

# DRIVE SYSTEMS

PRODUCTS

DC MOTORS

BLPM MOTORS

AC MOTORS

CONTROLLERS



# Iskra

Iskra Avtoelektrika d.d.

## VISION

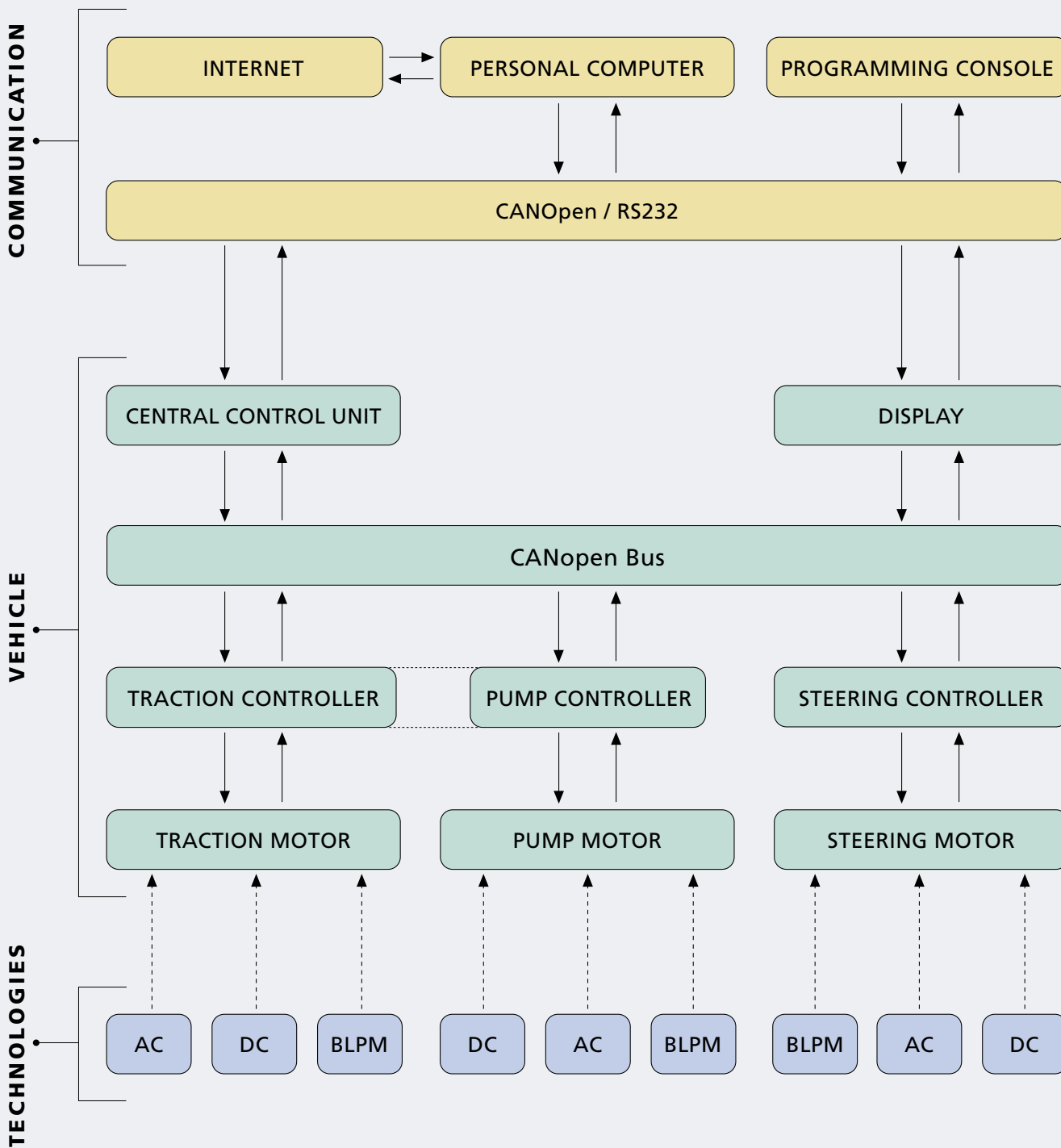
Based on innovations Iskra Avtoelektrika creates sustainable development and aims to be one of the world-leading suppliers of battery powered electric rotary machines in selected market segments.

## INNOVATION IN ROTATION

ISO/TS16949:2002 - ISO9001:2000 - ISO14001:1996  
REGISTERED



MOTORS AND CONTROLLERS FOR ELECTRICAL VEHICLES



Based on the given specification of your vehicle and various requirements you might have, Iskra's engineers will study and explore different possible solutions and prepare the best proposal for you.

