



CPS®
CONTACTLESS
POWER SYSTEM

VAHLE 
ELECTRIFICATION SYSTEMS



TABLE OF CONTENTS

CONTENTS	Page
Function principles and characteristics	
Overview of the functioning and advantages of inductive contactless power systems	2-3
Latest developments	
CPS® contactless power systems for electric monorail systems (EMS)	4
Primary Inverter	
Illustration and functional description of the primary inverter	5
Pickup units	
Overview of the pickup units for various fields of application (elec. monorail, floor conveyor)	6
Voltage regulation	
Overview of the available voltage regulators which, in conjunction with the pickup units, provide a ready-made supply voltage	7
Ancillary components	
Further components for extending a CPS® installation with inductive track guidance and data transmission	8
CPS® references	
Description of reference installations for floor conveying systems and electric monorail systems	9-10
Questionnaire	11

CPS® technology offers the following advantages over conventional methods of transmitting energy to mobile consumers (e.g. power rails, contact lines, festoon systems):

- exceptionally low maintenance due to the absence of wear parts
- contactless current conduction ensures clean and noise-free operation
- unlimited travel speed
- can also be deployed in complex track routing (e. g. track switching, lifting stations etc.), and under adverse conditions (such as dust, water, ice)
- high degree of track tolerance guaranteed by the clearance design between the pickup coil and the primary winding (up to 25 mm)
- CPS® technology allows the integration of battery charging functions, inductive track guidance and data communication
- optimum component selection coupled with the deployment of the most modern power electronics achieves an efficiency level of around 80%
- CPS® technology is EMF and EMC tested (see below)

EMF and EMC tested

EMF and EMC stand for “ElectroMagnetic Field” and “ElectroMagnetic Compatibility” respectively.

CPS® components are subjected to rigorous scrutiny. Testing of the contactless power system for the emission of, and resistance to electrical interference has been carried out by independent laboratories and professional associations, additionally to testing for human safety with regard to magnetic and electromagnetic fields.

The system complies with all test parameter requirements. The permitted effective magnetic flow density threshold values are not exceeded.



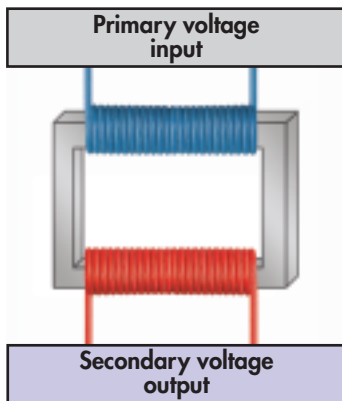


Transformer principle

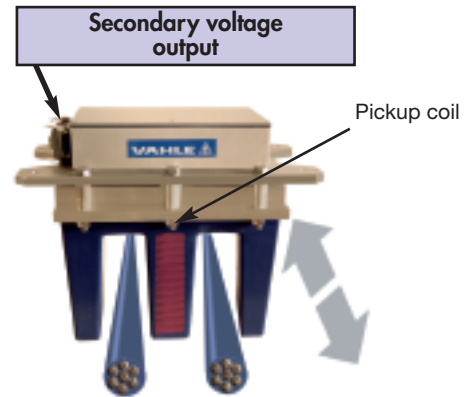
CPS® technology provides electrical energy without any mechanical contact. It works on the induction principle similar to a transformer's primary/secondary transfer. In a transformer, the primary and secondary windings are on a common, closed ferromagnetic core. This creates a high degree of coupling, but allows both windings no movement in relation to each other.

Open core

CPS® technology "stretches" the primary winding into a long loop and places the secondary winding onto an open ferromagnetic core which encloses the primary winding, thus allowing movement of the two windings relative to each other. By using a higher transfer frequency, the transmission characteristic is optimised.



