BAC500

PRODUCT DESCRIPTION

The ASI BAC™ 500 is a high power density electric bike controller that utilizes the latest in sinusoidal field oriented control to ensure smooth and quiet brushless DC motor operation and efficient vehicle operation.

The BAC 500 can operate over a nominal voltage range of 24 Volts dc to 48 Volts dc.

A robust MOSFET based three phase bridge switching at 20 kHz provides 95% efficient motor control, no audible noise and can switch motor currents up to 60 A peak. The optional field weakening feature facilitates higher speed motor operation. In addition to Hall sensor based motor commutation, sensorless commutation is also supported.

Programmable performance mapping allows throttle, torque, pedal and wheel speed sensor inputs to be adjusted via an optional vehicle display or ASI's BAC Door™ PC configuration software to meet specific performance requirements.

HDQ and 0 to 10 Volt analogue state of charge protocols are supported. Alternatively, a software based voltage model of the battery can be used to derive battery state of charge.

Communication to the drive is via a proprietary ASI object dictionary using the ModBus protocol. At the physical layer, either TTL level 232 or RS 485 protocols are supported. For applications requiring multiple devices, up to 240 devices can supported on the same network.

The enclosure is small (4100 square mm) to facilitate discrete mounting locations and has an ingress protection rating of 65 against dust and moisture.

Numerous programmable protection features including motor/controller temperature, battery over/under voltage, and motor/battery current limits increase controller and motor longevity.

KEY FEATURES

- Peak motor currents up to 60A
- 20 kHz PWM drive for low ripple current and silent drive
- Field oriented control for increased efficiency and smooth motor operation
- 4 analog/digital and 2 digital only inputs support multiple sensor configurations
- Configurable throttle, pedal torque, pedal speed and assist level select input functions
- Single pulse and quadrature pedal or wheel speed inputs
- HDQ, analog and voltage model based battery management system interfaces
- Networkable over ModBus
- Small size – 80.4 x 51 x 25.7 mm
- IP 51 rated enclosure
- Meets EN 15194 EMC and bike safety requirements
- Meets ISO 16750 – 3TA for vibration
- Fault protection including:
  - Bus over and under voltage
  - Motor over current
  - Motor and controller over temperature
  - POST on MOSFET bridge
  - Battery SOC foldback

APPLICATIONS

- Electric bikes
- Small electric scooters
- Small electric vehicles
- Small Recreational Vehicles

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PRODUCT SPECIFICATIONS

Input Power		
Feature	**Minimum**	**Maximum**
Input voltage	18 Volts	60 Volts
Input current	Motor, load and battery dependent (usually less than motor phase current)	
Standby power consumption	< 3 Watts	

Output Power		
Feature	**Continuous Amps (DC)**	**Peak Amps (DC)**
Output phase current	20 A[i]	60 A[ii]
Hall sensor 5V supply		75 mA
Throttle 5V supply		75 mA
Throttle 12V supply		75 mA

Controller Performance	
Description	**Range**
Speed regulation	+/- 5% at top speed
Speed range	Min (rpm) 10:1, 20:1 is typical
Minimum motor phase to phase inductance	100 uH
Drive and control efficiency	95 % at 25 °C
Motor control scheme	Sinusoidal field oriented (FOC)
Motors supported[iii]	Brushless AC and DC
Product warranty[iv]	1 year

Communications	
Feature	**Description**
Network	Proprietary ASI object dictionary over a variable baud rate ModBus network
Hardware Protocols	TTL Level 232, and RS-485
Baud rate	115200 bps maximum

Optional Features	
Feature	**Description**
Light sensor	Used to automate the 6V light feature
Light 6V supply	500 mA maximum output
IP 65 Rating	Waterproof enclosure and connectors

Input Specifications					
Type	**Quantity**	**Description**	**Voltage**	**VMin**	**VMax**
Hall inputs	3	Non isolated, diode protected to 50V max Used for motor commutation 20 kHz sampling rate Max frequency: 1000 Hz Min pulse width: 40 µsec	**Logic Low**	0 VDC	0.5 VDC
			Logic High	3.5 VDC	5 VDC
Digital inputs	2	Non isolated, diode protected to 50V max Used for pedal first sensor and cruise control related features 1 kHz sampling rate Max frequency: 500 Hz Min pulse width: 40 µsec	**Logic Low**	1.5 VDC	2.5 VDC
			Logic High	4.3 VDC	5 VDC
Analogue inputs	4	Non isolated, resistance protected to 30V max, Single ended 20 kHz sampling rate Min 10 bit resolution Used for throttle, BMS, and brakes		0 VDC	5 VDC

