Special motor for solar car
Powered by MITSUBA

First of all, we thank you very much you choose our product.
We wish you would have many opportunities and the best results in the races.

Please check the enclosed items;

1) motor
2) controller
3) electric wire with terminal
4) electric wire with terminal and switches
   (volume switch 2pcs / switch 3pcs / LED 1pc)
5) application CD-ROM for set up parameters
6) instruction manual book
7) sticker of MITSUBA
8) tool for center hub close and release

※ If you have any further questions, please contact to us.

The special motor development team of MITSUBA Corporation

MITSUBA　Special motor for solar car

instruction manual book

（　motor model：M2096D−Ⅲ
　controller model：M2096C　）

ATTENTION!!

Please read this installation manual carefully and understand it fully without fail before you start the installation and use it.

MITSUBA
株式会社 ミツバ

Main Features

★ specially designed for purpose of solar car race
★ very high efficiency of direct drive motor (wheel in motor)
★ very small cogging torque brushless DC motors.(32-pole,36-slot)
★ The efficiency more than 95% !! (including motor controller efficiency)
★ very high efficiency with wide range
★ An adapter compatible with MITSUBA M1596D motor is available (option)
★ very light weight motor (less than 11kgs!!)
★ very light weight motor controller (less than 3.5kgs!!)
★ very low current consumption motor controller
★ current control mode or manual PWM mode can be selected
★ User can adjust many kinds of parameters by your themselves
★ very high efficient generating brake

Contents

for safe

This instruction book is showing many kind of sketch.
It is shown for keep safe and no damage and no risk of bodily injury.
Make sure all the sketch and all of this instruction book.

WARNING

This indicate shows that the death or serious injuries can be expected,
If this warning is disregarded.

ATTENTION

This indicate shows that the serious injuries and some damages can be expected,
If this warning is disregarded.

IMPORTANT NOTE

This is showing important note for use this kit

WARNING

★ This kit is specially designed for solar car race, and purpose for solar car use only.
If this motor is used for other purpose, seriously accident or fire and burnout damage can be expected.
Above circumstance, only use for solar car, no use other purpose.

★ This kit is specially designed for solar car race, and this is not mass-production product.
And this kit is special kit and racing competition purpose.
So, we can not guarantee any of all things.
That mean you must understand you use under your responsibility by yourself.
Also we can not accept any claim even it is under the normal using.

★ Please not drive the car if you are using pacemaker on his heart.

★ Please confirm controller switch off and acceleration volume off (full unclockwise) before turn main switch on.

★ Please confirm forward / backward switch position before you make acceleration.

★ The motor controller is not waterproof.
So you must need waterproofing structure In by yourself in case driving in the rainy weather.
If you have flood or already flooded,
immediately make main switch off, and no make main switch on before all things be dry.

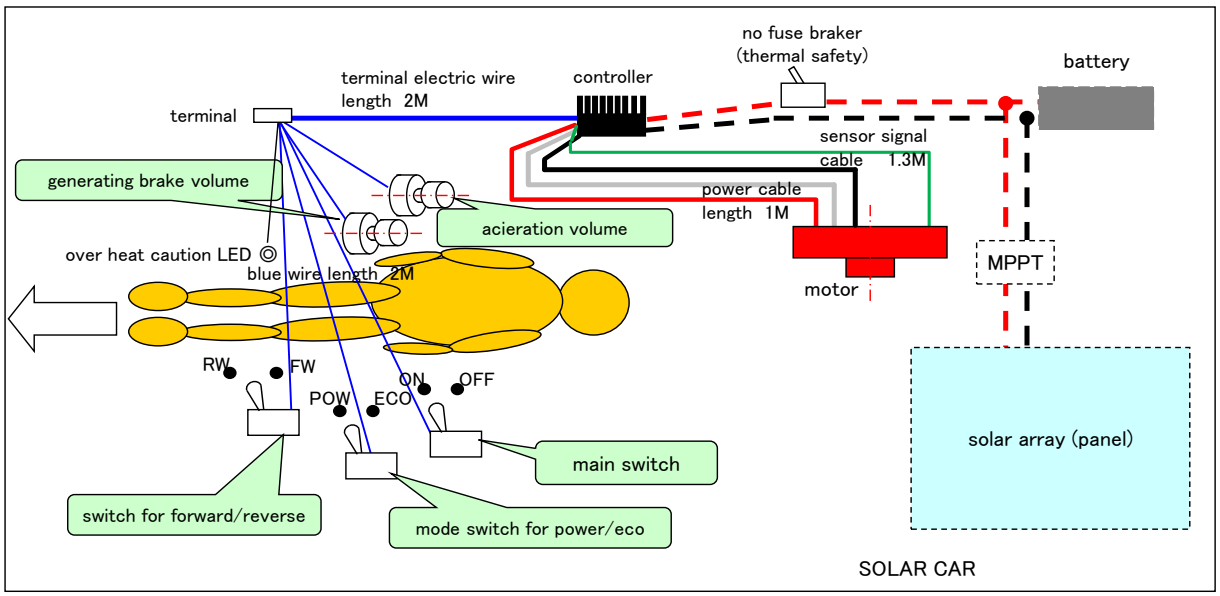
★ The car driver must turn the controller and main switch off when he get out car.

