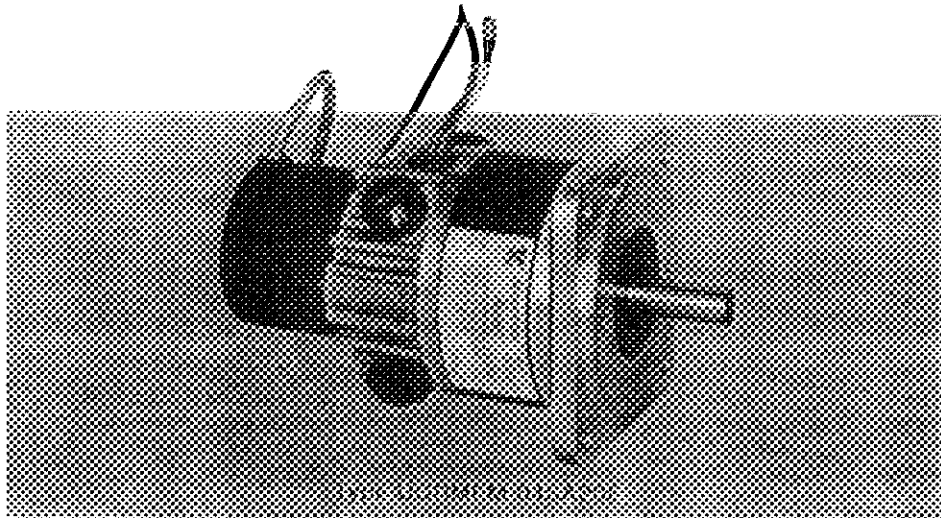


Minertia Motor RM Series

TYPE UORMEN

RM series is a new line introduced for integration into robots as an articulate power drive, or as a drive for insertion machines, IC bonders, or high precision X-Y tables.

RM series features compact size, light weight, yet possesses excellent torque/weight and torque/volume ratios in servodrive applications.



FEATURES

- High performance DC servomotor
- Magnetic field formation using rare earth magnet
- Rated speed as high as 3000 rpm
- Compact and light weight : Small diameter,
Short length
- Excellent torque/weight and torque/volume ratios
- Totally-enclosed construction having slot core armature
- Available with optical encoders, feedback units, DC tachometers
- Suitable motor controllers available for special applications
- Unique bearing configuration—no thrust movement of motor shaft

RATINGS AND SPECIFICATIONS

Time rating: Continuous

Insulation:

Class B for Type UGRMEM-01SA to -08MB

Class F for Type UGRMEM-40SA and -40MA

Dielectric Strength:

500VAC min. for Type UGRMEM-01SA to -08SA

1000VAC min. for Type UGRMEM-08MB to 40SA

1500VAC min. for Type UGRMEM-40MA

Enclosure: Totally-enclosed self-cooled type

Ambient Temperature: -10°C to +40°C in operation
-20°C to +60°C in storage (no condensation)

Humidity: 35% to 80% RH in operation
10% to 80% RH in storage (no condensation)

Vibration: V-15

Finish in Munsell Notation: N1.5 (Black)

Excitation: Permanent magnet

Mounting: Flange-mounted type

Drive Method: Direct drive

Table 1 Ratings and Specifications

Motor Type UGRMEM		-01SA	-02SA	-03MA	-04SA	-04MA	-08SA	-08MB	-40SA	-40MA
Peak Rated Torque	N·m	0.53	1.06	1.77	2.12	3.53	4.41	7.06	8.38	15.1
Rated Torque	N·m	0.106	0.212	0.353	0.424	0.706	1.06	1.77	3.18	6.0
Torque Constant	N·m/A	0.0534	0.0573	0.0812	0.084	0.119	0.142	0.231	0.365	0.487
Armature Winding Resistance	Ω (at 25°C)	2.75	1.12	0.94	0.59	0.41	0.41	0.49	0.57	0.34
Armature Inductance	mH	1.2	0.9	0.9	0.7	0.6	1.2	2.0	4.0	3.1
Peak Current	A	10	18.8	22.1	25.5	30.1	37.5	36.5	27.6	36.3
Voltage Constant	V/1000rpm	5.6	6.0	8.5	8.8	12.4	14.9	24.2	38.2	51.0
Viscous Damping Constant	mN·m/1000rpm	2.94	5.88	10.8	15.7	26.5	25.5	17.7	28.4	51.0
Friction Torque	mN·m	6.37	16.7	24.5	25.5	36.3	49.0	58.8	110	137
Inertia	$\text{kg} \cdot \text{m}^2 \times 10^{-4}$	0.046	0.157	0.28	0.96	1.68	5.1	8.3	25.9	44.1
Mechanical Time Constant	ms	4.4	5.4	4.0	8.0	4.9	10	7.7	11	6.1
Electrical Time Constant	ms	0.44	0.8	0.96	1.2	1.5	2.9	4.1	7.1	9.4
Power Rate	kW/s	2.44	2.86	4.45	1.87	2.97	2.2	3.73	3.94	8.16
Torque Inertia Ratio	rad^2/s^2	23000	13500	12600	4410	4210	2080	2120	1230	1360
Thermal Resistance	°C/W	3.5	2.33	1.86	1.86	1.55	1.25	1.0	0.8	0.6
Max Temperature Rise	°C	100	100	100	100	100	100	100	130	130
Rated Speed	rpm	3000	3000	3000	3000	3000	3000	3000	2500	2200
Max Safe Operating Speed	rpm	4000	4000	4000	4000	4000	4000	4000	4000	3500
Cooling Required	cfm, in H ₂ O	Totally-enclosed self-cooled								

Note: Rated torque is indicated by allowable continuous torque value at ambient temperature 40°C,

when the following heat dissipating aluminum plate is mounted on the motor:

150 mm × 150 mm × 3 mm for type UGRMEM-01,

250 mm × 250 mm × 6 mm for type UGRMEM-02, -04,

300 mm × 300 mm × 12 mm for type UGRMEM-08, -40

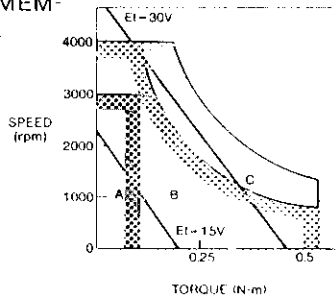
ELECTRIC CHARACTERISTICS

SPEED-TORQUE CHARACTERISTICS

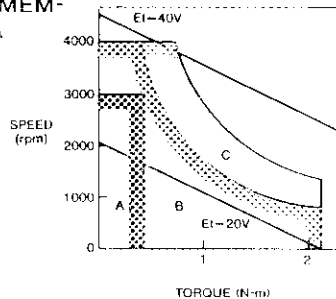
Speed-torque characteristics shown in Fig. 1 are based on armature voltage (E_t) and armature current (I_a) maintained constant at an armature winding temperature of 100°C.

