Algra keyboards – summary

Contents

Introduction

Without doubt, flat keyboards have made the break-through in the world-wide market. They have a modern industrial design and a compact construction. An answer to the question of an economical solution regarding the input element would be unthinkable without them.

Up until not long ago, the membrane keyboard was marketed as being the universal input element for all areas of use. Today you have a choice. It could be e.g. a membrane keyboard, a short travel switch (STS) keyboard, an Algra Dynapic or an Algra Dynasim keyboard.

First considerations

Whenever one creates a new keyboard a few thoughts have to be done. Please refer to following:

Use	• indoor / outdoor
Environmental conditions	• operating temperature • humidity / all weather resistance • suppression of electromagnetic interference • vandal resistance • easy to clean / chemical resistance • hygienic environment
Size and position of keyboard	
Key type (operation)	• key embossing • tactile operations or non-tactile operations • key insert • number of key presses
Windows in keyboards	• type of windows / colour • light conditions • scratch resistance
Overlay material of the keyboards	
Printing of the overlay	• numbers of colours • logos / text • insert legends
Interface	• integrated interface / print
Place of the cable outlet (tail)	
Plug type	

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Algra product range

Selection criteria	Scratch-resistant	Vandal-resistant	Outdoor use	Indoor use	Colour choice	Life expectation	Key designation changeable	Tactile feedback	Stampable formed	Hard window	Inserted window	Suppression of electro-magnetic interference
Algra membrane keyboards												
Normal	2	3	3	1	1	2	-	-	3	4	2	3
With insert	2	3	3	1	1	3	1	-	3	4	2	3
With „click“	2	3	3	1	1	2	-	1	2	4	2	3
With „bubble“ (or polydome)	2	3	3	1	2	3	-	2	1	4	2	3
STS (short travel switch)	2	3	3	1	1	3	-	2	3	4	2	2
Algra Dynapic												
With metal overlay (Metallic)	1	1	1	1	2	1	-	-	2	-	1	1
With plastic overlay (Membrane, standard)	2	2	3	1	1	1	-	-	-	1	3	2
With plastic overlay (Membrane option, embossed)	4	3	3	1	1	2	2	-	1	-	1	2
With glass overlay (Glass)	2	3	2	1	1	1	-	-	-	2	2	2
With integrated switch package (Super)	1	1	1	1	2	1	-	-	-	-	1	1
With individual switch package (Keytop)	1	1	1	1	2	1	1	2	3	-	1	1
Algra Dynasim												
With metal overlay (Metallic)	1	1	1	1	2	1	-	-	2	-	1	1
With plastic overlay (Membrane)	2	1	2	1	1	1	-	4	2	1	-	1
With glass overlay (Glass)	1	3	1	1	2	1	3	-	-	1	1	3

Legend: 1 = very good / 2 = good / 3 = less suitable / 4 = unsuitable / - = not recommended

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Algra Dynasim

Typical applications

- washing machines
- dishwashers
- coffee machines
- bank cash dispensers
- self-service vending machines
- cashless payment appliances
- lifts
- etc.

Advantages for the customer

- security
- reliability
- no mechanical wear
- long-life
- no down-time due to failure
- easy to clean and maintain
- free choice of design
- suitable for use in various areas (dust, humidity, vandalism, etc.)

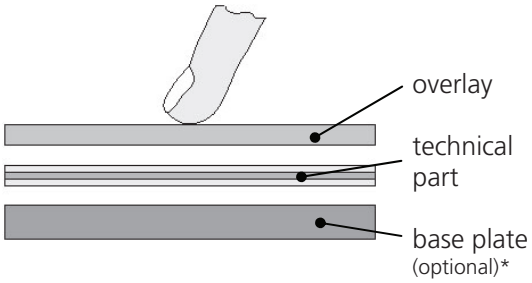
Advantages

- no cracks in the foil because there is scarcely any mechanical movement
- various overlay materials possible
- suppression of electromagnetic interference
- much more robust than membrane keyboards
- large batches possible (same as membrane keyboards)
- convex form possible
- **free choice of key size (no limit)**
- unaffected by chances in air pressure
- vandal resistant
- adjustable operating force

Description

Algra Dynasim is **the new option** amongst the wide range **of flat keyboards** available. Algra Dynasim has demonstrated that it is considerably more robust than all standard flat keyboards - at a comparable price.

Due to the fact that the cover plate is not being deformed when pressing a button, it is almost impossible to have a break of the overlay through over-use.



* Can also be stuck (adhesive) directly on the housing of the customer's appliance.

