



 **MABUCHI MOTOR**
MABUCHI MOTOR MICRO TECH CO., LTD.

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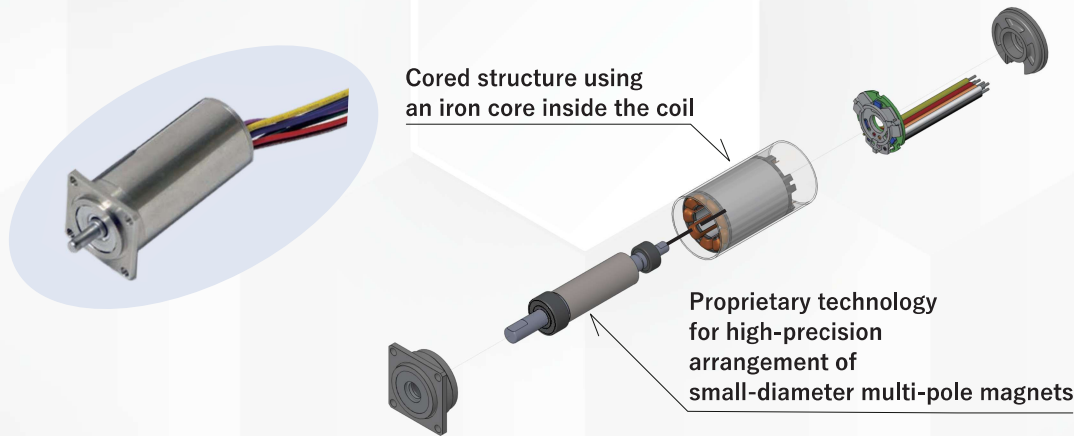
Ultracompact, High-Torque
Brushless DC Motor

Thumbelina®

MABUCHI MOTOR MICRO TECH CO., LTD.



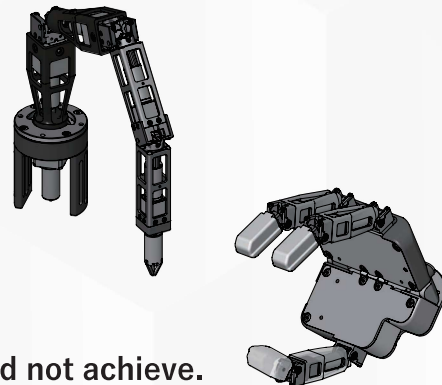
3 Phase Brushless DC Motor **Thumbelina®** Cored structure / Inner rotor type



【Features】

- **Ultracompact** | Small sizing enables easy mounting for narrow spaced applications such as robotic hands.
- **High torque** | By adopting a cored structure, exceptional performance is achieved for targeting high torque, braking characteristics, and reaching high holding force without any applied current.
- **High braking force**
- **High retention**
- **Multiple Options** | A wide range of reduction gears and encoders are available to best suit the application.

With Thumbelina®,
it is possible to realize
multi-finger, multi-joint robots
capable of delicate operations
in small, confined spaces—
tasks that conventional motors could not achieve.



【Motor Model】

TB	12	M	24	2	L	1	1	B	A
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

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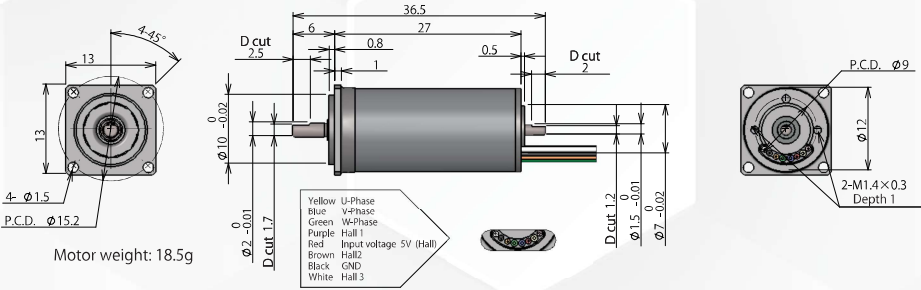
- | | |
|---------------------------------------|---|
| ① ... Fixed model | TB : Thumbelina series |
| ② ... Motor diameter | 12 : Φ 12mm |
| ③ ... Motor type | M : Middle type |
| ④ ... Voltage spec. | 12 : DC12V / 24 : DC24V |
| ⑤ ... Flange shape | 1 : TYPE1 Φ 13 / 2 : TYPE2 $\square$ 13 / 3 : TYPE3 $\square$ 20 |
| ⑥ ... Harness spec. | L : Lead wire |
| ⑦ ... Presence/absence of Hall sensor | 1 : with Hall sensor / 2 : without Hall sensor |
| ⑧ ... Output shaft shape | 1 : Φ 2 with D-cut / 2 : Φ 2 straight / 3 : Φ 3 with D-cut |

