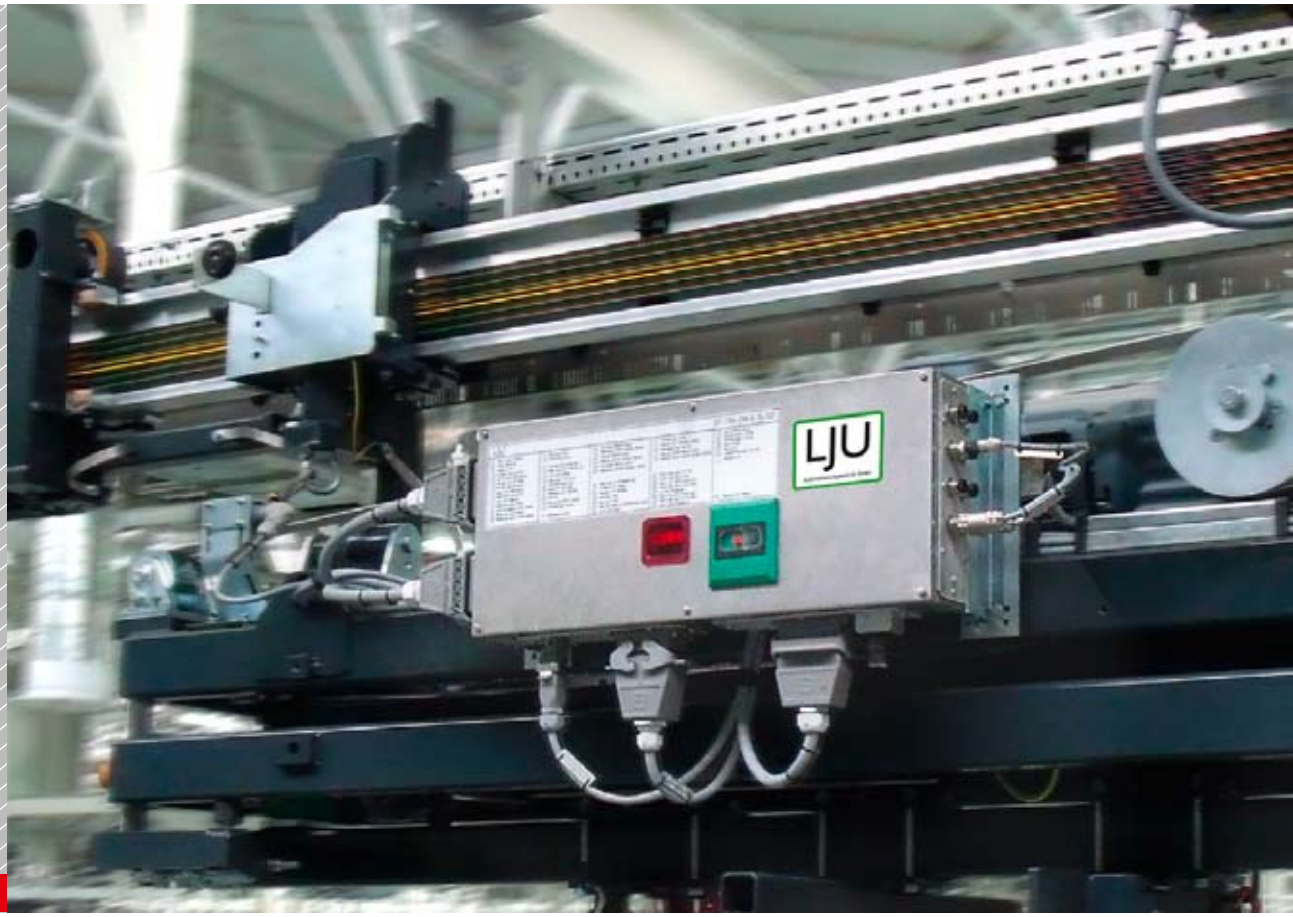
CONTROL SYSTEMS | POSITION RECORDING SYSTEMS
INDUCTIVE POWER SUPPLY SYSTEMS | DATA CAPTURE AND ANALYSIS
SYSTEMS | DECENTRALIZED BUS MASTER SYSTEMS



LJU Automatisierungstechnik GmbH

Technology

GRENZEBACH

High Tech Solutions have a name – Grenzebach

Grenzebach has achieved a leading position as an acknowledged specialist in handling, processing and automation technology.

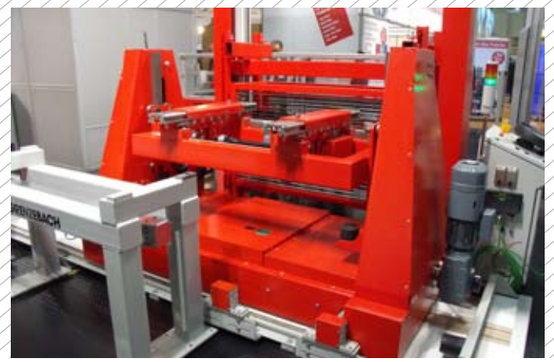
We design, manufacture and deliver fabrication lines and components for the production and processing of flat glass and building panels, for processing of gypsum from raw material to finished plasterboard and special equipment for cutting and drying of veneers. Further spheres of competence are production technology for display glass including clean room applications, technology for thin-film photovoltaic modules, process technology and automation systems for various industries as well as baggage handling equipment for airports.

