System Supplier for Input Devices
Construction | Production | Logistics

- Modules & System Solutions
- Keypads & Switches
- Cable Assembly & Connectors
- Electronic Components
- Moulded Parts & Tooling
N&H Technology GmbH was founded in 2001 and supplies components, and complete solutions for customer-specific user interfaces (HMI), according to our guideline: Single Source Supply.

**STRENGTHEN**

We see ourselves as a link between production plants in Asia and our customers in Europe. On the one hand, our strengths lie in the technical advice and support of our customers projects and on the other hand in professional procurement, quality assurance and logistics. Through highly qualified German and Chinese engineers in our company, we communicate excellently with our customers and suppliers, even about complex technical issues. On customer demand, we also can take over entire development and design tasks.

**PRODUCTION**

Our production processes economically take place in selected factories, mainly in China. All production plants are certified according to DIN ISO 9001, DIN ISO 14001, DIN TS 16949 and DIN ISO 13845. The European quality standards of our products are ensured by a comprehensive quality management system in the production plants and in-house.

**QUALITY**

We are certified according to DIN ISO 9001. In January 2013 we set up a second N&H location in China (Shanghai) to continuously improve our ongoing commitment to quality and service. In addition, we can carry out technical tests and analyzes for our customers in our own laboratory in Willich.

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Since the turn of the millennium, the area of the former Stahlwerk Becker has been transformed into a diverse business park, where carefully restored monuments alternate with modern architecture.
Please ask for our sample keypad.

The N & H sample set includes a special silicone rubber keypad with a variety of sample buttons and constructions, as well as a sample of a membrane keypad with various options.

We charge a nominal fee of 29,- € (excl. transport costs) for it.
TECHNICAL TYPES OF SILICONE RUBBER KEYPADS

- Keypads with Carbon Pills and Metal Pills
- Keypads with Polydome and Metaldome
- Multi Moulding Colours

- Translucent material for Night Design with positive & negative printing
- Laser Engraving on rubber keys for Night Design
- Laser Engraving on plastic caps for Night Design

- Keytop with PU or Epoxy Coating
- Silver painted or Chrome plated surface
- IMD film technique

- Rubber and plastic keys with integrated Light Guide
- Rubber with plastic keys
- P+R technique

- Integrated EL and LED Backlight
- Metal keys with backlighted legends and Metal Tops
- Other rubber parts
When heat is applied to the plastic raw materials, crosslinking occurs. This crosslinking (vulcanization) gives the material its permanent high elasticity through a chemical process in which the molecular chains interlink. It is not possible to reshape or recycle the vulcanized rubber material by reapplication of heat. The main advantages of this group include their elasticity and durability even under long-term thermal and mechanical stress. This viscoelastic property is also retained despite exposure to a wide range of temperatures.

Caoutchouc is a tacky, tough and plastic material composed of long, ductile and flexible molecular chains. If subjected to force, the molecular chains flow past each other causing the caoutchouc to change shape. After reduction of force, the material remains more or less in its distorted form.

However, vulcanization and the application of specified components cause the molecular chains to interlink and become permanent. Thus the original plastic caoutchouc is transformed into a rubber with elastic properties. Application of force now only causes the molecular chains to alter in shape and they do not slide past each other. They return almost to their original state after force is reduced.
VULCANIZATION PROCESS

When heat is applied to the caoutchouc compound, it is transformed from the plastic to the elastic state. The caoutchouc turns into rubber. This crosslinking process is called vulcanization.

MOULDING TYPES

Silicone Rubber Keypads are manufactured by using closed moulds and applying a discontinuous vulcanization process. Compression moulding is the most common method. Injection moulding is suitable for large and thin keypads, precision parts or for the manufacture of high quantities.

VULCANIZATION CHARACTERISTICS

The most important parameters of vulcanization are temperature and time. One must be coordinated with the other to enable optimal vulcanization of the given parts. The higher the vulcanization temperature, the shorter the curing time needed. This inevitably reduces the manufacturing costs. On the other hand, a reversion of the process may occur when the time can not be accurately controlled as in the case of too high temperatures. De-moulding is more difficult at high temperatures. Type and size of keypad are also crucial factors.

Thick parts have to be cured for a longer time at a relatively low temperature in order to achieve complete uniform vulcanization.