★ Please turn the main switch and controller switch off before you start the car maintainance or a adjustment.

ATTENTION

★ Please do not mistake the connection of positive (+) and negative (−), otherwise the control module will be damaged or broke
★ Please use the thermal safety (no fuse breaker) = (NFB)at positive line (+) for the protection from over current discharge.
★ Please do not open motor and motor controller, otherwise some damage or trouble can be expected.
★ Please do not modify motor and motor controller, otherwise some damage or trouble can be expected.

System configuration



※do not connect solar panel only it self.
must connect solar panel with battery like above sketch.
it make protection for solar panel open voltage (short circuit voltage)

※must use thermal safety (no fuse braker) = (NFB) at positive line (+)

※Mitsuba recommend electric wire for input power which size is about 14sq (14 square mm)

※the contain switch are just for test purpose only. You can choose at your side if you like

※description of contain kit
1) motor (power cable : 1m, signal cable : 1.3m)
2) motor controller
3) electric wire with terminal (2m)
4) electric wire with terminal and switches
(volume switch 2pcs / switch 3pcs / LED 1pc)
5) application CD-ROM for set up parameters
6) instruction manual book
7) sticker of MITSUBA (5pcs)
8) tool for center hub close and release
9) Conversion Cable

※above sketch is just for outline dimension how connect electric wires.
so you need adjust electric wire length by yourself if require.

※Mitsuba recommend to use 14sq (14 square mm) electric wire for make longer length.

※please contact us, if you need longer signal cable.

description of electric terminals

controller – terminal

description	parts terminal of number and position	wire color	terminal bar terminal number	note
main switch	center	white	01	
	side	black	20	
acceleration volume	2	white	02	
	1	black	21	
	3	red	03	
generating brake volume	2	white	22	
	1	black	04	
	3	red	23	
power / eco mode switch	center	white	05	
		—	24	prohibit to connect
	side	black	06	
forward / reverse switch	center	white	25	
	side	black	07	
			26	prohibit to connect
			08	prohibit to connect
			27	motor rotation pulse out put signal (0-5V)
			09	prohibit to connect
			28	GND
			10	prohibit to connect
			29	prohibit to connect
			11	Map_GND
			30	prohibit to connect
digital switch		red	12	Map_Bit0
		White	31	Map_Bit1
		green	13	Map_Bit2
		yellow	32	Map_Bit3
LED	K (–) :3	black / (brown)	14	LED_GND-0V
			33	prohibit to connect
LED	A (+) :1	white	15	LED_＋
			34	prohibit to connect
			16	prohibit to connect
			35	prohibit to connect
			17	prohibit to connect
			36	prohibit to connect
			18	prohibit to connect
			37	prohibit to connect
			19	prohibit to connect

motor sensor signal cable – controller

sensor circuit board	wire color	panel connector positions of R05-PB6N	
CON01	yellow	A	power input (+)
CON02	black	B	GND (0V)
CON03	red	C	A line
CON04	white	D	B line
CON05	green	E	C line
—	sealed	F	sealed

motor – controller

motor	controller
red	A
white	B
black	C

battery – controller

battery	controller
positive ＋	＋
negative —	—

if make mistake connection which will be make damage or broken this kit.

【signals for speed】

①pulse out put signal

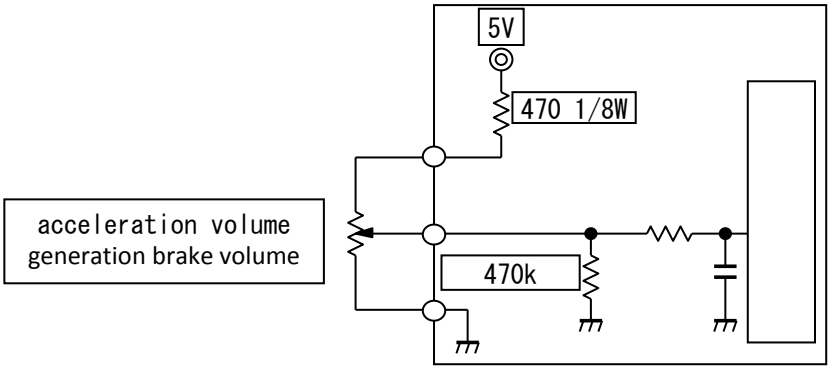
・you will have 0/5V (off/on) at terminal 27 – 28(GND(0V))