Conventional transformer



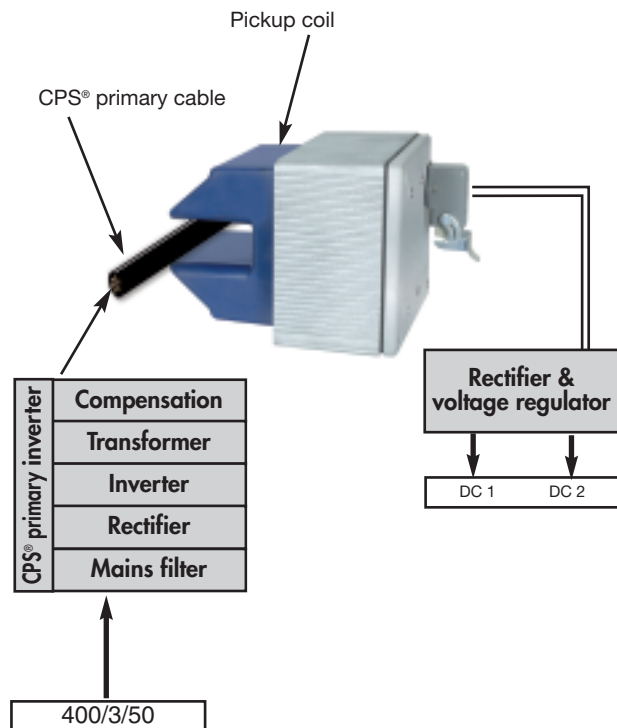
CPS® "transformer"

High frequency

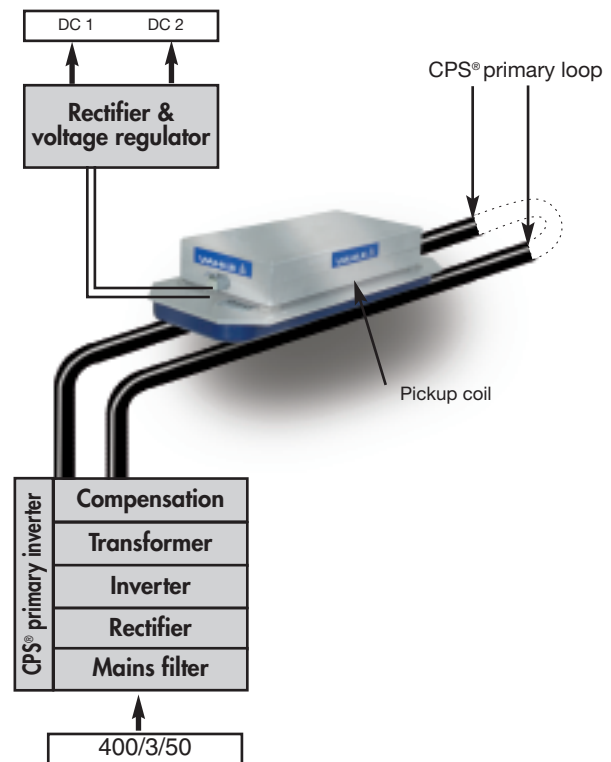
The CPS® primary inverter changes the normally available three-phase mains alternating voltage into a high frequency single-phase of 20 kHz. After matching the power factor, the voltage is then fed to the primary loop.

Variable output voltage

The alternating voltage thus generated is induced into the pickup coil, rectified and converted to normal voltages required by the corresponding consumer loads.



System structure for electric monorail systems "EMS"



System structure for floor conveyors "AGV"