If option is included, the following symbols are added (If not included, "-" is added)

- | | |
|--------------------------------------|---|
| ⑨ ... Reduction gear specification | Harmonic Drive® $\square$ 13
A : 1/30 B : 1/50 C : 1/100
Harmonic Drive® $\square$ 20
D : 1/30 E : 1/50 F : 1/100
CROWN ROBOXGEAR $\square$ 13
Z : 1/50
Planetary $\square$ 13
G : 1/4 H : 1/16 J : 1/48 K : 1/64 L : 1/256 |
| ⑩ ... Magnetic encoder specification | Incremental Φ 12
A : ABZ single 1024ppr / B : ABZ differential 1024ppr
Absolute Φ 12
K : SSI 1024ppr / L : SSI differential 1024ppr
Multi-turn Φ 20
T : $\sim$ 18bit (ST) / $\sim$ 39bit (MT) ※ST + MT = 50bit Max.
Analog Φ 12
Z : SinCos |

【TB12M Drawing】

Standard product : TB12M□2F11

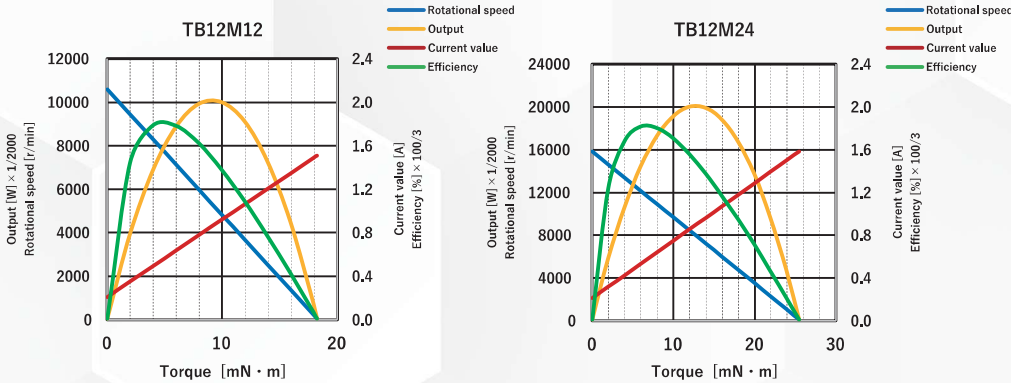


【TB12M Motor specs】

Model	Unit	TB12M12	TB12M24
Nominal voltage	V	12	24
No-load speed	r/min	10,000	15,000
No-load current	A	0.2	0.2
Rated torque	mN · m	6	6
Rotational speed at rated torque	r/min	7,000	12,000
Current at rated torque	A	0.6	0.5
Maximum output	W	5	10
Maximum efficiency	%	60	60
Stall torque	mN · m	18	25
Terminal resistance	Ω	4	8
Torque constant	mN · m/A	13	17
Speed/torque gradient	(r/min)/mN · m	550	600

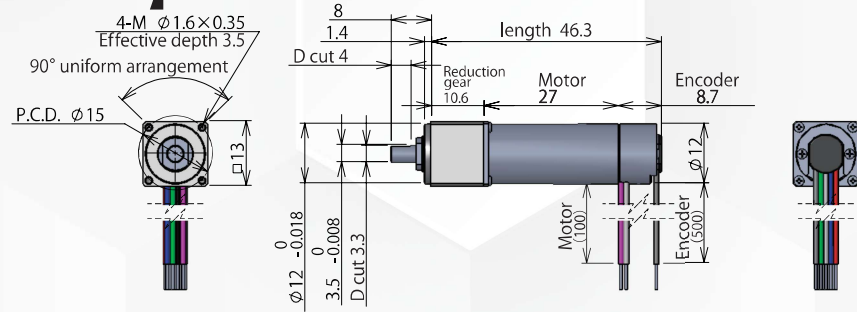
Driver circuit used : MTO-EV014FTG (IC : Toshiba TC78B016FTG)
These characteristic values are measured from a prototype and are not guaranteed.
For detailed specifications, please contact us.