Many years of experience in mechanical and electrical plant engineering and sophisticated plant controls, designed within the Grenzebach group, guarantee optimum line functioning. Various process and optical quality inspection systems and a comprehensive spectrum offered by our Competence Center Service complement our product range.

We develop, implement and integrate customized solutions for automation and optimization of complex processes. The focus of our solutions is on handling, conveyor technique, flow of material and intralogistics, complemented by high-performance, custom-made controls and components for transport and handling systems in various industries.

Grenzebach places great emphasis on maintaining cooperative partnership with its customers. With production facilities in Germany, the USA and China we are always close to their vicinity. Local support and service can also be obtained from one of our many representations throughout the world.

LJU Automatisierungstechnik GmbH



Over 25 years
innovativ Control-Solutions

LJU Automatisierungstechnik is your perfect partner with over 25 years of experience in controlling moving equipment.

1986 Established as a manufacturer of electronic devices and special equipment in Berlin-Steglitz

1987-89 Development of controllers for Electrical Monorail System (EMS-controller Series 5)

1991 Structural improvement and relocation to Gross Glienicke near Potsdam

1999 New production facilities in Potsdam, Introduction of Series 6 Controllers

2001 More new products for absolute position scanning, inductive energy transmission, rail bus etc.

2005 ISO 9001 Certification

2006 20th anniversary with more than 1000 installed transport systems (120.000 control boxes) worldwide Introduction of Series 7 Controllers and Omega monorail system

2009 LJU becomes part of the international Grenzebach

2011 Worldwide integration into the Grenzebach group and development of service facilities in China and the USA

Trolley Controllers

CHARACTERISTICS AND FEATURES

Controllers of the series ST-79x are programmable trolley controllers with integrated frequency inverters for Electrical Monorail Systems (EMS). These controllers are used for controlling drive, hoist and/or conveyance motors. Individual controller functions are standardized into function modules and are compatible with various systems; when used individually or in combinations.

The drive motors can be operated asynchronously (e.g. for general transportation tasks) or synchronously (e.g. driving in assembly lines). The controllers could have multiple inverters that could drive sequentially or in parallel depending on the requirement of the application and the model of the controller. The communication or transfer of commands to and from the system controller takes place over the

- Rail bus (RB),
- Inductive data bus (iDB),
- PCM or
- Half-waves

SPECIAL FEATURES/OPTIONS

- Safe deactivation of the inverter and brake in conjunction with the safety module (option)
- Safety circuit with special channels for 500mm switch-bridging and speed control in conjunction with the Inverter Controlbox ST 793 safety module and rotational speed monitoring (option)
- Use of IGBTs with low power loss
- Low profile height of controller housing with powerdependent heat sinks
- Variable power supply and brake voltages
- Inductive, contactless power supply (option)

ST-790-L STB-794-Si-iDB ST-796-2M-P-Si-SB

For special applications, external sensor systems can be connected to the controllers and the required configuration can be programmed.
Application software and the operating parameters can be transmitted to the controller via infrared using the handheld programming device MU 705. This allows quick and customized solutions for different system concepts and application scenarios.
For functions like manual movement of the trolley, the controller can be remotely operated using the infrared remote control.
Important trolley characteristics required for reliable operation are continuously monitored by the controller. In the case of a fault, the trolley is put into a safe operating mode (disabling all movements). Moreover, different messages are displayed on the trolley controller display and sent to the system controller.

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GENERAL FUNCTIONS

- Variable speeds
- Independent command and program processing
- Automatic positioning
- Positioning within millimeters with the use of a LJU-position reading system (e.g. with PLA14)
- Display of faults and operating modes on the display
- Status of connected sensors

On request, compatible controllers can be designed for controllers of other manufacturers that are no longer available on the market

PART DESCRIPTION KEY

A unique product number (WNR) is assigned to controllers of one system which is then used to track those features of the controller architecture for future enhancements and modifications. The controllers are manufactured using standard LJU components (e.g. CPU-boards, inverter boards or INI boards), customized to the application and system specifications of the particular end-user.

ST - 796 - 2M - P - Si - SB - Special

ST	**Trolley Control**
STB	**Trolley Control with inductive power supply**
79	**Trolley Control of series 7 with frequency inverters**
	For previous series description of classification e.g.:
69	Inverter Controls of Series 6
68	Triac Controls of Series 6
0	Power Range 0 up to 0,75 kW*
1	Power Range 1 up to 1,5 kW* 4,2 A
2	Power Range 2 up to 2,2 kW* 6,0 A
3	Power Range 3 up to 3,0 kW* 8,0 A
4	Power Range 4 up to 4,0 kW* 10,0 A
5	Power Range 5 up to 7,5 kW* 18,0 A
6	Power Range 6 up to 11,0 kW* 24,0 A
7	Power Range 7 up to 15,0 kW* 32,0 A
	* The motor power values are standard values, which refer to a 4-pole standard-asynchronous motor in star connection at 3x400V/50Hz in EMS-typical operating mode S3- 40/60%.
(remains void)	**1 Motor**
2M	**2 Motors (e.g. Drive + Lift)**
3M	**3 Motors (e.g. Drive + Lift + Rotate)**
nM	**n Motors**
P	**Operation mode parallel**
S	**Operation mode sequentiell**
PS	**Both modes in combination**
	N/A for single mode controllers.
Si	With safety module
	N/A for controllers without safety module.
SB	Communication via railbus
iDB	Communication via inductive wire bus
	N/A with PCM, half wave control or Z-Stop
...	Additional description