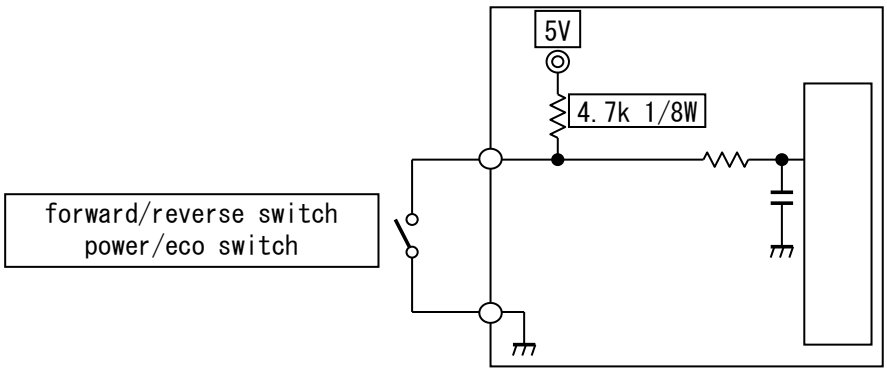
・16pulse/1rotation

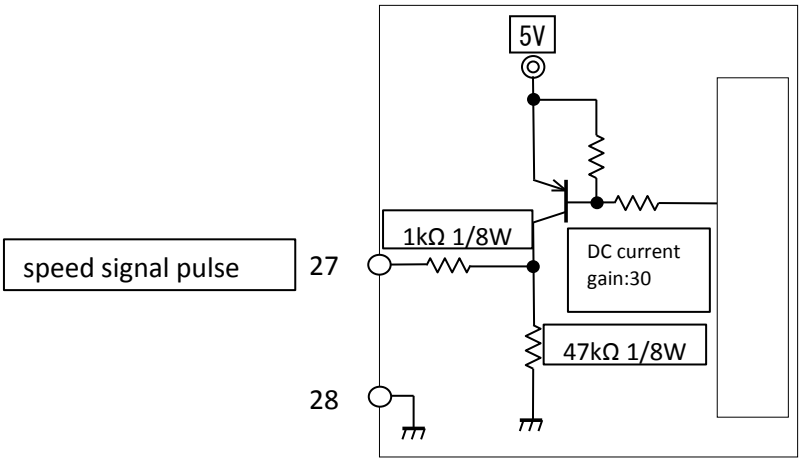
【acceleration volume】

Mitsuba recommend volume switch 5kΩ ～10kΩ and at full acceleration you will have 4.7V～4.8V at 02 – 21GND(0V)which are correct voltage.

