NICOMATIC HEADQUARTERS
173, rue des Fougères / ZI Les Bracots
74890 Bons-en-Chablais FRANCE
Tel: (33) 4 50 36 13 85 Fax: (33) 4 50 36 11 33
email: nicomatic@nicomatic.fr

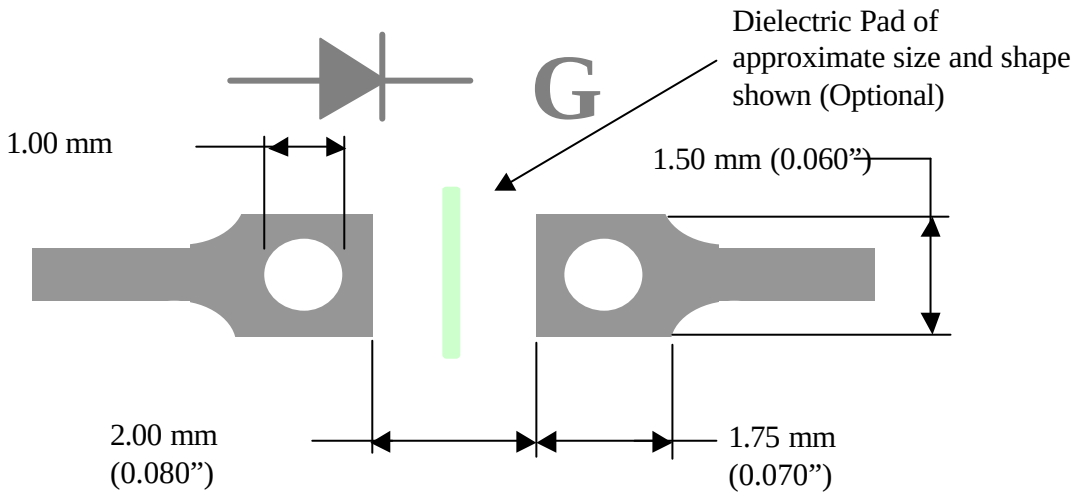
LED Placement Guidelines

The following guidelines are suggestions to the design engineer on the design and construction of membrane switches to facilitate automated placement of LEDs by Nicomatic or with Nicomatic equipment, primarily with dot dispensing. These guidelines are not intended to eliminate the possibility of other constructions and designs. In general, Nicomatic equipment is very flexible and can handle a wide range of design possibilities.

Design Guidelines

Pad Design – Nicomatic recommends a pad designed as shown below, with an inner circle which allows the adhesive to bond directly to the substrate. The circle is centered on the pad. We also suggest that a dielectric pad be printed between the two pads when possible. This pad creates and additional barrier to shorting.

It is recommended that the polarity of the LED and the color of the LED be printed on the circuit in order to aid in assembly and inspection.



LED Size and Style – Nicomatic recommends that the largest possible LED be used to reduce the assembly cost of the LED. For most designs, the length and width of the part is not critical, only the height of the LED needs to be minimized. Utilizing LEDs with smaller length and width dimensions will increase the assembly cost. The standard LED used in the industry is the 1206 LED.

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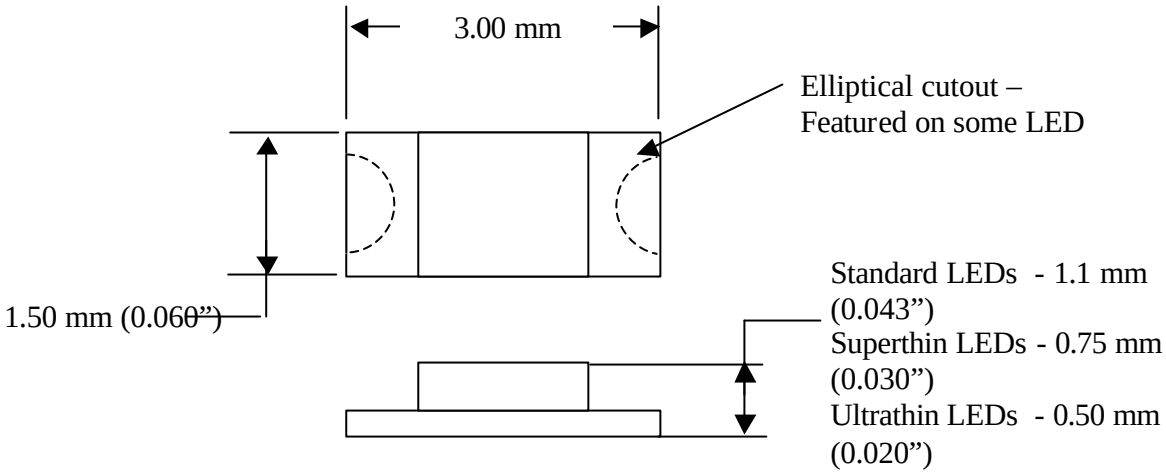
The approximate dimensions are shown below.



