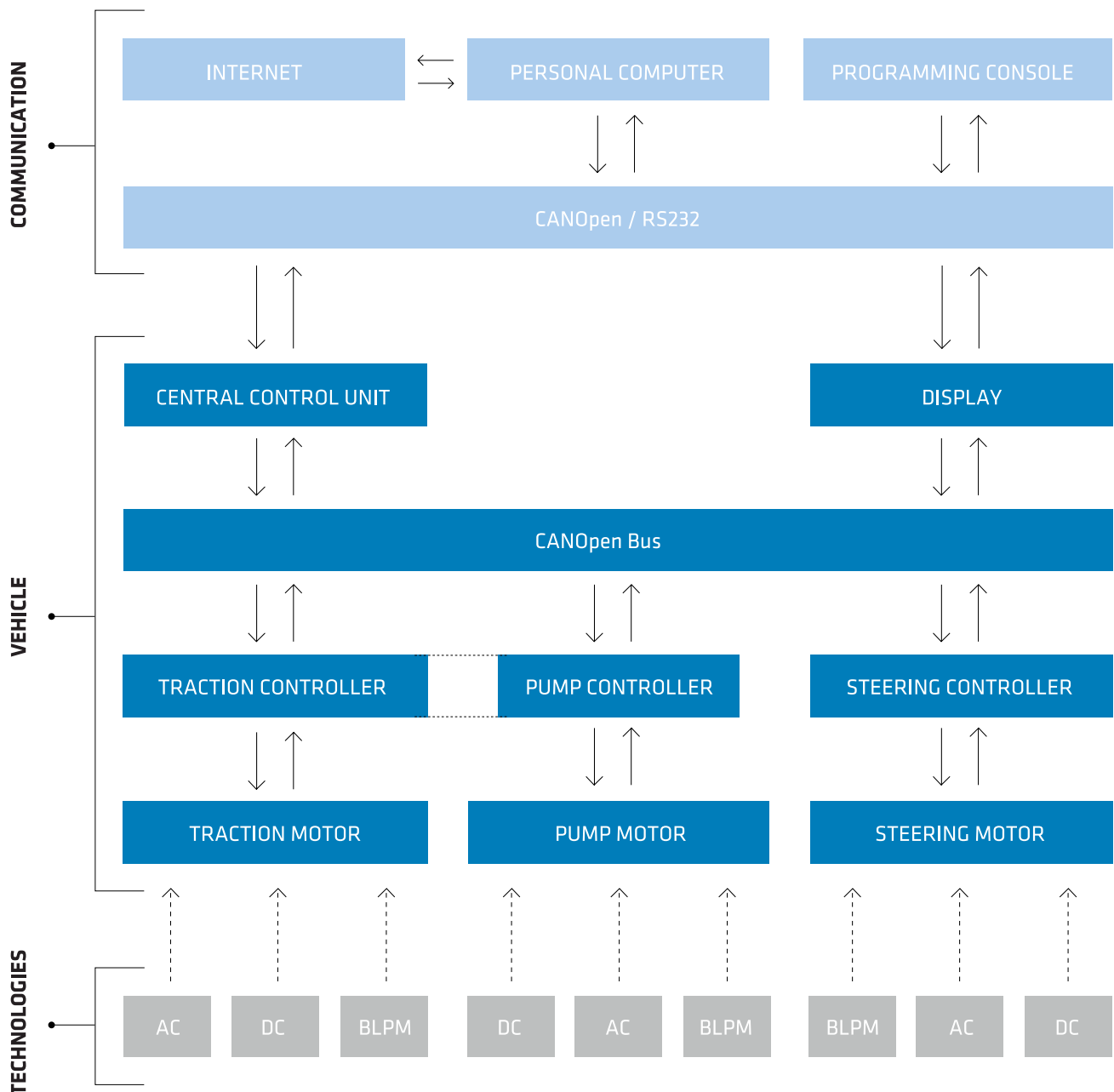




DRIVE SYSTEMS

PRODUCTS / DC MOTORS / BLPM MOTORS / AC MOTORS / CONTROLLERS

MOTORS AND CONTROLLERS FOR ELECTRICAL VECHILES



Based on the given specification of your vehicle and various requirements you might have, Letrika'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 Letrika's laboratories are equipped with highly professional testing devices.

