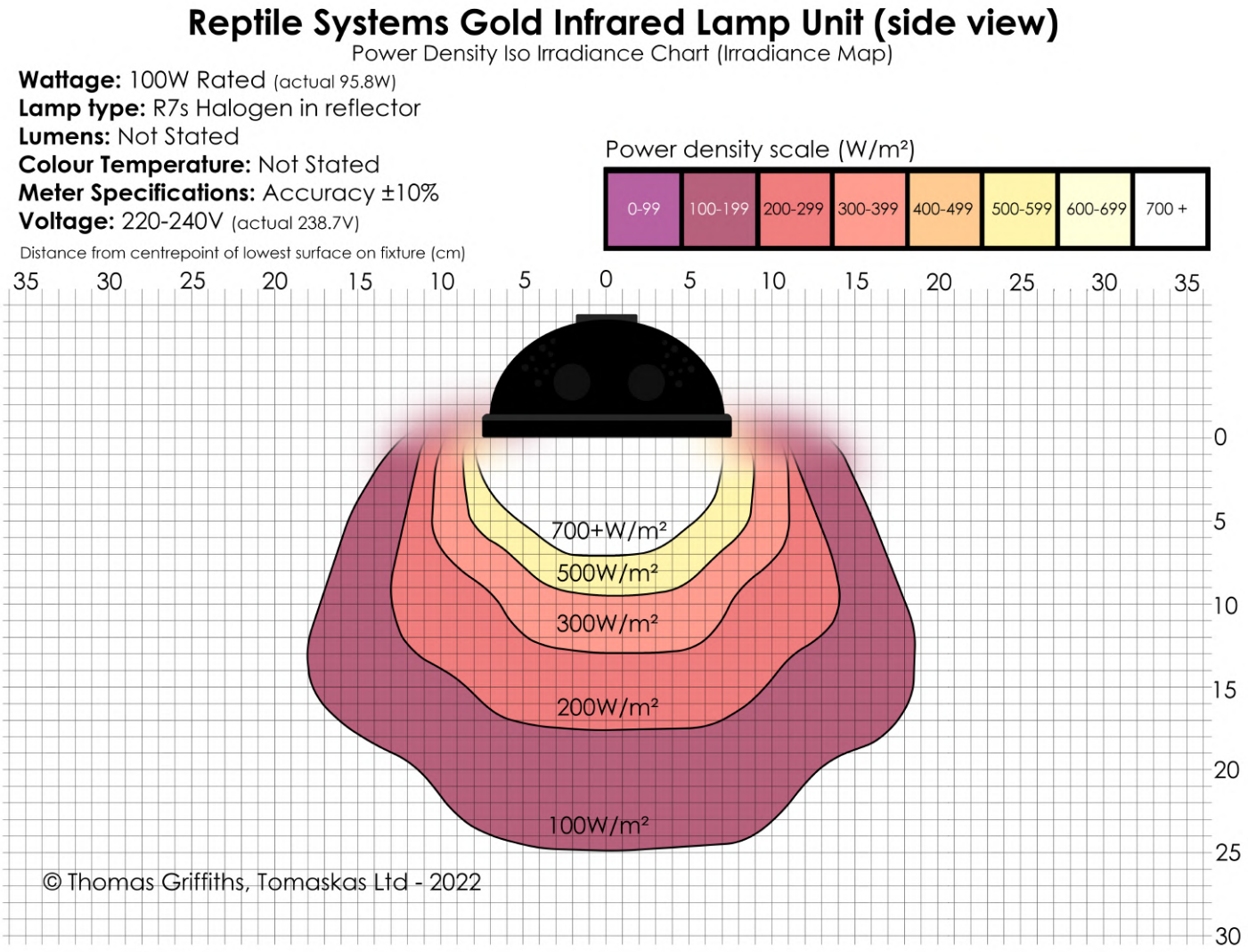
100W – SIDE VIEW



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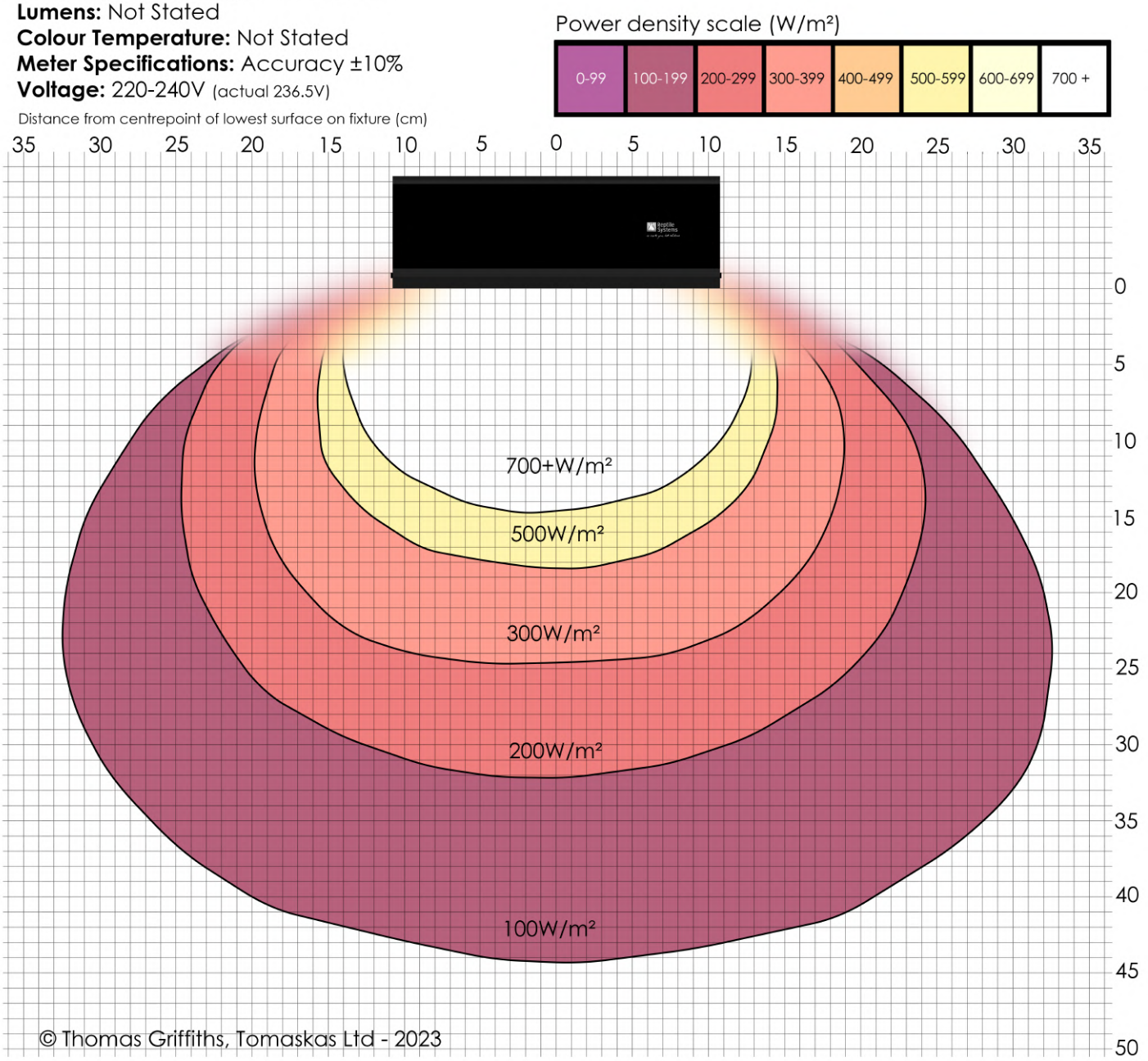
200W – FRONT VIEW