Technical data (standard value)

Electrical values

Charge from a 4x4 matrix:	0.5 nC/N
Charge from one key:	1.0 nC/N
Capacity 4x1/2 keys:	6 nF
Capacity of one key:	3 nF

Mechanical values

Mechanical loading:	up to 200 N/cm^2
Operating force:	from 0.5 to 100 N
Required operation speed:	ca. 10 N/s
Max. cycles per second:	> 1000 Hz
Storage temperature:	from -40 °C to +100 °C
Operating temperature:	from -20 °C to +60 °C
No. of press cycles:	> 10 millions

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Algra Dynapic

Typical applications

- washing machines
- dishwashers
- coffee machines
- chemical and laboratory tools and equipment
- bank cash dispensers
- self-service vending machines
- cashless payment appliances
- weighing and cash machines
- railways
- etc.

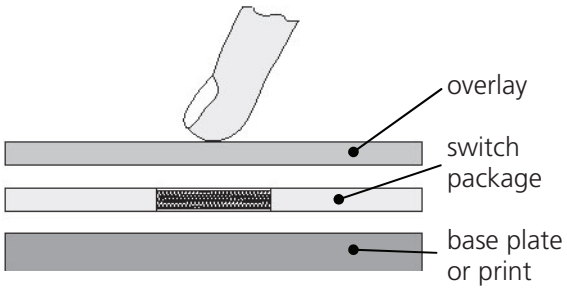
Description

The Algra Dynapic keyboard contains pressure sensitive ceramic elements in the contact area, which give off voltage when subjected to pressure.

The construction of Algra Dynapic is similar to that of the membrane keyboard. However, ceramic elements in the key area prevent deformation of the cover foil, which can be made from glass, metal or polycarbonate. The Algra Dynapic keyboard is therefore extremely robust and resistant.

Advantages

- vandal resistant
- suppression of electromagnetic interference
- much more robust than membrane keyboards
- insensitive against mechanical wear
- unaffected by changes in air pressure
- various overlay materials available
- adjustable operating force



Advantages for the customer

- security
- reliability
- long-life
- no down-time due to failure
- easy to clean and maintain
- suitable for use in various areas (dust, humidity, vandalism, etc.)

Technical data (standard value)

Electrical values

Voltage typically:	1 V/N (burden 10 M)
Impulse width typically:	70 ms (burden 10 M)

Mechanical values

Mechanical loading:	up to 200 N/cm^2
Operating force:	from 0.1 to 100 N
Storage temperature:	from -60 °C to +110 °C
Operating temperature:	from -40 °C to +80 °C
No. of press cycles:	> 10 millions

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Algra membrane keyboards and short travel keyboards

Typical applications

- washing machines
- dishwashers
- chemical and laboratory tools and equipment
- measuring applications
- various machines (less hostile environments)
- etc.

Advantages

- various overlay materials available
- low cost products
- large batches possible
- dust and spray water proof

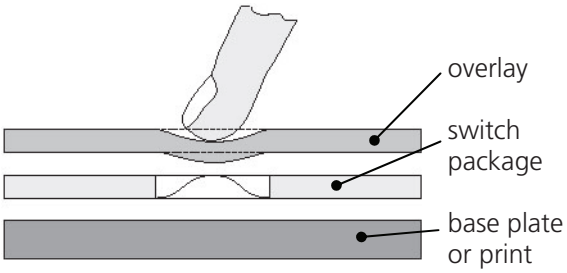
Advantages for the customer

- security
- reliability
- long-life
- economical
- easy to clean and maintain
- suitable for use in various areas (dust, humidity)

Description of membrane keyboards

Until now the most common flat keyboard is still the membrane keyboard. It is economical, has an extremely simple construction and is reliable in less hostile environment. Various models including with and without tactile feedback, with foil construction or with an integrated printed circuit board.

The contacts are contained in air-filled hollow space and short when pressed. The illustration clearly shows how the upper foil is particularly subjected to a high mechanical load. It is not only exposed to stretching the edges of the punched hole underneath in the separating foil act like a punch when subject to extreme loading.



Technical data (standard value)

Electrical values

Switching voltage:	from 1 to 50 V DC
Switching current:	from 5 A to 100 mA
Switching power:	< 1 W
Loop resistance:	< 200
Leakage resistance:	> 100 M
Bounce time:	from 0.5 to 10 ms

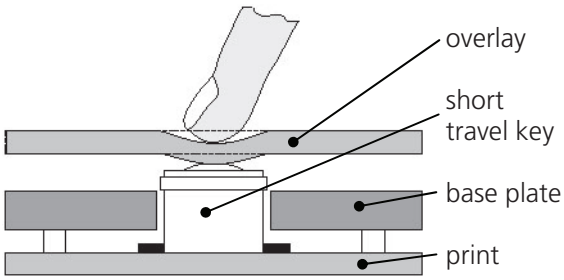
Mechanical values

Operating force:	from 1 to 6 N
Operating travel:	from 0.15 to 1 mm
Storage temperature:	from -40 °C to +70 °C
Operating temperature:	from -25 °C to +70 °C
No. of press cycles:	> 1 million

Description of short travel keyboards

The operating principle of such a keyboard is similar to that of a membrane keyboard fitted with a "click", whereby the latter is contained in a housing, which in turn is usually soldered to the printed circuit board.

