Rodent temperature control system

1. Introduction

It is important to keep small rodents warm during surgical and imaging procedures. We describe here a system used for many years on an inverted microscope. The system uses both bottom surface heating with a small thermal pad and infra-red heating of the upper surface. The bottom surface temperature is regulated with the aid of a rectal thermocouple while the upper surface is controlled with a thermocouple placed on the skin surface. We thus employ two independent control systems and both use proportional-integral-derivative control achieved using readily available commercial controllers.

The unit is constructed in a plastic case with aluminium front and rear panels, as shown in Figure 1 and the circuit is shown in Figure 2.

Figure 1. The control unit front panel. The neon indicators in the illuminated rocker switches enabling rectal and surface heating turn on when heating is required, as determined by thermocouple-sensed temperatures.

2. The control unit

The circuit is extremely simple, relying on most of the 'clever' control performed in the Eurotherm controllers. These provide 240V ac outputs: one of these supplies the infrared lamps through a local over-temperature switch, the other is transformed down to 12V to supply the heater mat. The section on the circuit marked 'on condenser unit' is specific to our arrangement, where the infrared lamps are mounted on a microscope light condenser assembly; this section merely acts as a convenient junction box and may be ignored in other applications.

Most of the circuit connections are at 240V AC and appropriate construction techniques are essential. **Warning:** do not attempt to construct this unless you have built mains-powered equipment before.

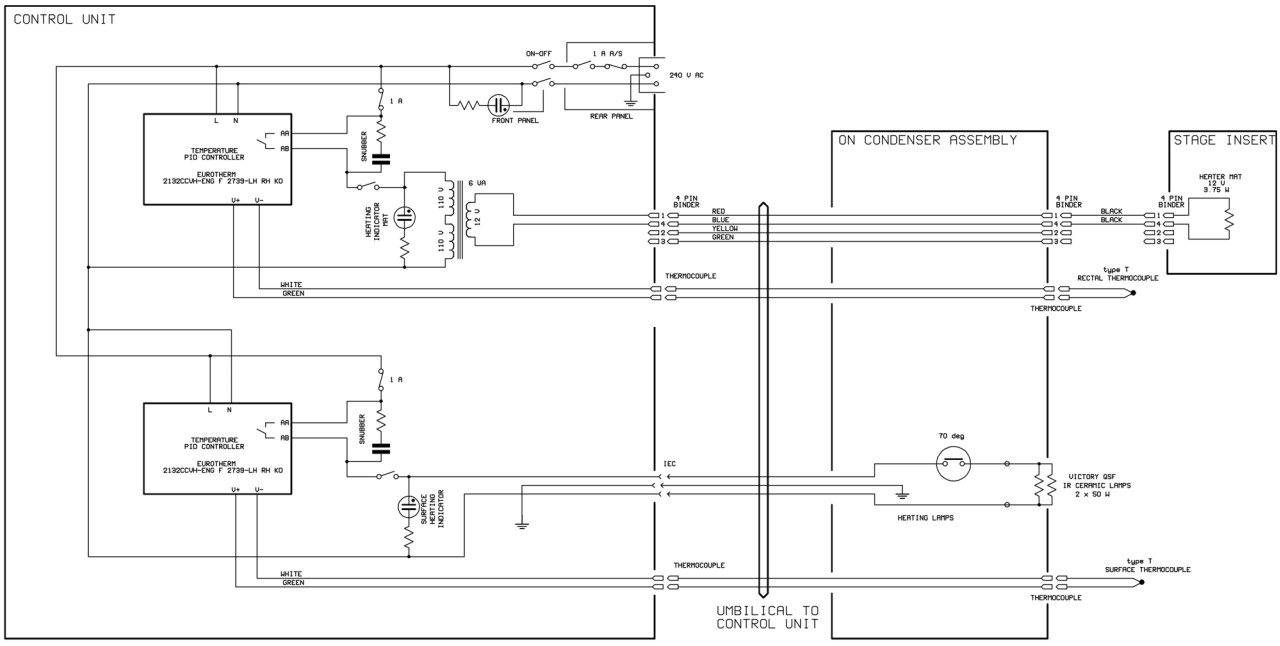

Figure 2. Circuit diagram of the control unit. The relay outputs from the controllers are fitted with external snubber networks to minimize the possibility of contact arcing. Separate switches are provided on the outputs to disable heating id required. The heater pad mains transformer is protected with a 1A fuse

The rear of the unit is shown in Figure 3. Thermocouple input connectors are provided while the outputs consist of a multipin heater output and a mains output to the infrared lamps, part of the IEC mains input connector.