【TB12M Motor characteristics (N-T characteristics)】



Model with Harmonic Drive® □ 13 reduction gear and encoder

【Exterior view】



Model number
1 2 v spec TB12M122L11__A
2 4 v spec TB12M242L11__A

Motor (with Hall sensor)
White Hall3
Black GND
Brown Hall2
Red Input voltage 5V
Purple Hall1
Green W-Phase
Blue V-Phase
Yellow U-Phase

Encoder (Incremental)
Red Input voltage 5V
Blue GND
White Z
Green B
Gray A

【Characteristics of TB12M motor with reduction gear】

Reduction gear model number		A	B	C
Reduction ratio		1/30	1/50	1/100
Size	length [mm]	46.3	46.3	46.3
	Reduction gear length [mm]	10.6	10.6	10.6
Reduction gear allowable torque	Continuous load torque [N·m]	0.06	0.11	0.15
	Intermittent load torque [N·m]	0.13	0.21	0.3
	Instantaneous load torque [N·m]	0.22	0.41	0.57
Characteristics of motor with reduction gear At continuous load torque operation DC12v spec	Torque [N·m]	0.06	0.11	0.15
	Rotational speed [r/min]	285	166	77
	Current [A]	0.39	0.39	0.33
	Output [W]	1.8	1.9	1.2
Characteristics of motor with reduction gear At continuous load torque operation DC24v spec	Torque [N·m]	0.06	0.11	0.15
	Rotational speed [r/min]	444	259	117
	Current [A]	0.32	0.33	0.28
	Output [W]	2.8	3.0	1.8

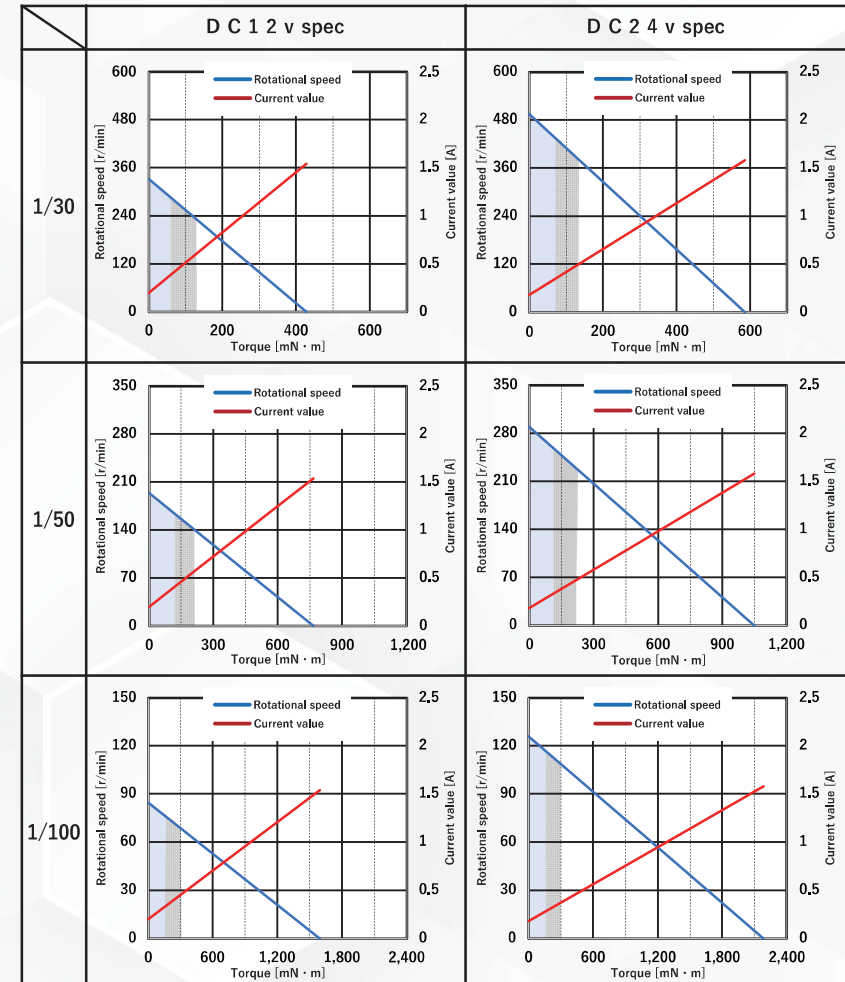
These characteristics are catalog values, not guaranteed values.
If you would like characteristic details and specifications other than those listed above, please contact us.