These keyboards allow longer switch travel, however this causes considerably more load on the cover foil. Operating pressure is 2 - 5 N, which is more suitable for switching and less suitable for the speed of input of data.



Base plates (for all keyboards)

We manufacture the base plates from aluminium, steel, plastic or other materials.
Surface treatment (matting, anodising, galvanising, etc.) can be performed on request.

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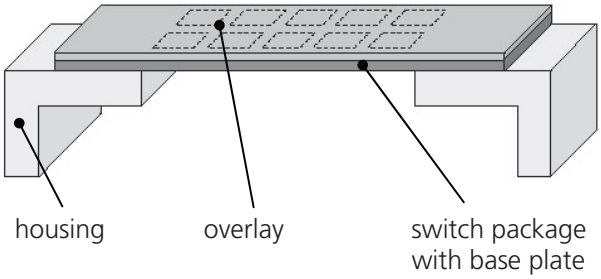
Installation of Algra keyboards

Surface mounting

The external edges of the keyboard are not protected. Longlife operation is possible only in a dry environment. This way of mounting is only recommended when vandalism does not occur.
Protection class IP50.

Typical applications:
- appliance controller
- indoor

Advantages:
- attractive solution (also in price)

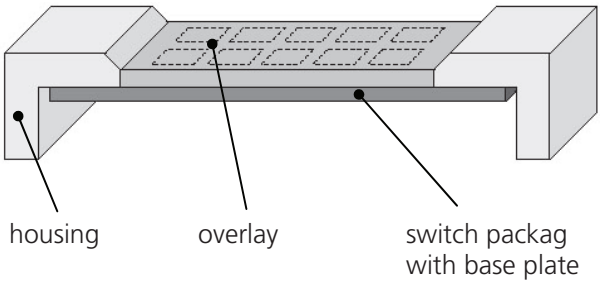


Integrated switch package

The overlay of the keyboard has the same material thickness as the housing. The switching unit is tightly sealed with the overlay, and is then tightly attached to the housing. Protection class IP68 is conformed to.

Typical applications:
- construction of appliance
- outdoor

Advantages:
- vandal resistant

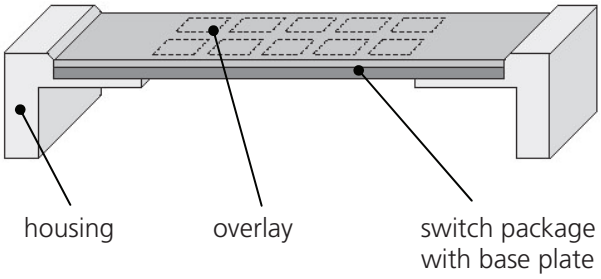


Flush mounting

The edges of the laminate are not well protected. This manner of construction is recommended only for use in a dry environment. Resistance to vandalism is limited. Protection class IP50.

Typical applications:
- machine controller
- indoor

Advantages:
- easy to clean

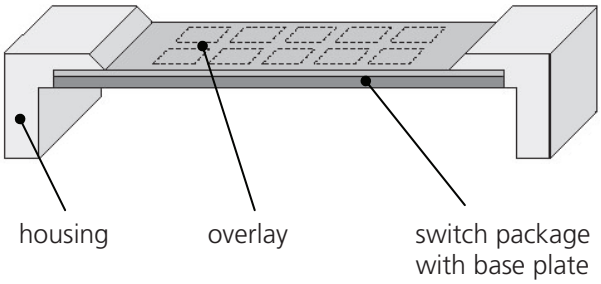


Recessed mounting

This manner of construction is strongly recommended. A sealed joint must be located between the keyboard and the housing. The requirements of protection class IP68 can be fulfilled.

Typical applications:
- coffee machine controller

Advantages:
- optimal rigidity
- easy to clean



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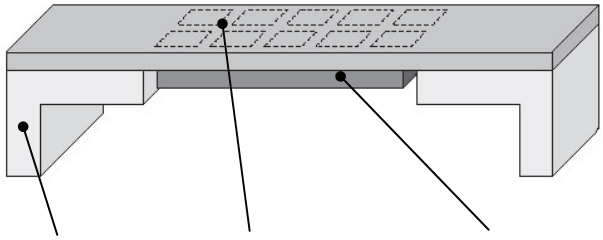
Individual switch package (for Algra Dynapic)

A metal overlay is placed onto the housing and the switching unit individually mounted behind it. This provides protection against vandalism. This manner of construction is particularly suitable for all types of publicly accessible self-service machines. Protection class IP68 is conformed to.

