Wergen Controls

We find lasting solutions to your problems

Wergen-Systemtechnik
Office for Engineering Design

Founded in 1994.

Design office Wergen-Systemtechnik

Wergen-Systemtechnik is a design office for electromechanical products, the focus being on the field of rehabilitation.

The designers are:

- **Gerhard Wergen, Graduate Engineer (Hon's) and Economist**
  - owner of the engineering office Wergen-Systemtechnik since 1994,
  - responsible for the design and development of electromechanical components.

- **Klaus Franz, Graduate Mathematician (Hon's)**
  - responsible for independent software development since 1995.

Our Development Philosophy

Wergen-Systemtechnik sees itself as a design office that looks after its products up to the stage of "over-the-counter sales". The products themselves are intended to solve existing problems. The problem solutions targeted should be highly simple and often unconventional. The close and interwoven cooperation between the software designers and the developers in the fields of electronics and mechanical engineering gives rise to integrated solutions that are unique within the market.

Since 1995 we have been working on our Wergen control system and have meanwhile developed the third generation. The work involved the parallel revision of the complete system of components (keyboard, mouse, infrared, talker-control, switch gates and notebook function). The current system is so robust, safe and sturdy that we have not recorded a single breakdown since the beginning of 2004, which is one good reason why we give a 3-year guarantee. But that's not the only reason why our products are gaining a reputation on the rehabilitation-equipment market.

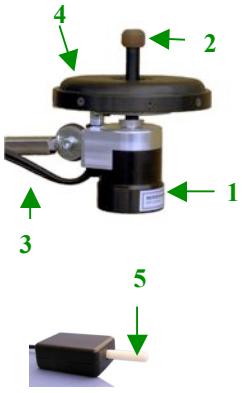
We can now rightly praise them as:

- a technically sophisticated modular-type system
- readily adaptable
- for a multitude of applications
- highly adjustable
- minimum failure rates, long-living, solid
- highly tolerant of operating errors
- esteemed by the health insurance funds and MDK [Social Insurance Medical Service]. Their opinion: "Those with the Wergen control system are well-equipped for the long-term future."

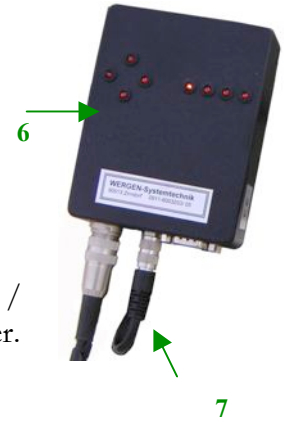
Our Products

The Wergen Control System

The Wergen control systems consists of



- **Joystick** (sensor cartridge [1] with control stick [2])
- The **bracket for fastening** [3] to the wheel-chair / stand and for fixing / support [4] for hand/finger.
- A **switch** [5] (for confirmation, or as an emergency brake for the wheel-chair)
- The electronic **evaluation unit** with display [6] and connections [7] for external components



The Wergen control component system is a product based on our market studies and experience.

Its heart is the **Wergen control system with ISS** (Intelligent Stabilization System). The combination of Wergen control with additional elements of this component system provides solutions for disabled persons who could not otherwise be cared for. The secret is taking account of the multifaceted nature of the problems faced, such as

- the characteristics of the disability (slowed-down movement, cramping and the related inability to let things go, etc.)

- the reduced possibilities for handling (fingers, hand surface, lips, etc.)

- the purpose of use (for wheel-chair control, computer keyboard, etc.)

The Wergen control system therefore has a very wide **field of application.**

We provide for people

- with great strength, but uncontrolled (e.g. persons suffering from severe spasms, ataxia and athetosis)

- who are as weak as possible (as from 50 mN ~ 5 g), e.g. persons suffering from muscular dystrophy, muscular atrophy, rheumatism, ASL or MS)

- with highly limited mobility (less than 2 mm, e.g. for persons with paraplegia to C0)

- with involuntary jittery, fidgety movements (e.g. persons with Parkinson's disease, ALS or MS)

- who are looking for more comfortable and more precise control technology for their wheel-chair.