No matter what kind of drive system is chosen the best combination of motor, control and other elements will be used to build the most efficient and cost effective system for your vehicle. Research and development work is supported by computerised simulation of complete systems and Iskra's laboratories are equipped with highly professional testing devices.

### TRACTION APPLICATIONS

Motors and controllers are designed for traction applications including hybrid vehicles and adapted for long-lasting operations at declared load (usually  $S1$  or  $S2 = 60$  min). Products are designed to provide long life operation. Various mounting flanges are available to mount on different types of gearboxes. Motors are available in DC commutator (permanent magnet, series, split field or separately excited winding), AC induction and BLPM version, voltage range from 12 V up to 80 V and power up to 18 kW. Microprocessor based controllers for series wound, commutator motors induction AC and BLPM motors are available, to form an effective and tuned drive system.

### HYDRAULIC APPLICATIONS

Motors and controllers for hydraulic applications are designed for intermittent periodic operation at declared load (usually  $S3 = 5$  up to 15% of duty cycle) mainly in one direction of rotation. Products are designed to be resistant against short time overloading and overheating. Motors are adapted to standard assembly dimensions of hydraulic pumps and can be oil proof on the drive end side. Motors and controllers are available in DC commutator, AC induction and BLPM version, voltage range from 12 V up to 80 V and power up to 28 kW. Easy programming of user defined parameters via laptop or a dedicated programming unit.

### STEERING APPLICATIONS

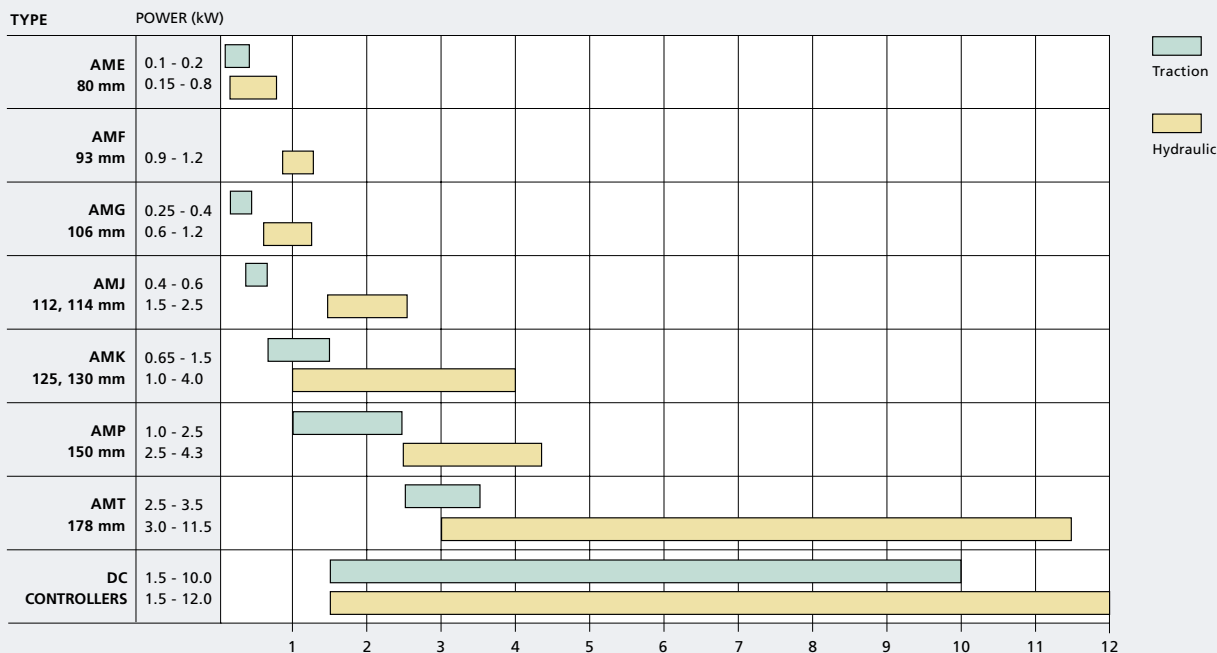
Brushless and commutator motors are produced for automotive industry, electrical forklifts and marine applications. Available as EHPS and EPS solution with built-in controller are designed to meet the international safety regulations. The main features are excellent dynamics, simple mounting, easy adaption to special requirements, high efficiency, low noise, EMC compatibility and optionally low maintenance. Available voltage range from 12 V up to 80 V and power up to 2 kW.