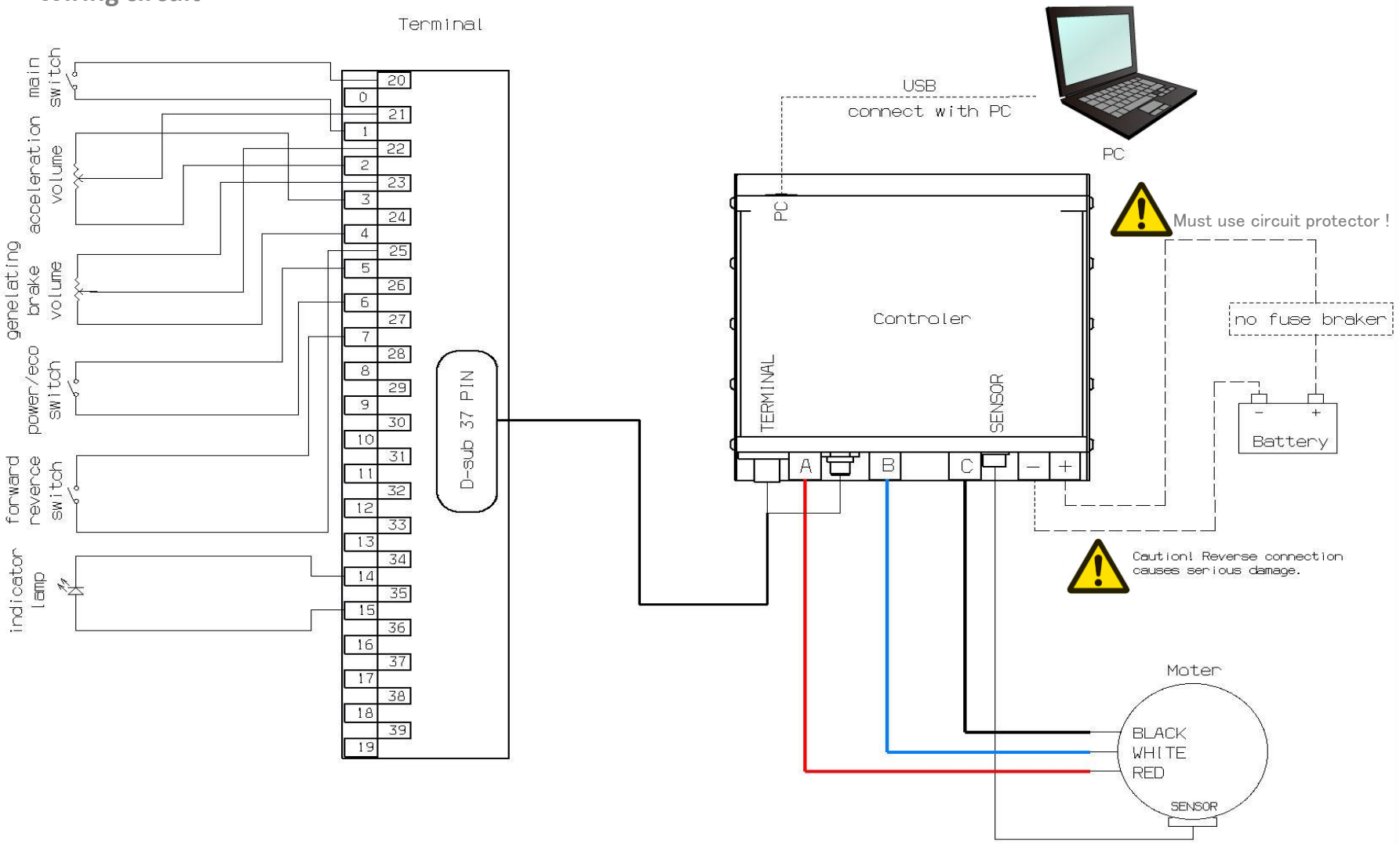
input / output composition figure



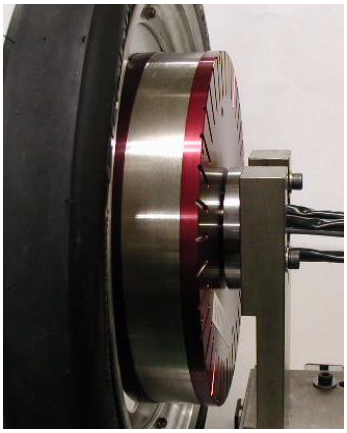




Wiring circuit



Handling notes for this kit



attention

This is direct drive motor (wheel in motor).
So, motor housing makes rotation,
(NOT shaft makes rotation)
In case, you need bench test,
you must fix and tight motor shaft like attached photo.

1. **posture for storage**

In case you take out the motor from car and strage it,
Please keep the face with electric wire up side and
the face with wheel locking face down side.
Otherwise wire harness would be damaged by the motor weight.

<good>

※the photo is 2003 ver

<bad>

attention

Please do not bring the motor with holding the wire harness.
Since sensor cable is sensitive and not durable.compared with power cable, please handle it carefully.

2. **power cable length (red / white / black)**

Original length of power cable is 1M.
You can cut and adjust power cable length according fix to you car.
※we recommend to use the shorter wire length and a big diamater wire cable.

3. **locking screw for wheel (rim) lock nut**

wheel (rim) lock nut have screw hole for insert screw which protect the turning.(loosening)
After fix and tight wheel lock nut, you put in screw.

※ M4 screw is not included this kit, please arrange at your side.

4. **how to tighten wheel (rim) lock nut**
please refer to below photo.