Typical applications:
- ticket machines
- entry controls

Advantages:
- vandal resistant



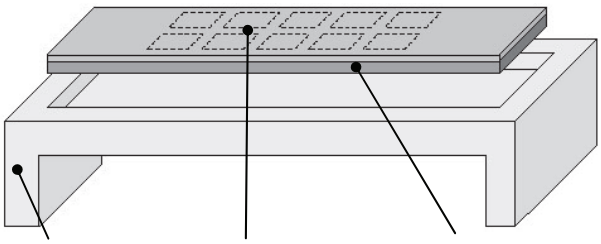
housing | metal overlay (max. 6mm) | switch package with base plate

Fitted mounting (for Algra Dynasim)

The keyboard is mounted directly (adhesive) on an existing housing.

Typical applications:
- small, mobile equipment

Advantages:
- very attractive solution (also in price) when large volume



housing | Algra Dynasim | screening of electro-magnetic interference self-adhesive

Protection classes

These norms set the sealing class for the housing, whereby the degree of protection inside the housing is also set (men - machine - interface).

The classes are indicated by the letters 'IP' followed by a pair of numbers.

The first number represents the degree of protection against solid objects, the second number represents the degree of protection to the entry of water. The norm does not say anything about the degree of protection against chemicals in solid, gaseous or fluid form.

For example, IP64 means "dust and spray water resistant".

Left number	
0	Not protected
1	Protection against entering of object bigger than 50mm.
2	Protection against entering of object bigger than 12mm
3	Protection against entering of object bigger than 2.5mm
4	Protection against entering of object bigger than 1mm
5	Protected against dust *)
6	Dust-proof

*) The entering cannot completely be prevented, the functioning however can be guaranteed.

Right number	
0	Not protected
1	Protection against water drops
2	Protection against water drops, also from the side
3	Protection against drizzling water
4	Protection against spray water
5	Protection against jet of water
6	Protection against strong jet of water
7	Protected against dip in water (only a few cm and limited time)
8	Protected against unlimited dip in water (details to be agreed)

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Windows in keyboards

Materials

Neutral window
A neutral window has the same type of surface as the rest of the keyboard, e.g. in a matt keyboard it has a matt surface. A neutral window can be printed from the rear with filter colours. Neutral windows are usually used for LED displays.

Transparent window
The transparent layer is applied to a matt surface with supplementary pressure. Thereby, an optical change takes place on the matt surface which in many cases is sufficient for an LCD. Transparent windows can be printed from the rear with filter colours.

Algraclear
Algraclear windows are produced by the LINDE process. The foil is printed with textured lacquer and the window with an anti glare lacquer or a scratch-proof lacquer. These windows can also be printed from the rear with filter colours. Algraclear windows are perfect for LCD's.

Anti glare windows
Algraclear windows and windows on glossy keyboard surfaces can be made anti glare. It causes a lightly matted surface and lessens transparency of the foil.

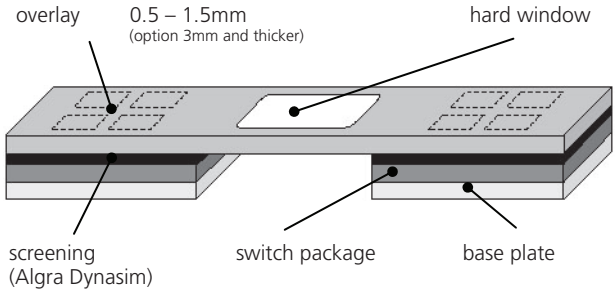
Disappearing effect
The term ‚disappearing effect' is used to describe those windows in the keyboard which are not visible when they are not illuminated. This effect is reached by the base colour in the window area being printed in the form of a grid. It is possible to print further, additional filter colours behind these areas.

Inserted windows
Instead of a printed window (filters), a window insert can be incorporated.

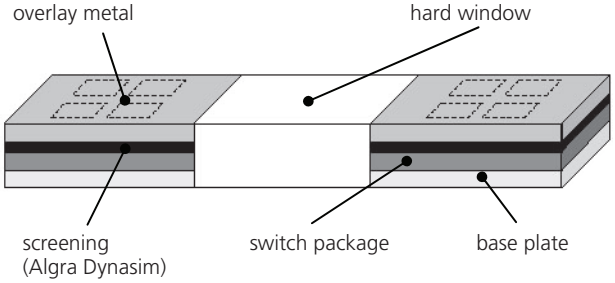
- **Plexiglass windows** have a good transparency. They can be used as a base plate.
- **Polycarbonate windows** are suitable for partial gluing behind the front foil. Polycarbonate is available in different colours.
- **Polarisation filters** are used as optical filters. They are usually 0.3 – 0.8mm thick and are available in different colours.