Figure 3. The control unit rear panel.

The dimensions of the cutouts of the front and rear panels are shown in Figure 4, which also shows the internal layout of the unit. The heater pad mains transformer is mounted on a small aluminium plate, also shown in Figure 4. A list of components used is provided at the end of this document.

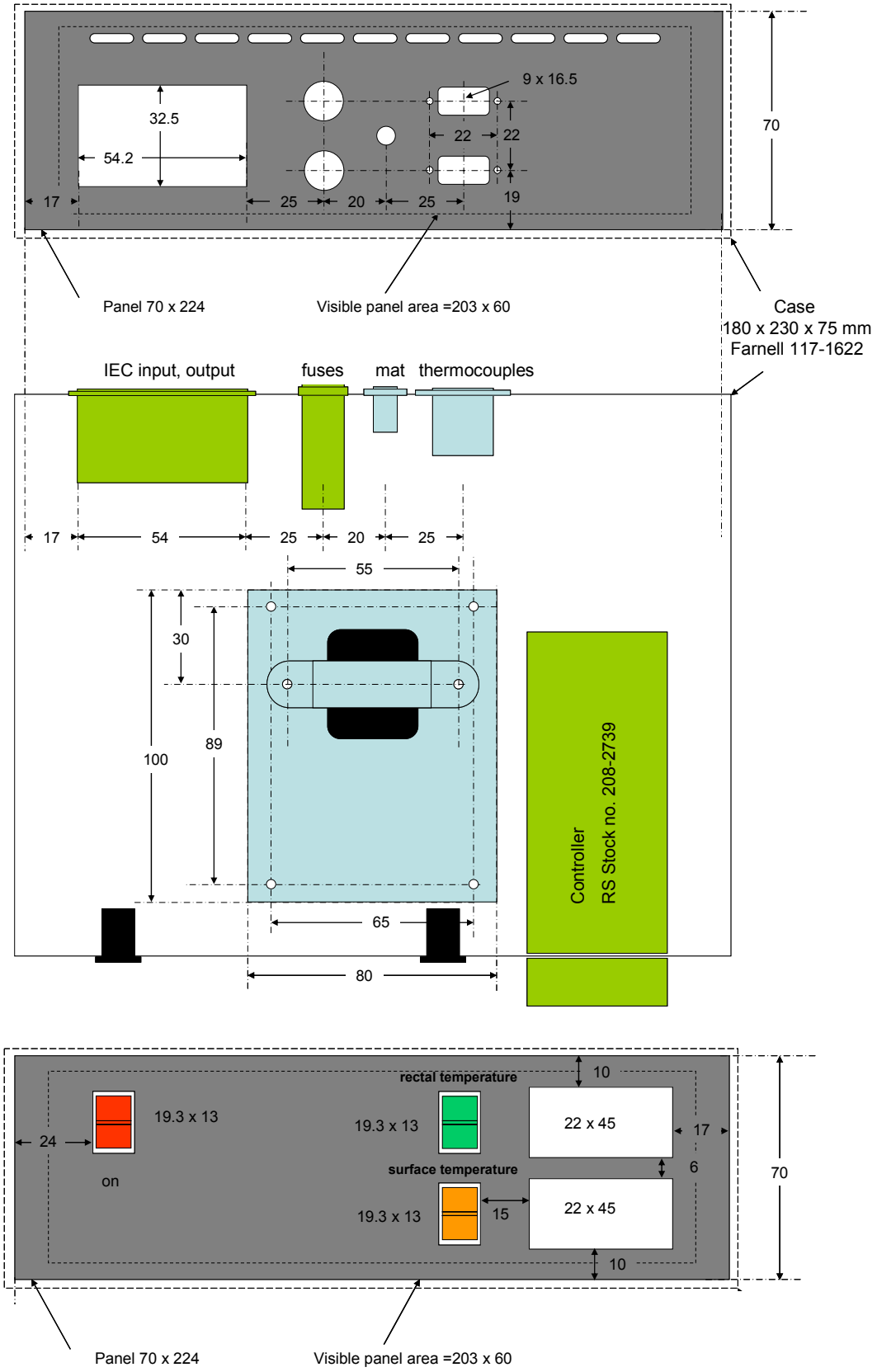

Figure 4: front and rear panel cutouts and internal layout of the unit

The controller is used in conjunction with a customized stage insert and an infrared heating lamp, shown in Figure 5.