To attain economical production of the keypads and at the same time realize an optimal vulcanization of the rubber, a Post Curing Process is applied as part of the standard process for Silicone Rubber Keypads. Another purpose of Post Curing is the diffusing out of uncombined constituents and the elimination of rubber colours.
### PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Conductor</th>
<th>Insulator</th>
</tr>
</thead>
</table>
| Density (g/cm³)  
**DIN 53479**                             | 1.2       | 1.1 - 1.4 |
| Hardness (Shore A)  
**DIN 53505**                              | 65 ± 5    | 30 - 85 ± 5  
(55 ± 5 typical) |
| Tensile strength (N/mm²)  
**DIN 53504**                                | 6.0       | 5.0 - 9.0 |
| Elongation at break (%)  
**DIN 53504**                                | 170       | 115 - 600 |
| Compression set (%)  
**DIN 53517**                                 | 20        | 11 - 22   |

### MECHANICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actuation force (cN)</td>
<td>20 - 500</td>
</tr>
<tr>
<td>Snap Ratio (%)</td>
<td>&lt; 80</td>
</tr>
<tr>
<td>Stroke (mm)</td>
<td>0.3 - 5.0</td>
</tr>
<tr>
<td>Operating life (cycles)</td>
<td>1 x 10⁷ - 3 x 10⁷</td>
</tr>
<tr>
<td>2 x 10⁷ typical</td>
<td></td>
</tr>
</tbody>
</table>

### ELECTRICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact resistance (Ω)</td>
<td>See table Contact Type</td>
</tr>
</tbody>
</table>
| Insulation resistance at 250V (MΩ)  
**DIN 53482**                                | > 100              |
| Dielectric strength (kV/mm)  
**DIN 53481**                                 | 23 - 27            |
| Contact bounce (ms)                          | ≤ 12               |
| Contact rating                               | See table Contact Type |
| Conductor volume resistivity (Ω•cm)          | 2.5 - 5.0          |
| Insulator volume resistivity (Ω•cm)          | > 2 x 10¹⁴          |

### MECHANICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature (°C)</td>
<td>- 40 ~ + 85 typical</td>
</tr>
<tr>
<td>Storage temperature (°C)</td>
<td>- 60 ~ + 120 typical</td>
</tr>
<tr>
<td>UL flammability</td>
<td>HB and 94V-0 HB typical</td>
</tr>
</tbody>
</table>

### CHEMICAL RESISTANCE

Due to its inert state, silicone rubber is not affected or damaged when exposed to various chemicals and food products for a limited time. However, continuous immersion for a longer period of time and at high temperatures may have an effect on the silicone rubber. There is no corrosion of silicone rubber as it does not contain any aggressive agents such as sulphur or plasticizers. Silicone rubber may be exposed for a short time to these media without any harmful effects:

<table>
<thead>
<tr>
<th>Solvents:</th>
<th>Acids:</th>
<th>Bases:</th>
<th>Food Products:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aceton</td>
<td>Acetic Acid 5%</td>
<td>Ammonium Hydroxide</td>
<td>Beer, Wine, Liquor</td>
</tr>
<tr>
<td>Butyl Alcohol</td>
<td>Hydrochloric Acid 10%</td>
<td>Potassium Hydroxide</td>
<td>Cola Syrup</td>
</tr>
<tr>
<td>Ethyl Alcohol</td>
<td>Nitric Acid 10%</td>
<td>Sodium Hydroxide</td>
<td>Coffee</td>
</tr>
<tr>
<td>Isopropyl Alcohol</td>
<td>Phosphoric Acid 10%</td>
<td></td>
<td>Vinegar</td>
</tr>
<tr>
<td>Mineral Spirits</td>
<td>Sulfuric Acid 20%</td>
<td></td>
<td>Water &amp; Steam</td>
</tr>
</tbody>
</table>

### OIL AND FUEL RESISTANCE

Most oils and fuels do not normally affect the physical properties of silicone rubber after a short time of exposure. Should it be necessary to expose the silicone rubber to oils and fuels constantly, the formula of the silicone may be adjusted to meet this requirement.

### ENVIRONMENTAL RESISTANCE

Sunlight and climate conditions neither affect the colour of silicone rubber nor cause it to disintegrate. Physical properties remain unchanged.
In applications where the keypad is completely sealed, Guide Holes are not allowed and air venting can be achieved through venting paths between keys, i.e. the air vents should not lead to outer edge of keypad.
The force drop from F1 to F2 yields Tactile Feeling. The higher the Snap Ratio, the stronger the Tactile Feeling. On the other hand, a higher Snap Ratio means a lower Return Force F3 which could cause Key Jamming. In the case of Polydomes or Metaldomes, the Tactile Feeling is concise and strong although the Snap Ratio is nominal low, because the force drop is rapid and the curve of the force drop is steep.
**FORCE DEFINITION**

The Actuation Force should be defined in proportion to the size of keys, especially when the keys have considerably different sizes.