Reptile Systems Gold Infrared Lamp Unit

Power Density Iso Irradiance Chart (Irradiance Map)

Wattage: 200W Rated (actual 197.2W)
Lamp type: R7s Halogen in reflector
Lumens: Not Stated
Colour Temperature: Not Stated
Meter Specifications: Accuracy ±10%
Voltage: 220-240V (actual 236.5V)



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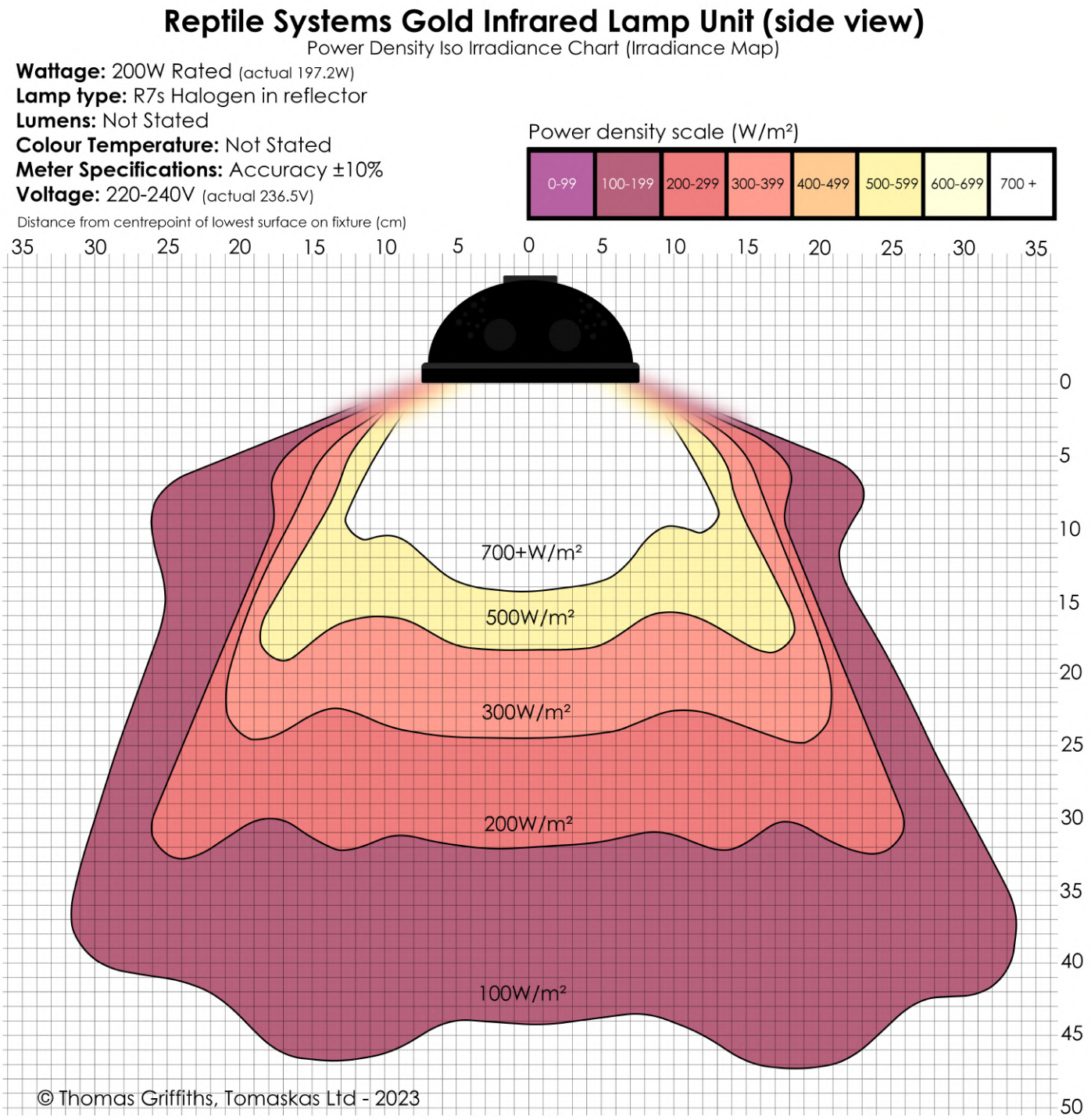
200W – SIDE VIEW