TYPICAL APPLICATIONS

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

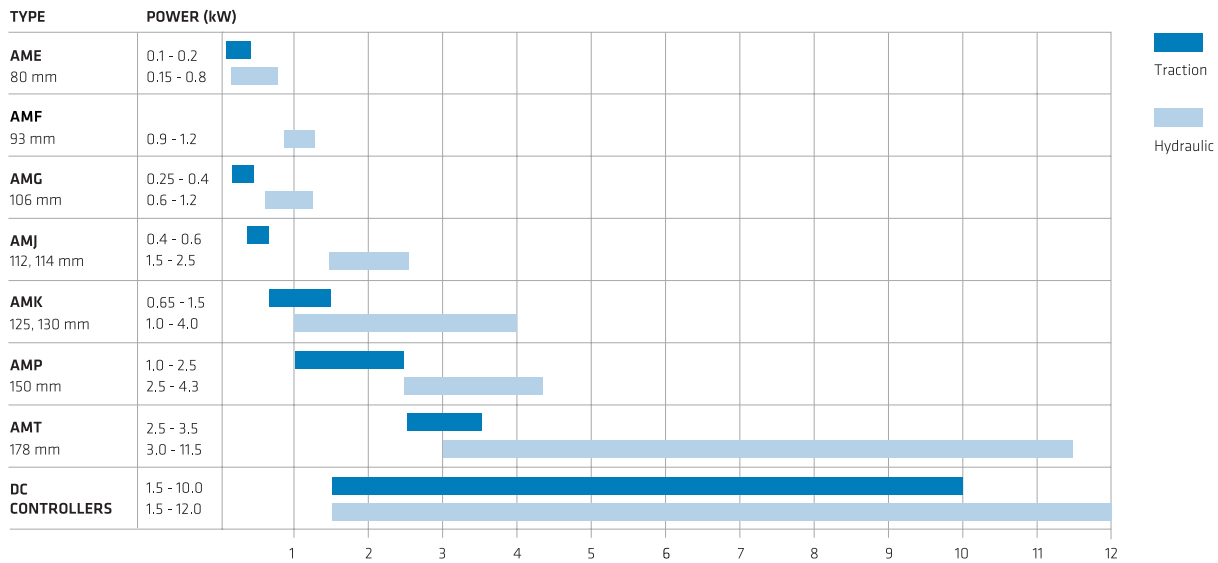
Brushless and commutator motors are produced for automotive industry, electrical forklifts and marine applications. Available as EHPS and EPS solution with built-in controller are designed to meet the international safety regulations. The main features are excellent dynamics, simple mounting, easy adaption 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

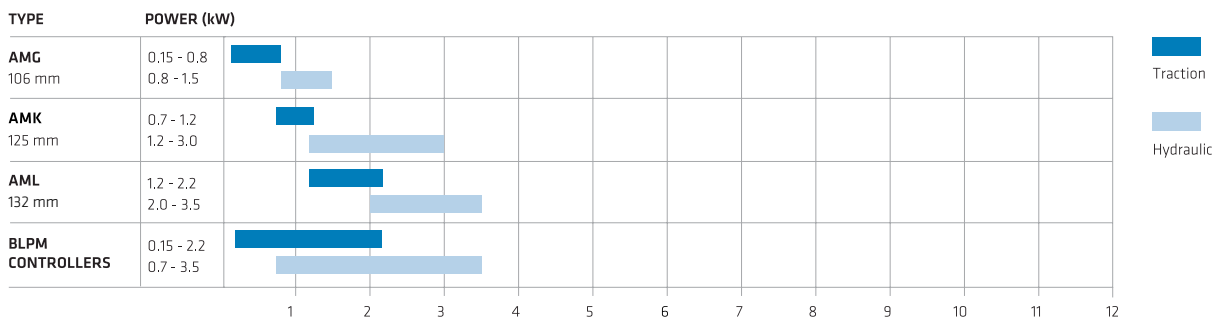
Letrika is producing also systems for other applications such as electric winches, air conditioning systems, industrial cleaning machines, platforms, etc. All of these designs are specially trimmed according to customer requirements such as type and duration of operation, protection against splashing 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.