Trolley Controllers

ADDITIONAL FUNCTIONS IN RAIL BUS OR CONTACT-LESS BUS SYSTEMS

- Automatic distance control
- Continuous data exchange between trolley and PLC
- Detailed status messages and fault messages to the PLC
- Download of parameters to the trolley from the PLC

MONITORING AND PROTECTIVE FUNCTIONS

- The trolley controller independently receives signals of connected peripherals and sensors. All moving functions (e.g. hoisting or conveying actions), are controlled using this information.
- All trolley functions and the connected trolley hardware are continuously monitored for desired operation. When a fault occurs, the trolley is stopped immediately and an alphanumerically coded fault message is displayed in the trolley controller display.
- Pending faults are reported to the PLC and partially logged in a data log in the controller. This can be read out with the hand-held programming device.

AVAILABLE SENSOR INPUTS

- General sensors (position sensors/light barriers, anti-collision proximity switches etc.)
- Distance sensors (photoelectric switches, ultrasonic sensors etc.)
- Switches and signal lamps (magnetic switches, stop switches etc.)
- Incremental sensors (cable length encoder etc.)
- Limit switches
- Optical scanners (PLA14, double light barriers etc.)

There are third-party products available on the market that can directly communicate with the internal LJU bus (e.g. cable length encoders or other positioning devices of various manufacturers).

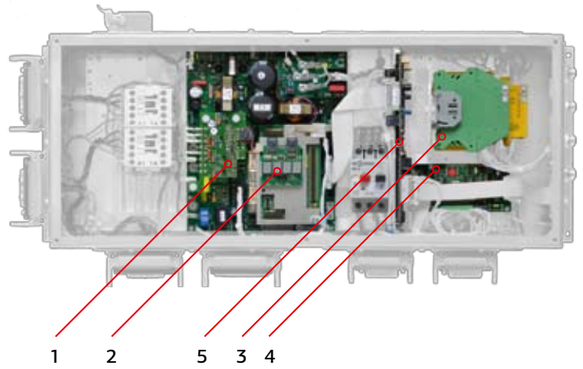
MODES OF OPERATION

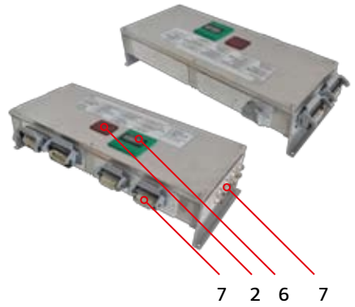
Depending on the application, the drive motors are controlled differently:

SIMPLE	**For controlling a single motion** e.G. driving only
SEQUENTIAL	**For controlling multiple motors with a single inverter (only one motion at a time)** e.G. driving and hoisting sequentially
PARALLEL	**For controlling of multiple motors with multiple inverters (multiple motions at a can time)** e.G. driving and hoisting in parallel

A combination of sequential and parallel operations is available in one trolley controller.

Controller Design and Modules





The trolley controllers of the series ST-79x are designed as a system with internal bus and modules for specific functions. The standard components are integrated in a controller housing, depending on system functionality.

All connections for the power supply unit, motors, external sensors etc. are with connectors. The connections depend on the model and customer requirement, and use harting industrial connectors, Faston, M12-plug connectors or STAF.

The controller can be deactivated with a built-in circuit breaker which is accessible from the outside of the housing.

SAFETY MODULES (OPTION)

The trolley controllers can be equipped with additional safety modules which monitor the dual-channel safety circuit of the trolley and the individual functions of the controller. This option provides a greater safety rating for the system.

With this method the general existing simple machine safety can be extended to safety of persons.

SAFETY RELAYS

To further ensure safe operation, the trolley controllers be equipped with one or more safety relays. The safety relay of category 3 monitors the dual-channel safety circuit of the trolley and disables all motions if the condition is met (accepted by TÜV).

1 Inverter modules
2 CPU with display and infrared interface
3 Safety module (option)
4 Communication interface
5 I/O units
6 Circuit breaker/main switch
7 Connections for motors and sensors

Accessories

DLS-2b

Trolley-based speed and position reading

Double Light Barriers

– As reference for synchronized driving and self-positioning

PLA-140

Absolute Scanner

– As position reference for distance control, trigger of actions, synchronized driving and diagnostics

OLM-708

Optical Linear Measurement Sensor

– Positioning/position reading in automated high-bay warehouses
– Positioning/position reading of floor conveyors, monorail conveyors, stackers which travel round curves, slewing rings/turntables, shuttles

Additional Modules

– Additional module for duplication of the display and infrared interface (for remote locations)
– Optionally configurable as an external address and data storage device

FAB-707

Trolley address box

– Trolley Address Function – This function allows assignment of a trolley number to a trolley, independent of the controller

FAB-707-IR

Trolley address box with display and infrared interface

– Trolley Address Function – This function allows assignment of a trolley number to a trolley, independent of the controller
– Status Displays – Important information about the trolley status, such as error messages, are displayed for the user and system operator on the device display. All messages are alphanumerically displayed.