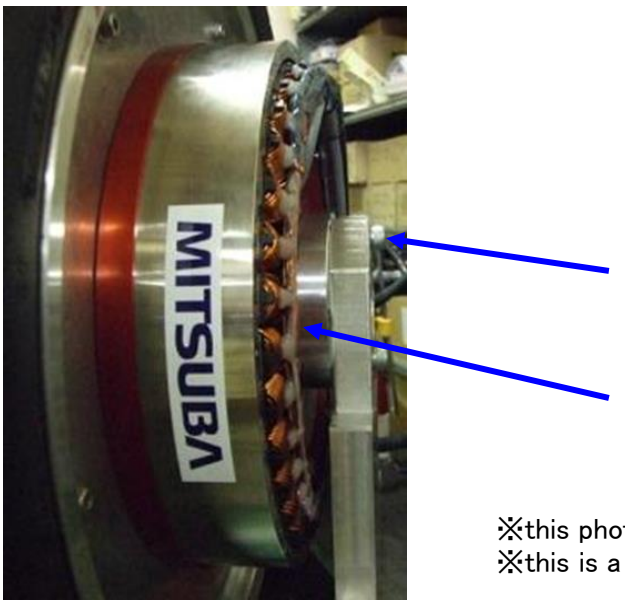
※this photo 2003 ver

※We recommend to apply the the lubrication on motor housing screw partion.

5. **motor housing fixing bolt length**
Please pay attention to the screw M8 length when the motor is installed to the car.
The screw length must be less than 12mm..

attention If too long screw is used, the motor housing would be damaged seriously.

attention



fix bolt

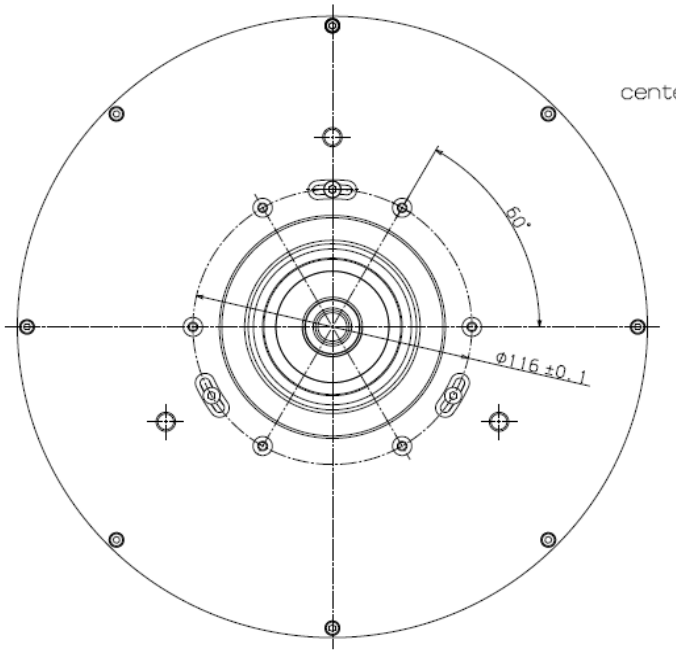
housing plate

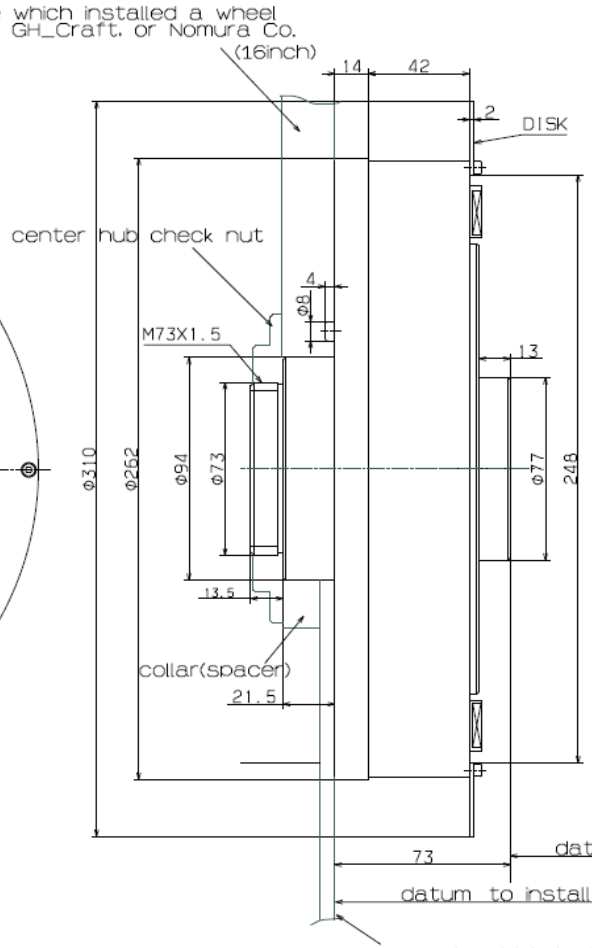
※this photo 2003 ver
※this is a holder for test purpose