Model with Harmonic Drive® □ 13 reduction gear and encoder

【Characteristics chart】

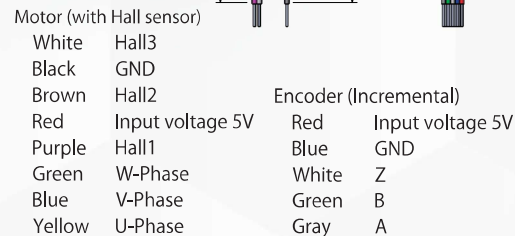
- Normal load range of reduction gear
- Intermittent load range of reduction gear with repeated starting/stopping

The load range is the range of the reduction gear.
Please check the temperature of the motor when in use.
These characteristics are catalog values, not guaranteed values.
If you would like characteristic details and specifications other than those listed above, please contact us.



Model with Harmonic Drive® □20 reduction gear and encoder

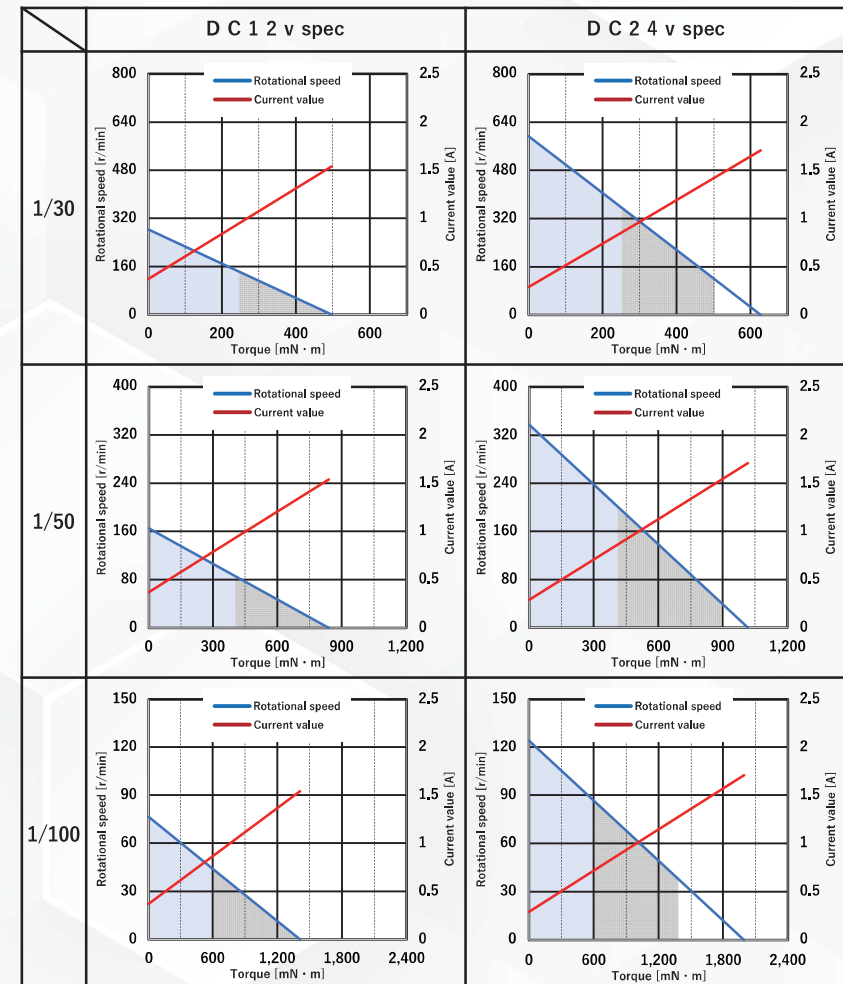
【Characteristics chart】



Reduction gear model number		D	E	F
Reduction ratio		1/30	1/50	1/100
Size	length [mm]	50.6	50.6	50.6
	Reduction gear length [mm]	12.7	12.7	12.7
Reduction gear allowable torque	Continuous load torque [N·m]	0.25	0.4	0.6
	Intermittent load torque [N·m]	0.5	0.9	1.4
	Instantaneous load torque [N·m]	0.9	1.8	2.7
Characteristics of motor with reduction gear	Torque [N·m]	0.05	0.09	0.16
	Rotational speed [r/min]	253	147	68
Continuous operation 0.5A comparison	Current [A]	0.50	0.50	0.50
DC12v spec	Output [W]	1.4	1.4	1.2
Characteristics of motor with reduction gear	Torque [N·m]	0.09	0.15	0.30
	Rotational speed [r/min]	508	288	106
Continuous operation 0.5A comparison	Current [A]	0.50	0.50	0.50
DC24v spec	Output [W]	4.9	4.5	3.3

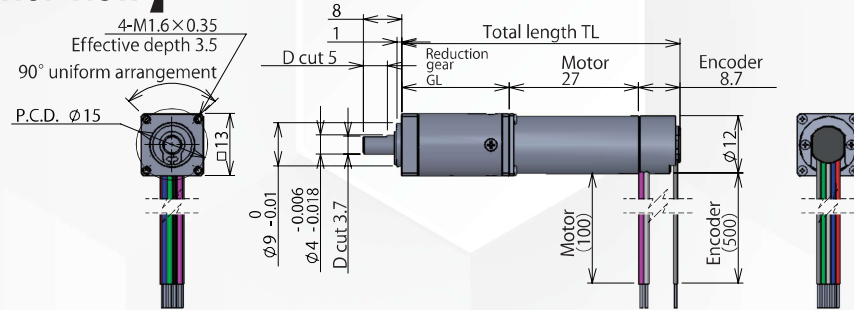
Normal load range of reduction gear
 Intermittent load range of reduction gear with repeated starting/stopping

The load range is the range of the reduction gear.
