

## Transparent heating elements

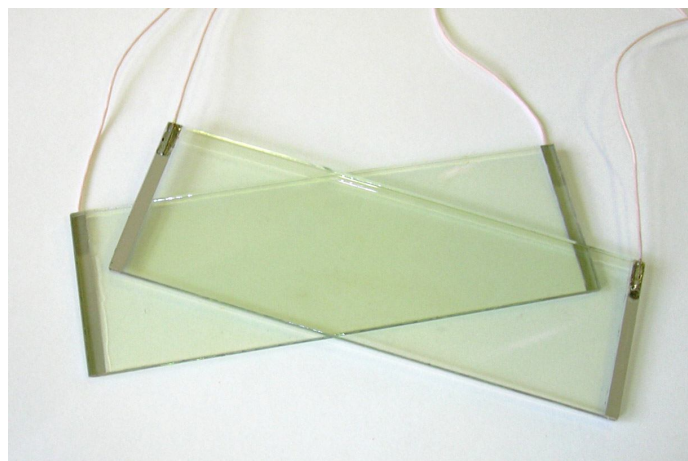
Transparent heating elements (THE) are designed to heat instrument windows and LCDs when working at low temperatures. THE expand the range of operational temperatures of conventional LCDs down to -60°C. THE are optically clear glass plates with a transparent conductive layer applied on one side.

### Advantages of THE:

- Expansion of the range of operational temperatures of LCDs to -60°C
- Easy installation
- Low power consumption
- Low-voltage power supply
- Shielding from electromagnetic interference
- Compact and lightweight design
- Protective function

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## Device and its functioning

THE are optically clear glass plates with a transparent conductive layer applied on one side. For uniform heating of the surface distributing electrodes are located at the edges of THE. A THE can be connected by flexible mounting wires (recommended type: MGTf). The wires are mounted to the THE on the conductive layer and electrodes side by soldering. The general scheme of a THE is shown in Illustration 1.

In terms of circuitry a THE is a permanent resistor of 4-300 ohms (depending on the model).

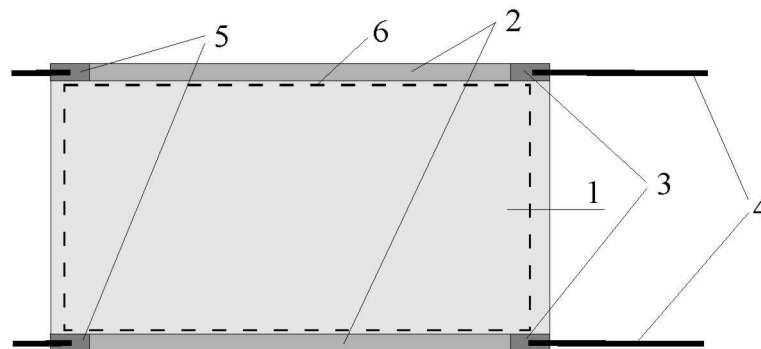


Illustration 1: General scheme of a THE

1 – glass plate, 2, 3 – distributing electrodes, outputs (soldering), 4 – mounting wires, 5 – additional outputs, 6 – edges of the visible area of the THE.

## Basic technical characteristics and parameters

The basic parameters of THE are listed in Table 1, the requirements for resistance to environmental influences in Table 2.

**Table 1: Basic parameters of THE**

Parameter	Value
Overall dimensions, mm	up to 425x325
Thickness, mm	0,7 - 10 (standard: 1,1 or 1,8 mm)
Resistance, Ohm	4 – 300
Power supply voltage, V	3.3 – 50
Power, W	0.5 – 100
Transmission of light in the range of 440-670 nm <sup>1</sup> , %	not less than 80 not less than 93