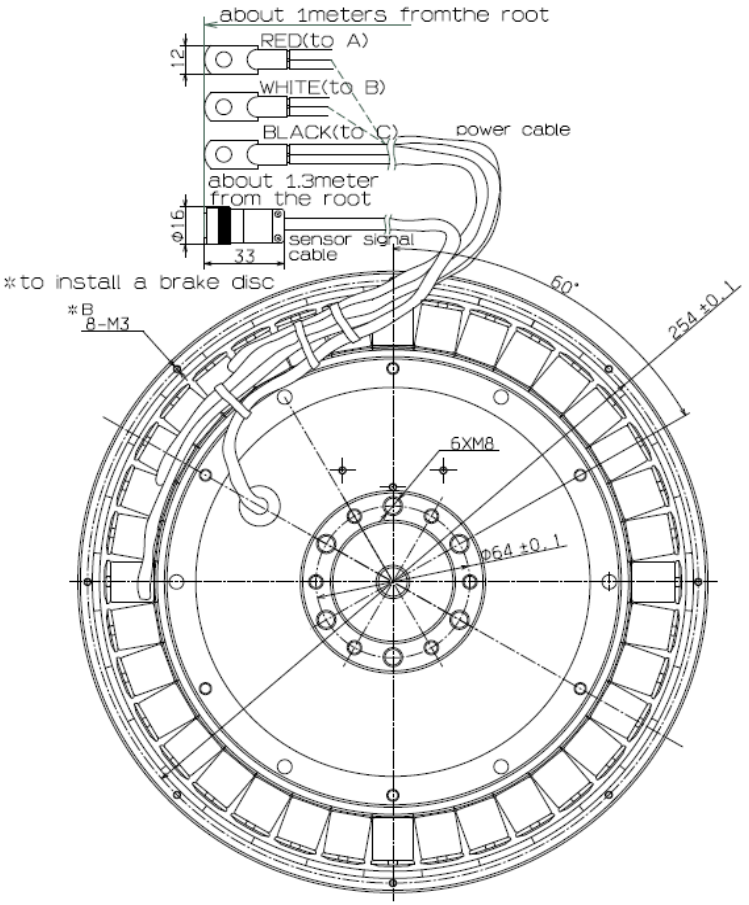
6. **others note**
・Please do not loosen the screws and dis-assemble the motor.
・normally the inside bearings are maintenance free.
If you would like overhaul, please contact to Mitsuba

M2096D-III Structures

2009model. M20xx compatible.