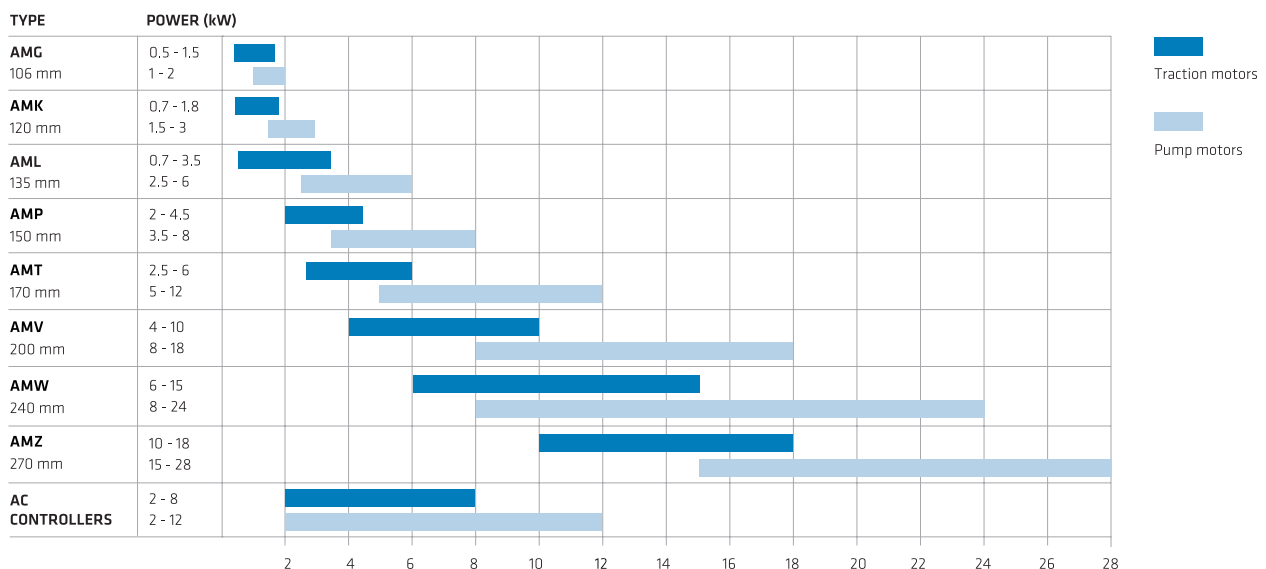
DC MOTORS AND CONTROLLERS



BLPM MOTORS AND CONTROLLERS



AC MOTORS AND CONTROLLERS



AME / AMG

DC permanent magnet motors

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 protection	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



AMF / AMJ

DC motors

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 protection	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



AMK / AMP / AMT

DC motors

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 protection	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



AMG / AMK / AML

BLPM motors with integrated electronics

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	0.5 - 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				132	
Length (mm)	134 - 235					265				350	
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 and others

Features

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

Design

- Compact design with integrated electronic or separated controller
- Programmable functions: soft start, speed loop option, analogue 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
- Available with electromagnetic brake



AMG / AMK / AML / AMP / AMT

AC induction motors

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 protection	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)
- Compact size
- Low noise operation
- Long life maintenance free operation
- Excellent dynamic response
- Precise control

Design

- Three phase four pole induction motor
- Aluminium squirrel cage rotor
- Different 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
- EMC compatible
- Available with planetary gearbox
- Available power cables directly from the motor



AMV / AMW / AMZ

AC induction motors

Main technical data

Type	AMV	AMW	AMZ
Nominal voltage (V)	24 - 80	48 - 96	48 - 96
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 protection	Thermo sensor KTY 84 - 130		

Applications

- Traction motor
- Pump drive

Features

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

Design

- Three phase four pole induction motor
- Aluminium squirrel cage rotor
- Different 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
- EMC compatible
- Available power cables directly from the motor



AEK / AEH / AES

Controllers for commutator motors

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



AEK / AEH

Controllers for BLPM motors

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 +55
Degree of protection	IP 65

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
- 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



AEK / AEH / AES

Controllers for AC induction motors

Main technical data

Type	AEK, AEH, AES
Nominal voltage (V)	24 to 80
Maximal current (A)	150 to 500
Operating frequency (Hz)	10,000
Ambient temperature (°C)	-30 to +55
Degree of protection	IP 65

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 analogue inputs available
- 4 digital outputs PWM controlled
- All inputs and outputs are short circuit protected
- Reverse polarity protection
- Available combi version
- 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



ARD

Solenoid switches

Main technical data

Type	ARD			
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 PADS

Key pad is an electronic product that - when it is connected to electrical vehicle system consisted of AC controller, EPAS/EPS 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)



DRIVER DIAGNOSTIC DISPLAY (DDI)

When display is connected to electric system consisted of AC controller, EPAS/EPS 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 UNITS (MCU)

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 +55

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 pictures are sent by MCU electronics
- Software parameters can be reprogrammed with appropriate use of switches on tiller head
- UL design available on request