Please check the temperature of the motor when in use.
These characteristics are catalog values, not guaranteed values.
If you would like characteristic details and specifications
other than those listed above, please contact us.



Model with Planetary □13 reduction gear and encoder

【Exterior view】



Model number
1 2 v spec TB12M122L12_A
2 4 v spec TB12M242L12_A

Motor (with Hall sensor)
White Hall3
Black GND
Brown Hall2
Red Input voltage 5V
Purple Hall1
Green W-Phase
Blue V-Phase
Yellow U-Phase

Encoder (Incremental)
Red Input voltage 5V
Blue GND
White Z
Green B
Gray A

【Characteristics of TB12M motor with reduction gear】

Reduction gear model number		G	H	J	K	L
Reduction ratio		1/4	1/16	1/48	1/64	1/256
Size	TL [mm]	54.7	58.2	61.7	61.7	65.2
	GL [mm]	19	22.5	26	26	29.5
Reduction gear specifications	Continuous load torque [N·m]	0.15	0.2	0.25	0.25	0.28
	Intermittent load torque [N·m]	0.35	0.65	1.1	1.1	1.1
	Efficiency [%]	85%	72%	61%	61%	52%
Characteristics of motor with reduction gear Continuous operation 0.5A comparison DC12v spec	Torque [N·m]	0.014	0.05	0.14	0.19	0.28
	Rotational speed [r/min]	1935	445	135	110	29
	Current [A]	0.50	0.50	0.50	0.50	0.31 ※
	Output [W]	2.9	2.4	2.0	2.2	0.9
Characteristics of motor with reduction gear Continuous operation 0.5A comparison DC24v spec	Torque [N·m]	0.014	0.05	0.15	0.22	0.28
	Rotational speed [r/min]	2812	673	212	174	46
	Current [A]	0.50	0.50	0.50	0.50	0.36 ※
	Output [W]	4.3	3.8	3.3	4.0	1.4

These characteristics are catalog values, not guaranteed values.

If you would like characteristic details and specifications other than those listed above, please contact us.