### OTHER APPLICATIONS

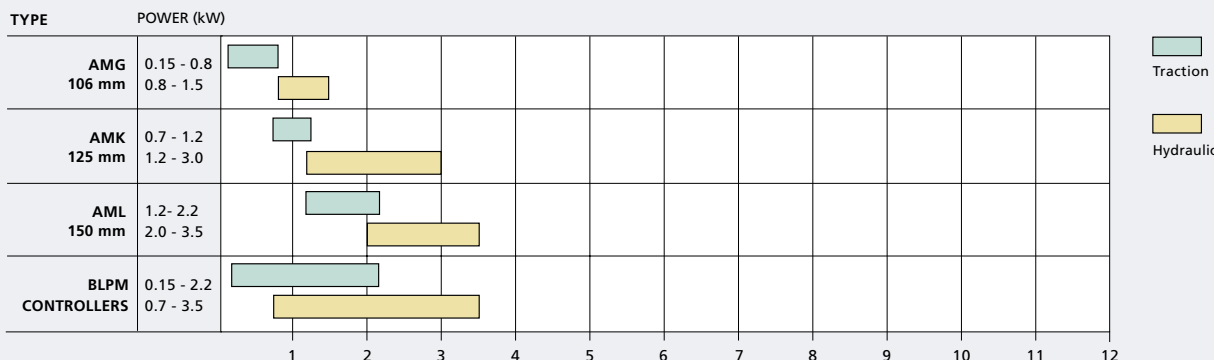
Iskra Avtoelektrika is producing also systems for other applications such as electric winches, air conditioning systems, industrial cleaning machines, platforms, etc. All of these designs are specially trimmed according to customer requirements such as type and duration of operation, protection against splashing water or very special mounting requirements. Many of the user defined controller parameters can be easily programmed via a laptop or a dedicated programming unit.



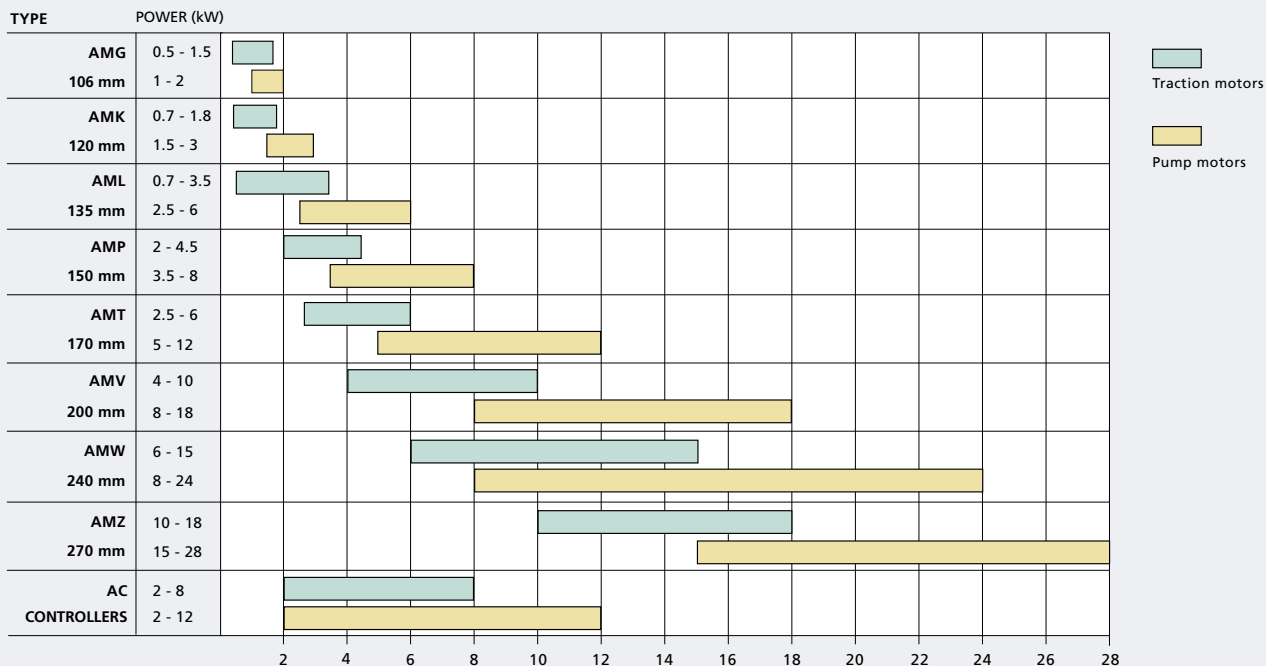
### DC MOTORS AND CONTROLLERS



### BLPM MOTORS AND CONTROLLERS



### AC MOTORS AND CONTROLLERS





### MAIN TECHNICAL DATA

Type	AME			AMG		
Nominal voltage (V)	12	24	48	12	24	36
Nominal power (kW)	0.1-0.8	0.35-0.8	0.5-0.8	0.25-1.1	0.4-1.2	0.5
Yoke diameter (mm)	80			106		
Length (mm)	137			136 - 174		
Weight (kg)	2.6			4 - 5.7		
Stator	6 permanent magnets			4 permanent magnets		
Degree of protection	IP 54, IP 65			IP 22, IP 54		
Ambient temperature (°C)	-20 to +70					
Thermal protector	Optional					