Types of construction

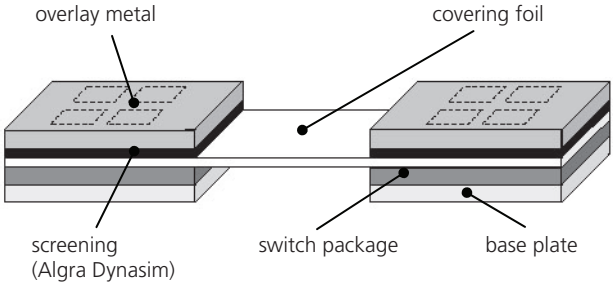
Algra Dynapic Design / Algra Dynasim Design
By employing a hard overlay made from glass, plexiglass or polycarbonate a closed surface covers the whole keyboard. Protection class IP68.



Algra Dynapic Metallic / Algra Dynasim Metallic Window inserted
A precisely fitting window made from plexiglass or glass is inserted into the opening. The requirements of protection class (min. IP50) follows in individual cases.



Algra Dynapic Metallic / Algra Dynasim Metallic Laminated foil window
A cover foil is laminated between the overlay and the switching unit. Windows with a large area are supported from the rear. Polyester or polycarbonate is suitable for the window material. The window surface can be printed on, textured, crystal clear or anti glare.



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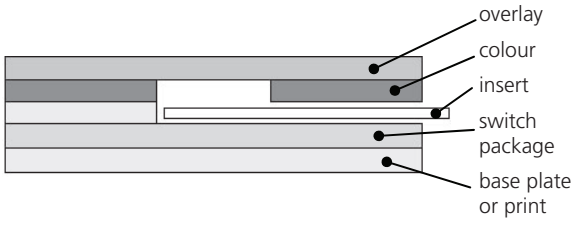
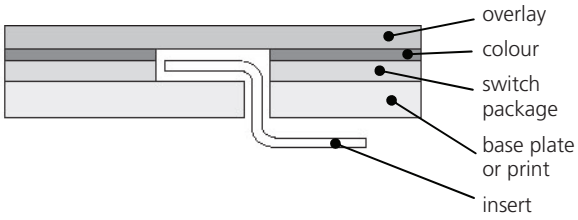
Insert legends

To allow for individual labelling of the keys or to be able to insert designated plastic labels at a later stage, the keyboards are provided with cut-outs into which the strips can be inserted either from the side or from the rear.

Side loading insert



Rear loading insert



Key embossing

General

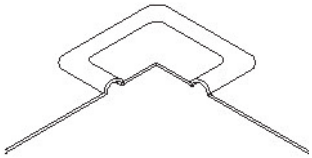
The keys themselves can be manufactured in various forms (square, triangular, circular, eliptical, etc.). Embossing provides spacing between the key areas. When the key is shaped and thereby deformed, radii appears on all sides of the embossing. For the embossing height, the basic rule is: 1.5 x foil thickness for polycarbonate, and 1 x foil thickness for polyester. Another proven material for shaping is aluminium.

ALGRA Ltd. offers mainly the following four types of key embossings:

- Edge embossed
- Point in the centre of the key
- Raised (plateau or pillow)
- Polydome (Bubble)

Edge embossed

Edge embossing is suitable for the finger touch. The level of the key area and front foil remain the same. Edge embossing can be carried out as requested. During the shaping process it is possible that material fatigue can occur. This can be countered by minimising the radii at the corners, therefore it is important that all corners have a radius of at least 0.5mm. Edge embossing can be applied with tactile and non-tactile keys, as well as with keys which accept an insert.

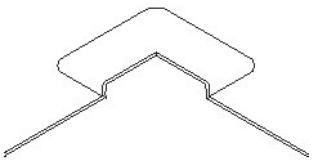


Point in the centre of the key

As an option, this shaped point can be formed with metal or foil overlays. It is often used for the central key in a numerical keyboard layout.

Raised keys

These embossing can take any form as required. All materials are suitable. The maximum height of embossing is equal to the material thickness. Raised keys are used only for tactile keys and they are suitable for keys with an insert. During shaping it is possible that material fatigue can occur. This can be countered by minimising the radii at the corners, therefore it is important that all corners have a radius of at least 0.5mm.



Polydome (Bubble)

This type of embossing enables a tactile feedback as well as a feeling from the key. Bubble embossing is used only for polyester foil. The diameter of this embossing measures between 8 and 15mm. The embossing height is between 0.3 and 0.5mm.

Other key embossings on request.

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Overlay materials

Choice of materials

The choice of overlay will decide how durable the keyboard will be. We can use the following:

- polycarbonate
- polyester
- aluminium
- stainless steel
- plexiglass
- glass

Description of the materials

Polyester
has a high degree of resistance to mechanical stress and is highly resistant to chemicals, therefore it can be used for all keyboards. The physical and chemical structure of the foil provides, along with many positive characteristics, also some negative ones; tiny irregularities in the adhesive or the other layouts are clearly visible and unfortunately can never be completely avoided. Also it is not easy to form this type of foil. There are two basic types of polyester which are used:

- **Polyester foil glass-clear** is used by us for keyboards the surfaces of which should be glossy or for keyboards with fully transparent windows. The front side of the surface is partially matted using a special process (LINDE-Texturing). There, where there isn't any texturing, the foil remains clear, which is particularly important in the case of LCD's.