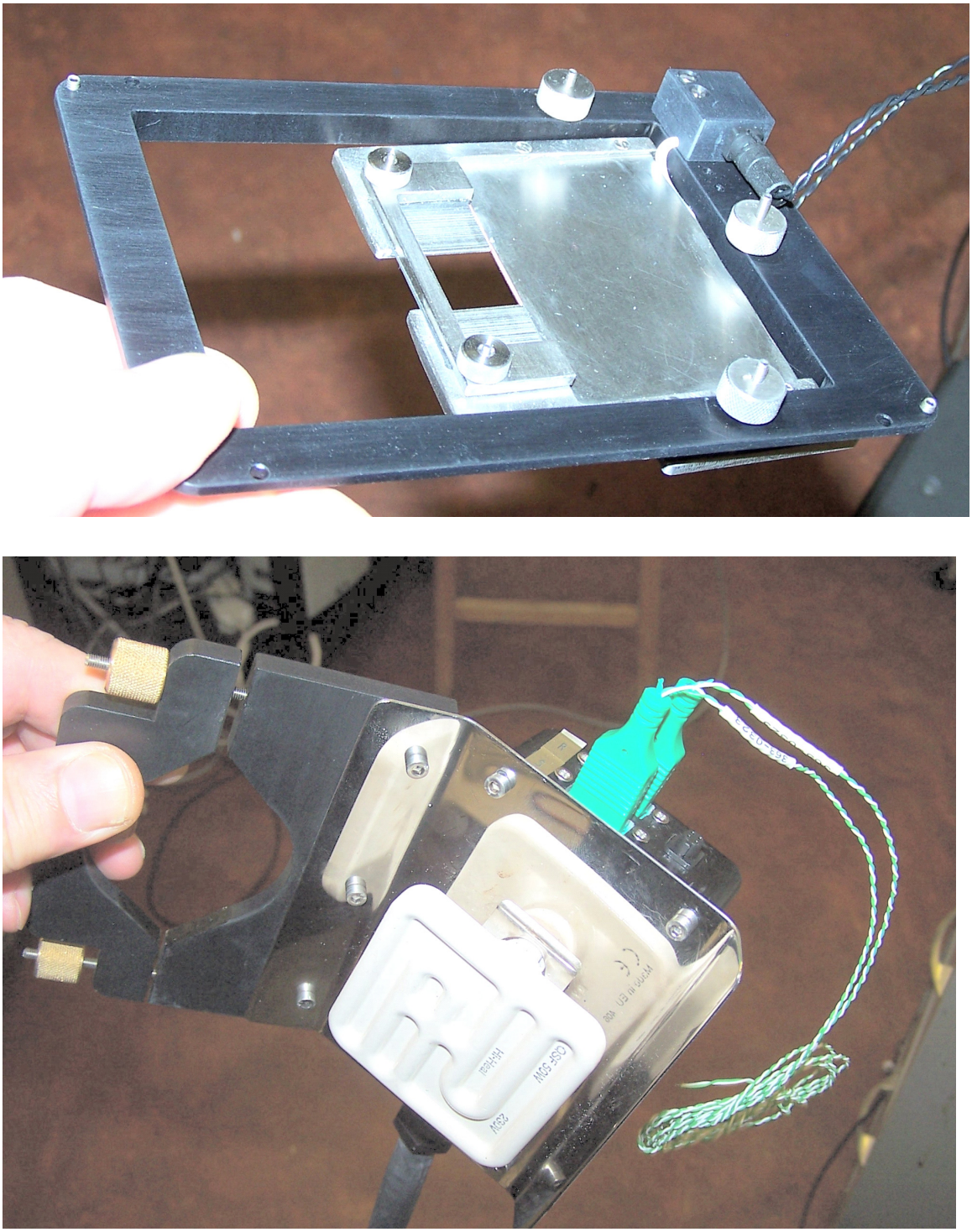

Figure 5. The heated stage and infrared lamp assembly.

