

# // APPLICATION DOCUMENTATION

**IFOY AWARD 2017**

TORWEGGE GmbH & Co. KG

In category  
**Automated Guided Vehicle (AGV)**

**TORsten**

<b>Length:</b>	1.285 mm
<b>Width:</b>	835 mm
<b>Height:</b>	235 mm
<b>Speed:</b>	max. 0,8m/s
<b>Dead weight:</b>	250 kg
<b>Load capacity:</b>	1,200 kg
<b>Control/operation:</b>	Autonomous or by remote control

- Omnidirectional movement
- Customised superstructures
- Sturdy design



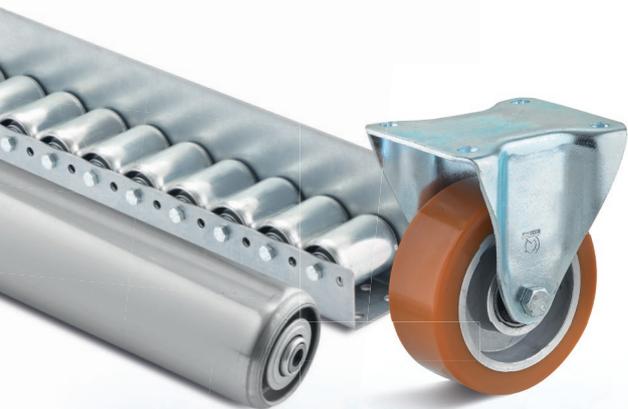
## // Reinventing material flows

strong  
flexible  
reliable  
powerful  
helpful

The word cloud looks like a job description. And TORsten from TORWEGGE ticks all the boxes. It offers unrivalled flexibility, as it can be equipped with a wide range of load platforms and is designed for omnidirectional transport. TORsten is a team player, as it assists its co-workers in performing their tasks through exceptional strength, manoeuvrability, load capacity and ergonomic design. If the layout of the factory or warehouse is modified, there are no additional changes required to the vehicle guiding system, as the TORsten navigates through the room based on a 2D layout of its working area. Customisable energy concepts and a sophisticated safety system make the TORsten not only highly reliable but also cost-efficient.



## // About TORWEGGE



TORWEGGE GmbH & Co. KG is a family company established 60 years ago. Its headquarters are in Bielefeld, Germany, and the company operates a number of branch offices in various European countries. In 1956, the business founder began producing wheels and castors in his garage. Over time, the company grew in size, employed more people and expanded its range of products, supplying more and more different industries. Today, TORWEGGE operates dedicated business units for Moving Components and Intralogistics Solutions. Apart from intralogistics components and systems, TORWEGGE develops customised future-proof material handling solutions for companies in a wide range of sectors.

Over 7,000 square meters of  
logistics, manufacturing  
technology and development



Headquarters:  
Total employees:  
Sales 2014:

Bielefeld  
approx. 130  
approx. 27 Million €

## // Why did we develop TORsten?

Over the years, our Intralogistics Solutions team has been designing various customised transport trucks and vehicles, including the electrical lift/transport truck known as eHFW for CompAir. The eHFW can best be described as a mobile lifting platform with detachable draw bar for 360° assembly. CompAir uses the eHFW for the assembly of components that weigh up to 3.5 t and are transported on the trucks from assembly station to assembly station.

Movability was the common feature that linked all load vehicles developed by the Intralogistics Solutions team. With the eHFW, we realised that some vehicles are actually standing still for prolonged periods while assembly work is being performed. We therefore asked ourselves whether we should design a transport system with a drive and navigation unit separate from the actual load carrier. Our engineers put their heads to the task.

Based on their experience in projects for various industrial customers, they came up with a modular drive system for AGVs.

*We therefore asked ourselves whether we should design a transport system with a drive and navigation unit separate from the actual load carrier.*

Initial market research showed that our approach was the right one. While there are many bespoke trucks and AGVs in operation across factory floors all over the world, none of these systems is as versatile and efficient as our modular all-rounder that combines autonomous navigation with excellent manoeuvrability. The development of the TORsten began in earnest in 2015.

We are convinced that the TORsten will take the market by storm, as it meets the requirements of modern factory operation.



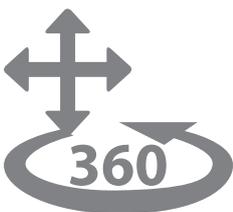
### eHFW



Greater safety for workers thanks to optimised material flows



Reduction in illness-related absences due to improved ergonomics



Adjustable working position for 360° assembly



Safe transport of weights up to 3.5 t



*From eHFW to TORsten*

## // What are the unique innovative features of TORs-

Compared to other AGV drive systems, TORsten is extremely flat (235 mm in height). It is of a modular design and can pull up to 7 t. Another unique feature is its striking futuristic design. The energy concept can be customised to suit the needs of the operator. The omnidirectional drive allows for forward, traverse and diagonal movement, which makes the TORsten the ideal solution for 360° assembly and manoeuvring in confined spaces.