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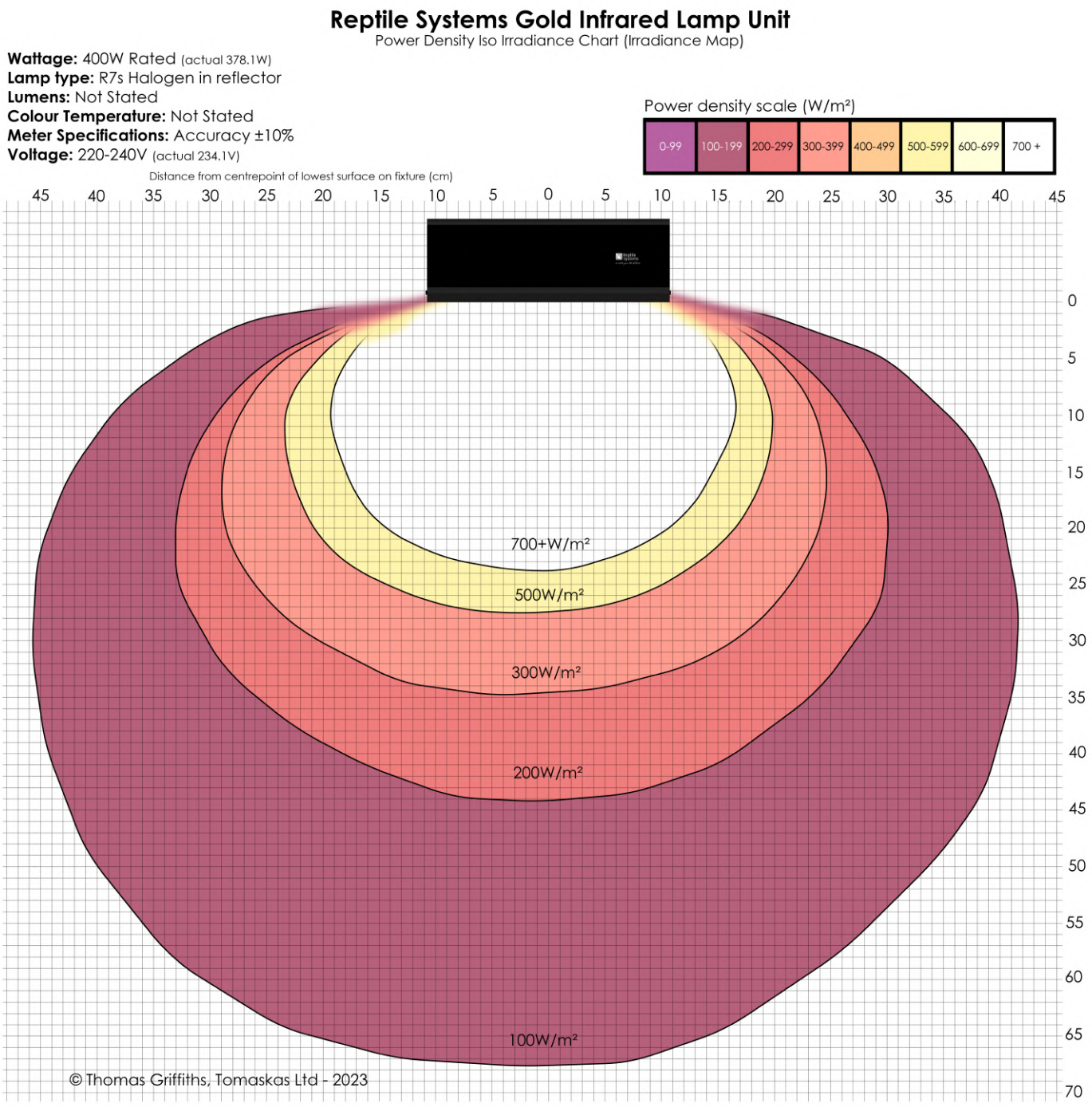
400W – FRONT VIEW



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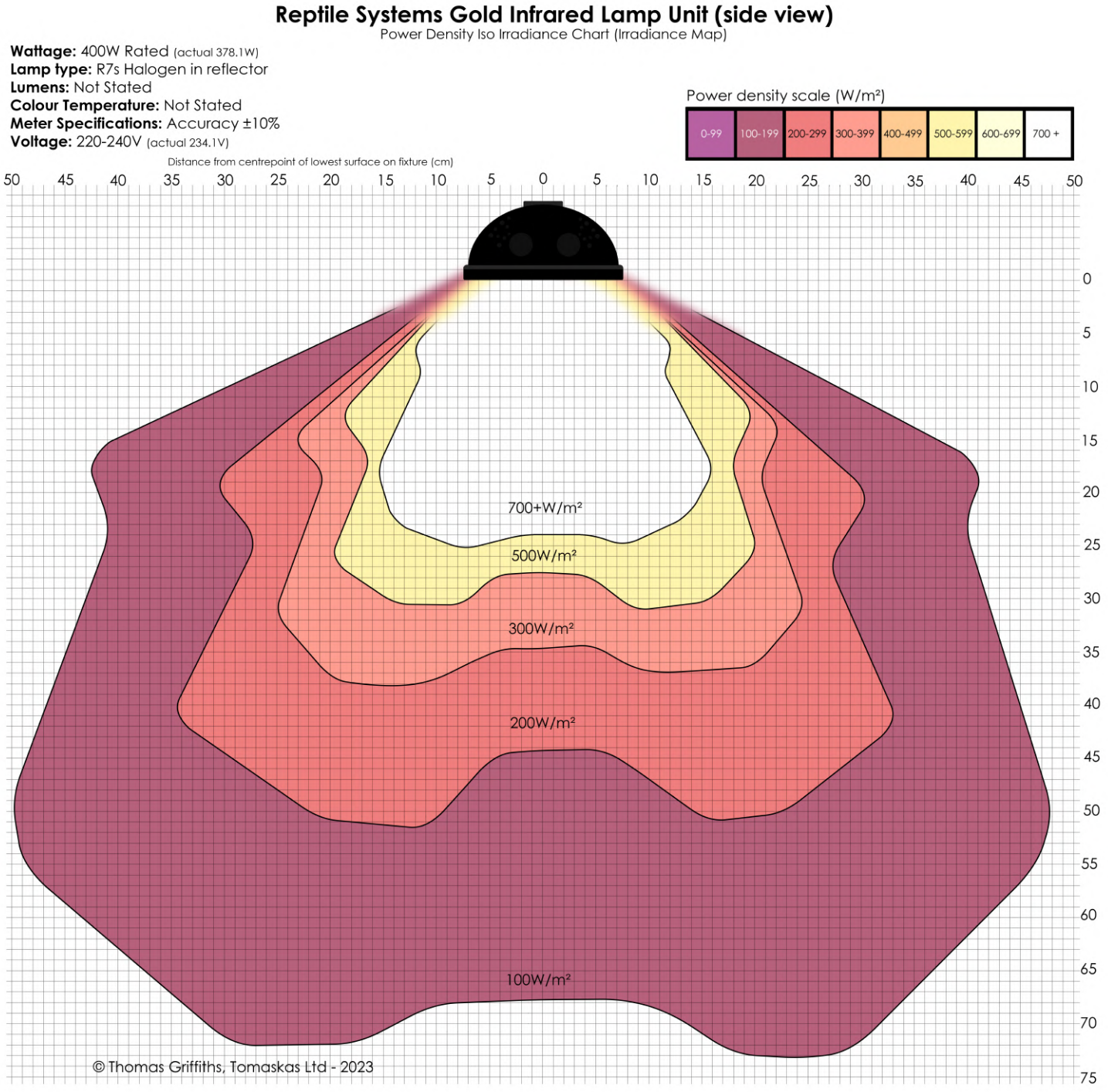
400W – SIDE VIEW