Environmental	
Name	**Range**
Ambient operating temperature	0 to + 55 °C
Storage temperature	-25 to + 70 °C
Humidity	10 to 90%, non-condensing
Ingress protection	IP 51
Salt spray	ATSM B117
Vibration	ISO 16750-3TA

System Protection Features	
Protection	**Description**
Over/Under Voltage	Voltage must be within a user programmed thresholds
Motor Over current	Instantaneous and averaged current must be less than user programmed thresholds
Bridge On/Off Test	MOSFET bridge must pass a series on turn on/off tests prior to providing power to motor
Motor Temperature	Motor temperature must be less than user programmed limit[v]
Bridge Temperature	MOSFET tab temperature must be less than the factory programmed limit
Battery SOC Foldback	Battery SOC must be greater than the user programmable threshold
Throttle/Brake Outside Range	Voltage must be within a user programmed thresholds
Internal Error	Processor has detected an error in flash memory or the main clock signal
Power On Self Test (POST)	Phase current sensors must calibrate correctly

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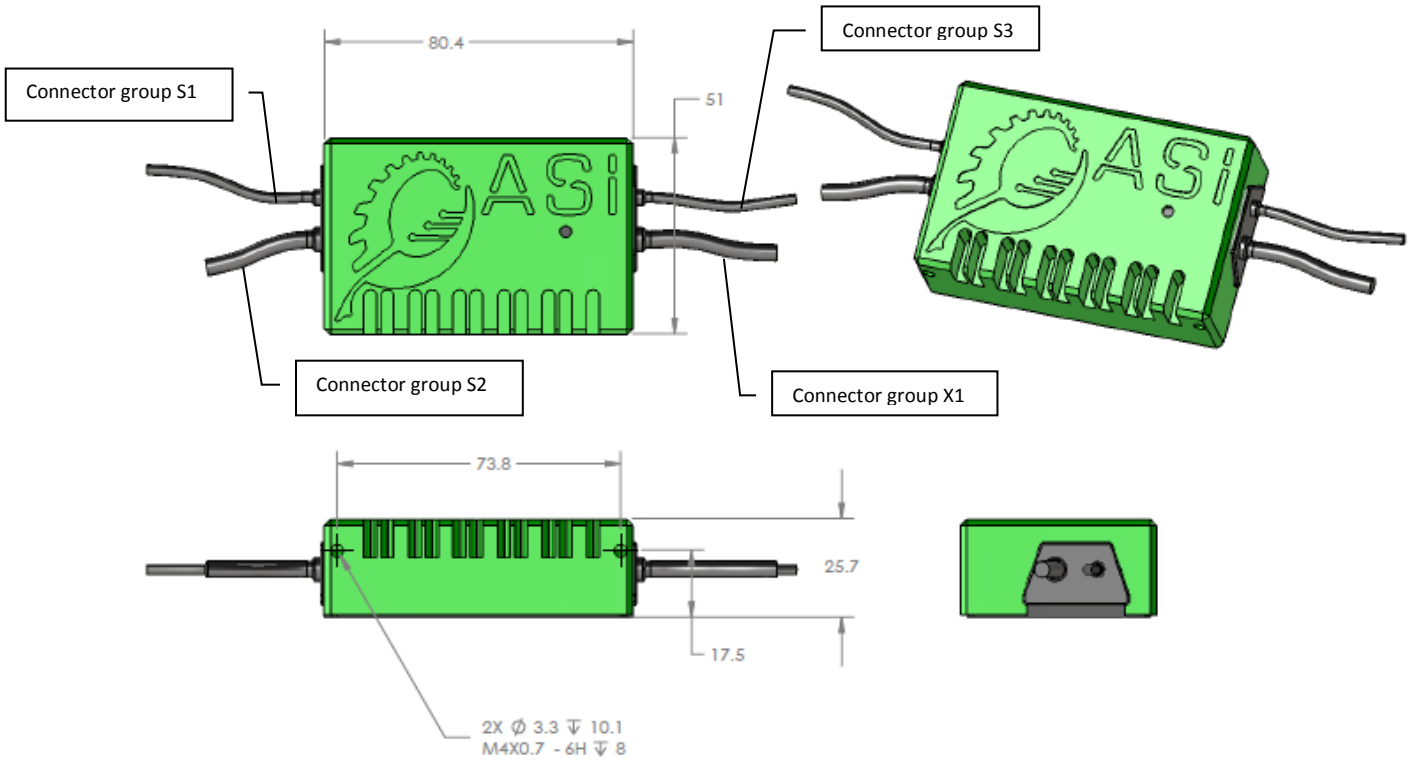
PHYSICAL DIMENSIONS