Thanks to its advanced navigation system, which can be programmed for self-learning navigation, the TORsten is an intelligent component of Industry 4.0. Top-quality parts and assemblies developed together with our business partners RWTH Aachen and SEW Eurodrive guarantee exceptional process safety based on latest technologies. The modular design of the TORsten makes the solution highly scalable and adaptable to new tasks and new industries.

## // TORsten drive and control concept

The modular power management and control technology of the TORsten meets the requirements of modern autonomous robot vehicles.

48 V DC power system; control voltage 24 V (industry standard)

- 48 V DC intermediate circuit with voltage and current monitor
- Energy supply through inductive power transmission or contacts
- Modern power storage system with environmentally friendly lead crystal batteries
- Operating time of minimum one shift without any need for recharging
- Integrated power management system from SEW Eurodrive

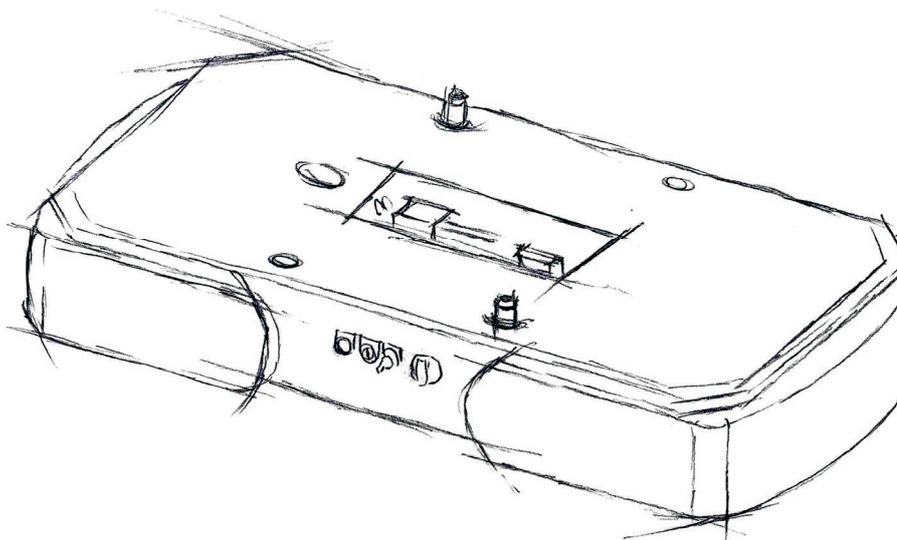
Modular control system for manual remote control or autonomous navigation with integrated route mapping processor

- User-friendly remote control with integrated safety technology for manual control
- Movement range in autonomous mode secured by safety scanners
- Automatic adjustment of vehicle speed to suit working area
- Speed-controlled scanned range switching for accurate movement in confined spaces
- Display of all vehicle parameters and states on stationary monitor

Distinct and consistent robot layer model for software and vehicle control (doing away with first navigation computer layer in the attached vehicle)

- Route planning system
- Robot kinematics (SEW Eurodrive/ MOVI-PLC)
- Multi motion (SEW Eurodrive/ MOVI-PLC)
- Drive power booster (SEW Eurodrive/ ELVCD)
- Drive units (SEW Eurodrive– CMP servomotors)

The motor and gear system are enclosed in a sturdy industrial drive box from SEW Eurodrive and can withstand heavy mechanical loads. The drive power booster, the motors and the gear system are maintenance-free IP 65 units suitable for operation in demanding industrial environments.



## // Navigation



After transmission of the destination, the TORsten automatically finds the best route to that position by autonomous navigation. For this purpose, the following software components are integrated at the core of the control system in the navigation computer:

- Localisation
- Global route planning
- Local collision avoidance



The **localisation** software is based on the widely used, highly reliable Adaptive Monte Carlo Localisation. Through a fuse of sensors, the data from the laser scanners, the integrated inertia measuring device (rotary speed/acceleration) and the wheel encoders is brought together and to determine the actual global position of the platform. The data from the laser scanners (2D light section) is compared with the factory layout, so that operators can track the position of the platform.



The **global route planning** system refers to a virtual route network that can be configured to reflect the actual physical environment. This approach does away with linear guide systems, inductive loops or magnetic track guide systems. The global route is calculated by means of an A\* algorithm, based on the travelled track.



**Local collision avoidance** makes sure that moving obstacles are reliably identified by the lasers. For this purpose, the planners devise what is known as local cost maps. These maps are constantly updated to show all local obstacles so that the shortest obstacle-free route from the current location to the destination can be calculated. The vehicle is therefore permitted to leave the initially chosen global route should this be necessary to prevent a collision.

## // Outlook

Thanks to TORsten's flexibility and integrability into existing intralogistics processes, the drive system is the ideal solution for a broad range of applications.

It is our objective to position the TORsten as the new standard transport vehicle in the market, thus helping shape the internal material flow processes of the future.

The TORsten is to become a key component of human-robot collaboration (HRC) in cyber-physical systems (CPS). Its robot command-based control and on-board intelligence opens up

new opportunities for interaction and collaboration between humans and machines.

As an Industry 4.0 component, the TORsten speeds up internal material flows and makes processes not just more efficient, but also much safer.

TORsten on YouTube  
[goo.gl/454HrF](https://goo.gl/454HrF)