Note: All Dimensions Shown are Approximate and Vary slightly from Manufacturer to Manufacturer

The rectangular style shown above is the most common and in most respects the simplest to use. The crescent shaped cutouts in the ends are preferred but not required. These cutouts increase the bonded surface area of the LED and the adhesive, which increases the overall bond strength.

Nicomatic recommends a clear, or water clear, lens be used to avoid the possibility of a false indication being seen by the operator thru a clear overlay.

Bi-Color LEDs – These LEDs are generally constructed by using a Printed circuit board that is almost twice the size of the standard single color LED in the same family. (Smaller Bi-Colored LEDs are available, but are more difficult to place.) The same design concepts apply to the bi-color layout as for the single color.

Spacer Design – The spacer requires a cutout for the LED. While the size of the cutout is typically less important for hand placement, it is a significant concern for automated placement. This cutout should be sized to allow for the assembly tolerances of the switch layers and the LED placement. The most significant reason to keep the cutout size small is to insure there is significant adhesive between the components to hold the layers together properly. This is of particular concern near the edge of the switch.

Typical assembly tolerances of concern are approximately +/- 0.25 mm (0.010”) for the cutout location, the size of cutout, lamination of the spacer to the circuit and less then +/- 0.125 mm (0.005”) for optically registered LED placement. For a total of as much as +/- 0.89 mm (0.035”) variation that can effect the LED placement location relative to the spacer cutout.

In addition, it is necessary to leave space around the LED for the adhesive and for the encapsulant, approximately 1 mm (0.040”) on all sides should be adequate.

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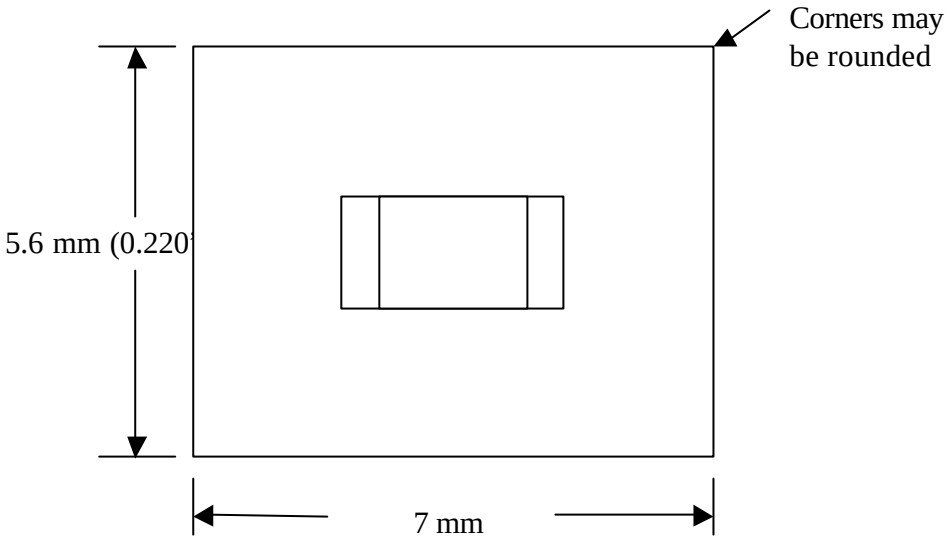
Based on these requirements, a rectangular cutout as shown below is recommended for automated placement of a 1206 style LED



Circular holes can be used, but they would require a larger total cutout area, a diameter of 7 mm (0.275") to be certain. However, a 6.35 mm (0.250") diameter cutout is common for this size of LED, if your die-cutting and laminating processes are well registered. However, if your processes are not under control this may result in additional problems.

Adhesive Application - Adhesive can be either screened onto the parts or dispensed and there are advantages to both processes. The advantage of screening on adhesive is that if registered properly, you can place smaller dots of adhesive, potentially allowing you to place smaller components. This also allows you to use your existing equipment to screen the adhesive and there is a wide a wide variety of placement equipment to place the components at very fast speeds.

However, for small and medium sized productions and frequently even for large production runs, we believe that dispensing is a more cost effective option for placement of LEDs. Primarily because there are no screens to make and clean and dispensing uses a smaller amount of the expensive conductive adhesive material then the screening processes. There is also less wasted material.

The only real downside of dispensing is the difficulty of placing very small components, but for most switch designs this is unimportant as long as the larger devices are available in similar heights as the small components. Nicomatic's ultrathin LED is as thin as the smallest LEDs available, so there is no advantage to using the smaller length and width parts.

Adhesives – Nicomatic recommends dispensing the adhesive because of the cost effectiveness and the flexibility for small and medium sized production runs. Nicomatic suggests a single dot of Loctite 454 between the two pads in order to eliminate the potential for shorting and to add strength to the assembly. This dot should be approximately 1.0 mm (0.040") in diameter.