**MOUNT BOSS**

For manufacturing purposes it is an advantage when the diameter of the mount boss is as large as possible.

**STABILIZER (STOP BAR)**

If the contact size is significantly smaller than key size, Stabilizers are necessary. This reduces keytop wobble.

**STRETCHING JOINT**

The Stretching Joint compensates the tolerances at assembly and is therefore necessary for rubber keypads with large dimensions.

**ROCKER KEY**

For Rocker and Cursor Keys please send PCB Contact Circuit to N&H for approval.

**SEPARATING GROOVE**

The Separating Groove enables the rubber keypad to be torn into sections.
Printing can be done on concave or convex keytop surfaces.

**KEYTOP COATINGS**

- Matt silicone spray (MSS)
- PU
- Epoxy \( \text{Standard} \) \( \text{UV-resistant} \)
- Others

The abrasion resistance of printed legends can be enhanced by surface coating. The touch feeling of PU Coating is matt and the surface allows optimal finger grip. The appearance of Epoxy Coating is similar to plastic and can be matt or glossy.

**CHOICE OF COLOURS**

An additional rubber colour can be easily realized, whereas an extra printing colour requires a completely new printing process. Therefore, a supplementary rubber colour is less expensive than a further legend colour.

**KEYTOP RADIUS FOR SILKSCREEN PRINTING**

\[
R_v = D + 1 \text{ mm}, \text{ R30 min.} \\
R_x = D + 1 \text{ mm}, \text{ R20 min.}
\]

**KEYTOP „5“ WITH ORIENTATION DIMPLE**

The Orientation Dimple can impair the quality of Silkscreen Printing. To define the dimensions \( a \) and \( b \) and the shape of Dimple, please contact N&H.

**LONG KEYS**

With longer keys there is more danger of wobbling and jamming than with circular and rectangular keys. Solutions to prevent this are available from N&H.

**GAP BETWEEN KEYTOP & BEZEL**

If the gap between the keytop and bezel can not be defined at the beginning of the project and needs to be clarified, N&H will provide details on procedure.

**DOUBLE SNAP KEYS**

For solutions on designing double snap keys please contact N&H.

**SPECIFICATION DETAILS IN THE DRAWING**

In addition to dimension definitions of keypad the drawing should include the following specifications:

1. Actuation force \( F_1 \) in cN with tolerance
2. Snap Ratio in % with tolerance of ± 10%
3. Return force \( F_3 \) in cN as minimum
4. Stroke \( S_2 \) in mm with tolerance of ± 0.1 mm
5. Life in cycles as minimum
6. Contact type
7. Material colour(s) in RAL, Pantone or NCS
8. Legend colour(s) in RAL, Pantone or NCS

Shape and dimensions of web will be determined by tool designer.
LEGENDS AND NIGHT DESIGN

POSITIVE PRINTING

Legend off-centre: ± 0.3 mm
Line width: ≥ 0.2 mm

Through application of transmissive material the keytop and the key flank can be backlighted.

NEGATIVE PRINTING

The legend, the margin of the keytop edge and the key flank are illuminated by use of transmissive material.

LASER ENGRAVING LEGENDS

The surface paint of legend area is evaporated by applying a laser beam. The basic paint, which makes up the legend colour, is a light transmissive layer, whereas the surface paint is impermeable to light. If the basic paint is omitted, the key material colour forms the legend colour.

ILLUMINATION OPTIONS

CENTER LED ILLUMINATION

SIDE LED MOUNTING

EL BACKLIGHTING

LIGHT GUIDE INTEGRATION

In order to eliminate the dark colour of the Carbon Contact, which is visible through translucent silicone rubber, the contact area can be pre-printed white before Carbon Dip Printing, or optionally Carbon Pills printed white on one side can be used.
ELECTRICAL CONTACT

CONTACT SHAPE

- Circular
- Circular Ring
- Semi-Circular Ring
- Oval
- Square
- Square Ring
- Semi-Square Ring