E_t : Armature voltage
A: Continuous duty zone
B: Intermittent duty zone
C: Recommended commutation limit

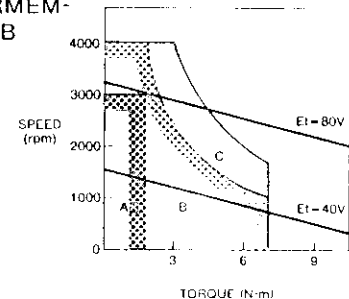
(a) Type UGRMEM-01SA



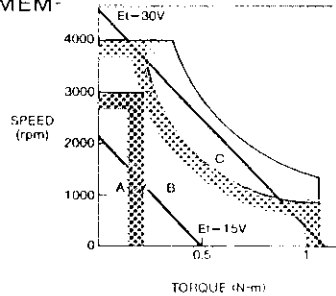
(d) Type UGRMEM-04SA



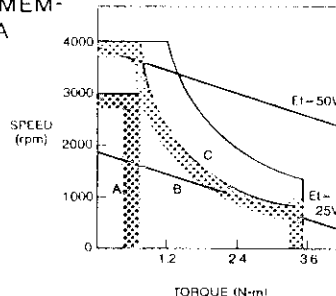
(g) Type UGRMEM-08MB



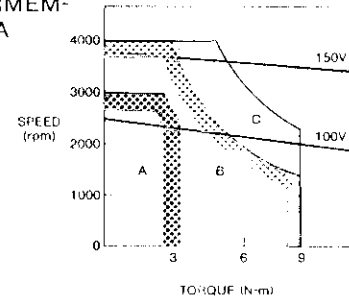
(b) Type UGRMEM-02SA



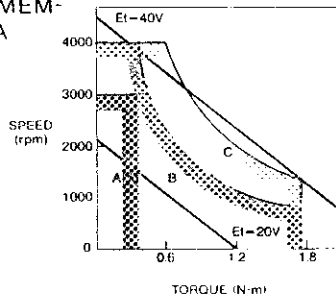
(e) Type UGRMEM-04MA



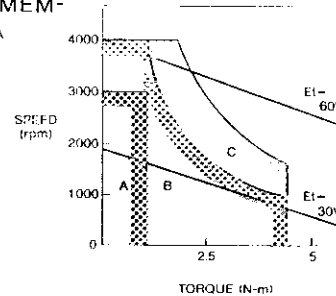
(h) Type UGRMEM-40SA



(c) Type UGRMEM-02MA



(f) Type UGRMEM-08SA



(i) Type UGRMEM-40MA

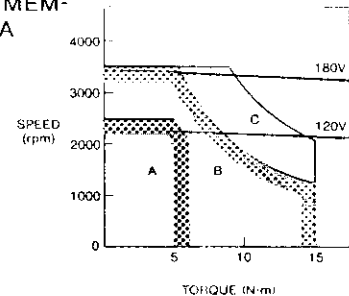
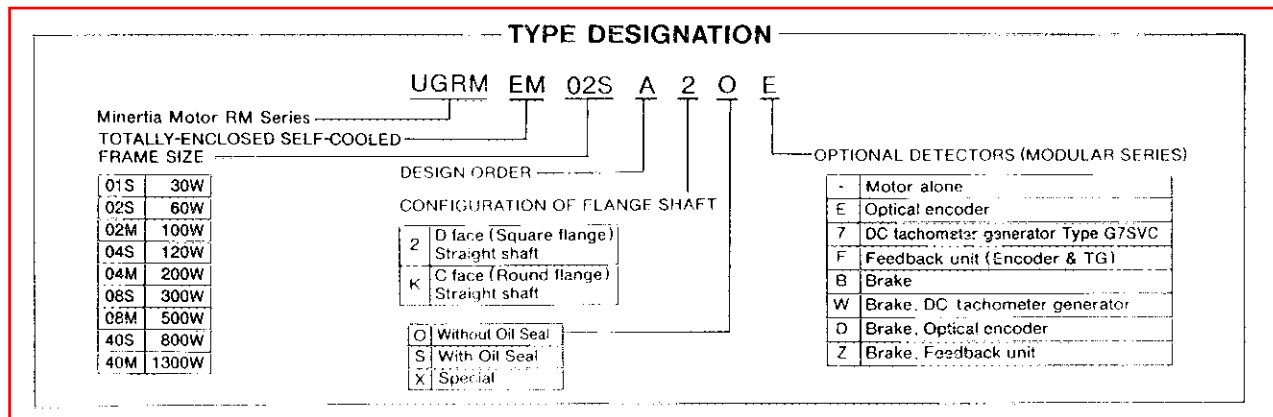


Fig. 1 Speed-Torque Characteristics



STARTING AND OVERLOAD CHARACTERISTICS

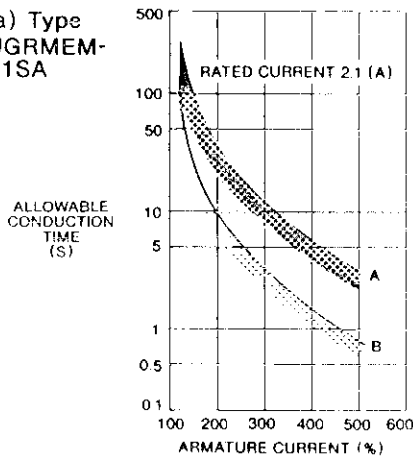
Fig. 2 shows the allowable conduction time of armature current at starting and during overload operation.

At cold condition (A) - Curves are obtained at

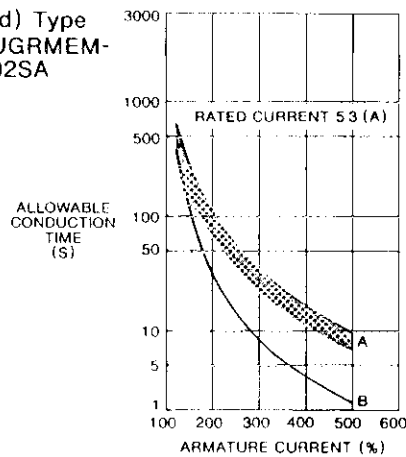
starting operation when armature temperature is equal to ambient temperature.