It is listed by the health insurance funds as remedial equipment:

Remedial Equipment List, Item No. 02.99.01.0001+18.99.08.7004

The Intelligent Stabilization System ISS of the Wergen control

1. **A "filter"** that extracts the trend from the disturbed joystick motion without delay, i.e. no cut-off or hold-up in the information transfer via the travel of the joystick.
2. **A "dynamic magnifier"**: this allows the user quick selection of all speeds between zero and top speed, retention of the speed selected and the option of making subsequent fine adjustments to it, i.e. users drive their wheel-chair from difficult terrain to top speed with a single drive level.
3. **An "adaptation to the user"**: since the basic settings are the same for all users and need not be reset every time the specific syndrome being treated changes, i.e. users with spasms, athetosis, MS, muscular dystrophy or paraplegia all drive with the same wheel-chair settings (regardless of the manufacturer) or mouse control.

The result: the wheel-chair (or mouse) reacts gently but without delay; and the user retains full control without any stress.
ISS is one of the most important components towards success with disabilities that would have remained unachievable with the use of other techniques.

ISS is a major component used in our two joystick (sensor) variants:

Joystick VS (very-sensitive)

has been trimmed as a lightweight (force sensor with a measuring range of 0.05 N – 3 N ~ 5 g - 300 g, with an overload of at least 100 N ~ 10 kg) and has a 6 mm axle.

Joystick HD (heavy-duty)

has been prepared as a robust/durable component (force sensor with a measuring range of 0.2 N -5 N ~ 20 g -500 g, with an overload of at least 2000 N ~ 200 kg) and has a 10 mm axle.

Joystick VS new Version (lightweight) and VS Switch

Joystick HD new Version (robust / durable Component)

In both cases

- the force joystick has a 255-level resolution from the rest position in all directions
- the path within the measuring area is 2 mm in each direction
- the joystick allows even users with little strength to quickly readjust a value, to retain this value and to make subsequent fine adjustments, something that no other joystick currently on the market can do
- larger joysticks or supports can be used to compensate for low initial strength on the part of the user, since the joystick is counterbalanced so that it will always find its rest position (zero point), regardless of whether the joystick is employed in a vertical, horizontal or sloping position (important if the electric wheel-chair is on uneven terrain)
- the joystick has an additional switch which, depending on the user's level of disability, can be employed as a standard switch or as a special switch
- the joystick is encapsulated as a protection against dampness and dirt
- the joystick has been function-tested at temperatures ranging from -20°C to 50°C
- all input and output points have been provided with special protection against overvoltage
- the joystick has been subjected to long-term testing of over a million movements in each direction across the entire working range
- the housing is made of VA and aluminium and has a VA axle (in the 10 years since these came into use not a single axle has been bent)
- calibration (which can be completed within 1 minute without auxiliary equipment) is undertaken at the production stage and remains unaltered throughout the life cycle of the device
- it is shock resistant
- Remedial Equipment No. 2.99.01.0001
- patented

Running Water about Joystick VS

Wheel-chair hangs on the Joystick HD

The Wergen Control For Wheel-Chair Drive

The most frequent use made of the Wergen control system is for **controlling a wheel-chair**.

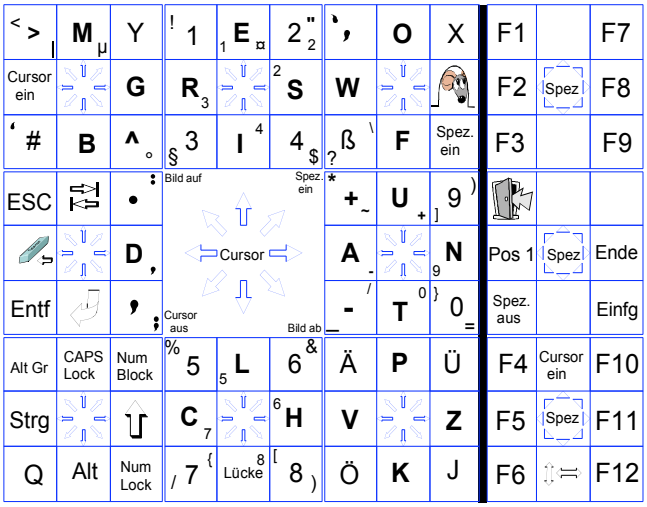
Our control system can be connected to almost all known electric wheel-chairs, whether directly or via an interface, without interfering with the drive console. It can be easily adapted to the characteristics of the object to be operated, such as a wheel-chair, and retains these settings permanently.