CONTACT TYPE

<table>
<thead>
<tr>
<th>Contact Surface of PCB:</th>
<th>Gold</th>
<th>Carbon</th>
<th>Gold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Contact Shape</td>
<td>Contact Resistance</td>
<td>Max. Rating</td>
</tr>
<tr>
<td>Carbon Dip Printing</td>
<td>no limit</td>
<td>150 - 300 Ω</td>
<td>&lt; 600 Ω</td>
</tr>
<tr>
<td>Carbon Pill</td>
<td>circular</td>
<td>&lt; 100 Ω</td>
<td>&lt; 200 Ω</td>
</tr>
<tr>
<td>Low Resistance Carbon Pill</td>
<td>circular</td>
<td>&lt; 10 Ω</td>
<td>&lt; 30 Ω</td>
</tr>
<tr>
<td>Polydome</td>
<td>circular</td>
<td>1 - 10 Ω</td>
<td>&lt; 30 Ω</td>
</tr>
<tr>
<td>Metal Powder Pill</td>
<td>circular</td>
<td>10 - 50 Ω</td>
<td>&lt; 100 Ω</td>
</tr>
<tr>
<td>Metal Pill</td>
<td>circular</td>
<td>1 - 5 Ω</td>
<td>&lt; 20 Ω</td>
</tr>
<tr>
<td>Metaldome</td>
<td>circular, square, oval</td>
<td>1 - 5 Ω</td>
<td>&lt; 30 Ω</td>
</tr>
</tbody>
</table>

The value of contact resistance is depending on the size of contact pill, the PCB circuit dimensions and the force applied by contact closing.

STANDARD SIZE OF CARBON PILL

Carbon pills are usually circular from Ø 2.5 mm to Ø 8.0 mm with step 0.5 mm. Other diameters and shapes are possible with more costs involved.

PCB CONTACT SURFACE OPTIONS

<table>
<thead>
<tr>
<th>PCB Contact Surface</th>
<th>Material</th>
<th>Contact Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigid</td>
<td>FR4, CEM1, etc.</td>
<td>Gold, Nickel, Carbon</td>
</tr>
<tr>
<td>Flexible</td>
<td>Polymide</td>
<td>Gold, Nickel</td>
</tr>
<tr>
<td>Flexible</td>
<td>Polyester</td>
<td>Carbon, Silver, Carbon-Silver-Mixture</td>
</tr>
</tbody>
</table>

For high reliability applications Gold plated PCB is preferred. Silkscreen printed carbon is the most commonly used plating because of low cost and high chemical resistance.

PCB CIRCUIT TYPE

- Gold Traces
- Carbon Traces

The PCB Contact Area in each direction should be 0.5 mm min. larger than the Contact Area of keypad. For Rocker Key and Keys with Metaldomes, please send PCB Contact Circuit to N&H for approval.
TECHNICAL OPTIONS OF KEYPADS

SILICONE RUBBER WITH POLYDOME

SILICONE RUBBER WITH METALDOME

SILICONE RUBBER WITH SNAP-ON PLASTIC CAPS

SILICONE RUBBER WITH FREE FLOATING PLASTIC CAPS

P+R TECHNIQUE

PLASTIC CAP WITH LIGHT GUIDE

IMD-FILM ON SILICONE RUBBER KEYPAD

IMD-FILM WITH POLYCARBONATE (PC) PIN
LIFE MEASURING

Firstly the key is loaded with Over Stroke Force F4 of 250 cN. The Over Stroke S4 is now determined. The push head of the Life Tester presses the key with a constant travel of S4 and a frequency of 3.3 Hz.

Mechanical life is evaluated when cracks arise in the web or the Actuation Force F1 is reduced by more than half. The life is dependent on the Material Hardness, Actuation Force, Press Travel and Snap Ratio. The higher these are, the shorter the life.

![Graph](image)

ABRASION RESISTANCE

The abrasion resistance of legends is tested by use of various methods. The standard tests at N&H are:

- Norman Tester
- STO Tester
- Wazau Tester APG

A paper strip is continuously pulled over a printed or painted specimen. A defined weight presses the paper strip on the specimen. The result of the test is the length of paper (STO and Wazau Tester) or wheel cycles (Norman Tester) until max.

0.25 mm² of legend area has been rubbed off.

![Graph](image)

ELECTRICAL CONTACT RESISTANCE MEASURING

The Contact Resistance depends on the contact material, size and circuit of keypad and PCB, the Force-Travel-Behaviour and the applied force. In order to compare the results the following standard measuring method is applied.

The rubber keypad is placed on a Gold plated PCB which shows comb layout of 0.3 mm line width and 0.3 mm line distance. The contact resistance is measured when the key is loaded with an Over Stroke Force F4 of 250 cN.

![Graph](image)

POST CURING

To determine that the rubber keypad is sufficiently post cured, the test of Weight Loss according to ETR-2 Part 2 from October 1992 is applied:

- Storage at room conditions for 24 hours
- Weight measurement
- Storage at 200 °C for 24 hours
- Weight measurement immediately

The weight loss must be ≤ 2%.