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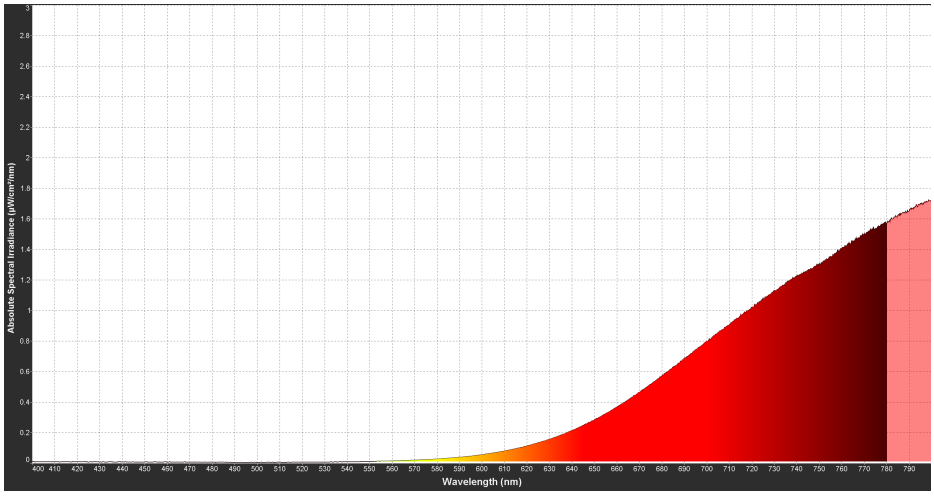
SPECTRAL MEASUREMENTS

The bulbs all emit the same colour spectrum, with the only variance being the intensity of the output. Because of this, I have included the reading for the 100W bulb. The spectral reading was taken at 30cm, after a 5-hour burn in and 1-hour warm up. The Lux reading at this distance was 30 Lux.

400-800NM



Full page graph is on the next page. Commentary is in a later section.

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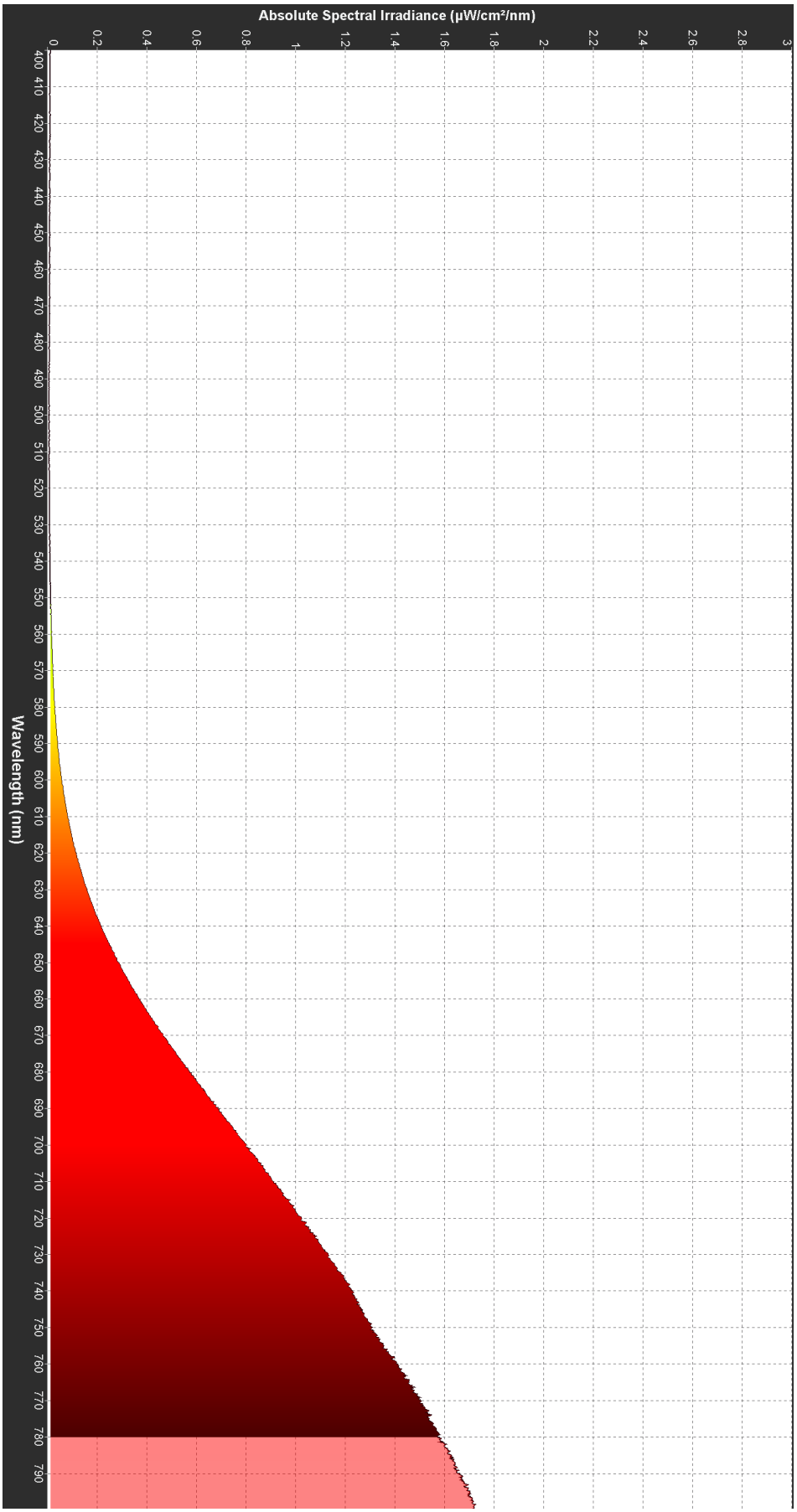