By means of an additional switch it is possible at all times, while driving a wheel-chair, to make an emergency stop, regardless of what other signals are being sent via the control stick. This is especially important for very weak users, when for example a hand has slipped from the wheel-chair controls on uneven terrain and the driver is unable to replace it again.

The other manufacturers of special controls have developed their own specific control modules for a variety of electric wheel-chairs. We chose a different approach, employing a versatile, external electronic control which can be easily adapted to almost all wheel-chairs without interfering with the drive console.

The Wergen Keyboard

Our second highlight is the Wergen keyboard. It is unique throughout the world and left the professionals flabbergasted at just how easily and quickly it can be used to operate a computer. It is actually a small indicator board that is connected like a standard keyboard, but is much easier to use, particularly by persons with massive motoric limitations.



It is characterized by the following properties:

- Is demonstrably operable at a rate of **up to 160 characters a minute** without creating fatigue
- Is independent of the operating system, requiring no special driver software and no other computer resources, i.e. does not reduce the display by introducing additional windows.
- Can also make use of Wergen infrared to establish a connection between the wheel-chair and the computer without using cables.
- Electricity supply via the interface (no external electricity supply required).

- Currently supports the PS/2 interface and the USB bus.
- Few movements (2-3) required for selection of a character or function.
- Once the arrangement of the characters has been learned, it is possible to write "blind", without having to look each time at the screen.
- The speed of the character-selection procedure is determined by the user and is not limited by waiting times.
- Emotional and physical influences, such as more or less pressure on the control stick, or faster/slower movements, have no effect on the control of the Wergen keyboard.
- Users find the Wergen keyboard fatigue-free, fast and safe, since they can concentrate fully on their set tasks (no word "forecast" to distract).
- Worldwide patents.

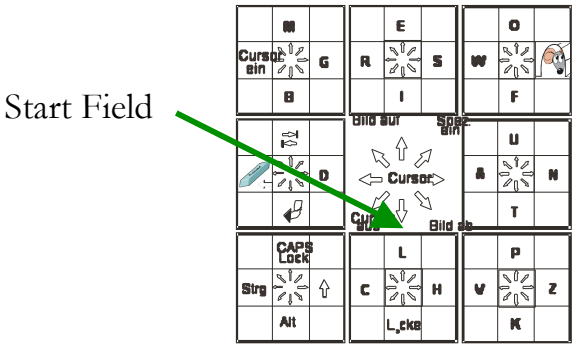
Many Wergen keyboard users have thereby been able to sit their school-leaving examinations, complete subsequent training and then to find work.

How Do I Move Around the Wergen Keyboard?

The Wergen keyboard can be controlled using two elements: the joystick and a button.

The  joystick functions like a key on the traditional computer keyboard. Here one operates the keyboard by pressing the key and then letting it go again. The same principle has been used for our control. One pushes the joystick in the desired direction and then lets it go again. A point of light appears in the field selected in this manner. Next one selects a character or a function by again pointing the joystick in the desired direction and letting it go again. In this way the character is written or the function is triggered. The point of light then automatically returns to the starting position.

Why is the Wergen keyboard so small and not arranged alphabetically?



Keyboard: characters in the main axes only

The keyboard is arranged in such a way that the most-used characters are the easiest to locate. The most-used characters and functions lie in straight-line directions, whereas the less-used ones lie on the diagonals. This makes it possible, after a short time only, to locate the characters "blind". And with a bit more practice, it is even possible to write with a speed of **over 160 keystrokes a minute** using our keyboard. The speed and simplicity of the procedure lies in the fact that the pushing and letting go takes place in a single movement, containing a direction-specifying impulse.

The Wergen Mouse

For many disabled persons, using a mouse is more of a problem than controlling a wheel-chair. Our mouse, like no other mouse on the market, allows even severely disabled persons to control the mouse cursor in a precise and differentiated manner.