#### Applications

- Pump drive
- Winches
- Traction
- Marine applications

#### Features

- High specific output power
- Long brush life
- High ambient resistance

#### Design

- Excitation by high quality ferrite 4 or 6 pole permanent magnets
- Compact design
- Motors with mounted switch available
- Custom design drive end brackets
- One or two terminal versions
- UL design available on request
- EMC filter for AME motors available
- High quality thermal resistant materials
- Free of asbestos, lead, cadmium, beryllium and ammonia



### MAIN TECHNICAL DATA

Type	AMF		AMJ				
Nominal voltage (V)	12	24	12	24	36	48	72
Nominal power (kW)	0.9	1.2	0.7-2.1	0.4-2.5	1.7	2.0	2.0
Yoke diameter (mm)	93		112-114				
Length (mm)	125		150 - 250				
Weight (kg)	3.5		5.3 - 9				
Stator	4-pole windings						
Degree of protection	IP 54, IP 65		IP 23, IP 44, IP 54				
Ambient temperature (°C)	-20 to +70						
Thermal protector	No		Optional				
Internal fan	No		Optional				

### Applications

- Pump drive
- Traction
- Winches
- Marine applications

### Features

- High specific output power
- Long brush life
- High ambient resistance

### Design

- Four pole motor with field coils excitation
- Series, compound and split field versions
- AMF only series wound
- AMJ heavy duty versions available
- UL design available on request
- EMC compatible
- Compact design
- High quality thermal resistant materials
- Free of asbestos, lead, cadmium, beryllium and ammonia



**MAIN TECHNICAL DATA**

Type	AMK				AMP				AMT				
Nominal voltage (V)	12	24	48	72	24	36	48	80	24	36	40	48	80
Nominal power (kW)	1.8-2.4	0.65- 4.0	3.0	1.0	1.0-4.1	4.1	1.0-4.3	3.0	4.3-5.5	6.9	3.8	2.5-11.5	7.6
Yoke diameter (mm)	125-130				150				178				
Length (mm)	175 - 283				250 - 350				260 - 430				
Weight (kg)	10.5 - 16.5				20 - 25				22 - 34				
Stator	4-pole windings												
Degree of protection	IP 12, IP 20, IP 43, IP 44, IP 54				IP 12, IP 21, IP 23, IP 24				IP 12, IP 21, IP 22, IP 24				
Ambient temperature (°C)	-20 to +70												
Thermal protector	Optional												
Brushware indicator	No				Optional				Optional				

**Applications**

- Pump drive
- Traction
- Winches
- Marine applications

**Features**

- High specific output power
- Ventilated or enclosed versions
- High ambient resistance

**Design**

- Four pole motor with field coil excitation
- Series, compound or SEM versions
- EMC compatible
- UL design available on request
- Available in EE version
- High quality thermal resistant materials
- Free of asbestos, lead, cadmium, beryllium and ammonia



**MAIN TECHNICAL DATA**

Type	AMG					AMK				AML	
Nominal voltage (V)	12	24	36	48	80	12	24	48	80	24	80
Nominal power (kW)	0.15-1.0	0.15-1.5	0.3-1.5	0.42-0.8	0.8	0.7-2.0	0.7-3.0	1.5	1.2	1.2-2.2	2.0-3.5
Yoke diameter (mm)	106					125				150	
Length (mm)	134 - 235					265				260	
Weight (kg)	3.5 - 8					10				20	
Stator	Three phase										
Degree of protection	IP 54										
Ambient temperature (°C)	-20 to +60										
Thermal protection	Optional										

**Applications**

- EHPS - electro hydraulic power steering
- Utility pump drive
- Traction systems
- Fan drive
- EPS - electric power steering (steer by wire)
- EPAS electric power assisted steering
- Compressor drive for air conditioning

**Features**

- Low noise operations
- High efficiency > 85 %
- Long lifetime > 10,000 hours
- Integrated temperature protection
- Simple installation

**Design**

- Compact design with integrated electronics or separated controller
- Programmable functions: soft start, speed loop option, analog input for speed control, current limit
- CAN open communication
- EMC compatible
- UL design available on request
- Over-voltage and under-voltage protection
- Permanent magnets on rotor
- Three phase windings on stator
- Available with planetary gear box