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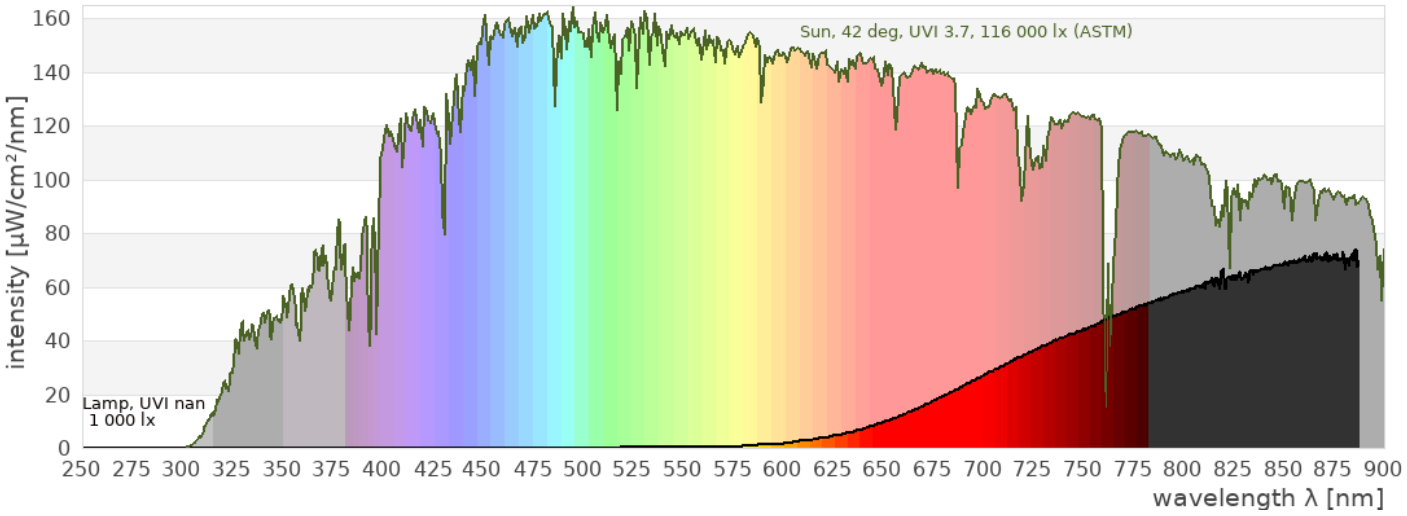
COMPARISON TO SUNLIGHT

The below chart shows the spectrum from the 100W bulb to sunlight (ASTM 42-degree sunlight). The spectral plot of the bulb has been drastically up-scaled (to approx. 1,000 Lux) in order to be visually comparable to sunlight for the sake of analysis. The true Lux reading at 30cm was 30 Lux (for comparison, the 400W was 600 Lux at 30cm).



Graph made using Reptile Lamp Database software, Courtesy of Dr Sarina Wunderlich

Full page graph is on the next page. Commentary is in a later section.

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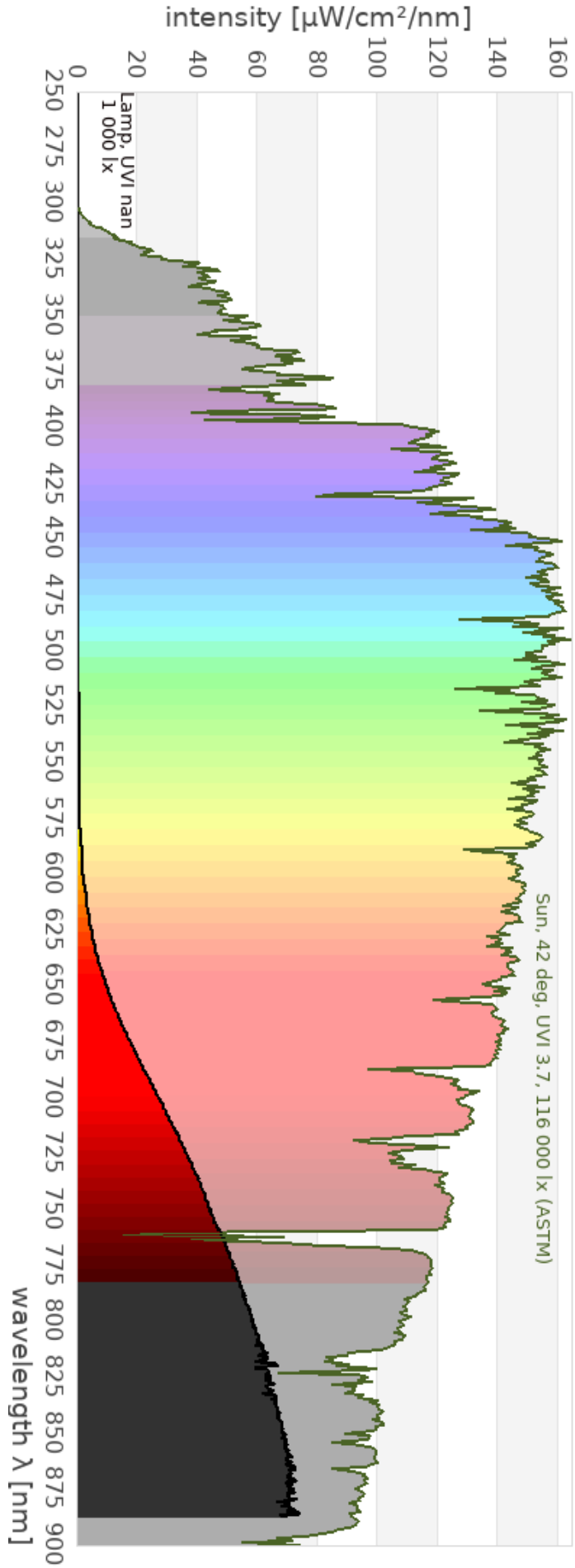

Graph made using Reptile Lamp Database software, Courtesy of Dr Sarina Wunderlich

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OTHER MEASUREMENTS

OVERVIEW

This section contains other measurements, such as power consumption details. The unit was given 60 minutes to warm up before each measurement was taken.

I have listed Power Density (Watts/m²) at 30cm, Power Factor, Amps, Frequency, Voltage and average wattage values.

This section also contains light spread and thermal imaging.