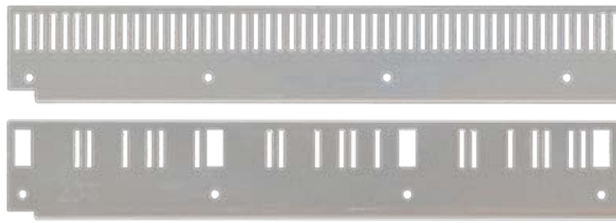
Field Mount Accessories

Incremental Rail for Synchronized Drive

– With equal divisions as fixed digital reference

Absolute-Coded Rail for Position Detection

– Coding for positioning within millimeters and for triggering system functions using the PLA-14 absolute value scanner



Barcode-Tape

– By reading the bar codes, which are printed on the bar code tape at 3cm intervals, the OLM-708 optical linear measurement sensor determines the current position of the trolley

Track-Switch Controller

– Handles the entire track-switch operation locally, including motor control and administration of safety blocks
– Only the power line, 24V line and bus line are required for operation of the track-switch controller

Infrared Destination Marker

– For defining action or station points along the path of travel when used with the front window of the controller or an external infrared module

Operating and Programming Devices

Infrared Device for Parameter Settings and Programming

– Read and write the parameter records, tables and other data
– Set display modes
– Read diagnostic data and version numbers
– Transmit firmware and user programs
– Perform test functions and remote control operation
– Remote control function

Infrared Remote Control

– Remote control of various movements of the trolley controller by the maintenance staff

Communication of Controller to PLC

For implementation of the following communication configurations, various interface modules are available, which allow interfaces between the electrical monorail system and the PLC.

HALF-WAVE AND FULL-WAVE CONTROL
During the half-wave activation, commands are sent from the system controller to the trolley controller via full waves and half waves over a control rail.

- Drive at multiple speeds
- Release the brake separately (e.g. for mechanical adjustment of trolley at loading points)
- Slow down and stop with a slow-down photo-switch and anti-collision proximity switch
- Additional speed through magnetic switch

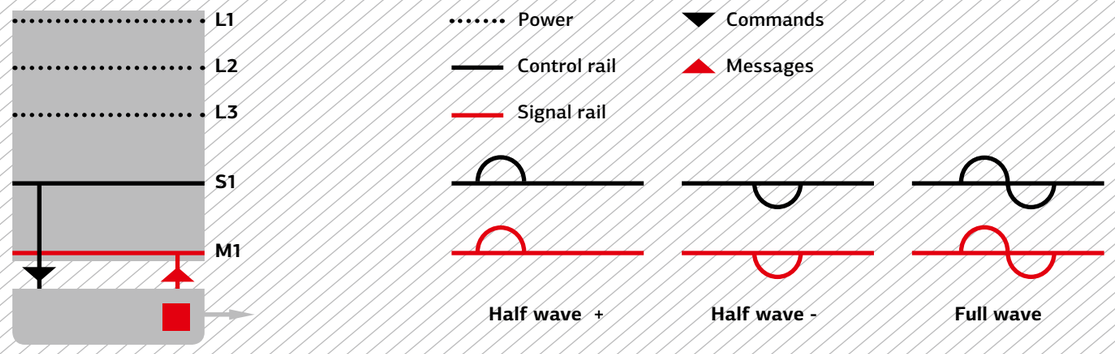
The trolley executes the actions (control commands) specified by the PLC and drives at the parameterized speeds V1, V2 (depending on the applicable control command) or releases the brake if needed. In addition, by activating a magnetic switch (evaluated by the controller), the speed is switched to another parameterized speed V3 in the controller, though the PLC specifies a different speed. If the switch is reset, the trolley once again drives at the PLC-specified speed. For anticollision protection there is a configurable proximity switch activating a ramped stop.

Control command	**Action**
Half wave +	Drive at V1
Half wave -	Release breake
Full wave	Drive at V2

MESSAGES

Half wave +	Presence message
Half wave -	Fault message

Messages like »Trolley Fault« or »Trolley in Segment« are sent over the signal rail to the PLC to be evaluated.



PCM-COMMAND SYSTEM (PULS-CODE-MODULATION)
The PCM command system represents an enhancement of the half-wave control. It allows a large number of commands to be transmitted over one control rail. A command code is transmitted over the one control rail and is synchronized with one phase of the power rail.

In the PCM command system, there are various LJU PCM modules that connect to the supervisory control system providing up to 191 different half wave patterns as commands to the drive controller. Some control commands are already predefined in the controller software (see following table), however some can be adjusted and modified to provide flexibility for the end-user.

Messages are transmitted by the trolley over the control rail as half-waves and full-waves and can be modified specifically for customers on request (e.g. completion messages for various movement sequences).

