Robotino® - The Mobile Mechatronics Learning System

- Robotino®2 – The new version
- PROLOG – Integration of Robotino® as an intelligent AGV in a MPS learning factory.
- Vocational training equipment for Robotino®

Part No.: 567300
Available: August 2010
Main Features of the new Version of Robotino®

- New controller board EA09
- New W-LAN Access Point
- New programming software Robotino View2
- New operating system 2.0
- Autonomous operation including W-LAN communication with external control device
- Additional sensors and devices

Part No.: 567300
Available: May 2010
Customer Expectations: Fully transparent Control

- Open programming interface of the embedded application controller PC104
- Monitoring and adjusting of internal motor PID controller
- Replace internal PID controller with user defined external closed loop controller
  - C/C++
  - Matlab
Why new Controller Board EA09?

Previous version:

- **Controller board** with external IO-interface

User access to controller board only via slow serial interface =>
  - no real-time monitoring and
  - no external motor control possible
New Controller Board EA09

- **Compatibility:** PC 104 communicates via serial interface with EA09 following the same protocol as before.

- **Direct fast access**
  to the EA09 via Ethernet switch

- **JTAG interface allows**
  Micro processor programming

- **FPGA provides**
  fast sensor evaluation

- **Available:**
  April 2010

- **Update:**
  Easy exchange possible
New W-LAN Access Point

Advantages:

• Very powerful and cost efficient

• Without housing the same access point is integrated in Robotino® controller housing.

• Allows to build up stable W-LAN network
Recommended W-LAN Configuration

Advantages:

- WLAN-card for PC not necessary
- Only one WLAN-network
- W-LAN network can be easily protected
Robotino® View 2

- **State of the art programming structure**:
  - Main program, subprograms,..
  - SFC programming following the international standard IEC 61131

- **Open user interface to create own generic function blocks using C++**

- **Online Update**
  to have always the actual version available
Robotino® View 2

- Several Robotinos can be controlled by one application program
- Library of prepared hardware device drivers (Robotino, camera, joystick,...)
- Open user interface to create own hardware device drivers in C++
Robotino® View 2 - Navigation

• Moving along a predefined path
• A path is given by
  • positions with orientation

• Path driver is a closed loop controller checking the actual position

• Actual position will be calculated by **odometry** (measurement of wheel rotations)

• Gyroscope provides rather high accuracy of odometry.

Part No.: 567138
Option: NorthStar 2 – Absolute Positioning

NorthStar works like an Indoor GPS System
Part No.: 549833

- More reliable
- High price reduction!
- Calibration only requires height of projector ceiling

Part No.: 549777

Part No.: 549778
New Operating System 2.0

- CF card (1GB) with Ubuntu Linux operating system (real-time kernel) (Part No.: 548693)
- **Recommended**: 4 GB card (Part No.: 567206)
- Upload of Robotino View project on Robotino controller => autonomous Robotino View application
- Update of CF card via Robotino View!
- Update of firmware on micro processor via Robotino View!

At present no update of firmware of IO
How to update Robotino -> Robotino 2?

• There is an update package of the new controller board (part no.: 567204)
  Just take out the old board and replace it by the new board

• Or: just order the new controller housing (part no.: 567302)

• There is no official update package for the new access point but it is possible to order the parts to do it.

• Software is available via Festo Homepage

• CF-card: If you have a 1 GB card then you can easily download the new operating system on this card, see Festo Homepage.

• Option: New 4 GB CF-card (part no.: 567206)
Robotino® SIM

- First steps in Robotino View by using 3D-simulation with integrated physics simulation engine
- Simulation of motors, distance sensors, bumper and camera
- No change of work cell is possible
- Free download
Robotino® SIM Professional

- LabCreator editor for modelling arbitrary work cells.
- Simulation of Robotino with any kind of sensors
- Library of sensors and devices will be continuously extended
- Arbitrary number of Robotinos in one work cell.
- Online update

- Part No.: 567230
  Network license for 25 user + 2 single licenses
ProLog Factory

Logistic training platform
KANBAN, Just in Sequence, Order scheduling ...

the ProLog factory offers an enthusiastic training platform – not only for logistics!
ProLog Factory

consists of 3 main areas:

- The **Production Line**, where the products are produced
- The Commissioning Station, where the orders are picked
- The Warehouse Area, where the orders (pallets) are buffered until delivery
Development Steps …

Robotino2 as Mobile Mechatronics Training Platform … to an Autonomous Intelligent Transport System
Challenges

• Interaction with stationary machines

• Navigation to unknown positions in a dynamic environment

• Communication with SCADA system
New Device for Interaction with Stationary Machines

Integration of a fork lift:

- Electrical linear drive belt axis with DC motor and incremental encoder
- Pallet lift with centering
- Position controller to lift up the pallet in very accurate positions
Navigation

- Robots receive two different task areas
- Navigation is reduced to positioning

![Diagram showing robot navigation and task areas](image-url)
Navigation

- Positioning with high accuracy
- Use of odometry for positioning
  - Gyroscope
    - Requires fixed start position
  - Inductive sensor for line following
  - Optical sensor for recognizing markers
  - Path planning function module
- Collision avoidance:
  - Infrared distance sensors
  - Separated work areas
    - Delivery orders
    - Loading of high-bay racking
Navigation needs Preparation of the Warehouse Field

Fixed start positions of the robots
Communication with SCADA System

- WinCC Order Entry
- Robotino 1 OPC
- Robotino 2 OPC
- WLAN
- Ethernet
- Order 1
- Order 2
- Order 3
- High-bay racking
- JIS parts supply
- S7 315
- Profibus DP
- Commissioning Robot
- Robotino 1 WLAN
- Robotino 2 WLAN
Communication via UDP/OPC

Robotino® View 2

UDP/OPC

Data Exchange Server

PLC with TCP/IP interface

Externer Access Point

WLAN
Communication - HMI Interface
Vocational Training Equipment

- Simple work arena of seize 0.9 m x 1.8 m
- Easy to setup and to transport

Teaching course material with the focus on
- Setup of a mechatronic system
- Sensors including first steps of image processing
- Integration of communication with PLC
- Material flow

Available in 09 – 2010
Structure of Training Environment I

• Simply folding workplate of size 0.9 m x 0.9 m

• Can be placed on any laboratory work table.

• There are rubber pimples on the backside to avoid slippery on the table.

• Prepared guiding lines with marking in order to renew them.
Structure of Training Environment II

Extension for Robotino:

• **Logistics Kit** (Part No.: 564179)

  Changes:
  • Shelves with digital optical sensors
  • One shelf will be loaded by a magazin
  • Autonomous charging device

• **User interface being protected via key switch**
Skills Competition Mobile Robotics

• Worldskills 2007 in Shizuoka, Japan
  • 10 teams

• EuroSkills 2008 in Rotterdam, Netherland
  • 6 teams

• Worldskills 2009 in Calgary, Canada
  • 14 teams

• EuroSkills 2010 (December) in Lisboa
  • Not yet known ( > 6 teams)

• Worldskills 2011 (October 5-8) in London
  • Expected more than 14 teams
RoboCup

- Festo Logistics Competition

- Festo Hockey Challenge Cup 2009 in Graz