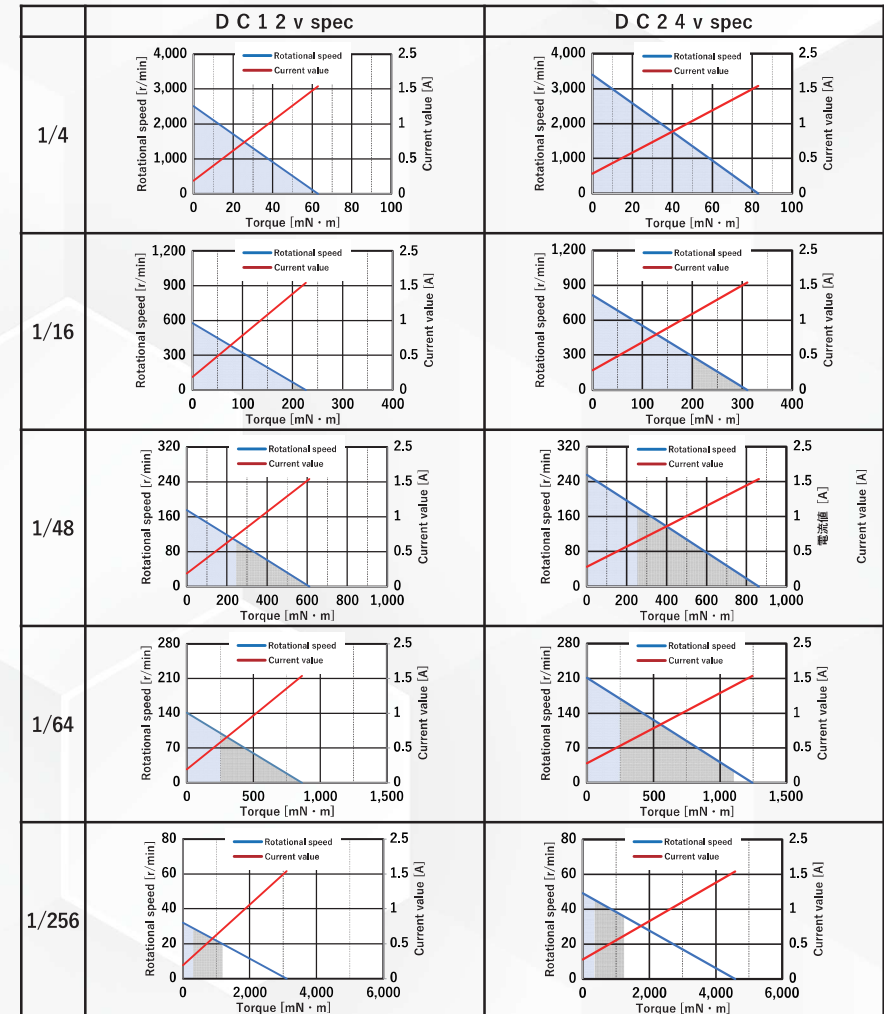
※Current value at continuous load torque of reduction gear

Model with Planetary □13 reduction gear and encoder

【Characteristics chart】

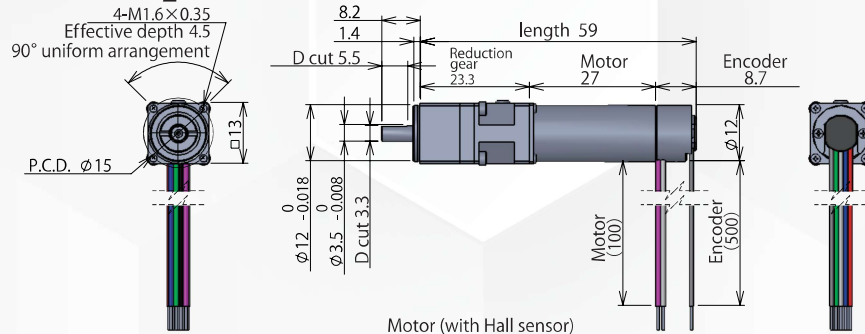
- Normal load range of reduction gear
- Intermittent load range of reduction gear with repeated starting/stopping

The load range is the range of the reduction gear.
Please check the temperature of the motor when in use.
These characteristics are catalog values, not guaranteed values.
If you would like characteristic details and specifications other than those listed above, please contact us.