At hot condition (B) - Curves obtained when armature temperature is at optimum at the rated operation.

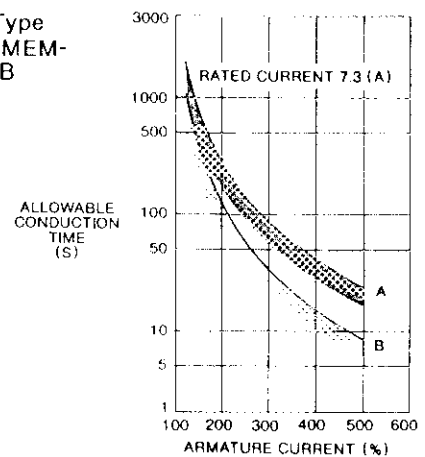
(a) Type UGRMEM-01SA



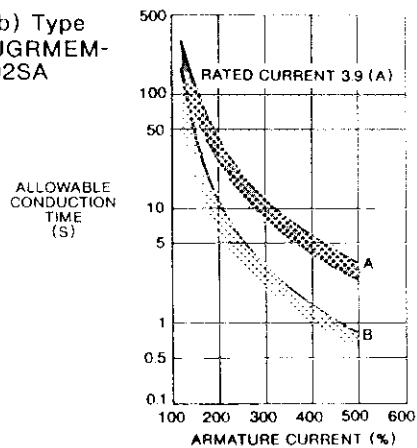
(d) Type UGRMEM-02SA



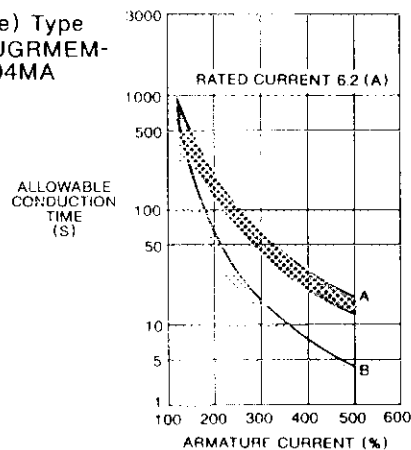
(g) Type UGRMEM-08MB



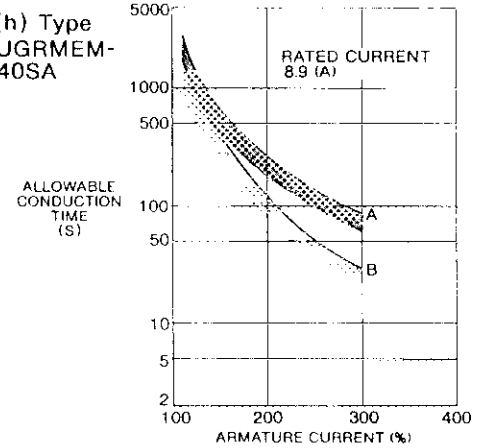
(b) Type UGRMEM-02SA



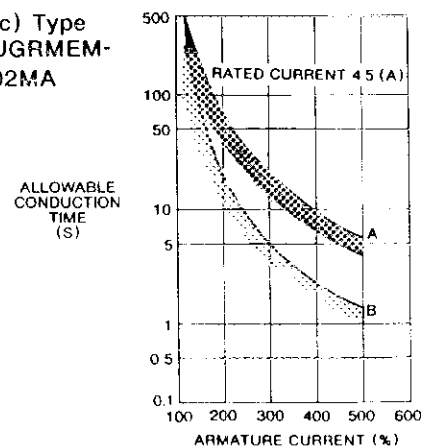
(e) Type UGRMEM-04MA



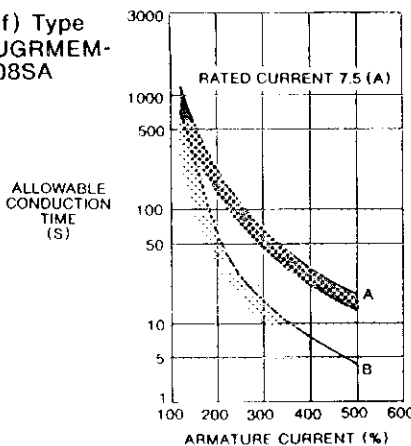
(h) Type UGRMEM-40SA



(c) Type UGRMEM-02MA



(f) Type UGRMEM-08SA



(i) Type UGRMEM-40MA

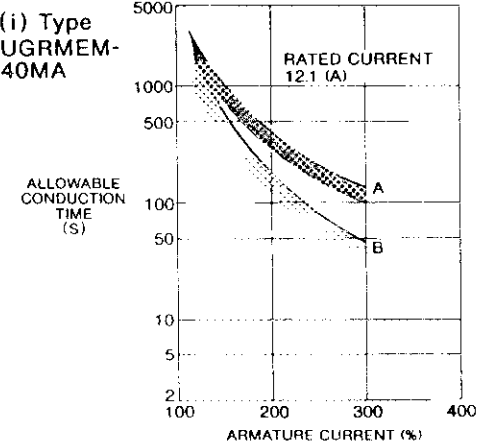


Fig. 2 Starting and Overload Characteristics

GROUNDING MOTOR POWER SUPPLY

When the Minertia Motor RM series is operated on DC power obtained by rectifying a single-phase AC current, the circuit should be grounded by the transformer as shown in Fig. 3.

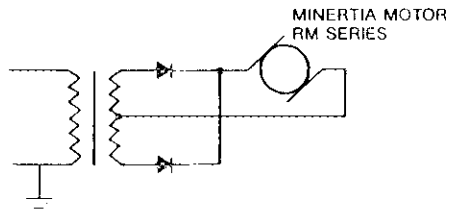


Fig. 3 Grounding of Motor Power Supply

OVERLOAD PROTECTION

It is recommended that the motor be provided with Yaskawa thermal overload relay type RHP-15/F for overload protection.