- **Matt polyester foil** is preferable for all keyboards which do not require a clear window. The surface has a fine matt finish and a lightly oily appearance, as opposed to polycarbonate foil which bears the structure of the roller from which it was made. If a clear window is required, it is possible to print a window lacquer on to the front. The quality of this window however is not quite equal to that of the glass-clear polyester foil.

Polycarbonate
has a brilliant, matt surface and can be very easily worked with and shaped. Colours adhere particularly well on to this material. Because of the poor resistance to mechanical loading it is not suitable for foil keyboards. However, this foil can be used very satisfactorily for Algra Dynapic and Algra Dynasim, as these keyboards are not subject to any form of mechanical loading.

All polyester and polycarbonate foils have a limited resistance to ultra-violet light. Therefore they should not be exposed directly to the sun for more than a short period of time. Steam can dissolve them, and a high degree of dampness can lead to electrolytic effects (silver migration). As a result, foil keyboards should not be used in the open air or in a wet or damp environment.

Along with plastic foil, there are other materials which can be used for the keyboard overlay.

Anodised aluminium
is an easy-care material which can be worked on and shaped well. This material is weather resistant, scratch and wear-proof. The colours are resistant to solvents and worked into the oxide layer. Aluminium is particularly suitable for use for Algra Dynapic and Algra Dynasim.

Stainless steel
can be used for Algra Dynapic and Algra Dynasim. Stainless steel is resistant to chemicals and easy to care for. Lettering with a laser or by etching is possible.

Plexiglass
is suitable as an overlay for keyboards with large and stabile windows.

Glass
is easy to care for and resistant to chemicals. Different types of matting or lettering can be chosen according to the type of display. To attain a higher degree of mechanical resistance, glass laminate in bonded glass can be produced. This is also an optimal solution with Algra Dynapic.

Other materials available on request.

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Chemical resistance of overlay materials

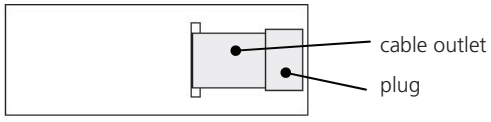
	polyester (180 m)	polycarbonate (175 m)	aluminium anodised	stainless steel	plexiglass	glass
1.1.1-trichlorethane		x			x	
Acetaldehyde		x			x	
Acetone		x			x	
Ether		x			x	
Formic Acid						
Benzene						
Benzole		x			x	
Cyklohexanole		x			x	
Dioxan		x			x	
Etylacetate		x			x	
Chlorofluorocarbons					x	
Isopropanole						
Methyl Ethyl Ketone		x			x	
Methylene Chloride		x			x	
Caustic Soda <10%						
Perchlorethylene		x			x	
Nitric Acid <10%						
Terpentine						
Toluone		x			x	
Xylene		x			x	

passed (tested for 24 hours at 50°C)
x not passed

The information provided here regarding chemical resistance of the materials is given according to the best of our knowledge. The user should perform his own tests to ascertain the suitability for his own particular uses.

Cable outlet

Cable outlet inside the keyboard
The cable outlet (tail) does not extend beyond the edge of the keyboard.



Typical applications:
- for front panels which are „sealed" by the key-board

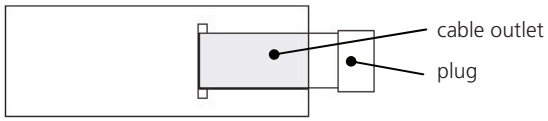
Advantages:
- no sealing action necessary around the keyboard

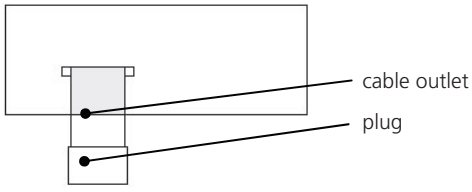
In this area, keys are only very limited possible.

The length of the cable outlet (tail) is > 40mm.

The cable outled should not be creased.
Minimum radius should be 4mm.

Cable outlet outside the keyboard
The cable outlet (tail) exceeds the format of the keyboard.





Typical applications:
- all kinds of appliances

Advantages:
- can be adapted optimal to any construction

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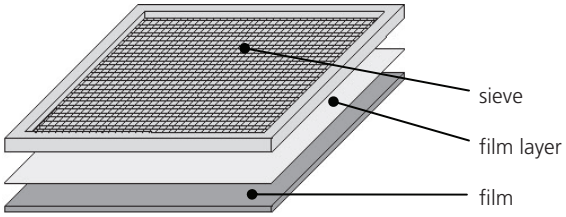
Printing processes

Silk-screen printing

The silk-screen print is a print-through process and not - as in the case of offset - a transfer print process. The carrier material of the silk-screen template causes a thick layer of colour on the offset plate. This is the advantage of silk-screen printing. The colour coating is more intensive, more effective.