Model with CROWN ROBOXGEAR □13 reduction gear and encoder

【Exterior view】



Model number
1 2 v spec TB12M122L13__A
2 4 v spec TB12M242L13__A

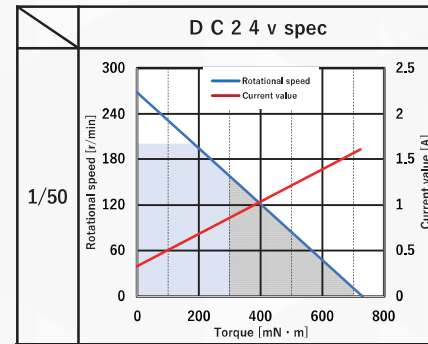
White	Hall3	Red	Input voltage 5V	Red	Input voltage 5V
Black	GND	Purple	Hall1	Blue	GND
Brown	Hall2	Green	W-Phase	White	Z
Red	Input voltage 5V	Blue	V-Phase	Green	B
Purple	Hall1	Gray	U-Phase	Gray	A
Green	W-Phase				
Blue	V-Phase				
Yellow	U-Phase				

【Characteristics of TB12M motor with reduction gear】

Reduction gear model number	Z
Reduction ration	1/50
Size	length [mm] 59
	Reduction gear length [mm] 23.3
Reduction gear allowable torque	Continuous load torque [N·m] 0.3
	Intermittent load torque [N·m] 0.7
	Instantaneous load torque [N·m] 0.8
Characteristics of motor with reduction gear	Torque [N·m] 0.1
Continuous operation 0.5A	Rotational speed [r/min] 231
DC24v spec	Current [A] 0.50
	Output [W] 2.4

【Characteristics chart】

■ Normal load range of reduction gear
■ Intermittent load range of reduction gear with repeated starting/stopping



The load range is the range of the reduction gear.
Please check the temperature of the motor when in use.
These characteristics are catalog values, not guaranteed values.
If you would like characteristic details and specifications other than those listed above, please contact us.

CROWN ROBOXGEAR

A compact precision reducer developed by Mu Lab, LTD., the first venture company originating from Fukushima University

Millimeter-sized precision transmission mechanisms are essential technology for realizing next-generation robots. At the core of this technology is the Crown Reduction Mechanism, a simple gear configuration comprising three rigid gears : the rotor gear, the stator gear, and the output gear. With the CROWN ROBOXGEAR, a next-generation compact precision reducer built around these three gears, as a key component, Mu Lab, LTD. also offers 3D cams and small electric grippers that support the development of robotic society.



The “strength” of compact precision reducers required in the era of small robots includes powerful torque, impact resistance due to high rigidity, and long service life to operate continuously even under heavy load conditions.

【 High Torque 】

Torqueful

The rated torque of the reducer is increased, allowing a small motor to deliver more power (double the torque compared to the same size).

Impact Resistance

Instantaneous maximum torque 0.8Nm ※

【 Long Lifespan 】

High load resistance

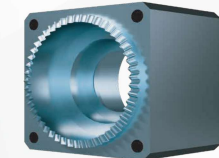
Rated torque 0.3Nm ※



Rotor gear



Output gear



Stator gear

※Outer Dimensions : 13 mm type

- The outer part of the rotor gear contacts the stator gear, and the inner part of the rotor gear contacts the output gear.
- The rotational motion of the motor is input through the press rotor and converted into precessional motion of the rotor gear.
- Through the precessional motion of the rotor gear, reduction occurs between the rotor gear and the stator gear, which have different numbers of teeth, and this reduced rotation is transmitted to the output gear to achieve the reduction operation.



Click here to watch the operation principle video!

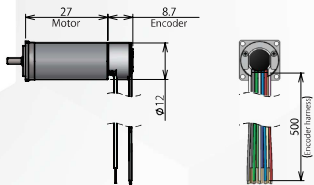
Encoder specifications

model number	Unit	A	B	K	L	Z	T
Output	—	Incremental		Absolute (single-turn)		Absolute (multi-turn)	
		ABZ	ABZ (differential)	SSI	SSI (differential)	SinCos	Biss-C
Resolution	—	1024 ppr	1024 ppr	1024 ppr	1024 ppr	—	ST:~18bit MT:~32bit (ST+MT=50bit max.)
Supply voltage	V	DC 5.0					
Accuracy	Deg	Typ. 0.3				Phase difference 90±0.2	—
Operating temperature range	°C	-40 ~ +85					-40 ~ +115