Connector Group S1		
Pin #	**Description**	**Wire Colour and Gauge**
S1.1	Hall sensor phase A	Blue – 24 AWG
S1.2	Hall sensor phase B	Green – 24 AWG
S1.3	Hall sensor phase C	Yellow – 24 AWG
S1.4	Hall 5V power	Red – 24 AWG
S1.5	Hall ground	Black – 24 AWG
S1.6	Motor phase A	Blue – 14 AWG
S1.7	Motor phase B	Green – 14 AWG
S1.8	Motor phase C	Yellow – 14 AWG

Connector Group S2		
Pin #	**Description**	**Wire Colour and Gauge**
S2.1	Throttle ground	Black – 24 AWG
S2.2	Pedal first sensor	Brown – 24 AWG
S2.3	Cruise control	Green – 24 AWG
S2.4	Throttle input	Grey – 24 AWG
S2.5	Throttle 5V supply	Red – 24 AWG
S2.6	Throttle 12V supply	Yellow – 24 AWG
S2.7	No connection	Orange – 24 AWG
S2.8	No connection	Blue – 24 AWG

Connector Group S3		
Pin #	**Description**	**Wire Colour and Gauge**
S3.1	Brake 5V supply	Orange – 24 AWG
S3.2	Brake 1	Blue – 24 AWG
S3.3	Brake 2	Grey– 24 AWG
S3.4	Brake ground	Black – 24 AWG
S3.5	Serial RX IN	Brown – 24 AWG
S3.6	Serial TX OUT	Green – 24 AWG
S3.7	Display power	Red – 24 AWG
S3.8	Key switch input	Yellow – 24 AWG

Connector Group X1		
Pin #	**Description**	**Wire Colour and Gauge**
X1.1	HDQ	Grey – 24 AWG
X1.2	Analogue SOC	Red – 24 AWG
X1.3	Battery positive	Red – 14 AWG
X1.4	Battery negative	Black – 14 AWG

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MATING CONNECTOR INFORMATION

Description	Manufacturer Part #	Mates To
8 pin, female	Molex 39-01-2080	S2
8 pin, male	Molex 39-01-2086	S1, S3
2 pin, male	Molex 39-01-3029	X1 pins 1, 2
Contact connector, female	Molex 39-00-0047	N/A
Contact connector, male	Molex 39-00-0049	N/A
Spade connector, female, insulated, 16-14 AWG	3M 94820	X1 pins 3, 4 S1 pins 6, 7, 8
Crimp tool	Molex 638191000A	N/A

ORDERING INFORMATION

Product	Description	Part #
BAC 500	48 Volt 500 Watt Brushless DC motor controller	10-000530

ACCESSORIES

Product	Description	Part #
RS 485 configuration dongle	USB to RS 485 serial convertor	40-000253
TTL RS 232 configuration dongle	USB to TTL RS 232 serial convertor	40-000254
Evaluation kit	Contains BAC 500, communication dongle, BacDoor software, and connector/cable kit	10-000541
BacDoor configuration utility	Configuration utility	

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[i] Moderate air over controller required.
[ii] Peak current output rated for maximum of 30 seconds.
[iii] Wye and delta winding configurations are supported.
[iv] See ASI BAC 500 product warranty for more detailed terms and conditions.
[v] Motor temperature can be sensed either directly using an external thermistor mounted on the motor windings or inferred based on a motor nameplate based I^2 T thermal model.