<sup>1</sup> more detailed optical characteristics are available upon request

- с просветляющим антибликовым покрытием

**Table 2: Requirements for resistance of THE to environmental influences**

Parameter	Value
Sinusoidal vibration	1-55 Hz, 2 g
Single mechanical shocks	10 g, 3 ms
Repeated mechanical shocks	5 g, 10 ms
Operating temperature range, °C	-60...+20
Extreme temperature range, °C	-70...+60
High humidity	
- during operation	80% at 15°C
- during transportation and storage	100% at 25°C
Resistance to cleaning solvents	resistant <sup>2</sup>

<sup>2</sup> only for THE without anti-reflective coating



## Information for developers

**This section contains brief information for you to learn about the THE technology. If you start creating a device, feel free to send us an enquiry (by fax, phone or e-mail) and we will provide you full information.**

### Selection of dimensions and THE mounting

Usually the dimensions of a THE are selected according to the size of the metal LCD frame. The length and width of the THE should be about 1-2 mm smaller than the outer dimensions of the frame, so as to avoid overlapping of the THE in case of inaccurate assembly. It is also necessary to keep in mind that the tolerance of THE dimensions is  $\pm 0,5$  mm (unless stated otherwise in the technical specification).

When assembling the device, remember that a gap of 1-1,5 mm for THE outputs and wires should be left between the THE and the LCD.

More detailed information about possible ways of THE installation is provided on request.

### THE visible area

The visible area is an optically transparent part of a THE. Very strict requirements regarding the absence of optical defects and impurities are set for visible areas of a THE. The size of the visible area cannot be smaller than the LCD visible area (Display area). One of the dimensions of the visible area should be at least 6 mm smaller than the corresponding dimension of its THE.

### Pitch and position of electrodes in a THE

The pitch and location of electrodes in your product are agreed upon during the design phase.

### Number of outputs: 2 or 4?

For large THE, it is recommended to install 4 outputs to improve the uniformity of heating. More detailed information is contained in the full version of this document.

### Calculation of electrical parameters, heating time

The necessary heating power can be estimated using the following formula:

$$Q = k \cdot S(T_{LCD} - T_{env})$$

where S is the area of the THE (dm<sup>2</sup>), T<sub>LCD</sub> is the minimum operating temperature of the LCD, T<sub>env</sub> is the minimum temperature of the ambient, k=0,2 W/(dm<sup>2</sup> °C) is the heat exchange parameter.



**Example:**

We need to provide heating of an LCD with the dimensions 120x80 mm, given that the temperature of the ambient is -40°C and the minimum operating temperature is -5°C.

Calculation:

$$S=1,2 \times 0,8=0,96 \text{ dm}^2$$

$$Q=0,2 \times 0,96 \times (-5 - (-40))=6,7 \text{ W.}$$

In terms of circuitry a THE is a permanent resistor. Power current for a THE may be either direct or alternating. The typical values are 5,12,24,27 V. In exceptional cases it can be powered by a source of 110 or 220 V. The possibility of creating a THE according to the given voltage and power is determined during the design phase.

The THE resistance can be calculated using the following standard formula:

$$R=V^2/P$$

where V is the supply voltage, R is the resistance, P is the thermal power.

When submitting an order, please keep in mind that the production technology involves deviation of resistance (power) values of THE from the same batch by approximately  $\pm 20\%$ . This means that if you require the deviation to be lower than 20%, the price of the order will increase.

The heating of a THE to its operating temperature takes approximately 5 minutes, regardless of the size of the THE (at the heating power calculated by the formula).

## Operating guidelines

Protect the THE from cutting and piercing, mechanical stress on the edges or impacts of any hard objects on the surface of the product.

Operation at ambient temperatures over +20°C with no thermostat is inappropriate and can lead to failure of the THE and/or of the heated LCD. The temperature of the THE itself during operation should not exceed 50°C.

1. It is recommended to plug the THE to the power supply via a thermostat, so as to avoid overheating of the THE or of the heated devices (LCD). For more information about thermostats for THE see our website or the catalogue.
2. The THE surface with anti-reflective coating requires careful handling. The surface can be cleaned with a soft cloth moistened with a mild detergent for optics.
3. Installation recommendations for THE are described in the full version of this document.