Our silk-screen roller printing machines allow with large sizes. The maximal size is 350 x 500mm. Another possibility is the flat bed silk-screen print, which sizes of 500 x 700mm or 700 x 1000mm can be printed.

Advantages:
- many colours available
- **printing on all materials possible**
- free choice of colour layer thickness

Dis-advantages:
- not scratch-proof (printing on front)
- colours are not light and weather resistant
- not resistant to solvents, chemicals, and cleaning materials

Grids in silk-screen printing

When defining grids in silk-screen printing, two standards values should be given particular attention:

- grid size / dot count (lines / inch)
- black portion / toning (%)

A grid picture is produced from a line grid. The dot size is produced from the no. of dots/grid width (e.g. 70 lines/inch) and the black portion/toning (e.g. 20%). 75 lines/inch as the upper limit for and 15 lines/inch as the lower limit for silk-screen printing. For colour runs the black part/toning is between 15% and 75%.

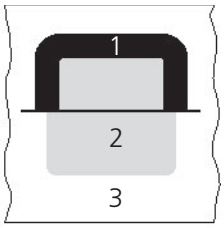
Colour overlapping

Two colours which are to appear alongside each other must be printed overlapped (approx. 0.3mm), (repeat accuracy). In the case of 2 light colours, a dark line (approx. 0.6 mm) must be pre-printed, otherwise a shadow will be visible.

Film manufacture

For each colour a film has to be produced, i.e., for each colour a silk-screen frame must be prepared. This printing process takes place from the rear, therefore the film must be positioned sideways reversed.
When performing silk-screen printing, the order of printing depends on the colours. First of all the darker colours are printed followed by the lighter colours. Finally, in most cases a cover colour is added to avoid the colours 'shimmering into each other'. This is particularly important when the foil is to be used for a keyboard which has a built-in light source. The cover colour prevents the formation of a space around the light source.

Front view:



1 black
2 grey
3 white

Print colours

For silk-screen printing we use printing ink in the colour tones from **RAL, NCS or PANTONE.**
(Other colours are available on request)

Dynaprint (Direct printing)

A new printing possibility is our digital print or as we call it "direct printing". No films are necessary as all data are being transferred directly to the printer.

Advantages:
- low price for small quantities
- no costs for films
- same quality as photo printing
- light and weather resistant
- resistant to solvents, chemicals, cleaning materials etc.
- the colours are scratch-proof

Dis-advantages:
- only for aluminium solutions
- small choice of colours (Algra colour-card available on request)

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Interfaces

What is an interface?

An interface is the connection between the keyboard and the control. Different functions such as permanent and long term contacts can be switched in with the Algra chip "Dysi 97". This can also be located directly on the control board.

When is an interface needed?

For Algra Dynasim and Algra Dynapic.

Types of interface

Interface	No. of circuits equals ...	Advantages	Recommended when ...	Aux. DC supply
Direct	No. of keys plus 1	- economical - short leads	- few keys	none
CMOS	No. of keys plus 2	- signal conditioning - insensitive to interference - adjustable operating pressure - closer and opener - partial bounce filter	- few keys - long leads (2-1000m)	3 - 12 V
Matrix	$2+2\sqrt{\text{no. of keys}}$	- signal conditioning - insensitive to interference - adjustable operating pressure - few leads - compatible with mechanical keys or membrane keyboards	- directly replacing existing keyboards - many keys - leads up to 1 m	3 - 6 V
Binary	16 keys 7 wires 32 keys 8 wires 64 keys 9 wires 128 keys 10 wires	- signal conditioning - insensitive to interference - adjustable operating pressure - full bounce filter - few leads - control of microprocessors	- many keys - micro-computer - leads up to 2 m	3 - 10 V
Serial (DYSI 97)	4	- signal conditioning - adjustable operating pressure - maximum 4 leads - partial bounce filter	- many keys - micro-computer	3 - 10 V
Serial (PC, IBM-AT, USB)	4	- signal conditioning - adjustable operating pressure - maximum 4 leads - partial bounce filter - compatible with PC	- many keys - connection to PC	5 V
Serial (RS 232)	5	- insensitive to interference - adjustable operating pressure - full bounce filter - only 5 leads	- many keys - direct connection to commercially available equipment (PC) - leads up to 10 m	± 12 V

Other interfaces are available on request.

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Plugs

All of our keyboards can be fitted with a 'female' or 'male' plug on request. Because we assume that the keyboard will be plugged in somewhere using a so-called 'pin row', e.g., on a print. There are plugs available with and without locking. The customer determines the type and form of the male plug in order to ensure a good connection. This is why we do not automatically deliver the opposing part, we let the customer decide.