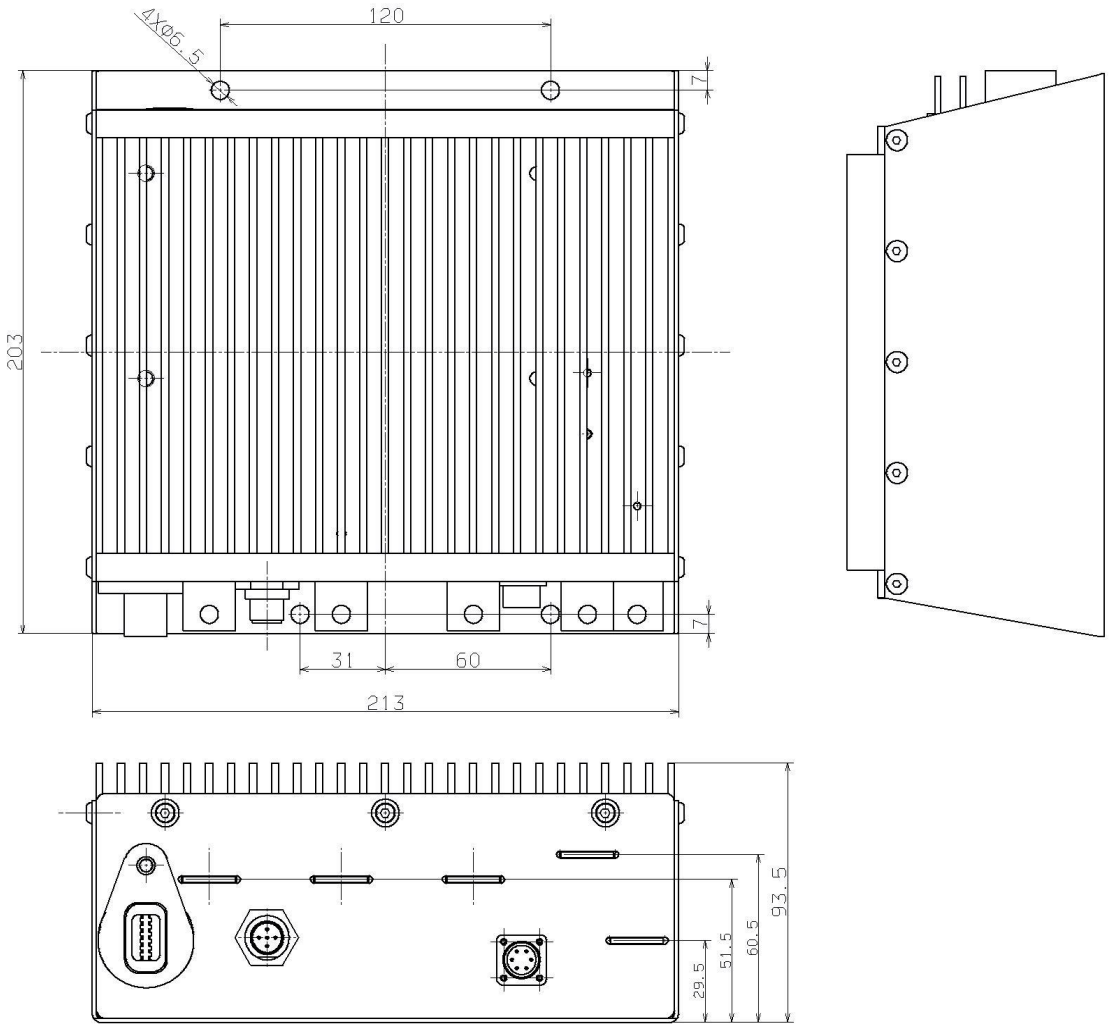
NOTE

1.center hub check nut is bundled to the motor.
2.The adapter compatible with MITSUBA M2096D-II motor is available
offset dimensions are same.(campatible with perfection)
3.electric wire is out from the coil side.
4. The parking disc brake only can be install to the screw hole to
show in *B. (option)
5.motor is only for cantilever support.