Table 2 Selection of Thermal Overload Relay

Motor Type UGRMEM-	Rated Current A	Thermal Overload Relay Type RHP
01SA	2.1	15/2.1F
02SA	3.9	15/3.9F
02MA	4.5	15/4.5F
04SA	5.3	15/5.3F
04MA	6.2	15/6.2F
08SA	7.5	15/7.5F
08MB	7.3	15/7.5F
40SA	8.9	15/8.3F
40MA	12.1	15/11.5F

Type	Rated Current A	Rated Current A	Rated Current A	Rated Current A	Rated Current A	Rated Current A	Rated Current A
RHP-15/()	6	3	1.5	1.2	1	1N0NC	70

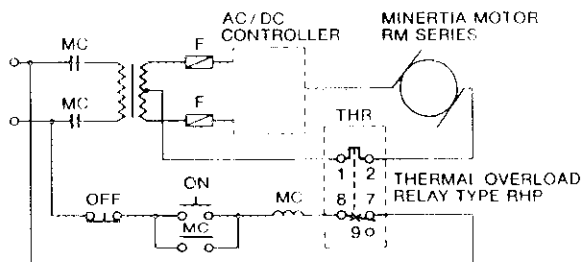


Fig. 4 Connection Diagram of Thermal Overload Relay Type RHP

MECHANICAL CHARACTERISTICS

MECHANICAL STRENGTH

Minertia Motors RM series can carry up to 500% of the rated momentary maximum torque at output shaft.

ALLOWABLE THRUST LOAD AND ALLOWABLE EQUIVALENT RADIAL LOAD

Table 3 shows allowable loads according to motor types.

Table 3 Allowable Radial Load and Thrust Load

Motor Type UGRMEM-	Allowable Radial Load (kg)	Allowable Thrust Load (kg)	Reference Diagram mm
01SA	4	2	
02SA	8	4	
02MA	8	4	
04SA	15	4	
04MA	15	4	
08SA	25	10	
08MB	25	10	
40SA	25	10	
40MA	25	10	

Note: Radial load and thrust load are the maximum value of total of the load causing from motor torque and the load applying to the shaft externally.

MECHANICAL SPECIFICATIONS

Table 4 Mechanical Specifications in mm

Accuracy (Fig. 4)	Reference Diagram
Flange surface perpendicular to shaft (A)	0.04
Flange diameter concentric to shaft (B)	0.04
Shaft run out (C)	0.02

*T.I.R. (Total Indicator Reading)

DIRECTION OF ROTATION

Minertia Motor RM series rotates counterclockwise viewed from drive and when lead connections are: red lead (+: plus); black lead (-: minus).

IMPACT RESISTANCE

Motor Only

When mounted horizontally and exposed to vertical shock impulses, the motor can withstand up to three impacts with impact acceleration of 50 G.

With Optical Encoder

With motor mounted horizontally and exposed to vertical shock impulses, the motor can withstand up to two impacts with impact acceleration of 10 G.

VIBRATION RESISTANCE

With motor mounted horizontally, the motor can withstand the vibration (vertical, lateral, axial) with vibration acceleration of 2.5 G.

VIBRATION CLASS

Vibration of the motor running at no load is V-15 or below. (amplitude 1.5 micron meter maximum p-p)

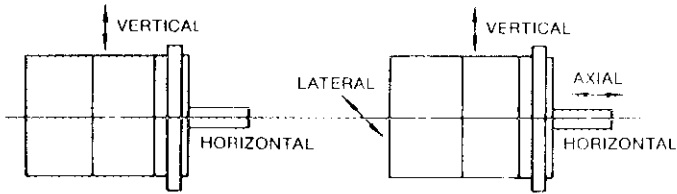


Fig. 5 Impact Resistance

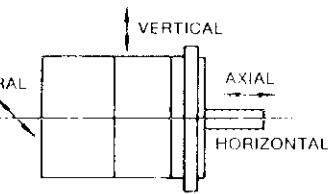


Fig. 6 Vibration Resistance

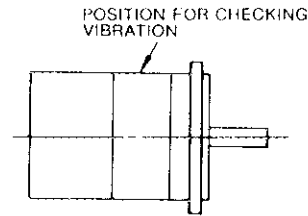


Fig. 7

MODIFICATIONS

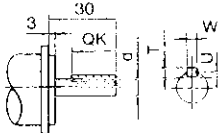
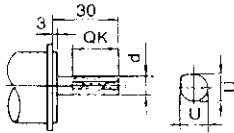
OPTIONS

Type of Shaft Extension

Recommended modification of motor shaft extension is shown in Table 5.

Table 5 Type of Shaft Extension

Dimensions in mm

Reference Diagram	With Key					Without Key		
								
Motor Type UGRMEM-	QK	d	T	W	U	QK	d	U
01SA	—	—	—	—	—	12	$6^{+0}_{-0.012}$	5.5
02SA	20	$8^{+0}_{-0.015}$	3	3	1.8	20	$8^{+0}_{-0.015}$	7.5
02MA	20	$8^{+0}_{-0.015}$	3	3	1.8	20	$8^{+0}_{-0.015}$	7.5
04SA	20	$11^{+0}_{-0.018}$	4	4	2.5	20	$11^{+0}_{-0.018}$	10
04MA	20	$11^{+0}_{-0.018}$	4	4	2.5	20	$11^{+0}_{-0.018}$	10
08SA	20	$14^{+0}_{-0.018}$	5	5	3	20	$14^{+0}_{-0.018}$	13
08MB	20	$16^{+0}_{-0.018}$	5	5	3	20	$16^{+0}_{-0.018}$	15
40SA	32	$19^{+0}_{-0.021}$	6	6	3.5	—	—	—
40MA	32	$19^{+0}_{-0.021}$	6	6	3.5	—	—	—

MODULAR MINERTIA MOTORS RM SERIES

Modular Minertia Motors consist of any combination of Minertia Motor RM series with DC tachometer generator, optical encoder, or magnetic brake.

Table 6 List of Options Combined with Minertia Motors RM Series

●: Standard ○, △: Available on order ×: Not manufactured

Type	Options	TG	OP	BR	FBU	BR&TG	BR&OP	BR&FBU
01SAKO	●	○	○	×	×	×	×	×
02SA20	●	○	○	○	○	△	△	△
02MA20	●	○	○	○	○	△	△	△
04SA20	●	○	○	○	○	△	△	△
04MA20	●	○	○	○	○	△	△	△
08SA20	●	○	○	○	○	△	△	△
08MB20	●	○	○	○	○	△	△	△
40SA20	●	○	○	○	○	△	△	△
40MA20	●	○	○	○	○	△	△	△

Note: For options indicated by △, contact your Yaskawa representative.
 TG: DC tachometer generator OP: Optical encoder
 BR: Magnetic brake FBU: Feedback unit

With Optical Encoder

Optical encoders are available as position and speed feedback signals. (For speed feedback signals, F/V converter should be used.) Specifications are listed in Table 7.