A problem can arise, when the customer wants to solder the male plug onto our keyboard. The soldering process takes place at a high temperature (approx. 200 °C). The result is that the heat of the soldering spreads out to the rear and thereby warms and destroys the conductive silver paste and the polyester foil. The result is failed contacts, and the keyboard does not function any more.

Types of plug

	Duflex (figure 1)	**Crimpflex (figure 2)**	**Clincher (figure 3)**	**Zero force or direct (figure 4)**
Grid size	2.54 mm (0.1")	2.54 mm (0.1")	2.54 mm (0.1")	
Housing				
- material	glass-fibre reinforced thermoplastic polyester		polypropylene	
- insulation resistance	min. $1x10^6$		min. $5x10^4$	This plug combination is often used. It is important that the layout is produced in the correct grid size. Also, the foil thickness on the plug should be so determined that the best possible contact can be made.
- temperature range	from -65°C to +125°C		from -65°C to +105°C	
- pole count	from 2 to 36	from 2 to 25	from 2 to 34	
- colour	light blue	black	light blue	
Contact socket				
- material	phosphor bronze	phosphor bronze	copper / nickel plated	
- surface	tin / lead or gold plated	tin / lead	tin / lead or gold plated	
- current loading	3 A	2 A	2 A	
- insertion force max.	3 N / contact	4 N / contact	3 N / contact	
Advantages	- passive locking - precaution against sideways insertion when using the prescribed pin row - can be inserted side-by-side or in-line	- simple housing form suitable for use with pin rows - passive locking - precaution against sideways insertion when using the prescribed pin row - can be inserted side-by-side or in-line	- simple assembly - gas tight connection - suitable for square or round pins 0.64 mm (0.0025") in 2.54 mm grid - double spring contact ensures exceptional electrical and mechanical properties - locking using additional clamps is possible	- grid size 1.25mm (0.05") possible - ideal when only limited circuit print space available - avoids circuit damage due to repeated insertion cycles (for flexible circuit connectors)
Disadvantages	- contacts can only be mechanically crimped	- contacts can only be mechanically crimped	- cable must be cut to exact width	- cable must be cut to exact width

Figure 1: Duflex-plug

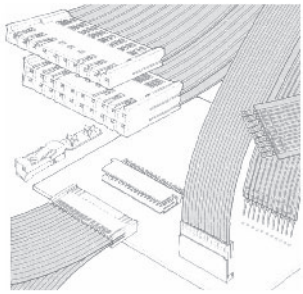


Figure 2: Crimpflex-plug

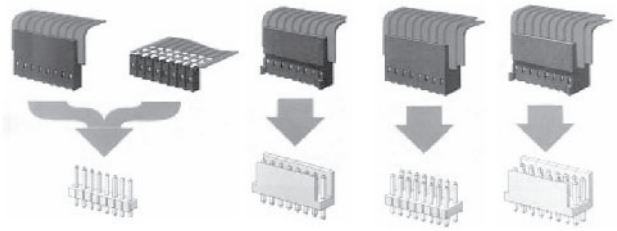


Figure 3: Clincher-plug

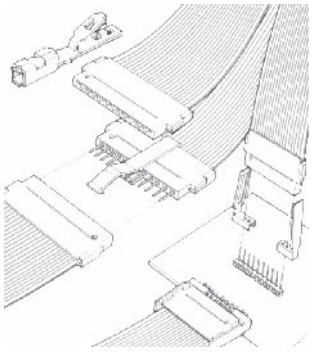
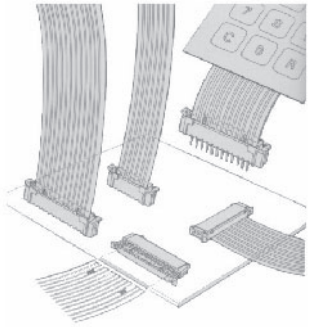


Figure 4: Zero force or direct-plug



General standards

General tolerances

For all dimensions without tolerances, the tolerance details (in the general precision grade M) shown in the following table should be used. They comply to the Swiss Norm SN 258440.

General precision grade	Nominal size (mm)							
	0,5 … 3	> 3 … 6	> 6 … 30	> 30 … 120	> 120 … 400	> 400 … 1000	> 1000 … 2000	>2000 … 4000
	tolerance (mm)							
F (fine)	± 0.05	± 0.05	± 0.1	± 0.15	± 0.2	± 0.3	± 0.5	--
M (middle)	**± 0.1**	**± 0.1**	**± 0.2**	**± 0.3**	**± 0.5**	**± 0.8**	**± 1.2**	**± 2.0**
G (coarse)	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2	± 2.0	± 3.0	± 4.0