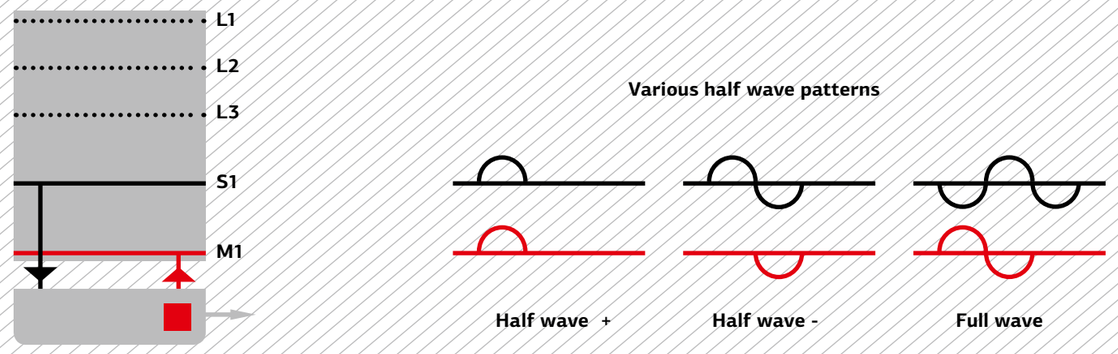
PCM-SYSTEM-COMMANDS

Commands	**Action**
0–1	Stop
2–10	Drive horizontally (forward, backward, at various speeds)
11–14	Drive up an incline (forward, backward, at various speeds)
15–19	Drive down an decline (forward. backward, at various speeds)
20–191	Synchronous movement and other user defined functions

MESSAGE OVER THE SIGNAL RAIL

Half wave +	Presence message (standard)
Half wave –	Fault message (standard)
Full wave	Message 3 (option)
Fault message output M	Relay contact 230V (L3) max. 0,5A

The system has proven to be reliable in hundreds of systems since its introduction in 1992. Our technical staff will gladly advise and support you in the technical configuration.



BUS SYSTEMS

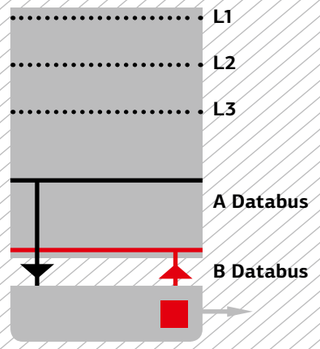
If a bus system is used, the data is transmitted to the trolleys in the system over the rail bus, for example over slide-contact rails or contact-free over inductive data bus (option). Commands, messages and trolley data are transmitted cyclically and acyclically over two bus lines A and B or over the inductive data bus between the trolleys and the system controller.

To use one of these bus systems it is required to use an LJU Bus master system as an interface between the system controller (PLC) and the trolley controllers Optionally the PLC can be connected via the Profibus DP-V1, Profinet, Modbus+, Devicenet, Modbus IP or other systems available in the market.

In this example, the trolley receives a routing table from the PLC. All other tasks are independently handled by the trolley controller in conjunction with the bus master. The trolley drives through the system at the speeds specified by the system table (system map in the bus master) and parameterized in the controller.
The controller uses the positions read by the PLA 14 (optical scanner for LJU position reading system) to detect the position of the trolley in the system and sends it continuously to the bus master. The bus master evaluates the position of all trolleys and indicates the free travel to each trolley. Now if the trolley approaches another trolley, it automatically reduces its speed and drives to a parameterized distance.
Positioning points can also be configured using the system table. If the trolley reaches these defined points, the trolleys precisely position to these points.
Moreover in specified areas of the system the hoisting motors should automatically move up to certain hoisting heights. If the trolley reaches one of these areas, the hoisting motor moves up to the defined height as specified in the hoisting tables stored in the trolley and the bus master.

Control commands via	**Action**
Acyclic telegram	Routing table

Messages over	**Action**
LJU Bus	Error (pending trolley error)
LJU Bus	Trolley status messages (e.g. position, in motion etc.)



Cyclic/acyclic data telegramms
Messages, Commands, Data

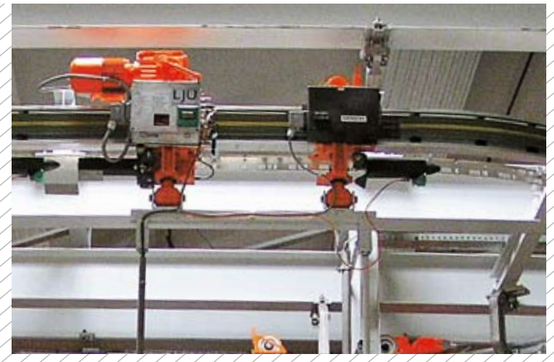
The flexible configuration of tables allows the user to design ergonomically optimized workstations, thus the hoisting height can be set based on the workstation and person. This hoisting height setting can always be by operating interfaces, programs or product-related requirements.