### MAIN TECHNICAL DATA

Type	AMG	AMK	AML	AMP	AMT
Nominal voltage (V)	24 - 48	24 - 48	24 - 48	24 - 80	24 - 80
Nominal power (kW)	0.5 - 2.0	0.7 - 3.0	0.7 - 6.0	2.0 - 8.0	2.5 - 12.0
Yoke diameter (mm)	106	120	135	150	170
Length (mm)	150 - 200	200 - 260	180 - 325	260	250 - 360
Weight (kg)	5 - 9	12 - 18	15 - 25	20 - 28	25 - 45
Stator	Three phase 4-pole				
Degree of protection	IP 20 - IP 54 (higher on request)				
Ambient temperature (°C)	-20 to + 60				
Thermal protector	Thermo sensor KTY 84 - 130				

### Applications

- Traction motor
- Pump drive
- Steering motor

### Features

- High specific power
- Low performance sensitivity to motor temperature (no permanent magnets)
- Small size
- Low noise operation
- Long life maintenance free operation
- Excellent dynamic behavior
- Precise control
- EMC compatible

### Design

- Three phase four pole induction motor
- Aluminium squirrel cage rotor
- Sensorbearing and other separate encoder options available
- UL design available on request
- Available in EE version
- High quality thermal resistant materials
- Free of asbestos, lead, cadmium, beryllium and ammonia



### MAIN TECHNICAL DATA

Type	AMV	AMW	AMZ
Nominal voltage (V)	24 - 80	48 - 80	48 - 80
Nominal power (kW)	4 - 18	6 - 24	10 - 28
Yoke diameter (mm)	200	240	270
Length (mm)	180 - 320	250 - 330	280 - 400
Weight (kg)	33 - 65	55 - 90	80 - 120
Stator	Three phase 4-pole		
Degree of protection	IP 20 - IP 54 (higher on request)		
Ambient temperature (°C)	-20 to +60		
Thermal protector	Thermo sensor KTY 84 - 130		

### Applications

- Traction motor
- Pump drive

### Features

- High specific power
- Low performance sensitivity to motor temperature (no permanent magnets)
- Small size
- Low noise operation
- Long life maintenance free operation
- Excellent dynamic behavior
- Precise control
- EMC compatible

### Design

- Three phase four pole induction motor
- Aluminium squirrel cage rotor
- Sensorbearing and other separate encoder options available
- UL design available on request
- Available in EE version
- High quality thermal resistant materials
- Free of asbestos, lead, cadmium, beryllium and ammonia



**MAIN TECHNICAL DATA**

Type	AEK, AEH, AES
Nominal voltage (V)	24 to 80
Maximal current (A)	130 to 800 (2 min rating)
Continuous current rating (A)	80 to 240 (one hour rating)
Operating frequency (Hz)	200 to 15,000
Ambient temperature (°C)	-20 to +60

**Applications**

- Traction
- Pump drive

**Features**

- Mosfet or thyristor power section
- Microcontroller failsafe logic
- Regenerative braking
- Thermal protection
- Overvoltage and undervoltage protection
- IP 54 enclosure
- Twin motor drive
- Number of parameters adjustable via digital programming console
- Built-in diagnostics
- Built-in hour meter
- LED diagnostics
- Last 10 errors EEPROM memory
- Complies with European CE Standards

**For the pump drive**

- Revolutions compensation
- Up to 6 adjustable speeds optional
- Optional proportional valves driving



### MAIN TECHNICAL DATA

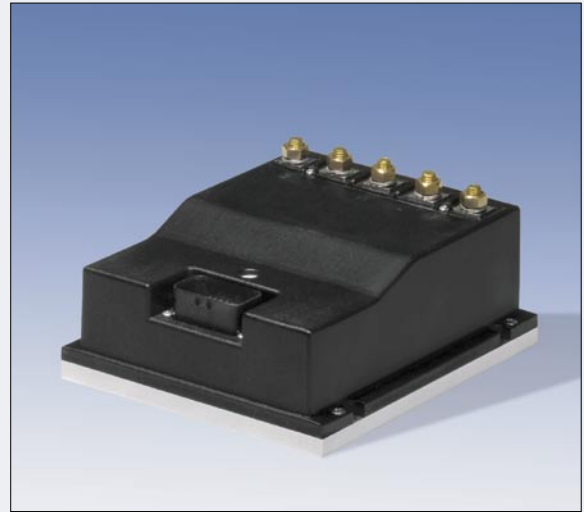
Type	AEK, AEH
Nominal voltage (V)	12 to 80
Maximal current (A)	50 to 300
Operating frequency (Hz)	15,000
Ambient temperature (°C)	-20 to +60