Table 7 Specifications of Optical Encoders

Optical Encoder Type	UTOPI-020,030,040,050,060,080,100,150,200,250	UTOPI-010,015,020,030,040,050,060,080,100,150,200,250
Input Supply Voltage	+12VDC ±5%	+5VDC ±5%
Current Consumption	150mA max	
No. of Output Pulses	Type UTOPI-020.....200 pulses/rev Type UTOPI-030.....300 pulses/rev Type UTOPI-040.....400 pulses/rev Type UTOPI-050.....500 pulses/rev Type UTOPI-060.....600 pulses/rev Type UTOPI-080.....800 pulses/rev Type UTOPI-100.....1000 pulses/rev Type UTOPI-150.....1500 pulses/rev Type UTOPI-200.....2000 pulses/rev Type UTOPI-250.....2500 pulses/rev	
Output Wave Form	Square Wave	
Output Signal Level	VOH: 10V Max VOL: 1.5V Max	VOH: 4V Min VOL: 0.4V Max
Rise Time	1μs Max	
Fall Time	0.5μs Max	
Output Circuit		
Phase Offset	ϕ : 25 ± 10%	
Flutter	2%p-p Max	
Pulse Duty Cycle	50 ± 10%	
Channel Z Pulse Width	50 ± 10%	
Response Frequency	75kHz	
Illumination Source	LED	
Sensor	Photo diode	
Max Allowable Speed	12,000rpm	
Moment of Inertia	7g·cm ²	
Ambient Temperature	0 to +60°C (in operation), -20 to +80°C (at standby)	
Humidity	20 to 80% RH	
Vibration (in operation)	2.5 G Max	

With DC Tachometer Generator

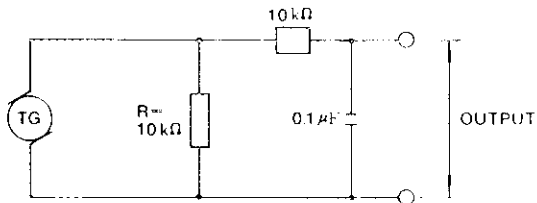
DC tachometer generators are available as speed feedback units. Specifications of DC tachometer generators are shown in table below.

Table 8 Specifications of DC Tachometer Generator

Type		TG-7SVC
Output Voltage	(V/1000rpm) $\pm 10\%$	7
Ripple Amplitude	% p-p (at 1000 rpm)	1.5
Ripple Frequency	Cycles/rev	13
Linearity	% (at 200 – 4000 rpm)	1
Direction Deviation	% (at 200 – 4000 rpm)	1
Armature Inertia	$g \cdot cm^2 \cdot 10^{-3}$	15
Armature Resistance	Ω (20°C) $\pm 10\%$	150
Temperature Coefficient	%/°C	< 0.05
Speed Range	rpm	200 4000
Max Speed	rpm	5000
Min Load Resistance	$k\Omega$	5.1
Insulation Resistance	M Ω	10
Dielectric Strength	VAC	500
Ripple Expectancy	H	5000

Note:

1. Output voltage is measured across the output terminals
2. Ripple amplitude and linearity are obtained through filter circuit as shown below.



With Feedback Units

Feedback units are available as position and speed detection units. Feedback units for Minertia Motor RM series unitized DC tachometer generator and optical encoder. Specifications are listed in Table 10.

Table 9 Specifications of Feedback Unit

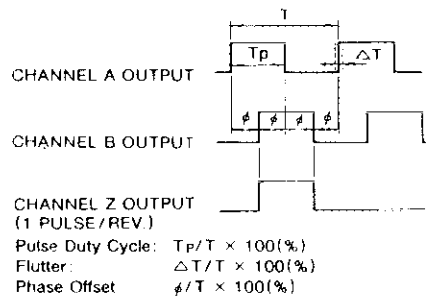
	TFUE-0000SA, TFUE-0000SU	
	TG-7SVC (DC tachometer generator)	UTOPI-0000SA, SU (Optical encoder)
Characteristics	See Table 8.	See Table 7.
Rotor Inertia J	25g·cm ² Max	
Friction Torque	14.7mN·m Max	
Filter Circuit	See Table 8.	--

With Magnetic Brakes

Magnetic brakes listed below are not used for stopping, but for holding after coming to a full stop.

Table 10 Specifications of Magnetic Brakes

	Magnetic Brake Type			
	MSB/90-3Y	MSB/90-4Y	MSB/90-6Y	FSB/90-40
Input Supply Voltage	90VDC $\pm 10\%$			
Braking Torque N·m	0.29	0.64	2.0	3.9
Applicable Motor Type UGRMEM-	02SA	04SA	08SA	40SA
	02MA	04MA	08MB	40MA
Type	Spring loaded fail-safe type			



Origin pulse, 1 pulse/rev synchronizes with channel B pulse.

Lead Identification of Encoders and DC Tachometer Generators

	Input/Output	Color	Lead Function
Encoder	Input	Red	+5VDC
		Black	0V
	Output	Blue	Channel A output
		Black	Channel A common
		Yellow	Channel B output
		Black	Channel B common
		Green	Channel Z output
DC Tachometer Generator	Output	White	Plus
		Black	Minus

MOTOR CONTROLLER

For detailed data on Servopack, refer to bulletin, Servopack Type CPR-**FR**.

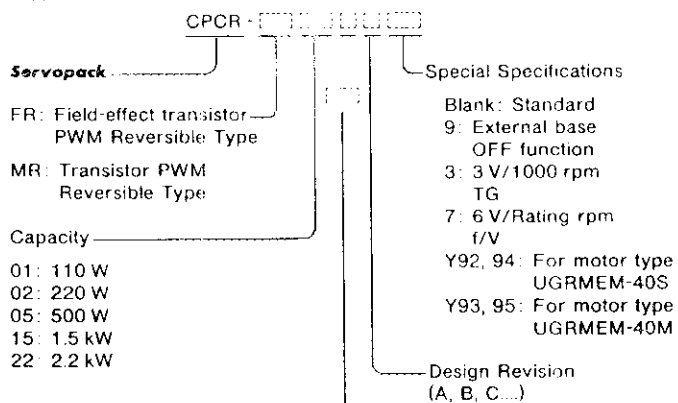
Listed below are Minertia Motors RM Series and

Servopack and f/V Converters. f/V converters are to be used only when speed feedback signal must be obtained from optical encoder.