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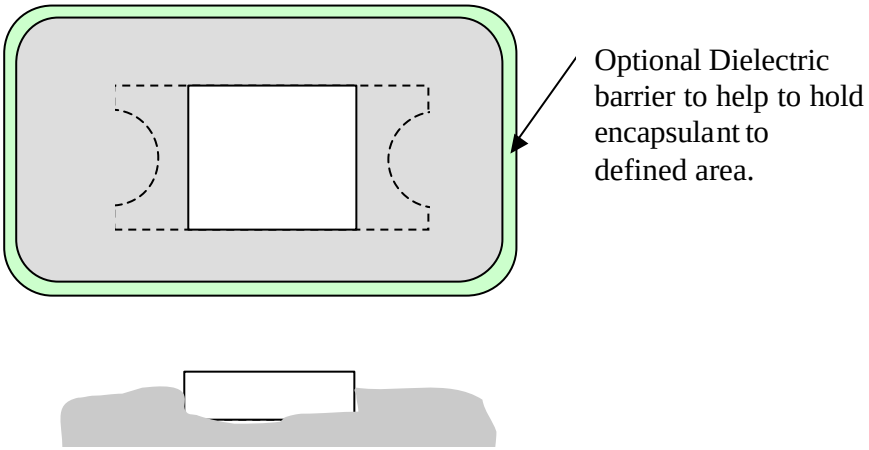
Nicomatic then dispenses two drops of conductive adhesive, typically EP-600 from Conductive Compounds, onto the pads. These drops are approximately 1.0 mm (0.040") in diameter as well. The LED is then placed onto the circuit, but care should be taken to not press the LED onto the circuit too tightly, which could cause all of the adhesive to be squeezed from underneath the LEDs.

Encapsulation – Nicomatic suggests a UV curable encapsulant to reduce the risk of shrinkage during cure causing damage to the adhesive bond. We suggest that the encapsulant be dispensed over the PCB portion of the LED, but not over the lens of the LED, as shown below;



Subcontracting LED Placement

There are many different assembly processes used in the industry and virtually all of them have advantages and disadvantages. We suggest the following process primarily because we believe it offers the simplest and most reliable assembly of the LEDs for subcontracting to Nicomatic. The LED placement equipment offered by Nicomatic is very flexible and if you are assembling the LEDs in house, there are other processes that may work better for you.

Switch Format for LED Placement - We suggest the you ship Nicomatic the Circuit Layer with optical registration marks printed with the same screen as the LED pads. All die-electric crossovers must be clear of the LED pads to allow for proper placement of the LEDs. Note: Care should be taken to package the product well to insure that it is flat and undamaged when it arrives.

Sheet Size Limitations - Generally, our equipment can handle sheets as large as 24" x 24", however the effective placement area for LEDs is more limited, to approximately 18" x 20" depending on the specific locations of your LEDs. If you have a sheet that nears these dimensions please submit a drawing to us for evaluation. Sheets that are half this size or less can be placed more economically, since two parts can be run simultaneously.

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While we can sometimes place LEDs on larger sheets in two steps depending on the layout, we are additionally limited by our oven size, which is currently limited to 18" widths. Larger parts must be air dried, which is not as cost effective, slower, and does not result is as good of a bond.

Adhesive Curing Temperatures – Once the LEDs are placed, the parts are cured at 120C for 15 minutes. Alternatively, if you prefer to ship the circuit layer with the adhesive or spacers already assembled, we will cure at 70C for 60 minutes, but this is more expensive. Alternative curing cycles, down to a room temperature cure, are possible if these guidelines are a problem for your product.

Shipping - The parts are then returned to you shipped with a layer of bubble wrap on top of each layer of parts. It is important to allow enough time for ground shipment. Shipment by Express services can be very expensive due to the dimensional weight of these packages.

Inspection - As a minimum, Nicomatic will sample inspect the parts you send to us electrically to insure proper assembly when possible. Heat seals and other assembled layers may interfere with our ability to test the circuits. Nicomatic can 100% test most switches electrically for an added cost, although based on our experience this is not generally required.

Components – Nicomatic can place a wide variety of components, as long as they can be supplied on tape and reel and potentially even tubed components. Although, we will generally place only 1206 components and larger, although smaller components are possible for added costs at our discretion. In general, these components can must be provided by you. Where possible it is more cost effective to use Nicomatic stocked parts, such our Ultrathin LEDs, since these components are already loaded on our machines and we absorb the costs of scrapped components. (Please ask for specifications)

If you are planning to supply components they must come on Tape and Reel and there must be extra tape and extra components to facilitate loading into the feeders and to accommodate possible scrap of components. Typically an extra 12" of tape and an extra 10 components or an extra 5%, which ever is larger are required for most jobs.

Request for Quote – In order for Nicomatic to provide a quotation on LED placement we must know the following as a minimum;

1. Sketch or drawing of sheet with sheet size and approximate location of components.
2. Format of Switch to be provided, ie circuit layer only or circuit with adhesive or spacer to determine acceptable temperature for curing.
3. Quantity of parts to be quoted
4. Components to be placed and who is to provide these parts.