### Applications

- Traction
- Pump drive
- EPS / EPAS
- EHPS
- Fan drive
- Compressor drive
- Boat propulsion

### Features

- Mosfet power section
- Microcontroller failsafe logic
- Flash EEPROM memory
- High efficiency
- Thermal protection
- Overvoltage and undervoltage protection
- IP 54 enclosure
- All inputs and outputs short circuit protected
- Adjustable characteristics via programming console or PC
- CANopen Bus communication
- PC connection for programming and diagnostics
- Speed loop option
- Full 4-quadrant control
- Field weakening mode
- Complies with European CE Standards
- UL design available on request



MAIN TECHNICAL DATA	
Type	AEK, AEH, AES
Nominal voltage (V)	24 to 80
Maximal current ( $A_{rms}$ )	150 to 500
Operating frequency (Hz)	10,000
Ambient temperature (°C)	-30 to +45
Degree of protection	IP 54

**Applications**

- Traction
- Pump drive
- Fan drive
- Servo steering systems

**Features**

- Mosfet chip and wire power section
- State of the art DSP processor
- Flash EEPROM memory
- Space vector modulation
- Full 4-quadrant operation
- Field oriented control algorithm for the highest performance
- 12 digital inputs available
- 9 digital outputs available
- 2 analog inputs available
- 4 digital outputs PWM controlled
- All inputs and outputs are short circuit protected
- Reverse polarity protection
- Controller thermal protection
- Motor thermal protection
- Hardware and software overvoltage protection
- High low speed torque
- CANOpen Bus communication
- RS 232 communication
- PC connection for programming and diagnostics
- Internal hour meter and battery discharge indicator
- Complies with European CE Standards
- UL design available on request



### MAIN TECHNICAL DATA

Type	ARD			
	12	24	36	48
Rated voltage (V)	12	24	36	48
Nominal current (A)	80, 120, 150, 300	80, 120, 150, 300	60, 100	60
Maximal permanent current (A)	80, 120, 150, 300	80, 120, 150, 300	60, 100	60
Short time maximal current (A)	300, 350, 500	300, 350, 500	200, 350	200
Degree of protection	IP 54, IP 65, IP 66, IP 67			
Ambient temperature (°C)	-20 up to +60			

### Applications

- Industrial electric trucks
- Battery powered vehicle accessories
- Electric road vehicles
- Marine equipment
- Railway equipment

### Features

- Different switch holders
- Direct current loads
- Excellent conductivity



Key pad is an electronic product that - when it is connected to electrical vehicle system consisting of AC controller, EPAS steering system, vehicle master control unit and display - gives us the opportunity to replace the key switch and allows log in. Through the CANOpen network we receive different information regarding the system and driving modes.

#### MAIN TECHNICAL DATA

Type	AED
Nominal voltage (V)	24
Nominal current (when replaced key switch) (A)	15
Communication type	CANOpen 4.0.2
Ambient temperature (°C)	-30 to + 45

#### Applications

- Built in electrical vehicle drive system

#### Features

- Key switch replacement
- Login with appropriate password as:
  - Administrator
  - User
- Demanded length of the password: 4 characters
- Max number of the users: 200
- Last 2000 transactions will be retained in the data bank. (A transaction is a record between one login and logout).
- Automatic logout when the lift truck is stopped (after few minutes)
- Automatic STOP mode when the lift truck is in log off state (after few minutes)
- Secure lock "out time" after 5 (default value) tamper attempts;

- Information recorded and seen on display:
  - Driver (PIN)
  - Trip distance
  - Date and time (at login)
  - Traction time
  - Pump time
  - Log on time
  - Crash sensor (Optional)
  - Crash counter (Optional)