Table 11 Minertia Motors and Applicable Controller **Servopack**

Minertia Motor Type UGRMEM	Servopack Type CPR-	DC Filter Type	Power Transformer Type OPT-	f/V Converter† Type JASP-
01SAKOE	FR01RB7-R1S	X5019 (3mH2A)	10042 (150VA)	FV010
02SA2OE	FR01RB7-R2S	X3064 (1mH8A)	10114 (210VA)	FV010
02SA2OF	FR01RB-R2S			---
02MA2OE	FR01RB7-R2M		10115 (310VA)	FV010
02MA2OF	FR01RB-R2M			---
04SA2OE	FR01RB7-R4S			FV010
04SA2OF	FR01RB-R4S			---
04MA2OE	FR02RB7-R4M	X5006 (2mH8A)	10092 (510VA)	FV010
04MA2OF	FR02RB-R4M			---
08SA2OE	FR05RB7-R8S		10116 (1010VA)	FV010
08SA2OF	FR05RB-R8S			---
08MB2OE	FR05RB7-R8M			FV010
08MB2OF	FR05RB-R8M			---
40SA2OE	MR15CY92, 94	X3056	---	FV010
40SA2OF	---	---	---	---
40MA2OE	MR22CY93, 95	X3057	---	FV010
40MA2OF	---	---	---	---

*Type Designation of **Servopack**



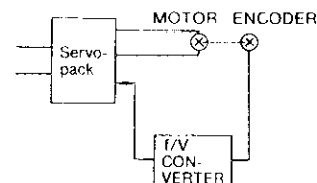
Motor Type

R1S: UGRMEM-01S
R2S: UGRMEM-02S
R2M: UGRMEM-02M
R4S: UGRMEM-04S
R4M: UGRMEM-04M
R8S: UGRMEM-08S
R8M: UGRMEM-08M

†Specifications of f/V Converter

JASP-FV000		
Power Supply	+12 V \pm 1% 110 mA, +12 V \pm 1% 50 mA, +5 V \pm 5% 200 mA	
Environmental Condition	Operating Temperature	-10 to +60°C
	Storing Temperature	-20 to +70°C
	Humidity	85% Max (No condensation)
Input	Frequency	90°C Phase difference 2-Phase pulse 50 kHz Max
	Pulse Voltage	12 V (JASP-FV001) 5 V (JASP-FV002)

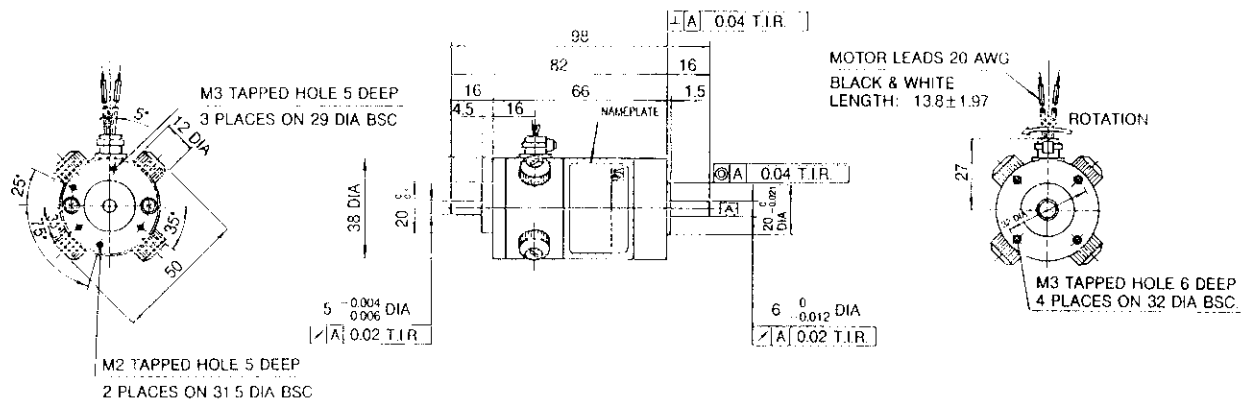
Contact the company representative.