![Graph](image)

ACTUATION FORCE TOLERANCE (CN)

The Normal criterion is the standard tolerance. The Critical criterion is only available after drawing evaluation by N&H.

Tol.[%] = 45 - \( \frac{F1}{10} \)

Note: Force measurement after 10 actuations.

![Graph](image)

DIMENSION TOLERANCE DIN ISO 3302-1 M2

<table>
<thead>
<tr>
<th>Dimension: mm</th>
<th>F = tool bound dimension</th>
<th>C = dimensions depending on tool closure</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 4</td>
<td>± 0.10</td>
<td>± 0.15</td>
</tr>
<tr>
<td>≤ 6,3</td>
<td>± 0.20</td>
<td>± 0.20</td>
</tr>
<tr>
<td>≤ 10</td>
<td>± 0.25</td>
<td>± 0.25</td>
</tr>
<tr>
<td>≤ 16</td>
<td>± 0.35</td>
<td>± 0.40</td>
</tr>
<tr>
<td>≤ 25</td>
<td>± 0.50</td>
<td>± 0.70</td>
</tr>
<tr>
<td>≤ 40</td>
<td>± 0.50</td>
<td>± 0.70</td>
</tr>
<tr>
<td>≤ 63</td>
<td>± 0.50</td>
<td>± 0.70</td>
</tr>
<tr>
<td>≤ 100</td>
<td>± 0.70</td>
<td>± 0.80</td>
</tr>
<tr>
<td>≤ 160</td>
<td>± 0.50</td>
<td>± 0.70</td>
</tr>
<tr>
<td>&gt; 160</td>
<td>± 0.50</td>
<td>± 0.70</td>
</tr>
</tbody>
</table>

Note: Dimension Tolerance Standard for plastic parts according to DIN ISO 16901
## N&H Product Range

### Modules & System Solutions
- Complete solutions for operating units
- Development and construction of assemblies
- Manufacturing and delivery
- Procurement of third-party components
- Final test

### Keypads & Touch Panel
- Silicone Rubber Keypads
- Membrane Switches
- Capacitive Keypads
- Vandal-resistant Keyboards
- Touch Panel

### Switches
- Micro Switches for SMD
- Vandal-resistant Push Buttons

### Mouldings
- Plastic Parts
  - Tool design
  - Single and multiple injection molding
  - Largest parts (tool weight up to 20t)
  - Micro precision parts
  - Various surface finishes
  - Combined plastic-metal parts

- Metal Parts
  - Die-Cast Metal Parts
  - Punched, Turned, Milled Parts
  - Deep Drawn Parts
  - Precision Parts
  - Combined plastic-metal parts
  - Combined rubber-metal parts

- Rubber Parts
  - Silicone Safety Covers
  - O-Rings, Grommet, Seals
  - Damper
  - PU molded parts
  - Combined rubber-metal parts

- Glass Parts
  - Front glass for input devices, chemically hardened
  - Formed glass panes, thermally hardened
  - Glass panels with optical coating
  - Glass panels for household appliances

### Connectors
- Spring contact pins (pogo pins)
- Single pens
- Spring contact connectors
- Male and female headers
- High current connector
- Magnetic connectors (customized)

### Cables
- Cable harness
- Data, communication cable
- Wire sets
- Connection cables for LCD and flat screen
- Coax cable
- Telephone cable
- Single cables, etc.

### LCD- and Optoelectronics
- TFT, OLED, DFSTN, FSTN, EBTN, STN, HTN, TN, VA
  - With Touch Panels
  - Alphanumeric and graphic
  - Controller (COB, COF, COG, TAB/TCP)
  - EL-, LED- or CCFL-Backlight
  - LED-Modules

### Acoustic Components
- Buzzer
  - Piezoelectric
  - Magnetic
  - For SMD / THT
- Transducer
  - Piezoelectric
  - Magnetic
  - Internal / external Drive
  - For SMD / THT
- Speaker
  - Microphones and Receiver

### PCB
- Flexible, rigid and rigid-flex circuits
- Multilayer

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A first project meeting in our company is possible at any time. Especially complex projects can be discussed and determined with our engineers in such a straightforward way.

N&H SERVICE

Each project is individually managed by one of our engineers. We offer technical support in the following areas:

• Research and Analysis on product feasibility
• Recommendation and advice on technical improvements
• Evaluation and technical options for cost-cutting solutions
• Construction, development and design (CAD-Software/ ProEngineer)
• Prototype construction with 3D printer

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