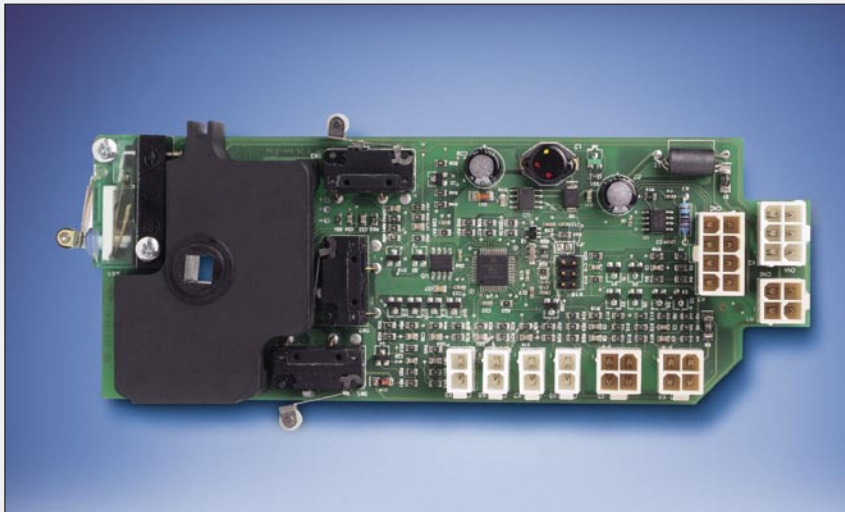
When display is connected to electric system consisting of AC controller, EPAS steering system, and vehicle master control unit, it enables us to see different information regarding the system.

#### MAIN TECHNICAL DATA

Type	AEB
Nominal voltage (V)	12, 24
Communication type	CANOpen 4.0.2
Ambient temperature (°C)	-20 to +60

#### Information seen on display

- Traction mode indication
- Battery discharge status
- Error code numbers
- Four different hour meters
- Which dig. inputs of AC controller are momentarily active (connected)
- Which dig. inputs of vehicle master control unit are momentarily active (connected)
- Software versions of all components connected in truck system
- EPAS torque, steering angle, battery current, battery voltage, AC motor voltage, phase currents, controller temperature, motor temperature...
- List of software parameters
- UL design available on request



Vehicle master control unit is a type of a master unit, that when it is built in an electric vehicle makes through hardware and CANOpen network request for appropriate vehicle operation.

#### MAIN TECHNICAL DATA

Type	AED
Nominal voltage (V)	24
Communication type	CANOpen 4.0.2
Ambient temperature (°C)	-20 to +60

#### Functions

- sending request to controller for speed and rotating direction of traction motor
- sending request to controller for speed of DC pump motor
- sending request to controller for PWM on proportional valve
- sending request to controller for belly switch function activation
- sending request to controller for horn activation
- sending request to controller for snail switch function activation
- sending information to controller of steer angle
- sending information to EPAS system of truck speed
- ALL messages to DDI display for different drawings are sent by MCU electronics
- Software parameters could be reprogrammed with appropriate use of switches on tiller head

Customer: .....

Address: .....

**APPLICATION**

- Driving pump
- Traction motor
- Winch
- Other .....

**AMBIENT CONDITIONS**

Temperature range:  
From ..... to ..... °C

**ELECTRICAL AND MECHANICAL REQUIREMENTS**

**NOMINAL RATINGS**

- 12V  24V  36V  48V  72V  80V
- Speed  $n_n =$  ..... RPM
- Current  $I_n =$  ..... A
- Torque  $T_n =$  ..... Nm
- Power  $P_n =$  ..... kW
- S2 = ..... min
- S3 = ..... % ED
- S1 = .....

**MAXIMAL LOAD**

- Current  $I_{max} =$  ..... A
- Torque  $T_{max} =$  ..... Nm
- S2 = ..... min
- S3 = ..... % ED

**MAXIMAL NO-LOAD SPEED**

$N_{max} =$  ..... RPM

**DIRECTION OF ROTATION**

View from drive end shaft

- ←
- 
- ↔

**EXCITATION**

- Series wound
- Parallel wound
- Compound wound
- Permanent magnets
- SEM - Sepex
- Split field
- AC
- BLPM

**OPERATING MODE**

1 cycle is..... s ON and ..... s OFF  
at  $I =$  ..... A and  $U =$  ..... V

**ENCODER**

Encoder type .....  
No. of pulses .....

**INSULATED GROUND**

- Yes  No

**INSULATION**

Insulation strength ..... V RMS per 1 min  
Insulation resistance > ..... MOhm

**SPECIAL ELECTRICAL REQUIREMENTS**

.....  
.....  
.....

**DESIGN REQUIREMENTS**

Max diameter ..... mm  
Max length ..... mm

**GRADE OF PROTECTION ACCORDING (DIN 40050)**

IP .....

**EXTERNAL APPEARANCE**

- Black varnished
- Zinc plated
- Other .....

**DIMENSIONAL REQUIREMENTS**

(specify / sketch) or enclose drawing  
.....  
.....

**ENVIRONMENTAL CONDITIONS**

- Salt spray
- High temperatures
- Humidity
- Dust
- Other .....

**SPECIAL REQUIREMENTS**

Safety standard: .....  
Specification standard: .....  
(please add copies)

Date: .....

Signature:.....

**Return this Form by Fax to 00 386 5 33 93 817**

Customer: .....

Address: .....