H. Uchiyama
2014. 2. 25

M2096C

outline dimensional drawing

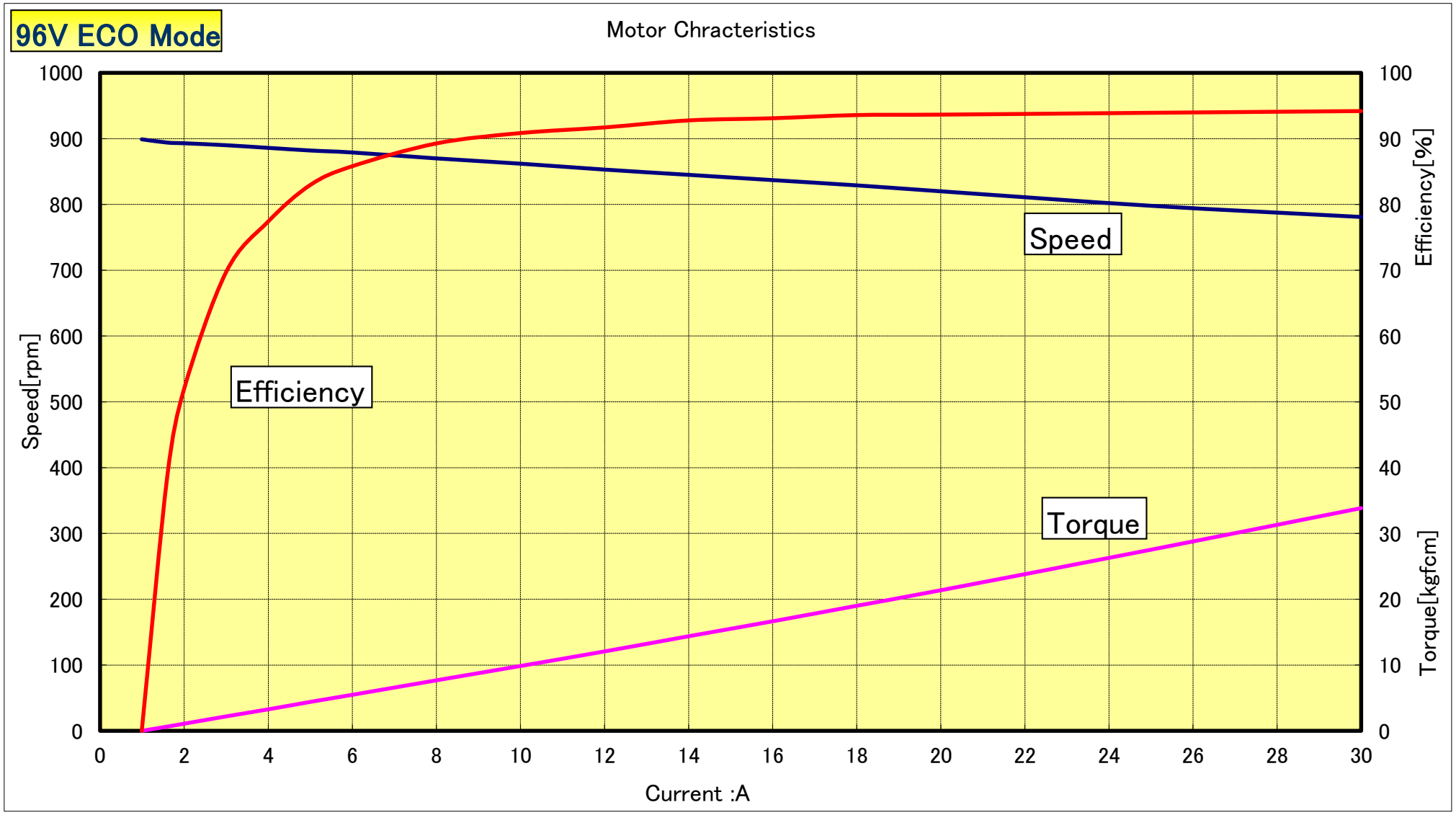


●M2096 specification

motor	
model number	M2096D-Ⅲ
dimension	φ 262mm×L73mm
weight	11kg
type	DC brushless motor in wheel type (direct drive type)
nominal power	2.0kW
maximum power	about 5000W (see note)
efficiency	more than 95% (including motor controller efficiency)
nominal load rotation speed	810rpm
rotating direction	forward：left turn (when see the wheel) / right turn optionally
controller	
model number	M2096C
dimension	W203mm×D213mm×H93.5mm
weight	3.5kg
cooling operation	natural air cooling
nominal voltage	96V
input voltage	45～160V
operation	120 degrees Square-wave control
control mode	
current control	checking input current and automatic adjust PWM DUTY
manual PWM control	direct control PWM Duty
reverse switch	available (with speed limit)
generation brake system	power adjust and voltage limiter (program by use)

note: maximum power which depend on voltage and battery

Tipical Motor chracteristics



Faults and Fail-safe

■Overcurrent Protection ■

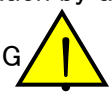
When the controller detects the overcurrent, it stops output to the motor.

■Overvoltage Protection (Drive) ■

For the battery and controller protection, it does not drive the motor during overvoltage.

■Overvoltage Protection (Regeneration) ■

For the battery and controller protection, the controller will limit the amount of regeneration by the battery voltage.

WARNING 

When the regeneration limit is applied, braking force is also reduced.

■Sensor Failure■

When the Hall sensor or circuit inside the controller fails, the controller stops output.

■Overheating Protection with LED warning ■

When the temperature of a controller becomes too high, the controller will reduce the output with LED warning.

■Fault List■

LED flashes	Fault	Set conditions	Controller action	Recovery conditions
1	Over current	Motor or battery current is too high	Drive stop	Reboot the controller
2	–	–	–	–
3	Hall sensor fault	Hall sensor is open / short circuit fault	Drive stop	Reboot the controller
4	Motor locked	No pulse from the hall sensor during driving	Drive stop	Reboot the controller
5	Sensor fault1	Current sensor, thermistor or voltage senso is open / shrot circuit	Drive stop	Reboot the controller
6	Sensor fault2	Accelerator voltage is out of range	Drive stop	Reboot the controller
7	–	–	–	–
8	High battery voltage	Battery voltage is too high	Drive stop	Voltage falls below 160V
9	Controller over heat	① 85℃ or over ② 95℃ or over	Power reduce to 1/2 Power down to 1/4	Reduction of temperature
		③ 105℃ or over	Drive stop	

Contact Information

ZIP CODE: 376-8555
1-2681, Hirosawa-Cho, Kiryu City, Gunma Pref. JAPAN
MITSUBA CO.,LTD SCR PROJECT
TEL: +81-277-52-0192
FAX: +81-277-52-1743
Cellular phone for emergency: +81-90-2498-7766

Senior Adviser
Masakatu Kimura m-kimura@mitsuba.co.jp

Motor Engineer
Hidekazu Uchiyama h-uchiya@mitsuba.co.jp

Electoric circuit Engineer
Kazuaki Nakazawa nakazawa-kazuaki@mitsuba.co.jp

Software Engineer
Junya Kitazawa j-kitaza@mitsuba.co.jp

Over sea market agent of racing motor
NOMURA CO. 野村商会
ADDRESS : 1-18, Koshien-Abiki, Nishinomiya, 663-8156 Hyogo, JAPAN
E-MAIL : nomnom13@yahoo.co.jp
TEL : +81 90-1586-7484 FAX : +81 6-6453-0635