It also has the following characteristics:

- The movement of the mouse is supported by the Intelligent Stabilization System ISS
- It corresponds to the interface definition and is therefore independent of the operating system and requires no special driver software.
- With a single button for the Wergen joystick (VS or HD), each of the three functions of a standard mouse can be simulated.

- The mouse is a purely hardware solution. It currently supports the serial RS232 interface, the PS/2 interface and the USB bus. Provided the computer supports one of these interfaces as a mouse interface, the Wergen mouse can also be used. The same applies to Wergen infrared, which can be used to establish a connection between the wheel-chair and the computer without cables.
- Even the connection of more than one mouse to a computer is possible, as is the connection of the Wergen mouse to various computers (PC and talker) at the same time.

Other Components:

The Wergen Lip Button

This is an axial button which is operated using the lips and enables the user to press the button and at the same time to activate the control functions using the stick (important as an emergency stop for wheel-chair users when, for example, the head has fallen forwards onto the control stick, or in the case of the mouse for holding and moving).

The Wergen lip button distinguishes between pressing the button and the control function, i.e. these functions are independent of each other. The lip button has been patented. There are joysticks on the market that integrate the button in the control stick. Such an arrangement makes the pressing of the button and movement much more difficult.

The Wergen VS Switch

A switch with these properties is a must in the field of rehabilitation, since it is a safety feature on the one hand, and is intended for use in extreme environments on the other. There is no comparable switch on the market.

It has the following properties:

- triggering force is 0.05 N or approx. 5 g
- works in every position
- is free of wear and is encapsulated as a protection against dampness (dip into Cola, then wash with water and leave to dry in the air)
- can be added to the key components
- max. of 40 V and max. of 10 mA
- can be manufactured at little cost

The Wergen Telescopic Stick for Lip/Chin Control

- As a stick for lip/chin control which can be compressed by 15 mm. The force required for this purpose increases dynamically. The function is solely intended as a means of improve the operating comfort, e.g. when a paraplegic person drives his or her wheel-chair over a cobblestone path.
- There is no other stick with these properties on the market.

The Wergen Notebook

This is a split-screen display that allows longer texts to be created from the wheelchair without a computer connection. The texts can then be subsequently transferred to the computer with a single click. This represents an inexpensive and highly effective addition for persons who are unable to speak or who have to be able to make notes while travelling. No comparable offer can be found on the market.

The Wergen Talker Control

The Wergen mouse for control of the talker is a hardware solution, not a software-emulated mouse, and does not therefore reflect the problems faced by other mouse manufacturers.

- It is possible as a digital joystick (e.g. the Delta Talker) or as a true serial mouse (e.g. the Power Talker) or via the USB mouse (e.g. the Tellus Talker)
- The movement of the mouse and of the digital joystick is supported by the Intelligent Stabilization System ISS (see above)
- For persons with muscular coordination difficulties, additional support can be activated

The Wergen Switch

This interface, which has proved to be very popular, is not offered by other manufacturers in this form.

- A 15-pin plug provides eight **zero-potential** switch outputs. These eight outputs are designed for max. 40 V and are secured by a 500 mA reset fuse. They can be freely configured and can be determined whether the output assumes the function of a pulse transducer or of a switch

- These switch outputs represent an open interface, i.e. any specialist can connect up further devices with switch inputs, as in the case of adjustment controls for the wheel-chair. Even the connection of a local-environment control is conceivable, i.e. has already been done
- Our bus system allows the number of switching outputs to be extended almost at will

The Wergen Infrared

The Wergen infrared option provides for cable-free data transfer between the wheel-chair and other external devices, i.e. no cable connection between the wheel-chair and the computer is needed. This interface is at present mainly used for connecting the Wergen mouse and keyboard to the computer. It gives the wheel-chair user more space to move at his or her computer workplace and eliminates the cumbersome pulling-out and plugging-in associated with cable connections. Our infrared control does not interfere with other infrared controls, such as that used for a talker.

- Two adjacent infrared interfaces do not influence each other, which also makes them suitable for use in school computer rooms
- Thanks to their unique transmission code, Wergen infrared is not destroyed or even disturbed by standard commercial infrared devices. In other words, parallel operation is also possible.