EXAMPLE OF APPLICATION OF BUS SYSTEM

- Drive at multiple speeds
- Automatic distance control
- Automatic positioning
- Automatic driving up to a hoisting height
- Routing through internal routing table

ADVANTAGES OF BUS SYSTEMS

- Positioning within millimeters with the implementation of the absolute-coded rails and PLA-14
- Automatic distance control without additional sensors
- Quick data transfer
- Greater flexibility in functionality with increased number of commands
- Detailed data transfer from the trolley to the system controller (e.g. for display purposes)
- Configuration of trolleys via the system controller
- Automatic update (e.g. of hoisting tables) in the trolley controllers
- Automatic routing function (option)



LJU Bus-Master

Software

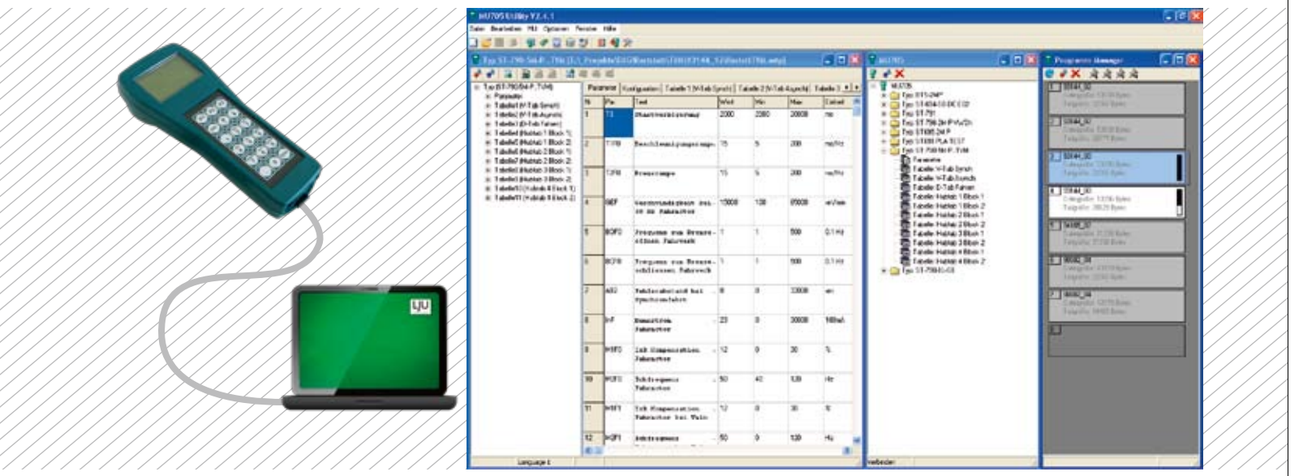
LJU software has matured with many years of experience in the conveyor technology sector. The special features of the industrial conveyor technology, specific to processes and systems, have been integrated into the LJU software distinguishing it from all others.

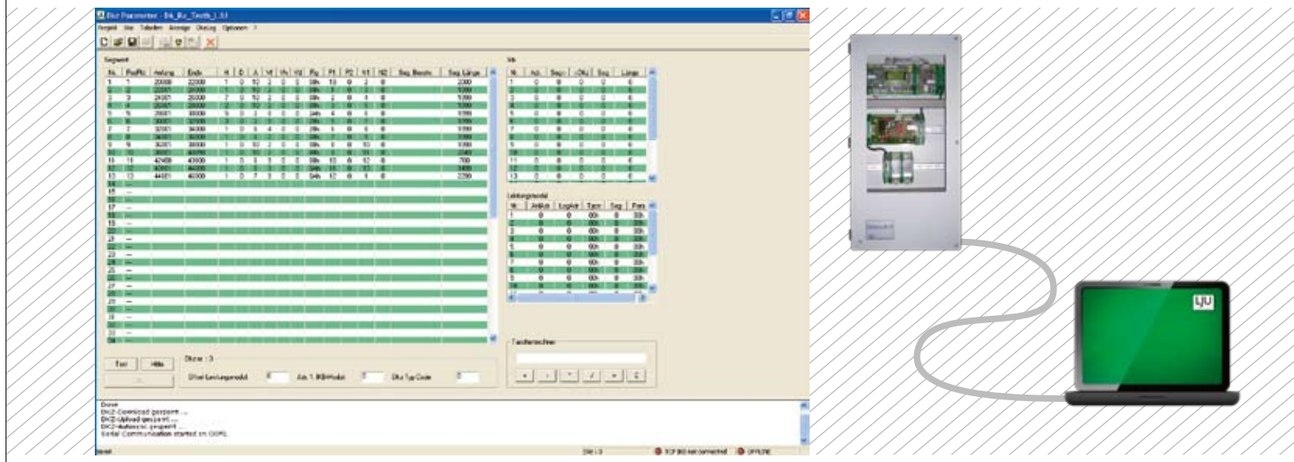
To a certain extent, these features influence all the components in the controller. LJU's goal is to provide users with products and software which takes advantage of the many years of experience, resulting in a product offering with the widest range of required system functions.
The system software incorporates the integration of these basic functions into the firmware, so that the user can set all parameters within system limits; however the responsibility for the dedicated functionality according to the user specification lies with LJU.