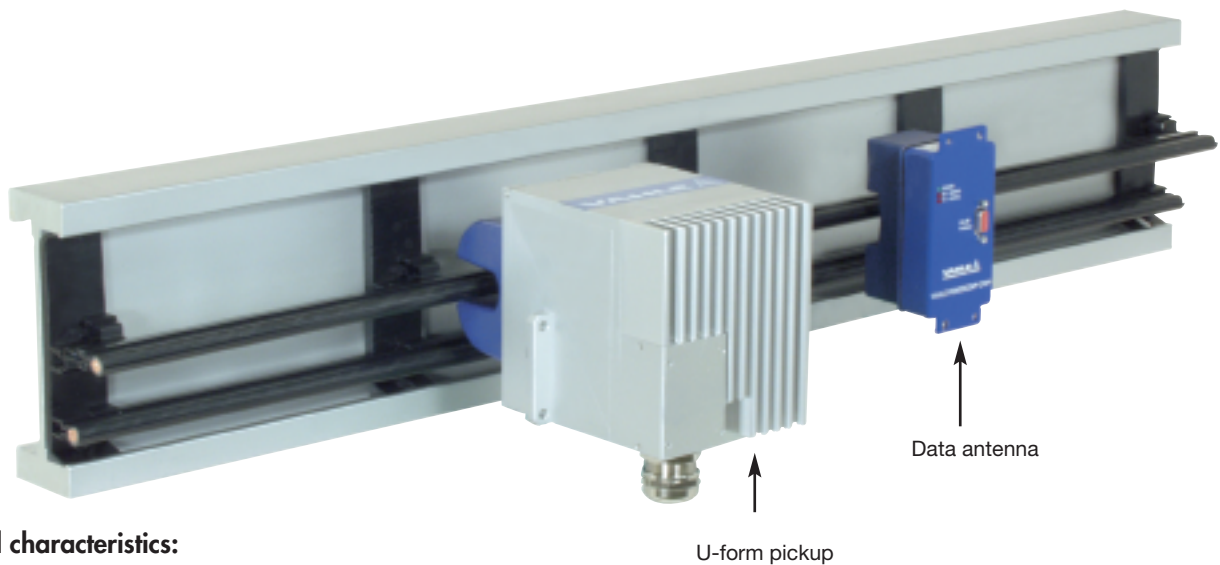


CPS® contactless power system for electric monorail systems "EMS"

CPS® technology has meanwhile also been successfully deployed in electric monorail applications. By completely eliminating contact dependant components, e.g. sliding contacts, maintenance work and the consequent running costs to the user can be significantly reduced.

The modular design of the mobile components of the CPS® equipment enables, as with the AGV sector, a wide span of power ranges to be covered easily using the U-form pickup units. Even the compact 0.7 kW pickup unit type PS 15 has a built in voltage regulator which provides a user-friendly supply voltage of 560 V DC in addition to an auxiliary voltage of 24 V DC for the control supply.

Along with inductive energy transmission, integrated data transmission is of course also available where required, as well as a position encoding system (see page 8 for description)

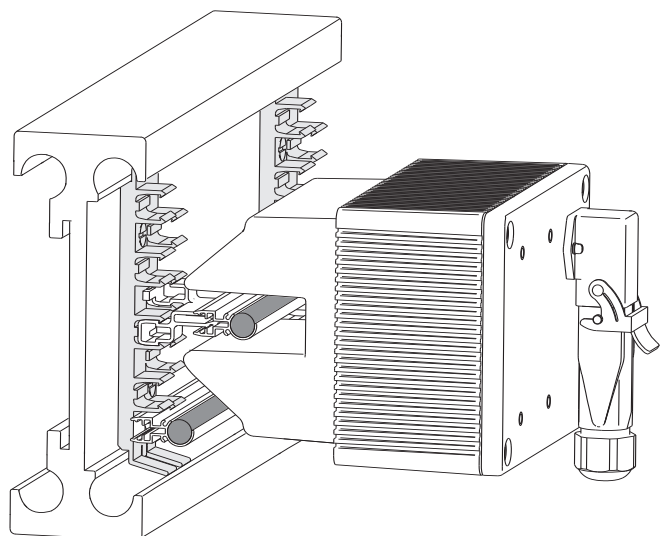


Special characteristics:

- Compliance with the VDI-C1 guidelines
- Simple and precise conductor installation in monorail profiles with clip-on holders
- Inductive supply (i.e. no cable chains) to track switches and lifters within the track routing is also available.
- Strict compliance with EMF threshold values by utilizing two-conductor technology and low primary current
- Smallest possible horizontal curve radius: 750 mm
- Smallest possible vertical curve radius: 1,500 mm

Advantages over conventional technology:

- 100% maintenance-free, therefore maximum plant utilization
- No carbon abrasion, therefore no work piece contamination
- Unlimited travel speed
- No noise development
- Integrated data transmission





The primary inverter supplies the installation with the power capacity necessary in each case. It converts the 50 Hz mains alternating voltage into a 20 kHz single-phase alternating voltage and feeds this into the primary cable. This method guarantees an optimum, low-loss transmission.