The Wergen Environment Control

We offer no environment control as such, since there are already enough inexpensive options available on the market. What we do offer, however, is the control of all existing environment controls - and we meanwhile have extensive experience in this field. We have, for example, prepared entire apartments with telephone, door, blinds, etc. for remote control from the wheel-chair/bed

- With our infrared interface we have the right basis for developing an environment-control system of our own.

The Wergen Mobile Phone Control

We have a very simple and inexpensive option for using a mobile phone. This does not rely on a PDA, as in the case of other manufacturers, but needs only an inexpensive mobile phone.

The Evaluation Unit

The joystick (sensor-technology) evaluation unit serves to convert signals received from the joystick to signals suitable for control of peripheral devices, such as wheel-chairs, computers, talkers, etc..

The display shows the following functions:
4 LEDs for direction (i.e. the direction in which the joystick has been pushed), and
4 LEDs for the function (wheel-chair drive, mouse, keyboard, etc.).

```
      O
   O     O          O     O     O     O
      O
```

The four horizontal LEDs have the following significance, depending on which LEDs light up:

X	O	O	O	Wheel-Chair Drive 1
O	X	O	O	Wheel-Chair Drive 2
O	O	X	O	Wheel-Chair Drive 3
O	O	O	X	Wheel-Chair Drive 4
X	O	O	X	The Wergen Mouse
O	X	O	X	The Wergen Keyboard
X	O	X	O	The Wergen Joystick
O	X	X	X	The Mobile Phone Control
X	X	O	O	The Digital Joystick
O	X	X	O	Digital Output 1
O	O	X	X	Digital Output 2
X	X	O	X	The Wergen Notebook

In addition to displaying the current operating status, blinking LEDs and "running" lights are also used to indicate faults. Practical experience has shown that this robust, inexpensive and simple type of display is fully adequate. This applies in particular to persons who cannot read or have poor vision. Where more information is required, we can also make use of an LCD display (see The Wergen Notebook). Many users, however, simply enjoy driving. That's why we prefer not to divert their attention or overtax them with an excess of technical displays and unnecessary information.

The Wergen Evaluation Unit has the following characteristics:

- Outputs: analog outputs for driving, inverse driving, steering, inverse steering, each of these in steps of 2 mV over a range 0.5 V – 10 V. A signal which switches with rest position / zero point.
- Eight zero-potential switch outputs (max. 40 V, 500 mA with reset fuses) that can be configured almost at will. The main application at present is the configuration of two groups, each to four contacts (forwards, backwards, right, left).
- On/Off or changeover switch for the Wergen control / original control
- Wergen-own bus system for external devices with infrared expander for mouse, keyboard, etc.
- Serial mouse (in accordance with standard specifications)
- RS232 interface for altering the parameters of the Wergen control
- The working range from -20°C to 50°C has been tested
- All input and output points have been provided with special protection against overvoltage.

What Benefits Does the Wergen Control System Offer in Particular in the Context of Specific Limitations?

Paraplegia (C0) or Far-Advanced Muscular Weakness

- "Wergen Lip Control": the axial button offers enormous ergonomic benefits for users whose lips are the only part of their body they can move, for paraplegics (C0) or for persons suffering from very advanced muscular weakness.
- One option for the Wergen Lip Control is a telescopic stick. The force required to use this device increases dynamically. This function is solely intended to improve the carrying comfort (avoidance of pressure sores), e.g. when a paraplegic person drives his or her wheel-chair over cobblestones or when his or her head falls forwards.
- The **Wergen Lip Control, specially adapted to the handicapped person, also supports the cervical vertebral column**, since the control does not require that the head be moved continuously, as is the case with chin-control, head-sticks or head-mouse (with infrared or ultrasound). The fast operation of the Wergen lip control, e.g. when used for the Wergen mouse, this does not require any movement of the head, with its considerable weight, but only of the lips, with the possible support of the tongue, the device being held between the lips and the teeth. The Wergen lip control can also be used well by someone whose head is in a fixed position.