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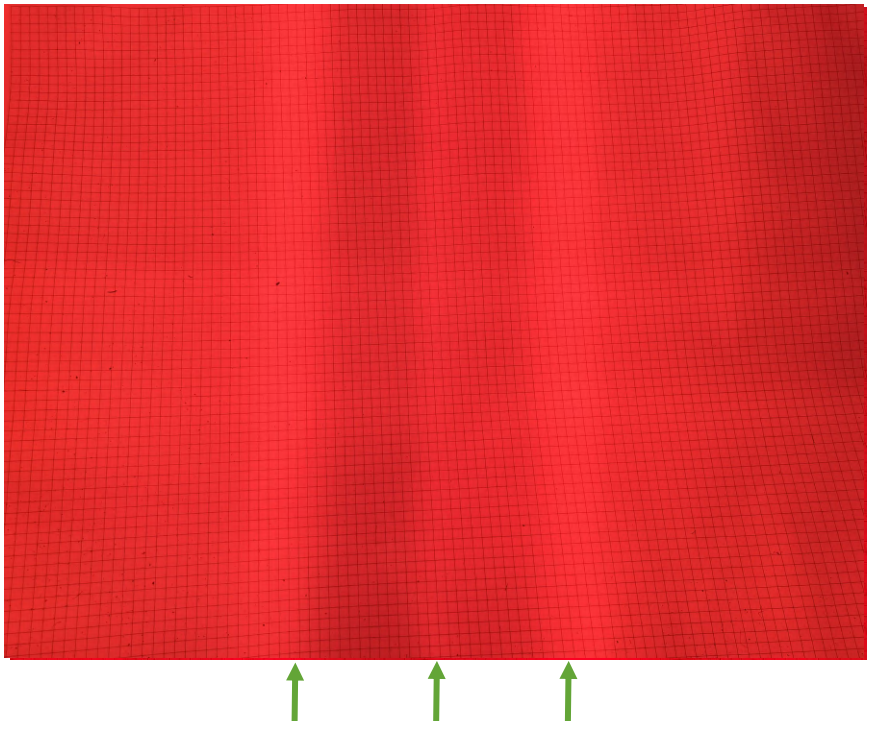
MEASURMENTS (AFTER BURN-IN)

The following are readings taken from the bulbs after a 5-hour burn-in period and a further 60-minute warm up each.

Category	75W	100W	200W	400W
Amps	0.29	0.39	0.81	1.6
Average Wattage	70.9	95.8	197.2	378.1
Frequency (Hz)	50	50	50	50
Voltage	237.3	238.7	236.5	234.1
Power Factor	1.0	1.0	1.0	1.0

LIGHT SPREAD

The spread of light can be seen as homogenous in the below image. This is at 30cm distance from the unit. Only one bulb is shown (400W), but this is the same for all the bulbs. Photo taken from "side view" of unit.



3 distinct bars of higher illuminance, middle bar is less bright

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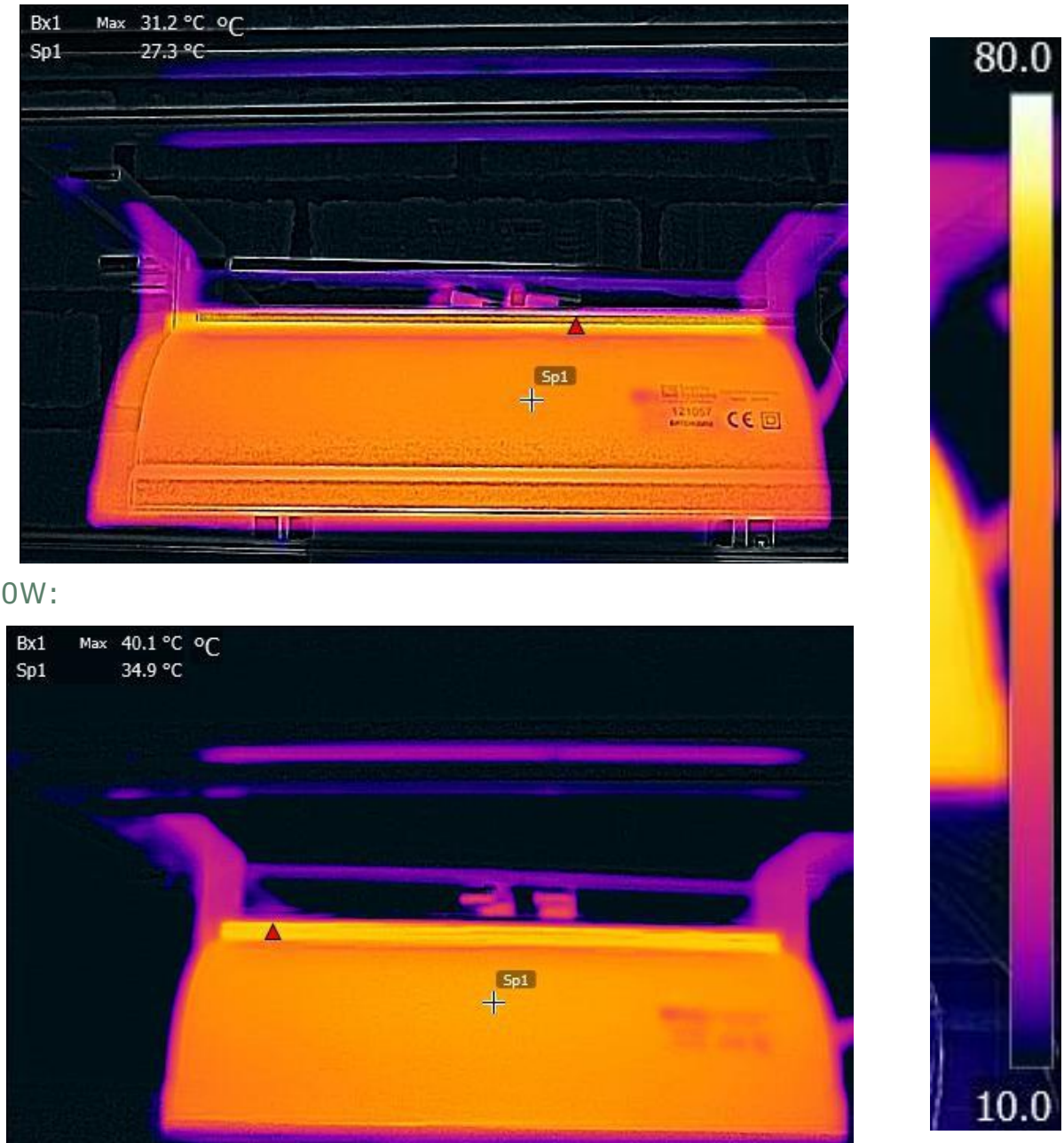
THERMAL IMAGING (AFTER BURN-IN)

The following images were taken after a 5-hour burn-in period and a further 60-minute warm up for each bulb. The ambient room temperature was approx. 15°C with the back wall being approx. 8°C. Note that the colour palettes between images are comparable.