All primary inverters (housing protection IP 20) supply a constant output current to the primary cable. A built in ventilation fan ensures peak performance at ambient temperatures of up to 35°C. Higher temperatures are accommodated by built-in air conditioning.

Two versions are available:

CPS® PI - 10 output capacity Pn 10 kVA

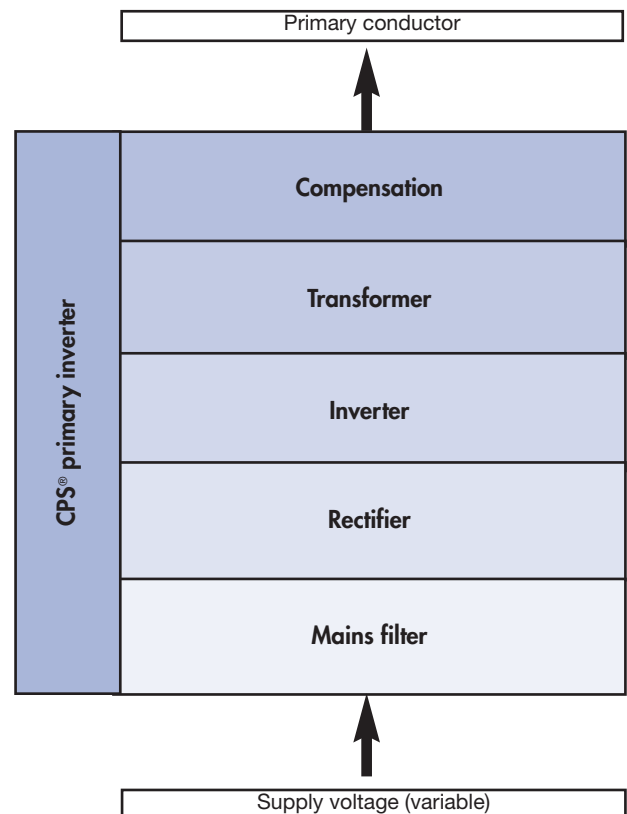
CPS® PI - 45 output capacity Pn 45 kVA

A decision is made during the project planning phase as to which primary inverter is best suited to a particular installation. Each customer-specific designed control cabinet contains all the CPS® stationary components in addition to the primary inverter (e.g. mains filter, isolating transformer, compensation modules and where applicable, switchgear for the control of individual track segments).

Control cabinet dimensions (standard):

2000 x 1000 x 500 (h x w x d), plus 200 mm base.

System design, control cabinet:





The pickup unit is responsible for the inductive pick-up of energy from the primary cable. Various types of pickups are available for this purpose, dependant on application.

Flat design

Type pickup CPS® PS 08 with integrated voltage regulator
PU 07 with separate voltage regulator (page 7)
PU 09 with separate voltage regulator (page 7)



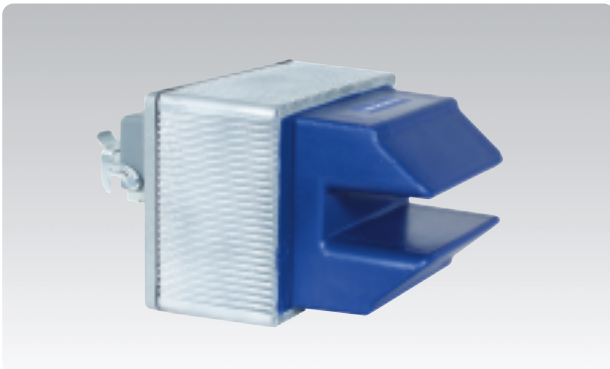
This pickup unit with it's flat design is conceived for use in automated guided vehicle systems (AGV), and for skid conveyor applications.