Spasms and Athetosis and Ataxia

- Persons suffering from spasms and athetosis derive great benefit from the Wergen control system. Thanks to the extremely robust Wergen control, even the smallest movement (approx. 2 mm) and force (as from 20 g) is sufficient for control and, via its selective trend-filtering feature, even users with very severe spasms and athetosis retain full control while driving. His or her wheel-chair can be driven safely. The wheel-chair reacts gently, making **no sudden or jerky movements** and **this greatly reduces the stress suffered by the**

user. This feature is not only important in controlling the wheel-chair, but also for the PC mouse, the PC keyboard, etc.

- The Wergen joystick recognizes, in the event of excessive pressure, **a cramping of the hands (athetosis)** and **stops the wheel-chair immediately.** The wheel-chair does not drive on until the cramp is over (joystick in rest position)

Muscle Dystrophy, Muscle Atrophy, Rheumatism

- The force required for operation can be adapted to the requirements of the user. If the hand can no longer be used for control, the same joystick with a different mounting can be used for the lips as a Wergen lip control.
- The control hand lies on top and no distance need be covered. The button is ergonomically placed closed to the stick.

Parkinson's Disease

The user can be as shaky as possible and nevertheless control the wheel-chair, the PC mouse, the talker or the PC keyboard precisely, with the help of the Wergen control system.

This presentation takes only a very superficial look at the products and their performance capacities and application options.

Extras in Our Systems

Despite the need for individualization in the specialist controls market, our system can be used as a standard!

Pre-Settings

The Wergen control system is very easy to preset in a variety of ways using appropriate software. These pre-settings require no special device, just a computer (with any of the operating systems from Windows 95 to Windows XP, Linus or Mac), the standard terminal program "Hyperterminal" which is delivered as a standard package and a serial cable.

The menu guide through the pre-settings and the help texts are integrated in the joystick (sensor technology), i.e. even a Wergen control system delivered eight years ago and run on "ancient" software can still be reset. Anyone who hates the very idea of computers can even complete the settings/resetting with the help of a telephone.

Thanks to the Intelligent Stabilization System ISS, which is a fixed component of the software, and our other signal processing, we have managed to provide users with spasms, muscle dystrophy or paraplegia with the same settings for using a wheel-chair, or the Wergen mouse or the Wergen keyboard, i.e. basic settings are the same for all users.

It is only necessary in individual cases to make the following one-time re-settings:

- With how much force can he or she operate the controls?
- How fast should the wheel-chair run?
- How quickly should the system react (wheel-chair hockey or soft-and-gentle in difficult terrain)?

Even in cases of alteration in the specific syndrome, the control need not be reset. Almost all users of the Wergen control system drive their wheel-chairs, from difficult terrain to top speed, using one and the same drive level, since the Wergen con-

trol system, thanks to its dynamic magnifier, allows the user to quickly reach and retain any desired interim speed (from stop to top speed), as well as to make subsequent minor adjustments with an amazing level of precision.

The Modular Components

From an economic standpoint the system must be highly flexible, extremely robust and at the same time inexpensive. These requirements can only be satisfied by means of a system of modular components containing very few parts, these however being almost universally combinable.

In particular, the modular principle permits a high level of flexibility. The following is an example of mechanical flexibility. With the help of a well-designed mounting comprised of two components, the VS or HD joystick can be attached and used at different places: on or under a table, for example, or vertically or inclined on the wheel-chair back, where it then can also serve as the bracket for a small table.

Safety

The wheel-chair user must be able to rely on the safe and secure functioning of his or her wheel-chair. Safety implies on the one hand that the software satisfies certain safety criteria. The operation of the wheel-chair, for example, is safety-relevant and therefore must be given priority over other activities (such as control of the mouse or keyboard), i.e. it must not be interrupted/stopped by these and therefore always accessible.

At the same time the joystick, the communication interfaces and the signal processing must be constantly checked, automatically, to ensure their correct functioning. If the safety monitoring detects a fault in the Wergen control system (e.g. if the connection cable to the joystick is defective or if the joystick is deflected on switching on the Wergen control system), the wheel-chair is immediately brought into a safe operational status, i.e. it is braked to rest position.

The Wergen joystick is a force sensor which can detect an athetosis, i.e. an involuntary spasm suffered by the user, and can then bring the wheel-chair to a standstill. There is no control system on the market that offers this feature. In certain cases, therefore, the Wergen control system must be used, because it incorporates an athetosis cutout.

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