DIMENSIONS in mm

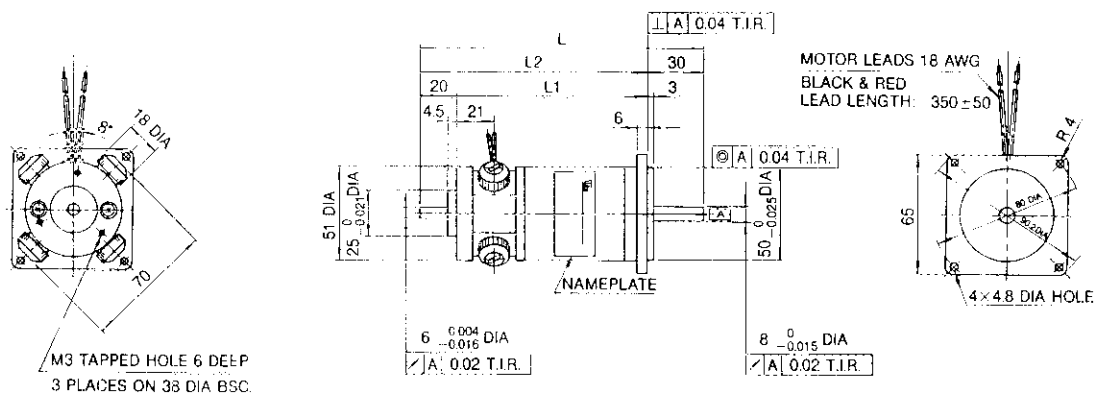
MOTORS ONLY

Type UGRMEM-01



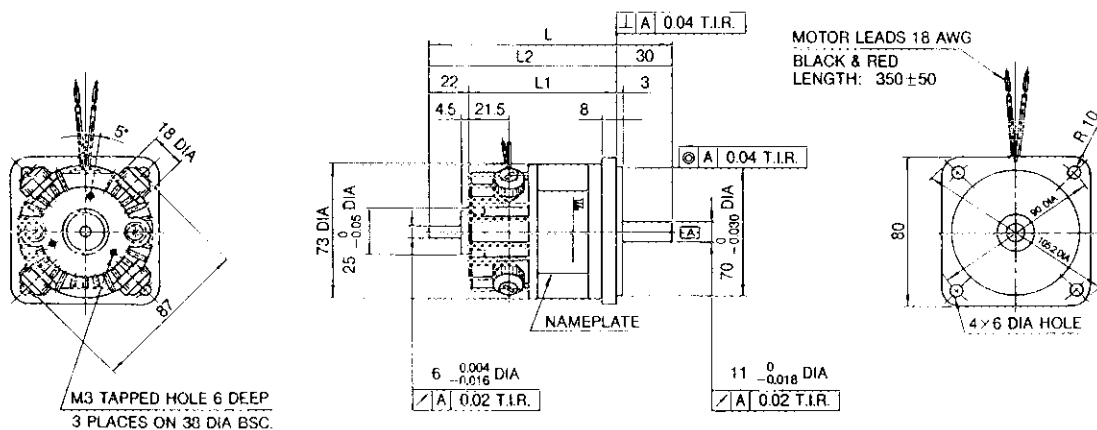
Drawing 1

Type UGRMEM-02



Drawing 2

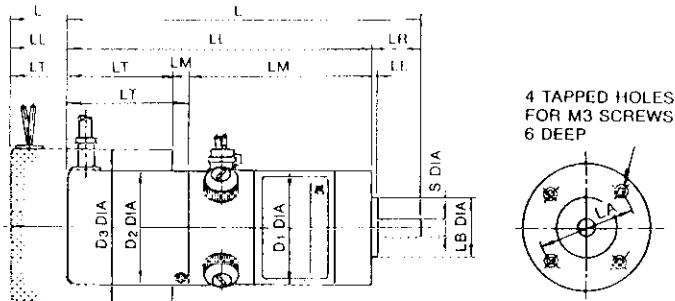
Type UGRMEM-04



Drawing 3

MOTORS WITH DETECTORS

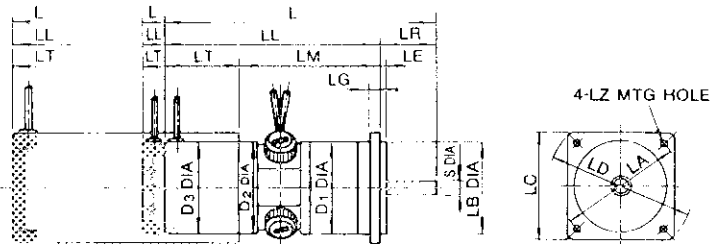
Type UGRMEM-01



- OP: Optical encoder
- TG: DC tachometer generator
- FBU: Feedback unit (OP + TG)

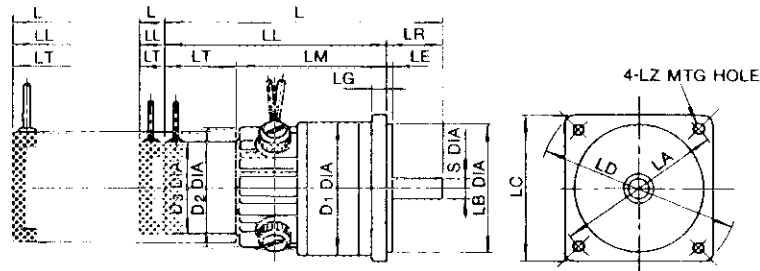
Motor Type UGRMEM-01	Detector	D ₁	D ₂	D ₃	LA	LB	LC	LD	LE	LG	LM	LR	L	LL	LT	S	Weight kg
01SAKOE	PG	38	38	—	32	20 ⁺⁰ _{-0.021}	—	—	1.5	—	65	16	114	98	33	6 ⁺⁰ _{-0.012}	0.4
01SAK07	TG	—	—	51	—	—	—	—	—	—	66	—	135	119	53	—	0.5

Type UGRMEM-02



Motor Type UGRMEM-02	Detector	D ₁	D ₂	D ₃	LA	LB	LC	LD	LE	LG	LM	LR	L	LL	LT	S	Weight kg
02SA2OE	PG	—	—	51	—	50 ⁺⁰ _{-0.025}	65	90	3	6	76	30	138	108	32	—	0.8
02SA2O7	TG	51	51	51	80	—	—	—	—	—	—	—	158	128	52	4.8	8 ⁺⁰ _{-0.015}
02SA2OF	FBU	—	—	60	—	—	—	—	—	—	—	—	232	202	126	—	1.2
02MA2OE	PG	—	—	51	—	50 ⁺⁰ _{-0.025}	65	90	3	6	104	30	166	136	32	—	1.1
02MA2O7	TG	51	51	51	80	—	—	—	—	—	—	—	186	156	52	4.8	8 ⁺⁰ _{-0.015}
02MA2OF	FBU	—	—	60	—	—	—	—	—	—	—	—	260	230	126	—	1.6

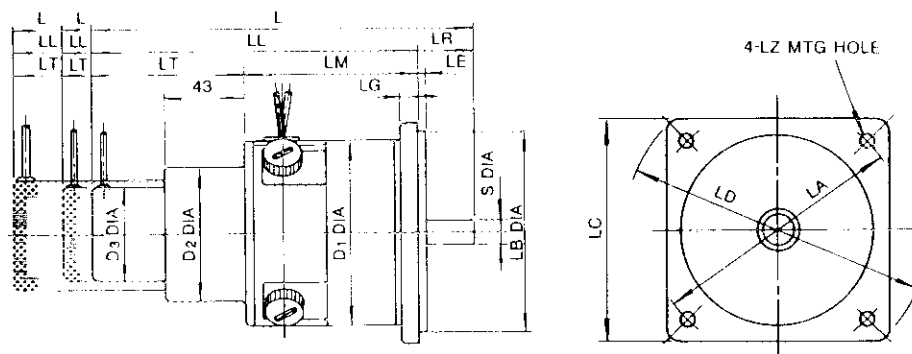
Type UGRMEM-04



Motor Type UGRMEM-04	Detector	D ₁	D ₂	D ₃	LA	LB	LC	LD	LE	LG	LM	LR	L	LL	LT	S	Weight kg
04SA2OE	PG	—	—	51	—	70 ⁺⁰ _{-0.030}	80	105	3	8	81	30	143	113	32	—	1.4
04SA2O7	TG	73	72	51	90	—	—	—	—	—	—	—	163	133	52	6	11 ⁺⁰ _{-0.018}
04SA2OF	FBU	—	—	60	—	—	—	—	—	—	—	—	237	207	126	—	1.9
04MA2OE	PG	—	—	51	—	70 ⁺⁰ _{-0.030}	80	105	3	8	107	30	169	139	32	—	2.2
04MA2O7	TG	73	72	51	90	—	—	—	—	—	—	—	189	159	52	6	11 ⁺⁰ _{-0.018}
04MA2OF	FBU	—	—	60	—	—	—	—	—	—	—	—	263	233	126	—	2.6