Incremental encoder

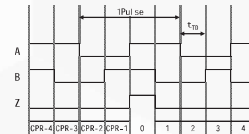
【Exterior view】

A : ABZ

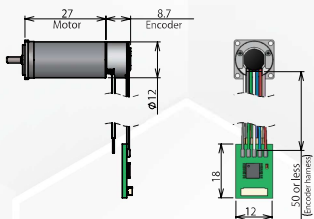


Output signal	Wire color
A	Gray
B	Green
Z	White
GND	Blue
DC5V	Red

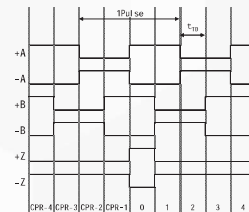
【Output signals】



B : ABZ(differential)



Pin	Output signal	Wire color
1	A+	Gray
2	A-	Pink
3	B-	Yellow
4	B+	Green
5	Z+	White
6	Z-	Brown
7	GND	Blue
8	DC5V	Red

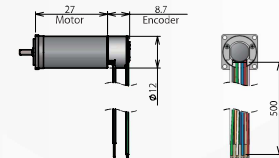


※ Includes a differential signal output board and a cable assembly not shown in the figure.

Absolute encoder (single-turn)

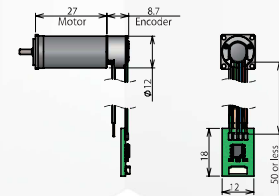
【Exterior view】

K : SSI



Output signal	Wire color
Data	Green
Clock	White
GND	Blue
DC5V	Red

L : SSI (differential)

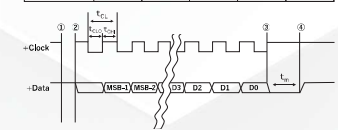


Pin	Output signal	Wire color
1	DC5V	Red
2	GND	Blue
3	Data+	Green
4	Data-	Yellow
5	CLK-	Brown
6	CLK+	White

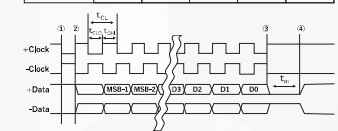
※ Includes a differential signal output board and a cable assembly not shown in the figure.

【Output signals】

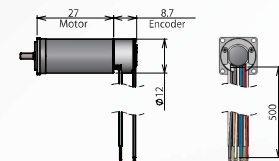
Parameter	Symbol	Minimum	Average	Maximum	Unit
Clock cycle	t_{c1}	0.25		$2 \times t_{c1}$	μ s
Clock High	t_{cH}	0.1		t_{c1}	μ s
Clock Low	t_{cL}	0.1		t_{c1}	μ s
Timer	t_{t1}	15	19	25	μ s



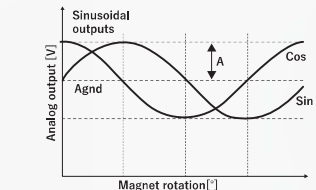
Parameter	Symbol	Minimum	Average	Maximum	Unit
Clock cycle	t_{c1}	0.25		$2 \times t_{c1}$	μ s
Clock High	t_{cH}	0.1		t_{c1}	μ s
Clock Low	t_{cL}	0.1		t_{c1}	μ s
Timer	t_{t1}	15	19	25	μ s



Z : SinCos



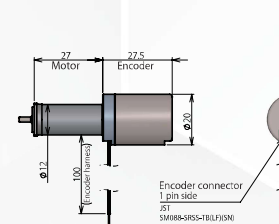
Output signal	Wire color
Cos	Gray
Sin	White
GND	Blue
DC5V	Red



Absolute encoder (multi-turn)

【Exterior view】

T : Biss-C



Pin	Output signal
1	DC5V
2	GND
3	MA+
4	MA-
5	SLO+
6	SLO-
7	NC
8	NC

※ A cable assembly not shown in the figure is included.

A magnetic absolute encoder capable of multi-turn position memory without a battery.

It retains the rotational position even without an external power supply.

Single-turn (ST) resolution : 15-18 bits
Multi-turn (MT) resolution : 12-39 bits
Configurable within these ranges.

※ ST + MT = 50bit Max.

For other specifications, please contact us.