List of components used in the rodent temperature control system. The component costs refer to 2007 prices, so these figures should be taken a guide only.

Item	Supplier	Stock #	Part #	Qty	Cost /each
Stage insert					
Heater connector	Farnell	112-2547	Binder 09 9765 30 04	1 off	£ 2.57
Heater cable connector	Farnell	112-2546	Binder 09 9764 70 04	1 off	£ 3.29
Heater mat	RS	245-512	50x75mm self-adhesive heater mat, 3.75W 12V	1 off	£12.34
Case assembly					
Controller	RS	208-2739	Eurotherm Controls # 2132-CC-VH-ENG-F2739-LH-RH-K-0	2 off	£150.00
AC input connector/ AC lamp socket	Farnell	112-4128	Bulgin IEC, AC fused,	1 off	£2.51
AC lamp cable plug	Farnel	112-5791	Bulgin 240 V rev IEC	1 off	£2.59
System on-off switch	Farnell	149-863	Arcoelectric red	1 off	£1.46
Mat output socket	Farnell	112-2548	Binder 09 9766 30 04	1 off	£ 2.75
Mat output plug	Farnell	112-2545	Binder 09 9767 70 04	1 off	£ 3.44
Heater transformer	Farnell	116-6329	12V 6 VA	1 off	£ 4.49
Thermocouple flanged socket	Farnell	381-0525	Labfacility IM-K-SSPF	2 off	£ 4.11
Thermocouple miniature plug	Farnell	708-6362	Labfacility IM-K-M (IEC)	2 off	£ 1.92
Heating switch / on indicator - mat	Farnell	149-864	Arcoelectric green	1 off	£ 1.46
Heating switch / on indicator - lamp	Farnell	150-388	Arcoelectric amber	1 off	£ 1.46
Fuse	Farnell	112-3131	1A delay	3 off	£ 0.173
Fuseholder (output)	Farnell	899-288	Multicomp	2 off	£ 0.86
Case	Farnell	117-1622	Retex 3503, 77 x 231 x 181 mm + *"rodent heater.ppt"*	1 off	£ 20.53
AC input cable	Farnell	112-4382	Volex X-285626A	1 off	£ 6.27
Thermocouple	RS	363-0323	K PTFE moulded min plug, 1m	2 off	£ 4.40
Thermocouple cable	Farnell	863-7180	10 metre length	1 off	£ 8.49
Condenser assembly					
Ceramic heater	Victory	QSF	50 W 230 V	1 off	£ 18
Mat output socket	Farnell	112-2548	Binder or similar	1 off	£ 2.75
Mat output plug	Farnell	112-2545	Binder 09 9767 70 04	1 off	£ 3.44
Thermocouple flanged socket	Farnell	381-0525	Labfacility IM-K-SSPF	2 off	£ 4.11
Over-temperature cutout	Farnell	100-6843	70 deg (100-6842 for 50 deg)	1 off	£ 1.85
Box 65 x 112 x 27	Farnell	117-1664	BIM 5003/13 BLK	1 off	£ 5.41
Cable gland	Farnell	143-607	PRO POWER 241/69/79B M13 x 1	1 off	£ 0.53

Supplier contact details:

Victory Lighting (UK) Ltd
Quay West, Salamander Quay, Harefield,
Uxbridge, Middlesex, UB9 6NZ
www.victorylighting.co.uk
Tel +44 (0) 1895 821 821
Fax +44 (0) 1895 821 822

Farnell in One
08701200 200
http://www.farnell.co.uk

RS Components
UK Orderline: 08457 201201
http://rswww.com/

This system was developed during the summer of 2007 and was used by G. Fruhwith at King's College London in Tony Ng's group. Most f the construction was performed by RG Newman and this note was prepared by B Vojnovic and RG Newman. It was slightly updated in August 2011.

We acknowledge the financial support of Cancer Research UK, the MRC and EPSRC.