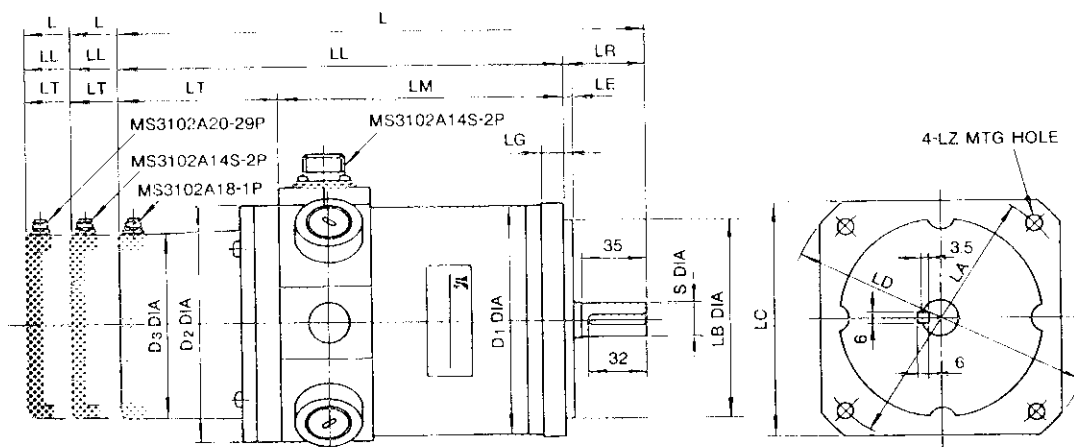
MOTORS WITH DETECTORS (Cont'd)

Type UGRMEM-08



Motor Type UGRMEM-08	Detector	D ₁	D ₂	D ₃	LA	LB	LC	LD	LE	LG	LM	LR	L	LL	LT	LZ	S	Weight g
08SA20E	PG	102	65	51	130	110 ⁺⁰ _{-0.035}	120	155	3	10	99	30	204	174	75	9	14 ⁺⁰ _{-0.015}	3.8
08SA207	TG			51									226	196	97			4.0
08SA20F	FBU			60									250	220	121			4.2
08MB20E	PG	102	65	51	130	110 ⁺⁰ _{-0.035}	120	155	3	10	123	30	228	198	75	9	16 ⁺⁰ _{-0.018}	5.2
08MB207	TG			51									250	220	97			5.4
08MB20F	FBU			60									274	244	121			5.6

Type UGRMEM-40



Motor Type UGRMEM-40	Detector	D ₁	D ₂	D ₃	LA	LB	LC	LD	LE	LG	LM	LR	L	LL	LT	LZ	S	Weight g
40SA20E	PG	127.5	135	105	145	110 ⁺⁰ _{-0.035}	130	165	6	12	150	45	283	238	88	9	19 ⁺⁰ _{-0.021}	9.2
40SA207	TG												303	258	108			9.5
40SA20F	FBU												333	288	138			10.0
40MA20E	PG	127.5	135	105	145	110 ⁺⁰ _{-0.035}	130	165	6	12	185	45	318	273	88	9	19 ⁺⁰ _{-0.021}	12.0
40MA-207	TG												338	293	108			12.3
40MA20F	FBU												368	323	138			12.8

Minertia Motor RM Series

TYPE UGRMEM-1 230



A Better Tomorrow for Industry through Automation

YASKAWA Electric Mfg. Co., Ltd.

TOKYO OFFICE Ohtomachi Bldg., Chiyoda-ku, Tokyo, 100 Japan
Phone (03) 224-9111, -9145, -9146 Telex YASKAWA J35530 Fax (03) 284 9034

SEOUL OFFICE Seoul Center Bldg., 91-1, So Kong-Dong, Chung-Ku, Seoul, Korea
Phone (02) 776-7844 Fax (02) 753-2635

SINGAPORE OFFICE CPF Bldg., 79 Robinson Road No. 24-03, Singapore 0106
Phone 2217530 Telex (87) 24830 YASKAWA RS Fax (65) 224-5854

TAIPEI OFFICE Union Commercial Bldg., 137, Nanking East Road, Sec. 2, Taipei, Taiwan
Phone (2) 531-7732, 551-7060 Fax (2) 537-3037

YASKAWA ELECTRIC AMERICA, INC.: SUBSIDIARY
Los Angeles Office 14211 Myford Road, Torrance, California 92680, U. S. A.
Phone (714) 731-6241 Telex (230) 676355 YASKAWAUS TSTN Fax (714) 730-8294

New Jersey Office 759 Northfield Ave., Suite 140, West Orange, NJ 07052, U. S. A.
Phone (201) 325-7337 Fax (201) 325-7232

Chicago Office/YASKAWA America 3160 MacArthur Blvd., Northbrook, Illinois 60062, U. S. A.
Phone (312) 251-2340 Telex (230) 270197 YSKW YSNC NBRK Fax (312) 564 3276

YASKAWA ELECTRIC EUROPE GmbH: SUBSIDIARY
Manschauerstrasse 1, 4000 Düsseldorf 11, West Germany
Phone (0211) 501127 Telex (41) 8585573 YASD D Fax (0211) 507737

YASKAWA ELETRICO DO BRASIL COMERCIO LTDA.: SUBSIDIARY
Av. Brig. Faria Lima, 1061-cj. 611, Pinheiros, São Paulo-SP, Brasil CEP-01452
Phone (011) 212-5464, 813-3694 Telex (811) 24158 FERN BR

Due to ongoing product modification/improvement, data subject to change without notice.

Printed in Japan September 1986 84-12 0.6 WA