75W:



100W:

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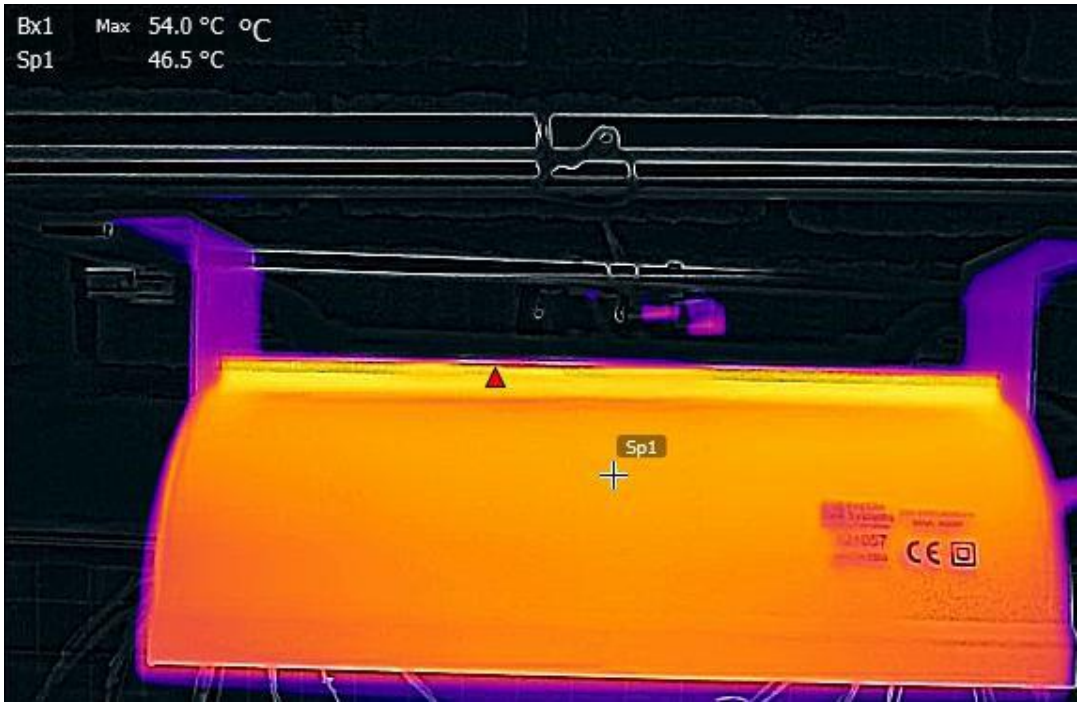
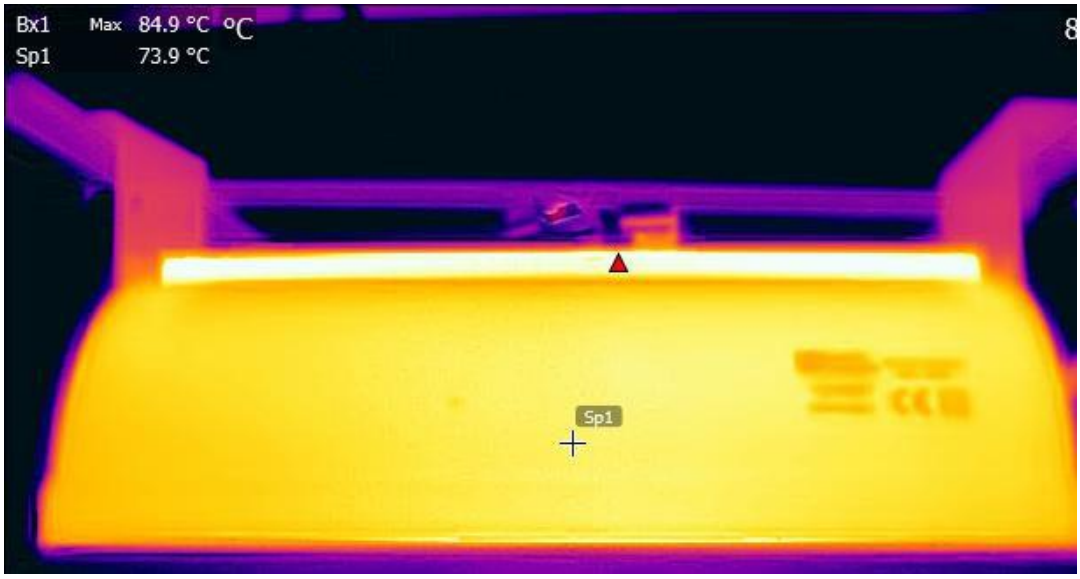
200W:



400W:



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COMMENTARY ON FINDINGS

OVERALL

The unit worked without any faults during the tests.

The unit shows European standard safety markings, but no UKCA marking. At the time of writing there is not a requirement for a product to have a UKCA marking, so this should not be a problem. The bulbs do have a UKCA marking.

OUTPUT OF INFRARED

The unit clearly outputs infrared when paired with each bulb, and the amount of infrared-A increases as the wattage increases – which is to be expected.

The bulbs appear to primarily output IRA and IRB. The apparent claim that the kit does not emit IRC (on the box) is not true. Both the bulbs and unit emit IRC, this is clear from thermal imaging and calculations based on our understandings of black body radiators.

BULBS AND THE GOLD COATING

The bulbs provided for testing, the ones sold by Reptile Systems for this lamp, are made bespoke for Reptile Systems. Such lamps are not readily available off the shelf in the wattages needed for the unit. The gold coating is designed to reduce glare when used in a human environment.

In an animal setting, it has probably been chosen to reduce the amount of overall light emitted. The coating will also act as a block for UV that is naturally emitted by an unprotected halogen lamp (standard quartz glass used in halogen bulbs is generally around 90% transmissible to UVC, UVB, and UVA). However, Reptile Systems' exact reason for the coating is unknown to me.

Because the lamps are only really available from Reptile Systems, this creates somewhat of a monopoly. However, it isn't difficult to find other (non-gold) R7s halogen lamps online and from stores (although, these are being phased out by LEDs more and more), including the "ruby red" variety.

RED LIGHT AND COLOUR RENDERING

The bulbs emit a red glow, due to the coating. This would be much brighter if the coating was of the "ruby red" variety.

Often, in the general reptile keeping hobby, red lamps are seen as somehow "dangerous" and damage the eyes of animals. Although there is no evidence that I can find to suggest that red light does indeed cause damage to a reptile's eyes, vision, or body. That said, red light is unsightly.

