ASI ACCELERATED SYSTEMS INC

BAC1000

PRODUCT DESCRIPTION

The ASI BAC™ 1000 is a high power density motor 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 1000 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 120 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 and regenerative braking 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 (152 square cm) to facilitate discrete mounting locations and has an ingress protection rating of 67 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 120A
- 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
- HDQ, analog and voltage model based battery management system interfaces
- Configurable throttle, brake cut-off and regeneration options
- Networkable over ModBus
- Small size – 121 x 126 x 58 mm
- IP 67 rated enclosure
- 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
- Scooters
- Small 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	40 A[i]	120 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

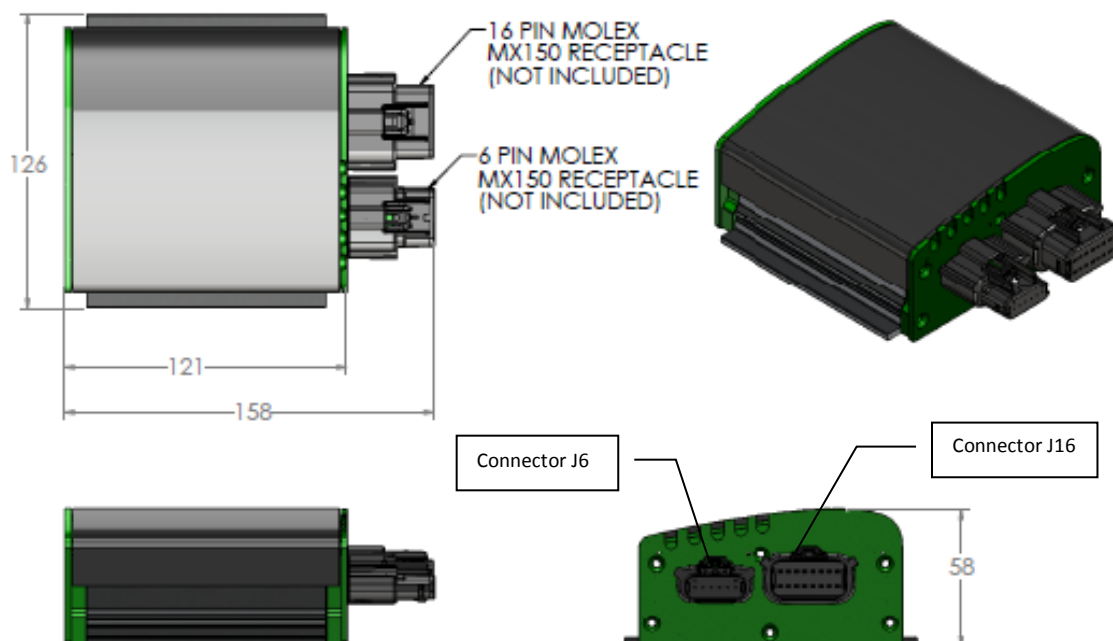| Feature	Description
Network	Proprietary ASI object dictionary over a variable baud rate ModBus network
Hardware Protocols	TTL Level 232, and RS-485
Baud rate	115200 bps maximum

Optional Features

Feature	Description
72V operation	Higher voltage MOSFETs can be used to extend nominal voltage range from 24 to 72 Volts

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 67
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

16 PIN MOLEX
MX150 RECEPTACLE
(NOT INCLUDED)

6 PIN MOLEX
MX150 RECEPTACLE
(NOT INCLUDED)

126

121

158

Connector J6

Connector J16

58

CONNECTOR PINOUTS

Connector J6		
Pin #	Description	Wire Colour and Gauge
J6.1	Hall 5V power	Red – 24 AWG
J6.2	Hall ground	Black – 24 AWG
J6.3	Hall sensor phase A	Blue – 24 AWG
J6.4	Hall sensor phase B	Green – 24 AWG
J6.5	Hall sensor phase C	Yellow – 24 AWG
J6.6	Brake 2	Grey – 24 AWG
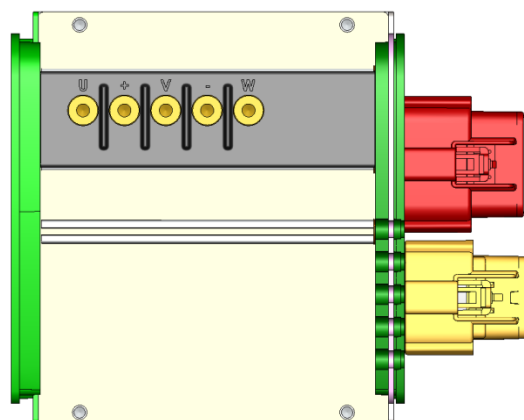
Connector J16		
Pin #	Description	Wire Colour and Gauge
J16.1	HDQ	Grey – 24 AWG
J16.2	Cruise control	Green – 24 AWG
J16.3	Analogue BMS	Green – 24 AWG
J16.4	Pedal first 5V supply	Red – 24 AWG
J16.5	Pedal first sensor	Orange – 24 AWG
J16.6	Brake 1	Brown – 24 AWG
J16.7	Throttle input	Blue – 24 AWG
J16.8	Throttle 5V supply	Red – 24 AWG
J16.9	Key Switch	Yellow – 24 AWG
J16.10	Serial RX IN	Brown – 24 AWG
J16.11	Serial TX OUT	Green – 24 AWG
J16.12	ModBus Termination[vi]	Not required on all drives
J16.13	Serial RX2 IN	NC
J16.14	Ground	Black – 24 AWG
J16.15	Throttle ground	Black – 24 AWG
J16.16	Throttle 12V supply	Yellow – 24 AWG

U + V – W

Motor and Battery Connections	
Description	Wire Colour and Gauge
Battery positive	Red – 14 AWG
Battery negative	Black – 14 AWG
Motor phase U	Blue – 14 AWG
Motor phase V	Green – 14 AWG
Motor phase W	Yellow – 14 AWG

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MATING CONNECTOR INFORMATION

Description	Manufacturer Part #	Mates To
6 pin, female MX150 series	Molex 0334710606	J6
16 pin, female MX150 series	Molex 0334721606	J16
Contact connector, female	Molex 0330122001	N/A
Spade connector, female, insulated, 14-16 AWG	3M 94820	U, V, W, +, -
Crimp tool	Molex 63811-6000	N/A

ORDERING INFORMATION

Product	Description	Part #
BAC 1000	48 Volt 1000 Watt Brushless DC motor controller	

ACCESSORIES

Product	Description	Part #
BAC 1000 cable kit	Cable assembly to connect to the BAC 1000	
BAC 1000 Evaluation kit	Contains BAC 1000, harness mounting screws, BacDoor software, and connector/cable kit	
BacDoor configuration utility	Configuration utility	

[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 1000 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.

[vi] Connects the termination resistor at the end of the daisy chained ModBus network if required.