With their robust housing design and resistance to short circuits and overloads, the reliability of CPS® components guarantee the highest level of plant utilization.

Available output capacities:
0.5 kW / 24 V DC
0.5 kW with battery charging management
1.5 kW
3.0 kW
(higher capacities are available by using parallel switching)

U-form design

Type pickup CPS® PS 15 with integrated voltage regulator



The U-form design of this pickup unit with its integrated voltage regulator is conceived for applications in the electric monorail sector.

The twin conductor system developed by VAHLE specifically for this application, has proven it's capability especially with regard to it's excellent EMF and EMC behavior.

Available output capacity:
750 W/560 V DC + 24 V DC auxiliary voltage

E-form design

Type pickup CPS® PU 22 with separate voltage regulator (page 7)



The E-form design of this pickup unit is conceived for use in material handling applications with an increased capacity requirement.

With their robust housing design and resistance to short circuits and overloads, the reliability of CPS® components guarantee the highest level of plant utilization.

Available output capacity:
24 kW

(higher capacities are available by using parallel switching)



Voltage regulator for U-form and flat pickups



In conjunction with the flat and U-form pickup units, the CPS® RE-07.1-xxx voltage regulator provides an appropriate supply voltage for mobile users with small to medium power consumption. This voltage regulator is designed for connecting to a single pickup. For applications in the AGV sector.

Available output capacities and voltages:
3.0 kW / 560 V DC and 0.2 kW / 24 V DC
3.0 kW / 48 V DC and 0.2 kW / 24 V DC

Other output voltages supplied on request.

Voltage regulator for U-form and flat pickups



In conjunction with the flat and U-form pickup units, the CPS® RE-07.4 voltage regulator provides an appropriate supply voltage for mobile users with a medium to high power consumption. This voltage regulator is designed for connecting to several pickups. For applications in the AGV sector.

Available output capacities and voltages:
3.0 kW / 24 V DC
6.0 kW / 560 V DC and 0.2 kW / 24 V DC
9.0 kW / 560 V DC and 0.2 kW / 24 V DC

Other output voltages supplied on request.

Voltage regulator for E-form pickups



In conjunction with the E-form pickup units, the CPS® RE-22 provides an appropriate supply voltage for mobile users. This voltage regulator is designed for connecting to several pickups. It is suitable for applications in the AGV sector and also other material handling systems where a higher capacity is demanded. The output voltage is a constant 560 V DC standard, as is the auxiliary 24 V DC for supply for secondary consumer loads.

Available output capacities and voltages:
40 kW / 288 V DC and 0.8 kW - 1.6 kW / 24 V DC
40 kW / 560 V DC and 0.8 kW - 1.6 kW / 24 V DC

Other output voltages supplied on request.

⁽¹⁾ Detailed product information on request



ANCILLARY COMPONENTS⁽¹⁾

Track guidance sensor



The track guidance sensor CPS® SS-01 detects the magnetic field of the CPS® primary cable, thus enabling reliable inductive vehicle guidance.

The VAHLE track guidance sensor is perfectly matched to the physical characteristics of the CPS® primary conductor. An additional cable for inductive guidance is no longer necessary.

The advantages of this contactless track guidance system are obvious. The supply of electricity and the track guidance are “one system”; there is no mechanical wear, the floors are even and offer no obstacles to cross traffic. Apart from this, the system guarantees the highest level of plant utilisation and is suitable for track switching and crossing layouts.

Data transmission



Data transmission using the VAHLE Powercom CPS® enables faultless communication to all connected mobile participants.