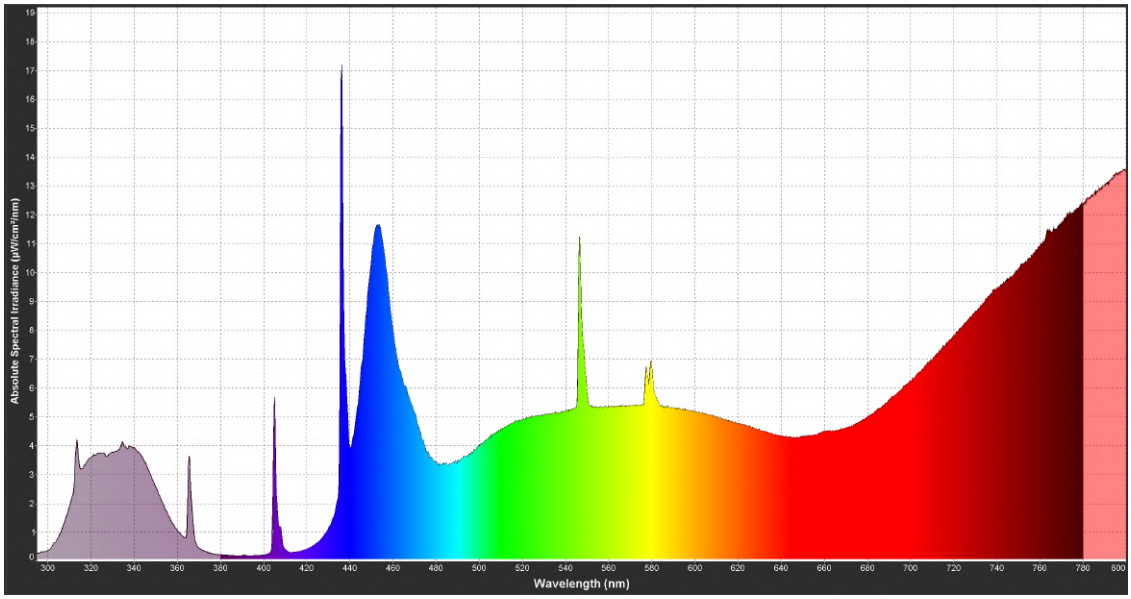
The red light alone does not render colours well at all. Everything illuminated is a shade of red – for example, for a human this means there is no way to differentiate between blue, green, or black. There is

no saying how this appears to a reptile. And although not necessarily dangerous, it is unnatural. The light is fairly homogenous with at least 3 distinct areas of higher illuminance.

USES

Reptile Systems makes no claim for this lamp to be the sole lamp in an enclosure. When speaking to Reptile Systems, they say that they always make recommendation for this unit to be paired with a high-quality visible light (LED) and a high quality UVB system.

If paired with an LED product and an appropriate UVB emitter such as a T5HO fluorescent, the result would be a wide basking area with a fairly broad spectrum of light and good colour rendering properties. This is illustrated below:



Reptile Systems Zone 3 T5HO (24W), Arcadia Jungle Dawn LED Bar (15W), and Reptile Systems Infrared Gold Lamp Unit (400W)

Cat.	CCT (Kelvin)	CRI(a)	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	DC<5 .4E-3
Ref.																		
Val.	5702K	90.1	88.9	91.2	91.9	88.4	90.1	91.6	89.8	89.1	92.4	91.2	88.4	75.6	87.5	95.1	92.8	FALSE

Colour rendering values of the above setup.

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OTHER COMMENTS

The bulbs are not very bright considering the wattage – however this is by design, the gold coating attenuates visible light output from the tungsten filament. The Power Factor of the bulbs is approximately 1.0, This is to be expected for a resistance-based load such as a halogen lamp.

The unit's body did not get unjustly hot for the 75W or 100W bulbs. The unit did get very warm when using the 200W and 400W bulbs – so it could be advised that extra protection for the animal is provided if using higher wattage bulbs.

There is no warning on the box to warn users of being careful when touching a quartz R7s halogen. Touching the glass with bare hands leaves behind a residue which causes hotspots when the bulb is turned on – this nearly always results in premature failure. Such information could be included in an instructions document if the unit was sold with one. The same instruction document could warn against purchasing standard quartz halogens due to UVC concerns.

As stated earlier, red light isn't necessarily any danger to an animal. although I do fear that this unit will suffer from "red lamp syndrome" in the general hobby. Red lights are perceived negatively by many in the hobby, and Reptile Systems may end up struggling to convince the hobby that the unit is indeed safe. I hope to have proven on the previous page that the light is fine as part of a broad-spectrum setup.

I feel that this unit would work especially well in tortoise enclosures, but could perform equally as well with something such as a leopard gecko or bearded dragon with the appropriate bulbs.

If used properly, without directly touching the bulbs with skin when installing, and with the appropriate measures in place to avoid overheating or burning an animal, this unit is safe and can form a part of a full spectrum lighting setup.

FURTHER TESTS

LONGEVITY AND DEGRIDATION

There is no longevity stated. It would also be difficult to test longevity as halogens can vary widely. A large sample size would be needed for this, with significant time set aside to turn the lamps on and off. This would certainly be doable with enough time and resources.

TEARDOWN

At this point I have not conducted a teardown of the unit. This could involve reviewing electronics inside, although I may seek further counsel on this first as I don't want to break any laws regarding intellectual property.

R7s units are widely used in other industries, so I don't suspect there is any ground-breaking technology inside to warrant a teardown.

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SPECIAL THANKS

Special thanks are in order for many friends, colleagues, and partners. I'd like to give a thank you to the following, but there are undoubtedly more that have not been named.

COLLEAGUES

The work of Roman Muryn C.Eng has been really helpful. Although Roman hasn't seen this document before release, his work has had significant impact on the way tests are conducted and the details I've provided. Please note that Roman Muryn C.Eng has not endorsed this paper before release.

Dr Sarina Wunderlich has kindly allowed me to utilise her Reptile Lamp Database system to generate some technical graphs and datasets. She has also acted as a point of consultation. Please note that Dr Wunderlich has not endorsed this paper before release.

Dr Frances Baines has acted as a point of consultation when discussing this test. Please note that Dr Baines has not endorsed this paper before release.

The Reptile Lighting Facebook Group as a whole have also acted as a point of consultation when discussing this test. The Reptile Lighting Facebook Group have not endorsed this paper before release.

Peter Blake at Reptile Systems has acted as a point of contact from Reptile Systems, and answered all my questions. He also arranged the unit and bulbs to be sent to me.

COPY

Rebecca Baines MA conducted spellchecks and ensured that I was making sense. She also provided much needed coffee.

LITERATURE AND FURTHER READING

In this paper, I have made comments supported by scientific literature, both peer-reviewed and not. Here is a list of literature that I have either directly referenced, or used in support of points and claims that I've made. The list is not extensive.

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