**APPLICATIONS**

- Traction                       Traction & Pump                       Pump                       Traction & Hydraulic valve

**TYPE OF SYSTEM**

- DC Series wound                       AC                       BLPM                       Other

**TECHNICAL REQUIREMENTS**

- |                              |     |                               |
|------------------------------|-----|-------------------------------|
| Voltage range .....          | V   | No. of analogue outputs ..... |
| Max current limit .....      | A   | No. of digital inputs .....   |
| Operating frequency .....    | kHz | No. of digital outputs .....  |
| Acceleration slope .....     | s   | Operating temperature .....   |
| Deceleration slope .....     | s   | Protection .....              |
| No. of analogue inputs ..... |     | IP                            |

**ACCELERATOR TYPE**

- Classic resist                       Hall                       Optical                       Other

**COMMUNICATION TYPE**

- RS 232                       RS 485                       CAN                       Other

**PROGRAMMING DEVICE TYPE**

- Programming console                       PC                       Other

**SYSTEM DIAGNOSTICS**

- PC                       Programming console                       Battery discharge indicator                       Error indicator                       Hour-meter

**FUNCTIONAL REQUIREMENTS**

- |   |   |
|---|---|
| Constant torque braking<br><input type="checkbox"/> YES <input type="checkbox"/> NO         | Speed limit input (s)<br><input type="checkbox"/> YES <input type="checkbox"/> NO       |
| Constant distance braking<br><input type="checkbox"/> YES <input type="checkbox"/> NO       | Additional inputs<br><input type="checkbox"/> YES <input type="checkbox"/> NO           |
| Brake on pedal release<br><input type="checkbox"/> YES <input type="checkbox"/> NO          | Electromagnetic brake drive<br><input type="checkbox"/> YES <input type="checkbox"/> NO |
| Brake on direction invert<br><input type="checkbox"/> YES <input type="checkbox"/> NO       | Main contactor drive<br><input type="checkbox"/> YES <input type="checkbox"/> NO        |
| Accelerator position follower<br><input type="checkbox"/> YES <input type="checkbox"/> NO   | Proportional valve drive<br><input type="checkbox"/> YES <input type="checkbox"/> NO    |
| Additional brake pedal input<br><input type="checkbox"/> YES <input type="checkbox"/> NO    | Real time clock<br><input type="checkbox"/> YES <input type="checkbox"/> NO             |
| Field weakening option<br><input type="checkbox"/> YES <input type="checkbox"/> NO          | Time to service counter<br><input type="checkbox"/> YES <input type="checkbox"/> NO     |
| Difference speed load / no-load<br><input type="checkbox"/> YES <input type="checkbox"/> NO | Errors history<br><input type="checkbox"/> YES <input type="checkbox"/> NO              |
| Speed loop<br><input type="checkbox"/> YES <input type="checkbox"/> NO                      | Software in-field update<br><input type="checkbox"/> YES <input type="checkbox"/> NO    |

Date: .....

Signature:.....

**Return this Form by Fax to 00 386 5 33 93 817**

**Customer:** .....

**Address:** .....

**TRUCK DATA**

Truck model .....	Drive wheel diameter ..... mm
Truck weight with battery ..... kg	Gear ratio .....
Truck rated load ..... kg	Rolling resistance - estimated .....%
Truck system voltage ..... V	Transmission efficiency .....%
Drive wheel material .....	Type of gear .....

**TRACTION MOTOR**

No. of motors on the truck .....	Max truck speed at no load ..... km/h
Type of motor on the truck	Truck speed with rated load ..... km/h
<input type="checkbox"/> DC <input type="checkbox"/> AC <input type="checkbox"/> Other	Truck gradeability - no load ..... %
	Truck gradeability - rated load ..... %

**TRACTION MOTOR CONTROLLER**

Controller model .....	Max phase current (AC Motors) ..... A
Max field current (DC motors) ..... A	
Min field current (DC motors) ..... A	
Max armature current (DC Motors) ..... A	

**PUMP MOTOR**

Type of pump motor	Oil flow at no load ..... 1/min
<input type="checkbox"/> DC <input type="checkbox"/> AC	Oil flow at rated load ..... 1/min
Pressure at no load ..... bar	Pump capacity ..... cm <sup>3</sup>
Pressure at rated load ..... bar	
Type of operation S3 ..... %	

**PUMP MOTOR CONTROLLER**

Controller model .....	Max phase current (AC Motors) ..... A
Max field current (DC motors) ..... A	
Min field current (DC motors) ..... A	
Max armature current (DC Motors) ..... A	

Date: .....

Signature:.....

**Return this Form by Fax to 00 386 5 33 93 817**

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