This software concept has successfully proven itself in »typical« systems and in critical and safety-oriented systems, which require greater diligence and care in the development of the specification.
In all controllers of the Series 7 it is also possible to perform softwareupdates (e.g. changes of user software) via infrared to the controller. This can also be executed by the end user.

TYPES OF SOFTWARE MODULES

- Processor firmware for components within the controller (no user access)
- Firmware for communication modules like the PCM central module, infrared or field bus modules (user access via approved protocol, standard signals or function)
- User software which controls the processes within the controller (as defined by customer set parameters or by the specification, both of which can be modified if required via the infrared interface)
- Configuration software for the user
  - MU utility (configuration software for the hand-held programming device)
  - Parameterization software for the configuration of the data concentrator for bus systems





MU-UTILITY

The MU-705 Utility software was developed for easy and clear management and storage of all the information existing in the hand-held programming device MU-705, the easy editing of parameters, tables etc.
and the installation of programs on the MU-705 for different controllers.
Thus the user can easily process and archive large data records by means of the MU-705.
The software can make a distinction between standard users and users with enhanced rights (Expert mode).

Standard Users

- Project upload
- Change of individual values
- Creation of backup copies
- Download of projects, applications and files

EXPERT MODE

- In addition to standard: Change and/or create projects
- Menu Manager

The MU-705 is connected to a USB-port of a computer with the supplied USB-cable.
The graphic user interface allows the creation and administration of multi-language menus and data records for the hand-held programming device MU-705.

The processing and data management of system tables is considerably simplified. All data can be exchanged with a connected PC as desired.
In the Program Manager, the corresponding user software is loaded from a PC to the programming device and it can then be transferred via infrared to the required controller.

DKZ PARAMETERIZATION SOFTWARE

This tool is used for the creation of system tables and online diagnostics of DKZ areas in systems with rail bus or inductive bus systems.
The connection can be set up directly via serial interface or via LAN.

In the system table, the conveyor route is divided clearly into segments, which are subsequently assigned with unique properties.

With the consecutive indexing of all segment properties, the commissioning and operation of the system is very flexible.

Poll lists, trolley simulation windows and data logging options shorten the commissioning time considerably.

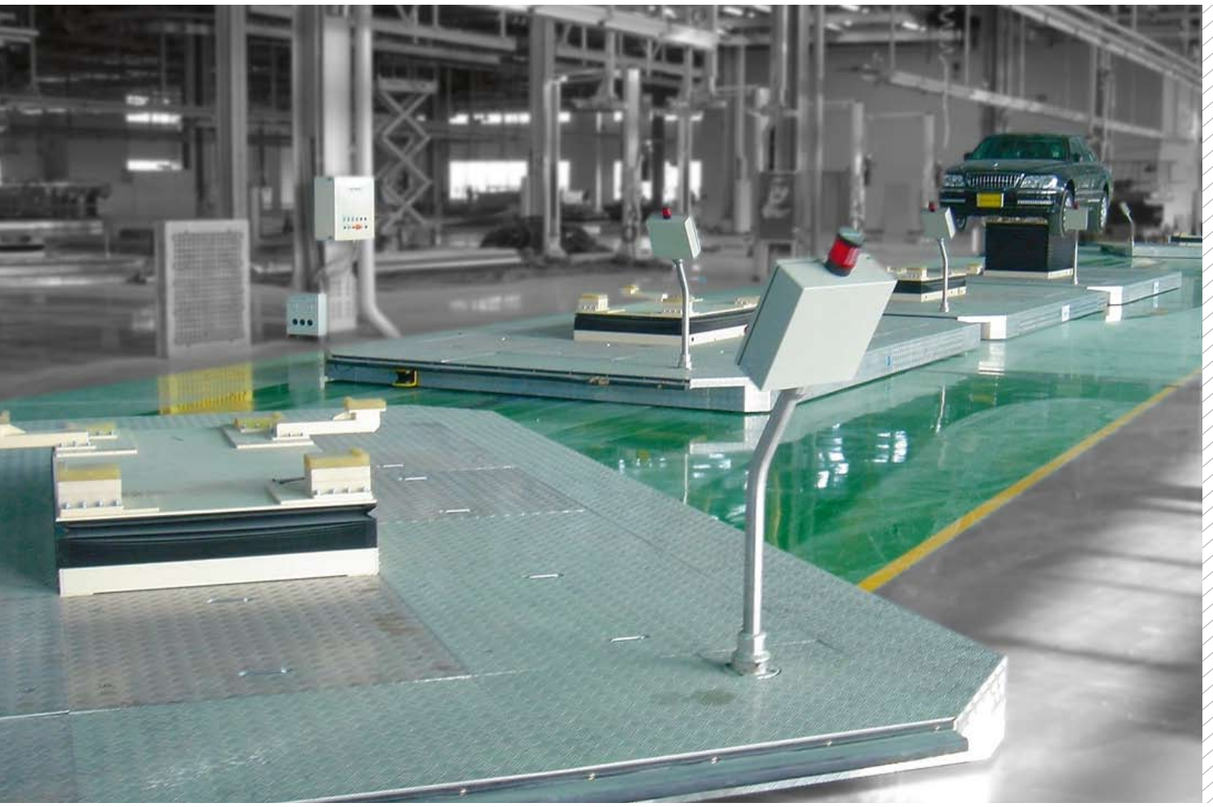
Inductive Technology

The inductive transfer system of LJU represents an innovative development for the contactless transfer of energy and data for mobile trolleys like electrical monorail systems, floor transportation systems, skillet systems etc.