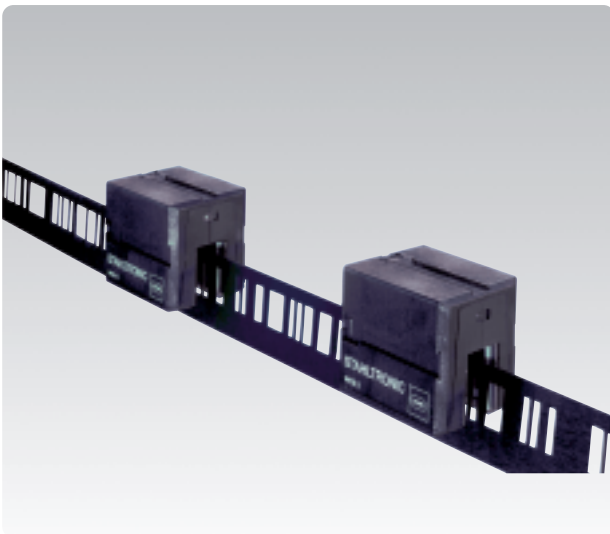
In addition to the 20 kHz used for energy transmission, a carrier frequency is coupled into the CPS® primary cable to provide fail-safe FSK modulated data signal transmission.

The CPS® primary cable is used for the transmission. In other words, an additional cable for data transmission is not necessary.

The VAHLE Powercom® CPS® rounds off the CPS® product range.

A reliable data interface is available for e.g. Profibus DP and other 2-wire bus systems with an 11 bit protocol and a data rate of up to 19.2 Kbit/s for AGV and elec. monorail systems.

If these VAHLE data transmission products are used, additional data transmission systems can be dispensed with completely. They are simply integrated into the CPS® energy supply system. No design changes to the CPS® track installation are necessary.



Absolute measurement processing

Contactless

Immune to power failure

No reference points

Accuracy = 0.8 mm

Speed up to 12 m/s

Variable track length up to 325 m

Suitable for curved tracks

Maintenance friendly



Characteristics:

- high level of plant utilization through maintenance-free energy supply
- shock hazard protection
- unlimited accessibility of the AGV track system
- variable, vehicles are deployed to match the production process
- no noise development
- no influence on functional safety from floor contamination

CPS® with inductive data transmission, VAHLE Powercom® CPS®:

In the assembly line of BMW AG's Munich works, in February 2000, a 285 m long assembly track was commissioned. It ranged over two floors on which, in the 1st construction phase, 49 AGVs, which conveyed the car engines between the work places, travelled over a lifting station, a crossing, several track switches and four switchable track sections to provide a smooth flow of materials. In the second construction phase during 2003/2004, the track was extended by 81 m with additional 9 vehicles in order to integrate the gearbox mounting into the production process. Further to this, on the upper floor, another assembly line with 14 AGVs was commissioned on which, after further process steps, the engine together with the gearbox and axle are transferred to an electric monorail system (EMS).

Based on Profibus DP, the transmission of energy and data to all 72 vehicles, takes place completely contact-free through the CPS® system.

A unique feature of the floor conveying system is the emergency stop switch-off capability for individual track segments by means of an appropriate CPS® concept.



CPS® with contactless track guidance:

In October 2001, in the SML/Ford works in Genk, Belgium, an automated guided vehicle system was commissioned. Over a total track length of 148 m, 23 AGVs transport car engines to the individual work stations.

Here contactless energy supply is operating with the aid of VAHLE CPS® technology. The on board AGV battery is merely for servicing and allows the vehicle to be moved under electrical power away from the CPS® supplied track. CPS® technology is also used here for the track guidance. An inductive track guidance sensor built into the vehicle detects the magnetic field of the primary cable laid in the floor and provides an analog signal for the steering.



CPS® REFERENCES

CPS® for electric monorail systems (EMS)

CPS® for electric monorail systems (EMS)

In Madison, a suburb of Jackson, the state capital of Mississippi in the USA, Tower Automotive Inc. have a production unit which supplies to the automobile manufacturer Nissan. Among other things, the chassis for the so-called SUV's (Sport Utility Vehicles) are produced here, which are subsequently further processed by Nissan at the Canton works about 3 miles north of Madison.

The EMS carriers are equipped with regulated 0.6 kW VFD (variable frequencies drive) motors and an Allen Bradley PLC to control the carriers. The decoupling of the necessary power from the CPS® primary cable is done with the aid of two pickup units from the series CPS® PU 13 with a nominal capacity of 650 W each.

A particular challenge for the VAHLE CPS® technology was the level of the intermediate circuit voltage for the vehicle drive. In this case, the secondary electronics of the CPS® RE-07 module, because of the normal 480 V 3-phase power supply network in the USA, provides a constant output voltage of 680 V DC for the drive and an auxiliary voltage of 24 V DC for the control supply.

Characteristics:

- high level of plant utilization and correspondingly low upkeep costs due to considerable freedom from maintenance
- unlimited travel speed and acceleration of the mobile users
- no noise development and no carbon abrasion due to the completely contact-free transmission of energy
- high track tolerance due to the specific design of the clearance between pickup coil and primary cable
- unlimited deployment even under adverse environmental conditions such as dust, ice, wind etc.
- high level of efficiency due to optimum component selection and utilization of the most modern performance electronics
- simple installation of the CPS® components using clip-on conductor holders in the powerail compact hangers
- in combination with the Stahltronic position encoding system WCS, VAHLE offers a complete contactless system solution for energy, data transmission and position encoding for the electric monorail sector

Technical data

Number of tracks:	2	Supply voltage carriers:	680 V DC & 24 V DC (250 W)
Track length:	176 m each	Installed CPS® capacity:	45 kW primary inverter per track
Carriers per track:	17	CPS® track equipment:	Round conductor 25 mm ² in monorail profile
Carriers nominal capacity:	650 W each	Pickup design:	2 x 650 W U-form pickups per carrier
Maximum capacity per carrier:	1.5 kW each		





Company: _____ Date: _____

Tel: _____ Fax: _____

E-Mail: _____ Internet: (URL) _____

1. Type of application: AGV EMS Skid conveyor Other (please state)

2. Number of tracks: _____

3. Track length: _____ m, Number of track switches: _____ pcs.
Number of lifts: _____ pcs. No. of switchable track segments: _____

4. Travel speed: _____ m/s Acceleration: _____ m/s²

5. No. of vehicles / units per track: _____

6. Max. power requirement per vehicle (P_{nom}/P_{peak}): _____

7. Simultaneity factor for vehicles: _____

8. Required voltage supply on the vehicle: _____

9. Drives with frequency inverter: yes no

10. Indoor Outdoor

11. Ambient conditions: _____

12. Dust / moisture / influence from chemicals etc.: _____

13. Ambient temperature: _____ °C

14. Inductive data transmission required? yes no

15. Inductive track guidance required? yes no

16. Position encoding system required? yes no

17. Remarks: _____

Date: _____



	Catalog no.
Copperhead Conductor Systems	1 a
Battery Charging Systems	1 b
Insulated Conductor Systems U 10	2 a
Insulated Conductor Systems U 20 - U 30 - U 40	2 b
Insulated Conductor Systems U 15 - U 25 - U 35	2 c
Aluminum Enclosed Conductor Systems LSV - LSVG	3 a
Powerail Enclosed Conductor Systems KBSL - KSL - KSLT - KSG	4 a
Powerail Enclosed Conductor Systems VKS - VKL	4 b
Powerail Enclosed Conductor Systems MKLD - MKLF - MKLS	4 c
Powerail Enclosed Conductor Systems VKS 10	4 d
Heavy Enclosed Conductor Systems	5
Trolley Wire and Accessories	6
Cable Tenders	7
Cable Carriers for □-tracks	8 a
Cable Carriers for Platform Cables on I-beams	8 bF
Cable Carriers for Round Cables on I-beams	8 bR
Cable Carriers for ◇-tracks	8 c
Conductor Cables and Fittings	8 L
Spring Operated Cable Reels	9 a
VAHLE POWERCOM®-Data Transmission Systems	9 c
CPS® - Contactless Power Supply	9 d
SMG - Slotted Microwave Guide	9 e
WCS - Position Encoding System	9 f
Motor Powered Cable Reels	10