In contrast to the conventional method of energy transfer to mobile trolleys (over conductor rails, contact lines and wiring systems that are prone to short circuits), LJU's contactless transfer of energy and data offers the following benefits:

- Energy transfer without risk to persons
- Maintenance-free and therefore low downtime and repair costs
- No noise development and no carbon wear, since energy is transferred without contacts
- High distance capability because of the air gap design between the current collector coil and current loop
- Capable to use in rough ambient conditions
- Capable to use in sensitive areas (e.g. food industry, clean rooms etc.)
- High efficiency due to optimal selection of LJU components and use of the latest power electronics

The combination of LJU systems for contactless energy and data transfer in addition to the routing of trolleys allows for a broad range of applications.



FUNCTIONAL PRINCIPLE

The system generates electrical energy according to the principle of induction, similar to the primary/secondary coils of a transformer. The transformer comprises a primary and secondary coil on a common, closed ferromagnetic core. This causes a high degree of coupling, however does not allow any relative motion of the two coils between each other.

The LJU inductive system, on the other hand, »stretches« the primary coil to a long conductor loop and places the secondary coil on an open ferromagnetic core (»Pick-up«), which almost envelops the primary coil. In this way, a relative motion of the two coils between each other is possible and the transfer behavior is optimized by using a high transfer frequency.

COMPONENTS

- Power supply modules
- Power pickups
- Data pickups
- Data pickups with integrated position reading
- Cable holder with and without position code
- HF-wire
- Compensation modules
- Separating modules
- Connection boxes
- Controllers
- Inductive bus master

Service

LJU Automatisierungstechnik GmbH is established as a component manufacturer and supplier of intelligent controller components. These are available to plant engineering and integration companies for use in their mechanical and electromechanical conveyance systems.

The components described in this brochure are generally customized for the intended application area and include not only the required hardware, but extensive knowledge gained from over 20 years of experience with industrial conveying technology.
Special technical features have been incorporated into the design of the supplied components. Such are: predominantly mobile operation and power supply using slide contacts or induction systems and thus generally having no fixed grounding connection for the electronics.

SPECIFICATION PLANS
The sales organization of LJU has available specification plans for all controller types, which must be completed in preparation of a project solely by the plant engineering and construction staff or together with technical sales people, in order to record all necessary properties of the devices in advance.

PROJECTION ASSISTANCE FOR BUS SYSTEM
In order to ensure optimal interaction of all components, LJU offers configuration assistance:
- DKZ zone layout
- Absolute-coded rail layout
- System bus layout
- Segment division (is only possible in cooperation with the customer)

This includes assistance in the calculation of throughput numbers and trolley accumulation analyses for highly diversified warehouse conveying systems.

TRAINING
Adjustable to the customer's requirements, there are two different packages, the scope of which depends on the local or project specifications.

- In-house trainings at LJU, with focus on the project team members responsible for the PLC program engineering and construction to understand the controller function and bus system hierarchy
- On-site trainings, primarily for the end-user maintenance staff

The fault display and reporting concept of the supplied controllers incorporate both internal as well as external status messages of the surrounding mechanical structure to the display or to a connected HMI system. Generally messages displayed by the controller are not always faults of the controller but rather an indicator of where to look for a fault. It performs a reporting function in many cases. Based on the role that LJU components play in many conveying systems, LJU is required to provide a multi-level service program. Therefore LJU Automatisierungstechnik GmbH offers services ranging from supporting the concept development of a controller/a system to the on-site commissioning to the fault detection in systems to the repair of devices.

COMMISSIONING SUPPORT AND FAULT ANALYSIS IN STARTUP OR EXISTING SYSTEMS
Before delivery, LJU controllers are passed through a multi-phased, certified quality assurance system. However, the controllers are designed not only to self diagnose internal faults but also to diagnose external faults, both of which can be displayed on the controller display. There are numerous reasons for these faults.

- Misunderstanding or modification of provided specifications versus actual specifications
- Unforeseen transit, component or manufacturing issues
- System parameters incorrectly downloaded
- Poor connections (primarily during new commissioning
- Incorrect parameter settings
- Fault conditions as reported by external sensors
- Fault conditions as reported by the supervisory PLC
- Safety circuits activation

For new installations and more specifically in new facilities, LJU strongly recommends commissioning support by an LJU-trained technician, answering questions and addressing potential issues without delay.
To address problems in or answer questions of the modification or enhancement of older systems, service staff o engineers from the sales or development department are available on request.

REPAIR SERVICE
A fully staffed and well equipped repair department is available for the repair and maintenance of all LJU products. In the event that a component manufacturer no longer supplies required components LJU will mostly be able to offer a compatible solution.
To ensure worldwide service, LJU Automatisierungstechnik GmbH cooperates with global representatives; their contact data can be viewed on the homepage of LJU (www.ljuonline.de). Detailed documentation and fundamental software packages or RMA forms for repair requirements are available for download.

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